Electronic Counting of River Herring

River Herring Counting Workshop

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New Bedford – SMAST Laboratory
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Smith-Root Electronic Counters

- Used since the 1960s – Hatchery use and West Coast salmon counting
- New England States adopt for river herring counting
- Monument River – 1980
- DMF shifted from SR1100 to SR1601 in the last decade with custom fabrications

Smith-Root Counters in Massachusetts

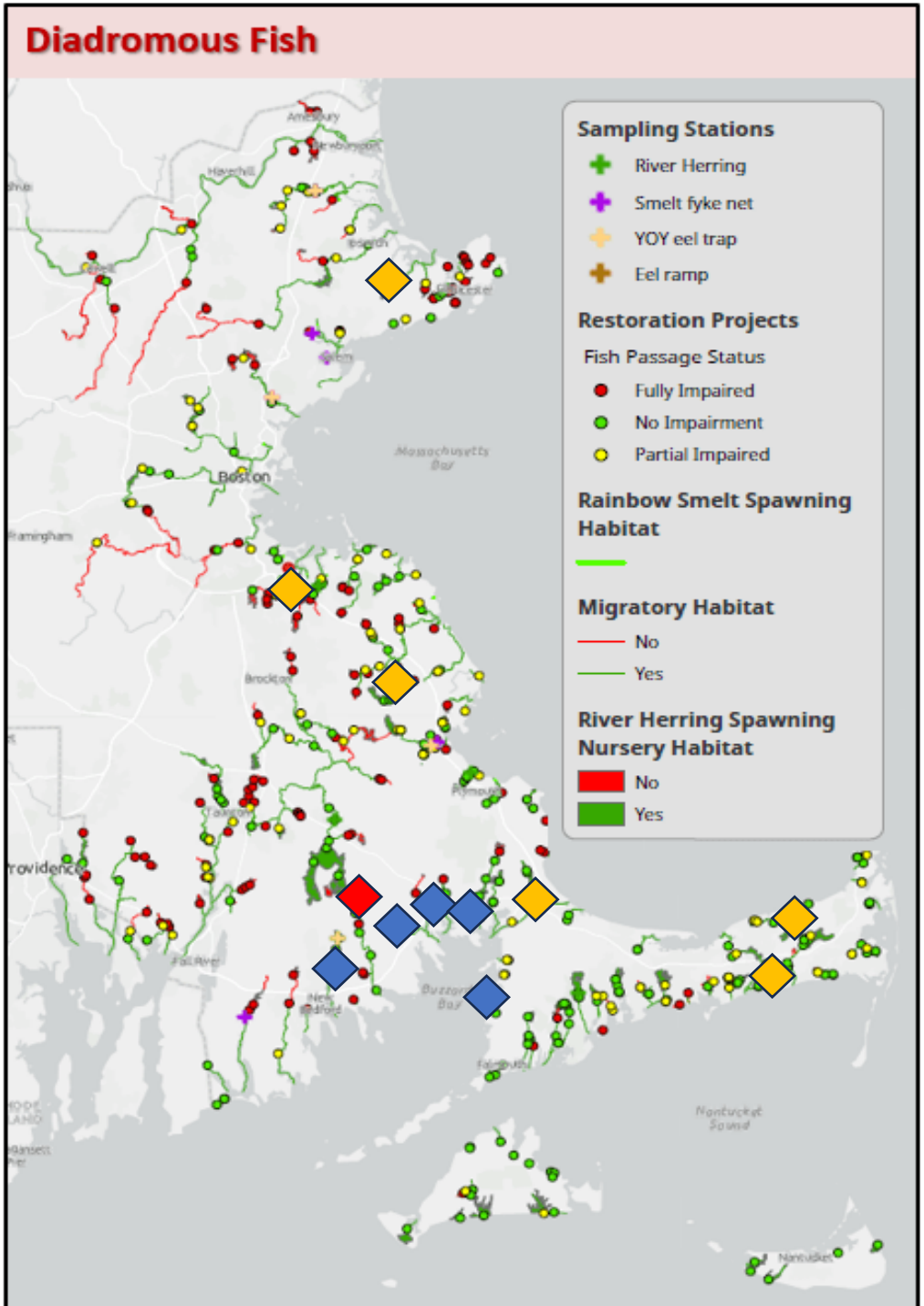
DMF – 6 multi-tube counters

Buzzards Bay Coalition –

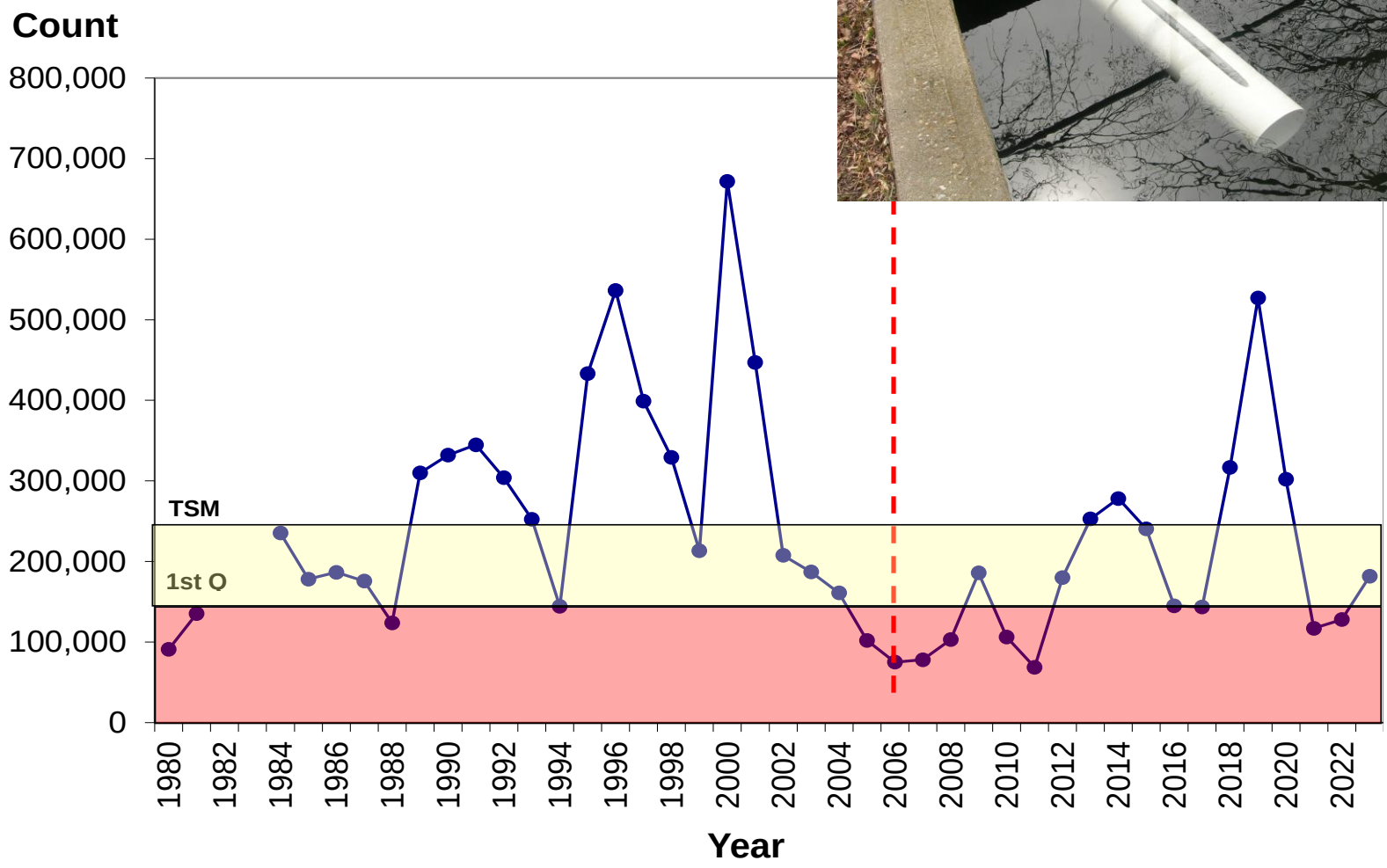
5 single tube counters

Alewives Anonymous –

1 single tube counter



Monument River
Electronic Counter – 1



Smith-Root Electronic Counters

Advantages

- can be highly accurate
- minimal cost to finalize data
- compatible with solar power
- compatible with volunteers

Disadvantages

- high start-up cost
- downrunning fish
- daily maintenance
- Not compatible with low flow

