



UC3: Marine Ecosystem Monitoring at EMSO-OBSEA

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UPC / EMSO ERIC

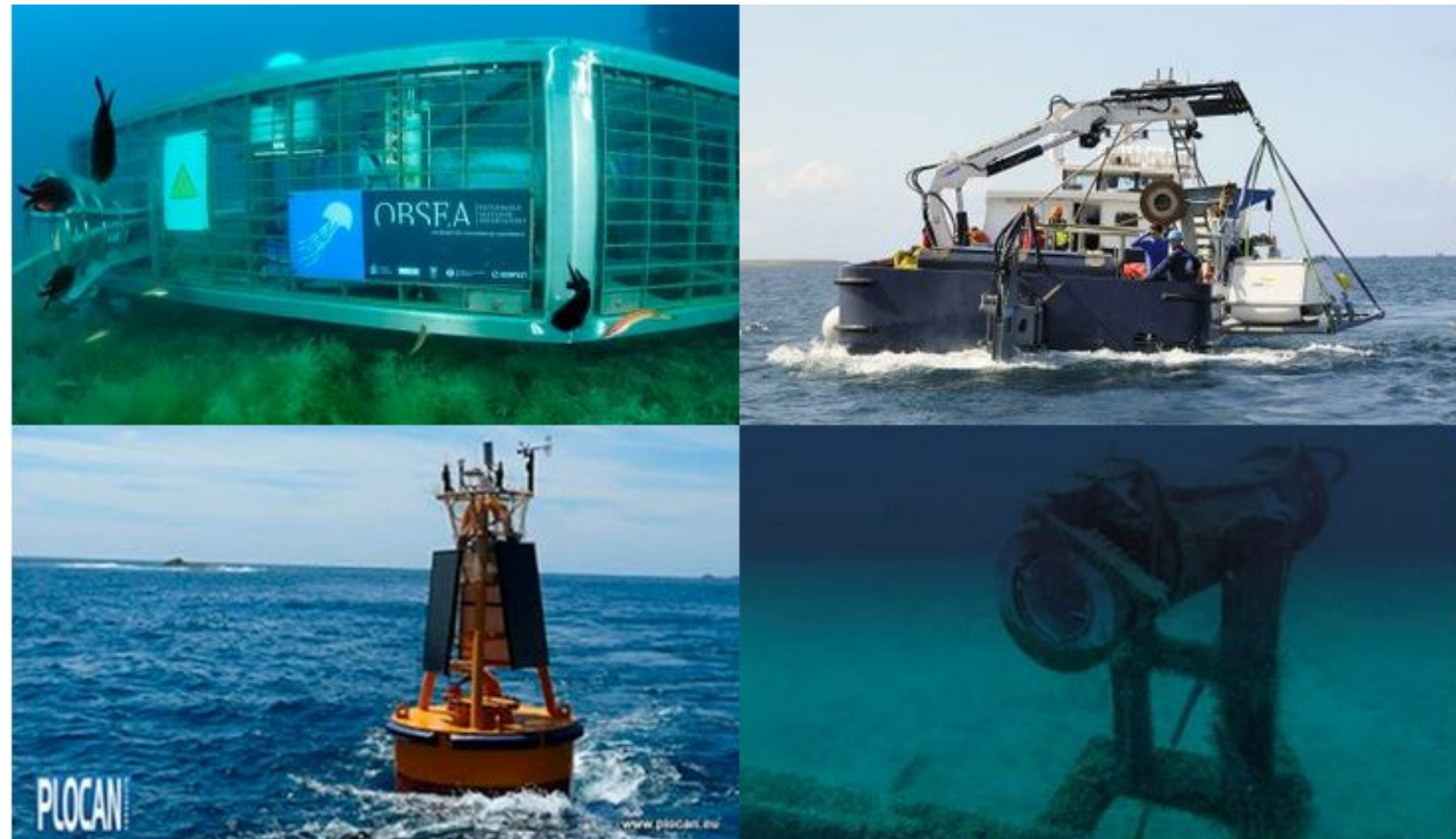
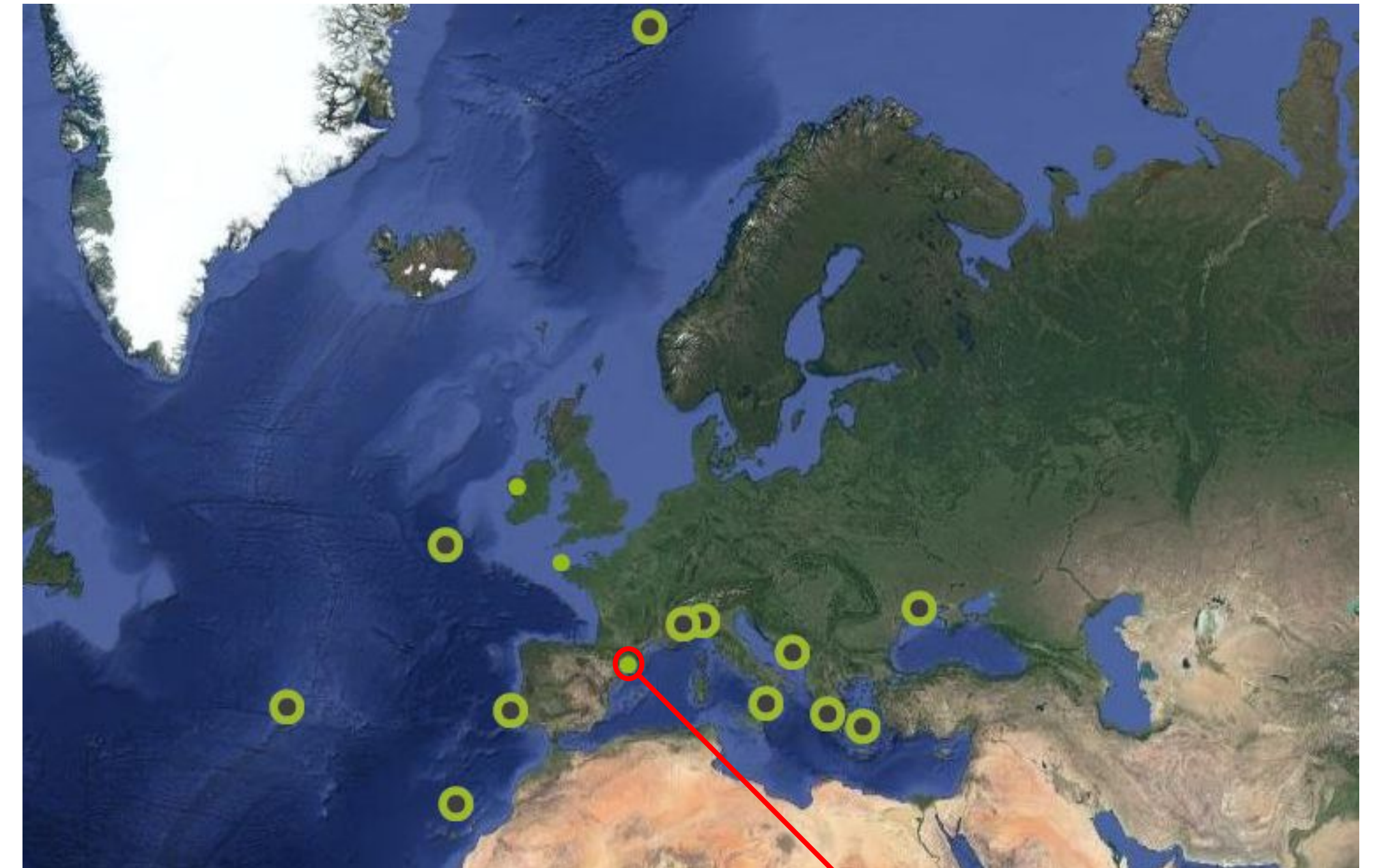


