



# Satellite Tracking of Western Arctic Bowhead Whales

Lori T. Quakenbush, Alaska Department of Fish and Game, Division of Wildlife Conservation, 1300 College Road, Fairbanks, Alaska 99701 USA; [lori.quakenbush@alaska.gov](mailto:lori.quakenbush@alaska.gov)  
John J. Citta, Alaska Department of Fish and Game, Division of Wildlife Conservation, 1300 College Road, Fairbanks, Alaska 99701 USA; [john.citta@alaska.gov](mailto:john.citta@alaska.gov)  
John C. George, North Slope Borough, Department of Wildlife Management, P.O. Box 69, Barrow, Alaska, 99723, USA; [craig.george@north-slope.org](mailto:craig.george@north-slope.org)  
Robert J. Small, Alaska Department of Fish and Game, Division of Wildlife Conservation, 1255 West 8th Street, Juneau, Alaska 99802, USA; [robert.small@alaska.gov](mailto:robert.small@alaska.gov)

**ABSTRACT:** The western Arctic stock of bowhead whales (*Balaena mysticetus*) has been the focus of considerable research because they: 1) are critical to the nutritional and cultural health of Alaska Natives, 2) likely play a significant role as zooplankton grazers in the Bering, Chukchi and Beaufort seas, and 3) are vulnerable to possible effects of oil and gas exploration, development, and production in their summer range. General movements are known from aerial surveys and from the timing of whaling in coastal villages, yet knowledge of movements during migration relative to bathymetry and ice cover is limited. Working with other researchers and subsistence whalers we have attached satellite transmitters to bowhead whales and during the 2006 spring and fall migratory periods we tracked a 45-foot (13.7 m) male bowhead over 2,500 km, from Point Barrow, Alaska, to Amundsen Gulf, Canada, and then to Chukotka, Russia. During the spring migration, between Point Barrow and Amundsen Gulf, this whale passed through seas with 90-100% sea ice cover. Using raw ARGOS location data and Bayesian state-space modeling, we interpolated whale locations and classified movements as migration (high speed and small turning angles), foraging (low speed and large turning angles), and a mixture of migration and foraging (low speed and small turning angles). Two other whales tagged at Barrow were also tracked to the Chukotka coast in fall. These data indicate that some bowhead whales are probably feeding in Amundsen Gulf, along the coast of Chukotka, and also near Point Barrow.

**INTRODUCTION:** Some movements and feeding patterns of the western Arctic stock of bowhead whales are poorly understood. Bowhead whales are known to winter somewhere in the Bering Sea and migrate through the Chukchi and Beaufort seas in spring, presumably to feed in the eastern Beaufort before returning to the Bering Sea in late fall. It is not known if bowhead whales feed in wintering areas or if other important feeding areas exist. Because activities related to oil and gas exploration and development are increasing in the Chukchi and Beaufort seas, effective management requires a better understanding of which habitats are important for bowhead whales and where migration corridors are located. The purpose of this project is to use satellite telemetry to identify feeding areas and migration corridors.

**METHODS:** Bowhead whales were tagged with satellite transmitters manufactured by Wildlife Computers and adapted and deployed using an airgun or pole method developed by Mads Peter Heide-Jorgensen and Mikkel Jensen. Location data were collected using the ARGOS system (Harris et al. 1990). Location qualities provided by ARGOS included B, A, 0, 1, 2, and 3 with 3 representing the highest quality and most accurate position. To determine which locations to use for analyses we used Bayesian state-space models to estimate the true locations (Jonsen 2005). In effect, the true location is treated as an unknown variable and can be statistically estimated. This technique has the advantage of being able to use all locations and the resulting track is generally more accurate than what filtering methods provide. Where possible, we also used Jonsen's (2005) model to estimate the state-space of the whale. States included movements consistent with feeding, migration, or intermediate state (i.e., an uncertain state). For sea ice data we used Moderate-resolution Imaging Spectroradiometer (MODIS) imagery available through the National Snow and Ice Data Center.



Figure 1. Track of bowhead whale #60010 during eastward spring migration through 90-100% sea ice cover.



Figure 2. Entire track of bowhead whale #60010 showing migration route and feeding areas.



Figure 3. Tracks and locations of three bowhead whales (#60010, #60009, and #42522) in fall showing routes across to Russia and feeding areas along the Chukotka Peninsula.

**RESULTS:** Bowhead #60010 was tagged near Barrow on 12 May 2006 and arrived in ice-covered Amundsen Gulf, Canada, 14 days later, (Fig. 1). A major east-west lead system visible from ice imagery was not used as a migration route and the whale traveled northeast beyond the lead to ~72 degrees North latitude before turning east to travel 1,100 km at ~78 km/day through 90-100% ice cover.

The whale remained in Amundsen Gulf for 68 days where its low swim speed and large turning angles indicated that he was likely feeding (Fig. 2). High swim speeds and small turning angles indicate that this whale transitioned into a 'migratory state' and traveled to the north end of Banks Island and returned (Fig. 2). This whale left Amundsen Gulf on 15 September and spent 17 days in the vicinity of a 2D seismic operation near Tuktoyaktuk, Canada (Fig. 3; see Citta et al. poster, this session) prior to migrating westward on 3 October. The whale passed Point Barrow 11 days later on 14 October, after covering 1,191 km in 270 hours. Although the whale averaged 4.41 km/hr during this time, the maximum sustained speed was 10.9 km/hr between Kaktovik and Barrow. After leaving Barrow this whale crossed the Chukchi Sea at approximately latitude 71 ° N and spent time along the Chukotka coast near Vankarem before following the coast southward.

Two other whales tagged at Barrow while feeding there in the fall also spent time along the Chukotka coast (Fig. 4).

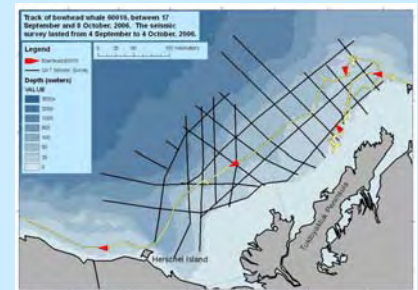


Figure 4. Map of seismic survey lines and track of feeding bowhead in Canada near Tuktoyaktuk.

## CONCLUSIONS:

- 1) Bowhead whales can migrate 78 km/day through 90-100% ice cover and do not appear to require major lead systems.
- 2) Likely feeding areas include Amundsen Gulf and Tuktoyaktuk in Canada, Barrow in Alaska, and the northern coastline of the Chukotka Peninsula in Russia.

Other maps and information about this project can be viewed at:  
<http://www.wildlife.alaska.gov/index.cfm?adfg=marinemammals.bowhead>.

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