

Summaries of 2021 Environmental Field Studies

Each year ConocoPhillips conducts scientific field studies throughout the Colville River and northeastern National Petroleum Reserve – Alaska (NPR-A) on the North Slope of Alaska. These studies are conducted by respected scientists with many years of experience on the North Slope. In 2021, our studies focused on several avian species (eiders, king eiders, yellow-billed loons), air quality, fish and local fisheries, caribou, hydrology, cultural resources, and subsistence.

In an effort to share the study information more broadly with our stakeholders, we asked the scientists to prepare a one-page summary explaining their work; where it was conducted; the reason(s) for the research; and an overview of their preliminary study findings. This booklet contains the one-page summaries of the biological and physical environmental field studies conducted in Colville River Unit and NPR-A during calendar year 2021.

ConocoPhillips has also posted these one-page summaries on the North Slope Science Initiative (NSSI) Nuiqsut Environmental Information Website. On this website, you can also find all the ConocoPhillips scientific reports from environmental monitoring studies conducted within 50 miles the Nuiqsut area.

<https://northslopescience.org/nuiqsut/>



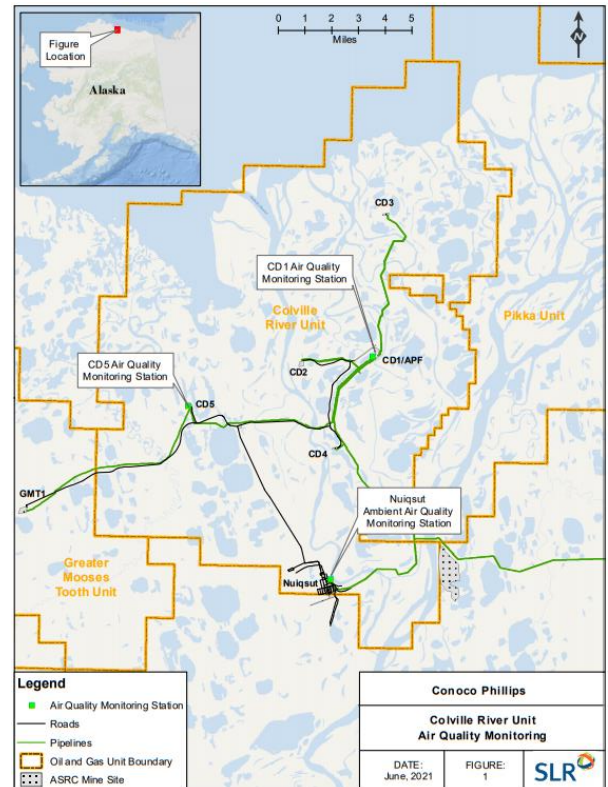
AMBIENT AIR QUALITY MONITORING FOR THE COLVILLE RIVER UNIT

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), SLR International Corporation (SLR) operates Air Quality Monitoring Stations in the Colville River Unit to collect continuous ambient air quality and meteorological data. These stations monitor concentrations of “criteria pollutants” — carbon monoxide, ground-level ozone, particulate matter, nitrogen dioxide, and sulfur dioxide. Each site utilizes Environmental Protection Agency (EPA) approved pollutant specific analyzers to continuously measure ambient air quality. Meteorological sensors are installed on a tower in Nuiqsut to determine local climate and atmospheric dispersion. Data has been collected at various sites since 1999, prior to the construction of the Alpine Central Processing Facility, and has continued throughout construction and operational phases of Alpine and its satellites.

Where did we go?

One station (Nuiqsut Monitoring Site, est. 1999) is located at the northern edge of the village of Nuiqsut, approximately 450 yards northwest of the community electrical generators, and is the site that accommodates a full meteorological tower. Another station is located at the Alpine CD1 facility (2012-2015; 2017-present), approximately 25 miles southwest of the Beaufort Sea and nine miles north of the village of Nuiqsut. Lastly, Alpine CD5 drill site (est. 2015) is near the Colville River Delta, 51 miles west of the Kuparuk River and eight miles north of the village of Nuiqsut. The data collected at these sites are remotely monitored by technicians in SLR’s Anchorage office, and on-site monthly maintenance is performed by these technicians to ensure quality data is being collected.



Monitoring locations in the Colville River Unit.

Why were we working in the area?

Nuiqsut Monitoring Site –This site collects EPA major permit quality data to document Nuiqsut air quality near regional oilfield development. This site measures a) background ambient concentrations of air quality pollutants and particulate matter to establish National Ambient Air Quality Standards (NAAQS) compliance status for the monitoring location, and b) meteorological parameters at the project site from ground level up to ten meters above ground level. It provides required meteorological data for the most widely used modeling system and meets the Meteorological Monitoring Guidance for Regulatory Modeling Applications that is necessary for air quality permitting. This site was voluntarily operated until the Greater Mooses Tooth (GMT) One Record of Decision from the BLM in 2015 required its operation in perpetuity.

CD1 Monitoring Site – Originally collected ambient air pollutant data representative of the CD1 area to support potential major permitting, for minor air quality permitting under 18 Alaska Administrative Code (AAC) 50.502, and to demonstrate “real-world conditions” representative of an operating production facility. Since 2017, this site collects EPA permit quality data to satisfy PM_{2.5} collocation monitoring requirements under 40 CFR 58.

CD5 Monitoring Site –This ambient air pollutant data is representative of the CD5 area and is being collected to provide local ambient air quality conditions required for EPA permitting, and minor air quality permitting under 18 AAC 50.502. This station is required by the North Slope Borough Rezone Ordinance for GMT2.

What are our preliminary findings?

Data collected to date in 2021:

- Satisfies NAAQS and Alaska Department of Environmental Conservation standards.
- Meets or exceeds EPA data quality requirements for PSD monitoring.
- Documents ambient air quality to be in “Good” to “Moderate” Index following the United States EPA Air Quality Index (AQI).



Interior and exterior photographs of CD5 Air Monitoring Station.

VOLATILE ORGANIC COMPOUND STUDY

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), SLR International (SLR) has been collecting volatile organic compounds (VOC) samples since 2014. The United States Environmental Protection Agency (EPA) defines VOC as “any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.” VOC originates from natural sources (forest, soil, etc.) and anthropogenic sources (urban and industrial activities). Samples of ambient air have been collected monthly in Summa canisters (see diagram below) from multiple sites near the Alpine oilfield and in an urban area, then sent for laboratory analysis.

Where did we go?

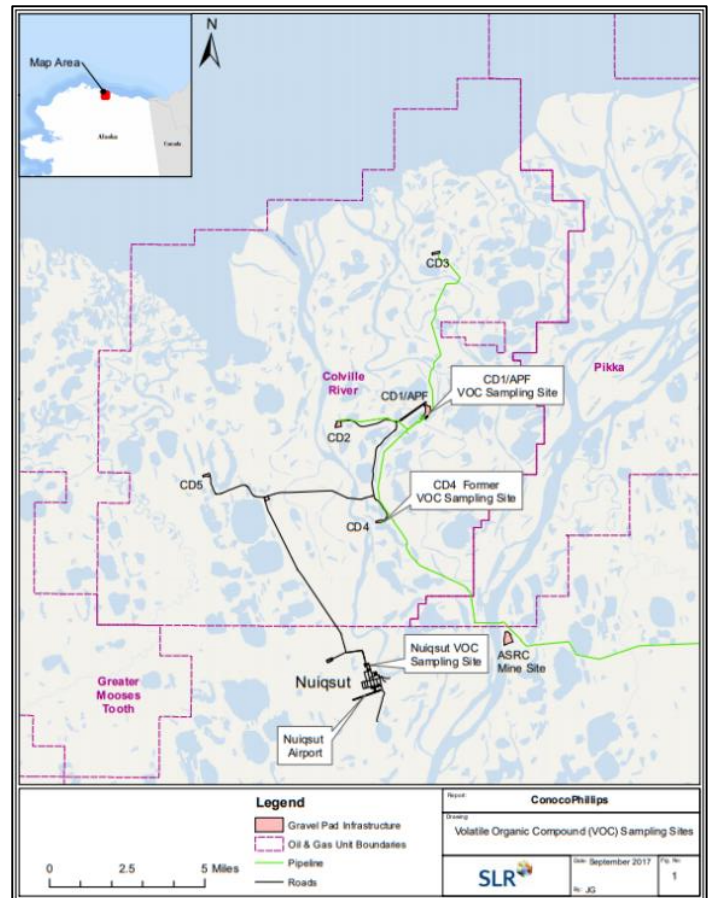
The study area includes Nuiqsut, CD1, and Anchorage. The North Slope samples are collected near the CPAI air quality monitoring stations. The Nuiqsut station is at the northern edge of Nuiqsut, approximately 450 yards northwest of the community electrical generators. The CD1 samples are collected at the Alpine CD1 facility, approximately nine miles north of the village of Nuiqsut. The Anchorage sampling site is collected at the CPAI downtown parking lot.

Why were we working in the area?

VOC samples are collected to address concerns of the residents of Nuiqsut regarding air quality in the village and potential impacts associated with nearby oilfield construction, drilling, and production activities. This additional program expands the ongoing air quality monitoring program on the North Slope. The VOC study program was designed to collect scientifically rigorous, accurate VOC data to document regional VOC concentrations that are representative of Nuiqsut, Alaska.

What are our preliminary findings?

The initial 2014 short-term VOC data results were below the method detection limits (MDL) and national toxic levels. Samples collected over a 24-hour period versus samples collected over a 1-hour period did not show increased VOC concentrations. The long-term ongoing VOC data results are similar to those observed during the initial survey, and 2021 results are in line with long term trend. Ambient VOC concentrations from the Anchorage downtown sample are generally greater than concentrations collected at the North Slope sites.



Alpine Oilfield VOC Sampling Locations.

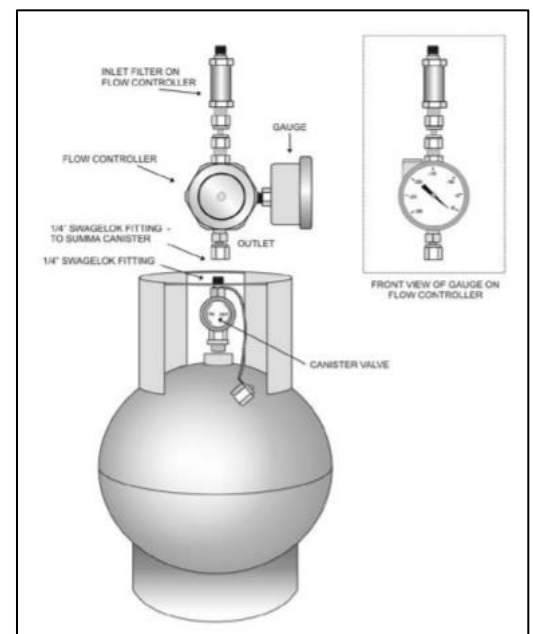


Diagram of a passive sampling setup for Summa Canister.

MONITORING EIDER NESTS AT ALPINE

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) conducted ground-based searches in June, primarily looking for nests of Spectacled Eiders. The goal was to locate nests of sensitive species such as Spectacled and Steller's eiders prior to conducting off-pad activities that could disrupt these nesting birds. Locations of active eider nests were communicated to CPAI field environmental staff, and planned activities occurring near nests were modified as needed to prevent disturbance. ABR, founded in Fairbanks, Alaska, has provided biological and ecological consulting services for more than 40 years. This summer was the 13th season that eider nest searches have been conducted in advance of off-pad work in the Alpine Oilfield.

