Effectively Managing Area-Based Management Tools; a New Toolkit for the Conservation of Marine Mammals

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ABSTRACT

Marine mammals play crucial roles in marine ecosystem function yet are threatened by increasing pressures from anthropogenic activities within marine ecosystems. Area-based Management Tools (ABMT) are key for their conservation and protection, yet their effectiveness is often hindered by lack of resources, technical capacity and political support. Yet, ABMTs are grounded in local, national, regional, and international agreements and policy frameworks including the Kunming-Montreal Global Biodiversity Framework (GBF). To support marine managers, the "Marine Mammals Management Toolkit" was developed and is composed of three core components, including the Self-Assessment Tool (SAT), founded on the Protected Area Management Effectiveness (PAME) framework, and is a multiple-choice tool that enables managers to evaluate the effectiveness of management plans regarding marine mammals through the production of a Management Effectiveness Score (MES). The SAT has been utilised across 24 MPAs in 18 countries. Two case studies are provided on its application. The Stellwagen Bank National Marine Sanctuary (SBNMS) evaluated their existing management plan, and scored an MES value of 7.8 with the Bermuda Marine Mammal Sanctuary (BMMS) scoring 4.7. The results of the SAT enabled the Bermudian Government to make informed decisions in developing a Marine Spatial Plan for the BMMS, and enables SBNMS to set a baseline to track effectiveness over the life-time of SBNMS and respective management plans; guiding local and national policy, as well as enabling Bermuda and the United States of America to contribute to their international commitments.

KEYWORDS

Marine mammals; Marine Protected Areas; Management Effectiveness; Marine Spatial Planning; Policy

1. INTRODUCTION

Marine mammals play critical ecological roles in the world's oceans as predators, prey, and nutrient vectors (Roman and Estes, 2018), and have direct and indirect influences on ecosystem structure, function, and productivity (Savoca *et al.*, 2021). Marine mammals provide valuable ecosystem services including cultural and economic benefits, such as ecotourism (Cook *et al.*, 2020). For example, whale watching at Stellwagen Bank National Marine Sanctuary (SBNMS) supports close to 1,500 jobs annually translating to USD $76 million in labour income (Schwarzmann and Shea, 2020).

Marine mammals face an abundance of anthropogenic hazards, such as incidental by-catch (e.g., Reeves, McClellan and Werner, 2013) entanglement (Hamilton and Baker, 2019), and ship strikes/collisions (Agardy *et al.*, 2019), with fishery by-catch being a dominant threat for many marine mammal species (e.g., Brownell Jr *et al.*, 2019; Anderson *et al.*, 2020).

With the continued threats to marine mammals, compounded by the detrimental effects of climate change (Tulloch *et al.*, 2019) , there is a real need for effective conservation measures. The diversity of threats faced by marine mammals requires an equally diverse suite of conservation tools including Area-based Management Tools (ABMT) such as marine protected areas (MPA). These have been regularly cited to provide critical benefits to marine mammals (e.g., Carlucci *et al.,* 2021; Tomás & Sanabria 2022), supporting effective management, and enabling the implementation of political agreements at national, regional, and international scales.

International policy has attempted, in many forms, to combat the threats faced by marine mammals throughout the world's oceans. For example, the landmark Moratorium on whaling in 1982 by members of the International Whaling Commission (IWC), the Convention on Biological Diversity's (CBD)

Aichi Targets (Target 12), and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention; CMS). The recently adopted Kunming Montreal Global Biodiversity Framework (GBF) (Targets 1, 3, 4 and 21) and the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ Agreement) further support the conservation and protection of marine mammals.

ABMTs may be designed to protect marine mammals directly by targeting threats or indirectly through management goals that may reduce impacts. However, in many cases, the success of an ABMT can be hindered through a lack of resources and capacity to make informed management decisions and effectively implement management practices. This gap can be bridged through the ability of managers to assess Protected Area Management Effectiveness (PAME); a vital component of responsive, pro-active protected area management (Hockings *et al.,* 2006). The framework of PAME, and the capacity of managers and Parties to undertake such assessments will be critical in achieving Target 3 of the GBF (Gurney *et al.,* 2023).

