

2022 Scientific Consensus Statement

Question 7.3 What are the critical success factors for greater Indigenous involvement in water quality decision making in the Great Barrier Reef region?

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Cover image credit: Conway Burns.

Dugoo Duwalami – Heart meeting place

The central component of the artwork is the roundtable for the Great Barrier Reef (GBR) with various seats around the table representing various institutions involved in decision-making and management of the GBR.

The upper half of the artwork represents the extensive pathways of engagement and involvement that these decision-making bodies for the GBR have travelled on, prior to the seat at the roundtable.

The opaque section (top middle) represents diverse Traditional Owner groups that have not been effectively involved or engaged in decision-making for the GBR over a long period of time.

Once resources towards building the presence, literacy, capacity and capability of Traditional Owners within existing GBR management frameworks are implemented, the head of the Rainbow Serpent (*Yindinji* - Butchulla) is set in motion.

The roundtable is now complete and two-way knowledge sharing ensues, where Traditional Owner groups are familiar with all legislative, policy and funding frameworks underpinning management of the GBR, and the primary concept of connectivity from freshwater headwaters, through diverse habitats and peoples, down to the GBR (light blue dots) is aligned to decision-makers and decision-making for the GBR.

Dugoo Duwalami ensures improved holistic outcomes for the species, habitats and people connected to the GBR through truly collaborative management.

Explanatory Notes for readers of the 2022 SCS Syntheses of Evidence

These explanatory notes were produced by the SCS Coordination Team and apply to all evidence syntheses in the 2022 SCS.

What is the Scientific Consensus Statement?

The Scientific Consensus Statement (SCS) on land use impacts on Great Barrier Reef (GBR) water quality and ecosystem condition brings together scientific evidence to understand how land-based activities can influence water quality in the GBR, and how these influences can be managed. The SCS is used as a key evidence-based document by policymakers when they are making decisions about managing GBR water quality. In particular, the SCS provides supporting information for the design, delivery and implementation of the Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP) which is a joint commitment of the Australian and Queensland governments. The Reef 2050 WQIP describes actions for improving the quality of the water that enters the GBR from the adjacent catchments. The SCS is updated periodically with the latest peer reviewed science.

C₂O Consulting was contracted by the Australian and Queensland governments to coordinate and deliver the 2022 SCS. The team at C₂O Consulting has many years of experience working on the water quality of the GBR and its catchment area and has been involved in the coordination and production of multiple iterations of the SCS since 2008.

The 2022 SCS addresses 30 priority questions that examine the influence of land-based runoff on the water quality of the GBR. The questions were developed in consultation with scientific experts, policy and management teams and other key stakeholders (e.g., representatives from agricultural, tourism, conservation, research and Traditional Owner groups). Authors were then appointed to each question via a formal Expression of Interest and a rigorous selection process. The 30 questions are organised into eight themes: values and threats, sediments and particulate nutrients, dissolved nutrients, pesticides, other pollutants, human dimensions, and future directions, that cover topics ranging from ecological processes, delivery and source, through to management options. Some questions are closely related, and as such readers are directed to Section 1.3 (Links to other questions) in this synthesis of evidence which identifies other 2022 SCS questions that might be of interest.

The geographic scope of interest is the GBR and its adjacent catchment area which contains 35 major river basins and six Natural Resource Management regions. The GBR ecosystems included in the scope of the reviews include coral reefs, seagrass meadows, pelagic, benthic and plankton communities, estuaries, mangroves, saltmarshes, freshwater wetlands and floodplain wetlands. In terms of marine extent, while the greatest areas of influence of land-based runoff are largely in the inshore and to a lesser extent, the midshelf areas of the GBR, the reviews have not been spatially constrained and scientific evidence from anywhere in the GBR is included where relevant for answering the question.

Method used to address the 2022 SCS Questions

Formal evidence review and synthesis methodologies are increasingly being used where science is needed to inform decision making, and have become a recognised international standard for accessing, appraising and synthesising scientific information. More specifically, 'evidence synthesis' is the process of identifying, compiling and combining relevant knowledge from multiple sources so it is readily available for decision makers¹. The world's highest standard of evidence synthesis is a Systematic Review, which uses a highly prescriptive methodology to define the question and evidence needs, search for and appraise the quality of the evidence, and draw conclusions from the synthesis of this evidence.

In recent years there has been an emergence of evidence synthesis methods that involve some modifications of Systematic Reviews so that they can be conducted in a more timely and cost-effective

¹ Pullin A, Frampton G, Jongman R, Kohl C, Livoreil B, Lux A, ... & Wittmer, H. (2016). Selecting appropriate methods of knowledge synthesis to inform biodiversity policy. *Biodiversity and Conservation*, 25: 1285-1300. <https://doi.org/10.1007/s10531-016-1131-9>

manner. This suite of evidence synthesis products are referred to as '**Rapid Reviews**'². These methods typically involve a reduced number of steps such as constraining the search effort, adjusting the extent of the quality assessment, and/or modifying the detail for data extraction, while still applying methods to minimise author bias in the searches, evidence appraisal and synthesis methods.

To accommodate the needs of GBR water quality policy and management, tailor-made methods based on Rapid Review approaches were developed for the 2022 SCS by an independent expert in evidence-based syntheses for decision-making. The methods were initially reviewed by a small expert group with experience in GBR water quality science, then externally peer reviewed by three independent evidence synthesis experts.

Two methods were developed for the 2022 SCS:

- The **SCS Evidence Review** was used for questions that policy and management indicated were high priority and needed the highest confidence in the conclusions drawn from the evidence. The method includes an assessment of the reliability of all individual evidence items as an additional quality assurance step.
- The **SCS Evidence Summary** was used for all other questions, and while still providing a high level of confidence in the conclusions drawn, the method involves a less comprehensive quality assessment of individual evidence items.

Authors were asked to follow the methods, complete a standard template (this 'Synthesis of Evidence'), and extract data from literature in a standardised way to maximise transparency and ensure that a consistent approach was applied to all questions. Authors were provided with a Methods document, '*2022 Scientific Consensus Statement: Methods for the synthesis of evidence*'³, containing detailed guidance and requirements for every step of the synthesis process. This was complemented by support from the SCS Coordination Team (led by C₂O Consulting) and the evidence synthesis expert to provide guidance throughout the drafting process including provision of step-by-step online training sessions for Authors, regular meetings to coordinate Authors within the Themes, and fortnightly or monthly question and answer sessions to clarify methods, discuss and address common issues.

The major steps of the Method are described below to assist readers in understanding the process used, structure and outputs of the synthesis of evidence:

1. **Describe the final interpretation of the question.** A description of the interpretation of the scope and intent of the question, including consultation with policy and management representatives where necessary, to ensure alignment with policy intentions. The description is supported by a conceptual diagram representing the major relationships relevant to the question, and definitions.
2. **Develop a search strategy.** The Method recommended that Authors used a S/PICO framework (Subject/Population, Exposure/Intervention, Comparator, Outcome), which could be used to break down the different elements of the question and helps to define and refine the search process. The S/PICO structure is the most commonly used structure in formal evidence synthesis methods⁴.
3. **Define the criteria for the eligibility of evidence for the synthesis and conduct searches.** Authors were asked to establish **inclusion and exclusion criteria to define the eligibility of evidence** prior to starting the literature search. The Method recommended conducting a **systematic literature search** in at least **two online academic databases**. Searches were typically restricted to 1990 onwards (unless specified otherwise) following a review of the evidence for the previous (2017) SCS which indicated that this would encompass the majority of the evidence

² Collins A, Coughlin D, Miller J, & Kirk S (2015) The production of quick scoping reviews and rapid evidence assessments: A how to guide. UK Government. <https://www.gov.uk/government/publications/the-production-of-quick-scoping-reviews-and-rapid-evidence-assessments>

³ Richards R, Pineda MC, Sambrook K, Waterhouse J (2023) 2022 Scientific Consensus Statement: Methods for the synthesis of evidence. C₂O Consulting, Townsville, pp. 59.

⁴ <https://libguides.jcu.edu.au/systematic-review/define>

base, and due to available resources. In addition, the geographic **scope of the search for evidence** depended on the nature of the question. For some questions, it was more appropriate only to focus on studies derived from the GBR region (e.g., the GBR context was essential to answer the question); for other questions, it was important to search for studies outside of the GBR (e.g., the question related to a research theme where there was little information available from the GBR). Authors were asked to provide a rationale for that decision in the synthesis. Results from the literature searches were screened against **inclusion and exclusion** criteria at the title and abstract review stage (**initial screening**). Literature that passed this initial screening was then read in full to determine the eligibility for use in the synthesis of evidence (**second screening**). Importantly, all literature had to be **peer reviewed and publicly available**. As well as journal articles, this meant that grey literature (e.g., technical reports) that had been externally peer reviewed (e.g., outside of organisation) and was publicly available, could be assessed as part of the synthesis of evidence.

4. **Extract data and information from the literature.** To compile the data and information that were used to address the question, **Authors were asked to complete a standard data extraction and appraisal spreadsheet**. Authors were assisted in tailoring this spreadsheet to meet the needs of their specific question.
5. **Undertake systematic appraisal of the evidence base.** Appraisal of the evidence is an important aspect of the synthesis of evidence as it provides the reader and/or decision-makers with valuable insights about the underlying evidence base. Each evidence item was assessed for its spatial, temporal and overall relevance to the question being addressed, and allocated a relative score. The body of evidence was then evaluated for overall relevance, the size of the evidence base (i.e., is it a well-researched topic or not), the diversity of studies (e.g., does it contain a mix of experimental, observational, reviews and modelling studies), and consistency of the findings (e.g., is there agreement or debate within the scientific literature). Collectively, these assessments were used to obtain an overall measure of the level of confidence of the evidence base, specifically using the overall relevance and consistency ratings. For example, a high confidence rating was allocated where there was high overall relevance and high consistency in the findings across a range of study types (e.g., modelling, observational and experimental). Questions using the **SCS Evidence Review Method** had an **additional quality assurance step**, through the assessment of reliability of all individual studies. This allowed Authors to identify where potential biases in the study design or the process used to draw conclusions might exist and offer insight into how reliable the scientific findings are for answering the priority SCS questions. This assessment considered the reliability of the study itself and enabled authors to place more or less emphasis on selected studies.
6. **Undertake a synthesis of the evidence and complete the evidence synthesis template** to address the question. Based on the previous steps, a narrative synthesis approach was used by authors to derive and summarise findings from the evidence.

Guidance for using the synthesis of evidence

Each synthesis of evidence contains three different levels of detail to present the process used and the findings of the evidence:

1. **Executive Summary:** This section brings together the evidence and findings reported in the main body of the document to provide a high-level overview of the question.
2. **Synthesis of Evidence:** This section contains the detailed identification, extraction and examination of evidence used to address the question.
 - **Background:** Provides the context about why this question is important and explains how the Lead Author interpreted the question.
 - **Method:** Outlines the search terms used by Authors to find relevant literature (evidence items), which databases were used, and the inclusion and exclusion criteria.
 - **Search Results:** Contains details about the number of evidence items identified, sources, screening and the final number of evidence items used in the synthesis of evidence.

- **Key Findings:** The **main body of the synthesis**. It includes a summary of the study characteristics (e.g., how many, when, where, how), a deep dive into the body of evidence covering key findings, trends or patterns, consistency of findings among studies, uncertainties and limitations of the evidence, significance of the findings to policy, practice and research, knowledge gaps, Indigenous engagement, conclusions and the evidence appraisal.
3. **Evidence Statement:** Provides a succinct, high-level overview of the main findings for the question with supporting points. The Evidence Statement for each Question was provided as input to the 2022 Scientific Consensus Statement Summary and Conclusions.

While the Executive Summary and Evidence Statement provide a high-level overview of the question, it is **critical that any policy or management decisions are based on consideration of the full synthesis of evidence**. The GBR and its catchment area is large, with many different land uses, climates and habitats which result in considerable heterogeneity across its extent. Regional differences can be significant, and from a management perspective will therefore often need to be treated as separate entities to make the most effective decisions to support and protect GBR ecosystems. Evidence from this spatial variability is captured in the reviews as much as possible to enable this level of management decision to occur. Areas where there is high agreement or disagreement of findings in the body of evidence are also highlighted by authors in describing the consistency of the evidence. In many cases authors also offer an explanation for this consistency.

