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Environmental data gathering technologies for decommissioning Net Environmental Benefit Analysis (NEBA)

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London Convention Science Day
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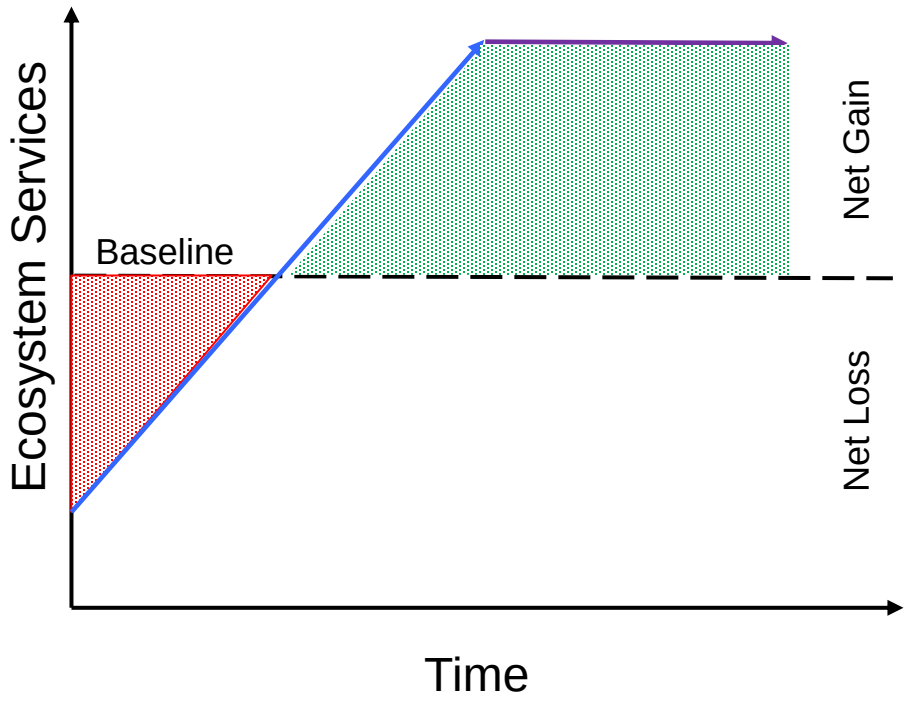
Comparative Assessment and Net Environmental Benefit Analysis (NEBA)

- NEBA = **objectivity, transparency and scientific approach** comparing decommissioning alternatives
- NEBA alternative comparison based on **ecosystem service value** & balanced against other benefits and risks
- **Communicates** environmental and socio-economic **changes** associated with alternatives in clear, meaningful units



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Level of Data Acquisition Required for NEBA

DATA LEVEL	LOW	MEDIUM	HIGH
Decommissioning Alternatives	Simple alternatives	Some complexity to alternatives	Complex range of alternatives
Use of Outputs	Internal assessment of alternatives	Internal use and some external visibility	High level of external interest/scrutiny
Level of detail	Qualitative	Semi-quantitative	Quantitative
Data Acquisition methods	Professional judgement	Data mining from existing ROV footage	Targeted campaigns using specialist equipment and expertise

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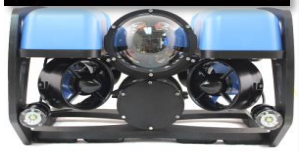
Methods for Assessing Offshore Environmental Values

Methods		Limitations
	**Seabed sampling (grabs, cores, trawls etc.)**	▪ Distance from structures being assessed ▪ Seabed not representative of water column / structure-related species ▪ Limited numbers of point samples
	**Diver surveys**	▪ Safety risk ▪ Diving skills and taxonomic expertise required ▪ Depth limitations ▪ Time consuming, expensive
	**Maintenance ROV footage**	▪ Large volume of data available ▪ Video often low resolution, identification difficult ▪ Difficult to quantify size and area sampled ▪ Large, work-class ROVs can affect fish behaviour
	**Mini-ROV with single camera**	▪ High quality video ▪ Limited effect on fish behaviour ▪ Difficult to quantify size and area sampled

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New Fish Survey Method: Mini-ROV with Stereo-Video

- Stereo-video measures XYZ coordinates:
  - **Fish length** (±1% accuracy)
  - **Area/volume sampled**
- High-def video allows species identification
- Mini-ROV = Limited effects on fish behaviour
- Can be used as a consistent method for platforms, pipelines, natural habitats
- Can retrofit stereo-cameras to existing ROVs

Collaboration between Chevron (Dr Michael Marnane) and Curtin University, Perth

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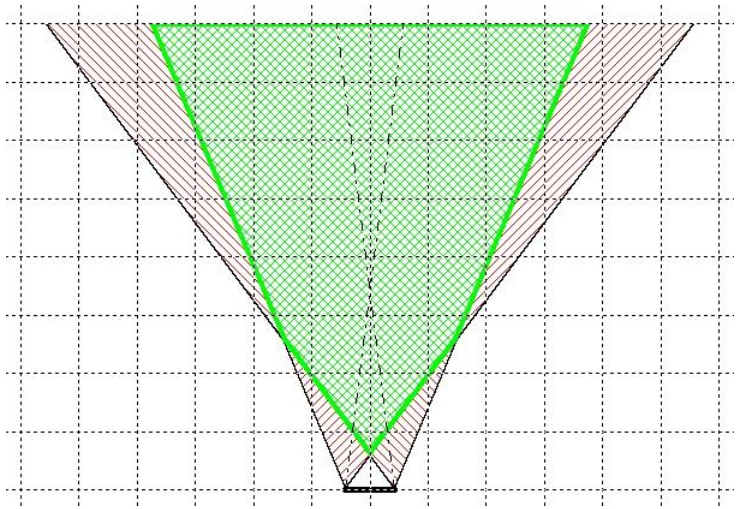
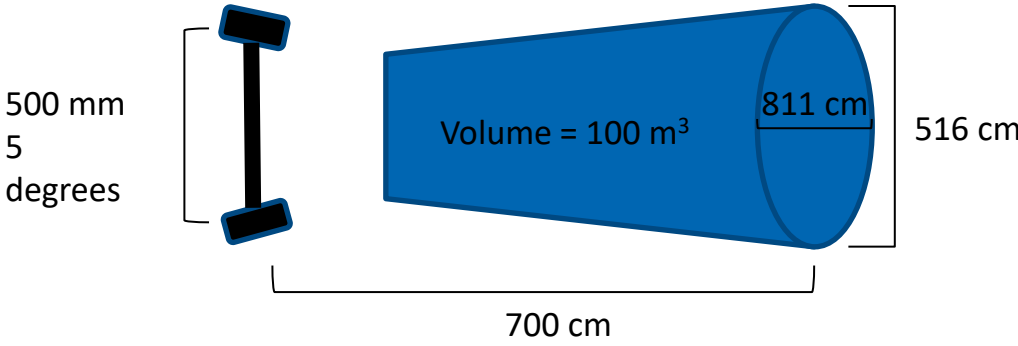
Volume of Sample Unit





