Supervised Team
YOLOv8 sub-team

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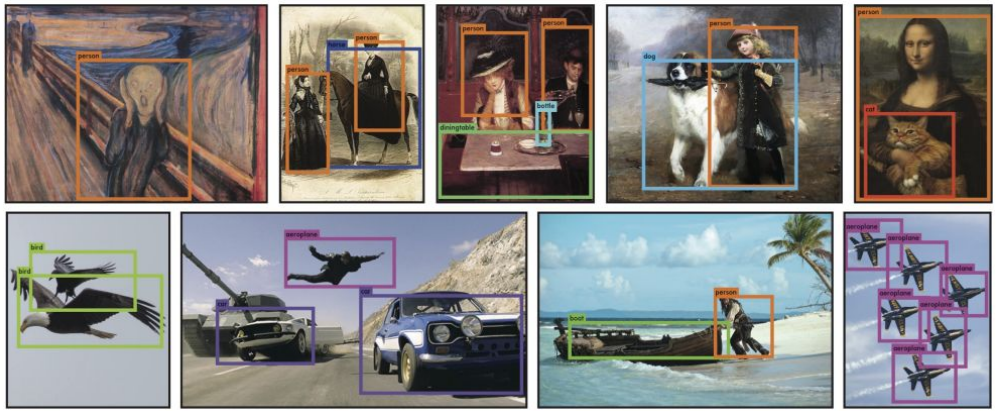
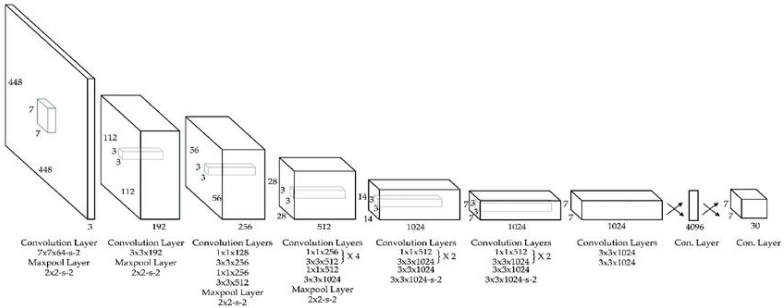
YOLO

Real-time object detection algorithm



24 convolutional layers followed by 2 fully connected layers, pretrained on ImageNet



You Only Look Once: Unified, Real-Time Object Detection (Redmon, 2015)

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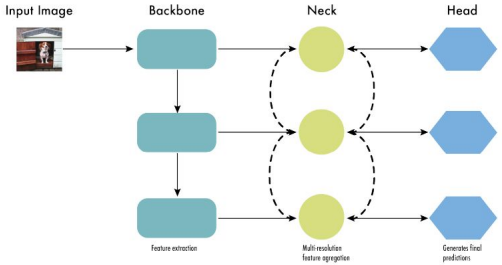
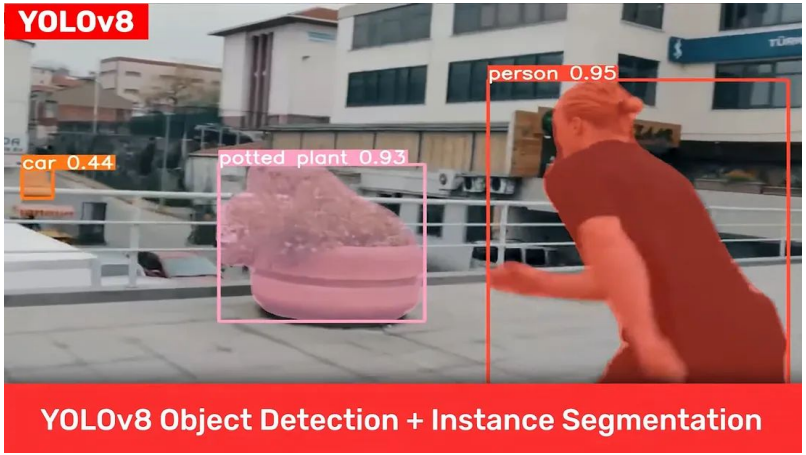
YOLOv8 (seg)

Latest implementation of YOLO, by Ultralytics (2023)

- Advanced Backbone and Neck Architectures
- Pretrained on COCO



A Comprehensive Review of YOLO: From YOLOv1 and Beyond (Terven, 2023)