To address threats to marine mammals, and build capacity of practitioners, managers, and policy makers to effectively conserve marine mammals, the Marine Mammal Twinning designed and created the "Marine Mammals Management Toolkit" for the inclusion of marine mammals into ABMT management plans while sharing knowledge, expertise and good practices among a network of managers (The Ocean Governance Project, 2021). The Toolkit is comprised of three core components; 24 Factsheets, Good Practices, and Self-Assessment Tool (SAT). The SAT enables managers to monitor and evaluate the status and effectiveness of an ABMT and develop, or adjust, management plans with respect to marine mammals utilising the PAME approach. The other components support capacity building and knowledge sharing to support managers to not only answer and further contextualise the questions, but to gather information to inform management decisions based on the results of the SAT. A Held Desk centre is also available on the toolkit containing tutorial videos and guidance around the Toolkit's use.

The SAT is adapted from the Management and Effectiveness Tracking Tool (METT) which, in 2001, was designed to measure progress in management effectiveness at particular sites over time (Stolton *et al.,* 2002). The SAT focuses specifically on marine mammals and subsequently enshrines the approach of PAME. The Marine Mammals Management Toolkit found a lack of specific tools, or adaptations, were available for managers with a specific focus for marine mammals and thus the SAT was developed - a process encouraged by the METT's developers (Stolton *et al.,* 2019). The SAT is designed to be used in compliment to the METT and other PAME tools, such as the Resilience SAT (developed under the Ocean Governance Project), and not replace existing tools.

2. MATERIALS AND METHODS

The SAT is a dedicated tool with a set of 120 questions that span across five core themes of the Toolkit: 1) management framework, 2) addressing activities and threats, 3) research and monitoring, 4) outreach and engagement, and 5) overall management effectiveness (Table 1). All questions included in the SAT are multiple choice, and respective answers are awarded a numerical value, or score – with the maximum score for a single question based on the number of available answers throughout the SAT. Upon completion of the SAT, the awarded scores are presented as an overall total, or Management Effectiveness Score (MES), with further disaggregated scores across the five core themes (Group Management Effectiveness Scores) and six sub-themes of the 'Addressing Activities & Threats' theme.

Assessors are able to answer 'Not Applicable' to questions removing the question from contributing to the calculation of the MES. The MES, group scores and additional scores are presented to assessors in a dashboard also containing visual graphical figures (Fig. 1). The MES is designed to be ABMT-specific and not to be used to compare ABMTs. Moreover, the assessment can be undertaken individually, in a group or completed as part of a workshop. However, due to the subjectivity of some questions within the SAT, managers are encouraged to undertake the assessment in a group or share the assessment for review with other managers of the same ABMT to support a representative assessment.

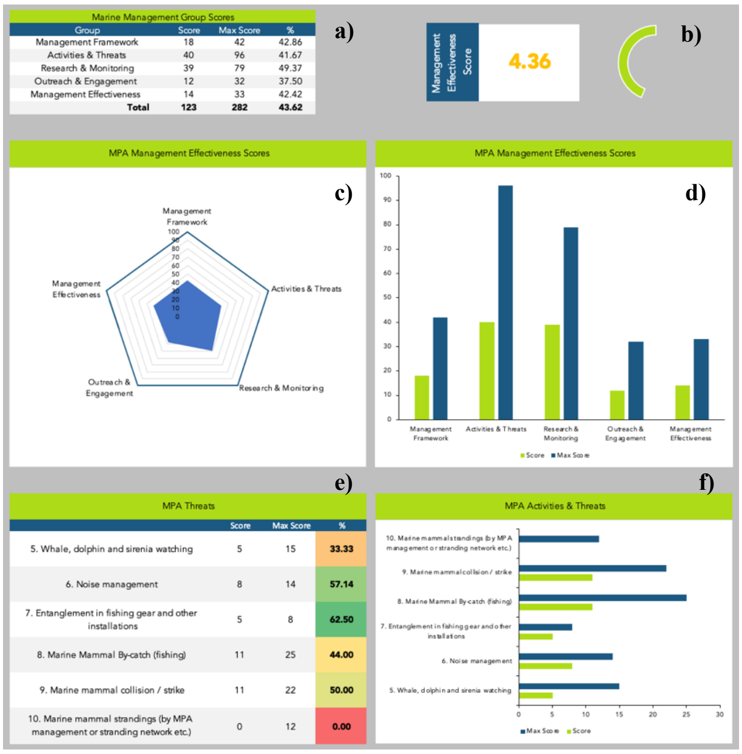

Figure 1. Example dashboard of the Self-Assessment Tool (SAT), as a component of the Marine Mammals Management Toolkit, with multiple visualisations of results; a) Management effectiveness scores across the five core themes; b) the total Management Effectiveness Score (MES); c) Radar plot of group management effectiveness scores; d) bar chart of maximum (blue) and awarded scores (green) of five core themes; e) Addressing Activities and Threats sub-themes; and f) bar chart representative of Addressing Activities and Threats sub-themes.

