

SUMMARY REPORT

Aerial Infrared Detection Survey for Polar Bear Maternal Dens in the Coastal Plain of the Arctic National Wildlife Refuge, Alaska



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INTRODUCTION

The polar bear (*Ursus maritimus*) is listed as a threatened species under the Endangered Species Act of 1973 and is assumed to occur in 19 relatively distinct subpopulations throughout the Arctic (Aars et al. 2009). One such subpopulation, the South Beaufort Sea (SB) population occurs throughout the northern reaches of the US state of Alaska. Reduction of seasonal sea ice resulting from climate change has been associated with reduced recruitment and fecundity of the SB subpopulation (Rode et al. 2014). In 2016 a listing review was conducted by the U.S. Fish and Wildlife Service as required under the provisions of the 1973 act. They determined that no change was warranted to the listing status of the polar bear, yet drastic circumpolar population declines are expected in all subpopulations before the end of the 21st century (Hunter et al 2010).

For decades the coastal plains (known as the 1002 area) of the Arctic National Wildlife Refuge (ANWR) in northeastern Alaska has been a target for the petroleum industry because it is believed to hold high oil and gas reserves. However, despite pressures from industry leaders, the 1002 area has remained protected from direct industrial process due to the fragile arctic ecosystem and its importance to local wildlife. Nearby Prudhoe Bay is the largest oil field in the United States and has been drilled continuously for more than 50 years (Morgridge and Smith 1972). With many oil and gas companies having established arctic drilling platforms and strategies already in place in Prudhoe Bay, drill platforms could be readily and quickly established in the 1002 area once lease sales are approved.

In late 2017, the United States congress passed a tax bill that allowed for oil and gas exploration within the 1002, effectively dissolving the 40-year-old drilling ban in the area. While no leases have yet been established, quick action is needed to ensure appropriate protection for SB polar bears establishing maternal dens within the 1002. On January 18th, 2018 Owyhee Air Research (OAR) was contracted through a cooperative agreement between the U.S. Geological Survey (USGS) and U.S. Fish and Wildlife Service (USFWS) to conduct aerial infrared (AIR) surveys for maternal polar bear dens in the 1002 area of the ANWR, which provides essential denning habitat for the SB subpopulation of bears. This survey was to be completed prior to spring emergence and a survey terminus date of March 9th, 2018 was set by USFWS Marine Mammal Specialists. The objectives of this survey were:

1. Survey critical portions of the 1002 for active polar bear dens and document all detected hotpots of interest.
2. Develop timely, practical, and measurable survey strategies for the 1002 designed to ensure maximum area coverage and detection rates.
3. Identify high priority areas within the 1002 where seasonal denning is most likely to occur.

METHODS

Owyhee Air's flight crew responsible for conducting this survey met with USFWS regulatory personnel for pre-flight briefing and orientation. Following orientation, OAR and USFWS personnel conducted a survey flight over high probability denning habitat for the purpose of instrument calibration prior to commencing survey operations over the greater coastal plain of the ANWR.

Survey operations of the 1002 commenced on February 18, 2018. The survey was conducted using a Partenavia P-68, lite twin, fixed-wing aircraft equipped with an L3-Wescam MX-10 camera system paired with a dedicated Churchill Navigation ARS computer system. When possible, the survey flights were conducted in the early morning or late afternoon during periods of twilight or darkness. Flights were conducted at an above ground altitude of 1000-1500 feet depending on cloud ceiling. Survey flights were not conducted if weather conditions did not favor IR detection rates (i.e. fog, high winds, blowing snow). Survey flights were only conducted during daylight hours if overcast conditions were present with sufficiently high ceilings to support survey parameters. Additionally, survey flights were not conducted over or directly to the south of Barter Island as per directives from USFWS personnel.

Potential denning habitat maps were obtained from the USFWS and were used to direct survey operations and crew attention during the survey flight. In addition to the potential habitat map, areas of terrain relief conducive to drifting snow were closely observed during the survey flight. OAR surveyed all terrain relief areas and identified possible denning locations within the coastal plain boundary.

