# Current Assessment of Fish Passage Opportunities in the Tributaries of the Lower Hudson River

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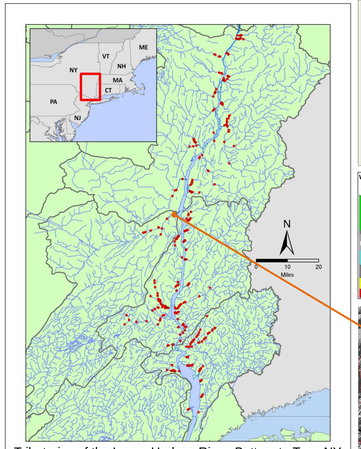
## Abstract

The Hudson River estuary supports numerous diadromous and potamodromous 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 upstream fish movement at the first and second barriers on each of 62 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.

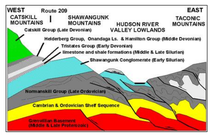
## Approach

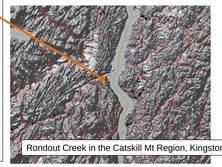
- Objectives
  - Investigate Changes to Fish Passage Impediments
  - Create an Inventory of Barriers for Use as a Decision Making Tool
- Scope of Effort
  - 65 Tributaries:
  - Update Prior Efforts (Schmidt et al 1996, Halavik and Orvis 1998, Machut et al. 2007)
    - Not Limited to Number of Barriers Assessed per Tributary
  - Desktop Tools
    - Google Earth, Bing, Digital USGS 7.5 Series Topographic
    - Digital NYS Dam Inventory
  - Ground -truthing – 35 all or partially field verified to date
    - GPS, Video, Photography, Notes
- Proposed Action
  - Dam Removal and Culvert Upgrades (Preferred)
  - Eelways, Fish Ladders, Rock Ramps, By-pass Channel (Less Preferred Alternative)
  - No Action (e.g., No Benefit, Owner Opposition, FERC Licensed, Regulatory Obstacle)



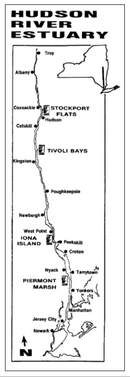

Tributaries of the Lower Hudson River, Battery to Troy, NY

NOAA's Hudson River Fish Passage Initiative Study Team has identified 307 barriers (red dots) to fish passage within the 65 major tributaries to the Lower Hudson Estuary. Take notice of how tightly these are clustered along the Hudson Main Stem. Whether by the hand of man or by nature's rock, the first barrier to every tributary falls within short distance of the confluence of the Hudson. Here the barriers are shown relative to the 5 major watersheds of Lower Hudson from the Battery in Manhattan to Troy, NY

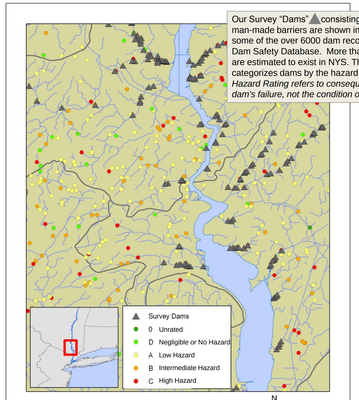


Rondout Creek in the Catskill Mt Region, Kingston NY




The Hudson Estuary is:
- 153 miles from The Battery to Troy NY.
- The total Hudson Watershed is 13,400 sq miles of which
- 4982 sq miles contribute directly into the Hudson Estuary
- There are over 100 tributaries/8,861 stream miles to the Estuary.




Our Survey "Dams" consisting of natural and man-made barriers are shown in relation to some of the over 6000 dam records in the NYS Dam Safety Database. More than 10,000 dams are estimated to exist in NYS. The DSD categorizes dams by the hazard they present. *Hazard Rating refers to consequences of a dam's failure, not the condition of the dam.*

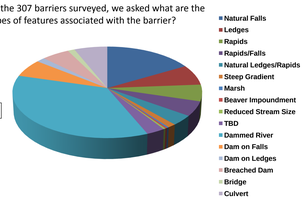
Lower Hudson River
Piermont to Beacon, NY

## Lower Hudson Tributary Barrier Statistics

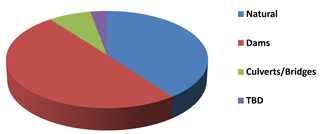
- 307 Barriers Identified on 65 Tributaries (215 miles)
- 153 Dams, 23 Culverts/Bridges, 122 Natural, 9 TBD
- Dams Constructed 1800-1999
- Dam Height Range of 1 ft to 141 feet
- Dam Length Range of 6 ft to 1,218 ft
- Spillway Width Range of 6 ft to 950 ft
- Includes stream segments where slopes exceed 1:40
- 73 Tributary Miles Currently Estimated Available to Diadromous Fish
- 30 Tributary Miles Potentially Available for Diadromous Fish and an additional 36 miles for American Eel via potential restoration actions.

