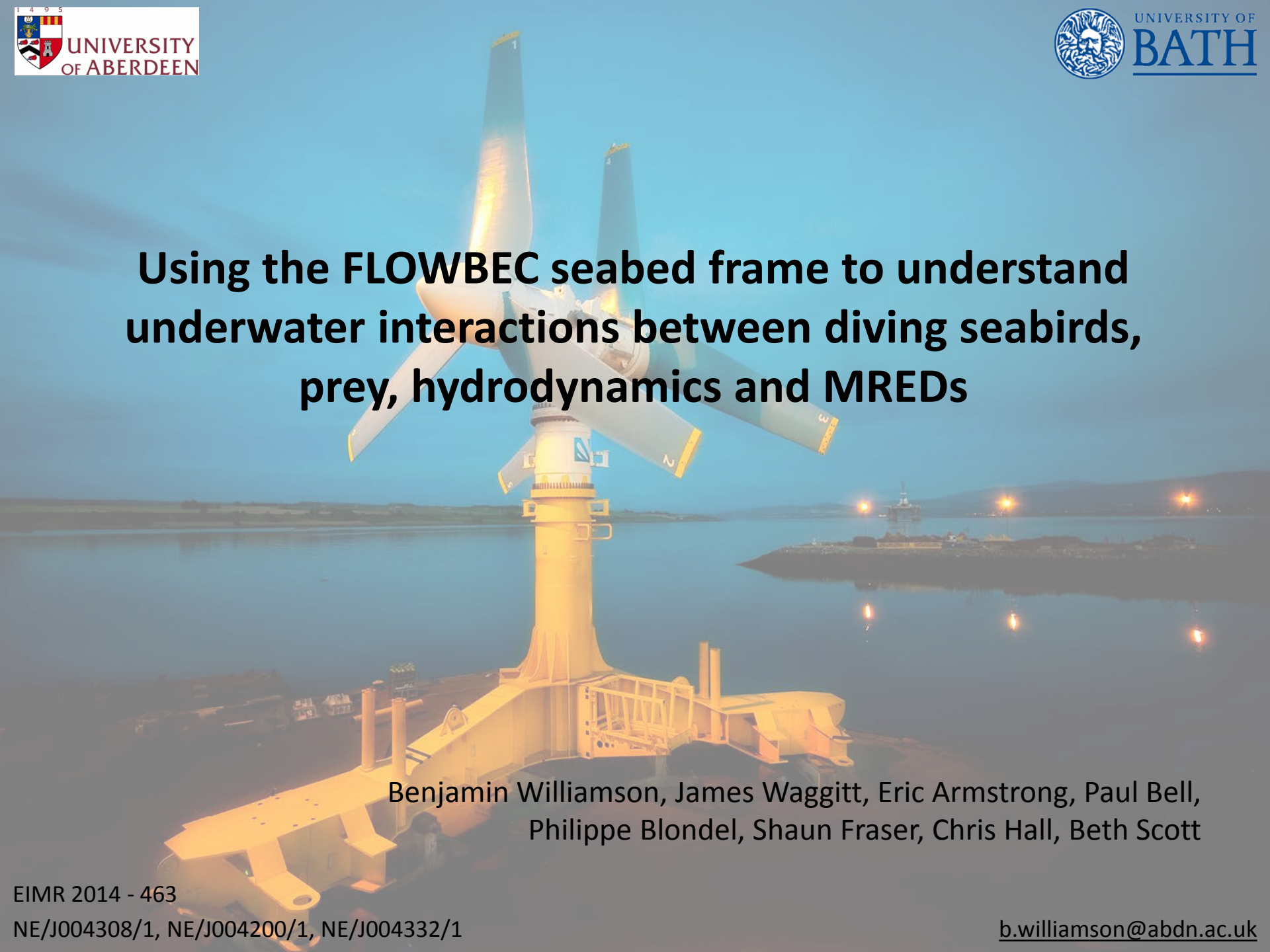

Using the FLOWBEC seabed frame to understand underwater interactions between diving seabirds, prey, hydrodynamics and MREDs

Benjamin Williamson, James Waggitt, Eric Armstrong, Paul Bell, Philippe Blondel, Shaun Fraser, Chris Hall, Beth Scott

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NE/J004308/1, NE/J004200/1, NE/J004332/1

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FLOWBEC upward facing sonar platform

- **Entire water column** (plankton, fish, seabirds, marine mammals)
- Captures **movement, behaviour and interactions** with MREDs
- Self-contained, portable between sites
- Continuously samples spring/neap 2-week period
- Complemented by concurrent:
  - hydrodynamic model data
  - above water radar and bird observations
- **Field proven**: 5 × 2-week deployments at EMEC, Orkney, UK

FLOWBEC upward facing sonar platform

Simrad EK60 echosounder (38, 120, 200 kHz)

- bird and fish abundance, school behaviour
- multi-frequency target identification
- morphology of turbulence, plankton

Imagenex multibeam sonar (260 kHz)

