Deep Learning and Computer Vision Techniques to Identify and Monitor *Ostreidae* Nondisruptively

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Abstract

Oysters are growing in importance both as a food source for a rising population and a natural filtration system for waterways. We have trained computer vision models to detect, classify, and track these oysters to allow for remote monitoring and counting, making it easier for farmers and environmental groups to assess the health, prevalence, and extent of oysters in an area. By utilizing YOLOv8 and its new features, we have been able to train and test oyster detection, classification, and segmentation models with better precision and tracking than last year's project. We believe our work so far has shown great promise in being adapted into use in the field and in oyster hatcheries as a way to monitor and track oysters, which should prove useful in the modernization of the aquaculture industry.

Methods

- Image Annotation
  - We used Roboflow to store and annotate our dataset as it was easy to collaborate and augment the dataset.
  - We used three statuses to classify the oysters: open, closed, and indeterminate.
- Data Collection
  - We visited Horn Point Hatchery to collect more testing and training images.
  - We also used the Underwater Image Enhancement Benchmark dataset to expand our collection of "false positive" images.

Results

- The image size which gave the best results was 640x640, and the best model size with 640x640 was nano, giving the highest mAP50 values out of each model size. The differences between 320x320 and 640x640 are very small, but noticeable if comparing pure precision.

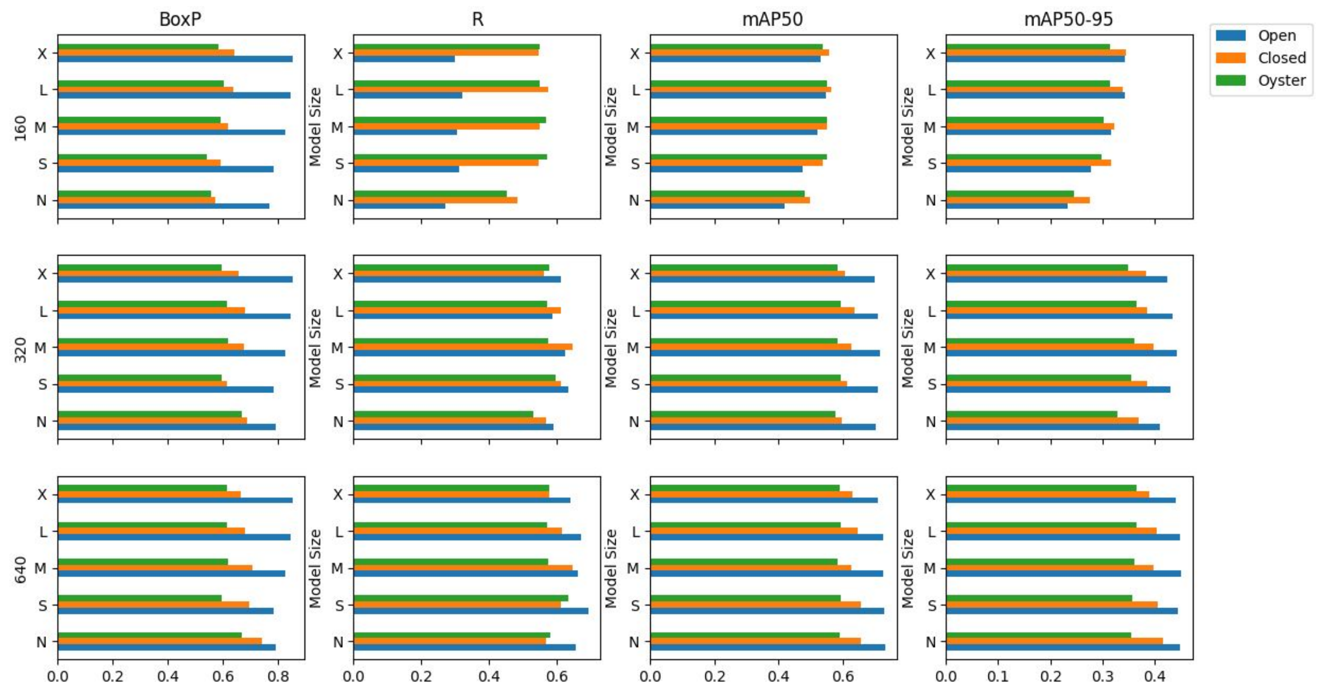
Class	Images	Instances	Box(P	R	mAP50	mAP50-95
all	95	3328	0.704	0.599	0.658	0.407
Oyster-Close	95	991	0.626	0.579	0.589	0.356
Oyster-Open	95	673	0.742	0.563	0.656	0.416
Oyster	95	1664	0.744	0.654	0.729	0.448

Statistics of 640x640 nano model

Discussion

- Our models have shown significant improvement over last year's work. While we could not provide a direct comparison due to backwards compatibility issues and lack of quantitative data from last year's project, we are confident nonetheless that our results have improved.
- We believe this improvement is due to us choosing YOLOv8 over YOLOv5, new annotation methods, and a larger dataset.
- YOLOv8's changes over its predecessors were a huge factor in the improvement of the models, as the changes to the head, neck, and backbone of YOLOv8 played a key role in improving the precision and results of our models.
- In addition, we were successfully able to incorporate video-based tracking into our work, useful for both stationary and moving shots of oysters.

Results using our detection model.



Conclusions & Future Work

- We believe that our work done throughout the course of this project has contributed to the goal of incorporating modern technology into the aging aquaculture industry. In addition, our work could be used to survey areas underwater to identify and estimate the number of oysters without having to physically disturb them.
- Despite our significant strides in this project, we believe there is still work to be done. Such improvements include:
  - Expanding our dataset to include both visual and physical data, which would allow the models to pick up on small details humans would otherwise not notice.
  - Incorporating new software, such as YOLOv8_OBB, which would boost the precision of the models even more.
  - Further refining of our dataset, including more varied images to help the models detect more oysters.
  - Creation of an easily usable software to run images and videos through to identify and track oysters.

References & Acknowledgements

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