KPMG

Shark Control Program Evaluation Report

Final Report

Prepared for
Department of Agriculture and Fisheries

19 November 2024

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Some of the findings in this report are based on a qualitative study and the reported results reflect a perception of DAF and stakeholders involved in SCP Program delivery but only to the extent of the sample surveyed, being DAF's approved representative sample of personnel. Any projection to the wider stakeholders is subject to the level of bias in the method of sample selection.

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Document Control

Version	Date	Key Changes
1.0	19 November 2024	Final Version

Contents

List of Figures

List of Tables

Abbreviations

Term	Definition
AAD	Advanced Aerial Detection
AMP	Affective Memory Potential
BRUVS	Baited Remote Underwater Video Stations
CASA	Civil Aviation Safety Authority
CAD	Catch-Alert Drumline
CBA	Cost-Benefit Analysis
CPC	Cost Per Click
CPM	Cost Per Millie
CPV	Cost Per Visit
CSULB	California State University, Long Beach
DAF	Department of Agriculture and Fisheries
DESI	Department of Environment, Science and Innovation
DTS	Department of Tourism and Sport
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Cth)
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
IMOS	Integrated Marine Observing System
MART	Marine Animal Release Team
MTD	Modified Traditional Drumlines
PIRSA	Department of Primary Industries and Regions, South Australia
QPWS	Queensland Parks and Wildlife Service
RIO	Risk, Issues and Opportunities
SCP	Shark Control Program
SLSQ	Surf Life Saving Queensland
SME	Subject Matter Expert
SMN	Shark Monitoring Network

Term	Definition
SOA	Standing Offer Arrangement
SSC	Shark Safety Centre
SWG	Scientific Working Group
UCSB	University of California, Santa Barbara
KZNSB	KwaZulu-Natal Sharks Board Maritime Centre of Excellence

Summary of findings

The Program Evaluation of Queensland's Shark Management Plan 2021-2025 (the Program or SCP) has found that there is a continued need for the Program to operate due to the significant threats to human safety that could arise in its absence. Initially launched with the aim of managing shark populations, the Program has undergone considerable transformation towards a comprehensive strategy that aims to balance risk mitigation with the conservation of environmental integrity, incorporating elements of research and trials to inform the continuous improvement of the Program. This evolution is exemplified in the Shark Management Plan (2021-2025) (the Plan), which reflects changing community attitudes, expectations, and legislative requirements. Moving forward, the Program needs to remain flexible and adaptive to external drivers and changing circumstances.

It has been identified there is a continuing need:

- **To avoid human-shark interactions (fatal and non-fatal):** To ensure human safety, there is a need for the Program to continue to respond to human demand drivers, including a growing population, increasing urbanisation of the coastline and overlap of human activity with shark populations, ongoing tourism, high beach usage, and participation in high-risk water activities. Additionally, the Program will need to adapt to environmental changes such as marine animal migratory patterns and populations and a changing climate.
- **To minimise negative impacts on marine ecosystems:** It is essential to minimise ecosystem impacts while ocean-based equipment remains part of the Program (e.g. Mesh Nets, Traditional Drumlines). Currently, the Program's operations are not meeting this objective.
- **To protect Queensland's Tourism industry:** Given the continued popularity of Queensland coastal destinations, there is a need for visitors from interstate and overseas to feel safe and confident while enjoying ocean-related recreational activities.
- **To comply with legislative requirements:** The Program will need to comply with permit conditions, with any changes to legislation or permit requirements driving adjustments to the Program.

It should be noted that the Program Evaluation has been constrained by the following:

- The stakeholders consulted included initiative owners and key delivery stakeholders, with the purpose of gathering information on historical program delivery rather than broad community views about the Program.
- Between 2001 and 2024, several operational changes were made to the delivery of the SCP, including equipment quantities, configuration and contractor effort. This affects the interpretation and analysis of the Program's catch data.
- The Program initially identified 19 shark species as potential threats to humans and categorised them as target species. However, in January 2023, the list was reduced to seven. This affects the interpretation and analysis of the Program's catch data.
- The financial statement regions do not align with the regions in which the SCP reports to operate. This minor misalignment means that when comparing financial data to catch data, there may be an over or under-estimation of the cost per species caught.
- The Catch-Alert Drumline Trial analysis uses data inputs provided by Department of Agriculture and Fisheries (DAF), which span January 2022 to August 2023. This data excludes the initial four-month period of the trial.
- The SharkSmart Campaign survey uses a small sample size (n=771) and is susceptible to self-reporting bias due to the question architecture. This may affect the accuracy of the results in reflecting the true behaviours and opinions of Queensland water users.
- The data analysis conducted as part of this evaluation is descriptive and does not apply inferential statistics, such as T-tests or confidence intervals, to validate findings or generalise results.

The Findings of this evaluation are outlined below against the focus areas of the Evaluation Framework. These are supported by evidence in the body of the report.

Appropriateness (Section 3)

The Appropriateness domain aims to understand whether the SCP's design and approach are suitable and align with stakeholder needs. The following detail the findings from the Program Evaluation:

- **Program Need:** The presence of dangerous species in Queensland waters poses a significant threat to beachgoers, necessitating ongoing protection measures. Shark incidents can negatively impact local tourism, highlighting the importance of risk reduction. Additionally, there is growing community demand for a program that minimises environmental impact while improving beach safety and complying with environmental laws and regulations.
- **Alignment with government legislation and agency priorities:** The SCP does not align with the intent of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), operating under an exemption to lethally target White sharks. The SCP aligns with Great Barrier Reef Marine Park Act 1975 (Cth) (GBRMP Act), Fisheries Act 1994 (Qld) and Marine Parks Act 2004 (Qld). The SCP's main purpose of protecting bathers from shark bites does not align with DAF's vision.
- **Stakeholder sentiment on Program appropriateness:** Stakeholders view SCP Trials, Research and Education as appropriate and designed in-line with the objectives of the SCP. There are conflicting views on the appropriateness of Operations, with some perceiving it as necessary to ensure a lower risk of human-shark interactions, some viewing it as resulting in unacceptable marine ecosystem damage, or some having no view due to a lack of information.
- **Changed conditions:** A variety of changes occurred across the Plan period, including:
  - Coastal areas are seeing a rise in residents and tourists, with more people frequenting beaches and engaging in activities that increase the likelihood of encountering a shark.
  - Shark activity is increasing, coinciding with a Triple La Niña event, reduced commercial fishing of sharks, decreased net fishing bycatch, new recreational fishing limits, and the recovery of some marine animal populations like humpback whales.
  - Public scrutiny of the Program's environmental impact has grown, driven by new ways of sharing operational content, leading to greater visibility into its activities.

Effectiveness (Section 4)

The effectiveness evaluation considers the extent to which the SCP achieved, or is expected to achieve, its intended outcomes of improving human safety, minimising adverse ecosystem impacts and delivering shark-risk education. The following detail the findings from the Program Evaluation:

Operations

Operations primarily consist of the deployment of Mesh Nets and Traditional Drumlines along Queensland's coastline. By the end of the Plan period, the Program had 27 Mesh Nets and 321 Traditional Drumlines in operation.

- Operations collectively eliminated 1,500 target sharks and relocated 168 within the Great Barrier Reef Marine Park, thereby permanently or temporarily reducing the risk of human interaction with these animals. This catch size was driven by a 25.1 percent rise in the average annual catch of target sharks during the Plan period compared to the previous 20-year period.
- Between January 2021 and October 2024, Queensland recorded four shark bites along its coastline, with one incident occurring at a beach where SCP gear is deployed. This represents an average of 1.04 incidents per year, a decrease from the 3.35 incidents per year recorded over the previous 20 years.
- Operations resulted in the mortality of 1,200 non-target species, with the total average annual bycatch mortality increasing to 362 animals during the Plan period, compared to an average of 305 animals over the previous 20 years. This increase represents a failure of the Program to improve its ecosystem impacts during the Plan period.

Trials

Six Trial initiatives were proposed; however, only four technologies—Alternative Gear (Circle Hooks), Catch-Alert Drumlines, Advanced Aerial Detection, and SharkSmart Drones—were physically trialled during the Plan period.

- Each technology trialled has either demonstrated or is expected to demonstrate improvements over current Operations in terms of reducing ecosystem impact. Interim

	results from Catch-Alert Drumlines show an improved survivability of catch (80%) compared to the Modified Traditional Drumlines (35%) used as the baseline. • SharkSmart Drones do not interact with marine life unless they malfunction and fall into the marine environment. Circle Hooks are designed to reduce gut hooking, which in turn lowers incidental catch mortality. The Advanced Aerial Detection Trial serves as an extension of the SharkSmart Drones initiative, posing no additional risk to the marine ecosystem. • SharkSmart Drones offer additional human safety benefits with the potential to compliment other mitigation measures, while Catch-Alert Drumlines potentially worsen the risk profile of beaches given their use during daylight hours only and improved survivability for target sharks, leaving sharks that are caught alive and released able to eventually re-pose a risk of interacting with water users.
Research	There were seven Research initiatives during the Plan period. Their effectiveness was determined by the extent to which the output or potential output of each one aligns with or contributes to the Program's intended outcomes. Research is effective across all three outcome areas; however, none of the initiatives primarily focus on the Program's ecosystem impact or shark bite prevention. The Shark Tagging and Tracking initiative is the only project contributing to all three outcomes.
Education	There were five Education and Engagement initiatives undertaken during the Plan period. The effectiveness of the Education pillar is assessed by the impact of the SharkSmart Education Campaign initiative on improving SharkSmart awareness, attitudes, and behaviours. It is measured according to the Swimmer Safety (SharkSmart) Campaign Evaluation results. The results from the most recent survey in 2024 show a plateau across SharkSmart awareness, attitudes and behaviours, along with a decline in the Affective Memory Potential (AMP) score. The AMP score reflects the measure of a marketing campaign's novelty, emotional impact, and relevance to the audience.

Efficiency (Section 5)

The efficiency evaluation aims to understand the extent to which the Program's inputs achieved the necessary outputs while reducing wasted effort. The following detail the findings from the Program Evaluation.

Operations	The contractor costs to maintain SCP equipment differ greatly across regions and have a weak correlation with the quantity of equipment in each area. The primary costs for contractors are wages, boat maintenance and fuel. Cairns had the highest cost per target shark caught, ranging between $60,000 - $100,000 per target shark between FY22-24. This high cost was due to a low number of sharks (31) caught over the period. The remainder of the SCP region's annual average was approximately $20,000 per target shark caught.
Trials	The SCP carried out two trials during the Plan period: the Catch-Alert Drumline trial and the SharkSmart Drone trial. These trials demonstrated efficiencies throughout their duration, including: • The Catch-Alert Drumline Trial in Capricorn Coast saved costs by using existing regional operations and designs from the NSW Shark Management Program. • The SharkSmart Drone trial improved average flight duration and created jobs for individuals with disabilities, neurodiverse people, and those affected by the COVID-19 pandemic.
Research	Stakeholders reported that research activities were carried out efficiently, leveraging existing operations as much as possible. These included researchers 'tagging along' on usual operations to conduct their activities and the SCP partnering with entities to conduct and share research.

Education

The SharkSmart Campaign, which has been running since 2020, has effectively reached a wide audience, including Meta. The FY23 campaign generally surpassed the industry benchmarks, particularly with YouTube.

The Program was also compared with other jurisdictions in Australia, with the NSW Shark Management Program receiving the highest at $20 million per year from 2022-2026, Queensland SCP receiving $14 million per year from 2022-2024, and the Western Australia Shark Mitigation Strategy receiving the least at $4.3 million per year from 2025-2028.

Impact (Section 6)

The Impact domain aims to understand the extent of the SCP's long-term results.

The evaluation found that the Program has contributed to the preservation of human life and injury avoidance since its inception in 1962. Shark incidents have not had a long-term impact on beach tourism, although the literature lacks empirical evidence. The Program initially aimed to reduce shark populations, resulting in high bycatch mortality, but its impact on marine ecosystems is still uncertain. The SharkSmart Campaign, launched in 2019, has enhanced public understanding of shark risks through various educational initiatives. This launch coincided with research and trial initiatives aiming to improve marine biodiversity and ecosystem health. Despite this, community cohesion and pride in resource management remain unclear, with misinformation potentially hindering progress.

Insights (Section 7)

The insights stem from a comprehensive review of the SCP. The high level insights from the Program Evaluation include:

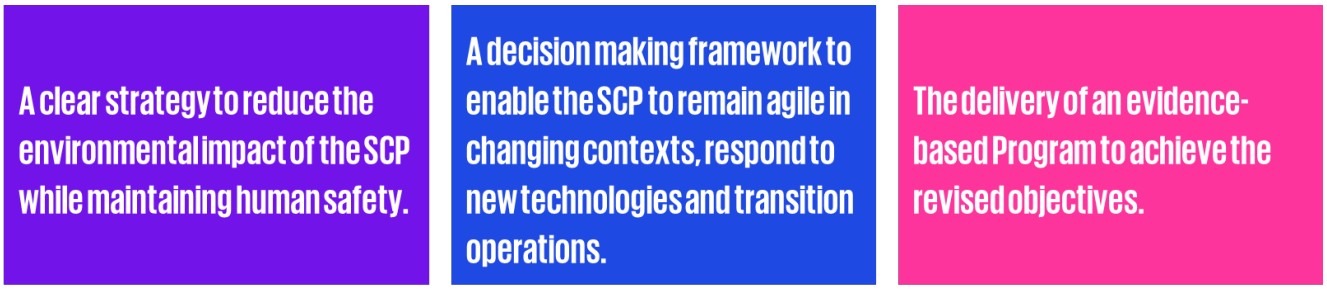
- **Program Need:** Shark bites are low-probability but high-consequence events that can cause extreme injury, death, and socio-economic and political consequences. These incidents have lasting effects on victims, their families, first responders, and the wider community.
- **Policy:** The review examines the alignment of the SCP with current policies and legislative frameworks, ensuring that the Program operates within the required legal boundaries and meets policy objectives. It considers the role of a clear purpose statement and objectives, a need for clarity in Program components, a need for performance measures, and the benefits of detailing future opportunities.
- **Legislative and Regulatory Alignment:** The SCP's compliance with relevant legislation, such as the Great Barrier Reef Marine Park Act 1975 and the Environment Protection and Biodiversity Conservation Act 1999, is assessed to ensure the Program's legal and environmental responsibilities are met. SCP needs to adhere to the Great Barrier Reef Marine Park Authority permit as part of the Administrative Appeals Tribunal and the implementation of Catch-Alert Drumlines and, while the SCP has met existing Department of Environment, Science and Innovation permit conditions, it must comply with new permit conditions by late 2025.
- **Program:** The effectiveness and efficiency of the SCP's operations, including the use of shark nets and SMART Drumlines, are evaluated. The review highlights the Program's strengths and identifies areas for improvement. It is anticipated that non-lethal operations and education components of the Program will be expanded into the future building on the evidence base developed under the current SCP, to deliver the Program objectives and meet community expectations.
- **Governance and Stakeholder Engagement:** The review emphasises the importance of effective governance and stakeholder engagement in the SCP. It discusses the roles of various stakeholders and the need for ongoing collaboration to enhance the Program's outcomes.

These insights in Section 7 provide a detailed understanding of the SCP's strengths, challenges, and areas for improvement, forming the basis for recommendations to enhance the Program's effectiveness and impact.

Recommendations (Section 8)

In response to increasing community demand and legislative requirements to eliminate environmentally harmful practises, it is crucial to develop a strategic plan that enhances environmental outcomes while ensuring human safety. A well-defined approach will facilitate a smooth, evidence-based transition that meets the expectations of both the community and the government. The recommendations focus on three key areas: reducing the environmental impact of the Program while maintaining human safety; establishing a decision-making framework to guide the operational transition; and delivering an evidence-based Program that achieves the revised objectives. By addressing these focus areas, the Plan aims to ensure a stable and proactive shift that aligns with sustainability goals and public safety.

The detailed list of recommendations in outlined in Section 8.



A clear strategy to reduce the environmental impact of the SCP while maintaining human safety.

A robust policy framework guides decision-making and aligns objectives to prioritise safety and environmental outcomes. Since current equipment does not meet desired ecosystem goals, alternative actions that mitigate adverse impacts must be considered. By defining outcomes, implementing changes, and establishing performance measures, the Program can reduce its environmental impact while upholding safety standards. This policy framework ensures consistent project delivery, risk reduction, and effective resource allocation, ultimately enhancing the Program's impact. Refining the SCP components will align this work with community expectations, legislative requirements, and Queensland Government Policy.

A decision-making framework to enable the SCP to remain agile in changing contexts, respond to new technologies and transition operations.

Strong processes for a planned transition will prevent disruptions typically caused by reactive changes, ensuring a more organised and evidence-based approach that meets community and government objectives. A decision-making framework will be crucial in achieving the Program's goals by establishing performance indicators and targets for continuous monitoring and improvement. This framework will use data collection and analysis to support informed decision-making, highlight areas for adjustment, and optimise efficiency and effectiveness. It will also identify risks early, enabling timely mitigation strategies for successful outcomes. Additionally, incorporating stakeholder feedback and leveraging a data capture system will provide transparent, up-to-date insights, improve communication, and drive ongoing success.

The delivery of an evidence-based Program to achieve the revised objectives.

An evidence-based Program aims to achieve revised objectives through three pillars: transitioning operational practises, advancing shark research, and expanding educational outreach. Operational changes aim to reduce environmental impacts through targeted trials, including consolidating equipment, removing shark nets during whale migration, streamlining service routes, and trialling drones and Catch-Alert Drumlines to improve efficiency. Research efforts focus on understanding shark and human behaviour to inform management strategies. This involves collaborations with universities, academics, and other programs. The Education pillar aims to refine the SharkSmart Campaign, targeting broad education, high-risk water users, and children to enhance awareness and safety.

Implementation

The recommendations have been grouped into four time horizons based on criticality, sequencing and impact. Outlined below is an overview of each of the stages. The ability to deliver these recommendations in the timeframes will depend on the resources available.

6 months

A clear policy framework and decision making structure to inform the next SCP

The immediate recommendations are focused on the delivery of a robust policy framework. To achieve this, the SCP policy will have a refined purpose and objectives, define desired outcomes, and establish measurable indicators for monitoring progress. These actions will deliver a strong policy direction and accountable processes to inform the next version of the SCP.

Next SCP Year 1

The delivery of an evidence based Program to achieve the revised objectives

These recommendations aim to strengthen the SCP pillars—Operations, Trials, and Education—by enhancing effectiveness and efficiency and delivering improvements to achieve the Program objectives.

Next SCP Year 2

A focus on continuous improvement and improved Program efficiency

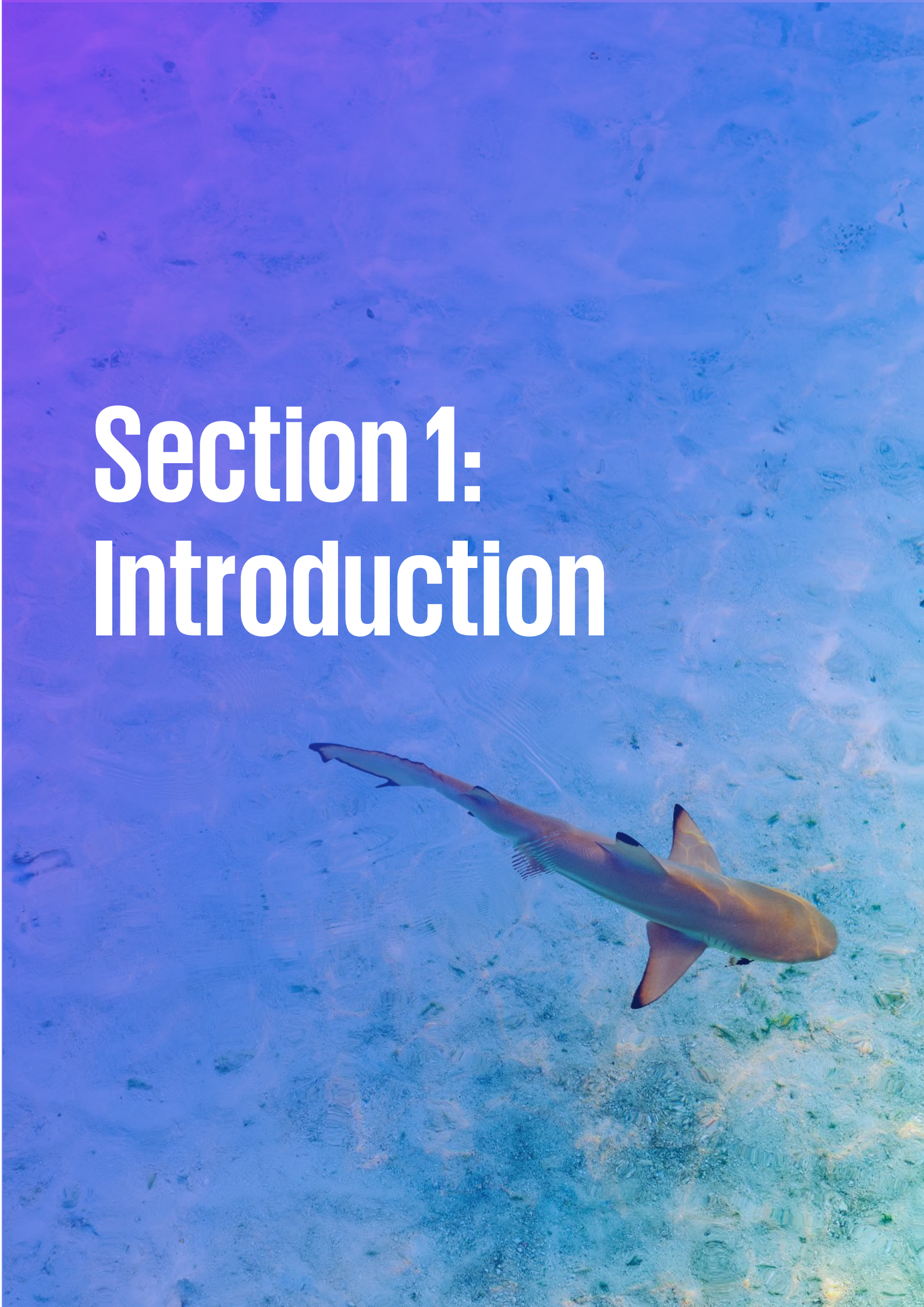
These recommendations are designed to drive continuous improvement and enhance the Program's efficiency. Key focus areas include refining operations for efficiency, strengthening Program oversight and effectively implementing research recommendations.

Ongoing

Continued delivery of aspects that work well

These recommendations prioritise the continued delivery of successful Program elements that have proven effective. By building on these strengths, the Program can ensure stability while creating a foundation for further enhancement.

Section 1: Introduction



1 Introduction

1.1 Shark Control Program Background

The purpose of the Queensland Shark Control Program (the Program or SCP) is to reduce the risk of shark bites in Queensland coastal waters. The Program was initiated in 1962 in response to a series of fatal shark bites. While most shark species do not pose a risk to people, the Program focuses on those that do, which are referred to as the 'target shark species' list.

The Program is principally administered by Department of Agriculture and Fisheries (DAF) in accordance with the *Fisheries Act 1994* (Qld), which includes provisions to reduce the possibility of shark bites on humans, mandating that measures be put in place to protect beachgoers. The current iteration of the Program is delivered under Queensland's Shark Management Plan 2021-25 which is due for revision in 2025.

Shark bites pose a risk of injury or death to water-users, which can cause widespread trauma affecting the victim, their family, first responders, and the broader community. Shark bite incidents, especially when a cluster of bites occur around one area, can lead to a significant decrease in beach activities and tourism, negatively impacting local businesses and weakening the local economy.[1]

Figure 1.1 : Map of SCP operations

Primary mitigation against human-shark interactions is achieved through the deployment of Mesh Nets and baited drumlines to catch and euthanise seven target shark species.[2] The Program services Queensland's most popular swimming destinations, with 27 nets and 383 drumlines active across 86 beaches and 10 contract locations from Cairns to the Gold Coast (see adjacent figure). Parts of the Program operate within Marine Parks. This includes the Great Barrier Reef Marine Park (GBRMP) where the SCP is required to have a non-lethal approach to shark control.[3] The SCP must also obtain a permit to capture animals in Queensland marine parks. In addition to Operations, the Program includes Research, Trials, and Education initiatives designed to enhance ecological outcomes, equipment efficiency, and awareness.

Implementing the Program's initiatives involves coordination among several stakeholders, including fishing contractors, Surf Life Saving Queensland (SLSQ), Local Governments, academic institutions, and other non-government organisations. The Program is supported by a Scientific Working Group (the SWG), which was established in collaboration with the Great Barrier Reef Marine Park Authority (GBRMPA) to provide independent, scientific advice on shark control activities. This group plays a key role in supporting research and trials, providing critical insights that inform broader Program decisions and ensuring the incorporation of the latest scientific advancements and best practices in shark mitigation.

[1] Neff, C. (2012). Australian Beach Safety and the Policies of Shark Attacks. Coastal Management, 40(1). 88–106. https://doi.org/10.1080/08920753.2011.639867; Barnett, A., Fitzpatrick, R., Bradley, M., Miller, I., Sheaves, M., Chin, A., Smith, B., Diedrich, A., Yick, J. L., Lubitz, N., Crook, K., Mattone, C., Bennett, M.B., Wojtach, L., & Abrantes, K. (2022). Scientific response to a cluster of shark bites. People and Nature, 4(4), 963-982. https://doi.org/10.1002/pan3.10337

[2] The Tiger Shark (*Galeocerdo cuvier*), Bull Shark (*Carcharhinus leucas*), White Shark (*Carcharodon carcharias*), Australian Blacktip Shark (*Carcharhinus tilstoni*), Common Blacktip Shark (*Carcharhinus limbatus*), Dusky Whaler Shark (*Carcharhinus obscurus*), and Grey Reef Shark (*Carcharhinus amblyrhynchos*).

[3] Great Barrier Reef Marine Park Authority. (n.d.). *Permit for Queensland Shark Control Program*. https://www2.gbrmpa.gov.au/access/permits/permit-queensland-shark-control-program#:~:text=catch%20alert%20drumlines%3F-,The%20permit%20requires%20a%20trial%20of%20SMART%20or%20catch%20alert,drumlines%20in%20the%20Marine%20Park

1.1 Scope of the engagement

KPMG was engaged by DAF to conduct a review of Queensland's Shark Management Plan 2021-2025 (the Plan) and provide recommendations for future iterations of the Program. The scope includes:

- Review of beaches covered by the Program
- Review of current equipment used in the Program (including location, number, historic catch)
- Results of trials of alternative shark bite mitigation technology conducted by DAF
- The latest shark research as it relates to shark bite risk
- Review of the SharkSmart Education Program
- The economic return the Program provides to the Queensland economy.[4]

Some items of the Program are beyond the scope of this review. This includes:

- Shark bite mitigation alternatives not investigated by DAF
- Personal shark bite deterrents not independently tested
- Marine Animal Release Team operations
- Review of, or changes to, Queensland Legislation as it relates to the Program
- Expanding the Program beyond the scope defined in the *Fisheries Act 1994* (Qld).

The Public Sentiment Research initiative commissioned by DAF was not available for this evaluation.

1.2 Purpose of this document

The purpose of this document is to provide DAF with a comprehensive evaluation of the Plan as part of its routine end-of-period review. It contains KPMG's findings on the Program's design and delivery, focusing on its appropriateness, effectiveness, efficiency, and impact, along with an implementation plan recommending updates to the SCP. This is intended to provide the Queensland Government with the evidence needed to enhance the Program in line with the state's evolving needs beyond 2025.

1.3 Report structure

The remainder of this report is structured as follows:

Section 2: Methodology

- This section outlines the approach and processes followed to conduct the evaluation of the Plan, including the methodology adopted, data gathered, analysis undertaken, and any limitations encountered.

Section 3: Appropriateness

- This section provides insights into the appropriateness of the SCP during the Plan period, evaluating whether the Program's design and approach meet stakeholder requirements in the current context.

Section 4: Effectiveness

- This section evaluates the effectiveness of the SCP during the Plan period, focusing on the extent to which the Program achieves, or is on track to achieve, its intended outcomes.

Section 5: Efficiency

- This section evaluates the efficiency of the SCP during the Plan period by measuring the resources allocated to the Program, including funding, human resources, technology and legislative support, against how these resources were utilised to deliver outputs.

[4] An economic analysis was conducted by BDO in 2023. KPMG did not validate the findings of the BDO report.

Section 6: Impact

- This section examines the long-term results of the SCP, highlighting the Program's broader ecological, social and economic impact since its inception.

Section 7: Insights

- This section outlines key findings from the SCP evaluation, drawing together findings across the four evaluation domains.

Section 8: Recommendations

- This section presents the recommendations to further improve the SCP, based on the findings of this evaluation. The recommendations are intended to guide future Program revisions.

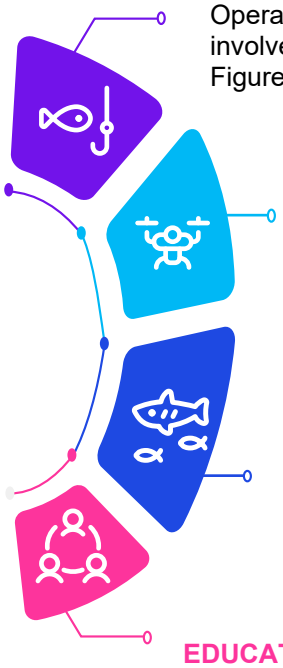
1.4 Policy and legislation context

1.4.1 Queensland Shark Management Plan 2021-2025

The Plan was published in November 2021 and represents the first significant change in the Program since its inception in 1962.[5] The Plan provides a modernised and structured approach, aiming to better align the Program with advancing scientific knowledge and Queensland's evolving economic and environmental shark control needs.

The Plan's overarching objective is to **minimise the risk of human-shark interactions while simultaneously working to sustain, and where possible improve, ecological outcomes**. This includes efforts to minimise bycatch and improve survival rates of marine animals caught in shark control equipment, following the 2019 Administrative Appeals Tribunal decision to mandate non-lethal shark control operations in the GBRMP.

To achieve these outcomes, the Plan outlines 20 initiatives across four distinct pillars: Operations, Trials, Research and Education.



OPERATIONS | 3 initiatives

Operations are the cornerstone of the Program's shark risk reduction efforts. It primarily involves the deployment of nets and baited drumlines across the 10 contract regions in Figure 1.1. The program operates a total of 27 Mesh Nets and 321 Traditional Drumlines.

TRIALS | 6 initiatives

Trials involve testing the suitability of alternative shark bite mitigation technologies, with a focus on reduced ecological impact, in Queensland conditions for possible inclusion in SCP operations. Aerial Surveillance Drones, Catch-Alert Drumlines, Circle-Hook fishing lines, Pingers and Shark Barriers have all been trialled during the Plan, each demonstrating varying degrees of promise in addressing the future needs of the Program.

RESEARCH | 9 initiatives

The Plan outlines various research initiatives aimed at improving understanding on a number of topics to inform Program decision-making. These initiatives include exploring shark bite mitigation techniques, such as personal electronic deterrents, investigating shark populations and movement through tagging and tracking.

EDUCATION | 5 initiatives

Education aims to reduce the likelihood of human-shark interactions by raising public awareness about shark risks and promoting shark safe practices among beachgoers, primarily through the delivery of the SharkSmart Education Program.

Details on shark control gear, locations, and catches are frequently uploaded to QFish and the Program's website, with annual updates provided on the Plan's implementation progress. This ensures transparency regarding the Program's efforts to reduce ecological impacts and address safety and effectiveness concerns regarding shark control measures. These updates are complemented by an end-of-period review based on the latest scientific findings and stakeholder feedback.

This document serves as the end-of-period review to inform the next iteration of the Program.

[5] The State of Queensland. (2024). *Queensland Shark Control Program - Queensland Shark Management Plan 2021-2025 – Publications: Queensland government*. https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/2879505f-f118-481c-aac5-38b952945851/queensland-shark-management-plan-2021-2025.pdf?ETag=c02bee17b4a21a3412af0794004ac958

Program Funding

The delivery of the Program over the 2021-2025 Plan period is principally supported by $23.1 million in funding from the Queensland Government. This investment was supplemented by a $5 million Commonwealth grant to enhance Research and Trials of non-lethal shark control technologies following the 2019 Administrative Appeals Tribunal decision.[6]

1.5 Relevant legislation

This section outlines the legislative framework that informs the implementation and operation of the Program. A comprehensive understanding of the legislative landscape is crucial to ensure compliance, transparency, and effective delivery of the SCP.

Four main pieces of legislation regulate the SCP, covering their duty to safeguard human life and manage marine interactions. Additional legislation governs specific operations such as animal welfare and aviation. This is illustrated in the figure below:

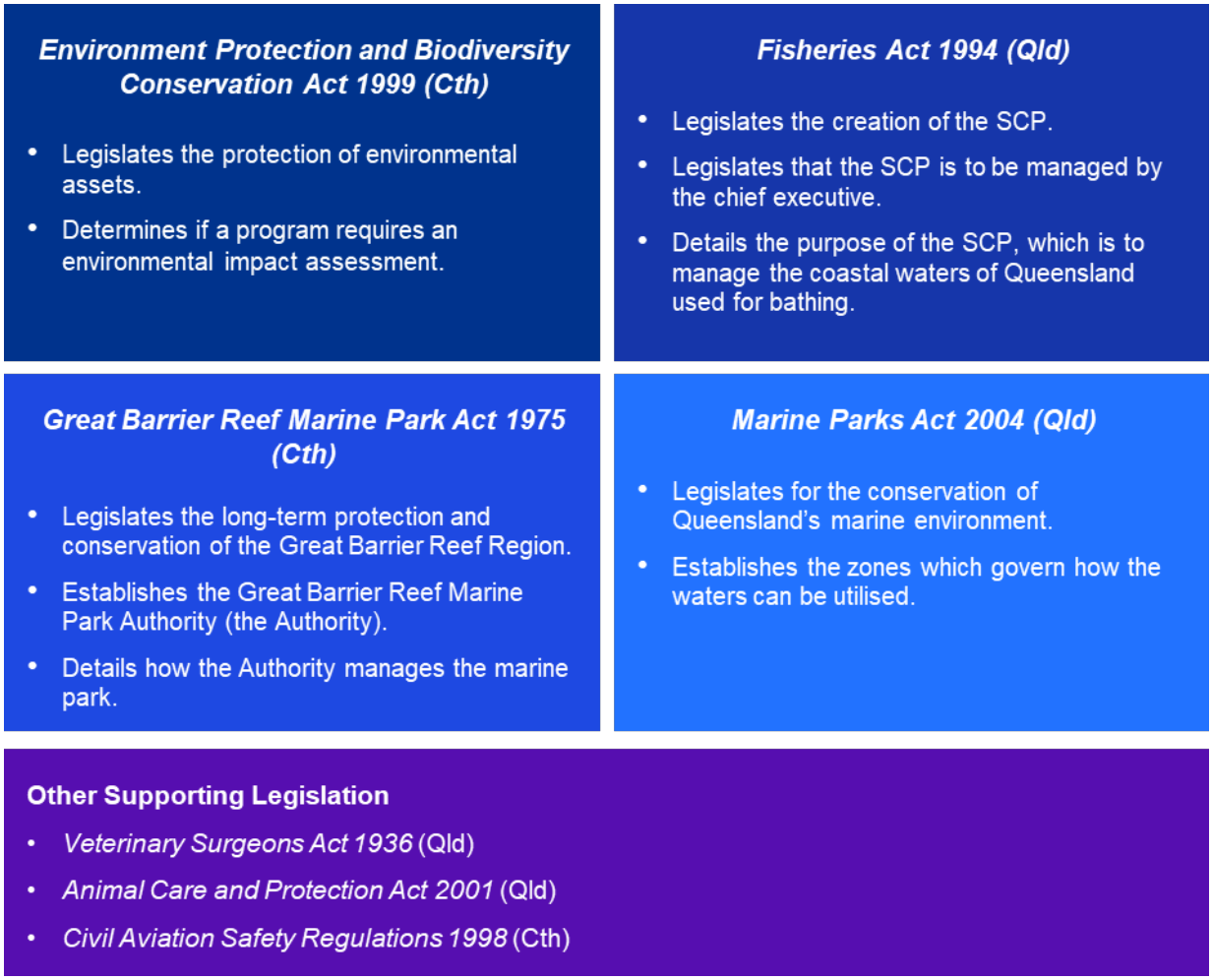


Figure 1.2: Legislation relevant to the SCP

[6] Great Barrier Reef Marine Park Authority. (n.d.). *Permit: Queensland Shark Control Program*. Retrieved 25 September 2024, from https://www2.gbrmpa.gov.au/access/permits/permit-queensland-shark-control-program

1.5.1 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the principal environmental legislation in Australia, aiming to protect national environmental assets. Its objectives focus on providing for the protection of the environment, especially in matters of national environmental significance and conserving Australia's biodiversity.

Operations impact items covered under the EPBC Act, including:

- Nationally threatened species (e.g. White sharks), ecological communities and migratory species
- The GBRMP and World Heritage areas.

The EPBC Act mandates that any actions by a group or individual that may have a significant impact on a matter of national environmental significance undergo an environmental assessment and gain approval from the Federal Environment Minister. The EPBC Act provides exemptions for certain activities through sections 43A and 43B. These exemptions apply to actions legally authorised before the commencement of the EPBC Act and to the lawful continuing use of exemptions that were in place immediately prior to the EPBC Act. This exemption is particularly relevant for the historical lethal shark control programs in New South Wales (NSW) since 1937 and Queensland since 1962.[7]

While the continuing use exemption exists, it is limited by subsection 43B(3). This subsection does not allow for the enlargement, expansion, or intensification of the exempted uses. Any substantial increase in impact due to changes in the location or nature of the activities is also not covered by the exemption.

The EPBC Act is currently being reformed by the Commonwealth Government to address various challenges in environmental conservation and management. Draft legislation is expected to be tabled in 2024-25, which will outline the implication of this reform on the SCP.

EPBC Act assessment processes

During the NSW north coast trial of shark nets and SMART Drumlines, the Commonwealth Government considered the long-standing Shark Management Program exempt from EPBC Act assessment processes. The government determined that, if the trial posed a significant impact on matters of national environmental significance, it would be subject to EPBC Act referral and assessment processes. No trials conducted in Queensland during the Plan period have required an EPBC Act assessment.

[7] Parliament of Australia. The Senate. Environment and Communications References Committee. (2017). *Shark mitigation and deterrent measures*. https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Sharkmitigation

1.5.2 Great Barrier Reef Marine Park Act 1975 (Cth)

The purpose of the *Great Barrier Reef Marine Park Act 1975* (Cth) is to provide for the long-term protection and conservation of the environment, biodiversity and heritage values of the GBRMP. Figure 1.3 shows the GBRMP, which begins from just north of Baffle Creek (north of Bundaberg) to Cape York. The Commonwealth and Queensland Governments jointly manage the Great Barrier Reef. Each jurisdiction has complimentary legislation, standards and policy which includes:

- *Great Barrier Reef Marine Park Act 1975 (Cth)* and *Marine Parks Act 2004 (Qld)* (the Acts)
- Great Barrier Reef Marine Park Regulations 2019 (Cth) and Marine Parks Regulation 2017 (Qld)
- Great Barrier Reef Marine Park Zoning Plan 2003 (Cth) and Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004 (Qld).

Figure 1.3: The Great Barrier Reef Marine Park Boundary

Source: Reef Authority (2024), Reef Geohub

Implementing the objectives of the Acts is managed by the GBRMPA as the lead Australian Government body, and the Queensland Parks and Wildlife Service as the lead Queensland Government agency. These agencies jointly issue permits to provide a transparent, consistent and contemporary approach to achieving the objectives of the Acts. A permit is required for a variety of activities within the GBRMP, some of which include:

- Most commercial activities, including tourist operations
- Research, except for limited impact research
- Installing, operating or repairing structures, such as jetties, marinas, pontoons.

SCP Operations include research and operating structures within the GBRMP. Therefore, the SCP must obtain a permit from the GBRMPA. The SCP was initially granted a permit to operate in 2017, which is valid until 2027.

Administrative Appeals Tribunal

In 2017, the Humane Society International (Australia) Inc. initiated action in the Administrative Appeals Tribunal (the Tribunal) to contest the GBRMPA's decision to grant the Queensland Government permissions for a Shark Control Program and related research.[8]

In 2019, the Tribunal issued its decision, modifying several permit conditions, including the non-lethal take of sharks, frequency of drumline attendance, and tagging and relocation of sharks.[9] Consequently, the permit

[8] Australian Government. Great Barrier Reef Marine Park Authority. (2013). *Permit for Queensland Shark Control Program.* https://www2.gbrmpa.gov.au/access/permits/permit-queensland-shark-control-program#:~:text=The%20Shark%20Control%20Program%20operates,on%20the%20Queensland%20Fisheries%20website
[9] Ibid.

was re-issued that year to incorporate the conditions imposed by the ruling. In summary, the re-issued permit mandates that the SCP, among other conditions:[10]

- Must carry out the Program in a manner that avoids, to the greatest extent possible, the lethal take of shark species.
- Only has a maximum of 131 baited drumlines, including SMART baited drumlines (SMART Drumlines), at any one time.
- Must conduct a trial of SMART Drumlines within a timeframe agreed with the GBRMPA. Following the trial of SMART Drumlines, the SCP must implement SMART Drumlines on a progressive basis within a further timeframe agreed with the GBRMPA.
- Must ensure that White sharks, Tiger sharks, Bull sharks and marine turtles are tagged before being released.
- Must establish a Scientific Working Group to determine appropriate research into non-lethal alternatives. Furthermore, the SCP must conduct research into alternative non-lethal shark control measures and the Tiger shark population.

Since 2019, the SCP has been progressively delivering the requirements of the permit. The revised permit is valid until April 2027.

1.5.3 Fisheries Act 1994 (Qld)

The *Fisheries Act 1994* (Qld) sets out Queensland's responsibilities for the management, use, development and protection of fisheries resources and fish habitats, the management of aquaculture activities and helping to prevent shark bites, and for related purposes. Part 3 of the Act establishes the SCP and appropriate laws to enable this Program to function. These laws include the establishment of exclusion zones around SCP equipment.

The legislation states that the SCP is managed by the chief executive, who is the Director-General of DAF. The Director-General can implement the Program independently of Queensland Government policy and all legal matters relating to the SCP are managed by the Director-General's office. Furthermore, any proposed changes to the SCP must be approved by the Director-General before they can be implemented.

1.5.4 Marine Parks Act 2004 (Qld)

This Act provides for the conservation of Queensland's marine environment by implementing a comprehensive range of management strategies, including the declaration of marine parks and the establishment of zones and designated areas, including highly protected areas within marine parks. The Marine Parks Act does not include Commonwealth marine parks (i.e. GBRMP).

Figure 1.4 shows the three state marine parks declared under the Act and the GBRMP (light blue). The state marine parks include the Great Barrier Reef Coast Marine Park (dark blue), Great Sandy Marine Park (orange) and Moreton Bay Marine Park (green).

[10] Reef Authority. (2019). *Permit Re-issue G17/33288.1*.

Great Barrier Reef Coast Marine Park

The Great Barrier Reef Coast Marine Park (GBRCMP) is a state marine park that runs the full length of the GBRMP. It provides protection for Queensland's tidal lands and tidal waters. The GBRCMP complements the GBRMP by adopting similar zone objectives and entry and use provisions.

There are a small number of exclusion areas in the GBRMP established around major ports and urban centres to support certain continued activities along the reef. The SCP operates within these exclusion areas, protecting beaches in major cities, including Cairns, Townsville, Mackay, Yeppoon, and Gladstone. These exclusion areas fall under the GBRCMP. Within these exclusion areas, the SCP is not bound by the permit issued by the GBRMPA.

The SCP has a permit to euthanise target species within the GBRCMP. The permit was issued in 2019 when the SCP's target list was 19 species. The SCP revised the target species list to seven in 2021. Since this revision, the SCP has removed the these target species from the GBRCMP.

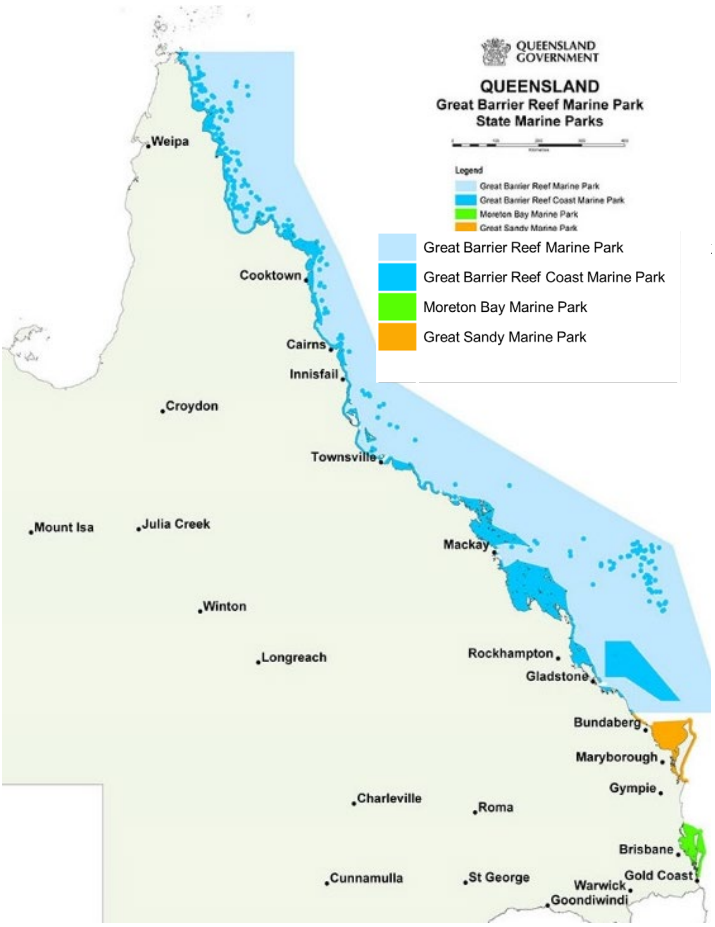


Figure 1.4: Queensland Great Barrier Reef Marine Park and State Marine Parks

Source: Queensland Government (2024), About marine park. Published 17 October 2017

The Great Sandy Marine Park and Moreton Bay Marine Park

The Great Sandy Marine Park extends from Rainbow Beach down to Noosa, while the Moreton Bay Marine Park extends from Caloundra to South Stradbroke Island. These marine parks have different zones within the marine parks which govern activities that can occur 'as of right' and those for which a permit is required. These four zones are:

- **Marine national park zone:** Activities such as fishing and collecting are prohibited. No-take activities such as boating, diving and photography are allowed.
- **Conservation park zone**: Protect significant marine habitats. Commercial trawling is prohibited in these zones as are most forms of commercial netting and harvest fisheries. Restrictions apply to most other activities conducted in this zone.
- **Habitat protection zone**: These zones are located over areas that contain sensitive habitats. Most activities are allowed in the habitat protection zones, however trawling is prohibited.
- **General use zone**: Most activities are allowed in the zone, however some require a permit.

The SCP has a permit to take animals posing a threat to human life within the Great Sandy Marine Park and Moreton Bay Marine Park.[11] This permit is valid until 2027 and stipulates that the SCP cannot conduct lethal operations within the marine parks after November 2025.[12]

[11] The State of Queensland. Department of Environment and Science. (2023). *Report on the administration of the Marine Parks Act 2004 (reporting period 1 July 2022 to 30 June 2023).* https://www.desi.qld.gov.au/__data/assets/pdf_file/0018/328140/report-on-administration-marine-parks-act-2004-2022-2023.pdf

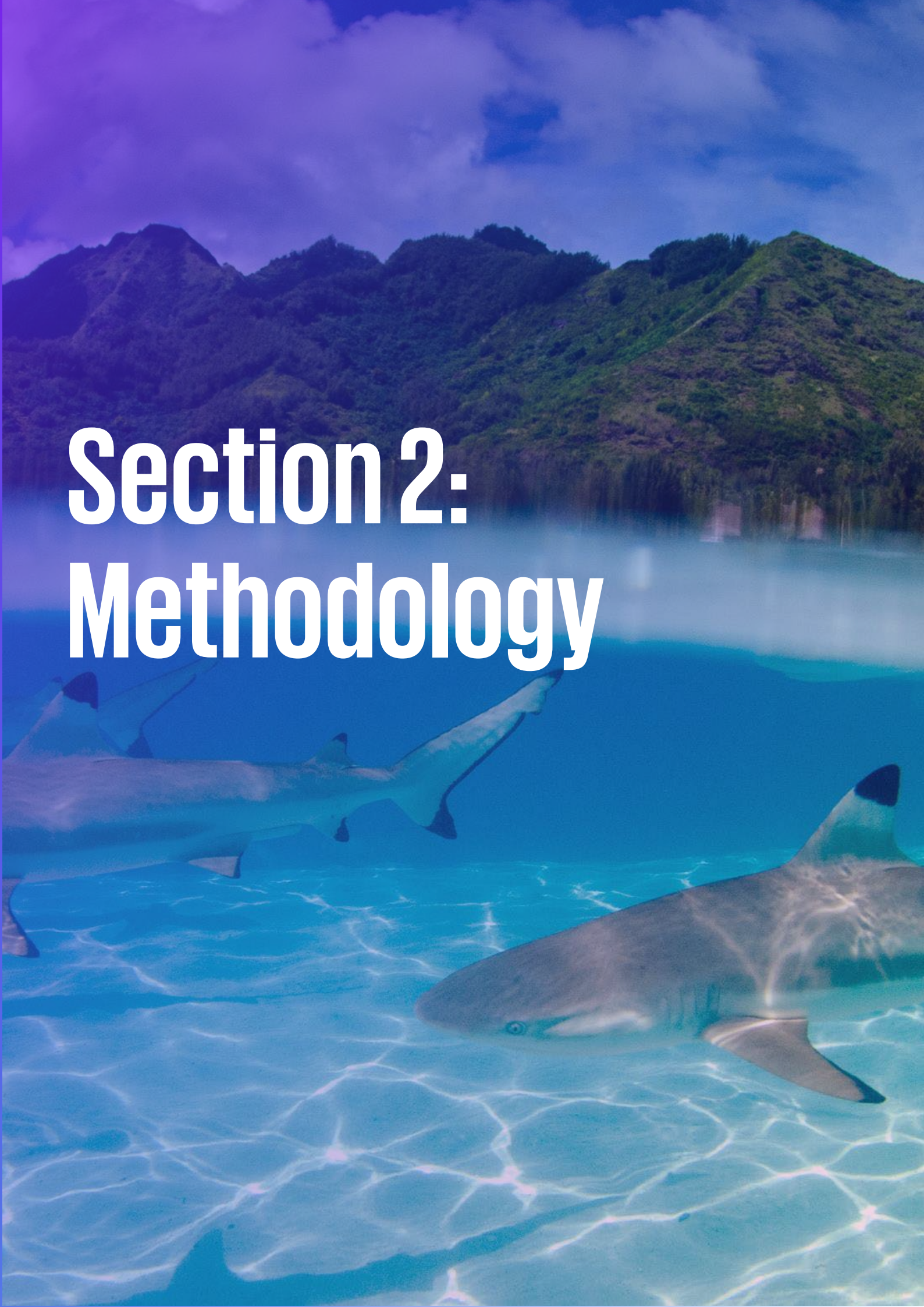
[12] Department of Environment and Science, (2017). *Marine Park Permit P-MPP-100080688*

1.5.5 Other Relevant Legislation and Regulations

The SCP's activities, which affect the marine environment and animals, are regulated by additional legislation that influences their operations. This legislation is detailed in Table 1-1 below.

