Using video analysis to measure juvenile river herring emigration in Massachusetts

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Drawing by Vasili Luzanau

Collaborators

Massachusetts DMF
Massachusetts DER
US Fish and Wildlife Service
Connecticut DEEP
Rhode Island DEM
New Hampshire DFG
Maine DMR
Lake Associations
Conservation Commissions

Funding

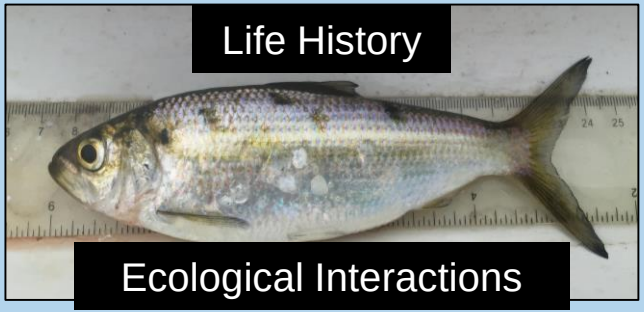
Commonwealth of Massachusetts DIVISION of MARINE FISHERIES
ATLANTIC STATES MARINE FISHERIES COMMISSION
UNIVERSITY OF MASSACHUSETTS AMHERST 1863
The Nature Conservancy Protecting nature. Preserving life.
NATIONAL FISH AND WILDLIFE FOUNDATION NFWF
USGS science for a changing world

UMass Amherst Student Research

Julianne Rosset (MSc, 2016)
-Delay between migration & spawning
-Adults present in lakes longer than we thought

Matt Devine (PhD; MSc 2017)
- Sampling methods for juvenile river herring
- Density-dependent growth rates

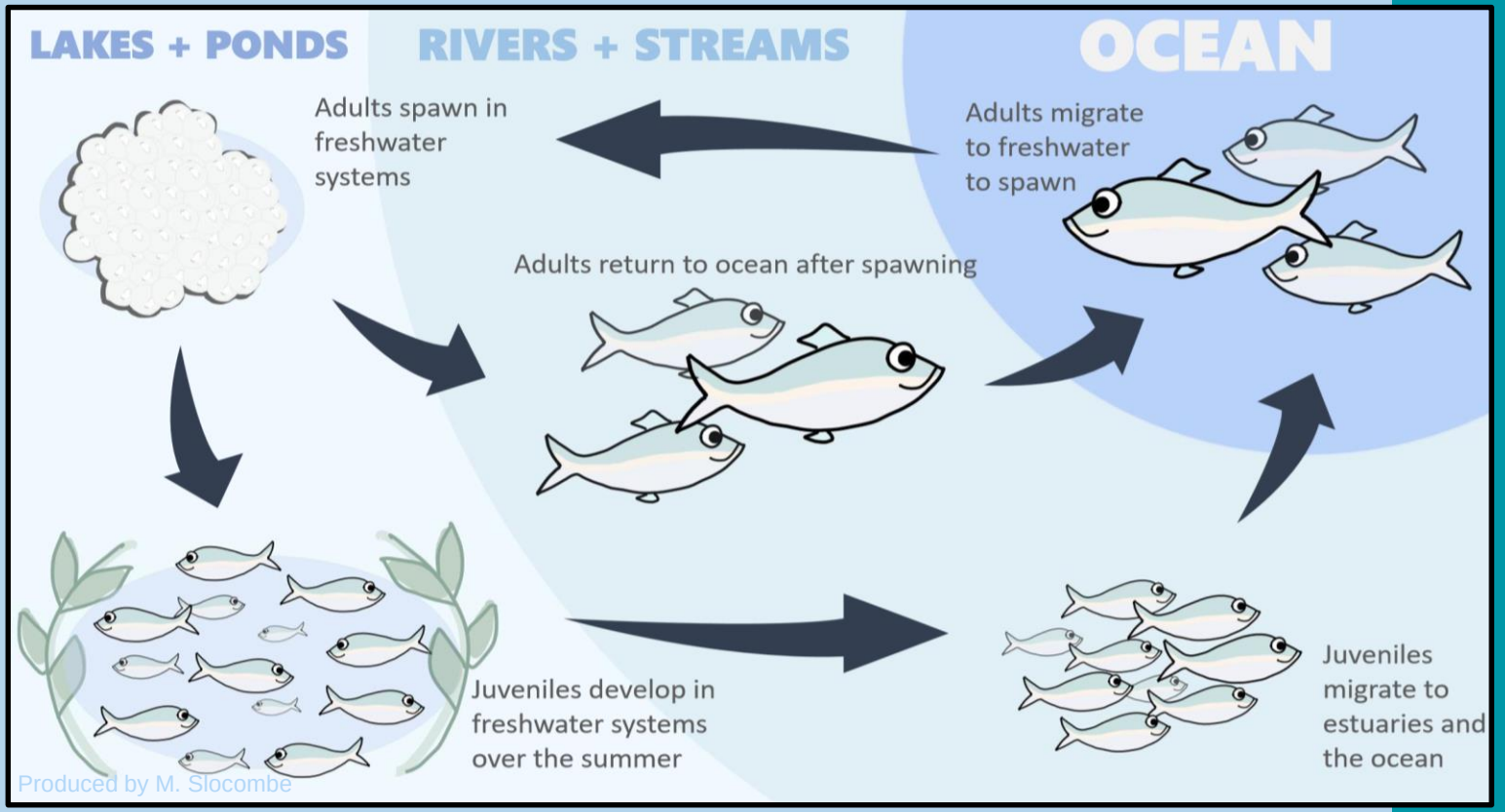
Steven Mattocks (MSc, 2016)
-Damming and lost river connectivity
-Alewife increase sportfish condition



