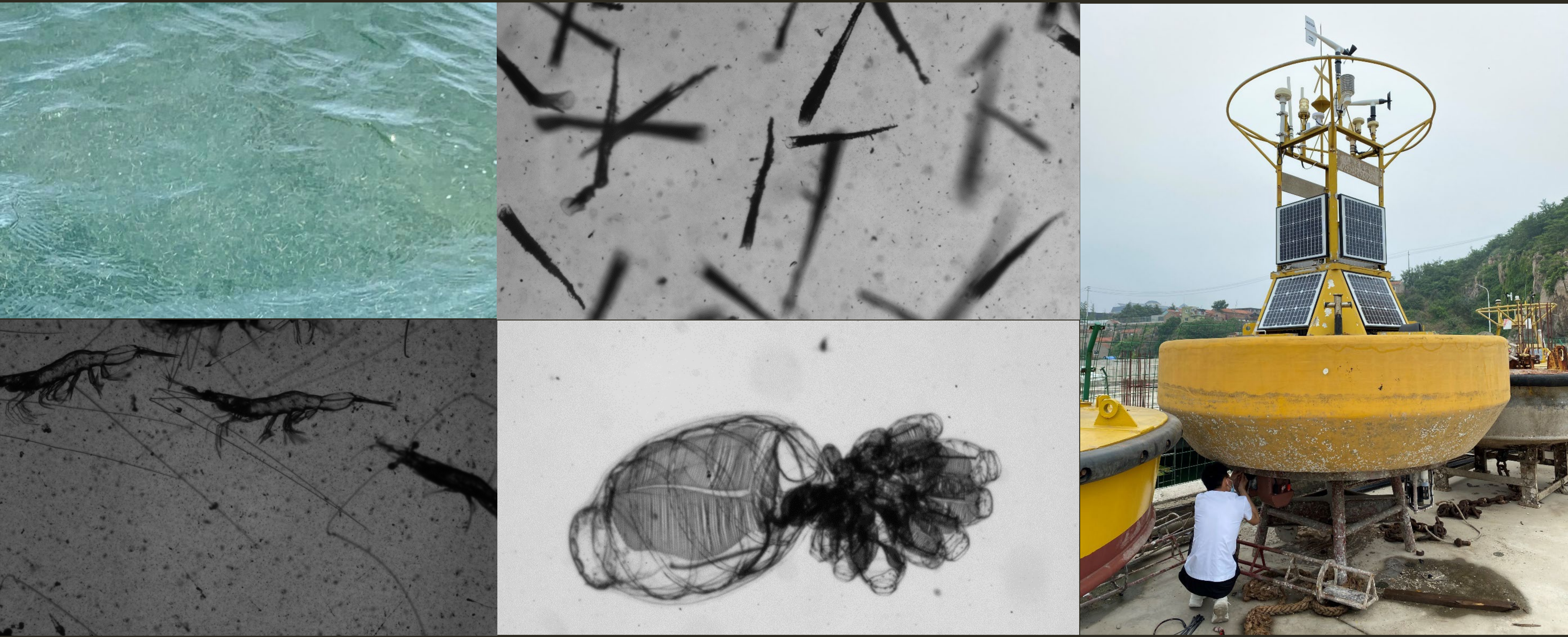

A NOVEL END-TO-END DEEP LEARNING SYSTEM FOR CLASSIFYING MARINE BIOLOGICAL AND ENVIRONMENTAL IMAGES

Hongsheng Bi, Yunhao Cheng, Xuemin Cheng, Mark Benfield, David Kimmel, Haiyong Zheng, Sabrina Groves, Kezhen Ying

CONTENTS

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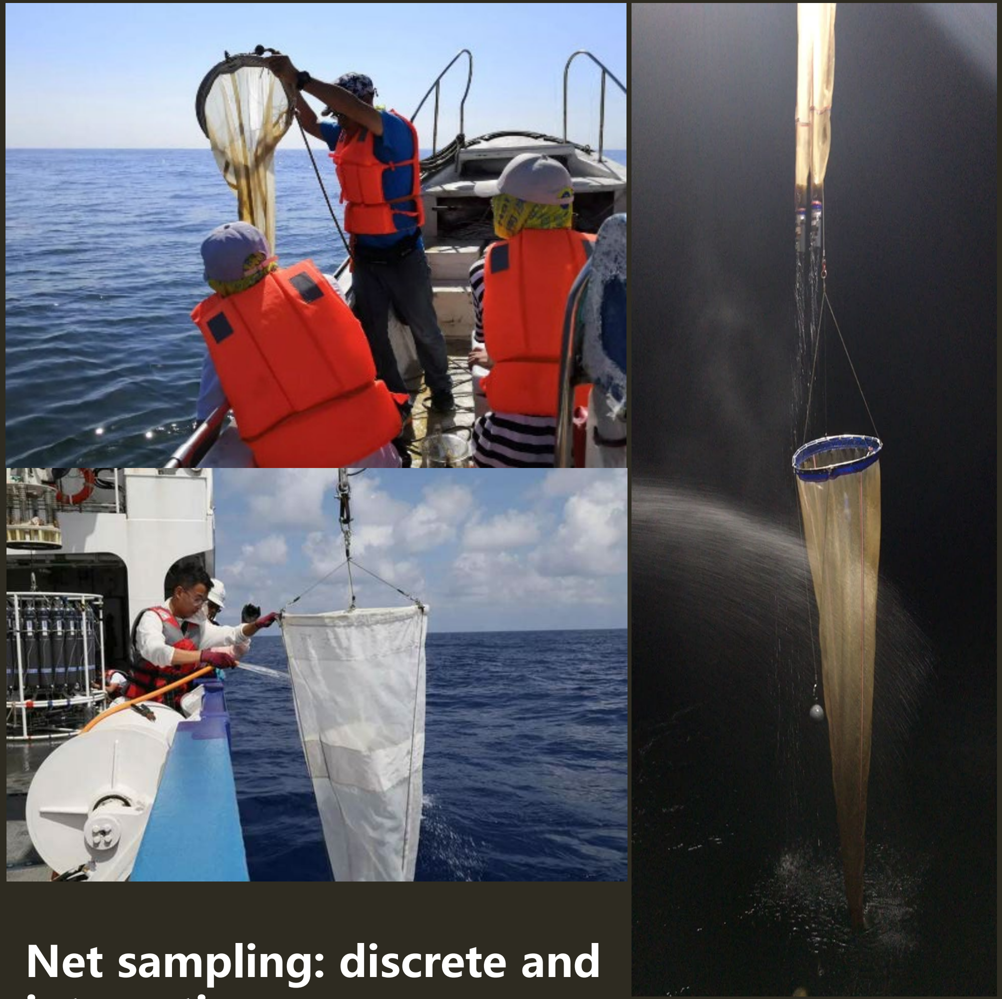
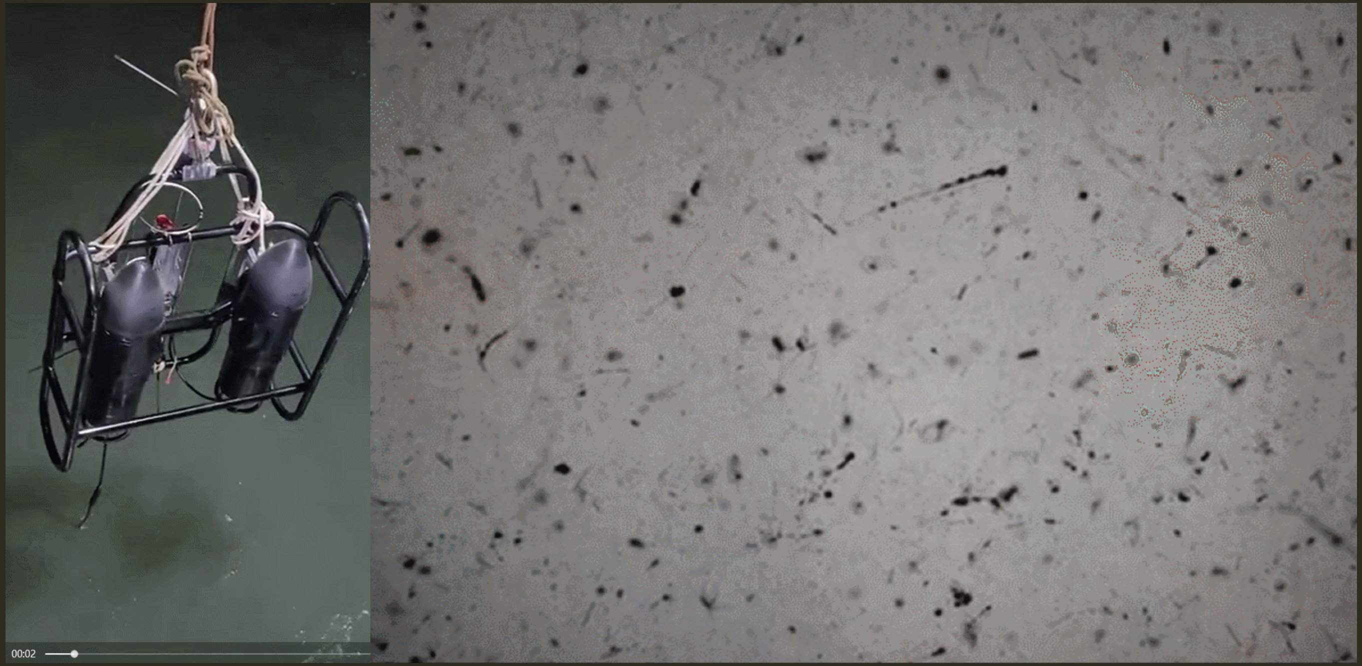
PART ONE