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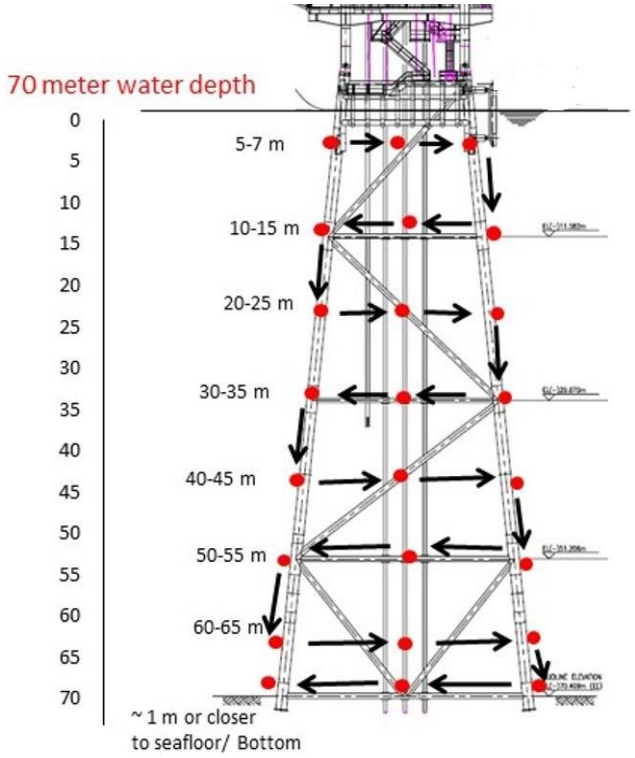
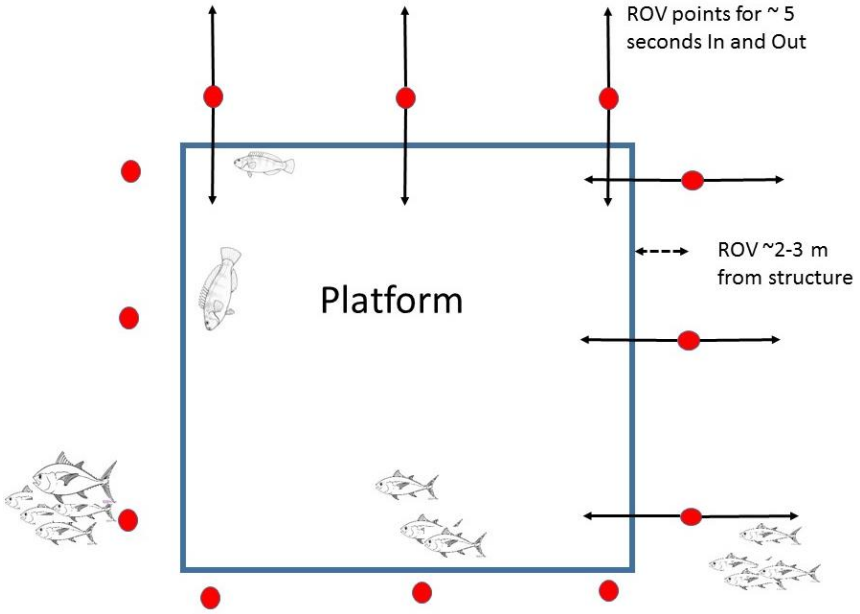
Stereo ROV Sampling Method





Note: controls were also collected. This involved flying the ROV in an identical pattern to the platform sampling at sites distant from all infrastructure

