Social Science for Meeting Australia's Ocean Goals

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Abstract

Marine social sciences (MSS) are the sciences of human-ocean interactions. They are key to ensuring the health and wellbeing of oceans surrounding Australia and that of the Peoples and nations with relationships to, and responsibilities of, caring for these oceans. Achieving such goals will benefit Australians in all walks of life, and in many sectors and businesses. This includes Aboriginal and Torres Strait Islander Peoples whose relationships with the ocean incorporate a range of tangible and intangible benefits, as well as obligations towards caring for Sea Country. It also includes non-Indigenous people whose well-being is tied to the ocean (directly or indirectly); researchers who study its movements, processes and patterns; communities and industries that rely on it for livelihoods and economic activity and decision-makers responsible for shaping how we interact with, transform, produce from, restore, and protect it.

The social sciences play a key role in enabling integration and innovation, providing new tools and capabilities for Australia's marine science agenda, particularly in decision-making, systems change, co-design, knowledge translation and future-facing management. Marine social sciences provide a means to ensure the marine sciences acknowledge and address equity issues explicitly. This paper outlines a pathway for Australia to achieve a marine science strategy which is responsive, trusted, and increases wellbeing for Australia's communities, industries and sectors benefiting from the ocean (livelihoods, recreation, seafood, economic productivity).

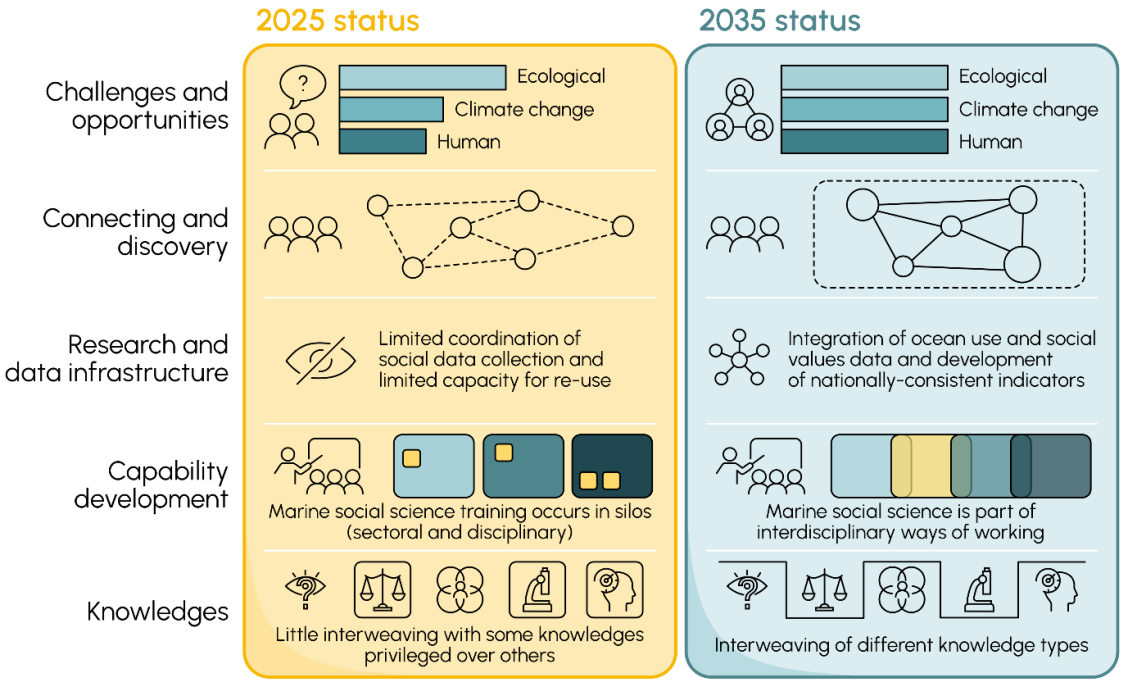
We present a structured framework that groups the enabling role of marine social sciences into three interlinked functions:

- **Understanding human-mediated drivers** (i.e., values, worldviews, behaviours, rules, knowledge systems) of changes in ocean health, benefits and outcomes for Australia's ocean interests, users, Traditional Owners and communities.
- **Designing human-centred ocean actions and innovations** which are evidence-informed, effective, socially responsible and pluralistic.
- **Science Programming of integrated, participatory and future-facing marine science** to amplify innovation and to support use, uptake, and impact across diverse contexts and diverse knowledges.

We recommend coordinated action in three priority areas: (i) Incorporate marine social sciences into marine science research and data infrastructure; (ii) Build capability in marine social sciences and other marine sciences for national integrated marine science initiatives and solutions; (iii) Recognise and work with diverse forms of knowledge and knowledge holders for equity and impact. These priority areas will support the integration of marine social sciences in national marine research and

policy, build enabling infrastructure, and enhance Australia's capacity to deliver ocean science that serves the public good.

Graphic abstract



"Flipping the Tide: A First Nations Vision for Indigenous Leadership in Sustainable Ocean Culture"

This document sets out an Indigenous-led blueprint for Australia's future in ocean management, emphasising the central role of Traditional Owners' and Aboriginal and Torres Strait Islander custodian groups' knowledge and leadership in ensuring healthy, sustainable oceans and coasts. The authors of this current white paper, who are non-Indigenous, fully support this vision, which calls for non-Indigenous researchers to act as respectful and collaborative partners with Indigenous leaders and custodian groups. In this context, we also acknowledge and support the Black Paper, which informs Australia's 2025–35 National Marine Science Strategy.

Accordingly, the present white paper on marine social sciences focuses on:
- Recognising leadership of Aboriginal and Torres Strait Islander Peoples and institutions in research agenda setting for managing oceans and coasts;
- Partnering through culturally-respectful research collaborations and practices with Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Sea Country and key leaders and partners;
- Supporting opportunities to weave different knowledge systems in partnerships with Indigenous leaders and custodian groups as knowledge holders, including different valuation processes; and
- Understanding and working with human-ocean relations, values and outcomes for equity and wellbeing for all Australians.

What do we mean by 'culture'?

In the present white paper, we use the word 'culture' for all groups in society, qualifying the term where necessary to clarify which groups we mean. We recognise the special, deep role of culture in relation to Country for Aboriginal and Torres Strait Islander Peoples, while also acknowledging the cultural connections of non-Indigenous Peoples with the sea. UNESCO defines culture as "the distinct spiritual, material, intellectual, and emotional features characterising a society. It encompasses arts, lifestyle, human rights, value systems, traditions, and beliefs" (UNESCO, 1982).

For Aboriginal and Torres Strait Islander Peoples, culture is inextricably part of Country and human interactions with Country. In the Australian environmental management context, the term is often assumed to mean Indigenous culture. For example, 'cultural fishing' refers to fishing by Traditional Owners, distinct from commercial or recreational fishing.

The Black Paper also uses culture in this inclusive way, highlighting Aboriginal and Torres Strait Islander practices, values, and beliefs in marine science, while recognising that non-Indigenous Peoples also have cultures that shape their connections to the ocean. It centres the idea of a 'sustainable ocean culture', understood as governance that balances profit with protecting people and planet, and identifies cultural diversity, cultural safety, and cultural respect as vital principles for marine science and planning.

Section 1: Why Marine Social Sciences Matter and How They Enable Australia's Ocean Goals

What are marine social sciences?

Marine social sciences encompass a broad field of theoretical and applied research that examines how people interact with, depend on, govern, and affect the ocean. They involve the study of human-ocean relations (Partelow et al., 2023) and draw on multiple disciplines, including sociology, political science, economics, anthropology, geography, psychology, education, history, and law, to understand marine-related behaviours, institutions, systems, and values (Moon & Blackman, 2014; Bennett et al., 2017b). Importantly, the application of marine social sciences enables acknowledgement, recognition and amplification of diverse knowledges and ways of knowing, including those of Aboriginal and Torres Strait Islander Peoples.

Marine social sciences draw on diverse methods, from quantitative statistical modelling and questionnaire surveys to participatory mapping, interviews, network analysis, direct observation, and co-design (Haider et al., 2018; McKinley et al., 2022). This methodological diversity enables marine social sciences to generate both foundational and practical knowledge —also referred to as "social technologies"—to improve outcomes in marine governance, conservation, innovation, and development. Table 1 summarises how social sciences contribute to marine science by linking the study of human values, markets, governance, and societies with applied social technologies.

Table 1. Social sciences and their applied contributions (technologies). Adapted from Academy of the Social Sciences in Australia (2021) *and* Bennett et al. (2017a)

Social Sciences (aim to understand)	**Social Technologies (aim to improve/design)**
Human values, beliefs, and behaviours	Participatory design, behavioural nudges, incentive design, social marketing strategies, agent-based modelling, wellbeing impacts, preference elicitation
Markets, economies, benefits	Economic impact, benefit-cost analysis, co-benefit assessment, cost effectiveness, non-market valuation, ecosystem services, market (e.g., demand) analysis, market-based management
Governance, law, and politics	Co-management institutions, regulatory framework design, accountability systems, strategy evaluation, scenario planning, foresighting, community appraisal mechanisms
Societies, social groups, culture (Indigenous and non-Indigenous), power relations, history, identity and knowledge	Social impact assessment, narrative change, culturally-respectful practices, cross-cultural competencies, equity assessment, weaving diverse knowledges and knowledge co-creation

These contributions are reflected across a wide range of disciplines and approaches, illustrated in Figure 1, which highlights key themes and opportunities in marine social science research.

