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Northwest Atlantic Pinniped Health Risk Factors

Northwest Atlantic Seal Research Consortium

Pinniped Health Working Group

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ABSTRACT

The Northwest Atlantic Seal Research Consortium (NASRC) developed a Heath Working Group during the Consortium's Organization Meeting in April of 2013. In January of 2016, a short-term work plan was established, which included the identification of risk factors impacting seal health. The culmination of risk factors facilitated the identification of regional questions and priorities to concentrate research efforts and resources. A follow-up in-person meeting was held on March 18, 2016 in Gloucester, MA to refine a working draft of risk factors, develop a plan to move forward with inventorying available samples, and initiate standardization of prospective sample collection. This report is the result of these meetings, and is intended to serve as a working planning document, in which additional components will be incorporated to develop a comprehensive *Pinniped Health Assessment Plan*.

KEYWORDS

Pinniped, Health, Risk Factors

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Introduction

The Northwest Atlantic Seal Research Consortium (NASRC) grew out of a series of workshops that included scientists, resource managers, and recreational fishermen to address issues and concerns related to increasing seal populations along the New England coast. Recent increases in local seal abundance have led to concerns about fisheries and other interactions between human and seal populations. The urgency of documenting, understanding, and mitigating these interactions has become more apparent, as has the need to improve our understanding of the ecological role of seals in the northeast United States. This encompasses issues such as: how they live, where they go, what they eat, their health and illnesses, and interactions with the world—including humans—around them.

In 2015, the NASRC hosted a pivotal workshop themed “Seals and Ecosystem Health.” One goal of the workshop was to develop an action plan for pinniped research in the Northwest Atlantic Region. Following this meeting, NASRC and NOAA Fisheries Northeast Fisheries Science Center (NEFSC) collaboratively held a workshop on *Developing an Action Plan for Pinniped Research in the Northwest Atlantic Region* in September 2015. Harbor seals (*Phoca vitulina*), gray seals (*Halichoerus grypus*), and harp seals (*Pagophilus groenlandicus*) are commonly found in coastal and offshore waters of Atlantic Canada and the U.S. Northeast and mid-Atlantic regions, which make up the transboundary Northwest Atlantic Region. The workshop focused on four broad themes pertaining to pinniped species: 1) Population abundance, 2) Foraging ecology/diet, 3) Fishery impacts, and 4) Health. Several of the presentations and panel discussion identified data gaps and needs; however, many needs specifically pertained to pinniped health. A primary need included the foundation of defining baseline health for the pinniped species most encountered within the Northwest Atlantic Region. Recommendations for studying health included establishment of a working group to define health criteria, standardize data collection, and centralize health data by utilizing collaborations among interested stakeholders.

Resulting from recommendations of the 2015 NASRC/NEFSC Workshop, the NASRC convened a Pinniped Health Working Group (PHWG) with an inaugural meeting in 2016. Over a series of meetings, the PHWG established a short-term work plan to begin addressing the recommendations set forth by the NASRC. The first action within the work plan was a comprehensive review of risk factors impacting pinniped health. The PHWG identified a number of factors that influence pinniped health, which range across all the themed categories discussed at the 2015 NASRC/NEFSC Workshop, as mentioned above, and beyond. Resulting from these risk factors the PHWG further identified regional research questions and priorities to concentrate research efforts and resources to aid in planning efforts. This report describes the outcomes of these discussions, and is intended to serve as a foundation for future research and collaboration among researchers and stakeholders. Moving forward, additional components will be incorporated to develop a comprehensive regional *Pinniped Health Assessment Plan*.

Pinniped Health Working Group

Purpose: Document broad-scale potential risk factors impacting pinniped health in the Northwest Atlantic.

Need: Identify research areas and questions to aid in assessing pinniped health through collaboration of researchers, stranding response and rehabilitation entities, Northeast Fisheries Observer Program (NEFOP), Department of Fisheries and Oceans Canada, and other interested stakeholders.

Intent: Evaluate and define regional objectives to assess health parameters of pinniped populations by conducting the following activities:

- Compile a comprehensive definition for pinniped health and establish criteria to define ill-health.
- Compile and review existing assessment parameters to standardize health assessment parameters among all collaborating entities.
- Inventory collected and archived health samples and data (ex: blood samples, tissues, swabs).
- Outline available resources and needed resources.
- Understand capacity for sample collection and storage.
- Utilize the above information to develop a regional data collection, sample collection and data analysis plan with the objectives of identifying appropriate scientific study design (Health Assessment Plan), including valid sample size and distribution.
- Establish a sample and data request/sharing policy between collaborating entities to facilitate collection in the field, dissemination, analysis, and sharing of results that is agreed upon and understood by all participants.
- Assess the need for a long-term data storage plan.

