

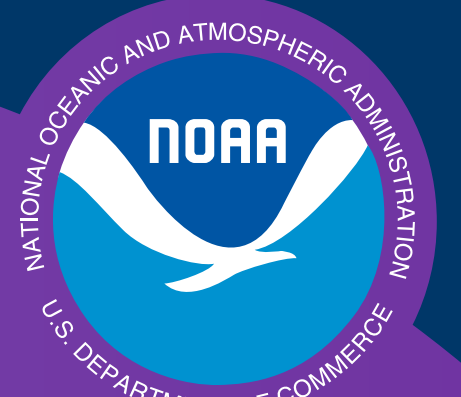
Chukchi and East Siberian Surveys (ChESS)

Joint U.S.-Russian Aerial Surveys for Ice-associated Seals and Polar Bears, 2016

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Introduction

Bearded seals, ringed seals, and polar bears are key components of Arctic marine ecosystems and important cultural and subsistence resources for northern coastal Alaska Native communities. Although these animals are protected under the Marine Mammal Protection Act (MMPA) and polar bears and ringed seals are listed as threatened under the Endangered Species Act (ESA), no current comprehensive abundance estimates are available for these species. Obtaining reliable abundance estimates is vital for developing sound plans for management, conservation, and responses to potential environmental impacts of oil and gas activities and climate change. The Chukchi and East Siberian Surveys (ChESS) project addresses the most critical need for fundamental assessment data on polar bears and ice-associated seals (also known as ice seals) through a cooperative effort with Russian researchers and the US Fish and Wildlife Service.

The best way to estimate the abundances of ice seals is to conduct aerial photographic and sightings surveys during the reproductive and molting period when the greatest proportions of the populations are hauled out on the ice and are available to be seen. The distributions of these animals are broad and patchy and so surveys must cover large areas. Similarly, the extent, locations, and conditions of the sea ice habitat change so rapidly that any surveys must be conducted in a relatively short period of time. The expense and logistic complexity of these surveys have been the primary impediments to acquisition of comprehensive and reliable estimates.

Survey Effort

Two rounds of surveys are required based on the availability of each seal species. The first round of surveys will focus on bearded seals and polar bears and are planned for April and early May, before the population of bearded seals breeding in the Bering Sea move north as the sea ice retreats. Preliminary analysis suggests that 11,760 km of track line will achieve target precision levels for bearded seals (CV<0.2) while achieving less precise (CV 0.28-0.35) but potentially useful estimates for polar bears (Conn et al. 2016). A second round of surveys focused on ringed seals is planned for late May and early June and is expected to have high precision (CV<0.15).