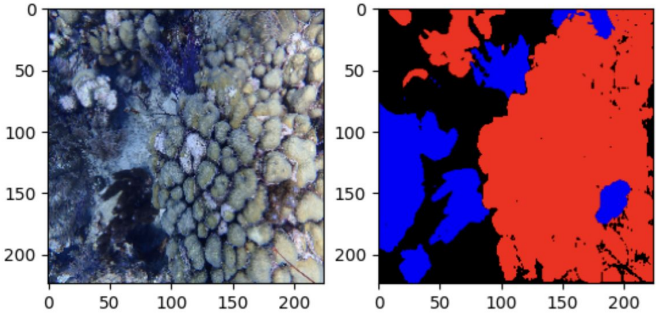


Instance Segmentation: **identifying**, **separating** and **classifying** individual objects within an image.
The output is a set of **masks or contours**, **class labels** and **confidence scores** for each object

Methodology

Using the benthic dataset, labels and masks (rs_labelled):

- Transform the **image segmentation masks** into YOLOv8 **PyTorch TXT** format (Notebook 1)
- Transform **files and folder structuctures** into format directly usable by YOLOv8 (Notebook 2)
- Train the baseline models (Notebook 3 and 4)



```
0 0.443359375 0.7646484375 0.44311234375 0.7
1 0.826171875 0.62646484375 0.826171875 0.626
1 0.06475830078125 0.58251953125 0.0645141601
0 0.37744140625 0.2396240234375 0.37719726562
0 0.31005859375 0.8251953125 0.309814453125 0
1 0.001750946044921875 0.9013671875 0.0015010
0 0.736328125 0.489990234375 0.736328125 0.49
0 0.163818359375 0.9453125 0.16357421875 0.94
```

Yolov8 PyTorch txt format

Preliminary results

Two baseline models

- Region specific (trained on SEAFLOWER_BOLIVAR)
- All regions

Test what works best for these models and datasets - Specific models might achieve better performance at the expense of worse generalization

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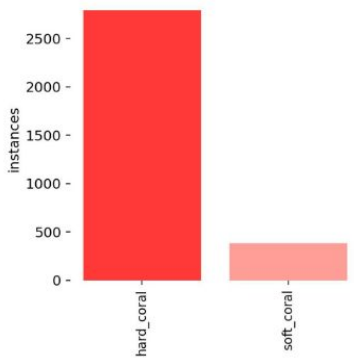
Baseline 1

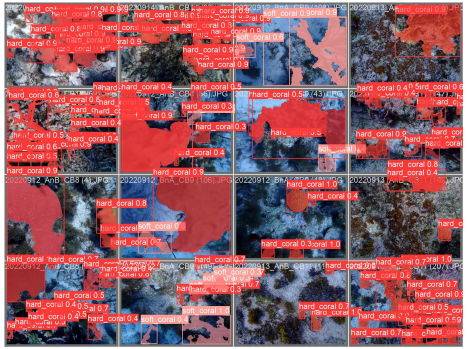
Data from only one region - SEAVIEW_BOLIVAR

- ➔ Task: instance segmentation
- ➔ Pretrained model size: m (~27M parameters)
- ➔ Number of epochs: 20 (~ training time: 20min)
- ➔ Dataset: *SEAFLOWER_BOLIVAR*, 80% random split train/val