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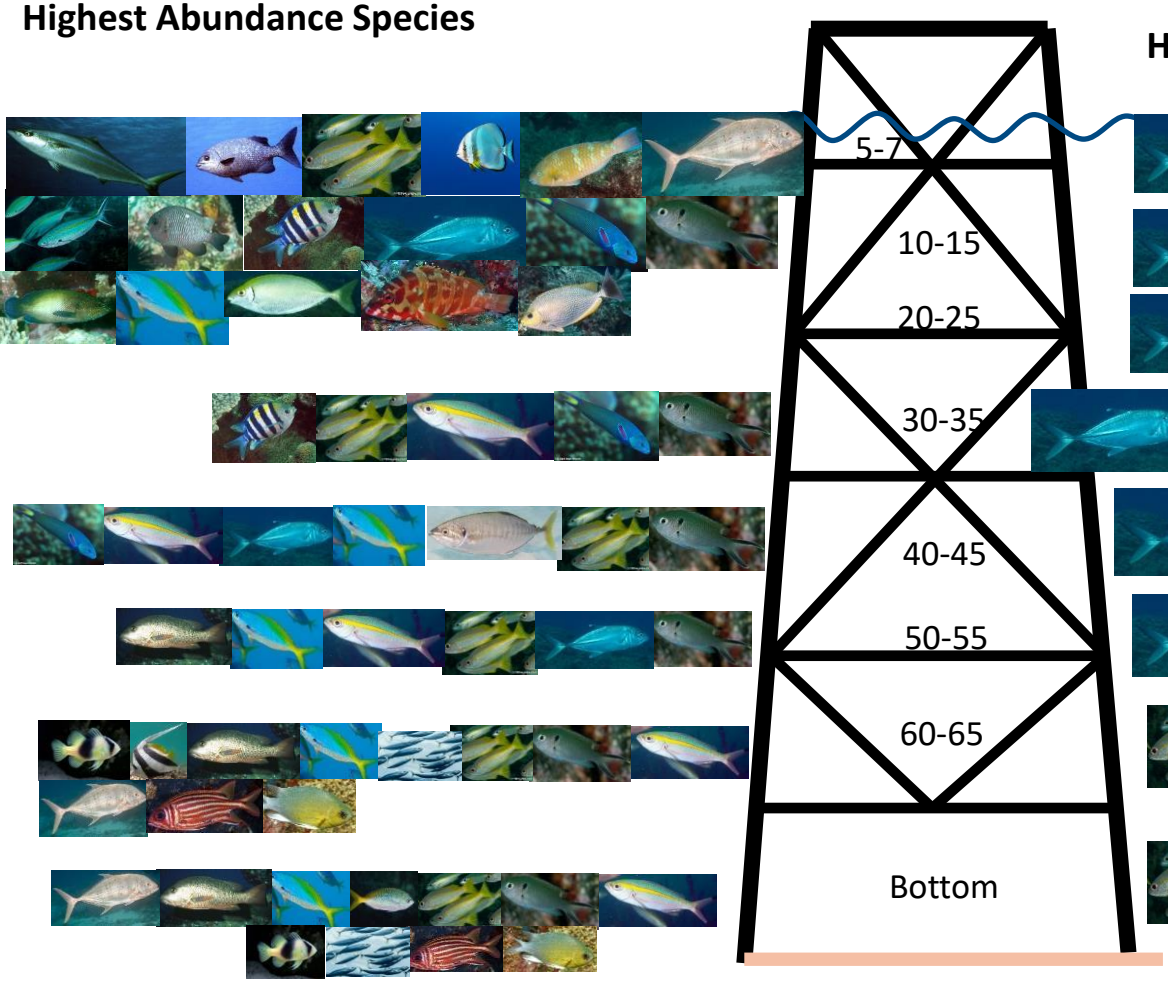
Example outputs of Stereo-Video Fish Surveys: detailed community assessments

Highest Abundance Species



Highest Biomass and Fishery Value Species

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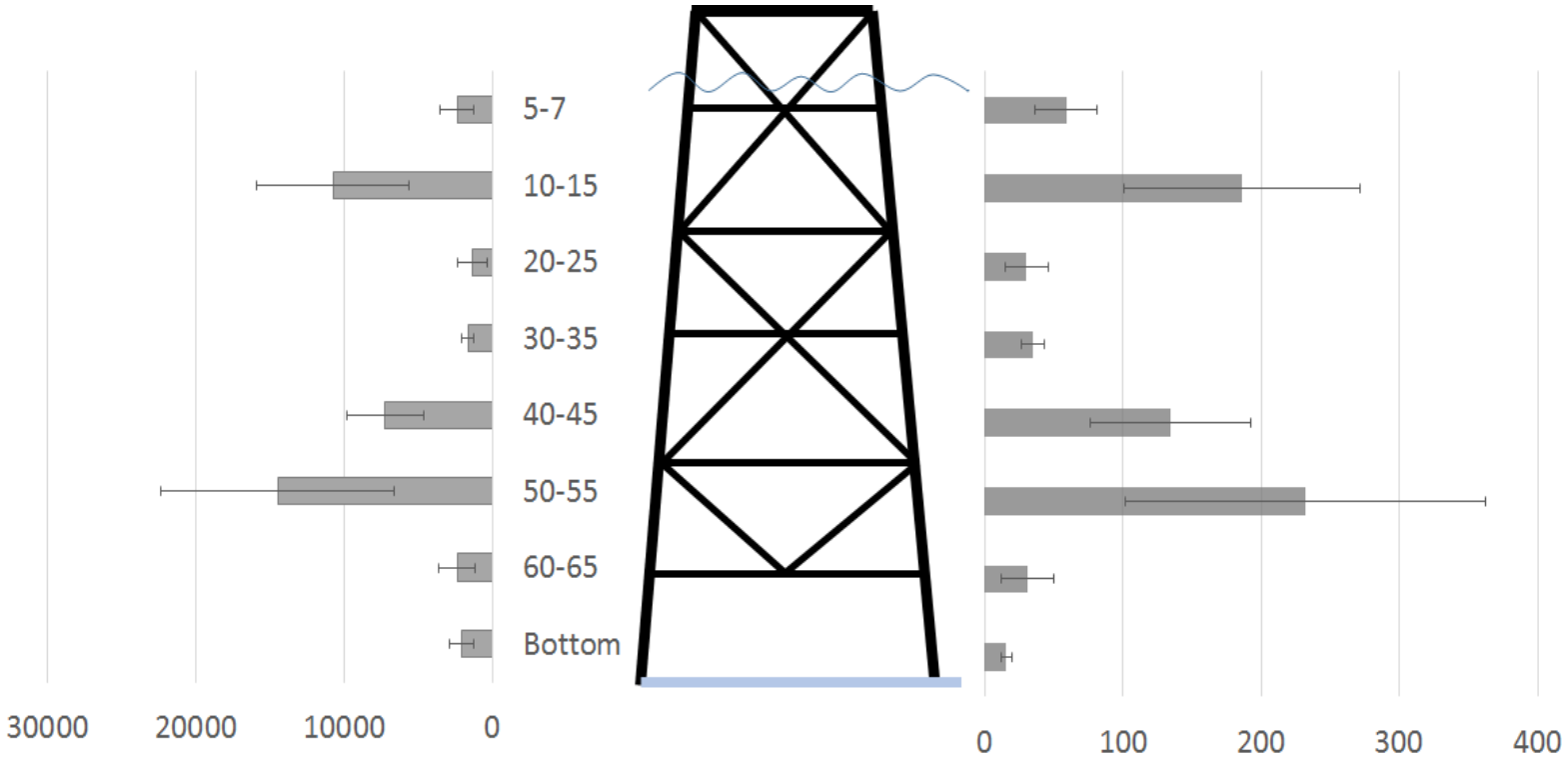
Example outputs of Stereo-Video Fish Survey: Standing biomass and value



