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Emerging human–shark conflicts in the New York Bight: A call for expansive science and management

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Abstract

Recent spikes in interactions between humans and sharks in the New York Bight have sparked widespread reporting of possible causalities, many of which lack empirical support. Here we comment on the current state of knowledge regarding shark biology and management in New York waters emphasizing that the possible drivers of increased human–shark interactions are confounded by a lack of historical monitoring data. We outline several key research avenues that should be considered to ensure the safe and sustainable coexistence of humans, sharks, and their prey, in an era of accelerated environmental change.

KEYWORDS
beach safety, climate change, Elasmobranch, human–shark interaction, predator–prey interactions

1 | INTRODUCTION

Population declines of sharks and their relatives have been well documented over the last several decades on a global scale—primarily attributed to targeted fishing and by-catch by commercial and recreational fisheries (Baum et al., 2003; Dulvy et al., 2014, 2021). In the United States, federal and state management actions such as catch quotas, closed seasons, gear restrictions, and species prohibitions aim to sustainably manage shark populations (Pacoureau et al., 2023; Shiffman & Hueter, 2017; Simpfendorfer & Dulvy, 2017). These measures may have been adequate to support initial recovery for some species (Pacoureau et al., 2023; Peterson et al., 2017). However, for others, current management efforts have proven unsuccessful (Sherman et al., 2023), or their effectiveness remains unknown (Barker & Schluessel, 2005; Dulvy et al., 2017).

In the temperate waters of the New York Bight, sharks have received heightened attention due to a reported increase in their activity close to the shore. Although only a recent development in the mainstream media, the seasonal occurrence of sharks in northern regions of the Mid Atlantic Ocean has been well established for decades (Curtis et al., 2018; Ingram et al., 2005; Musick et al., 1993; Nuttall et al., 2011). The seasonal occurrence of many species coincides with long-distance, northern migrations from southern wintering grounds around Florida and the Carolinas, to northern waters extending as far north as Canada during the late spring and early summer (Bastien et al., 2020; Bowers & Kajiura, 2023; Kneebone et al., 2014). In the New York Bight, sharks have historically supported recreational fishing communities dating back to the late 19th century, if not earlier. For example, a *New York Times* article published on July 13, 1884 (*New York Times*, 1884), stated that the "Great South Bay is full of sharks. From the island-dotted waters at Far Rockaway to the dimpling shallows of Bellport Bay…" or Thorne (1916) who over a 15-year period, claimed to have observed 2500 *Carcharhinus* sharks in the Bay, including 277 in a single year; both statements few would find reason to make today (Nuttall et al., 2011).

In recent decades, however, growing conservation concerns over the declining population status of many coastal and pelagic sharks (Dulvy et al., 2021; Sims et al., 2018, 2021) have gradually constrained quotas and size limits and have led to the prohibition of targeting and possession of an increasing number of shark species in the region. Targeted fishing for sand tiger (*Carcharias taurus*), dusky (*Carcharhinus obscurus*), and sandbar (*Carcharhinus plumbeus*) sharks has been

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prohibited in federal waters of the Atlantic and Gulf of Mexico since 1997, 2000, and 2008, respectively. These prohibitions were subsequently extended to recreational and commercial fisheries in New York State waters (www.dec.ny.gov/outdoor/119778.html) in 2010. Effective management and enforcement of New York's shore-based shark fishery to minimize interactions with prohibited species, however, is challenged by the overlap in gear types used to target sharks versus large teleost fishes, such as bluefish (*Pomatomus saltatrix*) and striped bass (*Morone saxatillis*). This has prompted the New York State Department of Environmental Conservation (NYSDEC) to propose gear and bait restrictions and mandatory best handling practices to protect fishers and sharks in New York waters (6 NYCRR Part 40, www.dec.ny.gov/regulations/106216.html).

