

Expanding from creeks to hydroelectric diversion facilities – Construction and *in situ* evaluation of large half-duplex PIT tag antennas to evaluate fish entrainment at high velocity water diversions

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Abstract

The implementation of Passive Integrated Transponder (PIT) technology for monitoring fish has historically required small detection areas in either creeks or constricted openings. Advancements in PIT technology have evolved to allow for much broader applications and larger monitoring areas. Custom fabricated large-scale PIT tag readers were used to estimate entrainment in two diversion tunnels (up to 3.8 m x 4.4 m) that experienced discharge as high as 31.1 cubic meters per second and operated in water depths of up to 6.4 m. The PIT arrays, consisting of three separate antennas stacked one on top of the other, were hand-molded from fiberglass into a hydrodynamic ‘wing’ shape. This design enabled the antennas to withstand high flows, while simultaneously detecting fish over the entire monitoring area of the diversion tunnels. This also allowed for the diversions to operate at full capacity and not be constrained to a modified smaller detection area. The antenna arrays and tag detection systems achieved optimal performance throughout the duration of the study. The antennas operated continuously for over a year, and monitored upwards of 99.0 percent of all diverted flows through the tunnels due to minimal required maintenance. A total of 220 unique detection events representing 58 fish were observed at the two diversion tunnels and equated to performance efficiency greater than 90 percent. The continuous operation and high detection efficiency achieved by the relatively large-scale PIT arrays confirms the success of this innovative deployment of PIT tag technology that was previously limited to small creeks and monitoring areas.

Keywords: *Passive Integrated Transponder, PIT tag, Entrainment, Hydroelectric Facility, Water Diversion, Telemetry*