

6th Marine Mammal Student Symposium

Navigating Arctic Waters: Strengthening ties between Marine Mammal Research, Indigenous Knowledge & Law and Policy Making

Program

- 10:00 - 10:05** Welcome and introduction
- 10:05 - 10:20** NAMMCO, NCLOS & Arctic and Marine Biology (AMB) Presentations
- 10:20 - 10:25** 5-minute break
- 10:30 - 11:40** Session 1: Student talks
1. Masiat Alam Zubair
(Adapting in the Arctic: Climate Change's Influence on Shark Habitats)
 2. Claudia D'Andrea
(Climate Change and the Arctic Ocean: Can the BBNJ Agreement Protect Arctic Marine Biodiversity?)
 3. Éadin O'Mahony
(Cultural transmission of bubble net feeding in Canadian Pacific humpback whales: an analytical challenge due to inherent sociality)
 4. Daniel Gómez-Lobo
*(Mitochondrial variation of bottlenose dolphins (*Tursiops truncatus*) from the Canary Islands suggests a key population for conservation with high connectivity within the North-East Atlantic Ocean)*
 5. Marina Metić
(The spatial and temporal variations in the body condition of harbour porpoises along the Norwegian coastline)
- 11:40 - 12:00** Breakout session
- 12:00 - 13:00** Lunch break
- 13:00 - 14:10** Session 2: Student talks
1. Lauren McDowell
(Factors influencing vessel incidents with southern resident and Bigg's killer whales in the Salish Sea 2011-2022)
 2. Caila Kucheravy
(Potential implications of increased killer whale presence in the eastern Canadian Arctic)
 3. Aisha Rashid
(Behavioural budgets of endangered southern resident killer whales)
 4. Roxanne MacLean
(Quantifying the habitat selection and distribution of marine mammals from aerial survey observations around Ellesmere Island, Nunavut)
 5. Azin Vedadi
(Identifying obstacles in the effectiveness of legal regimes and protection laws for the Caspian seal)
- 14:10 - 14:30** Breakout session
- 14:30 - 14:40** Coffee break
- 14:40 - 16:00** Session 3: Keynote speakers
1. Nikolas Sellheim
(Shoreline perspectives, capital blindspots: Reimagining decision-making on seals)
 2. Emma Vogel
(Marine mammal tracking for management and mitigation)
 3. Endalew Lijalem Enyew
(Arctic Indigenous Peoples' Right to Whaling: Making Sense of the IWC and NAMMCO Management Regimes)
- 16:00** Wrap-up followed by informal networking and pizza

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1. AISHA RASHID (Marine Biology, University of Washington)

Behavioural budgets of endangered southern resident killer whales

Southern resident killer whales are a salmon-eating *Orcinus orca* ecotype found in the Northwest Pacific ranging from British Columbia, the Salish Sea, to Monterey Bay. Since their endangered status listing in 2005 they have struggled to maintain consistent population numbers largely due to the decline of their prey base Chinook salmon. Given the decrease in fish abundance and compounding effect of smaller salmon, the exhibited behaviours in their salmon rich summer habitat off of the coast of the San Juan Islands has changed. The behavioural budget of these whales has changed to compensate for the need to eat more frequently and spend more time finding Chinook. In 2022, 20.9% of observed SRKW behaviour in the Salish Sea was spent on foraging while in 2023 it increased to 29.3%. This budget took out of their modified rest and travel budgets which decreased from 6.4% and 55.6% to 4.9% and 43.9% respectively. Though they spent more time foraging, they increased in socialisation, a behaviour distinctively found in orcas globally. In 2022 13.9% of their budget was spent socialising while in 2023 it increased to 19.5% of their budget. This increase in socialisation might also be attributed to increased prey sharing and food distribution to young males by their mothers. Overall, the changes in behaviour are indicating that the southern residents are able to rest for less time and are fishing more, supporting the idea that food scarcity is changing their exhibited behaviours.