The complex relationship between sharks and human stakeholders has been further ignited by the recent spike in negative human-shark interactions (NHSIs) occurring throughout the New York Bight. The NYSDEC has recorded a total of 17 reported NHSIs between 2018 and 2023 occurring from June to September, with the responsible shark species being confirmed from only a single NHSI event. Here, genetic analysis of tooth pulp extracted from an exploratory bite victim identified the individual involved as a subadult sand tiger sharks, a species that utilizes Great South Bay, New York, as a nursery area (WCS, unpublished data; NYSDEC, unpublished data; Shipley et al., 2021; Thorne, 1916). Prior to 2018, there were four confirmed, unprovoked incidents dating back to 1873 according to the International Shark Attack File (www.floridamuseum.ufl.edu/shark-attacks), when many species of sharks were more abundant in local waters (Baum et al., 2003; Nuttall et al., 2011). This raises the question as to why NHSIs appear to be on the rise. The reported NHSIs have heightened widespread media coverage, where several “explanations” have surfaced in efforts to apply causality to the proposed increase in interactions, all of which are largely anecdotal. These include but are not limited to (1) climate change–induced shifts in shark distributions; (2) “successful” management leading to an increase in the abundance of sharks; (3) an increase in key prey species, such as Atlantic menhaden (*Brevoortia tyrannus*) closer to shore; and (4) declines in historical prey species such as Atlantic mackerel (*Scomber scombrus*) and bluefish (NOAA Fisheries, 2023; Richardson et al., 2020), which have shifted sharks nearshore in search of prey. Although we acknowledge both sightings of sharks and reporting of NHSIs have increased in recent years, assigning any immediate causality would be irresponsible and risky to both sharks and human stakeholders in the absence of scientific support. This is largely because the information required to quantify recent changes to local ecosystem dynamics, including the biology of sharks and their prey, is limited for regions such as the New York Bight.

As scientists and fisheries managers face the difficult job of successfully gathering accurate information for the media and decision-makers, it is important that media releases follow current science (i.e., population assessments of sharks and their prey) and place statements in context. For example, a recent analysis suggests that some shark populations in the New York Bight may have increased in recent years (Pacoureau et al., 2023); however, not all species are increasing and/or their status is unknown (Rigby et al., 2022). Further, not all species present in the New York Bight are likely to be responsible for a NHSI. Therefore, statements generalizing that “sharks” have increased in abundance, while true for some species (Pacoureau et al., 2023), provide platitudes for media outlets, do not inform the public, and are contextually inaccurate. Further, this conjecture places blame on species that are not responsible for NHSIs, further increasing conservation risk for all species. For example, it is well established that NHSIs commonly elicit adverse consequences, such as culling (Fraser-Baxter & Medvecky, 2018) and negative attitudes toward shark conservation (Pepin-Neff & Wynter, 2018). Historical newspaper reports extending as far back as 1916 documented NHSIs followed by attempted culls (www.yesterdaysamerica.com/matawan-shark-attack-a-deadly-day-in-1916/). New York is therefore approaching an important stage in the evolution of shark conservation that will require tradeoffs between stakeholder activities and human safety while ensuring population rebuilding continues through strategic management initiatives.

Here, we discuss two major research avenues that could support real-time data for on-the-ground management decisions and thereby safe coexistence of human and sharks in the coming decades: (1) the expansion of coastwide shark and prey species monitoring programs in the context of climate change and (2) implementation of warning systems.

1.1 | Expansion of coastwide monitoring programs in the context of climate change

Alterations to the functioning of ecosystems are predicted consequences of climate change, due, in part, to alterations in species distributions (Albouy et al., 2014; Poloczanska et al., 2013). In sharks and their relatives, rapid ocean warming has been attributed to both range expansions and potential contractions throughout the northern Atlantic Ocean. For example, blacktip sharks (*Carcharhinus limbatus*), which are commonly associated with tropical and sub-tropical waters, have been detected with an increased frequency in coastal waters of the New York Bight (Bowers et al., 2023). However, warming-induced northward range shifts may come with increased contraction of suitable habitat, especially for pelagic species such as blue (*Prionace glauca*) and porbeagle sharks (*Lamna nasus*) (Braun et al., 2023). The effects of climate warming on the distributions of sharks are therefore complex, species-specific, and a “one size fits all” model would oversimplify and potentially lead to adverse management outcomes.

