

Changing Landscapes

Shrub Expansion

Middle School Guide

REACH Up

**Raising Educational Achievement
through Cultural Heritage Up**

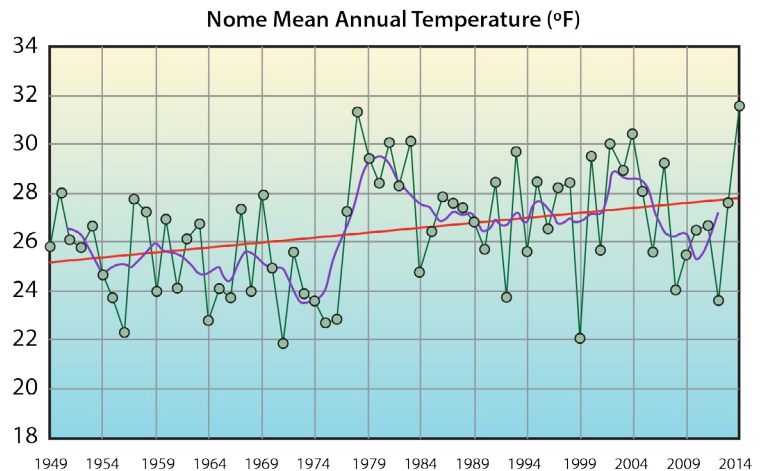
Changing Landscapes

How does climate change impact the landscape?

The climate in the Bering Strait region of western Alaska is warming. Increasing temperatures change the landscape in a variety of ways. Landscape changes impact local ecosystems and ways of life for local residents. What are these changes? What processes cause them? How do these changes impact Bering Strait communities?



Bering Strait, Alaska



Shrub Expansion

One of the frequently discussed impacts of climate change is shrub expansion. It has been referred to as the "greening of the Arctic". Elders and scientists alike have observed changes in vegetation on the tundra; plants such as spruce trees and tall willow shrubs have grown up in areas where previously only short plants such as blueberries and Labrador tea were found. Scientists have documented these changes using repeat photography.

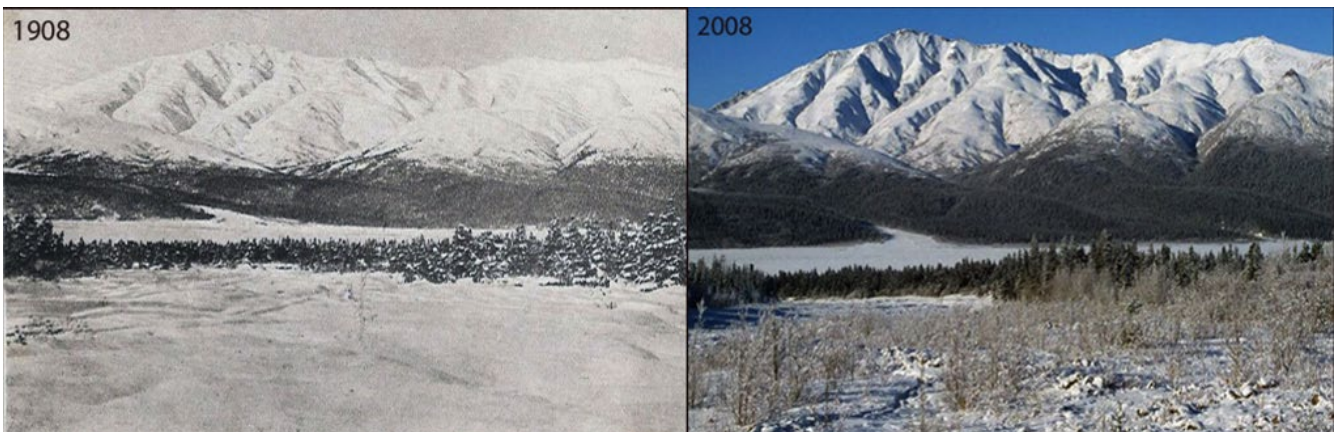


Photo Credit: Charles Sheldon (1908), Willie Karidis (2008), Denali National Park



Where's the Treeline?