iMagine RP1 review
5th December 2023

EMSO ERIC

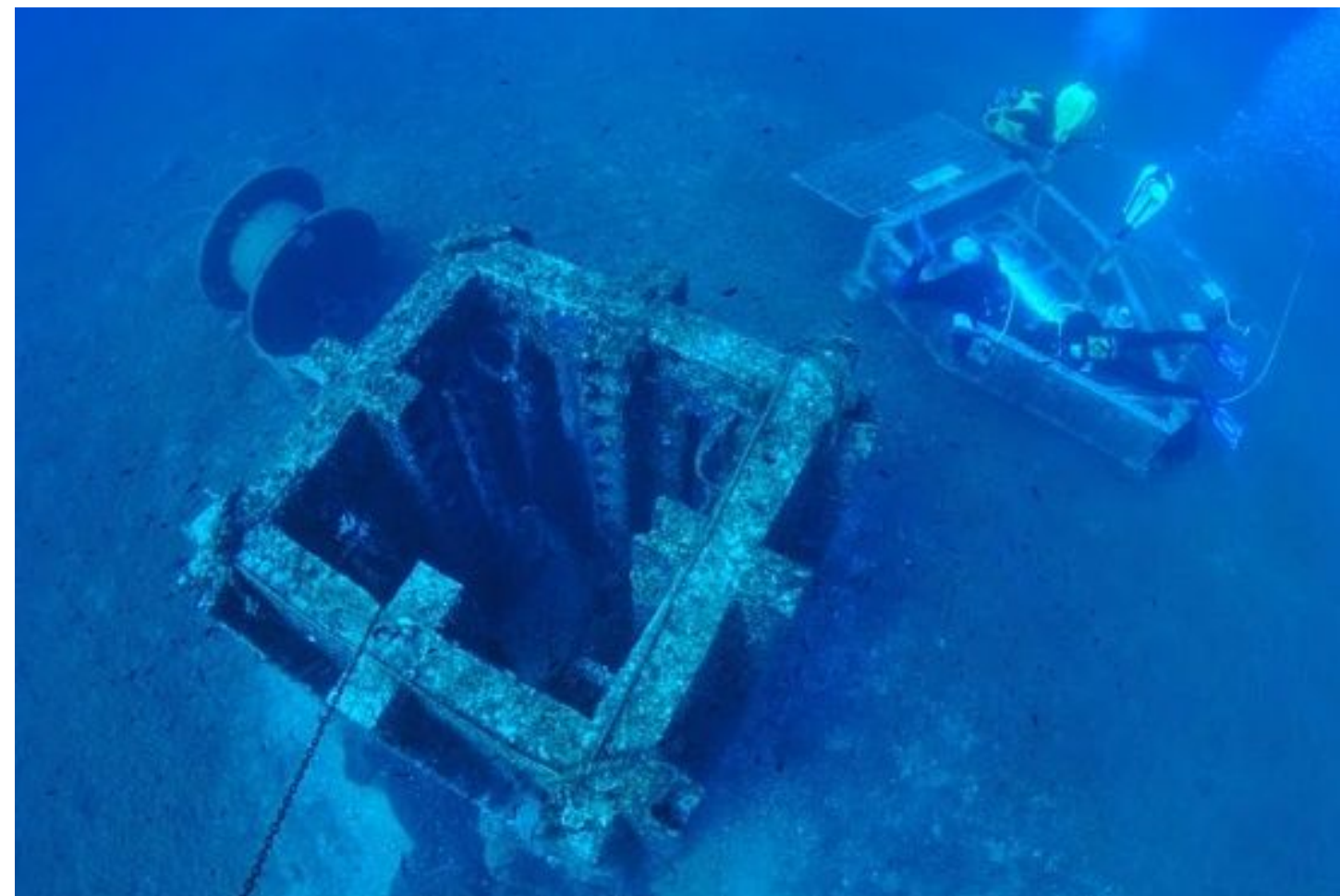
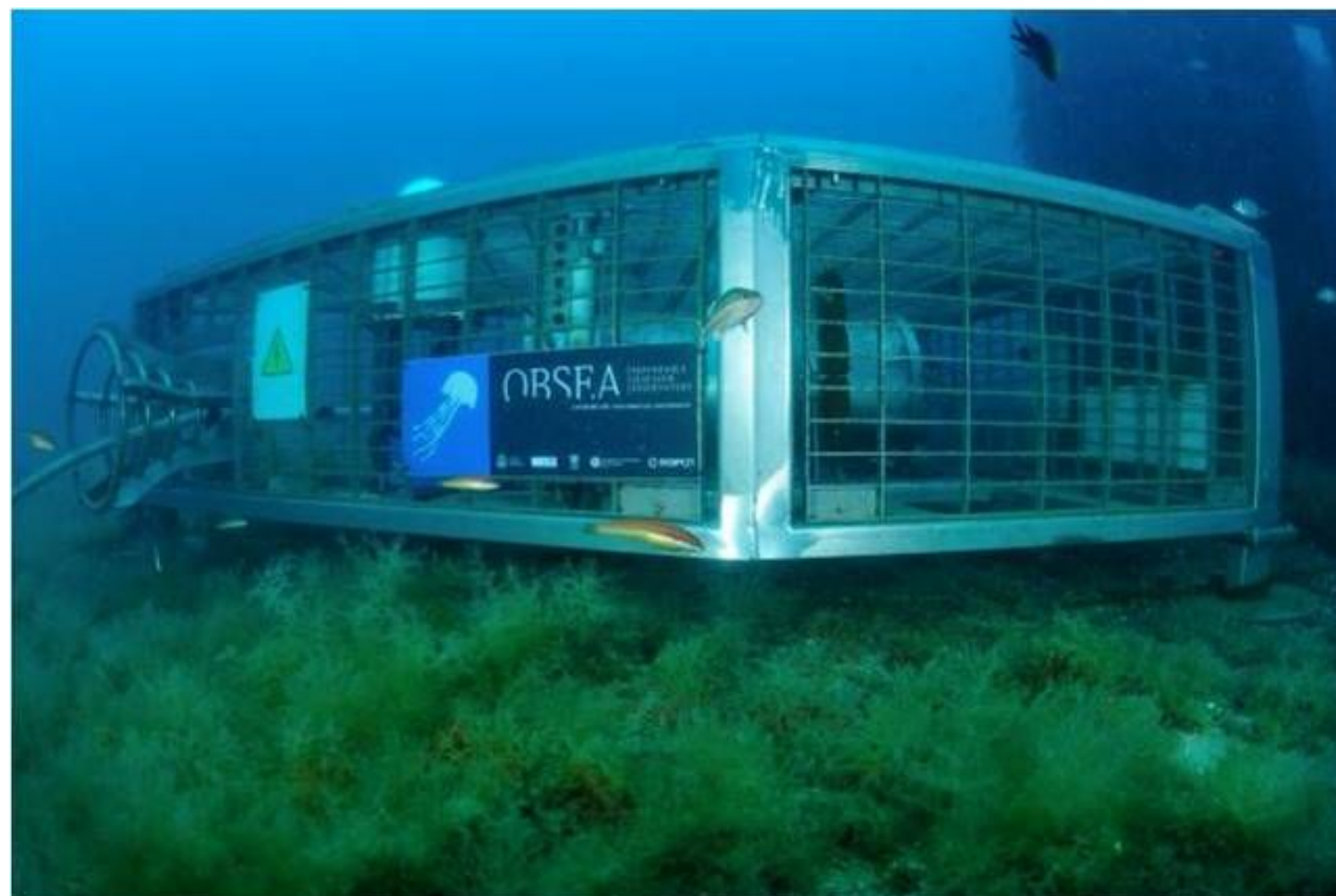
European Multidisciplinary Seafloor and water column Observatory