Pinniped Health Risk Factors

The PHWG identified the below **broad** pinniped health risk factor categories. Multiple factors can be contributed to a number of categories, and can be identified as multi-factorial risks. The multifactor component will become more substantive as the process develops, and the factors are prioritized and evaluated for linkages to incorporate into a *Health Assessment Plan*. The *Health Assessment Plan* is proposed to reflect the One Health approach, which is more consistent with an ecosystem based management model to target impacts at an ecosystem level. “One Health” is an interdisciplinary approach to strengthen systems globally and locally by recognizing the shared health of humans, animals and the environment. One Health / Ecosystem assessment plans will require identification and assessment of climate change impacts on pinniped species. Climate change impacts are mentioned in the below section, however the PHWG recognizes the rapidly changing data sources on this topic and anticipate additional scientific data becoming available to further inform planning processes under anthropogenic risk factors.

Anthropogenic Impacts

Human activity can impact pinniped health in both direct and indirect ways (Table 1). Direct interactions are those where a human activity directly affects pinniped health, e.g., approaching an animal that is hauled out on a beach and disrupting its behavior. Direct interactions can have a range of impacts to pinniped health, from disrupting natural behaviors to serious injury and mortality. Indirect interactions are those where a human can affect pinniped health without directly interacting with the animals, e.g., through affecting climate parameters that are critical to pinniped health. Indirect interactions can cause habitat degradation, chronic stress, and behavioral disruption, as well as lead to serious illness and mortality. In some cases, anthropogenic impacts may increase the likelihood of disease risks, which are covered in more detail in the subsequent section. For example, climate change that displaces current populations and/or leads to shifts in species distributions can result in higher intraspecific densities at certain haul out sites or more frequent inter-specific interactions, both factors that can increase the risk of disease transmission.

Table 1. Anthropogenic impacts. Risks to pinniped health resulting from human activities through direct and indirect interactions. The factors are not listed in order of priority.

Risk Factor	Type	Potential Impact
Acoustic disturbance	Vessel noise, oil and gas exploration, naval exercises	Chronic stress, behavioral disruption, physical trauma
Anthroponotic disease	Diseases that can be transferred from humans to other animals	Illness, mortality
Climate change	Increasing water temperatures	Thermal stress, shifting distributions of prey, predators, and competitors
	Increasing storm systems	Displacement
	Loss of sea ice	Disrupts critical habitat for ice-obligate species
	Sea level rise	Loss of haulout space
	Acidification	Food chain disruption
	Hypoxia	Habitat degradation and food chain disruption
Coastal development	Agricultural	Habitat degradation, e.g., nitrification leading to harmful algal blooms
	Industrial	Habitat degradation, e.g., run-off of pollutants
	Residential	Habitat degradation, e.g., run off of pollutants (infectious agents that have a source external to the ecosystem)
Fishery interaction	Entanglement	Chronic stress, serious injury or mortality
	Bycatch	Asphyxiation, serious injury or mortality
	Ingestion of fishing hooks	Serious injury or mortality
	Gaff, hooking, ballistics	Serious injury or mortality

	Acoustic deterrents (for other marine species, such as cetaceans)	Acute and/or chronic stress, displacement, habituation, or increased risk to entanglement
	Acoustic deterrents (targeting pinniped species, approved mitigation techniques)	Displacement, acute and/or chronic stress
	Overfishing	Reduction in prey base
Human interaction	Harassment, flushing	Chronic stress, pup abandonment, displacement
	Provisioning	Behavioral shift
Pollution	Acute exposure, e.g., to spills of oil or other hazardous materials	Ingestion of hazardous chemicals, physiological impacts, serious injury or mortality
	Chronic exposure, e.g., to persistent organic pollutants, metals, pesticides, and pharmaceuticals	Compromised immune system, reproductive effects, antimicrobial resistance, mortality
	Ingestion of foreign materials, e.g., plastics	Physiological impacts, serious injury or mortality
Vessel strike	Land or water vehicles	Blunt force trauma, lacerations, serious injury or mortality

Anthropogenic activities that pose a risk to pinniped health can be mitigated in many ways. The following activities represent mitigation measures for anthropogenic threats that reduce health risk to individual animals and pinniped populations.