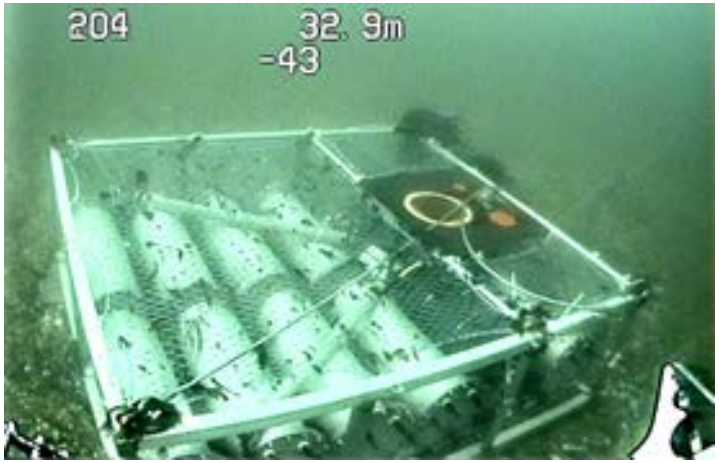
- interactions of fish, diving seabirds, marine mammals with MREDs
- target tracking, avoidance behaviour

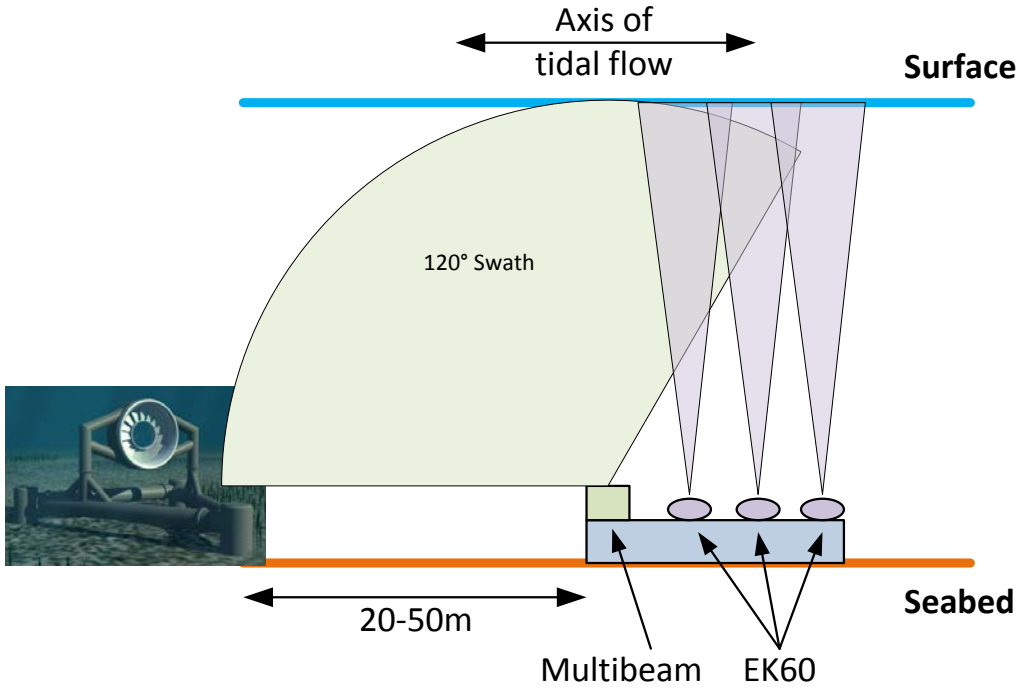
ADV

- current, temperature, depth

Fluorometer

- chlorophyll (phytoplankton)

