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Seals and Society: Considerations for Urban Waterway Navigation by Harbor Seals (Phoca vitulina) and Gray Seals (Halichoerus grypus) in New York City

As marine mammals navigate their environment, they may likely encounter areas that are both sparsely and heavily populated with human activity. For the latter, marine mammals are increasingly entering urban populated areas where the marine landscape has been significantly transformed both physically and ecologically. At select locations in New York City (NYC), Harbor seals (*Phoca vitulina*) and gray seals (*Halichoerus grypus*) frequent the NYC waterways during the winter months. Due to the public interest in these species, and the growing human population with its consequent development of shared habitats, it is critical that we understand the relationship between humans and these pinnipeds. We therefore stress the importance of understanding the history of NYC ecology relating to these waterways and advocate for the increased study of habitat use by seals, especially in the New York Bight apex (NYBA). Their return to New York City demonstrates survival strategies and adaptations in an urban environment and how they are adapting to dynamic and frequently changing environmental conditions. To date, there has been no published data of seals within the smaller channels of New York City, but our own observations from traveling within these smaller tributaries provide anecdotal evidence for the likelihood that individuals traverse the urban environment for migration and transportation and highlight the need for further research to ensure continued success of these shared habitats in one of the busiest shipping waterways on the eastern seaboard.

Keywords

Pinniped, Seals, New York Bight, Urban Ecology

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INTRODUCTION

Maintaining a balance between habitat usage by humans and animals is an ongoing concern in many shared locations around the world. As humans and non-human species increasingly populate these regions, a strain is placed on resources that both groups are likely to utilize. As marine mammals migrate, they may likely encounter areas that are both sparsely and heavily populated with human activity. For the latter, marine mammals are increasingly entering urban populated areas where the marine landscape has been significantly transformed both physically and ecologically from its historically natural habitat. At select locations in New York City (NYC), Harbor seals (*Phoca vitulina*) and gray seals (*Halichoerus grypus*) utilize the NYC waterways for feeding and resting during the winter months, and in the warmer months, these individuals typically migrate north to the cooler waters of New England (Payne 1989). Due to the public interest in these species, and the growing human population with its consequent development of shared habitats, it is critical that we understand the relationship between humans and these pinnipeds. It is equally critical that the humans who share the habitat are aware of the presence and habitat usage of seals in their area. We therefore stress the importance of understanding the history of NYC ecology relating to these waterways and advocate for the increased study of habitat use by seals. This is especially critical in the New York Bight apex (NYBA) which includes the Port of New York and New Jersey, the busiest port on the East Coast of the United States (Brown et al. 2019; Rodrigue 2003).

Considering historical trends in pinniped populations in the NYC area, current research of the seals' demographics and navigation patterns in these complex and dynamic waterways are needed to best protect them and their habitats while simultaneously enriching the lives of the humans that live in the same areas and rely on these same waterways. The New York City Harbor is continuously one of the largest ports on the eastern front. Simultaneously, the frequency of marine mammal populations, such as harbor and gray seals are on the rise in this same area (Sadove & Cardinale 1993; Woo & Biolsi 2018), prompting research considerations that must be given to these human-animal interactions in one of the most urbanized areas of the world.

URBANIZATION OF THE NEW YORK CITY MARINE HABITAT

Strategic for economic and military purposes during the early Native American Lenape and subsequent European colonization, the NYC region has approximately 2400km of shoreline (Gornitz et al. 2001). Prior to urbanization, NYC consisted of one of the largest wetland marsh systems in the United States (Hartig et al. 2002; Waldman 2012). Within the five boroughs of the city, there is a channel system that consists of three main rivers that intersect around the island of Manhattan (see Figure 1): Hudson River (west, and at 22 km for the length of Manhattan island, and separating Manhattan and New Jersey, but is 507 km in length and originating from the Adirondack Mountains), Harlem River (northeast, connecting 13km from the Hudson River to the East River, and separating the borough of the Bronx and Manhattan), and East River (east and connecting 26 km to lower Upper Hudson Bay and the Long Island Sound, separating Brooklyn and Queens from both the Bronx and Manhattan). The Hudson and East Rivers meet at the southern point of Manhattan (the Battery), which is the Upper Bay of the apex.