On the way out……

Maintenance and Diagnostics

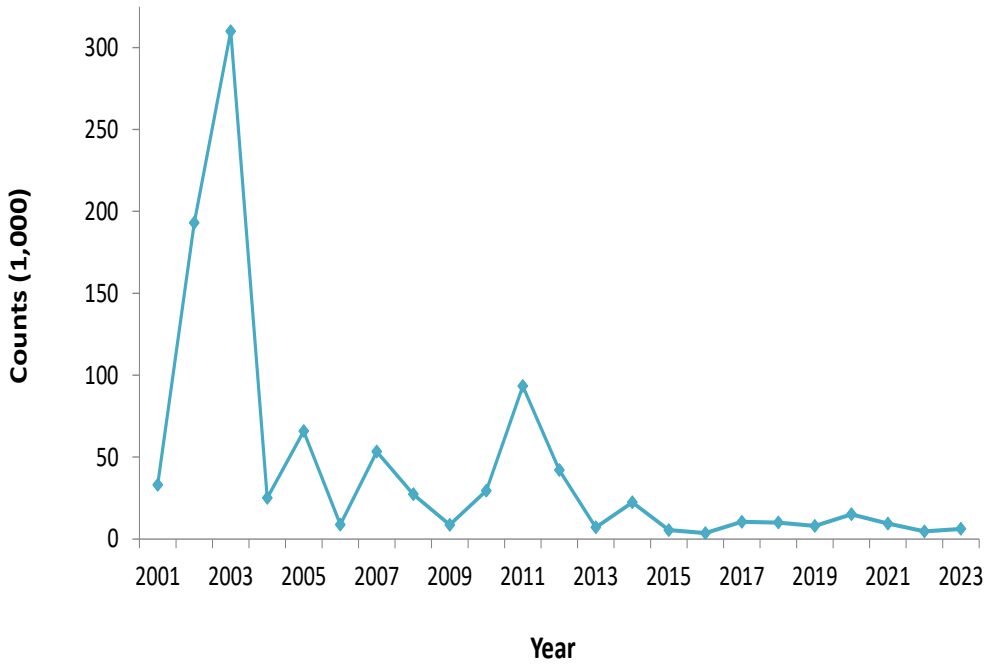
Daily visits are essential

- Visual inspection of tube array
- Record pond water level, battery voltage and check counter display
- Comparison Counts – one 5-minute count per visit
- Tube Velocity Check – measure velocity with each visit
- Bottle checks and Sensitivity adjustments

Buzzards Bay Coalition
Maintains 5 Smith-Root Counters

High Street Dam, Bridgewater

River Herring Count 2001-2023



Town River Fisheries Committee

Boston Harbor and North Shore Counters

- Essex River, Essex
- Back River, Weymouth
- Joe Holbeche runs these stations out of DMF's Gloucester lab

Herring Brook, Pembroke

High accuracy when carefully maintained daily

570,000 river herring in 2023

444,075 river herring in 2024

Check counts accuracy exceeded 90% in both years

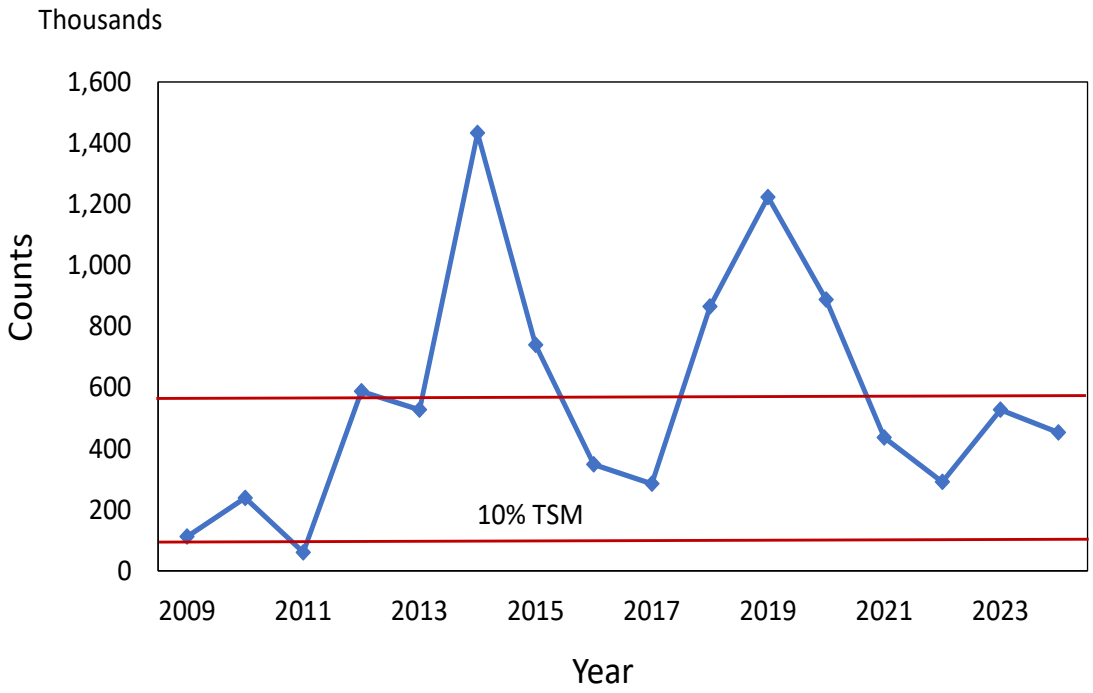
Stephanie Berkman runs this station for DMF working with the Pembroke Herring Fisheries Commission

Herring River, Harwich

- Large weir-pool fishway at tidal interface
- Smith-Root 1601 Electronic Counter – 8 tubes, Solar powered
- Auxiliary spillway with board slots
- Unique downrunner chutes

