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National **Environmental Science** Programme

Map-Based Portals for Marine Science Communication and Discovery

Report from July 2019 Workshop

Tim Langlois[1], Jacquomo Monk[2], Vanessa Lucieer[2], Brooke Gibbons[1]

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

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1 University of Western Australia
2 University of Tasmania

THE UNIVERSITY OF
WESTERN AUSTRALIA
SEEK WISDOM

UNIVERSITY*of*
TASMANIA

IMAS
INSTITUTE FOR MARINE
& ANTARCTIC STUDIES

Enquiries should be addressed to:

Tim Langlois
tim.langlois@uwa.edu.au

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EXECUTIVE SUMMARY

Map-based portals are being increasingly recognised for their utility in marine science communication and data discovery. It is important that current, relevant and reliable marine ecological data is readily available to a wide-range of users including managers, scientists and the general public.

This report describes the outcomes of a Marine Biodiversity Hub workshop held in July 2019 that hosted a discussion on "Map Based Portals for Marine Science Communication and Discovery. Portal champions, representing 16 existing map-based web portals together with a range of end users, including marine park scientists and experts in spatial marine data came together to review and learn from the national experience with their experiences in both delivering these services but also being end users. We captured the requirements from these different users through the narrative of "User stories", which provides us with useful information of explanations of the different portal features written from the perspective of the end user. We mapped the synergies between existing services and using the "The Marine Data Landscape", identified a variety of considered gaps and captured new suggestions for future developments, including an assessment on the priority and feasibility of these new initiatives.

The individual portal descriptions, user stories and recommendations listed in this report provide an overview on the lineage of the development of map-based portals for marine data in Australia. As the first workshop of its kind, this report brings together a synthesis of information that has not previously been available to the user community. This information and report is a step towards national coordination of these important services.

Existing web portals and data services have a range of recognised strengths, but also acknowledged limitations. We found that there is a need to create much closer integration and links between current web portals and data services to ensure that the plethora of marine data and products currently online is easily discoverable to users from a variety of backgrounds and expertise, and that the synergies, complementarities and links between different platforms is transparent to the end user.

One recommendation is to advocate that the community acknowledge the benefit of adopting standard machine-readable protocols. This will permit data and science communication products to be discoverable between platforms, meaning that the sharing and discovery of data and science communication products can be linked rather than duplicated. This will enable different users to interact with data on web portals at different levels of detail relevant to their interests, experience or needs. The democratic nature of these connections between portals would enable all users to explore the available knowledge to match their level of enquiry, but that the data will be delivered by the most appropriate and expert source.

To ensure that these portals continue to develop and prove to be useful for marine science communication will require sustained effort and the acknowledgement at both the individual and organisational level that a coordinated approach will deliver the best outcomes for national science needs when challenged by limited funding.

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1. INTRODUCTION

1.1 Background

There has never been a more important time for marine researchers to communicate their findings and make their data discoverable in a useful and understandable form for both data synthesis and science uptake. Map-based portals are increasingly being recognised as a useful tool for marine science communication and discovery. It is important that current and reliable marine ecological data is widely available to a range of end users. Such information could provide data discovery and decision support for management agencies (e.g. for Parks Australia's Monitoring, Evaluation, Reporting and Improvement program (MERI)) that meets the FAIR principles (Findable, Accessible, Interoperable, Reusable; Wilkinson et al. 2016). Information on marine environmental assets across all State and Commonwealth waters should also be easy to discover on the web and explore using the host website, and provide a valued experience for all users.

For marine information to meet these expectations it will require the architecture of data portals to be standardised so that the catalogue services are linked both spatially and temporally, and underpinned by a robust architectural data framework. Such services currently exist via many national portals (e.g. https://atlas.parksaustralia.gov.au) and data services (e.g. seamapaustralia.org), but what is missing includes direct link between the platforms- which will increase the potential for much of this data.

Existing web portals and data services have a range of recognised strengths but also weaknesses. The greatest weakness is that identical source datasets and records presented on one portal or service are not always comparable to data presented on another portal, which may be due to an update of the data, or the presentation of incomplete data. This leaves the user considering which dataset is the most current or complete for their application. There is a need to create closer links and better integration between current web portals and data services to ensure that the 'master' version of the data presented is the one that the user has access to. It is important in these times where there is a plethora of marine data and products available online, that these data products are easily discoverable by end users, particularly as the users backgrounds and expertise may be limited in making these assessments. Such linkages and integration of existing portals, data services and visualisation tools would immediately improve efficiencies in data discoverability thereby raising the value of these data assets.

In contrast to existing web-based science communication initiatives that typically host static material; live, dynamic content has the potential to create improved biodiversity discovery and exploration. Through "linking" rather than "duplicating" content, different users may interact with data at different levels of detail relevant to their interests, experience or needs. For example, primary school students might like to know where management zones are and what research has been done (e.g. via video clips and images), whereas marine park managers might want to visualise temporal and spatial trends in biodiversity indicators, with confidence bounds. Resource economists may want to access synthesis ready summaries of raw data records to build environmental accounts for national reporting. The democratic nature of these tools would enable all users to explore the available knowledge to match their level of enquiry.

This workshop targeted marine park scientists, managers and science communicators with the aim of asking them to contribute to a review of existing map-based portals and to assess their 'fitness for use' for marine science communication and discovery for their own applications. The scope of the review was to focus on curated science data products currently available on the web, and not raw data or uninterpreted data products.

This workshop built upon the consecutive Marine Imagery Discoverability & Accessibility 2019 workshop (Przeslawski et al. 2019). There was some coordination among workshop leaders, but each workshop was separately managed with a discrete report, but we have built upon the Marine Imagery Discoverability & Accessibility Recommendations (Appendix 1) generated by that and previous Marine Imagery workshops. The specific issues relevant to this report include:

- Develop and apply communication strategy between implementation group (e.g. marine imagery collective) and oversight group (e.g. National Marine Science Committee (NMSC))
- Specify a metadata/data format for organisations to submit information about marine imagery, including image URL, location, annotation method. This can be aggregated by the Australian Ocean Data Network (AODN) for discoverability and visualisation without having to store the imagery.