RESULTS

Survey flights were conducted over a 10-day period between February 18th and February 28th, 2018. A total of nine (9) hotspots of interest were identified during those flights (Table 1). Of those, six (6) were located within the 1002 (Fig 1). Two of the identified hotspots were further identified by USFWS personnel as likely being fox dens but warrant further examination. Two locations of high probability habitat were identified adjacent to Barter Island during the survey flights. However, neither of these two locations were thoroughly surveyed during the survey period due to persistent poor weather conditions (Figure 2). Weather conditions for each survey flight can be found in Table 2.

DISCUSSION

With the opening of the 1002 to exploration and the fact all industrial construction in the Arctic is conducted in the winter months, it is imperative that an effective and practical means of surveying the area for polar bear dens be established. While a prudent and effective method for den detection, AIR results are not guaranteed to be 100% accurate. Additionally, to the best of

our knowledge, AIR den detection surveys are typically conducted during the month of December when dens are still relatively fresh and surface snow levels have not accumulated greatly over den entrances. This survey was conducted in late February, by which time denning bears have been in their dens for over two full months. In that time, it is possible that blowing snow over the den could build up a sufficient enough surface layer to mask all heat signatures coming from the den. It is our recommendation that survey flights for the 1002 area also be completed in December or early January. Conducting survey operations in December would limit the possibility of heavy snow accumulation over dens and would eliminate confounding effects of daylight on survey parameters as well as simplify flight planning and logistics.

This year, the south Beaufort Sea coast experienced unseasonably high winter temperatures not common to the area. During our survey flight we also detected large overflow areas on river drainages. Due to the emissivity of bare ice, overflow areas in river drainages are intensely bright when viewed in IR. Further, some of the best denning habitat may occur along the banks of these river drainages. It is possible that thermal glare from the overflows obscured some den generated heat signatures along the banks. However, we feel that this source of error is nullified by our survey practices and expertise in filtering out thermal glare by continuously adjusting the IR filter settings, in real time, to accommodate changing surface conditions.

Weather conditions inhibited survey operations by grounding survey personnel for five (5) of the 10 days that were committed to the survey. Additionally, persistent ground fog and low ceilings prohibited OAR from thoroughly surveying two high probability areas adjacent to Barter Island (Figure 2). Despite numerous attempts we were continually forced out of those two areas by rapidly changing weather conditions that were not conducive to survey success or safe flight operations. Further, after consulting with USFWS personnel, OAR terminated survey operations on March 1st, 2018 due to predicted weather patterns rendering continued operations cost prohibitive. A third portion of the 1002 area was not surveyed during the operational period. Per the directives of USFWS personnel, Barter Island and surrounding coastlines, as well as mainland drainages directly to the south of Barter Island were not surveyed (Figure 3). Barter Island and surrounding coast lines are high probability areas for den sites. It may be likely that additional dens are located in those areas. It is our recommendation that future surveys include Barter Island and surrounding coast lines to allow for maximum detection and reduced error in denning population estimates.

One of the primary objectives of this study was to determine the most timely, efficient, and cost-effective means for surveying the 1002 for maternal polar bear dens. As a result, survey parameters were continuously adjusted following each survey flight as more of the area was covered. It was determined following the February 19th flight that representative photographs be taken of each detected hotspot. Of the nine (9) hotspots detected, only two (2) were detected after that date; hot spots 21-1 and 21-2 (Photo 1 and 2 respectively). Future surveys using integrated imaging and computing software should include screen shot images of each detected hotspots as some overlaid imaging data may not be represented in the recorded video footage.

SUPPLEMENTAL MATERIALS

In addition to this report, KML files of all data layers associated with this project are included.

- All detected hotspots over-laid on provided denning habitat.
- Aircraft Track during all survey flights.¹
- Camera View Track during all survey flights.²
- Camera Viewshed.²
- Video footage of the entire flight as well as all audio communications recorded continuously during each flight.¹

¹ Aircraft flight track and video recording for the training flight on the 17th was not saved at the discretion of onboard USFWS personnel.

