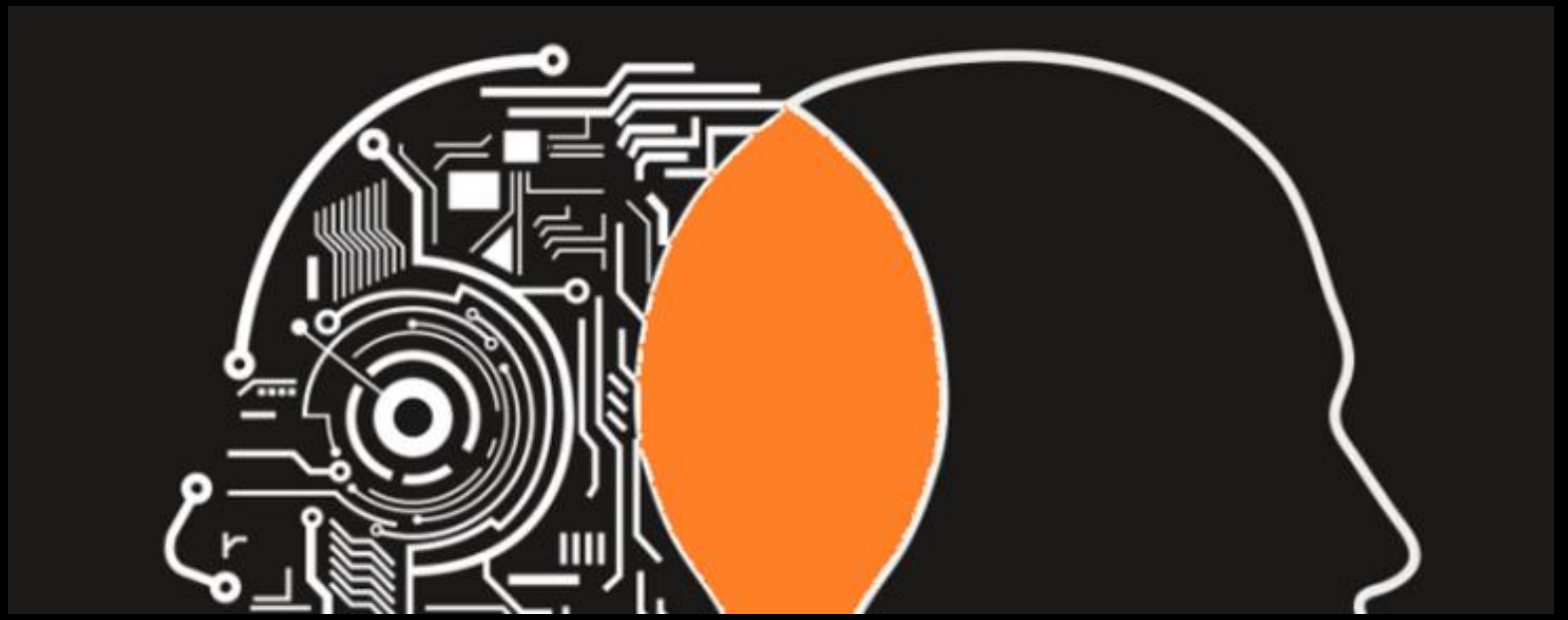
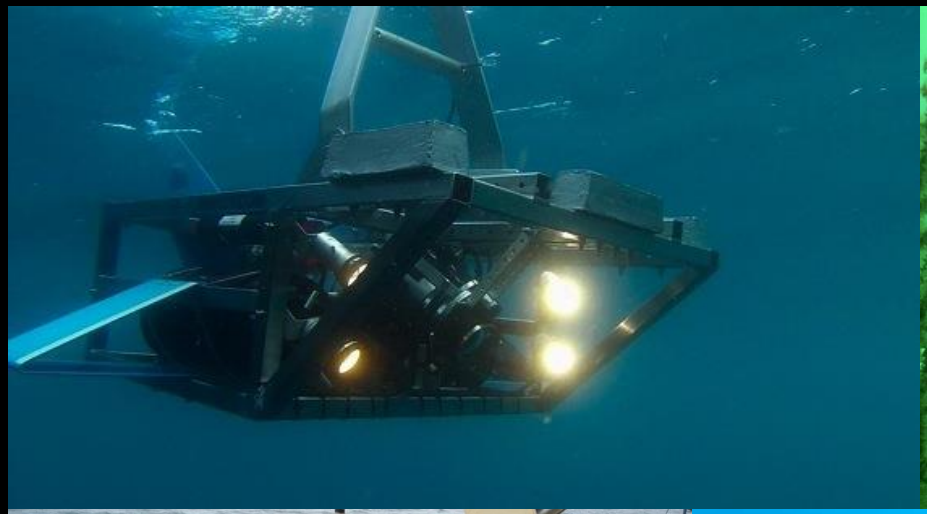
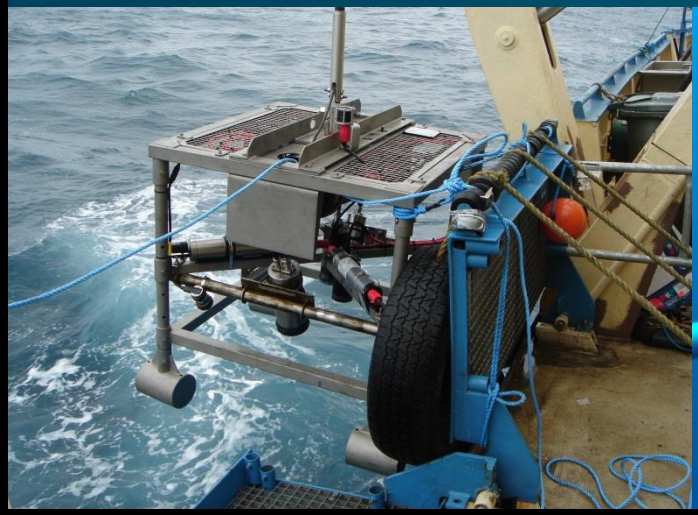
Challenges and progress in the application of artificial intelligence to marine survey and monitoring



