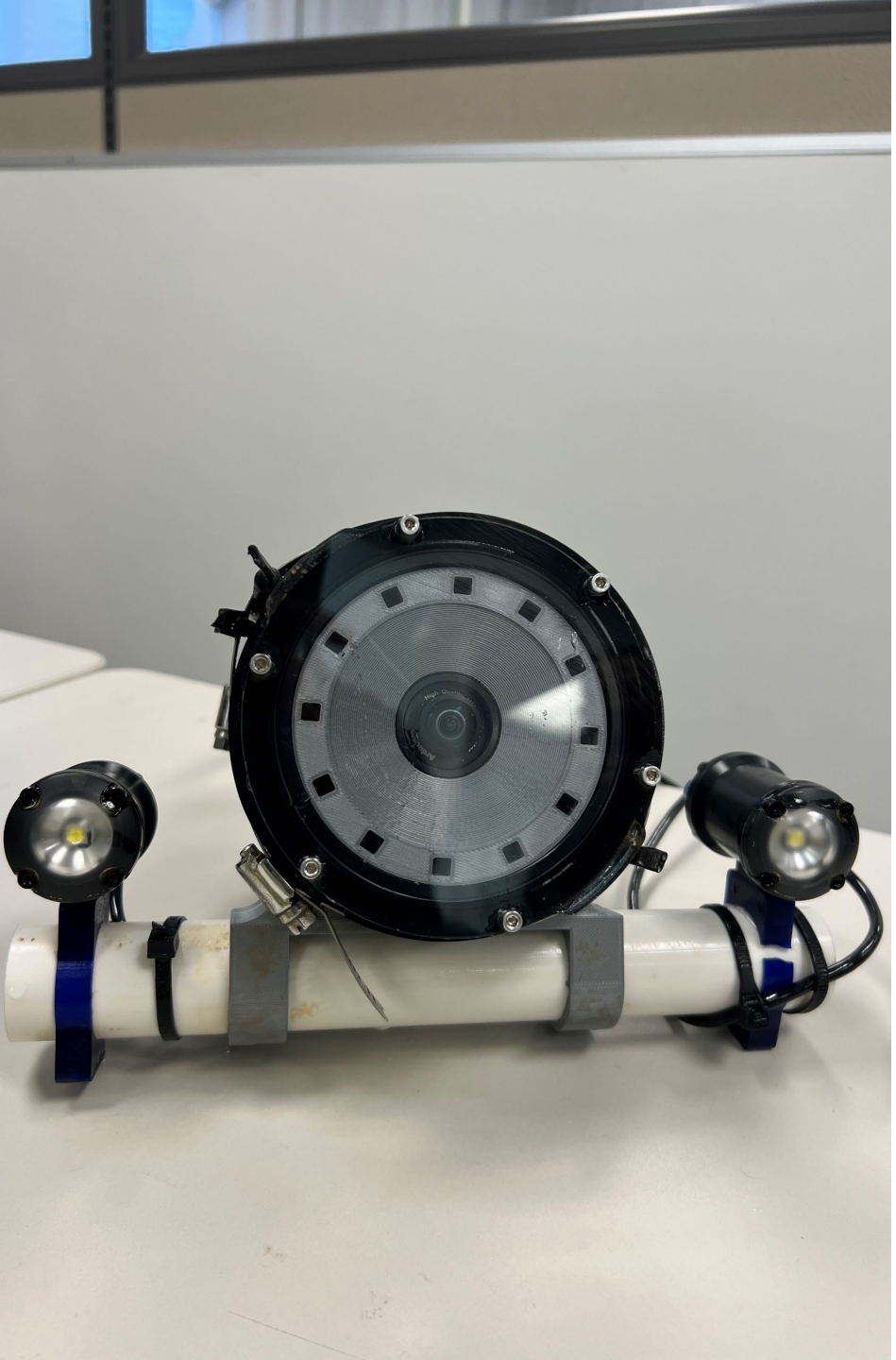

MortCam AI for Proactive Mortality Monitoring in RAS

October 16, 2024
Smolt Production Workshop, Sunndalsøra

Rakesh Ranjan, Kata Sharrer, Scott Tsukuda, and Christopher Good

Aquacultural Engineering 102 (2023) 102341

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MortCam: An Artificial Intelligence-aided fish mortality detection and alert system for recirculating aquaculture

Rakesh Ranjan *, Kata Sharrer, Scott Tsukuda, Christopher Good

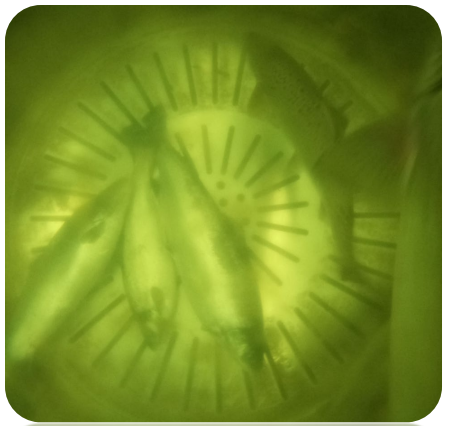
The Conservation Fund Freshwater Institute, Shepherdstown, WV, 25443, USA

THE CONSERVATION FUND FRESHWATER INSTITUTE

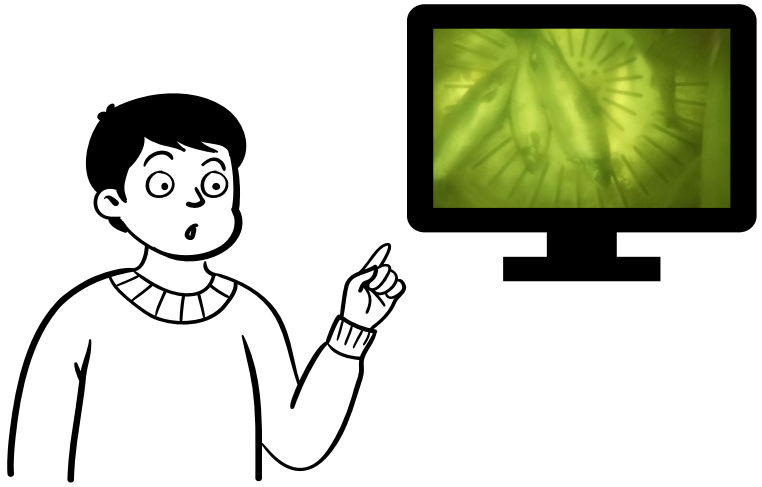
USDA ARS

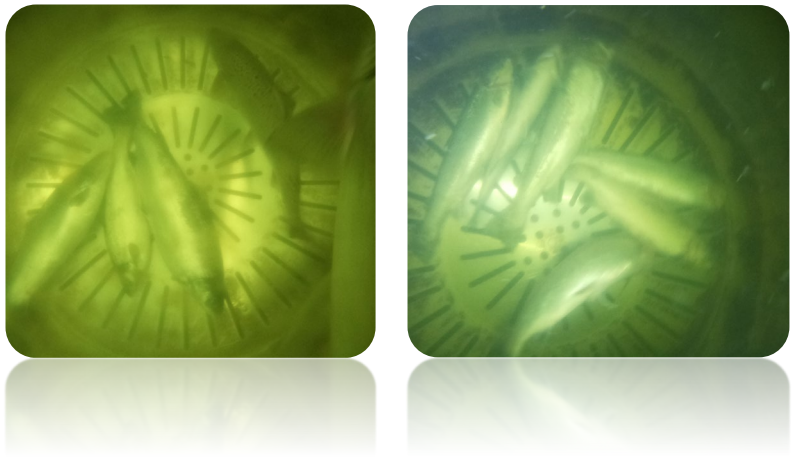
Why mortality monitoring is important for smolt production?