Plankton Monitoring

Image Processing

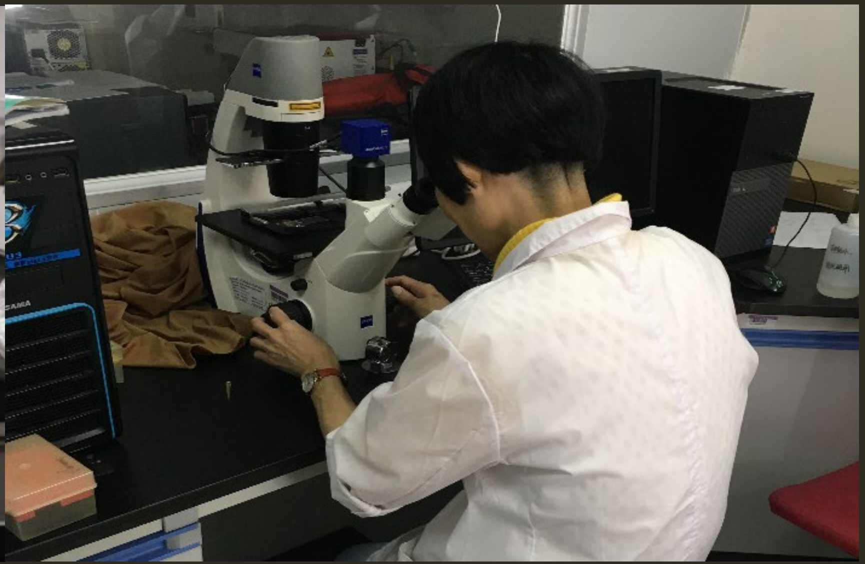


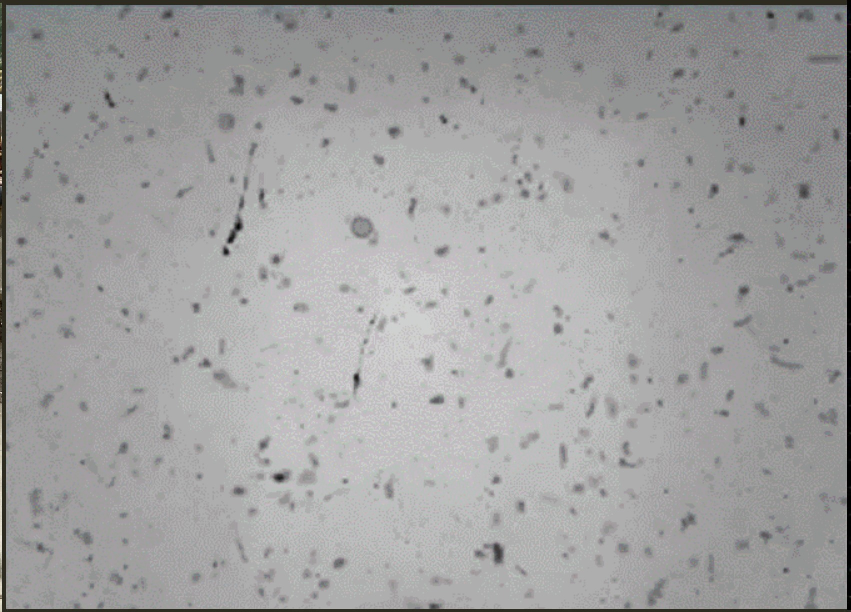
Net sampling: discrete and integrative

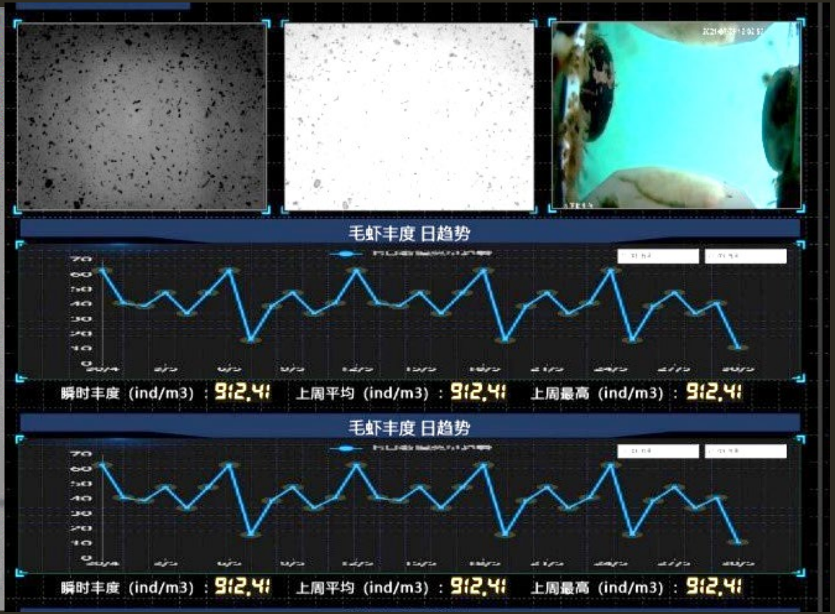


- In situ imaging system

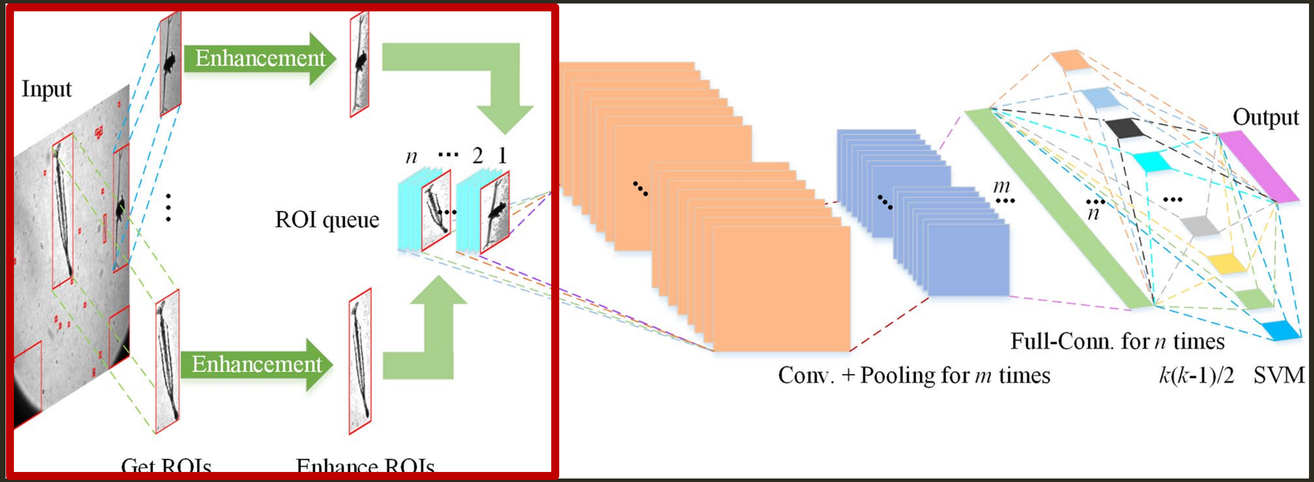
Plankton Monitoring



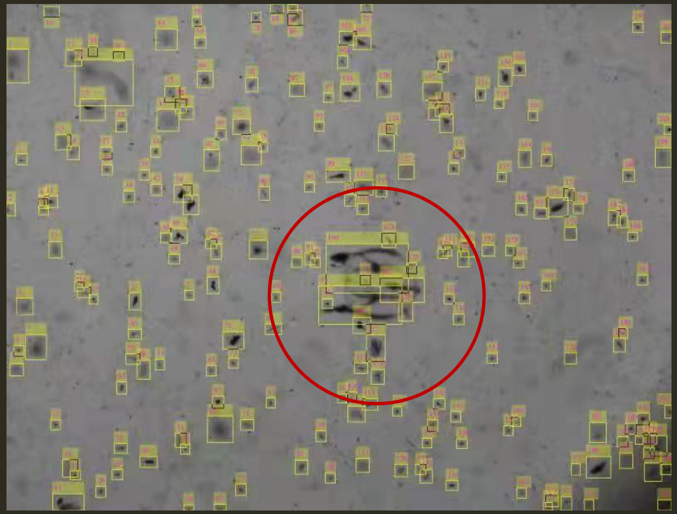




Common deep learning architecture for plankton recognition



Schematic Illustration



Oversegmentation