As a rich disciplinary field, marine social sciences can be applied in different forms, depending on context and purpose. They may involve collaboration across multiple social sciences to explore questions such as community perceptions of offshore wind developments. They may also adopt interdisciplinary approaches, combining social and bio-physical sciences to inform activities such as marine spatial planning or fisheries bioeconomic modelling, integrating economic and biological data to aid in fisheries management. In more complex contexts, marine social sciences may be transdisciplinary. They often involve co-designed research with non-academic actors such as local communities and Aboriginal and Torres Strait Islander Peoples. These collaborations can, for example, inform climate change pathways. These different forms reflect the adaptability and breadth of marine social sciences in contributing to marine science and governance.

Figure 1: Key themes and opportunities in marine social science research, illustrating how diverse disciplines and approaches contribute to understanding human–ocean relations. Adapted from Spalding and McKinley (2025).

Why marine social sciences are relevant to Australia's ocean interests

Australia's marine estate, the third largest globally, is of immense cultural, social and economic value. For Aboriginal and Torres Strait Islander Peoples, Sea Country is deeply linked to the well-being of people and communities. Ocean-dependent industries contribute over $100 billion to national GDP, while marine ecosystems support biodiversity, non-Indigenous and Indigenous communities' cultural practices, and community wellbeing (CSIRO & Bureau of Meteorology, 2022; Australian Institute of Marine Science, 2023).

However, threats such as climate change, biodiversity loss, unsustainable resource use, pollution, and governance fragmentation have significant implications for ocean health and equity (Trebilco et al., 2022). Marine social sciences help address these challenges by offering insight into how people use, value, and relate to the marine environment. They examine how people may be impacted by changes in the marine environment, including those wrought by management, and how they may respond to policy options designed to deliver solutions to these challenges. Applications of marine social sciences in Australia include:

- Improving understanding of human-ocean relationships such as use, place attachment, and values (Gurney et al., 2017; Voyer et al., 2017).
- Identifying social vulnerabilities, equity challenges and opportunities, including the needs of coastal communities affected by sea-level rise or policy reform (O'Brien, 2009; Hobman et al., 2024).
- Analysing the institutions and rules that shape marine outcomes, such as access rights, governance structures, regulatory and policy frameworks, and funding flows (Farmery et al., 2019; Fidelman et al., 2019; Vella et al., 2025).
- Evaluating trade-offs and co-benefits across social, ecological, and economic goals—an essential function for balancing competing objectives in marine policy (Pascoe et al., 2019).
- Supporting frameworks and governance systems that recognise and work with diverse knowledges, including those of Aboriginal and Torres Strait Islander Peoples (Hunter et al., 2025).

These applications are illustrated in Figure 2.

Marine social sciences are also critical for responding to climate change. The social, cultural and economic impacts of climate-driven change are becoming increasingly dominant and require greater attention. As shown in Figure 3, these impacts are rising in dominance and importance, underscoring the need for greater application of marine social sciences to prevent, mitigate, or ameliorate effects and to support adaptation of Australia's ocean-linked communities.

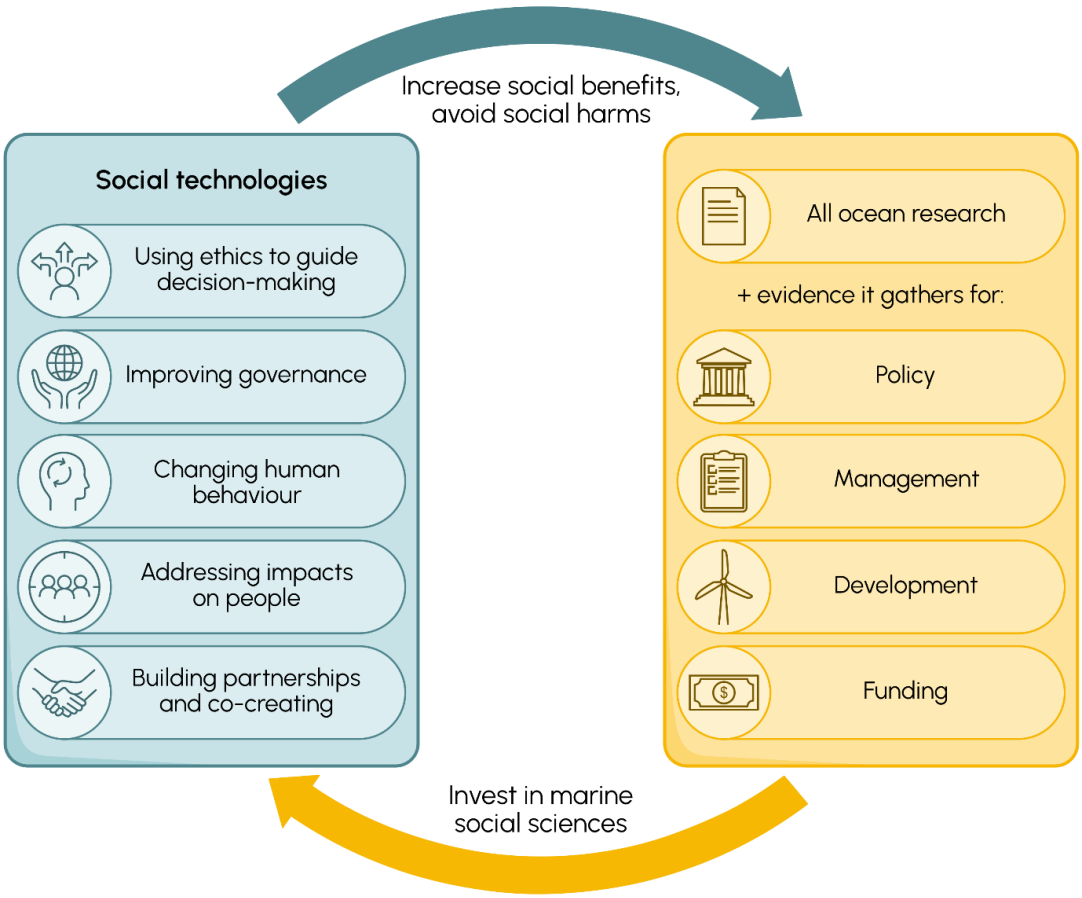


Figure 2: Phases of project collaboration and associated social intervention areas that can strengthen ocean science and subsequent sustainability initiatives. Adapted from Partelow et al. (2023)

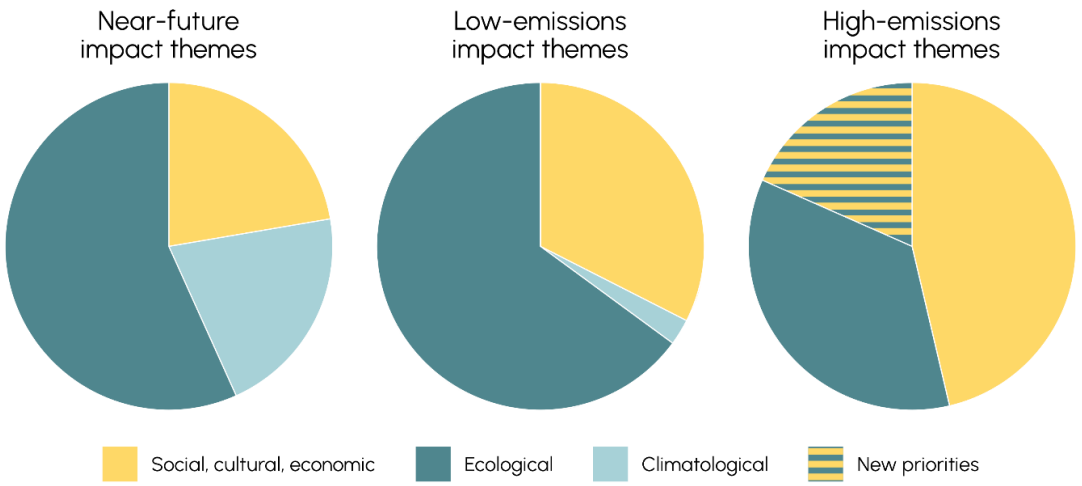


*Figure 3: Trends in dominance and importance of social, cultural and economic impacts of climate-driven change identified through multi-stakeholder engagement. Adapted from the Reef Futures Roundtables report (*Australian Academy of Science, 2023*).*

At a global level, the critical role of marine social sciences in addressing sustainability challenges is increasingly recognised. The High-Level Panel for a Sustainable Ocean Economy highlights ocean equity and ocean knowledge as central. Both are supported by marine social sciences (Österblom et al., 2023).

The UN Decade of Ocean Science for Sustainable Development calls for holistic, interdisciplinary science that is co-designed, solutions-focused, and usable (UNESCO-IOC, 2021; Arbic, 2024; IOC-UNESCO., 2024). Marine social sciences also underpin delivery of the Sustainable Development Goals. This includes SDG 2 (Zero Hunger), SDG 3 (Good Health and Wellbeing), SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 16 (Peace, Justice, and Strong Institutions).