Table 1-1: Summary of other relevant legislation and regulations

Legislation	Description	Implications for the SCP
Veterinary Surgeons Act 1936 (Qld)	The Act currently provides the head of power for the registration and oversight of veterinarians by the Veterinary Surgeons Board of Queensland.	A 2023 amendment to this legislation allows non-veterinary researchers to lawfully administer anaesthetics and analgesics and perform surgical procedures on animals. This allows researchers to internally tag sharks for tracking.
Animal Care and Protection Act 2001 (Qld)	Promotes the responsible care and use of animals. It places a legal duty of care on people in charge of animals to meet those animals' needs in an appropriate way.	The SCP's Operations are exempt from the Act under s46. Furthermore, shark researchers must adhere to the scientific code when tagging sharks.
Civil Aviation Safety Regulations 1998 (Cth)	Establishes a regulatory framework for maintaining, enhancing and promoting the safety of civil aviation, with particular emphasis on preventing aviation accidents and incidents.	This legislation outlines the requirements for the operation of uncrewed aircraft (such as drones). Changes are currently being implemented which impact training, certification, and how operators can use remotely piloted aircraft.



Section 2: Methodology

2 Approach

This section provides an overview of the structured approach used for the evaluation (this document), including the methodology adopted, data gathered, and analysis undertaken, as well as any limitations.

2.1 Evaluation Plan

An Evaluation Plan was developed in collaboration with DAF and the Scientific Working Group (SWG). The process involved the design of a Program Logic in the first instance (see Appendix A: Program Logic), which guided the development of evaluation questions and subsequent indicators that form the Evaluation Framework.

2.1.1 Program Logic

The Program Logic was drafted based on an initial review of SCP documentation provided by DAF alongside desktop research and finalised in collaboration with DAF and the SWG. For this evaluation, the Program Logic was drafted using a back-casting approach that first identified the long-term outcomes before the steps required to achieve these outcomes.

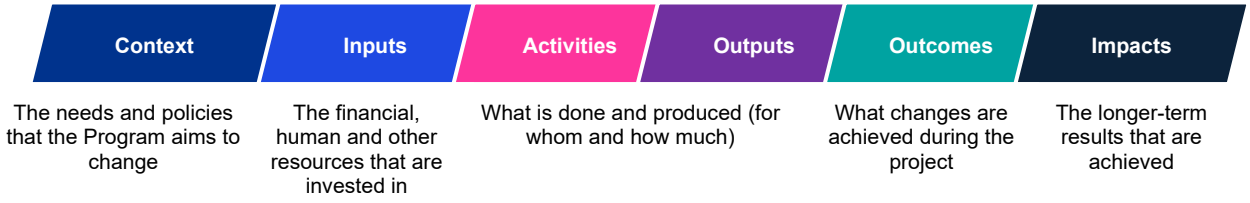


Figure 2.1: Program Logic Framework

Organising the Program into a Program Logic allows for each of its components to be evaluated according to a corresponding domain of inquiry, which includes:

1. **Appropriateness** – To what extent does the SCP address an identified need?
2. **Effectiveness** – To what extent has the SCP achieved the intended outcomes?
3. **Efficiency** – Do the outputs of the SCP represent value for money?
4. **Impact** – What long-term results have been produced due to the SCP?

Each domain delineates a set of key questions and sub-questions that collectively make up the Evaluation Framework (see Appendix B: Evaluation Framework). These questions are tailored to the SCP and crafted to comprehensively explore the design and delivery of each of the Program's four pillars. For each question, a single, or set of, indicators, measures and data sources were identified from a review of SCP documentation, desktop research and consultation with DAF, which are used to assess the degree to which the Program answers that question.

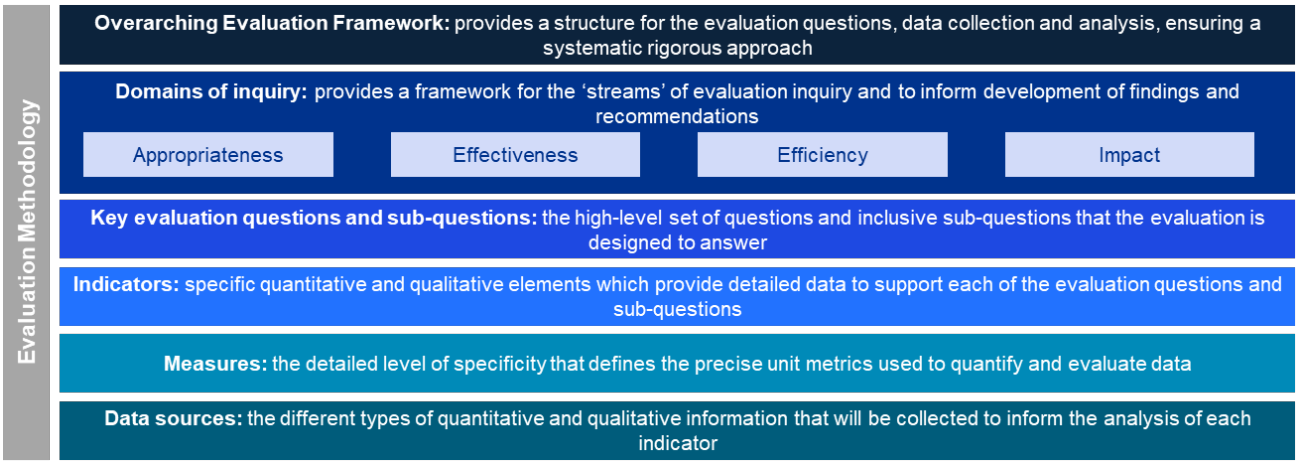


Figure 2.2 Evaluation Framework Methodology

2.2 Data Analysis

Quantitative and qualitative data were used to inform evaluation findings. Where available, quantitative data was used to demonstrate the impact of the SCP, while qualitative data was used to capture stakeholders' perspectives pertaining to the SCP.

The following data sources informed the evaluation:

- Content analysis of the documents provided by DAF and web searchers on each initiative
- Semi-structured interviews with internal and external stakeholders. These included:
  - DAF officers and SCP Operations contractors
  - Department of Environment, Science and Innovation (DESI), Department of tourism and Sport (DTS), Local Governments, GBRMPA and SLSQ
  - Sea World and university researchers
- Articles and papers from researchers in the field from a range of disciplines, including marine biology (shark behaviour), marine ecosystems, economics and beach safety
- International and interstate reviews were conducted to compare the Queensland SCP.

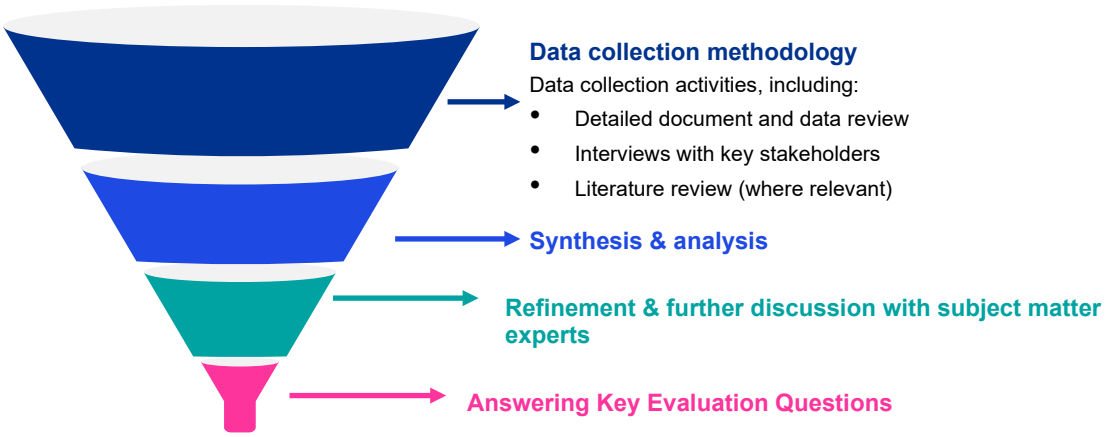


Figure 2.3: Data evaluation process

2.3 Stakeholder consultation

KPMG conducted an extensive data-gathering process to thoroughly understand the components of the SCP delivery. This involved a series of individual interviews with initiative owners and key delivery stakeholders, aimed at addressing the Evaluation Framework. The consultations aimed to assess the appropriateness, effectiveness, efficiency, and impact of the SCP during this period. Stakeholders included representatives from the State Government (DAF, DESI, DTS), Local Governments, SCP Operations contractors, Sea World, GBRMPA, SLSQ, and university researchers.

In total, 25 interviews were conducted, each lasting approximately one hour. These interviews were designed to extract insights on the SCP's objectives and processes from the key stakeholders involved. See Appendix C: Stakeholder list for the list of stakeholders consulted, and Appendix D: Consultation guide.

The consultation sought stakeholder views regarding:

- **Appropriateness** - The extent to which the SCP's design and approach met a need and was suitable in achieving the intended outcomes.
- **Effectiveness** - The extent to which the SCP's Operations, Trials, Research and Education initiatives achieved, or are expected to achieve, its objectives.
- **Efficiency** - The extent to which inputs into the SCP can deliver maximum outputs.

- **Impact** - The extent to which the SCP's Operations, Trials, Research and Education initiatives have generated, or are expected to generate, significant positive or negative, intended or unintended, higher-level effects.

The findings will help identify strengths and weaknesses, inform future strategies, and ensure the Program continues to meet its objectives in a cost-effective and comprehensive manner.

Subject Matter Experts (SMEs) were consulted to ensure this review's recommendations are relevant and suitable for the next iteration of the Plan. The SMEs consulted were experts in marine biology and ecosystems, shark mitigation, and public policy relating to human-shark interactions.

During the delivery of the evaluation project, KPMG engaged with the SWG on three occasions to test and confirm the approach to the:

- Evaluation Framework and measures
- Interim evaluation findings
- Insights and recommendations.

Collaborating with the SWG was essential due to their involvement in shaping research strategies for shark control in Marine Parks, optimising equipment to enhance effectiveness and reduce harm to non-target species, and exploring alternative, non-lethal technologies.

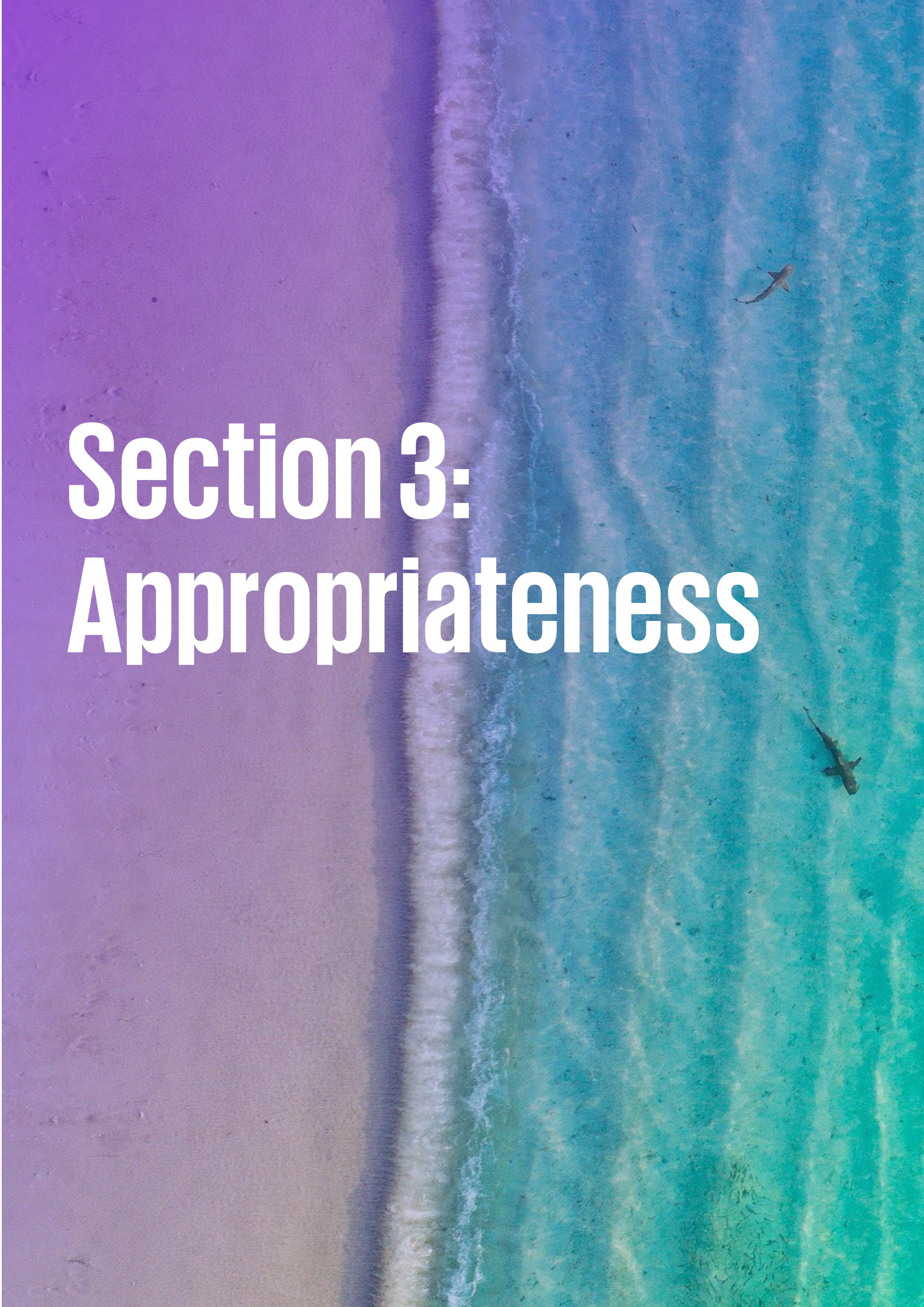
2.4 Limitations

The limitations refer to the constraints that affect the quality, accuracy, and applicability of data for the evaluation. These can arise from various factors, such as incomplete information, small sample sizes, lack of granularity, or reliance on estimates and assumptions. Additionally, data may lack comparability across different sources or regions due to differences in collection methods or standards.

Table 2-1 details the potential impact of the limitations on the evaluation findings as well as how this report deals with the limitations.

Table 2-1: Limitations of the evaluation

Limitation	Description	Action to address (within this report)
Stakeholder views	The stakeholders consulted included initiative owners and key delivery stakeholders, with the purpose of gathering information on historical program delivery rather than broad community views about the Program.	The scope of stakeholder consultation is detailed in section 2.3. The views of these stakeholders are not extrapolated to reflect the community's views about the Program.
Equipment changes during SCP delivery period	Between 2001 and 2024, several operational changes were made to the delivery of the SCP, including equipment quantities, configuration and contractor effort. This affects the interpretation and analysis of the Program's catch data.	Noted limitations in data analysis.
Target shark species list revision	The Program initially identified 19 shark species as potential threats to humans and categorised them as target species. However, in January 2023, the list was reduced to seven. This affects the interpretation and analysis of the Program's catch data.	The report used the current species list (seven species) in the analysis to ensure consistency with current program parameters.
Financial analysis	The financial statement regions do not align with the regions in which the SCP reports to operate. This minor misalignment means when comparing financial data to catch data, there may be an over or under-estimation of the cost per species caught.	The report has aligned the financial data with the regions as closely as possible.
Catch-Alert Drumline Trial analysis	The Catch-Alert Drumline Trial analysis uses data inputs provided by DAF which span January 2022 to August 2023. This data excludes the initial four-month period of the trial.	Noted limitations in data analysis.
SharkSmart Campaign analysis	The SharkSmart Campaign survey uses a small sample size (n=771) and is susceptible to self-reporting bias due to the question architecture. This may affect the accuracy of the results in reflecting the true behaviours and opinions of Queensland water users.	Noted limitations in data analysis.
Descriptive data analysis	The data analysis conducted as part of this evaluation is descriptive and does not apply inferential statistics, such as T-tests or confidence intervals, to validate findings or generalise results.	Noted as a limitation.
Shark Control Program catch data	The reported catch data used for analysis contains gaps in key fields, including the fate of the marine animals caught and their length, with some inconsistencies in data inputs across different contractors.	Noted as a limitation.



Section 3: Appropriateness

3 Appropriateness assessment

This chapter details the findings regarding the Appropriateness of the SCP. The Appropriateness domain aims to understand whether the SCP's design and approach is suitable and aligns with stakeholder needs. To evaluate appropriateness, the following areas are examined and detailed in the subsequent sections:

- **Program need:** Identifies the underlying problem or set of problems that create a clear need for the Program to be implemented.
- **Program comparison with other jurisdictions:** Explores the approaches taken by other jurisdictions and determines the degree of alignment with the Program's design and strategies.
- **Alignment with government legislation and agency priorities:** Determines the extent to which the Program's objectives, strategies, and implementation adhere to relevant government laws, regulations and policies, and how well they align with the priorities and strategic goals of the responsible agency.
- **Stakeholder sentiment on Program appropriateness:** Identifies stakeholder perceptions of the Program's appropriateness.
- **Changed conditions:** Identifies any changes in contextual factors over time that could influence the suitability of the Program's approach.

Key findings related to Appropriateness are summarised below.

Appropriateness – Key findings

3.1 Program need

Given the prevalence of potentially dangerous species in Queensland waters and their capacity to cause severe injury or death, there is a continued need to protect beachgoers. The potential impact of shark incidents on local tourism further underscores the need to reduce the risk of such events. Additionally, the community increasingly demands a Program that minimises environmental impact while maintaining or improving the risk profile of beaches, while navigating environmental protection legislation and regulations.

3.2 Program comparison with other jurisdictions

Most jurisdictions follow a similar approach in research, trials, and education, adopting comparable technologies and initiatives. However, the SCP differs with its duality of lethal and non-lethal shark control operations, employing a non-lethal approach within the GBRMP and a lethal approach outside it. Moreover, the SCP uses shark nets year-round, unlike NSW and KwaZulu-Natal (South Africa), which remove nets seasonally.

3.3 Alignment with government legislation and agency priorities

The SCP does not align with the intent of the EPBC Act, operating under an exemption to lethally target White sharks.

The SCP aligns with:

- GBRMP Act 1975 (Cth)
- Fisheries Act 1994 (Qld)
- Marine Parks Act 2004 (Qld).

The SCP's main purpose of protecting bathers from shark bites does not align with DAF's vision.

3.4 Stakeholder sentiment on Program appropriateness
Stakeholders view SCP Trials, Research and Education as appropriate and designed in-line with the SCP's objectives. There are conflicting views on the appropriateness of Operations, with some perceiving it as necessary to ensure a lower risk of human-shark interactions, some viewing it as resulting in unacceptable marine ecosystem damage, or and some having no view due to a lack of information.

3.5 Changed conditions
The following changes occurred during the Plan period and must be considered when evaluating the Program's appropriateness in the current context: • During the SCP delivery period, coastal areas observed a surge in residents and tourism with a disproportionately higher number of people frequenting the beach and participating in activities with the highest risks of encountering a shark. • Increased shark activity was observed over the Plan period, coinciding with the occurrence of a Triple La Niña event, a reduction in commercial fishing activities targeting sharks, decreased commercial net fishing that results in shark bycatch, the implementation of a possession limit of one shark for recreational fishers and 1.5-meter catch rule for sharks, and the continued recovery of some marine animal populations (e.g. humpback whales). • Shifting public attitudes have increased scrutiny of the Program's environmental impacts, amplified by new methods of disseminating operational content to the public, ushering in a new era of visibility into the Program's day-to-day activities.

3.1 Program need

This section outlines the need for the Program, assessing whether the purpose of the SCP remains valid. In other words, it evaluates whether the problems the Program was intended to address still exist and whether they persist to a degree that justifies the SCP.

The underlying problem that the Program seeks to address is the incidence of shark bites affecting beach users along Queensland's coastline. Tackling this issue introduces further challenges, as the Program must operate within a complex legislative framework and balance sensitivities of the marine ecosystem. Collectively, these problems give rise to four specific needs for the SCP in Queensland, with the avoidance of human-shark interactions being the primary need followed by the other three, ranked in no particular order:

- **To avoid human-shark interactions (fatal and non-fatal)**
- **To protect Queensland's domestic and international tourism industry**
- **To minimise negative impacts on marine ecosystems**
- **To comply with legislative requirements.**

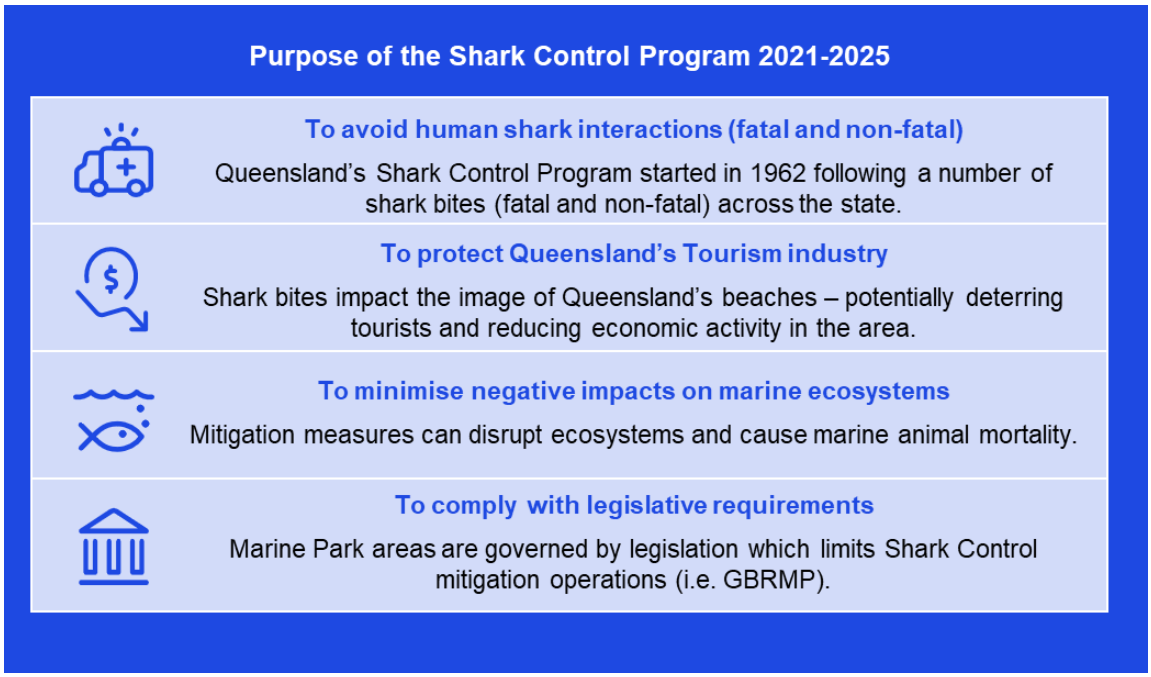


Figure 3.1: Purpose of the Shark Control Program 2021-2025

Source: KPMG SCP Program Evaluation Framework

The predominant view among stakeholders is that some form of the SCP remains necessary, but opinions vary on the extent and configuration of the Program. All stakeholders agree that further refinement is needed to better address the objectives of the Program. Divergent views on the Program's necessity generally stem from differing perspectives on how to balance human safety with economic and environmental factors. While ensuring human safety through the mitigation of human-shark interactions represents the primary concern, all stakeholders acknowledge the need for improvements to reduce the SCP's adverse impact on marine ecosystems.

To avoid human-shark interactions (fatal and non-fatal)

There is a need to reduce the risk of injury or death from potential human-shark interactions. Should an encounter occur, it can result in a traumatic event with wide-reaching impacts that affect the victim and their family, first responders and the broader community.[13] Queensland's coastline is home to several shark species, including Tiger sharks, Bull sharks, and White sharks, whose habitats partially overlap with human activity and have demonstrated a capacity to inflict injury or death upon human interaction.[14]

Before the Program's implementation in 1962, Queensland recorded approximately three shark bites per year, resulting in one death annually.[15] Since 1962, there have been 142 shark incidents resulting in 22 fatalities and 96 injuries. This includes 10 fatalities since 2001, with two of these occurring at SCP-protected beaches.

To protect Queensland's domestic and international tourism industry

Stakeholders have identified the need for the SCP to safeguard Queensland's tourism industry by ensuring tourists, particularly those from interstate and overseas, feel safe and confident while enjoying ocean-related recreational activities. The state's beaches are central to its tourism appeal, with coastal economies heavily reliant on this sector.

Shark bites are believed to lead to negative economic shocks, as media coverage of such incidents often sensationalises the danger, capturing global headlines and causing potential tourists to avoid affected

[13] Crossley, R., Collins, C. M., Sutton, S. G., & Huveneers, C. (2014). *Public Perception and Understanding of Shark Attack Mitigation Measures in Australia. Human Dimensions of Wildlife, 19(2), 154–165.* https://doi.org/10.1080/10871209.2014.844289
[14] Australian Shark Incident Database
[15] Shark bite incidents include both provoked and unprovoked cases, resulting in fatalities, injuries, or non-injuries (such as a shark missing the victim) but exclude incidents occurring in the open ocean and river systems.

regions.[16] A decline in tourist numbers would reduce immediate revenue, potentially impacting local businesses and employment opportunities that depend on a consistent influx of visitors.[17] This effect is expected to be exacerbated when a cluster of shark bites occurs in a particular region.[18] However, despite the logical expectation that tourism would decline following a shark bite, there have been limited empirical studies to investigate this association or to quantify its potential effect, especially in an Australian or Queensland context.

To mitigate potential risks to the tourism industry and instil confidence in the safety of Queensland's beaches, there is a need for a program to reduce the likelihood of shark bites, thereby decreasing the frequency of incidents that capture media attention and deter tourists.

Economic impact study at New Smyrna Beach, Florida[19]

A study on the economic impact of a shark bite incident in New Smyrna Beach, Florida found that there was a short-term increase of 424 hotel nights within the county as journalists and other interested parties were drawn to the event, but this was outweighed by a loss of 550 hotel nights in surrounding counties, with an additional loss of 415 hotel nights over the next 30 days as tourists adjusted their plans to avoid the area.

[16] Neff, C. (2012). Australian Beach Safety and the Politics of Shark Attacks. Coastal Management, 40(1), 88–106. https://doi.org/10.1080/08920753.2011.639867; Sabatier, E. and Huveneers, C., 2018. Changes in media portrayal of human-wildlife conflict during successive fatal shark bites. Conservation and Society, 16(3), pp.338-350.; Muter, B.A., Gore, M.L., Gledhill, K.S., Lamont, C. and Huveneers, C., 2013. Australian and US news media portrayal of sharks and their conservation. Conservation Biology, 27(1), pp.187-196.; Losen, B., 2023. Shark attack risk on Reunion Island: Emphasis on local media construction. Marine Policy, 157, p.105851.

[17] Barnett, A., Fitzpatrick, R., Bradley, M., Miller, I., Sheaves, M., Chin, A., Smith, B., Diedrich, A., Yick, J. L., Lubitz, N., Crook, K., Mattone, C., Bennett, M. B., Wojtach, L., & Abrantes, K. (2022). *Scientific response to a cluster of shark bites. People and Nature, 4(4), 963-982.* https://doi.org/10.1002/pan3.10337

[18] Neff, C. (2012). *Australian Beach Safety and the Politics of Shark Attacks. Coastal Management, 40(1), 88–106.* https://doi.org/10.1080/08920753.2011.639867

[19] Stair, C. A. (2018). Wildlife economics: The significance of economic impacts of wildlife associated activities (Graduate Theses, Dissertations, and Problem Reports, No. 7260). West Virginia University. https://researchrepository.wvu.edu/etd/7260

To minimise negative impacts on marine ecosystems

There is a clear and ongoing need for a modern SCP that is carefully managed to minimise ecosystem impacts. Historically, the Program sought to reduce local species populations of target sharks. Without a focus on marine ecosystem impacts, shark control measures could significantly reduce populations of some species, potentially causing impacts to food webs throughout the marine ecosystem.[20]

This concern is particularly relevant for vulnerable species like White sharks. Due to their low reproductive rates and long maturation periods, White shark populations are especially slow to recover from losses.[21] Moreover, as apex predators, their ecological role is critical and removal can significantly alter marine ecosystems, adversely affecting other marine life.[22]

Program stakeholders note that when traditional shark control operations began in 1962, the impact on ecosystems was not a salient concern, with the core objective being to lower shark populations in response to a series of fatal bites. This is evidenced by the initial phase of the Program predominantly deploying Mesh Nets which indiscriminately capture and kill various marine species in addition to target sharks. However, in the modern context, stakeholders recognise that growing conservationist attitudes have shifted priorities towards preserving ecosystems.[23] As coastal environments increasingly capture the public conscience and contribute significantly to tourism and recreational activities, the need for a program that minimises negative impacts on marine ecosystems has strengthened.

To comply with legislative requirements

The Program must meet various legislative requirements to ensure compliant operations:

- **EBPC Act**: The SCP operates under a Strategic Assessment Exemption from the EPBC Act, allowing for the removal of certain marine animals protected under the Act.
- **GBRMP Permit**: In the marine park area, the SCP is required to adhere to the permit issued by the GBRMPA, which stipulates the use of non-lethal methods for shark control. Additionally, the permit mandates that the SCP trial and progressively implement SMART Drumlines, experiment with novel non-lethal shark control techniques, and share the research results with the SWG.
- **Fisheries Act 1994 (Qld)**: The SCP is obligated to adhere to its legislative duty of safeguarding human life as stated by the Act.
- **Queensland Marine Parks Permits**: The SCP holds a permit that allows the Program to operate within Marin Parks.
- The permit to operate within the Great Sandy Marine Park and Moreton Bay Marine Park currently requires the Program to have a non-lethal approach within the two Marine Parks by November 2025.
- The permit to operate within the GBRMP does not have a non-lethality condition.

[20] Simpfendorfer, C. A., Heupel, M. R., & Kendal, D. (2021). *Complex Human-Shark Conflicts Confound Conservation Action. Frontiers in Conservation Science, 2, 692767*. https://doi.org/10.3389/fcosc.2021.692767
[21] Bowlby, H. D., & F. Gibson, A. J. (2020). Implications of life history uncertainty when evaluating status in the Northwest Atlantic population of White shark (Carcharodon carcharias). Ecology and Evolution, 10(11), 4990-5000. https://doi.org/10.1002/ece3.6252
[22] Ibid.
[23] Martin, C. L., Curley, B., Wolfenden, K., Green, M., & Moltschaniwskyj, N. A. (2022). *The social dimension to the New South Wales Shark Management Strategy, 2015–2020, Australia: Lessons learned. Marine Policy, 141, 105079.* https://doi.org/10.1016/j.marpol.2022.105079

3.2 Program comparison with other jurisdictions

To evaluate the appropriateness of the Program, it is important to understand the approaches taken by other jurisdictions, which this section outlines. Ultimately, the design and delivery of shark control programs vary across jurisdictions based on region-specific factors that render certain approaches more viable or appropriate than others.

Shark control measures are implemented in coastal waters across Australia and globally to reduce the risk of shark interactions with humans. Six jurisdictions that are funded by state or federal governments were selected for this review. These are:

- New South Wales (NSW) Shark Management Program, Australia
- Western Australia Shark Mitigation Strategy, Australia
- South Australia, Australia
- Kwazulu-Natal Sharks Board (KZNSB) Maritime Centre of Excellence, South Africa
- Reunion Island Shark Management Program, Reunion Island, France
- California Shark Beach Safety Program, United States

Non-governmental organisations and local governments also implement shark mitigation measures, such as Cape Town's Shark Spotters Program and beach enclosers maintained by local governments in NSW and South Australia. However, these initiatives are outside the scope of this report, as they are not principally funded by state or federal governments.

To facilitate comparison, this analysis categorises the programs into four main pillars: Operations, Trials, Research, and Education. Queensland’s SCP encompasses activities across all these pillars, aligning with practices in other jurisdictions.

In terms of operational equipment, Queensland's SCP aligns most closely with KZNSB, as both utilise nets and Traditional Drumlines. However, a notable difference is seen in the use of shark nets. Queensland deploys shark nets year-round, whereas NSW has recently announced the removal of Mesh Nets between April and August, one month earlier than in previous years, and KZNSB temporarily removes nets during the sardine run in June and July. This seasonal removal corresponds with a decline in beach attendance during the winter months and helps reduce the environmental impact, particularly by minimising the interference with marine life when the perceived risk to humans is lower. Western Australia (WA) delivers a different approach to operations, with equipment comprising aerial patrols and shark tagging. Réunion Island and Queensland are unique in their use of lethal methods for shark control, with Réunion Island being the sole location under review that has prohibited swimming.

Comparing programs across different jurisdictions is limited due to their customisation to address specific environmental factors. The structure of each program varies, reflecting local needs, shark behaviour, public concerns, different patterns of water use by people and conservation laws. For example, the NSW Shark Management Program covers the entire coastline, whereas Western Australia's Shark Mitigation Strategy focuses on metropolitan and South Coast beaches.

3.2.1 New South Wales Shark Management Program

Shark mitigation equipment has been deployed along the NSW coastline since 1936, with the current NSW Shark Management Program receiving $85.6 million over four years. The NSW program delivers initiatives across the four pillars of Operations, Trials, Research and Education.

The NSW Shark Management Program receives the most funding of any program of its kind in the world. The NSW Government has committed $85.6 million from 2022-2026 to manage the risk of shark interactions at all 25 coastal local government areas.[24] The program includes research and trials into shark behaviour and deterrent equipment, the use of SMART Drumlines and drone surveillance, and community engagement through the SharkSmart app and events. Table 3-1 summarises the NSW Shark Management Program.

Table 3-1: Summary of the NSW Shark Management Program

Operations	Trials	Research	Education
✓ 305 SMART (Catch Alert) Drumlines ✓ Drones ~50 beaches ✓ 37 shark tag listening stations[25] ✓ 51 shark nets	✓ Shark barriers	✓ Contributions to literature ✓ Social studies ✓ Personal shark deterrents	✓ SharkSmart

- **Operations:** The NSW program has implemented 305 SMART Drumlines across 19 coastal areas within local government areas from Tweed to Bega. SMART Drumlines trigger an alarm when an animal becomes hooked on its line, allowing the program's service crew to promptly relocate and release the animal, including sharks.[26] Past trials indicated that SMART Drumlines are four times more effective at capturing the intended shark species, with significantly fewer unintended catches compared to nets.[27] There are also 50 locations where Surf Life Saving NSW conducts drone surveillance, with ongoing experiments for extended-range flights. Shark nets in NSW are in place for eight months a year and are taken out during the May to August winter season. During the 2023-24 period, nets caught 13 Green Turtles, 11 Leatherback Turtles, and five Indo-Pacific Bottlenose Dolphins, which led to an operational review that culminated in increased aerial drone monitoring of shark nets and the removal of shark nets one month earlier in April, to accommodate heightened turtle activity.[28]
- **Trials:** Two shark barriers were initially proposed to be trialled for three years commencing in 2016, however trials were discontinued due to difficulties with installation in the sea and seabed conditions present in the trial area.[29]
- **Research:** The NSW program has funded various research, including studies on shark behaviour, community preferences, and personal shark deterrent equipment, including electromagnetic pulsing devices and bite resistant wetsuit materials.[30]

[24] NSW Department of Primary Industries. (n.d.). *NSW Shark Management Program. SharkSmart.* https://www.SharkSmart.nsw.gov.au/#:~:text=NSW%20Shark%20Management%20Program,the%20state%27s%20most%20popular%20beaches
[25] NSW Government. Department of Primary Industries and Regional Development. (2024). *Shark Listening Stations.* *SMS Factsheet - Shark Listening Stations (nsw.gov.au)*
[26] Guyomard, D., Perry, C., Tournoux, P. U., Cliff, G., Peddemors, V., & Jaquemet, S. (2019). An innovative fishing gear to enhance the release of non-target species in coastal shark-control programs: The SMART (shark management alert in real-time) drumline. *Fisheries Research, 216*, 6-17. https://doi.org/10.1016/j.fishres.2019.03.011
[27] NSW Department of Primary Industries. (n.d.). *NSW Shark Management Program. SMART Drumlines.* https://www.SharkSmart.nsw.gov.au/technology-trials-and-research/smart-drumlines
[28] NSW Government. Ministry of Agriculture. (2024). *Summer's shark management approach announced.* *https://www.nsw.gov.au/media-releases/summers-shark-management-approach-announced*
[29] NSW Department of Primary Industries. (2020). *NSW Shark Management Program: Barriers. SharkSmart.* https://www.SharkSmart.nsw.gov.au/__data/assets/pdf_file/0004/1237009/sms-factsheet-barriers.pdf
[30] Martin, C. L., Curley, B., Wolfenden, K., Green, M., & Moltschaniwskyj, N. A. (2022). *The social dimension to the New South Wales Shark Management Strategy, 2015–2020, Australia: Lessons learned. Marine Policy, 141, 105079.* https://doi.org/10.1016/j.marpol.2022.105079. Clarke, TM, P Butcher, M Green, C Huveneers 2024. Effectiveness of bite-resistant

- **Education:** The SharkSmart app provides real-time shark alerts, information, and resources for people using NSW ocean beaches. Furthermore, there were 10 community engagement events held in 2023-2024. Events included surfing competitions, music festivals, surf lifesaving competitions, lifestyle events, and community markets. Collectively, the events provided direct engagement and community support with approximately 2,700 stakeholders.[31]

Similarities to the Queensland SCP

The Queensland and NSW programs both align on the pillars of Research, Trials, and Education. They each add to knowledge about shark behaviour, the efficacy of shark deterrent technologies, and community attitudes towards shark management. The Program Leader of the NSW Shark Program is part of the SWG that provides expert advice to the SCP on alternative methods of shark mitigation, various shark species, shark studies, and program administration. Both initiatives utilise the SharkSmart brand to enhance safety and awareness. Queensland's approach includes widespread community engagement, collaborating with groups like SeaWorld and uses social media and traditional communication approaches to convey information on sharks and the shark bite mitigation. In contrast, NSW targets a broad audience with their SharkSmart smartphone application and conducts specific community outreach for high-risk aquatic user groups. Operational tactics differ between the two; NSW employs SMART Drumlines and drone surveillance, while Queensland is still testing these tools. Additionally, NSW opts to remove shark nets during the winter months, whereas Queensland keeps shark nets out all year. This reflects that Queensland beaches are still utilised during winter months, especially for high-risk water activities (surfing, spearfishing and scuba diving).

3.2.2 Western Australia Shark Mitigation Strategy

The Western Australian Shark Mitigation Strategy has been operating since 2008 and currently received $17 million over four years. The program delivers initiatives across the four pillars of Operations, Trials, Research and Education.[32]

The WA Shark Mitigation Strategy was developed in 2008, which included aerial and beach patrols. The WA Government has committed $17 million from 2021-2025 to manage the risk of shark interactions at beaches along the WA coast.[33] Table 3-2 summarises WA's approach to shark mitigation.

Table 3-2: Summary of Western Australia's Shark Management Program

Operations	Trials	Research	Education
✓ Beach and aerial surveillance ✓ Personal shark deterrent rebate ✓ Six beach enclosures ✓ Shark tag listening stations (real time monitoring)	✓ SMART (Catch-Alert) Drumlines	✓ Contributions to literature ✓ Personal shark deterrents	✓ SharkSmart

materials to reduce injuries from White (Carcharodon carcharias) and Tiger shark (Galeocerdo cuvier) bites. Final Report to New South Wales Department of Primary Industries. 28 pages.
Whitmarsh, S. K., Amin, D. B., Costi, J. J., Dennis, J. D., & Huveneers, C. (2019). Effectiveness of novel fabrics to resist punctures and lacerations from White shark (Carcharodon carcharias): Implications to reduce injuries from shark bites. PLoS ONE, 14(11), e0224432. https://doi.org/10.1371/journal.pone.0224432. Huveneers, C., Whitmarsh, S., Thiele, M., Meyer, L., Fox, A., & Bradshaw, C. J. A. (2018). Effectiveness of five personal shark-bite deterrents for surfers. PeerJ, 6, e5554. https://doi.org/10.7717/peerj.5554 .

[31] NSW Government. Department of Primary Industries and Regional Development. (2024). *Shark Meshing Bather Protection Program 2023-24 Annual Performance Report.* https://www.SharkSmart.nsw.gov.au/__data/assets/pdf_file/0010/1570987/Shark-Meshing-Bather-Protection-Program-2023-24-Annual-Performance-Report.pdf

[32] Government of Western Australia. (2024), *Helicopter patrols keep careful watch over WA beaches.* https://www.wa.gov.au/government/media-statements/Cook-Labor-Government/Helicopter-patrols-keep-careful-watch-over-WA-beaches--20230905

[33] Ibid.

- **Operations:** The WA program allocated $4 million in 2023-24 to Surf Life Saving WA for helicopter patrols and beach surveillance, especially in metropolitan and South-West areas.[34] This funding also supported the use of jet skis for urgent evacuations during shark sightings and coordinating responses to shark bites. The WA program further subsidises approved personal deterrents for surfers and divers, offering a $200 rebate on approved shark deterrent devices (only one provider is still in business).[35] Additionally, six beach enclosures have been established with the support for the WA Government to create safe swimming areas.
- **Trials:** The WA program has also tested non-lethal SMART Drumlines, with an independent assessment conducted by the WA Chief Scientist concluding that this technology was not successful as a shark mitigation measure under the conditions found in WA. Research into the effectiveness of personal electric shark deterrents in repelling White sharks was also conducted, showing that some deterrents were moderately successful in achieving this.[36]
- **Research:** The WA program has added to the body of knowledge concerning the patterns and activities of White and Bull sharks in Western Australian waters. The WA research program includes a shark tagging and monitoring system that provides real-time notifications when tagged sharks approach a monitoring receiver. [37] These notifications are delivered through the WA SharkSmart app and through sirens located at six WA beaches.[38]
- **Education:** The WA SharkSmart website offers up-to-date shark research, safety details and features a real-time shark activity map with recent sightings and tag detections. This information can also be accessed via the SharkSmart WA app. Additionally, WA's Sea Sense campaign educates on local shark mitigation measures, safety tips, ways to stay informed on shark movements, and the process for reporting shark encounters.

Similarities to the Queensland SCP

The Shark Management Program in WA shares certain aspects with the Queensland Shark Control Program, including contributing to research, testing SMART Drumlines, and employing the SharkSmart Campaign for public education. Yet, there is a distinction in WA's approach to trials, as their testing of SMART Drumlines was not successful. It focused exclusively on White sharks, but instead resulted in an unexpected capture of Tiger sharks. The proposal was also unsuccessful due to community opposition. Since Tiger sharks are a target species in Queensland, this outcome indirectly supports the potential use of the technology within the state. Additionally, local councils, with support from the WA Government, operate six beach barriers in WA, located in Melville, Albany, Wanneroo, Esperance, and two in Busselton. This technology was unsuccessfully installed in Ballina, NSW, due to shifting sands and community opposition. Queensland has also deemed these enclosures impractical for southern Queensland beaches due to similar reasons as NSW. Northern Queensland beaches are unsuitable due to their unique reef environments, strong currents, cyclonic weather, and community opposition. Moreover, the WA program encourages the use of personal shark deterrents by giving a $200 subsidy, and to date, they have issued over 9,200 rebates.[39] With support from WA Government, these devices were independently tested and shown to be effective against White sharks, while the Queensland SCP also tested personal electronic deterrents to find the devices worked on Tiger sharks as well, reducing bites on bait by up to 60 percent.[40]

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[34] Government of Western Australia. SharkSmart (n.d.). *Shark Mitigation Strategy*. https://www.SharkSmart.com.au/strategy/state-government/
[35] Ibid.
[36] Kempster, R. M., Egeberg, C. A., Hart, N. S., Ryan, L., Chapuis, L., Kerr, C. C., Schmidt, C., Huveneers, C., Gennari, E., Yopak, K. E., Meeuwig, J. J., & Collin, S. P. (2016). How *Close* is too *Close?* The *Effect of a Non-Lethal Electric Shark Deterrent on White Shark Behaviour*. PLOS ONE, 11(7), e0157717. https://doi.org/10.1371/journal.pone.0157717
Ryan, L.A., Chapuis, L., Hemmi, J.M., Collin, S.P., McCauley, R.D., Yopak, K.E., Gennari, E., Huveneers, C., Kempster, R.M., Kerr, C.C. and Schmidt, C. (2018). *Effects of auditory and visual stimuli on shark feeding behaviour: the disco effect*. Marine biology, 165, pp.1-16. https://doi.org/10.1007/s00227-017-3256-0
Egeberg, C. A., Kempster, R. M., Hart, N. S., Ryan, L., Chapuis, L., Kerr, C. C., Schmidt, C., Gennari, E., Yopak, K. E., & Collin, S. P. (2019). *Not all electric shark deterrents are made equal: Effects of a commercial electric anklet deterrent on White shark behaviour*. PLOS ONE, 14(3), e0212851. https://doi.org/10.1371/journal.pone.0212851
[37] Government of Western Australia. SharkSmart (n.d.). *Shark tagging.* https://www.SharkSmart.com.au/research/shark-tagging/
[38] Government of Western Australia. SharkSmart (n.d.). *Shark warning system.* https://www.SharkSmart.com.au/staying-safe/shark-warning-system/
[39] Government of Western Australia. (2024). *West Aussies embracing shark safety measures.* https://www.wa.gov.au/government/media-statements/Cook-Labor-Government/West-Aussies-embracing-shark-safety-measures---20240123
[40] Clarke, T. M., Barnett, A., Fitzpatrick, R., Ryan, L. A., Hart, N. S., Gauthier, A. R., B., T., & Huveneers, C. (2024). Personal electric deterrents can reduce shark bites from the three species responsible for the most fatal interactions. Scientific Reports, 14(1), 1-12. https://doi.org/10.1038/s41598-024-66679-6

3.2.3 South Australia

The Government of South Australia (SA) funds a fixed-wing aerial patrol but, due to recent shark bites, they have set up a task force to address the shark risk.

The SA Government provides funding for a fixed-wing aerial patrol of beaches as their principal means of shark mitigation. In response to several recent shark bites in the state, the SA Government established a task force, which has evaluated current and potential future mitigation measures.[41] This task force has representatives from the Department of Primary Industries and Regions South Australia (PIRSA), South Australia Police, Surf Life Saving SA, State Emergency Service and the Department for Environment and Water. They have also consulted with a variety of other agencies.

Table 3-3: Summary of SA's shark mitigation activities

Operations	Trials	Research	Education
✓ Aerial patrol ✓ Shark sightings reporting	The program does not conduct trials	The program does not conduct research	The program does not conduct education

- **Operations:** The SA Government deploys fixed-wing aircraft to patrol high-risk beaches during the summer season, operated by SAFECOM and the SA State Emergency Service. These patrols monitor coastline areas and use sirens to alert beachgoers of potential shark threats.[42] The state government also operates a shark spotting hotline, enabling the public to report shark sightings to local authorities if they pose a risk. This is managed by the Department of Primary Industries and Regions, South Australia.
- The SA Government has not funded any research, trials or education initiatives for managing shark risks.

3.2.4 Kwazulu-Natal Sharks Board Maritime Centre of Excellence

The KwaZulu-Natal Sharks Board Maritime Centre of Excellence in South Africa has been operating since 1952. The program delivers initiatives across the four pillars of Research, Trials, Operations and Education.