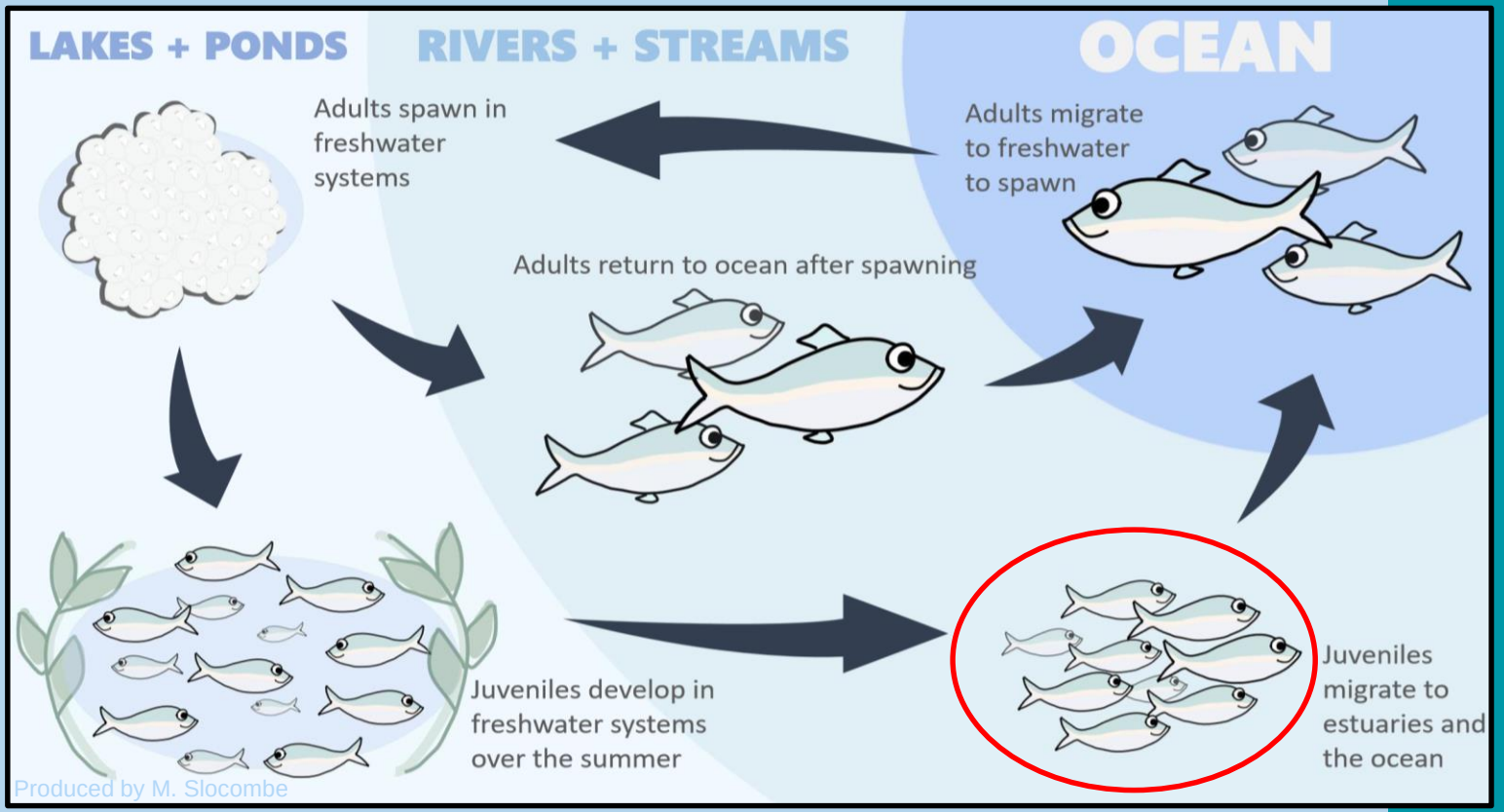
Meghna Marjadi (PhD, MSc 2016)
-Adult reproductive patterns
-Juvenile and adult emigration patterns

