

Environmental Variables and Seasonality Associated With Silver Eel Out-Migration on the Shenandoah River

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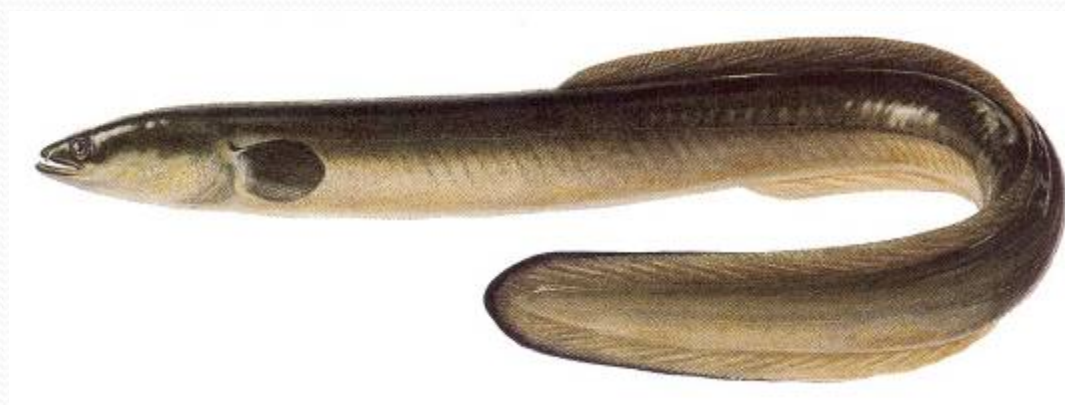
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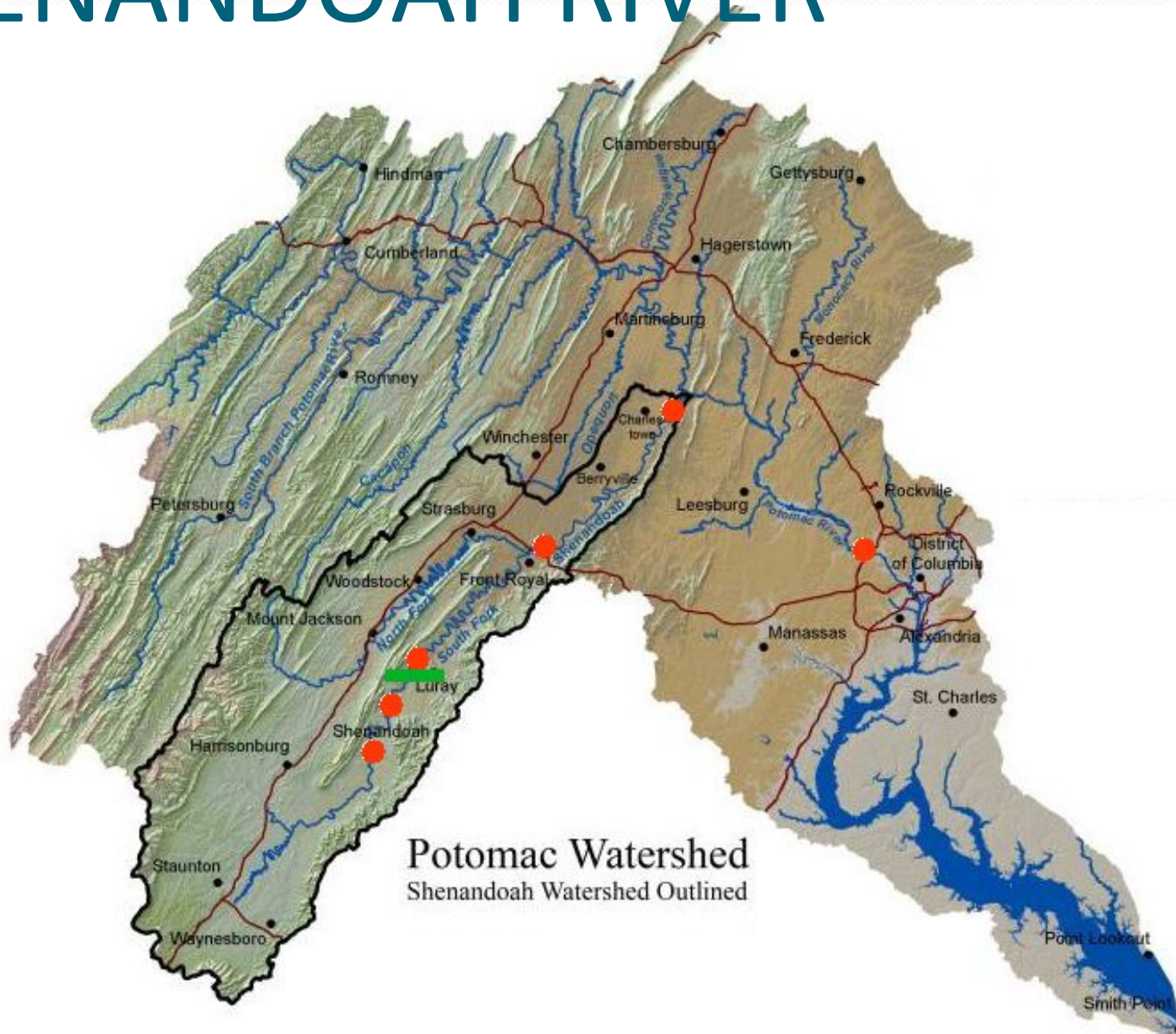
Leetown Science Center, U.S. Geological Survey

