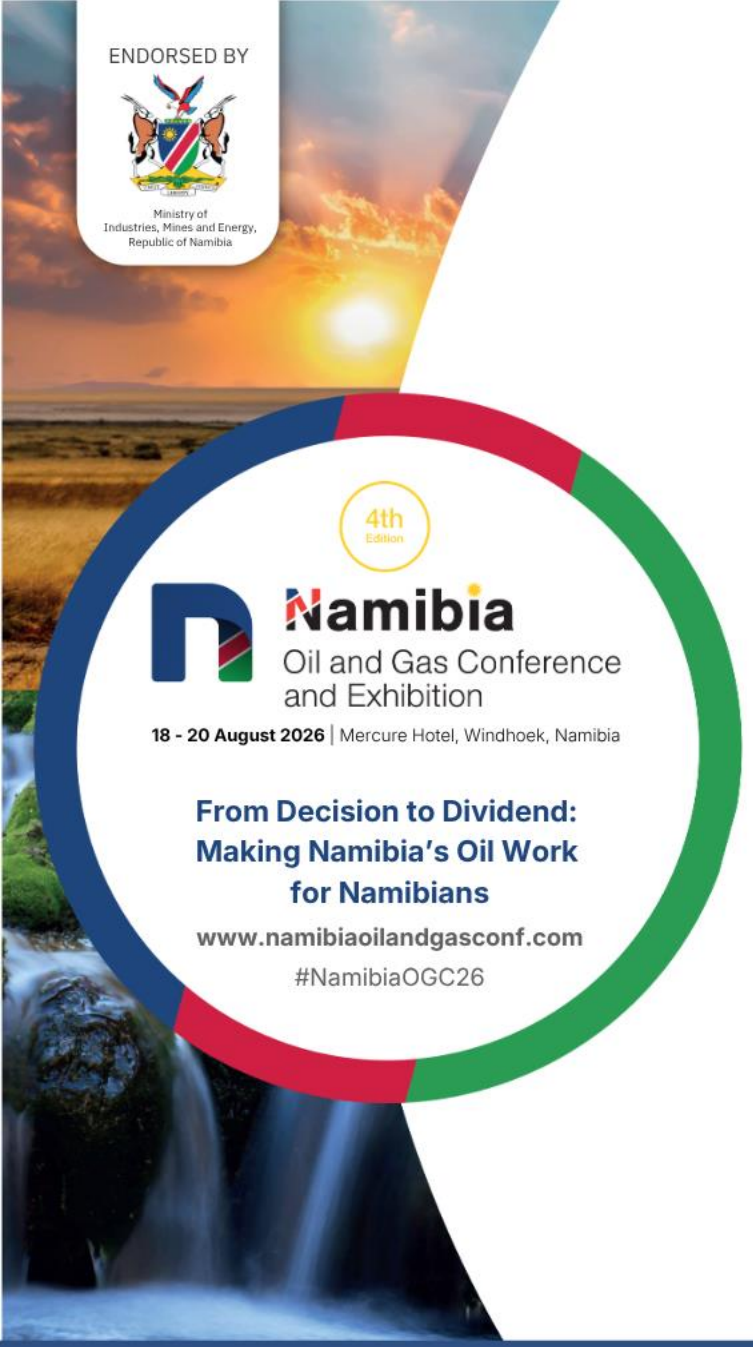


# Supporting sustainable offshore development through integrated marine science

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ANCHOR environmental
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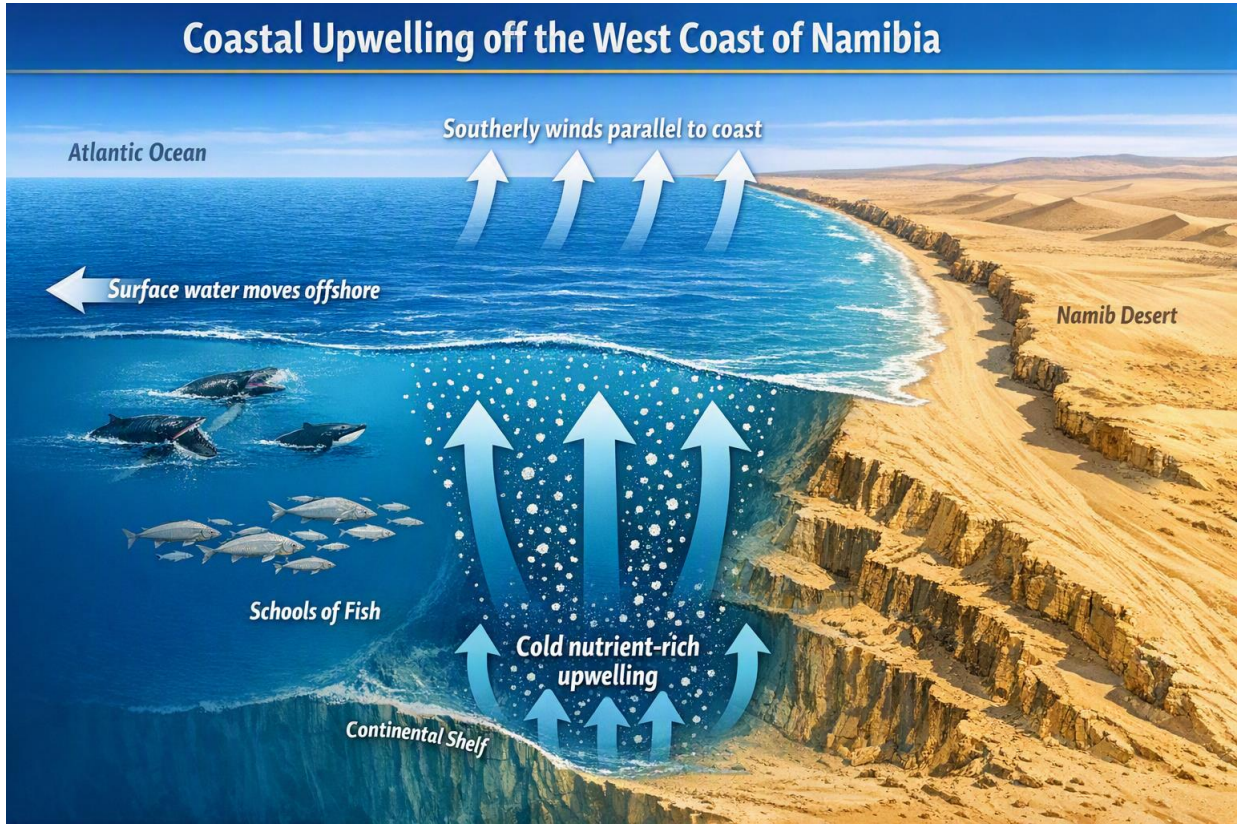
# Namibian Offshore Marine Environment

- Namibian offshore is very dynamic driven by seasonally variable upwelling system
- Winds blow parallel to the shore for much of the year: divert surface water offshore and cause cold and nutrient rich water to well up from below
- Upwelling makes this one of the most productive environments in the world
- High levels of nutrient support intensive phytoplankton production
  → supports high concentrations of zooplankton, small pelagic fish, demersal fish, seabirds and marine mammal populations
- High fish biomass also supports important commercial and recreational fisheries (subsistence and artisanal fisheries less economically important)