Peer Review and Quality Assurance

Each synthesis of evidence was peer reviewed, following a similar process to indexed scientific journals. An Editorial Board, endorsed by the Australian Chief Scientist, managed the process. The Australian Chief Scientist also provided oversight and assurance about the design of the peer review process. The Editorial Board consisted of an Editor-in-Chief and six Editors with editorial expertise in indexed scientific journals. Each question had a Lead and Second Editor. Reviewers were approached based on skills and knowledge relevant to each question and appointed following a strict conflict of interest process. Each question had a minimum of two reviewers, one with GBR-relevant expertise, and a second 'external' reviewer (i.e., international or from elsewhere in Australia). Reviewers completed a peer review template which included a series of standard questions about the quality, rigour and content of the synthesis, and provided a recommendation (i.e., accept, minor revisions, major revisions). Authors were required to respond to all comments made by reviewers and Editors, revise the synthesis and provide evidence of changes. The Lead and Second Editors had the authority to endorse the synthesis following peer review or request further review/iterations.

Additional Context for Question 7.3

There is a strong desire from policy and management representatives involved in Great Barrier Reef (GBR) water quality management to effectively engage Traditional Owners, and more specifically, involve Traditional Owners towards integration of Indigenous people and knowledge into decision-making frameworks for the GBR. This includes policy and management representatives involved in the development and implementation of the Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP), such as the Queensland Department of Environment, Science and Innovation (DESI) and Department of Climate Change, Energy, the Environment and Water (DCCEEW). Several avenues have been identified to progress this objective, including direct consultation and broader engagement via the update of the Reef 2050 WQIP including the representation on the Review Reference Group. It was also suggested by DESI, DCCEEW and the Great Barrier Reef Foundation (GBRF) Reef Trust Partnership Traditional Owner Partnerships team that the 2022 Scientific Consensus Statement (SCS) could provide valuable input with lessons from other places in Australia and elsewhere, although it is acknowledged that the SCS is constrained to peer reviewed published literature which may not (yet) be as applicable to this objective. Addressing this is a focus of the National Science and Research priorities. However, it was agreed that drawing on published evidence could provide useful insights from other parts of Australia and around the world to setting the direction for future work knowing that future work will aim to embrace Indigenous knowledge and knowledge systems that have a different approach.

The inclusion of a relevant question in the 2022 SCS was viewed as part of a two-staged approach:

1. Using the 2022 SCS to review evidence (from Australia and internationally, where relevant) of the success factors for greater Indigenous involvement in water quality decision making / management that could be applied for the management of the GBR.
2. Using the outputs of (1) to guide policy and management and in liaison with Traditional Owner representatives, consider the best ways to use alternative sources of evidence in decision making frameworks for greater Indigenous involvement in GBR water quality management, and also potentially in future SCS processes.

Only the first stage is within the scope of the 2022 SCS, and the second stage is to be progressed by policy and management representatives.

The following steps were undertaken to define the 2022 SCS question:

- Based on initial discussions with the GBRF's Reef Trust Partnership Traditional Owner team, potential questions were included in the draft list of SCS questions that were distributed for formal consultation with policy and management, science and stakeholder representatives (including the Reef 2050 Reef Advisory Committee [RAC] and the Reef 2050 Independent Expert Panel [IEP]), November 2021.
- Revised questions were proposed in consultation with the GBRF Traditional Owner Partnerships team who liaised with the Reef Trust Partnership Traditional Owner Technical Water Quality Group to review the questions relevant to Indigenous knowledge and involvement, January 2022.
- Discussions were facilitated by the SCS Coordination Team with representatives from the GBRF, RAC, IEP and DESI, 18 January 2022.
- The feedback received, and input from additional meetings held with individuals in January and February 2022, was used to refine the question for inclusion in the 2022 SCS.

The processes for Author Selection and the Methods for the synthesis of evidence were consistent with all other questions included in the 2022 SCS. These processes are considered to be scientifically robust and fit for purpose for the majority of questions in the SCS. However, the relatively constrained nature of the approach was only considered appropriate for this question in the context that additional effort was required by policy and management to ensure that this is only one step in a larger effort of seeking guidance on the success factors for greater Indigenous involvement in water quality decision making / management in the GBR. Recognising growing local, national and international discussions about Indigenous rights, free prior and informed consent, partnerships, and Indigenous self-determination, it is recognised that any further work must at a minimum include extensive consultation and input from Traditional Owners.

Contents

Executive Summary	1
1. Background	5
1.1 Question	5
1.2 Conceptual diagram.....	5
1.3 Links to other questions	7
2. Method	8
2.1 Primary question elements and description	8
2.2 Search and eligibility.....	9
a) Search locations.....	9
b) Search terms.....	9
c) Search strings.....	9
d) Inclusion and exclusion criteria	10
3. Search Results.....	11
4. Key Findings.....	13
4.1 Narrative synthesis	13
4.1.0 Summary of study characteristics	13
4.1.1. Summary of evidence to 2022.....	14
Indigenous involvement in environmental decision-making	14
Factors influencing involvement and engagement	17
The need for improved engagement.....	18
4.1.2 Recent findings 2016-2022 (since the 2017 SCS)	19
4.1.3 Key conclusions	19
4.1.4. Significance of findings for policy, management and practice.....	21
4.1.5. Uncertainties and/or limitations of the evidence	21
4.2 Contextual variables influencing outcomes	21
4.3 Evidence appraisal	22
Relevance	22
Consistency, Quantity and Diversity.....	22
Confidence.....	23
4.4 Indigenous engagement/participation within the body of evidence.....	24
4.5 Knowledge gaps.....	24
5. Evidence Statement.....	26
6. References	28
Appendix 1: 2022 Scientific Consensus Statement author contributions to Question 7.3.....	37

Executive Summary

Question

Question 7.3 What are the critical success factors for greater Indigenous involvement in water quality decision making in the Great Barrier Reef region?

Background

This question highlights the intent of the Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP) in addressing the absence or exclusion of Indigenous people in the management and decision-making for the Great Barrier Reef (GBR). It is evident that this is a national issue across governance of all natural and man-made systems, but also relevant across the globe. Within the context of decision-making for the GBR, the tangible degradation of the GBR's ecosystems and importance of water quality to Indigenous people provides a meaningful platform from which to address issues of Indigenous engagement and involvement. The solution, however, can include a focus on the social sciences to address issues of trust and communication. Understanding comes before acceptance and connections between Indigenous people and the natural environment are yet to be fully understood. This includes the benefits of 'caring for Country' using traditional land management practices; the meaning of 'connection to Country' and the relationship between healthy Country and healthy communities, environmental wellbeing and community wellbeing. The wellbeing of Indigenous people is intimately tied to custodial responsibility in that caring for Country assists in healing therefore, the value of holistic GBR management that integrates Indigenous values extends beyond the GBR itself, it extends to all aspects of Indigenous community.

This means that critical success factors *for* greater Indigenous involvement should implicitly consider the critical success factors *of* greater Indigenous involvement. Developing methodologies to quantify the state of the GBR from the Traditional Owner perspective, and then measure and value the benefits to Indigenous communities of fulfilling their custodial responsibilities to all of the GBR ecosystems through leadership and greater involvement is critical for future management of the GBR.

Methods

- A formal Rapid Review approach was used for the 2022 Scientific Consensus Statement (SCS) synthesis of evidence. Rapid reviews are a systematic review with a simplification or omission of some steps to accommodate the time and resources available⁵. For the SCS, this applies to the search effort, quality appraisal of evidence and the amount of data extracted. The process has well-defined steps enabling fit-for-purpose evidence to be searched, retrieved, assessed and synthesised into final products to inform policy. For this question, an Evidence Summary method was used.
- The search locations included JSTOR, Web of Science, Scopus, NLA Trove and Ngunjook.
- A further six publications were provided by an anonymous reviewer.
- The evidence was sourced globally.
- The total search revealed 539 studies, of which 119 studies were eligible for inclusion in the synthesis of evidence.

Method limitations and caveats to using this Evidence Summary

For this Evidence Summary, the following caveats or limitations should be noted when applying the findings for policy or management purposes:

- Only studies written in English were included.

⁵ Cook CN, Nichols SJ, Webb JA, Fuller RA, Richards RM (2017) Simplifying the selection of evidence synthesis methods to inform environmental decisions: A guide for decision makers and scientists. *Biological Conservation* 213: 135-145. <https://doi.org/10.1016/j.biocon.2017.07.004>

- Three academic databases (JSTOR, Web of Science and Scopus), the Ngonjook and NLA Trove search portals, and a manual search of the Reef 2050 WQIP webpage were used for the searches.
- Studies published prior to 1990 were not considered.

Key Findings

Summary of evidence to 2022

- Determining the critical success factors for greater Indigenous involvement in water quality decision making and management for the Great Barrier Reef is difficult within the constraints of the Scientific Consensus Statement process that uses peer reviewed scientific evidence only. To fully address this question requires Indigenous knowledge and input.
- Historic exclusion from natural resource management and decision-making precludes and impedes contemporary attempts to integrate cultural values. Improved understanding and collaboration across all sectors of natural resource management to recognise Indigenous connections to Country, the need for improved engagement frameworks specifically recognising social and cultural factors, and the socio-ecological benefits of Indigenous involvement in management and decision-making are identified as common needs for environmental programs globally.
- This synthesis has highlighted the urgent need to review and revisit all policies and engagement frameworks related to Traditional Owner involvement in water quality management for the GBR. Importantly, this will establish a platform from which to undertake meaningful engagements directly with Traditional Owner organisations to determine best practice from a cultural perspective. Learnings from this synthesis should be accompanied by the development of meaningful relationships, policies and frameworks led by Traditional Owners to ensure delivery of sustainable and holistic outcomes for the Great Barrier Reef and its associated catchments.
- The outcomes from Indigenous-led decision-making including a description of successful engagements or successful outcomes are rarely published in the scientific literature. Key learnings identified to be most relevant to the Great Barrier Reef from national and international studies are:
 1. Understanding: Cultural awareness across western societies of Indigenous people's connections with the natural world are low and not conducive to acceptance that engaging and involving Indigenous people in natural resource management has global benefits. Support for education campaigns and engagements around cultural awareness that are designed and delivered by Indigenous people 'on Country' and target senior management staff is critical for success. Recognition of the social dimensions of the issues and solutions is a priority.
 2. Respect: Cultural awareness builds respect for Indigenous culture, land and sea management practices, and innate connections to Country held within Traditional Ecological Knowledge. Relationships built on trust, respect and understanding have shown best results in supporting Indigenous organisations on the pathway from exclusion to decision-making and self governance. Furthermore, Traditional Owners are not stakeholders to be consulted but rather decision-makers and as such, should be included from the start in relevant management roundtables.
 3. Collaboration: Collaboration is required at all levels of environmental decision-making including research, planning, policy, implementation, assessment and overall governance; and establishing relationships that are founded on respect, trust and mutual capacity-building is critical. Collaborative research that integrates different types of ecological knowledge has demonstrated great success in environmental outcomes and led to increased recognition of the awareness of the knowledge and wisdom held and contributed by Indigenous people.
 4. Capacity: Contemporary Traditional Owner groups are expected to contribute effectively and efficiently across a vast scope of legislative, policy and planning frameworks.

Development of resources focused on improving literacy of Traditional Owners to understand these frameworks in formats that are more meaningful for Traditional Owners, and the provision of more opportunities for individuals to gain experience with relevant management programs, are beneficial for the building of this capacity. Efforts should also be made to include Traditional Owners in all engagements to ensure improved capacity as decision-makers for the Great Barrier Reef.

5. **Capability:** Greater resources and effort to support Traditional Owner organisations to acquire the skills needed to govern, manage and deliver programs in terms of design, research, policy, planning, implementation, assessment and management has been shown to be beneficial. Effective self-governance of Traditional Owner organisations should be an endpoint which is supported by all western organisations involved with the management of the Great Barrier Reef.
 6. **Adaptive management:** The critical success factors *for* greater Indigenous involvement should implicitly consider the critical success factors *of* greater Indigenous involvement. Integration of the steps above into policy and planning documents supported by fit for purpose Monitoring Evaluation and Reporting Strategies to measure success is necessary for continuous improvement and adaptive management.
- Consideration of these critical success factors can provide a useful foundation to build on and provide pathways for future engagement and involvement of Indigenous people in Great Barrier Reef water quality decisions and management.