2. AZIN VEDADI (NCLOS, UiT)

Identifying obstacles in the effectiveness of legal regimes and protection laws for the Caspian seal

This research delves into the challenges surrounding the protection and conservation of the Caspian seal, a unique mammal exclusive to the Caspian Sea. Despite efforts to examine its status under maritime law, the complex legal situation of the Caspian Sea, exempt from the Law of the Sea Convention (UNCLOS), presents hurdles. This study argues for the application of UNCLOS provisions to the Caspian Sea to address the species' plight effectively. The research aims to enhance legal capacities and processes for Caspian seal protection, proposing solutions to bolster law enforcement across Caspian countries. Employing a legal approach, it explores the legal framework pertinent to Caspian seal conservation, including international conventions and regional legislation. Interviews supplement data collection, revealing hidden insights related to the subject. Findings highlight the urgency of addressing legal provisions to defend the rights of endangered animals, particularly the Caspian seal. The study emphasizes the importance of establishing robust enforcement mechanisms to counter emerging threats effectively. Effective implementation of laws is paramount, as weak enforcement facilitates evasion of legal provisions. The research underscores the need for multifaceted approaches to Caspian seal protection, considering legal, social,

educational, organizational, cultural, and ecological aspects. Recommendations prioritize strategies for comprehensive protection measures.

3. **CAILA KUCHERAVY (University of Manitoba & Fisheries and Oceans Canada)**

Potential implications of increased killer whale presence in the eastern Canadian Arctic

Understanding the demographics of predator populations is critical to predict their impact on prey populations. Killer whale (*Orcinus orca*) sightings in the Canadian Arctic have increased as sea ice has declined, and new or increased predation pressure may affect the abundance and behaviour of marine mammal prey species. However, the population demographics (sex and age structure, abundance, and growth rate) of Eastern Canadian Arctic killer whales remains unclear. We estimated population sex- and age-class structure using skin biopsies sampled from 58 Arctic killer whales. We determined sex genetically (53% males, 47% females) and estimated the age of individuals using epigenetic aging based on DNA methylation patterns (43% juveniles, 57% adults, mean age=13.0). We conducted mark-recapture analysis using a Bayesian POPAN Jolly-Seber model of photo-identified (2009-2023; n=101) and genetically identified (2013-2021; n=46) individuals to estimate population abundance (169-280 whales) and the realized population growth rate ($\lambda=1.02$). The positive estimated growth rate aligns with the apparent increase from sightings reports. The estimated number of killer whales in this population could have substantial consumptive and non-consumptive impacts on Arctic-endemic prey, including beluga and narwhal. Inuit communities in Nunavut are concerned about the impact of killer whale predation on these species, since they are of socioeconomic and cultural significance to Inuit. Continued population growth and extension of the ice-free season could lead to further implications for prey species and Inuit communities. However, the current population size remains relatively small, and may warrant conservation protection. Therefore, concerns about the impact of killer whale predation on Arctic prey should be tempered with efforts to conserve this killer whale population.

4. **CLAUDIA D'ANDREA (NCLOS, UiT)**

Climate Change and the Arctic Ocean: Can the BBNJ Agreement Protect Arctic Marine Biodiversity?

The newly adopted BBNJ Agreement seeks to ensure the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction (ABNJ). One of its key features is the establishment of a global legal basis for the adoption of marine protected areas (MPAs) in ABNJ. A particularly unique and fragile marine area is the Arctic Ocean, already experiencing extremely adverse effects of climate change. Against this backdrop, it is investigated whether the BBNJ Agreement may aptly protect marine biodiversity in the

Arctic Ocean against the effects of climate change, particularly through the application of measures such as Area-Based Management Tools, including MPAs.

5. DANIEL GÓMEZ-LOBO (Marine Conservation, University of Oviedo)

*Mitochondrial variation of bottlenose dolphins (*Tursiops truncatus*) from the Canary Islands suggests a key population for conservation with high connectivity within the North-East Atlantic Ocean*