- Distributed research infrastructure
- 15 underwater nodes
- Fixed-point ocean monitoring:
 - Physical oceanography
 - Geochemistry
 - **Biological monitoring**



OBSEA Seafloor Observatory

- Underwater cabled observatory
- Located at NW Mediterranean Sea
- Shallow waters (20 m depth)
- Underwater pictures since 2011



UC3 Objectives

Ecosystem Monitoring at EMSO-OBSEA

Objective 1: Support Data Managers

- Develop an AI model to analyze underwater pictures to increase the impact of existing images archives

Objective 2: Support Biologists

- Use a service for automated analysis of underwater pictures to study fish communities (abundance, behaviour...).

Starting Point



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Departament d'Enginyeria Electrònica

Team Expertise

- Electronic/IT engineering
- Some biology expertise
- No AI experience in-house




Existing dataset

- 30k partially-labelled images
- low image quality (640x480 px)
- Biofouling issues
- **Unused dataset!**

Progress First Year

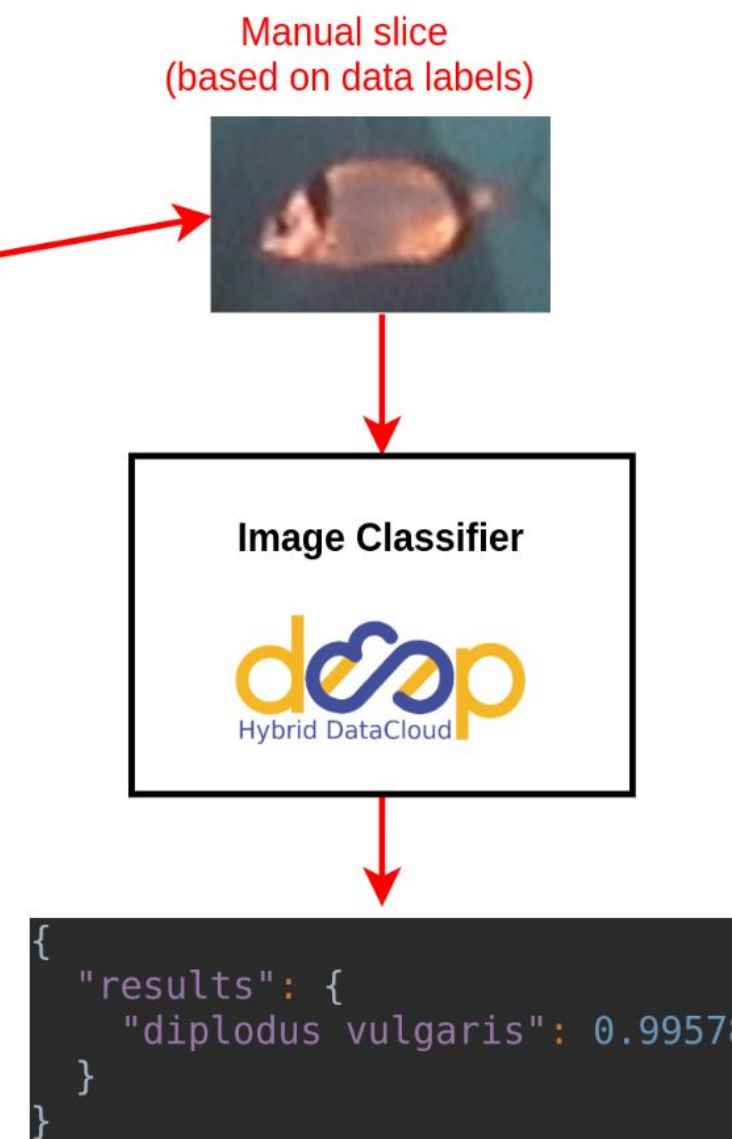
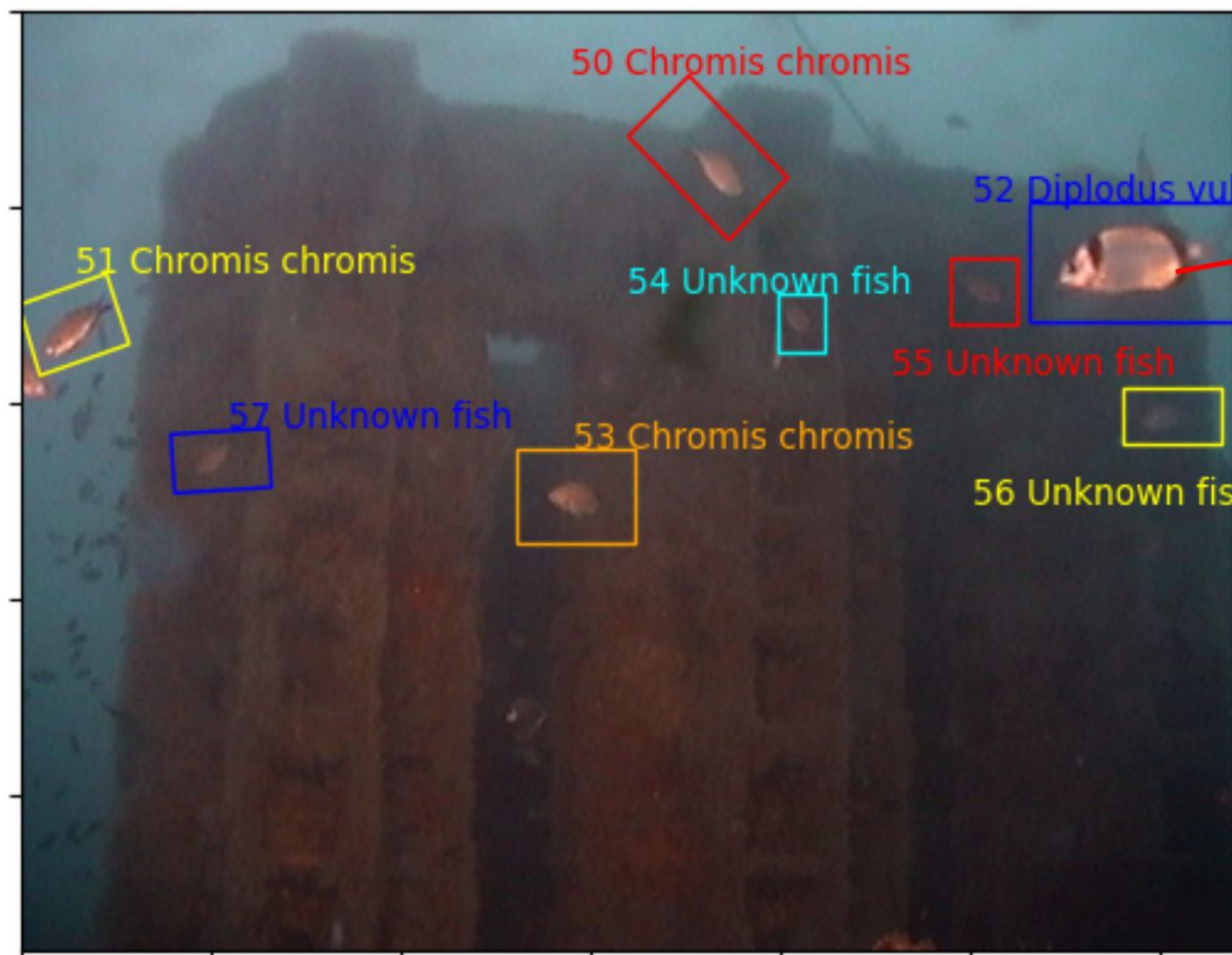


 Train an image classifier

Train your own image classifier with your custom dataset. It comes also pretrained on the 1K ImageNet classes.

PyTorch Object Classification

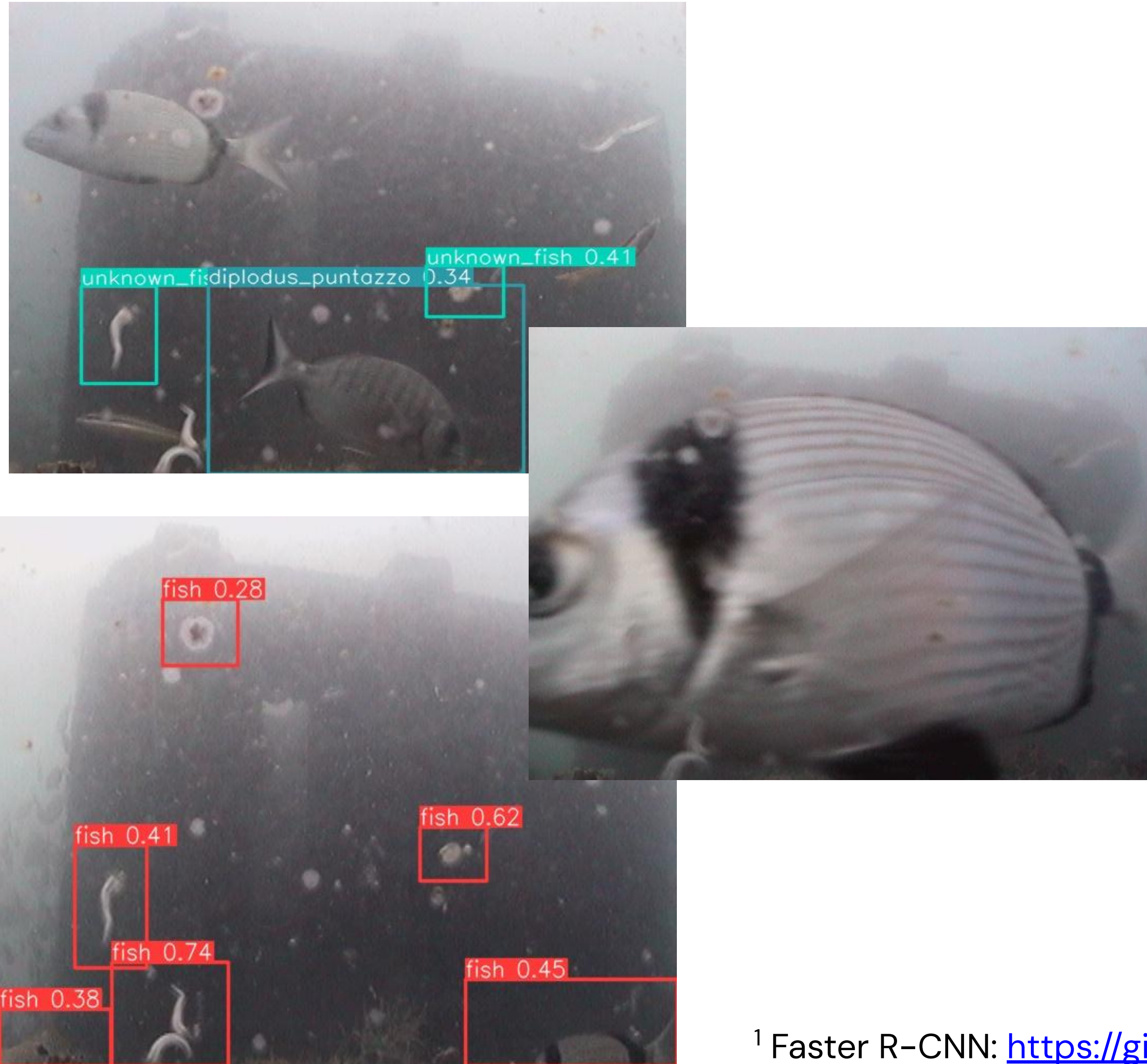
- off-the-shelf marketplace module
- trained with "old" dataset
- trained with iImagine platform resources