1.2 Objectives and recommendations

The objectives of the workshop were to:

1. Learn from past challenges developing web portals, data services and discovery services

2. Map the synergies between existing services and identify gaps using a "Marine Data Landscape" schema

3. Review the content requirements for different users - through the narrative of "User stories"

4. Capture suggestions for future developments

5. Make recommendations on the priority and feasibility of future developments

The recommendations of the workshop were designed to:

1. Prioritise and estimate the feasibility of future developments to link existing portals and data services to enable greater discovery, exploration and visualisation of spatial and temporal data.

2. Ensure the sustained discovery, exploration and visualisation of spatial and temporal data relevant to Australian marine ecological data - with a focus on ensuring services stay current, reliable and meet the needs of a wide-range of users.

1.3 The portals

We invited a champion to speak about each of the 16 map-based portals to present a summary of each platform and highlight the objectives and datasets. A summary of these portals, associated champions and broad scope are provided in Table 1.

Table 1 Map-Based Portals for Marine Science Communication and Discovery presented at the 2019 workshop.

Portal	Champion	Institution	Scope	URL
National Map	Mats Henrikson	CSIRO	An online map-based tool to allow easy access to spatial data from Australian government agencies.	https://nationalmap.gov.au/
AMP: Science Atlas	Parks Australia, Eric Lawrey	Parks Australia; AIMS	Designed to help communicate the science and research underpinning the design of Australian marine parks and share information about new and ongoing scientific research in these parks.	https://atlas.parksaustralia.gov.au/
Seamap Australia	Vanessa Lucieer	UTas	This portal brings together spatial data from national seabed mapping collections, making the data comparable, discoverable and accessible in the one location.	https://seamapaustralia.org/
ARMADA	Dave Watts	CSIRO	Provides data summaries of marine data from AODN partners and others using web services (WFS). It has been designed to aggregate and then identify data within Key Ecological Features, but it is also applicable to any other regions such as AMPs or GBR.	https://www.cmar.csiro.au/data/armada/
ALA	Miles Nicholls	CSIRO	A collaborative, digital, open infrastructure that collates Australian biodiversity data from multiple sources,	https://www.ala.org.au/

Portal	Champion	Institution	Scope	URL
			making it accessible and reusable.	
OBIS	Dave Watts	CSIRO	Provides a comprehensive gateway to the world's ocean biodiversity and biogeographic data and information required to address pressing coastal and world ocean concerns.	https://obis.org/
eAtlas	Eric Lawrey	AIMS	A website and mapping system for presenting environmental research data in an accessible form that promotes greater use of this information for the GBR and NW shelf. It is also a data management system for preserving and encouraging reuse of this data.	https://eatlas.org.au/
Reef Life Survey	Rick Stuart-Smith	UTas	Aims to engage volunteer divers in the collection of scientific data on the status of and trends in reef biodiversity.	https://reeflifesurvey.com/
eReefs	Eric Lawrey	AIMS	Focuses on the protection and preservation of the iconic Great Barrier Reef, and forms the first step in building a broader comprehensive coastal information system.	https://ereefs.org.au/ereefs
Eye on the Reef 2050	GBRMPA	GBRMPA	A monitoring and assessment program enables anyone who visits the Great Barrier Reef to contribute to its long-term protection by collecting valuable information about reef health, marine animals and incidents that is	http://www.gbrmpa.gov.au/our-work/eye-on-the-reef

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Portal	Champion	Institution	Scope	URL
			used to inform how we manage the Reef.	
Global Archive	Tim Langlois	UWA	An online centralised repository of fish image annotation, stereo calibration and associated information that provides the ability to upload data with flexible file formats.	https://globalarchive.org/
Squidle+	Ari Friedman	GreyBits	An annotation platform and online central repository for annotation data from marine imagery that allows for data aggregation for reporting.	https://squidle.org/
ReefCloud/ BenthoBox	Mark Rehbein	AIMS	An open-access platform that quickly and efficiently collates data to inform reef management decisions.	https://reefcloud.ai/
AusSeabed	Andy Carroll	Geoscience Australia	To serve the Australian community that relies on seabed data by coordinating mapping efforts in Australian waters and improving data access.	http://www.ausseabed.gov.au/
CoastKit	DELWP	DELWP	A central repository of Victorian marine and coastal scientific projects that provides info services to managers, such as summaries of information holdings and data products to show changes and status in biological communities. It also provides functions for researchers with data and imagery from previous surveys.	http://dev-coastkit.cbics.org/

Portal	Champion	Institution	Scope	URL
AODN	Benedicte Pasquer/ Sebastian Mancini	IMOS	Provides access to all available Australian marine and climate science data and is the primary access to IMOS data including access to the IMOS metadata.	https://portal.aodn.org.au/

2. THE PORTAL CAFÉ

We employed the method of the 'world cafe' following the presentations- This format makes use of an informal cafe setting for participants to explore an issue by discussing it in small table groups. Discussion was held in multiple rounds of 20-30 minutes, with the "cafe" style intended to allow for more relaxed and open conversations to take place. The Portal Champions were stationed around the auditorium and groups of participants rotated around these stations every ten minutes (Figure 1). This format permitted the participants to speak to each Portal Champion and a 'scribe' at each station recorded the feedback and suggestions for each portal. To structure the discussions, participants were asked to say: "why would you come back to this data portal?" and "why would you not come back to this data portal?"

Figure 1 Workshop participants in break-out groups (left) and participating in voting on key challenges for marine imagery (right).

3. THE USER STORIES

A "user story" is an informal, general explanation employed to assess the "user point of view" for a software feature. We employ this method to capture the feedback of users, in this case for each of the web portals. Its purpose is to articulate how a "software feature" (data portal toolset or visualisation platform) will provide value to the user. User stories provide a way to communicate back to the developer/creator the features required in a service and to also provide a record of the development rationale for assessing future investment. User stories can be structured with the narrative of "As a... (e.g. Marine Park Manager)", "I want… (e.g. a web portal), 'So that… (e.g. I can see trends in monitoring data)'. The more specific a user story is, the more useful it can be as a method of communicating with developers/creators or as a record of development rationale.