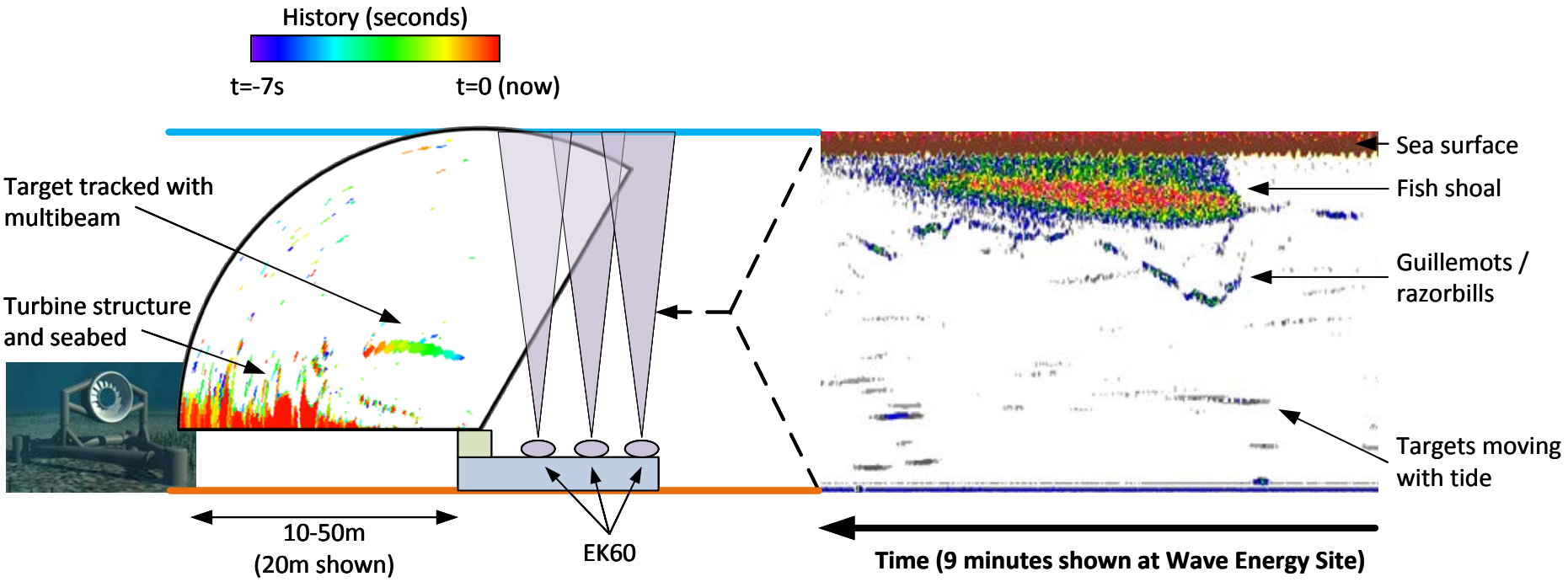




FLOWBEC upward facing sonar platform

Multibeam for target tracking

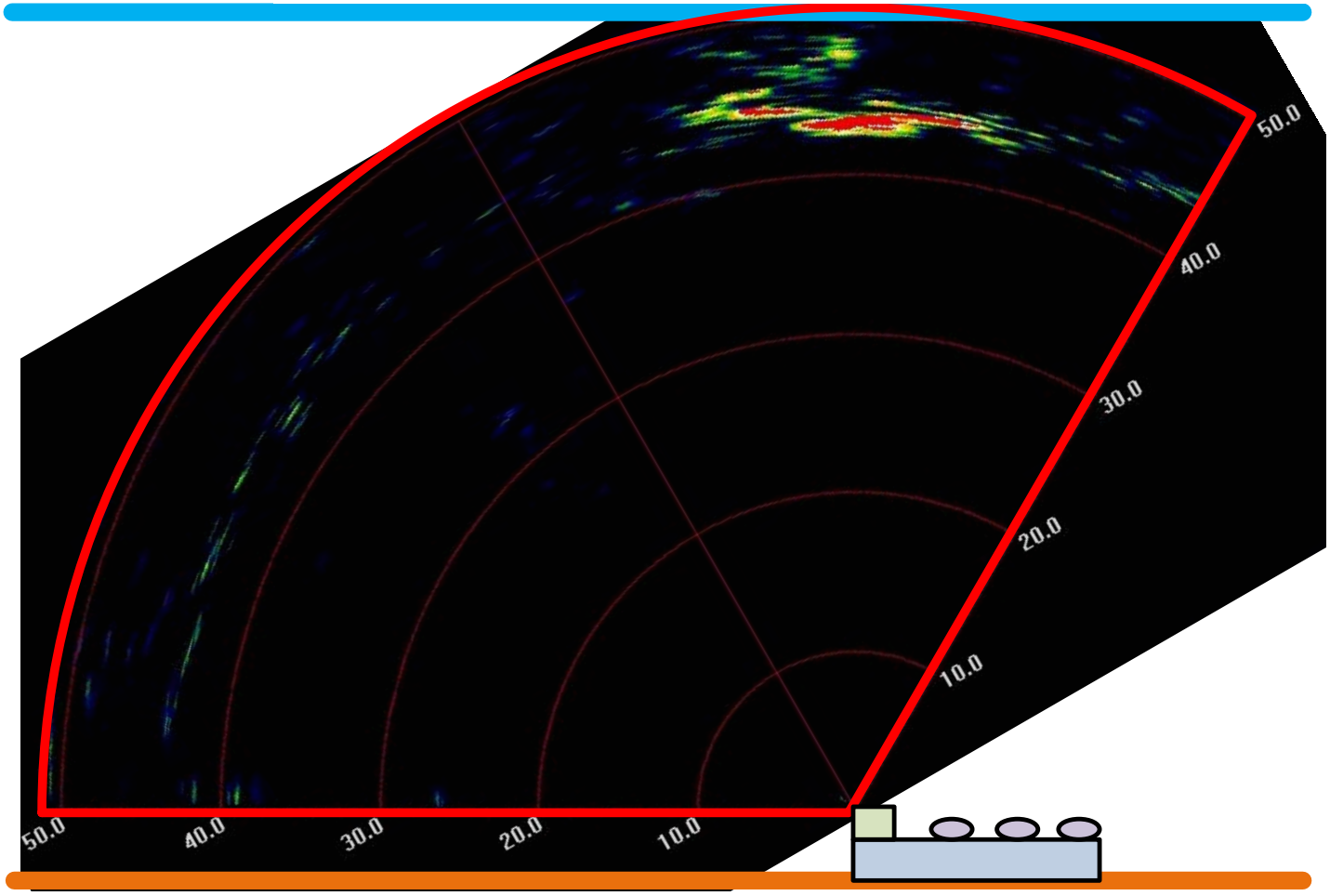
EK60 for multifrequency ID



Acoustic classification ground truthed by shore observations

