Bird, Plant and Carbon Dioxide Parameters of
Anadyr, Chukotka Autonomous Region, Russia:
A collection of baseline data for use
in future climate change studies

Conducted by Students of *Expedition Anadyr 2011*
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Abstract

From May 25 to June 6 2011, eight high school students from Anchorage, Alaska and ten from the Russian city of Anadyr came together in the Chukotkan capital for a cultural exchange and shared learning experiences, under the auspices of the Shared Beringian Heritage Program of the U.S. National Park Service. One purpose of the science aspect of the program was to investigate climate change effects in this subarctic community. By collecting oral histories from local Chukotka elders, we learned that winters in Anadyr are warmer than in the past, and that plants and animals are changing their patterns. To support the evidence from traditional knowledge, we surveyed plant and bird populations and created a data set that could possibly be used as reference points for future climate change studies. We documented the total number of species of birds seen during the 10-day period and recorded population size in town, river and tundra study areas. We also selected tundra vegetation plots in which we identified plant species and measured height, percent cover, depth to permafrost, and number and height of hummocks. We referenced all locations with a GPS unit. In addition, we collected CO_2 measurements from different tundra types. While collecting this data, we learned about tundra habitat and how it is susceptible to warming trends. From the native Chukotkans, we learned how important tundra plants are as a food source and as a habitat for the birds and mammals on which they depend.

BACKGROUND

Anadyr is the capital of Chukotka, a region in the far north-east of Russia. This city of 10,000 is situated on the Anadyr Estuary, where the Anadyr River meets the Bering Sea. The Kazachka River runs along the west side of town. On the south side of the city is a large area of low tundra hills and flat lands and to the north are high hills. Dominating the city is a coal-fired power plant which supplies all the electricity, but leaves a layer of ash and dust on the surrounding tundra, and in the air in town. Mining of coal, gold and other metals and petroleum development are the main industries, and large petroleum reserves have been identified for future development. Still, the area surrounding Anadyr is rich in wildlife resources and is very important for many species of bird and plants.

Birdlife International and the National Audubon Society have designated Anadyr Estuary as an Important Bird Area (IBA), because it plays such a critical role in maintaining and supporting migratory bird populations. The surrounding Anadyr Estuary isn't important just for birds, though. The estuary is home to many species of fish and marine mammals crucial for the survival of Anadyr and other Chukotka villages. In a place where a large percentage of the food is imported, thriving salmon fisheries are essential. Although petroleum and mining are immediate threats to Arctic environments, climate change is posing a potential danger to the habitats in the northern latitudes, and seems likely to threaten the habitat around Anadyr as well.

Importance of Carbon Dioxide in Climate Change Carbon is the building block of all the molecules important to life because it has the ability to form bonds with many kinds of elements to form huge molecules. When its bonds are freed during combustion, it rapidly bonds with two oxygen molecules, forming Carbon Dioxide in the atmosphere. CO_2 is considered a greenhouse gas because it traps long-wave radiation that comes from the Earth and keeps it from exiting to space. Instead, the radiation causes the CO_2 molecule to vibrate and generate even more long-wave radiation. Long-wave radiation is also known as heat. Lesser amounts of CO_2 keep Earth's temperature warm and suitable for sustaining life. Too great an increase in CO_2 levels might cause a rise in temperature, resulting warming climates especially in northern latitudes.

Study Goals

The purpose of our study was to learn about and document the natural habitat surrounding Anadyr, and to record data for use in future climate change studies. According to the oral histories we collected from town elders and from younger people, the climate in Anadyr is clearly warming. We wondered how that might be changing the local plant and animal populations, but since there was not any data for comparison we decided to create a database of our own. Also, by talking about the importance of the Anadyr Estuary with people living in the town, we hoped to raise awareness about the importance of the area to wildlife and encourage its protection.

STUDY AREAS

We chose three different habitats to study. Bird surveys were conducted on all three areas and plant surveys and CO_2 measurements were conducted in one area.