Before the workshop Portal Champions were asked to populate two broad types of user stories for their portal. These were "General" user stories and those specific to "Science Communication and Data Discovery". These user stories were further added to after the Portal Cafe outputs to provide a unique snapshot of the development rationale and features requested by users for the portals presented.

4. MAPPING THE OBJECTIVES AND ROLES OF PORTALS

Using the "Marine Data Landscape" (Fig. 2) and Digital Platforms for Marine Science Data Infographic (Fig. 3) as a framework for thinking about marine data presented, we asked each portal to map their domains and indicate how their requirements lead to whether or not their particular portal dealt with 'measurements'. This included the collection and archiving of raw data; 'data', which captures hosting of synthesis ready summaries of data; and 'products' which are science communication products prepared already for sharing with end-users (Fig. 2).
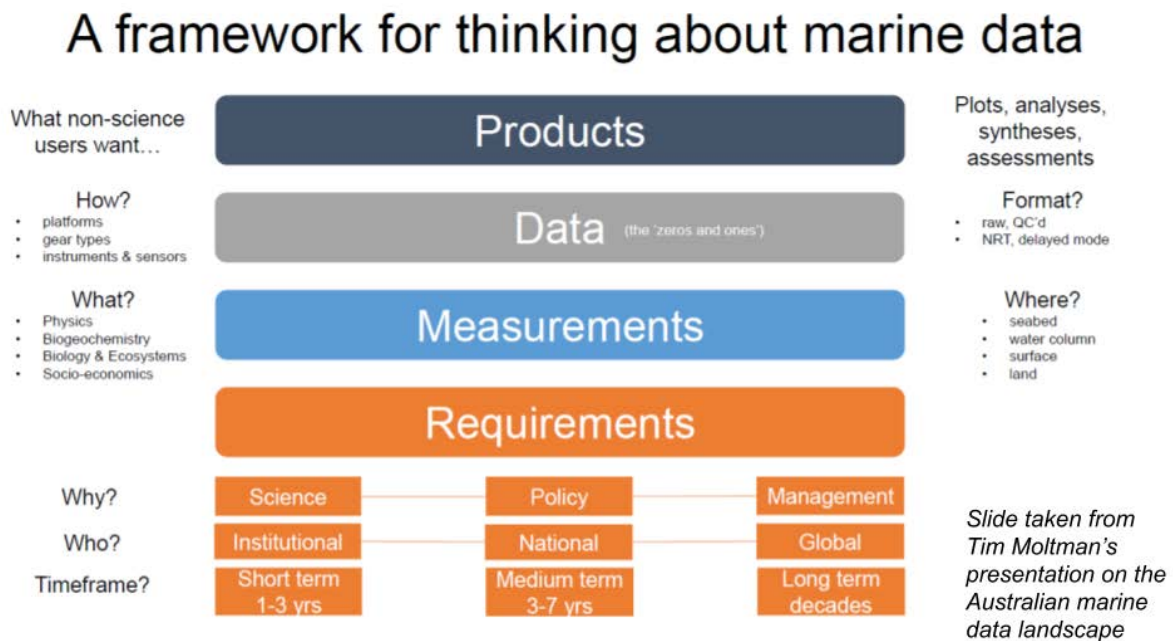
Figure 2 Marine Data Landscape - Slide taken from presentation on the Australian marine data landscape and used as a framework to understand the use cases of the portals presented in the workshop.

Figure 3 Digital Platforms for Marine Science Data Infographic

This framework revealed four broad classes of portal that were:

1. National product portals e.g. NationalMap, Seamap Australia;

2. Regional portals e.g. Eye on the Reef 2050;

3. Measurement and data portals e.g. AODN, AusSeabed, and;

4. Data workflow portals (e.g. Squidle+, GlobalArchive).

For all portals there was some overlap between all these classes, but these classes provide a useful short-hand to the objective and roles of different portals. Ongoing development of portals will require these classes to be revised.

5.   LESSONS LEARNED

5.1 The difference between raw and curated data products for science communication

The workshop participants experienced presentations on a range of map-based web portals, each of which had their own particular objectives and unique user stories. The "Portal Cafe" and "User Story" activities highlighted that the science communication information typically required by users needs to be summarised into interpreted products (maps, charts, infographics etc) and curated data products (shapefiles, sampled video data bytes) and not typically raw data products.

The optimisation of products for marine science communication requires a further targeted workshop to evaluate strategies for presenting representative products. It would be imperative that this workshop be led by science communication experts.

5.2 Data discoverability

The Portal Cafe discussion highlighted the need for discoverability of data hosted by portals. Participants in the Portal Cafe provided recommendations for data discoverability, based on accepted best-practices. These are to adopting Open Geospatial Consortium (OGC) compliant standards (https://www.ogc.org/standards) for all spatial data, both raw and curated summaries, that would include that adoption and regular updating of ISO metadata standards (e.g. ISO19115-3) and the serving of this data using Geonetwork (metadata repository) and Geoserver (Web Mapping and Web Feature Services) services to enable discovery. Risks to long-term data discoverability, raised in the Portal Cafe, included the stability of Geoserver services, where if data portals change, metadata formats or web addresses any links to existing Web Mapping and Web Feature Services may be broken.

We recommend that Open Geospatial Consortium (OGC) compliant standards should be adopted by all web-portals to enable the discovery of raw data, summarise and curated representative data products, but that best-practices should also be developed and adopted to ensure the long-term stability of data discovery.