In recent decades, worldwide cetacean species have been protected, but they are still threatened. The bottlenose dolphin (*Tursiops truncatus*) is a vulnerable keystone species and a useful bioindicator of the health and balance of marine ecosystems in oceans all over the world. The genetic structure of the species is shaped by their niche specialisation (along with other factors), leading to the classification of two ecotypes: coastal and pelagic. In this study, the genetic diversity, population structure, and ecotypes of bottlenose dolphins from the Canary Islands were assessed through the analysis of 49 new samples from biopsies and from stranded animals using the 636 bp portion of the mitochondrial control region and 343 individuals from databases ($n = 392$). The results reveal high genetic diversity in Canarian bottlenose dolphins ($H_d = 0.969$ and $\pi = 0.0165$) and the apparent lack of population genetic structure within this archipelago. High genetic structure (F_{st} , Φ_{st}) was found between the Canary Islands and coastal populations, while little to no structure was found with the pelagic populations. These results suggest that Canarian bottlenose dolphins are part of pelagic ecotype populations in the North Atlantic. The studied Special Areas of Conservation in the Canary Islands may correspond to a hotspot of genetic diversity of the species and could be a strategic area for the conservation of the oceanic ecotype of bottlenose dolphins.

6. ÉADIN O'MAHONY (Scottish Oceans Institute, University of St Andrews & Globe Institute, University of Copenhagen)

Cultural transmission of bubble net feeding in Canadian Pacific humpback whales: an analytical challenge due to inherent sociality

Bubble net feeding ('bubble netting') is a specialised, cooperative foraging technique practised by certain populations of humpback whales (*Megaptera novaeangliae*) worldwide. We report the diffusion of this behaviour throughout humpback whales of the northern Canadian Pacific, specifically in Gitga'at First Nation territory, during 20 years of study. Network-based diffusion analyses find strong evidence for the social learning of bubble netting, even after accounting for individual-level traits such as site fidelity and sex (all models: $p < 0.0001$). Here, we present the challenges associated with testing for cultural transmission when the animal behaviour of interest is highly cooperative in its nature, as is the case with group bubble netting. This is a pertinent challenge in the context that network-based diffusion analyses are developed for the testing of initial social learning of behaviours, followed by the individualistic performance of that behaviour once learned. We seek to

discuss the implications of applying this analytical approach to an inherently social behaviour and how best to proceed to best place humpback whale culture on the agenda for conservation management in the region, particularly given a recent 20% decline in this North Pacific population.

7. LAUREN MCDOWELL (University of New Hampshire)

Factors influencing vessel incidents with killer whale ecotype in Salish sea 2011–2022

Cetaceans are negatively affected by marine vessels, both directly and indirectly. Consequently, many government agencies have created vessel regulations for species protection. Our study focuses on two killer whale ecotypes found within the coastal waters of the Salish Sea, which spans from British Columbia, Canada, and Puget Sound in Washington State, USA: Bigg's (Transient) (BKW) and Southern Resident killer whale (SRKW) (*Orcinus orca*). While Southern Resident killer whale population is declining while under the Endangered Species Act, the occurrences of BKW population has increased since 2012 resulting in more interaction with vessels. There have also been no studies comparing the Southern Resident and Bigg's killer whale nor long term studies on the vessel incidents with Bigg's killer whales. In this study, we analyse the Whale Museum Soundwatch Boater Education Program data from 2011-2022 to understand and compare speed, in path, and distance vessel incidents around both ecotypes. This long-term dataset was also used to create a model for the factor influencing the incidents. Preliminary results show that the SRKW population exhibited higher incident rates in all incidents than BKW. However, incident rates around BKW increased over time as vessel restrictions increased, and in the last two years, BKW had a higher number of 200-yard incident rates. These results will help shed light on the differential impacts of vessel interactions on both ecotypes, emphasizing the importance of ongoing monitoring and management strategies to mitigate these effects and inform future conservation and marine policy efforts.

8. MARINA METIĆ (Biodiversity, Evolution and Ecology, University of Bergen & NAMMCO)

The spatial and temporal variations in the body condition of harbour porpoises along the Norwegian coastline