² Camera tracks and viewshed were not saved for the evening flight conducted on February 28th due to error on the part of the camera operator.

LITERATURE CITED

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Hunter CM, Caswell H, Runge MC, Regehr EV, Amstrup SC, Stirling I (2010) Climate change threatens polar bear populations: a stochastic demographic analysis. *Ecology*, 91, 2883–2897.

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TABLES

Table 1 Date, Name, Video Time, and geographical coordinates (WGS 84) of all hotspots of interest located during survey flights conducted between Feb 18th and 28th. Important notes or observations for specific detections are also included.

Date	Hotspot	Video Time	Lat	Long	Notes
18-Feb	18-1	0853	70.17545	145.95507	Flaxman Island
18-Feb	18-2	0935	69.97489	146.23589	
18-Feb	18-3	2009	69.82405	144.84955	
18-Feb	18-4	2034	69.89955	144.91192	Fox den
18-Feb	18-5	2154	69.93593	145.68072	
19-Feb	19-1	1132	69.84385	143.74106	
19-Feb	19-2	1150	70.03083	144.28693	Fox Den
21-Feb	21-1	1856	69.63727	141.25095	In a drift formed around the shipwreck, landward side.
21-Feb	21-2	1958	69.62714	142.04462	

Table 2 Daily weather conditions as observed from Deadhorse airport for each survey flight

Date	Time	Temp (F)	Wind (MPH)	Visibility	Sky Condition
2/17/2018	1647	12	7	10+	Overcast
2/18/2018	0615	9	9	10+	Partly cloudy
2/18/2018	1705	7	14	10+	Partly cloudy
2/19/2018	0645	14	12	10+	Cloudy - Survey area was fogged in.
2/29/2018	0940	15	10	8	Cloudy - Survey area cleared
2/20/2018	N/A	N/A	N/A	N/A	Weathered out due to blowing snow and ice fog
2/21/2018	1531	20	14	10	Overcast - Morning flight was cancelled due to low ceilings
2/22/2018	N/A	N/A	N/A	N/A	Weathered out due to high winds and blowing snow
2/23/2018	N/A	N/A	N/A	N/A	Weathered out due to high winds and blowing snow
2/24/2018	N/A	N/A	N/A	N/A	Weathered out due to high winds and blowing snow
2/25/2018	N/A	N/A	N/A	N/A	Weathered out due to high winds and blowing snow
2/26/2018 ¹	1304	1	19	5	Overcast
2/27/2018	0925	-5	10	10	Overcast - Flight was cut short due to low ceiling over survey area
2/28/2018	1635	-18	6	5	Clear - Flight was forced short due to fog over the survey area.

¹ At the time of this flight weather conditions over the unsurveyed portions of the 1002 area characterized by low ceilings, too low for effective survey work. This flight was conducted over the western portion of the ANWR, west of the 1002 boundary. It was an industry survey for SAExploration project site, Yukon_3D.