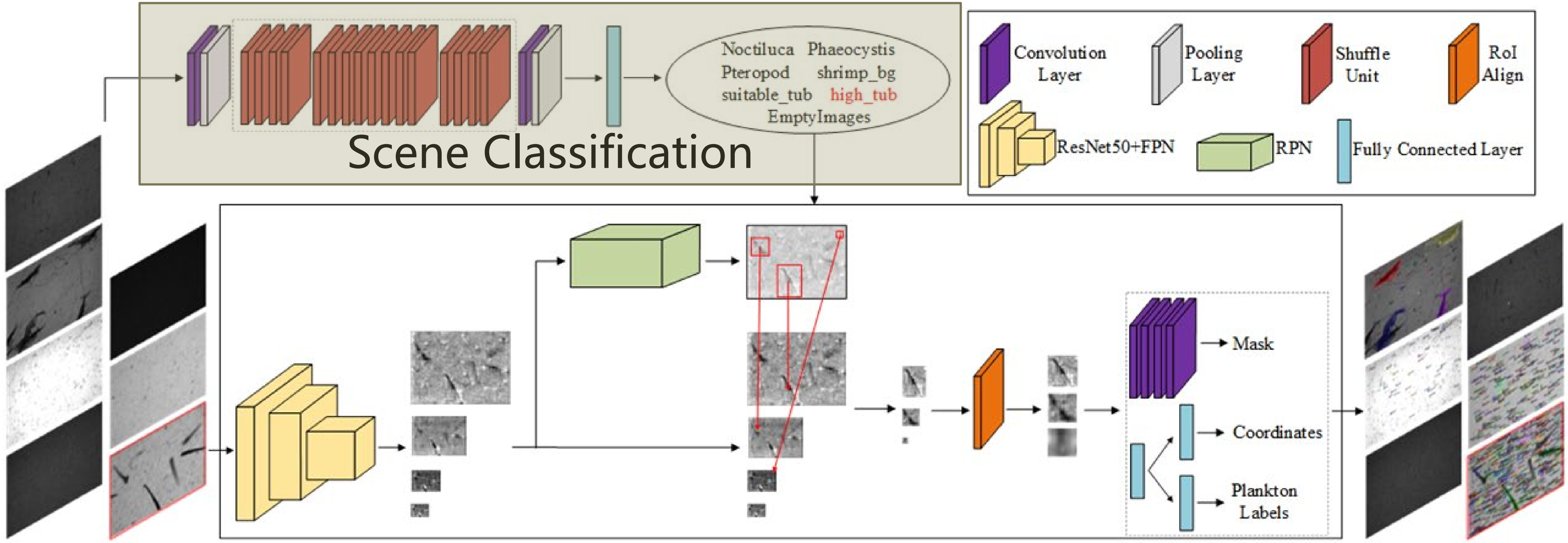
Missing targets

1. Large amounts of suspended particles
2. Marine organisms are patchily distributed
3. Large difference in abundance: copepod abundance high, shrimp abundances low

02

PART TWO

New End-to-End Deep Learning System



NEW APPROACH

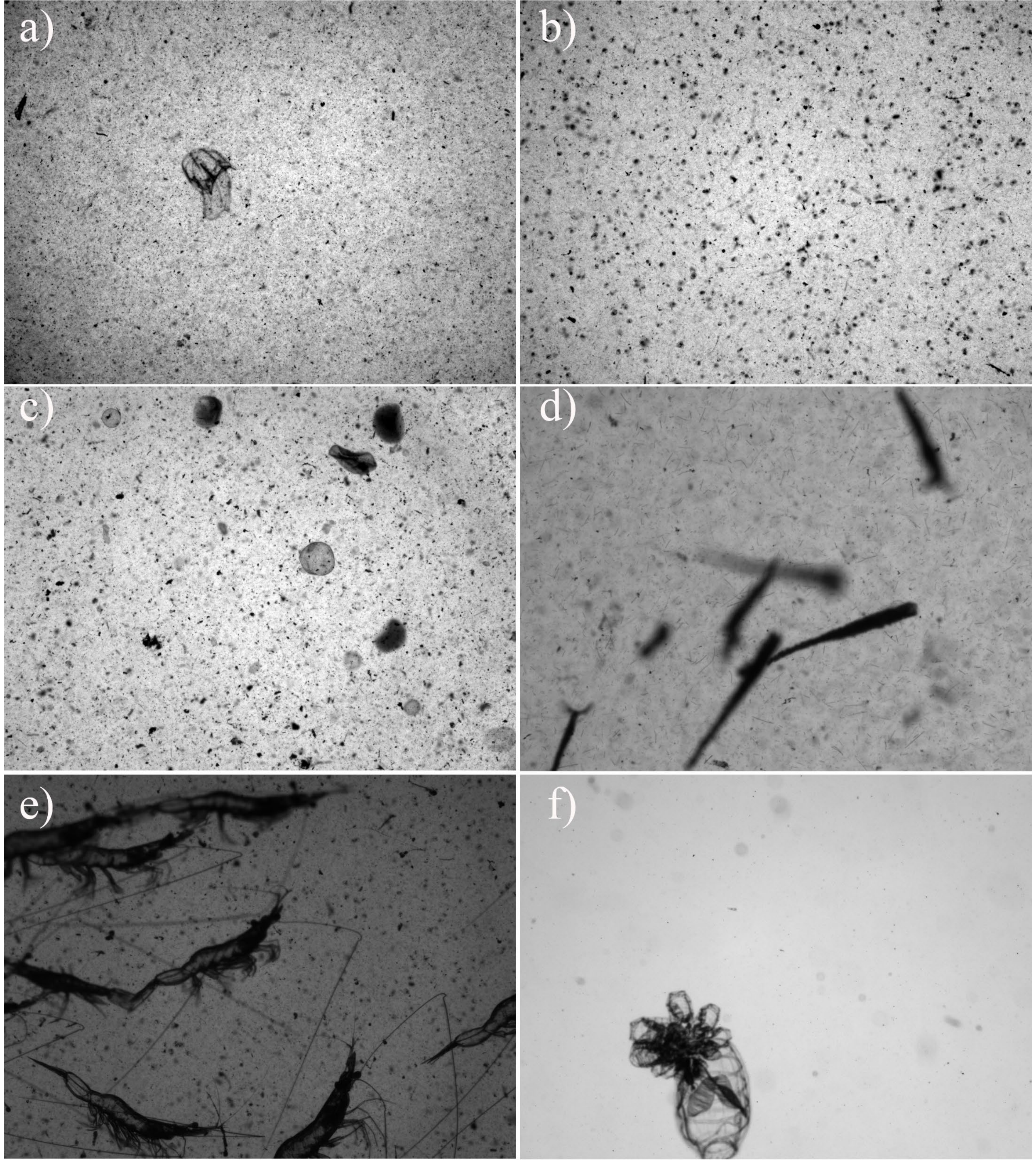
Use a scene classification as a primer, each scene has separate object detection & classification model

