

Aerial Infrared Survey of Maternal Polar Bear (*Ursus maritimus*) Denning Habitat



Winter 2020/2021

FINAL

Prepared for:



ConocoPhillips Alaska, Inc.
PO Box 100360
Anchorage, AK 99510

Prepared by:



Environmental Research and Consulting, LLC.
19409 Second Street
Eagle River, AK 99577

Introduction

Infrared (IR) surveys were conducted in the winter of 2020/2021 to locate potential maternal polar bear dens in the vicinity of ongoing and planned oil and gas operations occurring on the North Slope of Alaska. During a pre-flight meeting on November 12, 2020, the US Fish and Wildlife Service (USFWS) identified the specific survey areas to be flown based on the levels and types of activities to occur, as well as their location in proximity to known denning habitat. This report summarizes the results of the survey effort conducted on behalf of ConocoPhillips Alaska, Inc. (CPAI) under the Letters of Authorization (LOA) 16-13, 20-04, 20-09, 20-11, and 21-02 and as required by 50 CFR 18.128 and per the CPAI Polar Bear Avoidance and Interaction Plan (July 2016). Surveys are conducted in the manner described in USFWS's *Protocol for Using FLIR to Detect Polar Bear Dens from a Fixed-wing Aircraft*.

Areas encompassing CPAI planned activities for the winter of 2020/2021 were surveyed on December 7-9, 2020 and again on January 5, and 7-10, 2021. The areas and activities included:

- Routine operations and ice road construction within the Kuparuk River Unit (KRU);
- Routine operations and ice road construction within and near the Alpine oil field in the Colville River Unit (CRU) and Greater Mooses Tooth (GMT) Unit;
- GMT2 Development construction activities;
- Activities in the Bear Tooth Unit;
- Plug & abandonment activities; and
- Inspection/maintenance of the Department of Transportation (DOT) Sales Oil Pipelines between Kuparuk and Pump Station 1, and between Alpine and Kuparuk.

Methodology

The surveys were conducted using the Shared Services Aviation Twin Otter (DHC6-400, N790CP) equipped with a Star SAFIRE® 380-HDc FLIR. The aircraft and infrared camera were both newly acquired in 2020. Surveys were flown between 800 and 1,500 feet above ground level, depending on weather conditions. Use of an IR camera is a recognized method of conducting polar bear den detection surveys (USFWS, 2016).

Prime terrestrial maternal polar bear denning habitat in northern Alaska has been identified as snow drifts that form on banks or bluffs measuring $\geq 16^\circ$ in slope and ≥ 1.4 m in height (Durner et al., 2001). These features have been mapped as denning habitat (Durner et al., 2001; Durner et al., 2006; Blank, 2012; Durner et al., 2013), and were overlaid with the proposed winter 2020-2021 industrial activities. The crew utilized Global Positioning System coordinates, computer mapping software, and visual ground references to target these areas of overlap in-flight. Most areas were surveyed twice to increase the likelihood of den detection with some areas receiving additional overflights to account for unfavorable environmental conditions or suspect heat signatures that required follow-up. Surveys were conducted in early December 2020, and again in January 2021 to accommodate project schedules, avoid excessive snow accumulation that can reduce detectability (Amstrup et al., 2004, Robinson et al., 2014), and reduce the potential of den establishment post-survey (Rode et al, 2018). After consultation with USFWS, high probability denning habitat, e.g., along the barrier islands, outside of the planned areas of activity were also surveyed in order to calibrate the IR equipment.

Aerial infrared surveys for polar bear dens rely on a Survey Team comprised of Pilots, a Sensor Operator, a Survey Coordinator, and a Data Manager/Image Analyst. The Pilots operate the aircraft with direction from the Survey Coordinator on desired flight parameters (speed, altitude, direction, etc.). The Sensor Operator controls the infrared sensor with direction from the Survey Coordinator on the desired imagery parameters (zoom, search area, contrast, focus, etc.) In addition to directing the Pilots and Sensor Operator, the Survey Coordinator evaluates the imagery data as they are collected in-flight. The Data Manager/Image Analyst typically does not participate in the aerial data collection, but instead reviews the data post-flight to confirm the Survey Coordinator's determinations, identify areas that warrant follow up examination, and verify overall data quality. Additional observers may also participate in the surveys or post-flight data review. Survey Team members are presented in Tables 1 and 2.