FIGURE 1. Map of New York City and corresponding waterways, noting field locations for Orchard Beach/Pelham Bay (♦), Hoffman and Swinburne Islands (**X**), and observation location (▲). The main waterways between the five boroughs of New York City have been numbered: 1. Hudson River, 2. Harlem River, and 3. East River.

The marshes of the NY estuary system decreased rapidly with industrialization and shoreline modification in the 1800s (Hartig et al. 2002; Waldman 2012). In fact, the history of NYC urbanization in relation to the waterways can be broken down into four periods (O'Neil 2016). The first period is termed Pristine Estuary (1609-1800) during which time the waterways were full of oyster beds and marsh land. The Expansion Period (1800-1900) is noted by an exponential rise in human population of NYC, followed by the Degradation Period (1900-1970) where human sewage and industrial pollutants were dumped into the waterways causing a significant decline in ecosystem health and noted declines in marine life. The Improvement Period (1970-present) is noted by decreased pollutant levels and increased recovery of marine species (O'Neil 2016).

The decline of the marine ecosystems during the Degradation Period in NYC coincided with industrialization and poor waste management for both commercial and residential properties. Historically, New York City waterways had the highest global concentration of heavy metals such as silver (Ag), cadmium (Cd), copper (Cu), lead (Pb), zinc (Zn), and industrial fluids, such as polychlorinated biphenyls (PCBs; Feng et al. 1998). Due to a confluence for disregard in industrial waste management and the southerly flow of the Hudson River, the toxic commercial refuse discarded directly into the waterways consequently remained in the sediment for lengthy periods of time (Bopp et al. 1981). Related to industrial contamination, oxygen

depletion in the New York Bight also contributed to the steady decrease of shellfish due to anoxia (Falkowski et al. 1980). In addition, oil pollution and runoff from petroleum refineries along the New York Bight have historically (Hurley 1994) and currently (Vane et al. 2020; Zhang et al. 2021) continue to contaminate local marine ecosystems. While pollutants have been found in many flora (Bell et al. 2011; Parmar et al. 2016) and fauna species (Asahina et al. 1972; Pisani 1984) in NYC, products of flame retardants, such as tetrabromobisphenol A (TBBPA) and α-, β-, and γ-isomers of hexabromocyclododecanes (HBCDs) were found in tissues samples of stranded bottlenose dolphins (*T. truncatus*; Johnson-Restrepo et al. 2008). As mesopredators, bioaccumulation indicators continue to demonstrate the cumulative presence of lethal pollutants in urban marine ecosystems. While not in New York City but another urban location, Kakusche and Griesel (2016) examined harbor seal (*P. vitulina*) blood samples from urban (Wadden Sea and Elbe Sanctuary) and pelagic (Helgoland, North Sea and Kattegat, Baltic Sea) populations in Denmark and found that samples from seals living close to urbanized areas contained significantly higher concentration of nine trace metals, such as aluminum (Al), chromium (Cr), Cu, iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), Pb, and Zn out of 18 elements that were tested in total.