In the Australian context, the draft Sustainable Ocean Plan acknowledges that its goals will be enabled through inclusive, equitable ocean governance and socially informed innovation (DCCEEW, 2025). In this way, marine social sciences are directly relevant to achieving Australia's ocean interests and shaping a sustainable ocean future.

How marine social sciences enable Australia's ocean goals

Marine social sciences enable Australia's marine science strategy through three interconnected functions: understanding human-mediated drivers, designing human-centred ocean actions and innovations, and programming integrated and future-facing science. Each function contributes in distinct ways to addressing national challenges, delivering opportunities, and supporting other marine science enablers. Figure 4 illustrates these primary enabling functions.

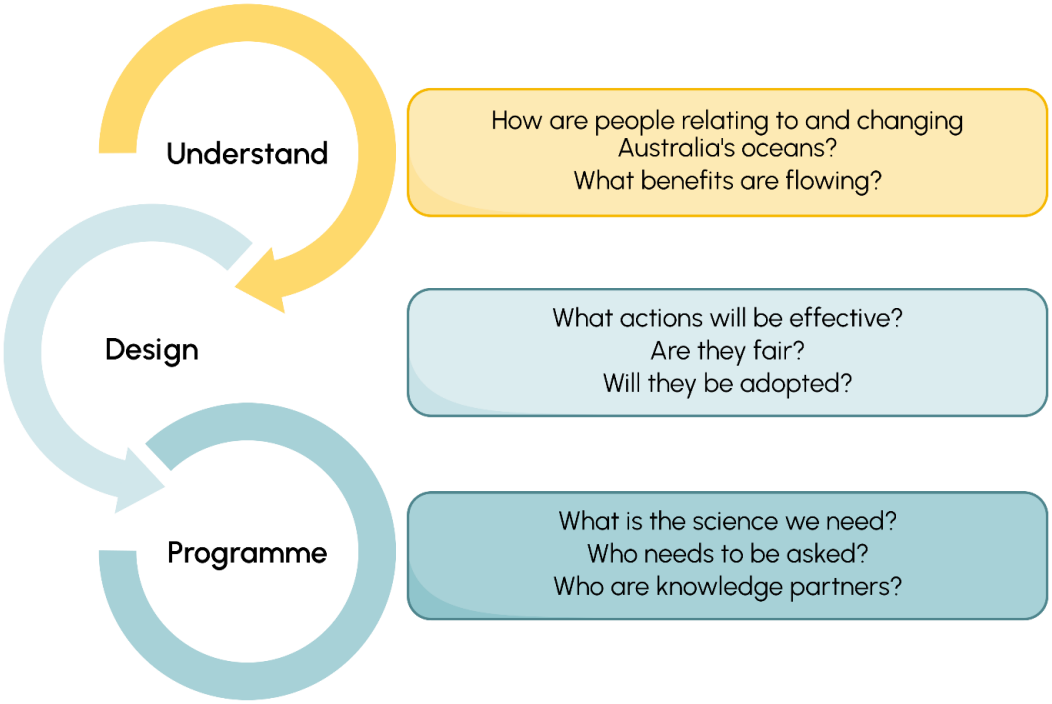


Figure 4: Marine social sciences primary enabling functions.

Understanding Human-Mediated Drivers

This function focuses on the observational data and knowledge that identify the nature of human–ocean interactions in space, time, and social context. People in Australia engage with the ocean in multiple ways, from spiritual and ceremonial practices and climate regulation, to fishing, recreation, industry employment, tourism, and conservation. These interactions both mediate ocean health and influence the wellbeing of Australian society.

Marine social sciences generate the evidence base from which human drivers of ocean health can be systematically tracked, causal factors diagnosed, societal impacts assessed, and viable solutions designed. This includes:

- Giving visibility to communities and diverse forms of knowledge in decision-making, such as highlighting dependence on the ocean for livelihoods, food security, and wellbeing.
- Measuring and communicating the social importance of the marine realm, as in the National Ecosystem Accounts (Australian Bureau of Statistics, 2025).
- Defining socio-demographic, cultural, and economic attributes of ocean users, such as through the Social and Economic Long-Term Monitoring Program (SELTMP) for the Great Barrier Reef (Hobman et al., 2024).
- Assessing impacts on ocean-dependent communities and users, using tools such as social and economic impact assessment.
- Diagnosing behaviours and institutions that drive change, including licensing rules, recreational fishing norms, and seafood consumer preferences (Mackay et al., 2019; Mackay et al., 2020; Bellanger et al., 2025)
- Informing marine management policies that benefit both people and ecosystems, for example, multi-use zoning in the Great Barrier Reef.
- Improving equity and inclusion by identifying how ocean services are distributed across groups, including marginalised communities.

Human–ocean interactions also draw on marine natural capital to generate values and benefits through ecosystem service flows. These include provisioning services such as food, regulating services such as climate regulation, and cultural services such as recreational amenity, spiritual values, and public health. Recognising these services provides a more holistic understanding of ocean benefits and trade-offs.

Marine social sciences also provide social technologies to measure and assess environmental, economic, and social trade-offs. These include benefit–cost analysis (Stewart-Sinclair et al., 2021), cost-effectiveness analysis (Scott et al., 2024), multi-criteria decision analysis (Pascoe et al., 2019), and wellbeing frameworks (Breslow et al., 2016; Voyer et al., 2017). Such approaches help balance competing objectives, quantify impacts, and identify their distribution across different social groups. Importantly, they can highlight issues of equity and inclusion by identifying how ocean

services are distributed across groups, including marginalised communities (Shellock & James, 2025).

Role of social sciences in understanding social, economic and ecological trade-offs and impacts in oceans management

Managing oceans can require balancing trade-offs between protection and production benefits and recognising the negative impacts of decisions. Marine social sciences provide several social technologies for measuring and assessing environmental, economic and social impacts for diverse social groups and ocean users, including ***benefit-cost analysis, cost-effectiveness analysis, multi-criteria decision analysis and wellbeing frameworks****. These frameworks can also identify the magnitude of these impacts and their relative importance to different groups.*

Designing Human-Centred Ocean Actions and Innovations

Social technologies help translate understanding of human–ocean interactions into the design of effective and socially responsible ocean actions and innovations. They guide questions of rights and interests, establish culturally respectful research relationships, diagnose governing systems, and ensure alignment with legal frameworks. In this way, they enable actions that are culturally and socially appropriate, responsive to user needs and preferences, and consistent with institutional conditions.

Designing human-centred actions involves:

- Recognising rights and interests, including Indigenous rights and responsibilities.
- Establishing culturally respectful research relationships.
- Diagnosing institutional and economic conditions that shape adoption of innovations.
- Assessing governing systems and legal frameworks.
- Co-designing solutions that reflect user needs and preferences.

Designing actions that are culturally and socially appropriate requires governance and equity analysis (Lawless et al., 2025). Analysis of equity in ocean governance can also facilitate the delivery of international obligations, including upholding the rights of Indigenous Peoples through principles such as Free, Prior and Informed Consent (FPIC). These insights inform the development of policies that link actions with desired social, economic, and ecological outcomes (Gurney et al., 2019). Evaluating both positive and negative social impacts of ocean actions is also critical for adaptive management (Gurney et al., 2014). Together, these approaches highlight critical governance reforms required to enable and support innovative, inclusive, and sustainable development.

Social technologies for designing strategies to support ocean technology innovation and uptake

*Through a co-design process, researchers worked with representatives and members from 15 communities across the Northern Peninsula Region in North Queensland and the Torres Strait Islands to identify traditional fishing behaviours, priorities, needs, and desired design features for a proposed traditional fishing monitoring app (*Bedford et al., 2024*)The findings from these community workshops were combined with insights from research on fishing apps and interviews with app developers and custodians to generate a list of potential features for the traditional fishing app.*

Community workshop activities (L-R, Iama, Ugar and Mabuiag). Photo credit: Kenny Bedford.

App design features

The results of the co-design community workshops, fishing apps research and expert interviews were compiled to provide a list of potential traditional fishing app features.

About this app information	Secure Log in page	Provision of informed consent to share data summaries	Fishing episode: Name, date, time, location	Fishing method
Was the catch a shared catch?	Number, gender and age categories of other fishers (if shared)	Number (and sizes) of fish caught	Ability to submit catch photos	Species identification
Local Indigenous fish names	Information on species biology and ecology	Ability to share catch summaries with others	Data analytics - Personal catch summaries - Community catch summaries	Weather, tides, warnings
Local and regional management information and rules	Community notifications	Cultural and seasonal information	Ability to report issues of concern (e.g. illegal fishing, invasive species)	General comments

Design also draws on social technologies to improve policy performance and compliance. For example, nudges and incentives have been trialled to improve recreational fishing practices and reduce bycatch, showing how behavioural insights can be applied in marine contexts (see box).

Social technologies for designing responsible fisheries management innovations

*Social science technologies contribute to the design and assessment of behaviourally informed interventions, such as "nudges" to improve compliance in recreational fisheries (*Mackay et al., 2019*;* Mackay et al., 2020*), and incentive-based approaches to reduce bycatch in fisheries and increase the biological control functions of fisheries in managing range-extending species (*Pascoe et al., 2010*;* Lubchenco et al., 2016*;* Bellanger et al., 2025*). These efforts demonstrate how marine social sciences can enhance the practicality, uptake, and effectiveness of marine policies by ensuring they are responsive to real-world constraints and opportunities.*

Marine social sciences also deepen understanding of human–nature connections, which is increasingly linked to pro-conservation behaviours and health and wellbeing co-benefits (Barragan-Jason et al., 2021; Alcock et al., 2025). These insights strengthen the case for inclusive and socially attuned ocean policies.