## BARRIER TYPES

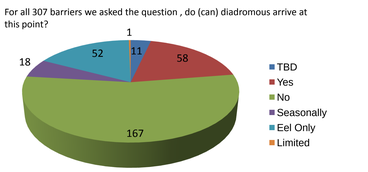
Of the 307 barriers surveyed, we asked what are the types of features associated with the barrier?



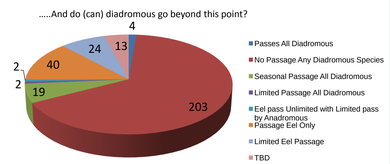

Of the 307 barriers surveyed, we asked what are the major categories present?




For all 307 barriers we asked the question , do (can) diadromous arrive at this point?

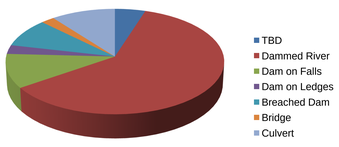



.....And do (can) diadromous go beyond this point?

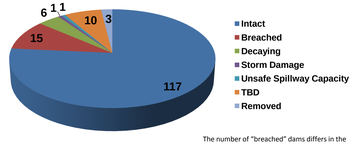



## BARRIER CONDITION

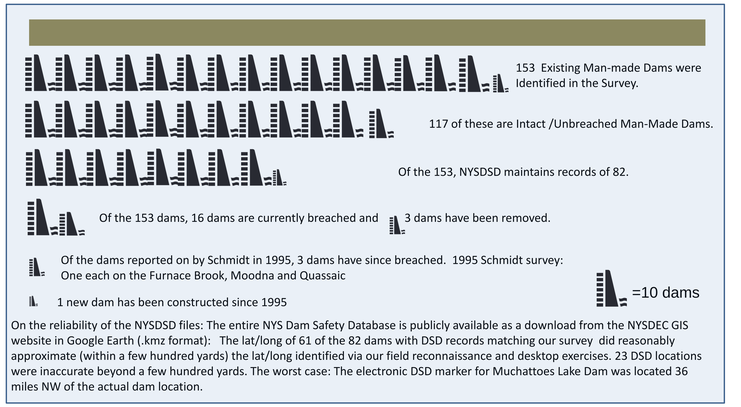
Of the potential 182 man-made obstructions to fish passage we asked, what are the types represented?




Of the 153 man-made dams we asked, what is the condition of the dam?




The number of "breached" dams differs in the Barrier Type and Barrier Condition analyses because 1 intact dam was land breached, thereby allowing passage.

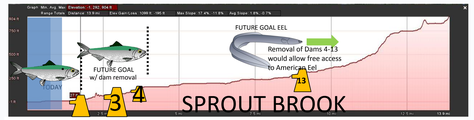



On the reliability of the NYSDSD files: The entire NYS Dam Safety Database is publicly available as a download from the NYSDEC GIS website in Google Earth (.kmz format): The lat/long of 61 of the 82 dams with DSD records matching our survey did reasonably approximate (within a few hundred yards) the lat/long identified via our field reconnaissance and desktop exercises. 23 DSD locations were inaccurate beyond a few hundred yards. The worst case: The electronic DSD marker for Muchattoes Lake Dam was located 36 miles NW of the actual dam location.

## Google Earth Elevation Profile Tool Demonstrating Three Examples of Potential Stream Miles Gained with Dam Removal


**CLAVERACK CREEK:** The spillway of Dam #1 is approx 24' elevation. Failure to remove Dam #1 results in no additional stream miles gained.

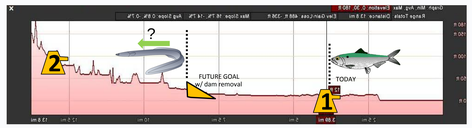
Dam #2 is breached and does not effect passage. Removal of Dams 1, 3 and 4 results in an additional **2.5 miles** of passage. Removal of dams 1,3,4 would allow herring or eel to pass to RM 4.5 where Dam #5 Stottsville Dam/Falls would present a significant challenge to both fish and eel – even if removed.




