Counting River Herring Using Underwater Videos and AI

2024 River Herring Network Meeting, Weymouth, MA

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Sea Grant MIT

MASHPEE WAMPANOAG TRIBE

MIT

IPSWICH RIVER WATERSHED ASSOCIATION

Woodwell Climate Research Center

Coonamessett River Trust

Citizen Scientists in River Herring Conservation

North and South Rivers Watershed Association

Citizen Science River Herring Counts Help Us Understand Population Decline

Posted on July 27, 2023 by Lori

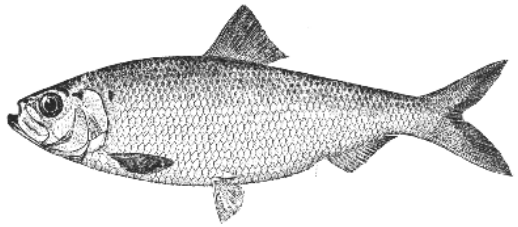
NOAA FISHERIES

You Can Help Scientists Count Migrating River Herring—Virtually

April 17, 2020

An underwater web camera lets citizen scientists help collect data on the annual spring migration of herring in historic Plymouth, Massachusetts.

Feature Story | New England/Mid-Atlantic



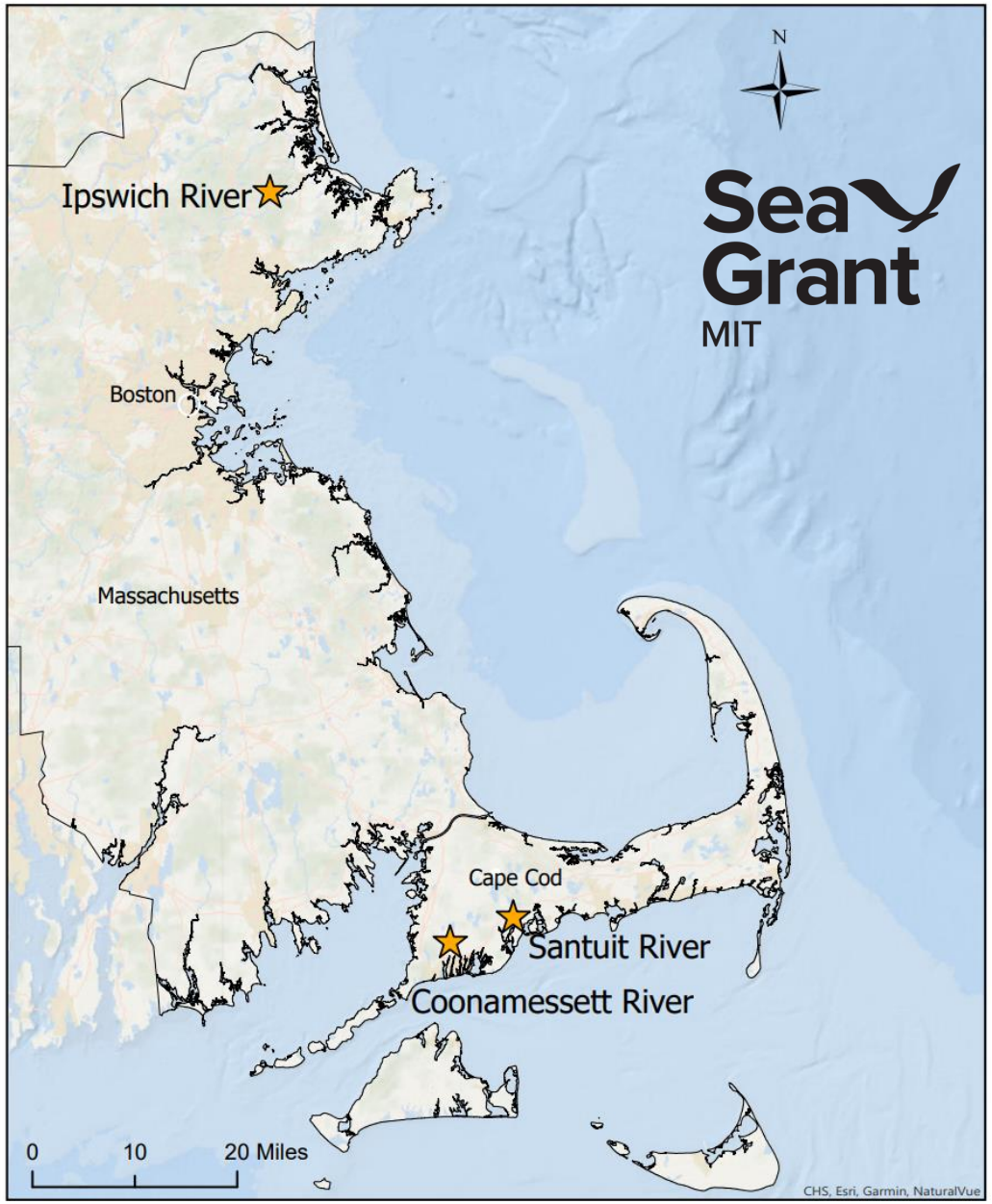
Volunteers Needed to Monitor Herring on the Concord River