Co-design processes, including deliberative forums, participatory scenario development, systems modelling, and joint problem framing, are fundamental to effective marine interventions (Dichmont et al., 2013; Bellanger et al., 2025; Gould et al., 2025; Pascoe et al., 2025). Establishing effective co-design programs is also essential to achieving the aspirations for Indigenous leadership articulated in the Flipping the Tide Black Paper (Hunter et al., 2025).

Programming integrated, participatory and future-facing marine sciences

Science programming refers to the ways marine social sciences operationalise and weave together marine science knowledge with other forms of knowledge. This includes processes to build trust, enhance interoperability, and ensure science is usable, adaptive, and sustained.

Marine social sciences also provide tools for reflexivity — that is, the science of science. They help analyse how science itself is produced, communicated, and trusted. This includes frameworks for measuring trust in science, identifying drivers of mis- and disinformation, and developing participatory approaches to agenda-setting and decision-making (Cologna et al., 2025; Pascoe et al., 2025). Such reflexive work supports practices that enhance legitimacy, fairness, and confidence in marine science (Kelly et al., 2020; Karcher et al., 2024).

These approaches go beyond communication. They enable co-production of context-appropriate solutions and support stepwise pathways from knowledge discovery to application and implementation. They involve knowledge co-production with Aboriginal

and Torres Strait Islander leaders and communities, collaborative monitoring and stewardship programs, and adaptive program design. They also include participatory scenario development, joint problem framing, and systems modelling, which help build legitimacy and ownership of outcomes. Programming in this way is reflexive, relational, and scalable (Shellock et al., 2024).

Social technologies for programming integrated and interoperable marine sciences
The Social and Economic Long-Term Monitoring Program (SELTMP) provides insights into how people use, value and respond to the Great Barrier Reef. This information supports reef managers to make socially responsive decisions (Hobman et al., 2024). Similarly, the Reef 2050 Traditional Owner Implementation Plan enables Traditional Owners to lead monitoring and management of Sea Country through co-designed frameworks and partnerships (The Reef 2050 Traditional Owner Steering Group, 2022).

Applied examples show how programming strengthens the usability of science. Citizen science initiatives and interdisciplinary data integration projects(Kelly et al., 2020) expand observational capacity and engagement. Work on marine ecosystem modelling demonstrates how outputs can be made usable for planners and decision-makers (Arseneault-Deraps et al., 2024). In the Great Barrier Reef, social sciences have supported adaptive monitoring in reef stewardship, restoration, and tourism (Taylor et al., 2019). These cases illustrate how programming enhances the relevance and uptake of marine science in real-world contexts.

These technologies highlight the value of learning networks, science–user partnerships, and feedback mechanisms that link researchers, managers, ocean users, and Traditional Owners. They are particularly critical in contexts of uncertainty, complexity, and change, ensuring legitimacy, relevance, and equity as core elements of durable marine outcomes. They also demonstrate how marine social sciences can strengthen the interoperability of natural and social sciences and embed social technologies across marine science programs to support innovation and resilience (Curnock et al., 2024).

The enabling functions of marine social sciences, i.e., Understanding, Designing, and Programming, together contribute to all 13 challenge areas identified by the National Marine Science Committee (see Table A, Supplementary Materials, for examples). While the contribution of marine social sciences will vary depending on the challenge or opportunity, social sciences and technologies consistently provide knowledge about human-mediated drivers, improve the design and delivery of solutions, and enhance the usability of marine science infrastructure and products. Marine social sciences also support the delivery of the other enablers identified by the National Marine Science Strategy (see Table B, Supplementary Materials, for examples).

Section 2: State of Australia's Marine Social Sciences

Growth, recognition and integration as a marine science field

Over the past decade, there has been an almost exponential growth in marine social sciences research (see Figure 5; and Jefferson et al. (2021), McKinley et al. (2022), Partelow et al. (2023), Spalding and McKinley (2025). However, rapid expansion is outpacing the capacity to build a cohesive MSS community, creating a fragmented research landscape (McKinley et al., 2022).

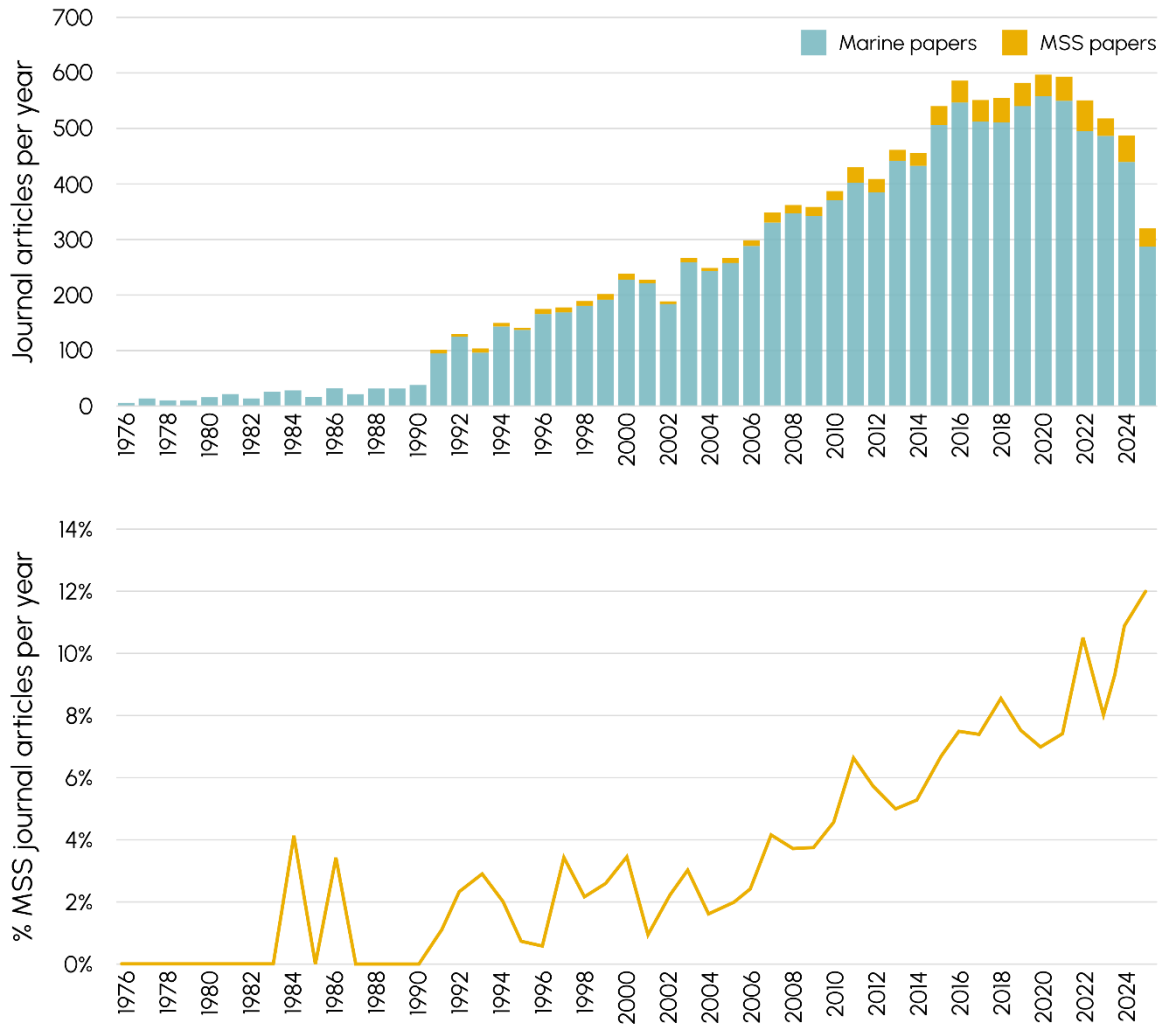


Figure 5: Australian marine social science papers compared to all Australian marine science papers over the last 50 years (2025 data are year to date).

Fragmentation occurs in part because social science research is predominantly conducted by individual scholars, small research teams or area-specific networks (e.g., the Social Science for the Great Barrier Reef) operating in relative isolation from one another. While this decentralised approach is not fundamentally problematic, it presents significant structural challenges when contrasted with the natural and

technological sciences, which have increasingly adopted large-scale, multi-institutional collaborative models. This relative isolation constrains the capacity for the social science community to scale up its research activities, leading to foregone research opportunities and economic losses for both the academic sector and the broader Australian economy (Academy of the Social Sciences in Australia, 2021).

In recent years, an informal network for collaboration and knowledge exchange amongst marine social scientists has formed in Australia, known as MarSocSciAus. This partnership, comprising universities and research institutions such as CSIRO, and industry-oriented science organisations such as the Fisheries Research and Development Corporation (FRDC), forms a strong basis for future research collaborations nationally and across Australian marine sciences (Figure 6).