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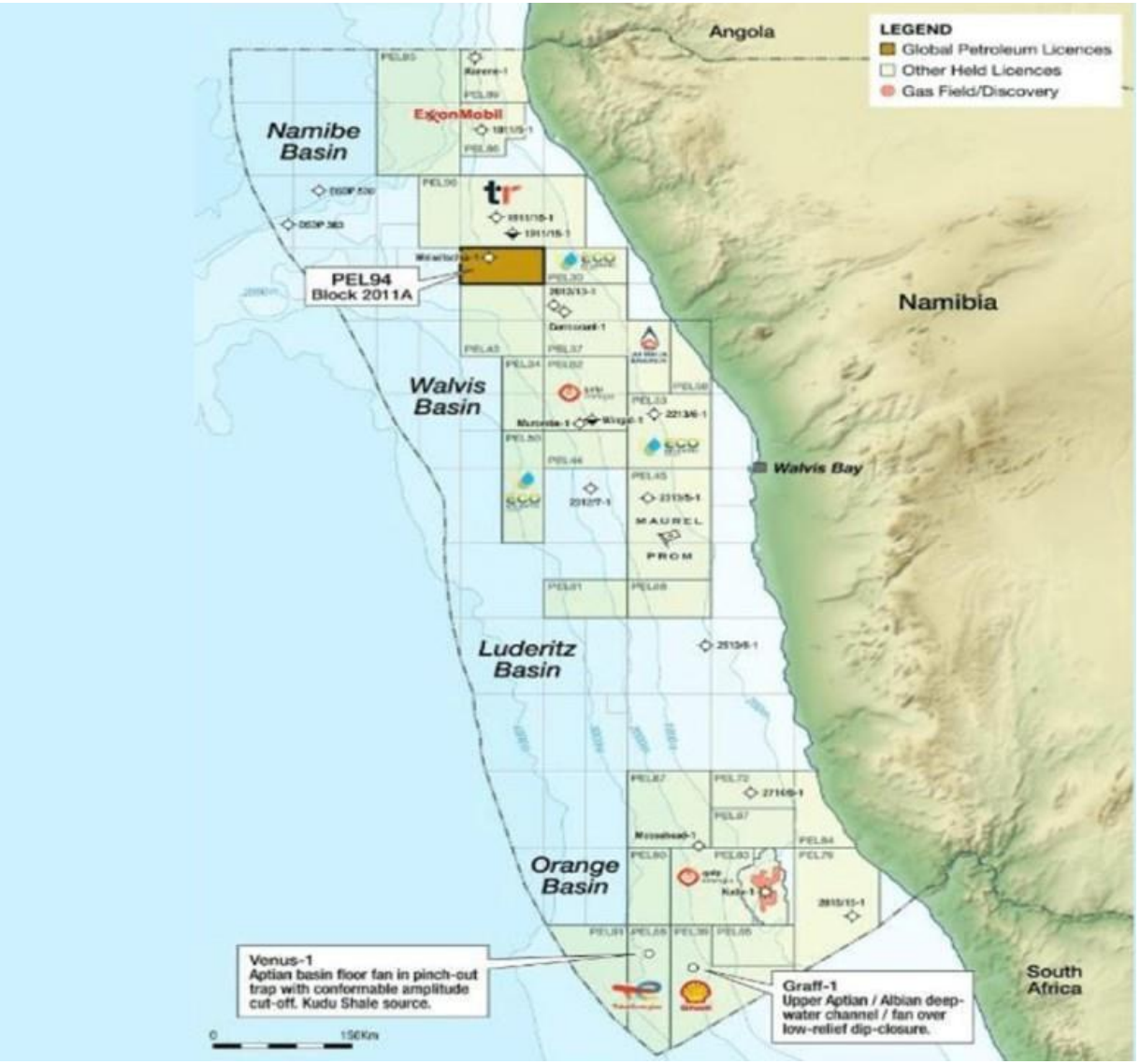
# Existing Knowledge Base

- Some aspects of the offshore marine environment are well studied and understood
- Many aspects (e.g. benthic communities, deep water habitats) are poorly studied and not well understood
- Understanding potential risks and impacts from offshore activities on biodiversity and ecosystem services improves with knowledge of what biodiversity is present, how ecosystems function, what dependencies exist and the relative sensitivity of different receptors
- Such information needs to be collected from scratch e.g. though:
    - Baseline surveys (pre-construction)
    - Monitoring surveys (operational phase and post construction)