We all are attracted to the larger animals in the ocean. Kids are especially drawn to the whales, sharks, and seals. These more charismatic species play an important role in our ocean ecosystem, but they are part of the food chain and rely on their prey, the smaller “forage” fish [video], to survive.

How Artificial Intelligence (AI) can help?

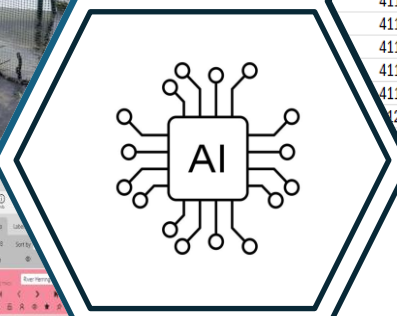
- 24/7 continuous monitoring
- Process large volumes of video data quickly
- Work in various weather and lighting conditions (with proper setup)
- Generate detailed data logs automatically
- Maintain consistent counting criteria once trained
- Track patterns and trends in real-time

AI-Driven Strategic Counting of River Herring



Camera system

AI model

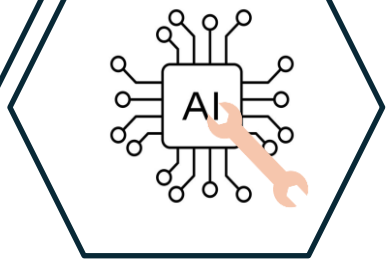


Count table

	time	label	count_in	c
160	77.36	in	1	
1163	77.566	in	2	
1168	77.896	in	3	
1174	78.299	in	4	
4108	274.142	in	5	0
4112	274.407	in	6	0
4114	274.54	in	7	0
4116	274.675	in	8	
4118	274.806	in	9	
4119	274.872	in	10	
125	275.271	in	11	
7	275.404	in	12	

