

SOME RECENT BIOLOGICAL FINDINGS ON BOWHEAD WHALES: IMPLICATIONS TO MANAGEMENT AND OFFSHORE INDUSTRIAL ACTIVITY

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Abstract: The bowhead whale is a large robust cetacean inhabiting most of the ice-covered seas of the circumpolar Arctic. Bowheads exhibit unusual morphological and life history traits. They have the thickest blubber of any cetacean and the longest baleen. They grow rapidly to ~8 m in their first year, and then experience a 2-3 year growth pause in body length and mass. Bowheads may routinely live to ~150 years and thereby are the longest-lived mammal. Age at sexual maturity occurs at >20 years. Their long baleen plates are highly specialized with fine fringe-hairs which allow them to feed on small nekton prey; e.g., small copepods. Their metabolic rates may be lower than other large cetaceans. Taken together, these characteristics make bowheads robust to some environmental and industrial stressors but vulnerable to others. The complexity and size of the baleen rack suggests greater vulnerability to oil fouling than other large whales. While buffered somewhat by a high adult survival rate, their relatively low reproductive rate and delayed maturity is reflected by the conservative harvest strategy implemented through the International Whaling Commission's aboriginal whaling management procedure. Bowheads likely can not tolerate elevated chronic anthropogenic removals from: gear entanglement, ship strikes, or oil releases. Bowheads exhibit strong reactions to even low levels of anthropogenic sounds, therefore maintaining relatively low levels of man-made noise within their range is advisable for both animal health and hunting success. Regarding climate change effects, their extensive blubber buffers bowheads against high annual variability in ecosystem productivity; however, it is unknown how they or their prey will tolerate major ecosystem disruption. Their low metabolic rates suggest that even low prey-density feeding areas may be useful to bowheads and require protection. Young bowheads (<5yr) face energetic challenges; hence, areas where they aggregate, along with adults, requires special attention. Recent studies suggest the possibility of olfaction in bowheads. The cumulative impact of Arctic climate change and increases in human activities on bowheads remains an important question.

Biology

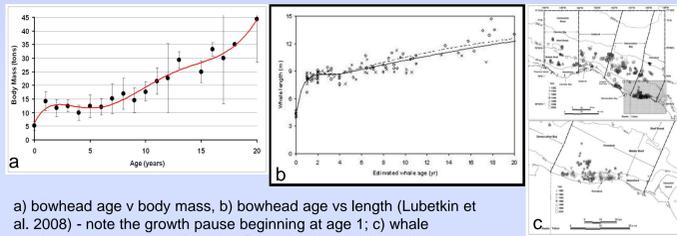
Bowhead baleen and...

The structure of bowhead baleen is very different than Balaenopterids and gray whales which have short rigid plates. Bowhead baleen is the longest of any baleen whale and has delicate fringe hairs which filter small invertebrates. It takes a bowhead over 20 years to achieve adult-length baleen. Lambertson et al. (2005) postulates that the convex shape of the baleen rack actually may accelerate water into the mouth and elicit a counter-evasive behavior in prey.



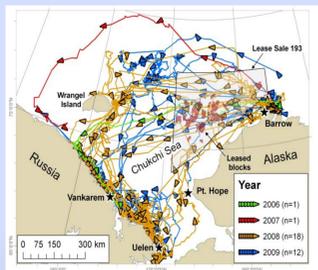
...body growth

Recent research on growth and age of bowhead whales (Lubetkin et al., 2008; George 2009) has shown that bowhead whales experience a 2-4 year growth pause following weaning (at age 1). George (2009) also showed that bowheads lose weight during this period. We speculate that sub-adult whales may experience higher mortality rates and therefore areas where these age classes aggregate might be considered for protective measures during aggregation periods.



Satellite Telemetry

Areas where bowheads feed are reasonably well known in the Beaufort Sea from 30 years of aerial surveys but not in other parts of their range. Recent satellite telemetry studies suggest some additional aggregation/feeding areas. These 'new' areas near Wrangle Island and possibly the Bering Sea during winter. Note that all tagged whales aggregate, and presumably feed along the north Chukotka coast. These tracks confirm observations by Russian Natives that large numbers of bowheads aggregate there in autumn. Also note that all of the tagged whales transited through Chukchi Sea Lease 193 on their way to their wintering areas.



Satellite telemetry tracks of bowhead whales in autumn; also see poster by Quakenbush et al., this session.

Olfaction in bowheads

Recent anatomical studies strongly suggests that bowhead whales may have functional olfactory lobes which suggests that, unlike other cetaceans, bowheads are capable of smell (Thewissen, H. et al. Submitted manuscript).



Olfactory tissues extracted from subsistence harvested bowhead whales during fall 2009.