- Health and welfare indicator
- Abiotic/biotic stress indictor
- Fish Mortality
- Economic losses
- Affect system operations

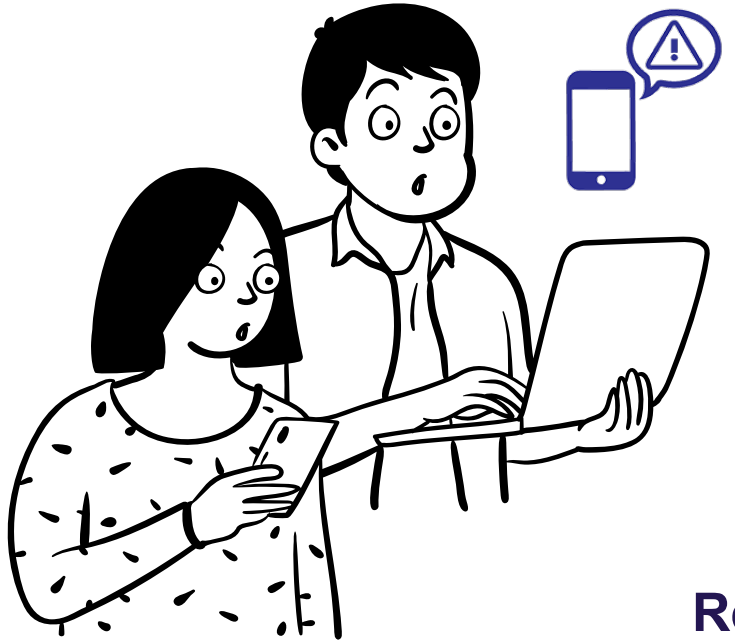


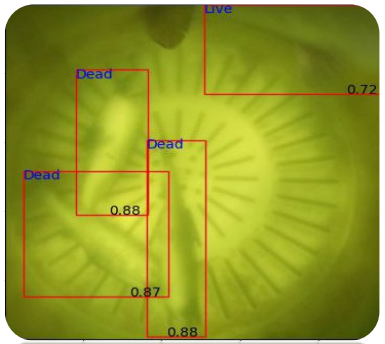
Mortality monitoring





Human observation

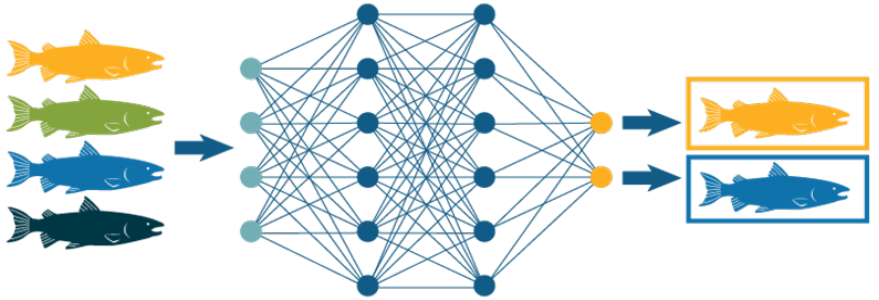




Real-time monitoring and alert

Study objective

AI-enabled underwater mortality monitoring system



Train, optimize, and validate an edge-deployable mortality model

Email and text alerts for proactive measures

MortCam components

Sensor components

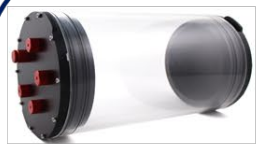
RGB Sensor and Lens

Edge computing unit

Raspberry Pi 4 (model B)