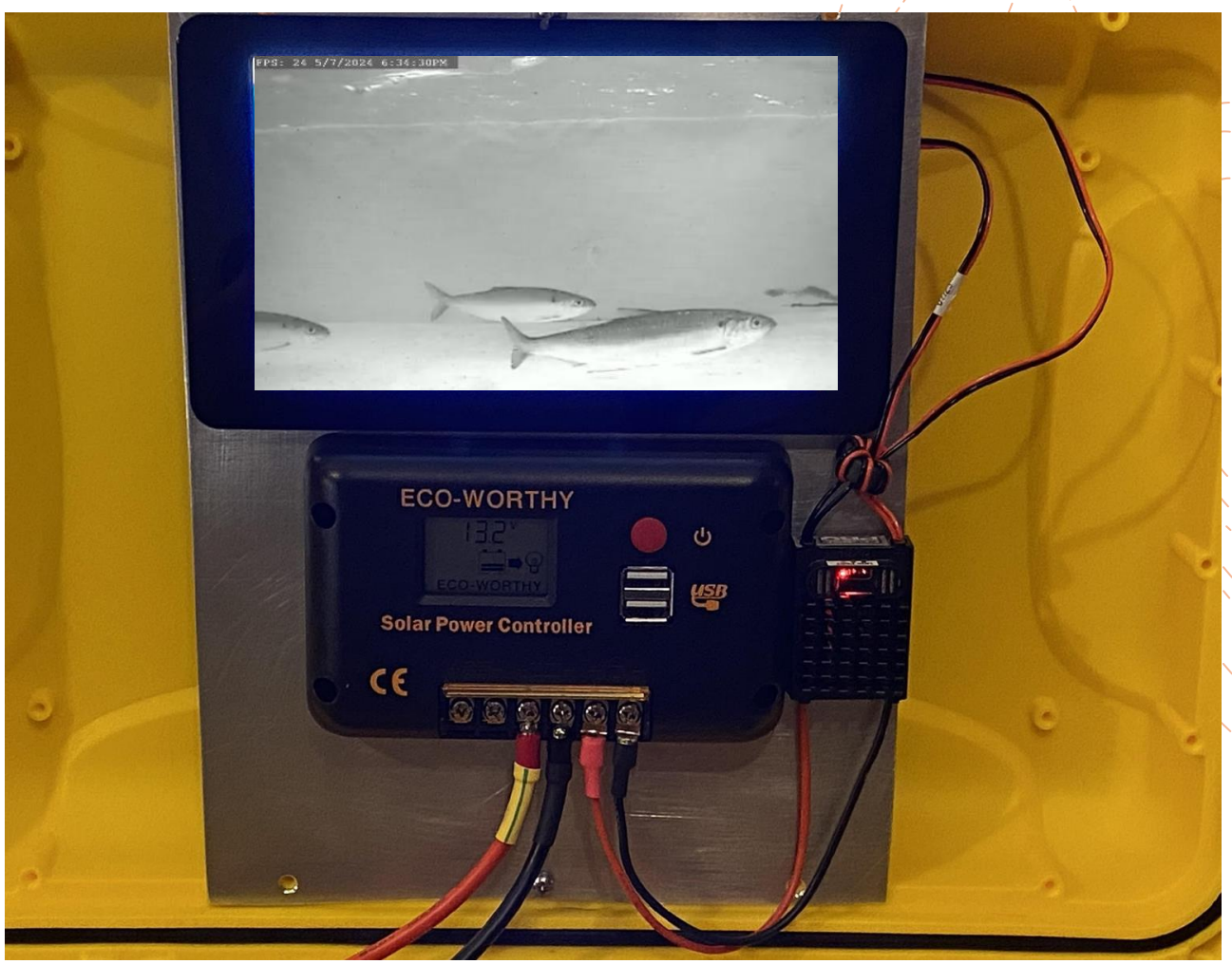
Video Processing

Model Evaluation & Improvement



IPSWICH RIVER WATERSHED ASSOCIATION

Coonamessett River Trust



Camera System

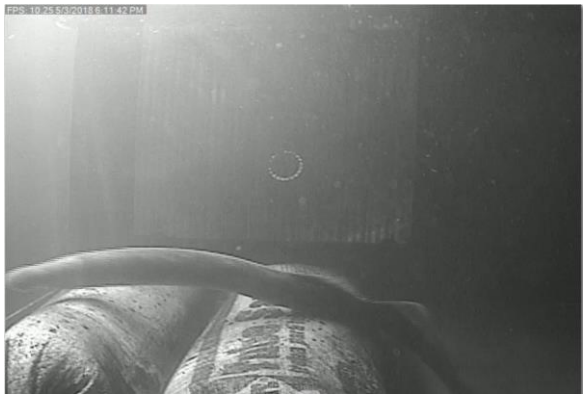
(Solar powered + Infrared light)