5.3 Mapping synergies and identifying gaps

The "Marine Data Landscape" schema provided a framework to map the synergies, overlap and gaps between existing map-based web portals. In addition, the 2019 Marine Imagery Discoverability & Accessibility workshop (Przeslawski et al. 2019) generated a Digital Platforms for Marine Science Data and Information infographic further capturing the synergies between portals. To address Marine Imagery Discoverability & Accessibility Recommendations 1.5 (Appendix 1), we recommend each portal be assessed as to how it maps to the "Marine Data Landscape" schema and the Digital Platforms for Marine Science Data and Information infographic (Fig. 3). This should be used to inform future workshops to review the prioritisation and planning of investment in map-based web portals.

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5.4 User stories

The user stories created for each portal by workshop participants, provide a record of the development rationale and features requested by users (Appendix 2). These user stories provide a transparent statement that has not been solicited before in a collective and constructive way. We recommend that the user stories collated by this workshop should be used to inform future workshops and that they are reflected upon when planning new developments for existing map-based web portal tool kits, extensions and summarised data products and used for communication with the NMSC and stakeholders.

5.5 The challenge to link raw data to curated and representative data products

Discussions during the Portal Cafe recognised that different users require different levels of detail in their information which requires access to either raw data, data summaries or curated data products. These discussions and the "Marine Data Landscape" framework highlighted how certain portals are designed to deal with raw data and data production (e.g. Squidle+), whilst others are designed to simply display and contrast curated data products (e.g. NationalMap). The main objective of this workshop was to explore how map-based portals can be used for marine science communication and discovery. It is likely that for science communication high level summaries or curated data products will be required, however these requirements need to be informed by the above recommended workshop to optimize products for science communication that are representative of Australian marine ecosystems. The workshop and its recommendations will help to prioritise the importance of maintaining direct links between raw data, summaries and curated products. The technical challenge to ensure the links are maintained between raw data, summaries and curated products is likely to be very high.

We recommend any future evaluations of the optimisation of data products for marine science communication should also include a cost-benefit analysis of the need to link raw data to both summaries of data and curated data products.

6.   CONCLUSION

A key recommendation from this workshop is the need to promote the adoption of standard machine-readable protocols, data and science communication products that can be made discoverable at different levels of detail required by the varying needs of the user community. This would result in a mechanism where the sharing and discovery of data and science communication products can be 'linked' rather than 'duplicated'- relying on there being one 'source' of the data on a specific geoserver and that all other sites link to it. This will enable different users to interact with data on web portals at different levels of detail relevant to their interests, experience or needs. For example, marine park managers might discover spatial predictions of fish diversity sampled by baited remote underwater video via SeaMapAustralia.org, but resource economists might follow links from SeaMapAustralia to the original annotation data sets on GlobalArchive.org to download synthesis ready open-data summaries of raw data records to build environmental accounts for national reporting. An additional benefit to accessing the data in this way is that the 'master source' can be updated in one place- ensuring web-based data is current, accurate and controlled by the custodian. The democratic nature of such connections between portals would enable all users to explore the available knowledge to match their level of inquiry. A demonstration of this recommendation was provided in our workshop by the ease that 'National Maps' was able to access and display data displayed on and served by 'Seamap Australia'.

The portal descriptions, user stories and recommendations listed in this report provide an overview of the development of map-based portals in Australia. To ensure that these portals continue to develop and maintain their relevance for marine science communication and discovery, will require sustained effort and drive to progress, at both the individual and organisational level.

7. RECOMMENDATIONS

We recommend that Open Geospatial Consortium (OGC) compliant standards should be adopted by all web-portals to enable the discovery of raw data, data summaries and curated data products, but that best-practices should also be developed and adopted to ensure the long-term stability of data discovery.

The optimisation of products for marine science communication would benefit from a further targeted workshop to present and evaluate alternative strategies, that is led by science communication experts. This workshop should also include an analysis of the cost and benefits of linking raw data, summaries of data and curated representative data products.

We recommend each portal be assessed as to how it maps to the "Marine Data Landscape" schema and the Digital Platforms for Marine Science Data and Information infographic. This should be used to inform future workshops to review the prioritisation and planning of investment in map-based web portals and used for communication with the research-users and stakeholders.

We recommend that user stories collated by this workshop should be used to inform future workshops and reviews for the planning of map-based web portal development and provides a clear way to collate the needs of users.

Finally, additional recommendations that add to those made at the 2019 Marine Biodiversity Hub workshops on Marine Imagery Discoverability & Accessibility (Przeslawski et al. 2019) include:

- Develop design protocols for spatial portals to enable immersive data exploration accessible to a wide variety of users.
- Hold a follow up workshop with professional educators to further develop concepts for immersive marine science communication.

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APPENDIX 1: MARINE IMAGERY DISCOVERABILITY & ACCESSIBILITY RECOMMENDATIONS

Developed at preceding Marine Imagery Discoverability & Accessibility workshops from 2018 and 2019 (Przeslawski et al. 2019).

Bold items are the focus of the current workshop and report.

	Task
1. Governance, oversight, and working group(s)	1.1 Present to NMSC on state of Australian marine imagery data
	1.2 Define and promote the role of the NMSC or relevant working group as an oversight committee to provide broad strategic guidance on marine imagery and data accessibility.
	1.3 Establish a marine imagery collective (or revisit ToR for an existing group) to develop a strategy for moving forward as a united community (vision, communicate value, risk and mitigation, funding), including progression of action items detailed in this report
	1.4 Identify leader of this collective who can progress recommendations in this report. Establish support (e.g. funding) for this leader, as this will involve a lot of work.
	1.5 Develop and apply communication strategy between implementation group (e.g. marine imagery collective) and oversight group (e.g. NMSC)*
	1.6 Ensure future versions of NESP field manuals 1) define clear data release workflows, including minimum meta data requirements and consistent vocabularies and 2) articulate the oversight and implementation groups related to marine imagery
	1.7 Continue to promote field SOPs and data standards
2. Long-term or institutional support	2.1 Develop a transparent prioritisation of preferred funding priorities, including: requirements of users regarding data acquisition and product delivery, capacity to contribute to impact, international context (UN SDGs, EOVs), cost-effectiveness and operating scale. Collaborate and communicate this to marine imagery collective.
	2.2 Encourage larger partners in the collective to provide contributions to base funding to ensure resilience and demonstrate buy-in
	2.3 Ensure successful funding proposals address multiple recommendations in this report
	2.4 Develop and apply communication strategy between implementation group (e.g. marine imagery collective) and oversight group (e.g. NMSC)