Where did we go?

ABR conducted ground nest searches on the Colville River Delta and in the Greater Mooses Tooth (GMT) development area at Alaska Clean Seas (ACS) spill response sites, pipelines, ice roads, and lake sites. Biologists drove and walked to sites near the road system when possible and used a helicopter to access sites far from roads. See sites in the map to the right.

Why were we working in the area?

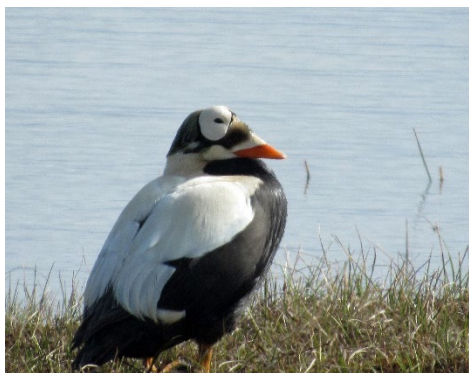
The Alpine Satellite Development Project (Alpine) is within the current or historical breeding ranges of 2 species of eiders that are listed as threatened under the Endangered Species Act (ESA), these are: Spectacled Eider and Steller's Eider. Spectacled Eiders are regularly observed in the Alpine region while Steller's Eiders are extremely uncommon. CPAI occasionally conducts off-pad activities necessary for regulatory compliance and operations during the eider breeding season (June and July), such as tundra clean-up after the ice-road season, spill-response equipment deployment, hydrological monitoring, water access, or civil surveys. Searching for eider nests before off-pad work is conducted is a requirement of ESA compliance and development permitting.

What are our preliminary findings?

- ABR searched 16 sites in June 2021 and found 1 Spectacled Eider nest and 1 unidentified eider nest. Both nests were found outside the 200-meter buffer around off-pad work sites.
- The team also found 88 nests of 12 other species, including 74 Greater White-fronted Geese, 1 Snow Goose, and 1 Cackling Canada Goose. A Rough-legged Hawk nest was found on the bridge near the ALP-16 ACS site.



Alpine study area



Male Spectacled Eider.



Eider nest.



Nest-searching crew waiting for helicopter.

AERIAL SURVEYS OF EIDERS ON THE COLVILLE RIVER DELTA

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) conducted surveys of Spectacled and King eiders on the Colville River Delta during the pre-nesting season (early June) using a small fixed-wing aircraft. Biologists recorded species, numbers, locations, and habitats for all eiders observed. ABR has provided biological and ecological consulting services for more than 40 years. This long-term study began in 1993, prior to oil development on the delta. During the past three decades, ABR has identified important locations and habitats used by eiders and have monitored eider numbers throughout all phases of construction and operation of the oilfields in the Colville River Delta.

Where did we go?

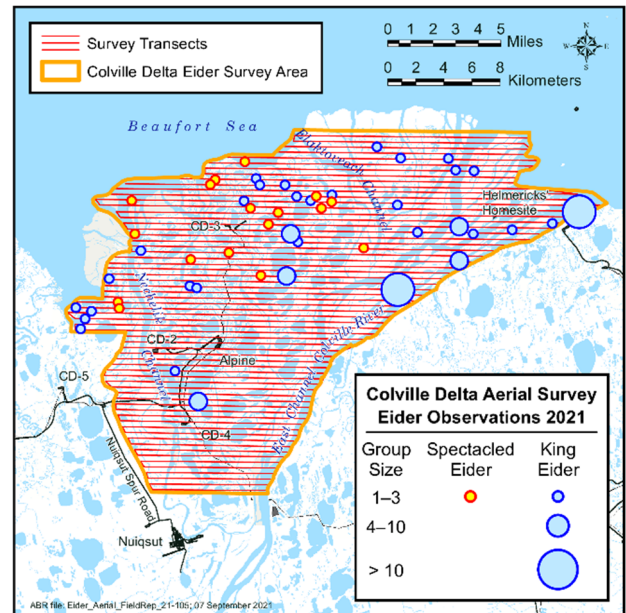
ABR surveyed the area between the Nechelik and East channels of the Colville River (see map to the right). The survey area was bounded on the north by the mud flats of the outer delta, and on the south by an east-west line about 2 miles (3.2 km) north of the village of Nuiqsut.

Why were we working in the area?

The Colville River Delta is recognized as an important breeding area for eiders. The Spectacled Eider was listed as threatened under the Endangered Species Act in 1993. CPAI was required by the U.S. Fish and Wildlife Service to study the species when the CD3 drillsite was built in the early 2000s. King Eiders are an important subsistence resource in North Slope Borough communities, and migration studies have indicated that the species has declined in recent decades in the Arctic. The North Slope Borough has required continued monitoring of eiders on the Colville River Delta due to the value of the delta for these sensitive species and the importance of these species to local communities.

What are our preliminary findings?

- There were more King Eiders than Spectacled Eiders on the Colville River Delta during the pre-nesting period in 2021. In the past, Spectacled Eiders often outnumbered King Eiders during this survey, but King Eiders have been more abundant in 12 of 28 years since 1993.
- The density of Spectacled Eiders on the Colville River Delta was below average in 2021. Spectacled Eider numbers have varied from year to year, but overall, their numbers on the delta have not changed much since surveys began in 1993. In contrast, the density of King Eiders was well above average in 2021, and numbers have increased within the study area over the past 30 years.
- As in previous years, most Spectacled Eiders were found north of Alpine and east of the Elaktoveach Channel. King Eiders were widely distributed, with concentrations occurring in river channels and flooded areas near the coast.
- Based on the habitats that Spectacled and King eiders were observed using and on past observations during ground nest searches, it is likely that most Spectacled Eiders seen during the pre-nesting survey were breeding on the Colville River Delta and that most King Eiders were likely moving through the area to breed elsewhere.



Colville Delta study area



Spectacled Eider pair.



King Eider pair.



View of Colville Delta during survey.

AERIAL SURVEYS FOR MOLTING AND BROOD-REARING GEESE IN THE WILLOW PROJECT AREA

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) conducted an aerial survey for molting and brood-rearing geese in the Willow Project area during late July. Surveys were timed to avoid impacts to subsistence users in the area. Biologists recorded species, locations, and numbers of adults and young for all geese observed. ABR has provided biological and ecological consulting services in Alaska for more than 40 years and last surveyed geese in the Willow Project area in 2001–2004. Biologists will compare the current number of geese in the Willow Project area with the number of geese observed in 2001–2004, and with the number of geese in other locations on the Arctic Coastal Plain. This was the first year of a multi-year study.

Where did we go?

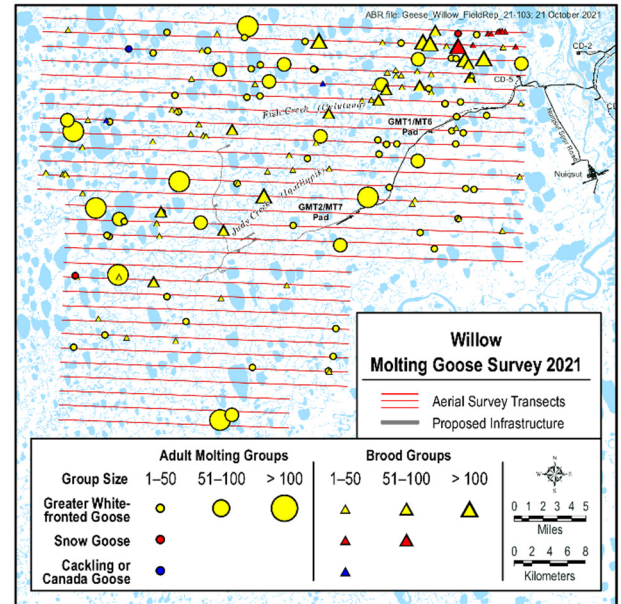
Using a small fixed-wing aircraft, ABR flew surveys in the GMT and Willow project areas, as shown in the figure to the right. The survey area, which included Fish and Judy creeks and existing and proposed infrastructure in the project areas, was 4.5 mi (~7 km) west of Nuiqsut and encompassed about 760 mi² (1970 km²).

Why were we working in the area?

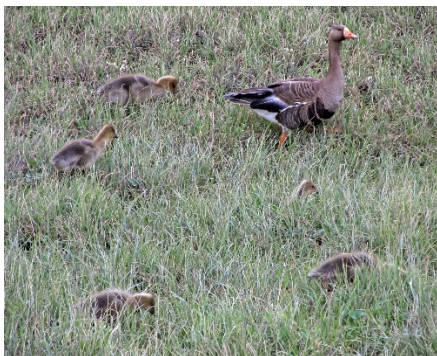
CPAI funded these surveys to satisfy North Slope Borough rezone stipulations for the Willow Project. Geese are an important subsistence resource, and molting and brood-rearing geese are sensitive to disturbance because they are unable to fly. These surveys provide valuable information on the status of goose species near current and future oil development. Data from this project will be used to identify any important goose brood-rearing and molting areas in the Willow Project area.

What are our preliminary findings?

- Biologists recorded 161 groups of geese (4,848 adults and 1,362 goslings) on water bodies (excluding birds seen only in flight). Densities were highest in the northern half of the study area.
- Greater White-fronted Geese were recorded throughout the study area and were by far the most abundant species (4,398 adults and 1,114 goslings). The density of Greater White-fronted Geese appears to have increased substantially in the area since 2001–2004.
- Snow Geese prefer coastal areas for brood-rearing and molting, and most Snow Geese were found in the northeast corner of the survey area, within 5 mi of the coast. Very few Snow Geese were recorded in the area during earlier surveys in 2001–2004, but their numbers and range have increased substantially in the region over the past 15 years.
- White-cheeked geese (Cackling and/or Canada geese) were found in small numbers in the northern part of the study area, similar to results from 2001–2004.
- The survey was postponed over a week in 2021 to avoid disturbance to subsistence caribou hunts, and many geese had regained flight by early August when the survey was completed. We hope to conduct future surveys earlier in the season, when more molting geese are flightless, to better measure the numbers of geese that molted there.



Willow survey area



Greater White-fronted goose and brood feeding.



Greater White-fronted Goose.



White-cheeked geese (Cackling and/or Canada geese).

SHOREBIRD MONITORING IN THE WILLOW PROJECT AREA

What did we do?

On behalf of ConocoPhillips Alaska (CPAI), ABR, Inc.—Environmental Research & Services (ABR) searched for nests of shorebirds, songbirds, and waterfowl during early June through mid-July 2021. A team of biologists established new plots at a variety of distances from planned infrastructure and will monitor the plots before, during, and after construction of the Willow Project. The team found nests using 2 methods: rope dragging to find nests of species that tend to flush from nests at close distances, and behavioral observation to find nests of species that tend to flush at farther distances. They also re-established 4 historical plots located north of the GMT2/MT7 pad that ABR surveyed during 2001–2004. ABR is monitoring the plots to see whether there have been any changes to the distribution and number of shorebird nests since 2004. At all plots, biologists collected data on predators and environmental factors such as snow cover and habitat type. This was the first year of a long-term study, and biologists will search the same plots for nests in future years. ABR, founded in Fairbanks, Alaska, has provided biological and ecological consulting services for more than 40 years.

Where did we go?

