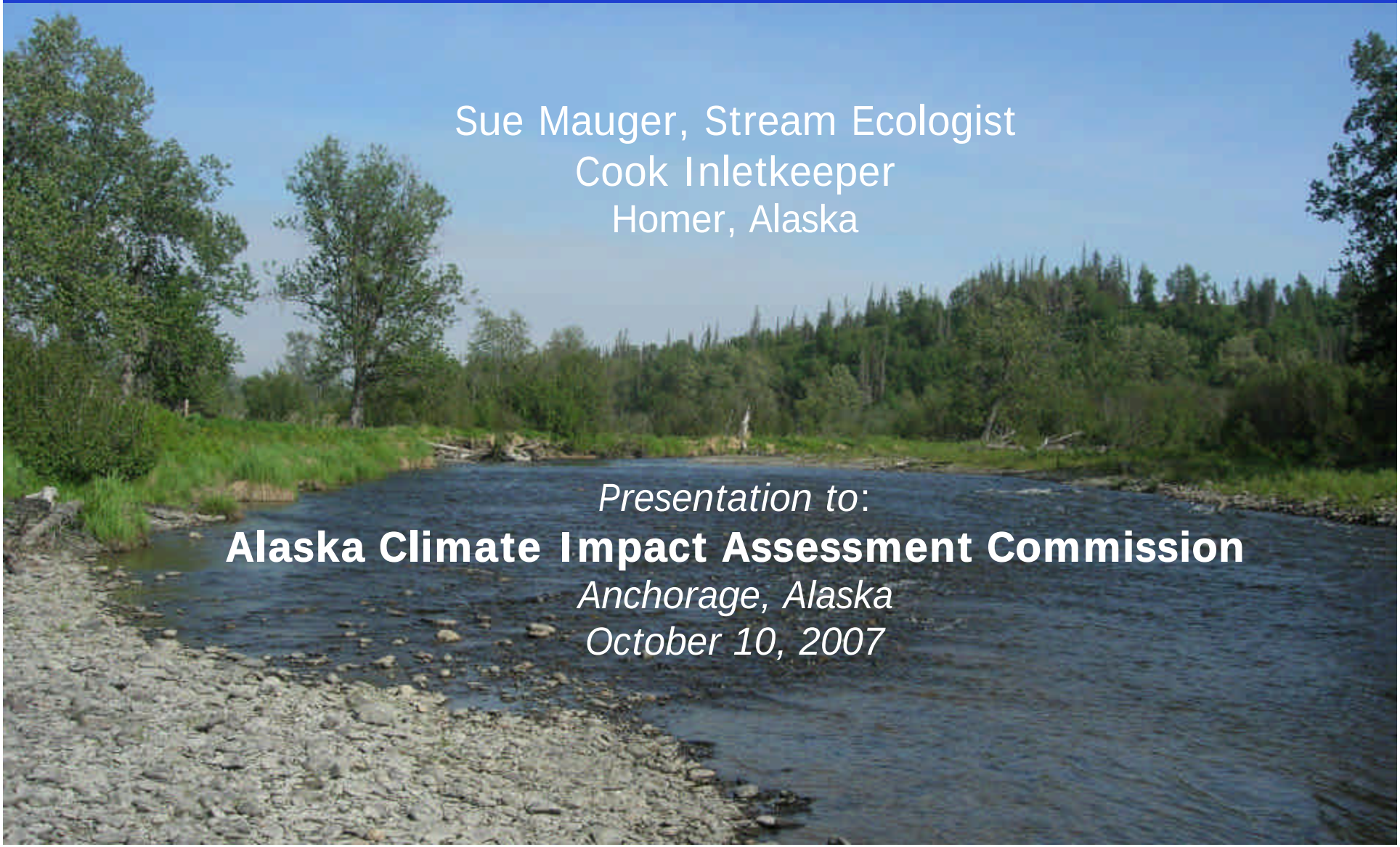
Changes in Alaska Salmon Stream Habitat Due To Climate Warming