Treeline is a term that describes the edge of where trees are able to grow. Above treeline the conditions are too harsh for tree growth. Although there are many factors that will determine where treeline occurs, general patterns are based on both latitude and elevation. "Above treeline" can refer to how far north you are. For example, the landscape of Northern Alaska is treeless tundra. The same is true in the Southern Hemisphere. Close to the South Pole, conditions are too harsh for trees to grow. Above treeline can also refer to elevation. If you went hiking on a mountain near the equator, you might find alpine tundra. At high elevations, the conditions are too harsh for trees to grow.

Looking back over time, the treeline has changed as the climate has changed. During periods of high glaciation the northernmost treeline was in the Lower 48, while during interglacial periods treeline extended as far north as the Seward Peninsula and North Slope of Alaska. Over the course of thousands of years, the boreal forests have gone through several declines and reestablishments.

Today most of western Alaska remains treeless, but the tundra vegetation is changing.



Photo from Alaska Center for Conservation Science report, Vegetation Map and Classification: Northern, Western and Interior Alaska



Shrub Expansion

Shrub expansion has been observed throughout Alaska. When scientists talk about shrub expansion, they are referring to an increase of trees and shrubs growing in a tundra area because warmer temperatures are allowing the trees and shrubs to thrive there. An increase in shrubs may mean more individual shrubs, or the shrubs growing thicker and taller, or both. Increased vegetation where the soil has recently been disturbed, such as after a wildfire or where a new road has been built, is not considered shrub expansion. Like many other landscape changes people have observed, shrub expansion seems to be happening rapidly.

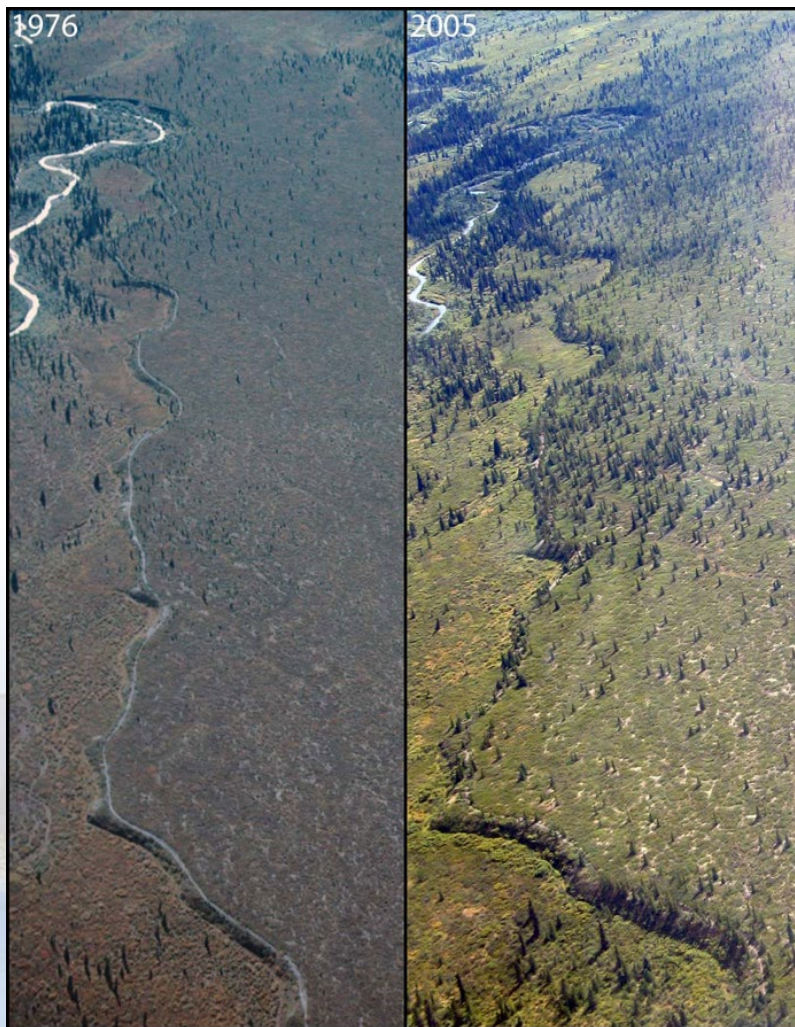


Photo credit: Fred Dean (1976), Carl Roland (2005)

Aren't more trees a good thing?

