A Comparison of Brook Trout Diel Movement Patterns to Spawning Activity and Other Environmental Factors

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Background

➢ Brook Trout *Salvelinus fontinalis.*

- Top predators & indicators species in coldwater streams.
- Popular, native sportfish in Wisconsin.
- Spawn in fall-winter by constructing redds.
- Limited knowledge on diel (hourly) movements that may indicate feeding, spawning, & survival behaviors.

➢ Little Plover River (fig 1).

- 2nd order, class 1 trout stream, in Plover, Wisconsin.
- Recent low flow events have led to watershed restoration efforts and increased research.

Objectives

➢ Determine if Brook Trout diel movements corresponded with spawning activity (weekly redd counts) or differed with environmental conditions.

Methods

➢ Brook Trout sampled with electrofishing (fig 1).

➢ Individuals ≥ 120 mm implanted with passive integrated transponders (PIT tag) since fall 2015.

➢ PIT antennas at four sites throughout river (fig 1) to passively detected tagged fish (March '16- Dec '20).

➢ Weekly redd surveys conducted in Fall 2017-2020.

➢ Data filtered to 1 detection/15 min/individual and categorized as diurnal or nocturnal.

➢ Histograms of detections by hour constructed to evaluate diel patterns relative to weekly redd counts, time of year, water temperature, and discharge.

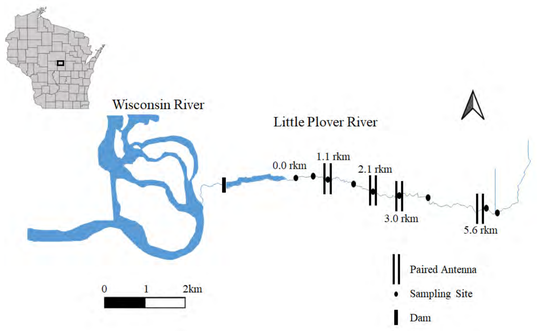

Figure 1. Little Plover River with marked sampling sites (n=9) and paired PIT antennas (n=4) to passively detect tagged Brook Trout.

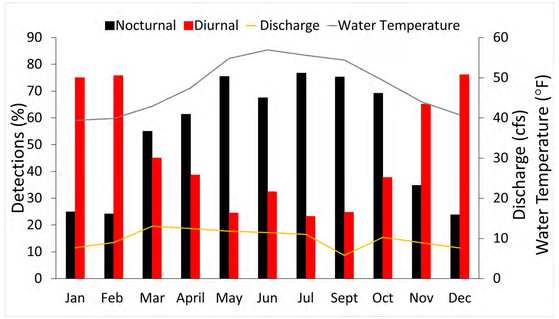

Figure 2. Brook Trout nocturnal and diurnal detections (%) compared to discharge (cfs) and water temperature (°F) by month (Mar. 14, 2016 – Dec. 31, 2020).

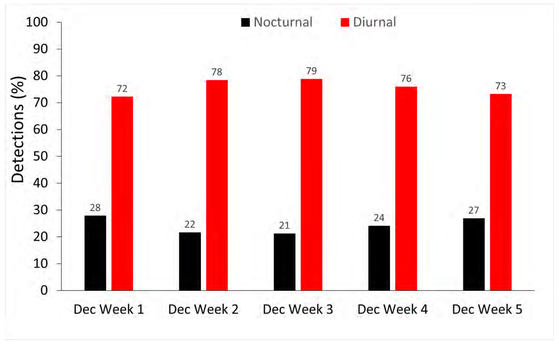

Figure 4. Brook Trout nocturnal and diurnal detections (%) per week in December (2016 -2020).

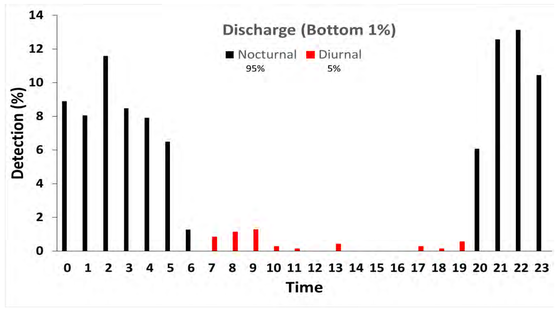

Figure 6. Brook Trout nocturnal and diurnal detections (%) during the bottom 1% of discharge (cfs).