PoE HAT board

Accessories



Sensor enclosure

LED light

PoE & CSI cable

Lens holder

Ballast weights

Processing softwares

Roboflow

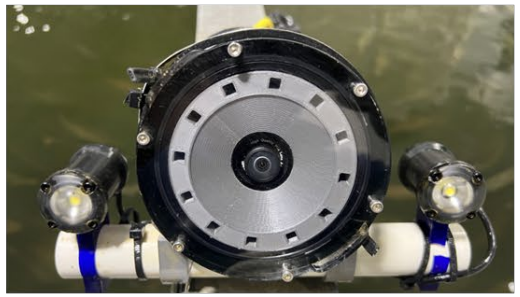
Ultralytics

Colab

Python

Mort Cam

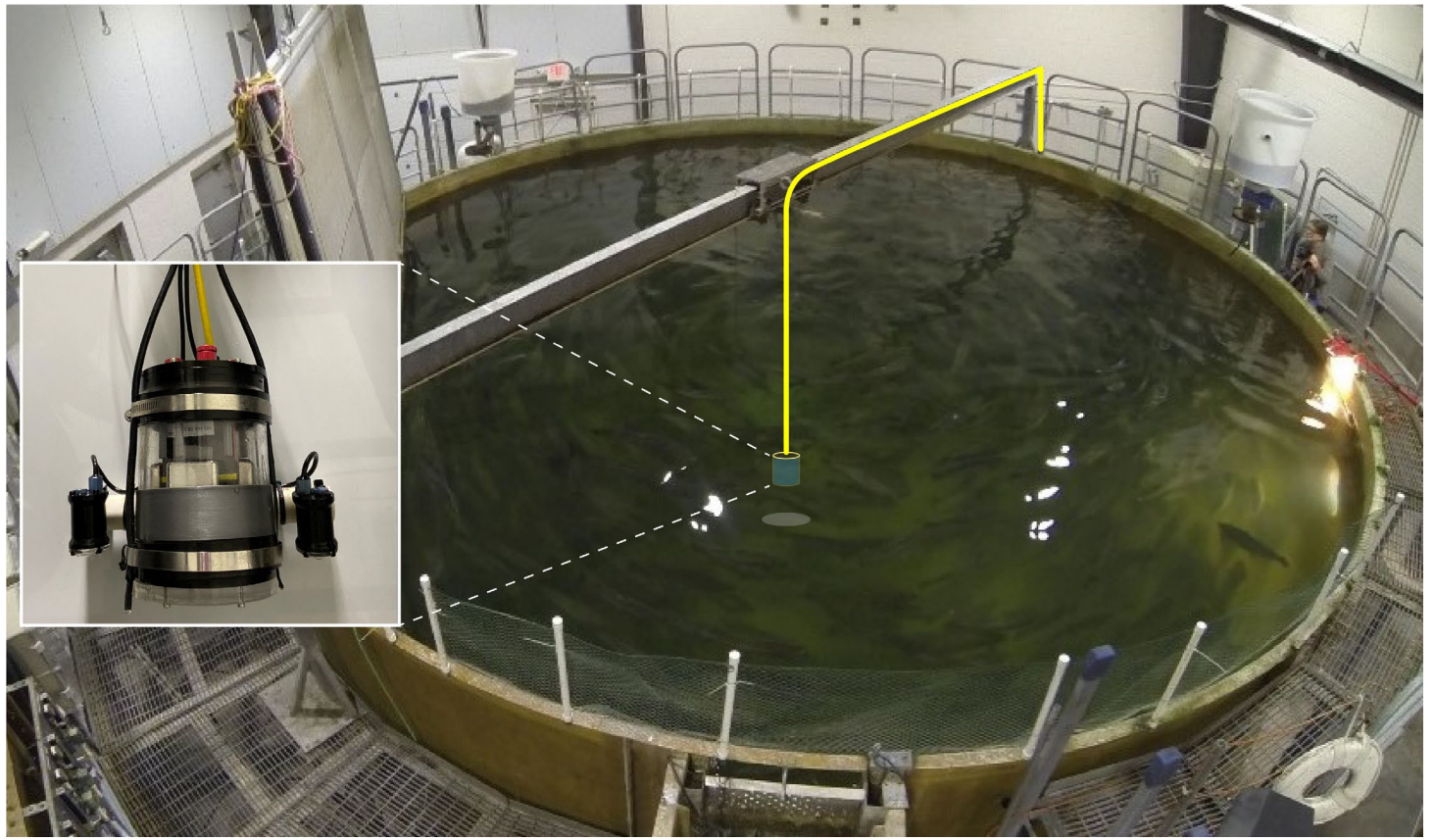
User device

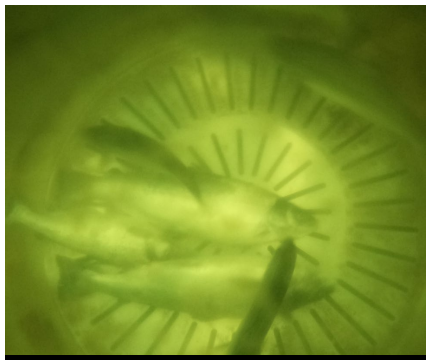


Mort Cam

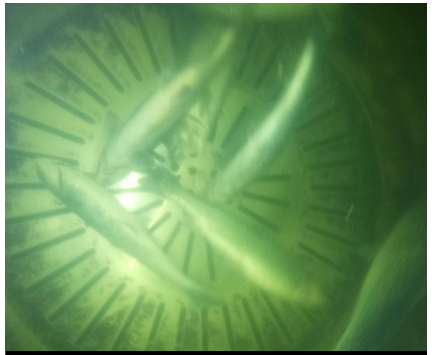
Cloud

MortCam deployment





Ambient light



Supplemental light

Mortality model

Import and Organize
- 70% Train
- 20% Validation
- 10% Test

roboflow

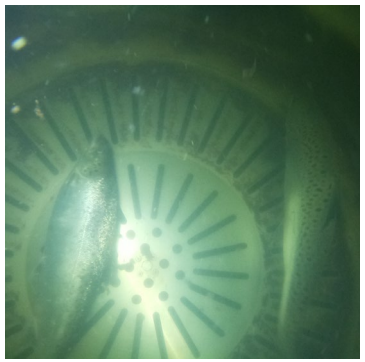
Image Annotation
- Dead
- Alive

roboflow

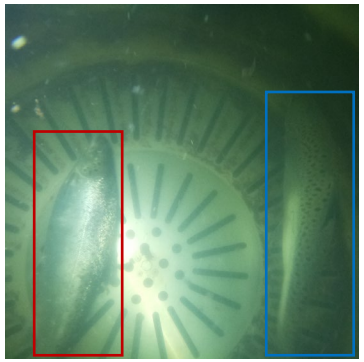
Preprocessing
- Auto-orient
- Resize (416 x 416 px)
- Augment

roboflow

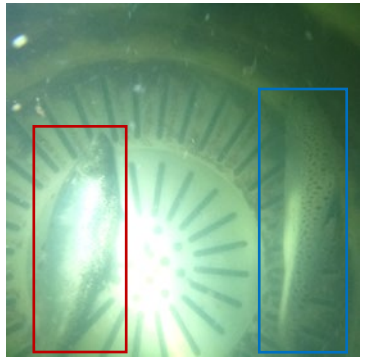
Model Development
- Label export
- YOLOv7 hyper tuning
- Model deployment



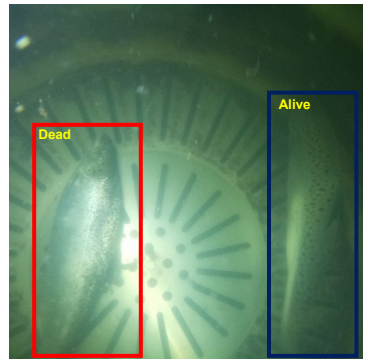
Input image
(972 x 972 px)



Annotated image
(972 x 972 px)

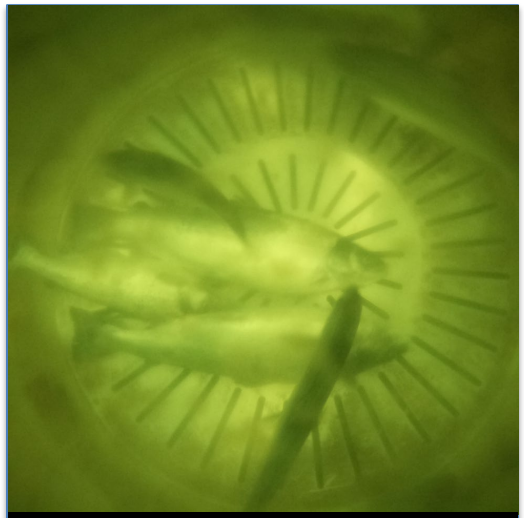


Preprocessed image
(416 x 416 px)

