Salmon Stressors:
Rising Temperatures in Kenai's Salmon Streams

Sue Mauger, Science Director
Cook Inletkeeper

Salmon Stressors

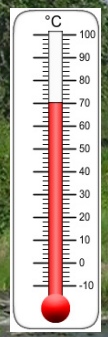
What are the major climate-related stressors?

How will they impact Kenai Peninsula streams?

What can we do to build resilience?

Climate-related stressors

Changes in air temperature and precipitation patterns affect:

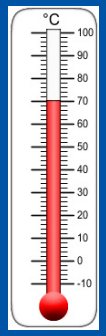


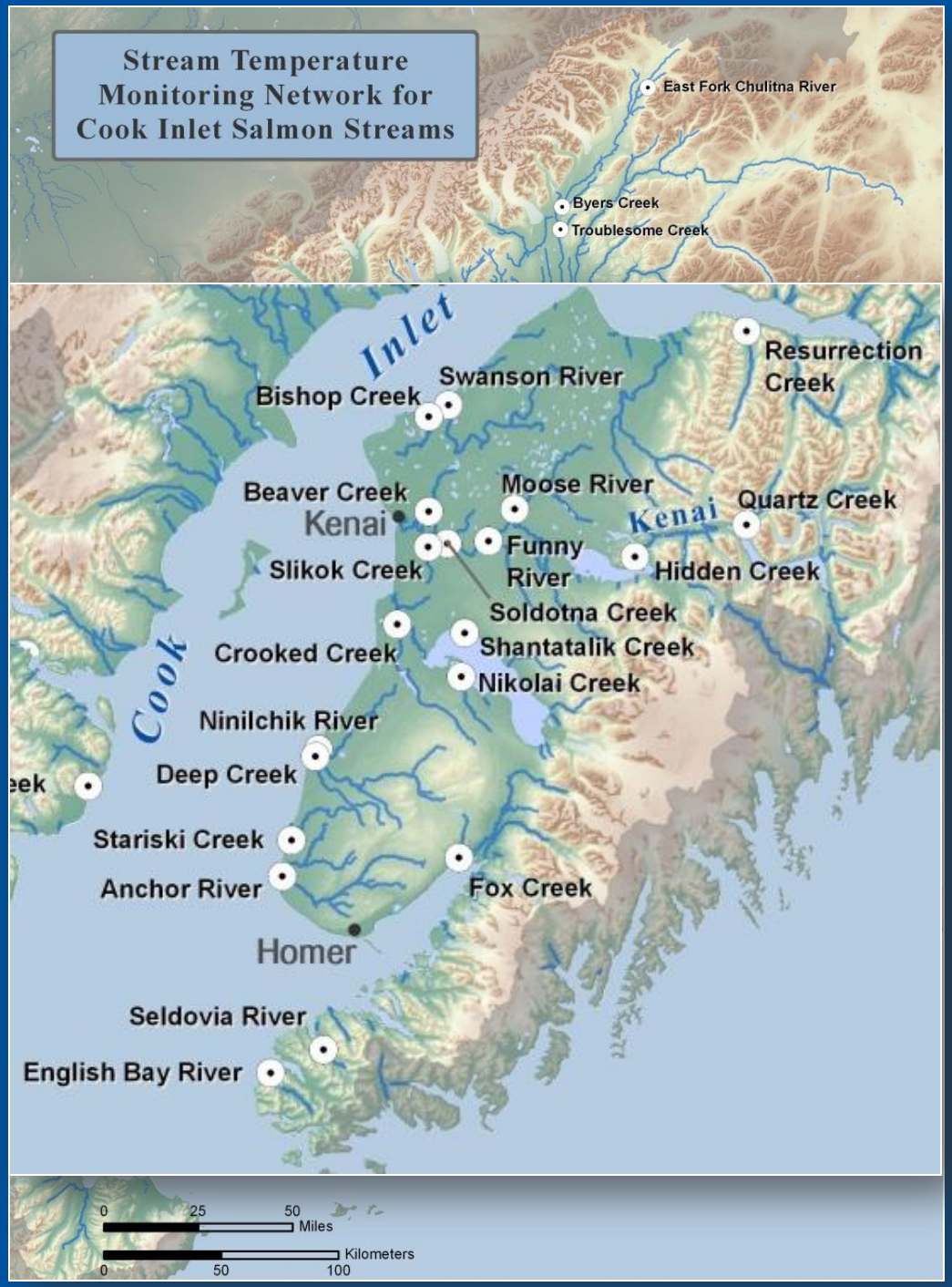
Water temperature

Water volume