Suspect heat signatures are evaluated and, if not eliminated from further consideration, are labeled as follows:

- **Revisit**- A warm spot that appears in the right location but is missing some of the obvious signs of a polar bear den (e.g., tailings pile, signs of animal activity, appropriate shape or size), and that could not be easily discounted. These locations are revisited during subsequent surveys and either eliminated from further consideration or reclassified and upgraded to a "Hotspot".
- **Hotspot**- A warm spot of appropriate shape and size located near the middle of the snow drift. Signs of wildlife activity (i.e., digging, tracks) may be present. Suspected den sites that are found still open (not drifted closed by snow) are considered hotspots because a polar bear may excavate exploratory dens when searching for suitable habitat (Durner et al, 2020), and these hotspots will eventually cool down and be eliminated from further consideration. These locations are examined during subsequent surveys and either eliminated from further consideration or upgraded to a "Putative Den".
- **Putative Den**- A distinct thermal signature that persists for several days, may show evidence of animal presence, is in the appropriate habitat, and cannot be definitively attributed to a non-polar bear cause (e.g., exposed ice, exposed tundra, fox or other animal digging). The final disposition of these putative dens (whether or not it is truly a den, if it produced cubs, when the bears emerged and departed) is usually unknown as they are not further investigated, monitored, or revisited in the spring for confirmation. Some dens are confirmed if they are monitored remotely or in an area (e.g. near infrastructure) where the den fate is observable (e.g. den emergence phase is observed).

Infrared imagery can be affected by wind, airborne precipitation, atmospheric humidity, and solar radiation (Amstrup et al., 2004; Robinson et al., 2014; Smith et al., 2020) therefore surveys were flown when reported weather indicated conditions were conducive to quality data collection. Generally, clear, calm, dry, and dark conditions are the best for den detection surveys although these variables must be considered in context. For example, fresh snow particulates can be mobilized by even light winds, masking IR signatures on the surface. Conversely, a hard crusted snow surface will remain in place in much stronger winds though the permeating heat signature may be swept away. IR surveys have detected dens during periods of strong winds and active precipitation as well. Setting finite limits on environmental conditions is impractical for many

reasons such as: dens that have not been sealed (closed) by blowing snow can be detected in most conditions, orientation or location of a den may protect them from the wind allowing the heat signature to be detected, and conditions at weather reporting stations can differ from those present at survey areas. Some challenges with environmental conditions and IR imagery can be overcome by reducing the distance between the sensor and the target (i.e., flying lower or closer), or simply shifting to a new area and returning when the weather improves.

The Survey Team evaluated crew, aircraft, and equipment readiness prior to each flight. The presence of fog, blowing snow, excessive daylight, and reported winds over 15 knots precluded survey. Occasionally survey efforts were redirected, after takeoff, to seek out areas with more favorable conditions. In total, inclement weather completely grounded the survey crew for five days. Data collection attempts on December 13, 2020 and in the evening of January 10, 2021 were aborted due to unfavorable environmental conditions and obscured imagery.

Image quality and the identification of Hotspots and Revisits throughout the surveys indicate that data were collected in favorable conditions. To maximize performance of the IR sensor on each flight CPAI utilized a second Sensor Operator from Mag Aerospace as a technical expert on the operation and performance of the FLIR 380 HDc camera.

Survey Activities

On December 7-9, 2020 and January 5, and 7-10, 2021, potential denning habitat, including drainages, bluffs, and channels conducive to adequate snow drifting, was surveyed near CPAI project areas. Survey dates/times, locations, and flight crew information are shown in Tables 1 and 2. Reported weather conditions at nearby airports are shown in Tables 3-10. Survey areas and aircraft flight tracks are shown in Figures 1 and 2.

Results

Video imagery was reviewed by the Data Manager/Image Analyst post-flight to identify potential locations to re-survey. As soon as possible, considering the time required to transmit very large files from the North Slope where bandwidth is limited, survey video and a summary of preliminary findings, were made available to USFWS via a document storage and sharing website.