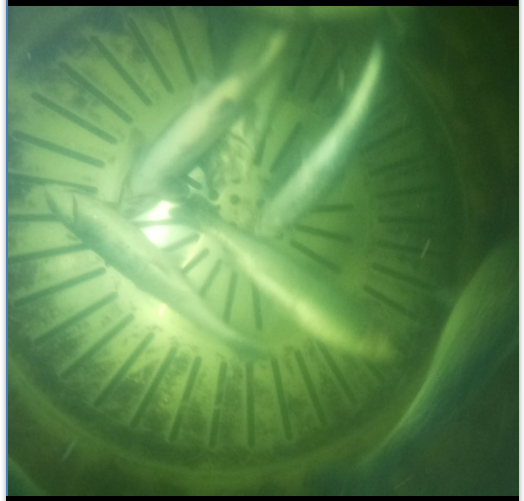


Model prediction

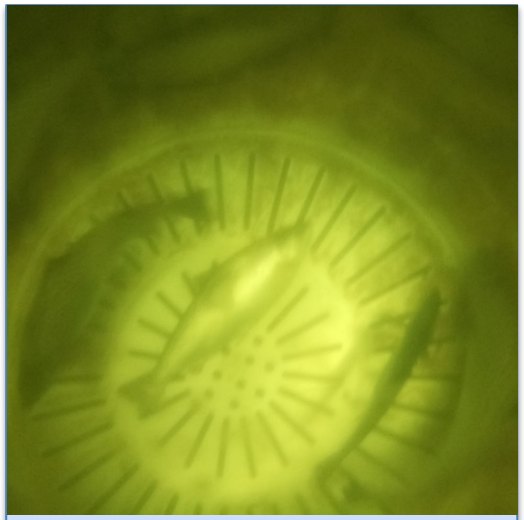
Mortality model

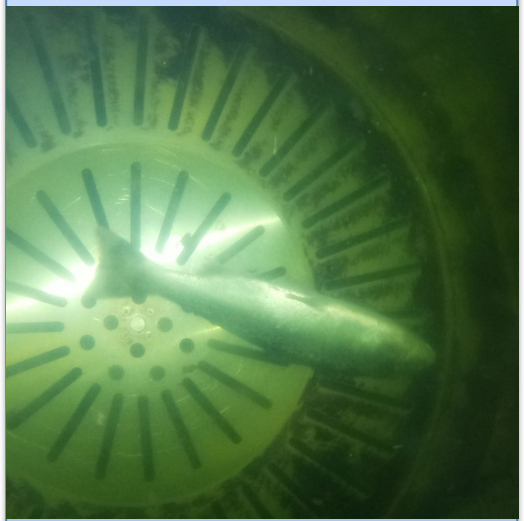


Ambient Light (AL) model



Supplemental Light (SL) model

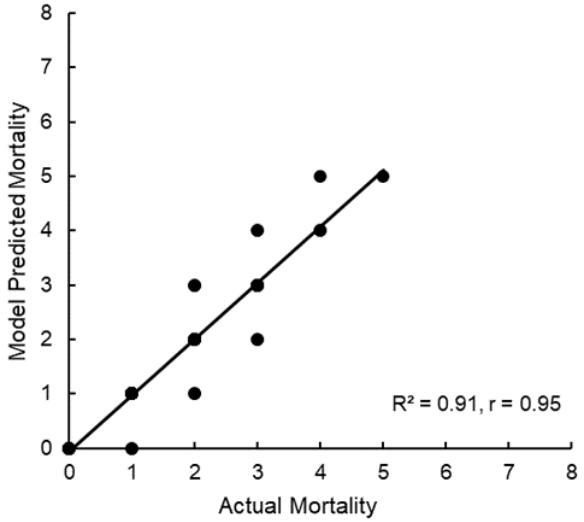


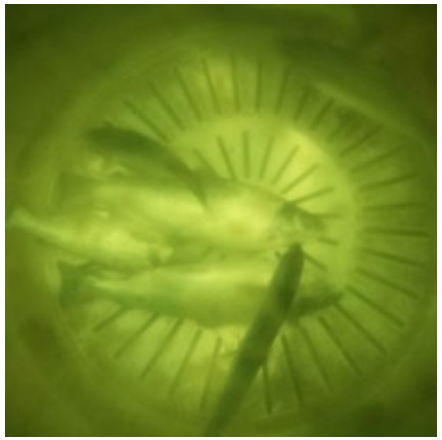


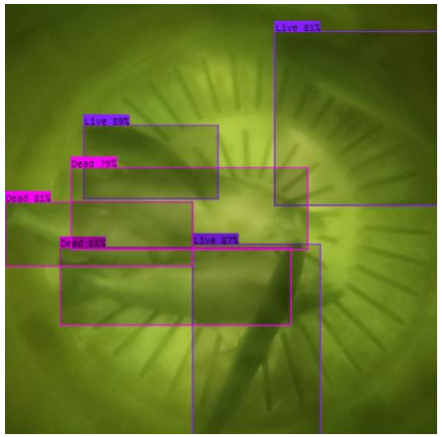
Mixed model

Mortality model validation

AL model tested on AL images

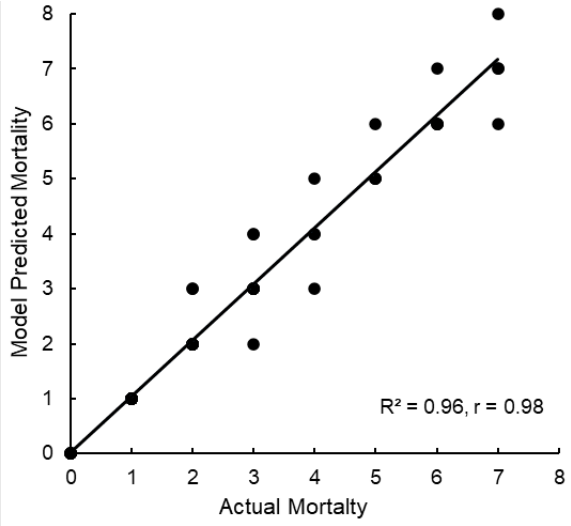


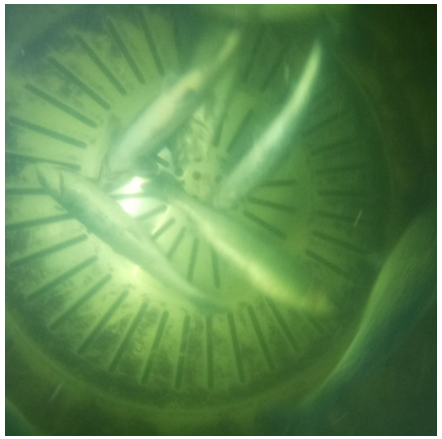


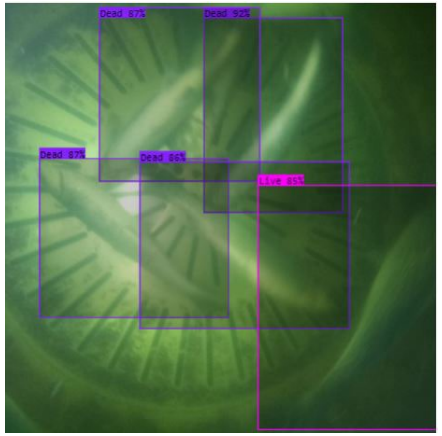


Model prediction

SL model tested on SL images



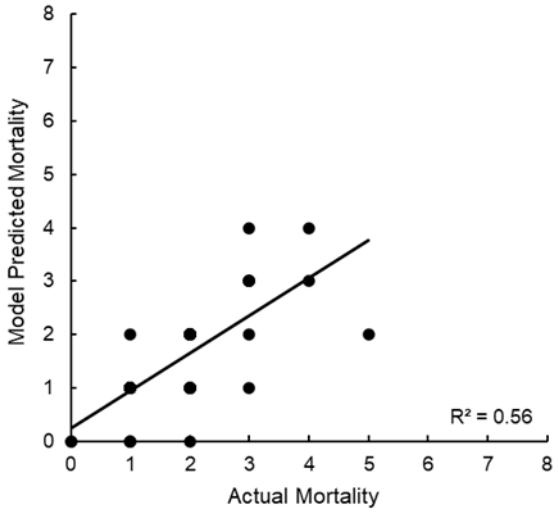


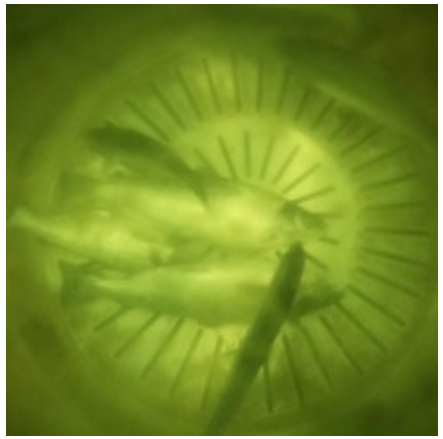


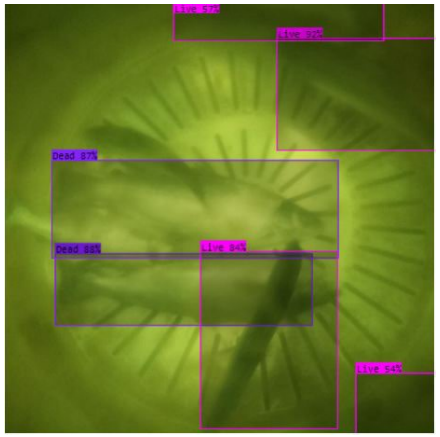
Model prediction

Mortality model validation