Mean Economic Value (Thai Baht ± SE)

Mean Biomass (kg ± SE))

Average for jacket =

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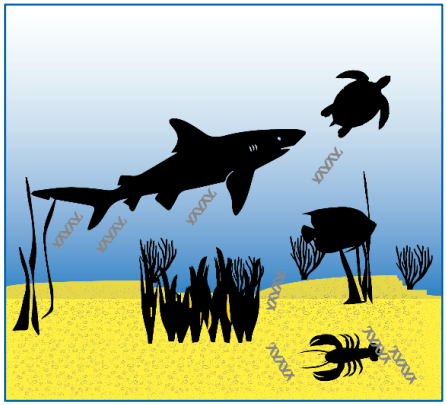
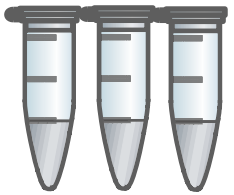
Rapid Biodiversity Assessments Methods: Environmental DNA (eDNA)

- eDNA detects organisms based on presence of DNA fragments in environment
- DNA detected in samples is then compared to a growing library of DNA sequences to determine taxa
- Whole-community eDNA assessments made possible due to recent advances in sequencing technology





Collaboration between Chevron (Dr Michael Marnane, Sarin Chaiyakul, Paweena Sitaworawet) and Curtin University, Perth

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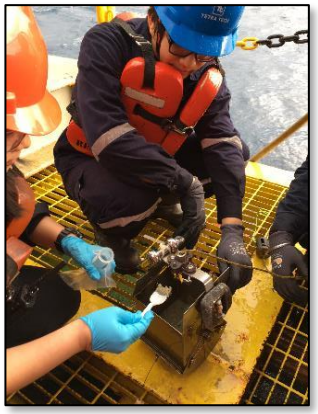
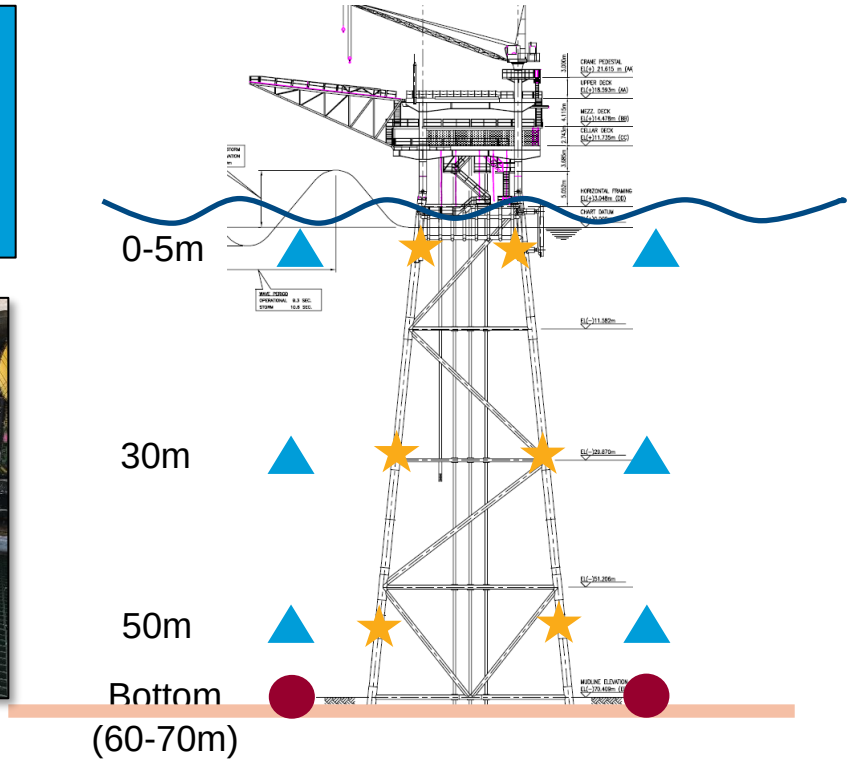
Example eDNA Survey Approach for Platform Jackets

Environmental DNA metabarcoding studies are critically affected by substrate selection

Adam Koziol, Michael Stat, Tiffany Simpson, Simon Jarman, Joseph DiBattista, Euan Harvey, Michael Marnane , Justin McDonald, Michael Bunce. Molecular Ecology Resources 2019



▲ **Water** ● **Sediment** ★ **Biofoul**



x 2 sides of Jacket

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Example eDNA Sampling Approach for Offshore Structures

Biofoul:

- Scraper on ROV manipulator arm
- Collection funnels allow multiple samples per ‘dive’ to increase efficiency
- For shallow platforms: mini-ROVs were used, with small, fixed collection devices