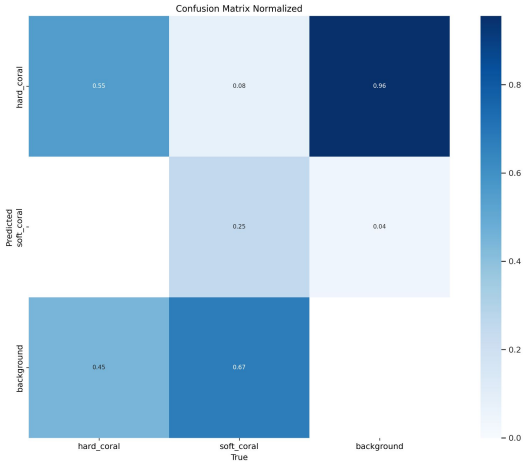
Labels

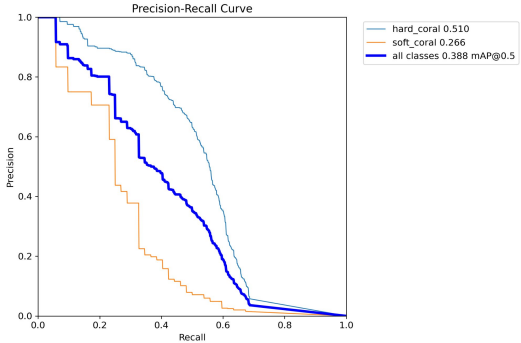


Predictions



Performance





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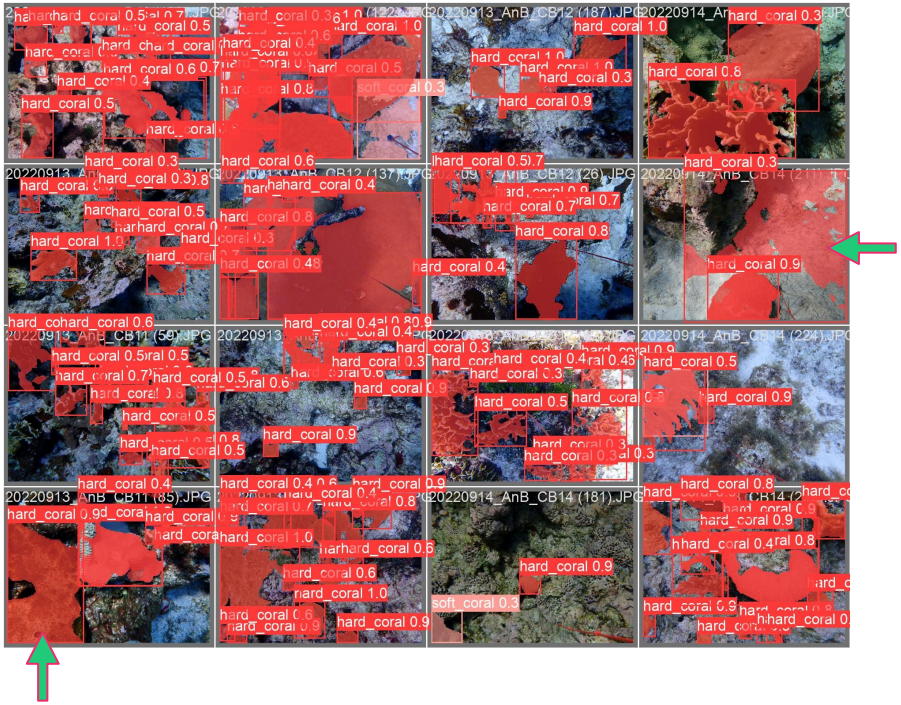
Baseline 1

Data from only one region - SEAVIEW_BOLIVAR

Ground truth

Prediction



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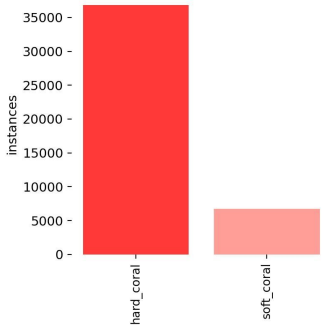
Baseline 2

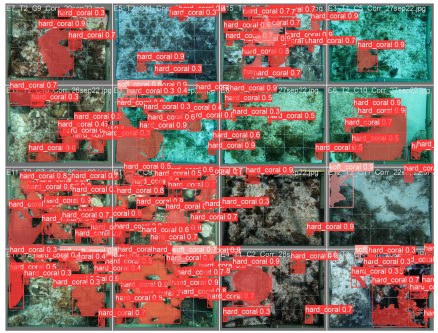
Data from all regions (but SEAVIEW_PAC_AUS)

- ➔ Task: instance segmentation
- ➔ Pretrained model size: m (~27M parameters)
- ➔ Number of epochs: 20 (~ training time: 1h40m)
- ➔ Dataset: *All regions except SEAVIEW_AUS - 80% random split train/val*