1. Different scene reflect image contents and layout
2. Improve the consistency between image and the model

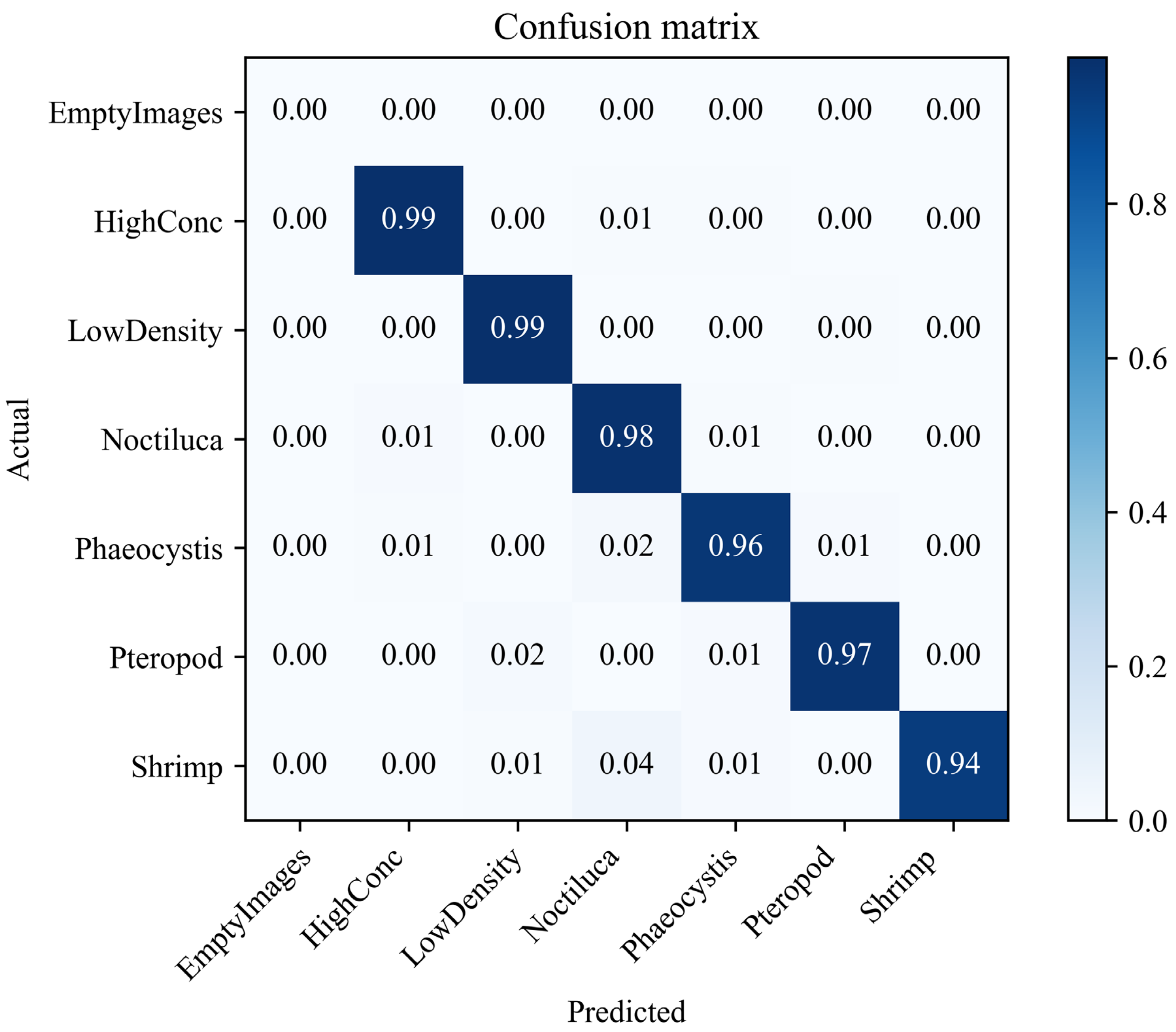
Comparison

1. Full model:
   - Mask R-CNN for all scene together
2. Scene Specific model
   - Separate Mask R-CNN for each scene

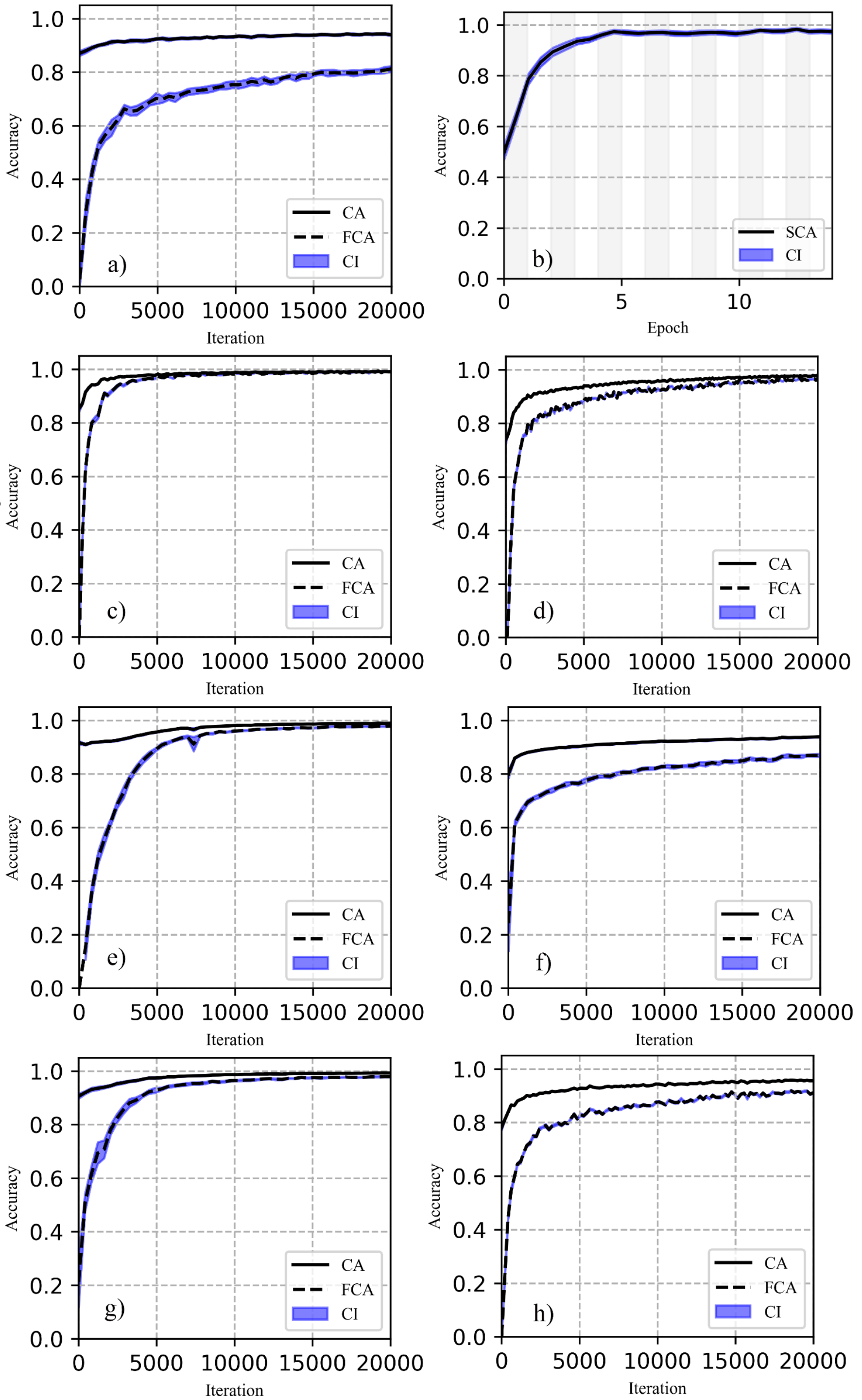
a) High Concentration
b) Nocticula
c) Phaeosystis
d) Petropod
e) Shrimp
f) Low Concentration