However, recent studies have suggested that the overall health of New York City's marine ecosystem is improving. As stated, we are currently in the Improvement Period (O'Neil 2016). Taillie et al. (2020) sampled multiple marine locations in New York City for total nitrogen (N), total phosphorus (P), dissolved oxygen (O), chlorophyll *a*, and water clarity and found a positive trend towards improved ecosystem health. Similarly, as important factors within the marine food web, prey species of pinnipeds such as fish have also seen increases in population growth and sustained biodiversity in the Hudson and East Rivers (Park et al. 2020; Neiman et al. 2021). In the next predator tier, Lomac-MacNair et al. (2022) conducted aerial surveys between 2017-2020 and recorded fin (*B. physalus*), humpback (*M. novaeangliae*), and minke (*B. acutorostrata*) whales feeding regularly on schooling fish in the New York Bight. These trends that suggest a gradual and continual improvement demonstrate supportive resources for sustaining mesopredators, like pinnipeds, and in turn apex predators that depend on them, such as sharks (Roff et al. 2016). Apex predators are unquestionably bioindicators of ecosystem health and so is the importance of their prey as measures of environmental robustness. One other measure of predator health is the bioaccumulation of natural, unnatural, and artificial compounds. Perez-Venegas et al. (2020) studied the scat of three pinniped species (South American sea lion, *Otaria byronia*; Juan Fernández fur seal, *A. phillippii*; and South American fur seal, *A. australis*) in Peruvian and Chilean coastlines and found that 68% of all samples contained microplastics, whereas 81.5% of filaments were anthropogenic in origin, suggesting one additional method to monitor the health of predators and in turn providing implication for ecosystem health. Thus, the demographic, behavioral, and intrinsic monitoring of the local success of mesopredators and apex predators offers multiple assays that can be used to assess the current status of ecosystem health.

With this in mind, it should be noted that the Improvement Period in which the NYC waterways are currently in, was driven by the creation of the U.S. Environmental Protection Agency, the Clean Air and Clean Water Acts, and the work of various non-government agencies (Wyman 2023). Research on the ecosystems in combination with government and local actions was the foundation of the recovering waterways, which today is highlighted by the resurgence of

pinniped species in and around NYC, as they were previously locally extinct during the Degradation Period. A similar tact of research and government/local action must focus on local ecology, pinniped demographics, and waterway usage by these animals - if we are to ensure the continued recovery of these marine mammals. Studies in urban ecology have been steadily increasing as a way to investigate ecological models and subsequent processes in highly modified environments as a consequence of anthropogenic events and yet published research on the relationship between NYC waterways and local marine mammal species have been rare (Woo & Biolsi 2018; Brown et al. 2019; Brown et al. 2022). If we are to avoid approaching a tipping point in the near future where species' recovery is halted, or even reversed, due to conflicts between marine mammals and human activities such as dredging and shipping, increased research must be carried out in relation to our constantly changing urban waterways.

MARINE MAMMALS IN NEW YORK CITY TODAY

Current research on marine mammal populations in the NYC area is encouraging. Between 2011-2016, Brown et al. (2019) recorded 409 opportunistic sightings of humpback whales (*M. novaeangliae*) in the New York City Bight. From 2017-2020, Zoidis et al. (2021) conducted seasonal aerial surveys and observed the presence of six species of large mysticetes in the New York Bight, with a total of 318 sightings of blue whales (*B. musculus*), humpback whales (*M. novaeangliae*), fin whales (*B. physalus*), Northern Atlantic right whales (*Eubalaena glacialis*), sei whales (*B. borealis*), and sperm whales (*Physeter macrocephalus*). Chou et al. (2022) collated data from various researchers confirming regular sightings for the humpback whale, fin whale, North Atlantic minke whale (*B. acutorostrata acutorostrata*), and North Atlantic right whale from 1998–2017.

To compliment naturalistic observations, environmental DNA (eDNA) is an emerging technological tool that has been used to monitor cetaceans and pinnipeds but is currently being employed to study the prominence of humpback whales, fin whales, common minke whales, and bottlenose dolphins (*Tursiops truncatus*) in the NYBA (Alter et al. 2022). With this increase in marine mammals, proactive research needs to assess the usage of these waterways – especially the rivers, estuaries and channels connecting the larger bodies of water such as NY Harbor and the connected LI Sound. Understanding the waterway usage and how marine mammals navigate these bodies of water will be another tool to help ensure the health and safety of both the human and marine mammal species utilizing these habitats. As population numbers of both human and other animals continue to rise, conflict will indelibly follow. We must be proactive to ensure these federally protected marine mammals are safe and not victim to anthropogenic factors such as the ones that initially decimated their original numbers prior to the industrialization of NYC.