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	Task
3. Centralised repository and tracking system	**3.1 Specify a metadata/data format for organisations to submit information about marine imagery, including image URL, location, annotation method. This can be aggregated by AODN for discoverability and visualisation without having to store the imagery.**
	3.2 Use above framework to characterise current holdings and adapt organisational workflows to ensure appropriate meta data for marine imagery
	3.3 Scope long term sustainable federated repository (including both images AND annotation, georeferencing, backups, security/sharing, and citation system) or centralised harvesting service with ARDC and other major agencies that have invested in their own appropriate repositories (e.g. geoserver).
4. Bottlenecks	4.1 Address bottlenecks relevant to the objectives of funding proposals, such that a user-friendly and practical national workflow is achievable (see red parts of Figure 4)
	4.2 Prioritise funding proposals that address the bottlenecks and underdeveloped links.
	4.3 Meet with NCRIS to discuss speed-of-access issues with big data
	4.4 Develop workflows (including bottlenecks and undeveloped links) for each of the major imagery sampling gear (AUV, BRUV, Towed imagery, ROV, UVC/DOV).
5. Communication and collaboration	5.1 Develop image analysis workflows
	5.2 Hold annual meetings to ensure continued dialogue and collaboration
	5.3 Adopt a collaborative approach in funding proposals seeking to develop marine imagery capability, such that a clear national workflow(s) is developed and communicated to the marine community
	5.4 Demonstrate how a funding proposal is gear- and platform-agnostic or clearly identify its association with a particular gear type (e.g. AUV).
	5.5 Prioritise funding proposals that adopts a collaborative approach to develop marine imagery capability between the main groups.
6. Other	6.1 Each organisation take responsibility for ensuring their data abides by FAIR principles, including funding, input, and support for infrastructure
	6.2 Scope the need, scale, and cost of digitising legacy data at risk of being lost (e.g. VHS imagery)
	6.3 Funded projects should clearly identify the intended user of the proposed infrastructure or research, ideally addressing diverse end-user case studies.

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Task
6.4 Set targets for Open-data and encourage use of time-locks or embargoes on data, but avoid mandating. In particular, this will promote industry data sharing. Note that all other recommendations detailed in this report will also promote industry data sharing by developing the practical infrastructure that encourages data input into safe repositories.

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APPENDIX 2: User Stories

GlobalArchive general	User Stories	
As a...	**I want...**	**So that...**
stereo-video ecologist	a secure centralised data archive	data is organised (findable)
stereo-video ecologist	a secure centralised data archive	data is open or share-able (accessible)
stereo-video ecologist	a secure centralised data archive	data is standardised (interoperable)
stereo-video ecologist	a secure centralised data archive	data is easy to use and access (reusable)
stereo-video ecologist	direct import of annotation data	so annotations are interoperable and can be re-annotated
stereo-video ecologist	to import of historical and modern annotation data	time-series data is interoperable
stereo-video ecologist	data sharing control	metadata is public and findable
stereo-video ecologist	data sharing control	annotation data is accessible and can be Open or shared with particular users
stereo-video ecologist	sampling methods type and variations are recorded	data is findable and interoperable for synthesis
stereo-video ecologist	direct link to statistical software	so analyses and reporting are reusable
stereo-video ecologist	a tool to import data for visual checking	I can see outliers
Marine park manager	To be able to get species, abundance and length summaries for fish communities within the Park, Zone, or specific location at a particular time period.	We can understand changes in fish communities through time.

GlobalArchive	science communication and data discovery	User Stories
As a...	**I want...**	**So that...**
stereo-video ecologist	to be able to upload links to curated videos	people can find and explore video footage for science communication
stereo-video ecologist	to be able to upload links to publications	people can find my open-access publications to read more
stereo-video ecologist	to be able to upload links to summary figures	people can find and explore these figures for science communication
stereo-video ecologist	to be able to upload links to predictive model outputs (WMS)	people can find and explore these products for science communication
Marine Park scientist	to view temporal and spatial trends in metrics	data is reusable to brief a minister or for a school talk
Marine Park scientist	to view spatial management regulations/zoning	marine park management context is provided for metrics
Marine Park scientist	to be able to view raw and modelled data	statistical inferences can be made
Marine Park scientist	to be able to request extra metrics and compare	data is reusable for reporting
marine park science officer	to be able to generate a report for an area (either a polygon or feature on an existing layer like Australian Marine Parks) with count of samples per method (inc date and custodian info)	I can identify gaps to plan for future investment or project involvement
marine park science officer	to be able to easily ingest samples metadata into my GIS tool, preferably as a WMS/WFS	I can identify and report on where BRUVs have been used in the parks I manage for the purposes of science program planning
stereo-video ecologist	A geoserver to serve the metadata	Other infrastructure - e.g. AODN, Seamap can link to in and point people to GlobalArchive to find current annotation data

AusSeabed User Stories

As a...	I want...	So that...
Parks Australia monitoring officer	the area of bathymetry and backscatter coverage and % coverage in area of interest (e.g. estate, network, park, zone, IUCN category, zone category)	I can efficiently prepare annual reports
1. Parks Australia science project planner 2. Parks Australia park manager 3. Parks Australia authorisations officer 4. Parks Australia communications officer 5. Parks Australia monitoring officer	To be able to see bathymetry visualisation products (e.g. bathymetry contours, bathymetry colour gradation, hill-shade, geomorphological features, backscatter etc) at the highest resolution available for areas of interest (e.g. network, park, zone, specific location).	So we can see the features in the parks and use this to plan future bathymetry surveys, ecological surveys, in the authorisations space use it as a proxy for areas of high biodiversity in the absence of existing ecological information, use for communications purposes to share our understanding of AMPs with the public.
1. Parks Australia communications officer 2. Parks Australia park manager	To be able to see communication-ready bathymetry visualisation products (e.g. Bathymetry of key seafloor features in Jpeg, TIFF format to show oblique views, or ability to change your angle of view, flythroughs, infographics using bathymetry as a base) at the highest resolution available for areas of interest (e.g. network, park, zone, specific location).	So we can better explain the significance of key features In our parks and use them for communications purposes to share our understanding of AMPs with the public.