The KwaZulu-Natal Sharks Board Maritime Centre of Excellence (KZNSB) manages bather protection against sharks along the KwaZulu-Natal coastlines. Shark nets were first deployed in Durban in 1952 to protect bathers by catching potentially dangerous sharks, specifically targeting the Bull shark, Great White shark, and Tiger shark. Currently, there are 37 beaches protected by the KZNSB.[43]

Table 3-4: Summary of KZNSB's Shark Management Program

Operations	Trials	Research	Education
✓ 165 drumlines ✓ 15 km of shark nets	The program does not conduct trials	✓ Contributions to research	✓ School outreach program ✓ Boat Tours

- **Operations:** Beach protection methods typically involve the combination of two nets or one net along with four drumlines, although the specific amount of equipment differs for each beach. As of 2019, the KZNSB had installed 165 drumlines and a total of 15 kilometres of netting along the shoreline.[44]

[41] Australia, *Parliamentary Debates,* Legislative Council, 6 June 2024, 14:30 (The Hon. C.M. Scriven, Minister for Primary Industries and Regional Development, Minister for Forest Industries)
[42] State Emergency Service of South Australia. (n.d.). *Shark Patrol.* https://www.ses.sa.gov.au/about-us/what-we-do/shark-patrol/
[43] Kwazulu-Natal Sharks Board Maritime Centre of Excellence. (n.d.). *Protected beaches on the KZN coastline.* https://shark.co.za/bather/
[44] Kwazulu-Natal Sharks Board Maritime Centre of Excellence. (n.d.). *Shark Nets and Drumlines.* https://shark.co.za/nets-and-drumlines/

- **Trials:** The KZNSB program trialled a shark deterrent cable in 2014 at Cape Town. The trial was a success with 100 percent of sharks being deterred by the device. The deterrent cable has since been installed at the Busselton Jetty, WA.[45] No publicly announced trials have been conducted since 2015.
- **Research:** The KZNSB program is committed to research that helps decrease bycatch, explores the use of wider mesh in the net design, and involves tagging and release of sharks.
- **Education:** The KZNSB conducts a school outreach initiative that features shark anatomy lessons. This educational presentation aims to engage and inform students and the general populace, covering topics like the sensory systems of sharks and their importance as apex predators in ocean ecosystems. In addition, the KZNSB provides boat excursions for the public, during which attendees can observe the maintenance of shark safety equipment along the coast off Durban's Golden Mile.

Similarities to the Queensland SCP

The KZNSB program shares similarities with the Queensland SCP. Both programs use Traditional Drumlines and nets to protect beaches. Furthermore, both programs contribute to the research, trial new shark mitigation technologies and have an outreach program for education. Both programs have also gradually phased out Mesh Nets in favour of drumlines. The KZNSB differs from Queensland as it is a non-lethal program, where sharks caught in equipment are released.

3.2.5 Réunion Island Shark Management Program

Réunion Island has established a Shark Management Program overseen by the Shark Safety Centre (SSC).[46] This centre implements several initiatives across the four key pillars.

Reunion Island is a French overseas department located in the Indian Ocean, around 950 km from Madagascar. Shark encounters in the region have been recorded since 1913, with a notable increase between 2011 and 2013 when there were five bites, three of which were fatal.[47] These events led the local authorities to impose a temporary prohibition on swimming and other aquatic activities outside of designated areas.

Table 3-5: Summary of the Réunion Island Shark Management Program

Operations	Trials	Research	Education
✓ Swimming ban ✓ Preventative Fishing Program ✓ Shark barriers ✓ Beach signage	✓ New shark barriers ✓ The Shark Lookout Program ✓ The Water Patrol ✓ On-site communication	✓ Personal Protective Equipment Project ✓ Baited Remote Underwater Video Stations ✓ Sonar ✓ Autonomous cameras and sonar ✓ GENERISK	✓ Dorsal app ✓ On-site communication

- **Operations:** After five shark bites occurred between 2011 and 2013, the government imposed a lasting swimming ban. This greatly affected the island's economy, prompting the SSC to enable water activities by installing shark barriers and implementing a lethal shark fishing program. Despite the government ban in 2013, some individuals still entered the water, leading to four fatal incidents from 2015-2019. Due to ongoing incidents, the temporary prohibition on swimming and water activities remains in effect as of 2024.[48] Swimming and other water activities are only allowed at select beaches with lifeguard supervision and at lagoon beaches. Surfing is allowed at one break in Saint-Leu where a water patrol is present. At

[45] Seidler, K. (2019, December 2). Electromagnetic shark curtain being installed at the Busselton Jetty. *Busselton-Dunsborough Mail*. https://www.busseltonmail.com.au/story/6530419/electromagnetic-shark-curtain-being-installed-at-the-busselton-jetty
[46] Centre Sécurité Requin. (n.d.). https://www.securite-requin.re/
[47] Pinel, R., Denayer, D. & Bambridge, T. (2023). *Living with the Sharks: A Multi-Methods Study Analyzing Human-Wildlife Conflicts as a Step Towards Coexistence (Réunion)*. Hum Ecol 51, 1085–1111 (2023). https://doi.org/10.1007/s10745-023-00461-6
[48] La Reunion. (2024). *The most beautiful beaches of reunion island*. https://en.reunion.fr/discover/the-most-beautiful-beaches-of-reunion-island/

this location, to be granted access to the water, surfers must follow strict protective measures, including registering their activities with the patrol and wearing personal protective devices. Shark barriers have been set up at three beaches, with two of them being the smaller barriers currently under trial. Each morning, after inspecting the barriers, the SSC decides if bathing is allowed for that day. The Preventative Fishing Program targets areas at risk of shark bites outside lagoons and reef flats using SMART Drumlines and horizontal bottom longlines. Captured Bull and Tiger sharks are euthanised, while non-target species (including White sharks) are released immediately. There is also significant beach signage across the island warning water users of the danger of sharks.

- **Trials:** Shark barriers were initially tested in 2015 but abandoned in 2017 due to reliability and cost issues. Two smaller, easily removable barriers are currently under trial at tourist sites, boosting economic activity with plans to expand to other areas on the island. The Water Patrol, operational since 2021 at Saint-Leu surf spots, uses jet skis and a patrol boat for visual surveillance and emergency response, costing around €700,000 annually. Meanwhile, the Shark Lookout Program, active at one of seven surf spots, combines swimmer lookouts with technology for enhanced monitoring, communication, and quick evacuation when sharks are spotted.
- **Research:** Research has been a major priority for the SSC. Historically, the SSC has led technological advancements, one notable achievement being the development of the SMART Drumline, which is currently in use in NSW, trialled in WA and undergoing trials in Queensland. Present investigations are aimed at innovative methods for shark detection, evaluation of personal protective gear, and conducting social studies. These include the Personal Protective Equipment Project, launched in 2017, which focuses on testing shark repellents and studying the effects of electric fields on sharks' sensory systems.[49] Additionally, various shark detection technologies, such as Baited Remote Underwater Video Stations (BRUVS), sonar systems, and autonomous cameras, have been tested in Réunion Island waters to monitor shark activity. The GENERISK research initiative explores historical and social factors influencing shark risk management on the island to enhance future environmental and risk management policies.[50]
- **Education:** The SSC introduced the Dorsal Réunion mobile app for reporting and tracking shark sightings along Reunion's coast. It covers the entire coastline, especially near water sports areas. Information is instantly uploaded onto the website and to users of the app. The SSC also informs the public about shark risks through media and social networks.

Similarities to the Queensland SCP

The Queensland SCP and Shark Management Program both have a focus on research, including understanding shark behaviours and detection, personal equipment evaluations, and the social views around shark mitigation strategies. A major difference between the two programs is the ocean conditions. Queensland SCP is deployed at ocean beaches or calmer embayment where as at Reunion Island equipment is deployed at a coral reef area directly influenced by the open ocean.

Both programs trial equipment and methods which are tailored to their unique conditions. Both programs also euthanise target sharks caught on their equipment. Yet, the strategy of Reunion Island to prohibit water access beyond patrolled beaches and lagoons is distinct. This prohibition has impacted the tourism economy, causing surf schools to leave the island. Surf tourism is slowly recovering due to the introduction of water patrols, which allow surfing at one prominent break, requiring surfers to use personal protective devices.

[49] Gauthier, A. R., Chateauminois, E., Hoarau, M. G., Gadenne, J., Hoarau, E., Jaquemet, S., Whitmarsh, S. K., & Huveneers, C. (2020). *Variable response to electric shark deterrents in Bull sharks, Carcharhinus leucas.* Scientific Reports, 10(1), 1-13. https://doi.org/10.1038/s41598-020-74799-y

[50] Pinel, R., Denayer, D. & Bambridge, T. (2023). *Living with the Sharks: A Multi-Methods Study Analyzing Human-Wildlife Conflicts as a Step Towards Coexistence (Réunion).* Hum Ecol 51, 1085–1111 (2023). https://doi.org/10.1007/s10745-023-00461-6

3.2.6 California Shark Beach Safety Program

The State of California provided funding to support White shark research and education. This funding focused on shark environmental studies, economic impacts of shark bites and school student education.

In 2018, The State of California provided USD$3.75 million over five years to the California State University, Long Beach (CSULB).[51] The purpose of the investment was to conduct scientific research on the growing White shark population off the coast of California to increase knowledge, improve public understanding and reduce public safety risks. Table 3-6 highlights the program's key components.

Table 3-6: Summary of the California Shark Beach Safety Program

Operations	Trials	Research	Education
The program does not conduct operations	The program has not conducted trials	✓ Shark environment studies ✓ Shark Tagging and Tracking ✓ Economic impact of shark bites ✓ Public perception research	✓ Lifeguard training ✓ Educational programs ✓ Shark Shacks

- **Research:** Over 13 years, CSULB has conducted an electronic tagging study and published several academic papers including the general ecology/biology of White sharks. Research in the last five years has focused on juvenile sharks and mitigating/understanding interactions with humans. This has included research on public perceptions of sharks and studying the economic consequences of shark bites by analysing detailed tourism data.
- **Education:** The Program has both a lifeguard and school-based education program. The lifeguard training covers marine life identification, shark behaviour, and strategies to reduce human-shark interactions. Meanwhile, the school-based program delivers kindergarten to year 12)STEM-focused shark safety lessons that introduce students to shark safety concepts. Other public outreach includes the Shark Shack, which is a travelling educational marque along California's beaches, educating beach users on White sharks.[52]

Similarities to the Queensland SCP

The Queensland SCP and California Shark Beach Safety Program have several aspects in common. They both engage in Shark Tagging and Tracking, evaluation of the economic consequences of shark bites, and carrying out environmental research. Additionally, these programs emphasise public safety by utilising lifeguards and educating students in schools. However, the Californian program does not operate any shark control equipment.

[51] California State University, Long Beach. (n.d.*). CA shark beach safety program*. Retrieved from https://www.csulb.edu/shark-lab/ca-shark-beach-safety-program
[52] California State University, Long Beach. (n.d.). *Shark Shacks*. Retrieved from https://www.csulb.edu/shark-lab/ca-shark-beach-safety-program

3.3 Alignment with government legislation and agency priorities

This section details how well the SCP aligns with government and agency priorities.

Alignment with government legislation

The Legislation section of this report covers all the Acts which influence the SCP's objectives and operations. The table below summarises the SCP's alignment to this legislation.

Table 3-7: Alignment of SCP with government legislation

Legislation	Description	Assessment of Alignment
***EPBC Act 1999* (Cth)**	White sharks are listed as vulnerable under the Act and the focus of a statutory Recovery Plan.	The SCP currently operates a lethal fishing program targeting White sharks. The Queensland SCP operates under an exemption and is not subject to review under the EPBC Act. Refer to section 1.5.1 **The SCP does not align.**
Great Barrier Reef Marine Park	*See below GBRMP Act*	
***GBRMP Act 1975* (Cth)**	The SCP holds a permit allowing it to carry out activities in the GBRMP. The SCP's initiatives within the GBRMP are designed to be consistent with the objectives outlined in the GBRMPA's governing legislation.	The SCP does not operate a lethal program within the GBRMP, and conducts research and trials in accordance with the permit. There are still opportunities to improve the requirement to reduce the lethal take of sharks to the greatest extent possible. **The SCP aligns.**
***Fisheries Act 1994* (Qld)**	The SCP was established as part of the objectives under the Act, with its operations aimed at protecting swimmers from potential shark incidents. The SCP's initiatives align with the intent of the Act.	The SCP's primary purpose is to protect bathers in Queensland waters from shark interactions. **The SCP aligns.**
***Marine Parks Act 2004* (Qld)**	The SCP operates in alignment with the Act by removing animals that threaten human safety from Queensland marine parks.	The SCP has a permit to take target species in Queensland Marine Parks. The MBMP and GSMP permits require the Program to be non-lethal by November 2025. **The SCP aligns.**[53]

[53] The program will not align if lethal operations continue beyond November 2025.

Alignment with Queensland Government Policy

Program alignment with policy considers how the Program is contributing to the broader strategic goals and priorities set by the Queensland Government. Evaluating this alignment helps assess the Program's relevance, ensuring it addresses the identified needs and policy objectives. Additionally, alignment is used to understand the most suitable locations of the Program within the Queensland Government.

The alignment of the SCP to Queensland Government Policy and relevant Departmental policy is detailed below. The SCP relates to matters of the environment, tourism and beach activity in addition to DAF's departmental focus. The alignment of the SCP has been considered against the Queensland Government departments relevant to these areas. These include:

- DAF, which provides funding and oversees the SCP's management
- DESI, which supports marine animal research
- DTS, which focuses on the tourism effects of shark incidents
- SLSQ, which aids in beachside education and testing new technologies.

Stakeholders identified that the SCP assists the Queensland Government in achieving its aims by improving human safety. The SCP partially delivers the aim of "Great Lifestyle" through enhancing beach safety, however it contradicts the aspect of environmental conservation. The lethal measures carried out by the SCP outside the GBRMP do not align with commitments to environmental protection and ecotourism.

Additionally, the SCP's primary goal to reduce humans' shark interactions is not in line with any objectives detailed in DAF's Strategic Plan, signalling a possible misalignment with DAF's wider goals. The table below outlines how the SCP aligns with various departments and agencies of the Queensland Government.

Table 3-8: Summary of SCP alignment to Queensland Government policy

Policy	Description	Assessment of Alignment
Queensland Government objectives	The objectives of the Queensland Government are to provide "Good Jobs, Better Services, and a Great Lifestyle". Improving services encompasses safeguarding public safety, while a Great Lifestyle includes environmental conservation and improvement. [54]	✓ The SCP supports these objectives by promoting safety and future education in Queensland. ✓ Its non-lethal operations in the GBRMP preserve the marine ecosystem and national heritage. ! The SCP's lethal operations outside the GBRMP are inconsistent with environmental conservation.
DAF Strategic Plan 2023-2027	DAF aims for a thriving, resilient Queensland at the forefront of ensuring global food security and sustainability. [55]	✓ There is strong alignment of the SCP in the delivery of DAF's purpose of protecting Queensland's economy, environment, and way of life. ✓ The SCP's work with partner and stakeholder groups is aligned to the objective of being collaborative and capable to deliver on the best interests of Queensland. ✓ The SCP's work with researchers and the community supports DAF's goal of cultivating great relationships and partnerships that advance Queensland's economy, environmental health, and lifestyle.

[54] The State of Queensland. (2023). *Our Priorities*. https://www.qld.gov.au/about/how-government-works/objectives-for-the-community
[55] Queensland Government. (n.d.). *Strategic Plan 2023-2027.* Department of Agriculture and Fisheries. https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/67884371-8acc-4c66-986f-1899f54e6c1a/daf-strategic-plan-2023-27_final.pdf

Policy	Description	Assessment of Alignment
		✓ Its testing of innovative technologies reflects DAF's goal to boost productivity through new tech, AI, and automation. ! DAF's sustainability goals might influence future SCP activities because of the bycatch generated by operations.
DESI Strategic Plan 2023–2027	DESI aims to lead and collaborate in the preservation, restoration, and promotion of Queensland's natural surroundings, cultural heritage, and diversity.[56]	✓ The SCP supports further marine animal research, aligning with DESI's objectives. ✗ Bycatch from SCP activities conflicts with DESI's commitment to conserving and restoring Queensland's biodiversity and protected areas. ! DESI's objective to establish an exemplary environmental, heritage, and biodiscovery regulatory framework may affect future SCP activities.
DTS Strategic Plan 2023-2027	The objective of DTS is to attract and facilitate investment that enhances the competitiveness of tourism and to foster communities that are engaged in sport and healthy lifestyles.[57]	✓ DTS aligns to the SCP's objective to reduce shark interactions with humans, preventing a prolonged decrease in tourism and hindering participation in sports and active pastimes. ✓ DTS supports the SharkSmart educational initiative, trials and shark research. ✗ The lethal component of the SCP does not align with DTS' aim to establish Queensland as a premier ecotourism destination by advancing the adventure, nature-based, and ecotourism industries.
SLSQ Strategic Plan 2024-2027	The objective of SLSQ is to deliver services through prevention and education to achieve zero deaths in Queensland's beaches. The SCP shares SLSQ's commitment to attributes such as safety, community, trust, and innovation.[58]	✓ SLSQ endorses the SharkSmart initiative, which provides the community with information about sharks and swimming safety. ✓ SLSQ backs SCP's efforts in reducing shark-human incidents, reflecting their emphasis on safety and responsibility. ✓ SLSQ supports the innovative SCP drone trial to advance technology usage in their operations.

[56] Queensland Government. (n.d.). *Strategic Plan 2023-2027*. Department of Environment and Science. https://www.des.qld.gov.au/__data/assets/pdf_file/0028/315685/des-strategic-plan-2023-27.pdf
[57] Queensland Government. (n.d.). *Strategic Plan 2023-2027*. Department of Tourism and Sport. https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/487a85c7-ccfb-48cd-861a-4b1b6574747b/dts-strategic-plan-2023-2027.pdf?ETag=cb7fbaf12687dc5898e5dee7a9389113
[58] Surf Life Saving Queensland.(n.d.). *Strategic Plan 2024-2027*. https://lifesaving.com.au/app/uploads/SLSQ-StrategicPlan-2024-2027-V3-1.pdf

3.4 Stakeholder sentiment on Program appropriateness

Evaluating the appropriateness of the Program requires examining it from multiple perspectives. Stakeholders provide a range of views, with some supporting certain elements of the Program while expressing criticism or lacking information on others. To capture this variety, opinions were gathered across all four pillars: Operations, Trials, Research, and Education, and these insights are summarised in the table below.

Stakeholders agree that the Program's research, trials, and education efforts are appropriate, recognising the value in expanding knowledge on shark behaviour, sharing safety information with the public, and testing more effective and environmentally sustainable technologies.

Stakeholders noted conflicting views regarding the Operational pillar, in particular the use of lethal methods, based on differing value systems. For instance, those who primarily value avoiding human injury or death, or ensuring the public image of local beaches were less critical of the SCP's operational approach, despite the non-lethal methods used elsewhere.

Table 3-9: Summary of stakeholder views on the appropriateness of Queensland's approach

Pillar	Stakeholder views	Stakeholder sentiment
Operations	**No definitive view**	Stakeholders provided a spectrum of views regarding the appropriateness of the SCP's operations. These were categorised into three perspectives: supportive, unsupportive, and uncertain. A segment of stakeholders considered the SCP's operations appropriate, aligning with the Program's mandate to protect human life and uphold tourism. Stakeholders mentioned that Mesh Nets and Traditional Drumlines give beachgoers an important sense of security. On the other hand, there are stakeholders who refrain from casting judgement on the SCP's appropriateness. This is due to a lack of detailed understanding of the Program's operations and effectiveness. This group's hesitation is echoed by local government stakeholders. They believe that the appropriateness of the Program differs by jurisdiction, contingent upon each region's specific industries and cultural values. Lastly, a group of stakeholders view the SCP's operations as inappropriate, advocating for a cessation of all lethal activities due to environmental concerns. Some further criticised the inconsistency in the SCP's application of lethal versus non-lethal strategies. They argue that the demarcation between the GBRMP and Queensland waters lead to arbitrary delivery of operations.
Trials	**Appropriate**	Stakeholders agree that trials of non-lethal shark mitigation equipment are appropriate and express optimism for their future implementation into operations. They note that trialling alternative technology at popular beaches enhances public trust in the safety of Queensland beaches and the Program's efforts to improve its ecosystem impacts.
Research	**Appropriate**	Stakeholders agree that shark research is an appropriate aspect of the SCP. They acknowledge that research is instrumental in growing an understanding on shark behaviour, alternative technologies and the specific environmental conditions of Queensland beaches.

Pillar	Stakeholder views	Stakeholder sentiment
Education	**Appropriate**	Stakeholders agree that education is a fundamental and appropriate aspect of the SCP. They recognise that, in certain areas, education initiatives are more suitable, as ramping up operations could necessitate an extended approval procedure. Additionally, there is consensus that the various communication channels used by SharkSmart to disseminate their messaging has been appropriately chosen.

DAF is aware of the conflicting views of stakeholders on the appropriateness of the SCP's operations. At present, DAF is undertaking social research to gauge public awareness of the Program's operations. Part of the research objective is to ascertain the public's perception of the Program's appropriateness, both prior to and after receiving education on the SCP's procedures. The findings from this research are anticipated to inform future decision-making relating to the choice of shark mitigation equipment utilised.

3.5 Changed conditions

This section explores the evolving context of the Program, detailing the extent of changes in economic, environmental, regulatory, and social conditions since the Plan's implementation in 2021.

From 2021 to 2024, several key contextual changes have unfolded. Notable among these is coastal population growth, an increase in holiday visitations, and a rise in the number of people engaging in beach-based activities. Broader environmental and ecological trends have also emerged, including the recovery of certain marine animal populations, the occurrence of a Triple La Niña rainfall event, continued coastal industrialisation and increased shark activity. At the same time, advancements in shark control-related technologies are noted, alongside tightening economic conditions, shifting social attitudes, and an evolving legislative landscape. Collectively, these factors shape the context in which the SCP operates, influencing the ongoing relevance and appropriateness of the Program.

Influx of migration to Queensland's coastline

Queensland's population growth has been outpacing that of other Australian states, primarily driven by net interstate migration.

- From December 2020 to December 2023, Queensland's population grew by approximately 6.6 percent, compared with 5.2 percent and 4.2 percent for Victoria and NSW.[59]
- Coastal regions in the state have become some of the most popular destinations for movers nation-wide, observing significant population increases. Between June 2020 and June 2023, the Gold Coast grew by 6.4 percent to 666,087 residents, the Sunshine Coast by 8.1 percent to 365,942 residents, and Cairns by 4 percent to 175,398 residents.[60]
- For six consecutive quarters leading up to March 2024, the Sunshine Coast has been Australia's most popular domestic migration location, accounting for 16 percent of all net internal migration, followed by the Gold Coast in second place at 9.1 percent.[61] This indicates that between 2023 and 2024, approximately one in four people who migrated within Australia relocated to either of Queensland's two most popular coastal destinations.

[59] Australian Bureau of Statistics. (2024). *National, state and territory population.* https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/latest-release.
[60] Australian Bureau of Statistics. (2024). *Regional population*. https://www.abs.gov.au/statistics/people/population/regional-population/2022-23
[61] Regional Australia Institute. (2024). *Regional Movers Index*. https://regionalaustralia.org.au/Web/Web/Toolkits-Indexes/Regional-Movers-Index.aspx

Post-pandemic increase in tourism

Stakeholders have reported record tourism activity across Queensland's coastal destinations since the lifting of COVID-19 restrictions in 2021.

- This is evidenced by a surge in visitation numbers, with Queensland welcoming 26.97 million visitors in 2023 – a 31.3 percent increase on the 20.53 million who visited in 2021, although still slightly below the pre-pandemic peak of 28.7 million in 2019.[62]
- The Gold Coast, Sunshine Coast and Tropical North Queensland recorded 4.76 million, 4.5 million and 1.92 million visitors in 2023, respectively – up 46.46 percent, 47.85 percent and 6.14 percent from the COVID-19 lows of 2021.[63] This marks a record high for the Sunshine Coast, but a slight decline compared to 2019 levels for the Gold Coast and Tropical North Queensland region.
- As of March 2024, Queensland's share of the domestic holiday market is 0.6 percent higher than in 2019, with annual holiday spending of $34.1 billion, capturing 27.3 percent of total domestic holiday visitor expenditure, making it the second-largest market for holiday spending in Australia.[64]

Record high levels of beach use

Stakeholders widely agree that beach activity has increased since 2021, with many reporting record levels of visitations at various locations, including along the Gold Coast and Sunshine Coast.

- The number of beach visitations state-wide was 21 percent higher in 2022–2023 (20,798,125 visitations) than in 2019–2020 (17,103,926), and 11 percent higher than in 2020–2021 (18,728,013).[65]

Record high levels of participation in high-risk water activities

Stakeholders have observed an increase in the number of individuals participating in high-risk water sports.

- Since 2019, an estimated 196,000 Australians over the age of 15 have taken up surfing, exceeding the rate of population growth and the majority of which are women.[66] On the Gold Coast, surfing participation has more than doubled at certain breaks since 2019.[67]
- In 2022–2023, state-wide beach visitation data recorded a 10 percent increase in individuals participating in beach-based activities outside the flags compared with 2019–2020 and 2021–2021, reaching a total of 1.91 million participants.
- Stakeholders believe advancements in water sports technology, such as stand-up paddleboarding and hydro-foiling, have been key in attracting new water enthusiasts to Queensland's beaches. The SharkSmart Campaign survey reveals an increase in high-risk and moderate-risk profiles, rising from 28 percent to 29 percent and 46 percent to 56 percent respectively, between 2022 and 2024.[68] The high-risk profile includes activities, such as surfing, scuba diving, and spearfishing, where the likelihood of encountering dangerous marine life is greater. The medium-risk profile primarily refers to swimming,

[62] Tourism & Events Queensland. (2024). *Queensland Total Visitation: Tourism Data Explorer.* https://teq.queensland.com/au/en/industry/research-and-insights/tourism-data-explorer/total-visitation-tourism-data-explorer
[63] Ibid.
[64] Queensland Government. (2024). *International tourism expenditure rebounds beyond pre-pandemic levels in Queensland.* https://statements.qld.gov.au/statements/100687#:~:text=While%20Queensland%27s%20domestic%20holiday%20market,strong%20headwinds%20that%20have%20been
[65] Surf Life Saving Queensland Beach Activity Data 2019 – 2024
[66] Australian Sports Commission. (2022). *Surfing rides a wave of popularity during pandemic.* https://www.sportaus.gov.au/media-centre/news/surfing-rides-a-wave-of-popularity-during-pandemic
[67] McElroy, N. & Young, B. (2023). *Surfer numbers double at some Gold Coast breaks in five years as council looks to manage the wave.* ABC News. https://www.abc.net.au/news/2023-01-22/surfer-numbers-have-doubled-at-some-gold-coast-breaks-crowds/101875872
[68] Government of Western Australia. SharkSmart. (n.d.). *Staying Safe.* https://www.SharkSmart.com.au/staying-safe/

contrasting with the low-risk profile which encompasses safer activities like fishing and stand-up paddleboarding.

Environmental change

Stakeholders believe that changes in weather and ocean conditions over the Plan period have had some impact on the Program's operations.

- Stakeholders point to long-term climate change trends, including rising water temperatures, sea levels, and ocean acidity, as having some impact on the Program given the potential for these factors to alter marine animal migratory patterns and ecosystem health. However, the extent to which these factors have changed between 2021 and 2024 remains unclear.
- Stakeholders noted an increase in the frequency of extreme rainfall events over the period of the Plan, marked by the rare occurrence of three consecutive La Niña events, referred to as a "Triple La Niña". This period was characterised by heightened and prolonged rainfall, more intense tropical cyclones – such as the category 5 Cyclone Niran off the coast of Queensland – and increased flooding, as seen in the 2022 Brisbane Floods. These conditions contribute to murkier waters, higher-than-average water temperatures and alter the distribution and abundance of organisms, all of which are believed to influence marine animal behaviour and ecosystem health.[69]
- Stakeholders believe that the ongoing industrialisation of Queensland's coastline has increased the overlap between human activity and the marine environment, leading to more waste and debris entering the oceans, potentially attracting marine animals closer to the coastline and increasing anthropogenic mortality.[70]

Increased shark sightings

A range of stakeholders have observed a rise in shark activity over the Plan period.

- Program stakeholders have reported higher levels of Tiger shark and Bull shark sightings, noting that Tiger sharks have been increasingly caught on control equipment during the summer months — an unusual pattern compared to historical activity. This observation is supported by recent Program catch data, which indicates an increase in the average annual catch of target sharks to 438 sharks during the Plan period, compared to an average of 350 sharks per year over the preceding 20 years.
- The increase in stakeholder shark sightings coincides with several events. For instance, increases in the frequency of extreme rainfall events were also observed over the Plan period, which stakeholders believe might have created conditions conducive to increased shark activity in affected areas, such as warmer water, greater runoff and altered distribution of prey species.[71] Heightened shark observations also coincide with the implementation of the 1.5-metre catch rule and possession limit of one shark for recreational fishers in 2021, increased industrialisation of the coastline, and recovery patterns seen in marine animals such as whales, among other factors.

[69] Lagabrielle, E., Allibert, A., Kiszka, J. J., Loiseau, N., Kilfoil, J. P., & Lemahieu, A. (2018). Environmental and anthropogenic factors affecting the increasing occurrence of shark-human interactions around a fast-developing Indian Ocean island. Scientific Reports, 8(1), 1-13. https://doi.org/10.1038/s41598-018-21553-0

[70] Pawar, P.R., Shirgaonkar, S.S. & Patil, R.B. (2016). Plastic-marine-debris-Sources-distribution-and-impacts-on-coastal-and-ocean-biodiversity. PENCIL Publication of Biological Sciences Vol. 3(1):40-54. https://www.researchgate.net/publication/295919494_Plastic_marine_debris_Sources_distribution_and_impacts_on_coastal_and_ocean_biodiversity

[71] Lagabrielle, E., Allibert, A., Kiszka, J. J., Loiseau, N., Kilfoil, J. P., & Lemahieu, A. (2018). Environmental and anthropogenic factors affecting the increasing occurrence of shark-human interactions around a fast-developing Indian Ocean island. Scientific Reports, 8(1), 1-13. https://doi.org/10.1038/s41598-018-21553-0

Payne, N. L., Meyer, C. G., Smith, J. A., Houghton, J. D. R., Barnett, A., Holmes, B. J., Nakamura, I., Papastamatiou, Y. P., Royer, M. A., Coffey, D. M., Anderson, J. M., Hutchinson, M. R., Sato, K., & Halsey, L. G. (2018). Combining abundance and performance data reveals how temperature regulates coastal occurrences and activity of a roaming apex predator. Global change biology, 24(5), 1884–1893. https://doi.org/10.1111/gcb.14088

- Reports of shark depredation have increased, prompting a research initiative to investigate the problem. Interim findings have identified Bull sharks as one of the species responsible.

Challenging economic conditions

Stakeholders have reported that rising costs during the Plan period have strained the Program's budgeting and resource allocation.

- Inflation in Australia has increased prices for essential inputs like diesel and bait, necessary for operations.
- Stakeholders note that the price of nets have increased while the price of hook timers used in Catch-Alert Drumline Trials have also risen due to supply shortages.
- Australia's tightening labour market over the Plan period, with low unemployment, has further driven up subcontractor costs.
- These conditions have been exacerbated by an increased demand for resources needed to respond to the outcomes of the 2019 Administrative Appeals Tribunal decision, including contractor hours and operational inputs to service alternative equipment within the GBRMP.

Evolving legislative landscape

Legislative developments have influenced the SCP in recent years. The revision of the SCP's permit within the GBRMP has changed its operations. Concurrently, additional changes in the legislation have simplified, or are anticipated to simplify, research and trials. A summary of past and expected legislative changes are set out below:

- The SCP's operating permit in the GBRMP was revised in 2019, imposing new conditions, including non-lethal measures within the marine park, trials for innovative gear, and additional research initiatives.
- Civil Aviation Safety Authority (CASA) is in the process of revising the *Civil Aviation Safety Regulations 1998* (Cth). The updates will affect training protocols, certification processes, and regulations for the use of remotely piloted aircraft by operators. These modifications may influence how and where drones are utilised along the beaches of Queensland in the future.
- Amendments to the *Veterinary Surgeons Act 1936* (Qld) permitted individuals who are not veterinarians to perform surgical procedures to implant tracking devices in sharks.
- The EPBC Act is currently being reformed by the Commonwealth Government to address various challenges in environmental conservation and management. Draft legislation is expected to be tabled in 2024-25, which will outline the implication of this reform on the SCP.

Shifting social attitudes

Social attitudes toward the Program are believed to have shifted throughout the Plan period, coinciding with a new era of transparency in its operations.

- Stakeholders have noted a shift in the public's perception of the SCP, particularly among younger generations who they believe increasingly prioritise conservation and, as a result, are advocating for changes to the Program's Operations to reduce its impact on marine life. Studies demonstrate that Generation Z and Millennials are more sustainability orientated compared with earlier generations.[72]

[72] Yamane, T., & Kaneko, S. (2021). Is the younger generation a driving force toward achieving the sustainable development goals? Survey experiments. Journal of Cleaner Production, 292, 125932. https://doi.org/10.1016/j.jclepro.2021.125932

- Despite stakeholders' observed change in conservationist attitudes toward the Program, the SharkSmart Campaign survey found that public support for the SCP increased from 58 percent in 2019 to 65 percent in 2024, with support for Mesh Nets also rising from 51 percent to 57 percent. Support for Traditional Drumlines also increased from 39 percent to 42 percent. However, non-lethal methods remain more popular, with Catch-Alert Drumlines receiving 59 percent support, aerial surveillance drones rising to 87 percent, and personal electric shark deterrents growing from 54 percent to 62 percent.
- Stakeholders identified that some conservationist groups have become increasingly vocal in expressing their dissatisfaction with the Program. This has coincided with improvements in consumer technology such as camera equipped drones, and adoption of media platforms (e.g. TikTok), which have empowered conservationist groups to monitor SCP operations and distribute content to a wide online audience, thereby increasing visibility and awareness of its day-to-day activities.

Technological advancements

Technologies related to shark risk mitigation have advanced over the Plan period, improving both their affordability and potential applicability to the Program.

- Stakeholders have observed steady improvements in drone technology, including extended battery life, increased signal range, quieter propeller systems, and more advanced cameras capable of detecting animal life in the ocean – improving their scope for use in shark surveillance activities.
- Artificial Intelligence (AI) technology has advanced considerably. While the potential of AI in shark control is yet to be fully realised, as the technology is still in its nascent stages, it has already been utilised to enhance real-time detection and monitoring systems, predict animal movements using environmental data, and optimise detection strategies. For instance, California's SharkEye initiative has integrated AI software into surveillance drones to improve the real-time identification of shark activity.[73]
- Advancements in fishing technology have led to the development of smart fishing equipment that integrates GPS, sonar, AI, and mapping technology to increase the effectiveness of fishing operations and precisely track metrics (e.g. number of casts, catches and environmental conditions) for enhanced data analysis and decision-making.[74]
- Personal deterrents have gained popularity following WA's rebate program in 2017 and new evidence confirming the efficacy of electric-field-generating devices.[75] However, other methods, such as magnetic devices and scented waxes, have not demonstrated reliable shark repellent capabilities to date.

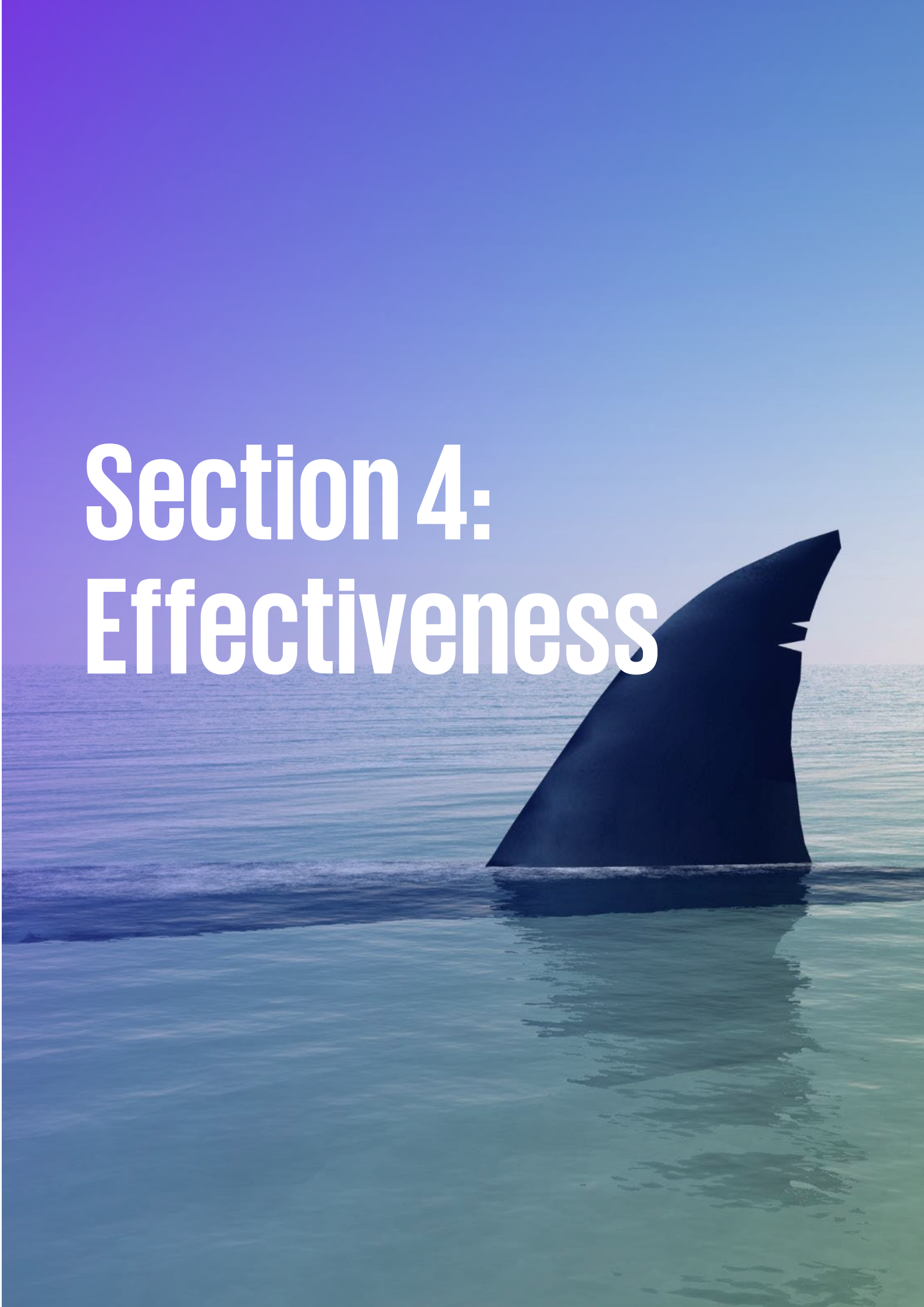
Poortinga, W., Demski, C., & Steentjes, K. (2023). Generational differences in climate-related beliefs, risk perceptions and emotions in the UK. Communications Earth & Environment, 4(1), 1-8. https://doi.org/10.1038/s43247-023-00870-x
Martin, C. L., Curley, B., Wolfenden, K., Green, M., & Moltschaniwskyj, N. A. (2022). The social dimension to the New South Wales Shark Management Strategy, 2015–2020, Australia: Lessons learned. Marine Policy, 141, 105079. https://doi.org/10.1016/j.marpol.2022.105079

[73] Watanuki, S. (2024). *California Beaches Are Using AI to Protect Swimmers From Sharks*. https://www.pastchronicle.com/fast_gallery/california-beaches-are-using-ai-to-protect-swimmers-from-sharks/

[74] Rowan, N. J. (2023). The role of digital technologies in supporting and improving fishery and aquaculture across the supply chain – Quo Vadis? Aquaculture and Fisheries, 8(4), 365-374. https://doi.org/10.1016/j.aaf.2022.06.003

[75] Clarke, T. M., Barnett, A., Fitzpatrick, R., Ryan, L. A., Hart, N. S., Gauthier, A. R., B., T., & Huveneers, C. (2024). Personal electric deterrents can reduce shark bites from the three species responsible for the most fatal interactions. Scientific Reports, 14(1), 1-12. https://doi.org/10.1038/s41598-024-66679-6; Huveneers, C., Whitmarsh, S., Thiele, M., Meyer, L., Fox, A. and Bradshaw, C.J., 2018. Effectiveness of five personal shark-bite deterrents for surfers. PeerJ, 6, p.e5554.

Section 4: Effectiveness



4 Effectiveness Assessment

This chapter details the extent to which the SCP achieved, or is expected to achieve, its intended outcomes. To assess the effectiveness of the SCP, the following domains are considered, which are detailed in the subsequent sections:

- **Program delivery of desired outcomes:** Measures the outcomes produced by the Program and determines their alignment with expectations.
- **Factors influencing the delivery of outcomes:** Identifies the variables that affected the Program's ability to achieve its intended outcomes and the degree of their influence.

Key findings related to effectiveness are detailed below.

Effectiveness – Key findings

4.1 Program effectiveness

Operations

The effectiveness of the Operations pillar is considered according to the extent to which it produced improved human safety compared with an absence of Operations and minimises adverse ecosystem effects.

Effectiveness to improve human safety is measured primarily by a reduction in the risk of human-shark interactions, for which the capture and removal or relocation of target species is used as a proxy.

Over the Plan period, Operations have been effective in delivering improved human safety through:

- Eliminating 1,500 target sharks and relocating 168 within the GBRMP. This outcome was driven by a 25.1 percent increase in the annual average catch of target sharks compared to the previous 20-year period.
- Between January 2021 and October 2024, Queensland recorded four shark bites along its coastline, with one bite occurring at a beach where SCP gear is deployed. This represents an average of 1.04 incidents per year, down from 3.35 per year over the previous 20 years.

The Operations pillar remained ineffective in improving ecosystem outcomes, with bycatch mortality increasing during the period:

- Operations resulted in the mortality of 1,200 non-target species, with the total average annual bycatch mortality increasing to 362 animals during the Plan period, compared to an average of 305 animals over the previous 20 years.

Trials

The Trial pillar's effectiveness is determined by the extent to which the trialled technologies improve human safety and ecosystem outcomes.

Six trial initiatives were proposed by DAF, however Alternative Gear (Circle-Hooks), Catch-Alert Drumlines, Advanced Aerial Detection and SharkSmart Drones were the only technologies physically trialled during the period.

- SharkSmart Drones led to 29 beach evacuations over the Plan period, effectively eliminating the risk of human-shark interactions during those times. It remains unclear whether Catch-Alert Drumlines maintain the same level of beach safety as traditional operations given the potential for released sharks to return to the beach post-capture. The application of both technologies is restricted when compared to traditional methods: drones only operate on weekends and holidays, with flights being vulnerable to weather cancellations, and neither technology is deployed at night or during higher risk periods such as dusk and dawn. Moreover, water turbidity can hinder drone visibility and prevent effective shark detection, however, the Advanced Aerial Detection trial is working to overcome this limitation through the use of AI and multi-spectral cameras.
- Catch-Alert Drumlines and drones were both effective in lowering adverse ecosystem effects, with improved catch survivability for Catch-Alert Drumlines (~80 percent) while drones do not interact with marine life unless they malfunction and fall into the marine environment.

- Circle-Hooks are still in the preliminary stages of trial and are yet to be assessed.

Research

The Research pillar's effectiveness is determined by the extent to which the output or potential output of each research initiative aligns with, or contributes to, outcomes of improved human safety, reduced adverse ecosystem effects or enhanced SharkSmart education. There were seven research initiatives delivered or in progress during the Plan period.

Ultimately, Research is found to be effective across all three outcome areas; however, it is noted that there are no research initiatives with a primary focus on understanding the Program’s impact on the ecosystem or in preventing shark bites. The Shark Tagging and Tracking initiative is identified as the only project that contributes to all three outcome areas.

Education

The Education pillar’s effectiveness is measured by the results of the Swimmer Safety (SharkSmart) Campaign Evaluation. The results from the most recent survey in 2024 show a plateau across SharkSmart awareness, attitudes and behaviours, along with a decline in the Affective Memory Potential (AMP) score. The AMP score reflects the measure of a marketing campaign’s novelty, emotional impact, and relevance to the audience.

4.2actors influencing the delivery of outcomes

There are a multitude of factors that influence the capacity of Operations to produce the Program’s desired outcomes, including a high level of political decision-making scrutiny, successful partnerships with various organisations and individuals, weather conditions, and regulatory and legislative requirements.

4.1 Program effectiveness

This chapter outlines the extent to which each of the Program's pillars have produced the intended outcomes in line with the Program's objectives. Each section outlines the initiatives delivered, the intended outcomes of each initiative, a review of their implementation, and an assessment of whether the outcomes were achieved.

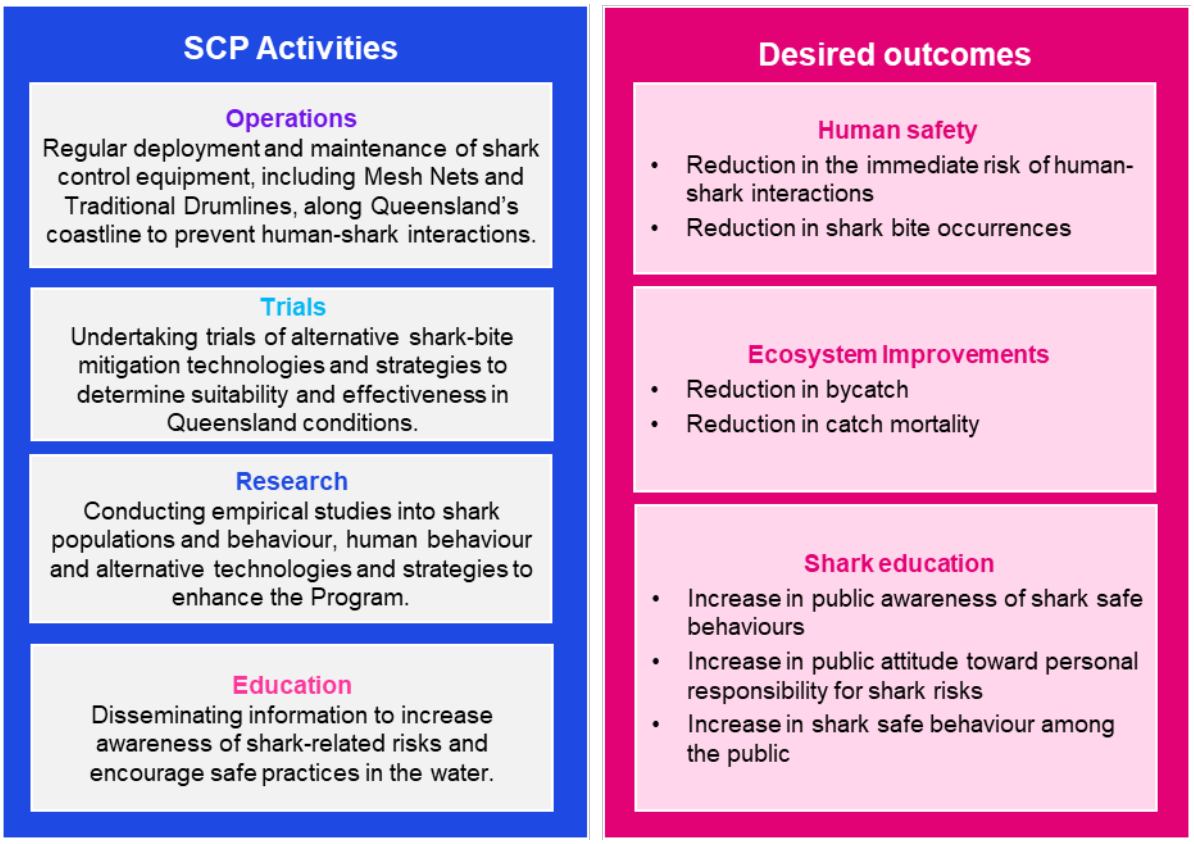


Figure 4.1: Overview of SCP pillars and the desired outcomes

4.1.1 Operations

SCP Operations include the deployment of Mesh Nets, Traditional Drumlines (baited hooks), or a combination of both, to capture sharks across 75 beaches and 10 regions along Queensland's east coast. This gear is used to catch sharks, with target species then euthanised as part of SCP protocol, unless caught within the GBRMP.

Mesh Nets are primarily deployed on the Gold Coast and Sunshine Coast. The Sunshine Coast and Townsville have the highest number of drumlines, with the Sunshine Coast covering the longest stretch of coastline. The equipment is deployed year-round and only Mesh Nets are removed during severe weather events. Typically, the equipment is serviced 3-4 days per week with maintenance checks conducted once every three weeks, unless serious deuteriation is detected earlier (e.g. build-up of green algae).

Table 4-1: Operations initiatives delivered in Queensland's Shark Management Plan (2021-2025)

Initiative	Description	Locations (No. of equipment)
Mesh Nets	Mesh Nets are typically 186 metres long and 6 metres deep. They are deployed parallel to the shore and anchored to the seabed, with floats maintaining them in a surface-set position. Mesh Nets do not create a complete barrier, allowing sharks and other marine life to swim around or under them, but function by entangling animals that come into contact with them. When a shark or other marine animal is caught in the net, it is typically found and dealt with during checks by SCP contractors, where target sharks are euthanised if not already dead, and non-target species are released if still alive. All nets are modified with three dolphin pingers and four whale pingers in an effort to reduce entanglement with these species.	• Gold Coast (11) • Sunshine Coast (11) • Rainbow Beach (3) • Mackay (2) Queensland total of 27
Traditional Drumlines	Traditional Drumlines are a fishing apparatus consisting of baited lines suspended from a float, anchored to the seabed. Mullet or shark flesh is typically used as bait. Once an animal takes the bait, it becomes hooked and is held in place by the drumline until SCP contractors conduct their checks. Drumlines are positioned offshore, usually in a line parallel to the beach, in areas where swimmers and surfers are most likely to be present (i.e. patronaged beaches). Unlike shark nets, which passively entangle animals, drumlines actively target sharks that are attracted to the bait. This means that drumlines are more selective, as they primarily catch sharks that are actively feeding, rather than simply swimming by. Drumlines in North Stradbroke Island have a single whale pinger.	• Gold Coast (35) • North Stradbroke (35) • Sunshine Coast (78) • Rainbow Beach (12) • Bundaberg (20) • Tannum Sands (12) • Capricorn Coast (32) • Mackay (27) • Townsville (54) • Cairns (16) Queensland total of 321
Marine Animal Release Team	The Marine Animal Release Team (MART), with assistance from Sea World, conducts rescue operations to release marine animals caught in shark control equipment, including on Mesh Nets and drumlines. The team also responds to whale entanglements caused by other hazards, such as fishing aggregating devices.	• State-wide

Initiative	Description	Locations (No. of equipment)
	DAF typically receives reports from the public or other stakeholders regarding potential marine animal entanglements. Once notified and confirmed, DAF promptly deploys MART to carry out a release operation to free the entangled animal. MART primarily consists of DAF and Queensland Boating and Fisheries Patrol staff members who volunteer to be a part of the team. MART operations are conducted as part of their work duties. DAF works alongside national programs (including in the Northern Hemisphere) to ensure MART follows best practice and has the highest training standards.	