Seals of the New York City Area

Historically, both harbor and gray seals commonly inhabited the waterways of New York City. By the 1900s, there was a sharp decline in seasonal populations (Burrows & Wallace 1998; Sanderson 2013). Their presence was notable in earlier records of early European colonization; however, demographic accounts of their sustained presence were absent in the literature for nearly 100 years (Sanderson 2013), which may have represented a hiatus in their use of the harbor. Beginning in the 1990s, anecdotal sightings of individuals were reported in the lower

NYBA that includes the Raritan River in New Jersey and the lower Hudson River basin (Woo & Biolsi 2017). Further anecdotal reports were observed from Sandy Hook Bay in New Jersey to the extension of the Gateway National Park in Jamaica Bay, New York (Handel et al. 2016). Research on population dynamics conducted between 2014-2022 at two urban shoreline locations within New York City has demonstrated that seasonal populations are currently stable with slight annual increases in recruitment (Woo & Biolsi 2018; McKenzie et al. 2023). These main haul-out sites are Middle Reef at Orchard Beach and Pelham Bay in the Bronx (40° 52' 17.4324" N, 73° 46' 14.6388" W), and Hoffman (40° 34' 45.084" N, 74° 3' 14.202" W) and Swinburne Islands (40° 33' 56.9232" N, 74° 3' 0.0468" W; Woo & Biolsi 2018). Population numbers are consistent at these haul-out locations and behaviorally, these local aggregations appear to be vigilant to anthropogenic activity yet are only reactive to certain proximal environmental stimuli. Their return to New York City demonstrates survival strategies and adaptations in an urban environment that are important for understanding their use of these heavily traffic waterways and how they are adapting to frequently dynamic and changing environmental conditions.

Rivers as Vectors for Transportation

Outside of these known seasonal haul-out locations most sightings are typically random and are often of a single individual, as opposed to social aggregations. For example, at Inwood Park, located at the northern tip of Manhattan Island and near the banks of the Hudson and Harlem Rivers, a harbor seal that the locals have named ‘Sealy’ is a regular attraction (Carlon 2019; Krisel 2019; Letzter 2019). Sealy has been consistently sited in Inwood Park and reports show that the seal may be staying in the area year-round, therefore not making the typical annual migration north each summer (Krisel 2019; Letzter 2019). Inwood Park contains the last remaining salt march in Manhattan (Conservancy North n.d.; Kennedy 2014), which may be the cause for Sealy taking up residence there. While this is a lone individual, Sealy’s presence in Inwood Park demonstrates the use of smaller waterways/rivers by seals indicating they are not constraining themselves to larger waterways such as the Long Island Sound, or NY Harbor. In fact, seals have been spotted in the Hudson River as far north as Rockland County (Cutler 2023), Albany (Spector 2019; New Country Albany, 2024), and even Saugerties NY (Wallace 2021).

Unfortunately, and often due to restricted waterway space for transportation, some marine mammals also enter channels that are too shallow to support large body masses. In 2007, a young common minke whale (*B. acutorostrata*) that was nicknamed ‘Sludgie’, entered the Gowanus Canal, an urban waterway with historically notable levels of toxic contaminants (Miller 2016), with visible lesions on its head and died shortly thereafter by beaching itself (Alexiou 2020). In 2013, a common dolphin (*Delphinus delphis*) also entered the Gowanus Canal, and subsequently died by stranding (Di Leo 2013). It has been proposed that marine mammals that navigate poorly into unsupportive waterways may inherently be afflicted by physical trauma, such as injury (Yamamoto et al. 2016), or disease (Davis et al. 2019) by the time they enter the urban ecosystem. A successful future with an increasing human population, increasing shipping, and an increasing marine mammal population requires planning with these human-animal interactions in mind. As we consider conservation of urban ecosystems, we must include marine mammal use of rivers and other waterways. Given the geography of NYC, and the interconnection between the major waterways, these animals most likely have large