Stressors

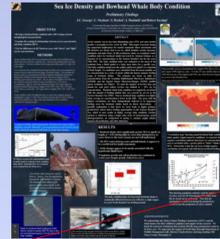
Man-made noise

A considerable body of literature regarding reactions of bowheads to man-made sound exists. New information from analysis of acoustic data collected at BPs Northstar facility confirms that bowheads may react to very low-levels of industrial sounds (Richardson (ed.) 2006) particularly during migration. Deflections associated with these low-level sounds appear to be small. In contrast, recent and past studies (and personal observations) of feeding bowhead whales suggest that bowheads show reduced reactions to noise when they are feeding, e.g., Ljungblad et al. (1988).



Climate change

Studies of landed whales along with population studies have so far indicated that sea ice retreat and climate warming in the arctic has not had significant population level effects (George et al., 2006). However, if Arctic climate warming continues, it is not known how this will affect bowhead whale population size or health or bowhead's prey.



Ship strikes and line entanglement

Continued monitoring of landed whales has indicated that bowhead whales continue to experience line entanglement and ship strikes. While injuries from ship strikes are quite rare, roughly 10% of the landed bowheads line entanglement injuries appear on. Recent carcasses found in the Chukchi show possible ship strike injuries.



A bowhead fluke with a propeller injury (above) and a dead female bowhead with crab-gear wrapped around the peduncle. Line scars on a recently landed bowhead (inset).

Offshore industrial activities



Contaminants

Man-made contaminants are now globally distributed and have been detected in bowhead whales. Fortunately levels are comparatively low in western arctic bowheads for a number of reasons.



Diet

We have learned that bowheads are feeding across the Beaufort Sea and later in the fall than previous studies have indicated (Lowry et al. 2004). Also, fish are becoming more prevalent in the diet of bowheads as determined through postmortem examinations.



It is difficult to measure cumulative effects on individuals and populations. Population level indices are often used but this approach may only be sensitive to very large effects. Monitoring health indices, studying behavior, or developing quantitative models of bowheads may prove to be more useful.

Discussion

- Recent studies suggest baleen growth is essentially a prerequisite for body growth for bowhead whales. It may take five years or more before whale can effectively feed on their small prey that occur at small densities. Little is known about how crude oil affects bowhead whale filtering efficiency. We know of only one experiment conducted to date that examines this question and recommend that further research be conducted on the effects of oil contact on filtering efficiency.

- With regard to offshore industrial activity, most regulations focus on protections of mother-calf pairs and feeding aggregations. However, areas where sub-adults aggregate should receive consideration as well given bowhead life-history characteristics. Koski and Miller (2009) analysis shows that sub-adults are more frequent in the near-shore waters of the central-Beaufort Sea; hence we recommend further photogrammetric studies in this region and consideration of reduced activity in those areas at certain times of the year.

- Recent investigations suggest that bowhead whales, unlike toothed whales, are capable of smell. This could have implications to offshore industrial activities. Air quality and emissions from vessels, offshore oil and gas activities, and other human activities should be considered in offshore management strategies.

- Telemetry data suggests new and confirms existing feeding/aggregation areas in the Beaufort Sea, near Barrow, Wrangle Island, along the Chukotka coast, within the Bering Strait, and wintering areas in the Bering Sea. These areas require careful management consideration in terms of oil and gas operations, shipping and/or commercial fishing. Feeding later in the year could have implications to proposed shipping routes between Europe and Asia through the Bering Strait. Analysis by Lowry et al. (2004) suggest that bowheads engage in a feeding migration across the Beaufort Sea. A higher frequency of fish has been noted in the bowhead diet, but the management implications of this are unclear.

- The subsistence hunt of bowhead whales by Alaskan Eskimos is regulated through an effective co-operative agreement between NOAA and the Alaska Eskimo Whaling Commission (AEWC). Population size has increased at about 3.5% annually over the past 3 decades despite a continuous harvest during this period. Over 30 years of research and numerous simulation studies by US and IWC scientists strongly suggests that current harvest levels are safe and do not pose a conservation risk to this herd.

- Contaminant levels in bowheads are relatively low compared with most marine mammals and *currently* are not considered to pose a threat to subsistence users nor to the animals themselves. However, this should be carefully monitored.

- Bowheads are an ice-associated cetacean, however, several indices suggest that western arctic bowheads are healthy and increasing despite substantial ice reduction and sporadic oil and gas activity over the last 3 decades. However, as in the case with north Atlantic right whales, we speculate that cumulative anthropogenic effects (climate change, industrial activities, shipping, noise, contaminants, etc) should they become more intensive in the Arctic, will eventually have negative effects on this population. It is unknown at what activity level population effects will occur.

The cumulative effect of these stressors and proposed offshore oil and gas activity on bowheads is unknown. We urge a cautious science-based approach be taken, which incorporates community input and traditional knowledge, to manage offshore industrial activities across the bowhead's range.

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