Target shark species list revision

The Program initially identified 19 shark species that operations sought to capture and euthanise. However, in January 2023, this list was reduced to seven to focus on the most dangerous species. The current target shark species include:

- Bull Shark (*Carcharhinus leucas*)
- White Shark (*Carcharodon carcharias*)
- Tiger Shark (*Galeocerdo cuvier*)
- Australian Blacktip (*Carcharhinus tilstoni*)
- Common Blacktip Whaler (*Carcharhinus limbatus*)
- Dusky Whaler (*Carcharhinus obscurus*)
- Grey Reef Whaler (*Carcharhinus amblyrhynchos*).

Among this list, the Bull shark, Tiger shark, and White shark are of greatest concern, accounting for over half of all recorded shark bites in Queensland where the species was identifiable.[76] In cases where the species was not identifiable or only identified by genus (e.g. whaler sharks), stakeholders believe these three species comprise a significant proportion.[77] For these reasons, analysis of Operations and trials details these three species separately, while grouping the remaining four (Australian blacktip, common blacktip, dusky whaler, and grey reef whaler) as "other target sharks".

Effectiveness of implementation

The effectiveness of implementing the SCP Operations includes the proficiency of management in executing the Program, including the deployment and servicing of equipment by contractors.

The effectiveness of the implementation of Operations is summarised in the table below.

Table 4-2: Effectiveness of implementation for operations

Operations	Effectiveness of implementation
Maintaining and positioning SCP equipment – nets and drumlines	✓ Drumlines and nets receive maintenance or replacement at least once every 21 days, ensuring the equipment remains effective. ✓ Experience of contractors and local knowledge of seaways enhances operational safety and enables delivery of Operations in adverse conditions. ✓ Contractors use suitable bait for drumlines, adapting to shark bait when non-target species are nearby to reduce unwanted catches and increase operational effectiveness.

[76] Taronga Conservation Society Australia. (n.d.). *Australian Shark Incident Database*. https://taronga.org.au/conservation-and-science/australian-shark-incident-database
[77] Blount, C., & Macbeth, W. (2020). *Selectivity of nets and drumlines used in the Queensland Shark Control Program* (FQ19025 B). Prepared for the Queensland Department of Agriculture and Fisheries. Cardno Pty Ltd. https://qfish.fisheries.qld.gov.au/

Operations	Effectiveness of implementation
	✗ SCP equipment is not maintained daily, which may lead to the drumlines becoming ineffective until the next service (i.e. if there is no bait, a shark will not be caught). ✗ The majority of the equipment has stayed in largely unchanged, arbitrary positions since it was first installed, mostly before the year 2000.
Procuring and managing contractors	✓ The procurement process ensures that SCP equipment is serviced by capable contractors. ✓ Record keeping protocols were followed, including taking photos for species validation, recording catch details and reporting equipment damage.
MART	✓ Operations were successfully conducted, with every whale caught in SCP equipment during the Plan period released alive and no staff members sustaining injuries, despite a record number of whale distress calls.

Source: Stakeholder interviews and the Shark Control Program website.

Operational changes during SCP delivery impacting analysis

Between 2001 and 2024, several operational changes were made to the delivery of the SCP which affect the interpretation and analysis of the Program's catch data. **These Program changes should be considered when interpreting the data analysis in this section.**

These include:

- **Number of Traditional Drumlines**: The quantity of Traditional Drumlines reduced during the Plan period (from 383 in January 2021 to 321 in March 2024), lowering the overall catch capacity of traditional drumline operations.

  These changes include:

  - In the Capricorn Coast, in September 2021, 22 Traditional Drumlines were replaced with Catch-Alert Drumlines (11) and MTDs (11)
  - In Cairns, in February 2024, 22 Traditional Drumlines were replaced with Catch-Alert Drumlines (11) and MTDs (11)
  - In Mackay, in February 2024, 18 Traditional Drumlines were replaced with Catch-Alert Drumlines (9) and MTDS (9).

- **Number of Mesh Nets**: The quantity of Mesh Nets has been reduced since 2001 and replaced with drumlines, lowering the overall catch capacity of mesh net operation. These changes include:
  - The removal of nets from Cairns beaches in 2013
  - The removal of nets from two Mackay beaches between 2015 and 2017.

- **Hook changes to Traditional Drumlines**: The replacement of J-hooks with Circle-Hooks to all operational drumlines (alternating half and half) as part of the Alternative Gear Trial, commenced in November 2023. These equipment modifications may alter the Program's catch results. Stakeholders expect Circle-Hooks to be better at catching Bull sharks and juvenile sharks compared with J-hooks.

- **Pingers**: During the delivery of the SCP, pinger technology has been applied to Mesh Nets and Traditional Drumlines in an effort to repel non-target species from the equipment. The effectiveness of these technologies is yet to be confirmed but they may affect the operation's catch results for certain marine animals. Modifications include:
  - Whale pingers: Whale pingers have been used on Mesh Nets across Queensland for over a decade, and they were added to drumlines at North Stradbroke Island during the Plan period.
  - Dolphine pingers: Dolphin pingers have been used on Mesh Nets across Queensland for over a decade.

Operational changes during SCP delivery impacting analysis

- **Contractor effort**: The number of times contractors service the equipment (i.e. replace bait, record and euthanise/relocate a captured marine animal caught on equipment) changed during the Plan period and by location. This change includes:
  - Within the GBRMP, in 2020, effort increased from 182 days per year to 260 days per year.

Improving human safety

Limitations in measuring the effectiveness of Operations to improve human safety

Assessing the effectiveness of Operations or any shark bite mitigation strategy on improving human safety is a challenging exercise given the uncertainty in quantifying and attributing any change in risk to the SCP.

- **Immediate risk of human-shark interactions:** Predicting when or if a shark will interact with a water user is virtually impossible until it happens. Although capturing and euthanising target sharks completely removes the risk of those specific animals ever interacting with humans, it is unknown whether they ever pose a real threat. Similarly, capturing and relocating target sharks removes the immediate risk of those specific animals interacting with humans. This uncertainty limits the ability to assess the operation's effectiveness in preventing injury or death.
- **Shark bites:** Quantifying the number of shark bites prevented by the SCP is challenging due to several factors: the infrequency and variance of bites, numerous confounding variables, and the lack of a reliable control group given that the Program has been in place since 1962 and Queensland's unique and changing environmental conditions.

The primary goal of the Operations pillar is to deliver improved human safety, which is evaluated by assessing the degree to which the Program has achieved the following two outcomes:

A reduction in the **immediate risk of human-shark interactions**

A reduction in **shark bite occurrences**

Stakeholder views on the effectiveness of Operations to reduce the immediate risk of human-shark interactions and shark bites vary. Most stakeholders agree that since its inception in 1962, the SCP has had some impact in mitigating these risks, particularly through reducing shark populations at SCP beaches. An initial decline in shark catch rates after the installation of nets supports this view.[78] However, stakeholders view the migratory nature of some sharks, coupled with gaps in coverage from nets and drumlines, as a limiting factor in the Program's ability to effectively improve human safety at SCP beaches. This concern is underscored by Queensland's most recent shark incident (April 2024, Bargara Beach, Bundaberg) and fatality (September 2020, Greenmount Beach, Coolangatta), both occurring at beaches where shark control equipment is deployed.

A reduction in the **immediate risk of human-shark interactions**

To measure a reduction in the immediate risk of human-shark interactions, the following measures are used in this evaluation:

- **Target species capture:** The number of target sharks captured and either euthanised or relocated serves as a proxy for a reduced risk of human-shark interactions compared to if there was no program in place.
- **Captured target species size**: An increase in the size of target sharks caught represents the removal of more dangerous sharks (i.e. sharks that pose a greater risk).

The above measures are detailed below.

[78] Dudley, S. (1996). A comparison of the shark control programs of New South Wales and Queensland (Australia) and KwaZulu-Natal (South Africa). Ocean & Coastal Management, 34(1), 1-27. https://doi.org/10.1016/S0964-5691(96)00061-0

Sharks considered in the assessment of human safety

This evaluation considers target sharks according to the most recent list of seven species introduced on 1 January 2023. The 12 species removed from the list, but which were captured and euthanised up to 2022, are not considered a threat to human safety for the purposes of this evaluation.

An increase in target species capture is observed

The capture and euthanasia of target sharks serve as a practical proxy for reduced human-shark interaction, based on the logic that removing a shark situated near water-users eliminates the potential risk of that shark interacting with humans.

During the Plan period, the SCP's Operations captured an average of 438 target sharks annually, a 25.1 percent increase over the previous 20-year annual average of 350 (see Table 4-3). **This led to the elimination of 1,500 target sharks along Queensland's coastline, representing the removal of the potential risk of those sharks interacting with humans and aligning with the Program's objective of improving human safety.**

There were 178 sharks captured or euthanised, but not killed, by the equipment. Of this number, 168 were caught within the GBRMP and relocated one kilometre eastward for release, as mandated under the GBRMP permit. The risk of interaction between this portion of target sharks and humans was temporarily reduced given their displacement relative to the shoreline and water users, although their risk was not as consequentially reduced as their permanent removal. The remaining 10 sharks caught outside the GBRMP either escaped before they could be euthanised, or were released as euthanasia was considered too dangerous for SCP contractors to perform.

Although the annual number of target sharks caught increased substantially over the Plan period, the proportion resulting in mortality decreased by 7.9 percent, reaching 89.4 percent. This decline reflects the GBRMPA's catch-and-release mandate and potential gear modifications.

Only one Grey Reef Whale was caught during Operations in the Plan period.

Table 4-3: Shark Control Program Target Shark Catch – Mesh Nets & Traditional Drumlines

Metric	Target Shark Catch		
	Current SCP 2021-2024	2001-2020	Change from 2001-2020 to 2021-2024
Avg Annual Target Shark Catch	438	350	+88
Avg Annual Target Shark Mortality	366	347	+19
Mortality as a Percentage of Total Target Shark Catch	89.4%	97.3%	-7.9%
Total Target Shark Catch	1,678	6,997	
Total Target Shark Mortality	1,500	6,810	
Total Catch	3,596	15,581	

Source: Shark Control Program catch data (2001–2024)

Traditional Drumlines accounted for 77 percent of the total catch (399 target sharks), which is a larger proportion (11.5 percent more) than in the previous period (see Table 4-4). Currently, there are significantly more Traditional Drumlines in operation than Mesh Nets, with a ratio of approximately 12 to 1. However, these two gear types operate differently and cannot be compared solely on the basis of quantity.

Table 4-4: Shark Control Program Target Shark Catch by Gear Type

Gear Type	Target Shark Catch by Gear Type			
	Avg Annual Current SCP 2021-2024	Avg Annual 2001-2020	Total Current SCP 2021-2024	Total 2001-2020
Traditional Drumlines	399	310	1,530	6,200
Mesh Nets	40	41	148	797

As shown in Table 4-5, Traditional Drumlines caught more Tiger, White and other target sharks per year than over the previous 20-year period. The largest increase occurred in Tiger sharks with 62 more sharks captured per year. Annual Bull shark catches dropped by three sharks on average. The catch per drumline was higher across each shark species, with the previous period observing on average less than one target shark catch per drumline per year. **These increases culminated in an average Traditional Drumline catch of 1.142 target sharks per drumline per year, a 41.17 percent increase on the 0.81 target sharks per drumline caught during the previous period.**

Table 4-5: Shark Control Program Average Annual Target Shark Catch Statistics – Traditional Drumlines

Species	Average Annual Target Shark Catch – Traditional Drumlines					
	Current SCP 2021– 2024	2001 – 2020	Change	Catch/Drumline Current SCP 2021–2024	Catch/Drumline 2001 – 2020	Change
Bull shark	78	81	-3	0.223	0.211	+0.012
Tiger shark	269	207	+62	0.771	0.540	+0.231
White shark	5	4	+1	0.013	0.011	+0.002
Other target shark	47	18	+29	0.135	0.048	+0.087
Total[79]	399	310	+89	1.142	0.810	+0.332

Source: Shark Control Program catch data (2001–2024)

The average annual target shark catch of Mesh Nets, while marginally decreased (approximately one target shark per year higher less), has remained consistently lower than Traditional Drumlines. However, on a per unit basis, Mesh Nets catch more Bull sharks. Conversely, Traditional Drumlines are more effective at catching Tiger sharks than Mesh Nets. This difference supports the view of stakeholders that drumlines are less effective at catching Bull sharks compared to Tiger sharks, due to Tiger sharks' opportunistic feeding behaviour and their tendency to forage in open water.

Table 4-6 provides a summary of the Mesh Net catch, showing an average of 0.734 Bull sharks caught per mesh net, which is higher than the 0.223 Bull sharks caught per Traditional Drumline (refer to Table 4-5). Nets caught 0.396 Tiger sharks, which is 0.338 fewer than Bull sharks, even though approximately three times as many Tiger sharks were caught in total by the Operations compared to Bull sharks. White shark catches remained constant across the Plan period for both gear types and continue to be the least commonly caught of the three highest-risk species.

[79] Totals are influenced by rounding and may not be equal.

Table 4-6: Shark Control Program Average Annual Target Shark Catch Statistics – Mesh Nets

Species	Average Annual Target Shark Catch – Mesh Nets			
	Current SCP 2021– 2024	2001 – 2020	Change	Catch/Net 2021–2024
Bull shark	20	20	0	0.734
Tiger shark	11	12	-1	0.396
White shark	3	3	0	0.097
Other target shark	6	6	0	0.203
Total[80]	40	41	+1	1.43

Source: Shark Control Program catch data (2001–2024)

Note: Due to a lack of detailed information on the specific dates when net quantities were reduced, a reliable Catch/Net statistic for the previous 20-year period is not available.

An increase in captured target species size is observed

According to Table 4-7, **the mean length of Tiger and White sharks increased considerably over the Plan period, by 20 centimetres and 18 centimetres, respectively.** In contrast, the length of Bull sharks remained approximately constant, while the average length of other target sharks decreased by 33 centimetres.

The frequency of large catches (i.e. sharks greater than two meters in length) increased across all four taxa. This increase was most notable in Tiger sharks, with large individuals caught an average of 64 more times per year compared to the previous 20-year average.

The increase in the frequency of large target shark catches reflects the risk of more dangerous sharks being mitigated during the Plan period. However, this does not necessarily indicate that Operations have become more effective at catching larger sharks. Stakeholders highlight additional factors, such as gear modifications, changes in quantity, the implementation of the 1.5-meter catch rule, and recreational shark fishing quotas, as contributing to a reduction in other sources of anthropogenic mortality, which may lead to larger sharks in the environment.

Table 4-7: Shark Control Program Average Annual Target Shark Catch Length – Traditional Drumlines + Mesh Nets

Species	Target Shark Catch Length – Operations					
	Mean Length (meters)			Avg. Annual Number of Target Shark Catch > 2 meters		
	Current SCP 2021-2024	2001-2020	Change	Current SCP 2021-2024	2001-2020	Change
Bull shark	1.71m	1.74m	-0.03m	29	31	+2
Tiger shark	2.49m	2.29m	+0.20m	194	130	+64
White shark	2.79m	2.61m	+0.18m	6.5	5.6	+0.9
Other target sharks	1.57m	1.90m	-0.33m	11	10	+1

Source: Shark Control Program catch data (2001–2024)

Mesh Nets caught larger sharks on average than Traditional Drumlines, except for White Sharks, where Traditional Drumlines captured larger individuals on average across both periods. **While Traditional Drumlines recorded the highest number of target sharks over two meters, the proportion of total target sharks exceeding two meters was highest for Mesh Nets at 65 percent, compared to 54 percent for Traditional Drumlines** (refer to Table 4-8 and Table 4-9). This is similar to the previous period (67 percent versus 49 percent).

[80] Totals are influenced by rounding and may not be equal.

Table 4-8: Shark Control Program Average Annual Target Shark Catch Length – Traditional Drumlines

Species	Average Annual Target Shark Catch Length – Traditional Drumlines					
	Mean Length (meters)			Avg. Annual Number of Target Shark Catch > 2 meters		
	Current SCP 2021-2024	2001-2020	Change	Current SCP 2021-2024	2001-2020	Change
Bull shark	1.65m	1.65m	0m	20	21	-1
Tiger shark	2.48m	2.27m	+0.21m	184	121	+63
White shark	3.01m	2.73m	+0.28m	4	4	+0
Other target sharks	1.48m	1.7m	+0.22m	6.8	5.2	+1.6

Source: Shark Control Program catch data (2001–2024)

Table 4-9: Shark Control Program Average Annual Target Shark Catch Length – Mesh Nets

Species	Average Annual Target Shark Catch Length – Mesh Nets					
	Mean Length (meters)			Avg. Annual Number of Target Shark Catch > 2 meters		
	Current SCP 2021-2024	2001-2020	Change	Current SCP 2021-2024	2001-2020	Change
Bull shark	1.96m	2.09m	-0.13m	8.4	10	-1.6
Tiger shark	2.75m	2.59m	+0.16m	9.9	10	-0.01
White shark	2.42m	2.41m	+0.01m	2.4	1.6	+0.8
Other target sharks	2.31m	2.59m	-0.28m	4.4	5.1	-0.7

Source: Shark Control Program catch data (2001–2024)

A reduction in **shark bite incidents**

Limitations of shark bite incident data

The following factors should be considered when interpreting the shark bite incident statistics in this section.

- **Under-reported incidents**: Shark bite incidences are likely under-reported, given that not all victims will seek public medical attention or report the incident to authorities; however, this is most likely the case for non-injurious or minor injury interactions.
- **Inclusion of provoked bites:** The shark bite statistics in this section include both provoked and unprovoked bites, which include situations where individuals unintentionally encounter a shark along the coastline and subsequently provoke it.
- **Other considerations**: Shark bites that did not result in injury because the shark ultimately missed the victims are still included as shark bite incidents. Bites that occurred in the open ocean are excluded as they fall outside the geographic scope of the SCP.

A reduction in shark bite occurrences is observed

Between 2001 and 2020, 67 shark bites were recorded in Queensland, including 10 fatalities, averaging 3.35 incidents per year.[81] **Between January 2021 and October 2024, Queensland recorded four shark bites, averaging 1.04 incidents per year.**[82] One of these bites occurred in 2024 at an SCP-protected beach in Bundaberg, which aligns with historical data and reflects the consensus among stakeholders that the Program's Operations are not entirely effective in safeguarding water-users.

The literature indicates that Operations have likely had some effect in reducing shark bites since the implementation of nets and drumlines, with substantially lower shark bite incidences and fatalities recorded at beaches with SCP gear[83]—only two fatalities have occurred at SCP-protected beaches since the Program's inception, despite such locations having the highest beach activity and populations which have grown significantly since 1962. However, the magnitude of this effect and its specific impact over the Plan period remains unknown due to confounding variables and the low incidence and high variability of shark bites obscuring analysis.[84]

A decreased number of shark bite incidences over the Plan period is aligned with the Program's intended outcome of improved human safety; however, due to data limitations, attributing a quantified reduction in bites to Operations is not attempted as part of this evaluation.

[81] Ibid.
[82] Taronga Conservation Society Australia. (n.d.). *Australian Shark Incident Database.* https://taronga.org.au/conservation-and-science/australian-shark-incident-database
[83] Dudley, S. (1996). A comparison of the shark control programs of New South Wales and Queensland (Australia) and KwaZulu-Natal (South Africa). *Ocean & Coastal Management*, *34*(1), 1-27. https://doi.org/10.1016/S0964-5691(96)00061-0
Cardno NSW/ACT Pty Ltd. (2020). *Data review for Queensland Shark Control Program regions & The Whitsundays* (FQ19025A). Queensland Department of Agriculture & Fisheries. https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/4c292b0c-df4e-4b0f-83fd-c5ea6e403752/data-review-SharkSmart-regions-2020.pdf?ETag=9ac8f3c1298961dfda7cff77612ac0db
[84] Huveneers, C., Blount, C., Bradshaw, C. J., Butcher, P. A., Lincoln Smith, M. P., Macbeth, W. G., McPhee, D. P., Moltschaniwskyj, N., Peddemors, V. M., & Green, M. (2023). Shifts in the incidence of shark bites and efficacy of beach-focussed mitigation in Australia. Marine Pollution Bulletin, 198, 115855. https://doi.org/10.1016/j.marpolbul.2023.115855

Minimising adverse ecosystem impacts

The objective to lower the impact of Operations on Queensland's marine ecosystems differentiates the current SCP from previous periods. To evaluate the Program's success in achieving this objective, the extent to which Operations produce the following outcome is assessed.

A reduction in **bycatch mortality**

Many stakeholders believe that the bycatch impact of Operations remains unacceptably high, with particular dissatisfaction expressed towards the use of Mesh Nets. Nets lead to high mortality rates, especially for species that require continuous movement (obligate ram ventilators, e.g. tuna, sharks) or regular surfacing (obligate air breathers, e.g. loggerhead turtles, dolphins) to oxygenate, as they are unable to move once entrapped in the netting.[85] The use of nets has become increasingly problematic during the winter months due to recovering whale populations resulting in more frequent entanglements. Stakeholders prefer drumlines, which are designed to specifically target actively feeding marine predators and therefore have a smaller bycatch impact. However, the view is that there is still room to improve the selectivity of drumline fishing. While operational catch data may record a non-target species as being alive when released, stakeholders caution it is unclear whether the released animal would be in a sufficiently healthy state to survive long-term, thereby implying under-reported bycatch mortality.

Changes influencing bycatch mortality during SCP delivery

Two programmatic changes have occurred during the delivery of the SCP that will affect the interpretation and analysis of bycatch mortality. These are:

- **GBRMP permit**: Following the Administrative Appeals Tribunal in 2019, the GBRMP permit was amended mandating the release of all living animals captured within the GBRMP, except for instances where the animal was considered unlikely to survive post-release or where its release would endanger the SCP crew. Prior to the permit, target sharks were euthanised, contributing to mortality numbers in the 2001–2020 period but not over the period of the Plan.
- **Target shark list change**: The 12 shark species removed from the target shark list in January 2023 are now classified as bycatch. Previously, these species were euthanised between 2001 and 2022, inflating bycatch mortality for this period.

Limitations in interpreting bycatch trends over time

A potential limitation in interpreting changes in bycatch is the influence of autocorrelation, where a reduction in bycatch during the Plan period may simply reflect a diminished marine animal population resulting from operational impacts in an earlier period. This means that a decrease in bycatch may not necessarily indicate an improvement in operational effectiveness but rather a delayed negative consequence of previous activities. Current data availability does not allow the differentiation between this effect and other explanations for bycatch change.

A reduction in **bycatch mortality**

An increase in bycatch mortality is observed

The total average annual bycatch killed over the Plan period increased by 19 percent to 363 compared with the previous 20-year average of 305 (see Table 4-10)**.**

An analysis of the Program's catch data reveals an increased impact of Traditional Drumlines on the ecosystem, with a substantial rise in average annual bycatch and bycatch mortality. **Ultimately, operations resulted in the death of 1,390 non-target marine species over the Plan period**.

[85]Dapp, D.R., Walker, T.I., Huveneers, C. and Reina, R.D., 2016. Respiratory mode and gear type are important determinants of elasmobranch immediate and post-release mortality. Fish and Fisheries, 17(2), pp.507-524.

Table 4-10: Shark Control Program Bycatch – Operations

Metric	Non-Target Species Catch		
	Current SCP 2021-2024	2001-2020	Change
Avg Annual Bycatch	500	429	+71
Avg Annual Bycatch Mortality	363	305	+58
Bycatch as a percentage of Total Catch	53.3%	55.1%	-1.8%
Mortality as a percentage of Bycatch	72%	73%	-1%
Total Bycatch	1,918	8,584	
Total Bycatch Mortality	1,200	6,095	

Source: DAF, Shark Control Program catch data (2001–2024)

Table 4-11 demonstrates that **Traditional Drumlines exhibited a 19 percent increase in bycatch mortality, increasing to an annual average of 222 animals killed, up from 148 over the previous 20-years**. This rise is observed despite the phased replacement of 62 Traditional Drumlines to the Catch-Alert Drumline Trial. The ratio of bycatch mortality to target shark capture increased by 0.12 marine animals and the quantity of catch that was bycatch was substantially higher over the Plan period (319 compared to 208).

Table 4-11: Shark Control Program Bycatch Statistics – Traditional Drumlines

Metric	Bycatch Statistics – Traditional Drumlines		
	Current SCP 2021-2024	2001-2020	Change
Avg Annual Bycatch	319	208	+111
Avg Annual Bycatch Mortality	222	148	+74
Bycatch as a percentage of Total Catch	44.4%	40.2%	+4.2%
Mortality as a percentage of Bycatch	69.7%	71.2%	-1.5%
Ratio of Bycatch Mortality to Target Shark Capture	0.60 : 1	0.48 : 1	+0.12:1
Total Catch	2,753	10,367	
Total Bycatch	1,223	4,167	
Total Bycatch Mortality	852	2,968	

Source: DAF, Shark Control Program catch data (2001–2024)

During the Plan period, Mesh Nets killed an average of 140 non-target species per year, a decrease of 16 animals compared to the previous period (see Table 4-12). This is still considerably lower than the 222 non-target species killed by Traditional Drumlines. The proportion of total Mesh Net catch that was bycatch shrunk to 82.4 percent, down from 84.7 percent, while the proportion of bycatch resulting in mortality increased substantially to 77 percent, up from 70.8 percent.

Mesh Nets are less selective than Drumlines, killing over 3.6 non-target marine animals for every target shark caught, compared to Traditional Drumlines, which had a bycatch ratio of 0.6 non-target animals per target shark caught.

Table 4-12: Shark Control Program Bycatch Statistics – Mesh Nets

Metric	Bycatch Statistics – Mesh Nets		
	Current SCP -2024	2001-2020	Change
Avg Annual Bycatch	181	221	-40
Avg Annual Bycatch Mortality	140	156	-16
Bycatch as a percentage of Total Catch	82.4%	84.7%	+6.6%
Mortality as a percentage of Bycatch	77.4%	70.8%	-2%
Ratio of Bycatch Mortality to Target Shark Capture	3.64 : 1	3.92 : 1	-0.28 : 1
Total Catch	843	5,214	
Total Bycatch	695	4,417	
Total Bycatch Mortality	538	6,095	

Source: DAF, Shark Control Program catch data (2001–2024)

Target Shark Mortality in the GBRMP

While the impact of Operations on the ecosystem is measured using bycatch mortality, Operations within the GBRMP boundary are mandated to release sharks caught alive on equipment. During the Plan period, 455 target sharks became caught on Traditional Drumlines within the GBRMP, resulting in a mortality rate of ~ 63 percent (287 sharks).

Queensland Fisheries – Marine Animal Release Team (MART)

MART stakeholders have reported a significant increase in whale entanglements during the Plan period, noting that the 2023 winter alone generated over 900 calls to the shark hotline to report possible incidents, compared to the typical 200 calls received in a year. This rise in calls aligns with observations of recovering humpback whale populations.

Between January 2021 and October 2024, 38 humpback whales were entangled in SCP equipment, with no fatalities recorded. All whales were successfully released, either through self-release or by MART. In some instances, members of the public also played a role. This achievement demonstrates MART's continued success in reducing bycatch mortality along Queensland's coastline.

4.1.2 Trials

SCP trials involve testing the suitability of alternative shark bite mitigation technology in Queensland conditions to ensure effectiveness and environmental compatibility. The SCP has trialled an array of different technologies with various applications to potentially enhance future Operations, including:

- SharkSmart Drones
- Shark Barriers
- Trial Catch-Alert Drumlines
- Alternative Gear
- Advanced Aerial Detection
- Double Servicing.

These trial initiatives are described in more detail in the table below.

Table 4-13: Trial Initiatives delivered in the Queensland's Shark Management Plan (2021-2025)

Initiative	Description	Locations (No. of equipment)
Catch-Alert Drumlines	This trial tests the effectiveness and suitability of Catch-Alert Drumlines in Queensland conditions to increase the survival of t**he** catch, in line with the GBRMP permit. From September 2021, 11 Traditional Drumlines were replaced with Catch-Alert Drumlines. Catch-Alert Drumlines are satellite buoys equipped with baited hooks that send real-time alerts to SCP personnel when an animal is caught. This alert enables a rapid response to reduce the time animals remain hooked, improving the chances of survival. Unlike Traditional Drumlines, which have traditionally used J-style hooks and chain trace, Catch-Alert Drumlines use a circle hook and wire trace. The circle hook is designed to reduce deep hooking, further increasing survival rates of a catch. Catch-Alert Drumlines are deployed during daylight hours only, usually from around 5:30 AM to 4:00-5:00 PM, in the same locations as MTDs, parallel to the beach line. The SCP crew respond immediately to any catch alerts during the day. Target species caught on the Catch-Alert Drumlines are tagged and relocated one kilometre eastward from the site of capture to deter their return to the beach area. Bycatch is simply released as quickly as possible to maximise its chances of survival. Catch-Alert Drumlines are paired with MTDs which also use circle hooks and wire traces (instead of the traditional configuration). MTDs, however, do not have real-time alerts but are equipped with hook timers that track how long an animal has been hooked. This allows for MTDs to serve as normalised control for comparing catches and survival of marine fauna caught on the two drumline types, isolating the effect of the Catch-Alert Drumline alert system. Based on the interim results of the Catch-Alert Drumline Trial in the Capricorn Coast, it has been extended to June 2025 and was expanded to Cairns and Mackay in February 2024. **Trial period:** January 2022 – June 2025	Catch-Alert Drumlines • Capricorn Coast (11) • Cairns (11) • Mackay (9) Queensland total of 31 MTDs • Capricorn Coast (11) • Cairns (11) • Mackay (9) Queensland total of 31

Initiative	Description	Locations (No. of equipment)
SharkSmart Drones	The SharkSmart Drone Trial is an initiative by DAF, in partnership with SLSQ, to test the effectiveness of drones for shark detection at Queensland beaches. The drones are equipped with high-resolution cameras, with the ability to record video footage and assist with identification and size estimation of sharks. The drones are operated at a constant altitude of 60 metres, providing a clear view of the water with a 110-metre field of view. Drones are operated on weekends, public holidays, and school holiday weekdays. Each flight covers about 800 metres of beach and lasts up to 30 minutes, with 45-minute intervals between flights. The drones are manually controlled by SLSQ trained drone pilots, who operate from a drone landing pad on the beach. If a dangerous marine creature is spotted, the drone operator alerts lifeguards, who decide on a course of action, such as beach closures or evacuations. **Trial period:** August 2020 – June 2025	• Gold Coast (3) • North Stradbroke Island (1) • Sunshine Coast (5) • Townsville (1) Queensland total of 10
Alternative Gear	The alternative gear trial focuses on testing circle hooks to evaluate their effectiveness in catching target shark species. Specifically, it aims to compare 24/0 Circle-Hooks with wire trace against traditional J-hooks and chain trace used on drumlines. The design of circle hooks increases the likelihood of sharks being securely hooked in the corner of the jaw, reducing mortality compared to J-hooks, which often result in throat or gut hooking. The trial is currently being conducted at 16 beaches where Traditional Drumlines are already deployed. Odd-numbered drumlines are equipped with J-hooks, while even-numbered drumlines are fitted with circle hooks, allowing for a controlled comparison. Hooks are switched approximately every 21 days to ensure that any differences in catch rates or survival are due to the hook type rather than environmental factors at small spatial scales. Consistent baiting (i.e. mullet or shark fillet) is maintained across all drumlines to standardise conditions. **Trial period:** November 2023 – December 2024	Circle-Hooks • Gold Coast (18) • North Stradbroke Island (17) • Sunshine Coast (39) • Rainbow Beach (6) • Bundaberg (10) • Tannum Sands (6) Queensland total of 96
Shark Barriers	The shark barrier trial was intended to test the suitability and feasibility of non-electric shark barriers in Queensland conditions. These barriers are non-lethal structures designed to prevent sharks from entering designated swimming areas. They are solid or semi-permeable physical barriers that create a complete, enclosed area, ensuring sharks are kept out of specific swimming zones. The trial did not advance beyond the desktop research phase due to a number of reasons, including Queensland's challenging currents, tides, seabed conditions, and community opposition.	n/a

Initiative	Description	Locations (No. of equipment)
	Out of the 30 beaches investigated in North Queensland, two were deemed viable, however resistance from the local government and concerns that the visual impact of the barriers would create a perception of increased shark risk, led to the trial not proceeding. **Trial period:** November 2021 – July 2022	
Advanced Aerial Detection	The Advanced Aeiral Detection (AAD) Trial aims to assess the suitability and effectiveness of AI and various spectrum camera lenses in enhancing the detection of sharks. Turbid water conditions and human error can sometimes result in drone pilots missing a potentially dangerous shark. As part of the first phase, the trial tested different AI software to evaluate its ability to accurately identify target sharks. In the second phase, a range of spectrum cameras were trialled to determine the most suitable lens for specific ocean conditions. Field testing for AAD is completed, and results are pending. **Trial period:** November 2023 – November 2024	• Gold Coast • Mackay
Double Servicing	The Double Servicing trial aimed to evaluate the feasibility of servicing Traditional Drumlines twice daily in Townsville. It was expected that this approach would decrease catch mortality and ultimately yield improved ecosystem outcomes. However, the trial did not progress due to insufficient time and a desktop evaluation employing computer modelling is underway instead. **Trial period**: n/a	• Townsville

Effectiveness of implementation

The effectiveness of the implementation of the trials is summarised in the table below.

Table 4-14: Effectiveness of implementation for Trials

Trial	Effectiveness of implementation
Catch-Alert Drumlines	✓ The Catch-Alert Drumline Trial is currently underway at 11 beaches across the Capricorn Coast, Mackay and Cairns. ✓ Alterations to SMART drumline units were made to tailor their performance to the distinct marine environments of Queensland, forming the Catch-Alert Drumline units. This includes refinement of the hook material. ✓ Is delivered by existing SCP contractors, leveraging established processes and contractor knowledge. ✗ The interim report indicates a high incidence (51.5 percent) of marine animals failing to activate the satellite buoy when hooked. ✗ Cairns has produced a high frequency (57) of false alerts. ✗ The Catch-Alert Drumline Trial in Cairns and Mackay, which was initially planned for 2023, was delayed to early-2024 due to a lack of resources.

Trial	Effectiveness of implementation
SharkSmart Drones	✓ Locations where drones are deployed grew from five in 2021 to the 10 serviced today. ✓ Equipment has been upgraded with the introduction of Mavic 3 Classic drones, providing better clarity and longer flight times (average flight time extended to 25 minutes from 22 minutes) ✓ SLSQ has trained 120 remote pilot qualified pilots to undertake SharkSmart Drone patrols. ✓ During the most recent trial period (January to June 2024), 51 flight days were cancelled, representing just 5.74 percent of the total planned. In comparison, 152 cancellations (18.49 percent of the total planned) occurred over the same period the previous year. Throughout the drone trial, flights were cancelled due to rain, strong winds, and operational issues such as pilot sickness and staffing shortages in Townsville (in 2023 and 2024). ✗ CASA rules require that drone pilots maintain a visual line of sight, reducing the distance and frequency of flights. ✗ The Cairns trial was discontinued due to high water turbidity. ✗ Flight footage required frequent transfers of multiple 4TB external hard drives to DAF for data storage, causing occasional bottlenecks and delays in data processing. ✗ Drone operations were scheduled to align with SLSQ beach patrols. This prevented flights at Bribie Island during unpatrolled periods in May and June 2024, as lifeguard services were only funded for the Winter School Holidays.
Alternative Gear	✓ There were no issues in procuring and deploying Circle-Hooks (for both Catch-Alert Drumlines and Traditional Drumlines).
Shark Barriers	✓ A desktop research assessment of 35 beaches was carried out to determine the suitability for shark barriers. ✗ Community and local government opposition prevented the trial from progressing beyond the desktop research assessment.
Advanced Aerial Detection	✓ The AI trial (Phase A) was successfully carried out at Burleigh Beach, Gold Coast. ✓ The multi and hyperspectral camera testing (Phase B) was successfully carried out at Harbour Beach, Mackay. ✗ Poor weather conditions have prolonged the trial.
Double Servicing	✓ Initial assessments indicated that the likely impact of double servicing could be predicted using data modelling which is a more economical way to provide initial insights into this potential strategy, leading to its transformation into a research initiative.

Source: Stakeholder consultations, the Shark Control Program website and, where available, interim trial reports.

Improving human safety

A central objective of the Trials pillar is to identify alternative shark control measures that are suitable in Queensland conditions, and which improve ecological outcomes without changing the risk profile of the beach or improving it. To evaluate whether trials have achieved this result, the extent to which each trial initiative produced the following two outcomes is assessed:

A reduction in the **immediate risk of human-shark interactions**

A reduction in **shark bite occurrences**

Stakeholders believe that SCP trials have been somewhat effective in achieving these two outcomes. However, they note that trials have primarily focused on improving ecosystem outcomes rather than directly enhancing human safety, with emphasis on ensuring any benefit to the ecosystem does not meaningfully worsen the risk profile for beachgoers.

Some stakeholders have expressed dissatisfaction with the Catch-Alert Drumline Trial's ability to maintain the beach's risk profile, noting that it not only increases the survivability of captured target sharks but must also comply with the GBRMP's catch-and-release mandate. This mandate requires that captured target sharks be relocated one kilometre offshore, which has raised concerns, as tagged sharks have been observed returning to the coastline, thereby reintroducing the risk of shark interactions with beachgoers. Traditional Drumlines within the GBRMP face similar criticism; however, they result in much lower survival rates for sharks, leading to fewer being released back into the ocean.

On the other hand, some stakeholders believe the effectiveness of traditional operations is limited or dubious to begin with, even outside the GBRMP where captured sharks are euthanised, arguing as a result that the risk profile of Catch-Alert Drumlines remains largely the same but with the added benefit of substantial ecosystem improvements.

The SharkSmart Drone trial and its extension, the AAD trial, received unanimous support. Stakeholders appreciate the additional visibility and awareness these technologies provide, potentially filling in protection gaps where existing measures fail to prevent dangerous sharks from entering close to the beach. Stakeholders also highlight the limitations of drones, noting that they can only be deployed under specific conditions. This limits their ability to provide consistent protection.

Shark barriers are another technology that stakeholders believe could lead to improved human safety compared with baseline operations. This is due to its solution of creating a permanent enclosure to block out large, dangerous marine animals. However, stakeholders are cautious about their future use due to the challenges posed by Queensland's conditions and the community opposition encountered during the trial.

The Circle-Hooks and pingers focus on reducing negative ecosystem impacts; however, stakeholders suggest that the Circle-Hook is more effective at capturing Bull sharks than traditional J-hooks, which may lead to increased capture of target shark species.

The effectiveness of each trialled technology against the two outcome areas is detailed below.

A reduction in the **immediate risk of human-shark interactions**

To measure whether a trial initiative demonstrates a reduction in the immediate risk of human-shark interactions, two measures are used:

- **Target species captured or detected**: The capture or detection (using drones) of target sharks serves as a practical proxy for reduced human-shark interaction, based on the logic that capturing or detecting a shark situated near water-users, and either relocating it or alerting water users, lowers the potential risk of that shark interacting with humans. An increase in the number of target species captured or detected represents a reduced risk of beachgoers encountering a dangerous shark.
- **Captured or observed target species size**: An increase in the size of target sharks caught represents the removal of more dangerous sharks.

A reduction in **shark bite occurrences**

The number of shark bites that occurred in the trial area during the Plan period is noted; however, due to the rarity and variability of bites, along with confounding factors, attributing a reduction to any specific trialled technology has not been attempted.

Catch-Alert Drumlines

A decrease in target species' capture compared with MTDs is observed

From January 2022 to August 2024, Catch-Alert Drumlines caught fewer animals (207) compared to MTDs (331) (refer to Table 4-15)**. This includes fewer target species, with 52 Bull sharks, 28 Tiger sharks and 21 other target sharks caught on Catch-Alert Drumlines compared to 100, 67 and 21 caught on MTDs, respectively – a 53 percent smaller target shark catch**.

Many sharks caught on MTDs were captured at night, dawn, and dusk when Catch-Alert Drumlines were not in use. An absence of Catch-Alert Drumlines during these periods not only results in the capture of fewer target

species but it also leaves water users unprotected during the high-risk hours. However, these periods coincide with fewer water users compared to daytime hours.

Table 4-15: Catch-Alert Drumline Trial Shark Catch Statistics (January 2022 – August 2024)

Metric	Modified Traditional Drumline	Catch-Alert Drumline	Difference *Catch-Alert Drumlines compared to baseline*	
Total Catch	331	207	-124	Catch-Alert Drumlines caught fewer catch
Target Shark Catch	189	101	-88	Catch-Alert Drumlines caught fewer target sharks
Tiger Sharks	67	28	-39	Catch-Alert Drumlines caught fewer Tiger sharks
Bull Sharks	100	52	-48	Catch-Alert Drumlines caught fewer Bull sharks
White Sharks	1	0	-1	Catch-Alert Drumlines caught fewer White sharks
Other Target Sharks	21	21	0	No difference

Source: DAF, Shark Control Program Catch-Alert Drumline Trial data (2022–2024)

A decrease in captured target species size compared with MTDs is observed

Between January 2022 to January 2023, the average lengths of both Tiger sharks and Bull sharks caught on Catch-Alert Drumlines were smaller (2.54m and 1.12m, respectively) compared to MTDs (2.91m and 1.34m). This difference highlights the daytime activity of juvenile Bull sharks in the Capricorn Coast trial area[86]; however, stakeholders view these smaller animals as less dangerous to water users.

No shark bites were observed

Zero shark bite incidents were recorded at Cairns, Mackay and the Capricorn Coast (the trial sites) during the Plan period.

Unlike outside the GBRMP, where captured sharks are euthanised to prevent any risk of human interaction, sharks caught on Catch-Alert Drumlines are relocated and released one kilometre eastward. Stakeholders involved in the Catch-Alert Drumline Trial have reported cases of released sharks returning to, and being recaptured at, the beach site, suggesting a lower effectiveness in preventing human-shark interactions than Traditional Drumlines. This concern is supported by the Shark Tagging and Tracking research initiative, with interim findings showing that 21.3 percent of Tiger sharks and 31.3 percent of Bull sharks captured, tagged and released eventually returned, albeit after an average period of 155 days and 92 days post capture, respectively.[87] This effectively minimises the immediate risk of caught target sharks interacting with humans; however this does not completely eliminate the risk of any interaction as a lethal procedure would. Bull sharks exhibited the longest visits, often beginning in the afternoon and continuing into the night.[88]

On the other hand, MTDs, which are still subject to the GBRMP mandate, lead to higher rates of target shark mortality because SCP contractors do not service the equipment immediately after a marine animal is caught. This delay results in fewer sharks being released, thereby lowering the risk of interaction compared with Catch-Alert Drumlines.

[86] Department of Agriculture and Fisheries. (2023). *Queensland Shark Control Program: Catch alert drumline trial 2022–2023*. Queensland Government.

[87] Department of Agriculture and Fisheries. (2024). *Shark Tracking Program interim report: July 2024*. Queensland Government.

[88] Ibid.

NSW SMART Drumlines

In NSW, SMART Drumlines – the same technology as Catch-Alert Drumlines – have been in place at Ballina and Evans Head for approximately eight years, and in 17 other locations since 2022. Between 2016 and 2020, there were no shark interactions with target sharks (White, Tiger and Bull sharks) recorded at beaches while the drumlines were operational; however, there were some bites by generally harmless sharks (e.g., Grey Nurse sharks or Wobbegongs) while the gear was operational. Three bites from target sharks occurred over this period while SMART Drumlines were not deployed, either due to time of day (early morning) or rough weather conditions.[89] Since 2020, there have been several shark bites at beaches where SMART Drumlines are normally deployed, however all but two of these occurred when the SMART Drumlines were not operational. [90] Stakeholders note that the environmental and operating conditions SMART Drumlines operate within in NSW differ to what Catch-Alert Drumlines are subject to in Queensland. For instance, White sharks are the animal of primary concern in NSW, whereas Bull and Tiger sharks are of greater concern in Cairns, Mackay and the Capricorn Coast (where Catch-Alert Drumlines are trialled) due to being more common in those areas. Catch-Alert Drumlines have also received some alterations, further differentiating the two technologies. These differences limit any direct and equal comparison of effectiveness between the two gear types and reinforce the need for a local trial.

SharkSmart Drones

An increase in target species detected is observed compared to no drones

From April 2022 to June 2024, 15,846 drone flights were conducted. During this period, a total of 5,665 sharks (all species) were detected, with 282 of these estimated to be two metres or larger.[91] Large groups of juvenile whalers made up the majority of sightings. Shark sightings were influenced by location, presence of other fauna, season, and time of day, with the highest sighting rates at North Stradbroke Island and Burleigh Beach.

A total of 29 beach evacuations were conducted after SLSQ lifeguards determined that a shark detected by a drone posed an immediate risk of human-shark interaction.

This course of action effectively eliminates the risk of a shark encounter as it leaves no beachgoers in the water to possibly interact with the shark, notwithstanding public disobedience. However, given that it is virtually impossible to predict whether a shark will interact with a human until it happens, it is unknown if any of the 29 evacuations actually prevented shark bites.

The SharkSmart Drone trials were limited to specific days (public holidays and weekends) and were not operated during dawn and dusk, leaving large periods of time where water users remain unprotected. Moreover, poor weather prevented the flying of drones on certain occasions, further demonstrating that this technology cannot provide consistent protection against human-shark interactions.

No shark bites are observed

Zero shark bite incidents were recorded at beaches while drone trials were conducted. However, sharks sighted resulting in beach evacuations were in close enough proximity to people for an interaction to occur.

Shark Barrier

Identified potential for reduced human-shark interactions

Shark barriers are currently considered unsuitable for widespread use on Queensland beaches. However, under appropriate conditions, shark barriers could significantly reduce the risk of human-shark interactions by preventing large target shark species from entering designated swimming areas.

These enclosures are unsuitable for installation across most of Queensland's coastline due to environmental and practical constraints. In South-East Queensland, strong surf conditions make these barriers impractical for effective use. In contrast, North Queensland beaches, which are somewhat protected by the Great Barrier Reef, are more favourable for barrier installations. Locations around Cairns, such as Trinity Beach, Palm Cove, and Ellis Beach,

[89] Cardno. (2021). NSW *Shark management strategy: Non-lethal shark mitigation measures*. NSW Department of Primary Industries. https://www.SharkSmart.nsw.gov.au/__data/assets/pdf_file/0009/1398267/Cardno-Report.PDF
[90] see Huveneers, C., Blount, C., Bradshaw, C.J., Butcher, P.A., Smith, M.P.L., Macbeth, W.G., McPhee, D.P., Moltschaniwskyj, N., Peddemors, V.M. and Green, M., 2024. Shifts in the incidence of shark bites and efficacy of beach-focussed mitigation in Australia. Marine pollution bulletin, 198, p.115855.
[91] Drone Trial Interim Reports from July 2022-June 2024, SLSQ, 2024

were identified as potentially suitable locations for the effective deployment of barriers to reduce human-shark interactions.

Barriers were found to be potentially ineffective in preventing other threats, such as stingers and crocodiles, which are generally considered a higher risk to swimmers than sharks, from entering the enclosed areas. Small gaps in the barrier structure allow smaller marine animals to pass through.

Alternative Gear

Alternative gear is still in the preliminary stages of testing, with no available data yet for assessment.

Identified potential for increased target species capture

Circle-Hooks are designed to catch in the corner of a shark's mouth, allowing the shark to keep swimming and ventilate its gills after being hooked, which improves the chances of its survival upon release. The circular shape of the hook also reduces the likelihood of gut or throat hooking, which is often fatal.

Stakeholders believe that the Circle-Hook design will enhance Bull shark retention by making it harder for sharks to dislodge the hook. Additionally, the wire trace paired with the Circle-Hook, replacing the chain trace used on J-hooks, may improve Bull shark capture effectiveness due to its flexibility and reduced visibility. Ultimately, stakeholders anticipate that the switch to Circle-Hook gear will increase Bull shark capture rates.

Identified potential for a decrease in captured target species size

Stakeholders have noted that Circle-Hooks may be more likely to catch smaller, juvenile sharks, which could potentially reduce the capture rate of larger, higher-risk sharks. However, it is also possible that Circle-Hooks maintain the capture rate of larger sharks while increasing the capture of smaller sharks, thereby lowering the average size of sharks caught without worsening the beach's risk profile. The Program will analyse shark sizes as part of the Alternative Gear Trial evaluation to identify any such effect.

Advanced Aerial Detection

There is currently no data available to assess the AAD trial.

Identified potential for increased target species detected

The AAD trial aims to increase the detection of target species by SharkSmart Drones by improving the cameras' effectiveness in different water conditions, such as turbid water. If successful, AAD could result in more instances of preventative action on beaches, such as beach evacuations, to reduce the risk of human-shark interactions.