Recorded 1st million fish count in MA in over 20 years

Herring River, Harwich
River Herring Counts
2009 - 2024



Count Ratio Average = 13 %

Range = 4 to 31 %

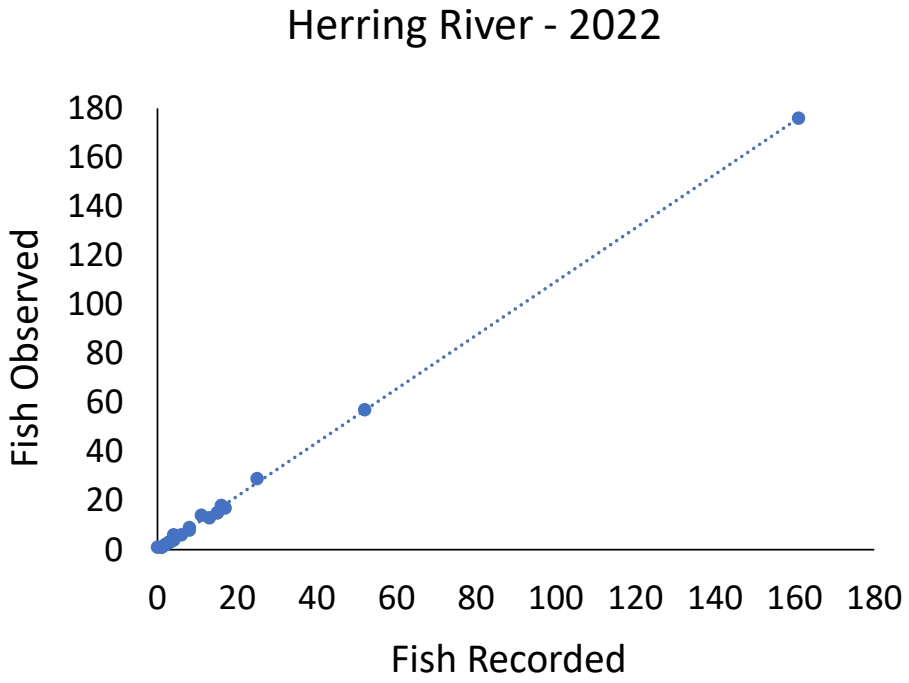
Sustainable Fishery Mgt Plan - Allows 10% of time series mean (570,000 fish)

Smith-Root Check Counts - 2022

57 check counts conducted

29 zero counts

28 with fish counts



Ave. Count Accuracy – 91%

Cumulative Count Accuracy – 92%

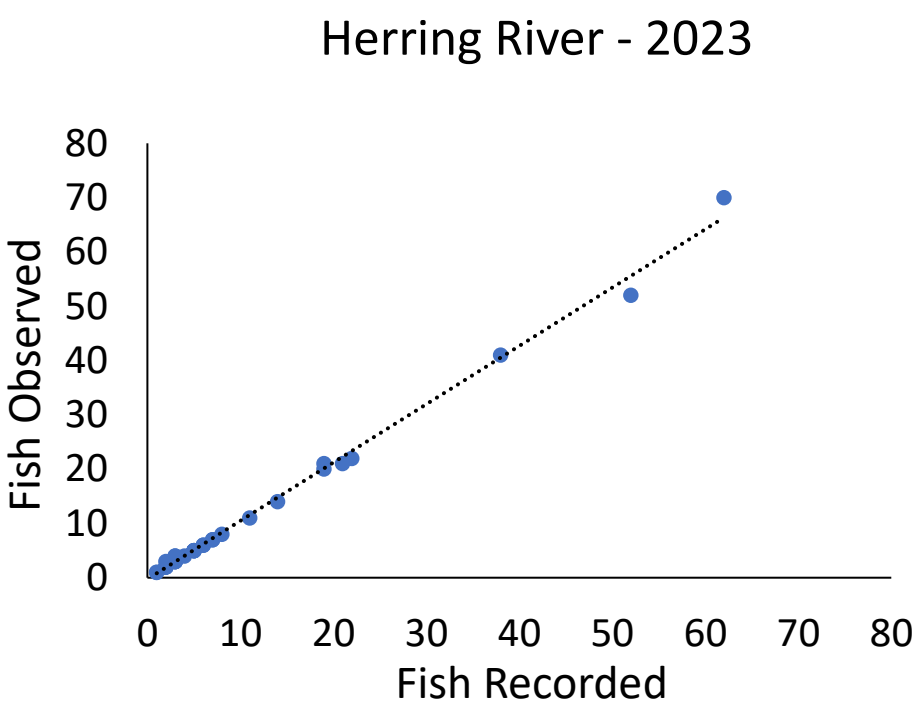
Data Adjustment – Three 1-day battery failures (solar controller) adjusted with fish/hour extrapolation

Smith-Root Check Counts - 2023

61 check counts conducted

25 zero counts

36 with fish counts



Ave. Count Accuracy – 97%

Cumulative Count Accuracy – 96%

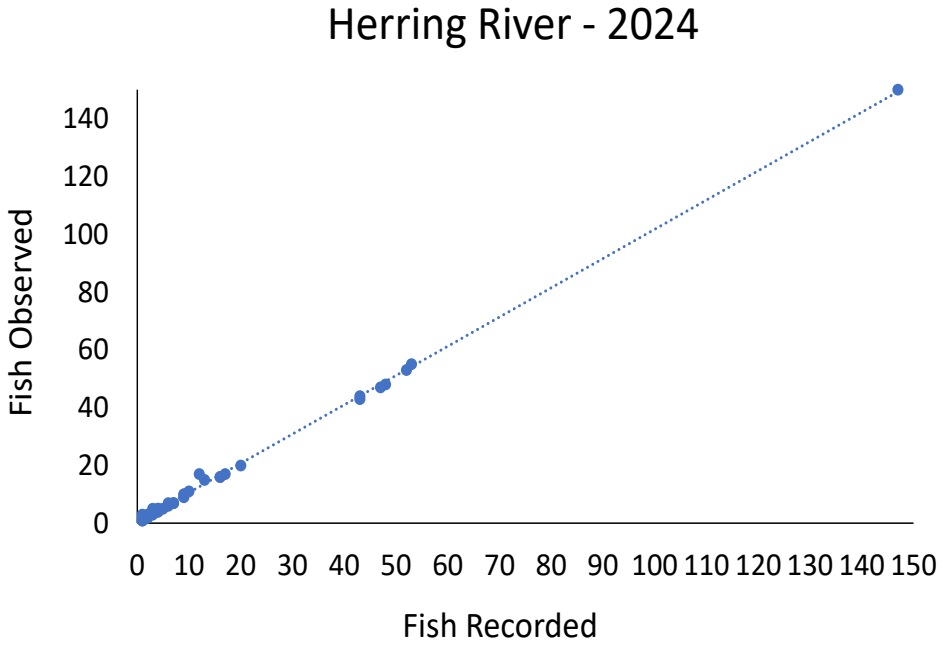
Data Adjustment – Excellent data quality all season. Only 1 day required minor adjustment for debris in tubes