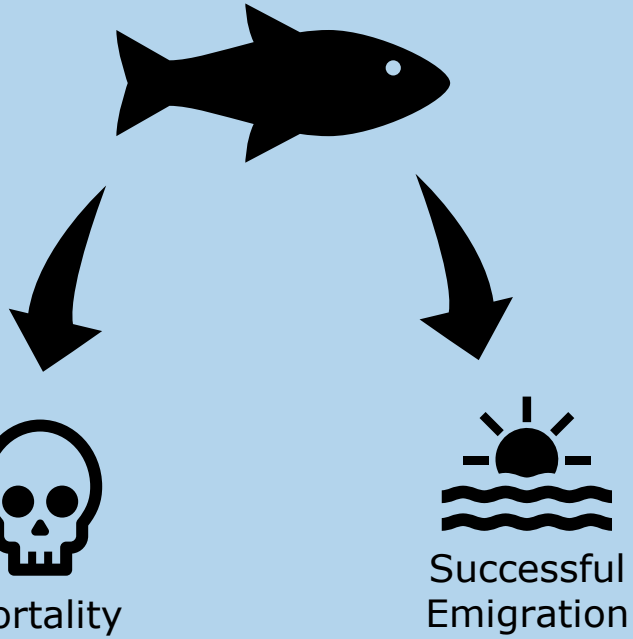
Lian Guo (PhD)
-Juvenile growth temp & food limited
-Decreases lake temps (>25°C)