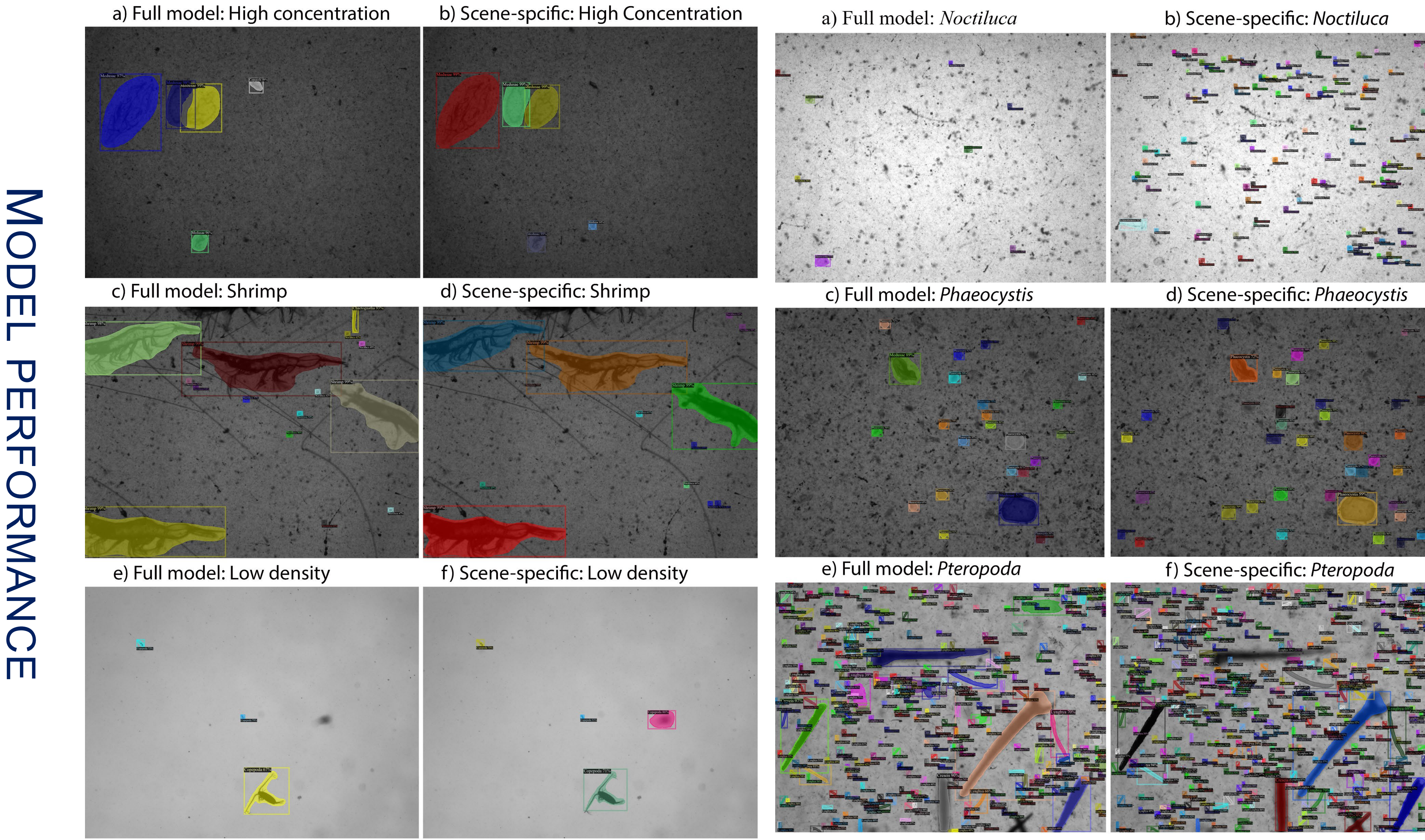


Model performance



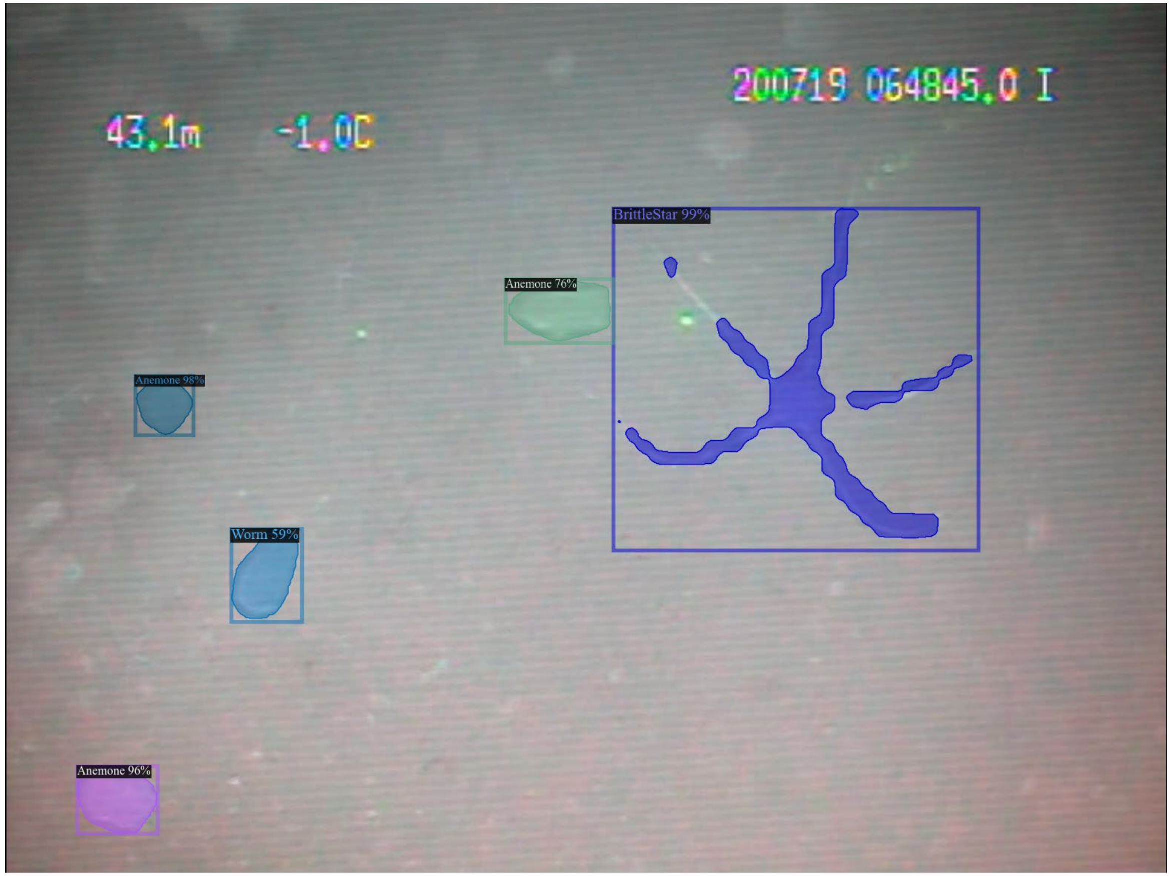
a). Full model
b). scene classif.
c). High conc
d). *Nocticula*
e). *Phaeocystis*
f). Pteropoda
g). Shrimp
h). Low density



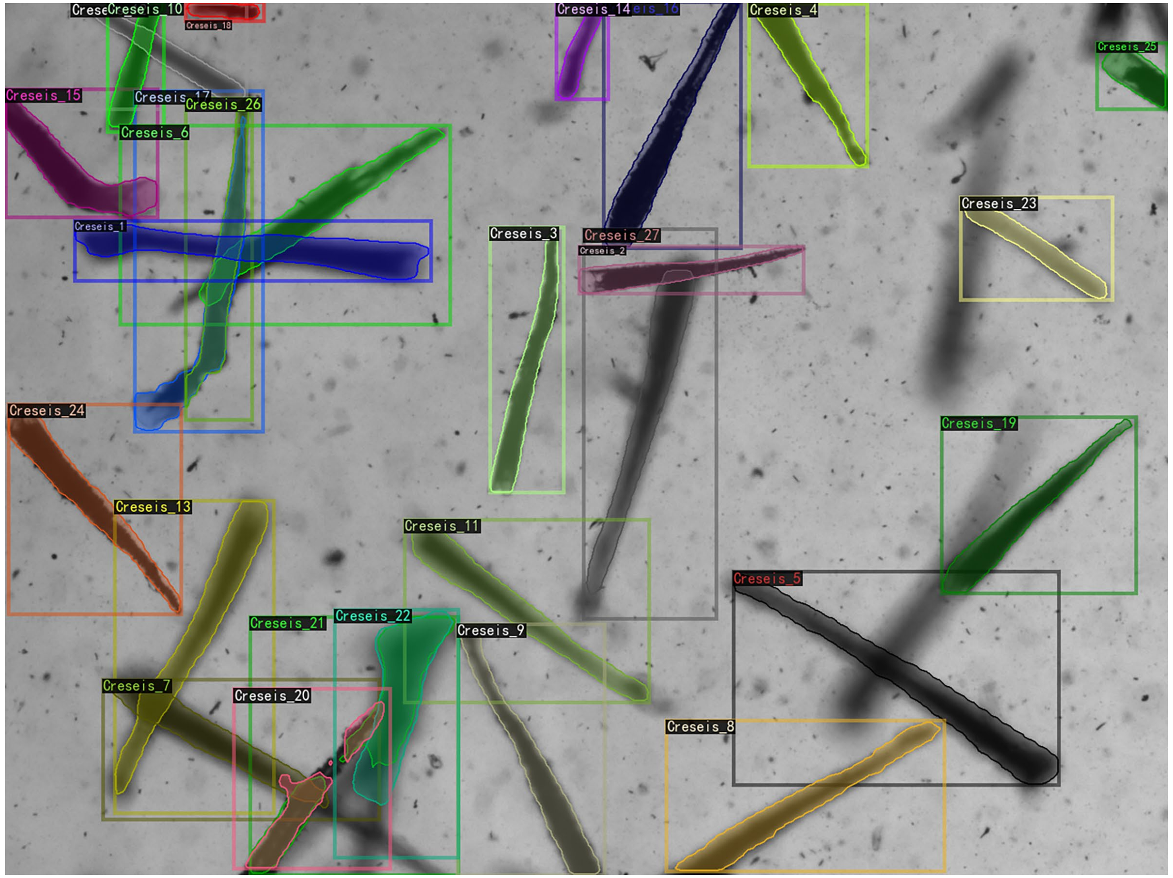


MODEL PERFORMANCE
a) Full model: High concentration
b) Scene-spcific: High Concentration
c) Full model: Shrimp
d) Scene-specific: Shrimp
e) Full model: Low density
f) Scene-specific: Low density
a) Full model: Noctiluca
b) Scene-specific: Noctiluca
c) Full model: Phaeocystis
d) Scene-specific: Phaeocystis
e) Full model: Pteropoda
f) Scene-specific: Pteropoda

