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A Possible Structure for a Bowhead Whale Health Report

J. Craig George, Robert Suydam and Raphaela Stimmelmayer



INTERNATIONAL
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J. CRAIG GEORGE, ROBERT SUYDAM, AND RAPHAELA STIMMELMAYR

North Slope Borough, Department of Wildlife Management
Barrow, Alaska

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ABSTRACT

The North Slope Borough Department of Wildlife Management (NSB DWM) has maintained a bowhead research program to provide scientific data used primarily for managing the Bering Chukchi Beaufort Seas stock of bowhead whales, since 1981. While one of the main objectives of the NSB program has been to provide population abundance data, it has also provided considerable life history and health assessment information used in management considerations, assessment models, and basic biological publications on cetacean science. The objective of this manuscript is to provide a proposed structure for a succinct, possibly annual, bowhead whale health report summarizing basic health and life history information. In depth analyses of bowhead health data would be continue to be summarized in peer-reviewed publications. We are seeking advice from the Scientific Committee regarding the usefulness of such a report and what it should include. Possible topics are presented.

INTRODUCTION

Bowhead whales of the Bering-Chukchi-Beaufort Seas (BCBS) stock are the subject of an annual subsistence hunt along the coast of Alaska and to a lesser extent Russia. The hunt is managed under a quota system in compliance with the International Whaling Commission and co-managed by the Alaska Eskimo Whaling Commission (AEWC) and /NOAA cooperative agreement (Suydam et al 2014).

In 2001, the Scientific Committee (SC) of the International Whaling Commission (IWC) recommended an Aboriginal Whaling Scheme (AWS) to the Commission (IWC 2002). While the AWS has not yet been approved by the Commission, it contains important advice related to implementation reviews and data collection. For example, an unscheduled implementation review might be triggered if certain factors deem necessary. Examples of factors include:

- (1) Major mortality events (e.g., suggested by large numbers of stranded animals).
- (2) Major changes in whale habitat (e.g., the occurrence of natural or anthropogenic disasters or changes, such as an oil spill or dramatic change in sea-ice).
- (3) Major ecological changes resulting in major long-term changes in habitat or biological parameters.
- (4) A dramatically lower abundance estimate (although the *SLA* has been tested, the Committee would review the potential causes of unexpected very low estimates).
- (5) Information from the harvest and hunters (this might include very poor harvest results, reports of low abundance despite good conditions, reports of large numbers of unhealthy animals).
- (6) Changes in biological parameters that may result in changes to management advice (e.g., reproduction, survivorship).
- (7) If there are cases when need is not being satisfied, significant positive information that might narrow the plausibility range and allow an increase in block limits.

Furthermore, the SC noted the value of including traditional ecological knowledge in Implementation Reviews. Despite these recommendations, there is no formalized structure for presenting these types of information to the SC.

A main objective of this paper is to present an outline for discussion by the IWC SC of a bowhead whale health report (BWHR). The report could be presented annually, bi-annually or when requested by the SC. This report would help ensure that the SC remains informed about the status of the BCBS bowhead population in addition to receiving regular updates on harvest and population abundance and trends. More specifically, it would provide a record of various population and individual health metrics and provide information useful to the SC when making recommendations about safe harvest limits. The BWHR is not intended to be an exhaustive health assessment analysis but rather a mechanism to record health information in a structured and timely manner to keep the SC current on factors affecting the stock.

The authors present this outline as a “straw man” to the SC for discussion about its usefulness in managing the BCBS stock of bowhead whales.

STRUCTURE OF REPORT

Listed below are possible subjects related to bowhead whale health which could be included in the report. The report could be formatted as a table where appropriate, although explanatory text would be added where needed.

Calf Production via fall aerial surveys (NMFS/BOEM)

Aerial surveys are flown annually by the U.S. National Marine Fisheries Service (NOAA-NMFS: Aerial Survey of Arctic Marine Mammals (ASAMM) survey, with funding from the U.S. Bureau of Ocean Energy Management (BOEM). These surveys provide statistics on the ratio of calves (number of calves/number of total whales seen) during the autumn bowhead migration across the Beaufort Sea. The database and annual reports date to 1982 thereby providing a good long-term indicator of bowhead whale calf production, as well as distribution, relative abundance, frequency of feeding and other metrics. As an example of what might be included, Clarke et al (2014) reported: “The calf ratio during fall [2013] was 0.106, which is higher than any calf ratio previously recorded for any single year from 1982-2012 (0.022 to 0.058; Clarke et al. 2012, 2013a).”