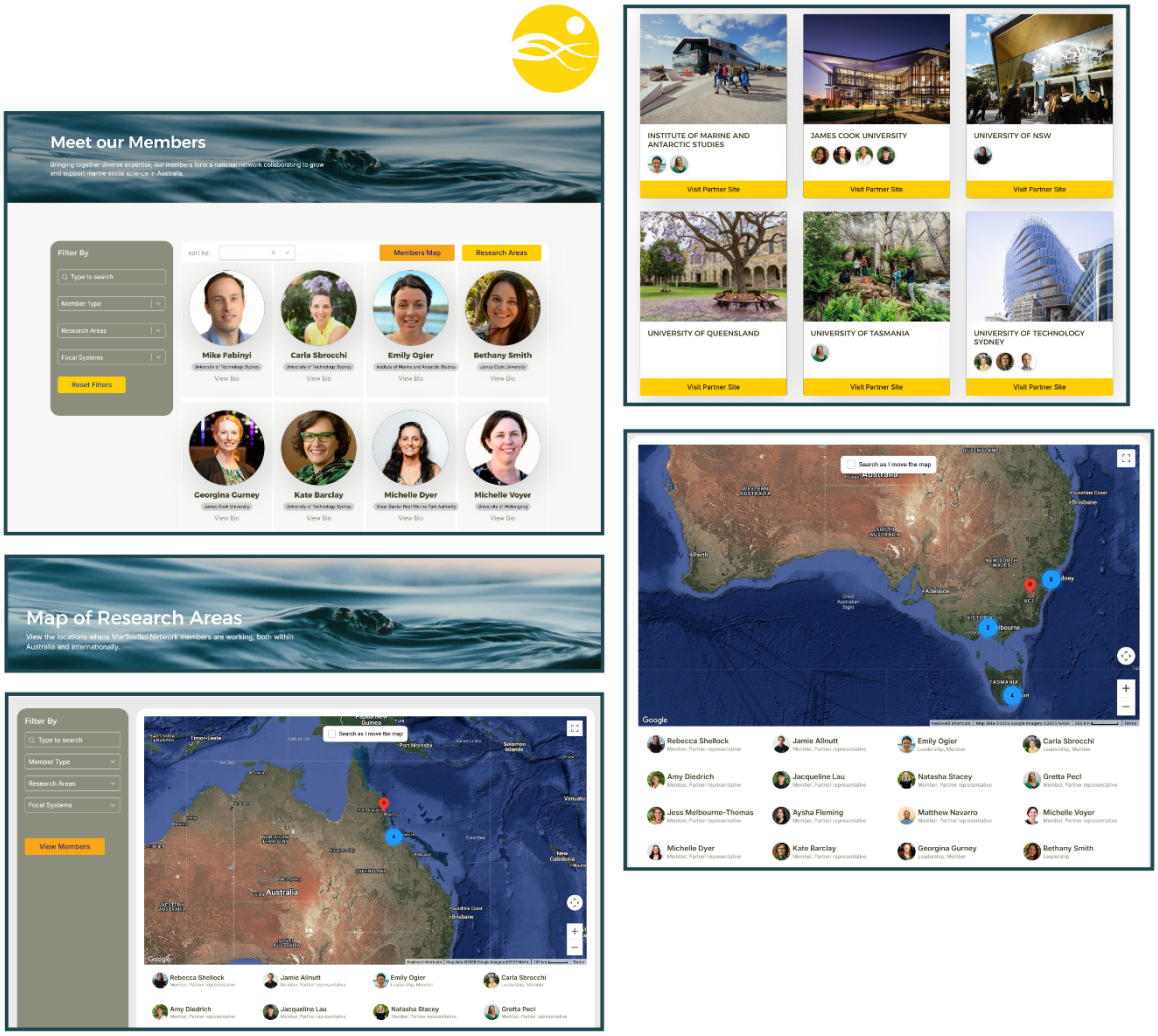


Figure 6: MarSocSciAus is developing a website that will provide a database of marine social scientists working in Australia.

Although marine social sciences are increasingly recognised as an important part of integrated science responses to ocean related issues, disciplinary silos still persist. Funding mechanisms for social sciences broadly remain a major constraint (Academy of the Social Sciences in Australia, 2021), with marine social sciences historically under-represented in nationally important marine science initiatives. Natural sciences typically lead large collaborative research programs, with marine social sciences contributions inconsistently embedded. With the exception of economics, which has a longer history of interdisciplinary marine research in Australia, marine social sciences are often mistaken for outreach, communication, or stakeholder engagement, and in many cases, social scientists are invited to support community engagement or compliance, rather than to shape research questions, inform policy design, or co-produce solutions (see Dichmont et al. (2013) and Pascoe et al. (2019) for examples of the latter). This reinforces perceptions that marine social sciences are an accessory rather than an enabler (Bennett et al., 2023; Spalding & McKinley, 2025). However, there are signs of change. The inclusion of marine social sciences in the scope of the National Environmental Science Program (NESP) marine and coastal investments, the Ocean Decade Collaborative Centre (ODCC), Reef 2050 Plan, Future Seas, and the Great Southern Reef Research Partnership activities suggests growing recognition of its value.

Research and data infrastructure for MSS

In the broadest sense, marine social sciences recognise that many forms of knowledge are held by many knowledge holders about Australia's oceans, and that many of these forms are important 'beyond the mere integration of knowledge systems' or their translation into data (see the *Flipping the Tide: A First Nations vision for Indigenous leadership in sustainable ocean culture* Paper in this series, (Hunter et al., 2025)).

Where social data for understanding and tracking Peoples' interactions with Australia's oceans is appropriate and wanted, such datasets are highly limited and variable in spatial and temporal scope. Social data are collected largely on a project-by-project basis, with data collection varying by jurisdiction, and often not available (due to ethical requirements) for other uses. Broader socio-demographic data are produced at a local government area level by the Australian Bureau of Statistics, although linking these to fisheries or marine management outcomes is often not possible due to their aggregated and generic nature. Greater coordination and collaboration in data collection and sharing across jurisdictions would improve the ability of social scientists to provide quantitative input into marine resource management.

Interdisciplinary marine science requires data to be interoperable in some way so that the work can be translated appropriately for its users. Natural science approaches favour large datasets, often quantitative, whereas social sciences research data comes in many forms. Social science researchers (Academy of the Social Sciences in Australia, 2021) identify key gaps or constraints in their research approaches which

have played a role in the limited integration to date of marine social sciences in data-rich marine science research infrastructure:

- Social scientists historically have not used major equipment and facilities (like satellites, computer labs, or advanced imaging technology) and may struggle to imagine how these tools could support their research;
- Social science researchers need supporting data infrastructure to work with big data and new digital technologies; and
- Social science data may be protected, in that some information must be de-identified or withheld to protect people or their culturally significant information

An interdisciplinary focus will require the marine research community to work together to imagine new ways of working with big data and digital technologies, and to develop protocols for data sharing and re-use that will both ensure integrity of the data but open up new avenues for data integration. The *Illuminating Hidden Harvests* project on small-scale fisheries (FAO et al., 2023) could inform ways of doing this, as it used existing social datasets to develop fisheries management and policy. The development of Ecosystem and Ocean Accounts (see the *Ocean Accounting* White Paper produced as part of this series, (Milligan et al., 2025)) can also help formalise the role for social science in monitoring marine resource use and supporting future policy.

Marine social sciences contribute to Australia's national marine data environment by determining the value of information to different parties; the required basis for shared data frameworks to succeed (e.g., see Western Australia Marine Science Institute (WAMSI's) Shared Environmental Analytics Facility that aims to support industry data sharing for specific purposes, such as updating modelling, without requiring raw data; and Australian Research Data Commons (ARDC's) Food Security Data Challenges: Increasing food security through liberation of fishing and aquaculture data); and public demand for transparency and translating those transparency standards to use of data in decision-making.

Capability in social sciences and interdisciplinary sciences

One third of marine industry employers anticipate changes in the disciplinary knowledge needs of their organisation in the next decade, but they have difficulty finding graduates with the necessary expertise, e.g. in social sciences and law (MacKeracher & Marsh, 2019). Graduate completion rates show that social science training is not a gap in Australia (Figure 7), but attracting social scientists into the marine sector is a challenge. It will be important to consider how to attract those with degrees in social sciences and law to a marine-sector career, and to integrate established marine social scientists into the collaborative ocean science environment to ensure the 'pipeline' of social scientists is available to the marine sector into the future.

Many natural scientists identify that the marine social sciences greatly enhance their work and seek additional training to supplement their knowledge gaps. Several

international institutions (e.g., International Council for the Exploration of the Sea (ICES) Human Dimensions) and consulting firms offer short-courses in marine social sciences to help bridge the disciplinary divide and provide natural scientists with an understanding and appreciation of the field. These courses and offerings are important for exposing natural scientists to marine social sciences theories and approaches but are unlikely to replace the knowledge of a fully qualified social scientist on a team. Social science training often considers approaches and methods for recognising and working across diverse knowledges and as such - whilst not a substitute for dedicated cultural awareness training - can also assist in enabling culturally respectful relationships with Aboriginal and Torres Strait Islander Indigenous research leaders and custodian groups.