Minimising adverse ecosystem impacts

The purpose of trials is to identify alternative mitigation technologies or techniques that improve the survival of the catch and therefore limit adverse impacts to the ecosystem.

A reduction in **adverse ecosystem impacts**

To evaluate the extent trial initiatives produced improved ecosystem outcomes, the following two measures are considered:

- **Bycatch**: The number of non-target species caught on trialled shark control technology. Low figures represent that a technology is either more accurate in targeting the sharks of concern or is not designed to entrap animals, resulting in reduced potential for collateral damage to the wider ecosystem.
- **Catch mortality**: The number of marine animals killed as a result of the shark control technology is measured, with a decrease indicating improved survival of animals affected by the technology. It takes into consideration mortality across taxa, rather than just that of non-target species, given the potential for trialled technology's future implementation in marine parks where non-lethal methods are mandated for all sharks.

A reduction in **adverse ecosystem impacts**

Stakeholders generally view all technologies undergoing physical trials as improvements over traditional operations in terms of reducing ecosystem impacts, and there is broad support for the continued development of each technology solution.

Catch-Alert Drumlines

A decrease in bycatch compared to MTDs is observed

The trial demonstrates that Catch-Alert Drumlines result in decreased bycatch compared with MTDs.

Table 4-16 demonstrates that between January 2022 and August 2024, Catch-Alert Drumlines recorded a greater number of species caught (20) compared to MTDs, which caught 16 species. However, MTDs resulted in more bycatch, with 142 animals caught compared to 106 on Catch-Alert Drumlines. This difference is largely due to the higher total catch of MTDs (331 animals versus 207 for Catch-Alert Drumlines), as Catch-Alert Drumlines were only deployed during daylight hours. Of Catch-Alert Drumline catches, 51 percent were bycatch, compared to 43 percent for MTDs, and for every target shark caught, Catch-Alert Drumlines caught approximately one marine animal, whereas this ratio was slightly lower for MTDs at 0.75 to one.

Table 4-16: Catch-Alert Drumline Trial Catch Statistics (January 2022 – August 2024)

Metric	Modified Traditional Drumline *Control*	Catch-Alert Drumline *Trial*	Difference *Catch-Alert Drumlines compared to baseline*	
No. Species	16	20	+4	Catch-Alert Drumlines caught more species
Total Catch	331	207	-124	Catch-Alert Drumlines caught fewer animals
Total Bycatch	142	106	-37	Catch-Alert Drumlines caught fewer bycatch
Bycatch as a percentage of Total Catch	43%	51%	+8%	Catch-Alert Drumlines have more bycatch as a percentage of total catch

Metric	Modified Traditional Drumline *Control*	Catch-Alert Drumline *Trial*	Difference *Catch-Alert Drumlines compared to baseline*	
Ratio of Bycatch to Target Shark Capture	0.75 : 1	1 : 1	+0.25	Catch-Alert Drumlines catch more bycatch per target shark capture

Source: DAF, Shark Control Program Catch-Alert Drumline Trial data (2022–2024)

A decrease in catch mortality compared with MTDs is observed

The mortality rate of animals caught on Catch-Alert Drumlines was lower, at 20 percent, compared to 65 percent on MTDs (see Table 4-17).

For every target shark caught on an MTD, approximately one marine animal was killed, whereas for Catch-Alert Drumlines, on average, more than two target sharks were caught before a marine animal died.

Table 4-17: Catch-Alert Drumline Trial Mortality Statistics (January 2022 – August 2024)

Metric	Modified Traditional Drumline *Control*	Catch-Alert Drumline *Trial*	Difference *Catch-Alert Drumlines compared to baseline*	
Mortality as a percentage of Total Catch	65%	20%	-45%	Catch-Alert Drumlines killed fewer animals
Ratio of Bycatch Mortality to Target Shark Capture	0.56 : 1	0.24 : 1	0.32 : 1	Catch-Alert Drumlines killed less bycatch per target shark capture
Ratio of Catch Mortality to Target Shark Capture Ratio	1.1 : 1	0.4 : 1	-0.7 : 1	Catch-Alert Drumlines killed less animals per target shark capture

Source: DAF, Shark Control Program Catch-Alert Drumline Trial data (2022–2024)

The low sample sizes for most species with 11 of the 20 taxa caught on Catch-Alert Drumlines so far represented by just three or fewer individuals (all non-target species), limits the ability to conduct robust survival analyses for most animal species. The following species had the largest sample sizes (n > 40) and were found to have improved survivability on Catch-Alert Drumlines at the 5 percent significance level:

- Bull shark
- Pig eye shark.

It is anticipated that once the new sites (Mackay and Cairns) have collected one year of data, the trial team will conduct a statistical analysis to determine the strength of the relationship between Catch-Alert Drumlines and catch survivability.

The SCP continues to refine Catch-Alert Drumline gear (e.g., adjusting magnet strength, various component lengths) to ensure Catch-Alert Drumlines are triggered when an animal is caught, aiming to further improve survival rates of animals in the GBRMP.

SharkSmart Drones

No bycatch or catch mortality is observed

SharkSmart Drones deliver a significant reduction in adverse ecosystem impacts given that they fly above the ocean without interacting with marine life, resulting in no bycatch or marine animal mortality.

This non-invasive solution almost completely eliminates the risk of harm to marine ecosystems – notwithstanding the potential loss of drone to sea following flight failure – offering a substantial ecological advantage over traditional operations and Catch-Alert Drumlines.

Shark Barrier

Identified potential for decreased bycatch and catch mortality

The effectiveness of shark barriers in delivering a reduction in adverse ecosystem impacts in Queensland was not determined.

Program stakeholders note that shark barriers would lead to some, potentially negligible, disturbance of the ecosystem at a local scale. However, the extent of this impact in a Queensland setting is unclear given that the technology did not progress past the desktop research phase. Despite this, it is expected the impact of barriers on marine life is significantly smaller in comparison with Traditional Drumlines and Mesh Nets given they are not designed to catch marine animals. The SWG noted the potential for dugongs to interact with some barrier products, making it important that any trial is closely monitored.

Alternative Gear

Alternative Gear (Circle-Hook) is still in the preliminary stages of testing, with no data available for assessment.

Identified potential for decreased bycatch and catch mortality

Circle-Hooks are expected to reduce the likelihood of deep hooking and foul hooking, which minimises internal injuries of catch and accidental cuts to animals swimming nearby, thereby increasing the survival rates of marine animals interacting with the equipment, compared to traditional J-hooks.

Advanced Aerial Detection

There is currently no data available to assess the AAD trial.

No bycatch or catch mortality is observed

As an extension to the SharkSmart Drones, AAD delivers a reduction in adverse ecosystem impacts compared with traditional operations as the technology does not interact with marine animals.

4.1.3 Research

The Research pillar aims to generate new knowledge, insights, and evidence that can inform program decision-making and policy. Topics include shark populations and behaviour, alternative technology solutions and human behaviour. The priority research initiatives delivered under the Program include:

- Prevalence and Behaviour of Sharks in the Whitsundays
- Support the Integrated Marine Observing System Queensland Acoustic Telemetry Array
- Investigating Fishing Depredation
- Shark Population Studies
- Assess Personal Deterrents
- Value contribution of SCP to Queensland economy.

The SCP has invested either directly through provision of funding or indirectly through in-kind support to many research programs. However, not all of these are considered, as this evaluation is concerned with the primary initiatives in which DAF has been most involved in delivering over the Plan period (i.e. from 2021).

These initiatives are described in more detail in the table below.

Table 4-18: Research Initiatives delivered in the Queensland's Shark Management Plan (2021-2025)

Initiative	Description
Prevalence and Behaviour of Sharks in the Whitsundays	A research initiative devised to investigate shark prevalence and behaviour in Cid Harbour, following a cluster of shark bite incidents in late 2018. It initially aimed to achieve this by conducting five week-long field trips between December 2018 and January 2020 to examine potential Tiger and Bull shark activity, which involved: • Capturing sharks using droplines and longlines • Deploying BRUVs to observe sharks and their prey • Tagging sharks with acoustic and satellite transmitters to track their movements • Using side-scan sonar to assess prey availability. The project was later expanded (Stage 2) to encompass broader areas of human activity within the Whitsundays, such as tourist-frequented snorkelling, swimming, and fishing sites to capture the wider Whitsunday's region. This was achieved by reducing the receiver coverage in Cid Harbour and broadening the monitoring area to include adjacent estuarine and coastal habitats and islands. **Initiative period:** Stage 1: November 2018 – June 2020 Stage 2: October 2020 – May 2022
Support the Integrated Marine Observing System Queensland Acoustic Telemetry Array (Shark Tagging and Tracking)	The Integrated Marine Observing System (IMOS) Queensland Acoustic Telemetry Array supports marine animal tracking projects, including the SCP's Shark Tagging and Tracking Program. The Shark Tagging and Tracking Program aims to investigate the behaviour of Tiger and Bull sharks captured and released from drumlines deployed at beaches within the GBRMP. It involves: • Tagging sharks with external acoustic transmitters in four key regions within the marine park—Cairns, Townsville, Mackay, and the Capricorn Coast • Transmitters then emit a unique sound signature that is detected by a widespread network of acoustic receivers, revealing the presence of tagged sharks proximal to the equipment

Initiative	Description
	• There are 345 receivers in Queensland and 1,146 active receivers nationally as part of the broader IMOS National Receiver Network. **Initiative period:** February 2020 – June 2025
Investigating Fishing Depredation	A pilot study to investigate shark depredation, which refers to the partial or complete consumption of fish caught in fishing gear by sharks, in Queensland fisheries. The study was initiated to contribute to DAF's understanding of the potential for sharks to be attracted to boats and fishing activities and how that may relate to shark bite risk. It involved: • Use of cameras and genetic analysis to identify shark species responsible for depredation • Creation and trial of a beta version of an app for fishers to report depredation events and assess its usability • Provision of recommendations for future monitoring studies and possible interventions. **Initiative period**: May 2022 – January 2024
Shark Population Studies	DESI and Queensland Parks and Wildlife Service (QPWS) commissioned Biopixel Oceans Foundation to conduct a study on shark prevalence, movements, and behaviour around North-West Island. The project spanned four to six trips over two years. It involved: DAF, in collaboration with: • Catching sharks using set lines, tagging them with acoustic devices, and releasing them to track their movements • Utilising underwater cameras and drone surveys to monitor shark activity • Analysing shark movements in relation to human activities. **Initiative period**: 2022 – 2024
Barriers To Adopting SharkSmart Messages – Behaviour Change	DAF commissioned Hall & Partners to conduct independent research on studying and influencing responsible fish waste disposal to reduce shark bite risk in areas frequented by humans. The research focuses on the Whitsundays and Moreton Bay regions in Queensland, Australia, and is structured in two phases: • Phase 1: A combination of qualitative and quantitative research, including stakeholder interviews, ethnographic immersions, and a survey, to understand behaviours and attitudes toward fish waste disposal • Phase 2: A qualitative evaluation of behaviour change strategies with fishers and swimmers, aimed at developing effective behaviour change interventions. **Initiative period**: July 2022 – June 2025
Assess Personal Deterrents	An experimental study was conducted in collaboration with Flinders University to test the efficacy of commercially available personal shark deterrents on Tiger sharks. The two Shark Shield Pty Ltd products tested were: • Ocean Guardian Freedom+ Surf: A product designed for surfers • Ocean Guardian Freedom7: A product designed for divers and swimmers.

Initiative	Description
	Both products work by emitting electric pulses that disturb the sharks' electroreceptive systems, potentially deterring them from biting. This technology had previously been shown to be effective on Bull sharks and White sharks. Trials were conducted at two locations – Norfolk Island and Saunders Reef – and involved the following: • Attaching shark deterrents (either the active deterrent or a control, which mimicked the appearance of the device without being active) to a buoyant board, with bait placed nearby to attract sharks • Recording Tiger shark interactions with the equipment, using 360-degree cameras • Analysing video footage to categorise shark behaviours using predefined ethograms. **Initiative period**: December 2021 – 2022
Value Contribution of SCP to Qld Economy	The SCP commissioned an economic analysis of the SCP. The objective of the analysis was to build an understanding of the economic returns provided by the SCP at the local, regional, and state levels, and to support decision-making by comparing the costs and benefits of the Program. It achieved this by applying a Cost-Benefit Analysis (CBA) framework that considers two project options: • Option 1: Business-as-usual, where the SCP continues in its current capacity • Option 2: Enhanced SCP, where the capacity and scope of the program are increased through the use of trialled technologies. The quantified benefits include reduced shark-related fatalities and injuries, increased tourism expenditure and environmental impact, while operational costs and capital expenditures make up the costs. **Initiative period**: June 2020 – June 2023

Scientific Working Group (SWG)

Research initiatives are complemented by reviews and input from the SWG. This multidisciplinary body consists of stakeholders and subject matter experts from DAF, DTS, GBRMPA, SLSQ, government agencies, and academic institutions. Its primary role is to convene to offer expert guidance on various aspects of the SCP, including the evaluation and implementation of alternative shark mitigation technologies, species-specific shark behaviour and research, and overall program management.

SWG period: 2017 – present (ongoing)

Public Sentiment Research

The need for a Public Sentiment Research initiative arose from heightened public awareness of the SCP and growing concerns about its appropriateness in a modern context. Results from initial SharkSmart Surveys gave a snapshot of the levels of support for shark mitigation measures. DAF identified an opportunity to further investigate unprompted sentiment about SCP equipment and alternatives, and to explore areas of misunderstanding and has since progressed the Public Sentiment Research initiative.

This initiative seeks to investigate opinion about SCP equipment and alternatives. It will involve:

- Qualitative research and quantitative surveying of a large and diverse sample, encompassing individuals from various risk profiles and geographical locations
- Capture public opinions on SCP equipment and alternatives, such as shark nets, Traditional Drumlines, Catch-Alert Drumlines, SharkSmart Drones and education

- Educate participants on the function and practicalities of SCP equipment and alternative and resurvey to capture their updated views.

Public Sentiment Research period: 2024

Effectiveness of implementation

The effectiveness of the implementation of the research is summarised in the below table.

Table 4-19: Effectiveness of implementation for research

Research	Effectiveness of implementation
Prevalence and Behaviour of Sharks in the Whitsundays	✓ Out of 270 sharks caught across 23 species in the Whitsundays region, 135—including Tiger and Bull sharks—were successfully tagged. ✓ Accumulated 3.5 years of shark movement data through both acoustic and satellite methods to detail shark behaviour, allowing for longitudinal analysis. ✓ Stakeholders agreed to expand the research program from Cid Harbour to investigate the broader Whitsundays region. ✓ Human behaviour, such as the disposal of food scraps, was identified as a possible attractant for sharks in the region. ✗ Bull sharks were elusive, which impeded a detailed understanding of their behaviour in Cid Harbour. ✗ Some acoustic receivers were damaged or lost, preventing complete data recovery.
Support the Integrated Marine Observing System Queensland Acoustic Telemetry Array (Shark Tagging and Tracking)	✓ Shark tagging has been executed as intended so far, with 150 Tiger sharks and 34 Bull sharks tagged. ✓ Data from sharks tagged through the IMOS acoustic tracking program has been integrated, allowing for comparison of behaviour of sharks tagged at SCP beaches with those tagged at IMOS sites. ✓ Over 42 percent of tagged Tiger sharks and 52.9 percent of tagged Bull sharks were detected throughout the IMOS receiver network, indicating successful tracking of relocated sharks after release. ✓ Twenty additional receivers were successfully procured to address gaps in coverage and redundancy. ✓ Changes to the *Veterinary Surgeons Act 1936* (Qld) and *Animal Care and Protection Act 2001 (Qld)* enabled researchers to internally tag sharks which has been shown to provide data for a longer period of time post-release (up to 10-year battery life) than attaching the tag externally. ✓ Working to increase coverage through the procurement and deployment of more receivers. ✓ The IMOS array is critical to the success of a range of research and trials, including the Catch-Alert Drumline Trial, Shark Tagging and Tracking, Shark Population Studies, Whitsundays and North West Island Shark Studies. ✗ Due to poor retention of external tags and lower catch rates, data on Bull sharks was relatively limited, making it challenging to draw robust conclusions about their behaviour compared to Tiger sharks.
Investigating Fishing Depredation	✓ Genetic analysis of swab samples to identify shark species involved in depredation was effective, with an 83.5 percent success rate. ✓ A total of 167 samples out of 200 analysed were successfully tested, identifying 12 species of sharks, with Bull sharks the most common depredators. ✓ From 550 hours of footage, 21 depredation events were captured. ✗ Despite extensive promotion through newsletters, social media, and direct outreach, mobile app uptake was minimal, with only 11 sign-ups and nine depredation entries. ✗ Some cameras were lost during the study when sharks broke the fishing lines, which reduced video coverage of depredation events.

Research	Effectiveness of implementation
	✗ There was notable resistance from fishers, with some hesitant to collaborate with DAF due to existing frustrations with fisheries management.
Shark Population Studies	✓ The North West Island study into local shark populations has been delivered on time with a draft final report now in preparation. ✓ Tiger shark population study commenced through a collaborative project. ✓ Ongoing collection of genetic samples from sharks caught in Operations continues to contribute to future research aimed at estimating the population of Tiger sharks.
Barriers To Adopting SharkSmart Messages – Behaviour Change	✓ Phase 1 completed as planned, finding that a high proportion (97 percent) of fishers were already disposing fish waste in ways that minimised risks. ✓ Successfully engaged with 12 key stakeholders and surveyed 1,000 fishers. ✓ The "fish-a-longs", where researchers physically accompanied recreational fishers on their fishing trips, were a success, allowing researchers to observe real behaviours rather than relying on self-reported data.
Assess Personal Deterrents	✓ Delivery of the research was undertaken by an experienced team of shark experts who combined research activities to deliver efficiencies in field work. ✓ The efficiency of electric deterrents to reduce shark bites from Tiger sharks was successfully tested, with electric deterrents reducing shark bites by ~60 percent. ✓ Findings from the study were delivered on time and a peer-reviewed article summarising the results has also been published. ✗ Attempts to collect data on the distance between sharks and the deterrent boards failed due to restrictions of the cameras, limiting understanding on how far sharks stayed from the deterrent.
Value Contribution of SCP to Qld Economy	✓ The CBA was delivered as intended, finding that both business-as-usual (Option 1) and the enhanced SCP (Option 2) provide positive economic returns to Queensland, with the latter providing the highest overall benefits.
Scientific Working Group	✓ The SWG met 10 times over the Plan period to discuss a range of topics which Program stakeholders felt provided meaningful guidance.

Source: Stakeholder interviews, Shark Control Program website, and, where available, interim and final research reports.

Improving human safety

Due to the nature of research initiatives, they do not immediately produce direct and measurable improvements in human safety. However, some research efforts indirectly contribute by expanding the Program's understanding of shark behaviour and human activities, or by providing evidence to support alternative technologies, which in turn informs education programs, trials, or operational strategies that ultimately enhance safety outcomes. Therefore, the effectiveness of research in improving human safety is assessed by how well the potential outputs of each initiative align with the following two outcomes:

A reduction in the **immediate risk of human-shark interactions**

A reduction in **shark bite occurrences**

Stakeholders viewed the delivery of research as a crucial component of the SCP, underpinning the Program's efforts to provide more targeted operations and identify future solutions to supplement current protection efforts.

The potential contribution of each initiative to these goals is detailed below, while initiatives with outputs that do not align are excluded.

Prevalence and Behaviour of Sharks in the Whitsundays

A potential reduction in the risk of immediate human-shark interactions and shark bites

While this research project found no unusual abundance of Tiger sharks or Bull sharks in Cid Harbour, it offered valuable insights for enhancing human safety by highlighting the potential role of human behaviour, such as boaters disposing of food waste and intentionally feeding sharks, in attracting sharks to the area.[92]

The report also recommends the ongoing monitoring of shark behaviour and human activity in high-traffic areas, like anchorages and swimming zones, under various environmental conditions, to inform targeted, site-specific shark mitigation strategies.[93] These operational optimisations would intuitively lead to improved human safety outcomes.

Support the Integrated Marine Observing System Queensland Acoustic Telemetry Array

A potential reduction in the risk of immediate human-shark interactions and shark bites

This shark tracking initiative collected detailed data on Tiger and Bull shark behaviour after release from drumlines, providing an evidence-base for the effectiveness of Catch-Alert Drumlines in safeguarding beachgoers (e.g. identifying the movements of tagged sharks post-release from Catch-Alert Drumlines). The data shows that certain species and groups spend more time at some locations and identifies areas of higher shark activity, such as Magnetic Island, Ellis Beach and Amity Point.[94] This information can be used to refine future shark mitigation measures by reconfiguring equipment to target specific locations or enhance monitoring efforts in key areas.

Assess Personal Deterrents

A potential reduction in the risk of shark bites

This initiative contributes to the scientific evidence-base for the ability of electric repellents to improve human safety. The experiment of the personal deterrents confirmed their effectiveness against Tiger sharks, finding that the products decreased the proportion of Tiger shark bites by approximately 60 percent.[95] This result adds to the previous findings that the technology works against Bull sharks and White sharks, demonstrating protection against the three most dangerous species. The evidence generated from this study is expected to support broader adoption of the technology.

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[92] Barnett, A., Abrantes, K., Bradley, M., Fitzpatrick, R., Sheaves, M., & Bennett, M. (2021). *Prevalence and habitat drivers of parallel movement patterns of coastal predators*. Queensland Government. https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/ac9f0f89-a69e-43de-b11f-0086895783f6/barnett-a.-abrantes-k.-bradley-m.-fitzpatrick-r.-sheaves-m.-and-bennett-m.-2021.-prevalence-and-.pdf?ETag=9b4da9760200be51067585195c8e2226

[93] Ibid.

[94] Department of Agriculture and Fisheries. (2024). *Shark Tracking Program interim report: July 2024*. Queensland Government.

[95] Clarke, T. M., Barnett, A., Fitzpatrick, R., Ryan, L. A., Hart, N. S., Gauthier, A. R., B., T., & Huveneers, C. (2024). Personal electric deterrents can reduce shark bites from the three species responsible for the most fatal interactions. Scientific Reports, 14(1), 1-12. https://doi.org/10.1038/s41598-024-66679-6

Minimising adverse ecosystem impacts

Given that the Research pillar does not produce outcomes with a direct and measurable impact on the delivery of SCP ecosystem improvements, the alignment of research outputs with the following outcome is instead considered:

A reduction in **adverse ecosystem impacts**

There is no research initiative focused primarily on the Program's impact on ecosystem health. However, research does seek to understand some aspects of the ecosystem by way of investigating shark populations and behaviour. In the case of the Shark Tagging and Tracking Program, one objective is to monitor the survivability of sharks captured and released in the GBRMP, including Catch-Alert Drumlines. This research, in turn, helps provide an evidence-base for the effectiveness of Catch-Alert Drumlines which, if determined successful, can lead to improved ecosystem outcomes through the technology's wider roll-out. Similarly, by proving the effectiveness of personal shark deterrents to mitigate human-shark interactions, which pose no risk to marine life, the Research pillar supports its adoption thereby reducing reliance on harmful measures (e.g. Mesh Nets, Traditional Drumlines).

Stakeholders view interventions in the ocean for research purposes, particularly initiatives involving the capture and release of sharks, as inevitably leading to some mortality and injury among marine wildlife. However, given the low frequency of these occurrences, their impact is considered negligible, especially when weighted against the potential benefit of research to inform improvements in human safety and education.

Delivering shark risk education

Research findings inform Program decision-making regarding education delivery, potentially improving future iterations of the SharkSmart Campaign. The effectiveness of research in delivering shark education is considered in terms of whether the potential outputs of each initiative align with enhancing the SharkSmart Campaign.

The potential for research to advance an understanding about sharks and their behaviour is viewed as an important aspect of the SCP because of its capacity to develop better educational material that more precisely addresses shark risks.

The potential contribution of each initiative to educational outcomes is detailed below, with initiatives that do not align or lack available information excluded.

Prevalence and Behaviour of Sharks in the Whitsundays

The research outputs from the Whitsundays' study identified human behaviour as a key factor in influencing shark activity in the region. In particular, it identified the frequent depositing of waste and fish scraps in the waters around the Whitsundays as problematic, supporting the decision to launch the Barriers To Adopting SharkSmart Messages – Behaviour Change initiative to explore better ways of influencing fishers' behaviour to stop discarding fishing waste into the water in areas where people swim.

Early findings from the study prompted the introduction of new educational signage for tourists and fishers, advising against depositing waste and fish scraps into the water. Additionally, two educational videos were created to guide visitors on how to be SharkSmart in the Whitsundays, with a separate video for the offshore islands of the GBRMP. The design and content of signage evolved throughout the research, incorporating fewer words, more imagery, and multilingual text. Additionally, the report's locational findings on shark activity informed the continued deployment of floating signage to provide more targeted warnings to off-shore water users.

Support the Integrated Marine Observing System Queensland Acoustic Telemetry Array

Data from the Shark Tagging and Tracking research revealed that certain species and groups are more prevalent at specific locations, identifying areas with higher shark activity, such as Magnetic Island and Ellis Beach. This information can be used to inform future education campaigns (e.g. signage) to certain times and places.

Barriers To Adopting SharkSmart Messages – Behaviour Change

Phase 1 of the research initiative found that, while most fishers responsibly disposed of fish waste in areas where people use the water, confusion around proper disposal practices and entrenched habits persisted, particularly

near swimming areas.[96] Some fishers did not view practices, such as using fish scraps such as berley, as a risk and were heavily influenced by their peers, often seeking validation from others about appropriate fish waste disposal practices. These findings will inform Phase 2 of the research and aid in identifying bespoke SharkSmart education measures that influence this target group's behaviour.

4.1.4 Education

The Education pillar is focused on raising public awareness about shark risks and promoting safer beach behaviours through the SharkSmart Education Program. Initiatives delivered under the Program include:

- SharkSmart Education Program
- Investigate human behaviour change
- Upgrade Signage
- Undertake Website Transformation
- Support Operations and Trials.

These education initiatives are described in more detail in the table below. The Investigate Human Behaviour Change initiative was found to fall under the Barriers to Adopting SharkSmart Messages – Behaviour Change research initiative and is excluded.

Table 4-20: Research Initiatives delivered in the Queensland's Shark Management Plan (2021-2025)

Initiative	Description	Locations
SharkSmart Education Program 	The primary initiative delivered under the SCP's Education pillar is the SharkSmart Education Program, which aims to educate beachgoers and the broader public about shark risks, safe swimming practices, and how to minimise the likelihood of shark encounters. The SharkSmart Campaign, launched in 2019, featuring the following elements: • Advertising: google search, catch up TV, radio, YouTube, Spotify and social media ads promoting key behaviours, such as swimming between the flags and avoiding swimming at dawn and dusk • Signage and Posters: Signage and public posters (digital and print) providing safety tips and shark warnings • The SharkSmart Website: The program website delivers videos and tips providing safety advice, program information updates and recent operational data • Public Feedback: Surveys and research monitor the campaign's effectiveness and inform future improvements. Messaging is seasonal, targets peak periods and user groups based on location, and is informed by tourism data. The core messages delivered are: • **S**wim between the flags at patrolled beaches and check signage • **H**ave a buddy and look out for each other • **A**void swimming at dawn or dusk To keep fish waste and food scraps out of the water where people swim • **R**educe risk, avoid schools of bait fish or diving birds	• State-wide

[96] Hall & Partners Behavioural Science Unit. (2023). *SharkSmart Behaviour Change Project: Phase 1 final report*. Department of Agriculture and Fisheries.

Initiative	Description	Locations
	• **K**eep fish waste and food scraps out of the water where people swim • **S**wim in clear water away from people fishing. **Initiative period:** 2019 – present	
Upgrade Signage	Following the shark bites at Whitsunday Islands and North West Island, shark risk signage was upgraded. This included: • Deployment of additional signage • Altered signage, featuring less text and more imagery to improve communication of messaging especially to international audiences • Multilingual signage so that messaging can be understood by international visitors • Deployment of floating signs to reinforce warnings about shark risks offshore.	• Whitsunday Islands • North West Island
Undertake Website Transformation	An upgrade of the SharkSmart website was undertaken to: • Improve clarity of SharkSmart messaging • Improve access to information on equipment and their locations, SharkSmart tips, and program research and data • Enhance user interface for better usability. **Initiative period**: 2023	• State-wide
Support Operations and Trials	The Support Operations and Trials initiative is responsible for addressing public inquiries and ensuring timely communication with the community regarding various aspects of the Program, including equipment, whale entanglements, and guidance on reducing shark interactions. It involves developing targeted 'Communication and Engagement Plans' for specific initiatives (e.g. SharkSmart Drone trial, Catch-Alert Drumline Trial).	• State-wide
Public Sentiment Research	Public sentiment towards the Program has been preliminarily measured through the Swimmer Safety (SharkSmart) Campaign Evaluation. Two additional projects are currently underway to provide further insights into various elements of the Program: • Public Sentiment Research project: A survey designed to record sentiment toward the Program's shark control approach and equipment effectiveness. • Public Sentiment of Personal Deterrents: A university study looking into sentiment toward the effectiveness and use of personal shark deterrents.	• State-wide

SharkSmart target audiences

The Kantar Public segmentation of water users has been the key tool for identifying and tracking target audiences for the campaign since 2019. Of the four segments identified, the primary target audiences have been the 'Positive Preventers' and 'In-Between and Keen,' who, together, account for 50 percent of Queensland water users. In 2021-22, the 'She'll Be Righters' were identified as a secondary audience (12 percent). Description of these target groups is as follows:

- In-Between and Keen: As the name suggests, they align with overall sample characteristics most of the time. They are more likely to believe that a range of SharkSmart behaviours are effective in reducing risk

and are more confident in their own ability to adopt these behaviours. They know what actions prevent risk and consistently avoid risky behaviours.

- Positive Preventers: This group is confident in knowing how to behave to reduce risk and understands where to find information on effective risk-reduction strategies.
- She'll Be Righters: This group is more likely to engage in risky behaviours and is less concerned about the consequences. This group is less likely to adopt SharkSmart behaviours, less likely to believe they are effective, and have less confidence in carrying them out.
- The 'Scared Believers' are not targeted, as they are less likely to encounter a shark but are more prone to anxiety and worry about a potential encounter.

Source: DAF Audience Profiling 2024

Effectiveness of implementation

The effectiveness of the implementation of education is summarised in the table below. The Support Operations and Trials initiative is excluded given its operational and reactive nature.

Table 4-21: Effectiveness of implementation for education

Education	Effectiveness of implementation
SharkSmart Education Program	✓ The SharkSmart Campaign was implemented through signage, the SharkSmart website, SeaWorld, SLSQ and various advertising modes. ✓ Of the advertising modes, six out of seven nearly delivered or surpassed DAF's target, with Meta, YouTube and Spotify having the greatest reach.[97] o Meta: Fell slightly below the target (13,698,194 impressions) with (13,337,721 impressions) o YouTube: Achieved nearly double the target (418,301 views) with 827,919 views o Spotify: Slightly surpassed the target (894,631 impressions) with 895,171 impressions ✓ Sponsorships or collaborations with partners, including SLSQ, SeaWorld, and Noosa Biosphere Reserve Foundation (NBRF), have enabled the Program to achieve a wide reach that leverages target audiences. ✓ Partnership with NBRF to deliver the SharkSmart initiative as 'SurfSmart,' targeting the local surfing community. SurfSmart functioned as an interactive calendar where scientific knowledge was enhanced with local surfer and stakeholder knowledge to identify and agree on the times, locations, and conditions that posed the greatest risk of shark incidents. ✗ Personnel changes during the 2023 Spring school holiday period interfered with the scheduled media campaign for that time. ✗ Approval processes for advertising also interfered with media campaign schedule.
Upgrade Signage	✓ Floating signage was deployed at the Whitsunday Islands as intended. ✓ Enhancements were made to signage at the Whitsunday Islands and North West Island as intended.
Undertake Website Transformation	✓ Website upgrade was delivered as intended and under budget. ✗ The mapping tool was initially resisted by DAF. ✗ Some 'bugs' exist, such as the incorrect display of Catch-Alert Drumline on the equipment map.
Support Operations and Trials	✓ DAF officer responded to several inquiries, disseminating educational and informative material on the Program and shark risks. ✓ Developed Communication and Engagement Plans and briefed key stakeholders on trial progress and outcomes.

[97] Essencemediacom (2023), *SharkSmart 22-23 PCR.* The targets used in this assessment were defined by Essencemediacom.

Education	Effectiveness of implementation
Public Sentiment Research	✓ Survey conducted as part of the Swimmer Safety (SharkSmart) Campaign Evaluation, providing indicative insights into public sentiment toward the Program. Additional research currently underway.

Improving human safety

The primary goal of the Education pillar is to improve human safety through spreading awareness of shark risks and shark safe behaviours. There is unanimous agreement among stakeholders that the SharkSmart Campaign has been effective in improving human safety, with many pointing to education as having the greatest potential to reduce human-shark interactions into the future. This is especially the case for less popular beaches, where there is an absence of traditional operations and SLSQ presence which leaves beachgoers dependent on their own judgement to protect themselves and others from potential shark encounters.

To evaluate the effectiveness of the Program's Education pillar to improve human safety, the degree to which the SharkSmart Campaign has achieved the following outcome is assessed:

A reduction in the **immediate risk of human-shark interactions**

A reduction in the immediate risk of human-shark interactions is determined by the extent that the Program meets its objectives of increasing shark safe awareness, attitudes and behaviours – based on the logic that an increase in these psychosocial factors within the population reduces the likelihood of water-users unknowingly engaging in behaviours that elevate the risk of human-shark interactions.

The three psychological outcomes of the SharkSmart Campaign are measured using results from the Swimmer Safety (SharkSmart) Campaign Evaluation ('the SharkSmart survey') [98], conducted over five separate years since 2019. The survey shows that the SharkSmart Campaign has improved awareness, attitudes, and behaviours since its inception, indicating a reduced immediate risk of human-shark interactions during the Plan period compared to the previous period where there was no education campaign. This assessment is detailed in Section 0.

Limitations in linking education to shark bite occurrences

Measuring the effectiveness of the SharkSmart Education Program to reduce shark bite occurrences is a limited exercise. The rarity of shark bites, combined with various confounding factors, makes it difficult to attribute any changes in shark bites directly to education. Inconsistent uptake of shark safe behaviours and awareness across the state and the lack of controlled conditions further decreases the reliability of such an approach. For these reasons, the outcome of "a reduction in shark bite occurrences" is not considered as part of the evaluation of education. However, when considered logically, reduced human-shark interactions lead to decreased shark bite incidents, assuming all other factors remain constant.

[98] Smallcombe, K., & Nuss, K. (2024). *SharkSmart Campaign Evaluation: April 2024*. Verian, for the Department of Agriculture and Fisheries.

Minimising adverse ecosystem impacts

The delivery of education does not produce, and is not expected to produce, outcomes that impact the marine ecosystem.

Delivering Shark education

To evaluate the Education pillar's delivery of shark education, the extent to which each education initiative produced the following three outcomes is assessed:

Increase in **public awareness of shark-safe behaviours**

Increase in **public attitude towards personal responsibility for shark risks**

Increase in **shark-safe behaviour**

Each outcome is assessed according to the corresponding measure taken from the SharkSmart survey, which are:

- **Respondents' awareness of shark risks:** Describes the knowledge or understanding people have about where to find information and how to behave in ways that reduce the risk of shark interactions. An increase in this factor represents a greater proportion of the population who are equipped with the necessary knowledge to avoid human-shark interactions.
- **Respondents' attitude toward shark risks:** Details the beliefs and feelings of individuals towards shark safety, such as the acceptance that personal actions in the water can influence the chances of a shark interaction. An increase in this factor represents improved responsibility among Queensland's population of their actions to manage shark risks.
- **Respondents' shark safe behaviours:** Refers to the actions taken by individuals to avoid shark risks based on their awareness and attitudes, such as swimming between the flags, avoiding swimming at dawn or dusk, and keeping fish waste out of the water. An increase in this factor represents more individuals acting responsibly to safeguard themselves from shark encounters.

Limitations of the SharkSmart Campaign survey outcomes

The SharkSmart Campaign survey is limited to individuals who are aged 16 years and above and are residents of Queensland – overlooking domestic tourists and international visitors who stakeholders consider higher-risk given their lack of understanding of the Australian environment and allure to coastal regions. The sample size for the 2024 survey (n=771) may introduce sampling bias and limit the ability to accurately reflect the views of the broader population of Queensland water users. Respondents provide their recollections and intentions, which makes them susceptible to self-report bias, potentially leading to inaccurate reporting of their behaviours.

This Section 0 uses the surveyed responses for attitude, awareness, and behaviours as a proxy for reducing human-shark interactions. Thus, the approach taken does not account for the full range of factors (e.g. environmental conditions) that influence the risk of shark encounters.

Results from the most recent SharkSmart Campaign survey are summarised in the table below.

It was observed that:

- Overall, the campaign observed progress, with B3, B5 and B6 all recording their strongest responses yet in 2024, and responses for all criteria being higher than in 2019, apart from AT1. Except for AW1, all results are within 5 percent of DAF's targets. However, results have remained stable since 2023. This suggests the impact of the current SharkSmart Campaign, in its current form, has reached its potential (to shift shark safety awareness, attitudes and behaviours) and has plateaued.[99]

[99] Government of Western Australia. SharkSmart. (n.d.). *Staying Safe*. https://www.SharkSmart.com.au/staying-safe/

- Awareness is slightly decreasing, below DAF's target: Decreases are observed across both AW1 and AW2, with 2024 marking the worst year for both criteria since 2019. The result for AW1 sits seven percentage points behind DAF's target while AW2s is four percent short. This demonstrates that the effectiveness of the SharkSmart Education Program is below expectations with particular improvement needed to increase awareness of where to find information about protecting oneself from shark encounters.
- Attitude has remained stable, below DAF's target: In 2024, the number of people who identified as responsible for managing their own risk for human-shark interactions sat slightly below DAF's target of 76 percent. Responses have remained stable around this mark since 2019, with variations no greater than two percent.
- Behaviour has remained stable, most criteria are below DAF's target: B5 is the only criteria that meets DAF's target across all three psychosocial factors, with 2024 representing the best response yet at 81 percent, a 17 percent increase on 2019. The remaining five criteria all fall below DAF's targets, although the results for B3 show the largest gap at 6 percent. Since 2019, all responses have improved by at least 4 percent with B3 seeing the largest gain (20 percent). These results demonstrate that, while the SHARK acronym behaviours have become more widespread, further improvement is needed.

Table 4-22: SharkSmart Campaign evaluation results 2024

Category	Description	DAF Target	Apr-24	Jan-23	Jul-22	Feb-21	Dec-19
Awareness	AW1: Increase awareness of where to find information about protecting yourself from a shark interaction	**51 percent**	44 percent	47 percent	48 percent	48 percent	40 percent
	AW2: Increase awareness of how to behave in a way that reduces risk of a shark interaction	**67 percent**	63 percent	65 percent	64 percent	64 percent	60 percent
Attitude	AT1: Encourage target audiences to accept that their actions in the water will make a difference to their chance of shark interaction	**76 percent**	75 percent	76 percent	74 percent	74 percent	76 percent
Behaviours	B1: Swim between the flags at patrolled beaches and check signage	**86 percent**	84 percent	86 percent	83 percent	83 percent	82 percent
	B2 Have a buddy and look out for each other	**80 percent**	78 percent	80 percent	80 percent	80 percent	70 percent
	B3: Avoid swimming at dawn or dusk	**83 percent**	77 percent	77 percent	75 percent	75 percent	63 percent
	B4: Reduce risk, avoid schools of bait fish or diving birds	**80 percent**	79 percent	80 percent	77 percent	77 percent	-
	B5: Keep fish waste and food scraps out of the water where people swim	**81 percent**	81 percent	77 percent	80 percent	80 percent	64 percent
	B6: Swim in clear water and away from fishers	**86 percent**	84 percent	84 percent	83 percent	83 percent	77 percent

Source: Swimmer Safety (SharkSmart) Campaign Evaluation. April 2024.

Stakeholders identified that the SharkSmart Campaign was successful in educating the public on shark risks, with most surveyed participants agreeing with the campaign's overall sentiment and messaging. The campaign's effectiveness was attributed to its catchy and memorable tagline and its collaborative and respectful tone, which does not evoke strong negative feelings such as fear. Nonetheless, respondents reported effectiveness could be improved by strengthening the connection between the campaign's behaviours and the topic of shark safety through more explicit image selections. **This is reflected in a decrease in the campaign's Affective Memory Potential (AMP) from 36 percent in 2021 to 24 percent in 2024, indicating a diminishing level of impact and relatability of the campaign.** The AMP score reflects the measure of a marketing campaign's novelty, emotional

impact, and relevance to the audience. A plateau across all three of the psychosocial themes further reinforces the potential for improvement in the campaign.

While prompted recall of the SharkSmart Campaign remained steady at 43 percent of all Queensland water users, **unprompted recall of any swimmer safety and shark awareness advertising has seen a decrease in 2024 (44 percent from 49 percent in 2023)**. However, this score is still within the Social and Government Benchmark of at least 23 percent. Signage at beaches and posters in public places near beaches are increasingly considered the most effective locations to advertise SharkSmart education messaging, with the former scoring 74 percent (the highest of all advertising modes).

High-risk water users – such as surfers and spearfishers – found the SharkSmart messaging ineffective towards them. This is reflected in the AMP scores, where high-risk individuals scored 23 percent compared with 25 percent for moderate risk in 2024. There are still good grounds to retain many of the existing shark safety behaviours, as these effectively informed less frequent water users and those participating in lower-risk water activities. However, experienced individuals involved in higher-risk water activities often did not see themselves as the target audience and found the campaign less engaging.

Informing other activities in the SCP

The four pillars of the SCP are interconnected, where improving the effectiveness of one pillar has a flow-on effect to the others. This demonstrates that maintaining and improving the effectiveness of the SCP requires consideration of all pillars.

The Operations pillar is the foundation of the SCP. It provides on-field insights into ecosystem and equipment conditions, as well as shark activity, through the reporting of catch data, SCP crew insights, and the provision of deceased shark specimens, which inform the development of research initiatives and program monitoring. Changes in Operations and trials lead to corresponding changes in education, as the Program keeps the public informed on current mitigation measures by publishing catch data and progress reports online. The relationship between research and trials is circular, with research guiding trial design and expected outcomes, and trials either confirming or questioning research findings, which leads to further research or discussion. If a trialled technology is found to be effective and suitable for Queensland, it is implemented in Operations, with Operations acting as a baseline for assessing trial outcomes. Educational programs are shaped by research that identifies shark activity, locational risk, and human behaviour, that subsequently enable more targeted and accurate educational interventions. Moreover, research findings can inform adjustments to current Operations to improve efficiency, human safety or ecosystem outcomes.

Table 4-23: Relationship matrix of the SCP's pillars

	Operations	Trials	Research	Education
Operations		Operations serve as a baseline for assessing trialled technologies or strategies, allowing for the evaluation of differences in risk profile and ecosystem impact.	Operations support research with the provision of deceased sharks for study as well as information on day-to-day activities, including catch statistics and contractor insights on equipment and environmental conditions.	Operational data is uploaded to QFish to educate the public on the SCP's fishing outputs. Any changes in Operations (i.e. equipment or process) are reflected in engagement material.
Trials	Trials inform Operations by testing and validating new processes, technologies, or strategies to validate their effectiveness and feasibility for potential implementation in operations.		Trials contribute to research by enabling initiatives (e.g. tagging sharks caught on Catch-Alert Drumlines) and providing evidence that validates or challenges existing ideas.	Trial outcomes are communicated to the public.
Research	Research informs improvements to operations.	Research provides the foundation upon which trials are designed and conducted.		Researching human behaviour and shark populations and behaviour is instrumental in shaping the content and delivery of education campaigns. These topics made up the majority of research during the Plan period.[100]
Education	Educating the public supports the delivery of operations, trials and research by keeping the community informed about the Program's actions and progress toward objectives.			

[100] Queensland Government. (2021). *Queensland shark management plan 2021-2025.* https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/2879505f-f118-481c-aac5-38b952945851/queensland-shark-management-plan-2021-2025.pdf?ETag=c02bee17b4a21a3412af0794004ac958

4.2 Factors influencing the delivery of the outcomes

The delivery of the SCP is a complex undertaking influenced by environmental concerns and socioeconomic dynamics. In terms of perceived changes in the environment, there is a growing awareness of the ecological impact of shark control activities, prompting environmentally sensitive practises to protect both human life and marine ecosystems. These practises must also be economically and administratively viable. Funding levels and adherence to legislative requirements directly affect the scope and technological innovation possible within the Program. By engaging with stakeholders and conducting desktop research, the external influences that may support or impede the Program have been identified as follows:

High level of political decision-making scrutiny requires a sound evidence base to underpin the Program and any changes

The SCP receives a high-level of scrutiny, with the SCP being a topic of discussion in Queensland Government Estimates in 2023 and 2024. Program changes endorsed by the Minister for DAF can have political implications and DAF ensures that all changes are appropriately reviewed and signed off before implementation. A high level of oversight process makes implementing operational changes more challenging.

DAF officers contributed to the Program's success

Program staff at DAF were well-regarded by numerous stakeholders for their enthusiasm for innovation and their openness to change. The effort they invested in sustaining positive relationships, including their networking with non-government organisations (NGOs) and partners, was also commended by stakeholders.

Partnerships have played a crucial role in the Program

The consensus among stakeholders is that the implementation of the Program would not have been achievable without the collaborations that the SCP maintains with contractors, agencies, and various organisations. The success of SharkSmart was enabled by the partnership with SeaWorld, SLSQ, and other entities within the tourism industry. This cooperation has been instrumental in disseminating information to those who need it most regarding safe swimming practices.

DAF understands that maintaining credibility and being open about Operations is critical to building trust with society. Stakeholders reported that the SCP has a good relationship with respected and knowledgeable scientists. This has increased the credibility of SCP research. DAF has also been open to communicating with NGOs to hear their concerns. This has benefited both organisations - the NGOs' perspectives are received and DAF is able to share information on the SCP, particularly how it is responsive to stakeholder values.

Research and trials of new technologies to manage sharks in Queensland waters have been effective pillars of the Program. These would not have been possible without their partners in academia and other agencies. These technologies include drones, Catch-Alert Drumlines, personal protective equipment and shark barriers. The findings from this research are publicly available and stakeholders interviewed supported the ongoing development of these technologies.

The SCP also values the knowledge and expertise of the contractors who handle the specialised equipment used to mitigate shark interactions with humans. According to stakeholders, this cooperation has led to a culture of knowledge-sharing, enhancing safety practices during marine operations.

Collaboration with local government has improved Program outcomes

Achieving an effective SCP relies on the continued support of local governments and other government agencies. Stakeholders mentioned that educational campaigns have benefited from local government support. Furthermore, DTS and SLSQ have provided financial support to help implement research, trials and education initiatives.

Some operational equipment constraints are present in the SCP

Operations were reported as the key limitation of the current Program. Stakeholders reported that some beaches have equipment operating with chains which are larger and heavier than necessary. This is a result of legacy equipment still being utilised. Furthermore, shark nets are becoming more difficult to acquire. Stakeholders reported that there are only a few remaining suppliers who can produce nets. This has made the procurement of new nets more expensive. Finally, sourcing insurance to manage SCP equipment is challenging as no insurance companies located in Australia are willing to insure contractors.

Public questions and enquiries are time consuming drawing on officer time

DAF officers are responsible for managing public questions and inquiries, including calls from the general public reporting instances of whales caught in SCP equipment. Due to the high volume and detailed nature of these calls, responding to public inquiries is time-consuming and delays other responsibilities assigned to these officers.

Transparency of data is well supported but improvements have also been identified

The openness of catch information from SCP operations are enabled by QFish. This is a DAF-wide platform for marine animal catch records. Catch data for the SCP is made publicly available through this platform which includes shark and non-target species. Stakeholders were highly supportive of the transparency and hoped other jurisdictions would follow this example. Some stakeholders reported that the software can be difficult to use. There have been delays in uploading new catch data which has caused some NGOs to become concerned. Another concern raised by stakeholders was that QFish is not widely known in the general public. The database is typically one used by serious fishermen. They reported that the information could be made more easily accessible to the general public.

Bad weather impacts negatively on Operations for contractors

There are a variety of environmental factors which impact the effectiveness of the SCP. This includes how non-target species interact with the equipment and the conditions in which the equipment operates. During periods of bad weather, Mesh Nets are removed to prevent damage. This means that, during these periods, there is a reduced presence of shark protection equipment in the water. However, the risk to human life is not likely to increase accordingly as there are generally less bathers in the water during these times (although there can be more surfers).

Whale entanglements impact the animal, trigger additional operations and damage operating equipment

The humpback whale population has increased around Australia since the prohibition of whaling was introduced in 1978. This has correlated with an increase in whale interactions with SCP equipment, particular Mesh Nets. These interactions typically damage the net itself and significant SCP resources are devoted to trying to free the whale from the net.

Bycatch reduces support for the Program

The public support for the SCP is undermined by the incidental capture of non-target species in their conventional drumlines and shark nets. Incidents where whales become entangled in these nets often attract angry public attention, leading to calls from various groups and local authorities for the SCP to switch to non-lethal shark management methods. Additionally, stakeholders with prioritised environmental values do not support the Program's euthanasia of target sharks.

Regulation and legislation requirements for delivery research

Regulation and legislation impact how the SCP conducts initiatives. Research, Trials and Operations are all impacted by legislation.

