

Humpback Whales as Barometers of the Antarctic Sea-Ice ecosystem; Establishing a Powerful Biomonitoring Approach

Principle Investigator

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Project Description

Multiple disciplines of research have, over the past decade, been conveying a consistent signal of change within the Antarctic krill: Southern hemisphere humpback whale (HW) food chain. These signals range from increasing reports of temporal feeding by migrating whales, to increasing stranding numbers of malnourished individuals and reports of reduced blubber thickness and stomach content in harvested Antarctic minke whales, a species occupying a similar trophic niche.

More recently, the Principal Investigator (PI), Susan Bengtson Nash's own ten-year humpback whale toxicology program has revealed a disconcerting trend of steadily increasing HW blubber burdens of man-made, lipophilic, persistent organic pollutants (POPs). Rather than being a sign of dramatically increasing levels of environmental contaminants, the trend is more likely a sign of decreasing blubber reserves or changing feeding trophic level in the study population (E1 and Antarctic feeding area V as designated by the International Whaling Commission).

Shifting trophodynamics and foraging range in a high-fidelity krill predator are direct signals of a supporting ecosystem undergoing change. This has prompted a series of inter-related projects under the PI's Southern Ocean Persistent Organic Pollutants Program, aimed at developing new and novel tools for evaluating HW diet and "adiposity". The advances made by the team in HW chemical and biochemical biomarker techniques will now be integrated to establish HWs as a new and intelligent sentinel species for biomonitoring of Antarctic krill and the Antarctic sea-ice ecosystem. As such, the program shares clear synergies with the goals of the Southern Ocean Observing System (SOOS) and we therefore seek to move forward in contribution to, and with the endorsement of SOOS.

Specifically, the project will conduct long term monitoring of the HW sentinel parameters of adiposity and diet. Adiposity is tracked by way of blubber lipid % as well as the three novel biochemical markers developed by the PI, namely an adipocyte index (a standardised measure of adipocyte volume and inter-vacuolar space); adipokines as indicators of body mass index and POPs as indicators of whole-of-body adiposity. Historical and recent feeding by individuals is evaluated using traditional fatty acid and stable isotope techniques as well as the novel markers of radiocarbon and POP analysis developed by the investigative team.

The research has undertaken detailed evaluation of some parameters continuously since 2006, and all parameters since 2011, providing a modest temporal trend from which to pursue long term, sustained monitoring as advocated under the SOOS strategy. The SOOS Science and Implementation plan advocates use of existing data and building partnerships within the research community in order to effectively integrate and coordinate existing efforts. Further, the Strategy acknowledges the need for new technologies in the area of biology and ecology where there are no platforms for measurements of key variables in cost effective manner.

The outlined Program is already providing insight into the changing trophodynamics of a dependent predator of the Antarctic sea-ice ecosystem. Continued monitoring offers the opportunity to markedly improve the return on investment of in-situ Antarctic monitoring programs through targeting of a migrating predator and use of comparatively inexpensive biochemical tools.

*Please note, references have been omitted from this summary but can be provided upon request.

Project Timeline

2008 – Ongoing

Key deliverables

Humpback whales are biopsied by the PI annually off southeast QLD coast (North Stradbroke Island). Sampling time-points alternate between northward migrating cohorts in even numbered years and southward migrating cohorts in odd numbered years. Approximately 60 animals are sampled annually (30 males, 20 females and 10 calves-of-the-year). Skin and blubber biopsies from all individuals will be analysed for lipid content and fatty acids, adipokines, stable isotopes and will undergo histological analysis for derivation of an adipocyte index. Adult males only will be analysed for blubber POP content to avoid confounding factors of pregnancy and lactation. Baleen plates of stranded animals will be analysed for stable isotopes and radiocarbon in order to provide insight into historical feeding (up to 5 years prior to death). Combined, these biochemical markers will contextualise the sentinel parameters of diet and adiposity. An annual record permits evaluation of longitudinal trends and their connection with observed measurements of physical and biological forcing in the Antarctic sea-ice ecosystem.

Funding

Pacific Life Ocean Foundation; this funding lapsed in 2014 and further funding is currently being sought

Data Management

This research has grown from the core research of Griffith University's Southern Ocean Persistent Organic Pollutants Program within the Environmental Futures Research Institute. Data management therefore adheres to best academic practice and follows the requirements of respective funding bodies. At minimum, all data is collated and made publicly available via national and international conference presentations, peer-reviewed journal articles and student theses. A copy of all data is additionally managed by the PI.