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Health assessment of subsistence harvested Bering-Chukchi-Beaufort Seas bowhead whales (Balaena mysticetus):an overview

Raphaela Stimmelmayr

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HEALTH ASSESSMENT OF SUBSISTENCE HARVESTED BERING–CHUKCHI-BEAUFORT SEA BOWHEAD WHALES (BALAENA MYSTICETUS): AN OVERVIEW

R.Stimmelmayr[1],

[1]North Slope Borough Department of Wildlife Management, North Slope Borough, Barrow, Alaska 99723

ABSTRACT

General knowledge about diseases and natural causes of morbidity and mortality of bowhead whales is very limited. This report contributes to the body of knowledge on disease conditions in BCB bowhead whales. It provides a brief review and update on known causes of morbidity and mortality in subsistence harvested bowheads. Future and ongoing retrospective health assessment projects are presented.

KEYWORDS: ARCTIC; BALAENA MYSTICETUS; BOWHEAD WHALE; SUBSISTENCE HARVEST; HEALTH ASSESSMENT

INTRODUCTION

Natural morbidity and mortality rates of bowhead whales similar to other arctic marine mammals have the potential to increase with the ongoing shifting of species' specific ecological (i.e. sea ice extent; ocean acidity, etc.) and epidemiological constraints (i.e. warming Arctic, increased release of contaminants from multi-year ice, immigration of non-native species, vectors and pathogens, etc.) and the concurrent expanding development of offshore industrial oil resources and the general increase in arctic marine traffic (Gulland and Hall 2007; Moore and Gulland 2014; Reeves et al. 2014).

The North Slope Borough, Department of Wildlife Management, founded in 1972, has a long-standing harvest monitoring program in place for landed subsistence harvested bowhead whales (Albert 1988). Since 1980, all whales landed in Barrow and many others in the villages of Wainwright, Kaktovik, Pt. Hope, Gambell, Savoonga and Nuiqsut have been examined (George et al. 1994). Over the years, the general health examination of landed whales, an integral component of the spring and fall harvest monitoring, has evolved to address emerging issues and threats including scarring, line entanglements, ship collisions, killer whale attacks, whale lice abundance, etc. (for review Philo et al., 1993; George et al., 1994). In general, health assessments are done jointly by Inupiaq whaling crews, NSB DWM veterinarians, and/or biologists in the field during the harvest and butchering process. Bowhead health and thus food safety assessment is a critical and essential component of all Inupiaq subsistence activities. From an Inupiaq subsistence perspective, health assessment of bowhead whales starts with the actual hunt and continues through food processing, preservation, and storage. The expertise and knowledge of whaling captains, whaling captains' wives, and the community to health

assessments of harvested bowheads have hereby been essential to place "*normal, abnormal and/or new findings*" into a long-term traditional ecological knowledge context. In my experience, there is a significant degree of correlation and overlap of subsistence users' understanding of bowhead health and traditional and customary criteria with biomedical criteria of wildlife health and disease. This report provides an update on known causes of morbidity and mortality in subsistence harvested bowheads. The information presented stems from ongoing bowhead whale health research conducted on the Bering Sea stock by the Department of Wildlife management, North Slope Borough, Barrow, Alaska, the Alaska Eskimo Whaling Commission, and observations from captains, crews and whaling captains' wives from the 11 Alaskan Eskimo whaling villages recognized by the Alaska Eskimo Whaling Commission.

METHODS

Harvest Monitoring: Landed subsistence harvested bowhead whales are inspected by post-mortem evaluation to assess the health status of the harvested individuals and collect tissue specimens and baseline data on scarring, whale lice and unusual findings. Since 2011, our techniques of biological sampling of tissues for diagnostic and research purposes have been expanded to capture molecular diagnostic advances in biotechnology (for example RNA later for RNA-based research and molecular studies, blood filter strips, Port-a cul, minus 80 freezers, etc.)

Stranding Response: Since 2011, all large cetacean strandings in Barrow have been inspected by post-mortem evaluation. Pending carcass condition partial and/or complete forensic necropsy (i.e. systematic flensing and examination of soft tissue and skeletal elements, followed by histopathology) is performed to primarily evaluate evidence for blunt/sharp force trauma due to vessel strikes, killer whale attacks/predation and struck and loss.

RESULTS AND DISCUSSION

Pathologic Conditions, Trauma, and Whale lice

Since Philo's et al. 1993 in depth review of known causes of morbidity and mortality, a fair number of newly observed pathological conditions in subsistence harvested bowhead whales in Barrow have been documented (Table 1). With the exception of hepatic fatty tumors (multiple observations since 2011), observed pathological findings represent individual case reports. The majority of findings are considered incidental without a significant negative effect on overall bowhead whale health and/or human consumption of these animals. Evaluations of scarring on bowhead whales (1990-2012) suggests, in order of prevalence, injuries being due to line entanglement (12%), killer whale attacks (8%), and ship strikes (2%) (George et al. 2015). Prevalence of whale lice on examined bowhead whales (1973-2014) was 20 % with overall low intensity (< 10 per whale) (Van Duke et al. 2015).