# Affected Environment

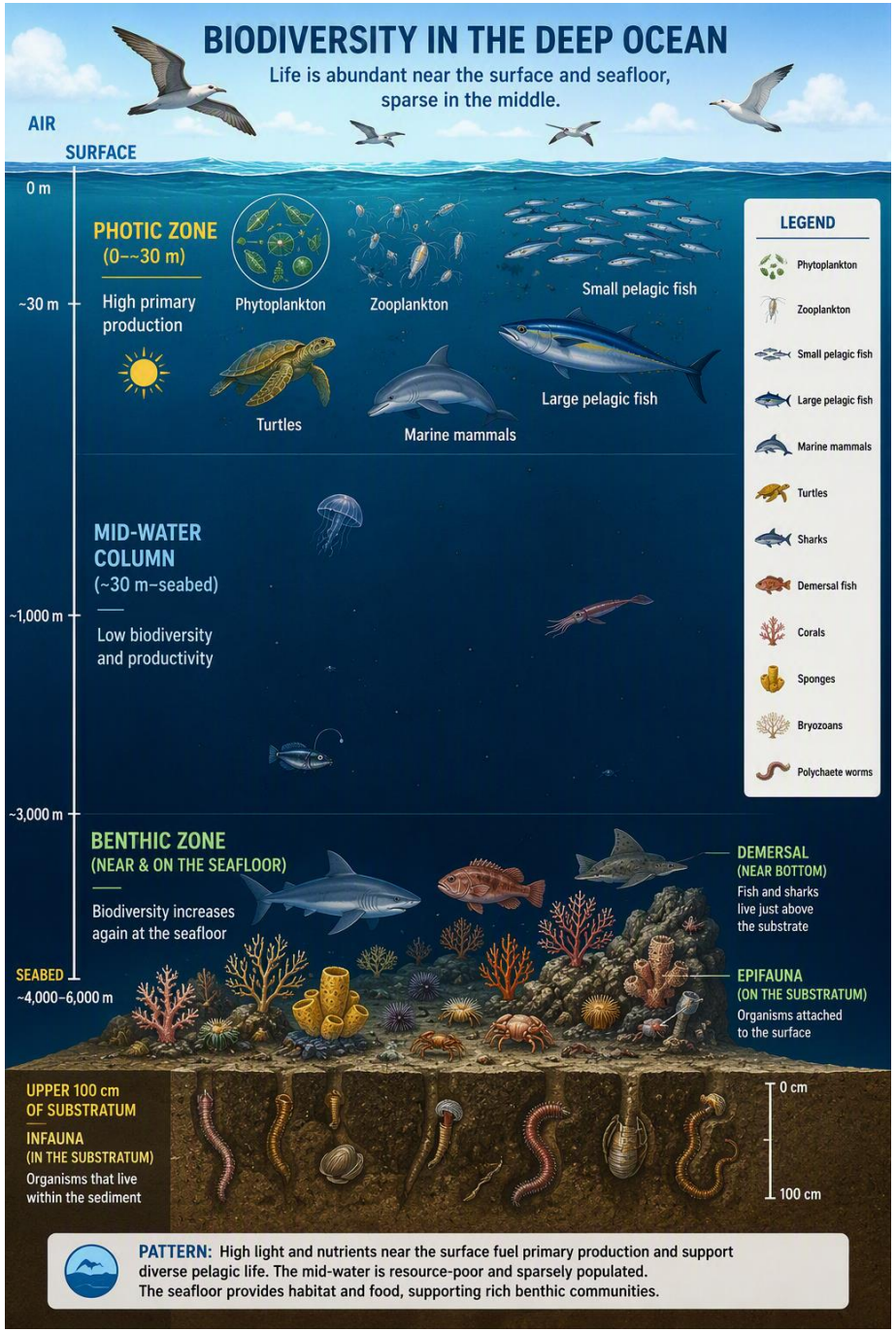
- Most Namibian Oil & Gas activity is offshore (seismic surveys, drilling, production)
- Some activities extend to the shore (e.g. pipelines if present, refit and repair of facilities and vessels, crew transfers, etc.)
- Accidents could pose a threat (e.g. oil spills)

➢ Baseline surveys and monitoring operations should focus on the offshore environment (which is least studied), but should also cover relevant shallow-water and coastal habitats



# Biodiversity in the Deep Ocean

- In the deep ocean, biodiversity is concentrated at the sea surface and near the bottom
  - *Above sea surface to ~100 m altitude:* seabirds are common
  - *Photic zone (0 to ~30 m depth):* primary production fueled by sun energy
    → Zooplankton, fish, turtles and marine mammals are abundant
  - *Mid water column (30 m to just above the sea floor):* typically supports very low diversity and abundance of life
  - *Benthic or demersal zone (near or on the seafloor):* typically again supports high diversity and abundance of life (epifauna, infauna, fish, sharks etc.)