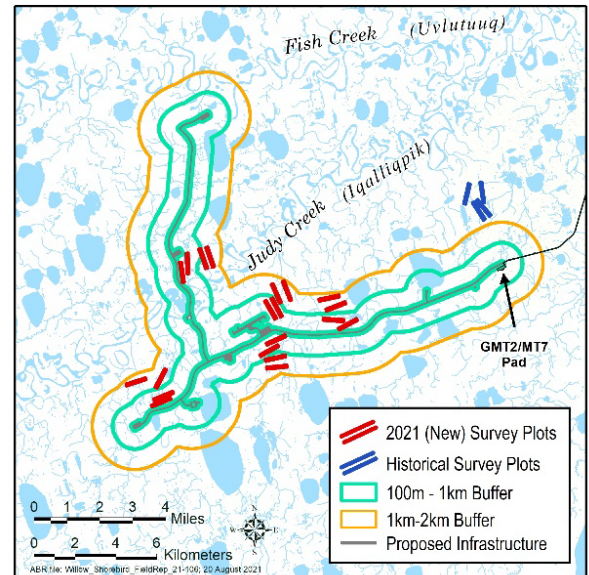
Biologists used a helicopter to access research plots in the Willow Project area, indicated on the map, and visited each plot multiple times during the season. As infrastructure is built, biologists will rely less on helicopters and more on trucks and walking to access plots in future years.

Why were we working in the area?

CPAI is funding this multi-year shorebird project to satisfy North Slope Borough (NSB) rezone stipulations for the Willow Project. Data collected during this study will help CPAI and the NSB understand the baseline (pre-construction) distribution, numbers, and success rates of shorebird nests in the Willow Project area. Comparing baseline results to post-construction results will help biologists, land users, and land managers understand what effects development and environmental factors may have on breeding shorebirds.

What are our preliminary findings?

- ABR established, searched, and monitored 24 research plots in the Willow area.
- Biologists found 183 nests of 20 species across all plots, including 92 nests of 10 shorebird species. The most common nesting shorebird species were Pectoral Sandpipers, Long-billed Dowitchers, and Red-necked Phalaropes. The most common non-shorebird species was Lapland Longspur.
- A biologist installed 10 small temperature loggers in the nests of common nesting shorebird species to help determine the exact date of hatch or failure. These may help reduce future researcher disturbance to breeding shorebirds by reducing the number of times each nest is visited. All 10 loggers successfully collected temperature data.
- The majority of shorebird nests found in 2021 hatched at least 1 chick. Similarly, when ABR last studied shorebirds in the NPR-A during 2001–2004, most shorebird nests hatched. The number of shorebird nests that hatch varies widely by species.



Willow shorebird study area



Pectoral Sandpiper chicks and egg.



Floating eggs to determine nest age.



Adult Long-billed Dowitcher.



Shorebird plot in the Willow area.

AERIAL SURVEYS FOR MOLTING AND BROOD-REARING BRANT AND SNOW GEESE ON THE COLVILLE RIVER DELTA

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) conducted an aerial survey for molting and brood-rearing Brant and Snow Geese on the Colville River Delta in late July 2021. Surveys were timed to avoid impacts to subsistence users in the area. Biologists recorded the locations of all Brant and Snow Geese observed, estimated the numbers of adults and young in each group, and photographed brood groups to obtain precise counts. ABR has provided biological and ecological consulting services in Alaska for more than 40 years, and has conducted similar surveys on the Colville River Delta since 1992.

Where did we go?

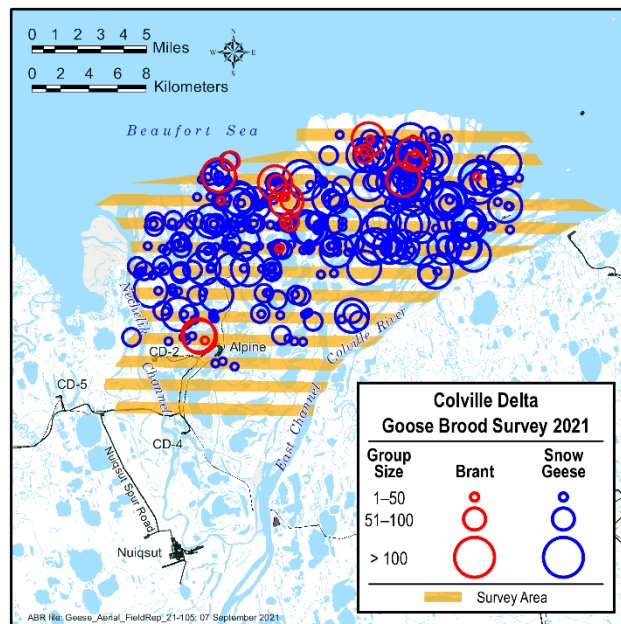
ABR used a small fixed-wing airplane to survey the area between the Nechelik and East channels of the Colville River, as shown in the map to the right. The survey area included a series of east-west oriented transects, each 0.5 mile (0.8 km) wide, and evenly spaced 1 mile (1.6 km) apart, resulting in 50% coverage of the delta. Biologists surveyed a total of 13 transects, which were bounded on the north by the mud flats of the outer delta and on the south by an east-west line about 6 mi (9.7 km) north of Nuiqsut. The total area surveyed was about 87 mi² (225 km²).

Why were we working in the area?

CPAI funded these surveys to satisfy North Slope Borough rezone stipulations for the Greater Mooses Tooth 2 (GMT2) Project. Geese are an important subsistence resource, and these surveys provide valuable information on the status of Brant and Snow Geese near current and future oil development. Data from this project will be used to look for changes in numbers of Brant and Snow Geese over time and to identify important habitats and specific locations used by brood-rearing geese on the Colville River Delta.

What are our preliminary findings?

- Biologists visually estimated 2,338 Brant (1,151 adults and 1,187 goslings) and 27,277 Snow Geese (14,183 adults and 13,094 goslings) during the survey in 2021. The photos have not yet been examined for precise counts.
- Numbers of brood-rearing Brant have increased steadily on the Colville River Delta over the past 3 decades, from fewer than 2,000 birds/year prior to 1998 to over 5,000 birds/year since 2017.
- Most Brant rear their broods on the outer delta north of CD3.
- Snow Geese were rarely seen on the Colville River Delta prior to the early 2000s, but their numbers have increased dramatically over the past 16 years, from fewer than 1,000 brood-rearing birds in 2005 to over 50,000 in 2021.
- Much like Brant, Snow Geese prefer coastal habitats for brood rearing, but in recent years their range has expanded, and in 2021, Snow Geese were found south of Alpine, up to 9 miles (14.5 km) from the coast.



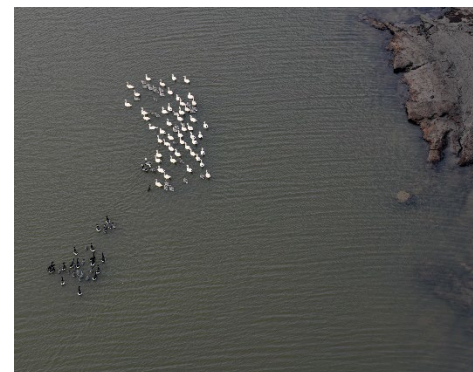
Colville Delta survey area



Brood-rearing Brant.



Brood-rearing Snow Geese.



Aerial view of Snow Geese and Brant.

MONITORING YELLOW-BILLED LOONS IN THE WILLOW AREA

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) flew surveys around lakes to look for Yellow-billed Loon nests in June and chicks in August. The purpose of the study is to determine the abundance, distribution, and nesting success of Yellow-billed Loons in the proposed project area. During the surveys, a biologist flew in a helicopter along the shoreline of lakes, islands, and peninsulas, and recorded loon observations. Scientists also set up time-lapse cameras at some nests to monitor the behavior of loons and identify egg predators. ABR, founded in Fairbanks, Alaska, has provided biological and ecological consulting services for more than 40 years. ABR has conducted Yellow-billed Loon surveys in the Willow area since 2017.

Where did we go?

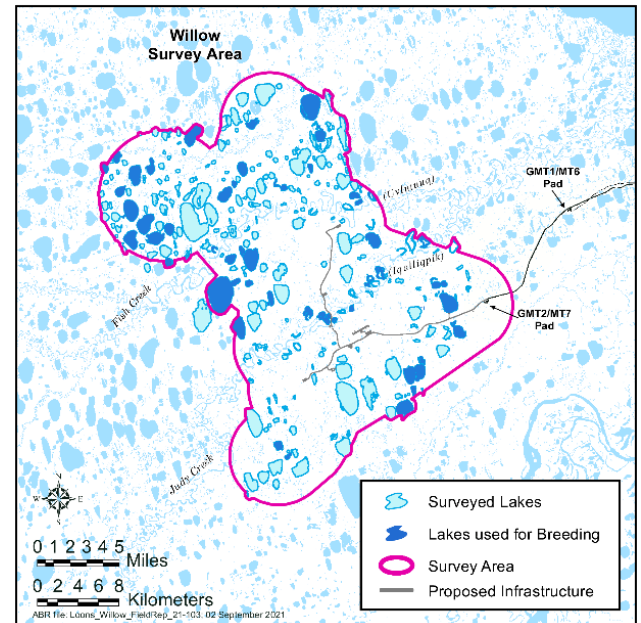
The Willow survey area includes over 300 lakes within 3 miles of the proposed Willow roads and pads—a survey area that extends 330 mi², shown in the map to the right. A helicopter must be used for surveys because the study area is large, and nests and young are most visible and best counted during short periods of the summer. It is important to fly surveys at the same time each year to compare the number of adults, nests, and chicks seen among survey years.

Why were we working in the area?

The Bureau of Land Management (BLM) designated the Yellow-billed Loon as a Sensitive Species, meaning that the BLM works cooperatively with other agencies and organizations to proactively conserve Yellow-billed Loons. Yellow-billed Loons are sensitive to disturbances and leave nests when people are nearby, exposing nests to predators. BLM stipulations specify setbacks between infrastructure and nest sites and lakes used by Yellow-billed Loons. Data from this study may help evaluate the effectiveness of the BLM stipulations. Monitoring of nesting Yellow-billed Loons also satisfies North Slope Borough rezone stipulations for the Willow Project.

What are our preliminary findings?

- ABR identified 2 new lakes being used by brood-rearing Yellow-billed Loons during surveys in 2021, increasing the total number of lakes used by breeding loons to 60 in the Willow area.
- ABR counted 33 nests and 18 young during 2021. That number is more nests than ABR has typically finds in the Willow area, but that was fewer young compared to most previous years.
- Yellow-billed Loons can hatch up to 2 chicks but most pairs in 2021 had only 1 chick during the brood-rearing survey.
- One time-lapse camera documented nest failure by a subadult Bald Eagle that landed at a loon nest to eat eggs.



Willow survey area



ABR biologist Joe Welch setting up a time-lapse camera.



Floating an egg to determine nest age.



Loon pair with chicks from time-lapse camera.