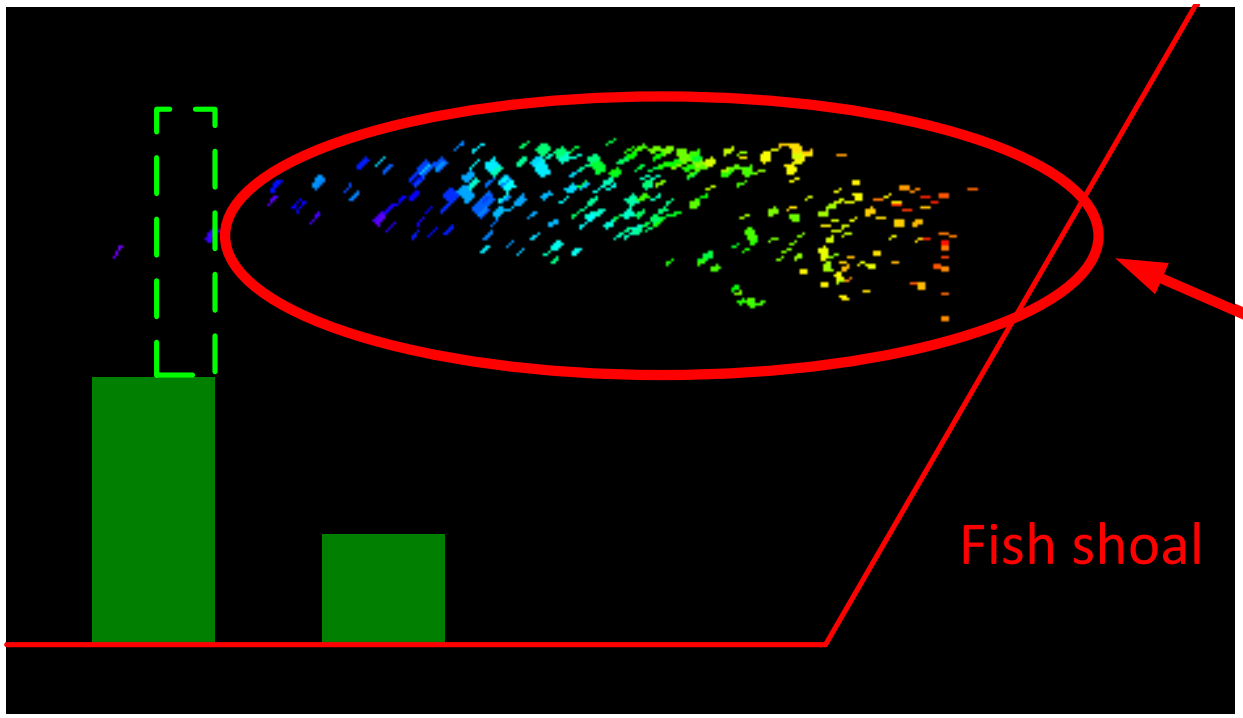
FLOWBEC first analyses

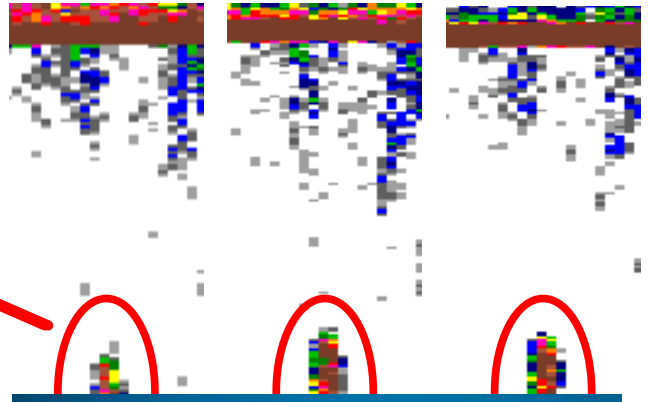
Multibeam tracking of diving guillemots/razorbills feeding beneath a fish shoal at a wave energy site

