Turbine Design for Fish Inclusion

Sterling Watson and Abe Schneider, Natel Energy

Email corresponding author: sterling@natelenergy.com

ABSTRACT: Migration corridors for riverine species tend to overlap with valuable hydropower resources. Supporting clean hydroelectric power generation while also protecting freshwater diversity is in many cases an unmet challenge, but is essential to achieve true sustainability in hydropower. Exclusion infrastructure (i.e., fine fish screens, behavioral guidance infrastructure, and bypasses) may be utilized to protect fish from turbine entrainment, but also limits the available passage routes for fish and constrains hydropower generation. Alternatively, turbines designed to pass fish downstream safely and expediently can maintain connectivity for downstream migrating species while also enabling uninterrupted hydropower production.

Integrating safe downstream fish passage into normal hydropower operations through the use of fish-safe turbines can reduce cost and complexity while facilitating downstream migration of fish, opening the door to ecological sustainability in contexts where conventional fish protection techniques fail. We will describe the function and application range of the Restoration Hydro Turbine (RHT), which incorporates novel features and design techniques to achieve safe fish passage while maintaining conventional design constraints (high power density, high efficiency, low cost).

At the core of our understanding of the mechanisms responsible for safe turbine passage outcomes, and the bounds within safe passage is possible, is a rigorous research program crafted from the perspective of ecological and population-level impact. We will share RHT passage testing results for American eel (*Anguilla rostrata*), Alewife (*Alosa pseudoharengus*), and Rainbow trout (*Oncorhynchus mykiss*), which have shown a >99% survival rate for fish that would be able to pass through a conventional coarse trash rack. Consequently, the fish-safe RHT could serve as a useful tool and best practice for fishery management in watersheds where hydropower is present.