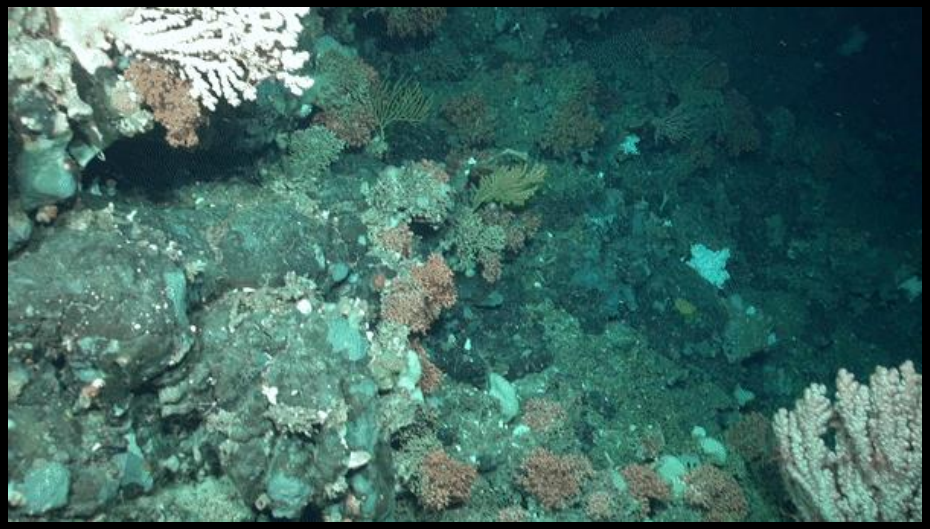
AI working group of the Big Picture Consortium

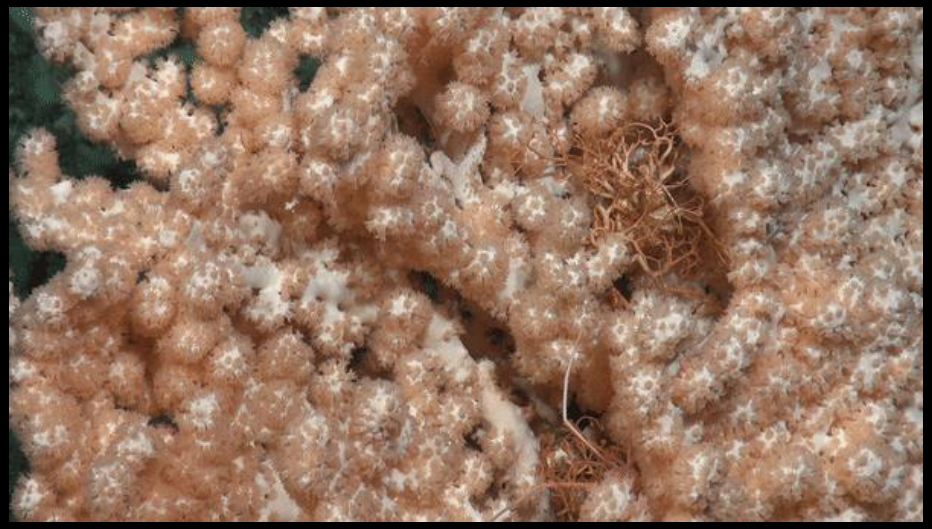
Use of cameras has seen rapid growth over the last 20 years



