Passage/Alternative Energy Working Group Discussion
February 10, 2011
NMFS Sturgeon workshop; Alexandria, VA

Dams and passage:

Summary of General Discussion

Connecticut River, Holyoke Dam—

Upstream passage facilities are present in the form of a fish lift, but the effectiveness for sturgeon is debatable. Additionally, there is a tail race and spillway for upstream passage of salmon, shad, and herring, which are operated in the spring time.

Downstream passage includes only passage over the dam and through the turbines. No safe downstream passage is available for sturgeon. Downstream facilities for other species include an elevated bypass canal with louvers, which goes to a bypass facility.

Shortnose sturgeon (SNS) above and below Holyoke dam: An above-the-dam tag and release study using 30 adult SNS was conducted, and concluded that some undertook behavioral spawning acitvity. However, fish turned and went back downstream, likely not surviving downstream passage through the turbines. Young fish, however, will go downstream through dam successfully. These young fish probably make it through alive (90% or better at Holyoke).

Cape Fear River—

Studying rock ramp design, and putting transmitters into 30 sturgeon for the next 3 years. This design was specifically aimed at passing sturgeon upstream and downstream. It is a low-head dam, with a slope on the backside of the dam, and a ramp for fish to follow over the dam.

South Carolina—

Upstream and downstream passage failure in SC rivers (Mark Collins). The St. Steven fish lift which has a viewing window, has only passed 6 shortnose sturgeon ever. Entry to the lift was designed for shad/herring and has an 8-10 foot step, which likely deters sturgeon.

Cooper River—

There is a vessel lock which sturgeon enter, but they encounter a 40 ft vertical sill, and shortly after this they exit the lock.

Savannah River—

There is a vessel lock, which is primarily operated for shad/herring, and like other similar locks, it also has a vertical step, and additionally the lock has been broken for years.

Annapolis—

Has ineffective passage for sturgeon, in which fish go through the turbines, and large dead Atlantic sturgeon have been found below the dam.

St John—

No sturgeon passage exists, but there is a healthy population on this river, and the first dam is relatively far upriver.

St Lawrence—

Unknown passage.

Santee Cooper—

Contains a split population due to dam without proper passage (like CT River). No recruitment has been observed below the dam, likely because of lack of habitat? Larvae and juveniles encountered below the dam may be drifting down from above the dam.

Rock Arch Ramp—

Lake sturgeon will ascend rock arch ramps, and exhibit spawning behavior in the ramps (information from Minnesota).

Nature-like fishways—

Shortnose sturgeon did not use these during studies conducted at Conte Anadromous Fish Lab on the Connecticut River.

Spiral fishway—

See the Kynard talk from the WSCS 2010 NAC meeting in Chico, MT.

White sturgeon example—

White sturgeon successfully pass the dam at Bonneville

Monitoring—

Following the Edwards Dam removal, fish in the Kennebec River (ME) appear to be doing well and using the additional habitat above the dam site. Shortnose sturgeon spawn both above the dam site (at the next dam—Lockwood, which is likely at the historic upstream extent of their range in the Kennebec). However, not enough monitoring is done, so this is anecdotal. Gail Wippelhauser has caught running Atlantic sturgeon in the Kennebec as well.

In general, it was agreed that monitoring passage of sturgeon past existing dams is insufficient and more monitoring is needed.

Research Questions

Research Questions and other questions for consideration:

- Would we expect one of the many designs for passage that successfully pass lake sturgeon to work for Atlantic and shortnose sturgeon? Steph Bolden found 25 examples that successfully pass lake sturgeon simply from a quick google search. Are these results transferable among sturgeon species?
- Do causeways have an impact to sturgeon and their ability to access habitat? Impacts to sturgeons form causeways are evident in some Canadian rivers (Kimberly Robichaud-Leblanc).
- Is it beneficial to restore sturgeon to their historic upstream habitat prior to identification and installation of effective downstream passage facilities? Iteroparous species must be able to successfully exit the system to return in subsequent years to maintain their genetic structure.
- Early life stage downstream dispersal studies (Micah Kieffer) have provided information suggesting that in systems where sturgeon must spawn below their historic spawning

sites, the early life stages might drift into saltwater portions of the river and estuary before they are physiologically adapted to survive there. Additional study may be warranted, as we currently gage spawning success from the capture of ELS.

- Is translocation of spawners above dams a good idea? On the Snake River, Idaho Power has translocated white sturgeon above the CJ Strike dam, and then allow the adults to pass over the dam (or through the turbines) on the way back downstream.

Action Items Regarding Passage

No specific action items were identified, but review of the research on passage section will allow identification of areas for improvement and issues needing further study

Entrainment/Impingement

Summary of General Discussion

Power Plant Intakes/Section 7—

During Consultations, NMFS has not been able to prescribe conditions such as intake velocities, because most of these structures were built during the 1970's, so modifying parameters such as flow velocity would be unreasonable. Could perhaps incorporate these suggestions if new intake structures are going to be built.

Connecticut River, Holyoke Dam—

Impingement and entrainment has been studied, and two laboratory investigations from Alden Laboratories indicated that approach velocities of 2 ft/sec or less reduces impingement. 2 ft/sec is the target velocity for the new trash rack at Holyoke?

Trash rack opening design depends on the turbines being used turbines, Holyoke went with 2 inch spacing in their trash rack. Information from Idaho on effects of pressure fields inside turbines exists and could be looked at for guidance. There is currently no information from Alden on pressure and sturgeon, but some work has been done with salmon that could be beneficial.

Kennebec and Androscoggin Rivers—

During the Spring of 2010, 35 shortnose sturgeon were trapped in the turbine cavern at the Brunswick dam.