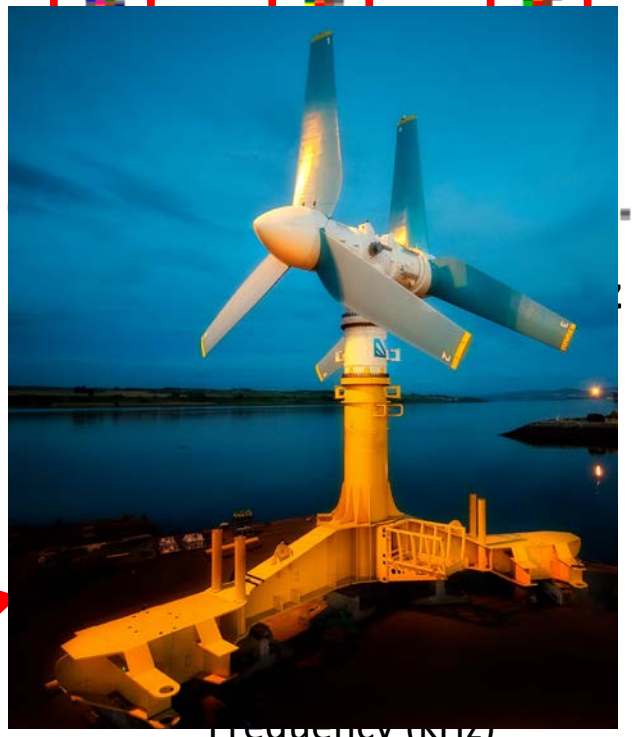


FLOWBEC target tracking

Green = Turbine structure, **Dashed** = Expected blade radius





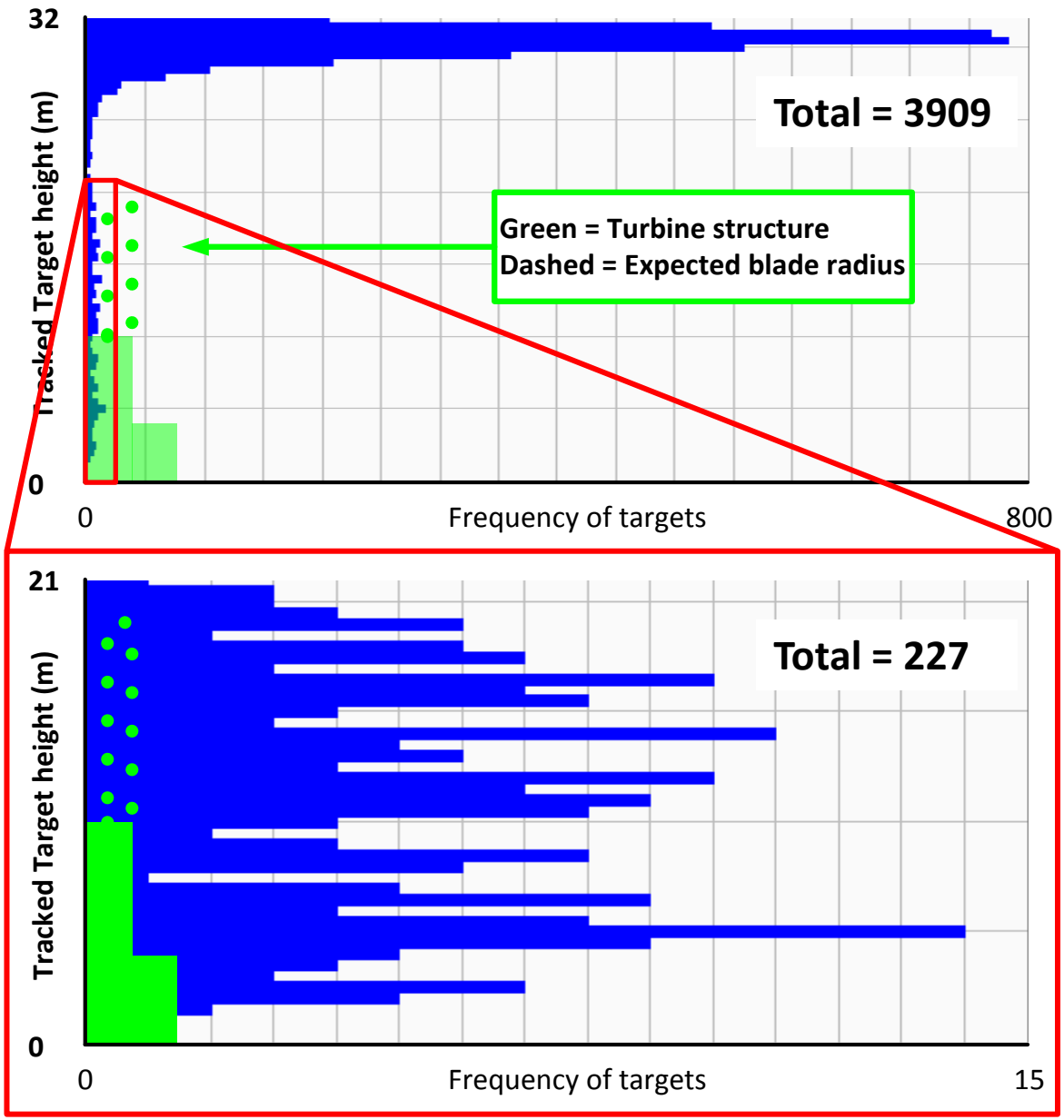


- **Target detection** using the multibeam **and EK60**
- **Target tracking** using the multibeam
- **Multifrequency analysis** using the EK60

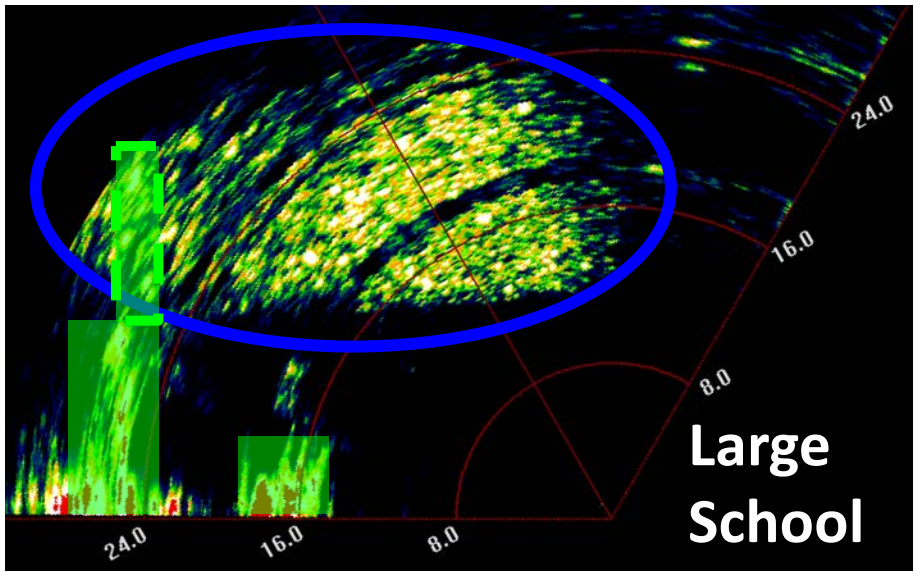
Target vertical distribution next to Atlantis turbine structure