Marine
Biodiversity
Hub

Any Portal User Stories

As a...	I want...	So that...
1. Parks Australia monitoring officer 2. Parks Australia science project planner	To know surveys (including counts of surveys) undertaken in my area of interest including instrument/platform, when, who, where.	1. I can efficiently prepare annual reports with # of surveys in an area of interest 2. I can identify survey gaps and plan future survey investment. And when I see "unmapped" in Seamap I can then go on to find out if there have been any surveys (but data has not been analysed) or if we need to do some surveys.
Parks Australia science project planner	To know the types of datasets that resulted from surveys in my area of interest that relate to bathymetry, substrate type (e.g. reef, sediment), sessile invertebrates, mobile invertebrates, demersal fish, pelagic fish	I can identify available data and plan future survey investment.
1. Parks Australia science project planner 2. Parks Australia authorisations officer 3. Parks Australia communications officer 4. Parks Australia monitoring officer	To visualise the location and number of monitoring sites, their purpose, and what is being monitored at each monitoring site, in my area of interest. To be able to identify monitoring sites that are part of the AMP monitoring program (i.e. to be able to differentiate these from other monitoring sites set up for different purposes).	1. I can plan a monitoring program 2. When I assess an activity for a permit or a licence, that that activity will not impact on long-term monitoring sites, 3. I can communicate about Parks Australia's monitoring program 4. Reporting for monitoring and evaluation, corporate plan etc.
Parks Australia science project planner	To know what voyages are being scheduled across the Australian RV fleet	I can identify future opportunities for collaborative surveys in AMPs
Parks Australia authorisations officer; Parks Australia park manager	A push button report that tells me, for an area of interest, what values are susceptible to what pressures	I can understand what habitats are susceptible to what pressures and use this to support decisions
Parks Australia's and other organisation's communications officers	To discover via a map, access, and use pre-selected stunning images	I can produce stunning communication products with confidence they occur in my park
Parks Australia science project planner	To know the number of voyages across the Australian RV fleet through an area of interest (e.g. estate, network, park, zone) over a period of time	I can communicate the interactions between marine parks and science activities
Parks Australia monitoring officer	For an area of interest within a time range provide location and levels of pressures and drivers acting on AMPs. e.g. climate change, invasive species distributions, resource extraction etc.	I can prepare yearly and 4 yearly reports including these stats to help answer: To what extent has the impact of pressures on AMP values been minimised or maintained at acceptable levels, in line with zone objectives?

National **Environmental Science** Programme

AODN general User Stories

As a...	I want...	So that...
Australian marine scientist	to spatially, temporally and/or by any other mean filter relevant datasets to my research prior to downloading it	I know whether there is data available and I only download the data for these areas/period/other filters of my interest.
Australian marine scientist	to visualise any gridded dataset prior to downloading it	I know whether it is worth downloading it
Australian marine biologist	to download in-situ data in CSV format	So that I can easily include it in my workflow
Parks Australia science project manager and authorisations officer	To discover DNP-funded and authorised outputs and determine their licensing	I can report on compliance with research funding and authorisation conditions

AODN science communication and data discovery User Stories

As a...	I want...	So that...
Australian marine scientist	to find datasets that are relevant to my research without having any pre-knowledge of IMOS or AODN partners infrastructure	It is easier to do my research
Australian marine scientist	to access Australian marine datasets in a single place	It is easier to collect data for my research

Squidle+ general User Stories		
As a(n)...	**I want...**	**So that...**
annotator of marine images	*to annotate marine imagery using a centralised, standardised online interface*	*I can analyse collected survey data using standardised tools without the need to download the imagery and metadata and manage the process using my own bespoke workflow*
annotator of marine images	*to export my annotations in a variety of different formats including all associated metadata*	*I can <insert science question>*
user of other annotation tools	*to be able to upload my annotation data to a centralised annotation repository*	*my data is made available in a consistent, standardised, national repository for future reuse and synthesis*
AODN portal user	*to be able to jump from the AODN portal to view / analyse datasets using online tools*	*I don't need to download entire datasets or manage my own bespoke workflow, and can maintain best practices and national standard for annotating imagery*
platform operator	*my uploaded survey data (imagery and metadata) to be automatically (or easily) imported and made publicly available for immediate analysis through a centralised online interface*	*the data is discoverable and available, we can reduce the time delay between turning data into information, it can be analysed in a consistent framework facilitating future reuse (standardised) and the data doesn't just end up on a hdd in a box under my desk*
annotator of marine images	*to be able to select from a range of standardised (or customised) annotation schemes to conduct my analysis, with the benefit of being able to crosswalk between annotations schemes (where possible and appropriate)*	*I can maintain national standards, and do not need to invent my own annotation schemes, but if I do, will at least have the data in a consistent framework that makes it possible to translate schemes helping to ensure the reusability and relevance of my data*
general user	*to be able to explore the collected survey data through a visual map-based interface and decide what datasets I want to examine/select for more detailed analysis*	*I have easy, quick access to all collected survey data without having to get in touch with the platform operators to track down the data I want to look at (or will otherwise most likely not even know exists)*
annotator of marine images	*to be able to choose available survey data using map-based tools, filters and standardised subsampling methods to create subsets of data for detailed analysis*	*I can quickly and easily generate manageable subsets for detailed analysis using accepted standardised practices without needing to download and process the metadata myself, write subsampling code or manage my own bespoke workflow for data analysis*
MPA manager/policy maker	*to have access to the most up to date SoE information informed by a national repository of annotations*	*I am equipped to make informed decisions*
MPA manager/policy maker	*to see high level overviews of annotation data in easily digestible report formats*	*I can see quick snapshots of useful info for my decisions and report without having to deal with exporting individual datasets*
machine learning researcher	*to have access to a large database of consistently labelled annotations along with underlying data to train and validate machine learning algorithms*	*we can advance the field improving the state of the art for automated labelling of marine imagery (through maximising the amount and quality of training/validation data)*