The Androscoggin River has an appreciable spawning run, and a large proportion of the shortnose sturgeon caught at Brunswick were females.

Snake River—

Fish also go into the power bays (as they did at Brunswick) when cleaning/maintaining

Sound blasts have been used to keep fish from the bays, and appear to be effective? Mark Collins says using mild explosives to keep sturgeon away from activities can be effective (they also respond to boat motor sounds)

It appears that it is common sturgeon behavior to go into these bays. Lake sturgeon are also attracted to flows from these bays.

Delaware River—

Larval Shortnose sturgeon were entrained at 2 power plants years ago, one which entrained 16 larvae, one the other 10-12 larvae, and although this entrainment event corresponded with very high flows, the flows were not necessarily out of the ordinary. Monitoring is not routine, and these events might be more common at these sites.

Other plants on Delaware and Hudson Rivers have intakes that have in the past and potentially do still entrain sturgeon.

Savannah River—

A power plant below the first dam took a few Shortnose sturgeon larvae, and some Atlantic sturgeon as well in a short study.

Research Questions that arose from Discussion

No research questions arose during this discussion

Action Items Regarding Impingement and Entrainment

No specific action items were identified

Alternative Energy Development

Summary of General Discussion

Alden study—

Blade strike studies have been conducted at Alden, which have results relevant to hydrokinetic or conventional turbines.

The study concluded that blade thickness was important relative to fish length, with blunter blades being less harmful than narrow blades. Additionally, modeling determined semicircular blades deflected fish best. If blade speeds were 15 ft/sec or less, mortality was not observed regardless of fish length. With velocities over 15 ft/sec, there was a good chance for injury to occur. They held fish for 4 days to observe delayed mortality and behavior, but don't look at sublethal injuries in any detail.

They completed studies of two turbine designs, but did not use sturgeon during testing (rainbow trout were used). The turbines studied were 1) Lucid spherical turbine and 2) Sea-to-sea turbine, ducted propeller design.

FERC pilot license procedure—

Can authorize pilot projects (8 year max time) with less NEPA clearance and process than with a full FERC license procedure. There are restrictions on number of units, not in sensitive areas, …

Offshore wind—

Issues for sturgeon might include: Construction, EMF, cable vibrations. Additionally, with a movement to wind power, the need for pump storage might increase, and there are environmental effects of pump storage. In the Connecticut River, when the pump storage facility is withdrawing (almost always at night—It is known that Gulf sturgeon move at night) from the river during low flow periods, the river can actually reverse flow direction in that area.

Research Questions that arose from Discussion

Much of the discussion centered around participants asking questions, followed by group discussion. Lthough not all were research questions, they have been captured below, along with any ensuing discussion:

- On likelihood of interaction with turbines--How close will sturgeon be to the bottom? We generally assume they are on the bottom, but some depth distribution data indicate this is not always so. For example, the Minas Passage is 98m in depth, and sturgeon used 13-65m depths when passing through (M Stokesbury). This is a very turbid environment, and it is unclear if this is typical behavior. What percentage of fish will go through the turbine? Monitoring of tidal turbines is difficult because of the environments where they are placed (Gayle Z.). Is movement in the high energy Bay of Fundy similar to other areas? In Southern systems they also see sturgeon throughout the water column.
- Can sturgeon sense and avoid turbines? In the Alden flume, they did see some avoidance behavior even though they attempt to force them through during their studies.
- Is there potential for effectively designed deflection devices to guide sturgeon around turbine sites? If sturgeon can feel pressure from trawls, they can avoid them , but if they can't sense the pressure soon enough they can't escape well (difficulty turning tail and running), so it might be good to determine this through study. This might lead to methods to deflect fish around turbine sites, but would need to test in large scale systems to mimic true environmental conditions (flows, etc.). Still, there is potential to exploit the behavioral responses sturgeon exhibit (K Sulak)
- Where could studies be conducted? DOE or one of the centers is doing open ocean current work, and are currently building a very large facility. Florida Atlantic University is another options?
- How would mooring a deflection device affect energy production? Turbines spaced to create laminar fields do not want turbulence, deflection structures design would need to minimize turbulence.
- What about acoustic arrays around turbines (difficulties)?
- Deflection and Prevention of passage through turbine sites presents other problems, such as impeding access to important habitat.
- Is there more to think about besides blade strikes? Consideration of turbine array extent and design: 1 array vs. many arrays, as well as the constituent parts and habitat alteration (EMF, etc.)
- Have there been EMF studies using sturgeon? Some studies using small sturgeon have ability to detect EMF. Tidal wave current?
- Will fish hang out below turbines (i.e., will they actually be attracted to flows, chopped up fish bits—Gayle Z)?
- Since sturgeon are often not the most economically important species in tidal systems, can we use concern for bluefin tuna or other species to address impacts of sturgeon?
- Strikes are obviously an issue, but is pressure kill an issue as well?
- Diameter of blades? Typically greater than 20 ft, presenting a fast angular velocity. But there are different designs, each with different problems, and always need to consider scaling up effects. For example 300 turbines in Minas passage is possible.
- Subsonic/sonic frequency issues? There is only limited, and speculative, work looking at sounds sturgeon use. Again with this issue, there will likely be differences between single turbines versus multiple, and different sound regimes.

Q: Sources of information that NMFS/FWS might not be plugged into? Where can we get info?

Electropower Research Inst (EPRI)—Hydropower

Andrea Copping—DOE: Working with companies in Europe, but companies own data, Andrea trying get their data for use.

Ocean Engineering and Technology and Marine Technology—Trade journals.

FORCE—Website

OEER—Nova Scotia, hydropower impacts

Action Items Regarding Impingement and Entrainment

No specific action items were identified