Recent findings 2016-2022

Fifty-three publications were documented between the 2016 and 2022 period. Of these, 27 publications focused on Indigenous participation in environmental management and decision-making, documenting key learnings from proposed and ongoing collaborative work. A vast majority of these publications point towards improved sustainability of social and environmental outcomes that acknowledge and support respectful integration of Indigenous knowledge and values, whilst meeting the management aspirations of Traditional Owners. Recommendations are also made in terms of preferred approaches to engagement, collaborative management and policy development. Another 17 publications focused on ongoing issues with communication, understanding and awareness between western societies and Indigenous communities, and the implementation of collaborative projects across this diverse landscape. Finally, a subset of publications focused on the success and benefits of Indigenous engagement and involvement on ecosystems and communities.

Significance for policy, practice, and research

This synthesis has highlighted the urgent need to review and revisit all policies and engagement frameworks related to Traditional Owner involvement in the management of the GBR. Importantly, this will establish a platform from which to undertake meaningful engagements directly with Traditional Owner organisations to determine best practice from a cultural perspective. Learnings from this synthesis should be accompanied by social science expertise to develop meaningful relationships, policies and frameworks with Traditional Owners to ensure delivery of sustainable and holistic outcomes for the GBR and its associated freshwater catchments. Importantly, these developments should have inherent strategies to deliver outcomes, and commitments to measure success at agreed timeframes to ensure greater Indigenous involvement in decision-making for the GBR.

Key uncertainties and/or limitations

The body of evidence presented in this synthesis is inherently limited to the scope of the question posed and confounded by the drivers of scientific publication in internationally peer-reviewed journals. Manuscripts generally publish a result, particularly a positive result. The publication of no result or negative results in science is much less common. In addition, manuscripts drafted by western authors without Indigenous participation may also claim success, however, this may not translate to successful outcomes for Indigenous people. The other limitation is that factors contributing to successful engagement with Indigenous groups across the globe, may not always be appropriate with Traditional Owners in Australia. Further engagement with Traditional Owner groups to determine the success, or

learnings, from existing engagements within the GBR context should be considered. These initial engagements can also be used to determine what the critical success factors from greater involvement are from the Traditional Owner perspective in Australia.

Evidence appraisal

The relevance of the overall body of evidence to the primary question was rated as Low, based on the assessment of the relevance of the study approach and study results to the primary question. Spatial and temporal relevance were not assessed due to the substantial variability in cultural values and priorities between Indigenous groups. Furthermore, the concept of greater Indigenous involvement is too variable across groups to provide a meaningful spatial or temporal assessment, even within Australia.

International literature outlined issues with Indigenous involvement in decision-making comprehensively, however, few case studies presented positive outcomes and the critical success factors to ensure greater Indigenous involvement in decision-making. This is most likely a result of few successful examples and the need for further work in this area and that publication of unsuccessful engagements and lessons learnt are not common. Examples of successful outcomes and approaches to engagement for researchers and Indigenous people were present in the literature, however, how these examples translate to decision-making for the GBR is yet to be seen.

Publications that were considered directly relevant to the question highlighted the deep connections between Indigenous people and natural ecosystems together with the need to improve engagement through approaches that prioritise relationships, context, trust, respect, inclusivity, connectivity, and capacity building. These critical factors enabled meaningful engagement and involvement towards decision-making authority and self-governance. In turn, these studies also highlighted the broad benefits to the health of Indigenous communities from self-governance and the inclusion of Indigenous people in environmental management and decision-making. In addition, seven of the nine publications were produced in Australia, and seven of the nine publications were published since 2016.

Although overall relevance was Low, two key consistencies were observed in the literature reviewed: 1) the documentation of exclusion of Indigenous people across the globe from natural resource management including identification of issues in communication whilst addressing the situation in contemporary settings; and 2) the desire for Indigenous people to be involved in natural resource management and the proposal for engagements to address this issue. Consistency across the body of evidence was rated as Moderate.

The quantity and diversity of study types was Low, with a mix of primary studies (30%, largely observational) and secondary studies (70%, primarily literature reviews and review of survey outcomes). The overall confidence in the body of evidence was rated as Limited, based on Low overall relevance and Moderate consistency. While 53% of the studies were sourced from Australia, there were few studies from within the GBR catchment area; the next greatest source was Canada (24%).

The review indicates that there is strong evidence that consensus of exclusion of Indigenous people from natural resource management, disparate views leading to communication issues, and the desire of Indigenous people to be engaged and involved is high. Publication of successful engagements or successful outcomes in decision-making once Indigenous people have been provided opportunities to self-govern are rare. This means that determination of the critical success factors for greater Indigenous involvement in decision-making for the GBR is difficult, however a set of critical factors have been identified. These factors should be used as a platform from which to undertake further engagements with Traditional Owners of the GBR to validate and identify pathways for future engagements and involvements to deliver collaborative actions to benefit the GBR.

1. Background

In preparation for the new Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP), a series of questions was put forward by policy, management and stakeholders to support the review of the existing plan. Question 7.3 asked ‘What are the critical success factors for greater Indigenous involvement in water quality decision-making for the Great Barrier Reef?’. Burnett Mary Regional Group (BMRG) has worked in close connection with local Traditional Owners for an extended period of time with multiple successful outcomes across the region. BMRG therefore embraced the opportunity to address this stakeholder issue.

This question highlights the intent of the Reef 2050 WQIP to address the absence or exclusion of Indigenous people in the management and decision-making for the Great Barrier Reef (GBR). It is evident that this is a national issue across governance of all natural and man-made systems, but also relevant across the globe. Within the context of decision-making for the GBR, the tangible degradation of the GBR’s ecosystems and importance of water quality to Indigenous people provides a meaningful platform from which to address issues of Indigenous engagement and involvement. The solution, however, can include a focus on the social sciences to address issues of trust and communication. Understanding comes before acceptance and connections between Indigenous people and the natural environment are yet to be fully understood. This includes the benefits of ‘caring for Country’ using traditional land management practices; the meaning of ‘connection to Country’ and the relationship between healthy Country and healthy communities, environmental wellbeing and community wellbeing. The wellbeing of Indigenous people is intimately tied to custodial responsibility in that caring for Country assists in healing therefore, the value of holistic GBR management that integrates Indigenous values extends beyond the GBR itself, it extends to all aspects of Indigenous community.

This means that critical success factors *for* greater Indigenous involvement should implicitly consider the critical success factors *of* greater Indigenous involvement. Developing methodologies to quantify the state of the GBR from the Traditional Owner perspective, and then measure and value the benefits to Indigenous communities of fulfilling their custodial responsibilities to all of the GBR ecosystems through leadership and greater involvement is critical for future management of the GBR.

This question considers these issues in the context of water quality management for the GBR and aims to identify the critical success factors for greater Indigenous involvement in water quality decision making in the GBR region.

1.1 Question

Primary question	Q7.3 What are the critical success factors for greater Indigenous involvement in water quality decision making in the Great Barrier Reef region?
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To address this question, the authors have considered the following sub-questions:

- What is Indigenous involvement in environmental outcomes / objectives at a global scale?
- What are the management frameworks and who are the decision-makers for the GBR?
- What is the importance of water to Indigenous Australians?
- What engagement and involvement models have been successful?

1.2 Conceptual diagram

This question is represented in Figure 1.

Dugoo Duwalami – Heart meeting place

The central component of the artwork is the roundtable for the GBR with various seats around the table representing various institutions involved in decision-making and management of the GBR.

The upper half of the artwork represents the extensive pathways of engagement and involvement that these decision-making bodies for the GBR have travelled on, prior to the seat at the roundtable.

The opaque section (top middle) represents diverse Traditional Owner groups that have not been effectively involved or engaged in decision-making for the GBR over a long period of time.

Once resources towards building the presence, literacy, capacity and capability of Traditional Owners within existing GBR management frameworks are implemented, the head of the Rainbow Serpent (*Yindinji* - Butchulla) is set in motion.

The roundtable is now complete and two-way knowledge sharing ensues, where Traditional Owner groups are familiar with all legislative, policy and funding frameworks underpinning management of the GBR, and the primary concept of connectivity from freshwater headwaters, through diverse habitats and peoples, down to the GBR (light blue dots) is aligned to decision-makers and decision-making for the GBR.

Dugoo Duwalami ensures improved holistic outcomes for the species, habitats and people connected to the GBR through truly collaborative management.



Figure 1. Illustration representing the scope of Question 7.3. Prepared by Conway Burns, 2022.

1.3 Links to other questions

This synthesis of evidence addresses one of 30 questions that are being addressed as part of the 2022 SCS. The questions are organised into eight themes: values and threats, sediments and particulate nutrients, dissolved nutrients, pesticides, other pollutants, human dimensions, and future directions, that cover topics ranging from ecological processes, delivery and source, through to management options. As a result, many questions are closely linked, and the evidence presented may be directly relevant to parts of other questions. The relevant linkages for this question are identified in the text where applicable. The primary question linkages for this question are listed below.

Links to other related questions	<p>This question has links to the following questions:</p> <p>Q1.1 What are the socio-ecological, cultural, economic and intrinsic values of the Great Barrier Reef?</p> <p>Q1.2/1.3/2.1 What is the extent and condition of Great Barrier Reef ecosystems and what are the primary threats to their health?</p> <p>Q7.1 What is the mix of programs and instruments (collectively and individually) used in the Great Barrier Reef catchments to drive improved land management actions for Great Barrier Reef water quality benefits and how effective are they?</p>
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2. Method

A formal Rapid Review approach was used for the 2022 Scientific Consensus Statement (SCS) synthesis of evidence. Rapid reviews are a systematic review with a simplification or omission of some steps to accommodate the time and resources available⁶. For the SCS, this applies to the search effort, quality appraisal of evidence and the amount of data extracted. The process has well-defined steps enabling fit-for-purpose evidence to be searched, retrieved, assessed and synthesised into final products to inform policy. For this question, an Evidence Summary method was used.

2.1 Primary question elements and description

The primary question is: ***What are the critical success factors for greater Indigenous involvement in water quality decision making in the Great Barrier Reef region?***

The sub-questions defined to assist in conducting the review are:

- What is Indigenous involvement in environmental outcomes / objectives at a global scale?
- What are the management frameworks and who are the decision-makers for the GBR?
- What is the importance of water to Indigenous Australians?
- What engagement and involvement models have been successful?

S/PICO frameworks (Subject/Population, Exposure/Intervention, Comparator, Outcome) can be used to break down the different elements of a question and help to define and refine the search process. The S/PICO structure is the most commonly used structure in formal evidence synthesis methods⁷ but other variations are also available.

- **Subject/Population:** Who or what is being studied or what is the problem?
- **Intervention/exposure:** Proposed management regime, policy, action or the environmental variable to which the subject populations are exposed.
- **Comparator:** What is the intervention/exposure compared to (e.g., other interventions, no intervention, etc.)? This could also include a time comparator as in 'before or after' treatment or exposure. If no comparison was applicable, this component did not need to be addressed.
- **Outcome:** What are the outcomes relevant to the question resulting from the intervention or exposure?

Table 1. Description of question elements for Question 7.3.

Question S/PICO elements	Question term	Description
Subject/Population	Indigenous Australians	Global Indigenous involvement in environmental decision-making.
Intervention, exposure & qualifiers	Water quality decision making	Who makes decisions for the GBR under what frameworks?
Comparator	Water to Aboriginal and Torres Strait Islanders	What is the importance of water to Aboriginal and Torres Strait Islanders and who made the decisions on management?
Outcome & outcome qualifiers	Success factors	What engagement and involvement models have been successful?

⁶ Cook CN, Nichols SJ, Webb JA, Fuller RA, Richards RM (2017) Simplifying the selection of evidence synthesis methods to inform environmental decisions: A guide for decision makers and scientists. *Biological Conservation* 213: 135-145. <https://doi.org/10.1016/j.biocon.2017.07.004>

⁷ <https://libguides.jcu.edu.au/systematic-review/define> and <https://guides.library.cornell.edu/evidence-synthesis/research-question>

Table 2. Definitions for any relevant terms used in Question 7.3.

Definitions	
GBR region	Great Barrier Reef World Heritage Area
Water quality	The physical, chemical and biological characteristics of water and the measure of its condition relative to the requirements for one or more biotic species and/or to any human need or purpose.
Indigenous Australians	Indigenous Australians are people with familial heritage from the Australian continent before British colonisation.
Indigenous involvement	The active integration of Indigenous people into the planning, implementation and assessment of activities.

2.2 Search and eligibility

The Method includes a systematic literature search with well-defined inclusion and exclusion criteria.