Smith-Root Check Counts - 2024

59 check counts conducted

19 zero counts

40 with fish counts



Ave. Count Accuracy – 90%

Cumulative Count Accuracy – 96%

Data Adjustment – 3 days required adjustments for different reasons: weeds in tubes, accidental shut-off, and solar charge controller failure

Herring River – Harwich
Tube Water Velocity

Target Range – 3.0 to 4.5 ft/s

2022 Range -	1.5 to 4.0 ft/s	Mean = 2.9 ft/s
2023 Range -	1.9 to 3.8 ft/s	Mean = 2.7 ft/s
2024 Range -	2.1 to 4.7 ft/s	Mean = 3.6 ft/s

- Check tube velocity twice weekly with Global Water FP111
- No identified accuracy or passage issues with low tube velocity
- Daily attention and maintenance still required

Tube Velocity Maintenance

Staff Gauge – learning how water elevation relates to counter performance

Side Sluice – add board to increase velocity

Bar Racks – add/ remove debris to change velocity

Downrunner Chute – installation reduces velocity

Rain Events – will increase velocity and mobilize debris on bar racks

Herring River
Data Adjustments

Very good data quality 2022-2024

Solar Charge Controller – failed in both 2022 and 2024. Minor data adjustments

Debris in Tubes – minor adjustments in two years with weeds in tubes

Water Velocity – no issues in 3 years

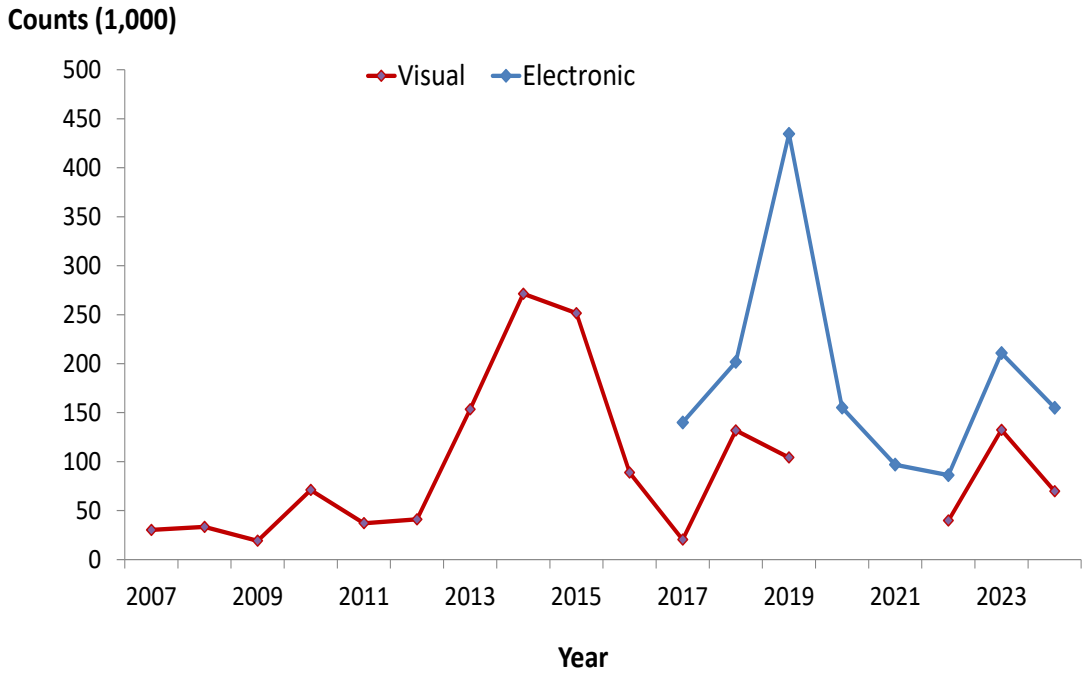
Stony Brook, Brewster Electronic Count 2016 - 2024