Since 1973 the National Oceanographic and Atmospheric Administration (NOAA), alongside state agencies and universities, has conducted several extensive fishery-independent monitoring surveys for sharks (e.g., COASTSPAN, GULFSPAN, VIMS longline survey, and SEAMAP). These surveys provide demographic information that is integrated into contemporary stock assessments. The spatial extent of these surveys currently comprises the Gulf of Mexico and much of the US Atlantic east coast, extending as far north as New Jersey. For waters adjacent to more northern states, such as New York and

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Massachusetts, there is an absence of long-term (i.e., multiple decades) historical survey data, despite recent efforts that have begun monitoring some populations, such as juvenile sand tiger sharks (WCS, unpublished data; Shipley et al., 2021; Shipley et al., 2022). Although the expansion of current surveys into more northern latitudes should be considered high priority, the absence of long-term historical context precludes inferences into regional (i.e., New York Bight) changes in the abundance and/or distributions of sharks, thereby confounding any possible relationships with NHSIs. Therefore, robust information on historical occurrence and abundance trends must be collated, synthesized, and made available to researchers and policy makers to accurately assess linkages between shark abundance and the role of climate in mediating their distributions.

This topic becomes further complicated when considering potential changes to the abundance and distribution of common prey items, such as Atlantic menhaden. The increased observations of interactions between sharks and large schools of common forage fishes could be explained by temporal and/or spatial change in environmental conditions (Olin et al., 2023) that bring these forage species and, as a result, sharks closer to shore. These changes may be due to shifts in local productivity, creating favorable conditions that support foraging hotspots in nearshore waters, more general climate-induced shifts in temperature regimes, or changes to the age composition of key prey species (i.e., Atlantic menhaden) that result in species distributional changes (Drew et al., 2021; Vaughan et al., 2002). This could lead to the perception of increased shark abundance. However, this is conjecture until targeted studies examine the spatial and temporal distribution of forage species, the predators they support, and how prey biomass is transferred to higher levels of the food web.

1.2 | Implementation of warming systems

Although the year 2023 has seen implementation of enhanced early-warning systems in the New York Bight, such as targeted drone flights, more systematic surveys are required to fully quantify shark activity and the activity of their prey, especially in regions shared with bathers (i.e., <500 m of the shoreline). Inspiration can be taken from several coastwide monitoring techniques applied to juvenile white sharks (JWS) in coastal California, which are greatly aiding in understanding the likelihood of NHSIs. Here, techniques including drone surveys (Rex et al., 2023), omnidirectional and traditional passive acoustic telemetry (Anderson, Burns et al. 2021; Anderson, Clevenstine et al. 2021; Spurgeon et al., 2022), environmental DNA (Lafferty et al., 2018), and potential future applications of automated underwater vehicles (AUVs, Lowe et al., 2018), have provided key information that can be used to inform public safety. For example, systematic drone surveys have identified specific user groups exhibiting the highest spatiotemporal overlap with JWS, including standup paddle borders and surfers (Rex et al., 2023). If applied to the New York Bight, these approaches could help determine the probability of shark encounters for specific ocean user groups (e.g., paddle boards, bathers, kayakers), but also provide a holistic understanding of environmental factors shaping high spatiotemporal overlap. These techniques would extend to quantitative tracking of prey schools, and the drivers determining their distributions, and overlap with user groups.

2 | CONCLUDING REMARKS

The noted increase in human–shark interactions occurring in the coastal waters of New York raises new challenges for human stakeholders and management agencies alike, reinforcing the critical need for expansive science that specifically addresses the complex dynamics occurring between sharks, their environment, and prey species, and how associated changes may be linked to human interactions. This will provide a scientifically accurate narrative that is based on current data, while dramatically reducing misinformation and negative management outcomes.

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ONS and MGF conceived the study and wrote the initial draft with significant input from JAO and MC. CS provided information on human-shark interactions. All authors approved the final version of the manuscript.

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