KING EIDER STUDY IN THE GREATER MOOSES TOOTH AND WILLOW AREAS

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) flew a survey over 2 new oil development areas searching for pairs of pre-nesting King and Spectacled eiders in early June. Following the aerial survey, 4 biologists searched for King Eider nests on the ground in 20 treatment plots (near planned or existing oil development) and 21 control plots (located far from developments), as shown in the map to the right. The team searched 8 new plots this year, and 7 plots searched in 2020 were dropped from the study due to poor eider habitat or changes in the Willow Development Plan. Plots searched in 2021 will be revisited during the remaining 3 years of this study. At each plot, biologists recorded details of all nests found (including those of non-eider species) and counted potential predators. They set up trail cameras on each active eider nest and revisited those nests post-breeding to determine nest fate. This was the second year of a 5-year study.

Where did we go?

For the aerial survey, a small fixed-wing aircraft flew along transects spaced evenly at half-mile intervals from Fish Creek south to include the Greater Mooses Tooth (GMT) and Willow project areas. For nest searching, the team used a truck to access all plots near the GMT road (within approximately 0.25 mile) and a helicopter to access plots that were far from the road.

Why were we working in the area?

As part of the rezone ordinance for GMT2, the North Slope Borough (NSB) required a waterfowl study to examine the potential impacts of oil development on nesting birds. CPAI and NSB biologists decided that King Eiders—an important subsistence species in NSB communities—would be the focal species of the study. The goal of the study is to determine if construction and post-construction activities of the GMT and Willow projects affect the nest site selection or reproductive success of King Eiders.

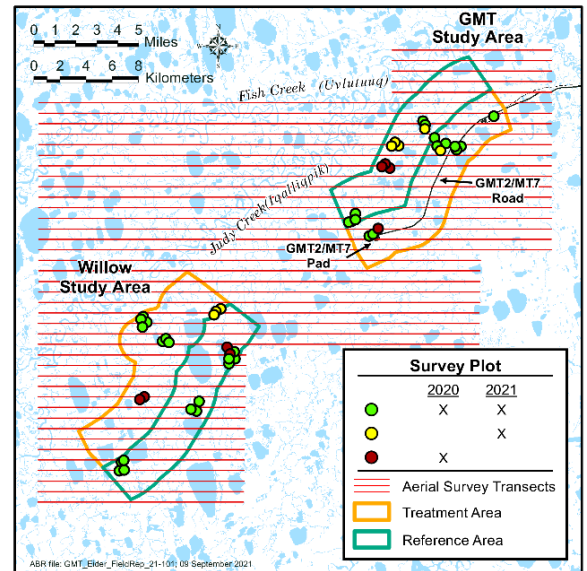
What are our preliminary findings?

Aerial Surveys:

- The team flew approximately 715 miles (1,150 km) of linear transects.
- King Eiders were broadly distributed throughout the study area. Biologists counted 143 King Eiders in 2021, which was similar to the number counted in 2020. Most occur as pairs or single males (assumed to be paired with females that are more difficult to see).
- Spectacled Eiders have occurred in very low densities during the first 2 years of this study. A single Spectacled Eider male was observed from the airplane in 2021, and none were observed in 2020.

Ground Surveys:

- In 10 days of nest-searching, 11 eider nests were found across the control and treatment sites. Nine nests were active King Eider nests, and 2 were failed nests.
- Cameras successfully recorded the fate of each active nest. Camera images will also be used to quantify incubation behaviors of female eiders.
- Of the 9 active nests, 8 were successful, and 1 failed from predation by an arctic fox.



GMT and Willow survey areas



Female King Eider on nest.



Arctic fox from nest camera.



Biologist setting up a camera on a nest.

AERIAL SURVEYS OF YELLOW-BILLED LOONS ON THE COLVILLE RIVER DELTA

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) flew surveys around lakes to look for Yellow-billed Loon nests in June and for chicks in August. During the surveys, a biologist flew in a helicopter along the shoreline of specific lakes, islands and peninsulas, and recorded loon observations. The purpose of the study is to document the abundance, distribution, and nesting success of Yellow-billed Loons in the project area. ABR first surveyed the area in 1993, prior to Alpine’s development. Surveys have continued throughout the construction and operational phases of Alpine and its satellites. ABR, founded in Fairbanks, Alaska, has provided biological and ecological consulting services for more than 40 years. This is the 27th summer of monitoring breeding Yellow-billed Loons on the Colville River Delta for CPAI.

Where did we go?

When surveys were first conducted, ABR surveyed all large lakes on the Colville River Delta. In more recent years, however, only the lakes where Yellow-billed Loons had been seen during the previous 21 years were included. The survey area, shown in the map to the right, is more than 200 mi² and contains roughly 120 survey lakes.

Why were we working in the area?

Yellow-billed Loons breeding in Alaska belong to a small, unevenly distributed population. In 2009, the species was proposed but not listed under the Endangered Species Act. Today, state and federal agencies still consider the Yellow-billed Loon a species that warrants special management. These surveys have been critical in assessing the status of the population and are helping land managers understand how loons might react to future oilfield development in the National Petroleum Reserve in Alaska. Continued monitoring of this species satisfies North Slope Borough requirements (2018 Alpine-GMT Rezone Ordinance).

What are our preliminary findings?

- ABR identified 2 new lakes being used by nesting Yellow-billed Loons during surveys in 2021, increasing the total number of lakes used by breeding loons to 65 lakes on the Colville River Delta.
- Biologists identified 29 nests and 11 young during surveys in 2021. While more nests than usual were found, fewer young were observed than typical. A similar number of loons were seen during surveys in 2020.
- The average lake size used by breeding Yellow-billed Loons on the Colville Delta is 53 hectares, an area equivalent to nearly 100 football fields. Within these lakes, the majority of nests are found on islands.



Colville River Delta survey area



Adult Yellow-billed Loon near nest.



Aerial view of nest site (yellow arrow) and proximity to the CD3 drill site.



Yellow-billed Loon chick in nest.

CULTURAL RESOURCES SURVEYS



The remains of a sod house and boat in the project area.

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), Reanier and Associates, Inc. conducted cultural resource surveys in CPAI's areas of operation and in the Willow area in 2021. The Willow Development area was previously examined for archaeological sites in 2017, 2018, and 2019. Examinations of the area date back to 1976 – only three years after Nuiqsut was re-settled and the first year that Dr. Rick Reanier worked in the Nuiqsut area. Barely visible in the photo to the left, a sod house was recorded in 2002. The most conspicuous feature is a wrecked boat, the bleached wood of which is clearly seen from the air. Most of the boat is on the south side of the house, but some wreckage is on the north and east sides. The boat's presence at the house is unusual – perhaps it was no longer usable as a boat, so it was incorporated into the house structure to strengthen it. The boat had been

modified to raise its rails a few inches to provide more freeboard (See photos below). Dr. Reanier later learned from Nuiqsut Elders that the house had likely belonged to George Leavitt Sr. In front of the house is an unusual artifact, a short wooden pole with a handle on one end and a split brass tube nailed to the other. Its function is unknown, but perhaps it is a short ice chisel, or *tuuq*. The brass tube is a match for one found at another sod house. Possibly it was left behind by the Navy in the mid-1940s and utilized by Mr. Leavitt.

Where did we go?

From 2017 to 2021, all of the areas for proposed Willow gravel roads and pads, including the airstrip and gravel mine, were searched for evidence of these old sites. Both aerial and on-the-ground surveys were conducted. As development plans evolved, new studies were conducted on the revised areas.

Why were we working in the area?

Archaeological and historic sites are places where people once lived and worked, leaving behind traces of their presence. Many such sites are also part of the cultural heritage of the village of Nuiqsut. There are numerous Borough, State, and Federal laws and regulations that prevent damage to archaeological sites. In order to adequately protect such sites, their locations must be precisely known, which requires an archaeological survey to find and record them. Visiting previously recorded sites to verify locations with modern GPS coordinates is also an ongoing part of the program.



The wrecked boat had been modified to raise its rails a few inches. New pieces of wood were fastened to the ribs and new strakes added.



*The unusual split brass tube attached to the short wooden pole. Perhaps this is an ice chisel or *tuuq* with the blade missing.*

What are our preliminary findings?

- Although there are a few cultural resource sites near the Willow area, sites in the area are generally located near lakes and streams, away from the proposed locations for development.
- Humans have lived on the North Slope for thousands of years, but the sites found in the Willow area relate mostly to historic Iñupiat use of the region and to the initial phase of oil exploration in the 1940s.

This data is shared with appropriate cultural resource agencies, but reports are not available on the North Slope Science Initiative website due to confidentiality requirements.

TINMIAQSIUGVIK/UBLUTUOCH RIVER GMT2 REZONE FISH SURVEYS

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), Owl Ridge Natural Resource Consultants conducted the second year of a five-year monitoring study in the Tinmiaqsiugvik River drainage in the National Petroleum Reserve-Alaska (NPR-A). These studies build on earlier studies in the area that began in 2001.

Researchers sampled three times: after break-up in June, during mid-summer in July, and just before freeze-up in late August. Fish were captured as they moved both upstream and downstream using specialized nets, called fyke nets, that funnel fish into a live-trap end. Water chemistry measurements were recorded daily at each site and all fish captured were identified and measured. Most fish were released, except for a sample of different-sized fish that were retained and analyzed in a laboratory for age and maturity. Fish longer than about seven inches were tagged with a unique number to help evaluate seasonal and annual movements within and between drainages. Local fishers who catch a tagged fish can help researchers understand fish movement by calling the phone number printed on the tag to report it.

Where did we go?

Researchers sampled 10 sites in 2021 and six sites in 2020 throughout the open water season along the mainstem of the Tinmiaqsiugvik River and in small creeks flowing into the river. Sites were located both downstream and upstream of the bridge crossing and accessed solely by boat in 2021.



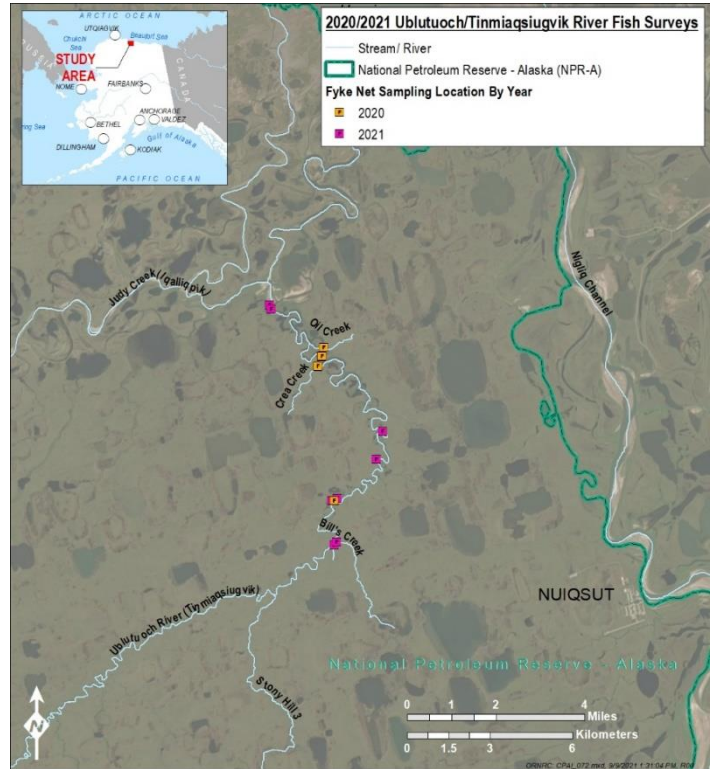
A burbot measuring nearly 30 inches in length caught in August.

Why were we working in the area?