These study areas are:

1) **City** The city transect ran along the main street 'Otke', from the Lyceum (the college preparatory school where we stayed) to the west end of Otke Street at the Children's Creativity Palace. The street was the busiest in Anadyr, and had few shrubs and trees lining the street. As it was still early spring there were no leaves on the trees yet;

2) **River** The river transect ran along the Kazachka River. The transect began at the bridge on the northwest end of the river, by the College (high school). It followed the river to the southwest, where the Kazachka Road crosses the river before turning to the east. The river is about 30 m wide and is bordered by a narrow strip of vegetation with a road to the west and buildings to the east.

3) **Tundra** Our tundra study site was an area 500m x 500m. It was chosen because it was the nearest area of dwarf-shrub tundra habitat to town, and was accessible with an hour-long walk. More natural tundra occurred further south of town but was unreachable in the time allotted. The east edge of the tundra plot was

disturbed by vehicle tracks, with exposed areas of peat. It was also drier and grassier.

The north and west edges were bounded by wetlands near the river and had standing water of about 10 – 30 meters. The south end extended for many miles with habitat similar to the study plot. The coal plant was about 800 m to the north.

Fig. 1 Map of study areas

Study Site Name	Length/area	Location
Otke Street Transect	1000m	Lyceum to the Children's Palace
Kazachka River Transect	1900m	Northwest Bridge to Southwest Bridge 64°43'52.60" N, 177°32'04.59" E *to* 64°43'17.40" N, 177°30'31.90 E
Tundra Plot	25,000 m^2	1 KM Southwest of coal power plant 64°43'04.71"N, 177°29'36.33 E

Table 1. Study site descriptions

MATERIALS AND METHODS

Bird Surveys

Materials. We used 10 x 40 Zeiss binoculars and a 40-60 x Nikon telescope to find and identify birds. We used a video recorder to record bird behavior. We used *Birds of East Asia* by Mark Brazil, and A *Bird List of Anadyr* by Pavel Tomkavich to help in identification.

Methods. For the tundra study area, all bird species within 500 m of the center of the tundra plot were identified and counted during a 30-minute period on four separate visits. For the river study, we conducted three counts of all birds in the river basin from the southwest to northwest bridge. For the city study, we conducted four counts of all birds seen on Otke Street from the Lyceum to the Children's Palace.

Habitat Surveys

Materials. We used a measuring tape to define meter-square plots that were randomly chosen within the tundra study area. We used rulers to measure plant and hummock height, #2 pencils to judge depth to permafrost, and a compass to gauge slope and aspect. We used a GPS unit to determine coordinates for the plots.

Methods. For each plot we measured temperature, slope and aspect, depth to permafrost, level of saturation, and wind direction. We identified and estimated percent cover of each species of plant in the plot, and measured the height of the tallest plant.

CO2 Off-gassing surveys

Materials. To collect carbon samples, we used Gastec GV-50ps gas collection pump and 0.03-1.0% CO_2 glass detection tubes that change color according to the percent concentration of CO_2 detected. We also used black plastic bags, stones to hold the bags in place, and a knife for puncturing the bag when taking measurements.

Methods. We trapped CO_2 by placing black plastic bags over a .5 square meter plot in the tundra, and weighted down the edges with stones. After 24 hours we punctured a hole in the plastic and placed the glass metering tube in the hole and slowly pulled back the syringe-like part of the Gastec device. This drew the CO_2 into the test-tube giving us the amount of CO_2 that the plot had given off. Finally we recorded the results of each of the experiments and compared the data found.

RESULTS

Bird Surveys.

By far, the bird found in greatest abundance on the transects was the

Vega Gull. Similar to Alaska's Herring Gull, the Vega Gull was a common sight in all three study areas. With its relatively dark back, dark wing tips, and large size, it was readily identifiable from the second-most common gull – the glaucous gull, which was nearly white, and more common closer to the water. Brant geese were the most common bird overall, as hundreds to thousands were seen flying high overhead to the west in the evening, heading up the Anadyr River.