Sue Mauger, Stream Ecologist
Cook Inletkeeper
Homer, Alaska

Presentation to:

Alaska Climate Impact Assessment Commission

Anchorage, Alaska
October 10, 2007

Overview

Importance of salmon to Alaska's economy

Salmon Stream Monitoring Program

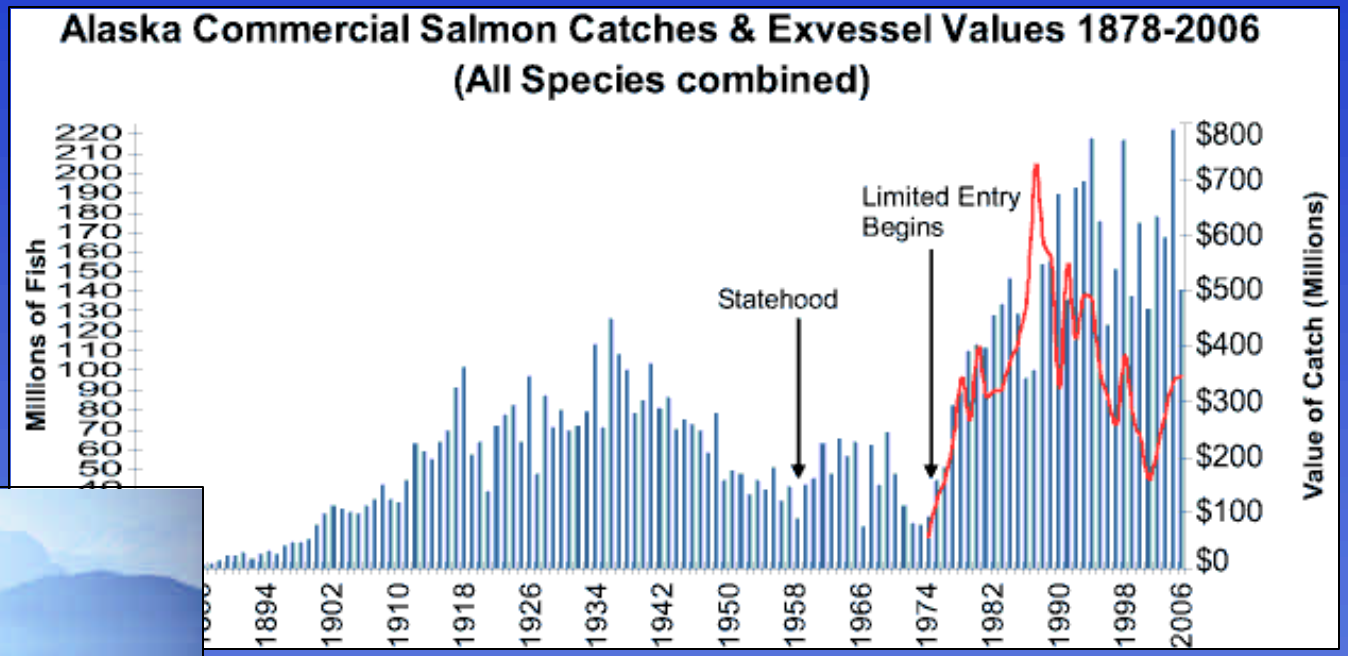
Stream temperatures

Monitoring results

Changing climate vs. changing landscape

Implications for Fisheries

Commercial Salmon Fishing in Alaska



Alaska Historical Commercial Salmon Catches, 1878–2006. ADF&G, Division of Commercial Fish
http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/catchval/history/all_1878.php

Sport Fishing in Alaska

Sport fishing expenditures in Alaska were estimated to be $640 million in 2003, and this generated 12,065 jobs and $259 million in wages and salaries.

This spending ultimately circulated through the economy and generated an estimated $1.04 billion in total fishing-related spending in Alaska.

American Sportfishing Association
http://www.asafishing.org/asa/statistics/saleco_trends/state_allfish_2003.html

Personal Use & Subsistence Use in Alaska

More than 25,000 household subsistence permits were issued in 2003.