The goal of this study is to better understand how, when, where, and what species, numbers, and ages of fish are using the Tinmiaqsiugvik River drainage. Data collected will support Greater Mooses Tooth 2 Rezone monitoring conditions required by the North Slope Borough. Fish tagging data is used to track fish movements and to develop population estimates that can be compared to past and future estimates. Continued monitoring of fish using the Tinmiaqsiugvik River may also allow an assessment of the potential effects of development activities and climate change on these fish populations.

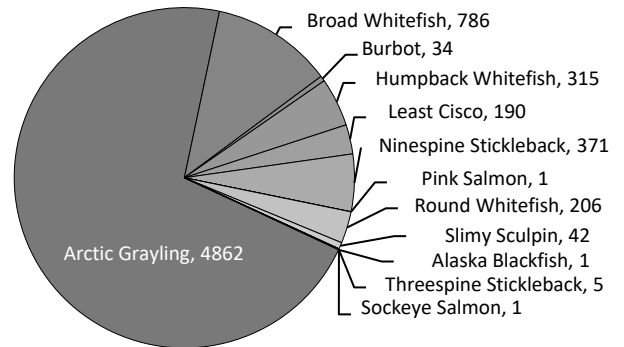
What are our preliminary findings?

- Arctic grayling was the most common species captured in both 2021 and 2020.
- In 2021, Arctic grayling accounted for over 71 percent of the total catch, followed by broad whitefish (12 percent), ninespine stickleback (5 percent), humpback whitefish (5 percent), and round whitefish (3 percent). All other species accounted for about 4 percent of the catch, including one sockeye salmon and one pink salmon.
- Species diversity was typically greatest at downstream mainstem areas of the river and was lowest in upstream reaches and in small creeks.
- Continued data analysis in 2021 will be conducted to generate population estimates and to determine the age, growth, maturity, and other characteristics of fish populations using the drainage.



2021 and 2020 study area and sites sampled.

2021 Breakdown of Captured Fish



2021 to 2020 Comparisons

	2021	2020
Hours Sampled	2,518	2,496
Fish Caught	6,814	7,365
Species	12	11
Fish Tagged	2,499	1,513
Fish Recaptured	766	418

FISH SURVEYS IN THE WILLOW AREA

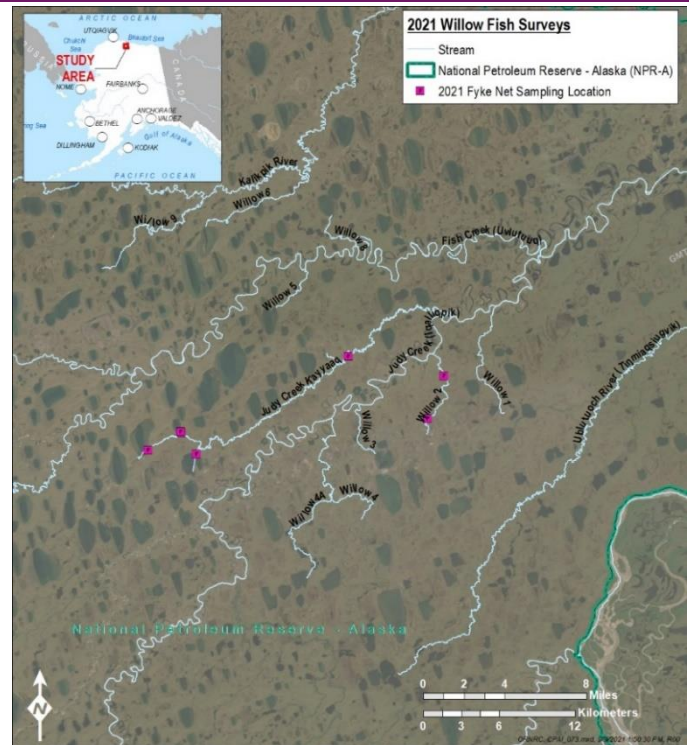
What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), Owl Ridge Natural Resource Consultants studied fish use of streams in the Willow area. Researchers identified the composition of fish species, their seasonal distribution and movements, and population characteristics, such as the size and numbers of fish using streams in the study area.

The team sampled fish three times during each year of the study: just after break-up in June, mid-summer in July, and just before freeze-up in late August. Fish were captured as they moved both upstream and downstream using specialized nets, called fyke nets, that funnel fish into a live-trap end. Each fish was identified, measured, and released. Fish longer than about seven inches were tagged with a unique number to help evaluate seasonal and annual movements within and between drainages. Water chemistry was recorded each day at each site. Local fishers who catch a tagged fish can help researchers understand fish movement by calling the phone number printed on the tag to report it.

Where did we go?

In the 2021 season, the team sampled seven fyke net sites distributed across the mainstem and headwater lakes of Judy Creek Kayyaaq and along a tributary of Fish Creek (Uvlutuq), named Willow 2.



2021 study area and sites sampled.



Tagged Arctic grayling in a holding pen prior to release.

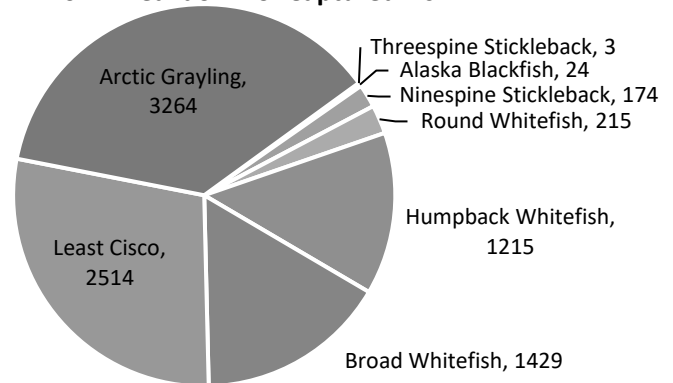
Why were we working in the area?

This study was initially required by the Bureau of Land Management and the Alaska Department of Fish and Game to provide a baseline for understanding how fish use streams in the Willow area and to assess potential future impacts to fish by development activities and climate change. The study is also required by the North Slope Borough and Willow Rezone to help detect and understand possible changes to fish within the project area over time. Collected data was used in bridge and culvert design and construction to ensure and maintain fish passage and fish habitat at stream crossings. In 2021, the sampling goals put emphasis on two specific streams to enable estimates of fish population sizes in addition to monitoring fish seasonal use patterns.

What are our preliminary findings?

- The team captured 8,844 fish consisting of eight different species from 3,930 hours of net soaking time.
- 3,170 fish were tagged, and another 588 fish were recaptured from being tagged earlier in the 2021 season or during past seasons.
- Arctic grayling were the most abundant fish captured and accounted for about 37 percent of total catch, followed by least cisco (28 percent), broad whitefish (16 percent), humpback whitefish (14 percent), and round whitefish (2 percent). All other species accounted for less than two percent of the remaining catch.
- No salmon were caught in the Willow area during 2021, however, low numbers of pink, chum, and sockeye salmon have been captured in the past.
- Fish were widely distributed across the study area and readily moved within and between drainages.
- Results from 2021 and previous years highlight the importance of maintaining habitat connectivity and season-long fish passage.

2021 Breakdown of Captured Fish



LAKE SURVEYS

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), Owl Ridge Natural Resource Consultants surveyed 20 lake basins for fish presence, water depth, and water quality in 2021. The purpose of the surveys was to document fish species presence and habitat within each lake and estimate the volume of water available for potential use based on identified fish and habitat. Surveyed lakes may be used as sources of freshwater during exploration and potential future development for ice road and ice pad construction, drilling support, and as potable water supplies.

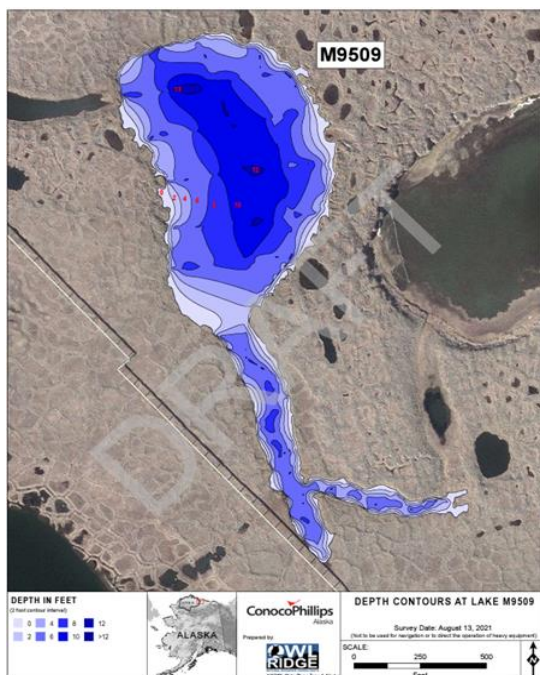
Field scientists surveyed lakes during mid-August. Fish sampling consisted of gill nets, minnow traps, seine nets, dip nets, and visual surveys. Each fish was identified, measured, and released. Water chemistry was recorded daily at each site and water samples were taken for laboratory analysis of water quality. Bathymetric data were collected by two methods to estimate lake volume – GPS/sonar units for lakes deeper than 4 ft and spot depth measurements to approximate maximum depth for lakes shallower than 4 ft deep.

Where did we go?

Lakes were surveyed west of Nuiqsut in the greater Willow project area, north of Nuiqsut along the Colville River, and east of Nuiqsut and the Colville River.

Why were we working in the area?

Lake survey information is required by the Bureau of Land Management (BLM), Alaska Department of Fish and Game (ADF&G) and Alaska Department of Natural Resources (ADNR).



Draft lake bathymetry map showing depth contours.



2021 study area showing sampled lakes.



Researchers conducting lake surveys.

Data informs the permitting process for withdrawal of water during operation and exploration activities. Agency permitting decisions on water withdrawal consider potential impacts to fish that depend on an adequate water supply for surviving winter. Water may be either withdrawn directly, withdrawn from below the ice, or collected as ice aggregate from the lake surface. Data collected during lake surveys ensures that water withdrawal is consistent with the fish species-specific limits established jointly by the ADF&G, ADNR, and BLM, that protect fish and fish habitat.

What are our preliminary findings?

- Detailed bathymetric, fish, and water chemistry data were collected from 19 lake basins and spot depth measurements and water chemistry data were recorded at one lake basin.
- Fish were found in 13 of the 20 lake basins, with broad whitefish and ninespine stickleback being the most commonly caught fish species, while round whitefish and slimy sculpin were the least common.
- Deep lakes with connections to adjacent lakes or streams most often had multiple species of fish, while isolated lakes distant to other waterways often did not have fish or were limited to ninespine stickleback.
- Many lakes were shallow with depths less than 10 feet, while other lakes, especially near the Colville River, exceeded 20 feet in depth.



A captured least cisco.

ICE BRIDGE SUPPORT & WATER QUALITY MONITORING

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), Michael Baker International (MBI) supported the Ice Bridge across the Colville River by monitoring three locations upstream and three locations downstream of the ice bridge. Data includes ice thickness, freeboard, snow and water depth, as well as in-situ water quality readings consisting of temperature, specific conductance, dissolved oxygen, salinity, and water velocity. The team also monitors pH and performs a settleable solids test on water collected at gravel minesites specified by the CPAI Field Environmental Coordinators (FECs). Lastly, measurements are collected on the total dissolved solids, conductivity, and salinity of various lakes used in ice road construction.

Where did we go?

