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Russian–American Long-term Census of the Arctic

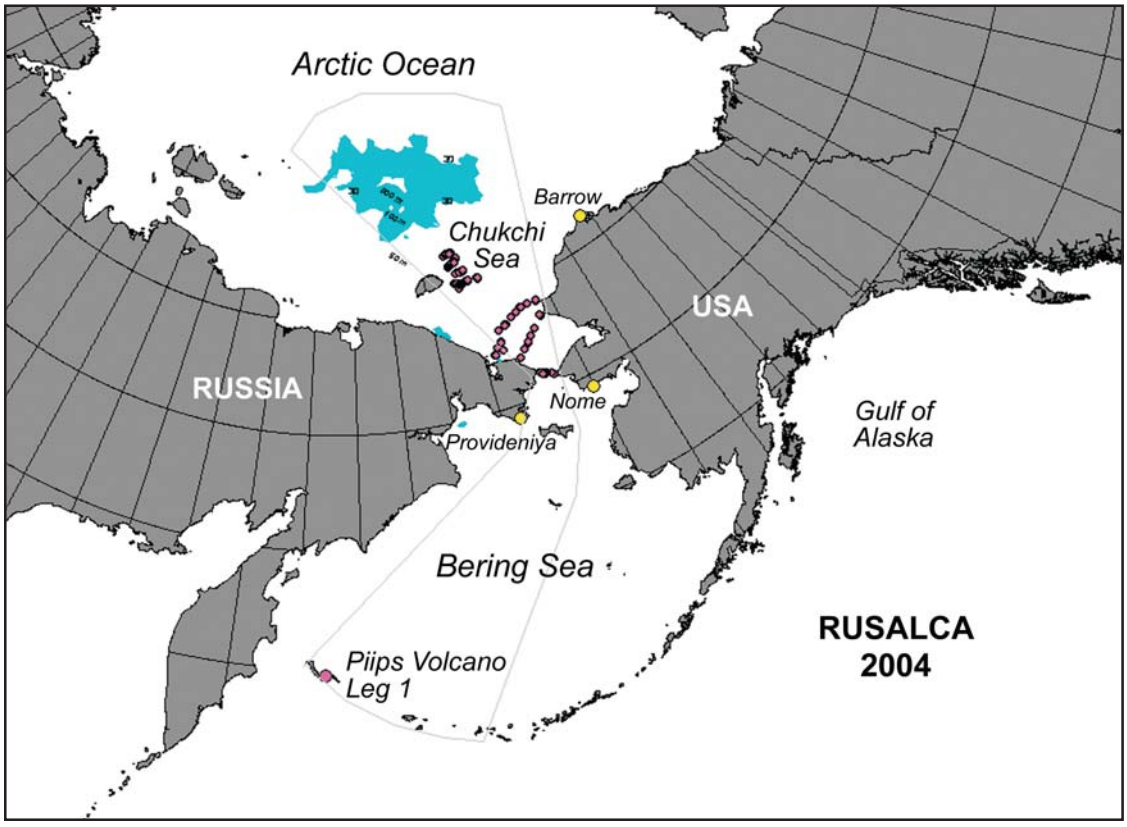
Initial Expedition to the Bering and Chukchi Seas

This article was prepared by Kathleen Crane, of NOAA's Arctic Research Office.

July 23, 2004, marked a historic day in Arctic research and exploration, as well as in Russian–U.S. relations. On this date the Russian research ship the *Professor Khromov* left Vladivostok, Russia, packed with U.S.- and Russian-funded scientists to begin a 45-day collaborative journey of exploration and research in the Arctic.

Stemming from a 2003 Memorandum of Understanding for World Ocean and Polar Regions Studies between NOAA and the Russian Academy of Sciences, this cruise was the first activity under the Russian–American Long-term Census of the Arctic (RUSALCA). RUSALCA means "mermaid" in Russian. In November 2003 a RUSALCA planning workshop was held in Moscow to outline the biological, geological, chemical, and physical oceanographic sampling strategies to be pursued in the Bering Strait and Chukchi Sea.

This initial cruise was a collaborative U.S.–Russian Federation oceanographic expedition to the Arctic seas regions shared by both countries: the Bering and Chukchi Seas. These seas and the life within are thought to be particularly sensitive to global climate change because they are centers where steep thermohaline and nutrient gradients in the ocean coincide with steep thermal gradients in the atmosphere. The Bering Strait acts as the only Pacific gateway into and out of the Arctic Ocean and as such is critical for the flux of heat between the Arctic and the rest of the world.