FIGURES

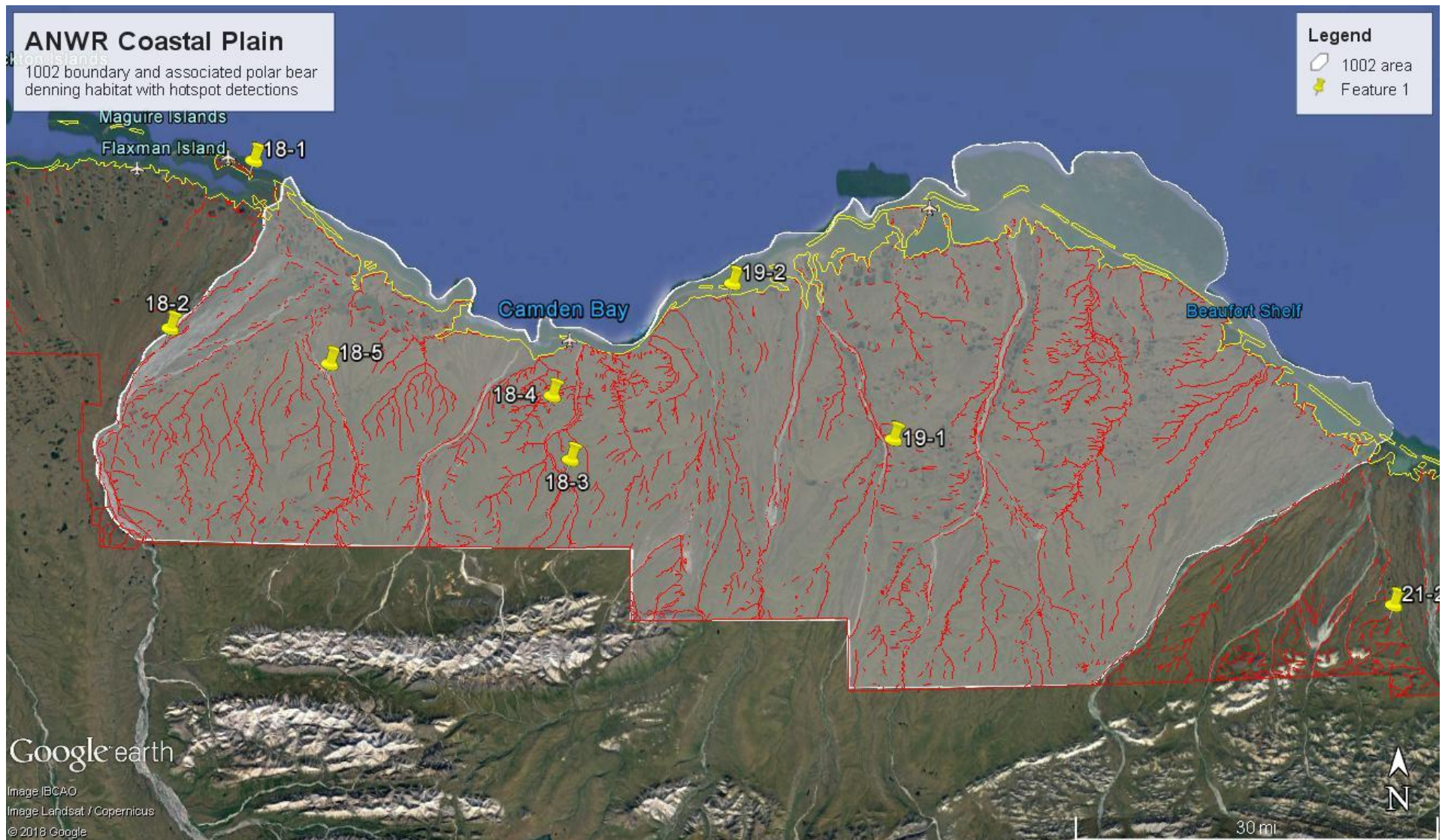


Figure 1 Identified hot spots of interest within the 1002 (white) survey area. Lines of terrain relief showing possible areas of suitable denning habitat is also reflected (red lines).