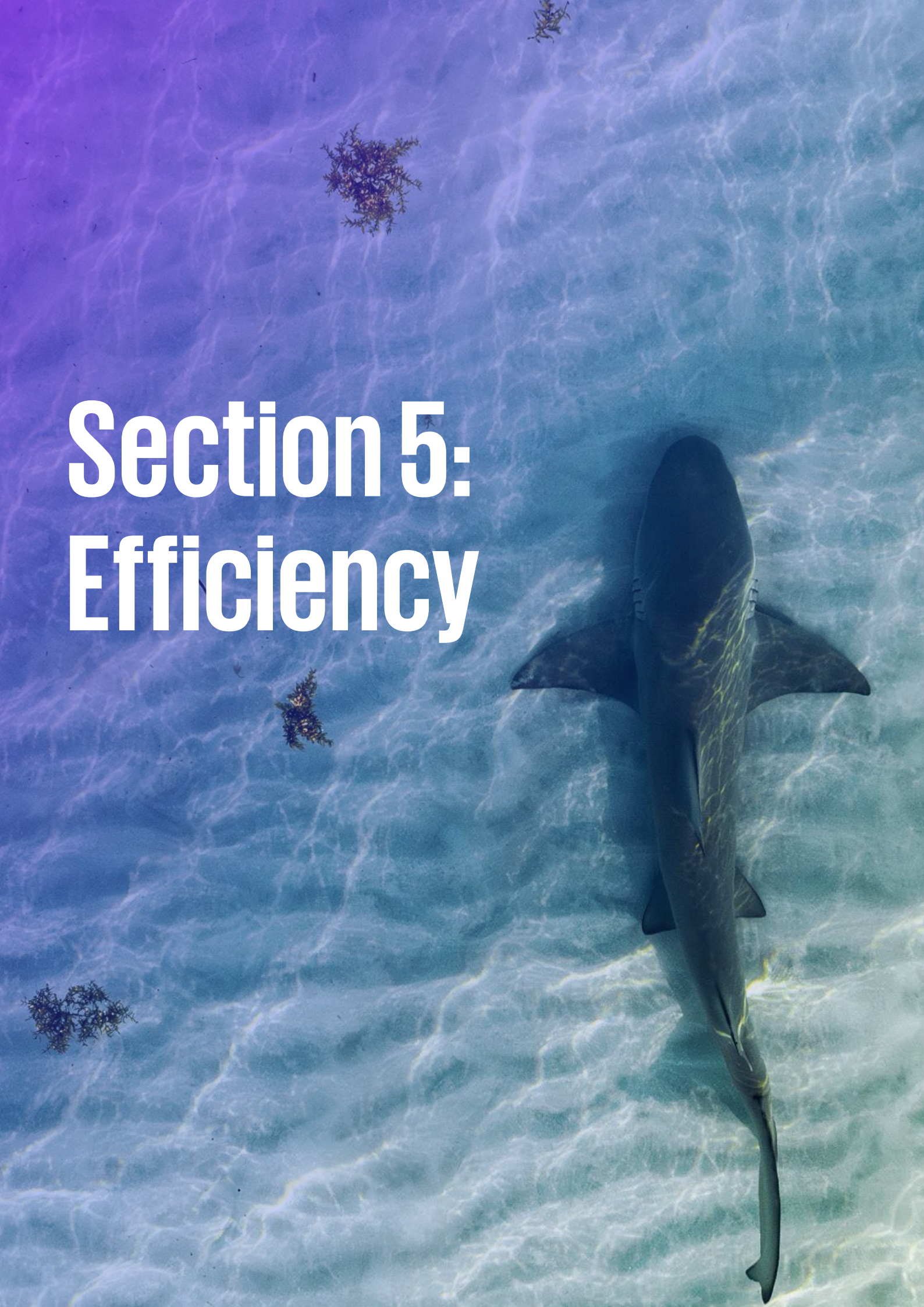
GBRMP and Queensland Government controlled waters have differing legislative requirements which impact how the SCP operates. The Program is compliant with the permit issued by the GBRMPA and the Program is effective at complying with these requirements. The Program is transitioning to using non-lethal equipment and all the research and trials are currently progressing as required under the permit.

Drone trials are significantly impacted by CASA legislation which governs how drones can be used, where they can operate and who can fly them. Stakeholders reported that this has limited their effectiveness along some beaches, for example near airports.

Legislative change related to who can surgically implant shark tags may improve the effectiveness of the Shark Tagging and Tracking Program in the future. All tagging by SCP contractors is external. Work Health Safety needs to be considered before considering introduction of internal tagging as part of the SCP.

Qualified researchers are able to internally tag sharks, which was previously reserved for qualified veterinarians. External shark tagging is less effective than internal tags, due to sharks shedding their tags by rubbing their body against the sea floor or other structures. Internal tagging is a preferred alternative.

Section 5: Efficiency



5 Efficiency Assessment

This chapter details the findings regarding the Efficiency of the SCP. The Efficiency chapter aims to understand the extent to which the Program's inputs achieved the necessary outputs while reducing wasted effort. It comprises the following areas which are examined in the subsequent sections:

- **Program efficiency:** Identifies the relationship between inputs (funding, human resources, technology) and outputs (target sharks captured, equipment serviced).
- **Funding benchmarking:** Examines the Program's funding relative to similar national programs.

Key findings related to efficiency are detailed below.

Efficiency – Key findings

5.1 Program efficiency

Operations

- The contractor costs to maintain SCP equipment differ greatly across regions and have weak correlation with the quantity of equipment in each area. The primary costs for contractors are wages, boat maintenance and fuel.
- Cairns had the highest cost per target shark caught ranging between $60,000 - $100,000 per target shark between FY22-24. This high cost was due to a low number of sharks (31) caught over the period. The remainder of SCP region's annual average was approximately $20,000 per target shark caught.

Trials

- The Catch-Alert Drumline Trial in the Capricorn Coast achieved cost efficiencies by leveraging the existing operations within the region and adopting Catch-Alert Drumline designs from the NSW Shark Management Program.
- The number of sharks observed during the SharkSmart Drone trial in FY23 and FY24 differed greatly because drones spotted large groups of sharks.
- The drone trials also saw improvements in average flight duration and provided employment opportunities for people with disabilities, neurodiverse people and those impacted by the COVID-19 pandemic.

Research

- Stakeholders reported that research activities were carried out efficiently, leveraging existing operations as much as possible. These included researchers 'tagging along' on usual operations to conduct their activities and the SCP partnering with entities to conduct and share research.

Education

- The SharkSmart media campaign, running since 2020, has effectively reached a wide audience, including Meta. The FY23 campaign generally surpassed the industry benchmarks, particularly with YouTube.

5.2 Comparison with other jurisdictions

- The three dedicated shark management programs in Australia vary in funding, with the NSW Shark Management Program receiving the highest at $20 million per year from 2022-2026, Queensland SCP receiving $14 million per year from 2022-2024, and the WA Shark Mitigation Strategy receiving the least at $4.3 million per year from 2025-2028.

5.1 Program efficiency

This section outlines the relationship between inputs (funding, human resources, technology and legislation) and outputs. It considers the extent to which the Program was delivered as expected, on time and on-budget.

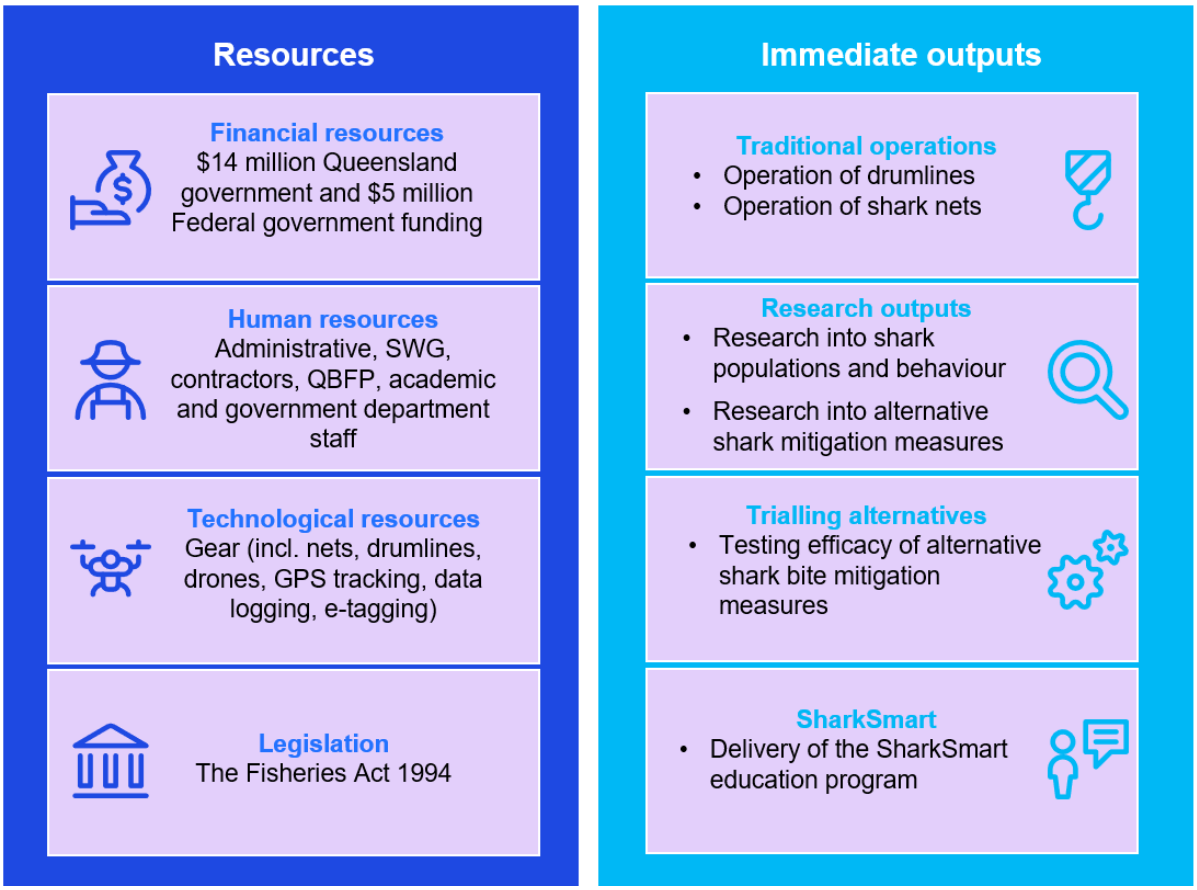


Figure 5.1: Overview of SCP resources and the outputs

The SCP receives funding from DAF and from the Commonwealth Government to conduct all their initiatives. Over the past three years, the SCP had an annual budget of between $13 to $14 million per fiscal year. Figure 5.2shows a breakdown of the expenditure over the past three years by pillar and includes the cost of administration.

- **Operations budget averaged approximately $7 million per year**. Most of this expenditure (97 percent) funds external contractors.
- **Research and trials budget averaged approximately $4.4 million per year**. These were jointly funded by DAF ($3 million per year) and the Commonwealth Government (averaging $1.4 million per year). Commonwealth Government funding was used to support the Catch-Alert Drumline Trial and other research activities in the GBRMP.
- **Education budget fixed at $600,000 per year.** The education budget funded the SharkSmart Education Campaign and other market research.
- **Administration costs averaged $1.8 million** over the past three years. These costs primarily were made up of SCP staff wages, building upkeep and other operational expenditures.

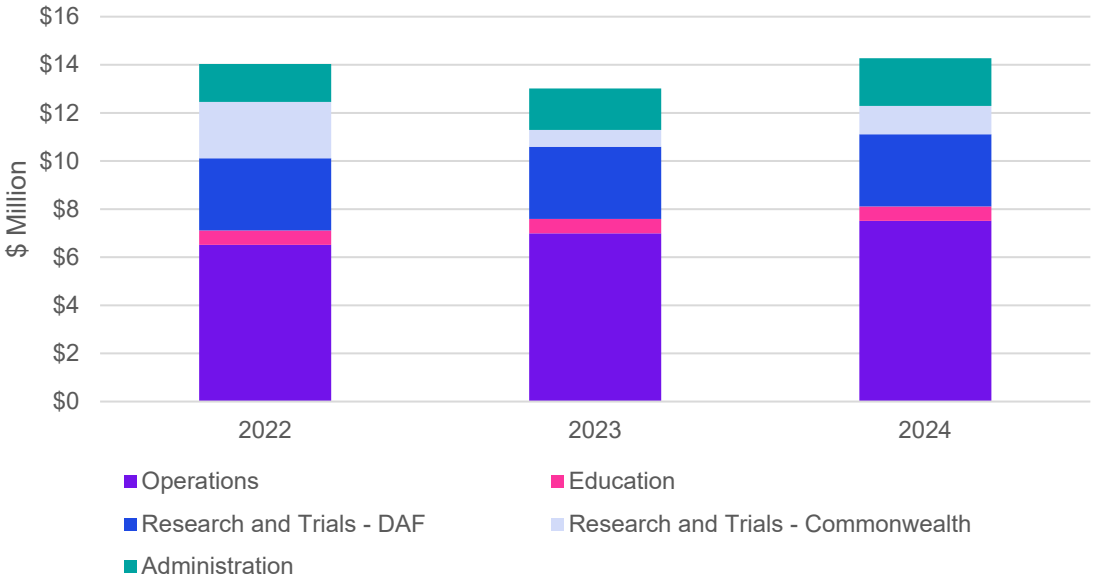


Figure 5.2: Total SCP expenditure, financial year

Source: DAF (2024), SCP financial statements (revised budget)

5.1.1 Operations

SCP operations involve the deployment of Mesh Nets, drumlines (baited hooks), or a combination of both by contractors. This section draws on stakeholder consultation and quantitative data provided by DAF to determine the efficiency of operations.

Stakeholder reflections on the efficiency of operations

Stakeholders reported that the servicing of SCP equipment was carried out efficiently. Utilising contractors was reported as efficient as they have local knowledge of seaways, aiding their ability to carry out day-to-day operations. Contractors were efficiently monitored by DAF through regular inspections and their internal iPad app which logs catch data and equipment damage. Finally, some sharks that are euthanised in the Program were made available for research (outside the SCP), reducing external research costs.

Stakeholders reported that the SCP's inventory management was an area for improvement. The SCP undertakes quarterly inventory stocktakes to assess equipment availability. However, there are no inventory requirements for each region and transporting equipment between regions is irregular. This lack of inventory management causes some beaches to have excess equipment while others experience shortages. Stakeholders further reported that the equipment is also becoming more difficult to procure. The number of suppliers willing to manufacture Mesh Nets has decreased in the past few years.

Operations cost breakdown

The SCP contracts individual contractors to service the Mesh Nets and drumlines. Figure 5.3 shows contractor spending accounted for $6.3 million (96 percent) of the total amount spent in FY22. Owing to increases in wages and fuel costs, the spend on contractors increased to $7.3 million in FY24. Spending on equipment and bait represents approximately three percent of operational spending. This includes the procurement of equipment, maintenance, and inputs to ensure the equipment functions as intended.

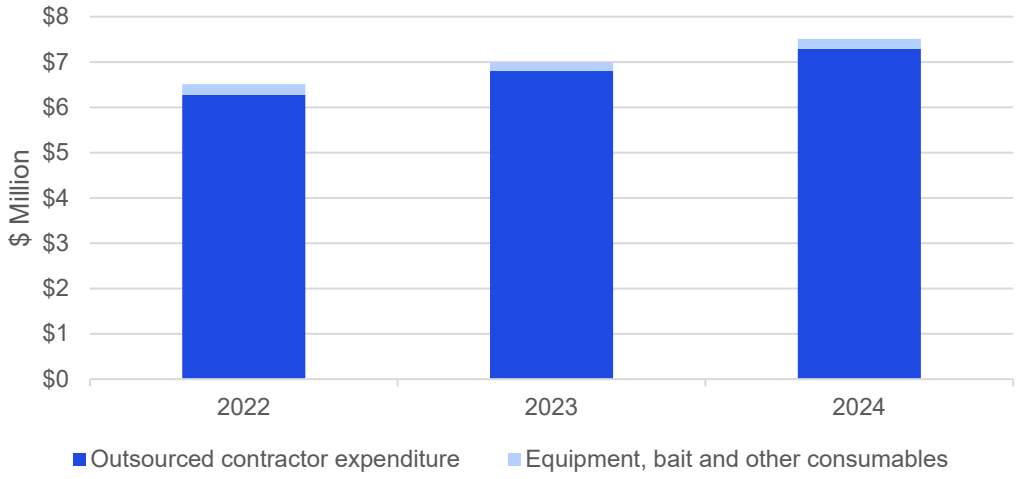


Figure 5.3: Operational expenditure breakdown, financial year

Source: DAF (2024), SCP financial statements (revised budget)

The efficiency in delivering SCP operations varies by region due to locational factors and the quantity of SCP equipment in each region.

Contractors service the SCP equipment all year, however they do not operate daily. Although individual contractors have unique agreements with the SCP, they generally perform maintenance on each piece of equipment daily, approximately 180 to 200 days annually within Queensland marine parks and 260 days per year in the GBRMP. Mesh Nets and drumlines are serviced together on contractor operations. Stakeholders reported that the main cost driver for contractors are the upfront costs including hiring personnel, boat maintenance and fuel, and other operational overheads. The cost of servicing either a net or drumline is roughly equivalent.

Some drumlines are currently operating without catching any target species in the past 10 years.

Drumlines are commonly set up in a row to protect a specific beach, with the number ranging from two to fifteen drumlines per beach. Currently, there are no specific guidelines for where these drumlines should be placed nor is there any regular evaluation of their effectiveness. The time needed to evaluate the effectiveness of drumlines requires further study. However, this analysis assumes that any drumline which has not caught a target species within 10 years is considered ineffective. The remaining ineffective drumlines consist of one or two drumlines at a specific beach being ineffective. Evaluating why these particular drumlines are ineffective could be a focus of future research.

Table 5-1 shows that there are 15 ineffective drumlines across the state. Amity Point has the highest concentration of ineffective drumlines, with five out of eight being ineffective. The reason behind the ineffectiveness of the current deployment configuration remains unclear. The remaining ineffective drumlines consist of one or two drumlines at a specific beach being ineffective. Evaluating why these particular drumlines are ineffective could be a focus of future research.

Table 5-1: Drumlines that have not caught any target species, FY2014 - FY2024

Location	Drumline
Sunshine Coast	Woorim (Bribie Island) Drum 66
Capricorn Coast	Cooee Bay Drum 15 Lammermoor Beach Drum 24
Gold Coast	Northcliffe Beach Drum 13 Sheraton Mirage Drum 4 Sheraton Mirage Drum 5
Mackay	South Lamberts Drum 32
North Stradbroke Island	Amity Point Drum 2 Amity Point Drum 3 Amity Point Drum 4 Amity Point Drum 5 Amity Point Drum 7

Location	Drumline
Sunshine Coast	Yaroomba Beach Drum 19
Townsville	Picnic Bay Drum 2 The Strand Drum 54

Source: QFish, DAF, 2024

Cairns has the highest cost per target shark caught of any region.

The SCP deploys equipment to catch seven target species of shark. All occurrences of bycatch or no-catch results are inefficient, as contractors still need to check on the equipment and re-bait drumline hooks. Assessing the efficiency of the Program catching target sharks was conducted through dividing the expenditure in each region against the number of target sharks caught. The number of target species caught was segmented by financial years to align with the financial statements, rather than calendar years as reported in Section 4 Effectiveness Assessment.

Figure 5.4 shows Cairns has the highest cost per target shark caught, with an annual average cost ranging from $60,000 - $100,000. This is more than three times higher than the rest of the region's annual average at approximately $20,000 per target shark caught. The main driver for this high cost was the low number of target sharks caught in Cairns, with total of 31 target sharks caught over the three-year period. By comparison, Mackay caught 101 target sharks with similar expenditure and equipment levels. Bundaberg, Townsville and Tannum Sands were consistently below the regional average cost per target shark caught.

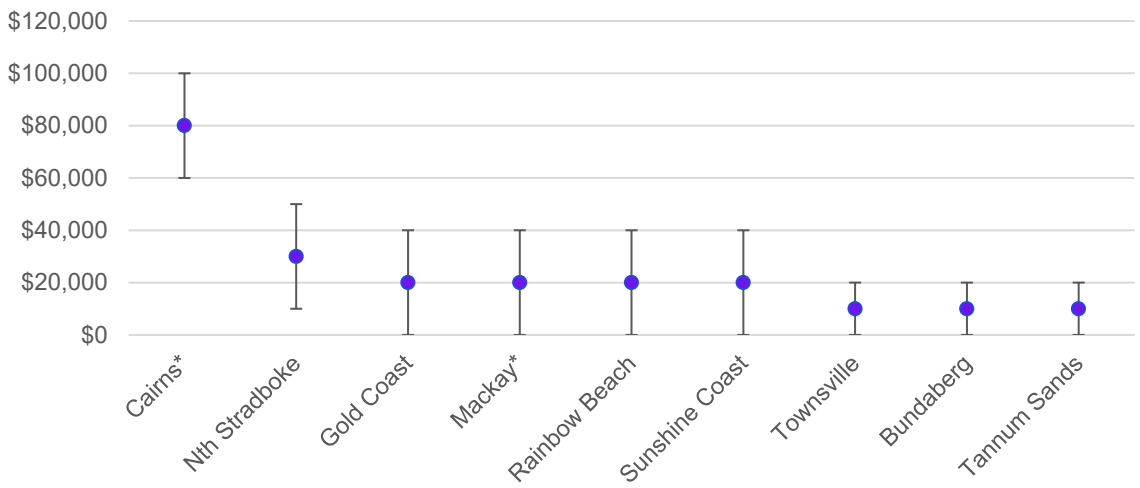


Figure 5.4: Annual average cost per target shark caught between FY22-24, by region

Source: KPMG calculation from data obtained from QFish and SCP financial statements, DAF, 2024

Note: Cairns and Mackay began Catch-Alert Drumline trials in January 2024. While Catch-Alert Drumline trials are more expensive than the normal operations, this has not meaningfully affected the average cost to service SCP equipment due to it only operating in the six-months in FY24. The Capricorn Coast was removed due to the Catch-Alert Drumline trial operating since 2021.

5.1.2 Trials

The SCP conducted trials by leveraging partnerships and contractors who carried out these activities. This review into the efficiency of trials involved interviewing contractors and DAF officers to evaluate the Program's activities. Stakeholders broadly agreed that the SCP's approach to conducting trials was efficient at achieving high-quality results in a timely and cost-efficient manner.

Catch-Alert Drumlines and Circle-Hooks

The Catch-Alert Drumline trial has primarily been conducted in the Capricorn Coast for the past three years. Cairns and Mackay only began trials in January 2024. Catch-Alert Drumlines are more expensive to procure compared to Traditional Drumlines. The purchase cost of a Catch-Alert Drumline was around $5,500 per unit in FY24. There is an additional cost for a satellite connection which is approximately $50,000 per year. This connection services all Catch-Alert Drumlines connected. Similar to Traditional Drumlines, the main expense is the cost to service the equipment. Contractors need to service the drumline at least twice per day and when an animal is caught. To offset these higher costs, the Program achieved cost efficiencies through:

- Utilising the existing contractors in each location who were servicing Traditional Drumlines daily. The Catch-Alert Drumline trial extended this existing contract, with trial equipment receiving an additional daily service and any Catch-Alert Drumline callouts. Leveraging the existing contractors and extending their operations resulted in significant cost efficiencies compared to procurement of a new contractor to service the equipment twice daily and any callouts.
- Leveraging the Catch-Alert Drumline technology from the NSW Shark Management Program and was modified with their assistance, eliminating the need for novel designs.
- Analysing the Catch-Alert Drumline trial data with the support of research students, which helped reduce trial costs and supported students achieve their academic goals.

False alerts on Catch-Alert Drumlines have been reported as a source of inefficiency in the trial. Contractors charge an additional fee for each call-out from a Catch-Alert Drumline and false alerts result in the SCP paying for contractors to check on an empty drumline. False alerts were provided for each trial region between 20 February to 20 August 2024, with Cairns having 57 false callouts, compared to Capricorn Coast's seven and Mackay's zero.

SharkSmart Drones

The delivery of the SharkSmart Drone trial was delivered by SLSQ, which stakeholders reported was efficiently carried out. Drones are piloted by lifeguards who are mostly employed as casual staff. Stakeholders identified that the drone trial has been a source of employment for some lifeguards and injured lifeguards. This employment option reduced SLSQ Workcover insurance. The trial also created job opportunities for retirees, neurodiverse individuals, people with physical disabilities, and commercial aviation pilots who were furloughed during the COVID-19 pandemic.

SLSQ are frequent purchasers of drones, enabling the Program to receive bulk purchase discounts on their drones. Furthermore, the servicing of drones was reported to be cost-effective with suppliers replacing drones under warranty at no additional cost. SLSQ spends approximately $550,000 per year on drones, drone maintenance, training, technical support and other non-wage costs. Wages costs comprise most of the spending on the Program, with wages costing $1.5 million in FY23 and $1.8 million in FY24.

Table 5-2 shows that the drone trial spent around $2.1 million in FY23 and $2.4 million in FY24. The introduction of the Mavic 3 drone in April 2023 with improved battery efficiency increased the average flight time in FY24 to 25 minutes per flight from 22 minutes. Over the past two-years, the drone trial detected 5,646 sharks, with 274 sharks of these sharks being an estimated two meters or above in length. This resulted in an average cost per shark detected of $1,240 in FY23 and $600 in FY24. The large deviation in average cost per shark detected is due to the spotting of large groups of sharks. The month-to-month variance was significant, with some months recording over 500 sharks, and other months recording as few as 30. Over the two years, 29 beaches were evacuated due to drone pilots spotting sharks which posed a concern to public safety.

Since the start of the drone trials in September 2020, 23 Bull sharks, zero Tiger sharks, and one White shark was detected by drones. This low number of Tiger and White sharks being spotted, relative to drumline and net catches, has been attributed to these species being caught at night when drones are not operating.[101]

[101] Key results from the SharkSmart Drone trial, which were provided by DAF

Table 5-2: SharkSmart Drone trial costs and flight time, FY23-24

Financial year	Cost	Total flights	Sharks detected	Large sharks detected (>2m length)	Cost per shark detected	Cost per large shark detected
2023	$2.1 million	7319	1695	58	$1,240	$ 36,250
2024	$2.4 million	7715	3951	216	$600	$ 10,900

Source: Drone Trial Interim Reports from July 2022-June 2024, SLSQ, 2024

Note: Some numbers may not add due to rounding

Shark Barrier

Community and local government opposition prevented the trial from progressing beyond the desktop research assessment.

Advanced Aerial Detection

The SCP contracted the assessment of the AAD trial to KPMG and we are evaluating the technology from multiple vendors. This trial is currently ongoing. Poor weather conditions delayed some of the test flights. However, this has not caused the trial to go over budget.

5.1.3 Research

The SCP conducts research by partnering with academics, academic institutions and non-profit organisations. Stakeholders reported that the SCP's approach to conducting research was efficient at achieving high-quality research in a timely and cost-efficient manner. These efficiencies include:

- The SCP's permit for the deployment of IMOS receivers in the GBRMP saves IMOS from being required to obtain their own permit.
- Contractors being able to tag sharks resulted in considerable cost savings for researchers, as it eliminated the need for dedicated excursions solely to tag the sharks and check on the IMOS receivers.
- Collaboration with academic institutions enabled research students to achieve their academic goals and contribute to the Program as a part of their studies.
- Knowledge sharing with the NSW Shark Management Program improving trial efficiency through a memorandum of understanding between Queensland and NSW for the first phase of the Catch-Alert Drumline Trial.

5.1.4 Education

Education encompasses the SharkSmart education initiatives, which is focused on educating the general public on shark safe behaviour. Over the past three years, $600,000 annually has been dedicated to education covering SharkSmart promotions, upgraded beach signage, and market research aiming to change the behaviour of target groups.

Queensland uses the SharkSmart branding (initially developed by NSW) to support education and awareness. NSW does not collect any royalties on using the brand name as both programs are aiming to achieve the same outcome. WA also adopted the SharkSmart branding. Stakeholders indicated this has been effective at succinctly communicating to the public the facts regarding sharks and shark safety.

SCP messages were integrated with other signage from the Queensland Parks and Wildlife Service, especially in regions where recent shark incidents occurred.[102] Furthermore, the website transformation was delivered efficiently, leveraging DAF-wide changes to the website. Federal funding allocated to this website transformation was re-allocated to other activities, ensuring the funding was utilised efficiently.

The SCP sponsored the Shark Bay exhibit at Sea World, Gold Coast to promote SharkSmart messaging. At this exhibit, school students are provided with material, which helps them learn about shark behaviour and how the SCP equipment operates. The total cost of sponsoring the Shark Bay exhibit is approximately $95,000 per year. Stakeholders reported that this was an efficient way to reach a young target audience and tourists. Furthermore, the SCP sponsored SLSQ and the Noosa Biosphere to promote the Program messaging.

The SCP has been running the SharkSmart media campaign since 2020. The focus of the media campaign was for water users based along the coastline of Queensland. Table 5-3**.** shows the SharkSmart media campaign for FY23. The campaign was efficient at reaching a wide audience, achieving above target for radio (online and traditional), message boards and online video including YouTube and Xaxis advertising.[103] Meta and web traffic slightly under-performed.

Table 5-3: Summary of advertising outreach, FY23

Channel	KPI	Benchmark/Target	Delivered Results
Xaxis Online Video	Impressions	518,159	520,021
Radio	Delivered spots	875	1,066
OOH - Convenience Advertising	Locations	50	57
YouTube	Completed Views	418,301	827,919
Online Audio	Impressions	894,631	895,171

[102] The Mad Crew. (2019). *Cid Harbour*. https://themadboat.com/cid-harbour/
[103] The benchmark was set by essencemediacom

Channel	KPI	Benchmark/Target	Delivered Results
Meta	Impressions	13,698,194	13,337,721
Search	Traffic (Clicks)	20,966	17,160

Source: SharkSmart post campaign media report 2022-23, essencemediacom, 2023

Assessing the value for money from advertisement is undertaken using standard metrics, which are outlined below:

- **Cost Per Millie (CPM):** refers to the average cost of 1,000 ad impressions. This is the average amount paid every thousand times an internet browser loads the advertisement.
- **Cost Per Visit (CPV):** The SCP only pays for advertisements that result in a website visit.
- **Cost Per Click (CPC):** The SCP only pays for advertisements each time a user clicks on a displayed advertisement.
- **Cost per Ad Recall:** The amount of advertising expenditure divided by the estimated number of people who could recall an ad. This aims to gauge the value for money from an advertising campaign.

All media channels outside of the search were delivered above the benchmark rate. Table 5-4 shows YouTube was the best performer, coming in at half the expected cost per view. Meta also performed well, with the CPM being $1.43 cheaper than expected. Advertisement recall rates were also higher than the benchmark, indicating that the SCP's advertisements were more memorable than the benchmark. Search had a more expensive CPC than expected, costing an additional $0.32 per click. The SCP did not advertise on any other platforms such as Tik Tok, free-to-air TV or dedicated podcast channels.

Table 5-4: Summary of advertising efficiency, FY23

Channel	KPI	Benchmark/Target	Delivered Results
Xaxis Online Video	CPM	$60.00	$59.97
YouTube	CPV	$0.04	$0.02
Online Audio	CPM	$20.74	$20.73
Meta	CPM	$4.05	$2.62
	Cost per Ad Recall	$0.19	$0.25
Search	CPC	$1.41	$1.73

Source: SharkSmart post campaign media report 2022-23, essencemediacom, 2023

5.1.5 Administration

The core staff of the SCP consists of four full-time administrative officers, with one part-time officer. There are also 10 regional support staff, which contribute 10 percent of their time to check and sign off on any broken equipment and replacements.

Stakeholders reported that the function of regional support staff could be conducted by core personnel, enabling funding for other roles. In FY24, DAF spent $93,000 on regional support personnel.

Finally, stakeholders reported that core staff were frequently answering public reports of whale entanglements. This has reduced the ability of core staff to efficiently carry out their duties.

5.2 Comparison with other jurisdictions

There are four dedicated shark management programs in Australia and the Queensland SCP received the second highest funding of all jurisdictions. The Queensland SCP is receiving approximately $14 million per year to conduct all the initiatives between 2022-2024. The largest program is the NSW Shark Management Program at approximately $20 million per year from 2022-2026 (a total over four years is $85.6 million).[104] This covers all their activities including operations, research, trials and education. The NSW program has higher operational costs due to the use of 305 Catch-Alert Drumlines, 50 drone patrolled beaches and 51 Mesh Nets. The WA Shark Mitigation Strategy, by contrast, receives the third largest funding at approximately $4.3 million per year from 2025-2028 (a total over four years of $17 million).[105] The WA operations are focused on aerial beach patrols, shark signage, shark barriers and subsidies for personal protective devices. SA operations are the least funded with only a fixed-wing patrol valued at around $700,000 per year.[106]

[104] NSW Department of Primary Industries. (n.d.). *NSW Shark Management Program. SharkSmart*. https://www.SharkSmart.nsw.gov.au/#:~:text=NSW%20Shark%20Management%20Program,the%20state%27s%20most%20popular%20beaches

[105]Government of Western Australia. (n.d.). *Helicopter patrols keep careful watch over WA beaches.* https://www.wa.gov.au/government/media-statements/Cook-Labor-Government/Helicopter-patrols-keep-careful-watch-over-WA-beaches--20230905

[106] South Australian Government. (n.d.). *SA Tenders and Contracts.* from https://www.tenders.sa.gov.au/contract/search?buyerId=56715&browse=true

Section 6: Impact

6 Impact Assessment

This chapter details the findings regarding the impact of the SCP. The Impact domain aims to understand the extent of the SCP's long-term results. To assess the Impact of the SCP, the following are considered:

- **Preservation of human life and injury avoidance**
- **Public understanding of shark risks in Queensland coastal waters**
- **Sustained economic activity and beach tourism**
- **Stronger community cohesion and pride in responsible management of local resources**
- **Sustained marine biodiversity and ecosystem health.**

6.1 Program impact

The Program has had a long-term impact in the preservation of human life and injury avoidance

Most stakeholders agree that the Program has had an impact in reducing shark risks since its inception in 1962. The most pronounced impact is believed to have occurred after the initial deployment of Mesh Nets and Traditional Drumlines, which were designed to catch sharks indiscriminately, potentially removing many resident sharks (particularly Bull sharks and juvenile sharks) from Queensland's most popular beaches. Before the Program's introduction in 1962, Queensland recorded an average of approximately three shark interactions per year, resulting in about one death annually. Since operations began, Queensland has recorded fewer than two-and-a-half interactions per year and less than 0.37 fatalities on average. Since 1962, only two fatalities have occurred at beaches where SCP equipment is deployed. These improvements in human life preservation have taken place despite a significant increase in Queensland's population and greater human overlap with shark activity due to coastal development and a higher uptake of high-risk water sports. Notably, the low number of shark bites is correlative evidence, as it is not possible to conclusively demonstrate causation. As such, improved preservation of human life has been achieved over the long-term with human-shark interactions remaining low.

Public understanding of shark risks in Queensland coastal waters has improved

The SharkSmart Campaign, launched in 2019, has been the key initiative aimed at improving public understanding of shark risks in Queensland coastal waters. Complementary efforts, such as research into human behaviour change, upgraded signage, and a revamped website, have also contributed to raising awareness of these risks. While five years of data from the SharkSmart Campaign survey indicate an observable impact of the Education program – albeit some evidence suggests the impact is plateauing – the relatively small sample size limits the ability to conclusively assess long-term effects. Additionally, the survey captures the influence of other educational initiatives aimed at enhancing public knowledge about shark safety and general beach safety, such as independent initiatives delivered by SLSQ.

There has been sustained economic activity and beach tourism

Shark incidents have not had a discernible long-term impact on beach tourism. While short-term effects have been anecdotally observed in Queensland, there is no empirical evidence to quantify their extent, nor is there evidence to suggest that a shark bite has resulted in a sustained impact on tourism in Queensland or anywhere else in the world. However, this gap in the literature does not necessarily indicate the absence of a long-term impact, rather that it has yet to be academically investigated.

Unable to determine if there has been stronger community cohesion and pride in responsible management of local resources

It remains unclear whether stronger community cohesion and pride in the responsible management of local resources has been achieved as a long-term outcome. To date, no significant community impact has been observed, and misinformation about the SCP may be obstructing progress in this area. The Public Sentiment Research survey will serve as a key benchmark for assessing this outcome in the future. Additionally, media articles and social media activity, particularly the ratio of positive to negative posts, could provide further insight into the long-term impact of the SCP.

Sustained marine biodiversity and ecosystem health

Initially launched with the sole aim of reducing shark populations, the SCP has resulted in shark and bycatch mortality alike due to the indiscriminate nature of Mesh Nets and, to a lesser extent, Traditional Drumlines.

However, whether operations have led to significant harm to the ecosystem, destabilising it or creating lasting cascading impacts is unclear based on the current research and understanding of the various other factors that influence ecosystem health. Some literature indicates that there has been an impact on the population of coastal sharks, which has resulted in disruption to marine ecosystems.[107]

In 2019, the Program underwent significant transformation following the 2019 Tribunal verdict to improve marine biodiversity and ecosystem health. The Plan incorporates elements of research and trials to inform continuous improvement of the Program in this area.

[107] Roff, G., Brown, C.J., Priest, M.A. and Mumby, P.J., 2018. Decline of coastal apex shark populations over the past half century. Communications Biology, 1(1), p.223. Henderson, C.J., Gilby, B.L., Turschwell, M.P., Goodridge Gaines, L.A., Mosman, J.D., Schlacher, T.A., Borland, H.P. and Olds, A.D., 2024. Long term declines in the functional diversity of sharks in the coastal oceans of eastern Australia. Communications Biology, 7(1), p.611.

Section 7: Insights

7 Insights

The insights in this section stem from a comprehensive review of the SCP, guided by the Program's Evaluation Framework. This review incorporates desktop research, stakeholder consultations, and data analysis to assess the Program's appropriateness, effectiveness, efficiency, and impact. Through this examination, an understanding of the SCP's strengths, challenges, and areas for improvement has been developed.

Insights have been structured as follows and are detailed further in the section below:

- Program Need
- Policy
- Legislative and regulatory alignment
- Program
- Governance and stakeholder engagement.

7.1 Program need

Shark bites are low-probability, high-consequence, traumatic events.[108] Although they may only last seconds, a single shark bite can cause extreme injury and have socio-economic and political consequences.[109] These medical emergencies can not only result in death or inflict lifelong trauma for the victim but also harm their family, first responders, and the wider community, making shark bites an injury with lasting and particularly wide-reaching effects.[110]

Continued operation of the Program is needed due to the significant threats to human safety that could arise in its absence. Initially launched with the aim of managing shark populations, the Program has undergone significant transformation towards a comprehensive strategy that aims to balance risk mitigation with the conservation of environmental integrity, incorporating elements of research and trials to inform the continuous improvement of the Program. This evolution is exemplified in the Shark Management Plan (2021–2025), which reflects changing community attitudes, expectations, and legislative requirements. The Program needs to remain flexible and adaptive to external drivers and changing circumstances moving forward.

There is a continuing need:

- **To avoid human-shark interactions (fatal and non-fatal):** To ensure human safety, there is a need for the Program to continue to respond to human demand drivers, including a growing population, increasing urbanisation of the coastline and overlap of human activity with shark populations, ongoing tourism, high beach usage, and participation in high-risk water activities. Additionally, the Program will need to adapt to environmental changes such as marine animal migratory patterns and populations and a changing climate.
- **To minimise negative impacts on marine ecosystems:** It is essential to minimise ecosystem impacts while ocean-based equipment remains part of the Program (e.g. Mesh Nets, Traditional Drumlines).
- **To protect Queensland's Tourism industry:** Given the continued popularity of Queensland coastal destinations, there is a need for visitors from interstate and overseas to feel safe and confident while enjoying ocean-related recreational activities.
- **To comply with legislative requirements:** The Program will need to comply with permit conditions, with any changes to legislation or permit requirements driving adjustments to the Program.

[108] Crossley, R., Collins, C. M., Sutton, S. G., & Huveneers, C. (2014). Public Perception and Understanding of Shark Attack Mitigation Measures in Australia. Human Dimensions of Wildlife, 19(2), 154–165. https://doi.org/10.1080/10871209.2014.844289
[109] National Library of Medicine. (2022). *Shark Trauma*. https://www.ncbi.nlm.nih.gov/books/NBK507855/
[110] Taylor, J., McLean, L., Korner, A., & Glozier, N. (2018). Direct and indirect psychological impacts of shark-bite events. Australian & New Zealand Journal of Psychiatry. https://doi.org/10.1177/0004867418808899

7.2 SCP Policy

This section details insights related to the policy document. It considers the role of a clear purpose statement and objectives, a need for clarity in SCP components, a need for performance measurement, and benefits of detailing future opportunities.

The purpose statement and objectives reflect the current focus of the Plan, although they may need to be revised to reflect a transition of operations

The current purpose is defined as 'to reduce the risk of shark bites in Queensland coastal waters', followed by four objective statements that broadly align with the Program's pillars. The purpose statement plays a crucial role in articulating the rationale behind the policy, ensuring a clear understanding of its objectives.

The objective statement for the Operations pillar is tied to the current equipment (Mesh Nets and Traditional Drumlines), worded as 'maintaining nets and drumlines at beaches while continually improving operations to minimise the impact on the environment'. Should operations eventually incorporate trialled technologies or strategies, this objective should change to be solution agnostic and focus on human safety, the primary outcome for the pillar.

The purpose of the SCP may need to be revised to reflect the desired future direction of the Program, which will likely include a focus on continued human safety, minimising environmental impact, and Program strengthening education. This insight has informed recommendation 1.1.

There is a gap in communication of SCP components, including initiative naming, description and link to outcomes

During the evaluation, there were difficulties in identifying the scope of initiatives and when changes to the Program were delivered. There is an opportunity to improve the level of information captured for each initiative to enhance record-keeping and increase transparency, establishing a reliable foundation for future decision-making. This will allow for actions to be linked with outcomes, making it easier to assess the impact of the Program and identify areas for improvement. Moreover, delivery patterns can be highlighted, enhancing communication by clearly demonstrating how the SCP operates and achieves results. This insight has informed recommendation 2.1.

There is a lack of detailed records on changes to Program parameters

Throughout the Plan, various operational parameters changed, including a reduction in the target shark list, modifications to equipment, and changes to effort (i.e. equipment servicing frequency). Clearly documenting each of these changes is essential for multiple reasons, including ensuring the accurate interpretation of operational data, maintaining a historical record for transparency and responding to public enquiries, facilitating replicability, and aiding in quality control processes. Such documentation is also important for decision-making, as it provides context for the data used by decision-makers and facilitates compliance with regulatory requirements. Maintaining clear records of operational changes upholds the integrity of data analysis, enabling robust and accurate interpretations while allowing any discrepancies to be traced back to their source.This insight has informed recommendation 2.1 and 2.3.

There are no performance measures to support continuous improvement and inform action

The SCP currently lacks clearly defined measures at the initiative, pillar, or program level, either outlined in the Plan or established internally. As a result, it is unclear which aspects of the Program are functioning as intended and which require specific attention and review.

Measures are important for effective policy implementation as they enable the assessment of a policy's effectiveness, ensuring the intended outcomes are being achieved and to the degree expected. They provide a basis for accountability, allowing for the evaluation of performance and adherence to goals. Regular measurement and evaluation offer data-driven insights that inform necessary adjustments, keeping the policy relevant and impactful. Measures not only ensure transparency but also guide the future direction of the SCP by defining measurable objectives and can be used to trigger specific actions, such as a review of activities at a location.

Given the dynamic social, legislative, and environmental context in which the SCP operates, the assessment of any future SCP measures will need to account for the various factors that might influence their interpretation and relevance. This insight has informed recommendation 1.4.

Measuring marine ecosystem attributes is challenging although important

Measuring the Program's impact on the marine ecosystem facilitates informed decision-making around minimising its environmental footprint, providing transparency, both internally and externally, on the Program's progression toward this objective. However, effectively measuring and analysing environmental attributes is challenging due to

the highly dynamic and interconnected nature of the marine environment, encompassing diverse species, habitats, and environmental factors. Measuring changes in the frequency of marine animals caught and killed, particularly threatened, endangered, and protected species, can serve as a proxy for ecosystem impacts. However, interpreting these measures has limitations, as fluctuations in catch rates or animal sizes may not necessarily reflect changes in the Program's operational effectiveness during that period. Such variations may instead be explained by other human activities (e.g. fishing) or environmental factors (e.g. changing migration patterns). In addition, high/low bycatch may indicate the health/decline of the ecosystem rather than the effectiveness of the operations. This insight has informed recommendation 1.4.

The Program lacks a performance monitoring framework to track changes in the delivery of Program objectives

A monitoring framework establishes key performance indicators and targets, enables implementation tracking and provides a pathway for continuous improvement. While the current SCP has progress reports, there is an opportunity to strengthen this approach. Regular monitoring ensures accountability by clearly documenting progress, resource allocation, and the achievement of policy objectives. This information provides a pathway for continuous improvement in the Program. By generating evidence through data collection and analysis, a monitoring framework supports informed decisions. It can highlight areas where adjustments or interventions are necessary, improving the efficiency and effectiveness of the SCP delivery. Monitoring supports the early identification of risks, allowing mitigation approaches to be developed to ensure ongoing, successful delivery of the policy.

A consistent, disciplined approach to monitoring data from operations (e.g. catch data) and other initiatives (e.g. Shark Tagging and Tracking) using the performance monitoring measures is crucial to ensuring success in improving ecosystem outcomes. The framework should include a stakeholder feedback loop to improve communication between DAF, initiative owners, and stakeholders by providing clear, evidence-based reports on progress. This process would be supported by the Data Capture and Dashboard system, enabling up-to-date and efficient extraction of insights. This insight has informed recommendation 2.3.

A range of shark management opportunities were considered but not communicated to the community

During the evaluation, it was evident DAF considered a range of emerging shark technologies and delivered new research. However, this broader and future-focussed work is not visible to the public, even at a high level. Identifying these initiatives in the shark management domain will inform stakeholders about emerging initiatives and research in the shark management domain.

These can be identified as future opportunities to overcome the challenge of committing to the emerging opportunities which can be difficult at the time of the Plan's publication due to uncertainties. By communicating that these opportunities will be considered throughout the Program, stakeholders are kept engaged and aware of potential developments. This transparency is particularly helpful to stakeholders who value more contemporary approaches. Additionally, signalling these opportunities to the market can attract potential collaborations, fostering partnerships that enhance the Program's effectiveness and innovation. This insight has informed recommendation 1.5 and 3.15.

A need to define the Program scope to improve community understanding and strengthen evidence-based evaluation

The scope of the SCP is not clearly defined, which can hinder the community's understanding of the Program and make it more challenging to establish an evidence-base for evaluation. Areas where the Program's scope could benefit from greater clarity include:

- Geography: Some stakeholders interpret the SCP's geographical scope as extending to prevent all shark bites along the Queensland coastline, while others view it as limited to currently SCP protected beaches. Most stakeholders agree that shark risks in open ocean (pelagic zones) and river systems fall outside the Program's geographic scope; however, these boundaries are not clearly communicated.
- Types of human-shark interaction: The Program lacks a clear definition of what constitutes a human-shark interaction within its scope, which will be crucial for establishing future performance measures. Some stakeholders view any instance of human and shark overlap as an interaction, while others believe it includes only negative encounters, such as shark bites or serious injuries resulting from bites. There is also divergence on the types of interactions to be addressed: some stakeholders believe both unprovoked and provoked interactions fall within the scope, while others consider only unprovoked bites relevant, as these incidents are beyond individuals' direct control.
- Legislative scope (limitations): The Program does not effectively communicate to the community the legislative framework that shapes each region's operational setup. For example, it is not widely understood that nets are absent in the GBRMP due to permit restrictions set by the GBRMPA.

This insight has informed recommendation 1.3 and 1.6.

7.3 Legislative and regulatory alignment

The section details insights related to compliance with legislative requirements and considerations for the future Program based on legislative trends.

Compliance with legislative requirements may change in the future

The SCP obtains permits to operate equipment within Commonwealth and state marine parks, which would otherwise be prohibited under legislation. When the SCP renewed these permits, both the GBRMPA and DESI required the Program to transition to a non-lethal approach within their jurisdiction, specifically:

- The outcome of the Administrative Appeals Tribunal resulted in modified options in the GBRMP to bring operations more in line with the legislative requirements under the *Great Barrier Reef Marine Park Act 1975.*
- The permit issued by DESI for the Great Sandy and Moreton Bay Marine Parks brings operations more in line with the legislative requirements under the *Marine Parks Act 2004 (Qld)* constituted in November 2025.

These permit conditions signal that, in the future, the Operations pillar of the Program may need to align more closely with the legislative requirements.

This insight has informed recommendation 2.6.

A need to comply with the GBRMPA permit as part of the Administrative Appeals Tribunal and implement Catch-Alert Drumlines

The permit issued by the GBRMPA contains conditions both for SCP operations and of research activities undertaken by the Program. The SCP has complied with all the conditions set out in the permit, including:[111]

- Not operating a lethal program within the GBRMP
- Trialling Catch-Alert Drumlines in the Capricorn Coast, Cairns and Mackay
- Meeting with the SWG annually at a minimum to discuss the progress of research and trials into non-lethal alternatives
- Conducting research focusing on personal protective equipment and Shark Population Studies.

However, the operational deployment of Catch-Alert Drumlines in the GBRMP has not yet taken place, as this technology is still undergoing trials. At present, there is no publicly available plan outlining the implementation of Catch-Alert Drumlines following the conclusion of these trials. There is a need to finalise the permit implementation and prepare an implementation report, addressing specific permit conditions and ensuring compliance of the Catch-Alert Drumline with regulatory requirements.

The current permit is valid until April 2027, at which time DAF will need to seek a new permit. Providing evidence of compliance and evaluation of the actions under the permit could be beneficial in obtaining a continuation of the permit, if desired, by DAF. This insight has informed recommendation 2.11.