In the city, the most common birds besides gulls were the house sparrows, which locals say come in container ships and are recently able to overwinter because of heating pipes under the buildings. Rock Doves also were common (about 35 total), but weren't seen on the transect. White and yellow wagtails brightened the town, with white being present when we first arrived, and yellows coming in a few days later. Temminks stints and wood sandpipers were common around the small pools. Temminks have started to defend territories and were very vocal. Ruffs were found in both the river and tundra habitats, and fortunately set up a lek in the tundra study area. We spent several hours on three occasions observing lekking behavior. The white male ruffs appear to be less dominant than the brown and red ruff males, and that the darkest male was the most dominant of all. The northern pintail duck was common and reminded us of Alaska, where it is also common. Another special bird of the tundra was the bluethroat, which sang a variety of bird songs, and even gave what might have been cricket sounds, learned on its African wintering grounds. The rarest bird we saw might have been the Ross' gull, which was small, and had a black stripe on the back of its neck. Out-of-place birds were the Arctic Tern and Bonaparte's gulls. A total of 52 bird species were seen on the trip.

Habitat Surveys.

The tundra plot was characterized by plants less than 40-cm tall, and by many small shrubs and other plants (forbs). This type of habitat is called dwarf-shrub tundra. The most common were the dwarf shrubs alder (*Betula)*, and willow (*Salix)*, low bush cranberry (*Vaccinium vitas-idea)*, Labrador tea (*Ledum)*, crowberry (*Empetrum)*, sedges (*Carex* and *Eriophorum).*

	Plot Number								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Ave.**
Temperature (degrees C)	5	5	7	4	4	5	7	6	**5**
Slope/aspect	0/0	0/0	0/0	4/N	3/N	5/E	0/0	0/0	**-**
Depth to permafrost (cm)	7	1.5	1.5	4	2	1.5	10	8	**4.4**
Lowest to highest surface point	26	13	19	22	24	29	21	44	**24.8**
Level of saturation	dry	dry	dry	moist	moist	dry	moist	dry	**-**
Number of hummocks	0	0	1	1	1	3	1	3	**1.3**
*Carex (*sedge*)*	0%	35%	2%	5%	8%	60%	40%	70%	**77.0%**
Calamagrostis (sedge)	0%	0%	0%	1%	3%	25%	8%	10%	**31.5%**
Vaccinium (lingonberry) брусника	30%	15%	10%	30%	50%	30%	8%	10%	**3.9%**
Salix (*Dwarf Willow)* ива	5%	0%	10%	30%	0%	4%	0%	0%	**24.3%**
Arctostaphylos (bearberry) волчья ягода	0%	0%	2%	20%	0%	20%	0%	0%	**25.2%**
Ledum (Labrador tea) багульник	15%	20%	50%	20%	40%	15%	26%	75%	**21.8%**
Empetrum (crowberry) шикша	0%	5%	10%	0%	3%	25%	8%	5%	**40.4%**

Betula Dwarf Alder карликовая ольха	15%	45%	75%	0%	30%	20%	35%	65%	**32.3%**
Rubus Cloudberry морошка	3%	1%	0%	2%	1%	0%	0%	1%	**75.0%**
Lichen ягель	45%	10%	25%	6%	10%	0%	0%	2%	**12.0%**
Moss мох	0%	3%	50%	20%	25%	25%	0%	5%	**32.5%**
Height of tallest shrub (cm)	20	23	39	30	43	23	24	43	**30.6**

Table 3. Percent cover and height of tundra plants in study plots

CO_2 Surveys.

We tested CO2 off-gassing in three types of tundra. The first was forb-dominated tundra, which was the type of considered to be in its most natural state for this area. The second type was grass-dominated tundra, which had many of the same plants but also had a lot of *Calamagrostis*; this type of habitat seemed to be closer to the areas where there was a lot of disturbance from vehicles. The third kind of habitat tested was peat-dominated, which meant that there was no tundra cover and the underlying peat was exposed, due to vehicle disturbance.