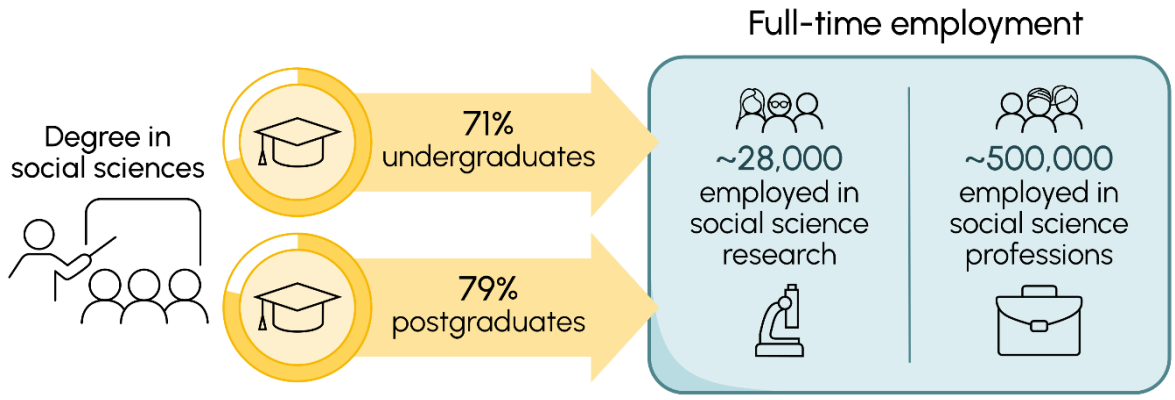


Figure 7: National training and capability in social science. Source: QILT (2023), Academy of the Social Sciences in Australia (2021).

Interdisciplinary training and professional capability development is occurring in Australia. The Centre for Marine Socioecology in Tasmania is one example of this, offering annual 'summer schools' dedicated to upskilling and exposing people from both social sciences and natural science backgrounds to integrated models of working together. Many universities provide funding to encourage interdisciplinary collaborations, such as the Global Challenges program at the University of Wollongong. These programs are an excellent catalyst for cross-disciplinary interactions and collaborations in research programs. Similar programs focused on weaving western science with Aboriginal and Torres Strait Islander Peoples' knowledges might also assist to relief the cultural burden experienced by many Aboriginal and Torres Strait Islander Indigenous researchers in educating their colleagues on culturally safe research practices

Marine science impact and translation

Australia's last Marine Science Plan 2015-2025, Australia's Strategy for Nature 2024-2030, Australia's draft Ocean Plan, and the UN's *Marine Social Sciences: for the Ocean We Want* plan all identify the need to better incorporate human dimensions to deliver

impact and meet their objectives. Limited impact arises in part because of challenges in translating research findings from both the natural and social sciences into clear, relevant guidance for policymakers, business leaders, and citizens who will apply these insights to improve our societies and institutions (see Ball (2023), who describes issues for the Australian Public Service in accessing the research they need to inform their work, and enabling research funding models). Regional imbalance is also a concern, with significant gaps in investment in marine social science in northern Australia and limited sustained engagement with many state-based science agencies (Navarro et al., 2020; BDO EconSearch, 2021).

Translational science models in other domains (e.g., medical science) are led by social sciences and demonstrate a positive model and pathway for marine social sciences to work with other marine science fields, such as robotics, autonomy and automation, and omics, synthetic biology and biotechnology - see papers in this series), to address specific oceans challenges. Under these models, social scientists play key roles across basic scientific discovery, limited application and testing, and scaled-up real world implementation, as each step requires different research designs, forms of knowledge, methodologies and approaches along the way (Western 2019)(Western, 2019). To enable marine science for society, the next Decadal Science Plan could assign a pot of money to 'translational trials' (see https://www.tri.edu.au/) that explore science translation mechanisms for different situations.

Australia is well positioned to lead in marine social science, but fragmented investment and weak coordination continue to hold it back. Broadly, marine social sciences need to be embedded as a core science and research field and form of social technology - essential for delivering effective, equitable, and enduring marine science outcomes. This shift needs to be aligned with and in support of Aboriginal and Torres Strait Islander Peoples' leadership in research agenda setting for Sea Country and for communities' custodial rights and obligations as knowledge holders. To shift from marginal inclusion of marine social sciences to systemic impact, stronger leadership, investment, and integration is needed. These priorities lead directly into the actions proposed in the next section.

Section 3: Priority Areas and Actions

Realising the full potential of marine social sciences in shaping Australia's ocean future, the next decade must focus on strategic areas for action. This section outlines three interconnected priority areas (see Table 2) designed to embed marine social sciences more systematically in Australia’s marine science strategy, ensuring that marine science is inclusive, responsive to societal needs, and has desired impact in meeting Australia's ocean goals.

The three priority areas are:

1. **Incorporate marine social sciences into marine science research and data infrastructure** to build an understanding of the human dimensions of Australia’s oceans and outcomes for sustainability, benefits and equity

2. **Build capability** in marine social sciences and other marine sciences for national integrated marine science initiatives and solutions

3. **Recognise and work with diverse forms of knowledge and knowledge holders** for equity and impact.

These priority areas address the foundational elements needed to establish marine social sciences as a core component of Australia's marine science capability while building the human capacity and institutional frameworks necessary for sustained integration and impact.

Table 2: Priority Actions for Social Sciences for Australia's Oceans Goals. MSS refers to marine social sciences.

Priority Areas	Key Actions	Expected Outcomes
1. Incorporate MSS into marine science research and data infrastructure	• National assessment of critical needs and capability for human-oceans data and information • Develop guidance for Australia's MS sector on applying best practice standards for ethical research and data governance • Develop a national data dictionary for MSS data cataloguing, inclusive of diverse data and knowledge types • Publish a national MSS metadata catalogue of MSS data assets • Pilot processes for integrating human ocean data with biophysical ocean data at regional scales • Coordinate development of nationally-consistent indicators for human activity, values, and observations • Develop a series of Field Manuals and Standard Operating Procedures for MSS research and data collection	• National marine research and data infrastructure enables discovery and sharing of human ocean data, and linking with biophysical data • Human ocean data collection and governance is culturally appropriate and safeguards human wellbeing • Human ocean data and information is available for tracking change and informing national reporting, including State of the Environment and Outlook reports, Ocean Accounts and Sustainable Ocean Plan implementation
2. Build capability in MSS and other marine sciences	• Map current MSS capability and capability needs across sectors, science organisations, and regions • Inventory available multi- and interdisciplinary training opportunities in marine sciences • Develop guidance for funding schemes and tender processes on MSS inclusion • Partner with interested marine policy and management agencies to develop and deliver MSS knowledge exchange opportunities	• Australia's marine science sector can work across social/human and natural/biophysical marine science disciplines • Ocean sectors and agencies have capability and direction to engage in MSS collaborations for science-based solutions that effectively address emerging complex challenges and realise opportunities for Australia's oceans goals

	• Develop toolkits for using social science and case-based learning resources which provide practical guidance to those applying MSS in technical or policy roles	
3. Recognise and work with diverse forms of knowledge and knowledge holders	• National scoping study of frameworks and science partnership models for recognising and weaving diverse forms of ocean knowledge • Partner with Aboriginal and Torres Strait Islander Indigenous knowledge leaders to learn from and support adoption of frameworks and protocols for Indigenous-led research • Develop protocols and toolkits and pilot these through case and place-based research for: o Monitoring and evaluation frameworks for marine areas which are inclusive of diverse forms of knowledge o Linking knowledges to information for policy and decision-making about marine areas	• Improved capacity to recognise diverse forms of knowledge and work with diverse knowledge holders • Indigenous-led research institutions and leaders set the agenda for MSS and science partnerships for sea Country • Oceans management and decision-making is informed by diverse forms of knowledge, contributing to more equitable outcomes for Australia's ocean communities and knowledge holders

Section 4: Implementation Roadmap and Strategies (2025-2035)

Realising Social Sciences as part of Australia's Marine Sciences

The vision outlined in this strategy—marine social sciences as a pillar of Australia's marine science —requires deliberate, coordinated action across multiple levels and timeframes. This implementation roadmap provides a sequenced pathway designed to create new ways of thinking, working, and collaborating (see Figure 8).