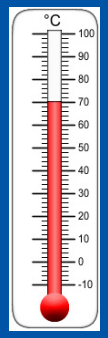
Flood frequency/intensity

Nutrient pathways



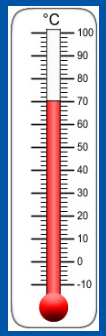


20 non-glacial Kenai Peninsula salmon streams



Effect of warm water on a cold water fish:

- 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
- greater risk of predation and disease


°C
100
90
80
70
60
50
40
30
20
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0
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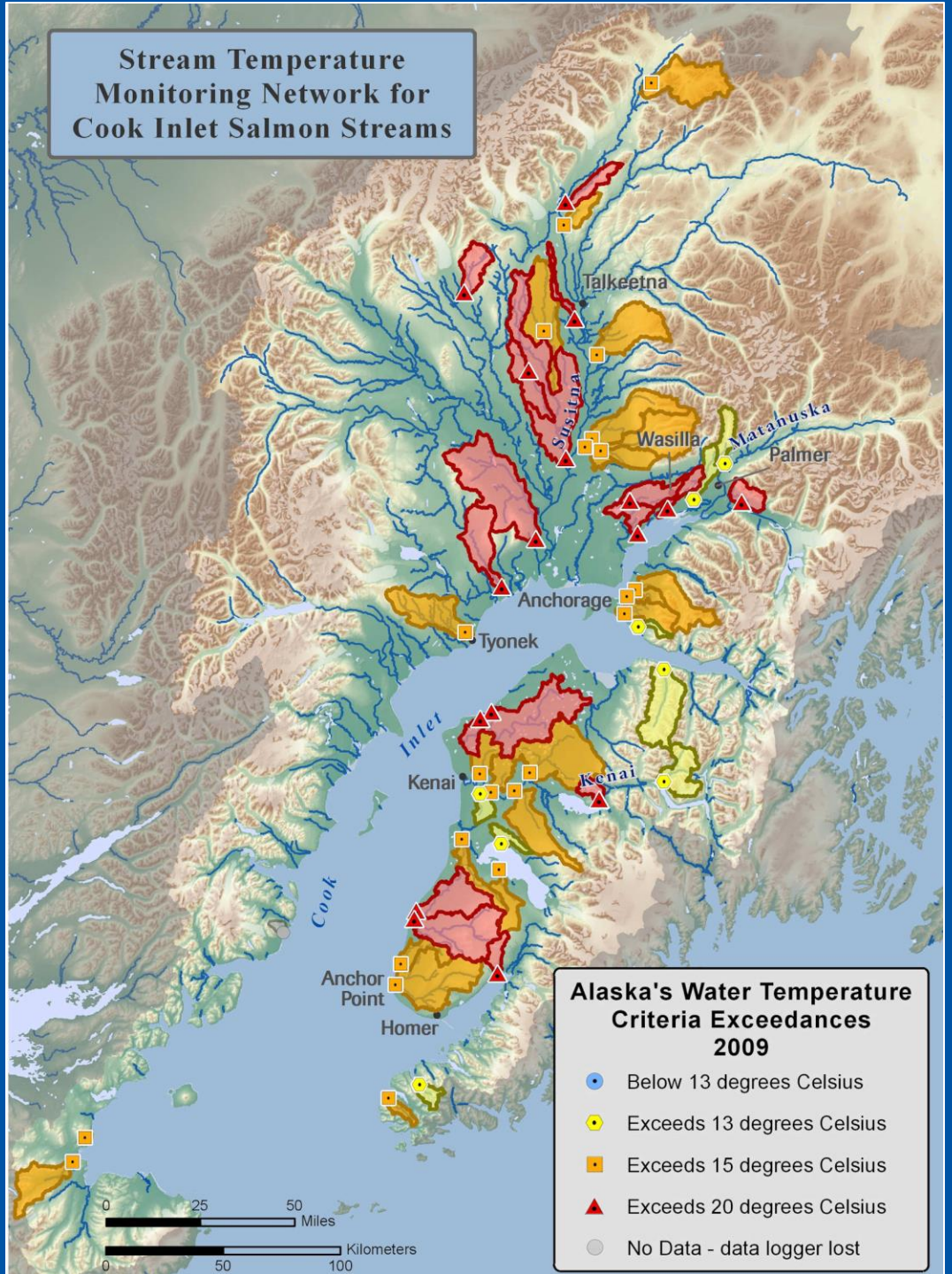
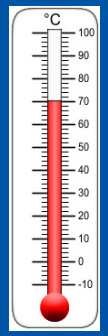