**SPROUT BROOK:** Dam #1 is 3' high and the base of Dam #1 at El 24'. Failure to remove the 1st dam results in no additional stream miles gained.

Assuming that the Cortland Lake Dam( #3 ) 15' in height remains in place, removal of Dams 1 & 2 results in no more than an additional **1.22 miles** of passage.

The removal of Dam 3 & 4 would allow river herring movement to a location approx RM 3.75 where a series of natural ledges at a gradient >5% would conservatively preclude their movement further.




**RONDOUT CREEK:** The 12' ft high Eddyville Dam (#1) stands at the head of tide.

Without removing the dam, fish would have no further access beyond the base of the dam.

Removal of Dam #1 would result in head of tide to approx. RM 7.5 (3.6 miles upstream). Herring would likely pass to the natural ledges at RM 8.10 (4.1 stream miles). Eel would continue an undetermined distance – possibly to the next dam at RM 13.0

Dam #1, Claverack Creek

Highland Ave Dam, Sproutbrook

Eddyville Dam, Rondout Creek

## Conclusions

- Digital desktop tools were a factor in the identification of impediments both downstream and upstream of the 1st and 2nd barriers identified in earlier studies.
- 115 barriers on 35 tributaries visited to date.
- Desktop tools allowed us to "visit" an additional 192 barriers.
- A better picture emerged of the overall habitat and potential ecologic uplift to be provided by the tributary.
- An additional barrier category emerged from the study: Reaches where slopes exceed >3-5%. Though crude, the accuracy and precision of the tools carries enough weight to allow the flagging of these locations of concern.
- Availability of high tech, low resolution tools such as the Google Earth Elevation Tool greatly assist in large scale planning but carry a warning of caution to the user!

## Next Steps

- Conduct more field reconnaissance / ground-truthing of unvisited barriers to fish passage
- Research historic and current use by diadromous fish
- Research biological limitations to access for striped bass and rainbow smelt
- Reconcile field observations and desktop with NYSDSD
- Develop precision tools in GIS to help determine where fish can pass based on terrain, hydrographic data, barrier information and opportunities for restoration
- Update catalog of tributaries
- Further develop prioritization criteria

## Fish Species Using Lower Hudson Tributaries for Spawning

### Diadromous Fish

**Anadromous**

- ❑ American Shad
- ❑ Hickory Shad
- ❑ Blueback Herring
- ❑ Alewife
- ❑ Striped Bass
- ❑ Rainbow Smelt

**Catadromous**

- ❑ American Eel

### Potamodromous Fish

- ❑ White Sucker
- ❑ Smallmouth Bass
- ❑ White Perch
- ❑ Yellow Perch
- ❑ Spottail Shiner
- ❑ Golden Shiner
- ❑ Carp
- ❑ Northern Pike
- ❑ Walleye
- ❑ Shorthead Redhorse
- ❑ Gizzard Shad

Source: Levinton and Waldman 2006, http://www.dec.ny.gov/animals/52634.html;

## Biological Limitations to Access

• 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: Consistent slope <3% gradient; Occasional slope of 5%-7% at short distances, requiring additional burst speed and deeper pools.
- Limited Passage: Consistent grades ≥5%
- Seasonal Passage: Seasonally low flow fluctuations, shallow water and lacking deep pools; Higher seasonal flows allows passage past low (<2 ft high) head dams and weirs.
- Impassable: >2 ft high dams and steep vertical faces. Seasonal high velocity flows overtopping >2 ft dams

➢ Eel
- Eel passage was determined by barrier height and gradient, surface roughness and wetness on steep vertical structures
- Unlimited Passage: Dams, natural falls and ledges ≤ 5.0 m high
- Passage Greatly Diminished: Dams, natural falls and ledges >5.0 m high within a short horizontal distance (steepness); # and size classes greatly reduced w/ multiple barriers (Machut et al. 2007); 10-100 fold reduction of eel beyond the first barrier 5 HR tribs (Machut et al. 2008)
- Impassable: Dams >5.0 m high precluding 90% eel passage

## References

Schmidt et al. 1996. A Catalog of Barriers to Upstream Movement of Migratory Fishes in Hudson River Tributaries. Report to Hudson River Foundation, http://www.hudsonriver.org/report_archives.htm

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