Body condition of landed whales (length/girth index, lipid density of blubber)

The girth/length index is a useful metric of body condition and can be compared with a long-standing database of measurements dating to the 1970s (George et al. 2015). This metric is easily computed and can provide an indication of relative body condition for a specific year or years. If reported, it would be important to compare specific cohorts (to each other) between years as different growth stages have very different physiological challenges which affect their health & condition (George et al., 2015). Blubber total lipid content analyses, if available, and analysis of hypodermis thickness may also be useful and could be presented.

Acoustic index

Spring migration

Bowhead whale abundance surveys have been conducted since 1978. Since 1984, a combined visual-acoustic survey has been conducted at various intervals. The acoustic aspect of the survey

provided, among many other metrics, whale locations and call counts through most of the spring migration used for abundance estimation (e.g., Clark et al. 1996; George et al. 2004).

In order to assess whether a count of bowhead calls recorded might provide a useful index of relative abundance of migrating bowhead whales, a single hydrophone package was moored off the ice edge west of Barrow, Alaska in 2015 and 2016. We wanted to analyze acoustic data from 1984 to present to determine if it is correlated with population abundance. These data are still being analyzed; however, based on an apparent change in acoustic behavior over this period whereby more "songs" have been recorded in recent years, we suspect that counts of the typical up-sweep calls (common in the 1980s and 1990s) may not be a reliable abundance metric.

Other methods to examine changes in bowhead relative abundance during the spring migration that use passive acoustic data include: a) documenting the beginning and end of the migration based on first and last dates of calls recorded, b) estimating the number of singers and distinct songs by year (following Hansen et al., 2015), or c) measuring the acoustic energy in the frequency band used by bowhead whales similar to the "fin index" described by Nieuwkerk et al. (2012).

Autumn migration

Oil and gas industry have monitored bowhead whales acoustically as they migrate across the Alaskan Beaufort Sea, primarily to improve our understanding of how whales respond to anthropogenic sounds (e.g., Richardson et al., 2008). Those monitoring efforts can be used to document annual call counts since about 2000; although currently there is little acoustic monitoring occurring in the Alaskan Beaufort Sea. Future monitoring efforts could be compared with past efforts and included in the bowhead health report.

Pregnancy rates of landed adult females

A crude pregnancy rate of adult females is presented annually in harvest reports (e.g., Suydam et al 2014). This is computed as a ratio (number pregnant /number presumed mature) based on an average estimated length of mature females. This metric is relatively easy to estimate and can be reported annually. While the crude pregnancy rate of landed whales is not necessarily representative of the entire population for a specific year (low sample sizes), the long-term dataset does provide a useful index of reproduction.

Hunter Observations of Bowhead whales

Over 150 whaling captains organize whale hunting crews annually along the northern and western Alaskan coasts to hunt bowhead whales. Whale hunters are astute observers of many aspects of bowhead whale life history, as attested by the many examples of traditional and local knowledge being used in scientific assessments and research (Huntington, et al. 2009; Noongwook et al., 2007; Wohlforth 2004). Obviously, summarizing 1000s of observations is not possible here, but specific unusual or specific observations or statements relative to whale health, timing of bowhead migration, etc. could be extracted and presented. For example, evidence of killer whales attacking bowheads is rare and is worthy of reporting.

Proportion of whales with line entanglement, killer whale, and ship scars and/or injuries

Harvested bowheads are carefully examined for scars (George et al., 2015; SC/66a/HIM_10). We examined scars on bowhead whales harvested by Alaska Native hunters to quantify the frequency of line entanglement, ship strike, and killer whale injuries. After data quality screening, we found records on scarring from 521 bowhead whales harvested between 1990 and 2012 within our database. Logistic regression was used to evaluate different combinations of explanatory variables (i.e., body length, year, sex) to develop a prediction model for each scar type.

Aerial photography is another useful tool for assessing the frequency of anthropogenic injuries of bowheads. Analysis of aerial photographs from 2003, 2004, and 2011 is currently underway to estimate entanglement rates via scarring frequency for BCBS bowheads (see Brattstrom et al. 2016, this meeting).