Inclement weather prevented complete survey coverage of all planned areas in December 2020. A complete survey of all project areas was performed in January 2021 and any areas not surveyed in December were instead surveyed twice in January. Thus, the entire Project Area received two comprehensive surveys (Figures 1 and 2).

A detailed account of Revisits and Hotspots are shown in Table 11. Several revisit sites (“Revisits”) were identified and attributed to landscape features, fox excavations, or other factors, and rejected from further consideration as potential polar bear dens.

Two hotspots were located on Howe Island, and one was located on Bodfish Island (Figures 1 and 2, Photos 1-3):

- HS2001 was discovered in December 2020 and appeared to be an open den; however, subsequent overflights did not detect a heat signature or obvious signs of a den.

- HS2002 was discovered approximately 25 meters from HS2001, in January 2021, and observed on multiple flights with an apparent den opening and bear tracks in the area.
- HS2003 was discovered on Bodfish Island in January 2021. Two apparent excavations were seen in close proximity to each other. The site was not revisited.

These hotspots were not further evaluated to determine if a den truly existed because they were not in planned areas of CPAI projects and therefore inconsequential to the purpose of the surveys.

No putative polar bear dens were detected in the CPAI survey area of planned winter activities during either the December or January surveys.

Summary

No suspected den sites were identified in CPAI's project area.

Table 1. December Survey Summary

Aircraft	Shared Services Twin Otter (DHC6-400) [N790CP]		
Sensor	Star SAFIRE® 380-HDc FLIR		
Pilot	Craig Briske – Dec 7 Adam Skinner – Dec 8-9		
Co-Pilot	Adam Skinner – Dec 7 Craig Briske – Dec 8 Jeff Martin – Dec 9		
Sensor Operator	Brian Nelson Dan Major (Mag Aero)		
Survey Coordinator	Justin Blank		
Observer	Kathleen Leonard (ERC) Robyn McGhee (CPAI) – Dec 7-8 Ari Haunschild (CPAI) – Dec 8 Christina Pohl (CPAI) – Dec 9 Sarah Byam (CPAI) – Dec 9		
Image Analyst/Data Manager	Kathleen Leonard		
Area Surveyed	CRU, NPRA, GMTU, BTU, KRU, Jones Islands, Howe Island, Staging Pad		
Survey Date	Dec 7	Dec 8	Dec 9
Departed	20:59	19:43	20:17
Landed	23:59	22:34	23:27
Notes	<ul style="list-style-type: none"> • Departed and landed at Alpine airstrip (PALP). • Barrier islands were surveyed for calibration before and/or after effort in the CPAI survey area. • A hotspot indicative of a polar bear den was detected on Howe Island (HS2001). • No potential dens were detected in the CPAI project areas. 		

Table 2. January Survey Summary

Aircraft	Shared Services Twin Otter (DHC6-400) [N790CP]				
Sensor	Star SAFIRE® 380-HDc FLIR				
Pilot	Craig Briske – Jan 5 Larry Shue – Jan 7-10				
Co-Pilot	Adam Skinner – Jan 5 Brooke Roman – Jan 7-10				
Sensor Operator	Don Short – Jan 5 Brian Nelson – Jan 7-10 Edgardo Macabalo (Mag Aero)				
Survey Coordinator	Justin Blank				
Observer	Christina Pohl (CPAI) – Jan 5 Nate Visser (CPAI) – Jan 5 Mike Hauser (CPAI) – Jan 6, 9, 10 Sarah Byam (CPAI) – Jan 7				
Image Analyst/Data Manager	Kathleen Leonard				
Area Surveyed	CRU, NPRA, GMTU, BTU, KRU, Jones Islands, Howe Island, Staging Pad				
Survey Date	January 5	January 7	January 8	January 9	January 10
Departed	22:09	17:19	17:22	17:18	12:50
Landed	1:18	23:50	21:07	22:56	13:46
Notes	<ul style="list-style-type: none"> • Departed and landed at Alpine airstrip (PALP). • Barrier islands were surveyed for calibration before and/or after effort in the CPAI survey area. • Hotspots indicative of polar bear dens were detected on Howe Island (HS2002) and Bodfish Island (HS2003). • No potential dens were detected in the CPAI project areas. 				