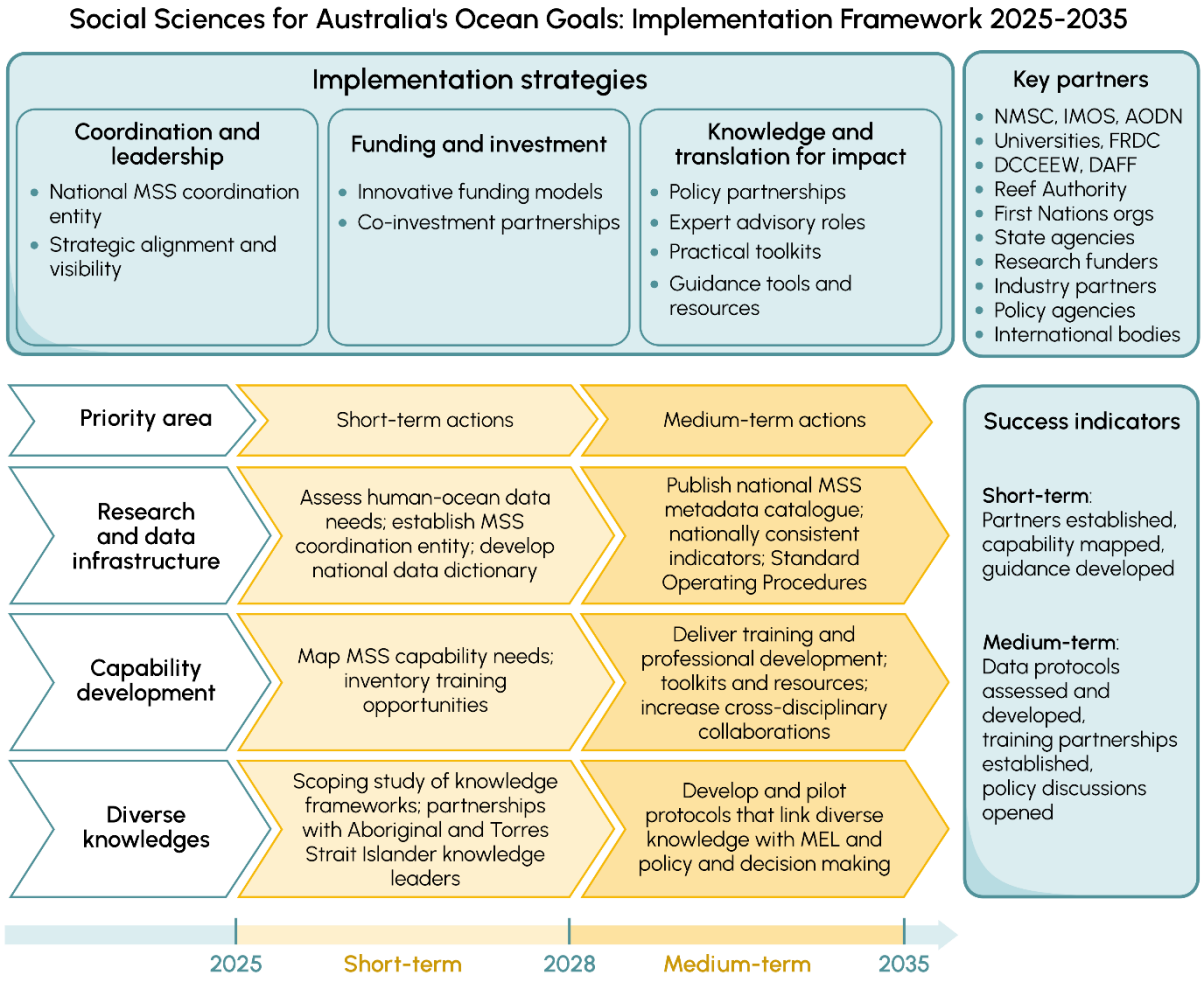


Figure 8: Proposed Implementation Framework 2025-2035

Strategies

These strategies enable this transformation:

- **Coordination and Leadership Strategy** centres on creating a national entity for coordination of marine social sciences under the NMSC and aligned with the proposed National Aboriginal and Torres Strait Islander Marine Science Institute

(NATSIMSI) that serves as the focal point for expertise, strategic advice, alignment, and partnership development.

- **Funding and Investment Strategy** moves beyond traditional short-term grants toward innovative approaches that leverage existing investment (i.e., through incentives for multi or interdisciplinary marine science proposals) while attracting new support (e.g., in nature credit markets, Blue Finance and ocean philanthropy).

- **Knowledge and Translation for Impact Strategy** addresses the critical challenge of ensuring marine sciences inform marine policy throughout the policy cycle by aligning marine social science expertise to government agencies, creating knowledge broker functions and fellowship programs, and developing practical tools that make social science accessible for decision-making and policy applications.

Implementation Timeline and Approach

The Short-term Phase (2025-2027, see Table 3) focuses on foundation through establishing coordination mechanisms, data infrastructure, and capability development. The Medium-term Phase (2028-2035) builds on these foundations to embed MSS into existing systems and at scale.

Table 3: Implementation Roadmap for Priority Areas, Actions and Strategies. MSS refers to marine social sciences. See note below table for additional acronyms.

Priority Area	Timeframe	Actions and Strategies	Key Partners (for full agency names see note)	Progress and Outcome Indicators
1. Incorporate MSS into marine science research and data infrastructure	**Short-term (2025-2027)**	• Undertake national assessment of critical needs and capability for human-oceans data, information and decision-support • Develop guidance for Australia's marine sciencesector on applying best practice standards for ethical research and data governance • Develop national data dictionary for MSS data cataloguing • Establish MSS coordination entity under NMSC • Identify and facilitate innovative funding models	NMSC, IMOS, AODN, IMAS, ARDC, ABS, universities, DAFF, DCCEEW, Aboriginal and Torries Strait Islander researcher leaders and custodian groups, FRDC, Reef Authority, NESP, GOAP	**Progress:** Critical data and information needs identified; MSS data dictionary and conventions defined; guidance tools developed **Outcomes:** MSS coordination entity operational; innovative funding partnerships established
	Medium-term (2028-2035)	• Publish national MSS metadata catalogue data assets held by agencies, research and sector		**Progress:** MSS metadata catalogue operational; pilot integration projects completed

		• Pilot processes for integrating human ocean data with biophysical data at regional scales • Coordinate development of nationally-consistent indicators for human activity, values, and observations which is interoperable with existing national oceans assessment and reporting frameworks • Develop a series of Field Manuals and Standard Operating Procedures for MSS research and data collection		**Outcomes:** MSS data linked to IMOS, AODN platforms; social indicators used in national reporting; sustainable MSS data systems adopted by key agencies
2. Build capability in MSS and other marine sciences	**Short-term (2025-2027)**	• Map current MSS capability and capability needs • Inventory available multi and interdisciplinary training opportunities in marine sciences • Develop guidance for funding schemes and	Universities, FRDC, ASSA, CRCs, NESP hubs, agencies, research funders, DCCEEW, DAFF, Reef Authority, DFAT, state agencies, Pacific and Indian Ocean RFMOs, CCAMLR, Aboriginal and Torries Strait Islander researcher leaders and custodian groups	**Progress:** Capability mapping completed; training inventory available; guidance for funders developed **Outcomes:** Training programs delivered; co-led research projects initiated; MSS embedded in curricula

		tender processes on MSS inclusion • Initiate partnerships with training providers • Begin knowledge exchange opportunities with policy agencies • Partner with interested marine policy and management agencies to develop and deliver MSS knowledge exchange opportunities		
	Medium-term (2028-2035)	• Deliver targeted training and professional development packages • Establish cross-disciplinary collaboration opportunities (fellowships, shared supervision, secondments) • Develop toolkits for using MSS and case-based learning resources which provide practical		**Progress:** Number of science organisations and agencies engaged in MSS activities; examples of social KPIs across policy contexts **Outcomes:** MSS expertise embedded in science and policy teams; social indicators integrated into evaluation frameworks; MSS-informed tools referenced in policy documents

		guidance to those applying MSS in technical or policy roles • Scale knowledge exchange and translation activities		
3. Recognise and work with diverse forms of knowledge and knowledge holders	**Short-term (2025-2027)**	• National scoping study of frameworks and science partnership models for recognising and weaving diverse forms of ocean knowledge held by Australia's diverse communities • Partner with Aboriginal and Torres Strait Islander Indigenous knowledge leaders to learn from and support adoption of frameworks and protocols for Indigenous-led research	Aboriginal and Torries Strait Islander researcher leaders and custodian groups, Reef Authority, Universities, FRDC, ASSA, CRCs, NESP hubs, agencies, philanthropic research funders, DCCEEW, DAFF, DFAT, state agencies, GOAP	**Progress:** Scoping study completed; partnerships with Aboriginal and Torres Strait Islander Indigenous research leaders formed **Outcomes:** Models and frameworks identified for working with diverse forms of knowledge and knowledge holders
	Medium-term (2028-2035)	• Develop protocols and toolkits and pilot and adapt these through case and place-based research for:		**Progress:** Protocols and toolkits developed; partnerships for pilots identified; pilot studies undertaken

		○ Monitoring and evaluation frameworks for marine areas which are inclusive of diverse forms of knowledge ○ Linking knowledges to information for policy and decision-making		**Outcomes:** Multiple forms of knowledge are shared, recognised and drawn on to inform management and decision making in multiple marine areas

Note: ABS – Australian Bureau of Statistics, AODN – Australian Ocean Data Network, ARDC – Australian Research Data Commons, ASSA – Academy of the Social Sciences in Australia, CCAMLR – Commission for the Conservation of Antarctic Marine Living Resources, CRC – Cooperative Research Centre, DAFF – Department of Agriculture, Fisheries and Forestry, DCCEEW – Department of Climate Change, Energy, the Environment and Water, DFAT – Department of Foreign Affairs and Trade, FRDC – Fisheries Research and Development Corporation, GOAP – Global Ocean Accounts Partnership, IMAS – Institute for Marine and Antarctic Studies, IMOS – Integrated Marine Observing System, MSS – Marine Social Sciences, NESP – National Environmental Science Program, NMSC – National Marine Science Committee, RFMO – Regional Fisheries Management Organisation

Navigating toward an ocean future enabled by social sciences

In conclusion, incorporating social sciences will enable Australia's marine science to contribute to equitable and sustainable outcomes for Australia's oceans and communities. The coming decade can be one in which Australia's marine science future builds social technologies to understand human-mediated drivers, design human-centred and socially responsible ocean actions and innovations, and program for marine sciences that recognises and amplifies diverse knowledge holders and forms of knowledge.