Treeline shift and shrub expansion bring both benefits and concerns. With more trees and shrubs, more carbon dioxide is absorbed through photosynthesis. Carbon dioxide is a gas that contributes to the greenhouse effect, so less carbon dioxide is a good thing. But dark-colored shrubs stand out above the snow and absorb energy from the sun, whereas snow reflects the light energy back into the sky. Increased shrub cover can result in a ground-warming effect. What other impacts of shrub expansion can you think of?



Ask an Expert

1. Watch the video *Vegetation Changes* available at www.k12reach.org/videos.php
2. Conduct your own interview with an elder or cultural knowledge bearer.

Some questions you may want to ask:

- How has the vegetation changed in this area in your lifetime?
 - Have changes in vegetation affected hunting, berry picking, and/or transportation?
3. If your interviewee speaks an Alaska Native language, ask them what language and dialect(s) they are familiar with. Ask them to please translate the following words:
 - Shrub
 - Willow
 - Tundra
 - Treeline

Compare your words with the translations on the following page. Are any of the terms the same or similar?



Donna J. Erickson, Unalakleet



Shrub Expansion Vocabulary

Would you like to know Alaska Native language terms related to climate change?

Work with your classmates to practice shrub expansion vocabulary words in English and the indigenous language of your community. Your teacher will give you vocabulary cards with the English word and an illustration on one side. Write the corresponding indigenous term on the blank line on the back of each card. Use the words that you learned from a local elder or cultural knowledge bearer, or choose the translation below that is closest to your community.

Miriam Toolie
Savoonga, AK
Siberian Yupik
St. Lawrence Island Yupik dialect
shrub - uqfilleqqaq
willow - uqfigaq
tundra - nunivak
treeline - uqfiget

Annie Conger
Nome, AK (from Brevig Mission)
Seward Peninsula Iñupiaq
Bering Strait dialect
shrub - uqpik
willow - uqpik
tundra - nuna
treeline - napaaqtut

Luci Washington
St. Michael, AK
Yup'ik
Unaliq dialect
shrub - cyaqsak
willow - uqvik
tundra - nunapik
treeline - apat ngeliit

Jolene Nanouk
Unalakleet, AK
Seward Peninsula Iñupiaq
Qawiaraq dialect
shrub - uqpik
willow - uqpik
tundra - nuna
treeline - napaaqtut



What is repeat photography?

Repeat photography shows a “then and now” scene. This tool has become extremely useful in science, as a qualitative way to document changes over time. Scientists create repeat photography by studying historic photographs, determining the exact location of the original image, and replicating the same shot.

Study the series of pictures on this page and the following page. Determine how the images were obtained. Do you think the photographs were taken:

- from the ground?
- at an angle from a helicopter?
- directly above from a plane?
- using satellite technology?

Does the vantage point make a difference in how you interpret the images?



Figure 1.

The top photo was taken in 1957 by George Kunkel.

The bottom photo was taken in 2007 by Ken Tape.



The Greening of the Arctic



Figure 2.
Chandler River, Alaska. The top photo was taken in 1947 by a Navy photographer; the bottom photo was taken in 2001 by Ken Tape.