interconnected navigational pathways. We propose that seals use smaller interconnected channels to regularly travel from haul-out and feeding locations within NYC. In addition, we note that for longer seasonal migratory routes, using the rivers as vectors for transport between the Atlantic northeast and their most likely southernmost locations of the Chesapeake Bay (Jones & Rees 2020), would also greatly reduce the amount of distance and time necessary to circumvent Long Island. While seals are also commonly found in the Long Island Sound (Payne & Selzer 1989), and along the eastern (Waring et al. 2015) and southern shores of Long Island (McCormack 2015), it appears likely that individuals may detour through New York City to preserve energy, reduce the distances between migratory locations, and decrease the travel time during seasonal migrations (Alerstam 2001).

To date, there has been no published data of seals within the smaller channels of New York City, but our own observations, along with other anecdotal evidence (e.g., Sealy) provide evidence that seals are traveling within these smaller tributaries. The only formal research data point we have thus provided is limited, but critical, evidence for the likelihood that individuals traverse the urban environment for migration and transportation.

At approximately 09:00 on March 3rd, 2019, we observed a harbor seal travelling in a westerly direction through the East River of New York City with the receding tide for Orchard Beach predicted at 10:54 for that day. Specifically, the individual was observed between the Throgs Neck and Whitestone Bridges, which separate the boroughs of the Bronx and Queens (see Figure 1). The East River connects to the Hudson River and Little Neck Bay, which is the southern end of Pelham Bay and Orchard Beach. This individual was observed while conducting a typical field survey; however, on this day, we had decided to traverse the East River with our vessel (10.6m Duffy Express Cruiser with a Yanmar 6CXM ETE 420HP engine that was built in the year 2000 by the Atlantic Boat Company, Brooklin, Maine) with the hope that we may encounter a seal that likely uses the river systems as vectors for transportation. To date, this is the only formally documented observation of seals traveling within the smaller channels of New York City and demonstrates the likelihood of individuals traversing the urban environment for migration and transportation. We thus highlight the need for further research focused not only on haul-out/resting locations but the movements of these animals through the waterways to ensure continued success of these shared habitats in one of the busiest shipping waterways on the eastern seaboard. Consideration must be given to how these seals use these waterways as data indicates that seals navigating through these rivers and channels will only increase as populations rise (Toth et al. 2018; Woo & Biolsi 2018). We note that additional research is needed to understand seals' movement patterns and navigational strategies so that we can anticipate clashes with humans, decrease anthropogenic impacts on these protected species, and preemptively consider ways to best utilize these waterways for all stakeholders.

IMPLICATIONS OF SHARED WATERWAY USAGE

Our observations are a first step in formally documenting that seals are not only using specific rock outcroppings to rest and thermoregulate while in the NYBA (Woo & Biolsi 2018), but that they are actively using these channels to navigate between locations. If this waterway navigation is in fact commonplace for these animals, then understanding these patterns of usage is critical to ensure minimal impact of anthropogenic factors on these protected species.

Anthropogenic Effects on Marine Mammals in New York Bight Apex

Dredging, particularly in the Upper and Lower bays is routinely implemented to preserve active transport for large vessels, increasing depth for barges but causing ecological damage (Peteet et al. 2018). This is required for shipping since landfill has narrowed many of the river systems, tapering most near or close to their deepest depths for commercial marine vessel transportation. In addition, given both tidal changes and natural riverine flow, loose sedimentation from the absence of flora (*Spartina alterniflora*) and bivalves (eastern oysters; *Crassostrea virginica*) has increased the volume of substrate deposited in the middle of the channels (Guo & Pennings 2012; Zarnoch & Schreibman 2012). Repeated dredging induces habitat destruction and loss of biodiversity, such as the impact of sedimentation stability on seagrass beds and species that depend on them for refuge and nurseries (Erftemeijer & Lewis 2006). The impacts of dredging also include masking and behavioral effects, such as noise disturbance from machine and seismic operations, and suspended sedimentation that may impact social interactions like communication or ability to detect predators, prey, and conspecifics in various marine mammal species (Todd et al. 2015).