EEL LIFE HISTORY

- Catadromous, spawn in Sargasso Sea
- Young eels spend several years migrating upriver
- Upriver habitat produces largest female eels
- Peak downstream migrations occur in fall



SHENANDOAH RIVER



SHENANDOAH HYDRO STATIONS

- 5 Hydropower Dams in South Fork and Mainstem
- Three lower dams have upstream eel passage
- All run-of-river dams
 - Maintain minimum spill (1")
- Run Francis Turbines
 - 2 to 3 units per dam
- Seasonal shutdowns



FISH COLLECTION AND TAGGING

- Boat Electrofishing used to collect eels
- Collections upstream of Luray
- Large eels radio tagged
- Released at capture location within hours



DOWNSTREAM MIGRATION

– RADIO TELEMETRY

- Monitoring Locations
 - 5 Shenandoah Dams



- Stationary Telemetry
 - Aerial
 - Underwater

TAGGED EELS 2007-2009

- 145 eels tagged falls 2007 - 2009
 - 92 silver
 - 28 intermediate
 - 25 yellow
- Average Weight 1388g
 - Range 660 to 2660
- Average Length 854mm
 - Range 720 to 1018



DOWNSTREAM MIGRATION

- 96 eels made downstream movements (81 silver)
 - 58 passed Millville Dam on Shenandoah River
- Downstream migrations past dams in every month except July