SL model tested on AL images

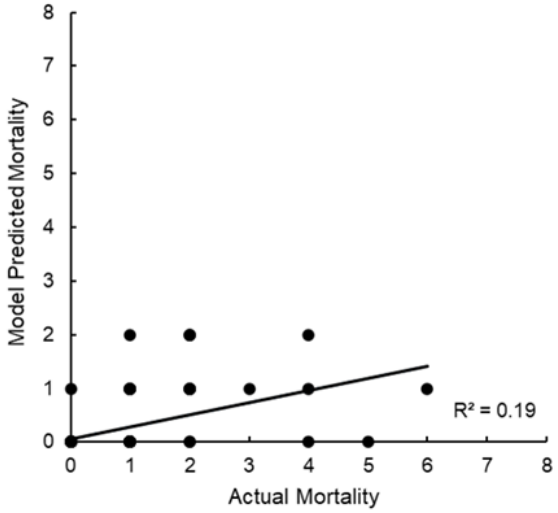


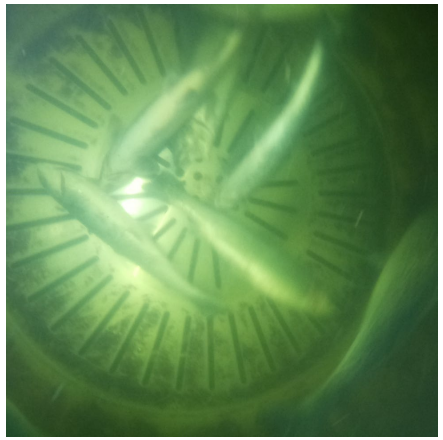


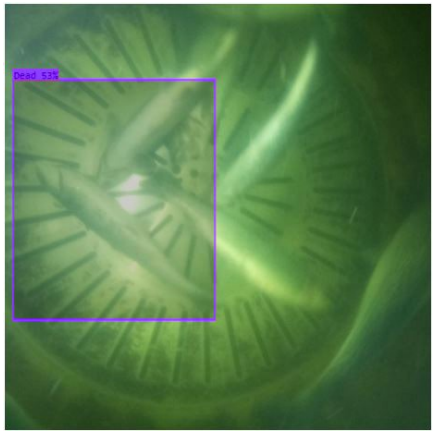


AL model prediction

AL model tested on SL images



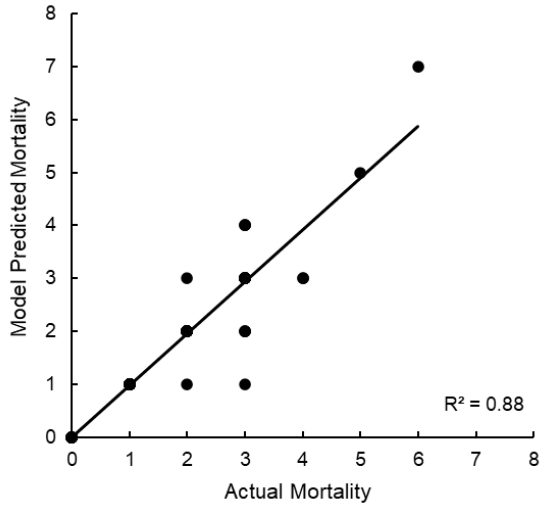




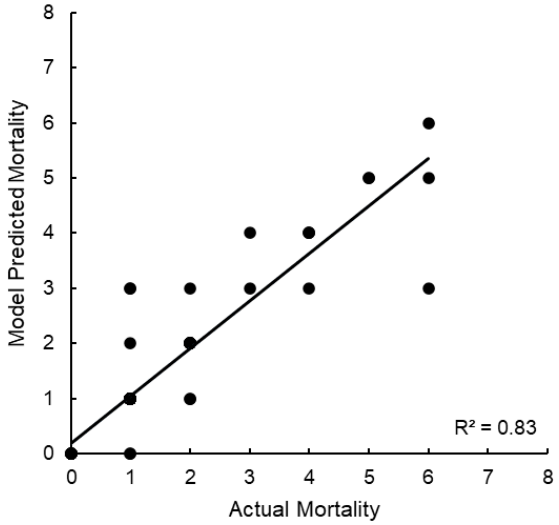
SL model prediction

Mortality model validation

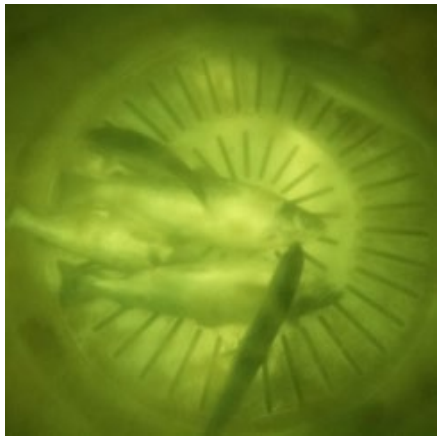
Mixed model tested on AL images

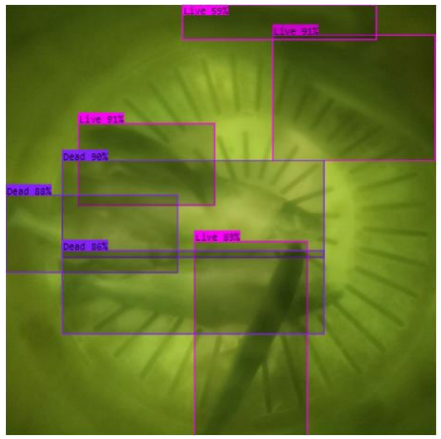


Mixed model tested on SL images

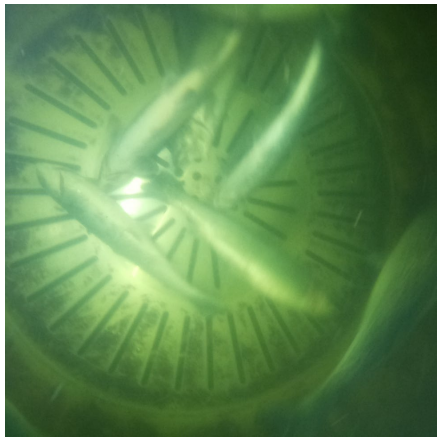


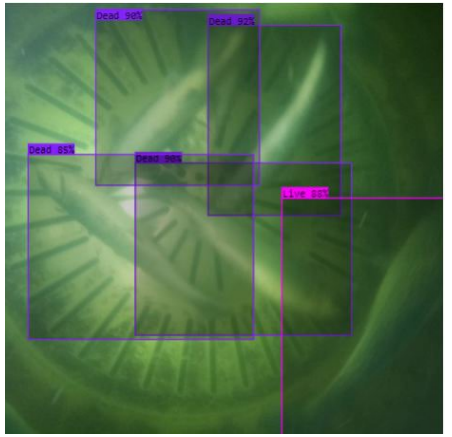
Mixed model: mAP = 95.5% and F1 score = 0.92





Mixed model prediction





Mixed model prediction

MortCam alert

Mort Cam Alert: Unusual Mortality Detected!

P [redacted]