Identifying eligible literature for use in the synthesis was a two-step process:

1. Results from the literature searches were screened against strict inclusion and exclusion criteria at the title and abstract review stage (initial screening). Literature that passed this initial screening step were then read in full to determine their eligibility for use in the synthesis of evidence.
2. Information was extracted from each of the eligible papers using a data extraction spreadsheet template. This included information that would enable the relevance (including spatial and temporal), consistency, quantity, and diversity of the studies to be assessed.

a) Search locations

Searches were performed in:

- JSTOR
- Scopus
- Web of Science
- NLA trove
- Ngunjook

b) Search terms

Table 3 shows a list of the search terms used to conduct the online searches.

Table 3. Search terms for S/PICO elements of Question 7.3.

Question element	Search terms
Subject/Population	Indigenous, Aboriginal, First Nations people, stewards, traditional custodians, Traditional Owners
Exposure or Intervention	Water quality, hydrological cycle, managing, administrating
Comparator (if relevant)	
Outcome	Influence, considerations, elements, parts, communications, outcomes, trainings, capacity, resourcing

c) Search strings

Table 4 shows a list of the search strings used to conduct the online searches.

Table 4. Search strings used for electronic searches for Question 7.3.

Search strings
indigenous OR aboriginal OR "traditional owners" AND "decision making" AND manag* OR administra*
indigenous OR aboriginal OR "first nations" OR "traditional owners" AND water AND involvement OR decision OR management OR govern* AND "great barrier reef" OR gbr OR queensland
"Rainbow serpent" OR Dreamtime AND "Australian indigenous culture AND "Traditional ecological knowledge" AND "Water connectivity" OR "hydrological cycle" AND "two-way knowledge sharing"

d) Inclusion and exclusion criteria

Table 5 shows a list of the inclusion and exclusion criteria used for accepting or rejecting evidence items. The authors approached inclusion and exclusion through agreement of the topics of relevance, and then collectively agreed on the items to be included or excluded in the screening processes. Many of the findings comprised only a small part of a study and therefore, review and selection of the items required detailed consideration of the full text to extract the relevant information. To ensure consistency between authors, a subset of evidence items was checked for consistency in inclusion or exclusion, and a final review of the selection was undertaken by the Lead Author.

Table 5. Inclusion and exclusion criteria for Question 7.3 applied to the search returns.

Question element	Inclusion	Exclusion
Subject/Population	Dreamtime/Traditional Ecological Knowledge. Indigenous Peoples. Engagement with Traditional Owners.	Not relevant to Indigenous knowledge or engagement.
Exposure or Intervention	Water, environmental or habitat management. Water quality. Hydrological cycle.	Non-water/environment subject. Decision making not related to Indigenous engagement and involvement. Policy.
Comparator (if relevant)	Value of water in Indigenous communities. Water quality decision making.	Broader Indigenous values. Decision making associated with other factors.
Outcome	Successful models of engagement and involvement. Unsuccessful models of engagement and involvement.	Outcomes that are not specific to engagement or involvement, particularly: <ul style="list-style-type: none"> • Education outcomes. • Health outcomes.
Language	English	Language other than English
Study type	Peer reviewed evidence. Scientific article, literature review, note to journal.	Non-peer reviewed evidence. Entire Book or book chapter. Thesis/report. Evidence not open access.

3. Search Results

A total of 533 studies were identified through online searches for peer reviewed and published literature. An additional 19 studies were identified manually through expert contact and personal collection, which represented approximately 4% of the total evidence. 113 studies were eligible for inclusion in the synthesis of evidence (Table 6) (Figure 2). Six studies were unobtainable.

Table 6. Search results table, separated by A) Academic databases, and B) Manual searches. The search results are provided in the format X of Y, where: X (number of relevant evidence items retained); and Y is the (total number of search returns or hits)

Date	Search strings	Sources				
A) Academic databases		JSTOR	Scopus	Web of Science	NLA Trove	Ngoonjook
	"indigenous" OR "aboriginal" OR "Traditional Owners" AND "decision making" AND manag* OR administra*	27 of 19,950 (first 100)	52 of 6,859 (first 100)	26 of 1,146 (first 100)	7 of 19	15 of 910 (first 100)
	"Rainbow serpent" OR "Dreamtime" AND "Australian indigenous culture" AND "Traditional ecological knowledge" AND "Water connectivity" OR "hydrological cycle" AND "two-way knowledge sharing"	7 of 728 (first 100)	0 of 1	8 of 13	0	0
Total items online searches		533 (97%)				
B) Manual search						
Date	Source	Number of items added				
	Great Barrier Reef Online Resources https://www.reefplan.qld.gov.au/	13				
	Anonymous reviewer	6/9				
Total items manual searches		19 (3%)				

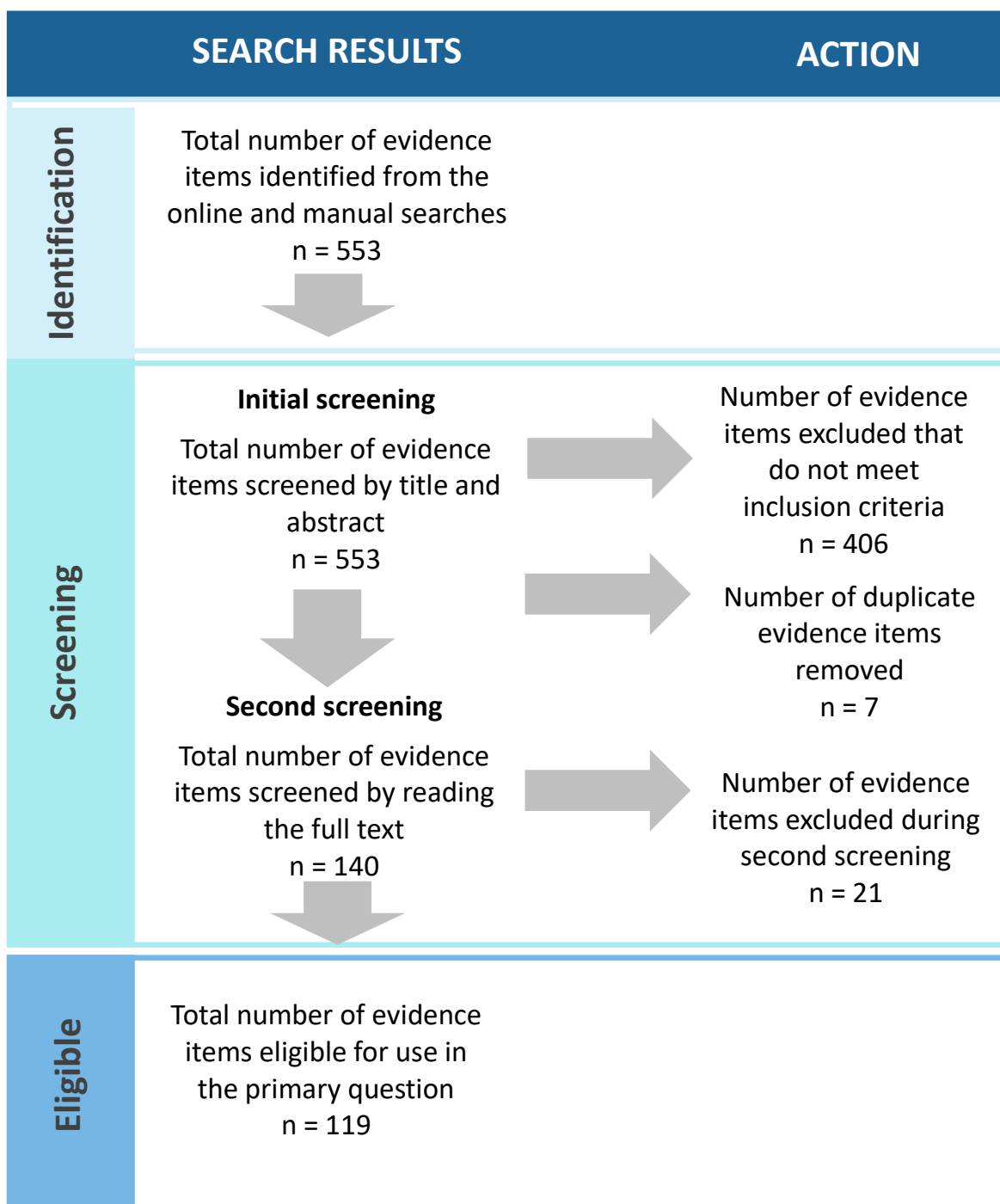


Figure 2. Flow chart of results of screening and assessing all search results for Question 7.3.

4. Key Findings

4.1 Narrative synthesis

4.1.0 Summary of study characteristics

Although in total, 119 studies were used in this synthesis, the number of publications relating to Traditional Owner engagement, cultural knowledge and two-way knowledge has been steadily increasing since the mid-2000s. Over 95% of the studies used in this synthesis were published after 2005, with two published as far back as 1991 (Figure 3).

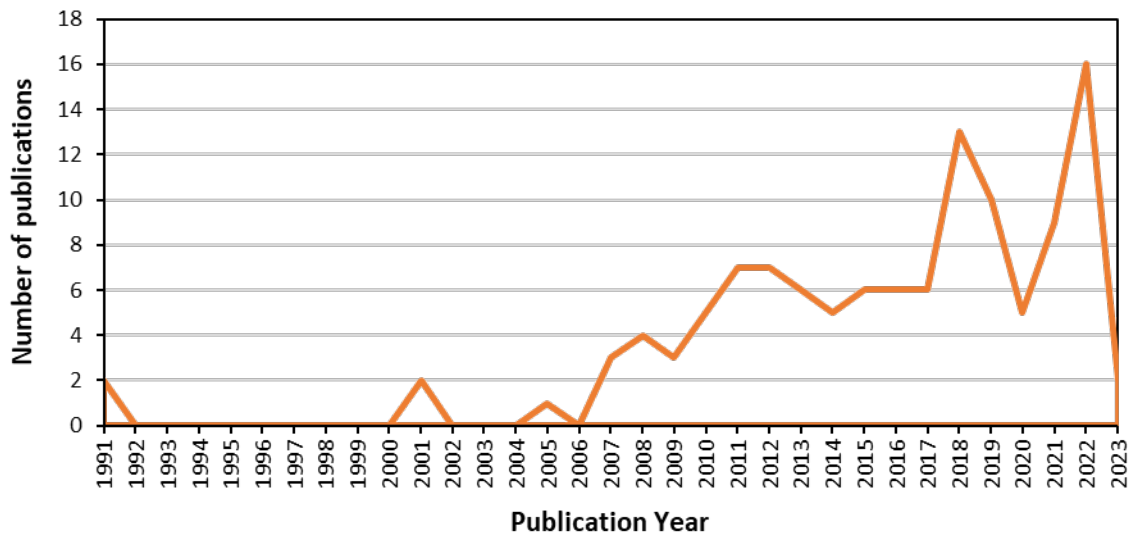


Figure 3. Number of studies across the year of publication from 1990 to 2023.

Of the 119 eligible studies, 104 (87%) had one or more authors affiliated with a university and only 27 (23%) had authors affiliated with Indigenous organisations, including Land Councils, ranger groups, Traditional Owners/First Nations Peoples (Figure 4). Despite the low rates of Traditional Owner authorship or affiliation, 60% of studies involved Indigenous participation, either through co-authorship, or through participatory workshops and interviews. Of the studies which involved Indigenous participation, almost 63% of these studies involved Traditional Owners from Australia, followed by Canada with 32% Indigenous participation (Figure 5).

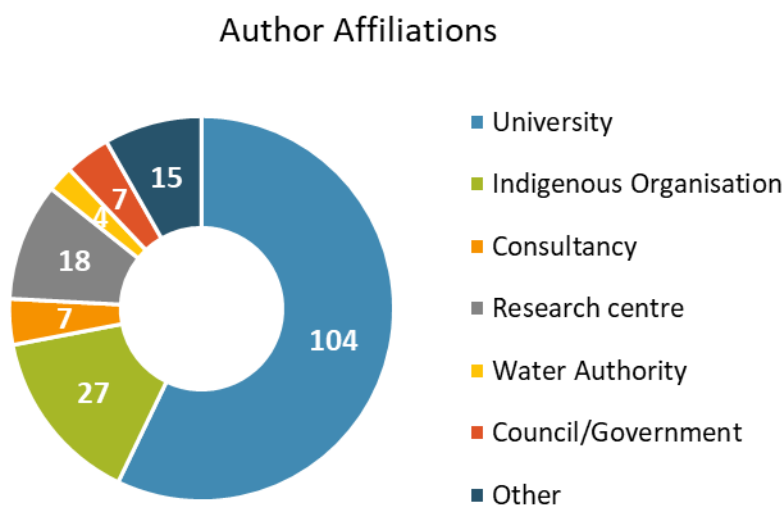


Figure 4. Number and source of author affiliations in the body of evidence.