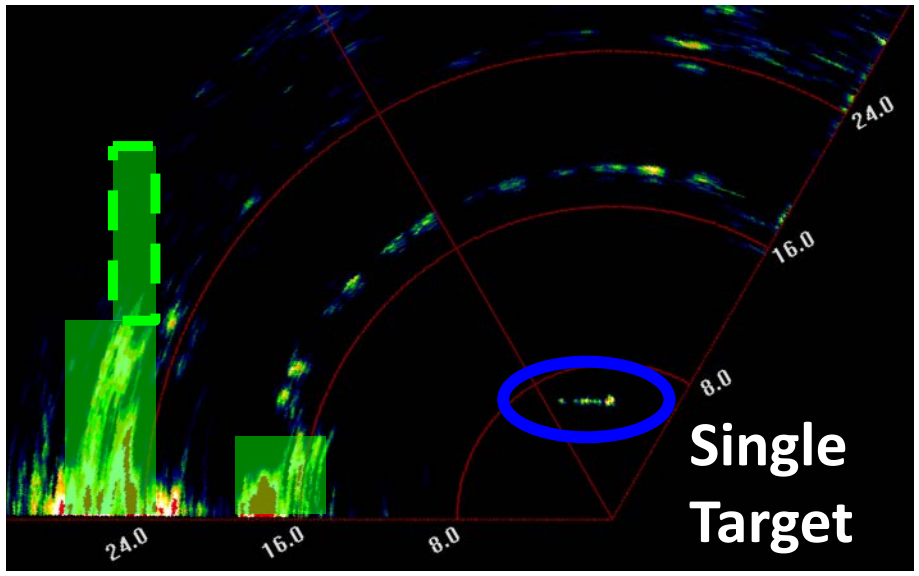
All tracked targets (mammals, birds, fish schools, individual fish) next to Atlantis turbine structure = 3909 tracks over 2 week period

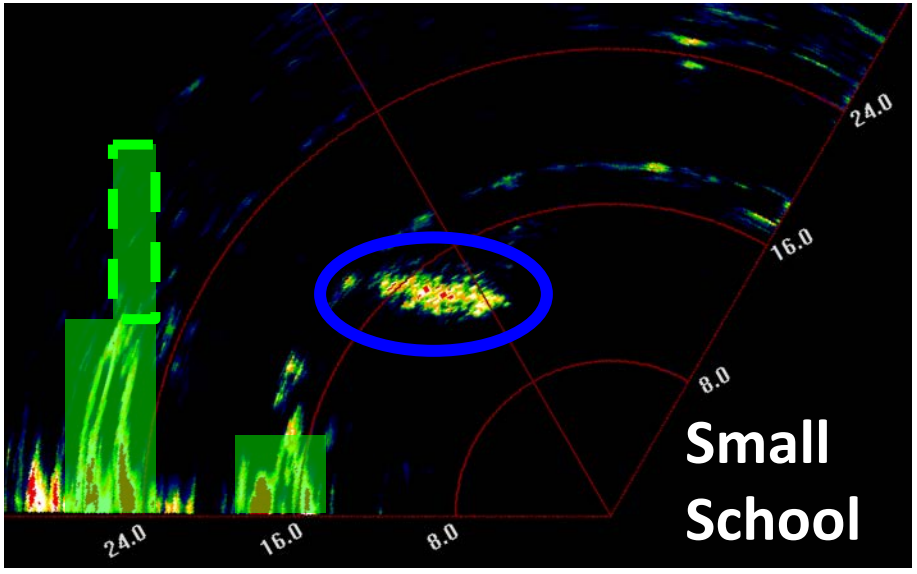
Vertical overlap with turbine height = 227 tracks over 2 week period