Body condition can refer to the overall health, fitness, and wellbeing of an individual, and can be estimated based on morphometric factors such as weight and amount of energy reserves. There are several different ways to quantify body condition, using direct measurement of energy reserves, such as blubber, as well as a variety of body condition indices. Based on the available data and research question, the chosen and best suited body condition index might vary. Harbour porpoise is one of the top predators in Norwegian coastal ecosystems. They are among the smallest species of toothed whales with high

metabolism rates and relatively short life cycle. In this study, the aim is to see how different biological and ecological aspects affect the body condition of this species. We show that sex has no effect on the body condition of the harbour porpoise, but data is showing some spatial and temporal patterns in body condition. Temporal analysis reveals seasonal changes in the body condition between spring and autumn, likely influenced by prey availability, reproduction cycle, and environmental factors. Spatial analysis investigates the effect of latitude on body condition, as well as how some other factors, such as prey availability or environmental factors change body condition. The results of this study will contribute to understanding spatio-temporal patterns in body condition of harbour porpoise and usage of appropriate body condition index for the species. Furthermore, the study highlights the importance of the species as a potential indicator organism, and the need for long-term monitoring of changes in the general state of the species.

9. MASIAT ALAM ZUBAIR (Dhaka University)

Adapting in the Arctic: Climate Change's Influence on Shark Habitats

Climate change is drastically altering the ecology globally, including in polar territories like the Arctic. Climate change's effects on Arctic shark habitat have not been as thoroughly examined compared to its influence on terrestrial and polar marine ecosystems. This abstract intends to emphasize the substantial influence of climate change on shark habitat in the Arctic region, backed by recent evidence. Recent research shows a significant increase in temperatures in Arctic waters, with a rate of warming that is double the global norm. This warming has caused decreases in sea ice coverage and depth, leading to alterations in ocean circulation, primary production, and prey abundance. Changes in environmental circumstances have a direct effect on Arctic shark species, as they depend on specific environments for eating, breeding, and migration. Information obtained from acoustic telemetry investigations and satellite tracking shows changes in the distribution and migration behaviours of Arctic shark species, such as Greenland sharks (*Somniosus microcephalus*) and Arctic lamprey sharks (*Etmopterus polaris*). Apex predators in the Arctic are essential for controlling prey populations and preserving environmental equilibrium. Changes in habitat availability and prey distribution caused by climate change endanger the survival of these species. Increasing temperatures could allow subarctic shark species to move northward into Arctic waters, which may result in heightened competition for resources and changes in predator-prey relationships. The disappearance of traditional Arctic shark habitat may have far-reaching consequences on the entire Arctic marine ecosystem, impacting not just sharks but also other marine creatures and indigenous groups that depend on Arctic resources. It is crucial to understand how climate change affects Arctic shark habitat to guide conservation and management efforts in the area. Collaboration among scientists, politicians, and indigenous groups is essential to reduce the impacts of climate change and safeguard the delicate Arctic ecology for future generations.

10. ROXANNE MACLEAN (Biology, York University)

Quantifying the habitat selection and distribution of marine mammals from aerial survey observations around Ellesmere Island, Nunavut

Habitat characteristics influence the distribution and ecology of animal populations. For ice-dependent species, the availability of suitable sea ice habitat is vital for many of their life processes. Changes in sea ice habitat are often reflected in the responses of Arctic marine mammals, making the habitat selection of these animals an effective indicator of underlying changes in the structure, and functioning of Arctic marine ecosystems. Under current climate modelling scenarios, the Last Ice Area surrounding northern Ellesmere Island in the Canadian High Arctic is predicted to host the last long-term year-round sea ice in the world, making this area a globally significant potential refuge for ice-dependent species. The objectives and proposed methods for this research are to (1) quantify the habitat selection of ringed seal (*Pusa hispida*), bearded seal (*Erignathus barbatus*), narwhal (*Monodon monoceros*), Atlantic walrus (*Odobenus rosmarus rosmarus*), and polar bear (*Ursus maritimus*) in both spring and summer within the Last Ice Area using resource selection functions, (2) investigate the interannual variability in habitat selection from 2018 to 2024 for each species, and (3) model the predicted distribution of each species in the Last Ice Area in both spring and summer using species distribution models, and to identify changes in distribution between years. It is hypothesized that the distribution of Arctic marine mammals in the Last Ice Area will be especially sensitive to particular sea ice habitat characteristics. Each species is expected to select for particular sea ice concentrations, ice types, distance to land, and bathymetry, with variations anticipated across seasons. This research will be the first to quantify the habitat selection and distribution of marine mammals in the Last Ice Area, yielding novel insights into this understudied yet ecologically significant area of the world.