## Supplementary Materials

Object detection algorithm parameters settings used in the Google Colab model implementation:

•   NVIDIA-SMI: 525.85.12

•   Driver Version: 525.85.12

•   CUDA Version: 12.00

•   PyTorch version: 2.0.1+cu118

•   Python version: 3.7

Training Configuration and steps:

•   Epochs: More than 5000

•   Initial IOU threshold: 0.5

•   Learning rate: 0.00261

•   This learning rate indicates that the model's parameters will be updated with relatively small steps during each training iteration.

•   Momentum: 0.9

•   The momentum value for the model is specified as 0.9. Momentum is a hyperparameter that accelerates the optimization process by accumulating the past gradients.

•   Weight Decay (Weight Attenuation Coefficient): 0.0005. Weight decay is a regularization technique that reduces overfitting by adding a penalty to the loss function proportional to the model's weight magnitude.

•   T. Step 1: 4800

•   T. Step 2: 5400
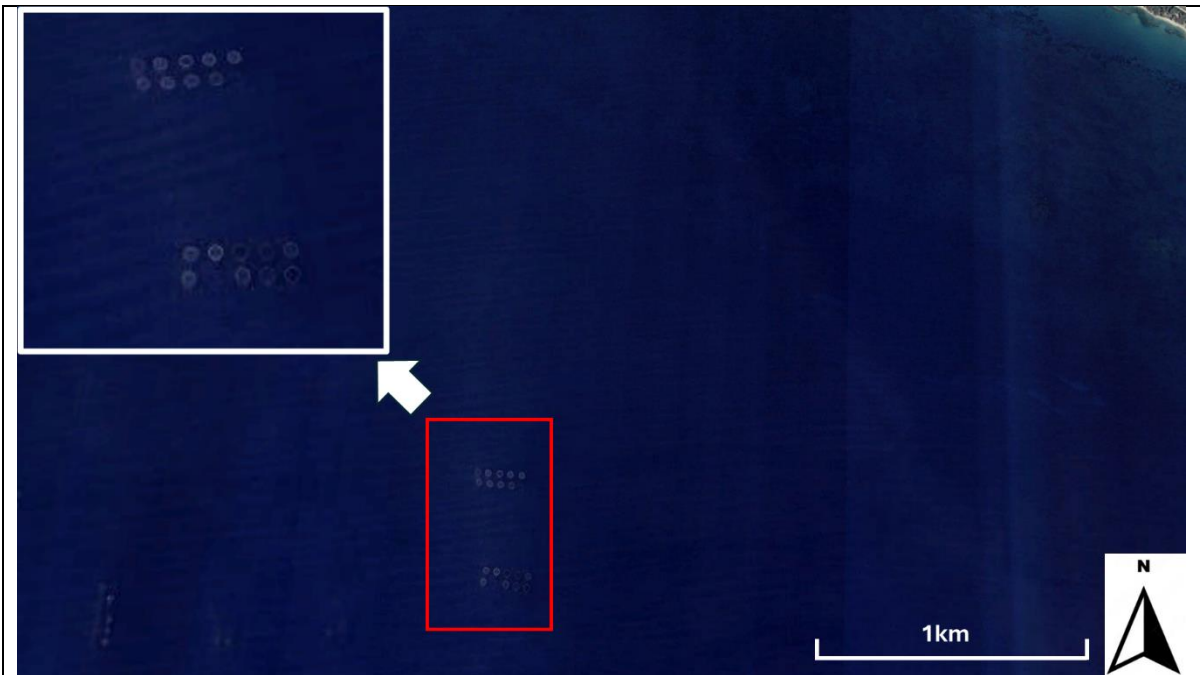
Floating sea cages located at Follonica Gulf (Grosseto Province)
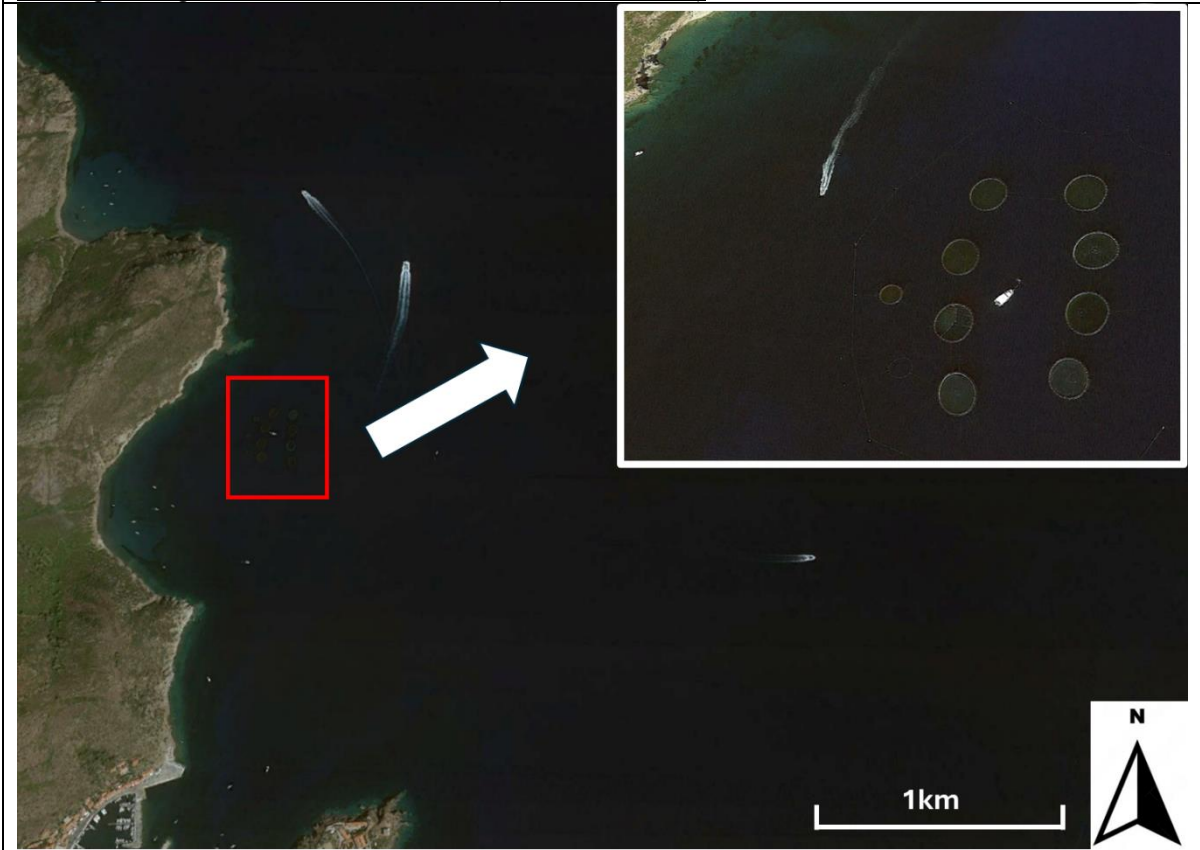
Floating sea cages at Capraia Island (Livorno Province)