Study Species: Anadromous River Herring

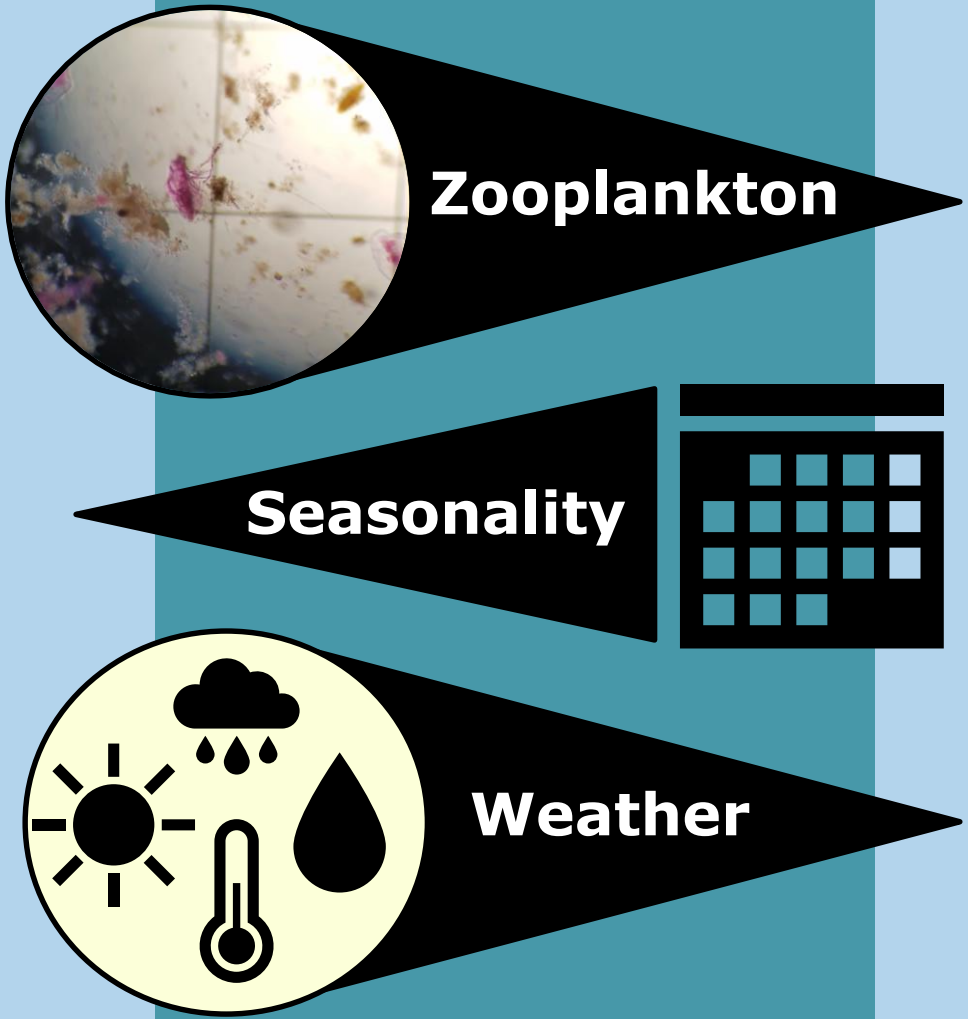


Study Species: Anadromous River Herring



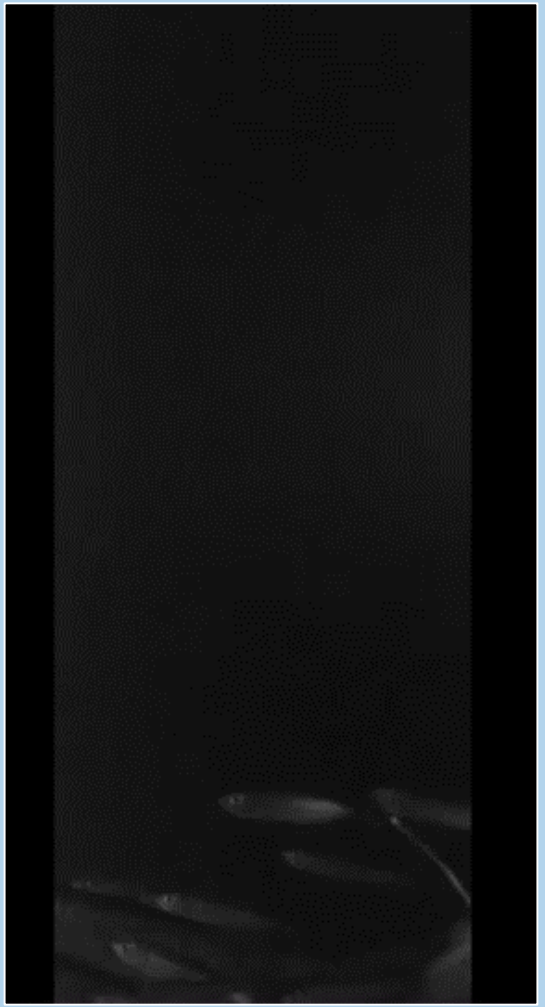


What role do environmental and biological factors play in juvenile success and emigration timing?



Camera at Herring Run Motel in Bourne, MA

Herring Run
MOTEL
VACANCY
COLOR TV
AIR CONDITIONED

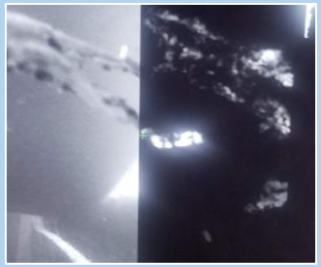


Collect Video Footage (2017-2019)

Primary Video Processing

Click Points

Algorithm Development



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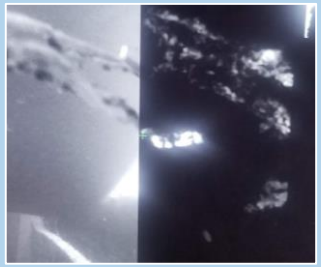
Collect Video Footage (2017-2019)