Stream Temperature Monitoring Network for Cook Inlet Salmon Streams
Talkeetna
Susitna
Wasilla
Matanuska
Palmer
Anchorage
Tyonek
Inlet
Kenai
Kenai
Cook
Anchor Point
Homer
Alaska's Water Temperature Criteria Exceedances 2009
Below 13 degrees Celsius
Exceeds 13 degrees Celsius
Exceeds 15 degrees Celsius
Exceeds 20 degrees Celsius
No Data - data logger lost
0
25
50
Miles
Kilometers
0
50
100

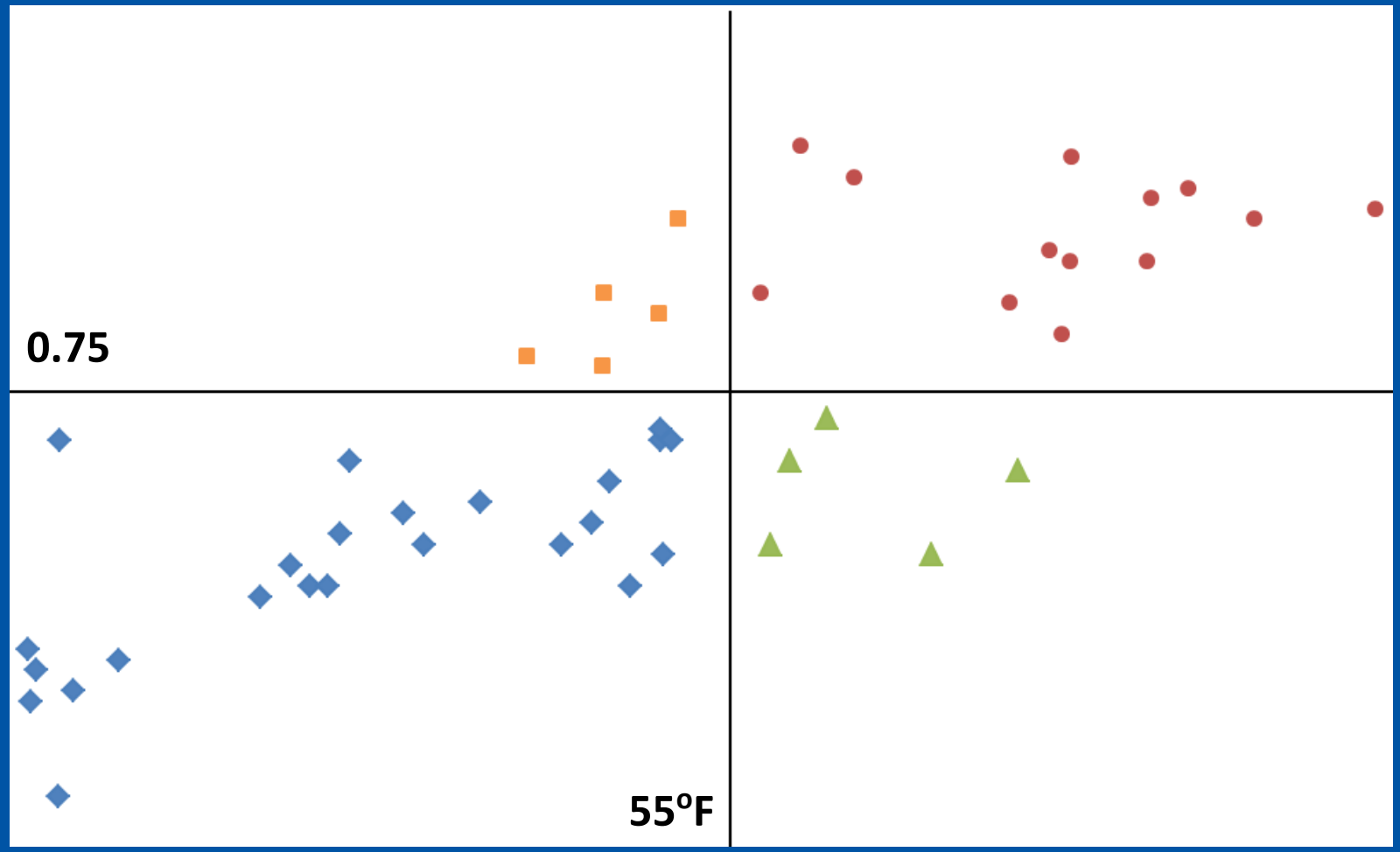
68°F

STOP

59°

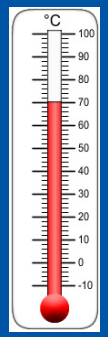
55°





sensitivity

average July water temperature



sensitivity

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Salmon Stream Temperature Fact Sheet

Why temperature?

Water temperature affects all phases of the salmon lifecycle, including :

- *timing of migration*
- *survivorship of eggs*
- *respiration*
- *metabolism*
- *availability of O_2*

Warm water temperature induces stress in salmon and makes them more vulnerable to pollution, predation and disease.

For more details about our methods or data, please contact:

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Swanson River

Cook Inletkeeper coordinates a Stream Temperature Monitoring Network across key salmon-bearing systems of the Cook Inlet basin. Our goal is to describe water temperature profiles and identify watershed characteristics that make specific streams more sensitive to climate change impacts. This fact sheet provides a summary of data collected on the Swanson River through this collaborative effort.

Water temperature monitoring site is located at the North Kenai Road crossing.
Latitude (N) 60.79200; Longitude (W) -151.01200

Watershed facts

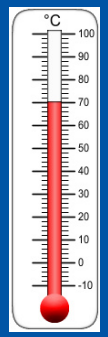
The Swanson River watershed (highlighted in green on map) is located on the northern Kenai Peninsula and is mostly encompassed within the Kenai National Wildlife Refuge.