Hydrologists work at locations 1200, 800, and 400 feet upstream and downstream of the Colville River Ice Bridge crossing, and also travel to the minesites on the east side of the Colville River. Additionally, the team travels to Nanuq Lake, Lake M0675, and other lakes as requested by CPAI FECs.

Why were we working in the area?

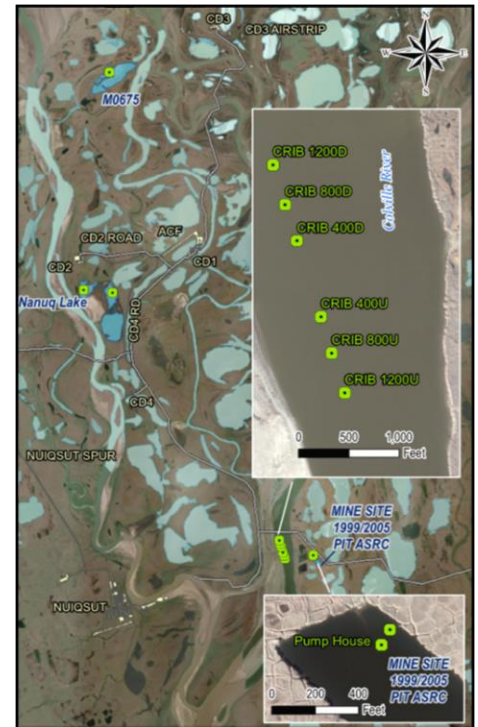
This work meets permit stipulations set forth by the Alaska Department of Fish and Game Fish Habitat Permits and Alaska Department of Natural Resources Temporary Water Use Authorizations. The permits state: "Water quality monitoring will provide data to evaluate free water space beneath the ice bridge to allow for the maintenance of fish habitat throughout the winter, determine whether water withdrawn from the river can be used during ice bridge construction, and determine whether water withdrawn from minesites and lakes can be used during ice road construction." Monitoring reports are provided to agencies weekly during ice bridge construction and operation.

What are our preliminary findings?

- As of 4/20/2021, the average ice thickness at CPAI sites on the Colville River was 6.2 feet.
- Colville River ice thickness grew an average of 0.24 feet every week.
- Colville River water velocity measured at 1200 feet downstream was an average of 0.01 ft/s.
- The water at the ice bridge location is fairly salty. The average salinity reading was 16.8 parts per thousand (ppt) on 4/20/2021; normal saltwater is 33-38 ppt and freshwater is 0.5 ppt or less.
- pH measured at the ASRC Minesite 2005 cell ranged from 7.30 to 7.72.

Interesting facts!

As the smaller streams freeze solid, less freshwater is available to flow downstream and enter larger streams. West winds combined with the Coriolis effect (winds deflecting to the right due to the rotation of the earth) push the saltwater upstream in the winter when flows are lower. Saltwater is denser than freshwater, so the saltwater is on the bottom of the channel when it comes up the river and is commonly referred to as the "salt wedge." The river ice can rise about 1.5 feet after a strong westerly windstorm.



Study area and sites within the Colville River Delta.



Hagglund parked at the 400 feet downstream station.



Team member measuring water quality through the ice.

SPRING BREAKUP MONITORING & HYDROLOGICAL ANALYSIS

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), Michael Baker International (MBI) deployed remote equipment and field personnel to monitor and assess spring breakup flooding within the existing Alpine and Greater Mooses Tooth (GMT) developments as well as in the proposed Willow development. MBI measured hydrologic data including stage and discharge; observed breakup flooding around oil and gas facilities (pipelines, roads, pads, and locations of hydraulic importance); monitored performance of culverts and bridges; and documented breakup flood extents, ice jams, and associated backwater effects. The team additionally monitored proposed stream crossing locations during the summer to document base flow conditions.

Where did we go?

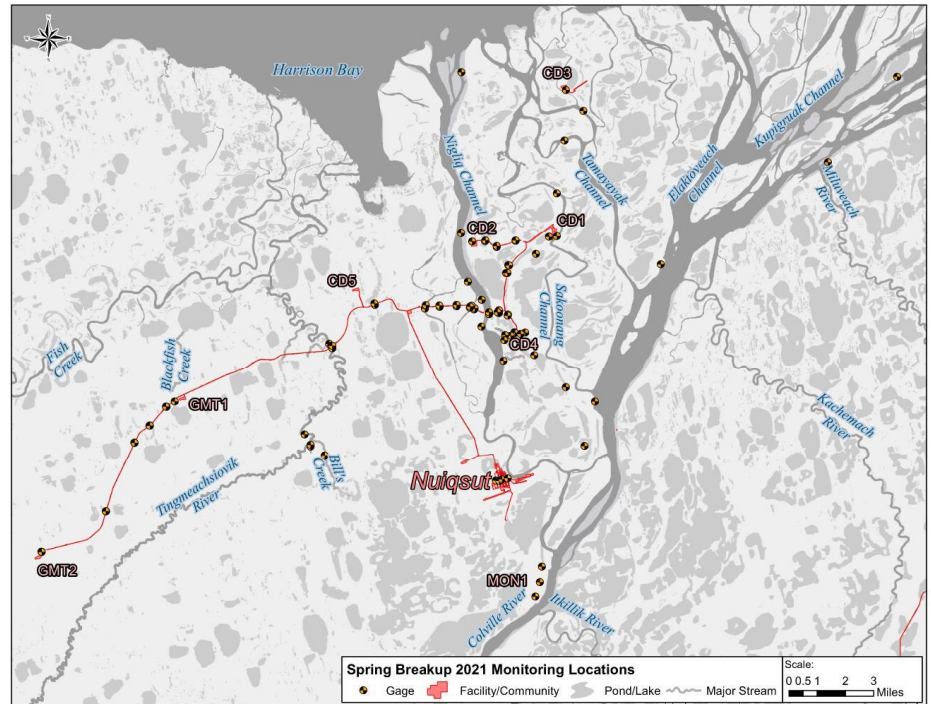
MBI worked at lakes, streams, and flow paths throughout the Colville River Delta and west into the National Petroleum Reserve - Alaska. Field personnel used the road system to access sites along the CD1, CD2, CD4, CD5, GMT1/MT6, and GMT2/MT7 roads. Helicopter use was required to access sites in the Delta not on the road system and sites in the proposed Willow development area.

Why were we working in the area?

This work meets permit stipulations set by the U.S Army Corps of Engineers (USACE) and the Alaska Department of Fish and Game to monitor and mitigate the impacts of installing infrastructure in and around water bodies and to support maintenance of fish habitat. Flood monitoring is also required to inform facility design. Spring breakup monitoring is required at Alpine facilities annually throughout the life of the project per the CD5 USACE permit and for three years post-construction at facilities outside the Colville River Delta (standard USACE stipulation). This was the 30th consecutive year of monitoring in the Colville River Delta.

What are our preliminary findings?

- The 2021 spring breakup flood occurred over a two-week period and water levels were low in the Colville River Delta.
- Peak flooding in 2021 occurred on June 6th and 7th. Peak breakup flooding typically occurs between May 23 and June 5.
- This year's flooding event had minimal ice jamming effects with no backwater or overbank flooding.
- Preliminary 2021 peak stage (water level) at MON1 (see map) was 12.3-ft. The highest observed stage on record was 23.47-ft in 2015 and the average stage is around 17-ft for the last 30 years.



Study area and sites within the Colville River Delta and National Petroleum Reserve – Alaska.



Small ice jam near the East Channel of the Colville and the Nigliq Channel bifurcation.



Measuring flow at culvert along the GMT2/MT7 road.



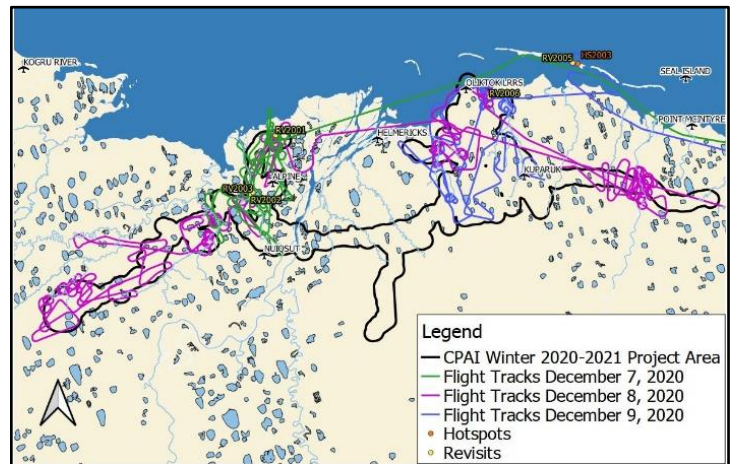
AERIAL INFRARED SURVEY OF POLAR BEAR DENNING HABITAT

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), Environmental Research and Consulting (ERC) conducted aerial infrared surveys in the winter of 2020/2021 to locate potential maternal polar bear dens in the vicinity of ongoing and planned industrial operations occurring on the North Slope of Alaska. Mapped polar bear denning habitat in the CPAI project area was surveyed twice (in early December and early January) to increase the likelihood of den detection. The surveys were conducted using the ConocoPhillips Global Aviation Twin Otter aircraft equipped with the Star SAFIRE® 380-HDc FLIR sensor. Infrared sensors are used to detect heat signatures on the snow surface from the emitted body heat of denned bears.

Where did we go?

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 ≥ 1.3 m in height. These features have been mapped as denning habitat and were overlaid with the proposed CPAI winter activities. Denning habitat within the Kuparuk River Unit, Colville River Unit, Greater Mooses Tooth Unit, Bear Tooth Unit, and along the pipeline routes connecting to TAPS were surveyed. The above map shows survey flight tracks in the project area from December 2020.



Aerial Infrared Survey for Polar Bear Dens-Flight Tracks.

Why were we working in the area?

These surveys are an integral part of a multi-tiered approach to minimizing potential den disturbance from industrial activities, and to better understand bear's use of the landscape. CPAI conducts surveys for polar bear dens prior to initiating winter activities in order to maintain compliance with the U.S. Fish and Wildlife Service issued Letters of Authorization. CPAI has relied on aerial infrared surveys since the early 2000s as the preferred method to meet this requirement.

What are our preliminary findings?

- No suspected den sites were identified in the CPAI project area.
- Two potential polar bear dens were detected in close proximity to one another on a remote island. The barrier islands are considered high probability denning habitat. While outside of the project area, the barrier islands are routinely surveyed to calibrate the IR equipment.
- Other points of interest were identified during the survey effort. Several required re-visits or additional scrutiny of recorded survey footage and were determined to be landscape features, fox excavations, or other landscape features, and were rejected from further consideration as potential polar bear dens.



Twin Otter survey aircraft.



Polar bear den detected on a remote island.

CARIBOU IN THE COLVILLE RIVER DELTA AND GREATER MOOSE TOOTH UNIT

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) used a combination of aerial surveys, satellite imagery, and analysis of radio collars deployed on caribou to assess the seasonal distribution and movements of caribou in the Colville River Delta and Greater Moose Tooth (GMT) Unit. Since 2001, the team has been conducting aerial surveys annually between April and October to count caribou in the area and determine how the densities of caribou vary seasonally and annually. Satellite imagery is also used to map the timing of spring snowmelt and the growth of vegetation in the spring and summer. Using radio collar data, the team tracks the movements of individual caribou and examines how their seasonal movements are influenced by snow cover, vegetation, terrain ruggedness, insect harassment, and distance to coast. This multiyear dataset provides detailed information on which areas are used consistently during different seasons, how those areas correspond with proposed development, and if patterns change after construction. ABR has provided biological and ecological consulting services in Alaska for more than 40 years.