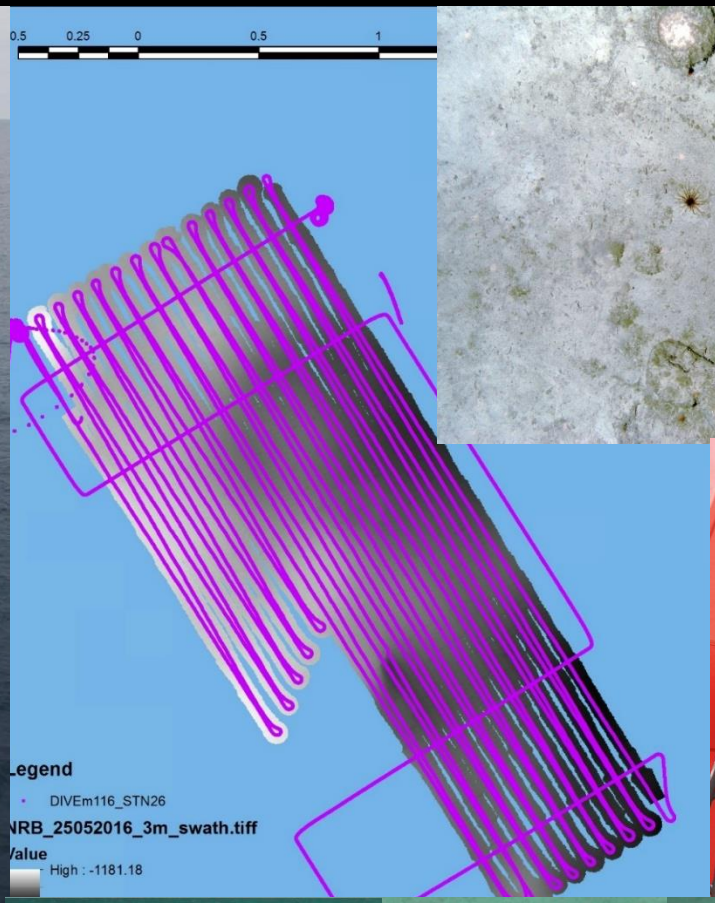


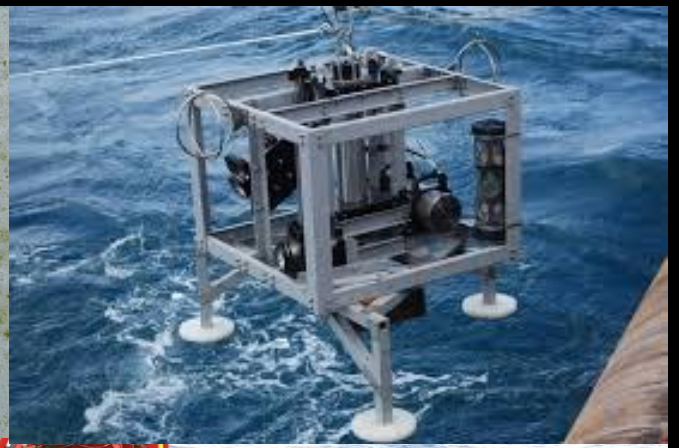
Cameras have revolutionised marine ecology