Table 3. Weather Conditions on December 7, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	20:49	20:05	18:45	18:16	20:55
Temperature (Celsius)	-21.0	-18.9	-17.0	-21.0	-16.9
Dew Point (Celsius)	-24.0	-21.7	-19.0	-23.0	-18.7
Altimeter (inHg)	29.74	29.69	29.74	29.73	29.67
Wind Direction (magnetic)	20	320	50	40	70
Wind Speed (knots)	7	8	12	4	6
Visibility (miles)	10+	5	4	8	7
Ceiling (feet)	2,000	3,100	2,500	800	2,800
Cloud Cover (feet)	OVC 2,000	OVC 3,100	OVC 2,500	OVC 800	SCT 1,500 SCT 2,200 OVC 2,800
Notes	Light Snow	Mist	Light Snow, Mist	NA	NA

Table 4. Weather Conditions on December 8, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	19:48	19:53	18:45	19:57	19:55
Temperature (Celsius)	-21.0	-19.4	-21.0	-21.0	-18.1
Dew Point (Celsius)	-24.0	-22.2	-23.0	-23.0	-20.0
Altimeter (inHg)	30.00	29.97	29.97	30.02	29.95
Wind Direction (magnetic)	40	50	40	20	50
Wind Speed (knots)	12	16	15	11	16
Visibility (miles)	10+	3	5	5	3
Ceiling (feet)	9,500	9,000	>12,000	4,000	8,000
Cloud Cover (feet)	FEW 3,000 BKN 9,500	OVC 9,000	FEW 11,000	BKN 4,000 OVC 10,000	OVC 8,000
Notes	NA	Mist	Mist	Mist	Mist

Table 5. Weather Conditions on December 9, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	20:46	20:53	18:45	19:53	20:55
Temperature (Celsius)	-22.0	-20.6	-23.0	-23.0	-20.5
Dew Point (Celsius)	-25.0	-23.3	-25.0	-26.0	-22.5
Altimeter (inHg)	30.31	30.27	30.27	30.30	30.27
Wind Direction (magnetic)	50	70	70	30	90
Wind Speed (knots)	11	15	13	9	17
Visibility (miles)	10+	10+	10+	10+	10+
Ceiling (feet)	>12,000	1,400	>12,000	>12,000	>12,000
Cloud Cover (feet)	SKC	OVC 1,400	SKC	FEW 1,600	SKC
Notes	NA	NA	NA	NA	NA

Table 6. Weather Conditions on January 5, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	21:47	21:53	18:45	19:55	21:55
Temperature (Celsius)	-33.0	-31.7	-36.0	-33.0	-33.5
Dew Point (Celsius)	-37.0	-35.0	-39.0	-36.0	-37.0
Altimeter (inHg)	29.35	29.33	29.36	29.37	29.33
Wind Direction (magnetic)	-	250	140	160	250
Wind Speed (knots)	Calm	5	3	3	8
Visibility (miles)	14	10+	10+	7	10+
Ceiling (feet)	>12,000	300	>12,000	1,100	>12,000
Cloud Cover (feet)	FEW 12,000	OVC 300	SKC	OVC 1,100	SKC
Notes	-	-	-	-	-

Table 7. Weather Conditions on January 7, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	16:45	16:53	16:45	16:51	16:55
Temperature (Celsius)	-28.0	-29.4	-30.0	-28.0	-29.5
Dew Point (Celsius)	-32.0	-32.8	-33.0	-31.0	-32.6
Altimeter (inHg)	29.48	29.46	29.47	29.48	29.47
Wind Direction (magnetic)	-	60	60	360	-
Wind Speed (knots)	Calm	5	2	3	Calm
Visibility (miles)	10+	10+	10+	6	10+
Ceiling (feet)	9,500	>12,000	>12,000	9,500	>12,000
Cloud Cover (feet)	BKN 9,500	FEW 9,500	Few 20,000	OVC 9,500	SKC
Notes	-	-	-	Haze	-

