Environmental Monitoring and Surveillance

Challenges, Solutions and Opportunities

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Our view - multispecies and habitats - Integration -

- animal behavior

distribution water column processes seafloor features



Major research activities

Ocean Research

- Ocean dynamics & processes
- Habitat & Species mapping
- Megafauna behaviour & ecology

Environmental Monitoring

- Vulnerable habitats
- Priority species
- Invasive Alien
 Species
- Human-related impacts

Data & Knowledge transfer

Management

• MPA design

- Regulating exploitation of living and non-living resources
- Bridge the gap and inform stakeholders and decision makers

Research questions

- What are the drivers of biodiversity & productivity?
- What prey characteristics matter to predators?
- How predators respond to environmental variability?

Ocean Research

- Where are essential habitats for large predators located ?
- How human activities affect predator distribution ?

Environmental monitoring

- What fraction of habitats should be protected to ensure resilience ?
- Where, how many and how big MPAs should be?

Management

Great whales migrations and habitat use



Silva et al (2013) PLoS ONE; Prieto et al (2014) Endangered Species Research.

Blue shark habitat preferences



Vandeperre et al (2014) PLoS ONE

Whale diving and foraging behaviour



Devil-ray migrations and extreme deep diving



Thorrold et al (2104) *Nature Comms*

Synoptic observation fish 3D behavior vs. its food



Monitoring marine litter





Pham et al. 2014. PLoS ONE

Vulnerable Marine Ecosystems (VME) & MPA design



Challenges of VME monitoring

CONDOR Seamount Management and Research Tools - the Condor case study



Challenges of VME monitoring



The vision...

Combination of fixed and autonomous sensors



Challenges: coordination among vehicles



Challenges: multiple goal oriented sampling designs (multiple resolutions are needed over space and time)





Challenges: event-trigger-response



Challenges: Drivers of predator distribution & behaviour



Observing patterns and processes at same scales Lower

trophic levels

Human-related impacts

Predators

Challenges: Drivers of predator distribution & behaviour



Space

Challenges: real time 4D animal tracking & environmental sampling



Providing a mechanistic understanding of ocean processes driving animal behaviour





Challenges: monitoring animals & environment over time

Capturing ecossystem variability and human pressures across diel, monthly, annual and decadal cycles



Challenges: monitoring animals & environment over time

Example: Understanding effects of management actions (Seamount MPAs)



Challenges: monitoring animals & environment over time

Example: Understanding effects of management actions (Seamount MPAs)



Challenges: obtaining relevant and accurate satellite observations

Knowledge of how animals respond to ocean processes and ecosystem variability is crucial for:

- selecting/finding novel variables that measure properties relevant for the animals
- understanding how surface patterns correlate to processes across water column



Challenges: remote sensing is fantastic! But...

Resolution is not sufficient to investigate crucial processes occurring at finer scales, such larval dispersal and localized productivity....



Challenges to Marine Technology

- Intelligent vehicles capable to interact with environment in real-time:
 - Detection of animals using acoustic, optical, electromagnetic, DNA cues (eg. Mimic guided military torpedoes)
 - Detection of oceanographic structures using gradients in temperature, Chl a, pH, oxygen
 - Adaptive surveying: respond to animal/oceanographic detection
 - Innovative sensors: acoustic, optical, chemical, molecular, particle imaging systems
 - Increased autonomy, speed, depth rating

Challenges to Marine Technology

- <u>'Animal-borne' vehicles:</u>
 - "Pilot-fish/remora" robot (Similar to CADDY Prj.)
 - Parasite robots

- Interactive network of autonomous and fixed platforms:
 - Bi-directional, real time communication using acoustics, satellite, radio
 - Coordinated surveying
 - Dynamic configuration

Acknowledgements

Grants

PTDC/MAR/74071/2006 TRACE: Cetacean habitat associations in oceanic ecosystems: an integrated approach

M2.1.2/F/012/2011 MAPCET: Integrating cetaceans into marine spatial management in the Azores

PTDC/MAR/108232/2008 SEAMOV: Movimentos, uso do habitat e conectividade de peixes em montes submarinos

FP7, N°210496 MADE: MITIGATING ADVERSE ECOLOGICAL IMPACTS OF OPEN OCEAN FISHERIES

M2.1.2/F/018/2011 MONIZEC: An assessment of the Azorean MPA network

Funding