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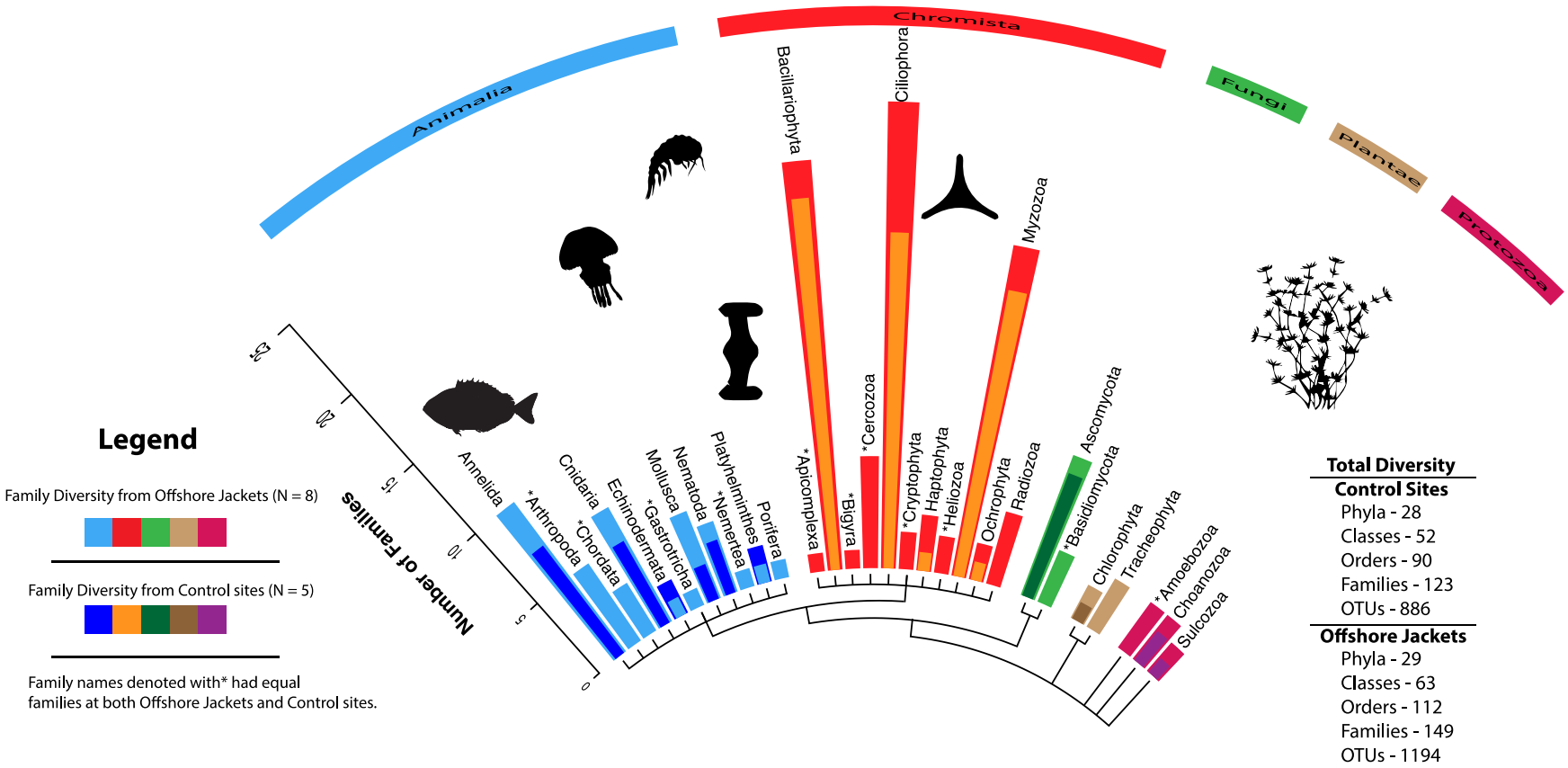
Example eDNA Outputs using 18S Assay: Sediment Biodiversity for Jackets versus Control Sites



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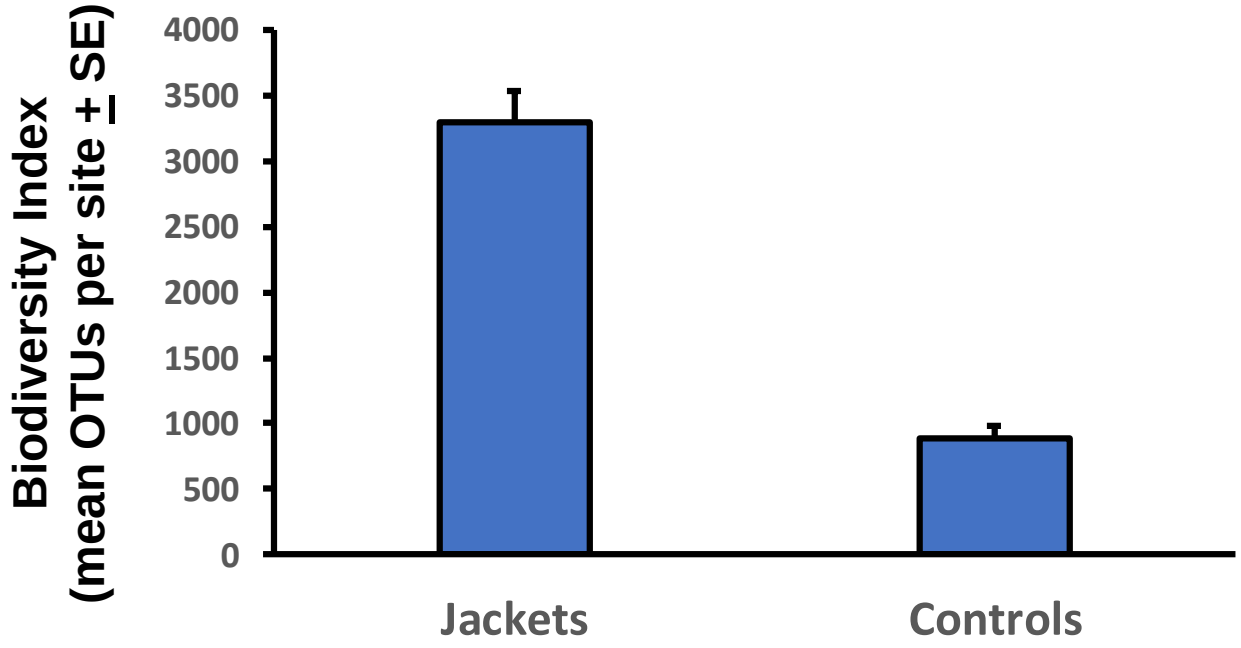
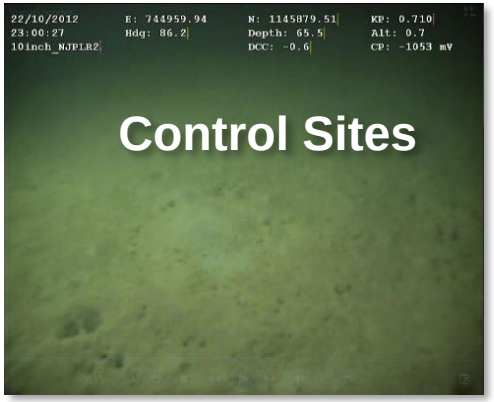
Comparison Between Jackets and Control Sites: Biodiversity Index of Taxa Present in Sediment + Biofoul