Total subsistence harvest of salmon was 1.003 million fish in 2003.

Alaska Department of Fish and Game. 2005. Alaska Subsistence Fisheries 2003 Annual Report. Division of Subsistence. Juneau. http://www.subsistence.adfg.state.ak.us/download/asf2003.pdf

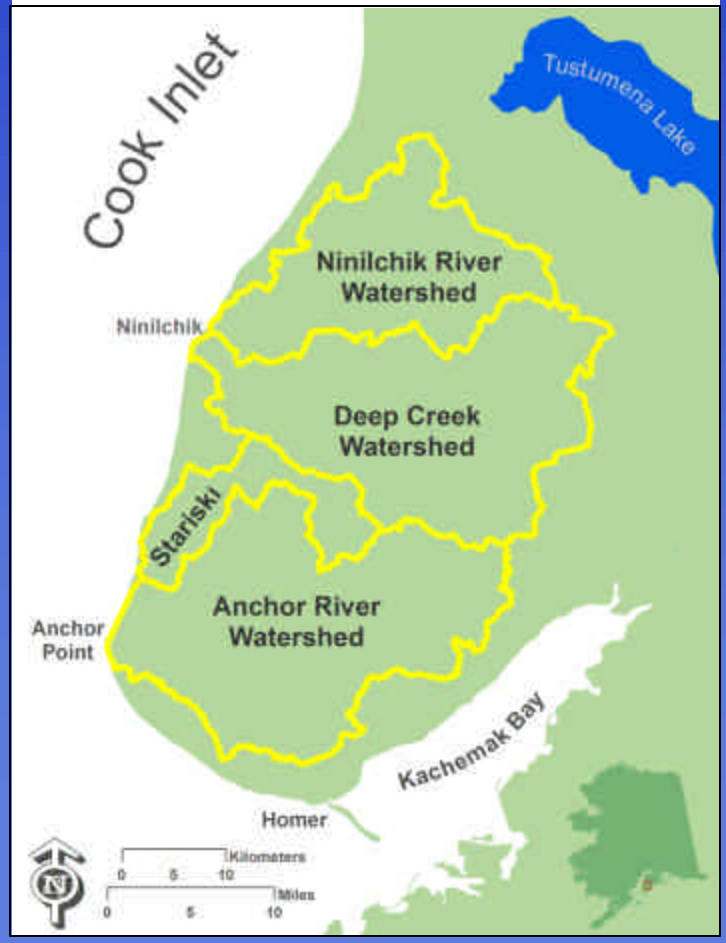
Salmon Stream Monitoring Program

Program began in 1998 to inventory baseline water quality in lower Kenai Peninsula salmon streams.

Commercial fishing, sport fishing and tourism are the economic base for Ninilchik and Anchor Point.

COOK INLETKEEPER
Protecting Alaska's Cook Inlet Watershed and the Life it Sustains

Homer Soil & Water Conservation District



Salmon Stream Monitoring Program

Monitoring was initiated due to community concerns about:

Water Temperature

Site visits in 1999 – 2001 identified warm summer temperatures as a growing concern. Re-designed monitoring program in 2002 to include temperature data loggers.

StowAway TidbiTs (by Onset)

Collecting data every 15 minutes

Why are warming stream temperatures a concern?

Higher stream temperatures result in:

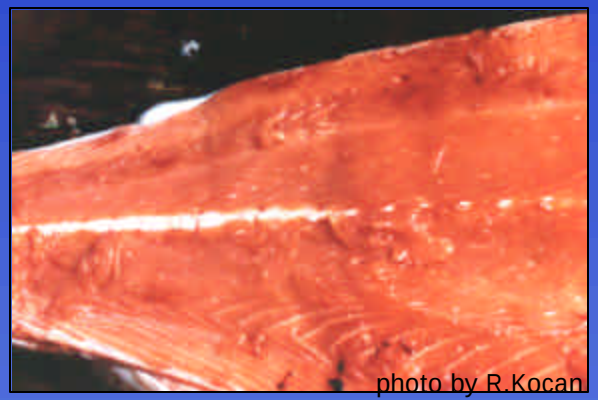
- reduced survivorship of salmon egg and fry;
- reduced growth rates due to increased rates of respiration and metabolism;
- premature smolting and shifts in emigration timing reducing marine survival;
- greater vulnerability to pollution due to increased toxicity of some organic chemicals and metals, including mercury; and
- greater risk of predation and disease.