Stations undertaken during the voyage of the Professor Khromov, *a Russian research vessel engaged in the RUSALCA expedition. The colored area in the Arctic Ocean indicates a region of enhanced ice melting between 1970 and 2001.*

Vice-Admiral Lautenbacher (NOAA) and Vice-President Laverov (RAS) signing the Memorandum of Understanding between NOAA and the Russian Academy of Sciences.

Monitoring the flux of fresh and salt water and establishing benchmark information about the distribution and migration patterns of the life in these seas are also critical tasks that must be completed prior to the placement of a climate-monitoring network in this region.

The cruise was divided into two legs, which included sampling and instrument deployment in U.S. and Russian territorial waters. The cruise objectives were to support the U.S. interagency Study of Environmental Arctic Change (SEARCH) program and the NOAA Ocean Exploration Program.

Many Russian Federation agencies participated in the planning and execution of the RUSALCA 2004 mission. These included the Ministry of Defense, Roshydromet, the Ministry of Natural Resources, the Ministry of Science, and the Russian Academy of Sciences, the initial partner of NOAA. Group "Alliance," a private company registered in Moscow, Russia, facilitated the international agency support.

Dirty ice near Herald Island, as seen from the Khromov. *Arctic scientists are continuously finding new and interesting, sometimes even alarming, information about changes in the sea ice over time.*

Leg 1: Piips Volcano

The first leg was in the Bering Sea, with the ship leaving Vladivostok, Russia, on July 23 and arriving in Nome, Alaska, on August 6. The U.S. chief scientist was Kevin R. Wood, of NOAA's Pacific Marine Environmental Laboratory. The chief of the expedition was Captain Vladimir Smolin, of the Ministry of Defense, Russian Federation.

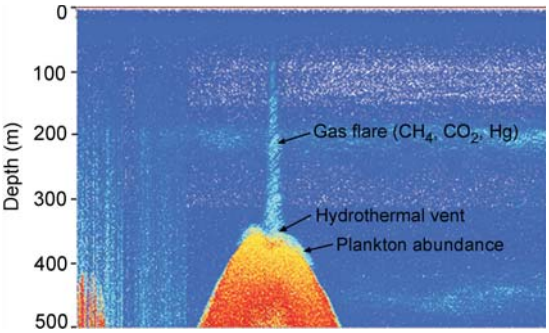
Bordering the Bering Sea at its southern terminus with the Pacific Ocean is the Aleutian Volcanic Arc. Waters entering and exiting the Bering Sea from and to the Pacific Ocean transit through this arc and are most likely chemically and dynamically modified by their interaction with the intense hydrothermal activity resulting from the mid-water volcanoes. Quantifying the flux from this relatively shallow volcanic arc and its influence on the waters and atmosphere above are important factors when considering the relationship between earth processes, the ocean, and greenhouse gas exchanges.

Russian Federation scientists have explored this region in the past. However, this was the first opportunity for scientists from the U.S. and Russia to work together to map the volcanic features and search for fluxes of methane, mercury, and other hydrothermal fluids and gases.

The first leg of the RUSALCA expedition focused on the hydrothermal activity and related geological and biological processes associated with the Piips volcano, which lies at a depth of 300 m in the southern part of the Komandorskaya depression of the western Aleutian Arc.

Russian marine geologists discovered the Piips hydrothermal field in 1987. Temperatures of up to 130°C were measured, and hydrothermal deposits composed of sulfates, carbonates, amorphous silica, and other materials were discovered. In addition, large fields of bacterial mats and numer-

Starfish from the Russian waters of the Bering Strait.

