**Biology**

Bowhead baleen and...

The structure of bowhead baleen is very different than Balanopterids and gray whales which have short rigid plates. Bowhead baleen is the longest of any 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 arch actually may accelerate water into the mouth and elicit a counter-aversive behavior in prey.

...body growth

Recent research on growth and age of bowhead whales (Lubberts et al., 2008; George 2009) has shown that bowhead whales experience a 2-4 year growth pause following birth (s). 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.

**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 BP’s Northstar facility confirms that bowheads may react to very low-levels of industrial sounds (Richardson et al. 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 bowhead whales show reduced reactions to noise when they are feeding, e.g., Ljungblad et al. (1988).

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 bowhead whale entanglement injuries in 2010 appear on Recent carcasses found in the Chukchi show possible ship strike injuries.

**Contaminants**

Marine contaminants are now broadly distributed and have been detected in bowhead whales. Fortunately levels are comparatively low in western arctic bowhead whales for a number of reasons.

Olfaction in bowheads

Bowheads are an ice-associated cetacean, however, several indices suggest that western arctic bowheads are healthy and have considerable if commercial quantities of bowhead whales for a number of reasons.

Whale hunting

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

**Cumulative Effects**

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 bowhead whales may prove to be more useful.

**Discussion**

- Relent studies suggest growth is essentially a prerequisite for body growth for bowhead whales. It may take five years or more for young bowhead whales to reach their small prey that cover small densities. Bowhead whales may have functional olfactory lobes which suggests that, unlike other cetaceans, bowhead whales are capable of smell. This could have implications to offshore industrial activities. Air quality and emission 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 within the Bering Sea. These areas require careful management consideration in terms of oil and gas operations, shipping and commercial fishing. Feeding later in the year could have implications to proposed shipping routes between Europe and Asia through the Bering Strait. Analysis by Ljungby et al. (2004) suggest that bowhead whales engage in a feeding migration across the Beaufort Sea. A higher frequency of fish has been noted in the bowhead diet, but the margination implications of this is unclear.

- The subsistence hunt of bowhead whales by Alaskan Eskimos is regulated through an effective co-operative agreement between NOAA and the Alaskan 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 WC species scientists suggest that current harvest levels are safe and do not pose a conservation risk to this herd.

- Cumulative levels in bowheads are relatively low compared with most marine mammals and currently are not considered to pose a threat to subsistence users or not to the animals themselves. However, this should be carefully monitored.

- Bowhead whales is 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 to be taken, which incorporates community input and traditional knowledge, to manage offshore industrial activities across the bowhead's range.