1. *Federal, state, and local regulations that modify or restrict fishing practices* can have positive impacts on pinniped health. These regulations include targeted measures to reduce marine mammal interactions, e.g., gear modifications or protected areas in critical marine mammal habitat. Fishing regulations put into place for other reasons, e.g., to sustain fish stocks, can also have positive impacts on pinniped health by reducing the likelihood of marine mammal interactions and increasing prey availability.
2. *Federal, state, and local regulations that aim to reduce marine debris and other marine pollution* can also positively impact pinniped health. For example, local communities that regulate the use of plastics or put into place practices to mitigate run-off of chemical pollutants can reduce the risk of adverse health effects in pinnipeds associated with ingestion of marine debris and chronic exposure to chemical pollutants.
3. *Conservation efforts* such as beach clean-ups that remove ghost gear and other marine debris can help reduce the risk of entanglement and ingestion of foreign materials.
4. *Rehabilitation programs* directly mitigate anthropogenic impacts by providing treatment and care for animals impacted by human activities. For example, pups that have been abandoned due to human interaction are often successfully rehabilitated and released back into the wild.

5. *Education/ecotourism* programs, such as curriculum design for K-12 education, can provide the public with tangible ways to reduce health risk to individual animals, and specifically to pinniped populations. These teaching modules for students can be adapted and shared with seal tour operators as well as developed into PSAs for ecotourism.
6. *Stakeholder engagement* meetings allow for discussion of ideas and solutions that are applicable to the communities where threats emerge from and most often where most are documented. For example, focusing on key locations with high rates of entanglement cases or locations where vessel interactions are highest can result in more effective implementation of solutions and trusted partnerships.

Animal Disease

Endemic infections and disease outbreaks have historically been documented in pinniped species globally and continue to be an area of research to better understand causative factors, transmission, clinical signs, and population level impacts, as well as zoonotic risk to human populations. Many stakeholder groups incorporate sample collection for disease surveillance programs and health assessment projects that inform management frameworks and ongoing research activities. Marine mammals, such as pinniped species, serve as sentinels for ocean and ecosystem health, and research into emerging and reemerging diseases may be warranted to contribute to marine species and public health monitoring (Bossart, 2011). Environmental changes can lead to negative impacts on pinniped health. Anthropogenic factors, such as those listed above, can influence prey distribution, animal behavior, and habitat features that can have negative impacts on pinniped health. For example, limited availability or poor quality of prey can lead to starvation, which in turn can lead to disease. Extreme weather events resulting from climatic changes can displace animals or change distribution patterns resulting in an increased risk of disease transmission for animals encountering and interacting with other species.

Table 2 categorizes disease factors into core areas by general etiology (i.e., cause, set of causes, or manner of causation of a disease/condition). The factors are not in any particular order of priority.

Table 2. Animal Diseases. Risks to pinniped health resulting from disease processes.

Risk Factor	Type
Infectious Disease (Acute and Chronic)	Parasitic
	Viral
	Bacterial
	Fungal
	Protozoal
	Co-infections
Non-infectious Disease (Acute and Chronic)	Metabolic diseases
	Disease process of toxins
	Congenital / Degenerative
	Reproductive Health
	Nutritional
	Immune Disorders
Neoplasia	Genetic Disease
	Formation or presence of new, abnormal tissue growth
Idiopathic: Disease of unknown origin/etiology	Disease of unknown origin/etiology
	Alopecia syndrome

Mitigating Disease Risks

There is international support for caring for and treating injured and sick wildlife to counteract cumulative impacts to individual animals, populations, and habitats. Additionally, human or naturally-occurring mitigation activities can have a positive impact on pinniped health. Measures that may reduce health risk from disease to individual animals and pinniped populations include:

1. *Medical intervention and rehabilitation* are performed through formalized responses to sick and injured marine mammals. Animals are assessed by trained and authorized response personnel and candidate animals are admitted into rehabilitation for medical treatment and care. Supportive care and medical treatment are provided to reduce or eradicate clinical symptoms or disease with the ultimate goal of releasing healthy individual animals back into the wild.
2. *Vaccination* programs for wild marine mammal populations are rare, but can serve as a viable tool to protect against disease. The development of a vaccine and implementation of vaccination protocols for wildlife populations is resource intensive. Accessibility to animals must be considered to determine the efficacy of a vaccination protocol. Individual identification and network models may assist in the development of implementation frameworks that can lead to other areas of research (Robinson et al, 2017).