Results

- ✓ Reasonably good classification
- ✗ No detection
- ✗ Manual selection of regions

Progress First Year



Object Detection/Classification

- Two open-source models used:
 - Faster R-CNN¹
 - YOLOv8²
- Trained with “old” dataset

Results

- ✗ Missing “clear” specimens (top)
- ✗ Big fish not detected (middle)
- ✗ Biofouling/dirt detected as fish (bottom)

¹ Faster R-CNN: <https://github.com/sovit-123/fasterrcnn-pytorch-training-pipeline>

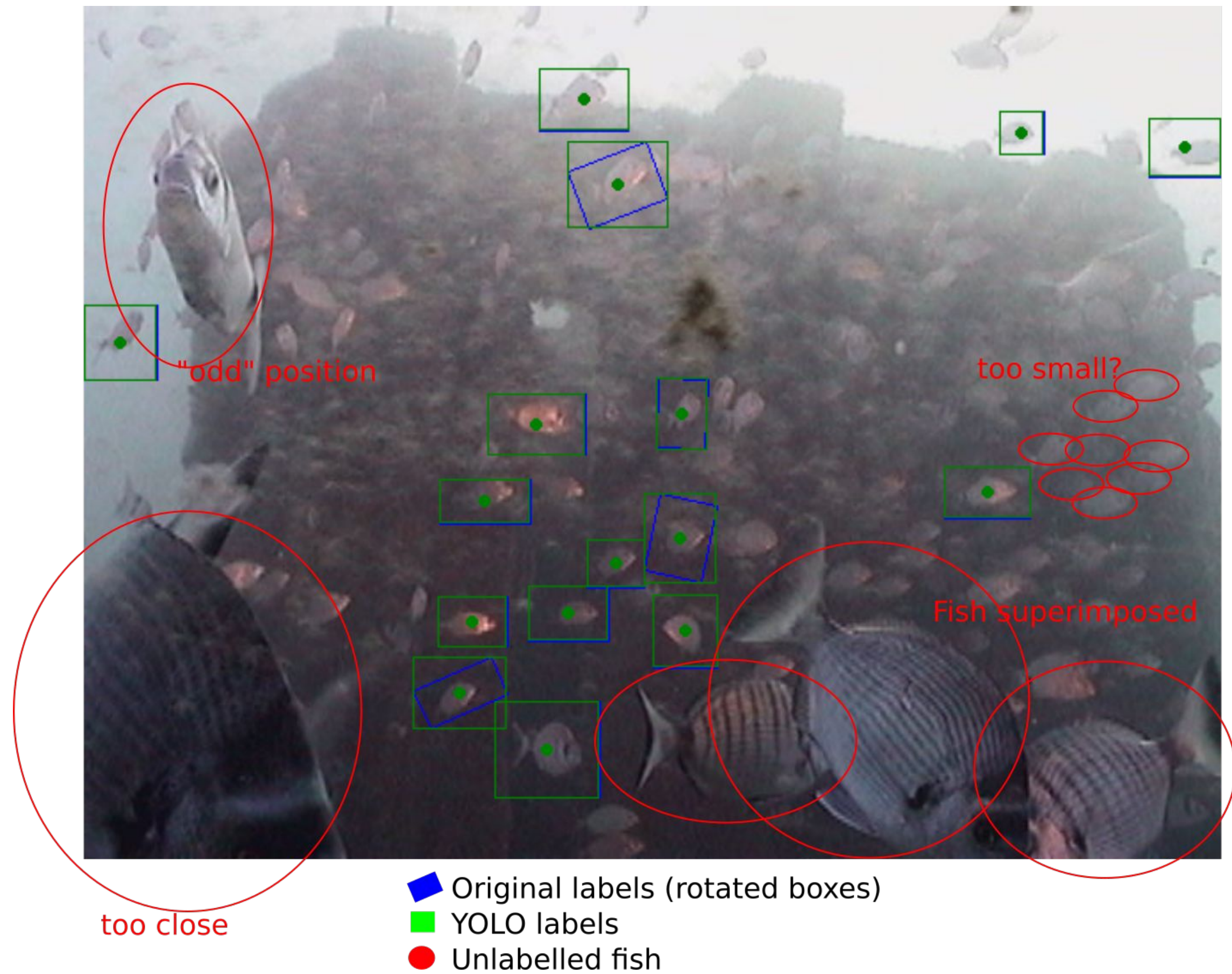
² YOLOv8: <https://docs.ultralytics.com/>

Old Dataset Analysis

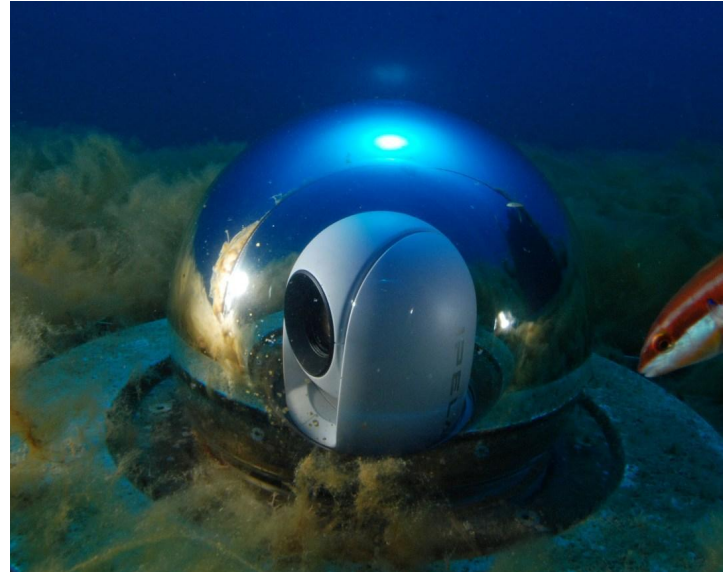
Missing labels:

- Overlapped fish
- "Odd" positions
- Close the optics

X Dataset not usable



Progress First Year



Old Camera
Resolution
Glass sphere



New HD Camera

- ✓ Reduced Biofouling
- ✓ Better Resolution
- ✓ New Dataset with HD pictures

Plans for 2nd Year



New Dataset

Create a new dataset with:

- HD pictures
- Good labels
- Quality over quantity!