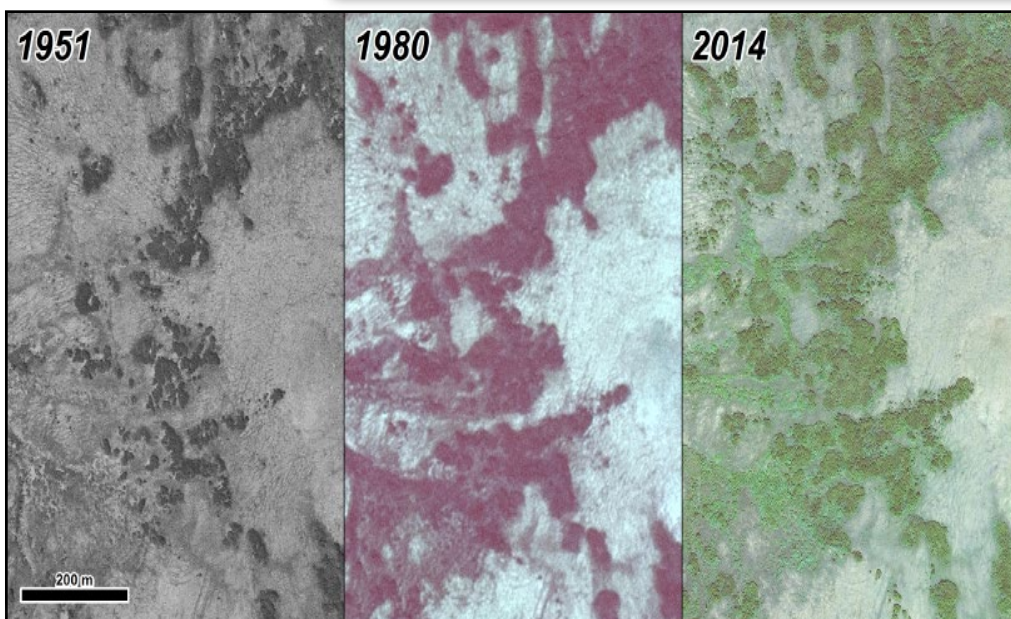


Figure 3.
Nulato Hills, Alaska.
Image by Gerald Frost

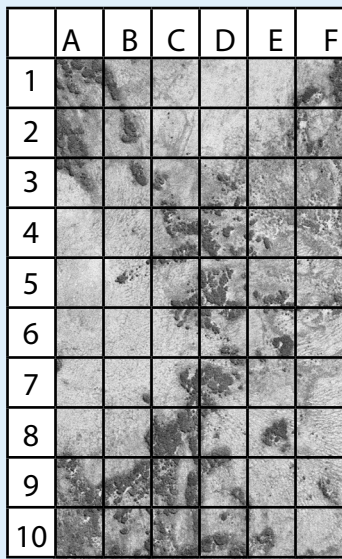


Quantifying Shrub Expansion

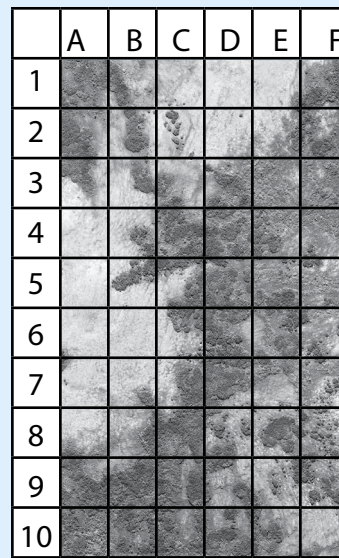
All of the images on the previous pages work well to demonstrate a change in shrub cover, but what if we wanted to measure the change? Quantitative data is the use of numbers to describe what is observed. For quantitative measurements, vertical images will work best. Figure 3, on the previous page, contains images that were taken directly overhead by a plane and satellite.

Plan your investigation

Your teacher can provide a grid printed on transparency film. Place the grid over the images on the following pages.



1951
Image

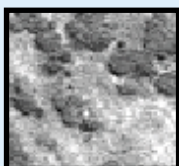


2014
Image

Start with the older image, and then do the same for the more recent image.

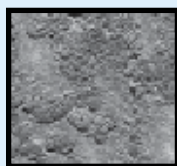
Estimate the percent shrub cover for each grid square. To estimate, give an approximate percent value for each square. Do not spend too much time deciding on the correct number.