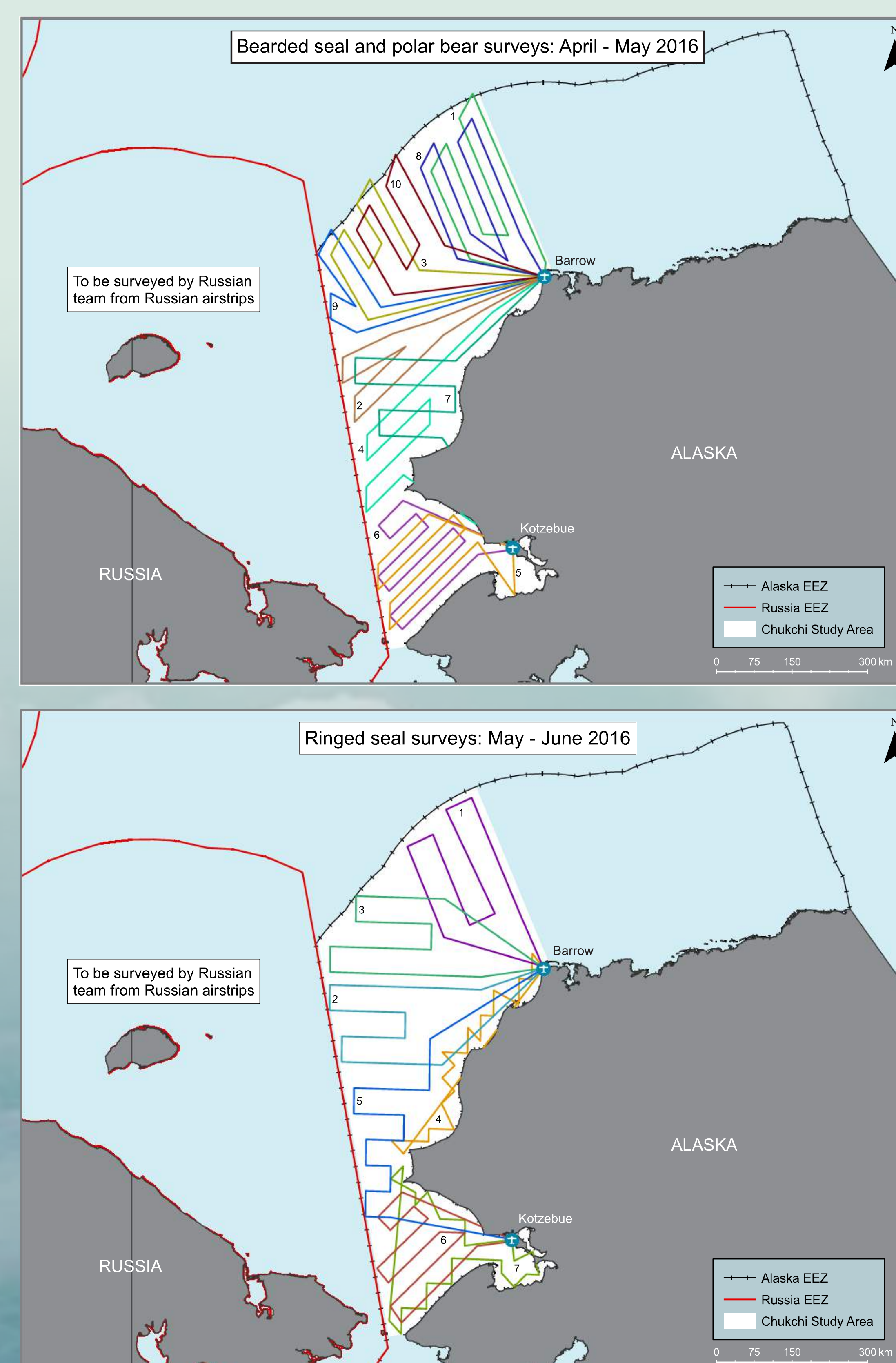


Figure 2. Example track lines for the eastern Chukchi Sea surveys for bearded seals and polar bears (above) and ringed seals (below).

Abundance Estimation

Analyzing abundance from thermal video and digital photography presents several statistical challenges due to incomplete detection, false positives, and species misidentification. Novel statistical approaches have been developed to deal with these challenges. The process involves running a spatial model in the background describing how animal abundance varies over the survey area, while actual counts are a function of a number of additional factors including random variability and incomplete detection. A temporal dimension is built on this hierarchical modeling framework to account for changing sea ice conditions that occur within our survey period. The final step will be to incorporate data collected by our Russian collaborators to ultimately provide the most comprehensive estimates of abundance for polar bears, bearded and ringed seals in the Chukchi and East Siberian Seas.