Manual Video Processing

Click Points

Algorithm Development



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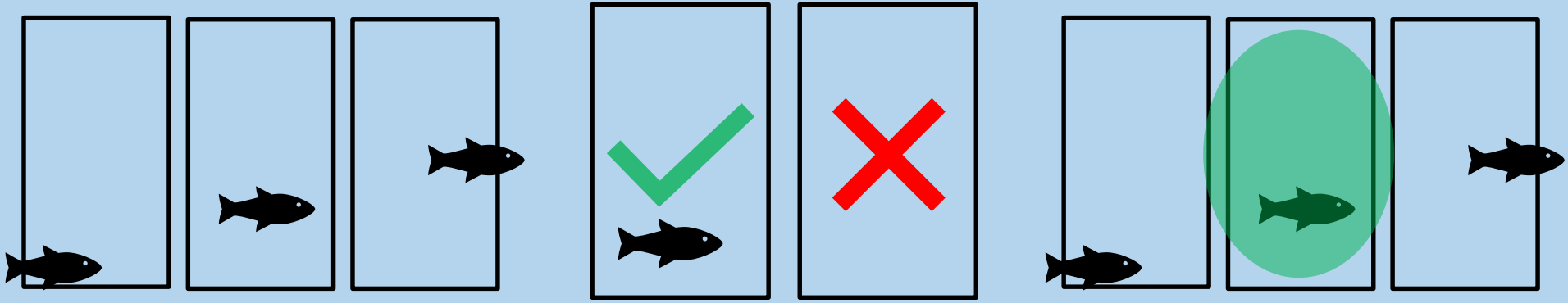
...we have A LOT of data