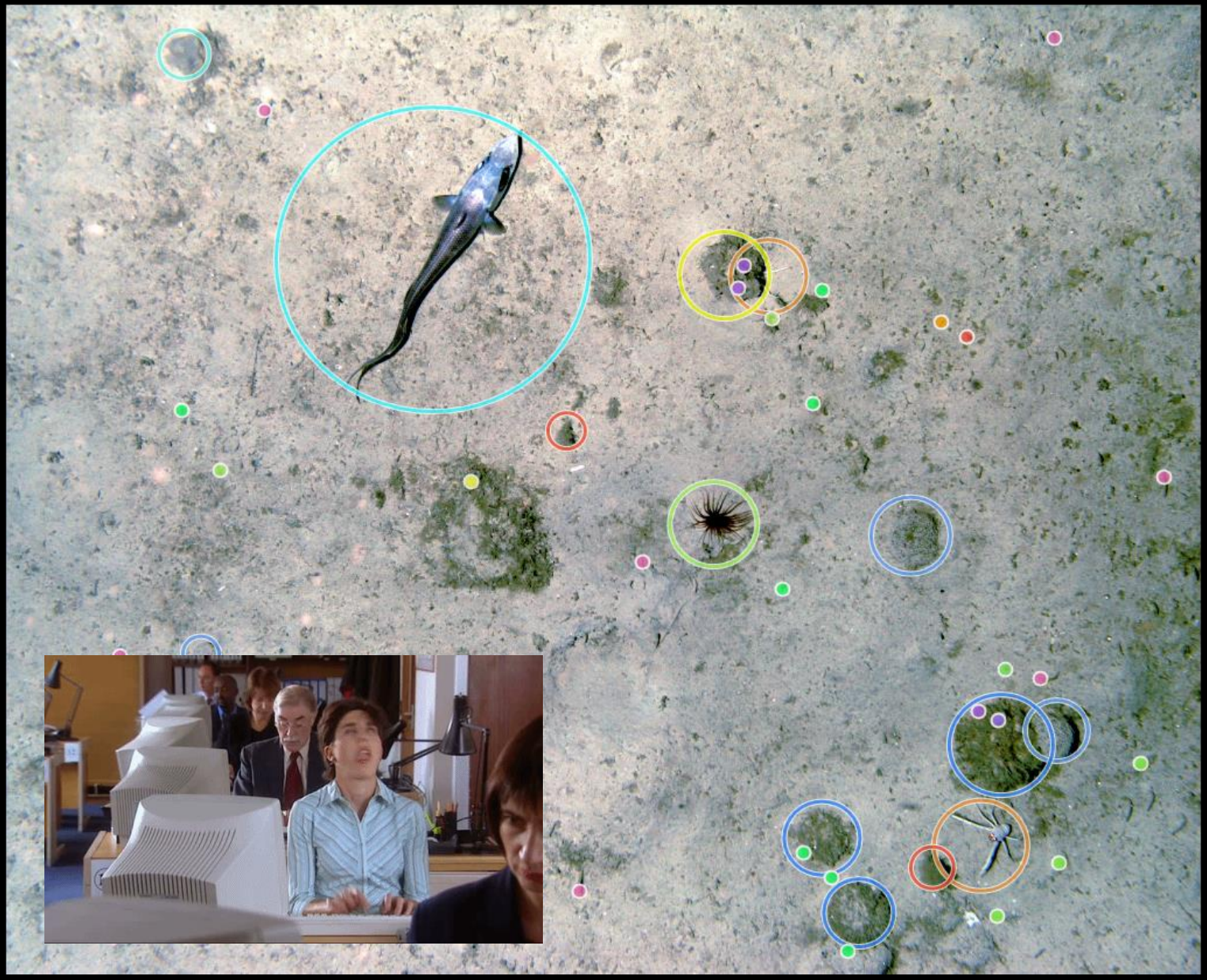


New technology producing vast datasets





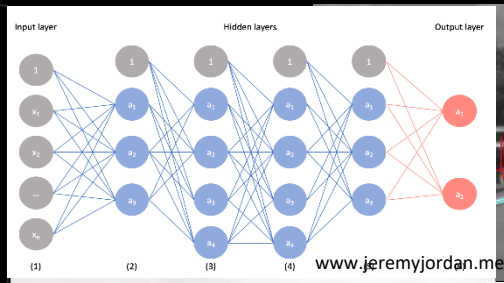
Big Data!

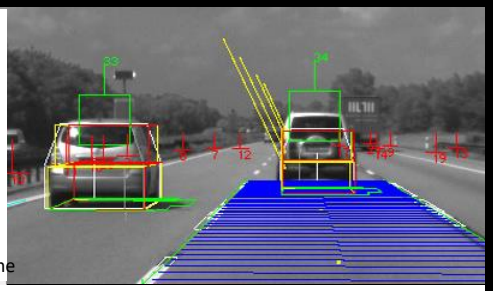


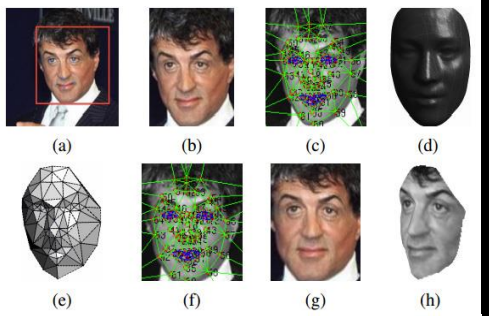
Computer Vision and AI

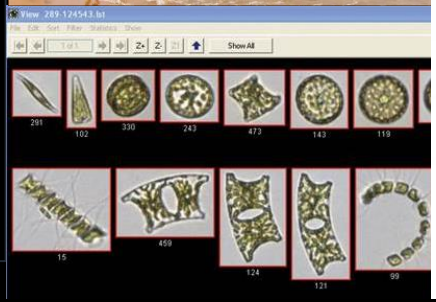
AI/Machine learning/ Neural Networks /deep-learning = Computer Vision

- Created for other applications
- **Examples of applications in ecology and taxonomy**
- Now many open source tools available
- Becoming “Easy” to use