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eDNA can also Detect Species of Interest or Concern

- Targeted PCR assays can provide greater resolution within a Phylum
- Can detect rare or endangered species
- Can detect invasive species

Alpheidae – Banded Shrimp

Pomacentridae - Damselfish

Arminidae – Nudibranch

Niphatidae - Demosponge

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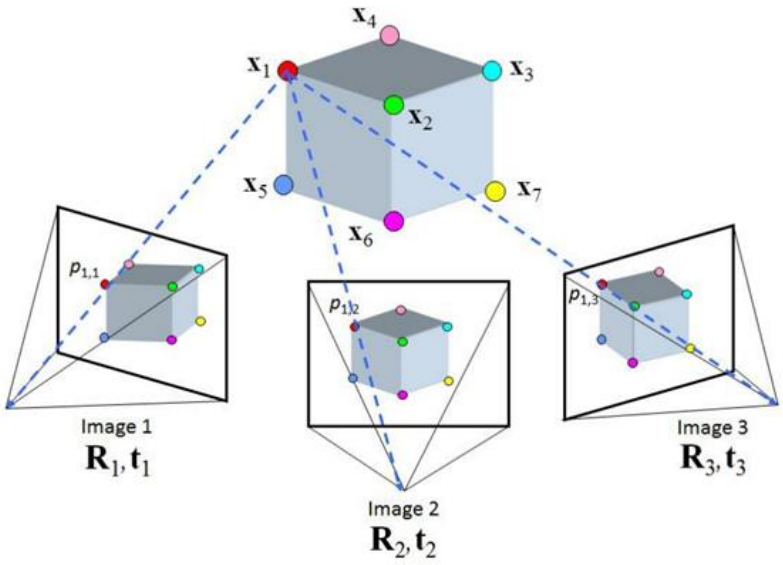
3D Photogrammetry: Marine Growth Volume, Roughness & Cover

- Uses multiple positions of video or still photos of same area to build up a 3D model
- Movement between images generates 3-D point clouds
- Reference photos stitched onto point cloud to provide 3-D photomosaic
- Can be used to provide:
  - % cover
  - Surface roughness (indicator of habitat quality)
  - Volume
  - Weight (if validated with scraping of biofoul)



Collaboration between Chevron (Sarin Chaiyakul, Paweena Sitaworawet, Peter Oliver) & Scottish Association of Marine Science & Tritonia Scientific Ltd.

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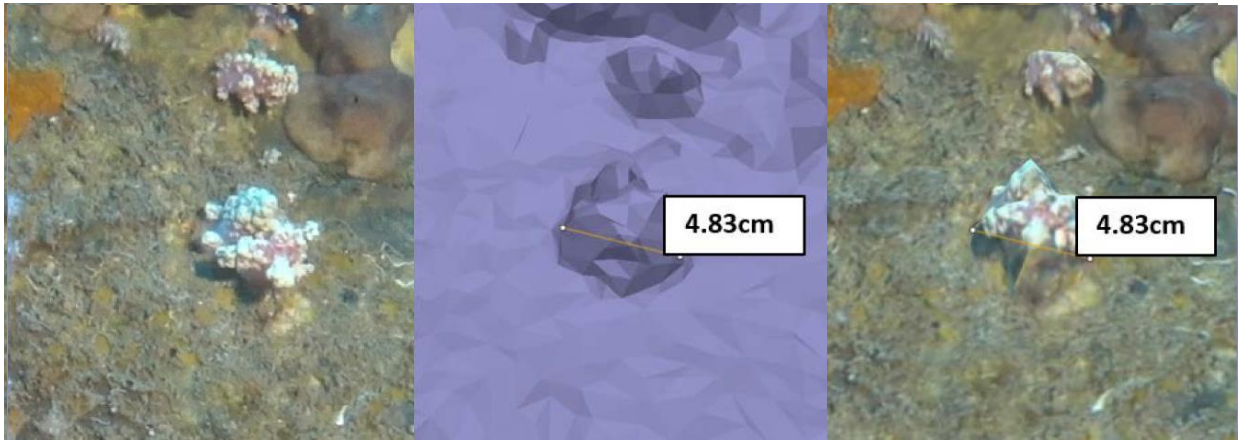
3D Photogrammetry:
Raw footage versus modelled comparison