Country of study with Indigenous participation

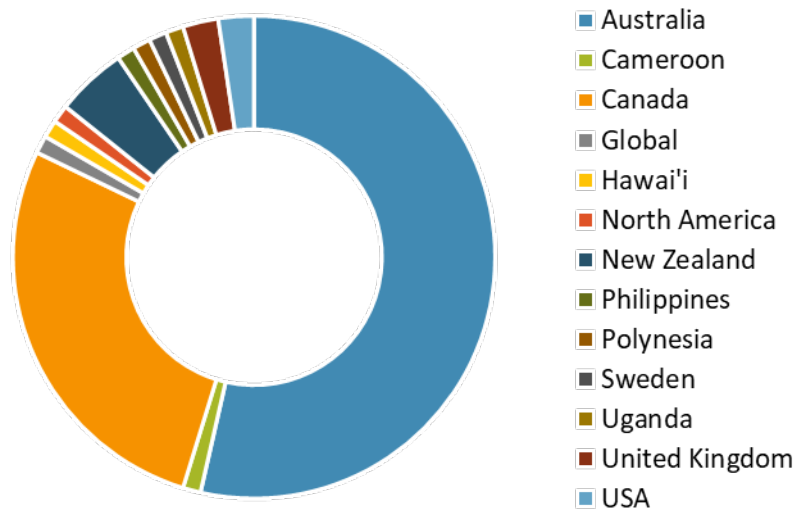


Figure 5. Indigenous participation in the studies in the body of evidence by country.

4.1.1. Summary of evidence to 2022

Indigenous involvement in environmental decision-making

Indigenous involvement in environmental management and decision-making is a global issue driven by disparate worldviews, exclusion of these worldviews within western governance constructs, and a lack of resources focused on building capacity of, or relationships with, Indigenous people (Alexander et al., 2011; Ali et al., 2022; Baijius & Patrick, 2019b; Bark et al., 2015; Bohensky et al., 2013; Collings, 2012; Diver, 2017; Diver et al., 2022; Finn & Jackson, 2011; Gaw et al., 2019; Hartwig et al., 2022; Kookana et al., 2013; Kuru et al., 2021; Leiper et al., 2018; Maclean et al., 2012; McGregor, 2012; Muller et al., 2019; O'Faircheallaigh, 2015; Simms et al., 2016; Tiparui et al., 1991; Turner et al., 2008; Weir, 2011; Wyatt et al., 2010). Indigenous worldviews are synchronous in familial connections to nature which drives custodial responsibilities to the conservation and management of natural resources (Arbon, 2008; Ban et al., 2020; Cameron, 2022; Louis, 2007; Marika-Mununggiritj, 1991; Ridges et al., 2020; RiverOfLife et al., 2020; Weir, 2012). Non-Indigenous worldviews primarily view man as separate to nature which drives the use of natural resources as a means of providing ongoing ecosystem services to humans (Gibbs, 2009; Larson et al., 2023; Muller et al., 2019; Weir, 2012). This has led to continual degradation of the natural environment, surpassing resilience thresholds and manifests as species extinctions, and the loss of ecosystem services that civilisation has previously depended on without recourse (Gaw et al., 2019; Latulippe & McGregor, 2022; Lindsay et al., 2022; Sahoo et al., 2022; Tsuji, 2021). As a result, the modern world is now looking to Indigenous people to incorporate principles of sustainability and responsibility into decision-making for natural resource conservation and management (Ban et al., 2020; Beveridge et al., 2021; Leiper et al., 2018; Lindsay et al., 2022; Maclean et al., 2012; McGregor, 2012; Prober et al., 2011; Thornton & Scheer, 2012b; Weir, 2012).

Findings from International studies

For Indigenous people around the world, the pathway from environmental exclusion to stakeholder to decision-maker is at various stages but overall can be considered incomplete (Lawrence, 2012; Maclean et al., 2012; Muller et al., 2019; Mwebaza, 2007). Various international legal instruments and forums have aimed to emphasise and improve Indigenous rights within the context of environmental benefits, involvement, decision-making and self-determination (Bohensky et al., 2013; Diver et al., 2019; Taylor, 2008; Wilson, 2019). Instruments such as the UNESCO World Heritage Convention, UN Expert Mechanism on the Right of Indigenous People (EMRIP) and the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) aim to promote and protect cultural heritage, particularly the relationship between Indigenous people and their traditional lands and resources (Disko, 2017; Smith & Turk, 2013). In addition, the '2030 Agenda for Sustainable Development' directly and indirectly integrates improved

Indigenous wellbeing and involvement across its 17 Sustainable Development Goals (SDGs) and associated targets, extending to the right to be involved in decision-making (Sahoo et al., 2022).

A majority of the published literature on Indigenous involvement in environmental decision-making logically comes from colonised regions such as the Americas and Australia, where colonists displaced Indigenous people and settled to govern land and people (Hartwig et al., 2022; Sahoo et al., 2022). The First Nations people of Canada may be considered as furthest down the pathway to decision-makers and self-governance with over 30 years of published literature documenting the struggle for engagement and involvement (Baijius & Patrick, 2019a; Curran, 2019; Diver, 2017; Houde, 2007; Wyatt et al., 2010). This has led to increasing authority afforded to First Nations decision-making in both marine and freshwater environments with concomitant calls for improved collaboration with existing research and management authorities (Adams et al., 2014; Jones et al., 2010). However, in some areas, inclusion of Traditional Ecological Knowledge in environmental policy and regulatory processes is still a work in progress (Crawford, 2018; Diver, 2017). Nonetheless, First Nations people in Canada are current world leaders in water governance research and community-driven programs that recognise, respect and include Traditional Ecological Knowledge and cultural responsibilities in water management (Latulippe & McGregor, 2022). Canada has thus led the way for open discussion towards self-governance and self-determination for the global Indigenous community (Simms et al., 2016).

Many Indigenous communities around the world are addressing issues of former exclusion on the pathway from stakeholder to decision-maker in attempts to “decolonise environmental management” and uphold the right to public participation in environmental decision-making and natural resource management (Diver et al., 2022; Muller et al., 2019; Mwebaza, 2007). Collaborative management and governance via the establishment and implementation of Indigenous ranger or guardian programs has been a preferred option to garner greater Indigenous engagement and involvement whilst improving cultural awareness for non-Indigenous collaborators (Ayre et al., 2018; Noble et al., 2016; Reed et al., 2021). However, an important stepping stone in that pathway is the transition from collaboration to co-governance with Indigenous people; a transition from management *with* Indigenous people to one that actively integrates Indigenous knowledge and culture (Carson et al., 2018; Hughey et al., 2017; Louis, 2007). Amendments to the US Clean Water Act, for example, has enabled many Native American tribes to self-govern by setting and implementing cultural water quality standards which are often more thorough than state regulations (Diver et al., 2019). This greater control in decision-making ensures that the benefits of Indigenous involvement in environmental decision-making are felt by Indigenous communities (Kuru et al., 2021; Wilson, 2019).

Findings from around Australia

For Aboriginal and Torres Strait Islander people of Australia, involvement in environmental decision-making over land and water is embedded within various policy and legislative instruments primarily developed over the past 30 years, and encompassing laws related to native title, water, biodiversity and the environment (Cuttriss, 2001; Goolmeer et al., 2022; Maclean et al., 2012; O’Faircheallaigh, 2015; RiverOfLife et al., 2020). Prior to this, conservation and protection of cultural heritage was primarily driven by the ICOMOS-based (International Council on Monuments and Sites) Burra Charter, developed in the 1970s, and driven by a values-based management approach (Buckley & Sullivan, 2014). Although the introduction of the *Native Title Act 1993* brought with it much promise, apart from recognition of ‘Country’ and ‘connection’, Indigenous governance over land and water has been limited and variable (Godden & Cowell, 2016; Hartwig et al., 2018; Weir, 2012). Existing and overlapping statutory and common laws such as land tenures and the *Wild Rivers Act 2005*, for example, have complicated native title rights and interests over land (Carter, 2010; Weir, 2012). Indigenous rights and access to water have been exacerbated by ‘water colonialism’, over-allocation and environmental degradation leading to national water reform in the early 2000s (Hartwig et al., 2022; Jackson, 2011; Weir, 2011). Resulting legislation changes to the Water Act, for example, must now improve consideration of cultural values in water planning however this has also met with variable success (Bark et al., 2015; Maclean et al., 2012). Integration of cultural water values into water planning has lacked meaningful engagement resulting in the environment being used as a surrogate in water allocation and schemes to restore balance and river health (Finn & Jackson, 2011; Weir, 2011). Inevitably, the concept of ‘cultural water’ remains obscure,

dichotomised by opposing world views, socio-ecological relationships, and management and governance objectives (Barber & Jackson, 2011; Bischoff-Mattsona et al., 2018; Gibbs, 2009).

Findings from the Great Barrier Reef

Acknowledgement of the need to engage and involve Indigenous people in the protection and management of the GBR was documented in the original *Great Barrier Reef Marine Park Act 1975* and the Reef Water Quality Protection Plan 2003 (The State of Queensland and Commonwealth of Australia, 2003). The *Great Barrier Reef Marine Park Act 1975* included a requirement for at least one part-time member of Indigenous background within the membership of its authority. In 1985, the Great Barrier Reef Marine Park Authority (GBRMPA) hosted a workshop in Townsville to assess the status of traditional knowledge of the marine environment in Northern Australia (Gray et al., 1988). The primary objective of this workshop was to understand how Traditional Ecological Knowledge could contribute to contemporary management of the GBR, however, a significant outcome was to also establish an ongoing coordinated education program to address gaps in knowledge, and improve dissemination, of traditional knowledge. In 1994, the GBR 25-year Strategic Plan was published which claimed involvement of over 15 Indigenous groups primarily concerned about the effects of World Heritage listing within the context of Native Title (GBRMPA, 1994). Within its short- and long-term objectives, commitments were made to ensure that Traditional Owners have opportunities for membership and full involvement in decision-making and employment. In addition, the first Indigenous person was then appointed to the GBRMPA Consultative Committee in 1996. In 1997, the Indigenous Protected Areas program was established together with a GBR Ministerial Council directive to develop co-management arrangements for dugong with Indigenous peoples. In 1997, a Review of Aboriginal Involvement in the Management of the Wet Tropics World Heritage Area (WTWHA) highlighted limited involvement of Aboriginal people in management of the WTWHA even though the mechanisms, policies and legislation were available (Wet Tropics Board of Management Review Steering Committee, 1998). Symptoms were attributed to lack of understanding, technical expertise and insufficient resources to meet obligations; whereas cause was attributed to a lack of commitment and political will to address Indigenous issues at a more than superficial level. By 2000, four GBRMPA Reef Advisory Committees across biodiversity, fisheries, tourism and water quality were established, and in 2002 the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) was established. By 2005 the first GBRMP Traditional use of Marine Resources Agreement (TUMRA) was established with a further 12 established since across the GBR catchments. The Torres Strait Island and Sea Management Strategy was developed in 2005 and finalised in 2016 with Traditional Owner engagement to document Cultural values and affirm holistic connections to Sea Country that would benefit contemporary management (Torres Strait Regional Authority, 2016). The Wet Tropics Regional Agreement was also developed in 2005 which built on the 'Which Way Our Cultural Survival' report from 1998 to review and subsequently identify the need for improved co-operative management of the Wet Tropics World Heritage Area with Aboriginal people (WTMA, 2005). In 2007, the first Indigenous ranger positions were made available under the Commonwealth funded Working on Country program that also facilitated partnerships between the Australian government and Indigenous organisations focused on managing natural resources including the GBRMPA Land and Sea Country Indigenous Partnerships program. This partnership also led to a sponsorship program where Traditional Owners could apply for funding to invest in their own training and development⁸.