Table 8. Weather Conditions on January 8, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	16:45	14:53	16:45	16:22	-
Temperature (Celsius)	-22.0	-24.4	-23.0	-24.0	-
Dew Point (Celsius)	-25.0	-27.2	-25.0	-27.0	-
Altimeter (inHg)	29.55	29.52	29.52	29.54	-
Wind Direction (magnetic)	120	170	80	180	-
Wind Speed (knots)	5	3	4	4	-
Visibility (miles)	10+	10+	10+	7	-
Ceiling (feet)	14,000	18,000	14,000	>12,000	-
Cloud Cover (feet)	SCT 1,200	BKN 18,000	BKN 14,000	SKC	-
Notes	-	-	-	-	-

Table 9. Weather Conditions on January 9, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	16:45	16:53	16:45	16:49	-
Temperature (Celsius)	-21.0	-27.2	-27.0	-21.0	-
Dew Point (Celsius)	-24.0	-30.0	-29.0	-23.0	-
Altimeter (inHg)	29.70	29.67	29.68	29.69	-
Wind Direction (magnetic)	-	250	280	-	-
Wind Speed (knots)	Calm	7	5	Calm	-
Visibility (miles)	10+	8	10+	7	-
Ceiling (feet)	8,500	>12,000	>12,000	9,000	-
Cloud Cover (feet)	BKN 8,500	SKC	SKC	OVC 9,000	-
Notes	-	-	-	-	-

Table 10. Weather Conditions on January 10, 2020. Station(s) representative of survey area are highlighted.

	Alpine (PALP)	Deadhorse (PASC)	Kuparuk (PAKU)	Nuiqsut (PAQT)	Point Thomson (PAAD)
Time (AKST)	12:45	12:53	12:45	12:51	-
Temperature (Celsius)	-20.0	-20.6	-21.0	-20.0	-
Dew Point (Celsius)	-23.0	-23.9	-23.0	-22.0	-
Altimeter (inHg)	29.46	29.42	29.44	29.45	-
Wind Direction (magnetic)	50	70	50	20	-
Wind Speed (knots)	6	6	8	7	-
Visibility (miles)	8	10+	10+	6	-
Ceiling (feet)	1,400	1,600	1,100	500	-
Cloud Cover (feet)	OVC 1,400	Few 400 OVC1,600	OVC 1,100	BKN 500 OVC 1,100	-
Notes	-	-	-	Mist	-

Table 11. 2020-2021 CPAI Polar Bear Den Survey Hotspot and Revisit Details

Hotspot/Revisit #	Area	Latitude	Longitude	Date Observed	Survey #	Description	Dismissed
HS2001	Howe Island	70.313136	-147.986039	7-Dec	1	Bright orb	N
				9-Dec	3	No visible signs detected	
HS2002	Howe Island	70.313333	-147.986608	5-Jan	4	Bright, distinct orb	N
				9-Jan	7	Still very bright, distinct orb	
HS2003	Bodfish Island	70.530678	-149.2722	7-Jan	5	Video review and reconsideration warranted upgrading RV2008 to HS2003.	N
RV2001	CD3	70.430283	-150.918344	7-Dec	1	Diffuse spot	Y
				8-Dec	2	Reject. No visible signs detected.	
RV2002	CD2	70.321614	-151.064997	7-Dec	1	Diffuse spot	Y
				8-Dec	2	Reject. Appears to be vegetation.	
RV2003	CD2	70.325581	-151.05395	7-Dec	1	Diffuse spot	Y
				8-Dec	2	Reject. No visible signs detected.	
RV2004	Howe Island	70.314700	-147.996811	9-Dec	3	Bright spot	Y
				5-Jan	4	Reject. No visible signs detected.	
RV2005	Bertoncini Island	70.532547	-149.300147	9-Dec	3	Bright spot. Located on barrier island outside of project area and not targeted for resurvey effort.	-
RV2006	Kuparuk	70.479294	-149.759894	9-Dec	3	Bright spot	Y
				7-Jan	5	Reject. No visible signs detected.	
RV2007	Alpine Resupply	70.229944	-150.271031	7-Jan	5	Bright, small spot	Y
				9-Jan	7	Reject. No visible signs detected.	
RV2008	Bodfish Island	70.530678	-149.2722	7-Jan	5	Bright spot with digging evidence apparent. After video review upgraded to HS2003.	N
RV2009	Cottle Island	70.499017	-149.093997	7-Jan	5	Bright spot. Located on barrier island outside of project area and not targeted for resurvey effort.	-
RV2010	Sales Line	70.287336	-148.957581	7-Jan	5	Diffuse spot with tracks nearby	Y
				9-Jan	7	Same as Survey 5 - diffuse spot with tracks nearby	
				10-Jan	8	Reject. Survey in daylight with EO and IR sensors. Thin area of snow raised, raised landscape with depression at Revisit location.	
RV2011	Sales Line	70.309917	-148.938314	7-Jan	5	Bright, small spot with tracks nearby	Y
				9-Jan	7	Reject. Fox den.	
RV2012	Alpine Resupply	70.250203	-150.315042	9-Jan	7	Diffuse spot	Y
				10-Jan	8	Reject. Tundra/bush poking through snow surface.	