Tundra Plant Type	Percent Composition CO2
Forb-dominated #1	0.03
Forb-dominated #2	0.03
Forb-dominated #3	0.03
Forb-dominated #4	0.03
Forb-dominated #5	0.03
Grass-dominated #1	0.05
Grass-dominated #2	0.05
Grass-dominated #3	0.05
Peat-dominated #1	0.07
Peat-dominated #2	0.07

The results of the carbon survey indicate there was no difference between forb-dominated tundra. In fact, when testing plain air in the tundra we came up with the same result – 0.03% CO_2. Grass-dominated tundra gave off a higher amount – 0.05%. However, in the complete absence of tundra cover plants, the CO_2 off-gassing more than doubled, to 0.07%.

DISCUSSION

All of the data we took during our brief stay in Anadyr can be used as baseline data for future studies on the changing environment in Chukotka. Birds are excellent indicators of habitat quality for many reasons. As a group, birds are omnivorous and eat many of the same things humans do, but respond to changes in the food base more quickly. Also, birds are easy to see and identify, so if they are monitored in the environment, a sharp increase or decline in population could be an indicator for a major change that could affect humans.

Also, since bird types reflect climate conditions, a slowly changing make-up of birds would be seen as the climate warms.

Winters become warmer, the frozen tundra thaws faster each spring. Plants that evolved to grow on top of frozen ground will become less common as grasses, shrubs and other fast growing plants with deeper roots take over. Over time, as the tundra warms the types of plants that used to dominate the tundra will become less and less common, leading to a decreased biodiversity in the Chukotkan tundra. We hope our vegetation plot data can be used to chart change in plant biodiversity over time.

As permafrost thaws, the peat soils undergo decomposition by increased microbe activity, which turns carbon that had remained trapped for centuries into even more CO_2. We knew that over time as the tundra warms, this process will allow more CO_2 to be given off. After analyzing results from our CO_2 data, we discovered that exposed peat moss gives off twice as much CO_2 than intact tundra. If humans continue to destroy large sections of tundra, even more CO_2 will be given off.

CONCLUSION

Even though we were only taking data for about ten days in the early summer of Anadyr, before the estuary ice melted, before many of the plants turned green, or many of the bird species had returned, we could see that the natural environment was supporting a variety of wildlife. We hope that climate change will not affect the beauty we saw in the tundra.

We also learned about the role that Anadyr Estuary plays in the migration of birds, and that these migrations link Anadyr to the great estuaries of the world, some of which are suffering huge habitat losses. Although it is iced over longer than others, Anadyr Estuary seems to offer a healthy habitat. As the climate warms, more and more species of birds might come to Anadyr as they lose habitat in the south. Fish are already doing that. It is our theory that as the climate warms, the Anadyr Estuary - already an internationally recognized Important Bird Area - might become home to southern species and thus may become even more critical. We hope that Anadyr Estuary, and all estuaries, will be protected for the benefit of both wildlife and humans.

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	Dasha Starovoitova	Diana Tinye	Tatiana Sorokovenno
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Цель проекта:

Сбор данных о климатических условиях, флоре и фауне окрестностей Анадырского лимана. Исследование роли Анадырского лимана, как возможного места для гнездовья большего количества видов мигрирующих птиц.
Задачи проекта:

1) Собрать сведения на основе рассказов охотников и коренных жителей о том, как изменение климата влияет на их жизнь и жизнь животных (К примеру, лежбища моржей, ранее находившиеся на льду, ныне находятся на берегах)

2) Составить базу данных по птицам и растениям для сравнения через 5-10 лет.

3) Исследовать уровень выделения углерода на территории поврежденной и

4) неповрежденной тундры.

5) Развивать навыки общения на иностранном языке.

6) Ознакомиться и сравнить культуру и традиции жителей Чукотки и Аляски.