# Key components of an Environmental Baseline Survey (EBS)

- **Climate** (air temperature, wind, cloud cover, precipitation, air pressure)
- **Oceanography** (waves, currents)
- **Air quality** (CO, NO, $SO_2$, PM, VOCs)
- **Noise** (above and below the water surface)
- **Water quality** (temperature, salinity, dissolved oxygen, pH, suspended solids, contaminants)
- **Sediment quality** (grain size composition, organic content, contaminants)
- **Biota**
  - Phytoplankton
  - Zooplankton
  - Benthic invertebrates
  - Fish & fisheries
  - Turtles
  - Seabirds
  - Marine mammals

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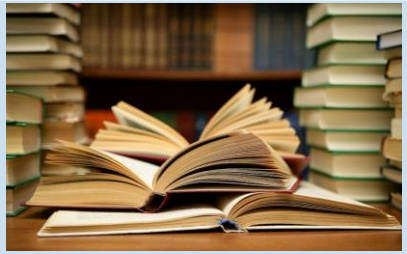
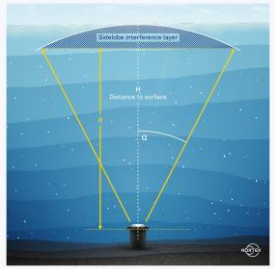
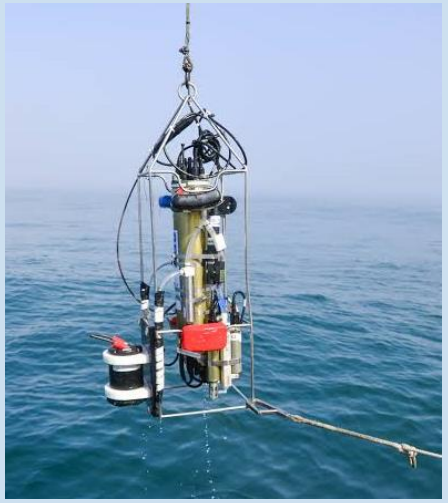
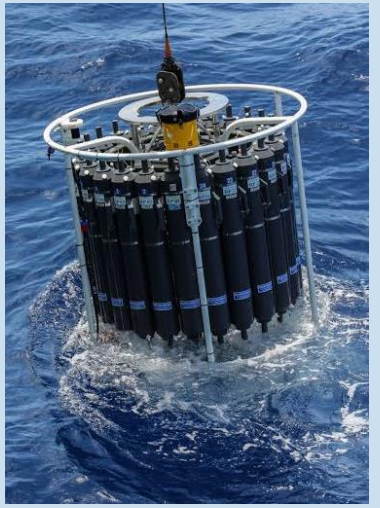
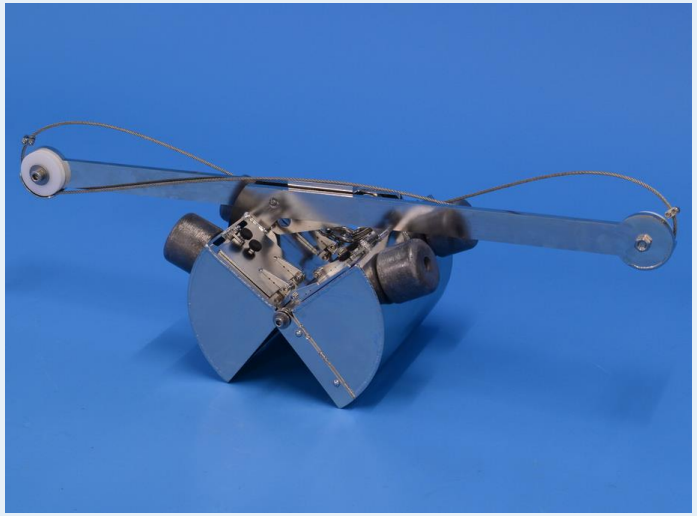
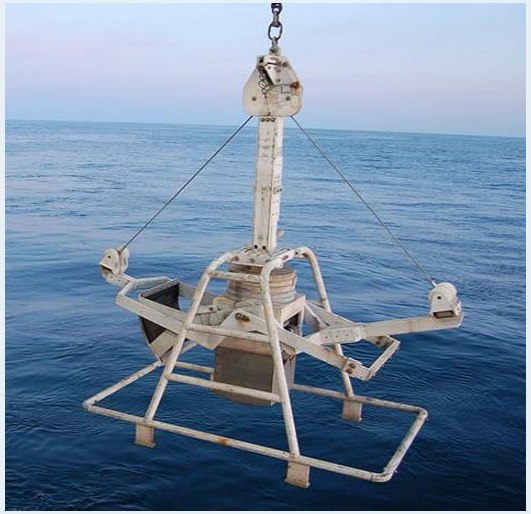
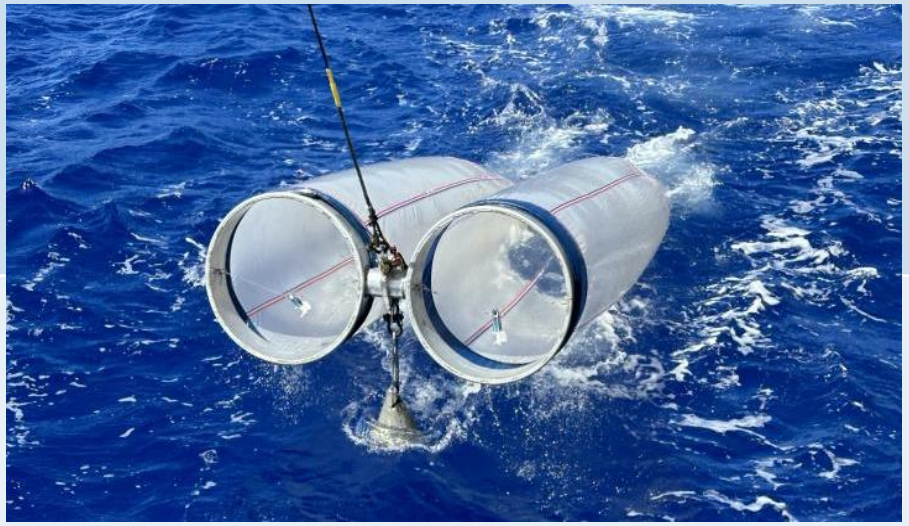
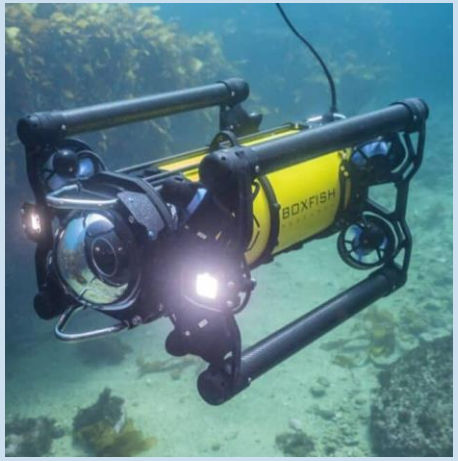
# Data sources for EBS and monitoring surveys