Status December 2023

In month M15 we already have:

- ✓ 1700 labelled images
- ✓ 15k manual annotations

Plans for 2nd Year

AI-models

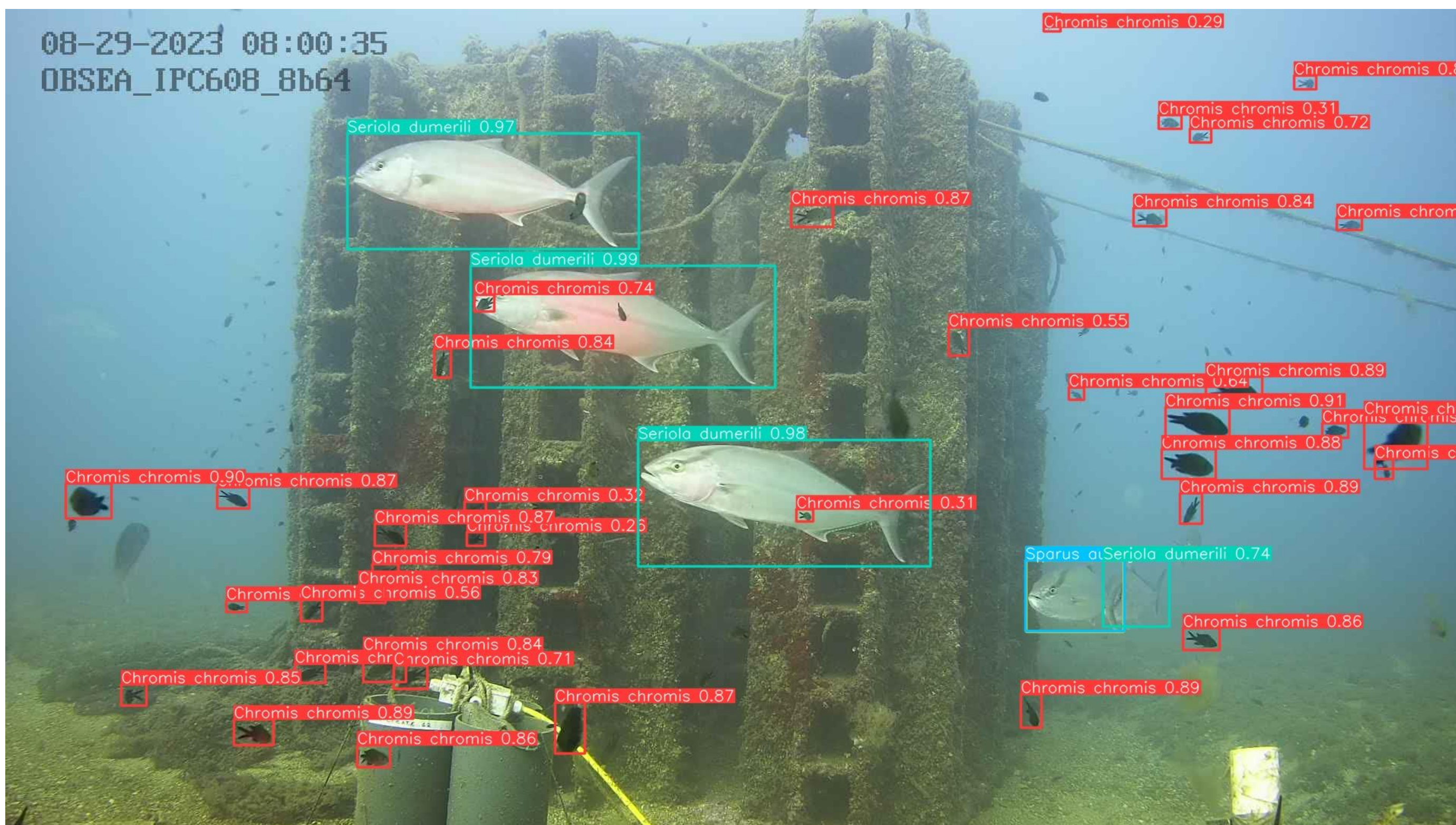
Train two YOLOv8¹-based models:

- **Slow** but precise model: 1 pic/min
 - High-precision scientific timeseries
- **Fast** model for real-time video: 24 FPS
 - Data managers / dissemination
- Publish to the marketplace
- Deploy models in production

Status December 2023

In month M15 we already have:

- ✓ 2 models trained!
- ✓ Published in the marketplace
- ✓ Youtube demo
- ✓ Working with WP4 for video inference



