Outer Cape Shark Mitigation Alternatives Analysis

Evaluating strategies to support regional decision making and public safety efforts

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Prepared for:
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The Cape Cod National Seashore**, in partnership with
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Executive Summary

To help support public officials, this study was commissioned as a joint stakeholder effort to compile information and perform an independent technical review of various shark mitigation alternatives. The intent is to provide a consolidated resource where various information can be obtained for stakeholders to review when considering alternatives. Results are provided in this report, including a series of tables to support decision-makers who are considering investing in measures to manage the public safety risk resulting from the increasing presence of white sharks along the Outer Cape. Findings in this report do not endorse any particular method or product, and are not intended to provide specific recommendations for methods to employ. That decision is complex and lies with stakeholders faced with varying levels of risk exposure, public assets, available resources, site-specific environment, and use patterns. The findings in this report also are not intended to assume any liability or responsibility for injuries that may occur regardless of whether mitigation alternatives are employed or not. There is no solution available that can ensure 100% safety to individuals who choose to enter the water.

Over the past several decades, regional gray seal (*Halichoerus grypus atlantica*) and great white shark (*Carcharodon carcharias*) populations have increased along Cape Cod's dynamic shoreline. Increasing great white shark activity in close proximity to public bathing beaches has resulted in very real public safety concerns among regional stakeholders. To address these concerns, regional beach managers and municipal officials took the following steps in to increase public safety and awareness along Outer Cape beaches in 2019: Investment in Improved Communications Infrastructure; Expanded Lifeguarding Presence; Expanded First-Aid Trainings; Investment in Medical Response Supplies; Updated and Uniform Signage and Safety Protocols; Improved Emergency Response Time; Expanded Research Efforts; Investment in Expanded Real-Time Alert-Based Systems and; Encouraging Beachgoers to Modify Behavior to Minimize Risk. A key element of any mitigation strategy to reduce the chances of an unprovoked attack is a strong commitment to education and outreach.

Regional beach managers and municipal officials also made a commitment to explore various technology-based, barrier-based and biologically-based shark mitigation alternatives that could potentially be deployed in the future to further reduce the risk of shark-human interaction. The 27 alternatives identified for consideration in this study were compiled based on: Strategies that have been implemented elsewhere around the world; Feedback received from local Towns, residents, and stakeholder groups in 2018 and; Strategies suggested through a public survey solicited in 2019. The list of alternatives that were considered is included in Table 1.

Assessments of shark mitigation alternatives and technologies have been conducted elsewhere around the world, but never within the context of the Outer Cape's unique coastal environment. To put this analysis in context, the study includes a summary of baseline environmental and meteorological (metocean) conditions characteristic of Outer Cape beaches and nearshore areas.

To better understand each individual mitigation alternative, a review of available peer-reviewed research, product specifications, and independent technical reports was conducted. Summaries of how each alternative is intended to function, along with documented positives and/or potential shortcomings are included in the final report.

Table 1: Comprehensive list of Tech-based, Barrier-based, and Biological-based alternatives included in the scope of this Alternatives Analysis.

Technology-Based	Barrier-Based	Biological-Based
Tagging (Acoustic, real time alert)	Flexible Exclusion Barrier	(Smart) Drum Lines
Tagging (Satellite, real time alert)	Rigid Exclusion Barrier	Cull Nets
Visual Detection (planes, helicopters)	Semi-Rigid Exclusion Barrier	Seal Contraception
Visual Detection (tower-based)	Bubble Curtains	Seal Culling
Visual Detection (balloons)	Live Kelp Forests	Indigenous Harvest
Visual Detection (drones, tethered drones)	Simulated Kelp Barrier	Electric Shock
Acoustic Detection (sonar buoy, real time alert)	Electrical Deterrents	Scent-Smell
Electromagnetic (active, wearable/mountable)	Electromagnetic Deterrents	Modify Behavior
Magnetic (passive, wearable/mountable)	Acoustic Barriers	
Adaptive Camouflage		

Lastly, an alternatives analysis was conducted to evaluate each alternative within the context of Cape Cod's coastal environment. An alternatives analysis is the identification and evaluation of different choices available to achieve a particular objective. The alternatives analysis described in this study evaluates the 27 individual alternatives against a total of 22 evaluation criteria, which considered the resilience to environmental conditions, costs, permitting feasibility, effectiveness, and unintended adverse impacts associated with each alternative. The study includes a summary of general findings for each category of alternative, regional considerations, and next steps.

The most important finding to emphasize from this preliminary assessment is there is no single alternative or suite of alternatives that can guarantee the safety of 100% of individuals who choose to enter the water. Further emphasis for the public and all stakeholders is to acknowledge that different behaviors (wading v. swimming v. surfing) pose different levels of risk. Members of all user groups should exercise caution, follow established best management practices (i.e., *Shark Smart Behaviors*), and be willing to assume the level of risk associated with their behavior prior to entering the water. It is important to remember that dealing with shark-human interaction is a global issue, not one that is isolated to our region.

Members of the public, State and local officials, and other associated regional stakeholders must take the time to educate themselves on the advantages and inherent disadvantages of various mitigation strategies. Future deployment of any shark mitigation alternative must be carefully considered by regional, and in some cases, individual stakeholders. The objective alternatives analysis presented in this report is intended to help facilitate this decision-making process. It is likely that the most effective alternatives and strategies will be regional in nature, and will utilize the most current, scientifically defensible data regarding the dynamics of the local shark and seal populations provided by the Massachusetts DMF Shark Research Program and their regional partners. Prior to the deployment of any alternative, it will be critical to develop a regional consensus regarding the most appropriate pathway forward, continue to expand education and outreach efforts, and facilitate open dialogue between stakeholder groups.