In 2016, the 'Reef 2050 Long Term Sustainability Plan: Indigenous Implementation Plan' (Department of Environment and Energy, 2016) represented a significant engagement with Traditional Owners which recognised a collaborative effort was required for the long-term and difficult task of improved management of the GBR. A key aim of this report was to initially identify the synergies in Indigenous interests and objectives of the plan with immediate identification of the desire of Traditional Owners to be more involved in management of the GBR. This led to meaningful consultation and engagement

⁸Reef Rescue Land and Sea Country Indigenous Partnerships Sponsorship Program 2011-2012, Guidelines for Applicants, <https://elibrary.gbrmpa.gov.au/jspui/bitstream/11017/1014/1/gbrmpa-Sponsorship-Program-Guidelines201112.pdf>

across various fora which identified several key factors to consider for collaborative and improved management. Capacity of Indigenous organisations to deliver co-designed actions for the GBR was found to be highly variable and requiring ongoing support in terms of corporate governance, coordination and ranger programs. Improved co-ordination was also identified at an overarching level to address issues in communication across organisations involved in GBR management and Traditional Owners, resulting in a proposed 'co-ordination unit', independent of government and providing ongoing consultation and communication to deliver collaborative actions. Storage and management of cultural heritage information was also identified as an issue, highlighting issues of trust between Traditional Owners and government. In conclusion, this report correctly identified: "However, ongoing consultation, continuous adaptive management and improvement will be required in the future. It is the vehicle for securing enduring benefits for the Reef and its Traditional custodians and not an end point" (Department of Environment and Energy, 2016). This has resulted in numerous Traditional Owner advisory bodies, committees and planning frameworks created to inform management of the GBR with variable success (Reef 2050 Traditional Owner Steering Group, 2023).

Factors influencing involvement and engagement

Socio-ecological aspects

Unfortunately, the degradation of Traditional Ecological Knowledge together with biodiversity is continuing to the detriment of Indigenous people who are forced into further assimilation when traditional cultural activities are no longer supported by local environments (Baijius & Patrick, 2019b; Ban et al., 2020; Cullen-Unsworth et al., 2012; Tsuji, 2021). Understanding and acceptance of the connection and dependence between community wellbeing and environmental wellbeing for Indigenous communities is of growing concern for governments and social welfare institutions (Ali et al., 2022; Bischoff-Mattsona et al., 2018; Black & McBean, 2016; Donatuto et al., 2014; Sangha et al., 2015; Taylor & Habibis, 2020). This has led to a growing need for quantification of the social dimensions of environmental degradation (e.g., social impact assessment), and in turn, the community benefits of engaging, involving and supporting Indigenous people in holistic environmental management for mutual benefit (Barber et al., 2015; Coyne et al., 2022; Leiper et al., 2018; Larson et al., 2023; Manero et al., 2022; O'Faircheallaigh, 2009; Ober & Fasoli, 2008; Taylor, 2008; Zander, 2013).

Capacity and capability

Resources spent on improving the capacity and capability have shown the broadest benefits to the environment and Indigenous participation towards self-governance (Bodle et al., 2018; Collings, 2012; Hemming et al., 2017; Jones et al., 2010; Nikolakis et al., 2023; Pence et al., 2010; Sangha & Russell-Smith, 2017; Tiparui et al., 1991). Australian Indigenous organisations in particular have expressed great desire to manage their conservation estates and drive their own capacity-building programs with successful outcomes demonstrated when Indigenous groups are resourced and given responsibility in water management and planning (Bark et al., 2015; Davies et al., 2013; Hemming et al., 2017; Maclean et al., 2012). Measuring the success and value of collaborative and inclusive management, with agreed criteria and indicators, on environmental and community outcomes is essential to sustainable and adaptive management (Coyne et al., 2022; Izurieta et al., 2011; Larson et al., 2023; Manero et al., 2022; Sangha & Russell-Smith, 2017; Stacey et al., 2013). This will also enable policy development that is informed by Indigenous people and recognises the intimate connection between environmental and cultural wellbeing (Barber et al., 2015; Black & McBean, 2016; Kookana et al., 2013; Sangha et al., 2015).

Collaboration

There is a rapidly growing body of literature detailing the benefits of collaborative approaches to Indigenous engagement for improved outcomes in research, policy and management (Beveridge et al., 2021; Bohensky et al., 2013; Dovers et al., 2015; Gaw et al., 2019; Hill et al., 2012; Jackson et al., 2014; Lilleyman et al., 2022; Muller et al., 2019). Collaborative research in particular across Indigenous and non-Indigenous organisations has demonstrated great success in environmental outcomes and awareness of the ecological knowledge and wisdom held, and contributed, by Indigenous people (Ali et al., 2022; Ayre et al., 2018; Beveridge et al., 2021; Cullen-Unsworth et al., 2012; Gone, 2019; Izurieta et al., 2011; Lilleyman et al., 2022; Lindsay et al., 2022; Maclean et al., 2012; Ober & Fasoli, 2008; Peltier,

2018; Prober et al., 2011). Hill et al. (2012) and Leiper et al. (2018) also showed that Indigenous-led or co-led approaches to integration of western science and Traditional Ecological Knowledge demonstrated better outcomes for sustainable environmental management across a number of Australian case studies.

Approaches that focus on building trust, capacity and two-way knowledge integration are also documenting the benefits to self-governance of Indigenous communities and decision-making for the environment (Adams et al., 2014; Collings, 2012; Cullen-Unsworth et al., 2012; Kuru et al., 2021; Latulippe & McGregor, 2022; Lindsay et al., 2022; Thornton & Scheer, 2012). This is paving the way for emerging Indigenous scholars, leaders and groups to use existing legislation and frameworks to ensure rights of Indigenous people protect and conserve natural and Cultural heritage (Brearley, 2008; Curran, 2019; Diver et al., 2022; Hemming et al., 2017; Jones et al., 2010; Pence et al., 2010; RiverOfLife et al., 2020; Yibarbuk & Cooke, 2001).

The need for improved engagement

A large body of international literature details the issues, and proposes the needs and means of improved engagement with Indigenous people for improved environmental management (Adams et al., 2014; Ali et al., 2022; Austin et al., 2018; Ayre et al., 2018; Baijius & Patrick, 2019b; Beaudoin et al., 2016; Black & McBean, 2016; Carson et al., 2018; Diver, 2017; Dovers et al., 2015; Gaw et al., 2019; Gone, 2019; Goolmeer et al., 2022; Hughey et al., 2017; Izurieta et al., 2011; Jackson et al., 2019; Kuru et al., 2021; Prober et al., 2011; Robitaille et al., 2017; Simms et al., 2016; Spaeder & Feit, 2005; Thornton & Scheer, 2012; Trigger et al., 2014; Turner et al., 2008; Wyatt et al., 2010). Collaboration is proposed at all levels of environmental management including research, policy, planning, implementation, assessment and overall governance, with the importance of prioritising social dimensions key to precluding relationships built on respect, trust and mutual capacity-building. These points are also reiterated across a small proportion of publications that provide perspectives directly from Indigenous groups and also highlight ignorance of non-Indigenous people towards Aboriginal culture (Ban et al., 2020; Barber & Jackson, 2011; Belisle & Asselin, 2021; Cameron, 2022; Denny & Fanning, 2016; Kookana et al., 2012; Larson et al., 2023; McGregor, 2012; Taylor & Habibis, 2020). Quantitative evidence of improved natural resource management through greater collaboration with Indigenous people is also emerging (Austin et al., 2018; Baijius & Patrick, 2019a; Leiper et al., 2018; Lindsay et al., 2022).

Success stories

There are several publications identified in the review that document successes in engagement and decision-making processes with Indigenous peoples at national and international levels, as well as some unsuccessful decision-making processes. These are captured in Table 7. While the studies are sufficiently relevant to include in this review, the specific detail has variable application to the GBR and therefore has not been extracted here. The findings of these studies do however reinforce the outcomes summarised in the information above and reiterate aspects of understanding and cultural awareness, respect, capacity, capability and the need for the application of an adaptive approach to management.

Table 7. Examples of studies that document engagement and decision making with Indigenous peoples at national and international levels.

Aspect	Relevant references
Documented engagement success with Indigenous peoples at national and international levels.	Bark et al., 2015; Beveridge et al., 2021; Cullen-Unsworth et al., 2012; Dovers et al., 2015; Gaw et al., 2019; Hemming et al., 2017; Hill et al., 2012, 2022; Jackson et al., 2014; Latulippe & McGregor, 2022; Lilleyman et al., 2022; Maclean et al., 2012; Muller et al., 2019; Pence et al., 2010; Yibarbuk & Cooke, 2001

Aspect	Relevant references
Documenting decision-making success afforded to Indigenous peoples at national and international levels.	Curran, 2019; Diver et al., 2022; Hemming et al., 2017; Muller et al., 2019; Yibarbuk & Cooke, 2001
Documented unsuccessful decision-making outcomes for Indigenous people.	Zorzin, 2014

4.1.2 Recent findings 2016-2022 (since the 2017 SCS)

Fifty-one publications were documented between the 2016 and 2022 period. Of these, 25 publications focused on Indigenous participation in environmental management and decision-making, documenting key learnings from proposed and ongoing collaborative work (Ali et al., 2022; Austin et al., 2018; Baijius & Patrick, 2019a; Ban et al., 2020; Belisle & Asselin, 2021; Beveridge et al., 2021; Black & McBean, 2016; Dale et al., 2021; Denny & Fanning, 2016; Diver et al., 2022; Gabriel et al., 2020; Godden & Cowell, 2016; Jackson et al., 2019; Jackson, 2022; Larson et al., 2023; McGaurr et al., 2016; Reid et al., 2022; Sahoo et al., 2022; Steenbergen et al., 2021; Wilson, 2019). A vast majority of these publications point towards improved sustainability of social and environmental outcomes that acknowledge and support respectful integration of Indigenous knowledge and values, whilst meeting the management aspirations of Traditional Owners. Recommendations are also made in terms of preferred approaches to engagement, collaborative management and policy development (Diver, 2017; Hughey et al., 2017; Kuru et al., 2021; Pyke et al., 2018; Robitaille et al., 2017). Another 16 publications focused on ongoing issues with communication, understanding and awareness between western societies and their Indigenous communities, and the implementation of well-meaning, collaborative projects across this diverse landscape (Baijius & Patrick, 2019b; Cameron, 2022; Carson et al., 2018; Crawford, 2018; Dale et al., 2021; Disko, 2017; Hartwig et al., 2018; 2022; Kutay, 2021; Muir, 2018; Muller et al., 2019; Searle & Mulholland, 2018; Simms et al., 2016; Taylor & Habibis, 2020; Tsuji, 2021; Zurba & Bullock, 2018). Finally, a subset of publications focused on the success and benefits of Indigenous engagement and involvement on ecosystems and communities (Coyne et al., 2022; Diver et al., 2019; Gómez-Betancur et al., 2022; Latulippe & McGregor, 2022; Nikolakis et al., 2023; Noble et al., 2016; RiverOfLife et al., 2020; Sangha & Russell-Smith, 2017).

4.1.3 Key conclusions

Key learnings identified to be most relevant to the Great Barrier Reef from national and international studies are:

1. Understanding: Cultural awareness across western societies of Indigenous people's connections with the natural world are low and not conducive to acceptance that engaging and involving Indigenous people in natural resource management has global benefits. Support for education campaigns that not only apply to stakeholders of the GBR but also encompass primary and secondary school curriculums are needed. These engagements should be designed and delivered by diverse Indigenous groups 'on Country'. On-Country engagements between Traditional Owners and senior management staff are also required and should be undertaken primarily 'on Country'. The classroom and meeting room should be 'Country' wherever possible and non-Indigenous managers advised to primarily listen to understand the historic issues before developing future directions. Recognition of the social dimensions of the issues and solutions is a priority.
2. Respect: Cultural awareness builds respect for Indigenous culture, land and sea management practices, and innate connections to Country held within Traditional Ecological Knowledge. Relationships built on trust, respect and understanding have shown best results in supporting Indigenous organisations on the pathway from exclusion to decision-making and self governance. Furthermore, Traditional Owners are not stakeholders to be consulted but rather decision-makers and as such, should be included from the start in relevant management roundtables.