Figure 1-ConocoPhillips Alaska Polar Bear Den Detection Survey-December 2020

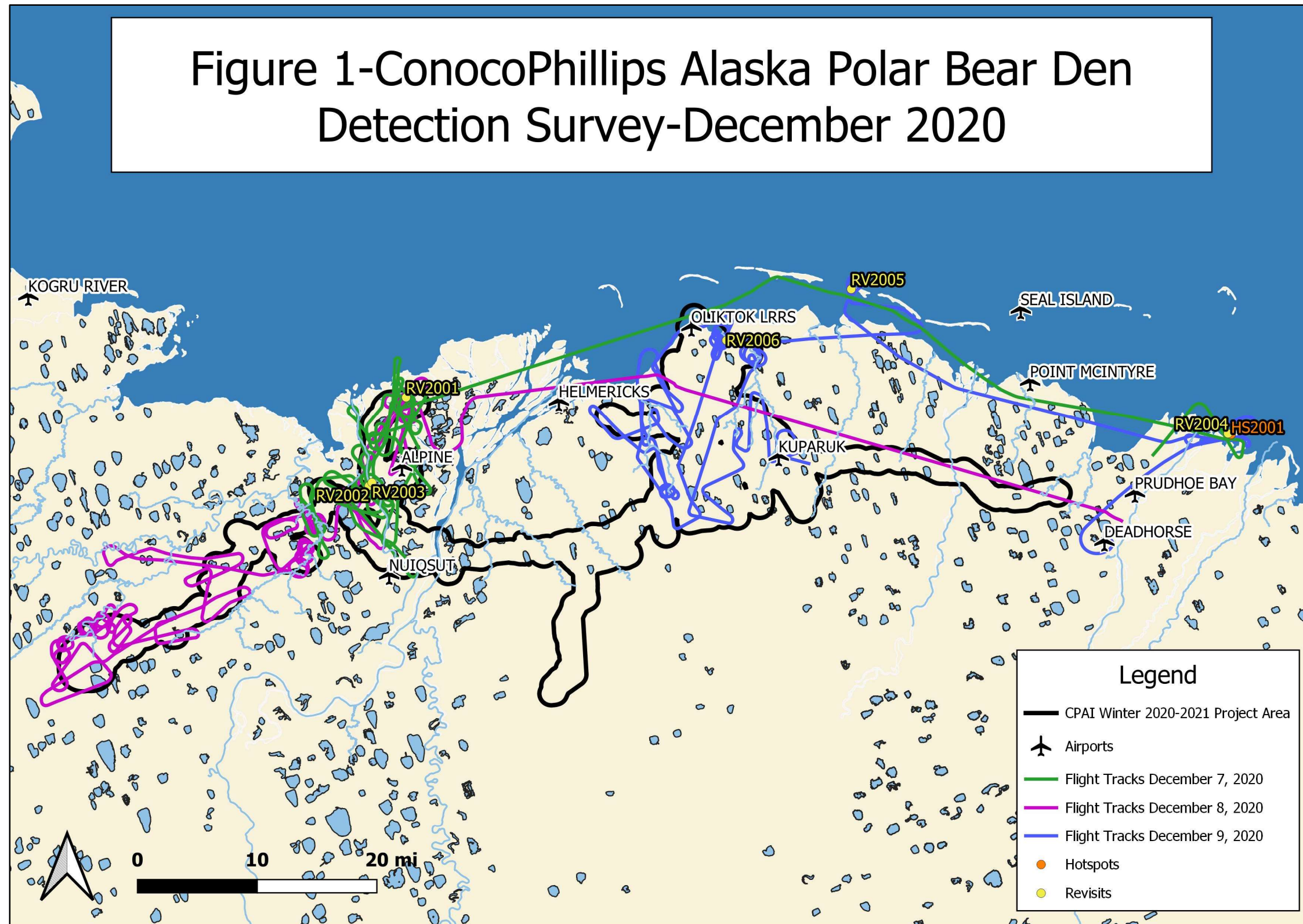


Figure 2-ConocoPhillips Alaska