Raw camera footage **Geometric mesh** **High resolution tiled model**

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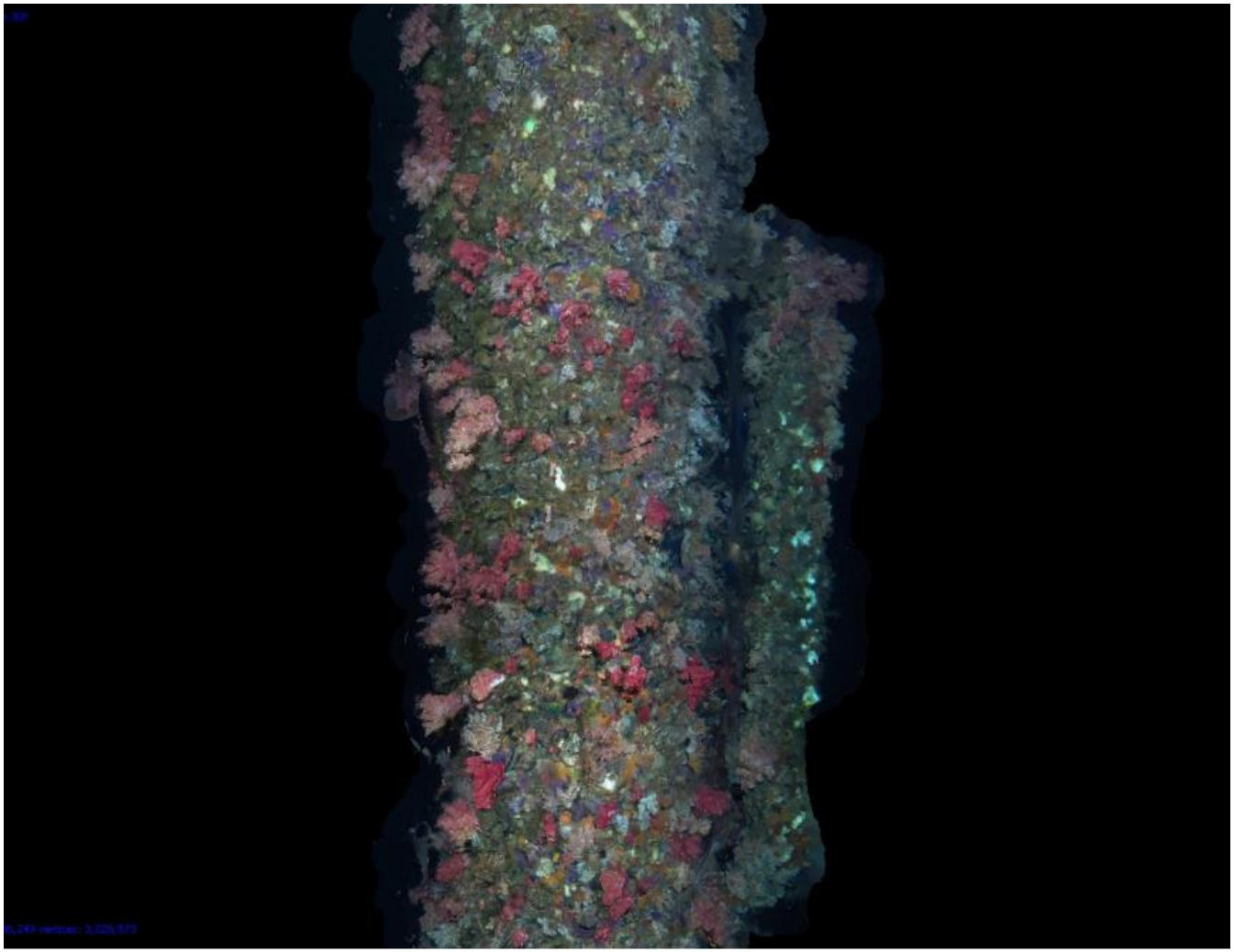
3D Photogrammetry: jacket leg example



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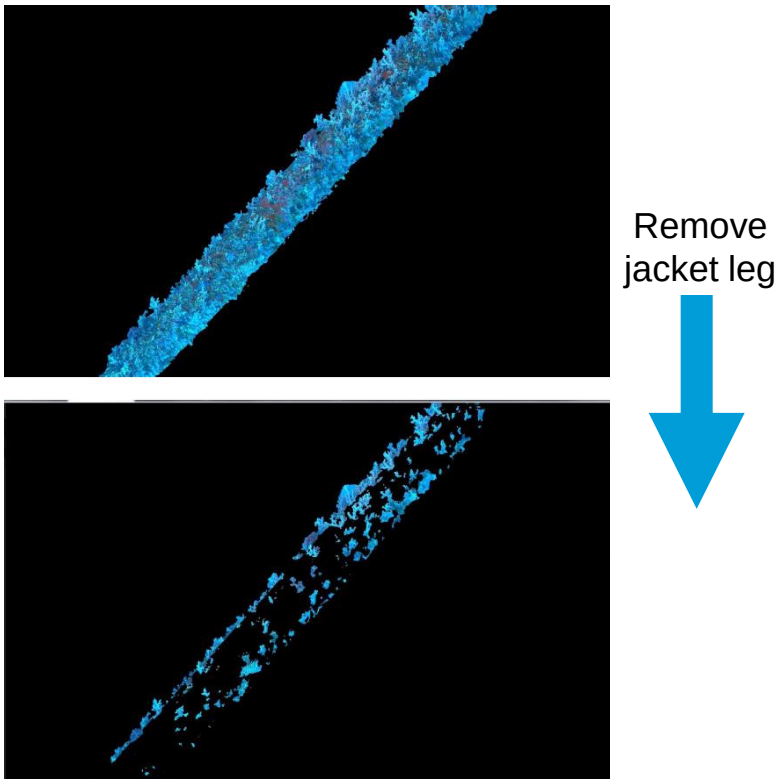
3D Photogrammetry: Biovolume and Weight Calculation

- Digital removal of the volume of the platform leg (using schematics) generates estimates of:
  - ➢ biofoul volume
  - ➢ weight (using calibration factor)
- Can monitor changes in biofoul communities due to towing or monitor recovery after reefing
- Can address engineering questions: weight/heavy lift vessel requirements