Smith-Root 1601 Electronic Counter – 10 tubes

110 V powered

Historic mill park setting – with mill water wheel side channel

Stony Brook, Brewster River Herring Counts 2007 - 2024



Count Ratio Average = 43 %
Range = 15 to 65 %

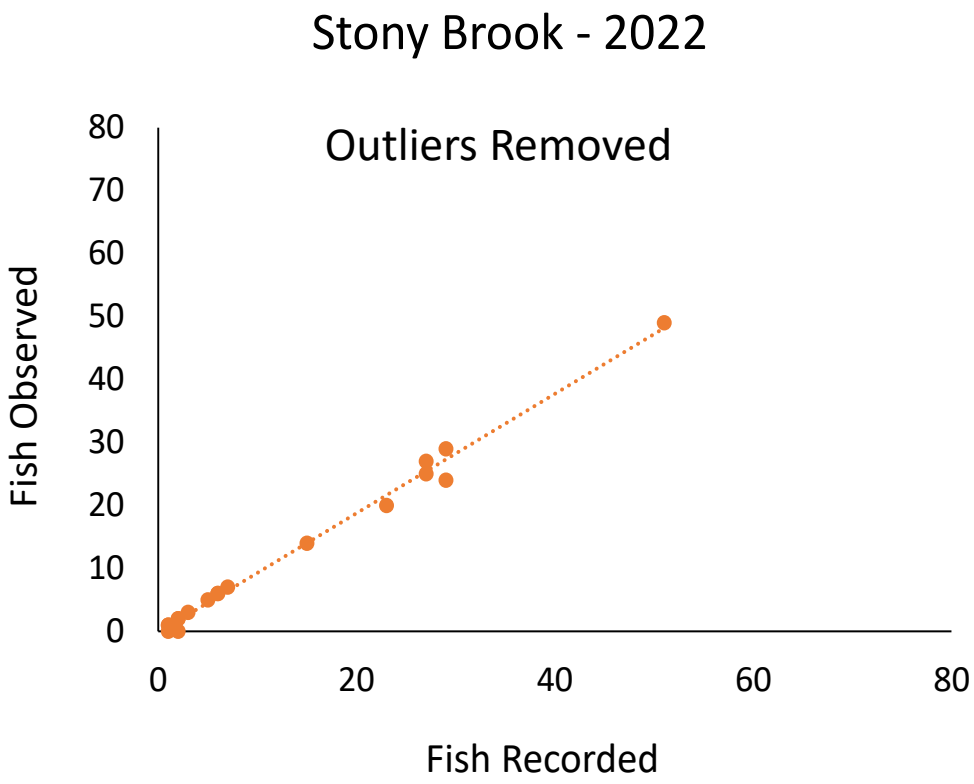
Spawning Habitat
441 acres

Smith-Root Check Counts - 2022

54 check counts conducted

34 zero counts

18 with fish counts

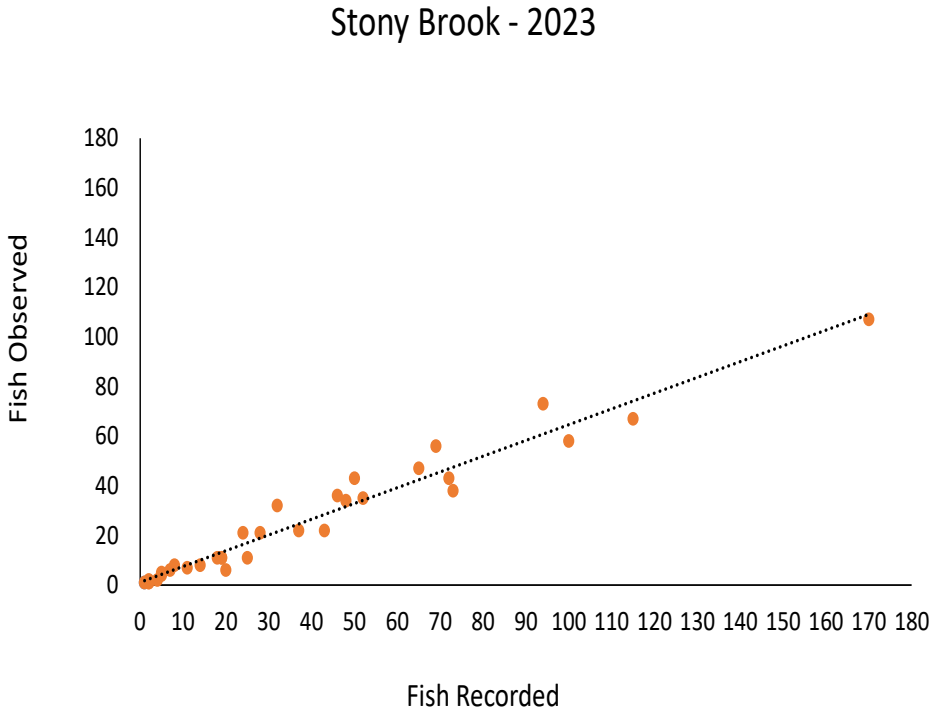


Ave. Count Accuracy – 86%

Cumulative Count Accuracy – 93%

Data Adjustment – reduce counts on 2 dates due to tube debris (use check count %)

Smith-Root Check Counts - 2023



61 check counts conducted

28 zero counts

33 with fish counts

Ave. Count Accuracy – 69%

Cumulative Count Accuracy – 66%

Data Adjustment – Significant issues: electrical problems with tubes #7-9 and periods of high velocity. Adjust entire season count

Stony Brook Maintenance - 2023

Three Separate Problems

1) **Tube 8 –** external wire damage. Picked up early and blocked

2) **Tube 7/9 –** junction box board error caused extra counts

3) **High tube velocity** – caused some double counts

Data Adjustments

Lower tube rack had more high velocity extra counts than top rack. Also had problem tubes 7 and 9. Difficult to isolate and quantify error.