Polar Bear Den Detection Survey-January 2021

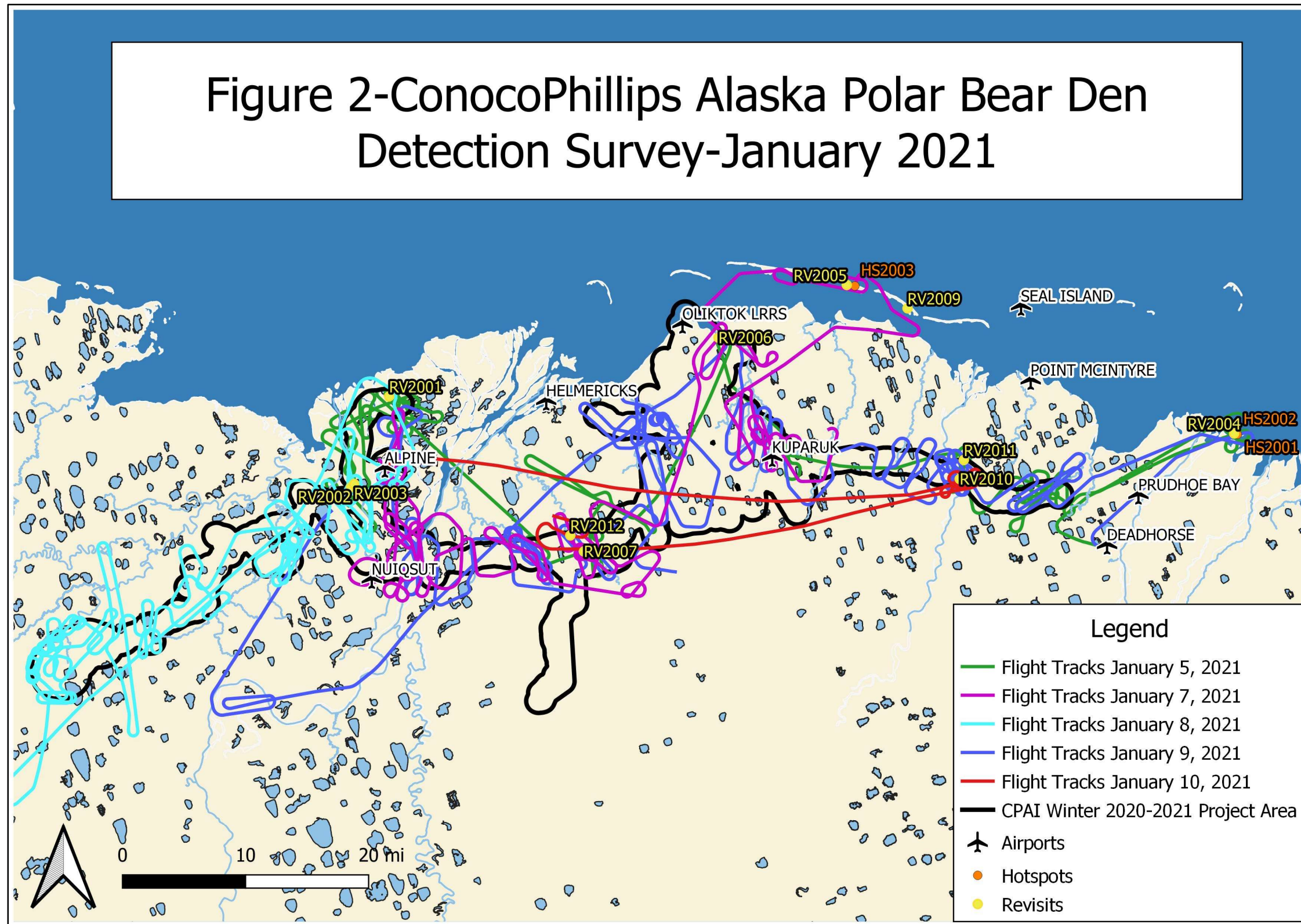




Photo 1: Hotspot 2001-December 2020