Gross Pathological findings from postmortem examinations of landed whales

Veterinarians, hunters and biologists examine landed bowhead whales on an annual basis. Extensive tissue samples are collected and gross examinations are conducted annually. These are periodically summarized (Philo et al. 1993; Suydam et al., 2015; Stimmelmayer 2015). Often it is the hunters that first identify abnormal findings. An example is the bowhead whale landed in Kaktovik in autumn 2015 that had many “encapsulated abscesses of variable sizes” probably associated with a hunter strike decades earlier (see Suydam et al. 2016, this meeting).

Proportion of landed whales positive for Harmful Algal Blooms (HABS)

Lefebvre et al. (2016) published a comprehensive study on the prevalence of HAB in Alaskan marine mammals including bowhead whales. Results of ongoing HABS monitoring efforts could be summarized and reported.

Number of dead floating and beach cast bowheads

Generally bowheads are rarely seen floating dead or sea or found as beach cast carcasses. Increased numbers of dead bowheads not associated with animals that are struck and lost in the annual hunt, may be an indication of changing environmental conditions. In 2015, the ASAMM surveys include structured annual aerial transects across vast areas of the Beaufort and Chukchi Seas observed a considerable number of floating dead whales. The North Slope Department of Wildlife management is a member of the Alaska Marine Mammal Stranding Network and monitors beaches in Barrow and other villages for marine mammal strandings. As stranding network member we report on all beach cast cetaceans and pinnipeds to NMFS. NMFS maintains a long-term database of stranded cetaceans in Alaska. Annual Alaska statewide bowhead whale stranding reports could be summarized and reported.

Proportion of landed whales with cyamids

Von Duyke et al. (2016; In Revision) describe a methodology for examining the prevalence of cyamid lice on bowhead whales. A good baseline has been established based on a sample of examinations of 673 whales. Continued monitoring of subsistence harvested whales for cyamids, along with further investigations into the roles of environmental and anthropogenic variables in cyamid prevalence, could be a useful indicator of changes in the Arctic ecosystem.

Radionuclide levels in landed whales

The interest in Arctic radionuclide monitoring increased after the 2011 Fukushima Daiichi nuclear plant accident. Our goal, similar to European radioecology programs (i.e., Sweden, Norway, Germany etc.) is to monitor levels of anthropogenic radionuclides in marine biota (i.e., bowhead, beluga and other marine mammals). A long-term northern Alaska based marine radioecology monitoring program will provide a better understanding of the changing status of legacy radionuclide sources from past Arctic ocean radionuclide waste disposal practices by the former USSR (Edson et al. 1997) as well as the 2011 Fukushima Daiichi nuclear plant accident. Updates from the ongoing NSB DWM monitoring program could be summarized and reported.

Hematology

At present, blood collection, basic hematology and clinical chemistry analysis is done on most whales landed at Barrow. While conditions are often imperfect for this type of screening, nonetheless, blood parameters relevant to health (i.e., total white blood cell count (WBC), lymphocyte counts, packed cell volume (PCV), etc. could be summarized and reported.

Proportion of landed whales showing evidence of feeding and diet description

Several publications (Lowry et al (2004; Moore et al., 2010) on bowhead whale feeding provide a good framework for reporting the frequency of bowhead whales feeding and diet in several areas across the BCBS range (Saint Lawrence Island to Kaktovik, Alaska). The diet database now spans 40 years. This metric would simply be the proportion of examined whales that were found to be feeding in both spring and fall.

The prevalence of examined whales with signs of *Anisakis* spp. infestation in the stomach (i.e., worms, gastric nodules, gastric ulcers etc.) can be tallied and reported.

Number of ship transits through the Bering Strait and North West Passage

The US Coast Guard and the Waterway Safety Committee provide statistics on the annual transit of large vessels through the Bering Strait. The BWHR could list the number of registered transits by large vessels (> 16 m) by year.

Spring Ice-based Visual Survey Index

Bowhead whales migrate along Alaska's NE Chukchi coast where a long time series of abundance estimates dating from 1978 to 2011 exists (Given et al., 2016). Partial or low-effort counts conducted from the ice edge and over long time periods could provide a useful index. Such counts could be conducted by Eskimo whaling crews.

FINAL THOUGHTS

If the SC views the bowhead "health report" as a useful contribution, it could be presented to the SC intermittently, unless there is a compelling reason (e.g., an observation of unusual numbers of floating dead bowheads) to do so more frequently. The hope is that the report would not add significant expense or effort to our ongoing bowhead studies program, but instead summarize and report health-related information in a useful, succinct, and timely manner for the SC, and whale hunting communities.

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