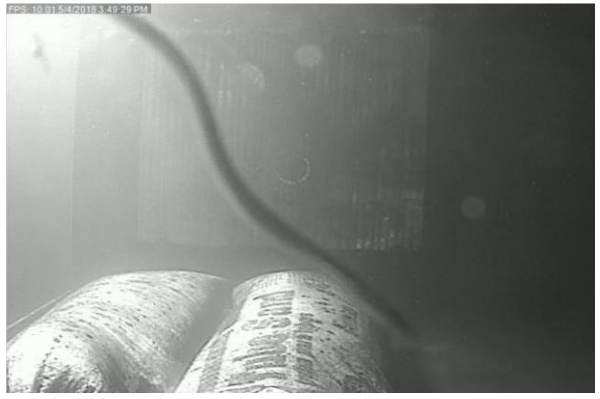
Bennett et al 2024 IEEE Oceans

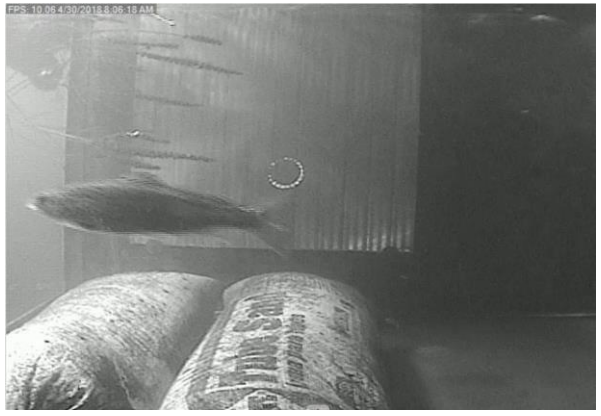
Coonamessett River, Falmouth

Santuit Pond, Mashpee

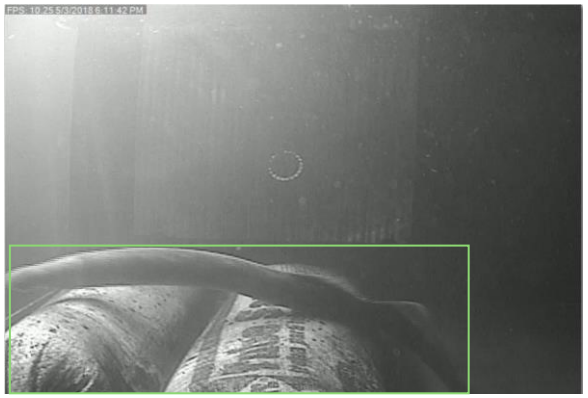
Videos for training AI model

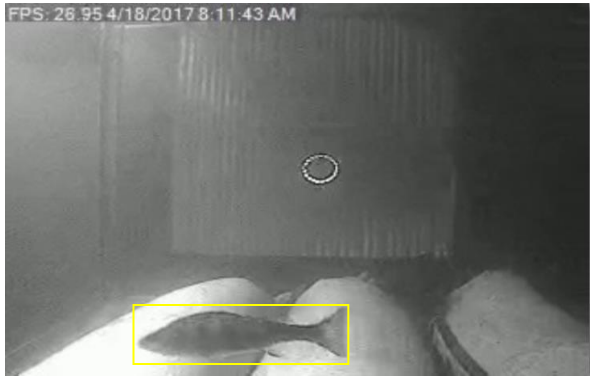


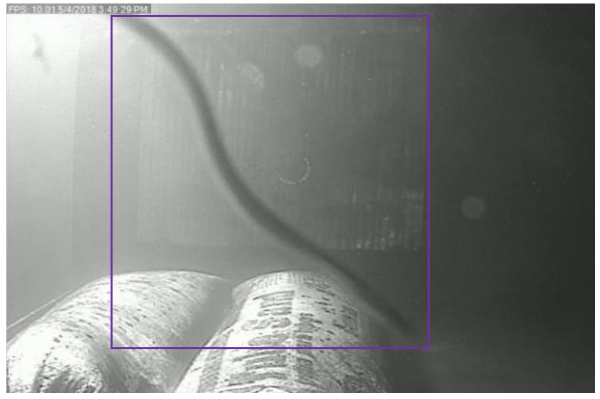


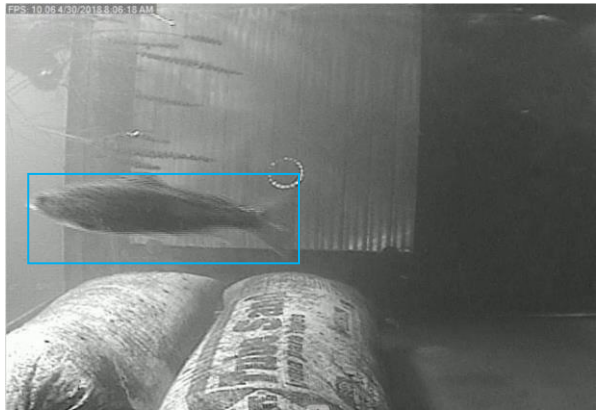


Labeling data for AI model training





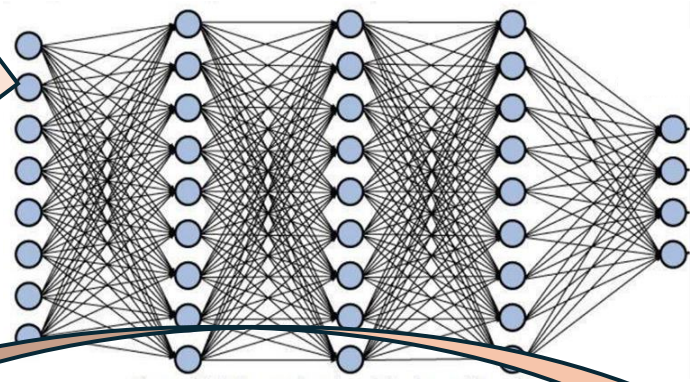




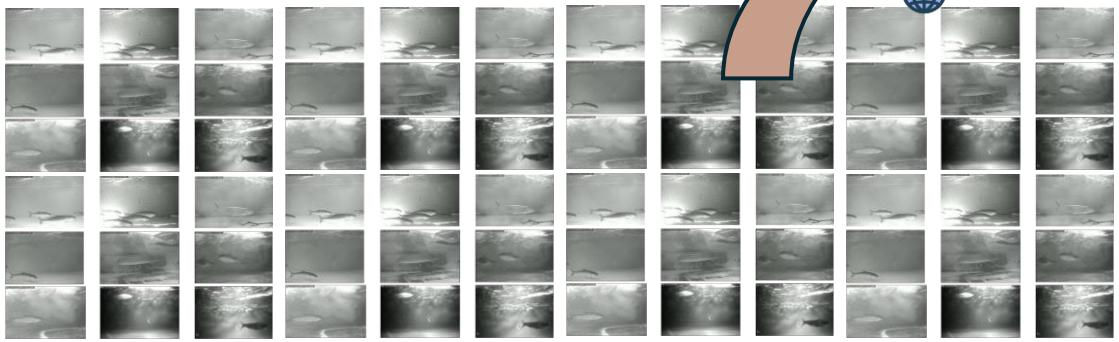