OVERCOME OTHER ISSUES



Broken target

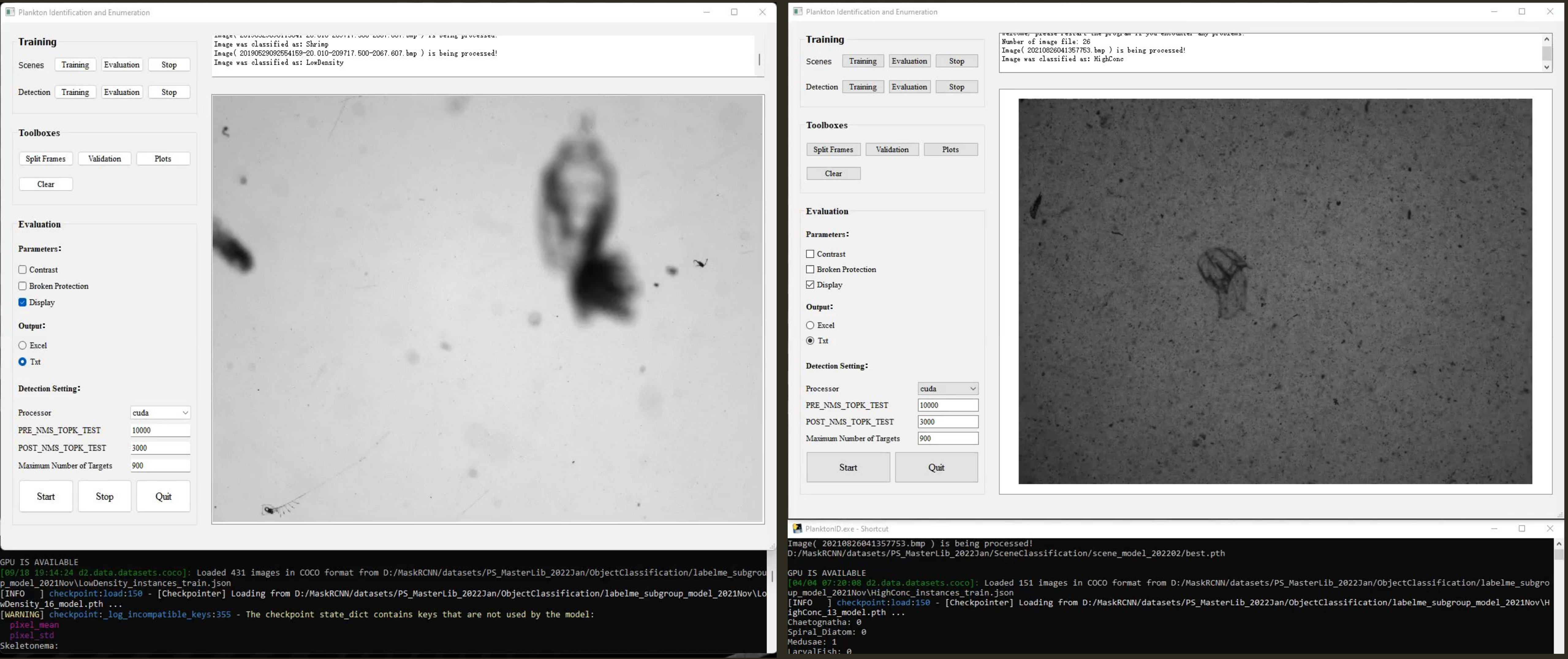


Overlapping targets

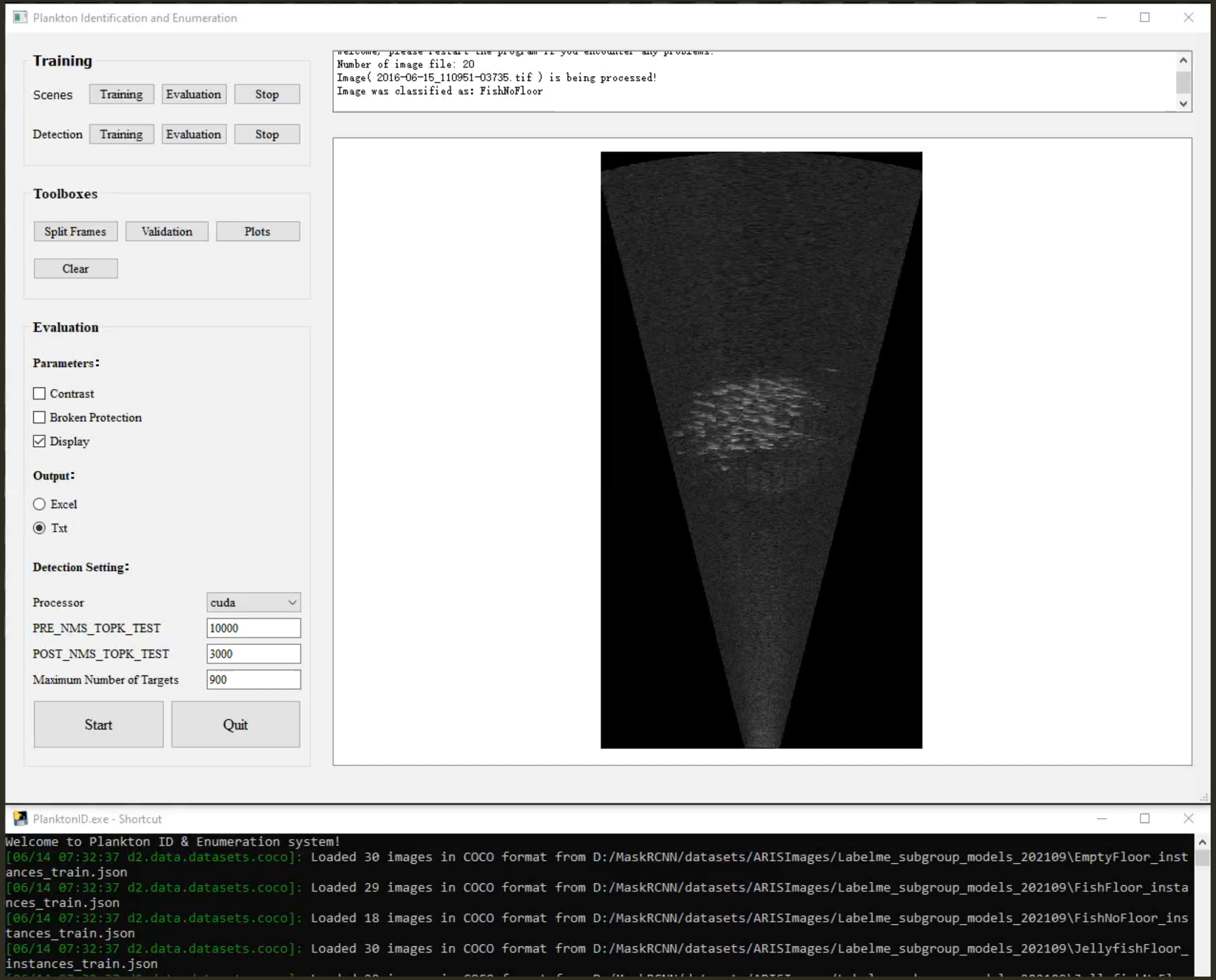
03

PART THREE

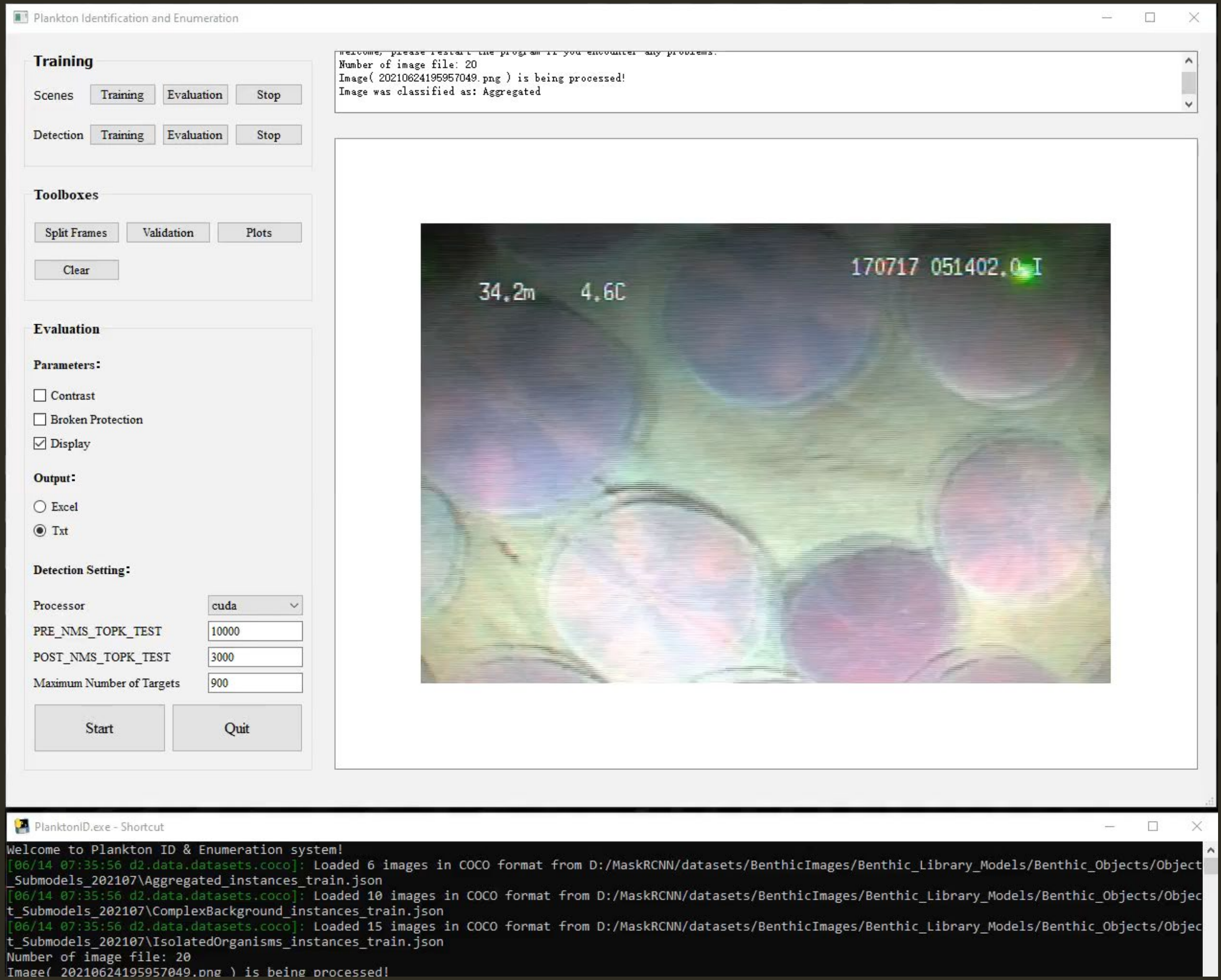
Applications


Plankton Identification and Enumeration
Training
Scenes Training Evaluation Stop
Detection Training Evaluation Stop
Toolboxes
Split Frames Validation Plots
Clear
Evaluation
Parameters:
Contrast
Broken Protection
Display
Output:
Excel
Txt
Detection Setting:
Processor cuda
PRE_NMS_TOPK_TEST 10000
POST_NMS_TOPK_TEST 3000
Maximum Number of Targets 900
Start Stop Quit
Image was classified as: Shrimp
Image(20190529092554159-20.010-209717.500-2067.607.bmp) is being processed!
Image was classified as: LowDensity
GPU IS AVAILABLE
[09/18 19:14:24 d2.data.datasets.coco]: Loaded 431 images in COCO format from D:/MaskRCNN/datasets/PS_MasterLib_2022Jan/ObjectClassification/labelme_subgroup_model_2021Nov\LowDensity_instances_train.json
[INFO] checkpoint:load:150 - [Checkpointer] Loading from D:/MaskRCNN/datasets/PS_MasterLib_2022Jan/ObjectClassification/labelme_subgroup_model_2021Nov\LowDensity_16_model.pth ...
[WARNING] checkpoint:_log_incompatible_keys:355 - The checkpoint state_dict contains keys that are not used by the model:
pixel_mean
pixel_std
Skeletonema:
Plankton Identification and Enumeration
Training
Scenes Training Evaluation Stop
Detection Training Evaluation Stop
Toolboxes
Split Frames Validation Plots
Clear
Evaluation
Parameters:
Contrast
Broken Protection
Display
Output:
Excel
Txt
Detection Setting:
Processor cuda
PRE_NMS_TOPK_TEST 10000
POST_NMS_TOPK_TEST 3000
Maximum Number of Targets 900
Start Quit
Number of image file: 26
Image(20210826041357753.bmp) is being processed!
Image was classified as: HighConc
PlanktonID.exe - Shortcut
Image(20210826041357753.bmp) is being processed!
D:/MaskRCNN/datasets/PS_MasterLib_2022Jan/SceneClassification/scene_model_202202/best.pth
GPU IS AVAILABLE
[04/04 07:20:08 d2.data.datasets.coco]: Loaded 151 images in COCO format from D:/MaskRCNN/datasets/PS_MasterLib_2022Jan/ObjectClassification/labelme_subgroup_model_2021Nov\HighConc_instances_train.json
[INFO] checkpoint:load:150 - [Checkpointer] Loading from D:/MaskRCNN/datasets/PS_MasterLib_2022Jan/ObjectClassification/labelme_subgroup_model_2021Nov\HighConc_13_model.pth ...
Chaetognatha: 0
Spiral_Diatom: 0
Medusae: 1
LarvalFish: 0

