
# Arctic Currents:
# A Year in the Life of a Bowhead Whale

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# Arctic Currents: A Year in the Life of the Bowhead Whale

A film production by the University of Alaska Museum of the North

## Project Overview

This project succeeded in the creation of a 25 minute 3D computer animated film, which tells the story of bowhead whale annual migration and their zooplankton prey. The purpose of the film is to build on the whale's story to demonstrate ecological connectivity and encourage public understanding of the marine ecosystem. Specific topics covered include: whale taxonomy, physiology, diet, behaviors, movement through subarctic and arctic waters, whale tagging and aerial observation programs, and collaboration with Inupiat whalers. Principle production and post-production services were carried out by the University of Alaska Museum of the North (UAMN) staff and University of Alaska Fairbanks (UAF) student employees. The visual elements of the film are centered on 3D photorealistic animations of whales, copepods, and krill in arctic waters; hemispheric-level interpretation of bowhead annual movement using satellite imagery; and orthogonal graphic imagery interpreting science dive data.

## Project Components

*Film Script*

The film draws its title and basic narrative from a 2013 calendar and teaching tool created by UAF oceanographer, Dr. Steve Okkonen, and colleagues. Early versions of the film narrative were reviewed by project scientists before being forwarded for visual design development. The draft then moved to a shooting-script format broken down by scene and driven by the visual story of the film. Two additional script reviews were completed by scientists and whaling captains as it moved to finalization in 2014.

*Representation of Human Characters*

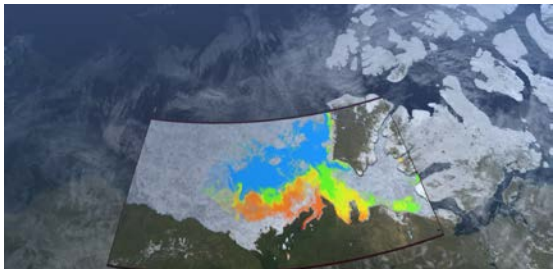
Shots in the film involving humans were rendered as animated paintings and then further graded and treated with both an artificial depth of field and a water effect to abstract the representation. This artistic choice enhances the film's focus on presenting a whale's perspective, with the added benefit of reducing costs.

**Example frame showing human animation.**

*Data Imaging and Graphic*

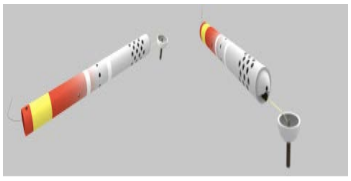
Hemispheric scale imaging of whale and krill position data (tagged and simulated) were

completed with final images ready for grading as the film was cut together. Pre-processed chlorophyll imagery was composited with the earth-view renders. Cladogram and mammalian age charts were generated as line-drawings of more than a dozen animals. Creative graphic illustrations of whale caloric intake included a clip using five gallon buckets and another featuring chocolate kisses swimming as a krill swarm. This last particular shot appears to be the most enjoyed by viewers. Laser scans of the museum's bowhead whale specimens were turned into a 3D model used to illustrate whale characteristics in the film.



**Example frame showing satellite data.**

Satellite imagery required for the film was available as predominantly MODIS imagery from the AQUA and TERRA satellites, with additional imagery from Landsat and bathymetry data converted to geoTIF. Data used included dive information from short duration tags, and seasonal maps and latitude/longitude data from bowhead whales tagged in 2011 and 2012.



**Whale tag schematic.**

*Representation of Whales*

Whale shots were the most expensive components of the film due to: (1) Difficulty of simulation, setup and rendering of ice and water, from both underwater and aerial perspectives, and (2) Effort involved in securing multiple, comprehensive reviews of whale animations. Whale images were reviewed by biologists and Inupiat whale experts from the villages of Barrow, Nome, Savoonga, and Gambell.

**Example frame showing whale animation.**

**Example frame showing whale from below.**

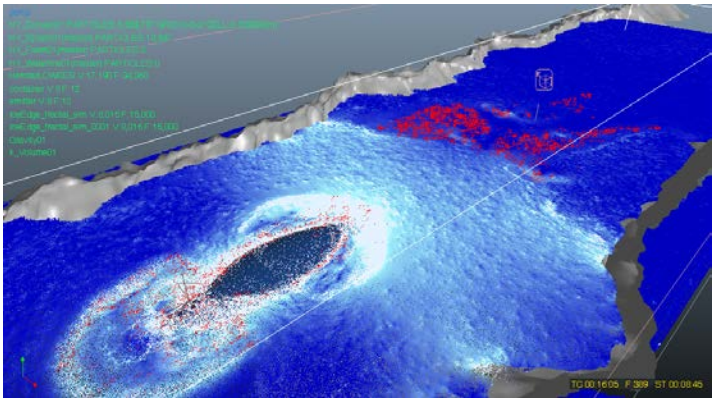
As in all films of this nature, an extensive catalogue of initial shots was required to ensure enough would be available to fit the script and film design, including shots that could be adapted for multiple contexts and camera angles. Shots with whale-water intersection largely fell under the classification of fluid simulations. These were the most highly technical to produce. For every shot that made it into the final film, there was another culled due poor quality.