AI model training and prediction

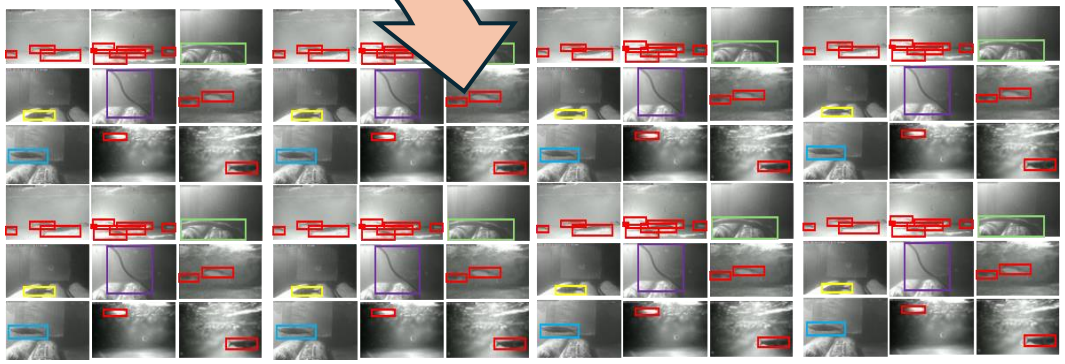
1. Training

AI model - Neural Network

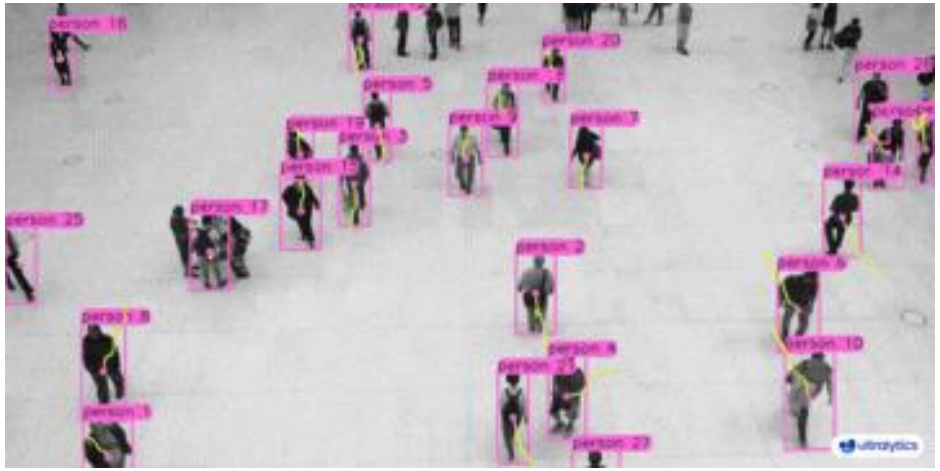


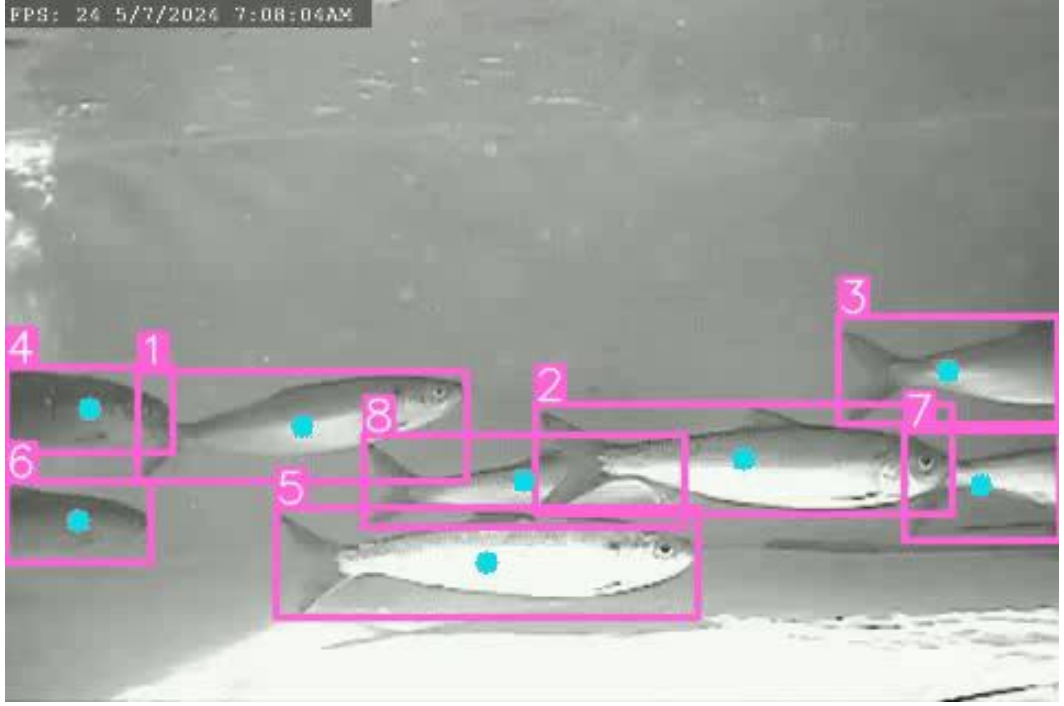
2. Prediction

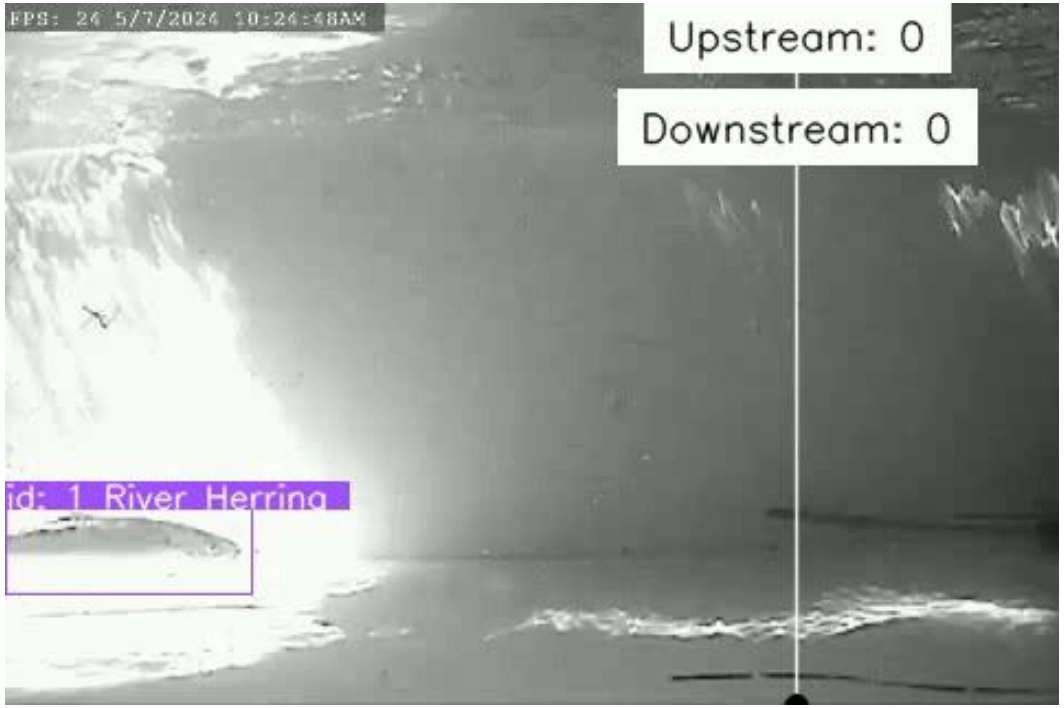




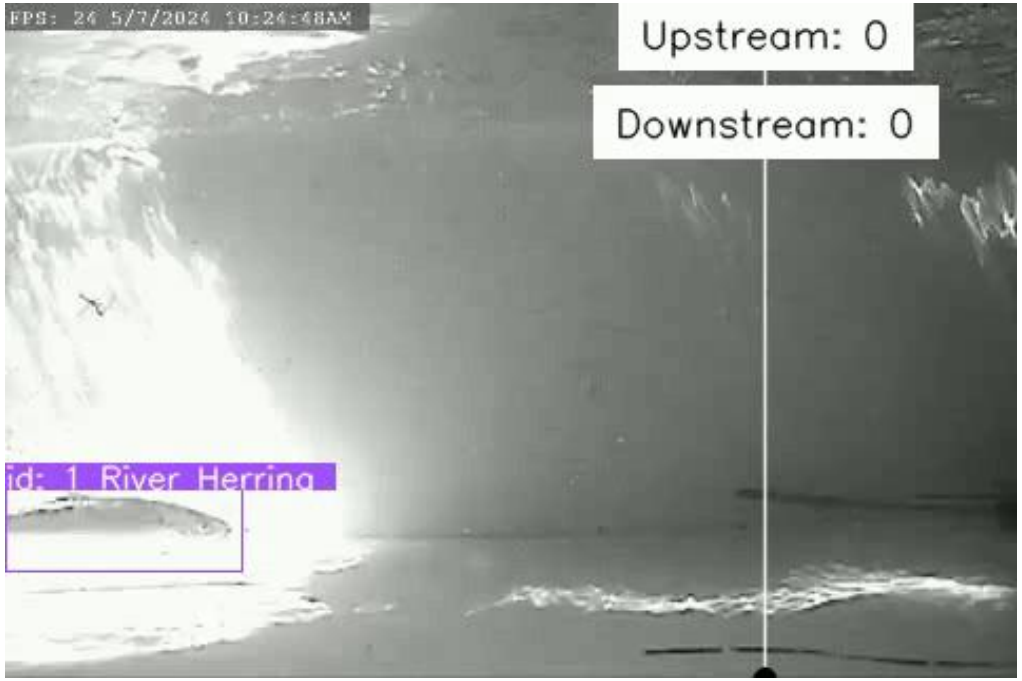
AI model applications







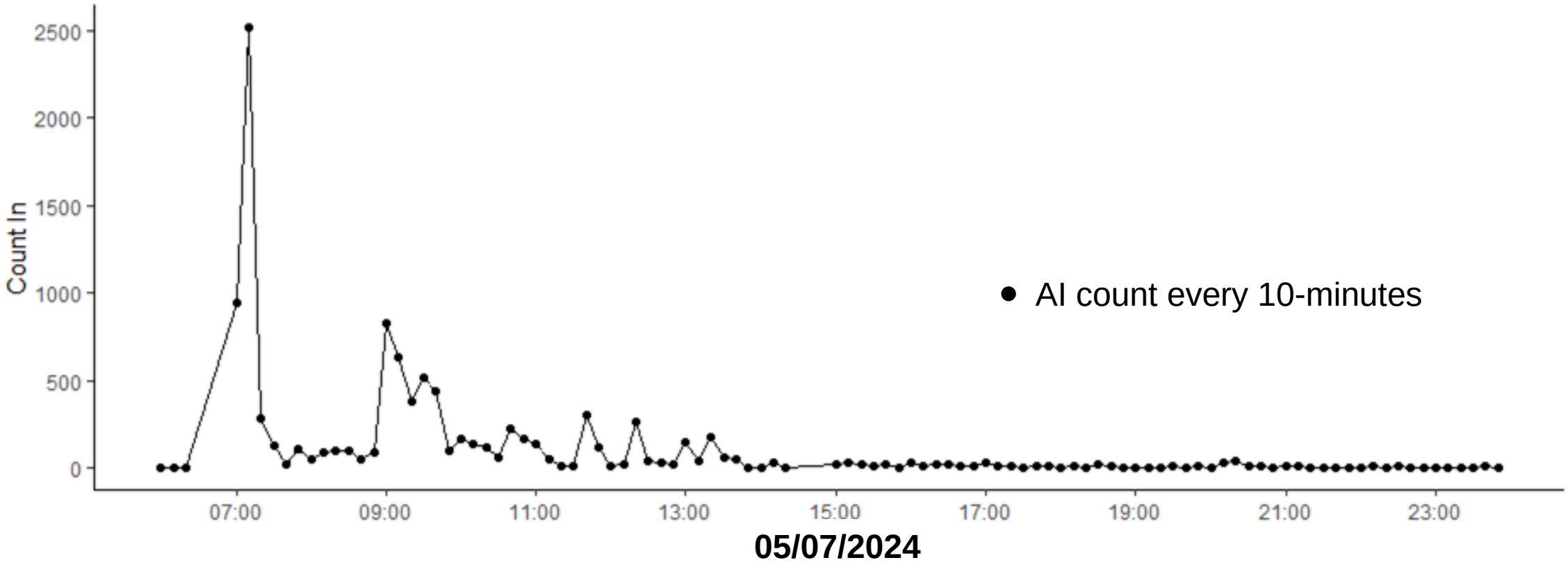
Use AI to Count River Herring



Customized output Data Sheet

frame	time	label	count_in	count_out