3. Collaboration: Collaboration is required at all levels of environmental decision-making including research, planning, policy, implementation, assessment and overall governance; and establishing relationships that are founded on respect, trust and mutual capacity-building is critical. Collaborative research that integrates different types of ecological knowledge has demonstrated great success in environmental outcomes and led to increased recognition of the awareness of the knowledge and wisdom held and contributed by Indigenous people.
4. Capacity: Contemporary Traditional Owner groups are expected to contribute effectively and efficiently across a vast scope of legislative, policy and planning frameworks. Development of resources focused on improving literacy of Traditional Owners to understand these frameworks in formats that are more meaningful for Traditional Owners, and the provision of more opportunities for individuals to gain experience with relevant management programs, are beneficial for the building of this capacity. Efforts should also be made to include Traditional Owners in all engagements to ensure improved capacity as decision-makers for the GBR.
5. Capability: Greater resources and effort to support Traditional Owner organisations to acquire the skills needed to govern, manage and deliver programs in terms of design, research, policy, planning, implementation, assessment and management has been shown to be beneficial. Effective self-governance of Traditional Owner organisations should be an endpoint which is supported by all western organisations involved with the management of the GBR.
6. Adaptive management: The critical success factors *for* greater Indigenous involvement should implicitly consider the critical success factors *of* greater Indigenous involvement. Integration of the steps above into policy and planning documents supported by fit for purpose Monitoring Evaluation and Reporting Strategies to measure success is necessary for continuous improvement and adaptive management.

This synthesis has highlighted that issues of communication, relationships, engagement and involvement of Indigenous people in natural resource management are not confined to Australia, but rather a global issue. In summary:

- 31 publications highlighted communication problems between contemporary management authorities and Indigenous people (Adams et al., 2014; Ali et al., 2022; Austin et al., 2018; Ban et al., 2019; Bark et al., 2015; Beaudoin et al., 2016; Cameron, 2022; Carter, 2010; Davies et al., 2013; Diver, 2017; Finn & Jackson, 2011; Hartwig et al., 2018; Houde, 2007; Jackson, 2022; Kutay, 2021; Larson et al., 2023; Maclean et al., 2012; Marika-Mununggiritj, 1991; Noble et al., 2016; O’Faircheallaigh, 2009; Prober et al., 2011; Searle & Mulholland, 2018; Smallacombe, 2005; Smith, 2019; Taylor & Habibis, 2020; Thornton & Scheer, 2012; Tiparui et al., 1991; Wohling, 2009; Yibarbuk & Cooke, 2001; Zorzin, 2014; Zurba & Bullock, 2018).
- 23 publications documented Indigenous exclusion from natural resource management and decision-making (Ali et al., 2022; Baijius & Patrick, 2019a; 2019b; Bélisle et al., 2021; Bohensky et al., 2013; Crawford, 2018; Diver, 2017; Diver et al., 2022; Finn & Jackson, 2011; Goolmeer et al., 2022; Hartwig et al., 2022; Kuru et al., 2021; McGregor, 2012; Muir, 2018; Muller et al., 2019; O’Faircheallaigh, 2009; Sahoo et al., 2022; Simms et al., 2016; Tiparui et al., 1991; Turner et al., 2008; Weir, 2011; Wilson, 2019; Wohling, 2009).
- 40 publications proposed improved engagement with Indigenous people for improved natural resource management outcomes (Adams et al., 2014; Ali et al., 2022; Austin et al., 2018; Ayre et al., 2018; Baijius & Patrick, 2019a; Ban et al., 2019; Barber & Jackson, 2011; Bark et al., 2015; Beaudoin et al., 2016; Bélisle et al., 2021; Black & McBean, 2016; Carson et al., 2018; Carter, 2010; Clapham et al., 2021; Collings, 2012; Denny & Fanning, 2016; Diver, 2017; Dovers et al., 2015; Finn & Jackson, 2011; Gaw et al., 2019; Gone, 2019; Goolmeer et al., 2022; Hartwig et al., 2022; Houde, 2007; Hughey et al., 2017; Izurieta et al., 2011; Jackson et al., 2019; Jones et al., 2010; Kuru et al., 2021; Larson et al., 2023; Leiper et al., 2018; Maclean et al., 2012; McGregor, 2012; Prober et al., 2011; Robitaille et al., 2017; Simms et al., 2016; Thornton & Scheer, 2012; Trigger et al., 2014; Turner et al., 2008; Wilson, 2019).
- 16 publications highlighted the need to direct resources towards capacity building of Indigenous organisations (Barber & Jackson, 2011; Bark et al., 2015; Bodle et al., 2018; Collings, 2012; Hemming et al., 2017; Herbert, 2008; Hill et al., 2012; Izurieta et al., 2011; Jones et al., 2010;

- Kuru et al., 2021; Leiper et al., 2018; Maclean et al., 2012; Ober & Fasoli, 2008; Pence et al., 2010; Taylor & Habibis, 2020; Tiparui et al., 1991).
- 17 publications documented successful engagements or decision-making with Indigenous organisations (Beveridge et al., 2021; Cullen-Unsworth et al., 2012; Curran, 2019; Diver et al., 2022; Dovers et al., 2015; Gaw et al., 2019; Hemming et al., 2017; Hill et al., 2012; Jackson et al., 2014; Kookana et al., 2013; Latulippe & McGregor, 2022; Lilleyman et al., 2022; Maclean et al., 2012; Muller et al., 2019; Pence et al., 2010; RiverOfLife et al., 2020; Yibarbuk & Cooke, 2001).
 - 31 publications highlighted Indigenous connections to Country and the benefits to communities from involvement in managing Country (Ali et al., 2022; Barber et al., 2015; Bark et al., 2015; Black & McBean, 2016; Bohensky et al., 2013; Cameron, 2022; Collings, 2012; Coyne et al., 2022; Davies et al., 2013; Donatuto et al., 2014; Gaw et al., 2019; Hartwig et al., 2018; Kookana et al., 2013; Larson et al., 2023; Leiper et al., 2018; Maclean et al., 2012; Manero et al., 2022; Marika-Mununggiritj, 1991; Nikolakis et al., 2023; Prober et al., 2011; Pyke et al., 2018; Ridges et al., 2020; RiverOfLife et al., 2020; 2021; Sangha et al., 2015; Sangha & Russell-Smith, 2017; Taylor, 2008; Tiparui et al., 1991; Weir, 2012; Yibarbuk & Cooke, 2001; Zander, 2013).
 - 21 publications identified recognition of the social dimensions of the issues and the need for social science expertise in the solutions (Adams et al., 2014; Barber et al., 2015; Bark et al., 2015; Bischoff-Mattsona et al., 2018; Bodle et al., 2018; Buckley & Sullivan, 2014; Coyne et al., 2022; Dovers et al., 2015; Hartwig et al., 2022; Hill et al., 2012; Larson et al., 2023; Maclean et al., 2012; Manero et al., 2022; Noble et al., 2016; O’Faircheallaigh, 2009; Sangha et al., 2015; Searle & Mulholland, 2018; Spaeder & Feit, 2005; Stacey et al., 2013; Taylor & Habibis, 2020; Zander, 2013).

4.1.4. Significance of findings for policy, management and practice

This synthesis has highlighted the urgent need to review and revisit all policies and engagement frameworks related to Traditional Owner involvement in water quality management for the GBR. Importantly, this will establish a platform from which to undertake meaningful engagements directly with Traditional Owner organisations to determine best practice from a cultural perspective. Learnings from this synthesis should be accompanied by social science expertise to develop meaningful relationships, policies and frameworks with Traditional Owners to ensure delivery of sustainable and holistic outcomes for the GBR and its associated freshwater catchments. Importantly, these developments should have inherent strategies to deliver outcomes, and commitments to measure success at agreed timeframes to ensure greater Indigenous involvement in decision-making for the GBR.

4.1.5. Uncertainties and/or limitations of the evidence

The body of evidence presented in this synthesis is inherently limited to the scope of the question posed and confounded by the drivers of scientific publication in internationally peer-reviewed journals. Manuscripts generally publish a result, particularly a positive result. The publication of no result or negative results in science is much less common (publication bias). In addition, manuscripts drafted by western authors without Indigenous participation may also claim success, however, this may not translate to successful outcomes for Indigenous people. The other limitation is that factors contributing to successful engagement with Indigenous groups across the globe, may not always be appropriate with Traditional Owners in Australia. Further engagement with Traditional Owner groups to determine the success, or learnings, from existing engagements within the GBR context should be considered. These initial engagements can also be used to determine what the critical success factors from greater involvement are from the Traditional Owner perspective in Australia.

4.2 Contextual variables influencing outcomes

The most relevant contextual variable to this question is the variability in cultural values between Indigenous groups, even between neighbouring groups. These values are likely to influence the factors identified to be associated with involvement and engagement in water quality or even broader natural resource management programs in the GBR. Governance and the history of decision-making processes are also likely to influence the outcomes.

4.3 Evidence appraisal

Relevance

The relevance of the overall body of evidence to the primary question was rated as Low, based on the assessment of the relevance of the study approach and study results to the primary question. Spatial and temporal relevance were not assessed due to the substantial variability in cultural values and priorities between Indigenous groups. Furthermore, the concept of greater Indigenous involvement is too variable across groups to provide a meaningful spatial or temporal assessments, even within Australia. No studies with relevant findings across multiple Traditional Owner groups in the GBR catchments were identified in this review.

International literature outlined issues with Indigenous involvement in decision-making comprehensively, however, few case studies presented positive outcomes and the critical success factors to ensure greater Indigenous involvement in decision-making. This is most likely a result of few successful examples and the need for further work in this area and that publication of unsuccessful engagements and lessons learnt are not common. Examples of successful outcomes and approaches to engagement for researchers and Indigenous people were present in the literature, however, how these examples translate to decision-making for the GBR is yet to be seen.

Publications that were considered directly relevant to the question highlighted the deep connections between Indigenous people and natural ecosystems together with the need to improve engagement through approaches that prioritise relationships, context, trust, respect, inclusivity, connectivity, and capacity building (Black & McBean, 2016; Carter, 2010; Diver et al., 2022; Goolmeer et al., 2022; Hemming et al., 2017; Hill et al., 2012; 2022; Muller et al., 2019). These critical factors enabled meaningful engagement and involvement towards decision-making authority and self-governance. In turn, these studies also highlighted the broad benefits to the health of Indigenous communities from self-governance and the inclusion of Indigenous people in environmental management and decision-making. In addition, seven of the nine publications were produced in Australia, and seven of the nine publications were published since 2016.

Consistency, Quantity and Diversity

There were two key consistencies in the literature reviewed. The first was the documentation of exclusion of Indigenous people across the globe from natural resource management including identification of issues in communication whilst addressing the situation in contemporary settings. The majority of manuscripts documented the historical and contemporary exclusion of local Indigenous people in all aspects of natural resource management with the following manuscripts to be considered in particular, including manuscripts investigating issues in communication relating to dichotomous perspectives with the natural environment (Adams et al., 2014; Ali et al., 2022; Austin et al., 2018; Baijius & Patrick, 2019a; 2019b; Ban et al., 2019; Beaudoin et al., 2016; Bélisle et al., 2021; Bohensky et al., 2013; Cameron, 2022; Carter, 2010; Crawford, 2018; Davies et al., 2013; Diver, 2017; Diver et al., 2022; Finn & Jackson, 2011; Goolmeer et al., 2022; Hartwig et al., 2018; 2022; Houde, 2007; Jackson et al., 2019; Jackson, 2022; Kuru et al., 2021; Kutay, 2021; Larson et al., 2023; Marika-Mununggiritj, 1991; McGregor, 2012; Muir, 2018; Muller et al., 2019; Noble et al., 2016; O’Faircheallaigh, 2009; Prober et al., 2011; Sahoo et al., 2022; Searle & Mulholland, 2018; Simms et al., 2016; Smallacombe, 2005; Smith, 2019; Taylor & Habibis, 2020; Thornton & Scheer, 2012; Tiparui et al., 1991; Turner et al., 2008; Weir, 2011; Wilson, 2019; Wohling, 2009; Yibarbuk & Cooke, 2001; Zorzini, 2014; Zurba & Bullock, 2018).

The second key consistency was the desire for Indigenous people to be involved in natural resource management due to inherent connections to nature, particularly in Australia where fulfilment of custodial responsibilities was a key driver. The proposal for engagements needed to address this issue were prominent throughout the literature (Adams et al., 2014; Ali et al., 2022; Austin et al., 2018; Ayre et al., 2018; Baijius & Patrick, 2019a; Ban et al., 2019; Barber & Jackson, 2011; Beaudoin et al., 2016; Bélisle et al., 2021; Black & McBean, 2016; Carson et al., 2018; Carter, 2010; Clapham et al., 2021; Collings 2012; Denny & Fanning, 2016; Diver, 2017; Dovers et al., 2015; Finn & Jackson, 2011; Gaw et al., 2019; Goolmeer et al., 2022; Gone, 2019; Hartwig et al., 2022; Houde, 2007; Hughey et al., 2017;

Izurietta et al., 2011; Jackson et al., 2019; Jones et al., 2010; Kuru et al., 2021; Larson et al., 2023; Leiper et al., 2018; Maclean et al., 2012; McGregor, 2012; Prober et al., 2011; Robitaille et al., 2017; Simms et al., 2016; Thornton & Scheer, 2012; Trigger et al., 2014; Turner et al., 2008; Wilson, 2019).