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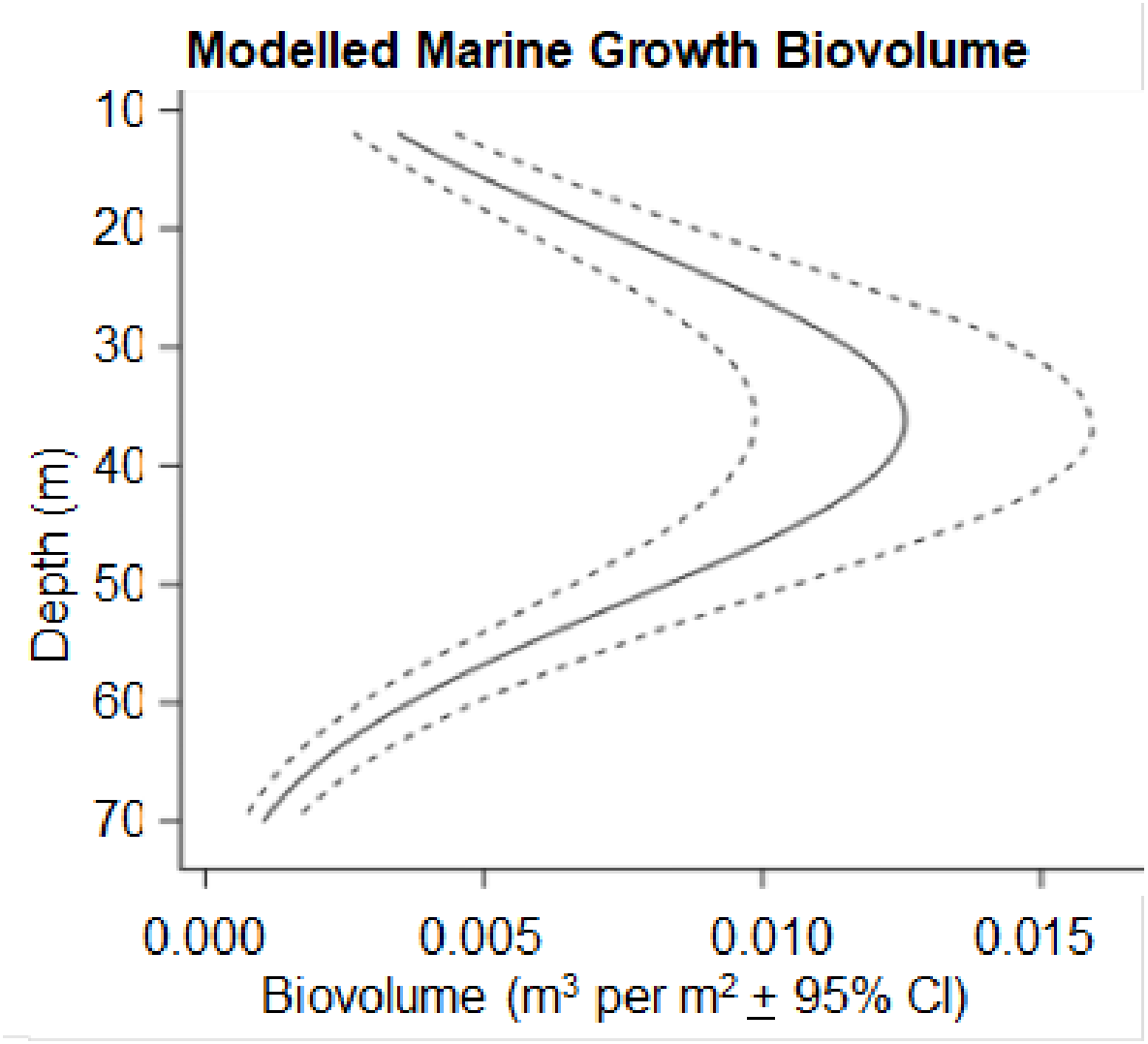
Biovolume



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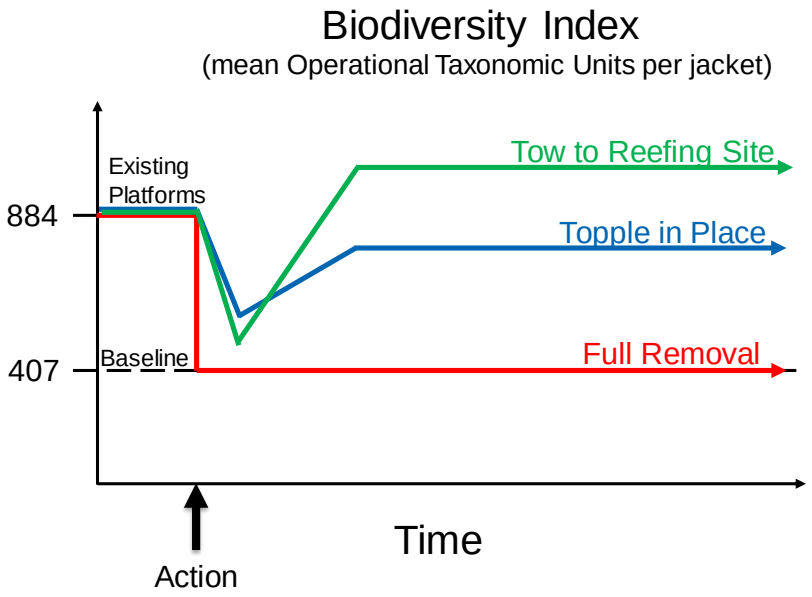
Summary:
New Technologies have Enhanced Data Quality for NEBA and Comparative Assessments

- Faster and cheaper
- Improved resolution
- Improved estimates of size and area
- Improved detection power
- Quantitative instead of qualitative
- Sets the foundation to move beyond ecological metrics and into socioeconomic value (e.g. fisheries)



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Data Gaps and Future Research Needs

- Scaling fish biomass to socioeconomic value
  - Rigorous process required to estimate value in context of fisheries
- Impacts to biological communities when structures are moved
  - How much biofoul is lost during decommissioning
  - What proportion of fish communities follow structures to new location?
  - How long does it take for recovery and to what end state?
- Other ecosystem service values
  - How do assets enhance connectivity among populations?
  - How do assets enhance fishery production through protection of spawning stocks?

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Discussion

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