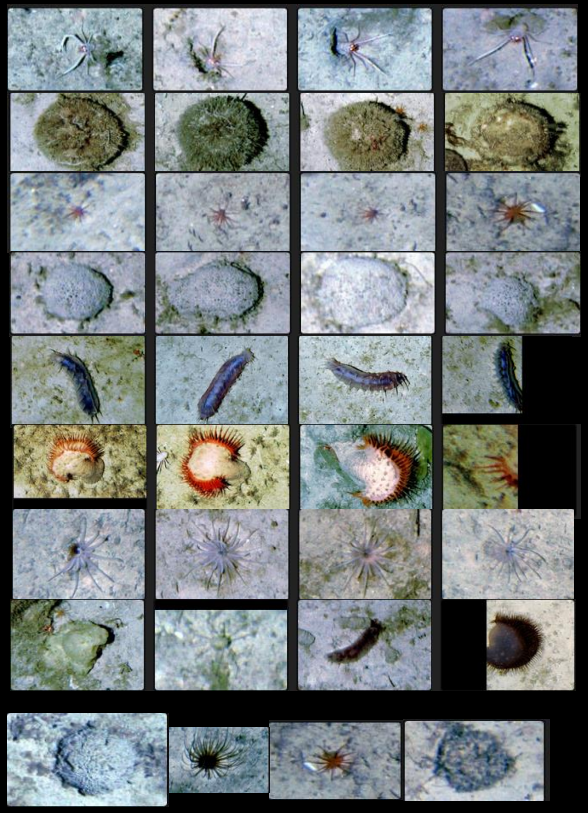


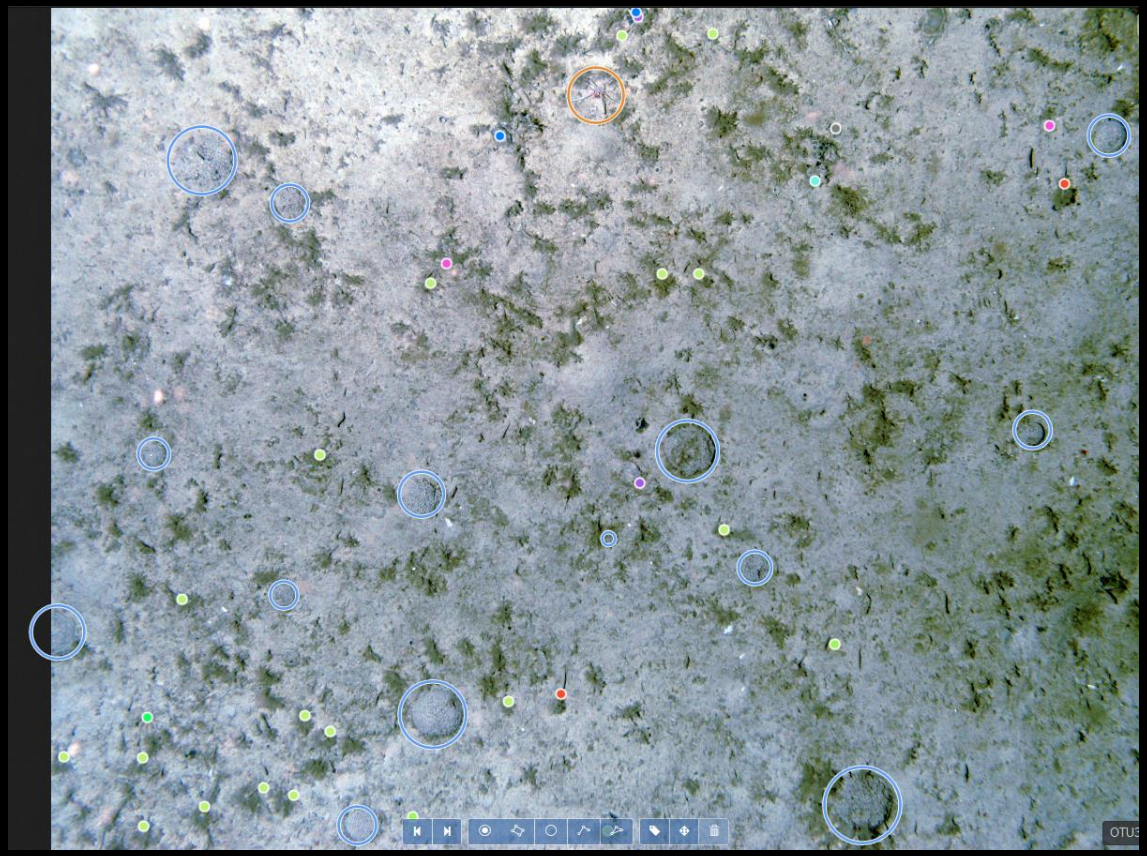


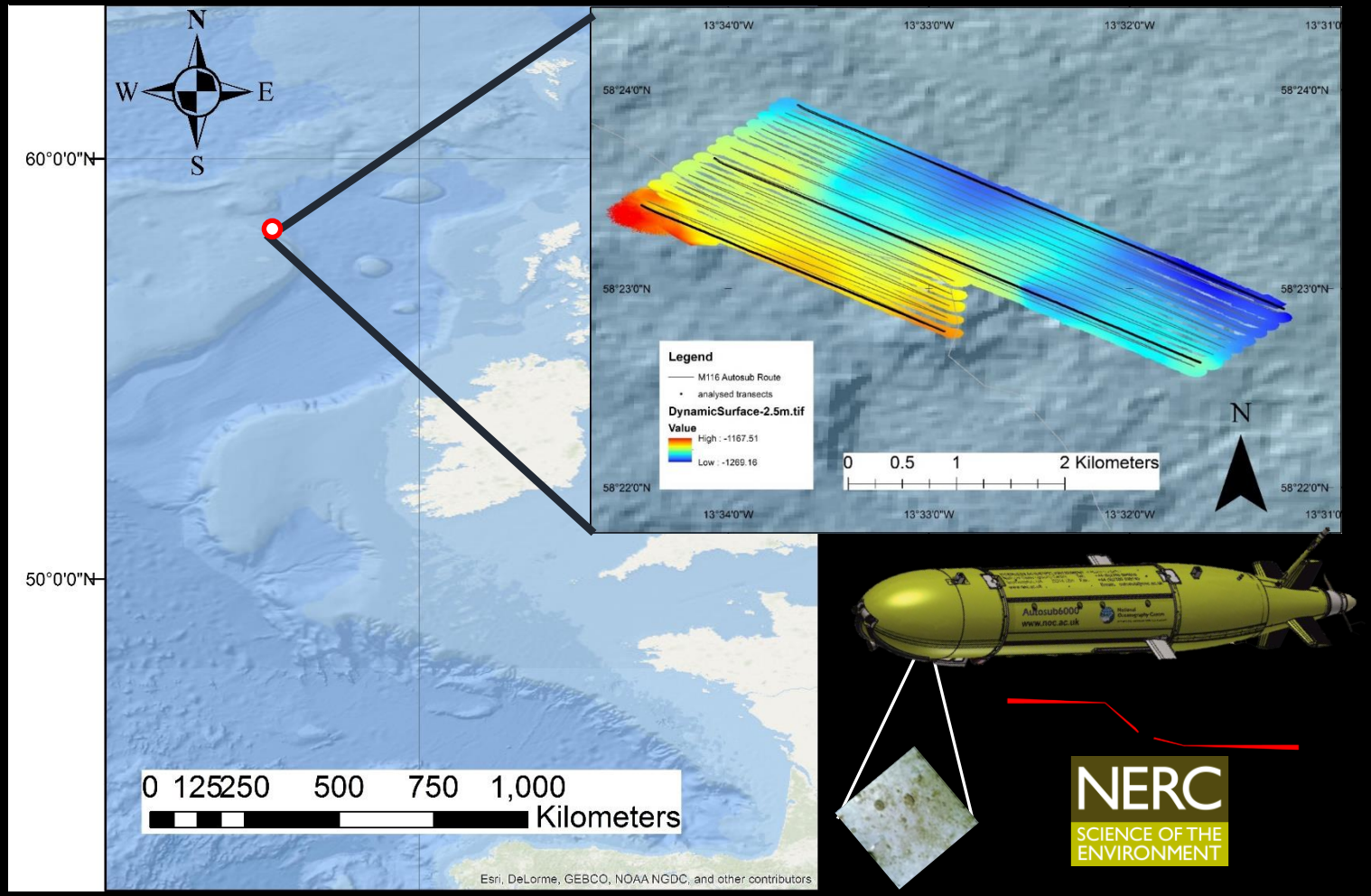


TensorFlow · Keras · Caffe2 · PYTORCH · Deep Cognition · YOLO

Use of artificial intelligence to interpret ‘big data’ is in development.







- DeepLink - JC136 (2016) on RRS James Cook
- 80 km line within a 1.5 x 3.5 km box by the AUV Autosub
- 1200m deep Soft sediments only
- 60000 images taken vertically below the AUV
- Annotated 1 transect (1700 photos)

NERC SCIENCE OF THE ENVIRONMENT

UK's National AUV Autosub6000

Piechaud, N., Hunt, C., Culverhouse, P.F., Foster, N.L. and Howell, K.L., 2019. Automated identification of benthic epifauna with computer vision. *Marine Ecology Progress Series*, *615*, pp.15-30.

UNIVERSITY OF PLYMOUTH
Faculty of Science and Engineering

Scottish Government
Riaghaltas na h-Alba
gov.scot

Automated Identification of Fish and Other Aquatic Life in Underwater Video

Scottish Marine and Freshwater Science Vol 11 No 18

S Blowers, J Evans and K McNally

marinescotland

Case studies on fish and benthic fauna detection and identification under different circumstances.

