



## Pacific Walrus Response to Arctic Sea Ice Losses

*Sea ice plays an important role in the life of the Pacific walrus (*Odobenus rosmarus divergens*). U.S. Geological Survey (USGS) scientists are seeking to understand how losses of sea ice during summer over important foraging grounds in the Chukchi Sea will affect walrus. USGS scientists recently modified a remotely deployed satellite radio-tag that will aid in studying walrus foraging habitats and behaviors. Information from the tags will help USGS understand how walrus are responding to their changing environment.*

### Walrus and Their Environment

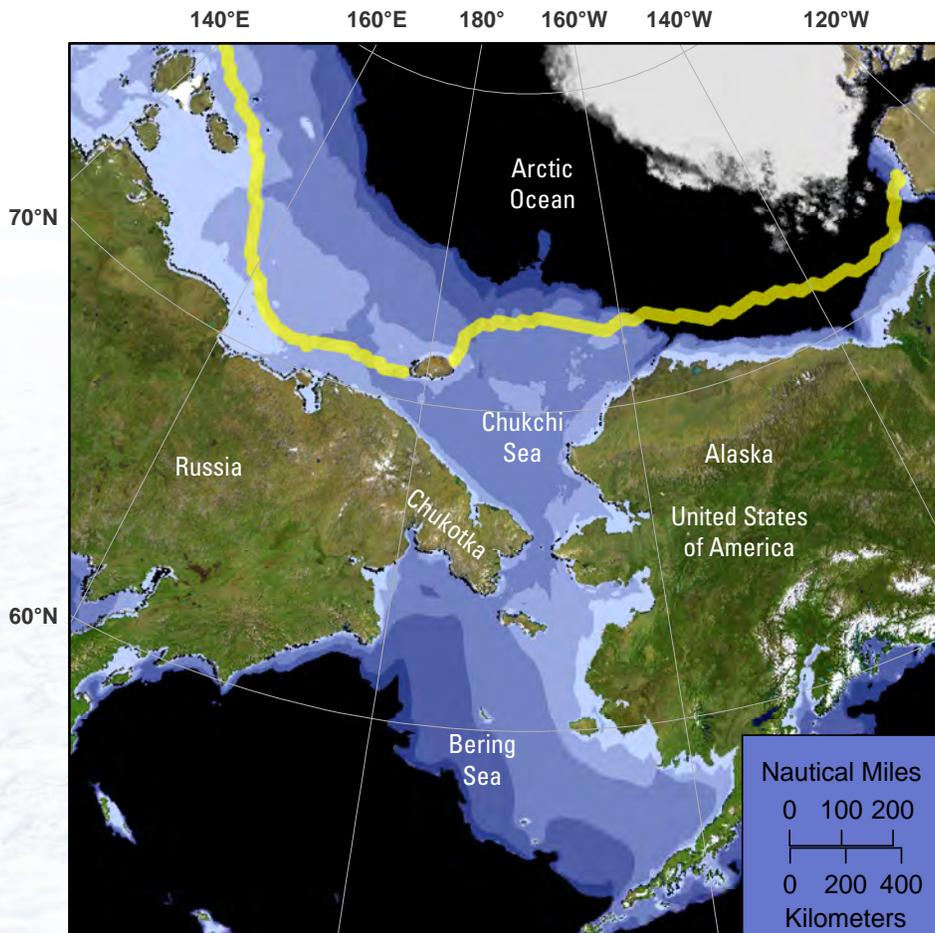
The Pacific walrus is a large pinniped, resident in the Bering and Chukchi Seas of Russia and Alaska, and is one of four marine mammal species managed by the U.S. Department of the Interior. Walrus feed on clams and a wide variety of other invertebrates from the seafloor. They rest between feeding trips on sea ice or land. Sea ice provides walrus with a resting platform, access to offshore feeding areas, and seclusion from humans and predators. The constant motion of sea ice transports resting walrus over widely dispersed prey patches. In winter, Pacific walrus live amid the dynamic sea ice in the Bering Sea. In spring, as the ice edge recedes northward and into

the Chukchi Sea, most adult males shift to using land to rest between feeding trips, while adult females and young remain with the sea ice (Fay, 1974; 1985).

Walrus can have a large effect on their prey and play an important role in the Arctic ecosystem by influencing the structure of benthic invertebrate communities. They can eat more than 50 clams during a single 7-minute dive to the seafloor and consume 35–50 kilograms (77–110 pounds) of food per day. Pregnant and nursing walrus consume even more food (Fay, 1985; Born and others, 2003). As walrus root along the seafloor in search of food, they plow through large quantities of sediment (Nelson and Johnson, 1987; Nelson and others, 1994). They remove large quantities of prey from the seafloor, affect the size structure of clam populations, mix bottom sediments while foraging, create new microhabitats from discarded shells, and generate food for seafloor scavengers from uneaten scraps of prey (Oliver and others, 1983).