One of the most immediate challenges to marine mammals in the NYC area is derived from the continued anthropogenic activities associated with an active shipping port. Currently, the NYBA contains the most active shipping port in the eastern United States (Rodrigue 2003) and whale sightings in the area appear to coincide with dredged shipping channels (Brown et al. 2018). Shipping channels have been described as high-risk areas for whales in other areas (i.e., Vanderlaan et al. 2009; Williams and O'Hara 2010, Rockwood et al. 2017) and the NYBA is no exception. In fact, the area just outside the entrance to the Port of New York and New Jersey, is designated as a Precautionary Area by the International Maritime Organization (International Maritime Organization 1985). The Mid-Atlantic region ranks second highest in the number of documented vessel strikes of baleen whales worldwide (Jensen et al. 2003; Aschettino et al. 2020). Considering that the highest levels of vessel traffic within the mid-Atlantic are found in the NYBA (Silber & Bettridge 2012), these, often lethal encounters are likely to increase.

Boat traffic, particularly large commercial barges that transport containers, is a physical and sensory threat even to smaller marine mammals such as pinnipeds (Avila et al. 2018). Similar to whales, pinnipeds that inhabit urban marine systems are subjected to the persistent dangers of collisions from marine vessels. There have been several accounts of pinnipeds encountering motorized vessels, typically resulting in propeller strikes that cause significant physical trauma (Meager 2016; Olson et al. 2021). Though the majority of vessel-pinniped collisions are non-lethal, commercial and recreational traffic can be deadly (van der Hoop et al. 2013). As the pinniped population increases in NYC it would behoove us to look to other parts of the world where larger populations of seals overlap with human activities such as shipping to help us predict and avoid future environmental pitfalls. Onoufriou et al. (2016) examined harbor seals (*P. vitulina*) and commercial vessel interaction in the Moray Firth, Scotland and found collisions were rare, but still likely to occur despite cohabitation of resident populations and frequent marine vessel movement. In studying the potential for pup and vessel collisions in the Caspian Sea, Wilson et al. (2020) developed a predictive model to demonstrate the likelihood of collisions with ice-breeding pinnipeds, such as bearded seal (*Erignathus barbatus*), gray seal (*H.*

grypus), harp seal (*Pagophilus groenlandicus*), ringed seal (*Pusa hispida*), hooded seal (*Cystophora cristata*), ribbon seal (*Histriophoca fasciata*) and spotted seal (*P. largha*) as a function of increased frequency of boat traffic, ultimately determining that collision rates are significant enough to consider management policies for the region. However, if seals can detect the frequency of propeller noise there is potential for them to use that sensory information to avoid contact with oncoming vessels, especially as seals are more maneuverable than many large commercial boats. In fact, Miersch et al. (2011) proposed that the vibrissae of seals are hydrodynamic receptors. Subsequently, studies provide evidence of harbor seal (*P. vitulina*) orientation and environmental discrimination based on hydrodynamic signals received by vibrissae (Hanke et al. 2010; Murphy et al. 2015). Therefore, as boat traffic and seal populations increase in the NYBA, research needs to focus on understanding the potential outcomes of boat/pinniped interactions. For example, in relation to vessel type and speed, it would be important to learn what the earliest detection distance is based on auditory and tactile information picked up by the seals and how much time they have to interpret the sensory information and make a decision allowing them to avoid a boat strike.