Richter A. and S.A Kolmes. 2005. Maximum Temperature Limits for Chinook, Coho, and Chum Salmon, and Steelhead Trout in the Pacific Northwest. Reviews in Fisheries Science, 13:23-49.

Disease

Ichthyophonus in Yukon River Chinook Salmon

"Examination of historic temperature data suggests that rising average water temperatures during the past three decades appear to be associated with the increase in disease and potential pre-spawning mortality among Yukon River chinook salmon."



White spots indicate infection

Kocan, R., P. Hershberger and J. Winton. 2003. Effects of *Ichthyophonus* on Survival and Reproductive Success of Yukon River Chinook Salmon. Federal Subsistence Fishery Monitoring Program, Final Project Report No. FIS 01-200. U. S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska.

Alaska's Water Quality Criteria for Temperature

13°C (55.5°F)
Alaska's upper limit for spawning areas, egg and fry incubation

15°C (59°F)
Alaska's upper limit for fish migration routes

20°C (68°F)
DO NOT EXCEED

Alaska Department of Environmental Conservation. 2006. 18 AAC 70, Water Quality Standards. http://www.dec.state.ak.us/water/wqsar/wqs/pdfs/18%20AAC_70%20_Amended_December_28_2006.pdf

Monitoring Results
Anchor River 2005

Exceeded on 88 days
Average of 16.6 hours/day
24 complete days
9 consecutive days

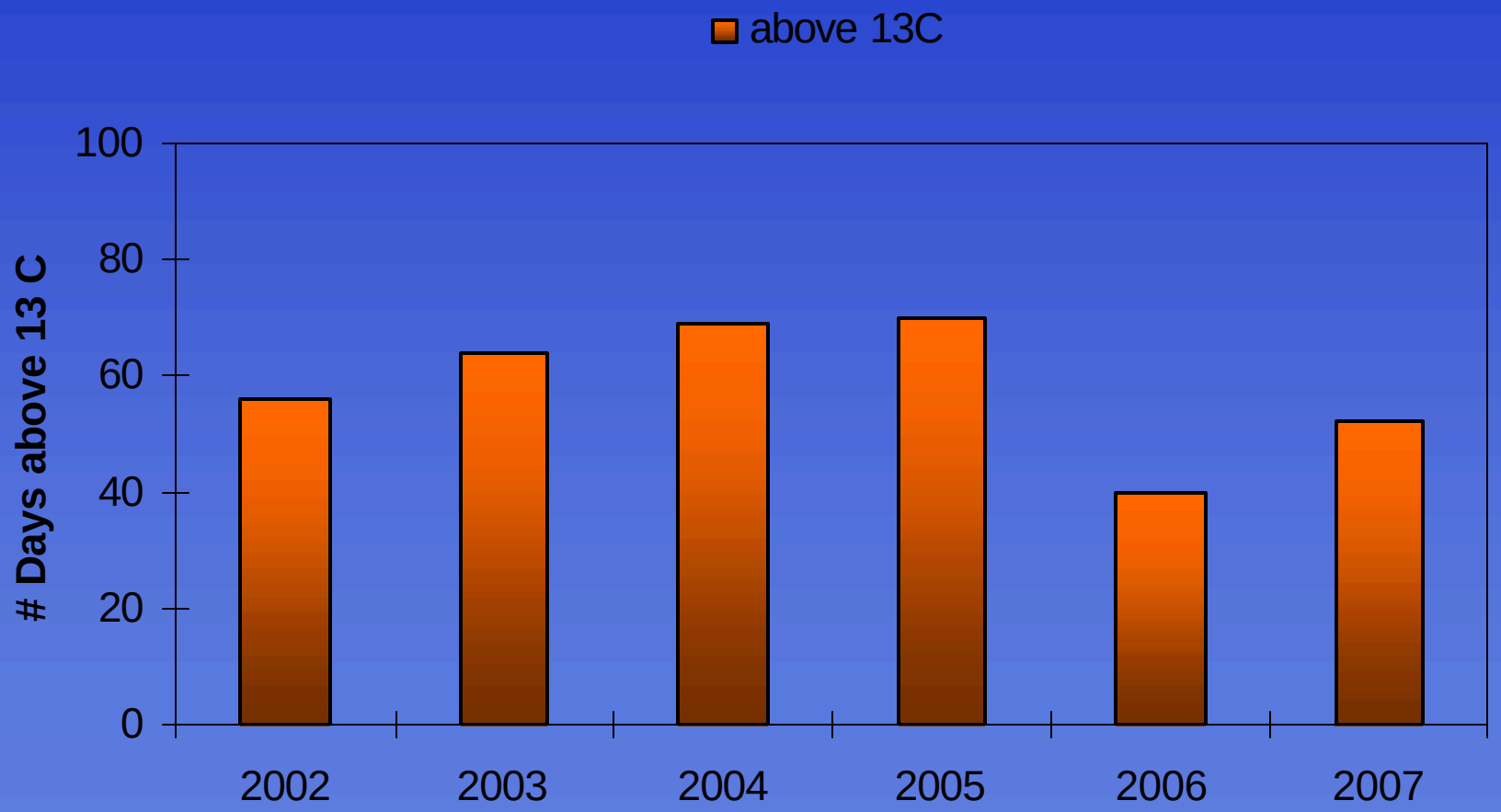
Exceeded on 65 days
Average of 11.0 hours/day