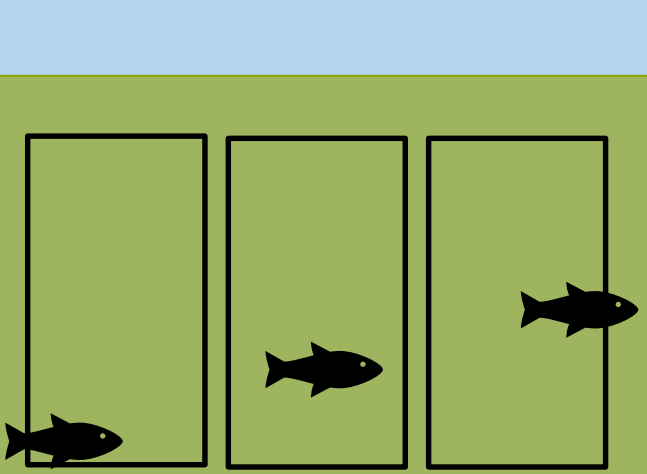
Primary Processing

Quantify the Average Recorded Activity

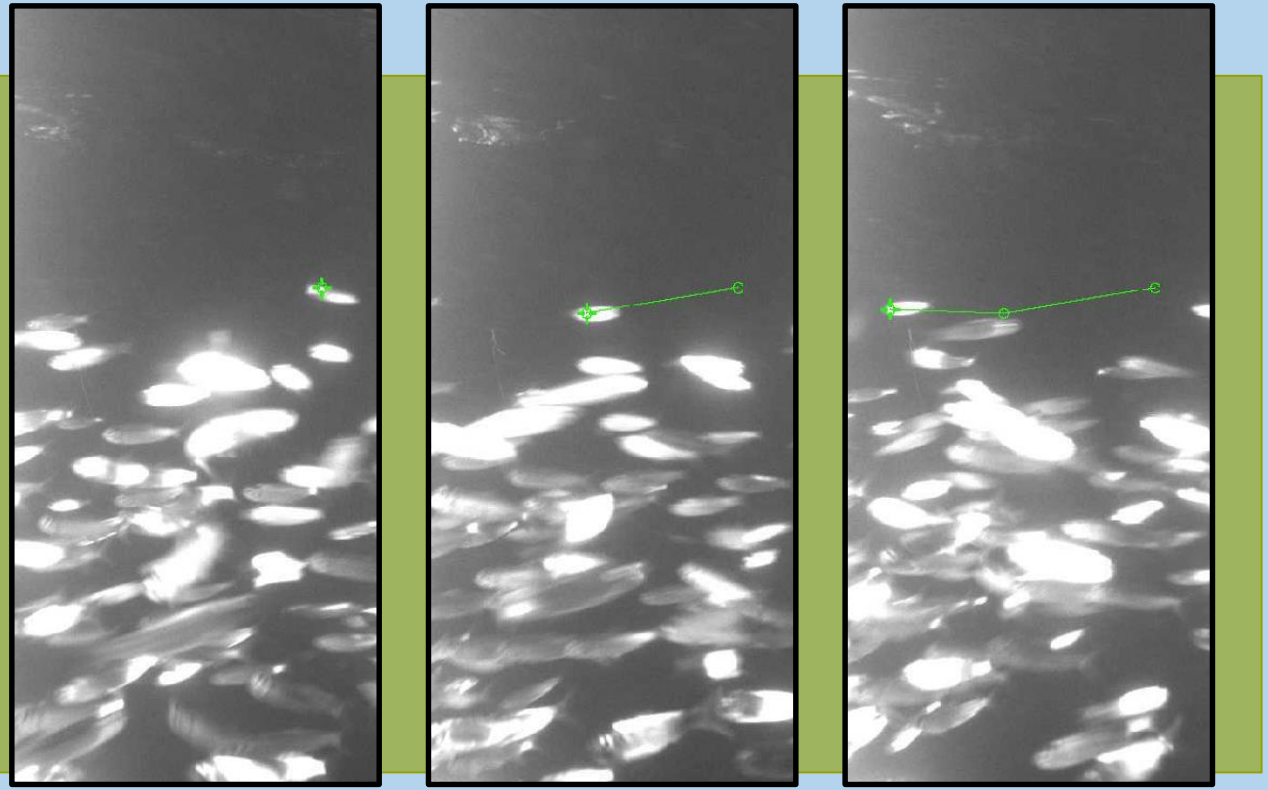
Extract Video Clips Containing Fish

Analyzing Representative Frames for Counting





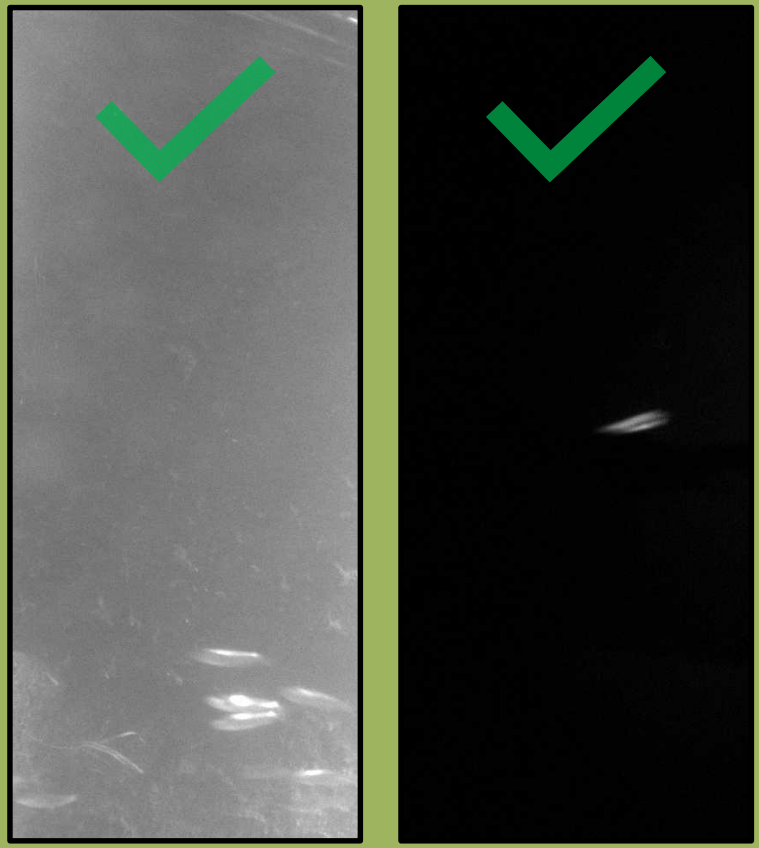
Click Points



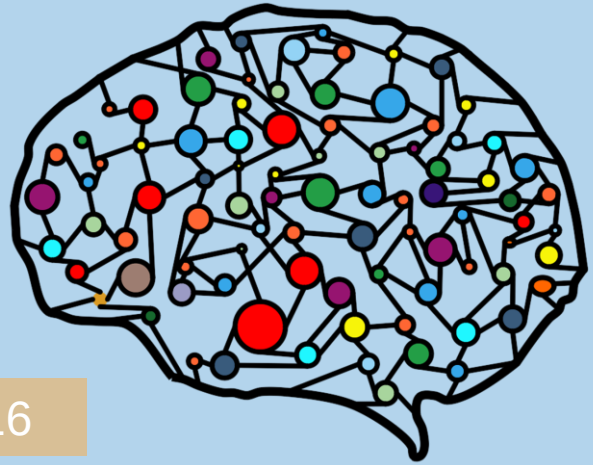
Gerum, R., Richter, S., Fabry, B. and Zitterbart, D.P. (2016), "ClickPoints: an expandable toolbox for scientific image annotation and analysis". Methods Ecol Evol. doi:10.1111/2041-210X.12702

False Detections

Accurate Detections



Neural Network



VGG16

Trained with 14 million Images In 1000 classes (ImageNet)