1160	77.36	in	1	0
1163	77.566	in	2	0
1168	77.896	in	3	0
1174	78.299	in	4	0
4108	274.142	in	5	0
4112	274.407	in	6	0
4114	274.54	in	7	0
4116	274.675	in	8	0
4118	274.806	in	9	0
4119	274.872	in	10	0
4125	275.271	in	11	0
4127	275.404	in	12	0

AI count result (Coonamessett River 05/07/2024)

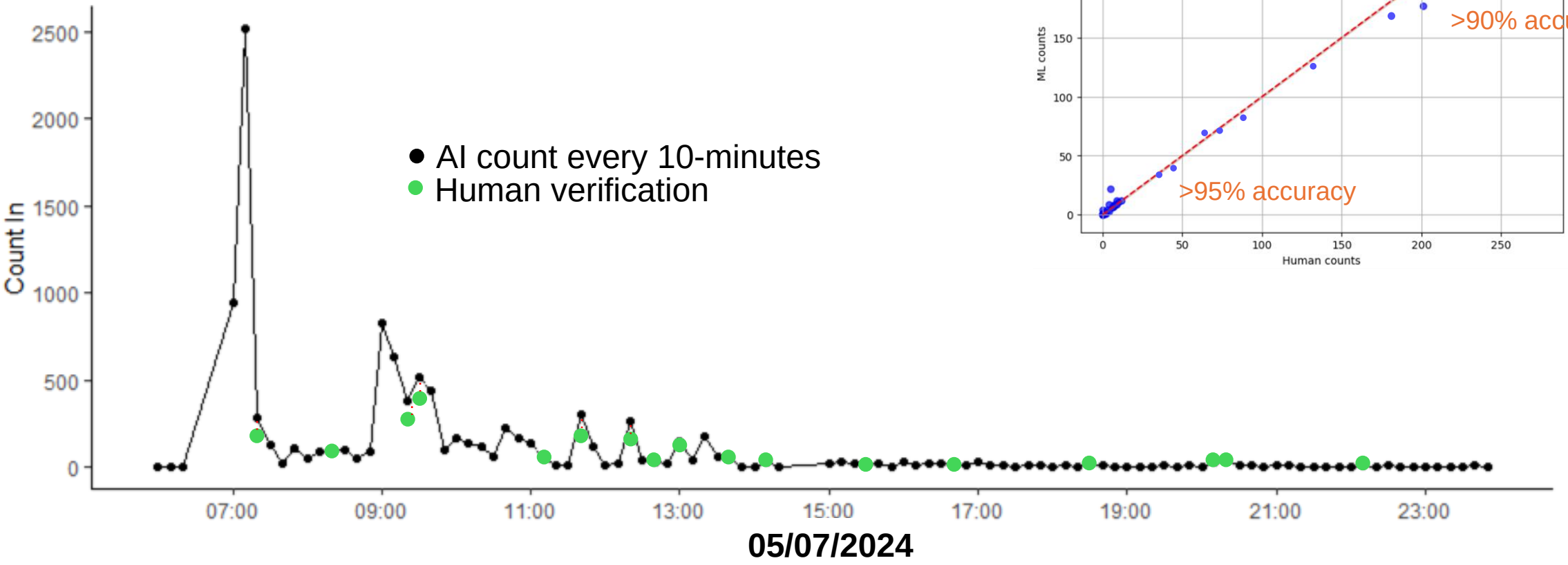


Human count – Model development/verification

Human Count data format

Time	Frame	Species	Direction
00:07:54	7108	Herring	up
00:07:55	7119	Herring	down

Compare AI vs Human count



Limitations of AI in fish monitoring:

- Adapt easily to unexpected situations or new scenarios
- Identify rare species without specific training
- Make contextual judgments about environmental conditions
- Troubleshoot equipment issues
- Understand the broader ecosystem implications
- Make qualitative observations about fish health or behavior anomalies

New tasks for Citizen Scientist

- Community engagement and awareness
- Results validation and verification
- Contributing to AI training
- Equipment maintenance and monitoring
- Qualitative observations
- Environmental monitoring beyond fish counting

Acknowledgements

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Sea Grant
MIT

MIT | UROP
Undergraduate Research Opportunities Program

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Woodwell Climate Research Center

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