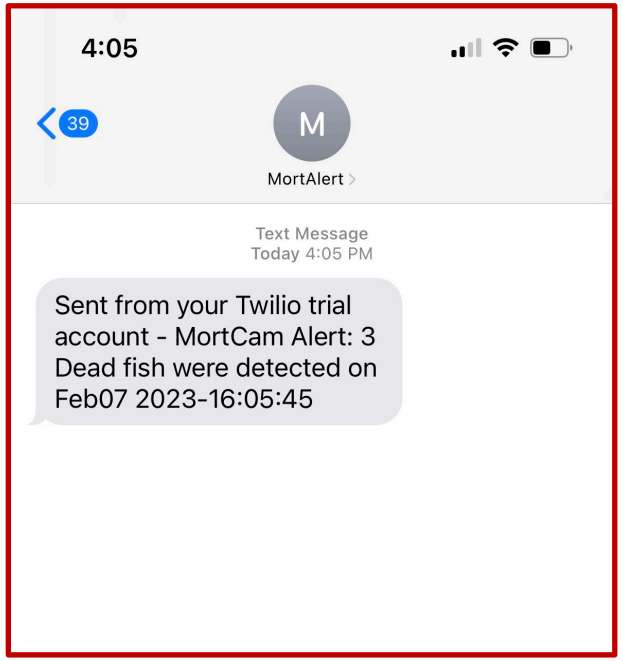
To Ranjan, Rakesh

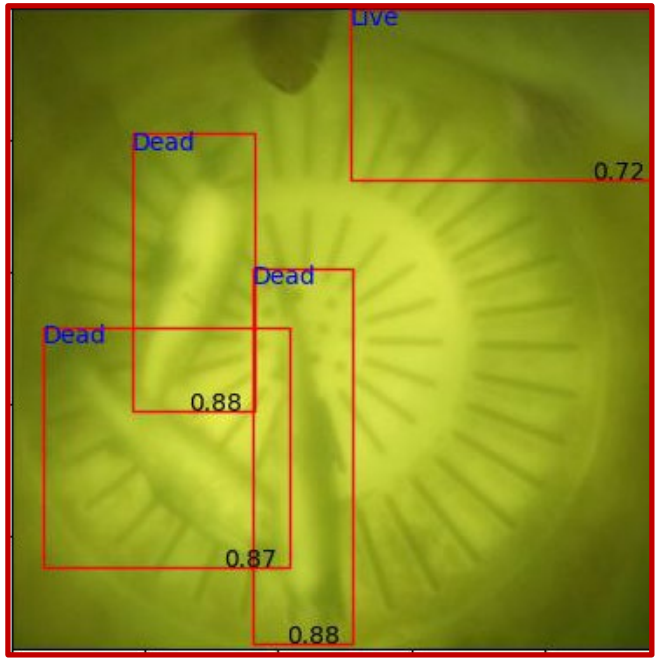
2/2/2023

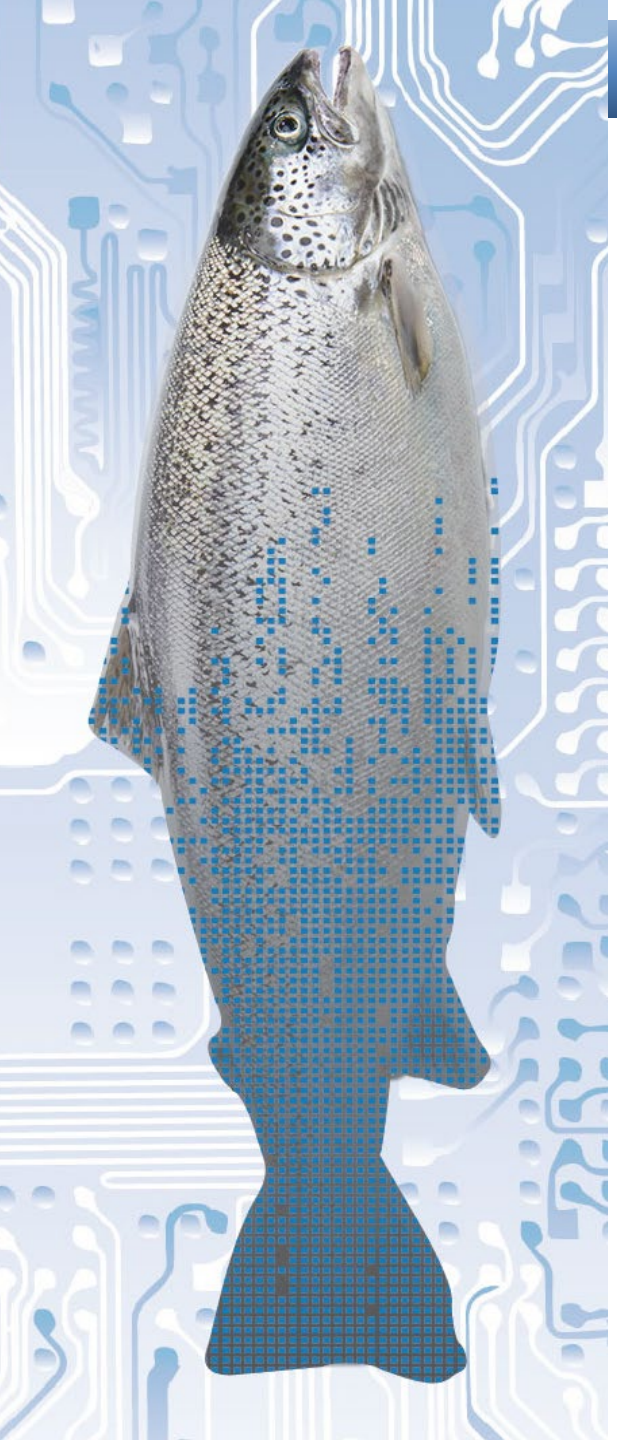
deadfish.jpg
22 KB

[EXTERNAL EMAIL]

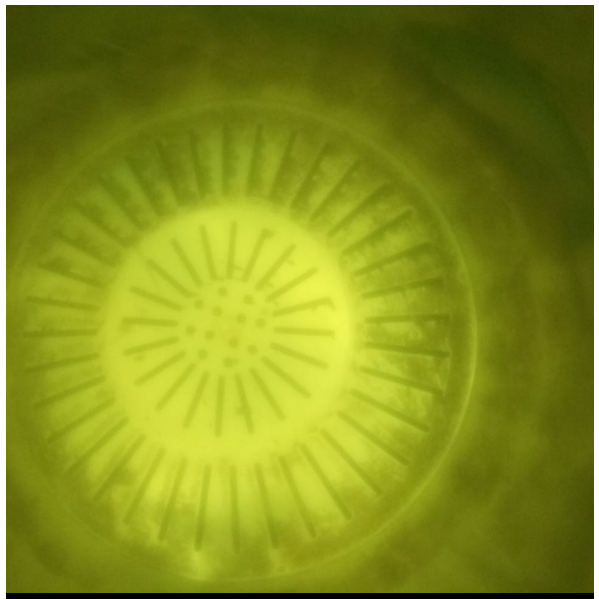
Rakesh! MortCam has detected an unusually high mortality in the Growout tank. 3 Dead fish were detected on Feb02 2023-12:00:15