Table 1. Example questions contained within the Self-Assessment Tool of the Marine Mammals Management Toolkit from three of the five core themes. The multiple-choice answers presented to users of the SAT are provided.

SAT Questions	Available Answers
MPA Management Framework	
1. MPA Management with respect to marine mammals	
• Do the stated objectives of the MPA include protection and maintenance of marine mammal biodiversity?	Yes / No
• Is marine mammal management within the MPA described clearly and in detail within a management plan?	Yes / No
…	
Addressing Activities & Threats	
8. Marine Mammal By-catch (fishing)	
• Are by-catch records (including species, locations, and gear-types) recorded in a central database?	Yes / No / Not Applicable
• Are observer monitoring programmes required on commercial fishing vessels?	All commercial fishing vessels / Only some commercial fishing vessels / No / Not applicable
…	
Management Effectiveness	
21. Reporting / Reviewing management effectiveness	
• Are performance measures for all marine mammal species conservation plans outlined?	Yes: All species / Yes: Some species / No

3. RESULTS & DISCUSSION

To date, the Self-Assessment Tool has been utilised by 24 MPAs across 18 countries (Table 2). Among these applications, the Self-Assessment Tool has been used to develop a Marine Spatial Plan (MSP) for the Bermuda Marine Mammal Sanctuary (BMMS), evaluate the existing management plan at Stellwagen Bank National Marine Sanctuary (SBNMS), and has been adopted by the AGOA Sanctuary (Caribbean) within the Sanctuary's 'Monitoring and Evaluation' plan to review the effectiveness of the sanctuary's management plan every five years. The SAT's use in the BMMS and SBNMS are presented below as case studies.

*Table 2. Table of Area-based Management Tools (ABMT) or areas where the Self-Assessment Tool (SAT) of the Marine Mammals Management Toolkit has been utilised to assess the management plan including the country of the ABMT, the year of establishment (Est.), size (km^2, and year of assessment (Year). *nd indicates no date provided for the assessment.*

ABMT Name	Country	Est.	Size (km2)	Year
Kiunga Marine Biosphere Reserve	Kenya	1976	250.00	2023
Menai Bay Conservation Area (MBCA)	Tanzania	1997	717.50	2023
Tumbatu Marine Conservation Area (TUMCA)	Tanzania	2014	162.90	2023
AGOA Sanctuary	The French West Indies (Martinique, Guadeloupe, Saint-Martin and Saint-Barthélemy)	2010	143,256.00	2022
Parc Natural Marin D'Iroise	France	2007	3,500.00	2022
Gokova Special Environmental Protected Area (SEPA)	Turkey	1988	817.76	2021
Parque Nacional de Cabo Polonio	Uruguay	2009	1,211.67	2021
Cerro Verde e Islas de la Coronilla	Uruguay	2011	72.84	2021
Skjalfandi Bay	Iceland			*nd*
Corales de Profundidad National Natural Park	Colombia	2013	1,421.90	2021
Stellwagen Bank National Marine Sanctuary	USA	1992	2,180.70	2023
Greater Farallones National Marine Sanctuary	USA	1981	8,534.01	2023
Cardigan Bay bottlenose dolphin SAC	UK	2004	960.00	2024
Southern North Sea harbour porpoise SAC	UK			2023
Área Natural Protegida Península Valdés	Argentina	1994	8.88	2021
Parque Nacional Marino de Abrolhos	Brazil	1983	879.54	2021
Parque nacional marino Saguenay-Saint-Laurent	Canada	1988	1,246.00	2021
Área Marina Costera Protegida de Múltiples Usos (AMCP-MU) Pitipalena-Añihue	Chile	2015	238.62	2021
Parque Nacional Gorgona	Colombia	1983	601.25	2021
Monumento nacional marino Papahānaumokuākea	USA	2007	1,508,846.78	2021
Reserva de la biosfera del golfo de california y delta del rio colorado	Mexico	1993	1,647.80	2021
Reserva Nacional Paracas	Peru	1975	3,350.00	2021
Santuario de Mamíferos Marinos Bancos de la Plata y la Navidad	Dominican Republic	1986	32,879.80	2021
Bermuda Marine mammal Sanctuary	Bermuda	2012	464,993.00	2019

3.1 The Bermuda Marine Mammal Sanctuary (BMMS)

The BMMS is Bermuda's entire exclusive economic zone (EEZ), situated in the North-West Atlantic and is an area of approximately 464,993km^2. In 2012, the Bermuda Government declared Bermuda's EEZ a marine mammal sanctuary where all marine mammals have been protected by legislation since 1978 (Bermuda Fisheries (Protected Species) Order 1978 made under section 5 of the Bermuda Fisheries Act 1972). Despite this, there is currently no management plan for the BMMS, however, many of the activities in Bermuda's EEZ are managed through national legislation or policies.