20°C

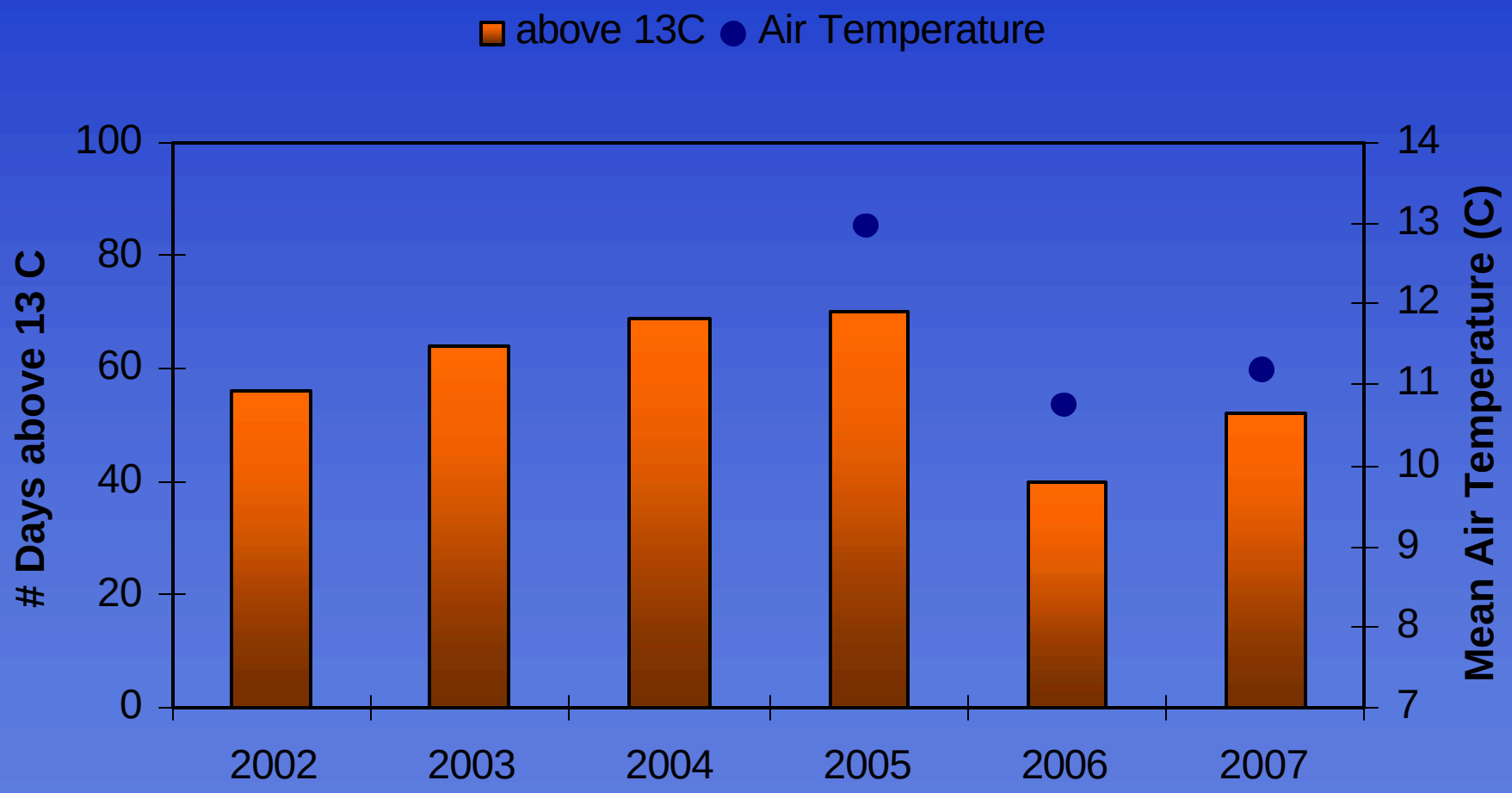
Exceeded on 6 days
Average of 2.9 hours/day
21.1°C maximum