Where did we go?

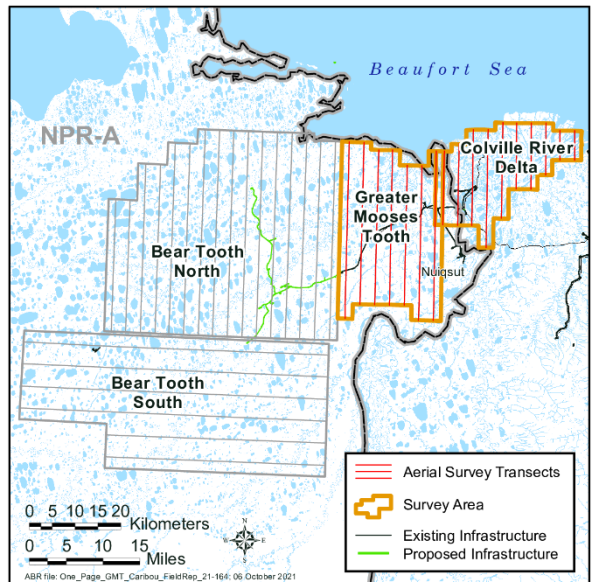
For this project, ABR studied caribou in the Greater Moose Tooth Unit and the Colville Delta, which includes the GMT1/MT6 and GMT2/MT7 pads as well as the Alpine and Alpine Satellite Development pads. A separate but related project studied caribou use of the Bear Tooth Unit to the west (see map above).

Why were we working in the area?

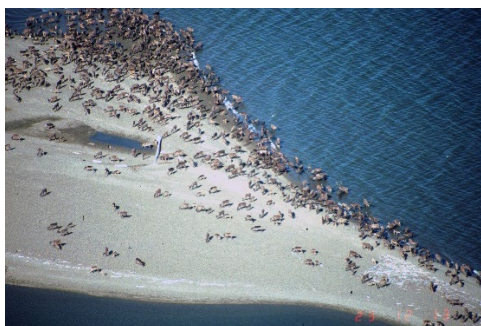
Caribou are a culturally important subsistence species and the most abundant large terrestrial mammal in the area. The potential impacts of oilfield development on caribou distribution, movements, or abundance are of great interest to stakeholders. Data from this study can help address public concerns related to potential impacts from oil development on caribou. Caribou studies conducted prior to and after construction are required by the North Slope Borough Rezone ordinances and the NPR-A Integrated Activity Plan in order to assess and minimize potential changes after development occurs.

What are our preliminary findings?

- Preliminary results from 2021 suggest that caribou densities in the area were low during the spring and early summer but increased in fall. Some large groups of Central Arctic Herd caribou were on the Colville Delta in mid-summer.
- Caribou distribution and movements vary widely by season and among years.
- Most caribou in this area are from the Teshekpuk Herd with occasional use by animals of the Central Arctic Herd.
- Most Teshekpuk Herd calving occurs near Teshekpuk Lake and the area north of the lake is important during periods of mosquito harassment.
- Caribou are generally found in drier landcover types, although riverine areas can be important for caribou in late summer. Caribou movements and distribution will be analyzed in relation to factors such as snow cover, vegetation, and distance to coast as well as distance to the road to GMT2/MT7.



Colville Delta and GMT survey areas



Large group on the coast.



Cow and calf.



Caribou on the move.

CARIBOU IN THE GREATER KUPARUK AREA

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) is collaborating with the Alaska Department of Fish and Game (ADF&G) to monitor caribou in and near the Kuparuk oilfield using radio collars deployed on caribou of the Central Arctic Herd. ABR has provided biological and ecological consulting services in Alaska for more than 40 years and has studied caribou near the Kuparuk oilfield since the 1980s, including aerial surveys in the area from 1993 to 2017. The team is now using data from radio collars to better understand caribou use of the Kuparuk area. Data from these collars can be used to describe seasonal caribou movements and distribution in relation to infrastructure. In 2021, CPAI funded 12 new collars that were deployed on caribou by the ADF&G.

Where did we go?

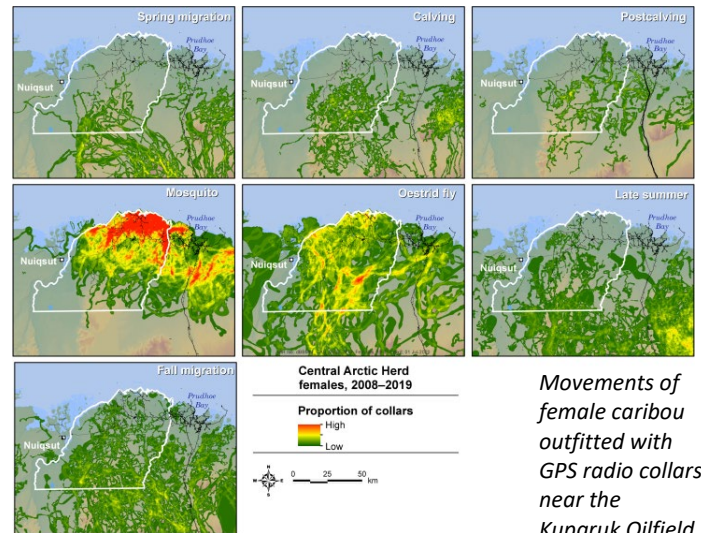
Biologists studied caribou distribution and movements near the Kuparuk Oilfield, between the Colville and Kuparuk rivers (see maps). The main herd in this area is the Central Arctic Herd, currently estimated to have a population of 30,000 caribou. No fieldwork was conducted in 2021, but data from radio collars was analyzed to expand knowledge of caribou movements and distribution in this area.

Why were we working in the area?

Caribou are a culturally important subsistence species and the most abundant large terrestrial mammal in the area. The Central Arctic Herd has been living in the Prudhoe Bay, Milne Point, and Kuparuk oilfields for more than 40 years. This herd, therefore, provides an opportunity to study caribou within existing oilfield infrastructure to see how those findings can be applied to new developments to help minimize potential impacts on caribou distribution, movements, or abundance.

What are our preliminary findings?

- In 2021, most of the collared Central Arctic Herd caribou were west of the Kuparuk River during calving and moved through the oilfields repeatedly during early and mid-summer. Some large groups were on the Colville River Delta in June and July.
- ABR analyzed 12 years of existing high-resolution GPS radio collar data from the Central Arctic Herd and published the results, “Caribou distribution and movements in a northern Alaska oilfield,” in the *Journal of Wildlife Management* in 2020.
- The results were generally consistent with previous studies in the area showing different behaviors and response to oilfields during different seasons.
- During calving, caribou tended to avoid roads and pads, but the avoidance declined after calving.
- In late June and early July, caribou moved rapidly through the oilfields and crossed roads frequently to reach coastal mosquito-relief habitat.
- In late July and early August, some caribou used gravel roads and pads to avoid harassment by oestrud flies.



Movements of female caribou outfitted with GPS radio collars near the Kuparuk Oilfield by season, 2008–2019.



A large group of caribou crosses a road.



Views of caribou crossing a road.

CARIBOU IN THE BEAR TOOTH UNIT

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) used a combination of aerial surveys, satellite imagery, and analysis of radio collars deployed on caribou to assess the seasonal distribution and movements of caribou in northeastern NPR-A, the National Petroleum Reserve, Alaska. ABR has provided biological and ecological consulting services in Alaska for more than 40 years. Since 2001, ABR has been conducting aerial surveys between February and October annually to count caribou in the area and determine how the densities of caribou vary seasonally and annually (see map to the right). Satellite imagery is used to map the timing of spring snowmelt and the growth of vegetation in the spring and summer. Using radio collar data, the team tracks the movements of individual caribou and examines how their seasonal movements are influenced by snow cover, vegetation, terrain ruggedness, insect harassment, distance to coast, and distance to ice roads. This multiyear dataset provides detailed information on which areas are used consistently during different seasons, how those areas correspond with proposed development, and if patterns change after construction.

Where did we go?

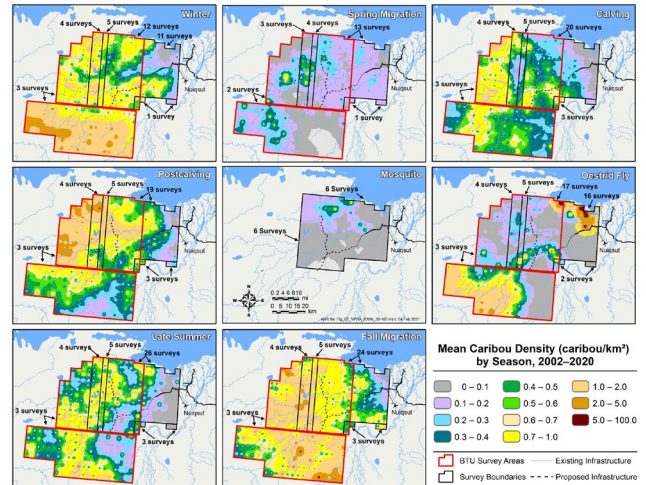
For this project, ABR studied caribou in the Bear Tooth Unit, which includes the area of the proposed Willow Development and an area to the south. A related project studied caribou use within the Greater Mooses Tooth Unit and the Colville Delta.

Why were we working in the area?

Caribou are a culturally important subsistence species and the most abundant large terrestrial mammal in the area. The potential impacts of oilfield development on caribou distribution, movements, or abundance are of great interest to stakeholders. Data from this project can help address and mitigate public concerns related to potential impacts from oil development on caribou. Caribou studies conducted prior to construction are required by the North Slope Borough rezone ordinances and the NPR-A Integrated Activity Plan because they are necessary to understand how caribou use the area prior to development in order to minimize and assess potential changes after development occurs.

What are our preliminary findings?

- Preliminary results suggest that seasonal use of the area in 2021 was similar to recent years. Caribou were somewhat farther west during calving and early summer, but there were high densities in the study area at times. Caribou movements and distribution will be analyzed in relation to factors such as snow cover, vegetation, and distance to coast.
- Most caribou in this area are from the Teshekpuk Herd. Most of the herd remains on the Coastal Plain during winter, but approximately 30% of animals winter in the Brooks Range in most years.
- Caribou distribution and movements vary widely by season. Most calving occurs near Teshekpuk Lake and the area north of the lake is an important area during periods of mosquito harassment.
- Caribou are generally found in drier landcover types, although riverine areas can be important for caribou in late summer.



Average seasonal caribou densities from aerial surveys for caribou conducted February–October 2002–2020. Surveys continued in 2021.



Aerial view of large caribou group.



Grazing caribou.



Caribou bull.

COLVILLE AREA SUMMER FISHERY HARVEST MONITORING

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), ABR, Inc.—Environmental Research & Services (ABR) attended the annual CPAI summer projects Open House in Nuiqsut, Alaska in mid-June to meet with fishers in advance of their summer subsistence fishing activities. ABR introduced residents to a new app which can be used by fishers to record their harvest data for their own records. During the two brief follow-up visits in July and August, biologists conducted daily surveys of the Nigliq Channel of the Colville River to monitor fishing effort and success. Each day, they met with a local hire and traveled by boat to Woods Camp. The primary objective each day was to count the number of active nets, and if possible, the number of nets drying on the bank. They also worked with fishers to count their harvested fish and to obtain otoliths (hard tissue with annual banding patterns) from a subset of the harvest for ageing in the laboratory, and collected ambient water quality data (temperature, salinity, dissolved oxygen, conductivity, and turbidity).