¹ YOLOv8: <https://docs.ultralytics.com/>

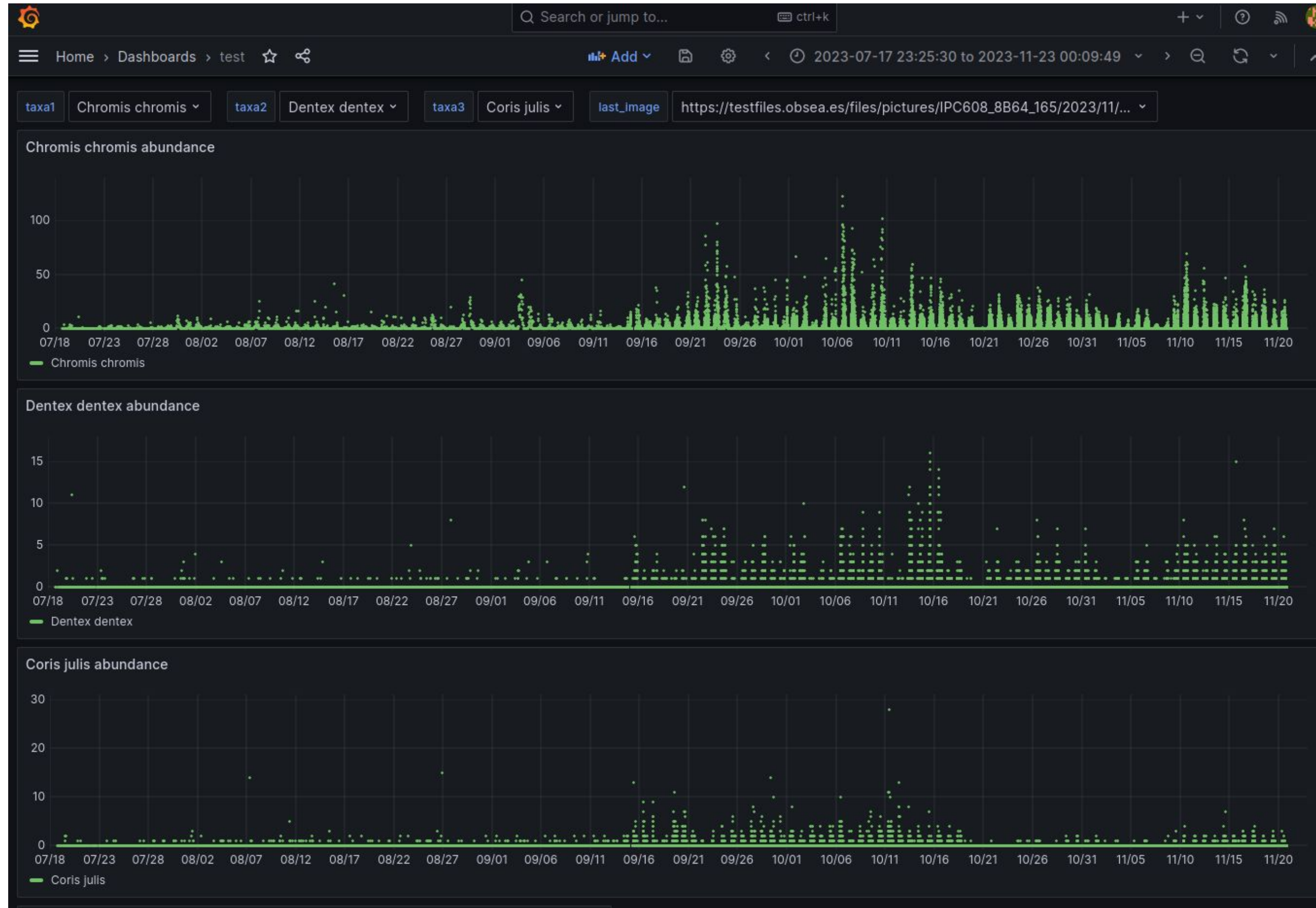
Preliminary Results



SCAN ME



Plans for 2nd Year



Data Production

- Extract fish abundance information
- Generate abundance time-series
- Publish dataset

Status December 2023

In month M15 we already have:

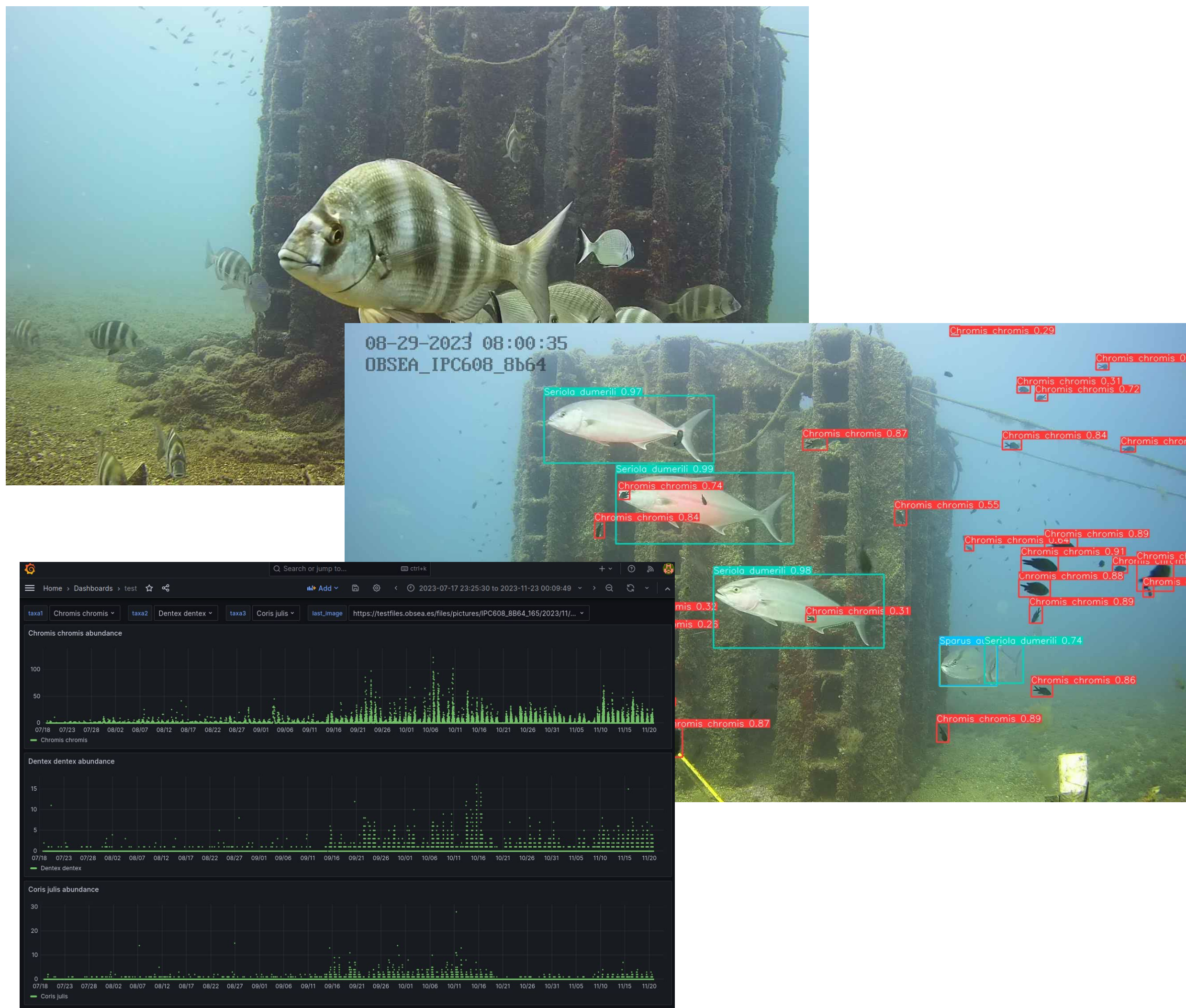
- ✓ Test time-series
- ✓ 50k pictures analyzed

Manually analysis of 30k images took **1 year**
50k images analysis on a laptop took **3 hours**