In 2019, the Bermuda Government committed to develop a Marine Spatial Plan (MSP) for the Bermuda EEZ, which was previously designated as the BMMS. To develop an MSP, the Bermudian Government utilised the SAT to determine of the baseline performance of existing legislation and policies for the management of Bermuda's EEZ, with a clear consideration of marine mammals.

The BMMS received an MES of 4.7, driven by reduced management actions around Activities & Threats, Research & Monitoring and Outreach and Engagement relating to marine mammals. Across the five core themes of the SAT, BMMS scored 71% for Management Framework and less than 50% for each of the other 4 groups (Table 3). The BMMS' Management Framework is driven by Bermuda's existing legislation and policies to control some activities in Bermuda's EEZ listed in the SAT. However, the other scores indicate that Bermuda is deficient in addressing activities that directly threaten marine mammals, among other actions.

The SAT highlighted that there is a need for greater pro-activeness regarding the management of novel marine activities, such as renewable energy and aquaculture, and the associated consequences these activities pose to marine mammals. The assessment informed the development of the drafted MSP and Blue Economy Strategy (BES) for Bermuda which aims to expand sustainable ocean industry within Bermuda's EEZ including placing 92,998 km^2 (20%) of the EEZ under full protection, and highlighted the need to provide and direct resources to address the existing gaps in the BMMS framework.

Table 3. The Management Effectiveness Scores (MES) (%) received by the Bermuda Marine Mammal Sanctuary (BMMS) following completion of the Self-Assessment Tool (SAT) in 2019 across the SAT's five core themes. The MES is formulated as a percentage from the score received and the maximum available score from each respective theme.

SAT Theme	Score Received	Max Score	MES
Management Framework	27	38	71.05%
Addressing Activities & Threats	36	84	42.86%
Research & Monitoring	33	81	40.74%
Outreach & Engagement	10	24	41.67%
Management Effectiveness	16	33	48.48%
Total	**122**	**260**	**46.92%**

3.2 Stellwagen Bank National Marine Sanctuary (SBNMS)

In 2023, the SBNMS applied the SAT to establish a baseline of effectiveness of the SBNMS' existing management plan, published in August 2023. NOAA's Office of National Marine Sanctuaries administers a network of 15 MPAs around the USA and the remote Pacific Islands, and SBNMS is the only national marine sanctuary in the Northeast USA located off the coast of Massachusetts. SBNMS is a 2,180km^2 marine protected area, designated by the U.S. Congress in 1992 due to its high value of natural and cultural resources and its contribution to the regional economy as an important fishing ground and world-renowned whale watching destination. Protection of sanctuary resources is guided by a published management plan that has 15 action plans addressing various issues and challenges, one of which is the protection of marine mammals. In SBNMS, baleen whales face significant threats from entanglement in fishing gear and strikes by large and small vessels.

SBNMS used the SAT to augment the existing performance measures in the management plan which are the primary means by which management effectiveness is evaluated. Evaluating the SBNMS' management plan across the five core themes, SBNMS scored an MES of 78.03% or 7.8 (Table 4). While this score was deemed adequate by SBNMS, the results required further analysis to understand the gaps in the management plan underpinning the score, and to guide management decisions. Gaps were identified in relation to the 'Addressing Activities & Threats' theme with the lowest scores recorded for whale watching (53.33%) and bycatch (52.00%) (Table 5). These lower scores were likely due to no regulations being present for whale watching in SBNMS and being unable to curtail the entanglement of marine mammals in fishing gear. Understanding these gaps, enables SBNMS to identify clear management actions to continue its work with partners to address the two deficiencies.

Table 4. The Management Effectiveness Scores (MES) (%) received by the Stellwagen Bank National Marine Sanctuary (SBNMS) following completion of the Self-Assessment Tool (SAT) in 2023 across the SAT's five core themes. The MES is formulated as a percentage from the score received and the maximum available score from each respective theme.