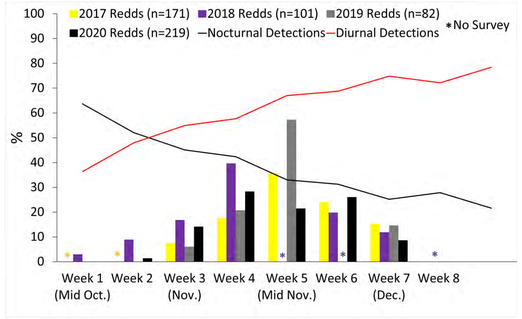

Figure 3. Brook Trout nocturnal and diurnal detections (%) compared to redds observed (%) in 2017-2020.

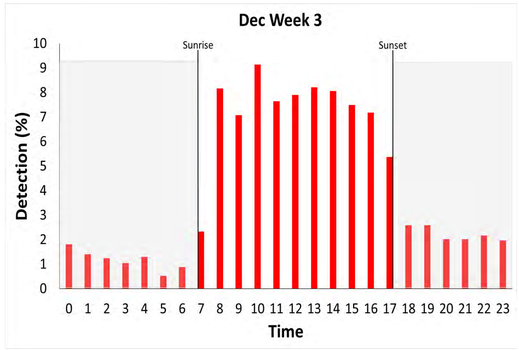

Figure 5. Brook Trout nocturnal and diurnal detections (%) in week 3 of December (2016 -2020). Shaded = Night

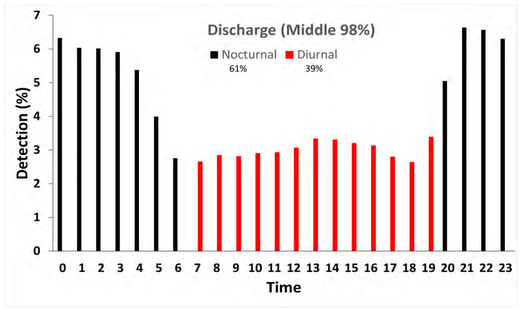

Figure 7. Brook Trout nocturnal and diurnal detections (%) during the middle 98% of discharge (cfs).

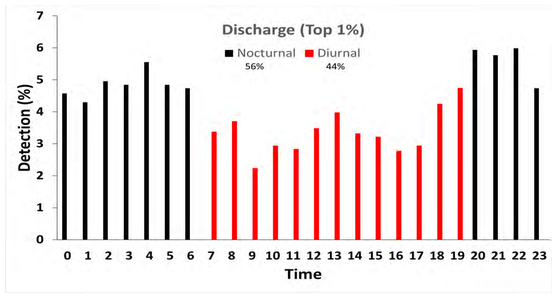

Figure 8. Brook Trout nocturnal and diurnal detections (%) during the top 1% of discharge (cfs).

Results

➢ Brook Trout nocturnal during most months, shifted to diurnal during and after spawning season (fig 2).

- Peak redd activity was week 3 of November (fig 3)
- Peak diurnal detections in week 3 of December, when 79% of detections between sunrise & sunset (fig 2, 4 & 5).

➢ Water Temperature: more nocturnal during warmer periods and more diurnal during cooler periods (fig 2).

➢ Discharge: Bottom 1% (fig 6) and middle 98% (fig 7) corresponded with nocturnal movement.

➢ Top 1% showed increased diurnal movement (fig 8).

Discussion

➢ Brook Trout diel patterns more closely related to water temperature & photoperiod then redds & discharge.

- Nocturnal activity was highest during the longest photoperiod and warmest water temperatures.
  - Movements during cooler water temperature at night in summer may reduce stress & increase survival.
  - Movements at night may provide reduced predator success in clear streams, increasing survival.
  - Aquatic macroinvertebrates drift most frequently at night, so increased movements may be for feeding.
- Diurnal activity was highest during shortest photoperiod and coldest water temperatures (Dec. – Feb.).
  - Movements during day may be less dangerous as certain predators hibernate or migrate south.
  - Warmer water temperatures during day hours in winter (increases metabolic rate – need to feed).
  - Redd construction & guarding typically during day.

➢ Brook Trout more diurnal as discharge increased.

- Noticeable increase of diurnal activity at top 1% of discharges and primarily nocturnal at lowest 1%.
  - Extreme high flow increases runoff into the stream, increasing turbidity = reduced visibility to predators.
  - River-wide movements increase with higher flows.

Future Research

➢ Investigate feeding activity relative to time of day and water temperature to evaluate our observed patterns.

➢ Evaluate additional environmental factors (e.g., barometric pressure, precipitation) on diel movements.

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