Where did we go?

2021 was a pilot effort, and the field survey was focused exclusively on the Nigliq Channel of the Colville River from the Nuiqsut boat ramp to Woods Camp near the mouth of the Colville River Delta where most fishing occurs during the summer months.

Why were we working in the area?

This survey work results from agreements between CPAI and the North Slope Borough-Department of Wildlife Management in accordance with the Greater Mooses Tooth 2 Rezone stipulations and is designed to better characterize and understand summer-based subsistence fishing for Nuiqsut.

What are our preliminary findings?

- Summer fishing is sporadic, and often opportunistic near Nuiqsut. Many fishers set a net while *en route* to other subsistence activities (e.g., caribou hunting and seal hunting) and check them semi-daily, usually upon return from a hunt.
- The river levels fluctuated widely during summer 2021. When water levels rose, fishers pulled their nets temporarily to avoid debris that would otherwise clog the mesh. These nets rested on shore until water levels dropped.
- Summer fishing effort was low compared to fall under-ice efforts. During each of the 2 field visits, there were approximately 3–5 nets deployed in the Nigliq Channel, with a similar number of nets resting on shore.
- The primary species caught in 2021 was Aanaaktiq (Broad Whitefish; *Coregonus nasus*). Pacific Salmon numbers were low during 2021 survey events, suggesting that Pink Salmon (*Oncorhynchus gorbuscha*), the dominant salmon species caught in the Colville River along with Chum Salmon (*Oncorhynchus keta*), are primarily an even-year spawner in the region. Only 1 Dolly Varden was recorded.
- Woods Camp was active in late July and early August with families harvesting Aanaaktiq to make pivsi strips (a typically salted, dried, and then smoked jerky-type treat).



Colville River Delta, including the Nigliq Channel and traditional water quality monitoring locations.



Survey team measuring and removing otoliths of recently harvested Aanaaktiq (Broad Whitefish).



Pink Salmon on measuring board.



Aanaaktiq Pivsi drying in smokehouse.

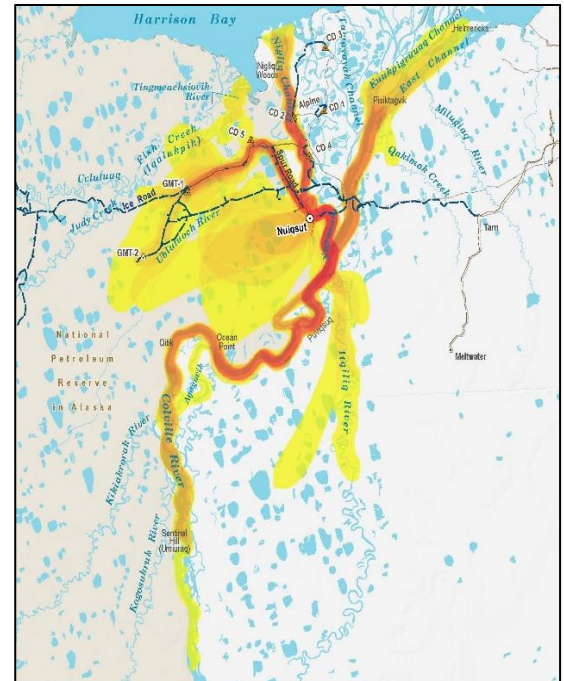
NUIQSUT CARIBOU SUBSISTENCE MONITORING PROJECT

What did we do?

On behalf of ConocoPhillips Alaska, Inc. (CPAI), in 2020 researchers with Stephen R. Braund & Associates conducted annual active harvester interviews with Nuiqsut caribou hunters to document harvest activities and household harvest surveys to document community-level harvests in hunting year 2019. This represents Year 12 of the Nuiqsut Caribou Subsistence Monitoring Project. These interviews and surveys document baseline caribou subsistence harvesting data and harvester observations regarding development-related impacts on caribou harvesting activities. In 2021, the study team conducted annual active harvester interviews and household harvest surveys for the 2020 (Year 13) study year, as well as continuing to conduct interviews for a one-time comprehensive (all resources) 10-year mapping study.

Where did we go?

In 2020, for the 2019 (Year 12) study year, researchers conducted active harvester interviews and household harvest surveys in the community of Nuiqsut at the KSOP office. However, due to the COVID-19 pandemic, fieldwork in Nuiqsut was halted in March 2020 before interviews were complete. The study team subsequently conducted additional household surveys remotely via local liaisons, by telephone, and using an online survey form. Interviews for the 2020 (Year 13) study year began remotely for the household harvest surveys in 2021; in-person fieldwork was delayed until June 2021 due to the ongoing COVID-19 pandemic. However, the study team completed the household harvest surveys and active harvester interviews for the 2020 (Year 13) study year. The study area for the Nuiqsut Caribou Subsistence Monitoring Project is all areas used by Nuiqsut residents for caribou hunting activities.



Caribou Subsistence Use Areas, 2019

Why were we working in the area?

CPAI initiated the Nuiqsut Caribou Subsistence Monitoring Project in response to a stipulation in the North Slope Borough's (NSB) permit to CPAI for the CD4 development. While the original stipulation required that the study occur for 10 years, both the NSB (2018 Alpine-GMT Rezone Ordinance) and Bureau of Land Management (BLM) (GMT2 ROD) required that monitoring continue beyond the initial 10-year time period. The monitoring study, which began in 2009 for the 2008 study year, is now in its 13th year. The purpose of the subsistence monitoring project is to monitor caribou subsistence harvester activity, harvest experiences, and hunter observations of impacts related to CD4 and other Alpine satellite developments. The one-time comprehensive all resources study started in 2020 is required by the BLM (GMT2 ROD).

What are our preliminary findings?

In 2020, survey participation rates were lower than usual due to the COVID-19 pandemic halting fieldwork in the community. Thus, all 2019 results should be viewed with these lower-than-usual response rates in mind. Year 12 (2019) findings include the following:

- In 2019, the community of Nuiqsut harvested an estimated 636 caribou, within the range of all previous study years (between 258 and 774 caribou).
- Active harvester participants identified 57 caribou subsistence use areas and 60 caribou harvest locations for the 2019 study year, the majority of which were located along the Colville River, along the lower Itqiliq River, and north and west of the community along the Nuiqsut Spur Road, the CD5 Road and the GMT1 Road.
- In 2019, the area "West of Nuiqsut" accounted for 65 percent of the caribou harvested, substantially higher than all previous study years.
- The overall extent of overland travel in 2019 was similar to many previous years, but with increased use along the road system and a smaller extent of riverine and overland subsistence use areas than some previous years.
- In 2019, the highest concentrations of harvests were documented along the road system, on the Itqiliq River, and on the East Channel.
- In 2019, 36 percent of respondents reported one or more perceived development-related impacts on their caribou hunting, the lowest of all study years but similar to the 2011 and 2016 study years.

Data from the Year 13 Caribou Subsistence Monitoring study (2020 hunter year) are not yet analyzed and will be reported later in 2021/2022. Interviews for the 2020 all resources 10-year mapping study will be completed in 2021/2022.

TUNDRA REHABILITATION—ALPINE AND KUPARUK

What did we do?

On behalf of ConocoPhillips Alaska (CPAI), ABR, Inc — Environmental Research & Services (ABR) monitored vegetation recovery after different kinds of disturbance, including exploratory well sites, gravel mines, off-road vehicle traffic, and multi-season ice pads. This program began in the early 1980s. Personnel who operate vehicles off the road system in Kuparuk also received training to help them minimize the risk of tundra damage.

Where did we go?

Each year personnel visit various sites in the Kuparuk and Alpine oilfields. Most of the sites can be reached by driving and walking. A small number of sites require helicopter access, but sites that required landing a helicopter on the tundra were not visited in 2021. The map shows the sites visited in 2021.

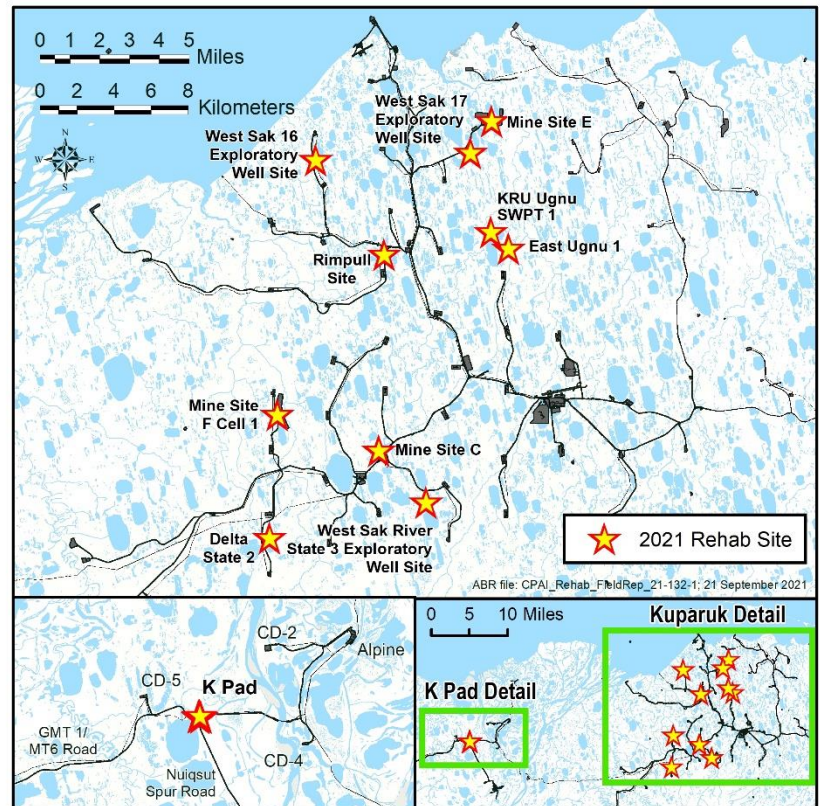
Why were we working in the area?

CPAI is required by local, state, and federal regulations to rehabilitate disturbed tundra within the oilfields. Teams monitor the sites regularly to make sure they are recovering well, with healthy plant communities and improved habitat value for wildlife. If a site is not recovering as expected, additional treatments to improve conditions in the future can be administered.

What are our preliminary findings?

While each site is different, below are some general learnings:

- Vegetation recovery is a slow process in the arctic, because of the harsh climate and short growing season.
- It's usually better to seed or plant typical tundra species, rather than relying on seed from commercial growers.
- Heavy grazing, especially by geese, can slow down vegetation recovery.
- At some sites in Kuparuk, naturally high salt levels in soil can affect plant growth.
- Small disturbances (e.g. vehicle tracks) can often be repaired by quickly replacing chunks of soil and plants that have been displaced.
- Damage to tundra from off-road traffic can be reduced by choosing the route carefully and not making too many trips in the same place.



Locations of tundra rehabilitation sites at Alpine and Kuparuk.



Native plants growing on a former gravel berm in the Kuparuk oilfield.