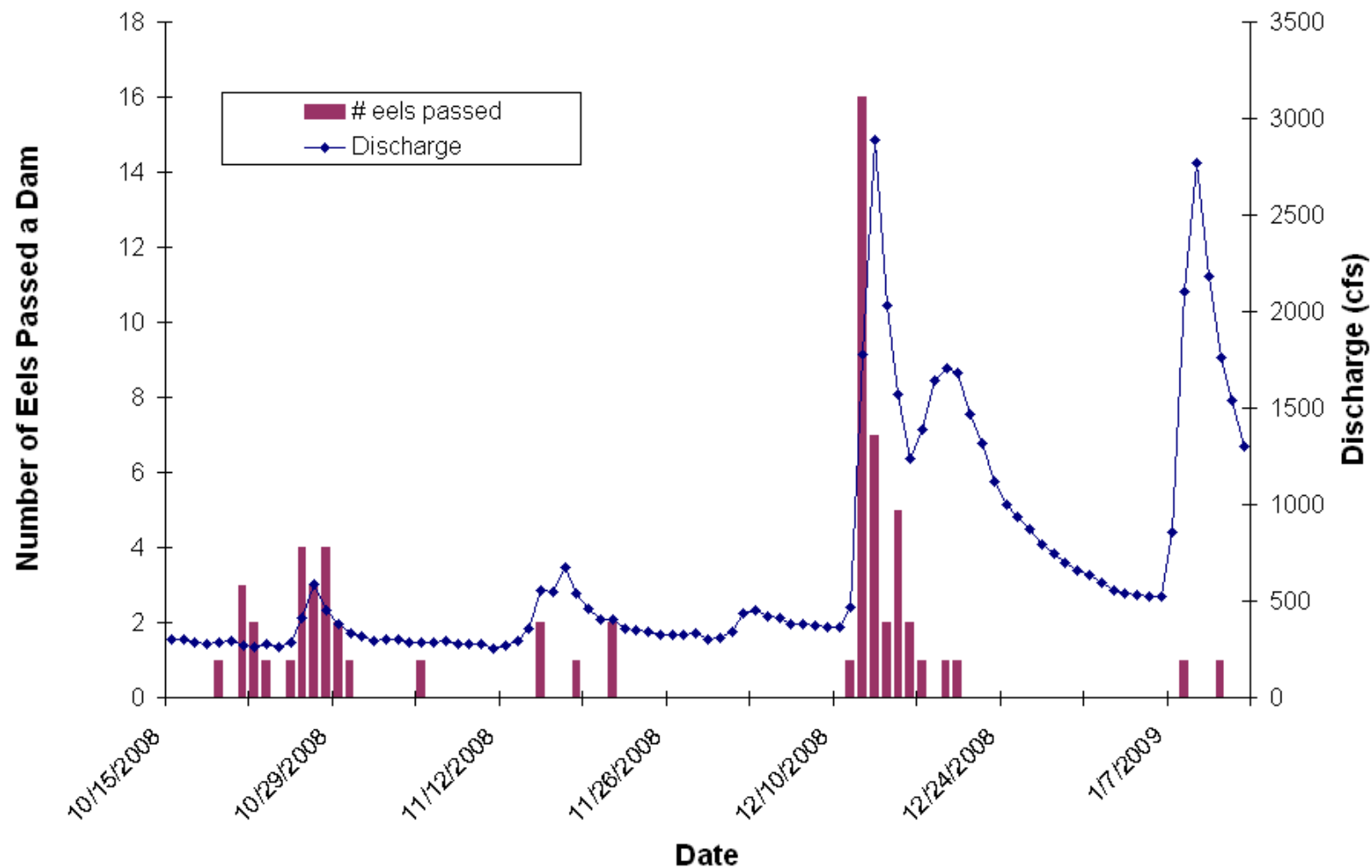


ENVIRONMENTAL CUES

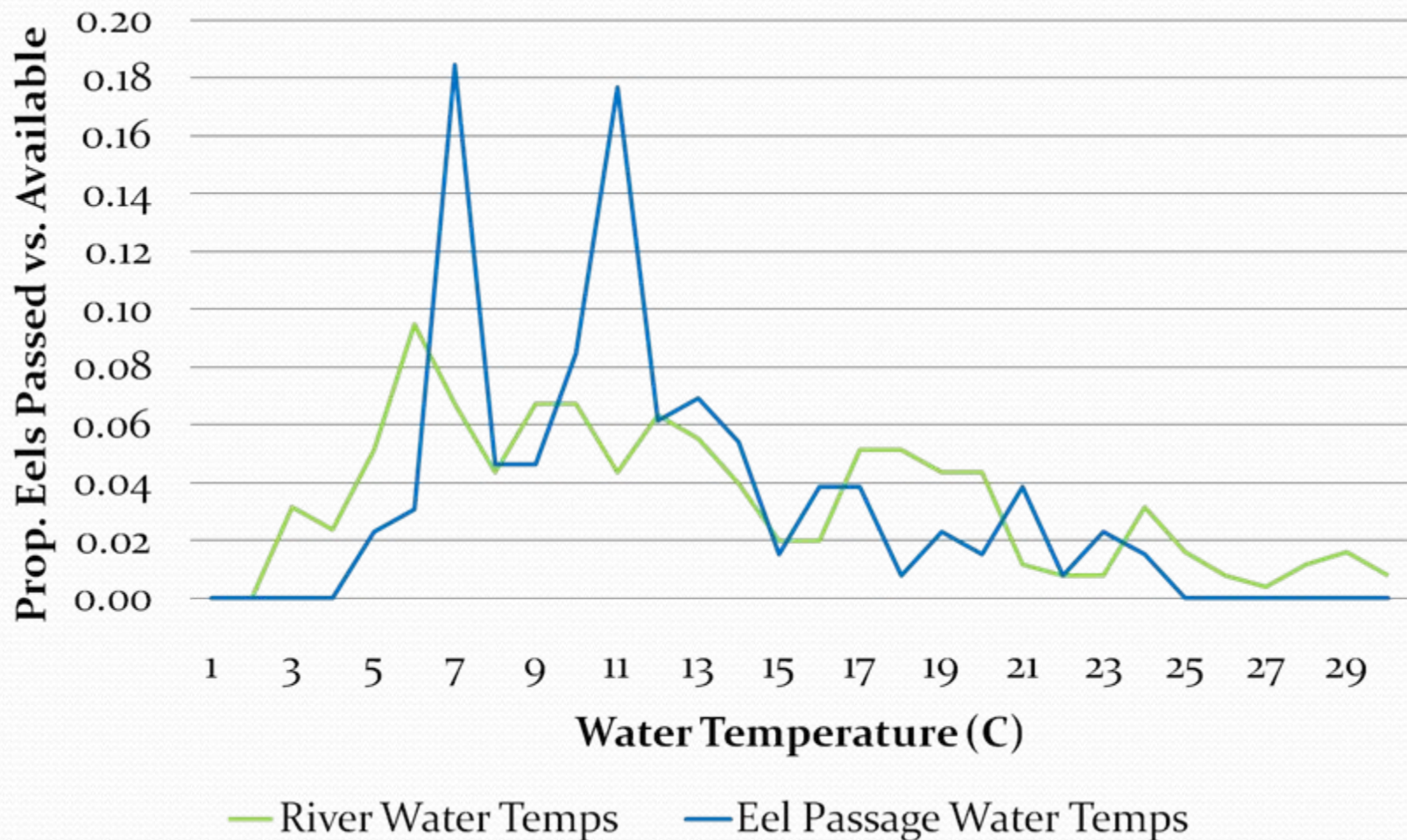
- Attempt to predict when eels are migrating downstream
- Variables considered:
 - Discharge
 - Lunar Phase
 - Water Temperature
 - Change in flow