SAT Theme	Score Received	Max Score	MES
Management Framework	36	40	90.00%
Addressing Activities & Threats	57	84	67.86%
Research & Monitoring	64	79	81.01%
Outreach & Engagement	20	28	71.43%
Management Effectiveness	29	33	87.88%
Total	**206**	**264**	**78.03%**

Table 5. The Management Effectiveness Scores (MES) (%) received by the Stellwagen Bank National Marine Sanctuary (SBNMS) following completion of the Self-Assessment Tool (SAT) in 2023 across the SAT's sub-themes of the "Addressing Activities & Threats' core theme. The MES is formulated as a percentage from the score received and the maximum available score from each respective theme.

SAT Sub-Theme	Score Received	Max Score	MES
Whale, Dolphin & Sirenia Watching	8	15	53.33%
Noise Management	11	14	78.57%
Entanglement in fishing gear and other installations	7	8	87.50%
Marine Mammal By-catch (fishing)	13	25	52.00%
Marine mammal collision / Strike	18	22	81.82%
Marine Mammal strandings (by MPA management or stranding network etc.)	0	0	0.00%
Total	**206**	**264**	**78.03%**

This initial application of the SAT by SBNMS served as a baseline for management effectiveness, enabling the tracking of performance measures for each action plan. SBNMS will continue to use the SAT on a biannual basis as another means to evaluate effectiveness of the management plan for protecting the threatened and endangered marine mammals in SBNMS.

4. CONCLUSION

The SAT can be used for different purposes depending on the status of the ABMT: a guide for developing a management plan, evaluating the effectiveness of an existing ABMT, or assessing local, national or regional legislative and policy landscapes for proposed ABMTs. Components of the criteria are intrinsically linked. For example, the management plan's mechanism to allow for regulatory modifications with respect to threats is assessed, alongside zoning and permitting, under Management Framework, which supports the responses under Addressing Activities and Threats – this enables a holistic assessment across the themes of SAT.

The SAT can also aid mangers in directing resources on areas of management that can be strengthened, for example, within the SBNMS where Whale, Dolphin and Sirenia Watching activities would benefit from further management actions alongside Marine Mammal By-catch, despite holding a strong Management Framework score. Whereas in Bermuda, the SAT demonstrated that, in the development of an management plan for the BMMS, greater attention must be placed in addressing threats, research and monitoring and outreach and engagement. Continuous assessments over time, using the SAT, will further support managers understanding of the impact of management decisions while enabling adaptive, and pro-active management.

The Marine Mammals Management Toolkit is a dedicated PAME tool for marine mammals that has been successfully applied in multiple ABMTs. Yet, the SAT does have limitations and should be used to complement existing PAME tools such as METT-4. For example, the SAT supports managers to specifically consider marine mammals in the ABMT and management plan, however, this results in highly specific questions and resources focused on management considerations, threats and research. The SAT does not enable the complete assessment of an ABMT's effectiveness (that is not solely designed for marine mammals) in a broader context and therefore, mangers should consider utilising the SAT in conjunction with other tools. This is applicable in Bermuda where by the SAT is suitable to develop, and subsequently assess, the BMMS, as well as considerations for management of marine mammals under the BES, but a broader tool would be suitable to assess the entirety of the MSP for Bermuda's EEZ. More so, the SAT's questions, and the Toolkit's resources, provide a greater focus on migratory and mobile species such as Cetaceans, Sirenians and Pinnipeds due the commonalities in threats and management approaches, with a lesser focus on marine Fissipeds. The Toolkit plans to further expand the usability of the SAT for marine mammals, including other mobile species, however, users are able to respond 'Not Applicable' to questions where the question may be too specific for the area being assessed enabling for a more flexible implementation of the SAT.

The Toolkit is designed to be an integrated resource, with the five core themes of the SAT running concurrently throughout the toolkit. The 24 factsheets available are spread across the five themes and contain general information, case studies and further literature for consideration, whereas the Good Practices provide contextualising examples of management actions. Therefore, managers are able to utilise the factsheets and good practices to make informed management decisions, and further expand their knowledge to address the strengths and gaps presented by the results of the SAT.

The SAT, and the wider Marine Mammals Management Toolkit, are valuable aids for countries in the achievement of national and international commitments notably Targets 1, 3, 4 and 21 of the GBF by reducing loss of biodiversity, effectively conserving 30% of the Ocean, managing actions and ensuring best available data and knowledge is available, respectively. It empowers managers and practitioners to better understand the protection afforded to marine mammals by management plans, and enables informed, management decisions to be undertaken, providing a vital mechanism to support managers and policy makers in the conservation, protection and restoration of marine mammals.

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