Simonyan, Karen, and Andrew Zisserman. "Very deep convolutional networks for large-scale image recognition." *arXiv preprint arXiv:1409.1556* (2014).

Photos: CC BY-SA-NC

Neural Network

Fish like?
Or not
fishlike?

Blob Size

Contrast
Level

Simonyan, Karen, and Andrew Zisserman. "Very deep convolutional networks for large-scale image recognition." *arXiv preprint arXiv:1409.1556* (2014).

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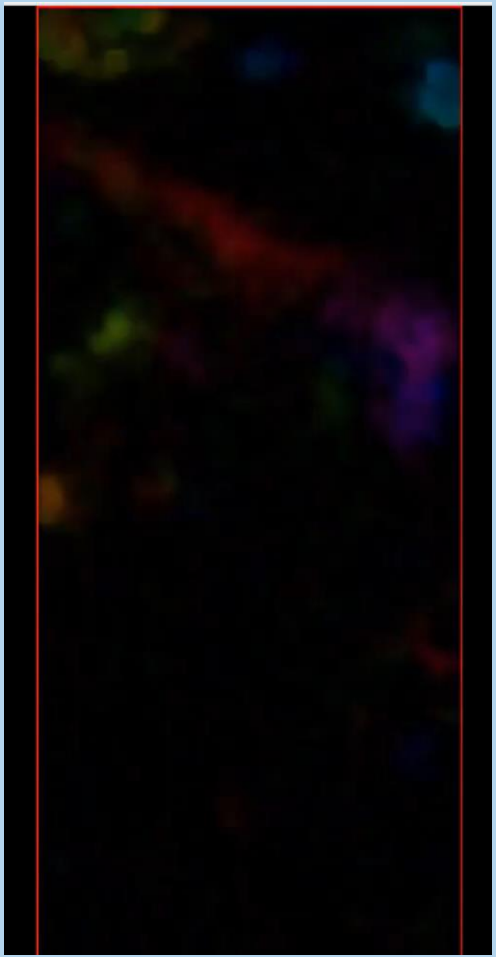
Original Frame

Algorithm Output



Detection of frames with fish

Confidence	Accuracy
50%	98.50%
75%	99.50%

Detection of individual fish

Confidence	Accuracy
50%	39%
75%	67%

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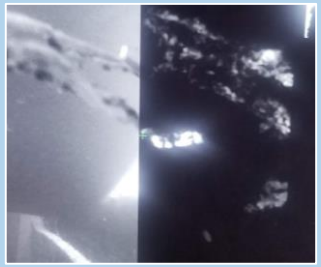
Click Points