Supplementary Materials

Table A: How marine social sciences supports each National Marine Science Strategy challenge and opportunity area through the three enabling functions.

NMSC Challenge Area	Understanding	Designing	Programming	Examples of social technologies
Flipping the Tide: A First Nations vision for Indigenous leadership in sustainable ocean culture (Black paper)	Aboriginal and Torres Strait Islander Peoples' rights and interests in Sea Country	Co-governance frameworks to support research and decision with Traditional Owners	Co-design of science knowledge programs to support Sea Country and caring for Country plans	Sea Country co-governance (e.g., Traditional Use of Marine Resources Agreements) and Traditional Owner marine monitoring initiatives supporting joint decision-making and stewardship (Nursey-Bray et al., 2018; Nursey-Bray & Palmer, 2018)
Australia's changing oceans: Building knowledge for actionable ocean outcomes	Social and equity risks and impacts of changing oceans and of climate policies Ocean climate literacy Behavioural drivers of ocean-climate actions and adaptation	Participatory climate adaptation planning processes Climate risk and response communication strategies	Working with local Indigenous and community knowledge systems together with downscaled climate impact models	Social dimension of processes develop Australia's first national climate risk assessment (Boulaire et al., 2025) Barriers and potential approaches for Indigenous, First Nations or Traditional Peoples to contribute to addressing warming oceans and changing

				climate (Fischer et al., 2022) Case studies of co-design, co-development and co-delivery for climate adaptation responses (Fleming et al., 2023)
Biodiversity and Ecosystem health	Community and economic dependencies on marine ecosystems and ecosystem goods and services Equity considerations	Co-management institutions for MPAs	Monitoring and tracking social and economic impacts and co-benefits of conservation measures Increasing capability in cross-disciplinary research to address challenges	Social and Economic Long-Term Monitoring Program for the Great barrier reef (Hobman et al., 2024). Measures for social and economic monitoring of the Australian Marine Parks (Navarro et al., 2020)
Towards a Sustainable Blue Economy for Australia	Livelihood strategies in marine industries Marine spatial use and conflict	Policy instruments for fair access to marine areas and benefit distribution	Capacity-building for inclusive innovation Monitoring and tracking flows of socio-economic benefits	Equity frameworks for Blue Economy governance (Croft et al., 2024)
Planning Urban and Coastal Development, Infrastructure, and Services in Australia	Community attitudes to coastal development Social impacts and co-benefits of coastal infrastructure and services	Participatory planning processes	Evaluation of social impacts and benefits of urban coastal interventions	CoastSnap community use and values (Elrick-Barr et al., 2023) Service delivery innovations for community resilience (Elrick-Barr et al., 2024)
Food Security	Social and economic determinants of impacts to	Policy and regulatory options supporting	Monitoring and tracking seafood access, benefits	Social and economic benefits of Wild-catch

	seafood sector livelihoods and viability Community preferences for and access to locally produced seafood Environmental, economic and social sustainability of seafood production (fisheries, aquaculture)	fisheries and aquaculture local food flows and within broader food systems	and local flows for Australian communities	Fisheries and Aquaculture in NSW and Victoria).(Voyer et al., 2016; Voyer et al., 2017; Abernethy et al., 2020) Demand for locally caught produce (Paredes et al., 2021; Pascoe et al., 2023) Identification of Aboriginal and Torres Strait Islander Peoples' concepts of nutrition, health and wellbeing in connection to seafood (Cubillo et al., 2023)
Energy Security, Diversification, and achieving Net-Zero	Drivers of conflict and social impact arising from energy transition Economic and behavioural barriers to energy diversification in maritime sectors	Programs and incentives to support diversification and energy transition by maritime sectors Governance frameworks to support just and sustainable energy transitions	Social impact monitoring of infrastructure deployment Benefit-cost of energy transitions	Social impact dimensions for marine spatial planning for offshore renewable energy development (Griffiths et al., 2025) Stakeholder perceptions to offshore wind energy (Condie et al., 2024)
Maintaining Sovereignty, Securing, and Defending Australia	Public awareness and attitudes to maritime security and policy Geopolitical drivers of maritime policy	Regional marine governance arrangements	Monitoring trust and legitimacy in maritime security initiatives	Human-centred perspectives on maritime security (Fabinyi et al., 2025)

Protecting Australia's Underwater Cultural Heritage	Community narratives of ocean-based livelihoods, practices and local identity	Protection protocols for cultural heritage values	Monitoring social value of cultural heritage and stewardship programs	Reef Plan 2050 (Commonwealth of Australia, 2023) Sea Country Alliance, as part of the First Nations Cultural Protection Alliance (https://nntc.com.au/our-alliances-partnerships/)
Marine climate interventions	Social impacts of changing oceans Bioethical and social risks of proposed interventions	Participatory processes for risk assessment Social safeguards	Bioethical assessments for integration into Monitoring, Reporting and Verification (MRV) of climate actions	Frameworks for socially responsible governance of ocean-based climate actions (Ogier et al., 2025)
Integrated Ocean Management and Resource allocation and management	Rights (e.g., Traditional Owner Native Title rights, Fishing use rights) and interest holder mapping and ocean use analysis	Deliberative and inclusive marine spatial planning processes	Multi objective (social, economic) frameworks for impact monitoring and trade off analysis	Integrating human dimensions in marine management (Stephenson et al., 2023) Triple bottom line harvest strategies (Dichmont et al., 2021)
Ocean Accounting	Social Accounts for inclusion of social, cultural (Indigenous and non-Indigenous) and equity data. Economic accounts - market and non-market values (NMV) for	Methods for NMV and integration of multiple accounts	Use of indicators from Social Accounts Ecosystem accounts and monetisation (valuation) of ecosystem services Reporting platforms visualising human wellbeing and ocean economy	Towards social accounts: Rethinking how we understand and use social information (Shellock & James, 2025) Ecosystem accounts (Pascoe et al., 2024b)

	ecosystem and ocean activity benefits			
Coastal and Marine Ecosystem Restoration and Repair	Local user observations of habitat and ecosystem service change Economic assessments of benefits and costs of restoration Understanding objectives of reef restoration	Community stewardship programs. Co-benefit schemes for local communities	Monitoring and evaluation of co-benefits Assessment of alternative options Traditional Owner Reef Restoration programs and Indigenous Partnerships Plans (e.g., AIMS)	Governance principles for novel restoration interventions (Shumway et al., 2024) Development of restoration objectives (Pascoe et al., 2024a) Social and Economic Monitoring Framework for Project Restore, Sydney Harbour (Barclay, 2024)

Table B: How marine social sciences support each National Marine Science Strategy enabler through the three enabling functions.

NMSC Enabler	Understanding	Designing	Programming	Examples of social technologies
Advancing Ocean Literacy, Education, and Training	Skills and capability shortages Barriers to participation in education and training Ocean literacy levels of Australian community	Initiatives to increase uptake of education and training opportunities Inclusive outreach and citizen science initiatives about oceans	Partnerships with ocean science education and training providers Ocean curriculum development	Nature and use of ocean literacy in achieving sustainable ocean futures (Shellock et al., 2024)
National Marine Research Infrastructure	User needs and behaviours Marine spatial use	Human-centred design and customisation to increase useability	Inclusion of diverse data, knowledge systems and knowledge holders in infrastructure design and deployment	Role of marine spatial use data infrastructure in sustainable management (Racetin et al., 2022)
Engineering, Prototyping, and Technology Development (Robotics, Autonomy and Automation)	Societal and ocean tech user attitudes towards ocean technologies	Frameworks and tools for socially responsible tech innovation and implementation	Monitoring uptake and use of tech among ocean sectors and science communities	Socio-economic dimensions of technology development for offshore aquaculture (Krause & Mikkelsen, 2017)
Artificial Intelligence and Machine learning	Social biases, risks and unintended consequences for vulnerable social groups Trust, uptake and use of AI tools among ocean users	Frameworks for ensuring socially responsible AI applications (e.g. algorithmic transparency) Tool specifications for collating and integrating data on ocean uses (e.g., recreational fishing)	Monitoring trust, uptake and use of AI tools among ocean users and for data integration	Identifying biases of AI (Grossmann et al., 2023; Urzedo et al., 2024; Xu et al., 2024) AI approaches to advance recreational fisheries monitoring (Baker et al., 2025)

Data through to Information	Baseline understanding of ocean uses and users Social drivers of mis/disinformation Information needs of users	Guides transformation of data into information based on user needs	National data integration frameworks and protocols for ocean use and user data (i.e., metadata dictionaries, common dictionaries, SOPs)	Combining spatial ecosystem data and economics to incorporate recreational fishing into marine spatial planning (Navarro et al., 2022)
Omics, Synthetic Biology, and Biotechnology	Community trust and bioethical dimensions of gene-based innovations	Protocols and safeguards for socially informed and responsible research of gene-based innovations	Diagnostic tools and risk assessment to identify and address bioethical dimensions	Principles for socially-responsible coral interventions (Lawless et al., 2025)
Modelling and Quantitative Science	User needs for model outputs Integrated model requirements for ocean/human data	Guides integration of user needs into model development	Model development of social, economic and governance sub-systems	Modelling triple bottom line harvest strategies (Dowling et al., 2020; Dichmont et al., 2021)

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