In addition to potential strikes, recreational and commercial marine vessels consequently produce a significant amount of auditory noise pollution. The impact of acoustic disturbance is well-documented in the literature (Gordon et al. 2003; Tyack 2008; Merchant et al. 2014), and it affects an individual's ability to communicate for a variety of social interactions (Weilgart 2007). One main concern is that anthropogenic noise masks auditory communication between conspecifics (Brumm & Slabbekoorn 2005; Erbe et al. 2016; Madsen et al. 2006). Motors from commercial shipping vessels produce low-frequency noise, which can travel far into the marine environment. Parks et al. (2007) examined the short-term and long-term behavioral effects of shipping noise on North Atlantic right whales (*E. glacialis*) and South Atlantic right whales (*E. australis*) and found behavioral differences such as an increased frequency of individual calling that was produced likely to overcome the masking of vocalizations. Parks et al. (2011) further found that North Atlantic right whales (*E. glacialis*) would modify their calls to produce louder vocalizations in response to increased environmental noise. Similarly, Buckstaff (2004) examined the impact of recreational watercraft on bottlenose dolphin (*T. truncatus*) communication and found that individual's whistle frequency and repetition rate increased upon watercraft approach, likely to compensate for signal masking. Bearded seals (*E. barbatus*), who vocalize for courtship and territorial defense, have also been found to alter the amplitude and frequency of their calls in response to anthropogenic noise (Fournet et al. 2021) to avoid the masking effect. Acoustic disturbance is likely amplified in an urban environment with an active shipping port as opposed to pelagic locations. The presence of larger and more frequent commercial traffic further increases the volume of noise pollution. Consequently, the interaction between larger and more frequent commercial vessels also produces acoustic noise in the immediate environment above the surface of the water. While the transmission of sound differs across air in comparison to underwater, noise still presents a challenge for aspects of communication while on land (Putland et al. 2018). Terhune (1991) conducted an experiment where the study simulated ambient noise to mimic the vocal detection threshold of harbor seal (*P. vitulina*) mother-pup air-calling communication through a single-tone, and to potentially mask signals between them. Ultimately, Terhune (1991) provided insight in psychophysical thresholds of auditory communication in isolated conditions. Subsequently, additional studies were conducted to investigate masking with multitone signals to simulate more dynamic

conditions (Turnbull & Terhune 1990). In support of earlier evidence, Erbe et al. (2018) found that the sound of commercial airplanes, recorded between 84-132 dB, penetrated the water-to-air barrier, and was detectable against ambient underwater noise that as recorded between 12-10 kHz. Additionally, Leone and Warren (2024) collected data on noise at two artificial reefs south of Long Island and along beaches in Southampton NY. Their research suggested that commercial vessels and aircraft are significant contributors of anthropogenic noise in underwater environments and along the coastal beaches of Long Island, NY respectively. Many urban environments have their airports along coastal locations and these studies imply that commercial passenger airplanes are likely detected by marine fauna, such as cetaceans, pinnipeds, and sirenians, which can impact social communication. Though these are examples of pinniped and anthropogenic interactions that are understudied, they provide some evidence and opportunity to pursue further investigation.

CONCLUSION

It is evident that these pinnipeds have elected to maintain wintering residence in NYBA, despite the threat of physical and sensory anthropogenic challenges to the marine environment and their own health. Moreover, they continue to combat the ecological challenges, like dredging and shipping that constrain their success. However, their sustained presence has broader implications for the improvement of the marine environment and the optimistic status of other local predator and prey species. Thus, the prevalence of pinnipeds in this particular urban environment is an important bioindicator for the marine ecosystem health of New York City, which is seemingly beginning to favor a progression towards genuine improvement.

Urbanization of an environment inherently creates additional dimensions of ecological complexity. Humans have steadily developed the infrastructure of urban environments to which any resident or visiting marine mammal must contend with the consequences of anthropogenic activity. We should celebrate the better water quality and the return of fish, marine mammals and other top predators to the NYC waterways while simultaneously preparing for the next challenge of increasing populations. If we do not collect critical data to make informed decisions on waterway usage, we may see this marine mammal rebound turn into a decline due to habitat use conflict. We currently know only a small amount of information regarding how seals live and thrive in this urban ecosystem, and how human behavior and development of housing and businesses along the shores impacts their habitat as well as shipping and dredging in the waterways. Continuing research will add to our understanding in these areas, will lend itself to science and to the enrichment of the local communities that utilize this shared habitat with marine mammals.

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