3. *Small-scale natural die-offs or epidemic* events in a healthy wild population can aid in population level immunity to disease pathogens. Regular or cyclical disease outbreaks can be expected in robust wildlife populations as a natural response to introduced or increased transmission of pathogens. Mortality rates under fifty percent of the total population could be expected, particularly for pups which are highly susceptible to disease (Brownell and Le Boeuf, 1969). However, mortality rates should be monitored closely to determine rates exceeding typical thresholds for population level impacts.

Assessment Strategies

After identifying the risk factors, the Working Group focused on research areas and questions to better understand these factors and the baselines against which to assess pinniped health. During this session of the workshop, the Working Group narrowed the scope of research for project development.

Objective: Evaluate pinniped response to health risk factors by establishing baseline parameters and assessing abnormal response through assessment tools and analysis.

Strategies to Assess Anthropogenic Impacts

- 1) Quantify bycatch and entanglement frequency by gear type.
- 2) Track sources of contaminants, pharmaceuticals, pollutants.
- 3) Investigate hearing capacity and acoustic impacts.
 - Identify data sources for hearing capacity for other species that may be applicable to pinnipeds.
- 4) Track source of fecal contamination (e.g., through microbial resistance and pathogens, host contributors).
- 5) Understand prey distribution and abundance, including historical references and changes due to human activity and development.
- 6) Characterize trophic interactions (i.e.: identifying diet).
- 7) Understand habitat expansion and range, by:
 - Document areas of species overlap
 - Map distribution and movement
- 8) Collect and share environmental data, including sea surface temperature, salinity, air temperature, and marine currents.

Strategies to Assess Disease Risks – *In priority order*

- 1) Monitor pathogens through routine water and animal (wild, stranded, and controlled studies) sampling.
- 2) Characterize and monitor acquired immunity from prior exposure.
- 3) Utilize population genetics to understand diversity and susceptibility/resistance to disease.
- 4) Measure density dependent response changes to disease.
- 5) Assess and quantify changes in pathogenicity over time (archived samples/prospective).

- 6) Characterize and monitor pathogen resistance.
- 7) Characterize baseline for pinniped microbiome (i.e., the microorganisms in a particular environment, including the body).

Inventory of Available Samples and Data

A sub-committee was developed to identify what samples and data are currently available to inform research studies above. The Working Group identified assessment of disease risk factors as the initial priority. Below is a draft work plan to achieve these goals.

Identified Collaborators

The Working Group identified the following entities as sample and/or data contributors or collaborating partners interested in analyzing or utilizing the samples and/or data to address the overall objectives of the NASRC Pinniped Health Working Group.

Northeast Fisheries Observer Program
Northeast Fisheries Science Center Protected Species Branch
Southeast Fisheries Science Center
NOAA Permitted Pinniped Researchers
NOAA Marine Mammal Health and Stranding Response Program
NOAA Greater Atlantic Regional Marine Mammal Response Program
Stranding Network Members
Existing Tissue Banks

Actions

- 1) Survey Stranding Network Members to summarize types of samples collected over the years of operation to better understand existing samples available for research efforts.
- 2) Develop a sample utilization plan, prioritizing disease surveillance by:
 - a. Assessing the likelihood of existing samples informing ongoing projects, such as avian influenza surveillance.
 - b. Develop a research study design incorporating available sample inventory.
 - c. Establishing protocols for sample submission, analysis, and data sharing across project(s).

Standardization of Sample / Data Collection

The need to standardize sample and data collection among collaborators for prospective studies was established as a priority by the Working Group. A conceptual *Sample Collection Workshop* was proposed as a short-term goal to bring together the collaborators above to develop standardized sample collection, storage, and archiving protocols. The proposed workshop would be a combination of lectures (e.g., permitting processes and requirements) and hands on experience (e.g., necropsy, sample collection from live animals). Including international collaborators in the workshop will be instrumental in identifying priorities for cross-boundary population research initiatives. Workshop development will be the focus of subsequent meetings.

Conclusion and Next Steps

The NASRC aims at hosting at least one meeting annually. The focus of the meetings may vary and pertain to particular subject matters or identified issues that can benefit from a collaborative approach through discussions among researchers, industry expertise, and management. The information presented in this PHWG report summary can aid in future discussions and regional prioritization of data and sample collection, research questions, resource needs and collaborative initiatives. A dedicated workshop to standardize sample collection, storage, and archiving protocols is recommended to bring together stakeholders engaged in these activities. Based on resources, the NASRC Steering Committee will consider this recommendation for future meeting and training workshop needs. Meeting reports and summaries can be found on the NASRC website at <http://nasrc.who.edu/workshops>.

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