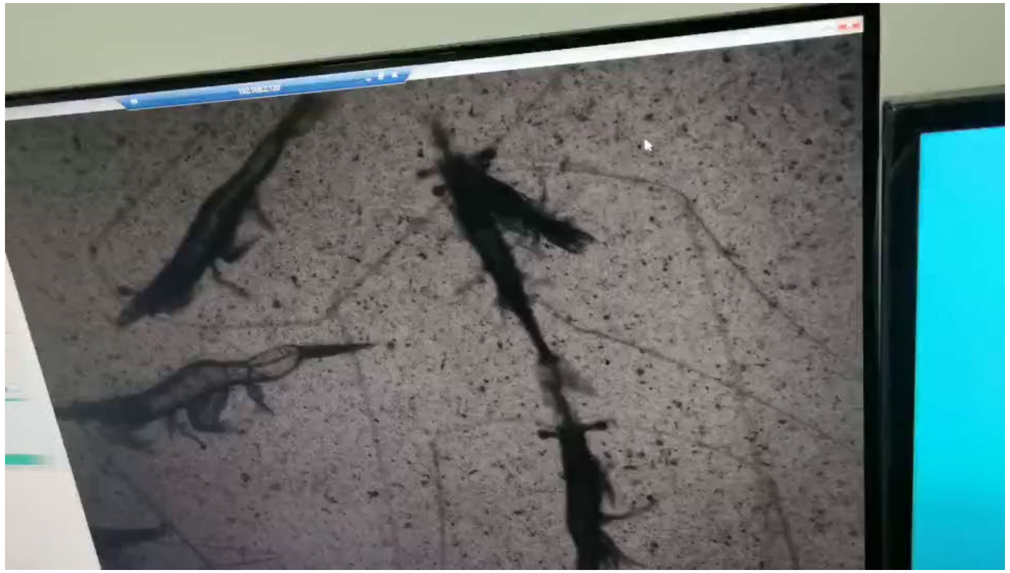
Sonar image processing

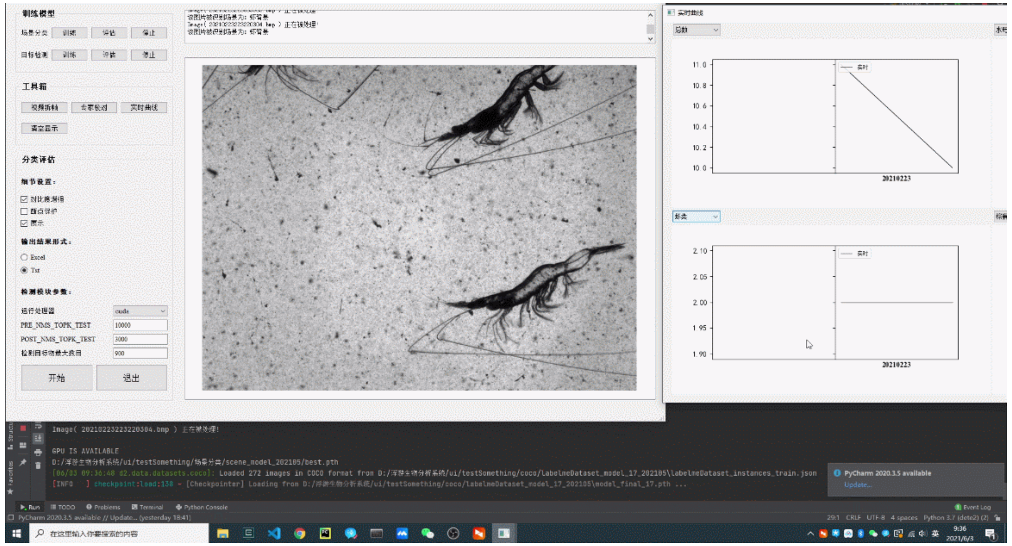


Benthic image processing

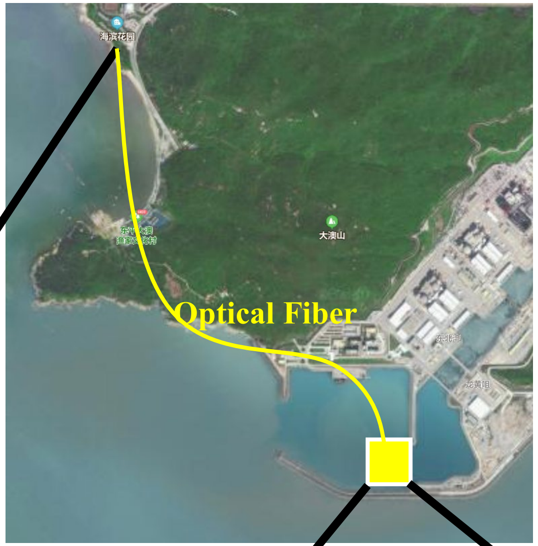


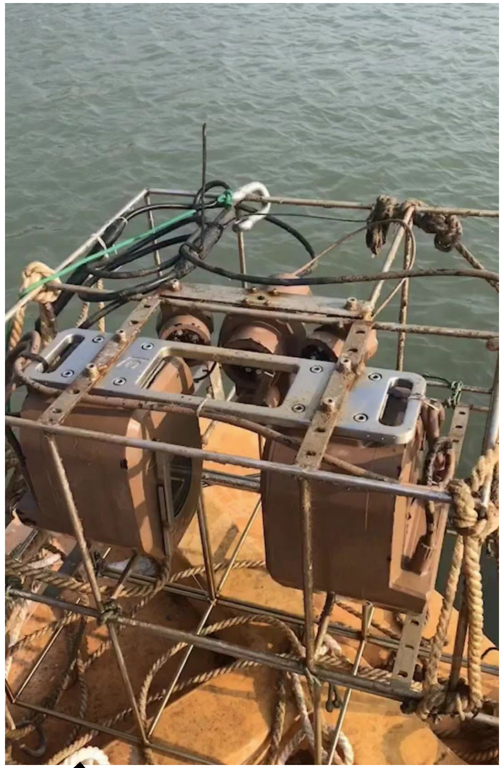
POWERPLANT COOLING WATER INTAKE

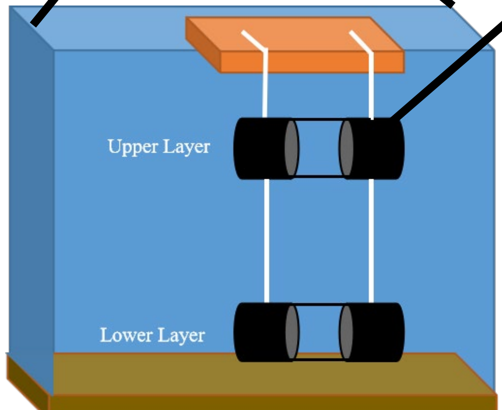




Data Center



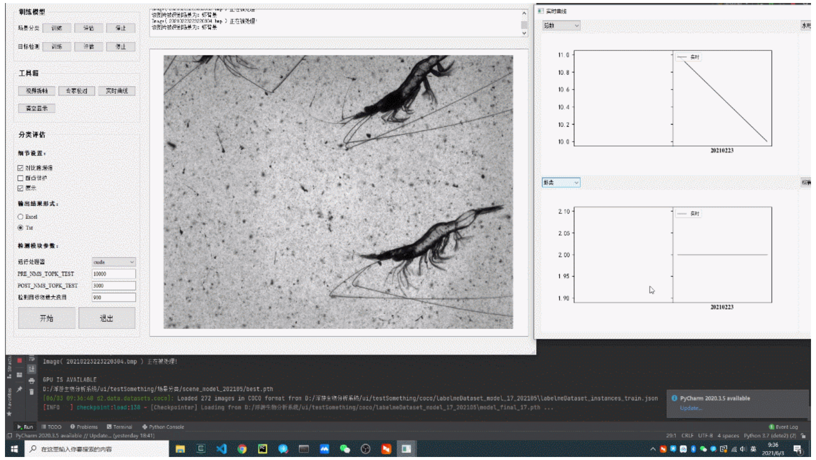




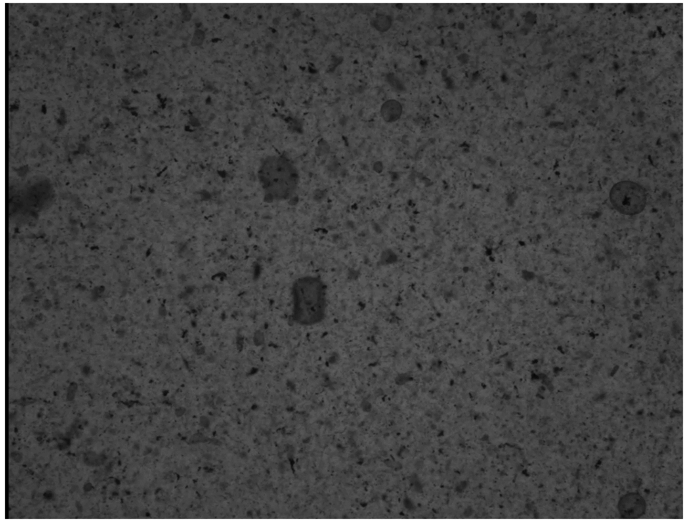
1. Upper for meduase
2. Lower for mysid shrimps

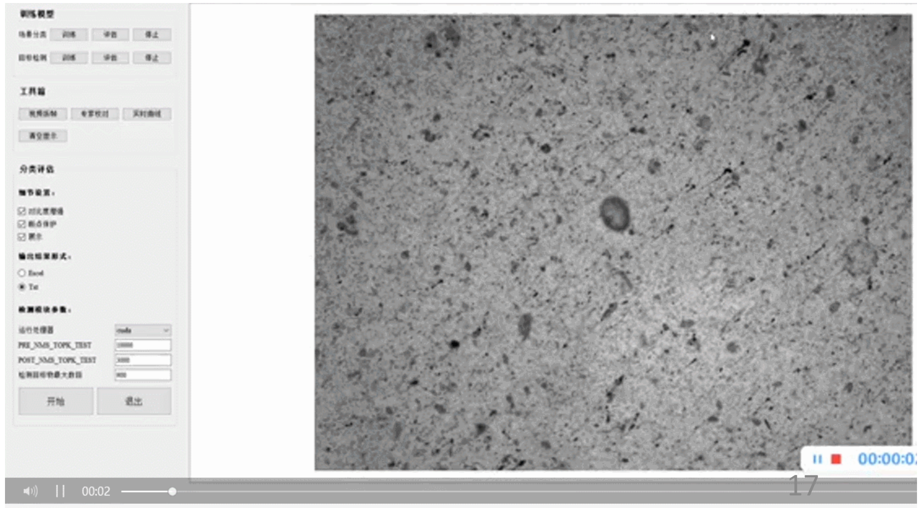
In Situ Plankton Monitoring