Algorithm Development



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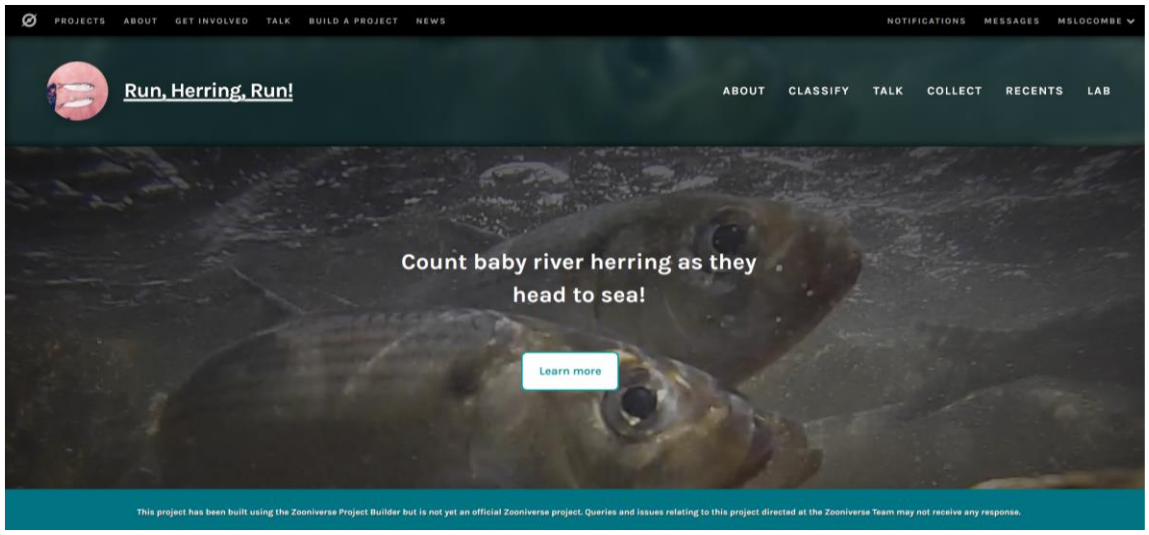
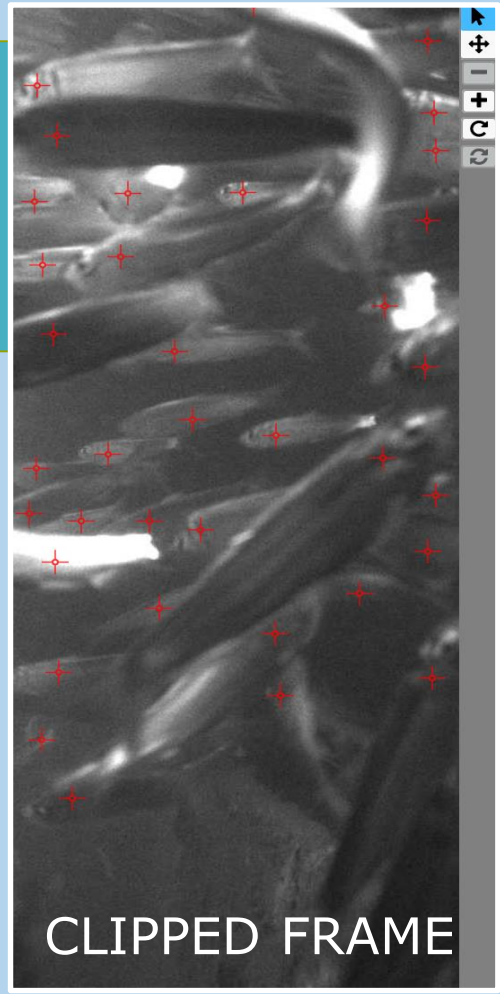
Citizen science:

- Help us process large amounts of data
- Provide opportunities for outreach
- Allow the public to become invested in our project





Future Plans

Zooniverse Testing for Algorithm Development

Citizen science analyses

New camera in Weymouth, MA in 2019

Coauthors and Collaborators: Meghan-Grace Slocombe, John Sheppard, Ryan Govostes, Joel Llopiz

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Great Herring Pond Watershed Association: Don Williams
Massachusetts Division of Marine Fisheries: Ben Gahagan,
Undergraduate Assistants: Freddie Meyer, Halley Steinmetz, Meghan Slocombe
Community Collaborators: Phillip Lofgren, Mystic River Watershed Association, River Herring Network

Thank you!

Check out Run Herring Run on Zooniverse

Darlyne A. Murawski, PEW Charitable Trusts.

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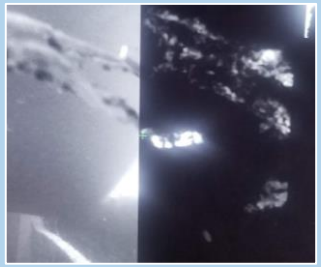

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