Marine Biodiversity Hub

National Environmental Science Programme

Scoping report:
Comparative assessment of benthic sampling platforms

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Project D2: Standard Operating Procedures (SOP) for survey design, condition assessment and trend detection

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1. BACKGROUND

Marine monitoring of Commonwealth reserves requires sampling of biological and environmental factors over space and time in order to assess status and detect trends. There is a huge range of methods used to sample benthic biota and environments, some of which are frequently used and well-established (Hopkins 1964), and others that are new or contentious (Rhoads et al. 2001). For biological sampling at the seafloor, sampling methods can be broadly grouped into destructive epifaunal samplers (sleds, trawls, dredges), destructive infaunal samplers (grabs, corers,), and non-destructive samplers (imagery systems) (Bowden et al. 2015). There is also a range of acoustic methods that can be used to map the seafloor (multibeam sonar, sidescan sonar, single-beam sonar) (Brown et al. 2011). Although these usually don't provide biological data, they are the foundation for monitoring activities in large regions, as they facilitate extensive and precise descriptions of physical habitat. A number of established protocols for marine sampling exist for various regions, habitats, and objectives (reviewed in Coggan et al. 2005) and have been nationally standardised and implemented for shallow Australian waters (e.g. Reef Life Survey (Stuart-Smith et al. 2017) and pelagic megafauna (e.g. Animal Tracking Facility). It can be daunting to consider all marine sampling platforms in the context of a monitoring program and to ensure that the most appropriate methods are adapted for a given purpose. There is thus a need for a synthesis of benthic marine sampling platforms as they relate to the design and implementation of monitoring programs.

As part of the NESP Project D2 ('Standard Operating Procedures for survey design, condition assessment and trend detection'), this scoping report will provide the basic framework for a subsequent report comparing benthic marine sampling platforms, including their suitability for use with different monitoring objectives. A complementary scoping report exists for pelagic platforms (Bouchet et al. 2017).

2. PROPOSED OUTLINE

The final comparative assessment of benthic marine sampling platforms will contain the following:

Chapter 1: Introduction

- Background
- Scope
- Objectives

Chapter 2: Review of Platforms[1]

- Direct Sampling
- Epifaunal samplers (sled, trawl, dredge)
- Infaunal samplers (grab, corer)
- Imagery (towed system, AUV, benthic BRUV, Sediment Profile Imagery)
- Acoustics (multibeam, single-beam, sidescan)

Chapter 3: User Perceptions of Platforms

- Description of online questionnaire completed in February 2017
- Summary of user perspectives

Chapter 4: Comparison of Platforms (General)

- Review of studies using multiple platforms & their findings (qualitative)
- Case studies where datasets from multiple platforms are available (quantitative)

Chapter 5: Assessment of Platforms (Monitoring)

- Using results from Chapter 4, relate to monitoring objectives
- Assessment of direct sampler platforms
- Assessment of imagery platforms
- Assessment of acoustic platforms

Chapter 6: Conclusions and Recommendations

- Summary of findings
- Recommendations for further research, particularly as related to knowledge gaps, future monitoring needs, technological developments, and ongoing programs (e.g. IMOS).

[1] This list is indicative and will be refined following literature review

3. PROPOSED METHODS

3.1 Literature review (Chapter 2)

Using the Web of Science database, the literature will be searched for existing descriptions and evaluations of marine sampling methods, from which a list of known benthic sampling platforms and their characteristics will be compiled (Table 1, 2). Previous Hub outputs will be targeted to ensure consistency and legacy value (Flannery and Przeslawski 2015, Hayes et al. 2015).

Table 1: Table template summarising the major types of benthic sampling platforms and their acquisition targets. Ellipses indicate information to be included in the comparative assessment report.

		Data Type	Data Target	Spatial coverage	Environment
Acoustics	MBES	Bathymetry, backscatter	Seafloor	Continuous	All
	Sidescan	…	…	…	…
	Single-beam	…	…	…	…
Imagery	AUV	…	…	…	…
	BRUV	…	…	…	…
	Towed Vid	…	…	…	…
	Sediment Profile Imagery	…	…	…	…
	Drop camera	…	…	…	…
Direct sampling	Grab/Corer	…	…	…	…
	Sled/Trawl	…	…	…	…
	Rock dredge	…	…	…	…
	SCUBA diving	…	…	…	…
	Suction sampler	…	…	…	…
Multiple	ROV	…	…	…	…

Table 2: Table template listing the advantages of key benthic sampling platforms. Ellipses indicate information to be included in the comparative assessment report.

	MBES	AUV	BRUV[2]	Towed Vid	Grab/Boxcore	Sled/Trawl
Continuous spatial coverage	X	…	…	…	…	…
Non-destructive	X	…	…	…	…	…
Able to revisit exact sites	X	…	…	…	…	…
Species-level identifications[3]		…	…	…	…	…
Genetic etc analysis possible		…	…	…	…	…
Quantitative	X	…	…	…	…	…
Physical and biological data		…	…	…	…	…

To identify potentially useful data and results incorporating multiple sampling platforms, the database will also be searched using keyword combinations of various gear types (sled, trawl, grab, *core, video, imagery, BRUV, AUV) and filtering by 'Marine Freshwater Biology'. Any study in which two or more of the sampling platforms listed in Table 1 are deployed and associated data are analysed will be short-listed for inclusion in a meta-analysis.

3.2 Online questionnaire (Chapter 3)

Although user perceptions are subjective and may not reflect a platform's true capability or cost, they are nonetheless important in a comprehensive evaluation to identify the reasons behind a given platform's use, or lack thereof (i.e. an appropriate platform may be underused simply because it is perceived as being too costly or difficult to operate). A questionnaire to gauge use and perceptions of benthic marine sampling platforms was released on 15 Dec 2016 to NESP researchers via Survey Monkey: www.surveymonkey.com/r/C2DQCRC. It was then advertised between 25 Jan – 23 Feb 2017 on the e-news of the Australian Marine Science Association and emailed to individual researchers as appropriate. The questionnaire was approved by CSIRO's Social Science Human Research Ethics Committee in accordance with the National Statement on Ethical Conduct in Human Research (2007).

There were 17 questions about respondents' marine survey experience, equipment use, and perceptions. A total of 49 people completed the survey, and a summary of the results will be included in our final report on the comparative assessment of benthic sampling platforms.

[2] Includes benthic BRUVs only. Pelagic BRUVS will be included in a separate report (Bouchet et al 2017).
[3] Refers to identifications able to be made with unknown or cryptic species (i.e. well-known, distinctive species can be identified via imagery)

3.3 Meta-analysis (Chapter 4)

A qualitative or quantitative meta-analysis will be undertaken based on the number and quality of studies short-listed from the literature review. It seems unlikely that a quantitative analysis will be suitable at a broad scale since preliminary work has shown high variation within a sampling platform type, as well as limited data available from multiple platforms within a particular survey (Flannery and Przeslawski 2015). Rather, quantitative analyses may be done on particular studies and datasets from given surveys.

3.4 Assessment of platforms for monitoring objectives (Chapter 5)

Based on the findings from the literature review, each key benthic sampling platform will be assessed regarding their utility to measure ecological indicators as identified from published research and communication with Department of Environment, with consideration of ongoing initiatives of similar indicators (e.g. GOOS Essential Ocean Variables).

4. REFERENCES

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