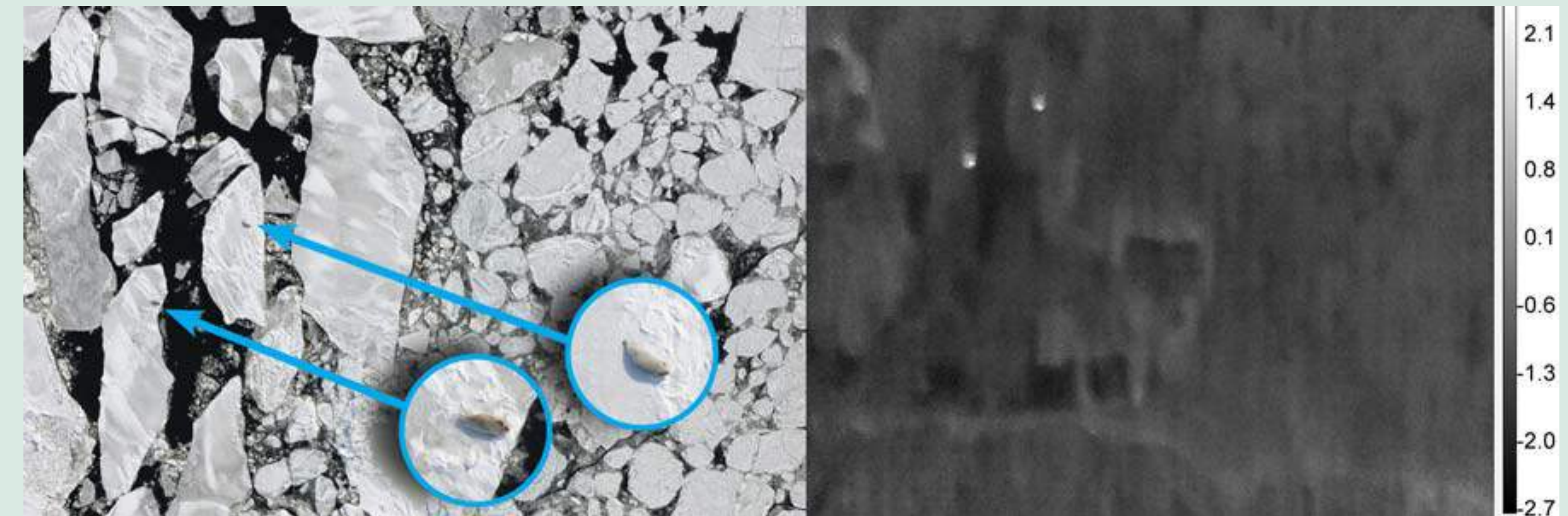


Figure 1. Example of two adult bearded seals detected using thermal imagery.

Advanced thermal-imaging technology will be used to detect the warm bodies of seals and polar bears against the background of the cold sea ice (Figure 1). High-resolution digital color images will be used to identify the species detected by the thermal imagers. Custom software will analyze the thermal data stream in real-time to detect “hot spots” on the ice. The software will collect both thermal and color imagery of each hot spot and log the GPS location for each sighting. Observers will review the color images to determine if the hot spot was caused by an animal or thermal anomaly (melt pool, dirty ice, etc) and identify species for each sighting. Additional imagery will be collected at a set interval to enable detection rate estimation.

The U.S. surveys will be conducted using machine vision cameras and thermal imagers mounted in the belly port of a King Air, fixed-wing aircraft from April to June 2016. Flights will originate from airports in Kotzebue and Barrow, Alaska (Figure 2). The target survey altitude is 300 m (1000 ft) to maximize the area surveyed while maintaining the target imaging resolution (2 cm/pixel) and minimizing the chance of disturbance to bears, seals other wildlife, and hunters. Three thermal imagers (FLIR SC6751) will record data in the 7.5-9.5 μm wavelength. Each thermal imager will be paired with a Prosilica GT6600c machine vision, 29 megapixel, color camera fitted with a 100 mm Zeiss lens. All six instruments will be mounted in an open-air belly port. The combined swath width will be approximately 470 m (1,500 ft).