Mysid shrimp



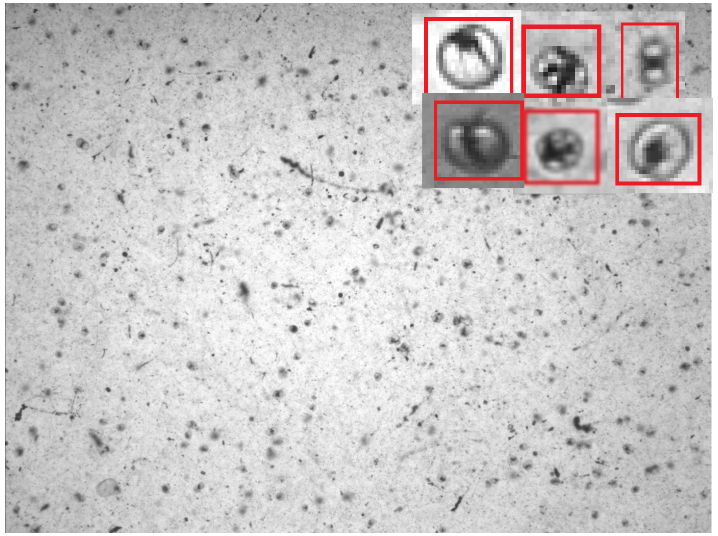
Phaeocystis



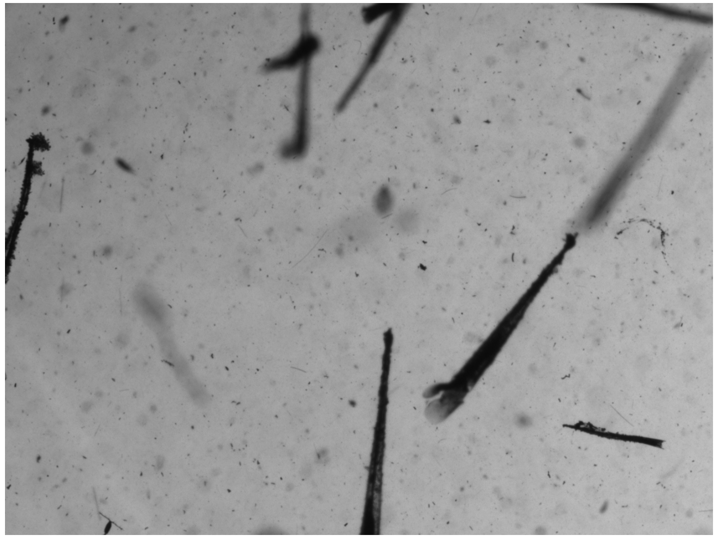


Other blooms

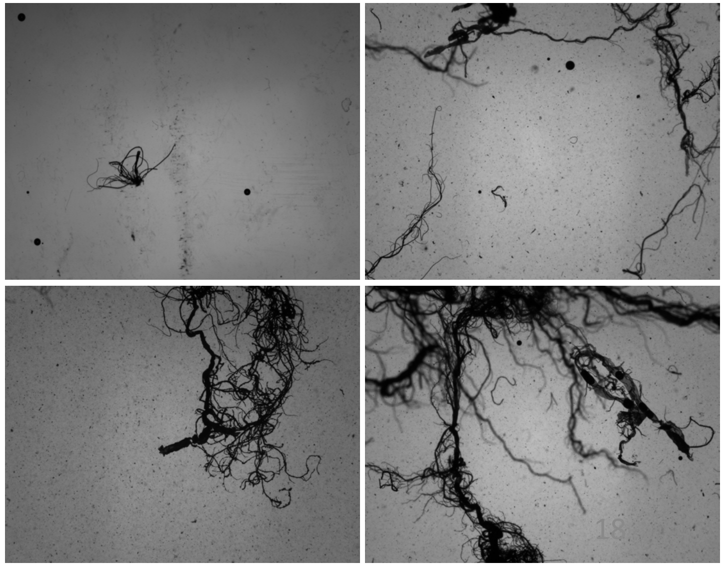
- Noctiluca



- Creseis



- Enteromorpha



CONCLUSIONS

- Plankton imaging systems readily available for monitoring work
- Deep learning systems make near real time image processing feasible
- Real time monitoring for plankton blooms or swarms is possible
- Imaging systems are useful tools for ecological process studies and ecosystem-based management