Mauger, S. 2005. Lower Kenai Peninsula's Salmon Streams: Annual Water Quality Assessment. Homer Soil and Water Conservation District and Cook Inletkeeper, Homer, Alaska. 62 p.

Ninilchik River



Ninilchik River



Are increasing water temperatures due to changing climate or changing landscape?

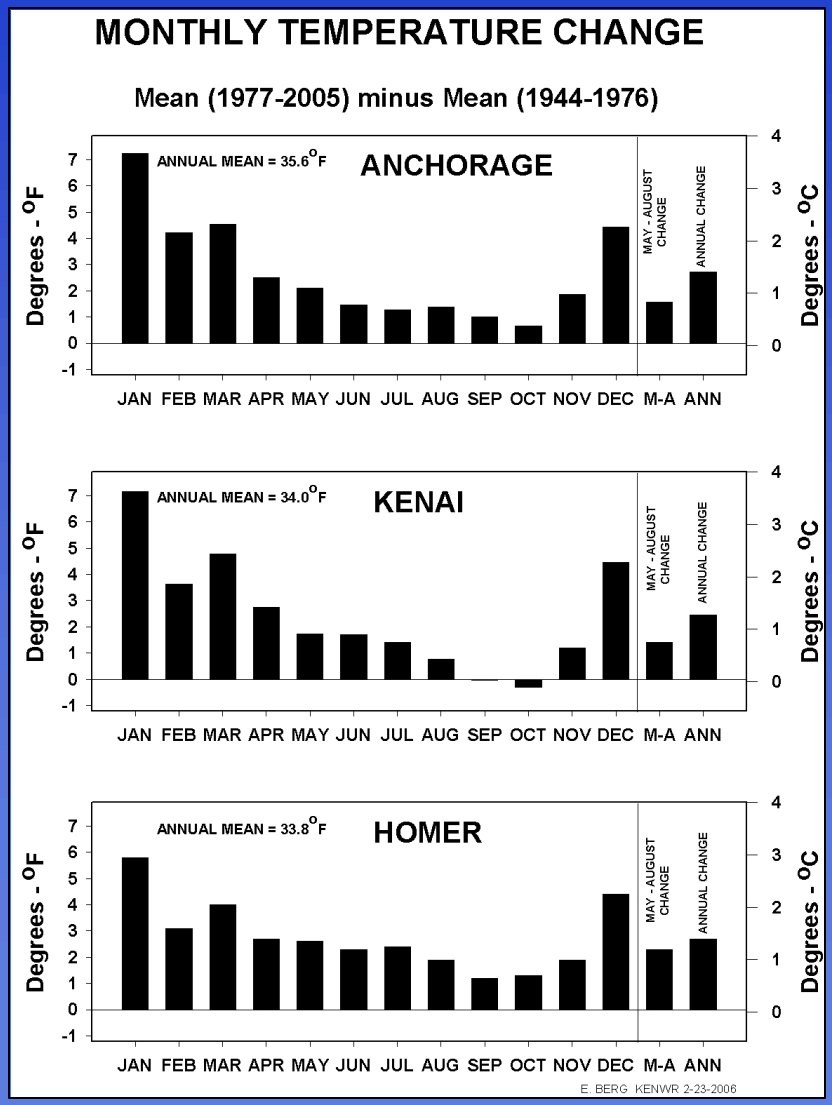
Changing Climate

Air temperature data from Anchorage, Kenai, and Homer Airports.

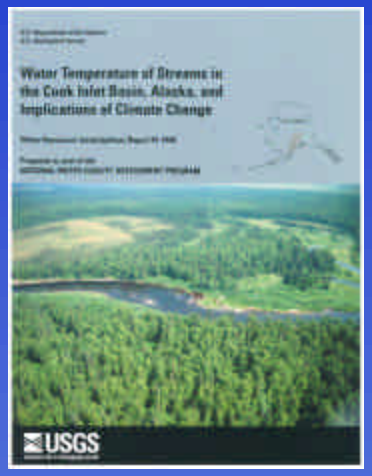
Monthly temperature change greatest in winters months.

Homer's summer air temperatures have warmed more than Kenai and Anchorage.

Graph prepared by Ed Berg, Kenai NWR



Changing Climate



2001 Report

- Historical air temperature information from the National Climate Data Center for seven climate stations in Cook Inlet;
- Historical water temperature data from 27 sites in Cook Inlet;
- General Circulation Models (GCMs) predict a mean annual air temperature increase from 7.2 – 8.5°C;
- Nonlinear regression model for predicting water temperatures from air temperatures

Conclusion: non-glacial systems have a predicted water temperature change of 3°C or more.

Kyle, R.E. and T.B. Brabets, 2001. Water temperature of streams in the Cook Inlet basin, Alaska, and implications of climate change. U.S. Geological Survey Water-Resources Investigation Report 01-4109.

Changing Climate

Hydrologic changes:

- Increase in annual precipitation
- Reduction in summer baseflows (less snowpack)
- Increase in flooding events

Changes in flow regimes are predicted but models are not yet refined at regional levels.

100 year flood event on Deep Creek (Oct, 2002)

Changing Landscape

Removal of stream-side vegetation
Increase in water withdrawals
Increase in # of dams/reservoirs
Increase in impervious surfaces
More channel engineering
Increase in sediment
Change in upland vegetation
Decrease in recruitment of wood

Impervious cover

Nationally, 10% watershed impervious cover has been linked to stream degradation.

In Anchorage, a study in five watersheds found measurable degradation at 4.4 –5.8% impervious cover.