Raceways facility at Stia (Arezzo Province)

Figure S1: Examples of coastal and land-based aquaculture production sites identified by the model in Tuscany region (Italy).
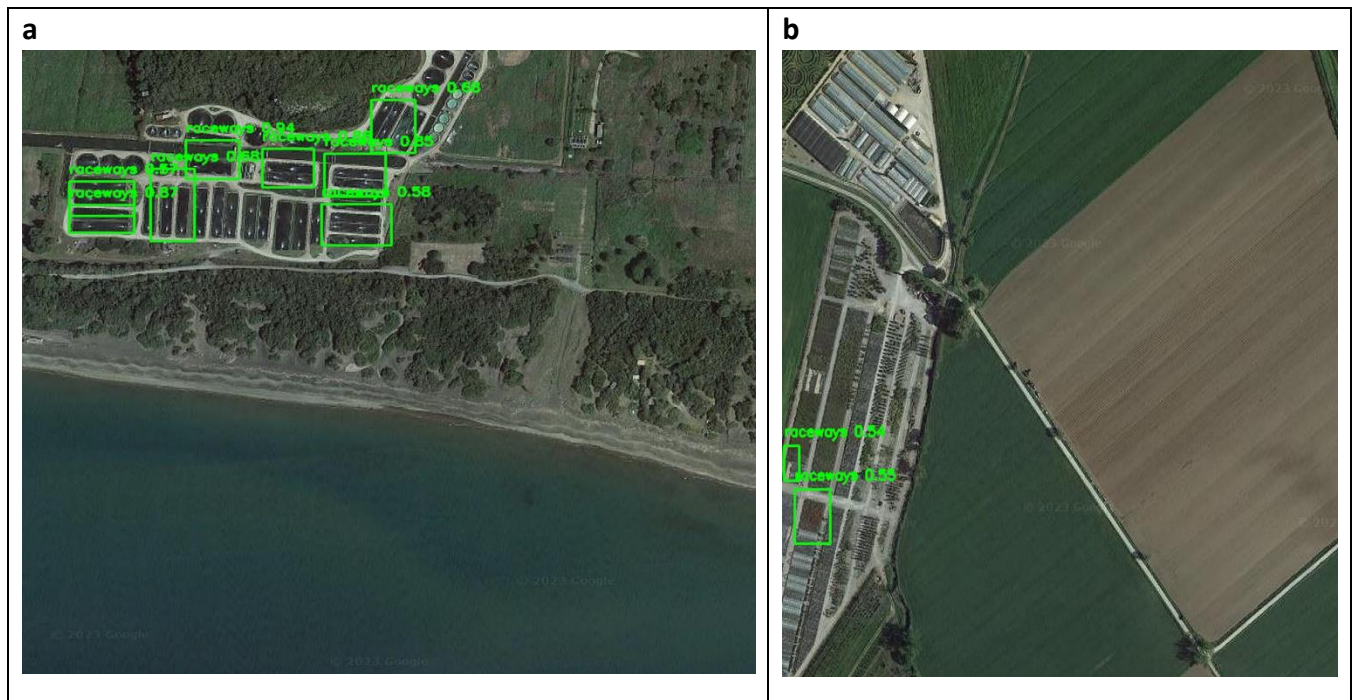
Figure S2: YOLO4 model examples of annotated images for correctly recognized land-based aquaculture facilities (a) and misclassified targets (b, i.e. crop fields).

In Figure S2 an example of the graphical outputs by the YOLO model is reported. Items correctly recognized as raceways (true positives; Figure S2a) or misclassified (false positive; Figure S2b) are evidenced within the bounding boxes along with the correspondent relative values of recognition percentage. The higher detection rate and the greater number of correctly identified structures demonstrate that the object detection task is being performed efficiently by the system.

It is worth noting that for the floating sea-cages, we obtained a high recognition rate primarily due to the intrinsic images characteristics, which contain few elements such as the sea and the cages themselves, with no other elements that can easily be confused with our target items. Indeed, these farming structures are circular and lighter in color, set against a uniform background (the sea), resulting in an inability of the model to identify false positives.