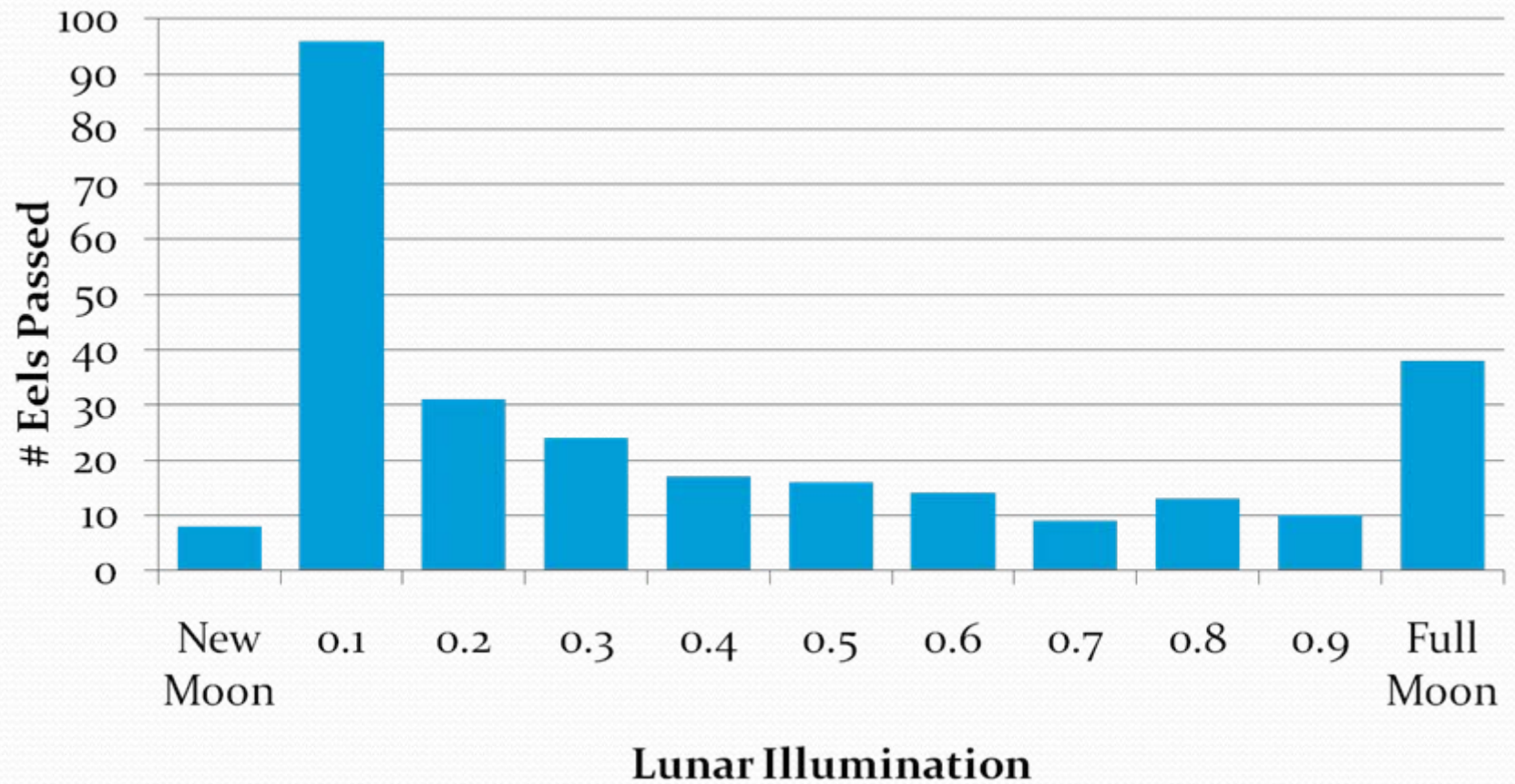
DISCHARGE



TEMPERATURE

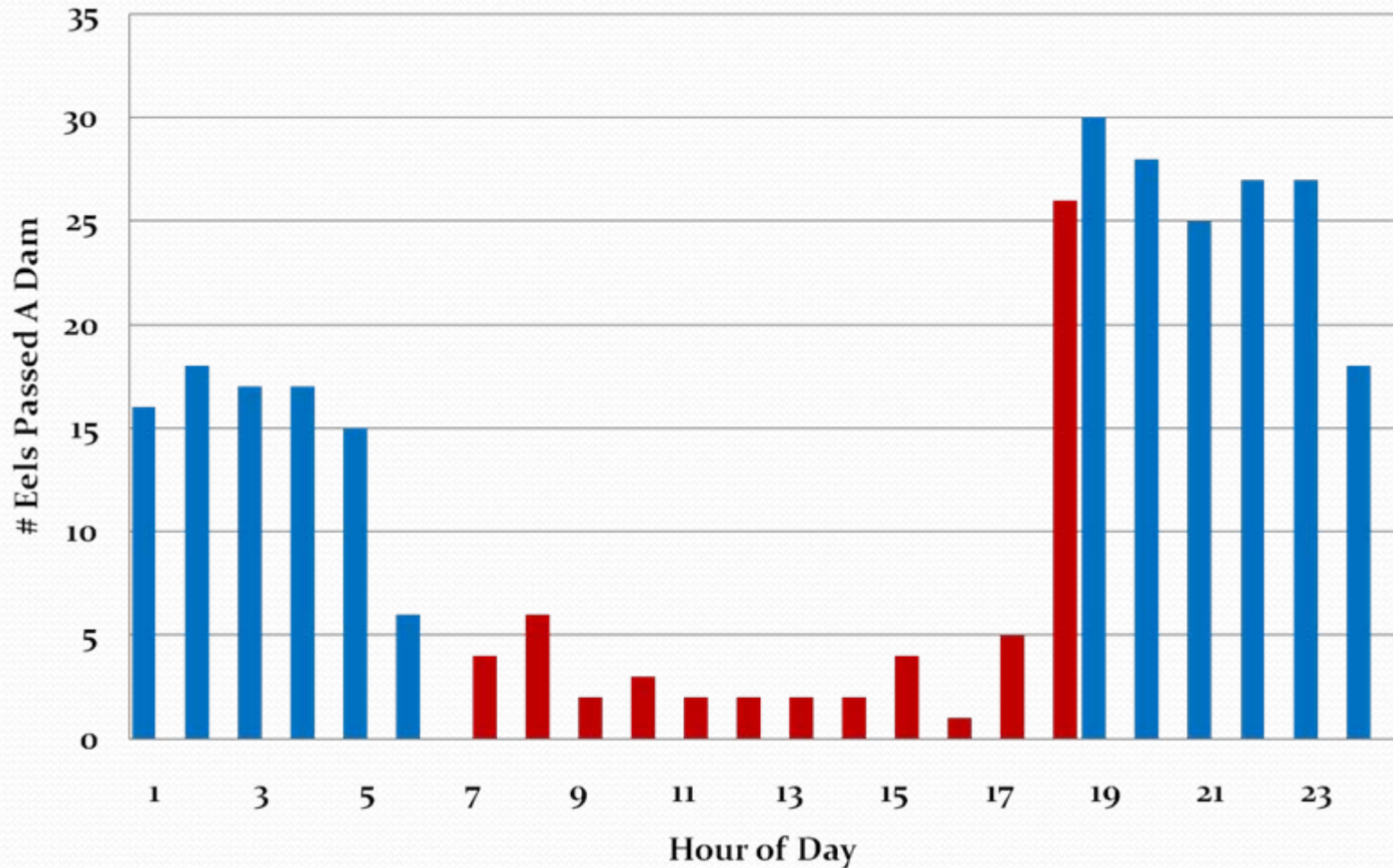


LUNAR PHASE



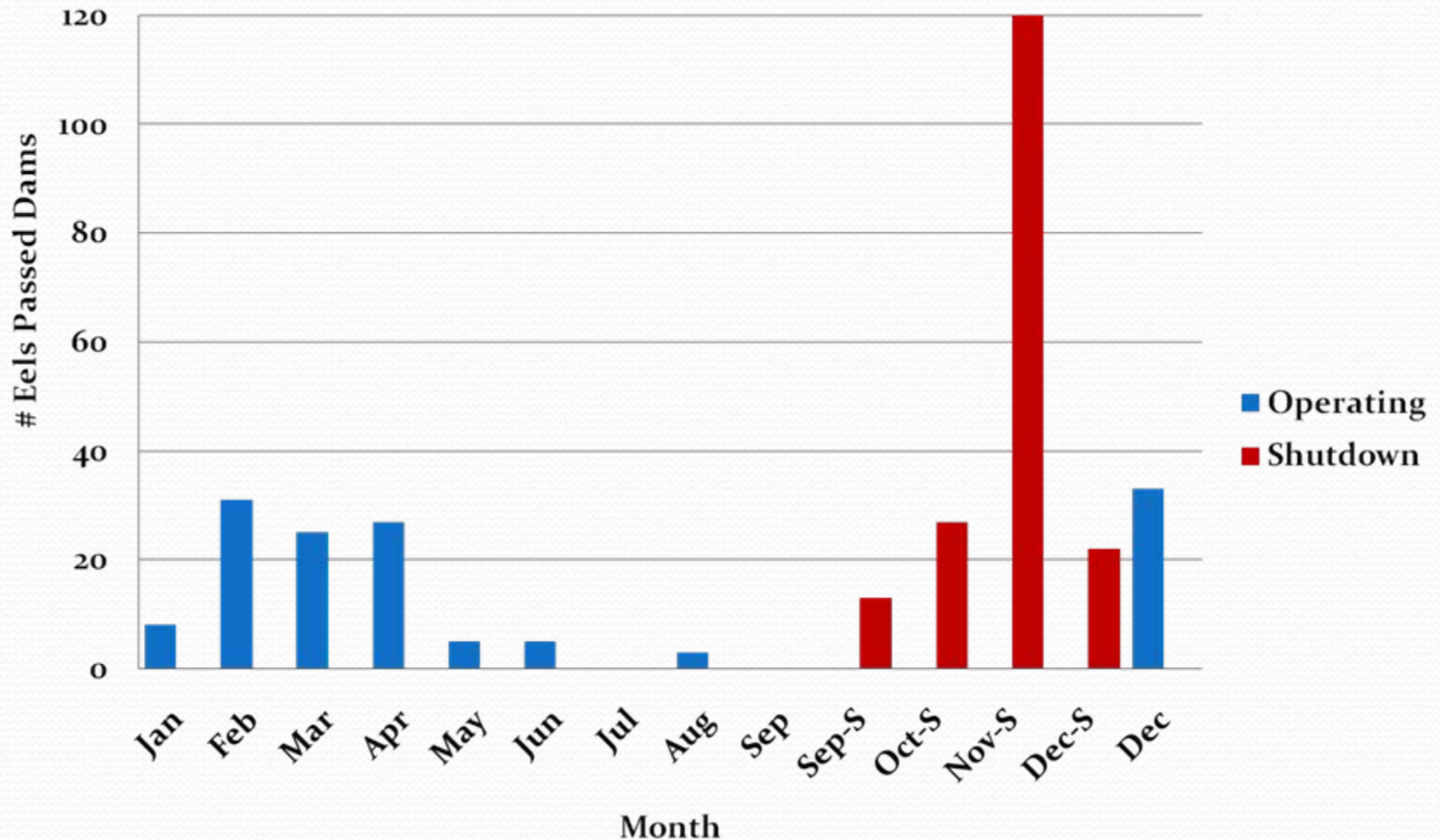
TIME OF DAY

- Hydro Shutdowns 1800 hrs to 0600 hrs (80%)



TIME OF YEAR

- Hydro Shutdowns 9/15 – 12/15 (39%)



PASSAGE METHOD

- Passage method known for lower 3 dams on river

DAM	TOTAL PASSED	SPILL (%)	HYDRO (%)	UNK. (%)
Luray	84	61	33	6
Warren	63	65	30	5
Millville	58	53	45	2

TURBINE MORTALITY

- Turbine mortality at every dam
- 28 tagged eels
- Mortality through hydro 15% to 39%
- Cumulative mortality:
 - During shutdown - 20%
 - Outside shutdown - 62%



NEXT STEP

- Determine optimal shutdown periods
- Make recommendation to power company
 - Time of day
 - Time of year
 - Water flow conditions



QUESTIONS?

