Analysis of Larval Fish Feeding Behavior under Naturalistic Conditions

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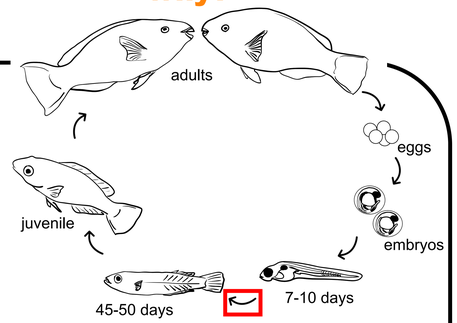
90% of fish die in the first weeks of their lives and we want to know – why?



survivorship:
10% > ocean
30% > aquaculture

Laboratory experiments show that larvae fail to capture their prey, starve and die.

This behavior was never imaged directly **In the field**.

Goal: Detecting larval fish feeding strike behavior in the wild

Tackling data acquisition

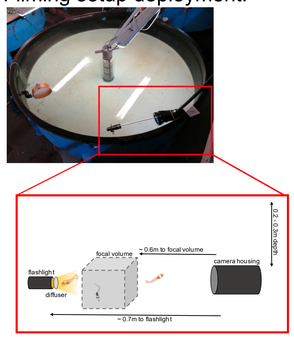
Larval fish are very tiny: **3-10mm**

Feeding strikes are extremely fast: **~40ms**

An underwater setup is necessary

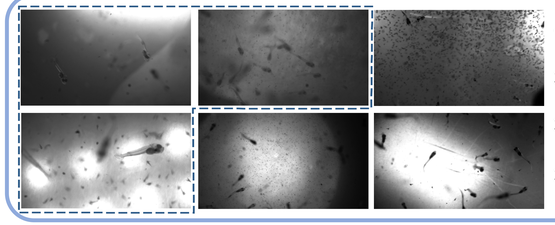
	Laboratory	In the field
tank volume	~100 milliliters	6000 liters

Filming setup deployment:



A high-speed camera (750fps) with an ultra-zoom lens coupled with backlight illumination.

What did we acquire?



19 fish cohorts

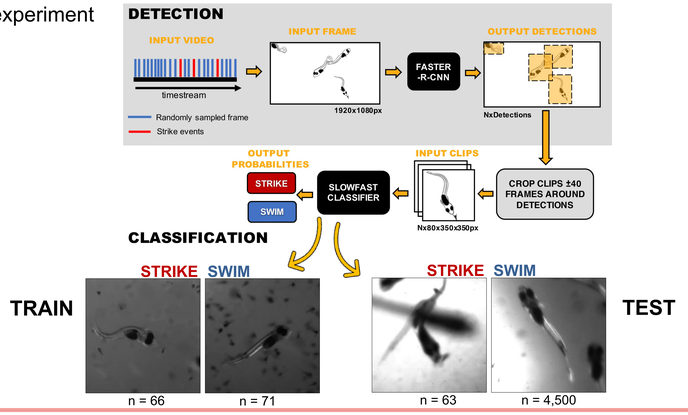
30 days per cohort

300 videos

37 videos annotated

How did we analyze it?

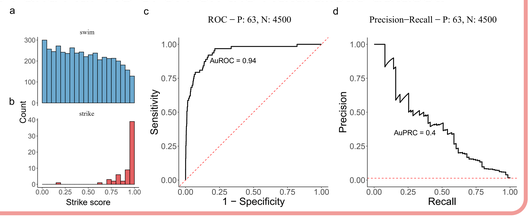
A pipeline of detection followed by action classification in a controlled experiment



What did our classifier do?

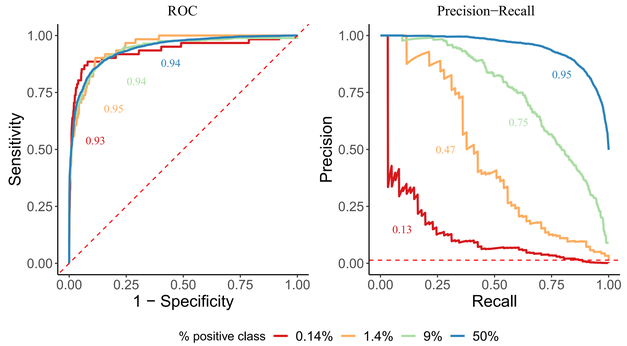
Achieved AuROC of 0.94 and AuPRC of 0.4 on the Naturalistic dataset.

It correctly mapped most feeding strikes, but there were many false positives.



What is the effect of rare events on model evaluation?

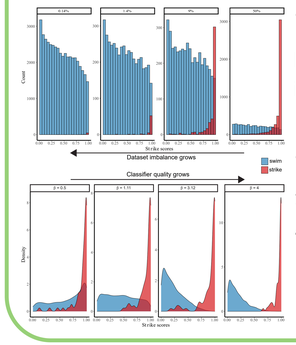
Rare events = small sample + HIGH imbalance



ROCs are notoriously optimistic for imbalanced datasets

PRCs are the consensus alternative

BUT PRCs change with data imbalance, **even for the same classifier**



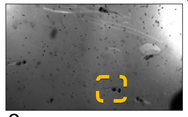
To understand our classifier's performance under different data imbalances we conducted a simulation study.

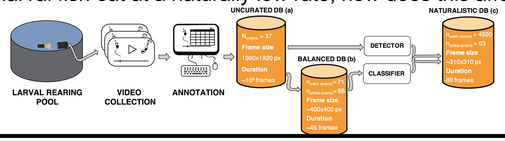
The above ROC/PRC were generated using the same simulated classifier at 4 data imbalance levels.

Scan for data & code

What challenges are we facing?

1. **Data acquisition** – how do we image tiny creatures in field conditions?



2. **Data analysis** – how do we automate behavior detection?

3. **Rare events** – larval fish eat at a naturally low rate, how does this affect us?