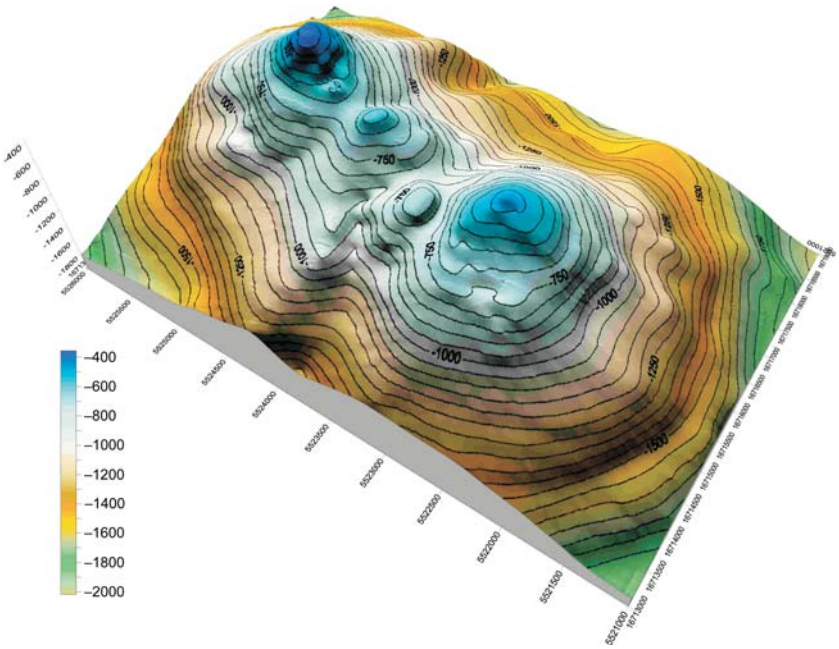


Gas plume venting from the Piips volcano .

ous hydrothermal fauna were detected. However, very little is known about the influence of hydrothermal activity on the regional biochemical and physical environment of the neighboring ocean.

During the RUSALCA expedition, the combined Russian side-looking sonar–CTD–methane sensors were lowered over the volcano. However, upon retrieval after the second launch, the sonar was lost at sea. Atmospheric monitoring of mercury along this leg from Vladivostok revealed high concentrations near the Asian coastline and again over the volcano. Because of the relatively shallow depth of the volcano, the data suggest that mercury is released to the water column and the atmosphere above as a result of vigorous hydrothermal activity at this site.

Bathymetry of the Piips volcano.

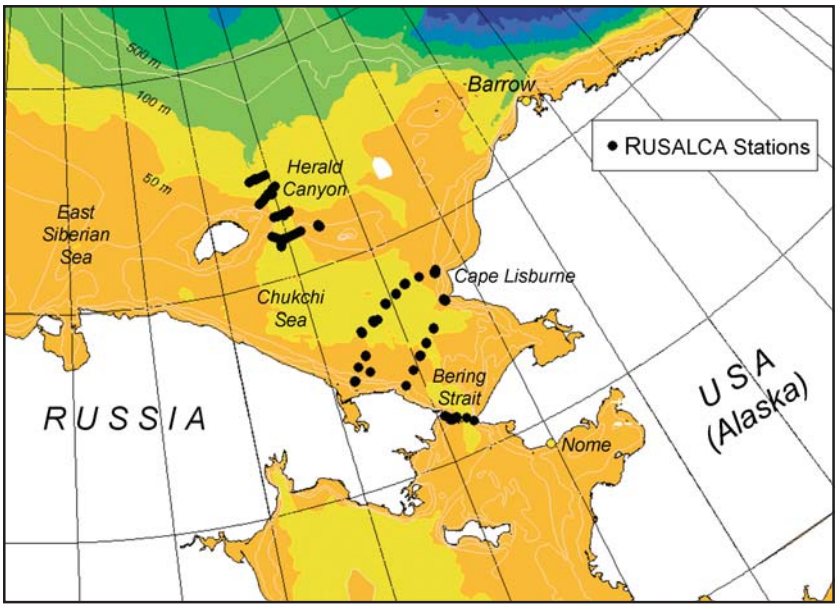


Leg 2: Bering Strait through the Herald Canyon

The second leg was in the Chukchi Sea, leaving Nome, Alaska, on August 8 and returning to Nome on August 24. The U.S. chief scientist was Dr. Terry Whitledge, of the University of Alaska. The chief of the expedition was Captain Vladimir Smolin, of the Ministry of Defense, Russian Federation.

Because of the reduction of ice cover in the Arctic and the possibility of permanent loss of the seasonal ice cover in the Chukchi Sea study region as shown by climate models, it is thought that this area might be subject to significant ecosystem change. A program of ecosystem-oriented exploration was planned for Leg 2 of the RUSALCA expedition to provide a foundation for detecting future ecosystem indicators of climate change.