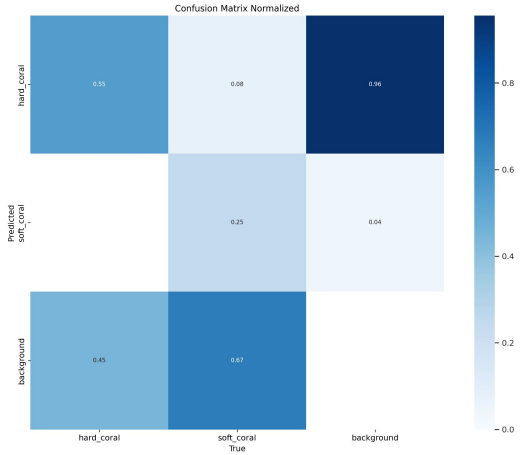
Labels

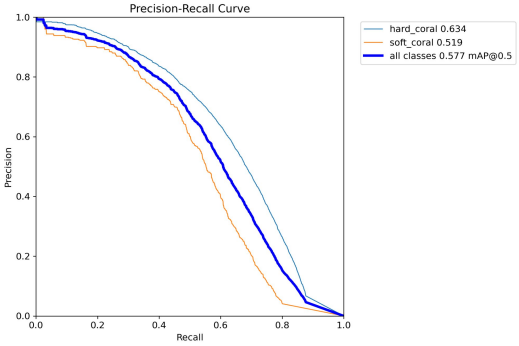


Predictions



Performance





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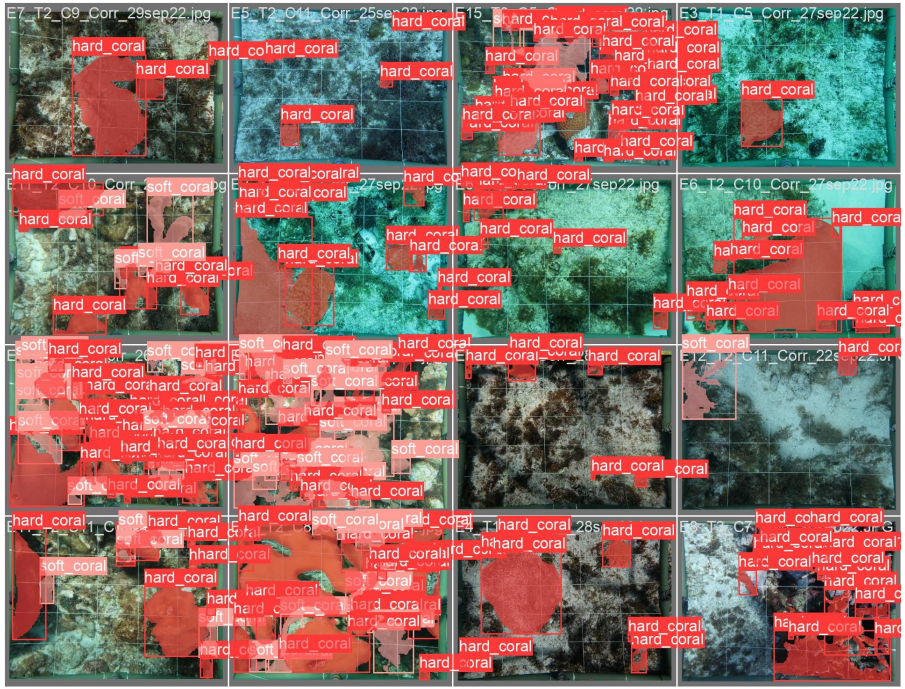
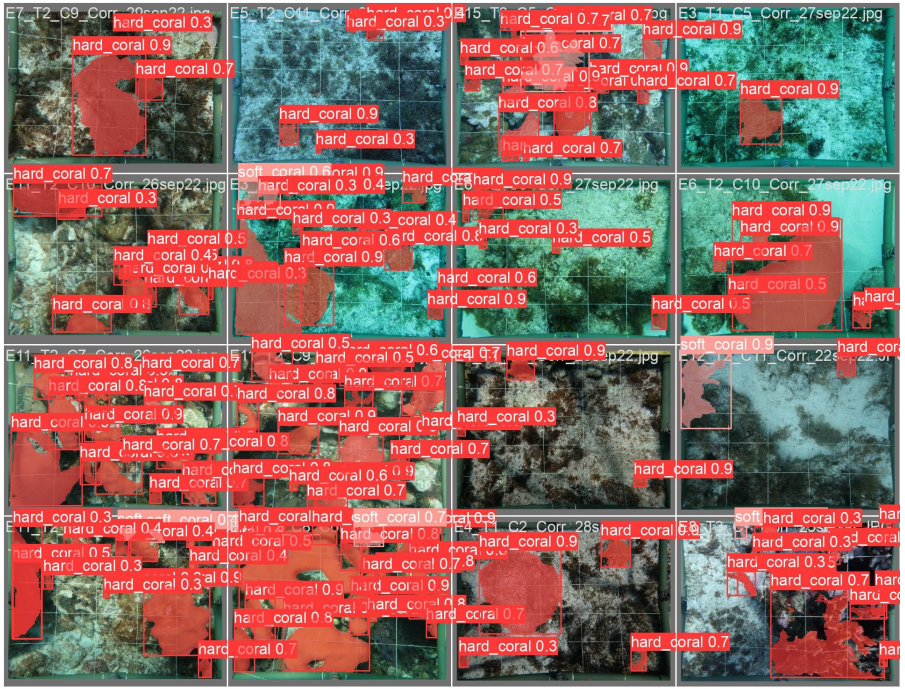
Baseline 2