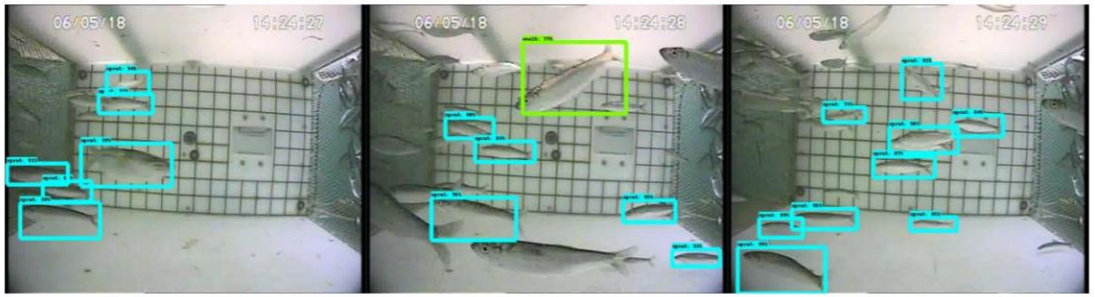


Figure 12: Fish detections in Video 6 with only sprats present using the RFCN model. Detections classed as sprats are shown in blue boxes, whereas detections classed as smolts are highlighted in green. It can be seen that the number of fish present in the video makes accurate counting and tracking very difficult.

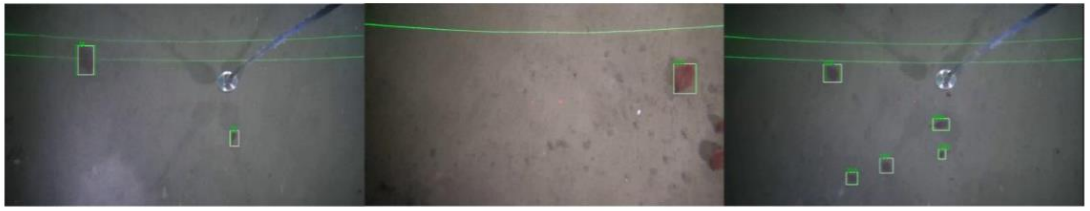
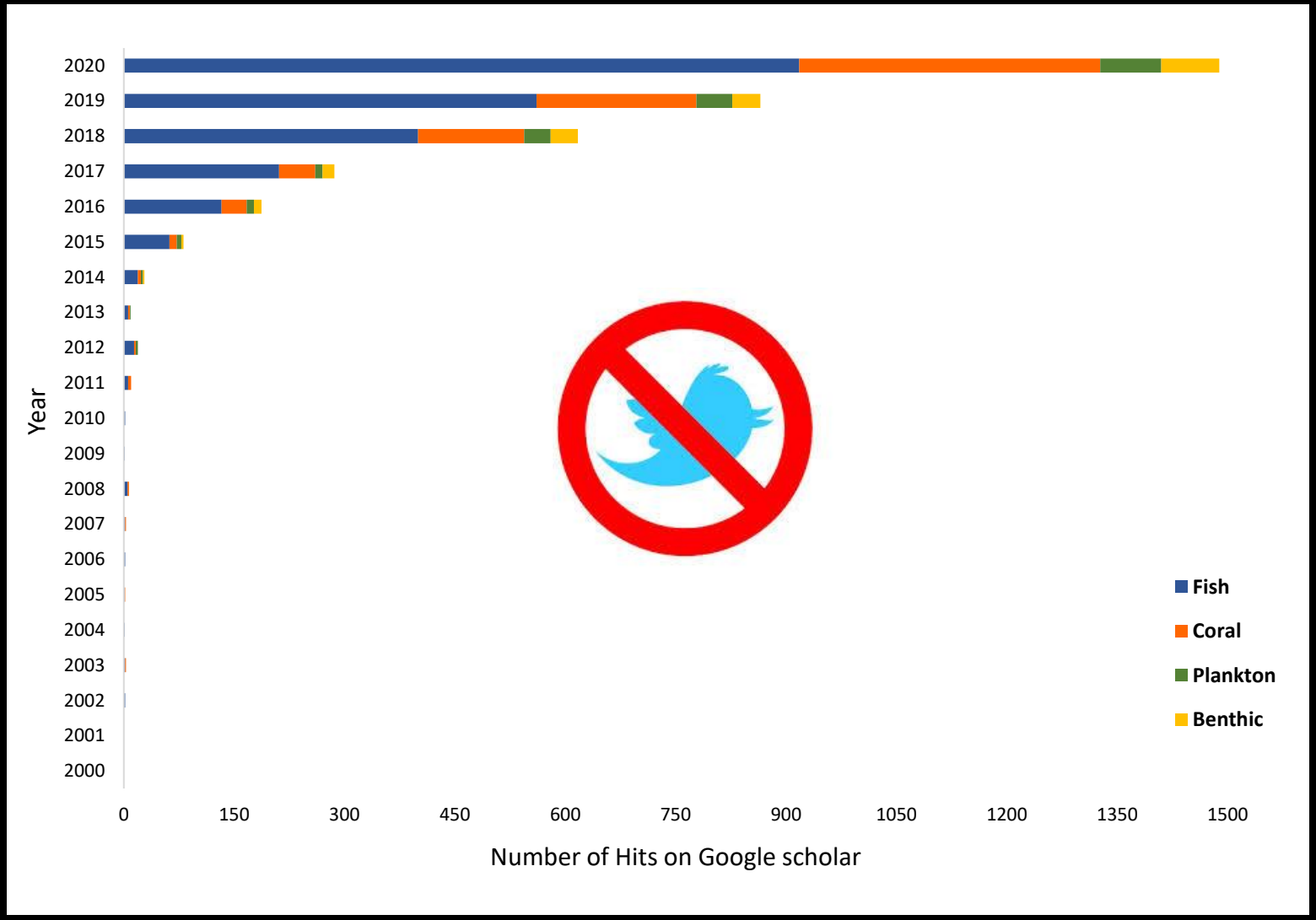