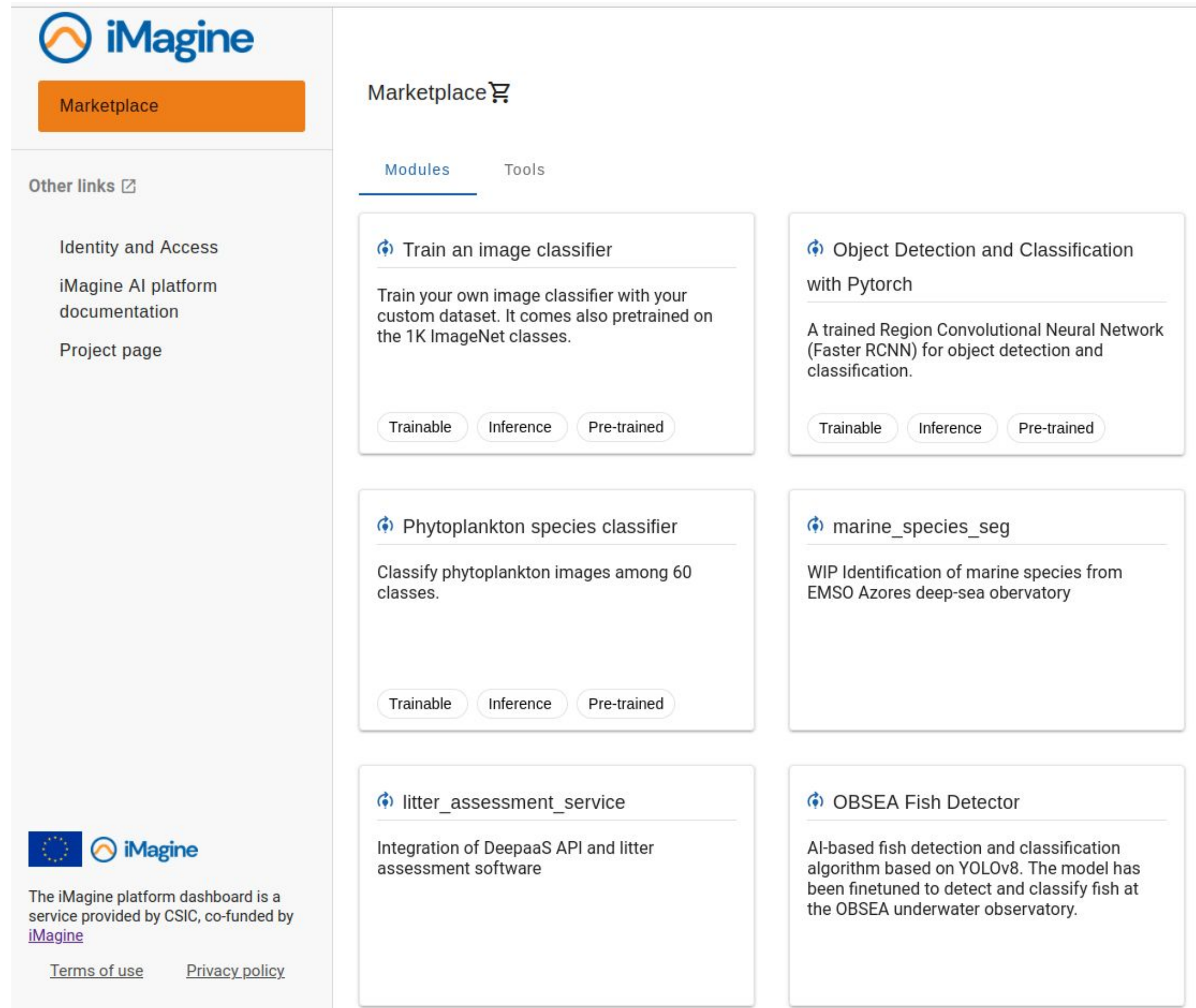
Plans for 3rd Year

Biological Information

- Publish scientific results
- Apply drift detection techniques
- MLOPs
- Promotion with other infrastructures:
 - EMSO SmartBay
 - EMSO Azores
 - PAP
 - JERICO
 - LifeWatch
 - EMBRC



The image displays a multi-layered visualization of biological data. At the top left, a photograph shows several fish swimming near a dark, textured underwater structure. Overlaid on this is a semi-transparent interface with a timestamp '08-29-2023 08:00:35' and ID 'OBSEA_IPC608_8b64'. The interface features a grid of bounding boxes around fish, each labeled with a species name and a confidence score. For example, one fish is labeled 'Seriola dumerilii 0.97' in a cyan box, while others are labeled 'Chromis chromis' with various scores in red boxes. Below the main image, a dashboard with a dark background displays three vertically stacked bar charts. The top chart is 'Chromis chromis abundance' with a y-axis from 0 to 100. The middle chart is 'Dentex dentex abundance' with a y-axis from 0 to 15. The bottom chart is 'Coris julis abundance' with a y-axis from 0 to 30. All charts share a common x-axis representing time from 07/18 to 11/20.



The screenshot shows the iImagine Marketplace interface. On the left, there is a sidebar with the iImagine logo, a 'Marketplace' button, and 'Other links' including 'Identity and Access', 'iImagine AI platform documentation', and 'Project page'. At the bottom of the sidebar, there is a European Union flag, the iImagine logo, and text stating 'The iImagine platform dashboard is a service provided by CSIC, co-funded by iImagine', along with 'Terms of use' and 'Privacy policy' links. The main content area is titled 'Marketplace' and has tabs for 'Modules' and 'Tools'. It displays six AI modules in a grid:

- Train an image classifier**: Train your own image classifier with your custom dataset. It comes also pretrained on the 1K ImageNet classes. (Trainable, Inference, Pre-trained)
- Object Detection and Classification with Pytorch**: A trained Region Convolutional Neural Network (Faster RCNN) for object detection and classification. (Trainable, Inference, Pre-trained)
- Phytoplankton species classifier**: Classify phytoplankton images among 60 classes. (Trainable, Inference, Pre-trained)
- marine_species_seg**: WIP Identification of marine species from EMSO Azores deep-sea observatory.
- litter_assessment_service**: Integration of DeepaaS API and litter assessment software.
- OBSEA Fish Detector**: AI-based fish detection and classification algorithm based on YOLOv8. The model has been finetuned to detect and classify fish at the OBSEA underwater observatory.

Experiences with the Platform

- ✓ User friendly
- ✓ Easy to deploy modules
- ✗ Some issues with virtualization
 - ✓ WP4 team fixed them
- ✗ Modules with broken dependencies
 - ✓ Good docs -> easy to recreate
 - ✓ Sandbox module



UC3 Marine Ecosystem Monitoring at OBSEA

Thank you for your attention