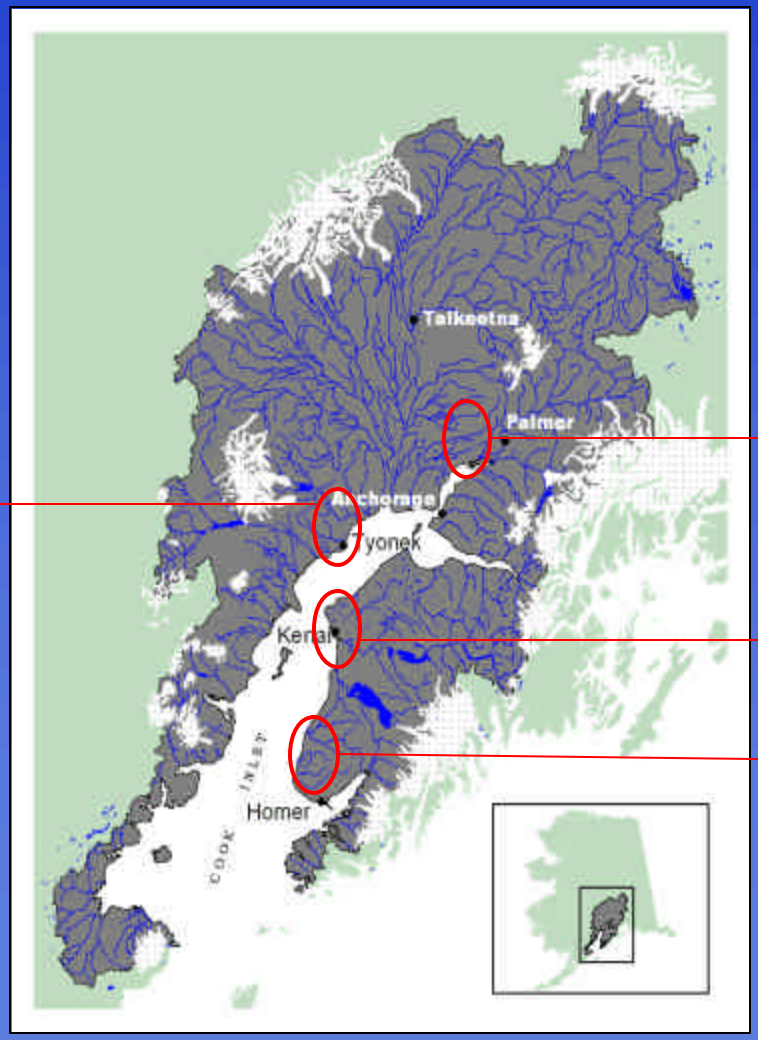
Lower Kenai Peninsula watersheds had 1.1% of impervious cover, based on 2002-2003 imagery, which is less than the level associated with water quality and habitat degradation.

Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques.* 1(3): 100-111.

Ourso, R.T. and S.A. Frenzel. 2003. Identification of linear and threshold responses in streams along a gradient of urbanization in Anchorage, Alaska. Hydrobiologia 501: 117-131.

Cook Inletkeeper. 2006. Mapping Impervious Cover to Correlate Land Use Activities with Salmon Health & Habitat on the Lower Kenai Peninsula. U.S. Fish and Wildlife Service Grant Agreement #70191-5-G344. Final report.

Above 20°C in Cook Inlet



Chuitna River

Cottonwood Creek

Bishop Creek

Anchor River
Stariski Creek
Ninilchik River
Deep Creek

Implication for Fisheries

"There is a high likelihood that further climate change will bring large-scale changes in commercial, sport and subsistence fisheries, but there remains little understanding of the potential magnitude or even direction of the projected changes in the north Pacific."

Southwestern Alaska: Temperatures have warmed, enhancing growth rates of juvenile sockeye.

Southeast Alaska: Pink runs declined in 2006 after warm instream temperatures in 2004.

Southcentral Alaska: Turbidity has increased and zooplankton biomass has dropped in Skilak Lake, diminishing the food supply of red salmon fry.

Cooperative Institute for Arctic Research. 2000. Impacts of Climate Change in the United States: Alaska. Cooperative Institute for Arctic Research, University of Alaska, Fairbanks.

Recommendations

Collect stream temperature and stream flow data in key watersheds across Alaska

Incorporate freshwater and marine temperature data and climate information into salmon management models and decision-making

Encourage borough-level actions to increase watershed resiliency to climate warming

Thank you!

Support for the Salmon Stream Monitoring Program provided in part by EPA Section 319 Clean Water Act grants from Alaska Department of Environmental Conservation and funding from the U.S. Fish and Wildlife Service - Alaska Coastal Program.

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