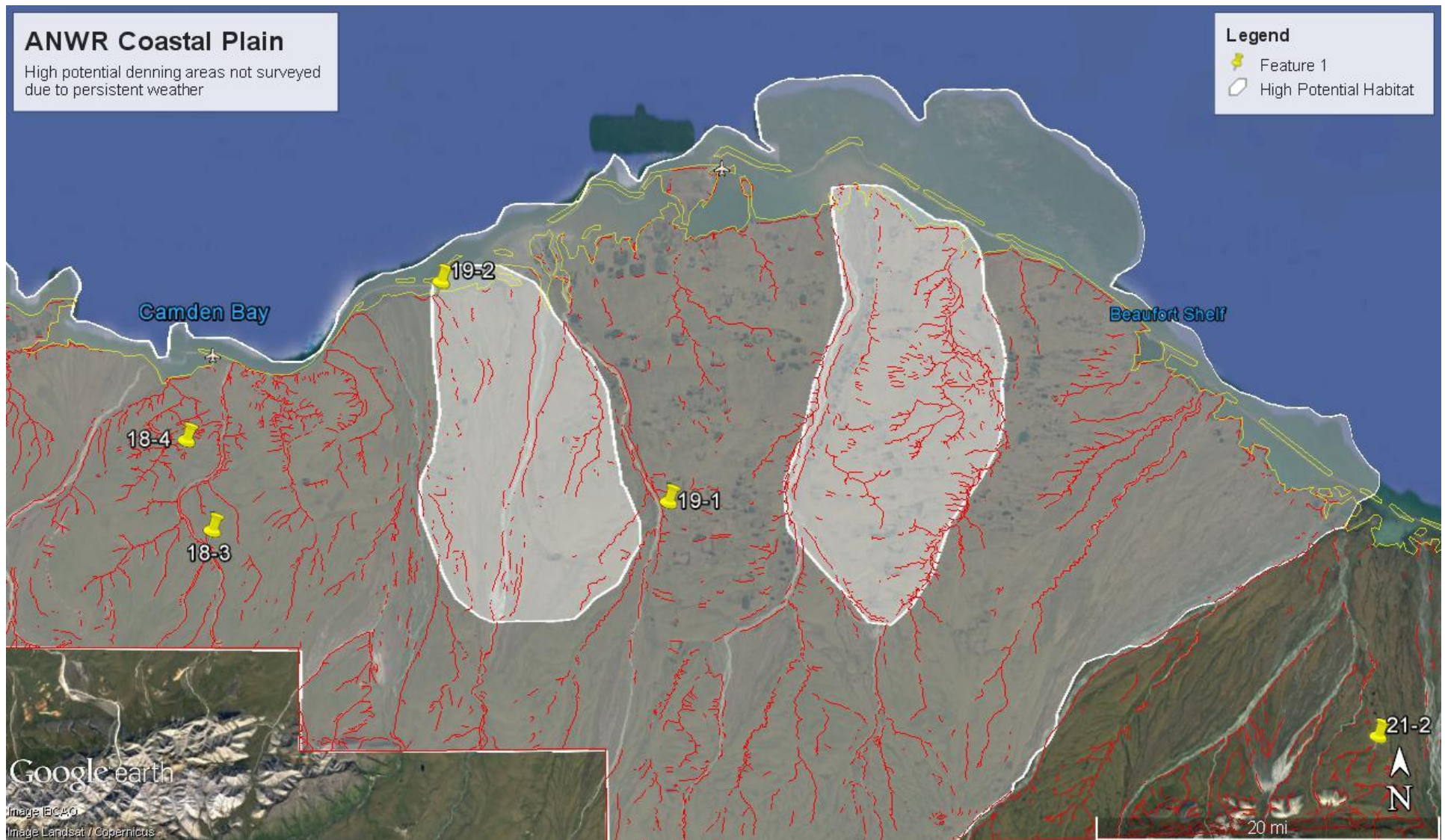


Figure 2 Areas of high denning potential (white) within the 1002 (transparent white) survey area that were not completely surveyed due to persistent weather conditions that were not conducive to survey success or safety. Multiple survey attempts were made in both areas but were routinely abandoned due to rapidly changing weather conditions.