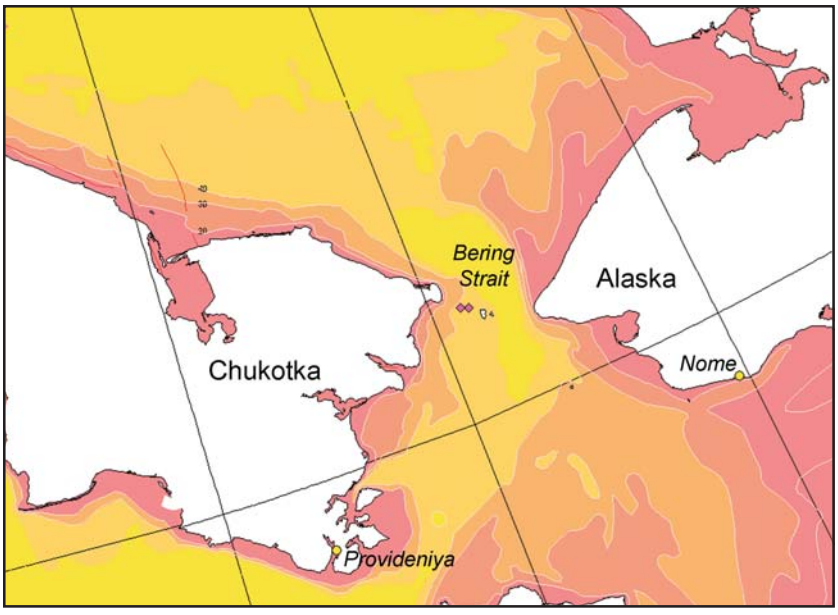
Twelve scientific programs examined benthic processes, a census of Arctic zooplankton, biodiversity of adult and juvenile fish, nutrient and primary productivity, marine chemistry, physical oceanography, microbial reactions and fluxes, side-looking sonar and video imagery of the seafloor, paleoceanography, and atmospheric contaminants. The primary study area lay between Wrangel Island and Herald Canyon in Russia Federation territorial waters to Cape Lisburne in Alaska to Point Barrow and south to the Bering Strait. A series of hydrographic transects were taken to allow sampling of all water masses during this summer period. A high priority of the hydrographic survey was to collect samples across the Bering



RUSALCA Leg 2 station locations.

Strait in support of the Russian and American moorings in the western Bering Strait, to collect a series of high-speed CTD transects across Herald Canyon, and to enhance the knowledge of faunal distributions for the Arctic census of marine life. The long-term goal in this region is to obtain continuous and comprehensive monitoring within the Bering Strait for several years, which will require routine access to the eastern and western portions of the study area for scientific operations.

High-density CTD stations also examined the role, rates, and rhythms of Pacific water transport through the Herald Canyon and analyzed the dispersion of this water into the greater high Arctic beyond. Until recently the transport pathways of water into and out of this region have been only poorly mapped. The degree to which these waters mix with newly invasive Atlantic waters over the Chukchi Plateau and the Mendeleev and Canada Basins is also not well known. Understanding these physical pathways and the consequent nutrient pathways is critical for mapping the distribution of biota and its migration routes through this region of the Arctic.



RUSALCA mooring locations in the western Bering Strait.

Leg 2 resulted in the following:

- 77 CTD and nutrient casts;
- Two moorings (both Russian and U.S.) placed in the western waters of the Bering Strait;
- 87 phytoplankton samples;
- A comprehensive survey and census of zooplankton species at 33 stations in the Bering Strait through the central Chukchi Sea;
- Benthic grabs at 11 stations;
- Benthic epifauna sampled at 17 stations;
- Larval and juvenile fish collected at 17 sites;
- 31 species of fish sampled;
- 27 trawls for adult fish, collecting 24 species; and
- Eleven remotely operated video lowerings from the Bering Strait into the Herald Canyon.

During Leg 2, the hydrographic, biochemical, and productivity sampling was integrated from all stations sampled, and the data from U.S. and Russian collaborators will be combined for the joint assessment of climate change, water mass properties, and a census of marine life in the Arctic.

Future Programs

The RUSALCA program anticipates returning annually to the Bering Strait to service the two Russian–American moorings left at their sites in the western part of the strait in 2004. Negotiations are developing to use a Russian Navy hydrographic research vessel to carry out the Bering Strait operations in 2005–2007.

NOAA anticipates that it will expand the breadth and range of the RUSALCA program during the International Polar Year if funding permits. Efforts are underway to design ship-based traverses from the Chukchi and East Siberian Sea shelves north into the deeper Makharov Basin to investigate ecosystem indicators of climate change, examine the physical and chemical properties of the ocean in the region where the greatest amount of thawing of Arctic sea ice has taken place, and carry out a census of marine life in this poorly explored and mapped region.