Table1. A summary list of disease conditions and natural causes of morbidity and mortality in subsistence harvested bowhead whales on the North Slope, Alaska. Source: case material: 1980-2000 see Philo et al. 1993 and individual citations (> 1993 – 2000); case material: 2001-2014 NSB unpub.data.

System	2001-2014	1980 -2000
Central Nervous and Sensory Organs	vestibular mass	ocular disease (Zhu Qian 1997)
Cardiovascular	myocardial and epicardial fibrosis; cardiac abscess	
Digestive	sclerosing mesenteritis; hepatic myelolipoma; Glisson capsule tear; ulcerative stomatitis and glossitis; colonitis; gum proliferation	pica (foreign material ingestion); hepatic lipoma, oral/gum abscess; intestinal volvulus (Heidel and Albert 1994)
Endocrine	adenomatous hyperplasia of the thyroid; Nodular adrenocortical hyperplasia	
Integumentary	dermoid cyst; scarring (line, killer whale etc.); skin lesions	line entanglement scars; killer whale scars; walrus tusk injuries; penetrating wounds from harpoon/whale bombs; embedded harpoon tips; propeller injury (George et al. 1994); skin lesions
Skeletomuscular	unidentified thoracic mass; bulgi femori (Sheffield pers. commun.)	mandibular fracture; bulging femori (Durham 1980)
Reproductive Female	cystic ovary; external genital polyp; uterine polyps	
Reproductive Male	male nipples (Sheffield pers. commun.)	penis malformation with hypogonadism; pseudohermaphrodism (Tarpley et al. 1995)
Urinary	kidney stones; kidney cysts	
Parasites	large round worm associated with the kidney (Crassicauda crassicauda); sarcocystis spp.; adult anisakis like roundworm in the stomach;	whale lice; Anisakis; Entamoeba sp. Ogmogaster plicatus

Harmful Algae Biotoxins

Limited biotoxin testing of feces from subsistence harvested bowhead whales (2006-2010; n=17) has indicated presence of harmful algae toxins (DA and saxotoxin) at generally low levels based on body size (K. Lefebvre pers. commun.) DA is produced by certain marine organisms, including the planktonic diatom of the genus Pseudo-nitzschia. Whale food such as copepods and euphausiids are known to feed on algae including toxigenic pseudo-nitzschia spp. Climate related sea ice and ocean temperature changes, in combination with increasing expansion of toxigenic algae species via ocean currents, and introduction of invasive species through the exchange of ship ballast water, may be setting the stage for the increased development of harmful algae blooms within the Bering-Chukchi-Beaufort water bodies. It is unknown if biotoxins could negatively affect bowhead health as species and age specific susceptibility to DOM toxicity has been shown. Sub-acute and chronic low level domoic acid exposure in northern right whales has been implicated as a contributing factor to overall poor survival and low reproductive rates (Leandro et al. 2010).

Stranding Response

Response to large cetacean strandings is an important wildlife health tool to better understand cumulative impacts of a changing Arctic (i.e. sea ice extent, trophic food web, industrial activities, maritime traffic, noise pollution, contaminants, emerging diseases, etc.) on baleen whale morbidity and mortality (Rosa 2009). During 2011-2014, five dead, beach cast bowhead whales and six gray whales were reported for Barrow. Cause of death by killer whale predation was 20% (1/5) for bowhead whales and 67% (4/6) for gray whales. The observed bowhead whale case is the first documentation of a confirmed killer whale predation on a bowhead whale on the North Slope. For bowhead whales, only one previous witness account of a killer whale attack on multiple bowhead whales in the vicinity of Saint Lawrence island (63°46'00"N; 171°43'58"W) has been reported from Gambell, Saint Lawrence island (2002 Leonard Apangalook; Gay Sheffield; Wade Okhtokiyu pers. commun.). Secondhand accounts of killer whale attacks on bowhead whales have been previously reported from Greenland and Eastern Canada (for review see Jefferson et al. 1991) and in a recent comprehensive traditional ecological knowledge study from Nunavut (Ferguson et al. 2012). No necropsy findings consistent with blunt and/or sharp force trauma due to vessel strikes were found.

Retrospective Health Assessment

The longitudinal harvest monitoring efforts of subsistence harvested bowhead whales have resulted in an extensive archival tissue collection. This bowhead whale tissue archive represents a significant resource to enhance our understanding of baseline health parameters and immune status for this important subsistence resource. As part of ongoing data mining and reorganization efforts of the NSB marine mammal tissue collection, available tissue specimens for bowheads, which consists of formalin fixated and frozen tissues, sera, plasma, whole blood, feces, urine and miscellaneous samples, have been inventoried and catalogued in a database for sample

identification. Formalin archived tissues have been transitioned to paraffin blocks and HE microscopy slides to lay the foundation for an archival master slide collection. Current prioritization of retrospective analyses for available archival tissues from subsistence harvested bowheads is as follows: *histopathological evaluation; serological evaluation for antibodies to priority pathogens as outlined by the Working Group on Unusual Mortality Events (*Venn-Watson et al. 2010*); biotoxin surveillance (Domoic acid and Saxotoxin), anthropogenic contaminants including legacy and emerging organic contaminants, PAHs, cesium 137 and 134 radionuclides, clinical pathology (hematology, clinical serum and urine chemistry) and fecal analysis for parasites.*

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