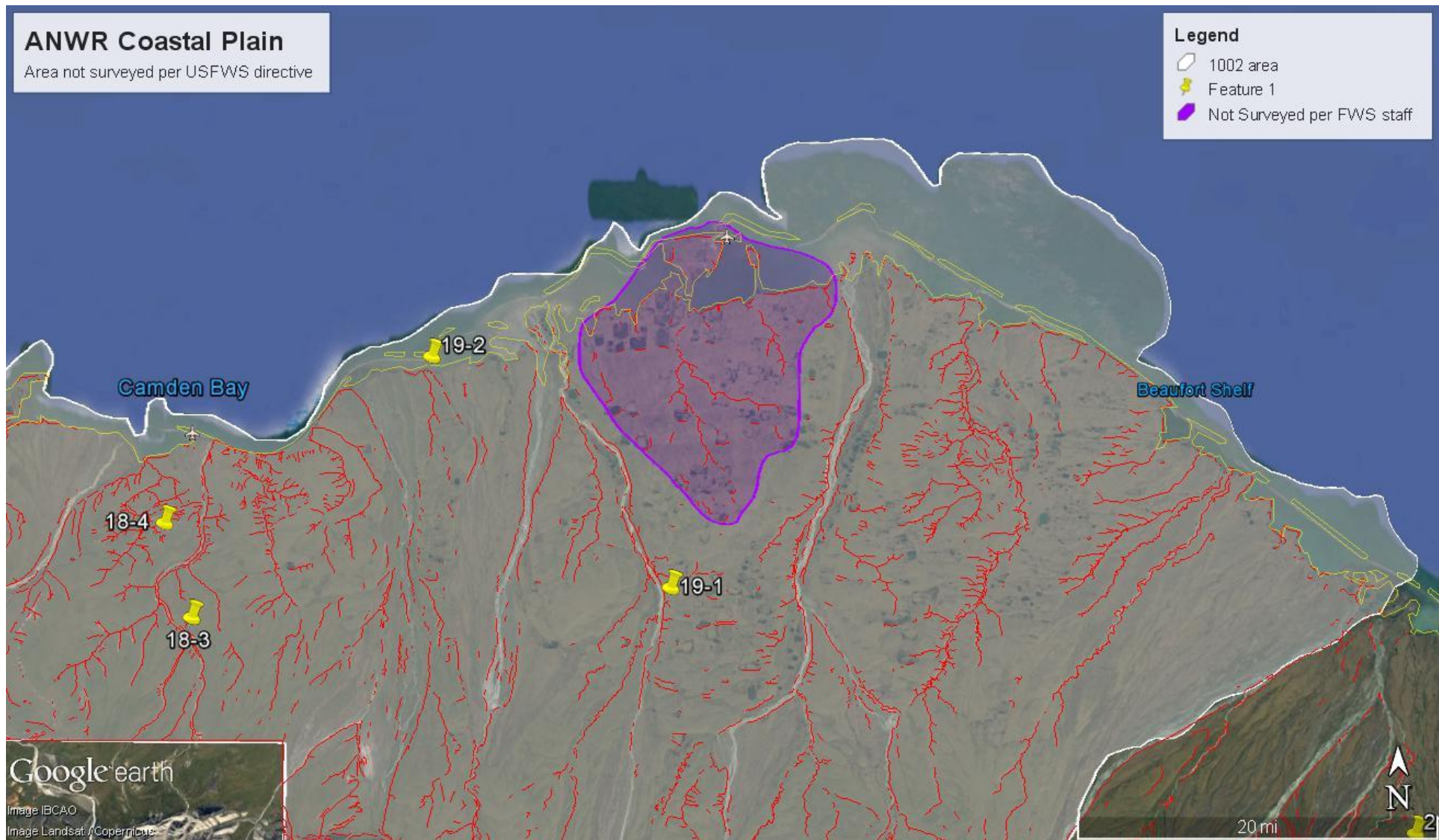


Figure 3 Area of the 1002 (transparent white) that was not surveyed (purple) as per directives from USFWS personnel. Barter Island and mainland drainages directly south of the island were intentionally avoided to avoid conflict with native inhabitants. Future surveys would benefit from obtaining permission from local inhabitants to conduct surveys around Barter Island.

PHOTOGRAPHS



Photo 1 Hotspot 21-1 detected in a drift along the landward side of a shipwreck approximately 6 miles west of the Canadian Border. Hotspot falls within the ANWR coastal plain but is not inside the 1002 area.



Photo 2 Screenshot of hotspot 21-2 located in the far eastern portion of the ANWR, outside the 1002 boundary. Hotspot was located in a river drainage in a foothill area approximately 13 miles from the coast.