Consistency across the body of evidence was rated as Moderate.

The quantity of studies was Low. Few studies were undertaken in the GBR catchment area. A majority of the studies were from other parts of Australia or Canada, and the remaining studies were dispersed globally. Despite the low rates of Traditional Owner authorship or affiliation (23%), 59% of studies involved Indigenous participation, either through co-authorship, or through participatory workshops and interviews. Of the studies which involved Indigenous participation almost 63% of these studies involved Traditional Owners from Australia, followed by Canada with 32% Indigenous participation.

The diversity of study types was Low, with a mix of primary studies (30%, largely observational) and secondary studies (70%, primarily literature reviews and review of survey outcomes).

Confidence

Overall confidence in the body of evidence was rated as Limited, based on Low overall relevance and Moderate consistency (Table 9). Overall, literature reviewed had low relevance to the question due to spatial and temporal variability in Indigenous groups and context. Apart from this, the literature reviewed was consistent in identifying issues of exclusion and proposing collaborative engagement for improved Indigenous decision-making capacity in natural resource management.

The review indicates that there is strong evidence that consensus of exclusion of Indigenous people from natural resource management, disparate views leading to communication issues, and the desire of Indigenous people to be engaged and involved is high. Publication of successful engagements or successful outcomes in decision-making once Indigenous people have been provided opportunities to self-govern are rare. Although publications relating to methods of proposed engagements are common, the outcomes or learnings from these engagements are not common, potentially highlighting negative results that were not published. In addition, successful methods and results at an international level, may not necessarily apply to Traditional Owners in Australia due to differences in cultures. This means that determination of the critical success factors for greater Indigenous involvement in decision-making for the GBR is difficult, however the authors were still able to assess the evidence to provide a set of critical factors. These factors should be used as a platform from which to undertake further engagements with the Traditional Owners of the GBR to validate and identify pathways for future engagements and involvements to deliver collaborative actions to benefit the GBR.

Table 8. Summary of results for the evidence appraisal of the whole body of evidence in addressing Question 7.3. The overall measure of Confidence (i.e., Limited, Moderate and High) is represented by a matrix encompassing overall relevance and consistency.

Indicator	Rating	Overall measure of Confidence
Relevance (overall)	Low	
-To the Question	Low	
-Spatial (if relevant)	N/A	
-Temporal (if relevant)	N/A	
Consistency	Moderate	
Quantity	Low	
Diversity	Low	

4.4 Indigenous engagement/participation within the body of evidence

Indigenous engagement was highly variable and also sometimes difficult to determine from methods. Direct Indigenous participation, either through authorship or consultation/engagement was determined for 34 publications within the synthesis (Adams et al., 2014; Ali et al., 2022; Ban et al., 2019; Barber & Jackson, 2011; Bark et al., 2015; Beveridge et al., 2021; Cameron, 2022; Collings, 2012; Crawford, 2018; Cullen-Unsworth et al., 2012; Denny & Fanning, 2016; Diver et al., 2022; Gaw et al., 2019; Goolmeer et al., 2022; Hemming et al., 2017; Hill et al., 2022; Jackson, 2022; Jackson et al., 2014; Kookana et al., 2013; Larson et al., 2023; Leiper et al., 2018; Lilleyman et al., 2022; Lindsay et al., 2022; Maclean et al., 2012; McGregor, 2012; Noble et al., 2016; Ober & Fasoli, 2008; Ridges et al., 2020; RiverOfLife et al., 2021; Simms et al., 2016; Smallacombe, 2005; Stacey et al., 2013; Taylor & Habibis, 2020; Yibarbuk & Cooke, 2001).

4.5 Knowledge gaps

A summary of the knowledge gaps for Question 7.3 are presented in Table 9.

Table 9. Summary of knowledge gaps for Question 7.3.

Gap in knowledge (based on what is presented in Section 4.1)	Possible research or Monitoring & Evaluation (M&E) question to be addressed	Potential outcome or Impact for management if addressed
Systematic assessment of Traditional Owner engagement and involvement in water quality management programs in the GBR, using locally relevant studies and direct engagement of Traditional Owner groups.	What are the factors that influence the success of Traditional Owner engagement and involvement in water quality management programs in the GBR?	Identification of options and opportunities to improve Traditional Owner engagement and involvement in GBR water quality programs, based on Traditional Owner knowledge and experiences.
Understanding of Indigenous engagement or involvement methods/processes that have not worked for water quality or related environmental programs.	What Indigenous engagement or involvement methods/processes have not worked for water quality or related environmental programs?	A list of methods / process/ actions <i>not</i> to do would be beneficial for people working in this space in future.
Understanding the role of legislative frameworks and instruments in the limitation of Traditional Owner engagement and involvement in GBR decision-making, and the characteristics that could be addressed for future improvements.	Why have existing legislative frameworks and instruments not effectively included, engaged or involved Traditional Owners in GBR decision-making? How can this be improved?	Identification of barriers for Traditional Owner engagement linked to legislative frameworks and instruments.
Status of cultural awareness across non-Indigenous stakeholders, drivers of limitations and how this can be improved.	Why is cultural awareness low across non-Indigenous stakeholders? How can this be improved?	Quantification of the efforts and options required to improve cultural awareness across non-Indigenous stakeholders to ensure that programs are fit for purpose and involvement in GBR water quality decision making processes is increased.
Improved understanding of the needs for greater capacity and	Why is capacity and capability development for Traditional	Identification of the needs and options for greater capacity and

Gap in knowledge (based on what is presented in Section 4.1)	Possible research or Monitoring & Evaluation (M&E) question to be addressed	Potential outcome or Impact for management if addressed
capability development among Traditional Owner groups in the GBR to become involved in GBR management, and identification of the options to address these needs.	Owners not effectively resourced or developed within the GBR management framework? How can this be improved?	capability development among Traditional Owner groups in the GBR to become involved in GBR management.
Methods for improving the integration of social science expertise into future Indigenous engagement programs to support water quality and broader environmental outcomes.	How can social science expertise be better integrated in future engagement programs to support water quality and broader environmental outcomes?	Integration of social science aspects into future engagement programs to support water quality and broader environmental outcomes.

5. Evidence Statement

The synthesis of the evidence for **Question 7.3** was based on 119 studies, undertaken in primarily colonial and settled nations (e.g., Australia, Canada) and published between 1990 and 2022. The synthesis includes a *Low* diversity of study types (30% primary studies, largely observational and 70% secondary studies primarily literature reviews and reviews of survey outcomes) and has a *Limited* confidence rating (based on *Moderate* consistency and *Low* overall relevance of studies).

Summary of findings relevant to policy or management action

Determining the critical success factors for greater Indigenous involvement in water quality decision making and management for the Great Barrier Reef is difficult within the constraints of the Scientific Consensus Statement process that uses peer reviewed scientific evidence only. To fully address this question requires Indigenous knowledge and input. While recognising this limitation, several factors and learnings can be identified from national and international peer reviewed studies. Issues of communication, relationships, engagement and involvement of Indigenous people in natural resource management broadly, and water quality management specifically, are a global issue. Historic exclusion from natural resource management and decision-making precludes and impedes contemporary attempts to integrate cultural values. Improved understanding and collaboration across all sectors of natural resource management to recognise Indigenous connections to Country, the need for improved engagement frameworks specifically recognising social and cultural factors, and the socio-ecological benefits of Indigenous involvement in management and decision-making are identified as common needs for environmental programs globally. Critical factors and key learnings from national and international studies include increased understanding and knowledge of Indigenous culture and connection to Country, helping to establish trust and respect between all partners through relationship building, support for increased capacity to engage and become involved in programs, support for improved capability to collaborate and deliver across all aspects of planning and delivery, and adoption of an adaptive management approach to program delivery. Learnings from this synthesis should be accompanied by the development of meaningful relationships, policies and frameworks led by Traditional Owners to ensure delivery of sustainable and holistic outcomes for the Great Barrier Reef and its associated catchments.

Supporting points

- Several issues were identified for Traditional Owner engagement in water quality and broader natural resource management programs relevant to the Great Barrier Reef, including: communication problems between contemporary management authorities and Indigenous people (31 studies); Indigenous exclusion from natural resource management and decision-making (23 studies); improved engagement with Indigenous people for improved natural resource management outcomes (40 studies); the need to direct resources towards capacity building of Indigenous organisations (16 studies); successful engagements or decision-making with Indigenous organisations (17 studies); Indigenous connections to Country and the benefits to communities from involvement in managing Country (32 studies); and recognition of the social dimensions of the issues and the need for social science expertise to be embedded in the solutions (21 studies).
- The outcomes from Indigenous-led decision-making including a description of successful engagements or successful outcomes are rarely published in the scientific literature. Key learnings identified to be most relevant to the Great Barrier Reef from national and international studies are:
 1. **Understanding:** Cultural awareness across western societies of Indigenous people's connections with the natural world are low and not conducive to acceptance that engaging and involving Indigenous people in natural resource management has global benefits. Support for education campaigns and engagements around cultural awareness that are designed and delivered by Indigenous people 'on Country' and target senior management

staff is critical for success. Recognition of the social dimensions of the issues and solutions is a priority.

2. **Respect:** Cultural awareness builds respect for Indigenous culture, land and sea management practices, and innate connections to Country held within Traditional Ecological Knowledge. Relationships built on trust, respect and understanding have shown best results in supporting Indigenous organisations on the pathway from exclusion to decision-making and self governance. Furthermore, Traditional Owners are not stakeholders to be consulted but rather decision-makers and as such, should be included from the start in relevant management roundtables.
 3. **Collaboration:** Collaboration is required at all levels of environmental decision-making including research, planning, policy, implementation, assessment and overall governance; and establishing relationships that are founded on respect, trust and mutual capacity-building is critical. Collaborative research that integrates different types of ecological knowledge has demonstrated great success in environmental outcomes and led to increased recognition of the awareness of the knowledge and wisdom held and contributed by Indigenous people.
 4. **Capacity:** Contemporary Traditional Owner groups are expected to contribute effectively and efficiently across a vast scope of legislative, policy and planning frameworks. Development of resources focused on improving literacy of Traditional Owners to understand these frameworks in formats that are more meaningful for Traditional Owners, and the provision of more opportunities for individuals to gain experience with relevant management programs, are beneficial for the building of this capacity. Efforts should also be made to include Traditional Owners in all engagements to ensure improved capacity as decision-makers for the Great Barrier Reef.
 5. **Capability:** Greater resources and effort to support Traditional Owner organisations to acquire the skills needed to govern, manage and deliver programs in terms of design, research, policy, planning, implementation, assessment and management has been shown to be beneficial. Effective self-governance of Traditional Owner organisations should be an endpoint which is supported by all western organisations involved with the management of the Great Barrier Reef.
 6. **Adaptive management:** The critical success factors *for* greater Indigenous involvement should implicitly consider the critical success factors *of* greater Indigenous involvement. Integration of the steps above into policy and planning documents supported by fit for purpose Monitoring Evaluation and Reporting Strategies to measure success is necessary for continuous improvement and adaptive management.
- Consideration of these critical success factors can provide a useful foundation to build on and provide pathways for future engagement and involvement of Indigenous people in Great Barrier Reef water quality decisions and management.

6. References

The ‘Body of Evidence’ reference list contains all the references that met the eligibility criteria and were counted in the total number of evidence items included in the review, although in some cases, not all of them were explicitly cited in the synthesis. In some instances, additional references were included by the authors, either as background or to provide context, and those are included in the ‘Supporting References’ list.

Body of Evidence

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Appendix 1: 2022 Scientific Consensus Statement author contributions to Question 7.3

Theme 7: Human dimensions of water quality improvement

Question 7.3 What are the critical success factors for greater Indigenous involvement in water quality decision making in the Great Barrier Reef region?

Author team

Name	Organisation	Role in addressing the Question	Sections/Topics involved
1. Tom Espinoza	Burnett Mary Regional Group	Lead Author	All Sections
2. Sydney Collett	Burnett Mary Regional Group	Contributor	Searches and data extraction.
3. Conway Burns	Burnett Mary Regional Group Butchulla Aboriginal Corporation	Contributor, Expert advice (Traditional Owner)	Conceptual model, wetlands section within the narrative synthesis and final revision of overall report.