Data from all regions (but SEAVIEW_PAC_AUS)

Ground truth



Prediction



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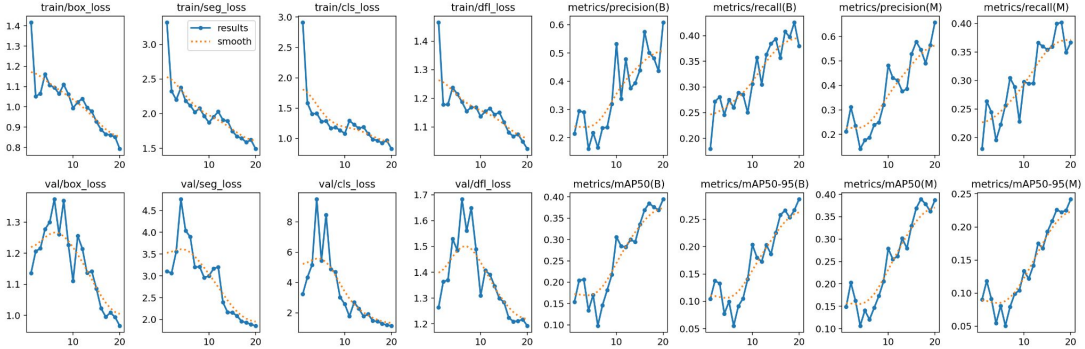
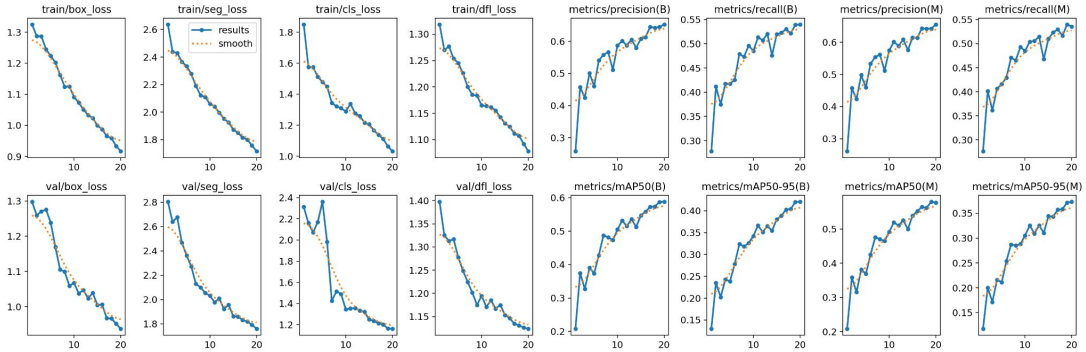
The baselines can still learn a lot!



Baseline 1 - region specific

Baseline 2 - All regions



Conclusions and next steps

- YOLOv8 seems like a good model for instance segmentation and can be trained on the available dataset.
- Higher **computer power** to train would still improve performance
- **Bigger YOLOv8 models** should be tried to better fit the data - we are currently using the middle size model `m` but large `l` and xlarge `x` are also available.
- It would be great to generate a **confusion matrix that reports pixel classification** errors. That would provide an idea on how the model will be used downstream (to evaluate **benthic coverage**)
- Consider other metrics

Roadmap

Improve the baselines

Bigger model size (triple the number of parameters)
Longer training times
Hyperparameter tuning

Important: Check the data quality issue reported by Ponniah

Improve the baselines

Keep iterating
Test on the common evaluation script provided by other teammates

1 model per region OR 1 general model?

Image Preprocessing
Combine with SAM

Look into how image preprocessing (eg. Sea Thru) can help with instance segmentation

Look into how a YOLOv8 object detector can be used with SAM for instance segmentation

Wrap up

Write the final report
Start cleaning up and wrapping up all work that is done.

Wrap Up

Cleanup code, notebooks
Write documentation on how to use and retrain the models
Share with ReefSupport.

Celebrate!

Questions?