Figure 14: Sea pen detections in Video S using the RFCN model. Detections from this CNN are shown as green boxes. The white boxes are from the DeepSORT tracking algorithm. The green number refers to the DeepSORT identification given to the tracked instance and does not necessarily reflect the count of instances.

Number of publications on Google Scholar using search terms “CNN”, “object detection” classification”, and “*benthic*” or “*coral*” or “*plankton*” or “*fish*”, where this is used as an indicator of the boom in using CNNs for such tasks amongst the major marine ecology fields.



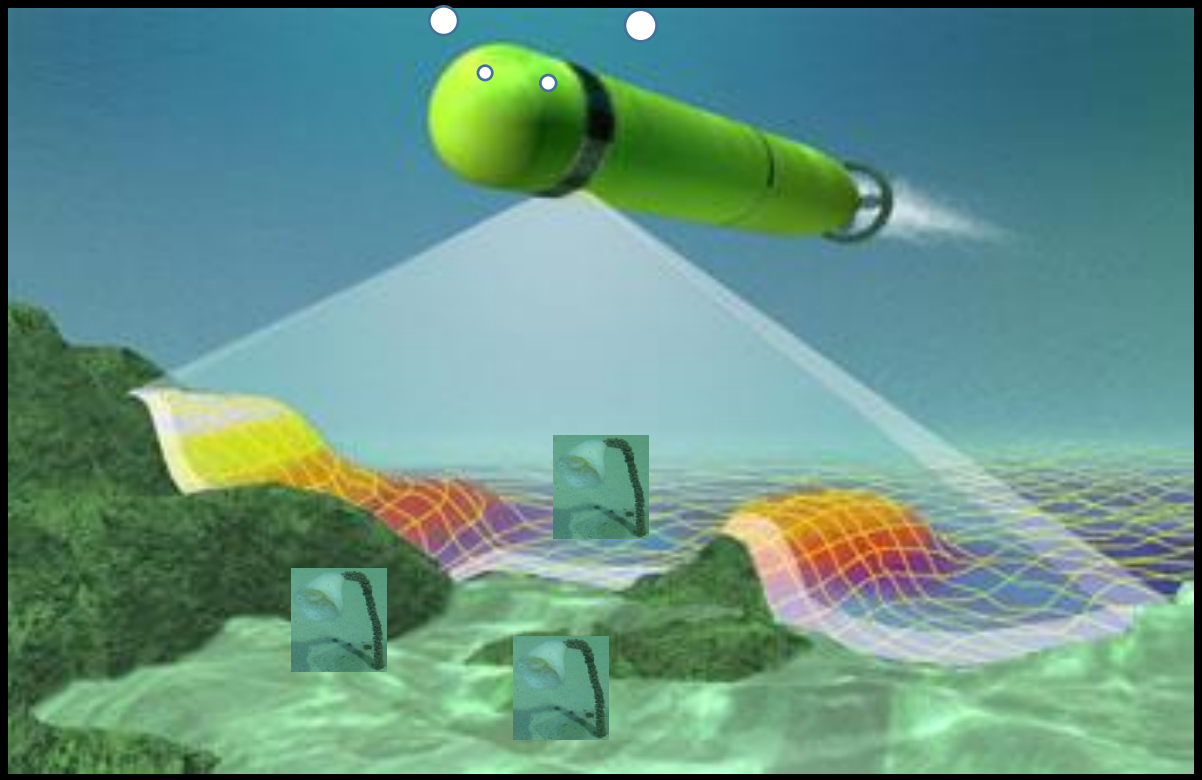
Erin Brown

Challenges

1. Workflows are complex and poorly integrated from data collection through to data archiving.
2. Tools available still require a good level of programming knowledge and are challenging for ecologists to work with.
3. Research needed on best ways to apply this technology (for example use of daisy chained / nested models, how / whether to group taxa)
4. Possible need to further develop tools.
5. Standards and protocols in testing model performance need to be established.
6. Appropriate training datasets are required – annotated images and video.
7. Lack of standardisation in taxon identification / classification between reference datasets that could be used to train CV algorithms – SMarTaR-ID
8. Lack of training materials to ensure more and better quality data.

Depth 700m, temperature 7°C, salinity 34‰

Hyalonema sp. x3



This opens up a world of possibilities!

Thank you for your attention