Squidle+ general User Stories

annotator of marine images	*to have access to the latest and greatest automated labelling tools*	*rather than manually labelling everything myself, I can spend time validating automated output which means I will have access to more labelled data and can spend more time on the science, rather than doing the grunt work.*
user of annotations	*to be able to assess the quality of annotations by having information about how the labels were obtained (I.e. who/what labelled them, and with what confidence)*	*I can assess the reliability of the labels before using them*
annotator of marine images	*to be able to collaborate with other annotators (human and/or algorithms) and to be able to conduct QA/QC on those labels*	*I can improve the quality and speed of the annotation process gaining access to more annotated data with less effort*
annotator of marine images	*have access to visual morphospecies catalogues while annotating*	*it is easier to maintain consistent labelling between users and standards are more easily upheld*

AMP Science Atlas general User Stories		
As a...	**I want...**	**So that...**
interested public	to understand what science went into the development of the Australian Marine Parks	I can be confident that they will be effective
tourism operator	to find information about the latest research in a marine park	I can tell interesting stories to my clients about the area I am taking them to
tourism operator	to find information about values in a marine park	I can tell my clients about the habitat and species that live in the area we're visiting
marine park communications manager	to engage the interested general public e.g. regional communities, school children	
marine park communications manager	to engage the interested general public	to increase awareness and support for management of marine parks (specifically research and monitoring).
marine park user	discover what information is known about a marine park of interest	I can develop a permit application to undertake an activity in the marine park
marine researcher	discover recent research and publications relevant to marine parks	I can identify research gaps or early scope my research
interested public	watch videos of life in marine parks (e.g. highlights footage)	I'm tired of cat videos
environmental manager	discover the science/research has been done in the marine parks	I can come up to speed with the issues affecting the marine park as I am new to the job.
marine park science manager	present information about our research and monitoring projects to the general public	I can increase understanding of marine park values, pressures and adequacy of management responses (Science Program objective)
marine park science manager	provide information about the management activities in our marine parks	I can improve understanding of the effectiveness of park management in protecting park values (Science Program objective)
marine park science manager	communicate and highlight our research priorities	I can encourage research and monitoring of park values, pressures and management effectiveness
marine researcher	share the details of my research in a marine park, including who and where	to demonstrate the management application of my research
marine park science manager	promote research undertaken in Australian Marine Parks	to demonstrate active science undertaken in partnership

AIMS eReefs portal general User Stories		
As a...	**I want...**	**So that...**
environmental manager	see what is happening with the latest conditions on the reef	I can be informed, report on conditions and consider if any management actions are required
environmental manager	look at the relationship between drivers (wind, temp, salinity, WQ)	I can understand the dynamics of the environmental conditions on the GBR
environmental manager	to have near real time visualisations	I can monitor unfolding impact events (flooding, thermal heatwave)
environmental manager	see monthly and seasonal summaries	I can see long term patterns to help identify regional differences (potential future refugia)
marine researcher	see what is happening with the latest conditions on the reef	I can better understand the environmental conditions that my survey areas have been subjected to
marine researcher	understand spatial patterns of environmental conditions	I can develop theories about environmental dynamics that explain ecosystem patterns
Reef Plan manager	a report card for the water quality for the GBR	I can track the effectiveness of GBR catchment land practices changes
Reef Plan manager	to compare the effect of different GBR catchment land practice changes	I can prioritise areas that should receive more funding to change
interested public	understand recent events (extreme weather)	I can understand what happened

eAtlas general User Stories		
As a...	**I want...**	**So that...**
environmental manager	discover what information is known about a location of interest	I can make more informed permit decisions
environmental manager	discover the latest research on a given topic	I can create synthesis reports such as the Outlook report
environmental manager	visualise spatial data to understand the broad patterns	I can make informed judgements on planning potential management policies
environmental manager	who are the relevant experts in each field	I can contact them with a question
environmental manager	understand how environmental systems work	I can come up to speed with the issues affecting the marine park as I am new to the job.
marine researcher	discover what research data is available	I can obtain data relevant for my research question
marine researcher	view metadata and a visualisation of the data	I can quickly assess whether the data is relevant for my question
marine researcher	be able to quickly download relevant datasets	I can integrate the data into my analysis
marine researcher	have detailed metadata and associated reports about datasets	I can understand the datasets and reuse them with confidence
marine researcher	datasets to be sufficiently documented	I can repeat baseline studies in the future
general public user	articles that describe general topics	I can understand a topic of interest
research program manager (RRRC)	know that research projects (NESP TWQ) are doing good data management	I can report progress to the funding body (DOEE)
research project leader	understand what is needed to be done for my data management	I can meet the data management requirements of my funding
high school educator	articles that describe general topics	I can provide additional training resources that match the high school curriculum

Eye on the Reef 2050 - User stories		
As a...	**I want...**	**So I can...**
Marine Park Manager	Access Marine data	interrogate and use up to date data to better manage Marine Park
General Public	First Stop Shop	remove the search for data providers and sources of data
Marine Park Educator	Engage public	increase awareness and understanding
Marine Park Manager	Understand where the knowledge gaps are	Guide research and science
Marine Park Manager	An integrated early warning system for threats to the Reef	Take action - i.e. CoTS response, Bleaching assessment etc
Marine Researcher	Know what is being monitored, where, how often, by whom	Value add and use other monitoring
Funding Providers	value for money projects	Manage commonwealth funding
Marine Park Manager	Integrate data	Analyse and display information
Marine Park Manager	Visualise data	Bring information together from a range of sources