Square-A1, 1951



25% vegetation

Square-A1, 2014



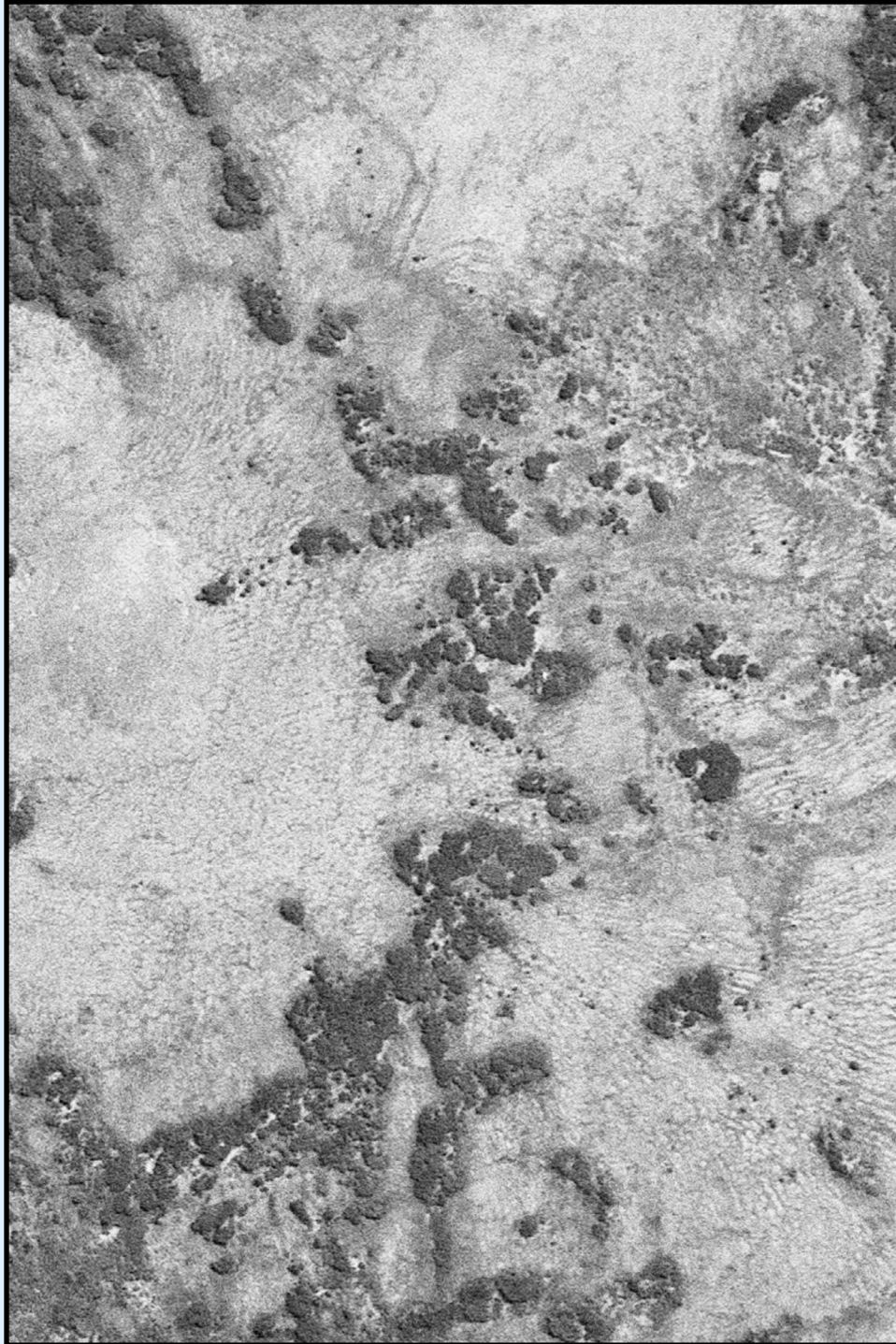
100% vegetation

If you work with a partner, one person can estimate the percent shrub cover and the other person can record the data. For your comparison to be consistent, it is important that the same person does the estimating for both images.

Next, add up all the grid squares and find the average for each image. Compare your calculations. What percent increase did you observe in the shrub cover?