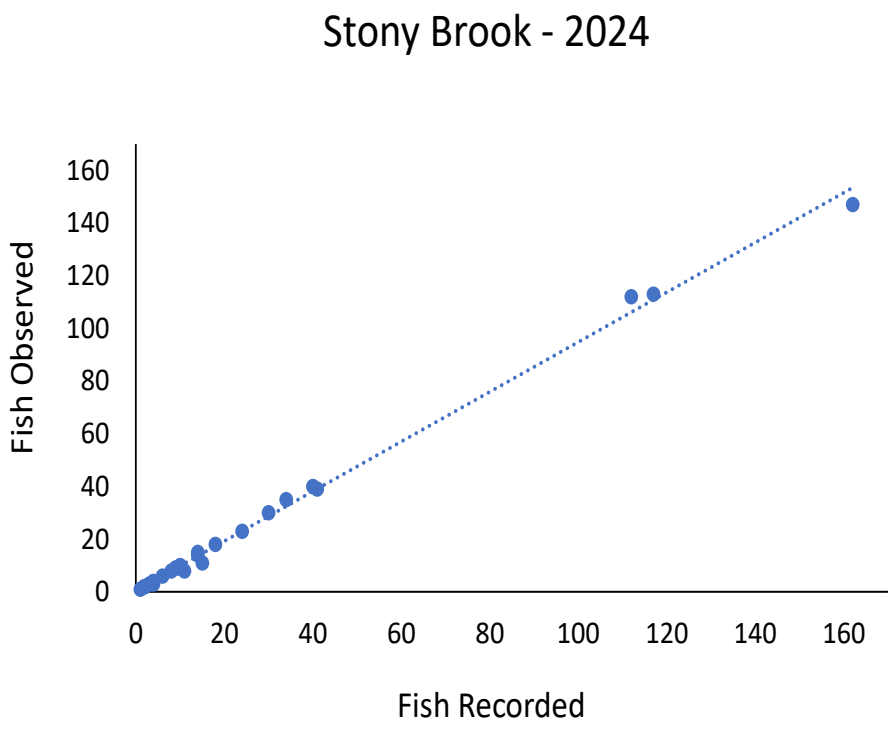
Applied 66% correction factor to entire season from cumulative accuracy of check counts

Smith-Root Check Counts - 2024

59 check counts conducted

32 zero counts

27 with fish counts



Ave. Count Accuracy – 96%

Cumulative Count Accuracy – 96%

Data Adjustment – Good data quality; yet tube 8 had to be blocked again, and data were adjusted for 9 days due to high velocity

Stony Brook – Brewster
Tube Water Velocity

Target Range – 3.0 to 4.5 ft/s

2022 Range - 2.7 to 5.2 ft/s, Mean = 4.5 ft/s

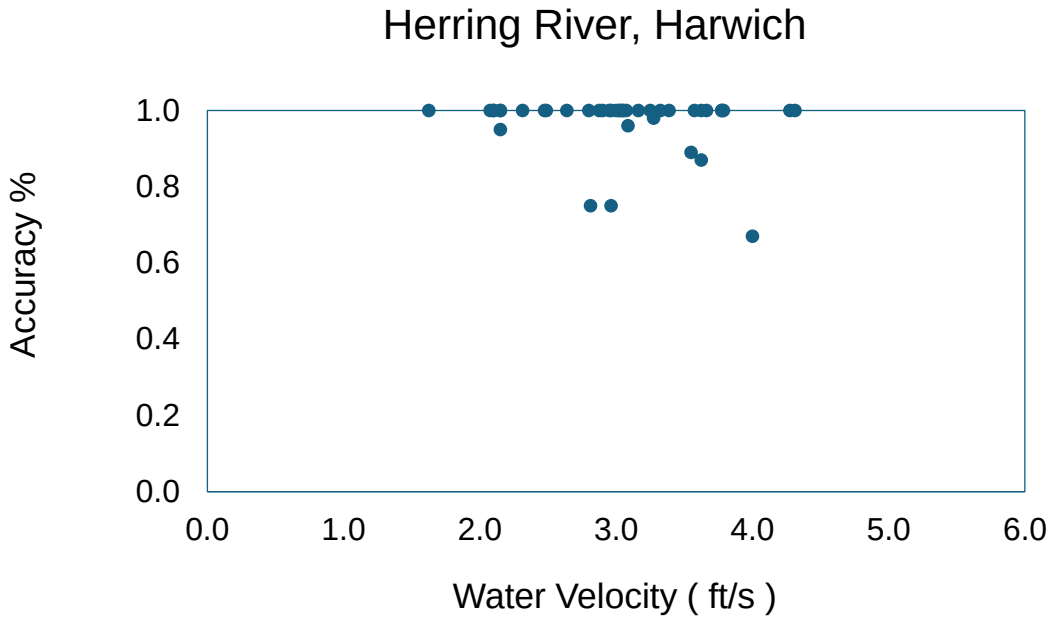
2023 Range - 3.7 to 6.1 ft/s, Mean = 4.9 ft/s