ReefCloud portal general User Stories

As a...	I want...	So that...
reef monitor	a tool that will help me manage my monitoring imagery in the field	I can keep them organised in a standard way
reef monitor	a tool that will allow me to tag my monitoring photos	I can tag photos using classifications that meet my legacy needs
reef monitor	a tool that will automatically tag my monitoring photos	I can phase out manual tagging
reef monitor	a tool that will analysis the results of the surveys	I can see the current status of the reefs that I monitor
reef monitor	a tool that will streamline the workflow from image collection to reporting	I can monitoring more locations for the same level of effort
marine park manager	see the status and trend of the reefs in my marine park	I can better understand the dynamics of the reefs
marine researcher	global (or multi-region) coral monitoring data	I can understand reef dynamics across a broad set of regions
Global Coral Reef Monitoring Network	a system for standardising coral monitoring globally	I can generate regular reports on the status of global coral reefs

IMOS-RLS NRMN general User Stories		
As a...	**I want...**	**So that...**
Marine scientist	to easily obtain raw data for a particular area (using a polygon or dropdown box) with fish and macro-mobile invertebrate species-level abundance data in a standardised format	I can analyse the data and use it for management reports, journal publications, thesis, public communications products, art, etc.
Marine Park agency	to see where data have been collected using standardised methods methods	So that I know what data are available for my jurisdiction, can identify gaps, plan monitoring investment, commission reports, and know where contextual data are available from elsewhere that are directly comparable
Marine Park agency	to easily obtain raw data for a particular area (using a polygon or dropdown box) with fish and macro-mobile invertebrate species-level abundance data in a standardised format	we can undertake our own in-house analyses and reporting, evaluate the performance of current management, and guide future decisions
Local government or council	to easily obtain raw data for a particular area (using a polygon or dropdown box) with fish and macro-mobile invertebrate species-level abundance data in a standardised format	we can undertake our own in-house analyses and reporting
School or research group	to easily obtain raw data for a particular area (using a polygon or dropdown box) with fish and macro-mobile invertebrate species-level abundance data in a standardised format	we can undertake our own in-house analyses for training and educational purposes, using data that can be accessed in a standard format
Data officer	to be able to access live, standardised data extracts	Photo Quadrat images can be shared with other users for scoring and analysis
Data officer	convenient access to the live updated, standardised data extracts	they can be used to generate species pages (RSoW), Indicator reports and other online RLS products
Data officer	convenient access to the live updated, standardised data extracts	I can share data with collaborators
Collaborator, technical staff or sub-contractor	Easy access to imagery from photoquadrats	I can download and score these on my own, without needing to make special arrangements to access the files

RLS Reef Species of the World general User Stories		
As a...	**I want...**	**So that...**
RLS or research diver	to generate a location-based species list (using a bounding box or dropdown menu), which can be ordered by how common species are within that location	I can prioritise the learning of fish and macro-mobile invertebrate species ahead of my field work
RLS or research diver	A comprehensive online field guide with images of multiple life stages and variations of each species	I can look up and identify species seen on a survey, to maintain data accuracy
RLS or research diver	to generate and export a species list for a particular area which I can order by taxonomy/survey method and/or frequency of occurrence	I can have a checklist of local species to help with data entry
RLS trainer	to be able to test the ID skills of RLS divers	we can approve the divers to collect data from new areas, confident in their ability to recognise the local fauna
An interested member of the public	to search for a comprehensive database of images that I can narrow down by taxonomy, size or location	to identify/look up the name of an unknown species from my dive
An interested member of the public	to browse images of species from a certain area	to learn the species I am likely to see when diving there (e.g. travelling to a new area to dive), or look up unknown species when there
An interested member of the public	to search a database of images of all species	I can identify an out of range or invasive species (and advise the relevant group (EPA, Redmap, etc))
An interested member of the public	an easy way to view random images (flash cards) of local marine life and test my own knowledge	to become more familiar with the marine life for a particular area or my local dive site
An interested member of the public	information about particular species, including how common it is, behaviour, variations in appearance	I can learn more about marine species, their variations and whether a sighting was of a rare species or common one, for e.g.
Government agency staff	a source of reliable and up-to-date information on species with images for my region of interest	Our agency can provide appropriate information to the public and line managers, and have a source of images to request and use for public materials.

ARMADA general User Stories		
As a...	**I want...**	**So that...**
marine park manager	discover what information is known about a marine park of interest	understand the values of the AMP
marine park manager	discover what information is known about a marine park of interest	Understand data gaps and potential baseline sites
marine researcher	discover existing surveys and data relevant to marine parks or KEFs	I can identify research gaps
environmental manager	discover the science/research has been done in the marine parks	I can come up to speed with the issues affecting the marine park as I am new to the job.
marine park science manager	present information about our research and monitoring projects to the general public	I can increase understanding of marine park values, pressures and adequacy of management responses (Science Program objective)
marine park science manager	provide information about the management activities in our marine parks	I can improve understanding of the effectiveness of park management in protecting park values (Science Program objective)

OBIS general User Stories		
As a...	**I want...**	**So that**
marine park manager	discover what information is known about a marine park of interest	what species exist, what species not seen recently, any invasive species so I can construct a suitable management plan
marine park manager	discover what information is known outside a marine park of interest	identify potential threats (invasive),
marine researcher	discover existing surveys and data relevant to my research	potential changes in distribution, population sizes
taxonomist	discover where specific taxa exists and the data sources	identify new ranges, check specimens

ALA general User Stories

As a...	I want...	So that
conservation manger	a list of species in an area	I can decide whether to make that area protected or allow development
student	a simple tool modelling tool	I can learn about species distribution modelling
data analyst/developer	to download data or access it via services	I can work with the raw data
citizen scientist	a tool to record sightings	to contribute to knowledge of biodiversity
collection manager/taxonomist	to see what specimens are available	I can conduct taxonomic research and manage my collection
researcher	environmental and biodiversity data combined	I can research biodiversity change, impact and the environment

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