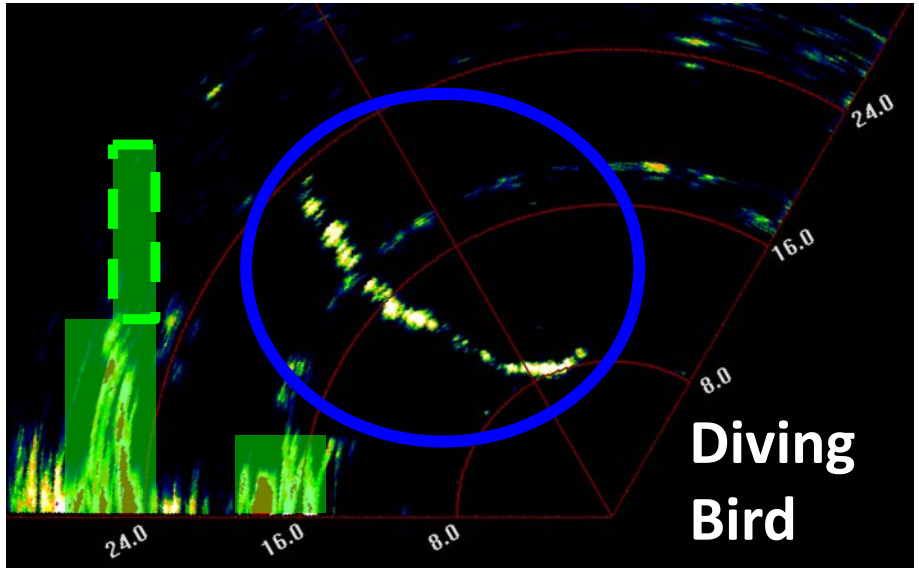


Target Classification

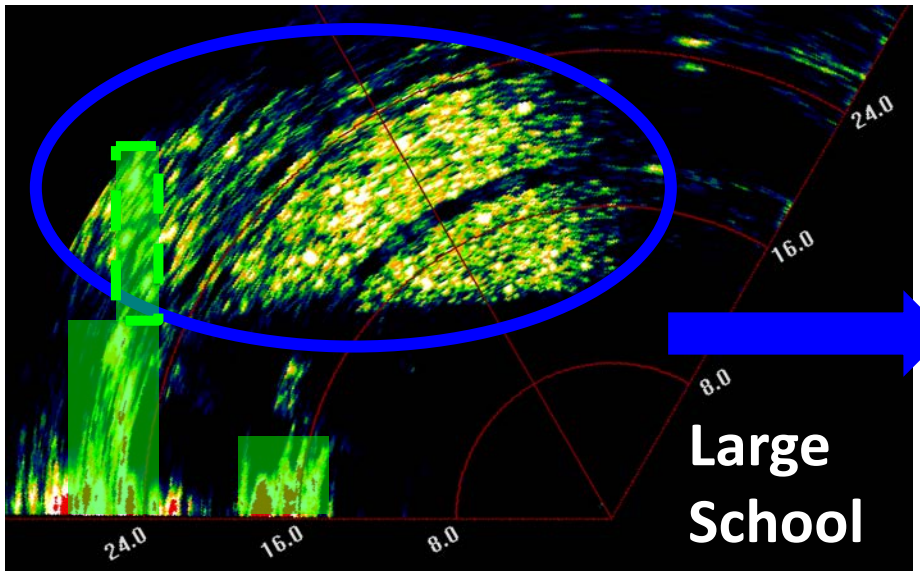


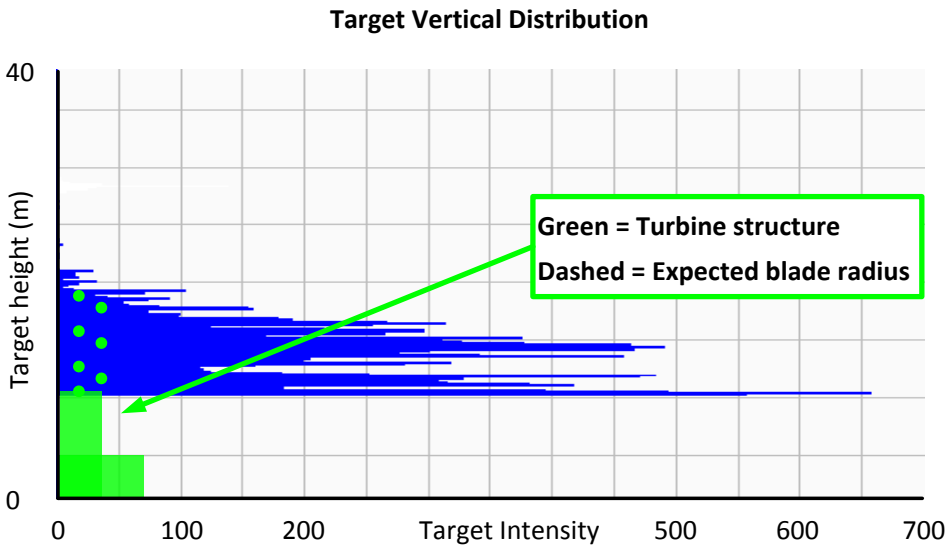


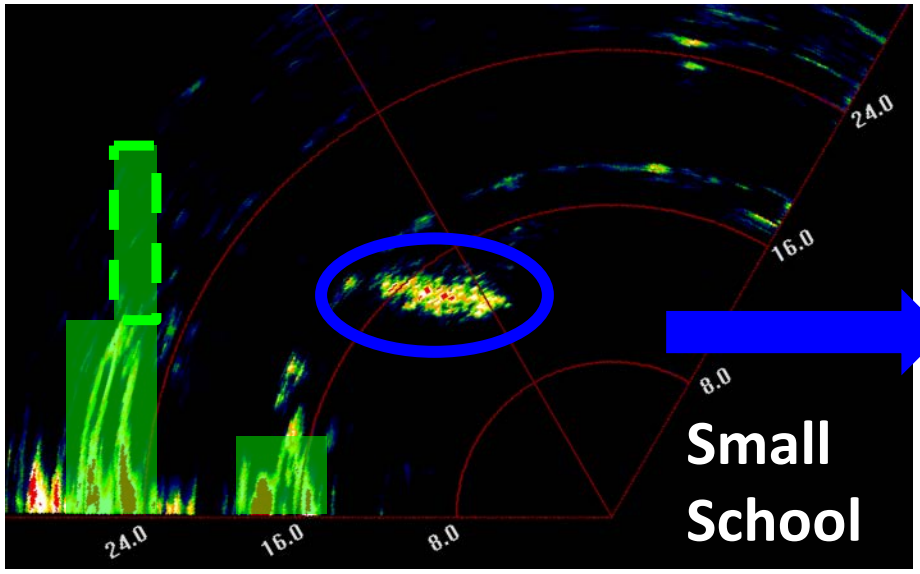


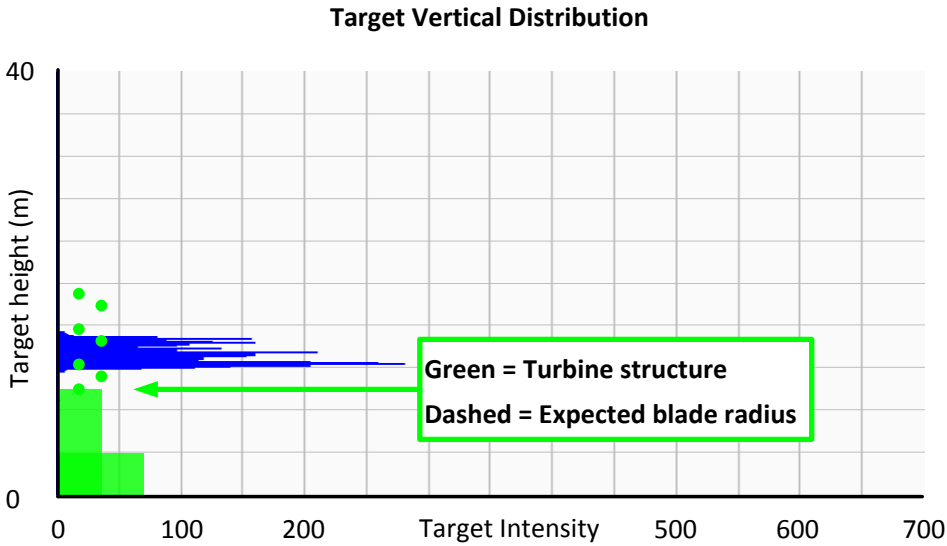


Vertical distribution (collision risk) of target classes









FLOWBEC upward facing sonar platform

Benefits:

- High range (≈50m) and good detection
- Visibility / illumination independent
- Small data volumes (raw ≈ 6GB/day)
- Low power (self-contained)
- Realtime processing feasible

Limitations:

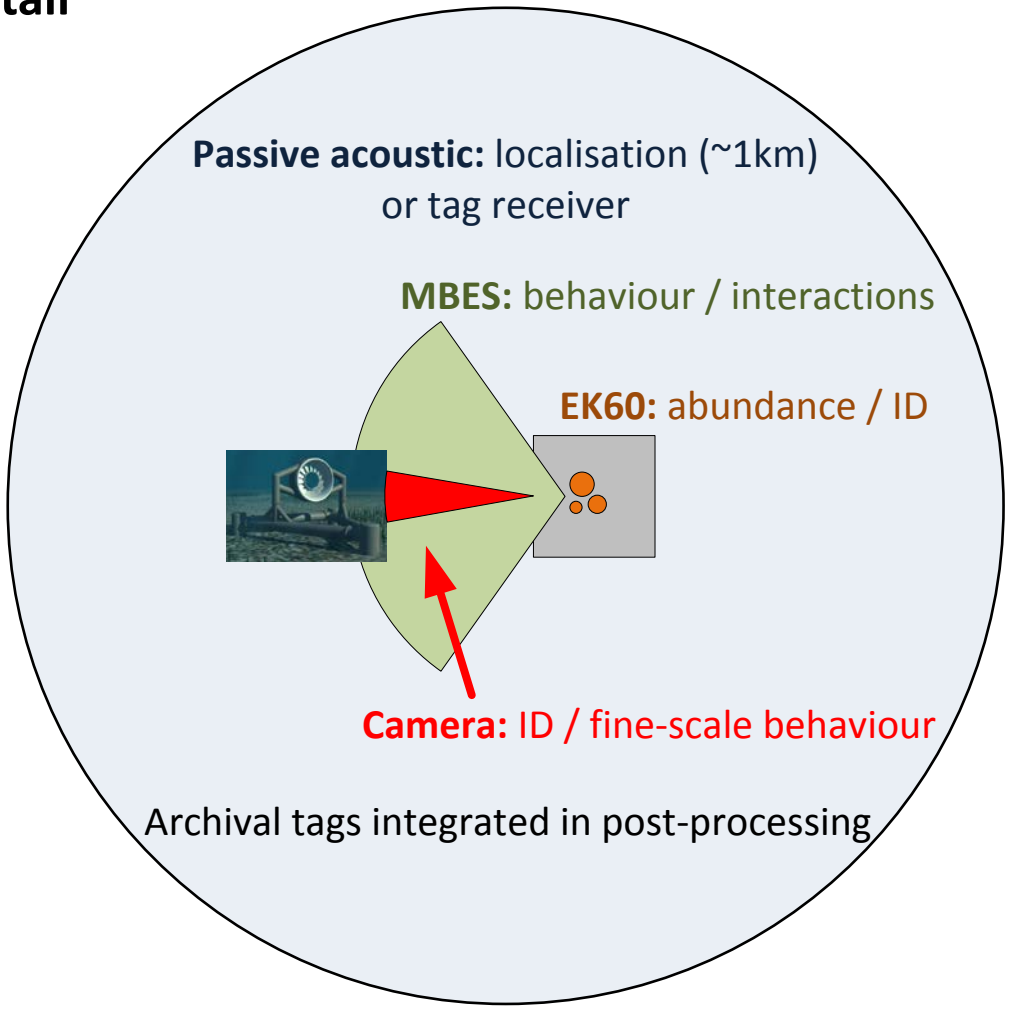
- Limited detail for species identification
- Observation of final (<1m) interaction
  - collision Y/N?
  - effect of collision?
- Any behavioural response to acoustics?

Potential solution: multi-instrument integration…

Multi-instrument integration

Intelligent triggering of instruments across **multiple scales**

- Combines **large-scale** with **fine-detail**
- Reduces data processing / archival
- Cycle passive / active acoustics
- Trigger camera for ID / detail



FLOWBEC Summary

Investigating the ecological effects of installing and operating MREDs

- Determine collision risk probabilities
- Define vertical habitat use and any changes in habitat use pre & post installation for a range of species
- Increase overall environmental understanding of mobile animal use of high energy sites
- Inform marine spatial planning, device design, licensing and operation
- Guide scaling-up to arrays and new site selection
- Increase predictive power to eventually reduce monitoring

Using the FLOWBEC seabed frame to understand underwater interactions between diving seabirds, prey, hydrodynamics and MREDs

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