**Mother and juvenile Pacific walrus.**





Base Map: September 2007 sea ice extent from NASA passive microwave imagery (12.5 kilometer resolution) processed by University of Bremen. Historical sea ice edge derived from median sea ice extent from 1979–2000 National Snow and Ice Data Center. Bathymetry from International Bathymetric Chart of the Arctic Ocean.

## EXPLANATION

In summer, a major segment of the Pacific walrus population, especially females and their young, ranges in waters across the continental shelf of the Chukchi Sea (light blue shades). By September 2007, the sea ice (upper right) was far north of the continental shelf and over the deep Arctic Basin. Historically, the annual sea ice minimum edge (yellow line) occurred over the continental shelf.

Although walrus are capable of deep diving (greater than 250 meters [Born and others, 2005]), they usually feed in waters less than 80 meters deep over the continental shelf where their prey are more abundant and easier to obtain than in deeper waters (Fay and Burns, 1988; Jay and others, 2001).

### A Changing Sea Ice Environment

The extent of Arctic summer sea ice has decreased sharply over the past several decades (Stroeve and others, 2007). Sea ice is more frequently disappearing from the continental shelf of the Chukchi Sea during summer months. In 6 of the last 9 years, the Chukchi Sea shelf was ice-free—with periods of no ice cover extending from 1 week to as much as 2.5 months. In contrast, there was always some ice over the Chukchi Sea shelf in all of the previous 20 years (1979–98) (passive microwave satellite imagery; Cavalieri and others, 1996 [2006]).

When the sea ice recedes over the deep ocean basin, walrus must either continue to haul out on the sea ice with little access to food, or abandon the sea ice and move to coastal areas where they can rest on land. During the record minimum sea ice extent in summer 2007 (National Snow and Ice Data Center, [http://nsidc.org/news/press/2007\\_seaiceminimum/20071001\\_pressrelease.html](http://nsidc.org/news/press/2007_seaiceminimum/20071001_pressrelease.html)), the Chukchi Sea

shelf contained little to no ice for about 80 days and several thousand walrus hauled out on previously unused shores of northwestern Alaska (Joel Garlich-Miller, U.S. Fish and Wildlife Service, oral commun., 2007).

During autumn 2007, tens of thousands female and young walrus began using resting areas along the northern coast of Chukotka, after sea ice was no longer available. There, a few thousand mortalities were reported, apparently from trampling due to disturbances that caused adults to stampede into the water (Anatoly Kochnev, ChukotTINRO, oral commun., 2007).

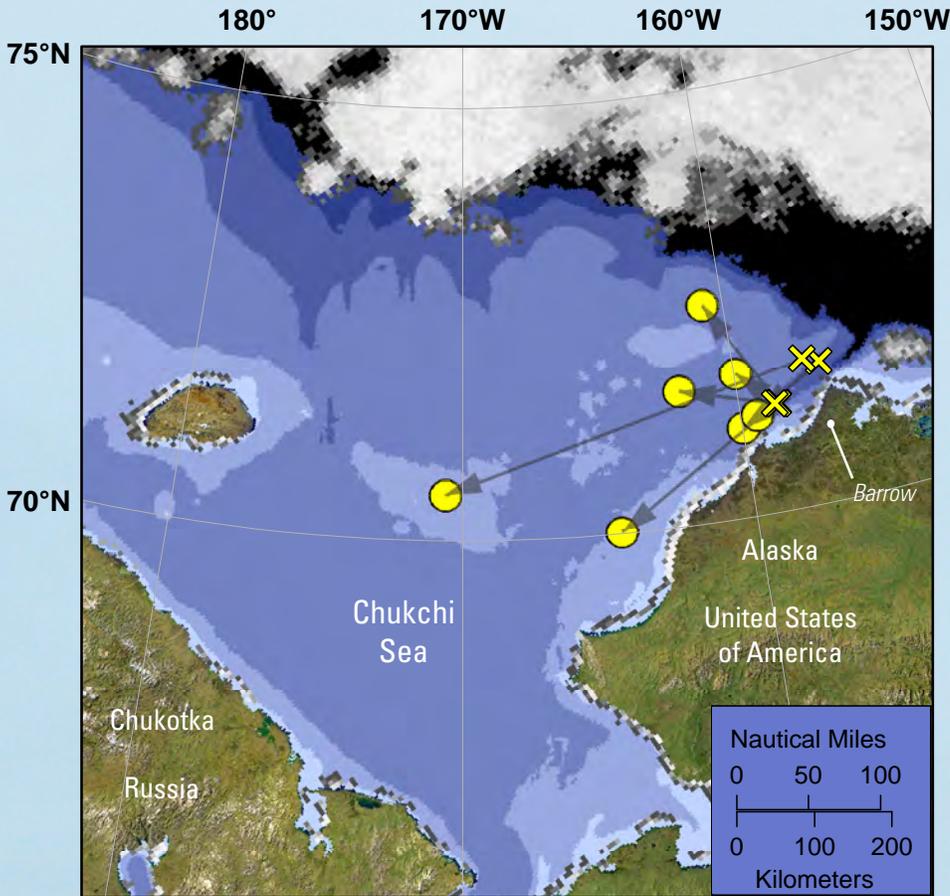
As more walrus haul out on land instead of sea ice, nearshore prey populations will be subjected to greater predation pressure. Today, it is unknown whether more concentrated foraging by walrus will change or deplete nearshore prey communities, or if walrus energetics will be affected if prey do become less abundant. A better understanding of walrus movement and foraging patterns is necessary to appreciate the ways in which decreasing availability of sea ice may affect walrus and the prey upon which they depend. This understanding will provide policy makers and regulatory agencies with information needed to address emerging issues related to climate change, such as new transoceanic shipping opportunities and increased resource development in the Arctic.