Photo 2: Hotspot 2002-January 2021

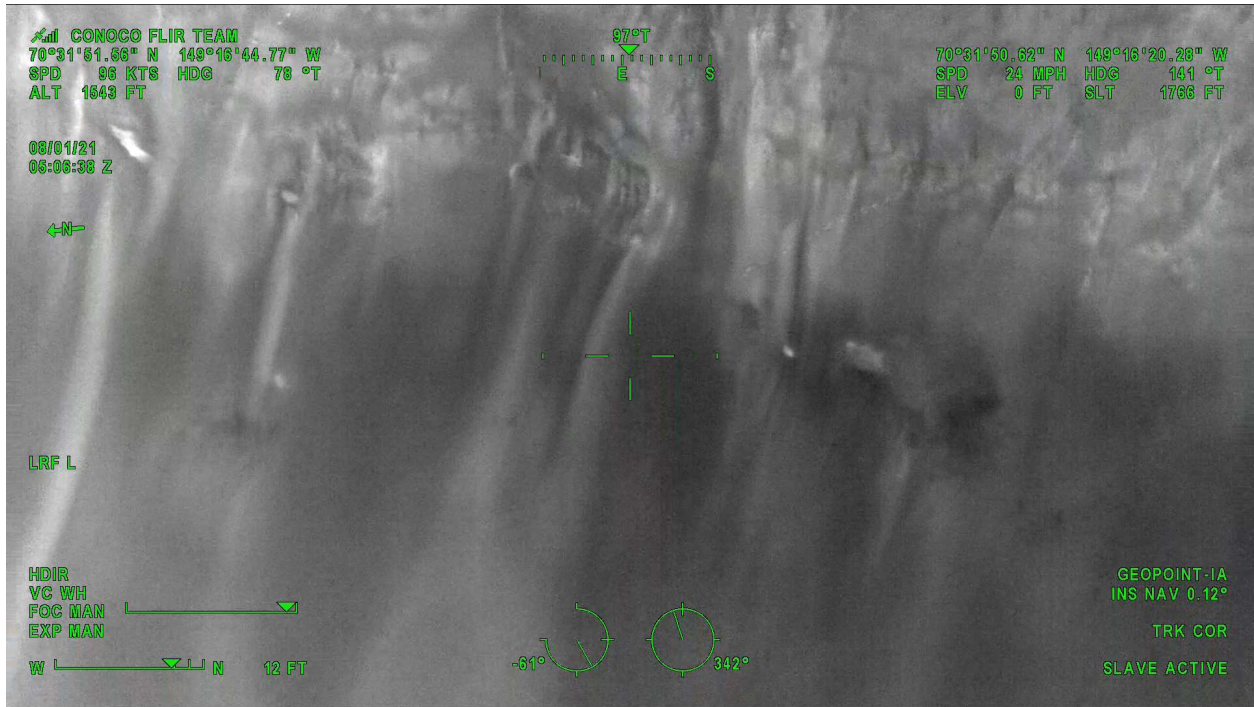


Photo 3: Hotspot 2003-January 2021

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