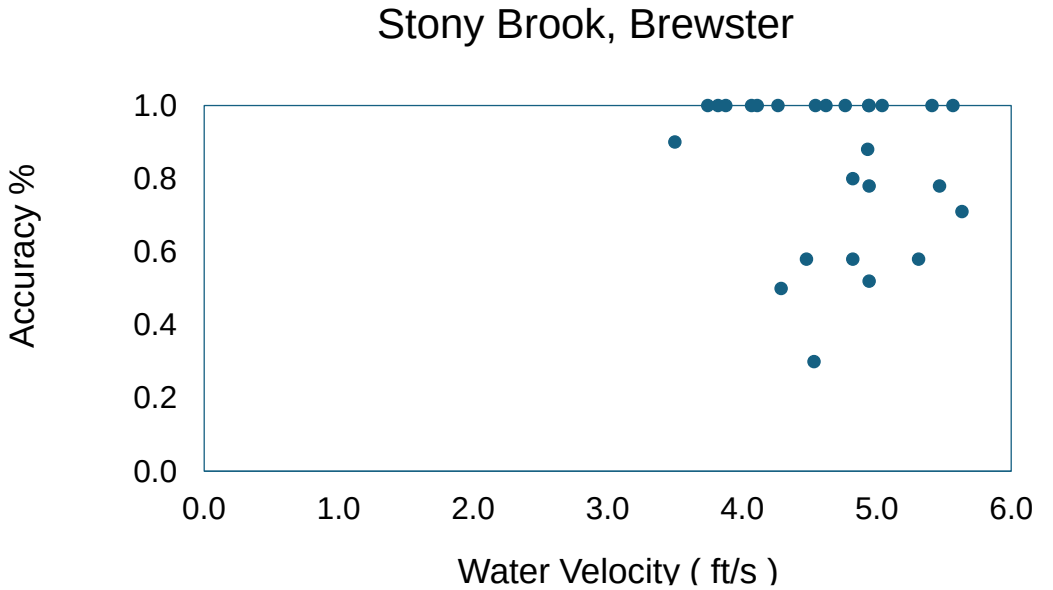
2024 Range - 2.8 to 6.3 ft/s, Mean = 4.4 ft/s

- Check tube velocity at least weekly with Global Water FP111
- No identified accuracy or passage issues related to tube velocity in 2022. Periods of higher velocity in 2023 and 2024 caused accuracy problems.
- Accuracy is good until around 5.5 ft/s. Top tube row is better

Comparison Counts vs Velocity

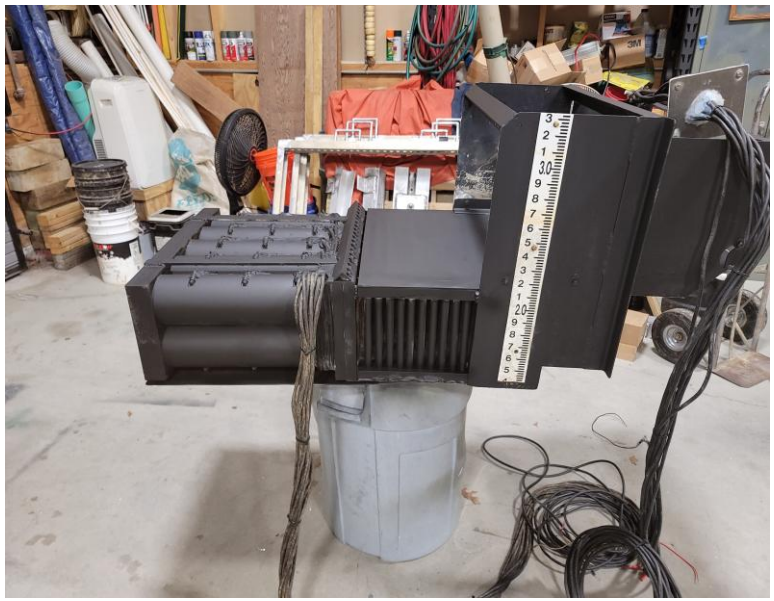
- Few comparison counts <85% at Herring River
- No velocity problems
- Stony Brooks shows both electrical errors and high velocity errors
- Nearly all from 2023





Stony Brook Solutions
2024

- Fix tube wiring and add protective plate
- Isolated and fix failed junction box connections
- Add side bar racks to reduce flow through tubes
- Learning to balance water wheel channel flow



Summary

High data quality is achieved with standard operation and maintenance protocols

Positive Bias….need to stay on top of O&M to prevent this

Overcounts	Debris in tubes
	Low and high velocity
	Junction Box or tube wiring failure
	Downrunners
Undercounts	Not common in multi-tubes (2 fish at once)
	Adjusting Sensitivity can help with single tubes