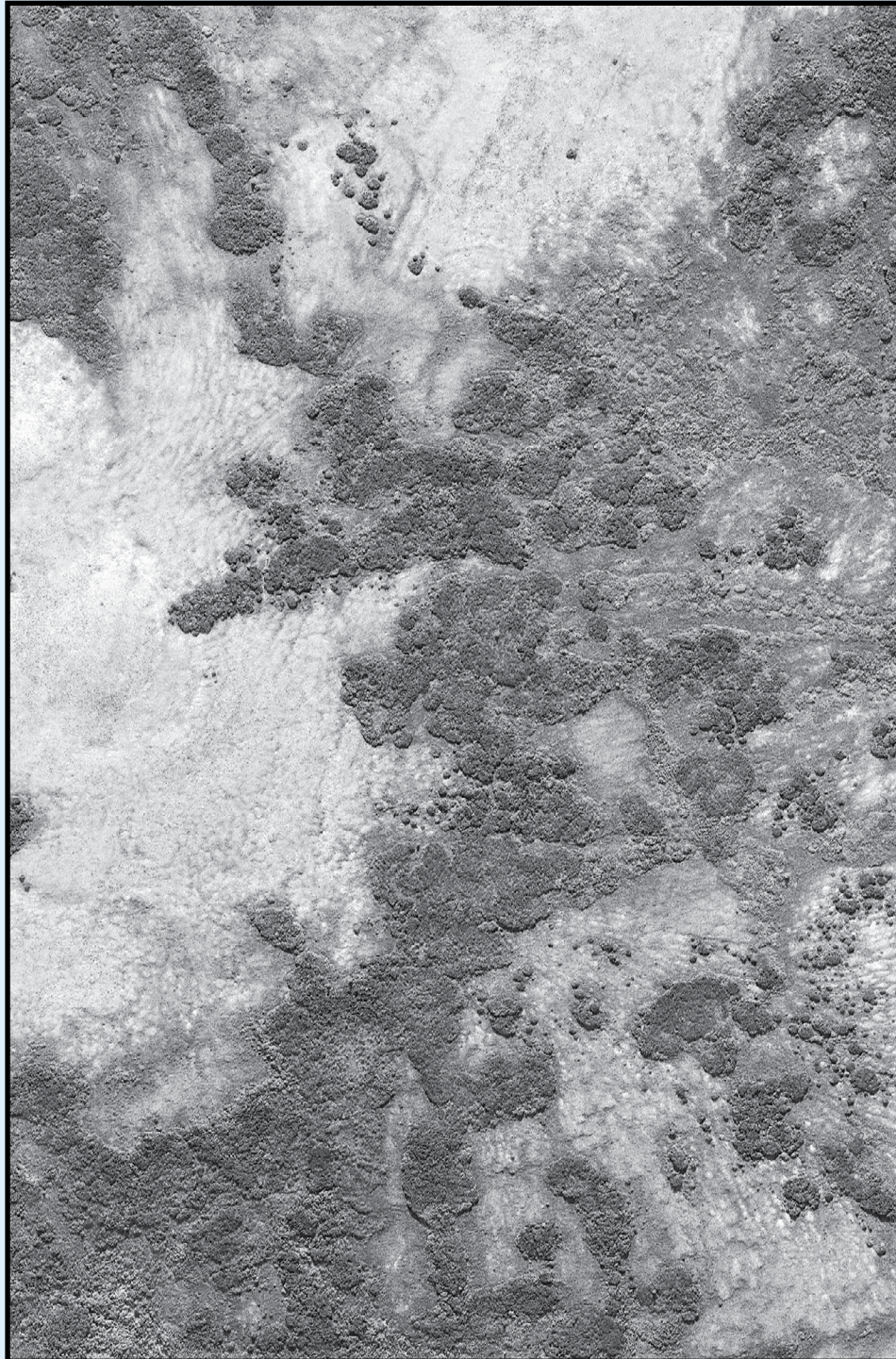
1951 Image



1951 image, Nulato Hills, AK. Image courtesy of Gerald Frost, PhD, Plant Ecologist




2014 Image



2014 image, Nulato Hills, AK. Image courtesy of Gerald Frost, PhD, Plant Ecologist





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