| EBS component | Key sources of data/information | |
|---|---|---|
| Climate | Literature, remote sensing |   |
| Oceanography | Literature, remote sensing, in situ measurement (wave rider buoy, ADCP) |    |
| Air quality<br>Noise | Literature, site specific so generally requires some direct (vessel-based) measurements<br>• Surface (air quality & noise)<br>• Underwater (noise) |   |

| EBS component | Key sources of data/information | |
|---|---|---|
| Water quality | Literature, site specific so requires direct measurement<br>• In situ: CTD instruments<br>• Lab analysis: Water samples |    |
| Sediment quality | Literature, site specific so requires direct measurement<br>• Grab sampler or box corer<br>• Lab analysis |   |

| EBS component | Key sources of data/information | |
|---|---|---|
| Phytoplankton | Literature, remote sensing, water samples for laboratory analysis, bongo nets |  |
| Zooplankton | Literature, bongo nets | |
| Benthic invertebrates | Literature<br>Field sampling:<br>• Infauna: Grab sampler, box corer<br>• Epifauna: drop camera, ROV |     |

| EBS component | Key sources of data/information | |
|---|---|---|
| Fish & fisheries | Literature, stakeholder consultation,<br>field surveys (very rarely) |   |
| Turtles, seabirds and marine mammals | Literature<br>Field sampling:<br>• Marine Mammal and Seabird Observers (MMSOs)<br>• Passive Acoustic Monitoring (PAM) |   |

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