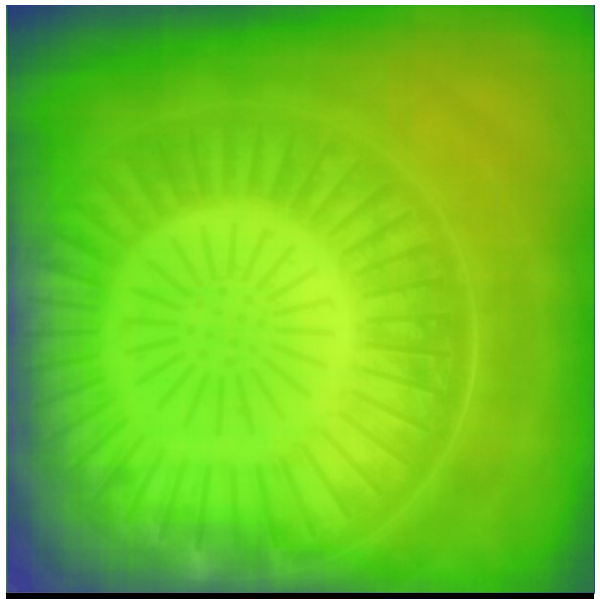




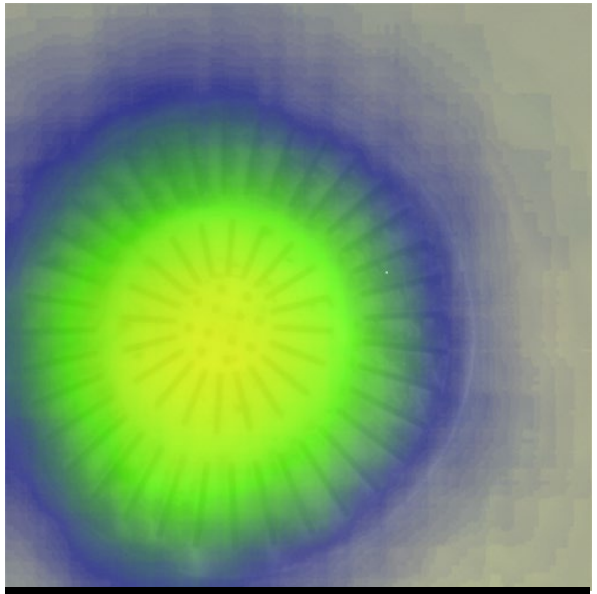
Data visualization



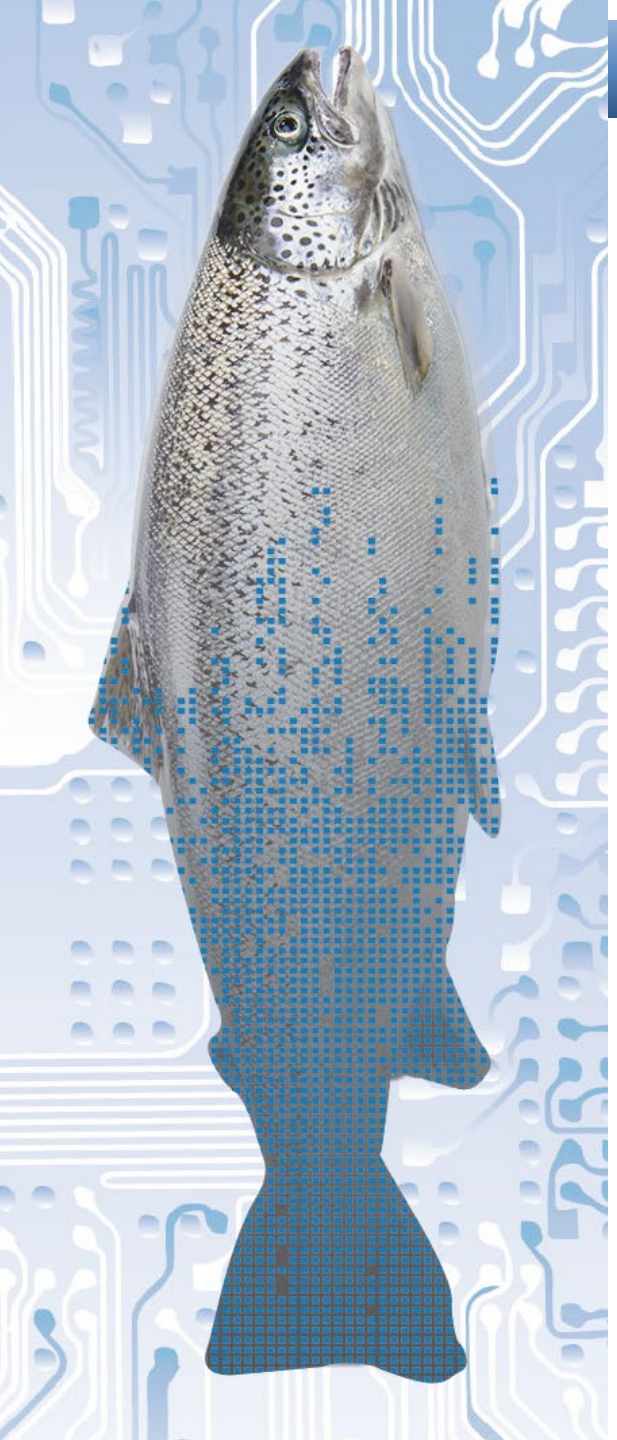
Drain plate



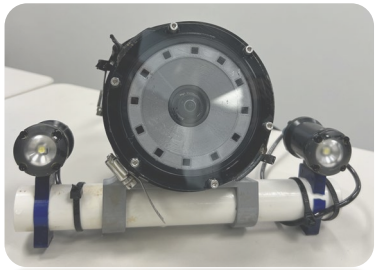
Alive fish



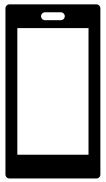
Dead fish



Conclusion and Further Research



MortCam AI

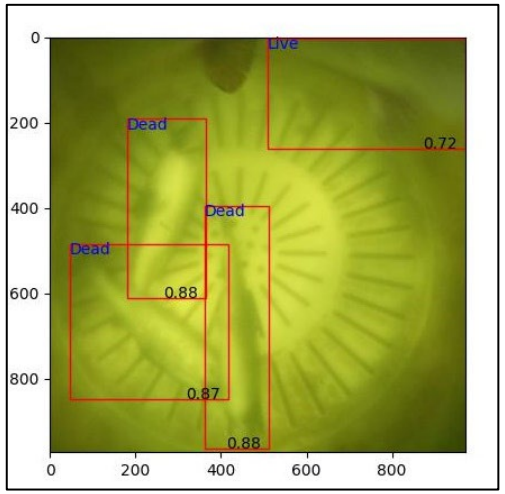


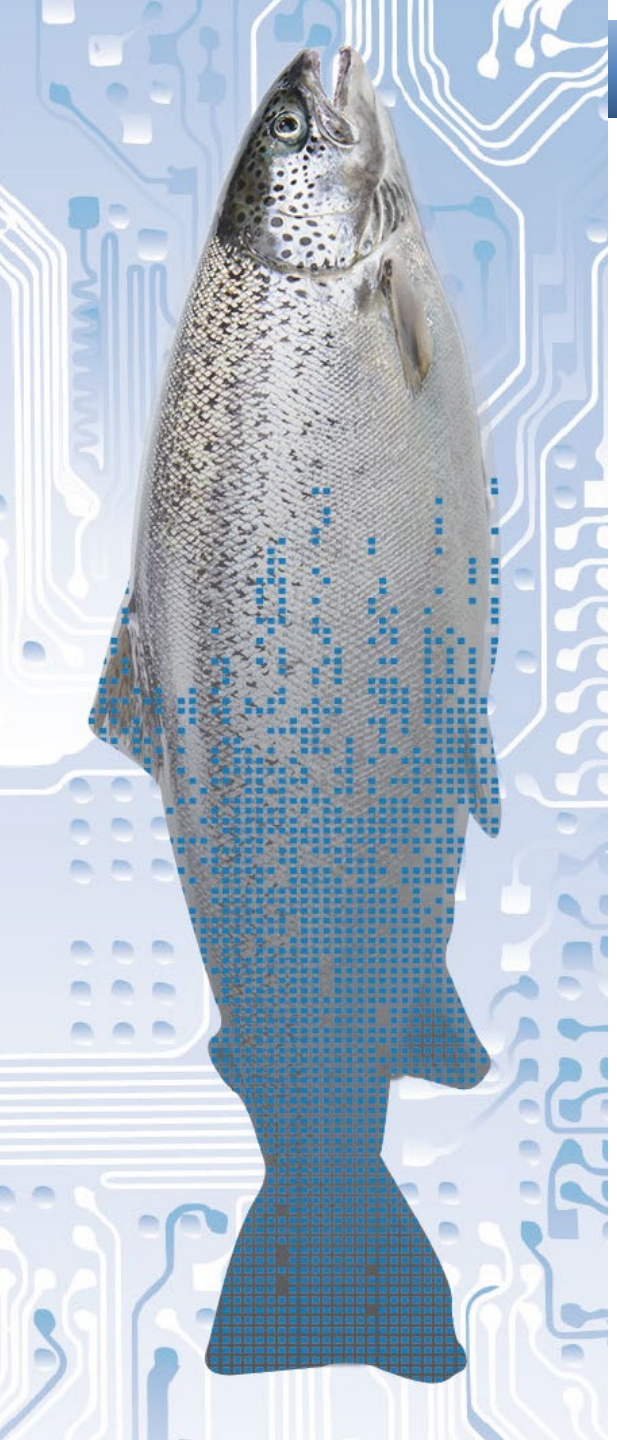
MortCam Alert for Growout Tank:
4 dead fish were detected today at 12:00.

Subject: Mort Alert

MortCam has detected high mortality in the Growout Tank.

4 dead fish were detected on 9 Nov 2023-12:00:15.





Recognitions

May/June 2023

update

A large tank of Atlantic salmon in a recirculating aquaculture system at the Freshwater Institute (*photo courtesy of The Conservation Fund*).

The Freshwater Institute has been selected for the NewTechAqua Award Challenge

In brief: The Conservation Fund's Freshwater Institute, an internationally renowned research and development program focused on recirculating aquaculture systems, announced its selection for the 2023 NewTechAqua Award Challenge.