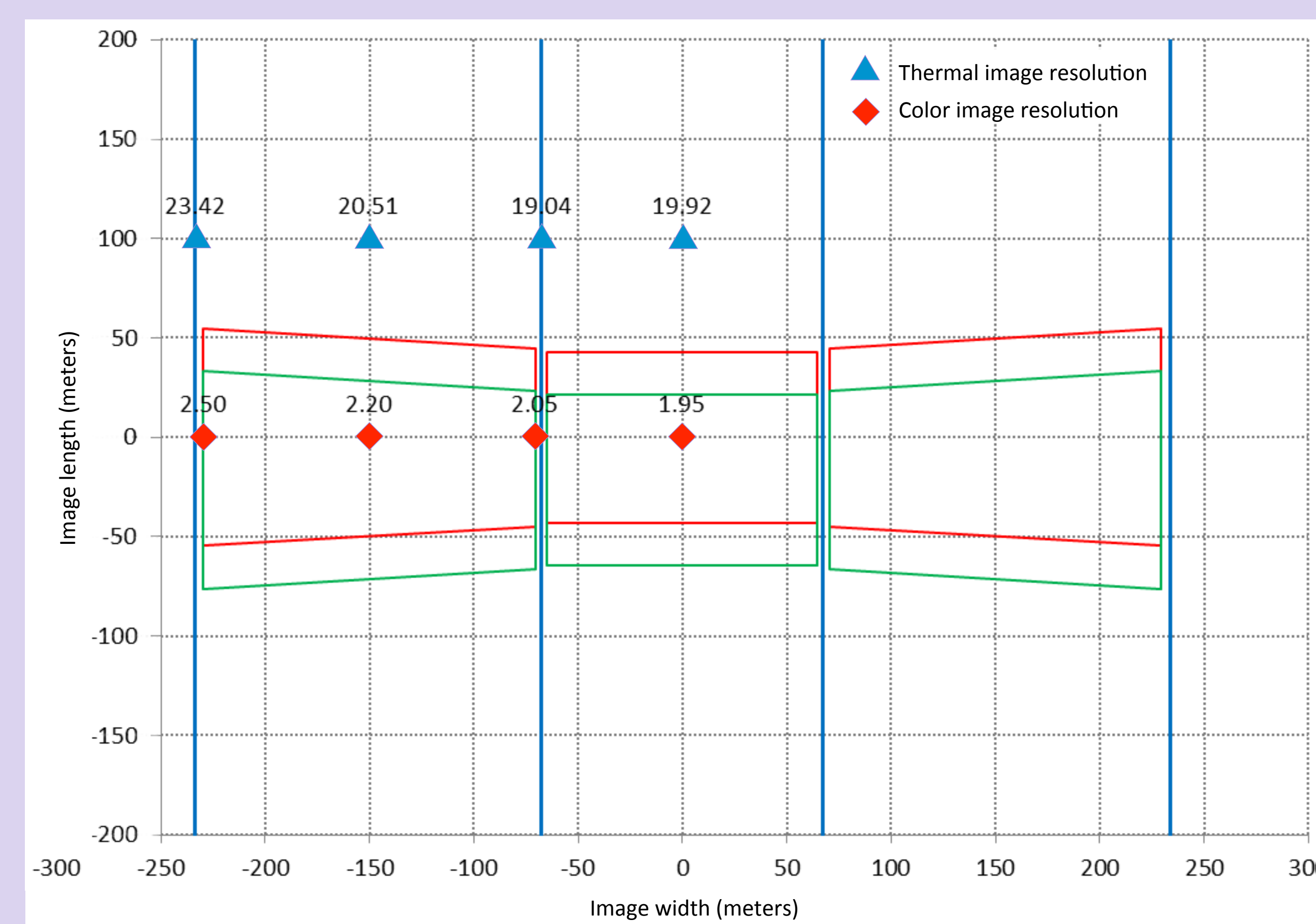
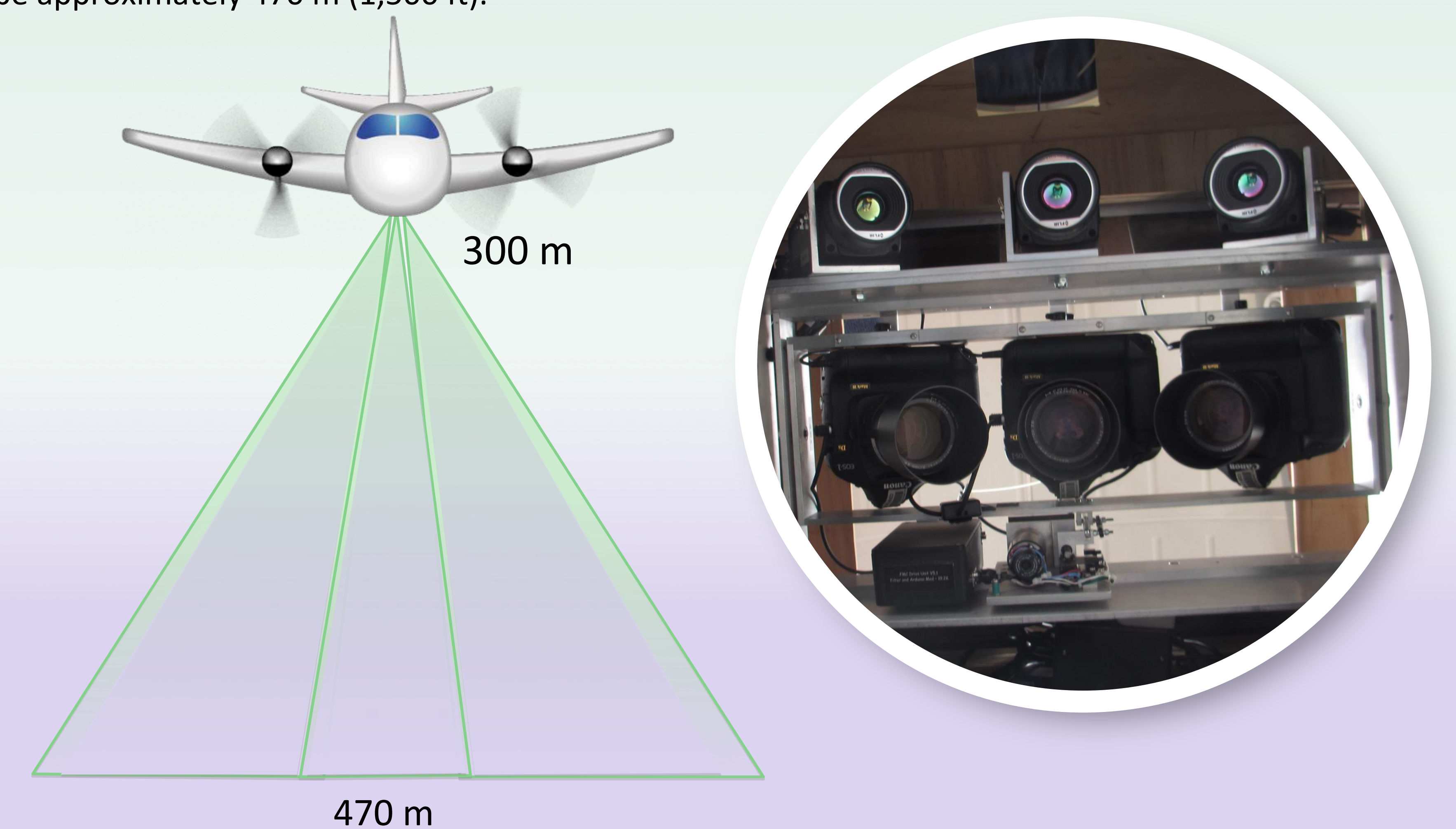


Figure 3. Projected footprint and calculated resolution (cm/pixel) of the three sets of paired cameras at target altitude (300 meters). The blue lines represent the swath of each thermal video camera and the blue triangles provide resolution moving away from the track line (0). Red and green lines show overlapping images from the machine vision camera with calculated resolution at the red diamonds (cm/pixel).



Photo credit: Kathy Crane, NOAA Arctic Research Program

Literature Cited

Conn PB, Moreland EE, Regehr EV, Richmond EL, Cameron MF, Boveng PL. 2016 Using simulation to evaluate wildlife survey designs: polar bears and seals in the Chukchi Sea. *R. Soc. open sci.* 3: 150561. <http://dx.doi.org/10.1098/rsos.150561>

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