## Insights from Tracking Walrus with Satellite Tags

To begin to understand where walrus go when the ice edge retreats off the continental shelf and over deep waters of the Arctic Basin, USGS researchers attached satellite radio-tags to walrus in the eastern Chukchi Sea. To avoid the difficult task of capturing walrus on sea ice, USGS developed a tagging system that uses a crossbow to deploy the radio-tags (Jay and others, 2006). Radio-tags were attached to nine walrus offshore of Barrow, Alaska, in June–July 2007, while the ice edge was still over the continental shelf. The tracking data showed that walrus rested on remnant ice floes that remained over the shallow waters of the eastern Chukchi Sea as the main ice edge retreated over deeper water. These observations suggest that walrus will exploit sparse ice to maintain access to preferred foraging areas over the continental shelf.



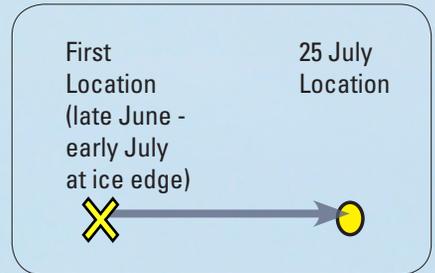
Pacific walrus with satellite radio-tag.



Base map: 25 July 2007 ice extent. Source of sea ice extent and bathymetry data same as described in previous sea ice map.

### EXPLANATION

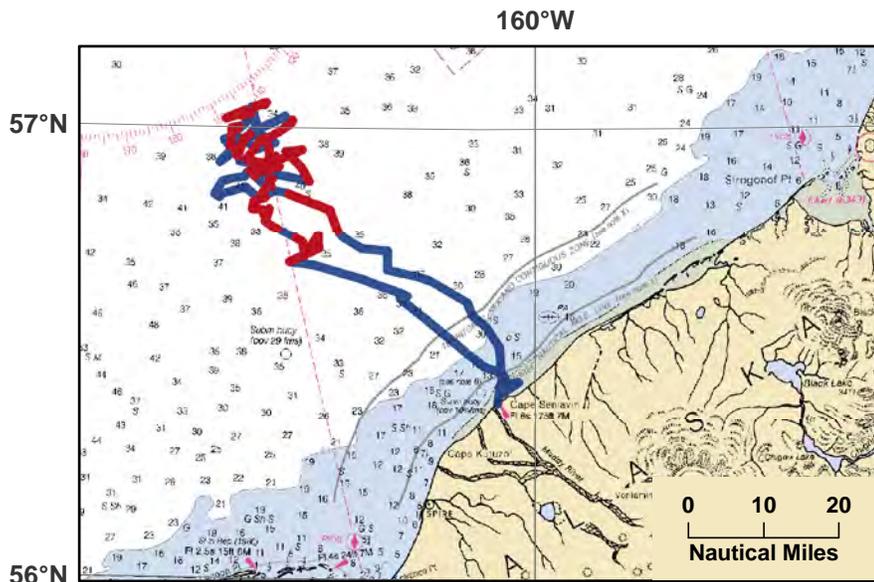
Seven walrus tracked with satellite radio-tags during June–July of 2007 remained over the continental shelf, far south of the pack ice.



## New Satellite Radio-Tags Identify Walrus Foraging Behaviors and Distribution

USGS researchers developed a new satellite radio-tag to record when walrus were feeding or not feeding. Data from these tags will allow researchers to identify foraging areas and compare activity budgets of walrus foraging from shore in ice-free conditions and walrus foraging from ice in offshore habitats. A prototype of the foraging-tag was deployed on a male walrus in the southeastern Bering Sea in September 2007,

and yielded a continuous chronology of hourly foraging status for almost 2 weeks. The movement patterns and habitats used by this walrus were consistent with findings from previous studies of walrus in this region. The foraging-tag promises to be an important tool for identifying when and where walrus forage under different sea ice conditions. This information will be critical for managing the expansion of offshore resource development activities and for understanding the consequences of summer sea ice loss due to climate change.



### EXPLANATION

An 8-day foraging trip of an adult male walrus in the southeastern Bering Sea, tracked with the new satellite radio-tag. The walrus left the haulout and traveled more than 25 nautical miles to the northwest and foraged in waters 50 to 100 meters deep.



Base map: NOAA Chart No. 16011  
Soundings in fathoms

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