*Representation of Krill and Copepod*

Krill, both as hero objects and in flocks, were animated and rendered for the film. In some shots, the animals are instanced to over 100,000 individuals. Krill appearances and textures were reviewed by partnering scientists. Copepods were modeled and rigged from scratch by the museum, and animations were reviewed by partner researchers to ensure models appropriately represented an arctic species.

**Example frame of copepod animation.**

*Fluid Simulations*



**Sample frame during fluid animation of whale breaking the water surface in transit.**

Fluid simulations were the most technically difficult part of the film and presented the largest number of issues with software, re-simulating, and memory management. A single 15 second fluid simulation shot might require over 500GB of hard-drive space for the particle field data, and 16-32GB of RAM during processing and rendering. A significant amount of time was spent honing the process on the initial fluid simulations.

*Languages and Sound*

Following two rounds of temporary (scratch) recordings of the narrative in English, a Gambell resident recorded the final track in English and St. Lawrence Island Yupik. Barrow residents translated the film into Inupiaq and provided a second English audio track for use in the final sound mix.

Early in production, it became apparent that capturing live whale recordings was cost prohibitive, so the film contains no in situ sound recordings except for hydrophone recordings. Music for the film was produced by UAMN.

**Making hydrophone recordings.**

*Text/Annotations*

The annotation of the film was originally conceived as an informal, non-font based style that

could also be animated. While animated text was not achieved (to quell excess motion in the frame), we did retain hand-written text in the final film product.

**Production Timeline**

Minor changes to the timeline took place throughout the production. Narrative writing took a month longer than expected so the subsequent storyboarding process was shortened. Additional time was also needed for the rendering and review of graphic elements, to finalize edits to the narration, and to record the translations.

**Film Premiere and Release**

The film premiered at the October 2014 Alaska Federation of Natives meeting in Anchorage, Alaska, and at the University of Alaska Museum of the North, in Fairbanks, Alaska, in January 2015. The film is being shown daily in UAMN auditorium and the Alaska SeaLife Center in Seward plans to show the film in their gallery. The Inupiaq version of the film was premiered in spring 2015 for Kaktovik residents visiting the UAMN archaeology collection.

The film, in all three languages, was uploaded to YouTube in January 2015 and iTunesU in February 2015. After two months online, the film was the 3rd most downloaded video on the UAMN YouTube account with over 2,400 downloads across all three languages. It was also 5$^{th}$ on a YouTube search for bowhead whale videos, despite being new to the Internet and having significantly less overall views than videos being online for years.

A run of 300 DVDs of the film, with all three language tracks was designed and printed in February of 2015. The first 200 DVDs were distributed among project partners and villages, Marine Advisory Program agents, and contributing researchers and whale experts in Alaska and the lower 48 states.

**Outreach**

The project team was involved in significant community outreach during the making of the film. UAMN Head of Production, Roger Topp, traveled to Barrow in April 2013 to speak with scientists and hunters during the spring whaling season. Informal presentations of animations in progress were made to many individuals, resulting in the further sharing of audio and video footage of ice and whales by both the scientists and whalers.

**Visiting Barrow for outreach.**

**Visiting Barrow during whaling.**

Lead Animator, Hannah Foss, traveled to Barrow during spring whaling in 2014 and during the Bowhead Whaling Commission meeting that fall. She also visited Nome,

Savoonga, and Gambell in late fall of 2014. Drafts of the film were presented at each location and positively received by the communities. Community input included comments on whale movement and activities that improved revisions of the film. Some community ideas could not be accommodated in revisions including adding a discussion of whale "footprints," and script changes for deeper exploration of Inupiaq and St. Lawrence Island culture.

Annual project updates were delivered in Fairbanks (2112, 2013) and Anchorage (2015). The film was shown in English and St. Lawrence Island Yupik at the Alaska Marine Science Symposium in Anchorage in 2015.

**2015 AMSS Presentation**

Ongoing outreach includes a blog chronicling the making of the film. By spring 2015, the blog had been viewed nearly 8000 times by over 3,900 unique visitors. The blog's address is http://arcticcurrents.wordpress.com

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**((L to R) Chris Koonooka, Fannie Akpik, Hannah Foss, Roger Topp, Kelsey Gobroski**

## The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

## The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.