Recirculating aquaculture systems, which are a specialty of the Freshwater Institute, allow producers to maintain ideal water quality and optimal fish health. However, fish mortality can still occur in such systems due to disruptions such as disease outbreaks and irregular water quality events.

"That's why our scientists proposed a mortality monitoring and alert tool to help farm managers make better-informed decisions for mortality management and maintaining fish health," said Brian Vinci, director of the Freshwater Institute.

The MortCam prototype (*photo courtesy of The Conservation Fund*).

and text alerts to notify operators of mortality events. These real-time mortality alerts can help operators proactively initiate procedures to prevent additional mortalities.

The development of MortCam is supported by funding from the USDA Agricultural Research Service. The USDA-ARS and the Freshwater Institute have collaborated for over 30 years and share a track record of providing the U.S. aquaculture industry with improved genetic stocks and new technologies for improving recirculating aquaculture systems, fish health, and management practices.

This recent initiative in precision aquaculture seeks to increase yields and product quality while improving production efficiency and enhancing animal welfare, thereby improving the economics of the U.S. aquaculture industry and increasing its competitiveness in the global economy.

As noted by Caird Rexroad, the USDA-ARS national program leader for aquaculture, "Applying precision agriculture to crop and livestock production has benefitted farmers and their ecosystems. Therefore, developing precision aquaculture technologies such as MortCam is a significant advance in our ability to sustainably produce fish while maintaining high standards of animal health and wellbeing."

For more information, contact Rakesh Ranjan, rranjan@conservationfund.org.

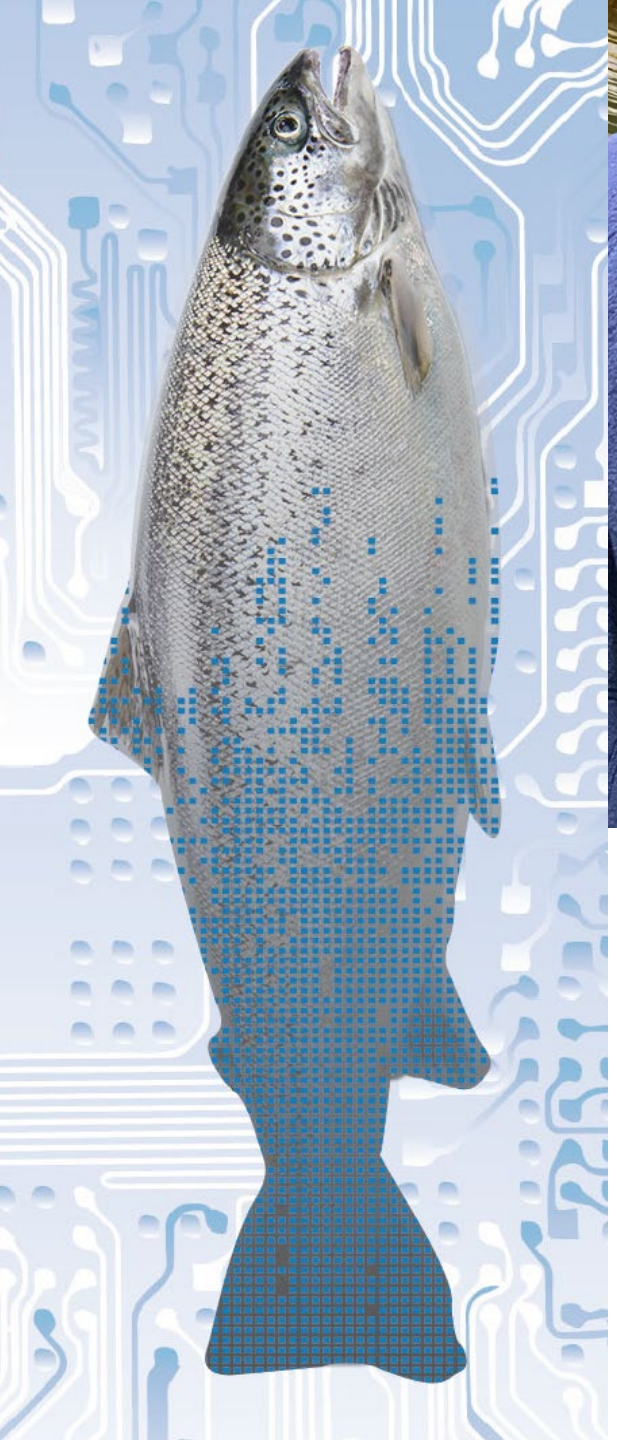
For more information on the NewTechAqua Award Challenge, visit https://www.newtechaqua.eu/check-the-selected-entities-newtechaqua-award.

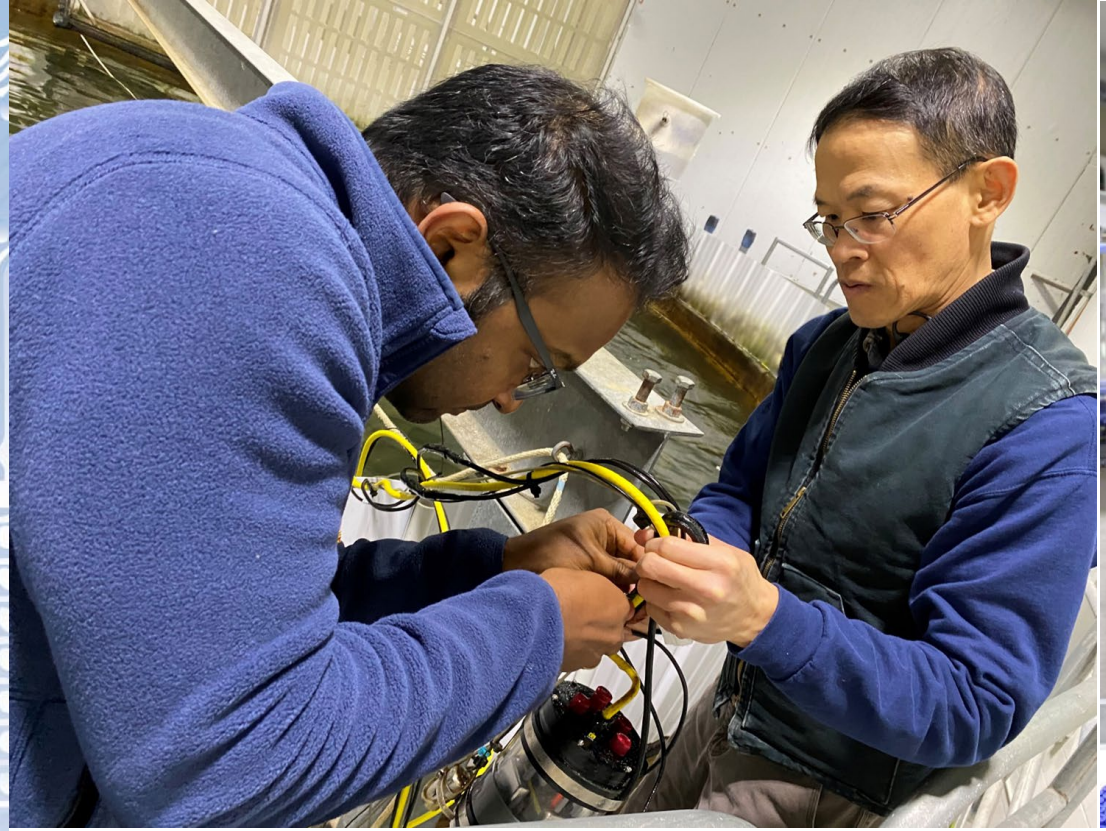
NewTechAqua
Innovation Award 2023

USDA ARS

SCIENTIFIC DISCOVERIES

AI is Catching on in Aquaculture





Thank you!

Rakesh Ranjan, Ph.D.

rranjan@conservationfund.org

+1-304-870-2203

THE CONSERVATION FUND
FRESHWATER INSTITUTE