[111] A full list of the permit conditions can be found on the Reef Authority website. Great Barrier Reef Marine Park Authority. (n.d.). Permit for Queensland Shark Control Program. https://www2.gbrmpa.gov.au/access/permits/permit-queensland-shark-control-program

The SCP has complied with existing DESI permit conditions, although they need to comply with new permit conditions by late 2025

The permit issued by the DESI contains conditions both for SCP operations and research activities undertaken by the Program.[112]

The SCP has undertaken the following actions to comply with the permit:

- Inspecting equipment with sufficient regularity (180-200 days per year) to ensure that any animals caught on Program equipment are attended to as soon as possible
- Ensuring that all Carcharias taurus (grey nurse shark) caught alive in Program equipment are tagged prior to their release
- Ensuring that all marine turtle species captured alive must be tagged in accordance with current DESI turtle tagging and reporting procedures prior to release at the site of capture
- Conducting collaborative research into population trends of the Tiger shark population(s) in Queensland's coastal waters and determine what role the Program has had on the trends described.

DAF has been required to trial non-lethal drumline alternatives (e.g. Catch-Alert Drumlines) and methods that minimise the lethal take of non-target protected species and ensure they are implemented on a progressive basis as soon as possible. Trials have been delivered in Cairns, Mackay and the Capricorn Coast, although these locations are not in the Great Sandy and Moreton Bay Marine Parks.

The Programs will need to make further changes to comply with the permit. These changes include:

- Remove all nets from within the Great Sandy and Moreton Bay Marine Parks as soon as practicable, but no later than 30 November 2025
- Ensure the Program becomes non-lethal (i.e. no target species) by 30 November 2025.

This insight has informed recommendation 2.12.

7.4 Program

This section details insights related to the Program's structure and each pillar of the SCP which includes operations, trials, research and education. Considerations for the Program's structure have been informed by inter-jurisdiction case studies. Insights relating to each pillar are discussed in separate sections.

7.4.1 Program structure

The interjurisdictional review identified that operations, education and research are typical components of shark management programs

A review of inter-jurisdictional activities has identified a range of interventions aimed at enhancing human safety around sharks—in water operations, observational operations, and education-related interventions. Water-based operations have a varied impact on shark and bycatch ecosystems. Trials are typically delivered to test new operations before formally committing to them as part of a program.

The diagram below categorises these interventions, with each type differentiated by a scale of initiatives. The initiatives currently implemented under the SCP are highlighted in bold. Figure 7.1 illustrates the various approaches to improving human safety in relation to sharks, although not all may be suitable for the Queensland context.

Research is delivered to inform continuous improvement in the three types of interventions. It is necessary to understand how to reduce the risk of shark bites by understanding shark behaviour and populations, human behaviour and the effectiveness of new technologies.

This insight has informed recommendation 1.2.

[112] A full list of the permit conditions can be found on the Reef Authority website. Great Barrier Reef Marine Park Authority. (n.d.). Permit for Queensland Shark Control Program. https://www2.gbrmpa.gov.au/access/permits/permit-queensland-shark-control-program

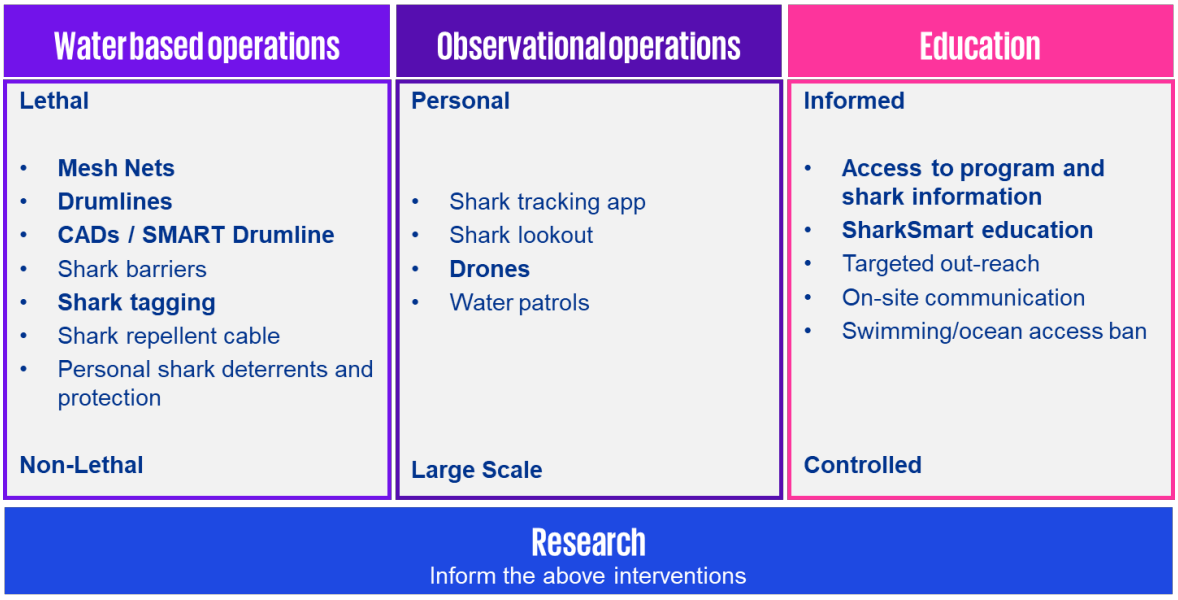


Figure 7.1: Framework to consider the types of shark bite mitigation interventions

Note: The ordering of initiative types under each intervention is indicative only. The bold initiatives reflect those included in the current SCP.

The Program is delivering safety and innovation through Trials, Research, Operations, and Education for a long-term shark mitigation solution

The current SCP delivers three types of interventions across four pillars: Trials, Research, Operations, and Education. Overall, the structure of the Program has received positive feedback. The SCP is effectively organised using this four-pillar approach, driving long-term improvement and innovation. Trials and Research foster continuous enhancement by testing new technologies and gathering evidence before implementing changes. These small-scale projects are an efficient way to assess the effectiveness of new equipment while reducing risk and funding requirements.

Operations remain the focal point of the Program, being the longest-running and most recognised element. Much of the community is only aware of operations as a shark bite mitigation measure. It is anticipated that Operations will continue to be a central pillar as it is the predominant method for delivering human safety, although the type of operations may change to reduce ecosystem impacts. However, this will likely be further complemented by the Education pillar, which also plays a critical role in promoting human safety and is a key element in other interjurisdictional programs. Research is delivered to understand how to reduce the risk of shark bites through understanding shark behaviour and populations, human behaviour, and the effectiveness of new technologies. It contributes to identifying trials, informing changes to operations and informing education approaches. As the Program matures and when there is a greater evidence-base, it is anticipated that Research and Trials will scale down in the long term, although still be key pillars of the Program. Operations and Education pillars are anticipated to be the key pillars of the Program, albeit Operations are expected to transform.

The mix of initiatives under each pillar should be responsive to external drivers while maintaining a clear focus on achieving the desired outcomes of the SCP and the objectives of each pillar.

This insight has informed recommendation 1.2.

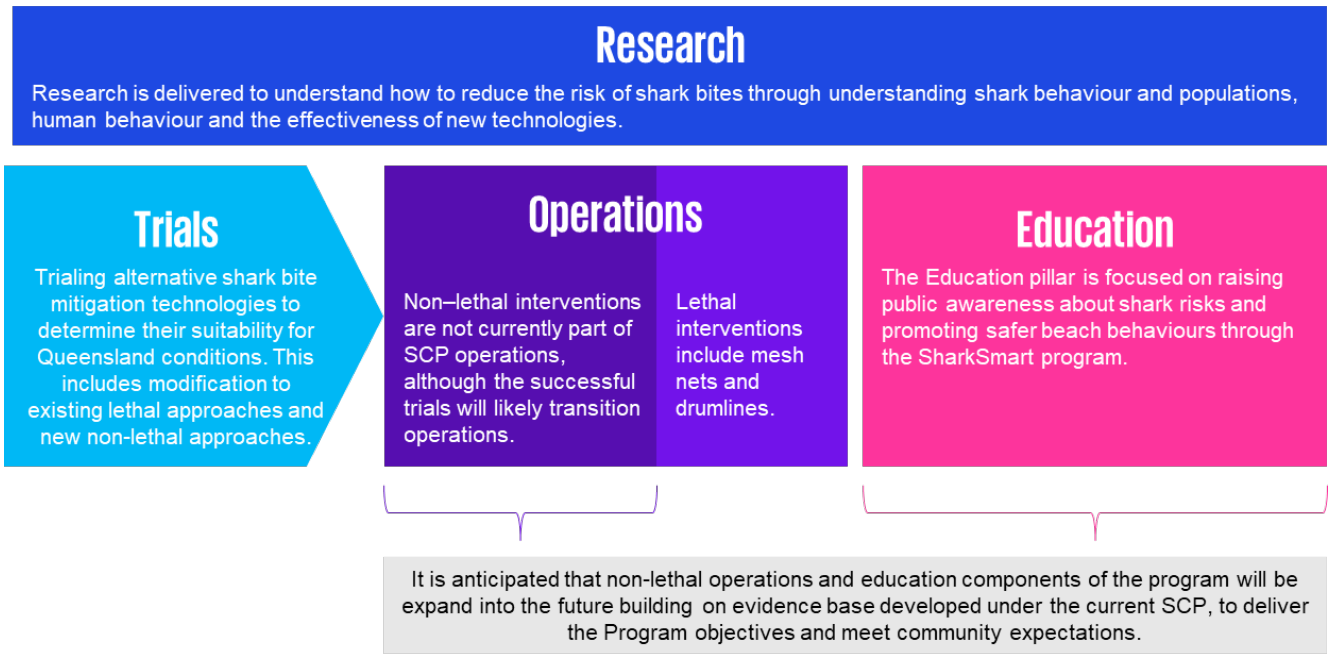


Figure 7.2: SCP delivers three types of interventions across four pillars

Participants of the qualitative research study preferred education and observational operations as shark bite mitigation approaches

The qualitative research study found that participants were more likely to prefer mitigation strategies that are less intrusive on marine ecosystems, believing there are more humane ways to reduce the risk of shark bites (Figure 7.3).[113] Education and observational operations were identified as the preferred mitigation approaches. Overall, participants were in favour of some sort of mitigation being in place compared to no mitigation, which aligns with the finding that there is an ongoing need for the Program.

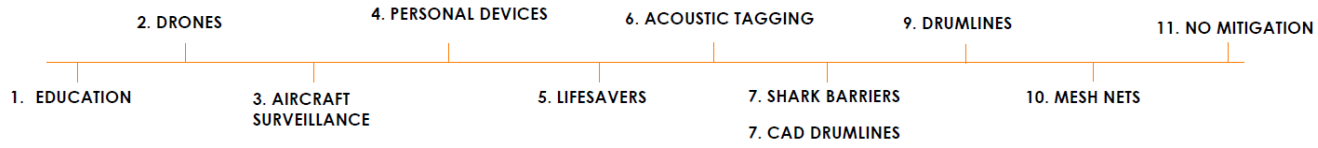


Figure 7.3: Ranking mitigation strategies

Source: Verian (2024). Shark Mitigation Devices Qualitative Research Report

The Program lacks a framework for assessing new initiatives

To ensure a systematic evaluation of potential changes to the Program, it is important to adopt a structured approach. This approach should assess project outcomes across various types of interventions, with relevant consideration of locational factors and community expectations. The framework should also consider the immediacy of action to support prioritised delivery. For example, it is important to be able to respond to identified risks in certain locations, such as the shark incidences that occurred on the Whitsundays.

A framework should be developed to align intervention types with key outcome areas, enabling a thorough evaluation of the suitability of each intervention. Notably, there needs to be a stronger link between some initiatives and the desired outcomes of the Program. This decision-making framework will provide a consistent method for assessing all proposed changes to the Program, ensuring targeted and effective delivery of initiatives. This insight has informed recommendations 1.1 to 1.4, 2.2 and 2.5.

[113] Verian (2024). *Shark Mitigation Devices Qualitative Research Report*

7.4.2 Operations

With the noticeable increase in participation of water-based activities along with a potential shift in shark behaviour and populations, there is an anticipated increase in the need for operations and/or education initiatives to enhance human safety. Assessing the suitability of the operations for specific locations is necessary, taking into account catch rates, costs, and community expectations. The operations' ability to adapt to the local context and meet regional requirements is essential for sustained support and effectiveness. To effectively address these evolving challenges, the operations could be more strategically aligned with the Program's environmental objectives.

Furthermore, it would be practical to consider seasonal adaptations for the Program, drawing on interjurisdictional precedents, community sentiment, and the potential impacts on marine life and whale populations. Such considerations will enable the Program to remain responsive and responsible in its approach to wildlife conservation and community safety across different times of the year.

Given that Operations is the most heavily funded pillar of the Program, there is a need to optimise operational efficiency. This will ensure that the Program not only meets future demands but also delivers value for money in an environment where funding might be limited. These insights are detailed further below.

The operations equipment has been effectively capturing target sharks over the Plan period

The primary goal of the Operations pillar is to enhance human safety by reducing the immediate risk of human-shark interactions. Since it is not possible to know for certain whether a shark will interact with a human until it happens, an increase in the capture of target shark species is used as a proxy measure for reduced risk. The Operations over the Plan period resulted in the average annual capture of 438 target sharks – a 25.1 percent increase compared with the previous 20-year period.[114] This outcome demonstrates a continued, if not increased, effectiveness of operations to reduce the risk of human-shark interactions.

However, the migratory nature of some sharks, coupled with select coverage from nets and drumlines, is a limiting factor in the Program's ability to ensure human safety at SCP beaches. Notably deploying nets and drumlines at every beach is logistically unfeasible, and even if it were, these methods alone cannot entirely prevent human-shark interactions. This is evidenced by the most recent shark bite in Queensland, which occurred at an SCP protected beach in Bundaberg.

The operations equipment is not delivering the desired ecosystem improvements

SCP operations negatively impact the ecosystem by using lethal techniques to manage sharks, which also unintentionally catch and kill non-target marine life. Marine animals become entangled or caught in shark control equipment. Since many marine animals are either obligate air breathers or obligate ram ventilators, they are unable to oxygenate when trapped on equipment and often die. In Queensland, 27 Mesh Nets and 321 Traditional Drumlines are deployed, resulting in an average annual mortality of 363 non-target animals.

There is a need to reduce the impact on ecosystems to meet legislative exemption permits and respond to community expectations. This insight has informed recommendation 3.1.

The target shark species list has been revised to reduce the number of sharks

The Program previously identified 19 shark species as posing a threat to humans and categorised them as target species. In January 2022, the list was reduced to seven to focus on the most dangerous species. Among this list, the Bull shark, Tiger shark, and White shark are of greatest concern, accounting for over half of all recorded shark bites in Queensland where the species was identifiable.[115] Notably, when consulting shark experts, only three species are commonly referred to as "target sharks" — the White, Tiger, and Bull sharks.

The target shark list is particularly relevant to lethal operations. Reducing the number of species on this list has lessened the Program's negative impact on the marine ecosystem compared with the scenario in which the list remained at 19 sharks. Further refinement of the list could lead to greater reductions in ecological impacts; however, all the target species have demonstrated a capacity to cause injury or death in Australian waters in the last 20 years.

Additionally, the target shark list plays a critical role in guiding research and education efforts. By studying shark populations and behaviours, DAF can better understand the potential risks of shark interactions and take informed steps to mitigate their risk.

There has been limited revision of locational deployment of gear

Despite 60 years of social and environmental changes, many locations and quantities of operational equipment have remained static. During this time, coastal populations, beach visitation, environmental conditions and participation in high-risk activities have changed significantly across the Queensland coast. There is currently no

[114] DAF (2024). Shark Control Program catch data (2001–2024)
[115] Taronga Conservation Society Australia. (n.d.). Australian Shark Incident Database. https://taronga.org.au/conservation-and-science/australian-shark-incident-database

framework to determine the optimal locations for gear deployment to maximise human safety outcomes, minimise ecosystem impacts and ensure program efficiency.This insight has informed recommendation 2.2.

The effectiveness of Traditional Drumlines is hampered by loss of bait and bycatch

Bait on Traditional Drumlines can be taken by non-target species, fall off in rough conditions, or degrade over time. Traditional Drumlines are not serviced daily or multiple times a day, meaning they are not always operating at full capacity. For example, if a Traditional Drumline catches an animal, the drumline becomes unavailable, leaving periods without protection for water users until it is serviced. In contrast, shark nets continue to function even when an animal is entangled. Similar bait challenges occur with Catch Alert Drumlines, but these are serviced when triggered by a catch increasing their fishing capacity. Further information from contractors could assist in quantitatively understanding the impacts of loss of bait and bycatch on the effectiveness of the equipment.

Mesh Nets are effective for catching Bull sharks but have high ecosystem costs

Mesh Nets, first deployed by the Program in 1962, are the oldest form of shark control equipment still in use. However, data indicates that they are the least selective, leading to high non-target species mortality, with an average of 3.62 non-target marine animals killed for every target shark captured. Public sentiment and stakeholder views toward nets are increasingly negative due to these adverse impacts, and nets have been removed from several locations across Queensland in recent decades, including areas within the GBRMP. Only 27 remain statewide. Nets are more effective than Traditional Drumlines at catching Bull sharks compared to Tiger sharks.

Queensland stands alone as the only jurisdiction that keeps nets in the water year-round, while NSW and South Africa withdraw them during marine animal migrations. Negative media coverage, high-risk whale entanglement releases, and frequent net repairs make the option to remove nets during whale migration season worth considering in Queensland, especially given the lower beach activity during winter months.

The feedback loop between research and contractors is valuable

Stakeholders have identified the value of information sharing, where researchers focus on identifying operational improvements that contractors ultimately deliver. Contractors provide practical insights on potential implementation considerations and report back on trials of new technologies. To facilitate this, DAF is conducting information-sharing workshops. Ongoing program communication will support delivery efficiency, effectiveness, and continuous improvement.

Determining the efficiency of operations is challenging

The SCP lacks measures or benchmarks to evaluate the efficiency of its initiatives. The primary expense of the Program is tied to contractor fees for deploying nets and drumlines. Generally, these contractors do not itemise their operational costs. Although the SCP tracks contractor costs over time, it has no way to ascertain whether the contractors are performing their duties efficiently. This insight has informed recommendation 3.3.

Reduced compliance checks of contractors

DAF personnel are deployed at all sites where SCP equipment is operational. These individuals verify that the equipment is properly inspected and that contractors adhere to their agreements. Consultation with the SCP revealed on-site inspections of contractor operations have decreased. This is because the iPad app used by the contractors provides the vessel's real-time location, which can be checked by SCP personnel. While this method is cost-effective, it does not ensure that contractors are correctly baiting and maintaining the equipment. This insight has informed recommendation 3.3.

Procurement and operational areas to be considered if operations change

If alterations are made to the Program, several procurement and operational aspects should be re-evaluated to ensure the continued efficacy of the operations. The optimisation of service regions and the restructuring of contracts should be taken into account. Efficiently servicing the targeted areas is key as operating cost is the most significant component of operations.

Contract structuring should be considered in relation to the geographical areas served. Structuring contracts that reflect the unique requirements of different locations allows for tailored operational responses that are both effective and economical.

The SCP standard contract outlines that suppliers must provide detailed forecasted expenses. This detail ensures the transparency of the costs and profits that suppliers expect. Catch-Alert Drumline Trial contractor agreements showed only the Mackay Catch-Alert Drumline agreement detailed the forecasted expenses.[116] The Capricorn Coast and Cairns Catch-Alert Drumline Trial contractor agreements did not detail their expenses, rather they only provided a daily rate for each year.[117] Providing transparency on contractor costs could help optimise operations and an improved understanding of what drives operational efficiency.

[116] DAF. (2024). *DAF23013-FQ209(c) Catch Alert Drumlines – Mackay.*
[117] DAF. (2024). *DAF23013-FQ209(b) Catch Alert Drumlines – Cairns.* DAF. (2022). *DAF22013-FQ209 Catch Alert Drumlines*

The procurement process for the SCP operations should continue to prioritise the engagement of qualified professionals. This ensures that the tasks are carried out with the highest level of expertise and adhere to the standards expected of the Program. It is necessary that any changes to operations do not compromise the quality of the work delivered.

As advised by contractors, it should also be noted that it is not possible to obtain insurance for the Mesh Nets within Australia. Consequently, insurance must be sourced internationally, leaving contractors unprotected by Australian Insurance Standards. This insight has informed recommendation 3.3.

Enabling and capturing the regional benefits from SCP operations

The Program's operational activities result in expenditure across Queensland's regional coastline, directly benefiting local communities through contractor employment. Contractors source maintenance and operational inputs from surrounding areas, which supports local businesses and flow-on benefits to communities. Enhanced itemisation of contractor expenses could improve understanding of the economic flow-on effects for these communities. Revising contracts to include requirements or incentives to increase regional benefits, such as local training, could further strengthen community impact. Additionally, there may be opportunities to align with other government skills programs, notably with identified upskilling needs in drone technology.

Seasonal operational changes to reduce impacts on marine ecosystems

Many species, including whales, travel along coastlines where shark equipment is deployed. This equipment, predominantly nets, while designed to reduce shark encounters near beaches, poses a risk to large marine animals like whales, dolphins, and turtles, leading to injury or death if they become trapped. The entanglement of marine life does not deliver the desired SCP ecosystem improvements.

In addition to impacts on marine ecosystems and marine life, other negative impacts include:

- Negative media attention and community sentiment: Typically, when there is a whale entanglement, it is captured in the media and the SCP is often mentioned. In addition, environmental stakeholders share images of other animal entanglements on social media.
- Public risk: In some instances, the public has attempted to rescue whales, putting their lives in significant danger.
- Use of DAF and MART resources: Currently, when a whale becomes entangled, DAF are alerted and mobilises a rescue team. DAF also addresses a number of false whale entanglement alerts which inefficiently use DAF resources.

Shark nets are removed in NSW during whale migration to prevent whales from becoming entangled in the nets. In July this year, the NSW Government announced it will be removing shark nets one month earlier, on 31 March 2025, to respond to increased turtle activity in April. The removal of nets during these months coincides with lower water use by people during the winter months. South Africa also removes Mesh Nets during the winter period to reduce bycatch rates.

A cost analysis was performed to evaluate the potential savings for the SCP if Mesh Nets were removed during the six-month whale migration season. Removing 14 nets for a period of six months could reduce SCP's costs by $57,000 annually. This analysis assumes a 75 percent reduction in both MART call-out costs and net damage expenses for the temporary nets. The most significant reduction comes from extending the temporary net's lifespan from two years to four years, which could save the Program around $31,000 each year. The reduction in net damage from fewer whale interactions could save the Program around $21,000 annually.

The decrease in protection from the temporary removal of nets might be offset by adding more drumlines. To maintain equivalent protection, two to five drumlines per Mesh Net may be necessary; however, the two types of gear function differently and are not equivalent.[118] This analysis assumes each net is replaced with three drumlines, costing around $50,000 per year. Contractor servicing costs are excluded since contractors are already maintaining drumlines along the routes where the nets are positioned.

Another alternative could be drones, which are currently in the trial phase. It is uncertain how many drones are required to compensate for the decrease in Mesh Nets. This analysis presumes that one drone could potentially replace three Mesh Nets on average, costing around $80,000 annually. The deployment of drones would not affect contractor operations.

This insight has informed recommendation 3.2 and 3.5.

Inconsistent and cumbersome operations data

Although the Program collects substantial data from operations, inconsistencies in data capture across contractors, coupled with the dataset's large size and the absence of an efficient data interaction tool, impede analysis of operational effectiveness. For example, variations in recording depredation events lead to inaccuracies in

[118] Blount, C., & Macbeth, W. (2020). Selectivity of nets and drumlines used in the Queensland Shark Control Program (FQ19025 B). Prepared for the Queensland Department of Agriculture and Fisheries. Cardno Pty Ltd. https://qfish.fisheries.qld.gov.au/

calculating catch sizes. Without an accessible and efficient means to derive insights from operational data, monitoring progress and evaluating Program outcomes are hindered. This insight has informed recommendation 2.4.

7.4.3 Trials

Trials are an effective approach to responding to drivers of change that will shape the Program into the future, particularly the testing of technological advancements. A central objective of the Trials pillar is to identify alternative shark control measures that improve ecological outcomes without changing the risk profile of the beach or enhance safety. Trials assess the compatibility of new technologies with the Queensland conditions. Under the current SCP, this includes the refinement of existing operational practices as well as the introduction of alternative, non-lethal technologies.

These trials are key in gathering valuable data that improves the understanding of both the marine environment and the behaviour and population of sharks. The insights derived from these trials are pivotal for the ongoing enhancement of shark management practices. The insights related to Trials are detailed below.

Trials have an important role in a phased approach to change

Trials have an important role in considering changes to the SCP, particularly when considering new technologies. By adopting a phased approach that manages risk, trials help mitigate the potential risks of negative outcomes and financial overcommitment, ensuring that any significant investments are backed by reliable evidence. They offer a controlled environment to determine effectiveness in local conditions, gauge public sentiment, assess operational challenges, and gather the evidence needed to inform decision-making. This approach not only promotes responsible use of public resources but also enhances the credibility of Program changes, fostering greater trust and adoption by communities.

The Program lacks a framework for progressing from Trials to Operations

The purpose of the Trials pillar is to test operational approaches to establish an evidence base to support further decision-making. Currently, there is no framework or measures to support decision-making in trials.

To maximise the effectiveness of these trials, it is essential to establish clear criteria for success that can guide the decision-making process. A decision-making framework would include the development of a set of criteria to benchmark trial outcomes, including trial evaluation metrics (e.g. bycatch mortality rates, target sharks captured/identified), to assess its effectiveness, risk profile analysis compared with baseline operations, cost-effectiveness, stakeholder approval, community approval, and policy and governance alignment.

When a trial demonstrates consistent performance, reliability, and measurable benefits that align with the SCP objectives, it should be considered for incorporation into Operations. Conversely, trials that do not meet these criteria should be analysed for potential improvements or discarded if they fail to meet operational standards.

A structured approach delivers an evidence-based decision offering consistency across the trial initiatives and transparency and accountability to stakeholders. This structured approach ensures that only the most effective technologies or equipment from the Trials pillar transition into operational use, thereby enhancing the overall efficiency and effectiveness of the SCP. The framework would need to consider locational differences across the Program which may necessitate further trials to test specific conditions. This insight has informed recommendation 2.5.

Drones are effective in shark surveillance and have delivered additional benefits

Drones have proven effective in shark surveillance. From April 2022 to June 2024, a total of 5,665 sharks (all species) were detected, with 282 of these estimated to be two meters or larger.[119] With approximately $4.4 million spent during this period, drones offer strong value, providing a cost-efficient solution when considering the number of sharks identified per dollar. Additionally, drones contributed to the closure of 29 beaches due to shark proximity, underscoring their role in enhancing swimmer safety.

Drones have indirectly supported public education efforts regarding the SCP. Informational materials, such as pamphlets and signage at drone sites, have attracted public interest and improved awareness, fostering a better understanding of the Program's objectives.

The procurement and maintenance of drones have been handled efficiently, benefiting from low maintenance costs, largely thanks to warranties. Advances in drone technology have extended flight times, increasing their capacity to monitor more sharks and further improving operational effectiveness.

The drone trial is producing a skilled workforce in regional locations, which will have positive long-term impacts as the skills are transferrable to other industries.

There is potential to expand drone surveillance to additional locations, with factors such as community sentiment, beach activity demand and ecosystem impacts guiding future decisions. There may be an opportunity for non-state-led drone programs run by resorts or local councils. There is also the potential for drones to provide more precise data on marine life (contributing to the understanding of marine ecosystems) and beach activity.

The limitations of drones are their reduced effectiveness in murky waters, and they are not operational at dusk and dawn due to lifeguard operational hours and the afternoon winds being too strong for drone flights. This highlights the need for clear criteria to determine where drones can be deployed most effectively for optimal results. Data storage of drone footage is a challenge that needs to be considered. This insight has informed recommendation 3.4 and 3.6.

The Catch-Alert Drumline Trial has delivered improved bycatch survivability

The trial demonstrates that Catch-Alert Drumlines result in decreased catch mortality compared to MTDs for both target shark catch and bycatch. However, Catch-Alert Drumlines tend to catch fewer target sharks than MTDs, as MTDs are in continuous operation while Catch-Alert Drumlines only operate during daylight hours, missing the higher shark risk periods of dawn and dusk when fewer people use the ocean.

Catch-Alert Drumlines have a lower impact on marine ecosystems compared to Mesh Nets and Traditional Drumlines as detailed in Section 0. However, they are costly to operate, primarily due to high operational expenses, servicing needs, and false alarms. The average annual cost per target species caught on a Catch-Alert Drumline was $4,402.[120] This is lower than the Mesh Nets and Traditional Drumlines' average of $19,000 per target shark caught.[121] In Cairns, Catch-Alert Drumlines faced significant issues with false alerts, which led to unnecessary expenses and increased operational inefficiencies.

Interim findings from the Shark Tagging and Tracking initiative reveal that 21.3 percent of Tiger sharks and 31.3 percent of Bull sharks captured, tagged and released in the area returned to the area, albeit after an average period of 155 days and 92 days post capture, respectively. This outcome represents a potential continued risk to beachgoers.

These points underscore the complexity of implementing Catch-Alert Drumlines, especially as a replacement to Traditional Drumlines which operate different hours and result in the permanent removal of target shark species. Careful consideration of the effectiveness, costs, and operational challenges of Catch-Alert Drumlines is required when considering deployment in other locations (given locational differences).

Other jurisdictions including NSW and WA deliver Catch-Alert Drumlines/SMART Drumlines. The combined approach with Queensland and NSW contributes a greater number of sharks being tracked. This insight has informed recommendation 3.4.

[119] Surf Life Saving Queensland (2024). *SharkSmart Drone Trial Program Drone Operations Interim Report January - June 2024.* Surf Life Saving Queensland (2023). *SharkSmart Drone Trial Program Drone Operations Interim Report July - December 2023.* Surf Life Saving Queensland (2023). *SharkSmart Drone Trial Program Drone Operations Interim Report January - June 2023.* Surf Life Saving Queensland (2022). *SharkSmart Drone Trial Program Drone Operations Interim Report July - December 2022.*
[120] KPMG calculation from data obtained from QFish and contractor agreements provided by DAF.
[121] KPMG calculation from data obtained from QFish and financial statements provided by DAF.

Advanced Aerial Detection will be an ongoing opportunity

The Advanced Aerial Detection trial aims to assess the suitability and effectiveness of AI and various spectrum camera lenses in enhancing the detection of dangerous marine animals. The trial addresses the current limitations of drone spotting, including improving detection in turbid water conditions and reducing human error.

While the results of the trial have not been published, ongoing advancements in shark risk mitigation technologies will likely improve both their affordability and potential applicability to the Program. If DAF pioneers innovative technology, consideration should be given to retaining Intellectual Property and commercial opportunities from the investment.

7.4.4 Research

Research overcomes the barrier of limited information, which restricts informed decision-making. SCP research focuses on understanding shark behaviour and populations, human behaviour, and evaluating the effectiveness of new technologies in reducing the risk of shark bites. A multi-lens approach to research is effective in building a balanced evidence base that informs Trials, Operations, and Education efforts. Leveraging low-cost delivery options, such as collaborating with PhD students, can enhance Research capacity. A strong evidence base is crucial for guiding program adjustments and supporting informed decision-making, with Research playing a key role in driving these improvements.

The Public Sentiment Research initiative will provide valuable insights

The initiative to assess public sentiment will provide valuable insights for decision-making. When public sentiment is reflected in decision-making, it ensures governments remain accountable and responsive to the electorate, reinforcing democratic values. Additionally, understanding public opinion helps assess the long-term impact of initiatives, particularly in fostering community cohesion and pride in the responsible management of local resources.

Challenges to Public Sentiment Research include the complexity of accurately capturing and interpreting diverse stakeholder concerns and the potential for shifting public attitudes that may require adaptive strategies. It will be important to proactively address these concerns to maintain community trust and engagement throughout the Program's lifecycle.

The SharkSmart Education survey should be distinguished from community sentiment surveys as they have different purposes – Program sentiment compared to the understanding of SharkSmart behaviours. Ultimately, creating an SCP that reflects public sentiment helps build consensus and broad support, reducing political polarisation and fostering a sense of shared ownership in shark mitigation efforts. This insight has informed recommendation 3.9.

Alignment between objectives and research can be strengthened

The discussion on defining the impact of research highlighted the need for a stronger link between research and the SCP Policy framework, suggesting that research should be structured and have criteria to inform its direction and evaluation. While the value of research was supported, it has been identified that research needs to be aligned with the Program's objectives to ensure it addresses relevant problems and contributes meaningfully to the Program. This insight has informed recommendation 1.1 to 1.4.

Research to measure the impact on tourism

There is an information gap regarding the economic impact on tourism and local communities following shark incidents. Currently, there is a notable absence of literature that quantifies the economic impact of shark bites, making it difficult to assess the full extent of their consequences on local economies. A study will help determine if there are adverse effects on tourism, beach activity, and beach-dependent businesses to provide evidence-based support for funding requests. Empirical data would help fill this gap, enabling more informed decision-making and resource allocation in response to such incidents. A methodology would need to be prepared that could be implemented when such an incident occurs. It would need to detail the key timeframes that data is collected to determine the severity and duration of the impact. This could then inform program-wide measures on tourism impact. This insight has informed recommendation 3.7.

Efficient delivery of research

The SCP conducts research by partnering with academics, academic institutions, and non-profit organisations, contracting the research activities. DAF utilise three procurement strategies: private contracting for specific requirements, grant/sponsorship agreements to fund operations like the drone trial and SharkSmart promotion, and collaborative agreements to share knowledge and resources with universities. Stakeholders reported that the SCP's approach was efficient in achieving high-quality research in a timely and cost-effective manner, with significant cost savings from contractors tagging sharks. Additionally, collaboration with the SCP allowed researchers to avoid the time-consuming GBRMP research permit process, and sharing research was crucial for

the Program's success, enabling research students to achieve their academic goals. This insight has informed recommendation 3.10.

Communicating the evidence-base to the community, particularly for the personal deterrent technologies

There is an opportunity to improve the public's understanding of the personal deterrent technologies that are effective and those that are not proven to be effective. The current challenge is that people are purchasing technologies without evidence of the effectiveness of the devices, or purchasing them because of marketing claims from the manufacturers despite the technologies being tested and found to be ineffective. This results in people being misinformed and potentially undertaking risky behaviours assuming they are protected from Shark interactions. It was noted by shark experts that there is misinformation in the market, with people buying products that have not been independently tested or shown to be ineffective, highlighting the need for better public education on effective technologies.

Notably, personal deterrent technologies need to be tested in conditions applicable to Queensland. The current supplier of the proven personal deterrent technology Shark Shield Pty Ltd supplier is no longer manufacturing the product as the company has gone into administration. This insight has informed recommendation 3.8 and 3.9.

7.4.5 Education

The evaluation has identified the continuing value of delivering the Education pillar. The primary goal of the Education pillar is to improve human safety by spreading awareness of shark risks and shark-safe behaviours. There is unanimous agreement among stakeholders that the SharkSmart Education Program has been effective in improving human safety, with many pointing to the Program as having the greatest potential to reduce human-shark interactions in the future. Additionally, the Program should maintain a user-friendly website to effectively communicate essential information about the Program. Outlined below are key insights into the future delivery of the Education pillar.

Education to inform behaviour change is a long-term investment

Education is a reliable and safe investment for governments as it is a pillar of the Program that is unaffected by legislative changes, ensuring long-term stability. With the growing prevalence of social media advertising and evolving consumption patterns, education can leverage these platforms to reflect contemporary trends and reach wider audiences. This presents significant opportunities for enhancement, allowing educational initiatives to stay relevant and effective. Moreover, education as a pillar consistently receives overwhelmingly positive feedback, highlighting its critical role in fostering informed (both in behaviour and about the SCP) and engaged communities, making it a cornerstone for the SCP into the future.

Education is not targeting high-risk water users

Key factors that influence people's risk include their behaviour, the frequency of ocean-based activity, the type of activity, and the location where it occurs.[122] The current campaign effectively targets two user groups ('positive preventers' and 'in-between and keen') comprising 46 percent of the audience.[123] The primary demographic audience to target in media buying is males, aged 16 to 34 years, and participating in activities such as swimming, surfing, snorkelling, kayaking and fishing.[124] The secondary demographic audience to target is 35-49 years, mixed gender, similar activities and similar socio-economic segments.[125]

There is an opportunity to target messaging to key water user groups, including surfing, snorkelling, kayaking, and fishing, with specific messaging. The NSW education program has been working directly with surfing groups to deliver target messaging.

The target audience has primarily been swimmers, which the SCP acknowledges is only a small number of the people bitten by sharks. Additionally, the SCP recognises geographical differences between target audiences, noting that how people use the water varies, with South East Queensland being a popular surfing destination while Far North Queensland is mainly frequented by swimmers and snorkelers. The SCP has considered targeting water users with a higher chance of encountering a shark, such as surfers, fishing and snorkelers. While some success was achieved through the SurfSmart campaign in Noosa, there was limited success in engaging this target group. Events were considered as venues where SharkSmart messaging could be promoted; however, event managers were cautious about the type of messaging they wanted at their events. Furthermore, some local governments, which need to approve any public displays, have shown limited interest in spreading shark information. This insight has informed recommendation 3.12 and 3.13.

SharkSmart messaging uses multiple channels

[122] Kantar Public. (2023). *Qualitative Shark Smart Campaign Evaluation 2023*
[123] Kantar Public. (2023). *Swimmer Safety (SharkSmart) January 2023 Campaign Evaluation*
[124] Ibid.
[125] Ibid.

The SCP's primary means of messaging is through social media, targeting a wide audience of people close to the beach or those interested in beach activities. This approach has proven effective, achieving the targets set out by the media company DAF contracted.

The contentious nature of the lethal Program and the perceived risk of creating fear hindering SharkSmart penetration

The SCP's operations have caused some difficulty in spreading shark messaging. Some groups and individuals will not engage with the SCP due to its lethal approach to shark management. Furthermore, other groups do not consider shark messaging a key priority as they do not view the risk of sharks as significant or knowingly accept the risk. The SCP understands that to engage with these groups, goodwill needs to be built with these communities, either through tailored messaging that better reflects local conditions or through changes to the Program.

Place-specific signage provides targeted place-specific messaging

There is an opportunity for place-specific signage to provide targeted outreach and guidance to specific user groups in local regions. Place-based advice can address unique concerns and conditions, ensuring that messaging resonates with the specific needs of each community. This presents an opportunity to combine common beach-related messaging, such as beach safety, shark awareness, and wildlife conservation, into a cohesive communication strategy. By fostering partnerships with local stakeholders, particularly local governments, integrated beach signage can be more effective, as they are well-positioned to deliver accurate, relevant information. In-situ signage, supported by these partnerships, could enhance public awareness and improve safety outcomes at the community level. Signage would be particularly relevant for areas outside of SCP operations or where operations may vary compared to other locations. This insight has informed recommendation 3.13.

A need for more accessible information about the Program

There is a need for more accessible information about the SCP, particularly regarding shark behaviour, risk factors, and actions individuals can take to reduce risk, including the use of personal deterrents. The public has a strong desire to make informed decisions, yet this is often hindered by a lack of readily available information. While there is transparency of information, format and terminology are crucial in communicating the Program's outcomes to non-technical audiences. A subset of stakeholders do not believe there is full transparency, although they do utilise the published or requested Program information to further access desired information.

During consultation, many stakeholders felt they did not have the facts to comment on aspects of the Program. Basic information on why target sharks are the focus of the Program, the behaviour of target sharks, and information on operations equipment would help stakeholders better understand the Program. This would enable people to have a better understanding of the risks that are mitigated by the Program and the unmitigated risks that remain.

While some people may have a higher tolerance for risk, they still benefit from being well-informed about the potential dangers. Other jurisdictions provide information through shark applications in addition to information on websites. This insight has informed recommendation 3.11, 3.14 and 3.15.

Misunderstandings about the Program contribute to poor public image and reduce the efficiency of operations

During the consultations, it was identified that there is a degree of misunderstanding in the broader community about the SCP, including equipment, objectives and impact. People's misunderstanding of the Program is a challenge to delivery as it can inform risky behaviours; if individuals are not accurately informed, they might engage in actions that jeopardise their safety. Furthermore, a lack of accurate understanding due to misunderstanding impedes the ability of all stakeholders to make informed decisions about the Program's direction, features, and policies, potentially compromising the Program's objectives and success.

Enhanced education about the Program could improve efficiency by reducing the number of inquiries and fostering greater buy-in from stakeholders. Providing clear, factual information would reassure the public that a program is in place and address specific concerns, such as misunderstandings about incidents like 'animals inside the net' where people assume the net runs the length of the coastline (while not a predominant view, this provides an example of misunderstanding). By improving communication and education, the Program can better manage expectations, reduce misinformation, and create a more informed and supportive community.

7.5 Governance and stakeholders

To ensure the successful implementation, oversight, and evaluation of the SCP, a well-defined governance structure is necessary to detail decision-making processes and integrate with other state departments. The SWG plays a crucial role in providing independent scientific advice, and developing robust systems to monitor performance, compliance, and outcomes is critical. While the Program has seen improved engagement with stakeholders, collaboration with Indigenous knowledge holders offers a unique opportunity to incorporate traditional ecological knowledge. These aspects, including the importance of expert guidance, monitoring systems, and stakeholder engagement, are discussed further below.

The Program does not have a documented governance structure outlining the approach to decision-making for Program changes

There is a need to strengthen and document the governance for the SCP to establish robust, well-documented processes for decision-making. This definition includes the Program structure, responsibilities, and processes through initiatives that are developed, implemented, monitored, and evaluated. It ensures that the pillars and initiatives align with the Program's objectives, legal requirements, and community standards, providing a clear roadmap for decision-making. The goal for governance is to establish robust, well-documented processes for decision-making and risk management.

The SWG forms part of this structure and their role should be detailed. The primary role of the SWG is to convene to offer expert guidance on various aspects of the SCP, including the evaluation and implementation of alternative shark mitigation technologies, species-specific shark behaviour and research, and overall Program management. This insight has informed recommendation 2.6 and 2.9.

There is a lack of collaboration with Traditional Land and Sea Owners

Collaboration with Traditional Land and Sea Owners offers a unique opportunity to incorporate traditional ecological knowledge and values into the Program. Traditional Owners have lived in harmony with their environments for thousands of years, observing natural cycles and changes that modern scientific methods may not fully capture. This knowledge and views of the community are currently not observable in the Program. By integrating traditional ecological knowledge, the Program can foster stronger partnerships with Indigenous communities, promote inclusivity, and deliver on government First Nations policy objectives. This insight has informed recommendation 2.7.

The Program has improved engagement with stakeholders

Stakeholders have observed a positive, noticeable shift in how they have been engaged in the current SCP compared to past programs. Engaging key stakeholders—including the community, industry, advocacy groups, and experts—has been essential in understanding diverse perspectives and needs. Open and transparent communication throughout the policy development process has helped to build trust and foster collaboration. The DAF team's cooperative approach and regular engagement with key stakeholders were highlighted. The effectiveness of the Gold Coast Working Group was identified, with suggestions that it could play a key role during transitions or times of change to the Program.

During the evaluation, it was noted that input from the tourism industry was somewhat limited, indicating that further engagement with this sector may be necessary to better understand and address its concerns regarding the delivery of the current SCP.

Additionally, the DAF project team's collaboration with other state departments and the NSW program was commended, emphasising the need for ongoing engagement due to the Program's wide scope. The collaboration with the NSW program has led to efficiency in the delivery of initiatives, particularly trials.

Future community consultation, including key groups such as environmental advocates, tourism operators, and beach users, was seen as critical when implementing changes to shark control programs. This ensures that concerns are addressed and that measures are accepted by a broad range of stakeholders. Overall, these discussions reflect the complex relationship between shark control measures and differing views on balancing human safety with economic and environmental considerations. This insight has informed recommendation 2.7.

Opposing stakeholder views and a lack of social licence is a barrier to delivering Program changes

The successful implementation of the next SCP is challenging given the presence of opposing stakeholder views and limited social licence. When key stakeholders, such as local communities, tourism industry groups, environmental advocacy groups or government bodies, hold conflicting perspectives on the prioritisation of Program objectives it creates friction that can limit progress or make change more difficult to implement. This is further compounded by a lack of social licence, where stakeholders feel misaligned or mistrusted of the Program's outcomes. Without broad community support and stakeholder alignment, achieving consensus becomes difficult, leading to resistance. Building a social licence through transparent engagement and addressing stakeholder concerns is critical for navigating these challenges and ensuring the Program's successful delivery. A social licence is built when the stakeholders trust that a program is acting ethically and transparently, aligns with societal values

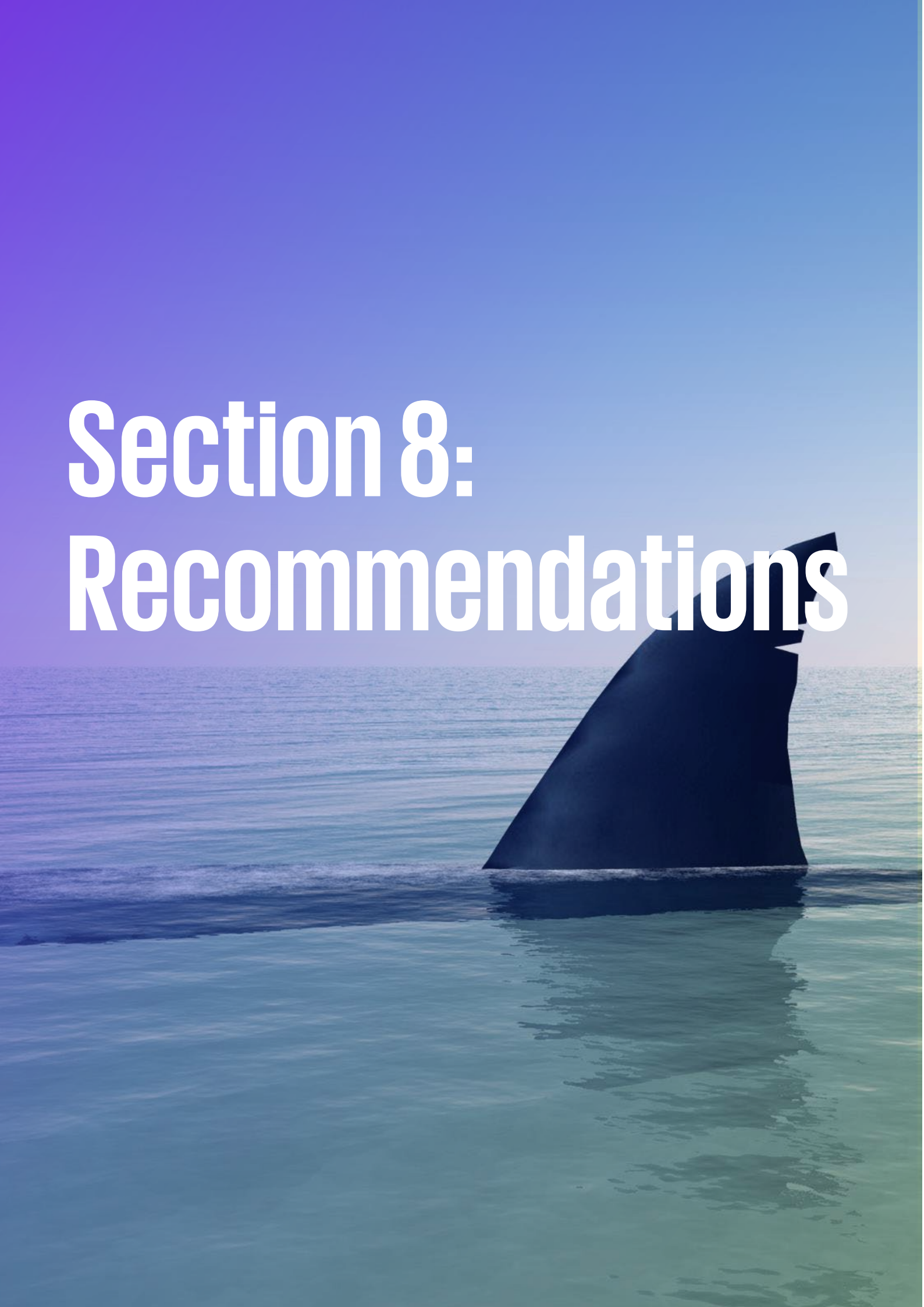
and norms, secures general community approval for its actions and impacts, and maintains ongoing, genuine engagement with stakeholders to address concerns. The challenge for the SCP is that it has three distinct stakeholder values groups – human safety, environment and tourism. This insight has informed recommendation 2.10.

Effective Program delivery through strategic resourcing and cross-government collaboration

The DAF officers have successfully delivered a significant scope of work under the Program. Drawing on expertise from other parts of government, industry and the research sector has proven to be an effective and efficient way to deliver the Program, allowing for flexibility in resourcing and access to expertise. Regional officers who have dedicated a portion of their roles to supporting the Program are currently under-utilised; they could be better utilised to contribute to education and community engagement efforts, as well as contractor monitoring.

Should the Program expand, particularly in the education space, additional team resourcing will be required. Initially, implementing improved internal processes and documentation will also demand greater resource allocation.

Section 8: Recommendations



8 Recommendations

With growing community desire and legislative requirements to phase out environmentally harmful practices, it is essential to develop a clear strategy for transitioning the Program in a manner that improves environmental outcomes whilst maintaining human safety. A well-defined approach will support a smooth, evidence-based transition that meets both community and government expectations. The recommendations focus on three key areas: reducing the environmental impact of the Program while maintaining human safety; establishing a decision-making framework to guide the operational transition; and delivering an evidence-based Program that achieves the revised objectives. Together, these focus areas will ensure a stable and proactive shift that aligns with sustainability goals and public safety.

A clear strategy to reduce the environmental impact of the SCP while maintaining human safety.

A decision making framework to enable the SCP to remain agile in changing contexts, respond to new technologies and transition operations.

The delivery of an evidence-based Program to achieve the revised objectives.

A clear strategy to reduce the environmental impact of the SCP while maintaining human safety.

A robust policy framework provides clear guidance for decision-making, aligning objectives to prioritise human safety and environmental outcomes. Given that current operational equipment falls short of desired ecosystem goals, alternative actions that mitigate adverse environmental impacts must be considered. Defining desired outcomes, implementing operational changes, and establishing performance measures within a structured policy framework will reduce the Program's environmental impact while maintaining safety standards. Additionally, a policy framework offers a cohesive strategy for consistent project delivery, risk reduction, and effective resource allocation, ultimately supporting a more impactful Program. Refining components of the SCP will reflect the work delivered under the current Program, community expectations, and legislative requirements and bring the policy more in line with Queensland Government Policy.

A decision-making framework to enable the SCP to remain agile in changing contexts, respond to new technologies and transition operations.

Strong processes to support planned transition will prevent the disruption often caused by reactive changes, allowing for a more organised, evidence-based and stable approach that best meets both community and government objectives. A decision-making framework will be essential to realising the Program's ambition by establishing clear performance indicators and targets, enabling continuous monitoring and improvement. By generating evidence through data collection and analysis, this framework will support informed decision-making, highlighting areas where adjustments are needed to optimise efficiency and improve effectiveness. It will also ensure early identification of risks, enabling timely mitigation strategies to ensure successful delivery of desired outcomes. Furthermore, incorporating a stakeholder feedback loop and leveraging a data capture system will provide transparent, up-to-date insights to improve communication and drive ongoing success.

The delivery of an evidence-based Program to achieve the revised objectives.

The delivery of an evidence-based Program centres on achieving revised objectives through targeted focus across each pillar: transitioning operational practices; advancing research into shark behaviour and human interactions; and expanding educational outreach.

The focus of operations is to reduce environmental impacts by implementing targeted trials and optimising operations. This includes trialling the consolidation of operational equipment, removal of shark nets during the winter whale migration season to reduce entanglements, reviewing contract delivery to streamline service routes and maximise gear servicing while minimising resource usage, and advancing broader trials of Drones and Catch-Alert Drumlines to enhance operational efficiency.

The research focus is to enhance understanding and inform shark management strategies with a focus on understanding shark populations and behaviour, human behaviour, Program understanding and sentiment. This is achieved by maintaining collaborations with universities, academics, PhD students, and other shark control programs. The Education pillar recommendations relate to a refinement of the approach to refresh target audiences and channels for the SharkSmart education campaign to prioritise broad education, high-risk water users and children.

8.1.1 Implementation

The recommendations have been grouped into four time horizons based on criticality, sequencing and impact. Outlined below is an overview of each of the stages and focus areas for the actions. The ability to deliver these recommendations in the timeframes will depend on the resources available.

Figure 8.1: Implementation of the Program Evaluation recommendations

8.2 Detailed recommendations

The detailed recommendations are grouped into three categories:

- **SCP Policy recommendation:** These recommendations relate to the delivery of a robust policy framework that includes a purpose and objectives, defines desired outcomes, establishes measurable indicators for monitoring progress, and includes governance structures to ensure accountability and effective oversight throughout implementation.
- **Supporting SCP processes recommendations:** These recommendations relate to the delivery of processes that outline the steps, roles, and responsibilities involved in executing a specific SCP process, ensuring consistency, accuracy, and compliance, and providing a clear pathway for decision-making and Program change.
- **SCP pillar and initiatives recommendations:** These recommendations aim to strengthen the SCP pillars—Operations, Trials, Research, and Education—by enhancing effectiveness and efficiency, and delivering improvements to achieve the Program objectives.

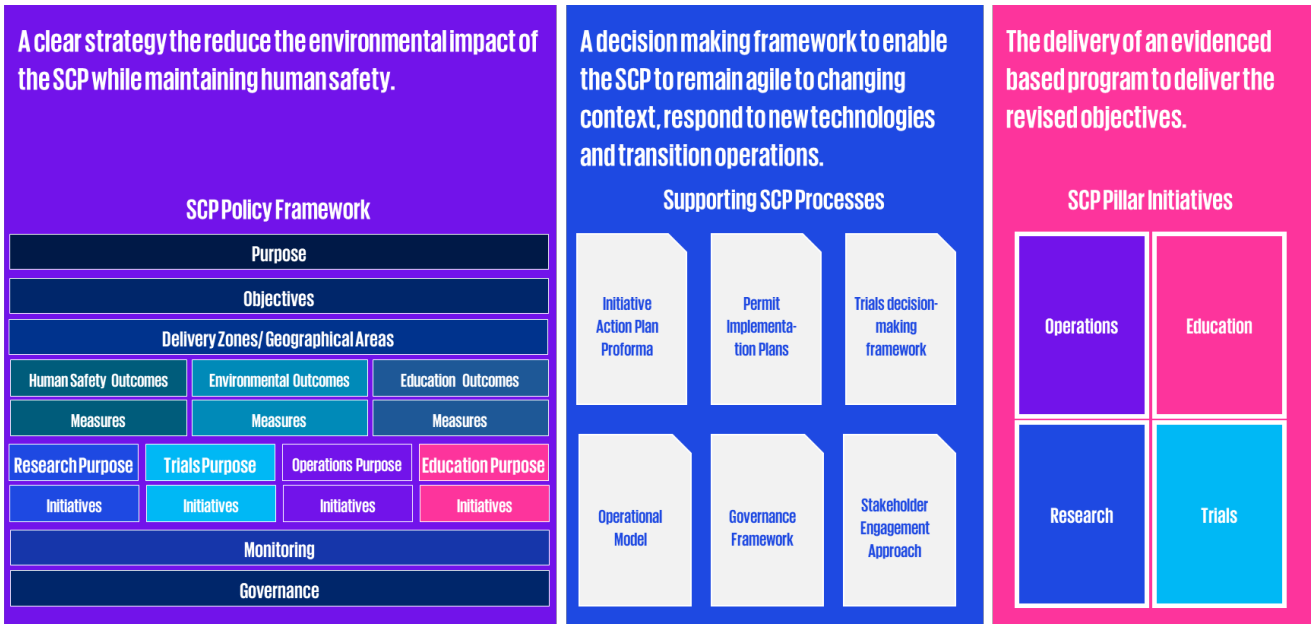


Figure 8.2: Recommendation focus areas for the SCP

8.2.1 SCP policy recommendations

Outlined below are the recommendations that relate to the delivery of the SCP policy.

	SCP Policy Recommendations	Timing
1.1	**Revise the purpose, objectives and outcomes to reflect the desired transition of the Program** Revise the Program's purpose, objectives, and outcomes to position it as a leader in innovation and sustainability within shark management, advancing transformative solutions and setting new industry standards. Ensure these program elements align with contemporary priorities, emphasising measurable progress, strategic partnerships, and a commitment to governance excellence.	**Next 6 months prior to next SCP**
1.2	**Strengthen the four-pillar approach** Maintain the categorical separation of Program initiatives under the four-pillar structure, clearly distinguishing between each pillar when communicating Program activities to stakeholders and the community. Ensuring initiatives are categorised in the correct pillar will enable a clear link between the objectives, actions and outcomes. Indicate how research and trials contribute to operations and education (as appropriate). This structure will guide understanding of how the different types of initiatives contribute to the delivery of Program objectives. Refine the purpose statement of each pillar to assist in the organisation of initiatives and alignment with objectives.	**Next 6 months prior to next SCP**
1.3	**Clarify the scope of the Program** Develop a scope document to clearly define the Program's focus and the boundaries of its initiatives. The revised scope may include: • Clarification of the Program's human safety objective (e.g. prevent shark bites (provoked and/or unprovoked) or human-shark overlap) • The target shark list, including a rationale for the exclusion of non-targeted shark species from the Program's scope • The legislative scope requirements.	**Next 6 months prior to next SCP**
1.4	**Develop performance measures** Key measures should be established to monitor the outcomes of the Program, enabling an effective evaluation of progress toward achieving these goals. For example: • Human safety: Number of human-shark interactions at SCP beaches. • Ecosystem improvement: Non-target species' mortality rate compared to previous periods or baseline operations (for evaluations involving trialled technologies). Thresholds or benchmarks for each measure should be identified to trigger predefined actions by DAF that respond to identified trends, ensuring timely adjustments to Program operations and maintaining alignment with objectives.	**Next 6 months prior to next SCP**
1.5	**Detail future initiative opportunities** Identify and explore emerging themes and innovations in shark bite mitigation to prioritise for investigation and monitoring in the upcoming Plan period. Transparent communication of these opportunities will keep stakeholders engaged and informed of potential advancements, fostering collaborations and partnerships that enhance the Program's effectiveness and drive innovation.	**Next 6 months prior to next SCP**

	SCP Policy Recommendations	Timing
1.6	**Delivery zones of the SCP** To enhance understanding of the Program of location difference as a result of legislation, environmental conditions and local communities, revise the definition of geographical areas. Using SCP zones will enable improved compliance with legislation and understanding of different Program approaches in Queensland's localities.	**Next 6 months prior to next SCP**

8.2.2 Supporting SCP Processes

Outlined below are the recommendations that relate to the delivery of the SCP supporting processes.

	Supporting SCP Process Recommendations – Policy	Timing
2.1	**Detail an Initiative Action Plan** Develop an Initiative Action Plan Pro forma that captures critical information about the project (including project title and description), alignment to Program objectives, approach to implementation and changes to delivery. Comprehensive initiative information will enable more accurate monitoring and evaluation.	**As part of the next SCP** **Year 1**
2.2	**Develop an SCP Operational Model and consolidate ineffective operational equipment** Develop an operational model to determine the optimal locations and configuration for gear deployment (e.g. Catch-Alert Drumlines, Traditional Drumlines, Mesh Nets, SharkSmart Drones) that maximises human safety while minimising ecosystem impacts. This model should consider factors such as the effectiveness threshold for each type of equipment, beach visitation, animal migration patterns, environmental conditions, seasonal changes, legislative overlays and current expenditure. It will identify the suitability of operational delivery options at each location (beaches), offering a set of discrete options for the Program to implement at critical decision points, such as at threshold triggers identified within the Performance Monitoring Framework. This model should guide the consolidation of shark control equipment by removing or relocating gear found to be ineffective (e.g. equipment not catching target sharks or deployed at locations with insufficient beach visitation to justify its presence). Insights from the 2020 Cardno report, *Selectivity of Nets and Drumlines in the Queensland Shark Control Program*, should also support these operational changes. The report highlights that certain beaches and equipment types capture few or no target sharks and frequently have a high bycatch ratio, underscoring the need for a more selective deployment strategy. The model should have a regular review (e.g. biannually) as the input variables change, for example, human behaviour and the environment.	**Next 6 months prior to next SCP**

	Supporting SCP Process Recommendations – Policy	Timing
2.3	**Develop a Program Monitoring Framework** Establish a Program monitoring framework to systematically track initiative delivery and assess progress toward achieving Program objectives. This framework should ensure that the Program remains aligned with its goals and allows for the discontinuation of ineffective initiatives. Key components of the framework should include: • Clear Performance Metrics: Establish pre-defined performance metrics and thresholds to evaluate initiative progress. • Data Collection Methods: Outline standardised data collection processes to ensure consistency. • Regular Reporting and Review: Implement frequent reporting and review cycles to assess progress and adjust as needed. Checklist: Create a brief checklist for initiative owners to facilitate data capture when changes occur in initiative delivery, ensuring that all Program modifications are documented.	**As part of the next SCP** **Year 2**
2.4	**Develop an interactive dashboard** Develop an internal monitoring dashboard to provide quick insights into operational effectiveness and ecosystem impacts, using data from ongoing Operations and Trial initiatives (e.g. Shark Tagging and Tracking). This tool will streamline the extraction and analysis of insights from the extensive QFish dataset, supporting up to date monitoring and refinement of the operational model. It will also facilitate comparisons of operational metrics against decision-making frameworks to guide Program actions.	**As part of the next SCP** **Year 2**
2.5	**Develop a trial decision-making framework** A decision-making framework should be established to systematically evaluate the progress of trials for alternative shark control technologies and strategies, providing an incremental pathway to integration into SCP Operations. This framework would ensure that decisions along the trial pathway are adaptable, align with the Program's objectives and maximise resource efficiency. A trial decision-making framework includes developing a set of criteria to benchmark trial outcomes, including but not limited to establishing a scientific evidence threshold and performance indicator metrics to assess the effectiveness, risk profile compared with baseline Operations, cost-effectiveness, public sentiment and policy and governance alignment of the trialled solution. Where appropriate, once a trial meets the established criteria, it should be included in the Program Operational Model.	**As part of the next SCP** **Year 1**
	Supporting SCP Process Recommendations - Governance and Stakeholders	
2.6	**Establish a Governance Framework that defines actions based on performance measures and specific events** This framework will provide a structured approach for decision-making, accountability, and oversight to ensure effective implementation of the SCP policy, aligned with its intended goals. It will clarify roles and responsibilities (e.g. DAF officers, Chief Executive, Minister, SWG), establish processes, and outline decision rules and actions triggered by performance indicators. Initial actions may include pre-determined management responses.	**Next 6 months prior to next SCP**

	Supporting SCP Process Recommendations – Policy	Timing
2.7	**Develop a stakeholder engagement plan** A stakeholder plan identifies and categorises relevant stakeholders, defines the frequency and triggers for engagement, and outlines the engagement approach. This plan should specifically include Traditional Land and Sea Owners and establish working groups to support the implementation of specific initiatives or changes to the SCP. Where appropriate, the plan may also track interactions with each stakeholder group, documenting key issues discussed, feedback received, and actions taken in response.	**Next 6 months prior to next SCP**
2.8	**Strengthen collaboration with local governments** Strengthen partnerships with coastal local governments to identify opportunities for delivering trials and educational initiatives and sharing research findings. Leverage these local governments' community connections and relationships with key stakeholder groups to support SCP implementation, with a strong focus on education. Coordinate beach messaging with local governments and SLSQ to promote targeted human behaviour change, including co-located beach signage and messaging.	**Ongoing**
2.9	**Structure of the SWG to reflect the Program pillars** For the next iteration of the SCP, review the membership of the SWG to ensure alignment with relevant stakeholder groups and the SCP's focus areas. While changes to the SWG may not be necessary, this review should confirm that its membership remains relevant to the SCP's objectives. Any identified gaps could be addressed by establishing additional working groups under the Stakeholder Engagement Plan.	**As part of the next SCP** **Year 1**
2.10	**Improving the social license of the SCP** Enhance transparency around Program achievements and changes that could boost public support for the SCP. Highlight opportunities to share positive developments, such as successful trials, and promote Program champions, like shark researchers, to showcase the SCP's progress and positive impact.	**As part of the next SCP** **Year 2**
	Supporting SCP Process Recommendations - Legislative	
2.11	**Deliver final actions to comply with GBRMPA permit and ongoing monitoring plan** To comply with the GBRMPA permit, complete the deployment of Catch-Alert Drumlines within the GBRMP according to a timeframe agreed with the GBRMPA. Summarise and disseminate research findings from the trials and related studies to relevant stakeholders, highlighting the environmental impacts, effectiveness, and potential benefits of Catch-Alert Drumline technology within the GBRMP. In consultation with the GBRMPA, develop an ongoing monitoring plan to ensure transparency and continued alignment with GBRMPA's vision and support evidence-based decision-making for a permit post-April 2027.	**As part of the next SCP** **Year 1**
2.12	**Develop a permit implementation plan for the Great Sandy Marine Park and Moreton Bay Marine Park and expand Catch-Alert Drumline Trials** A permit implementation plan addressing specific permit conditions should outline the steps, timelines, and responsibilities for ensuring compliance with non-lethal operations by November 2025. This plan will ensure all conditions are met effectively, SCP measures are assessed, risks associated with changes are minimised, and alignment with legal and environmental standards is maintained. The implementation plan would have similarities to the trial's decision-making framework (recommendation 2.4).	**As part of the next SCP** **Year 1**

8.2.3 SCP pillar and initiatives

Outlined below are the recommendations that relate to the SCP pillars – Operations, Trials, Research and Education.

	SCP Pillar Recommendations – Operations	Timing
3.1	**Reduce the environmental impact of Operations** Since the current operational equipment, nets and traditional drumlines, do not achieve the desired ecosystem outcomes, alternative initiatives or actions that reduce adverse environmental impacts need to be considered. Implementing the Operational Model, along with performance measures and a decision-making framework, will help identify Program changes that warrant consideration. A range of actions have been identified that would reduce the environmental impact of Operations. These include, but are not limited to: • Identifying areas and times of high bycatch and ineffective equipment to optimise gear deployment and consider alternative approaches, utilising findings from the Selectivity of Nets and Drumlines Used in the Queensland Shark Control Program report • Replacing J-hooks with Circle-Hooks if trials demonstrate their increased effectiveness in reducing catch mortality • Expanding Catch-Alert Drumline Trials to the state Marine Parks (recommendation 3.4) • Trial removing nets during the winter whale migration (recommendation 3.2) • Expanding SharkSmart Drone trials to additional, suitable locations and increasing the number of days in the year that they are operated (recommendation 3.4) • Refining the target shark list to reflect only the most dangerous species.	**As part of the next SCP** **Year 1**
3.2	**Trial removing nets during the winter whale migration season to reduce entanglement** Removing Mesh Nets during the whale migration season (April–October) reduces the environmental impact of operations by preventing whales from becoming entangled in SCP nets. This measure will not only improve the safety of DAF staff who undertake dangerous MART operations to release entangled marine animals but will also mitigate negative media attention and boost community sentiment. Cost savings should be redirected to community education on shark-safe behaviours and Program updates.	**As part of the next SCP** **Year 1**
3.3	**Review procurement and configuration** Contractor delivery should be reviewed to optimise operational service routes, ensuring that the maximum number of nets and drumlines are safely serviced while minimising resource use. This review should ensure transparency in costs and enable financial analysis of initiatives. Minor improvements to contractors may have a meaningful impact on the Program, given the costly nature of this component.	**As part of the next SCP** **Year 2**

	SCP Pillar Recommendations – Trials	
3.4	**Progress SharkSmart Drones and Catch-Alert Drumline trials through the trials decision-making framework and operational model** The trial implementation of drones and Catch-Alert Drumlines should continue to gather sufficient empirical evidence to assess their effectiveness in each region without increasing the current risk profile. Both technologies have shown the potential to reduce adverse ecosystem impacts compared to traditional operations at the trialled locations. Establishing a defined baseline for performance measures (ecosystem and human safety) at each SCP location will complement this process by providing a more reliable foundation for evaluating trials.	**Next 6 months prior to next SCP**
3.5	**Progress alternative gear trials** Circle-Hook trials should continue until sufficient evidence is available to assess their effectiveness and suitability for operational roll-out. Alternative fishing equipment that has the potential to improve operational efficiency, contractor safety, bycatch survivability, or target shark catch rates should be investigated and incorporated into the alternative gear trial, if deemed viable.	**As part of the next SCP** **Year 1**
3.6	**Expanding application for SharkSmart Drones** Greater value should be extracted from the SharkSmart Drones by expanding their applications to benefit SLSQ and other stakeholders. For example: • Drone technology and AI can be combined to help record more accurate beach activity data, supporting decision-making for the SCP, SLSQ, and local governments. • Drones can assist in identifying swimmers in distress and aid in search and rescue missions as needed by SLSQ and other first responders. The SCP should explore reallocating the costs of drone operations across the stakeholders who stand to benefit from their use, improving Program cost-efficiency.	**As part of the next SCP** **Year 2**
	SCP Pillar Recommendations – Research	
3.7	**Determine the impact of shark bites on tourism** Obtain or develop a methodology to be implemented during shark bite incidents in Australia, detailing the data needed and specific timeframes for data collection to determine the severity and duration of impacts on local businesses and tourism.	**As part of the next SCP** **Year 2**
3.8	**Continue shark tracking and tagging to inform research and education** Expand the shark tracking and tagging initiative to deepen understanding of shark behaviour. This ongoing research is crucial for understanding shark activity in key areas. It would directly support the collection of specific information on shark behaviour for research and education.	**Ongoing**

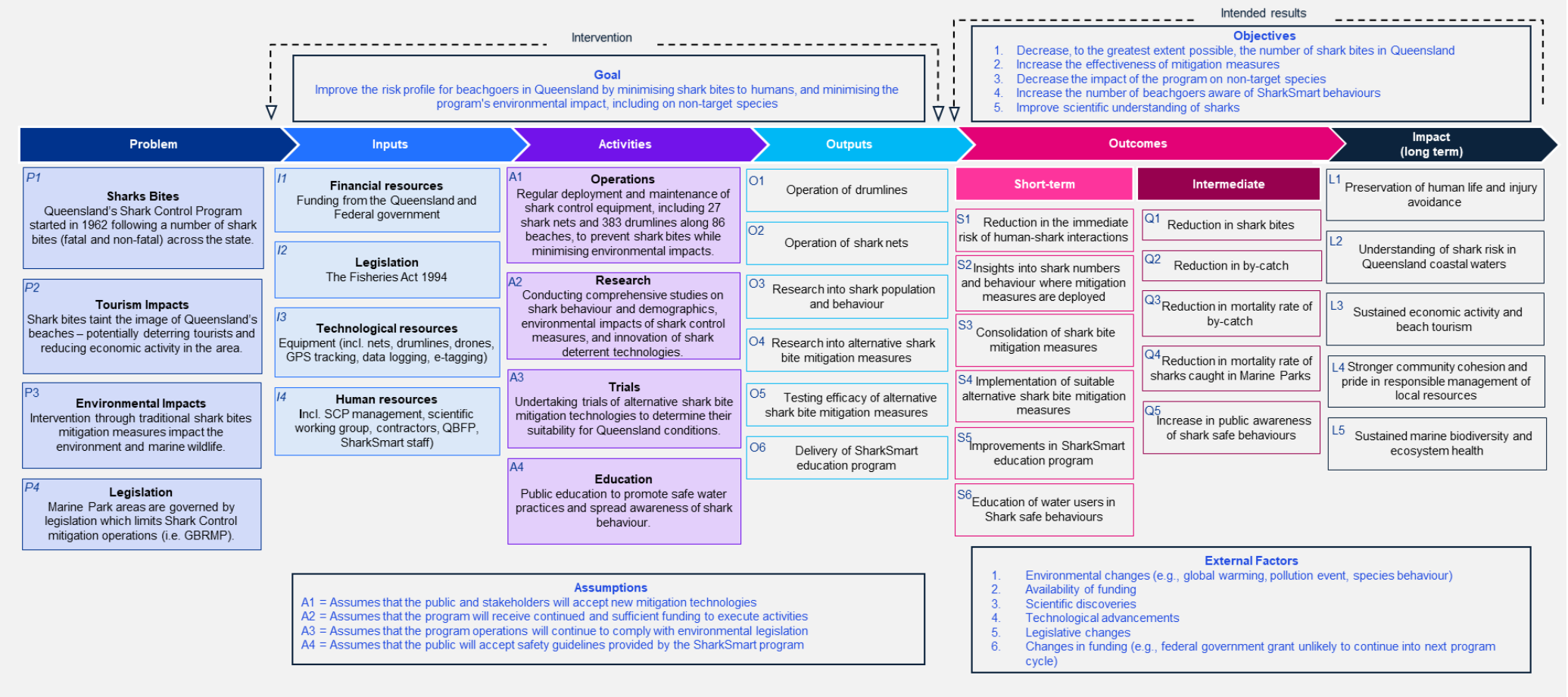
3.9	**Continue Public Sentiment Research** To support informed decision-making and ensure Program success, it is recommended to continue conducting Public Sentiment Research, including gathering longitudinal data to track how perceptions and impacts evolve over time. This approach will allow for a deeper understanding of community concerns and how they align with the Program's pillars, objectives, and key user groups.	**Ongoing**
3.10	**Maintain relationships with universities, academics, PhD students and other shark control programs** Continue to maintain strong relationships and collaborate with universities, academics, and PhD students. Research conducted by these groups, both DAF-initiated and independent, is a primary source of insights and innovative approaches that enhance operational delivery, trials, and educational initiatives.	**Ongoing**
3.11	**Share outcomes from Personal Deterrents Research** The findings from the Personal Deterrents Research should be shared with the public in an accessible format. Providing clear and easily available information will help the public make informed decisions about shark bite mitigation technologies, enabling consumers to opt for technologies that are proven to work and supporting businesses in the continued manufacturing and distribution of those products.	**As part of the next SCP** **Year 1**
	SCP Pillar Recommendations – Education	
3.12	**Refresh advertising target groups** Consider aligning the SharkSmart Education Campaign with other shark management programs by targeting marketing efforts toward high-risk and medium-risk user groups, as individuals in these categories account for a disproportionate number of shark bite incidents in Queensland. Develop activity specific SharkSmart behaviours (e.g. SurfSmart, DiveSmart, etc) and work with key activity stakeholders (e.g. clubs, social groups and academia) to disseminate messages. Provide user specific messaging on the website. Consider in-situ messaging targeting key groups at higher risk locations.	**As part of the next SCP** **Year 1**
3.13	**Revise channels of advertising based on refined target groups** Advertising channels should be revised to align with refined target groups. A scaled approach for reaching new target audiences (e.g. high-risk users) should be developed to facilitate feedback and refine messaging. For example, working with a small number of water sports clubs to develop suitable messaging. Collaborate with local stakeholders to explore the implementation of in-situ signage in high-risk locations.	**As part of the next SCP** **Year 1**
3.14	**Address FAQs on the website 1.6to improve DAF officer efficiency** To proactively address frequently asked questions and common misconceptions about the Program on the website and other suitable education channels to manage and reduce calls to the hotline and public inquiries. By providing clear, accessible information before public consultation, the Program can improve public understanding, streamline communication, and enhance the effectiveness of outreach efforts.	**As part of the next SCP** **Year 1**

3.15	**Increasing public knowledge about shark behaviour** Develop an education campaign focused on increasing public knowledge about shark behaviour patterns while also promoting shark-safe behaviours. Provide accessible, science-based information on shark species common to local waters, their feeding and migratory behaviours, and factors influencing their movements, such as seasonal changes and environmental conditions. Understanding these patterns can help the public make informed decisions about water safety. This could be delivered in partnership with local councils, SLSQ and educational institutions.	**As part of the next SCP** **Year 1**

Section 9: Appendices

Appendix A: Program logic

Below is the SCP Program Logic, which provides a clear visualisation of the SCP Program Evaluation structure and informs a series of evaluation questions corresponding to each domain of inquiry and relevant Program components.



Appendix B: Evaluation Framework

The following key evaluation questions and sub-questions make up the Evaluation Framework for this Summative Program Evaluation.

Domain	Key Question	Sub-Question
1. Appropriateness The extent to which the program's design and approach met a need and was suitable in achieving the intended outcomes.	To what extent does the program address an identified need?	• What is the need for the Program? • Is the Program the most appropriate approach? • How have economic, environmental and social conditions changed since the Program began? • How well does the Program align with government and agency priorities?
2. Effectiveness The extent to which the intervention achieved, or is expected to achieve, its objectives, and its results.	To what extent is the program achieving the intended outcomes, in the short, medium and long term?	• To what extent is the program producing expected outcomes and/or meeting its objectives? • What is the alignment between the program's stated objectives, its outputs, intended outcomes and impacts, and any government priorities? • To what extent has the program been implemented in line with intended design? • What else is helping or hindering the Program to achieve its objectives and outcomes?
3. Efficiency The extent to which inputs deliver maximum outputs.	Do the outcomes of the program represent value for money?	• To what extent is the relationship between inputs and outputs timely, cost-effective and to expected standards? • What were the costs and benefits of the Program relative to similar national and international programs and interventions?
4. Impact The extent to which the intervention has generated or is expected to generate significant positive or negative, intended or unintended, higher-level effects.	What results have been produced due to the Program?	• What evidence is there of the Program's impact (including unintended impacts?) • What were the reasons for variability in performance? • What has (and has not worked) for whom and in what circumstances?

Appendix C: Stakeholder list

KPMG delivered 22 x 1-hour interviews with relevant stakeholders that intersect with the program. These targeted consultations will allow us to capture more nuanced information on the delivery of the SCP that cannot be collected through desktop reviews alone. These will be semi-structured using the consultation guides as a starting point for the discussion.

The stakeholder groups consulted included:

- DAF Program Team
- DAF Initiative Owners
- SCP Contractors
- Surf Life Saving Queensland
- Flinders University
- Department of Tourism and Sport
- Department of Environment and Science
- Local Governments
- Flinders University
- Bond University
- Sea World
- Humane Society International Australia
- Great Barrier Reef Marine Park Authority
- Interstate Shark Control Programs - NSW Department of Primary Industries.

Appendix D: Consultation guide

Shark Control Program Review

Consultation Guide

Program Consultation

July 2024

Disclaimer

This consultation guide has been prepared as outlined with the Department of Agriculture and Fisheries (DAF) in the Scope Section of the contract dated 2 April 2024. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently, no opinions or conclusions intended to convey assurance have been expressed. No warranty of completeness, accuracy, or reliability is given in relation to the statements and representations made by, and the information and documentation provided by, DAF management and personnel consulted as part of the process. KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

Third Party

This consultation guide is solely for the purpose set out in the Scope Section and for DAF's information and is not to be used for any purpose not contemplated in the engagement letter or to be distributed to any third party without KPMG's prior written consent.

This report has been prepared at the request of DAF in accordance with the terms of KPMG's contract dated 2 April 2024Other than our responsibility to DAF, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

Contents

1 Project Purpose

KPMG has been engaged by the Department of Agriculture and Fisheries (DAF) to conduct a review and evaluation of Queensland's Shark Management Plan 2021-2025. This includes reviewing shark mitigation trials, research and education initiatives undertaken by DAF with the aim of providing recommendations to the Queensland Government on an improved program design tailored towards Queensland conditions that may be implemented beyond 2025.

The review of the Shark Control Program marks a critical juncture in the policy cycle as it brings together the findings from its previous research, trials, educational initiatives and operational outcomes, as well as previous reviews and benchmarking against other jurisdictions and programs, to identify what is working, what is not working, what is undergoing change and opportunities for improvement.

The Shark Control Program evaluation aims to support the development and implementation of evidenced-based policies for the Shark Control Program. By examining the program's design, implementation, and outcomes, this evaluation enables informed decision-making, enhances accountability, and establishes a robust basis for performance reporting.

Identifying strengths and weaknesses, and opportunities for improvement helps streamline processes and incorporate new evidence-based strategies aligned to the Shark Control Program. Specifically for the Shark Control Program, this evaluation is intended to guide the formulation of more effective and cost-efficient policies which will result in a number of benefits for Queenslanders and the Queensland Government.

A link to the current shark control program is provided here: Shark Control Program | SharkSmart (daf.qld.gov.au).[1]

2 Consultation approach

The stakeholder consultation for the Shark Control Program aims to evaluate DAF's operations in regard to initiatives, trials, research and education campaigns conducted between 2021 and 2024. By gathering diverse perspectives and expert insights, the consultation seeks to assess the appropriateness, effectiveness, efficiency and impact of the Shark Control Program's effort during this period. The questions contained in this consultation guide will relate to the four themes:

- **Appropriateness** - The extent to which the Shark Control Program's design and approach met a need and was suitable in achieving the intended outcomes.
- **Effectiveness** - The extent to which Shark Control Program's intervention, trials, research and education campaigns achieved, or are expected to achieve, its objectives, and its anticipated results.
- **Efficiency** - The extent to which inputs into the Shark Control Program can deliver maximum outputs.
- **Impact** - The extent to which the Shark Control Program's interventions, trials, research and education campaigns have generated or is expected to generate significant positive or negative, intended or unintended, higher-level effects.

The findings will help identify strengths, weaknesses, inform future strategies, and ensure the program continues to meet its objectives in a cost-effective and scientific sound manner.

3 Overview of the Shark Control Program

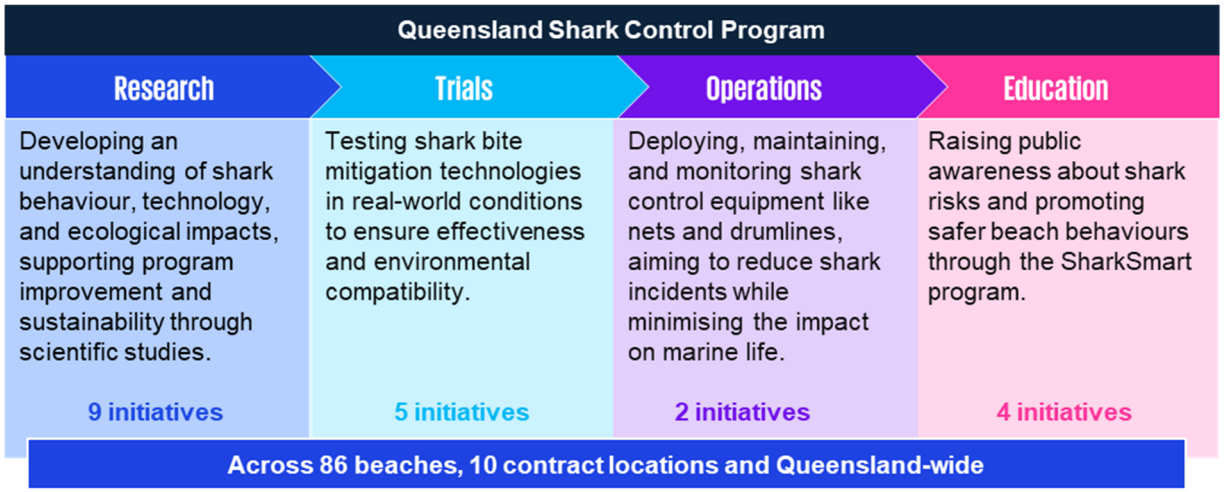
The Queensland Shark Control Program, initiated in 1962 in response to a series of fatal shark incidents, aims to enhance beachgoer safety by minimising the risk of shark-human interactions along Queensland's coastlines.

The current iteration of the program is detailed in Queensland's Shark Management Plan 2021-2025. The program is scheduled for revision in 2025.

The Program includes the delivery of 20 initiatives across four operational activities: research, trials, operations, and education.

Research aims to develop an understanding of shark behaviour, technology and ecological impacts. Operation activities include nets and drumlines with the delivery of 27 nets and 383 drumlines. Various alternative mitigation technologies, such as catch-alert drumlines and surveillance drones, are being trialled at several swimming destinations. Education focuses on the delivery the SharkSmart program. The Queensland Shark Control Program operates across 86 beaches, 10 contract locations from Cairns to the Gold Coast.

Summary of the Shark Control Program's activities



The Shark Control Program aims to instil trust in shark management measures in Queensland, supporting both tourists and residents to safely and confidently enjoy water-based activities and experiences. Tourism supports one in ten Queensland jobs and is worth more than $27 billion (pre-COVID-19) to the state's economy.[2] Queensland is renowned for its coastal holidays, identified as one of the state's key pillars of tourism and competitive advantages.

The Scientific Working Group was established in collaboration with the Great Barrier Reef Marine Park Authority **to provide independent scientific advice to the government on the program.** This group plays a key role in researching and trialling alternative mitigation measures suitable for Queensland.

The program has received $17.1 million in state funding, supplemented by a $5 million federal grant.

[2] Department of Tourism, Innovation and Sport, 2021

4 Stakeholder context

To understand the stakeholder involvement in the Shark Control Program.

Q1	Please describe DAF's role in the Shark Control Program from 2021 to 2025?
A1	

Q2	What is the current delivery status of the below Shark Control Program initiatives? • Is the Shark Hotline an initiative that should be included?
A2	

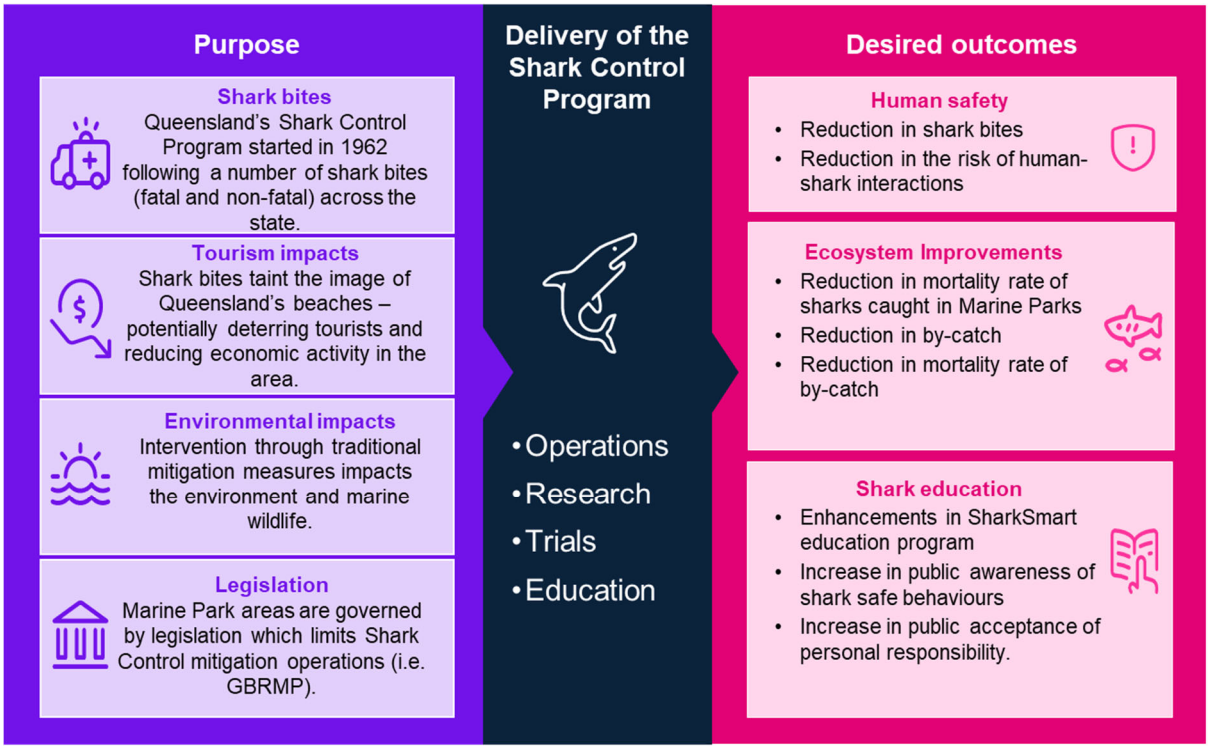
	Initiative	Status
Research	Prevalence and Behaviour of sharks in the Whitsundays	
	Support the Integrated Marine Observing System Queensland Acoustic Telemetry Array	
	Investigating fishing depredation	
	Shark population studies	
	Assess personal deterrents	
	Barriers to adopting SharkSmart messages – behaviour change	
	Value contribution of Shark Control Program to Qld economy	
	Shark Tracking	
	Public Sentiment Research	
Trials	SharkSmart drone trial	
	Assess physical barriers (did not proceed)	
	Catch alert drumline trial	
	Alternative gear trial	
	Advanced ariel detection trial	
Opera - tions	Tag and release tiger, white and bull sharks in the Great Barrier Reef Marine Park	
	Traditional Operations (Nets & Drumlines)	
Education & engagement	SharkSmart education program	
	Investigate human behaviour change	
	Upgrade signage	
	Undertake website transformation	

5 Appropriateness

This section aims to understand to what extent the Shark Control Program's design and approach meets the needs of stakeholders and was suitable in achieving the intended outcomes.

The appropriateness domain seeks to understand how the program's design and approach meets the needs of its stakeholders. To determine appropriateness, KPMG will evaluate the program's outcomes against the problems and context (purpose) it was designed to address.

The overarching purpose statement and outcomes of the Shark Control Program are outlined in the below diagram.



Q3	Why do we need a Shark Control Program for Queensland?
A3	

Q4	To what extent is the Shark Control Program the most appropriate approach to achieving Shark Control Program's purpose and outcomes? Consider approaches in other jurisdictions or for other similar problems.
A4	

Q5	How have economic, environmental, regulatory, and social conditions changed since the inception of the Shark Management Plan in 2021? Have these conditions impacted the delivery of your initiative?
A5	

Q6	Reflecting on the above answer, in what ways, if any, should the next version of Shark Control Program adapt to these changed conditions?
A6	

Q7	In what ways does the program align with government priorities? i.e., Federal, State and Local government priorities. Please note specific legislation or policy as required.
A7	

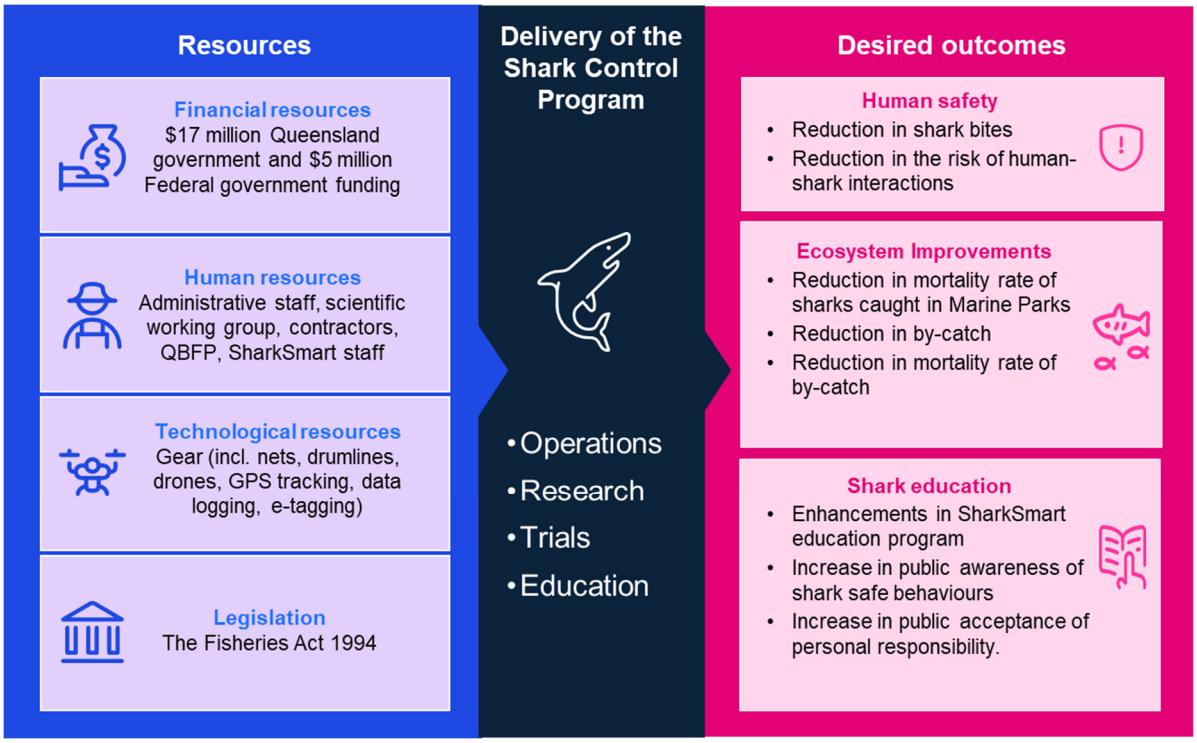
The Director-General of the Department of Agriculture and Fisheries (DAF) is responsible for establishing and managing the program in accordance with the Fisheries Act 1994. This Act states:

> '*Despite the main purpose of this Act, a further purpose of this Act is to reduce the possibility of shark attacks on humans in coastal waters of the state adjacent to coastal beaches used for bathing.*'

6 Effectiveness

The purpose of this section is to understand the delivery of the program from the resources allocated through to the outcomes. KPMG will measure the program's outcomes against the resources input into its activities to determine the effectiveness.

The resources and outcomes areas at a program level are detailed below. For the Shark Control Program initiatives only select inputs and outcomes will be relevant.



Q8	To what extent is the program producing expected results (outcomes)?
A8	

Q9	To what extent has the program been implemented in-line with its intended design?
A9	

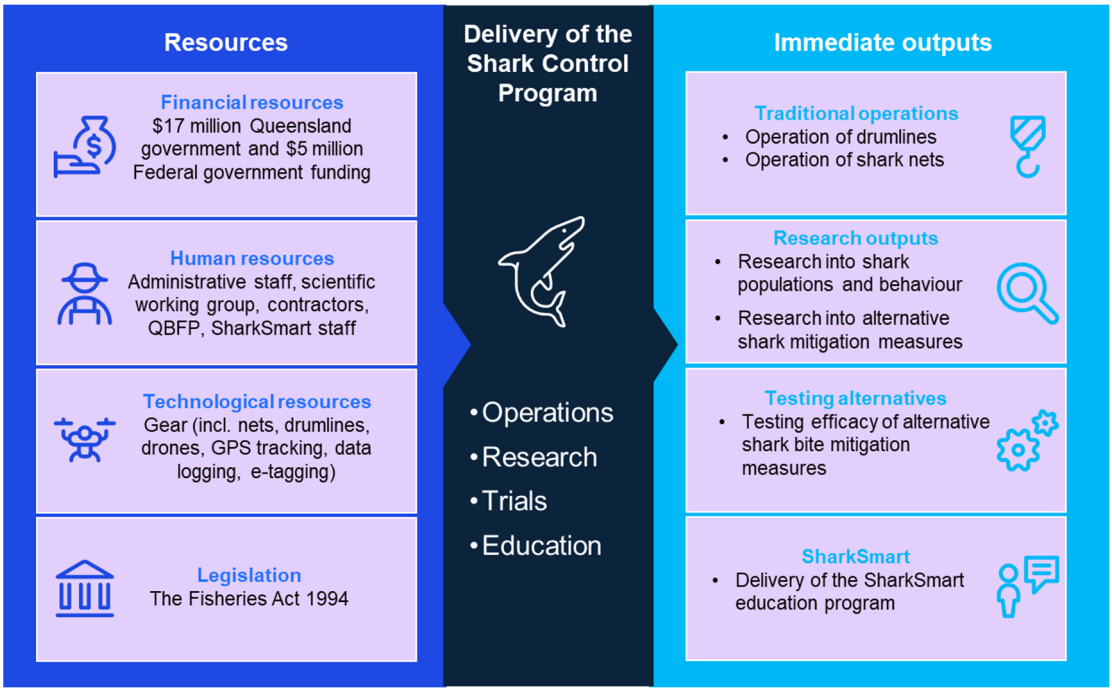
Q10	What is helping or hindering the program achieve its objectives and outcomes? Consider external factors such as political, economic, sociological, technological, legal, and environmental..
A10	

Q11	How could the current program be delivered more effectively to achieve the outcomes?
A11	

7 Efficiency

This section aims to evaluate how well the Shark Control Program manages its resources to maximise outputs. By understanding Shark Control Program's efficiency we can identify opportunities for streamlining processes, reducing costs, and optimising effectiveness.

The inputs and outputs areas at a Program level are detailed below. For Shark Control Program initiatives only a select inputs and outcomes below will be relevant.



Q12	How efficiently is the program delivered? • timely – time from commencement to outputs • cost-effective – represents value for money • delivered to expected standards – the quality of the outputs • workforce – a suitable workforce, recruitment needs, vacancies issues.
A12	

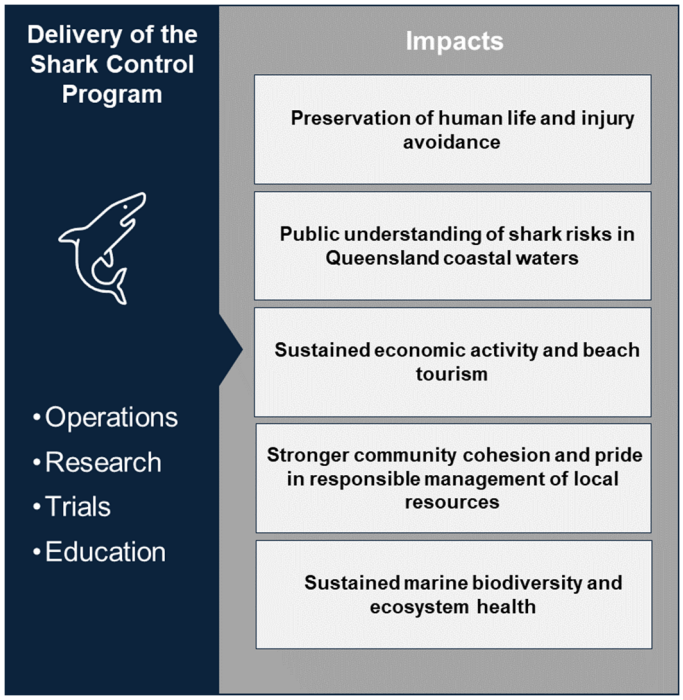
Q13	How could the efficiency of operations, trials, research or education be improved?
A13	

Q14	If known, how efficiently is the program delivered relative to similar national and international programs and interventions?
A14	

8 Impact

This section of the evaluation focuses on the impact of the Shark Control Program. KPMG will examine the extent to which the program has achieved addressing the problem. These impacts reflect the Shark Control Programs ultimate vision and enduring impact, and are influenced by various external factors beyond the program's direct control.

The impacts at a program level are depicted below.



Q15	What was the impact of the Program? Also consider the unintended impacts.
A15	

Q16	Was there any variability in performance? What were the reasons for this? What was the impact?
A16	

Q17	What has worked well and should continue in the future delivery of the Program?
A17	

Q18	What has not worked well? How could these challenges be overcome in the future delivery of the Program?
A18	

Q19	How can the program better measure the impact areas? How can the program better measure the impact on marine biodiversity and ecosystem health?
A19	

9 Close

Q20	Is there any other feedback you would like to provide regarding the Shark Control Program?
A20	

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