Watershed size	159,579 acres
Maximum elevation	503 feet
Mean elevation	216 feet
Percent wetlands	17.3 %
Connected lakes	Yes

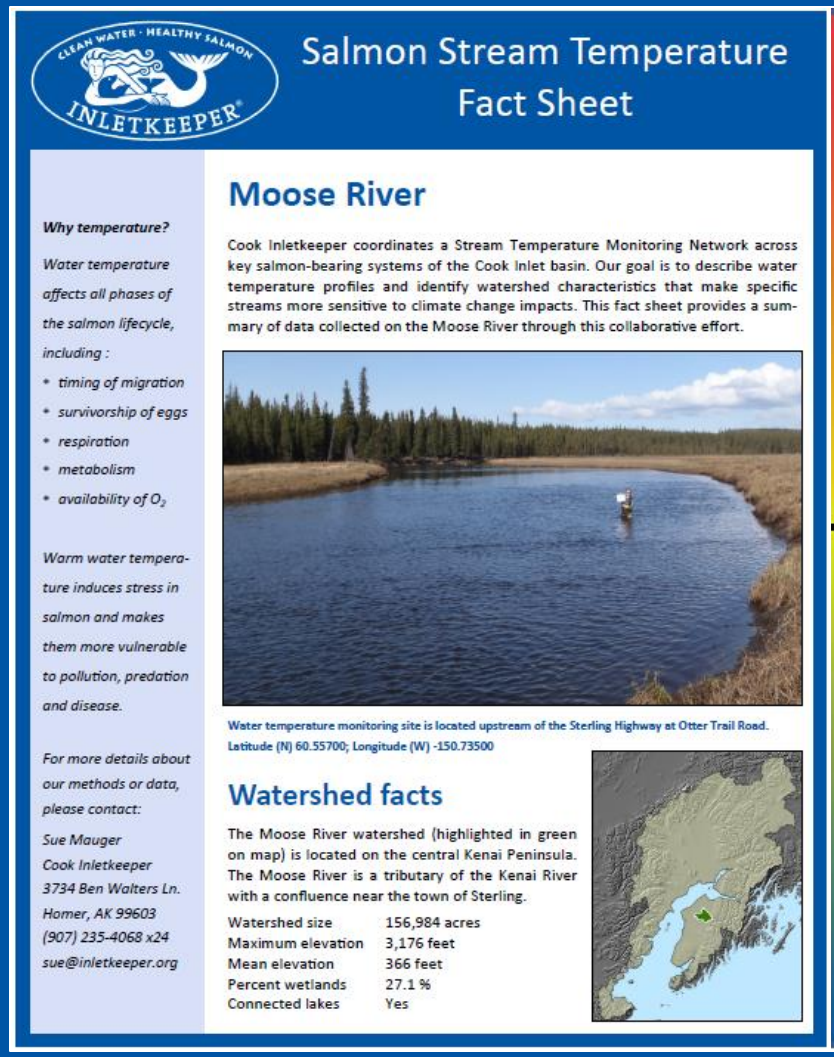
- Warm Temperature
- High Sensitivity

- Warm Temperature
- Low Sensitivity

average July water temperature



sensitivity



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Salmon Stream Temperature Fact Sheet

Moose River

Cook Inletkeeper coordinates a Stream Temperature Monitoring Network across key salmon-bearing systems of the Cook Inlet basin. Our goal is to describe water temperature profiles and identify watershed characteristics that make specific streams more sensitive to climate change impacts. This fact sheet provides a summary of data collected on the Moose River through this collaborative effort.

Water temperature monitoring site is located upstream of the Sterling Highway at Otter Trail Road. Latitude (N) 60.55700; Longitude (W) -150.73500

Watershed facts

The Moose River watershed (highlighted in green on map) is located on the central Kenai Peninsula. The Moose River is a tributary of the Kenai River with a confluence near the town of Sterling.

Watershed size	156,984 acres
Maximum elevation	3,176 feet
Mean elevation	366 feet
Percent wetlands	27.1 %
Connected lakes	Yes

Why temperature?

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- *survivorship of eggs*
- *respiration*
- *metabolism*
- *availability of O_2*

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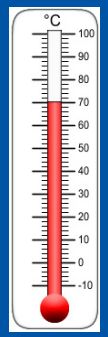
- Warm Temperature
- High Sensitivity

- Warm Temperature
- Low Sensitivity

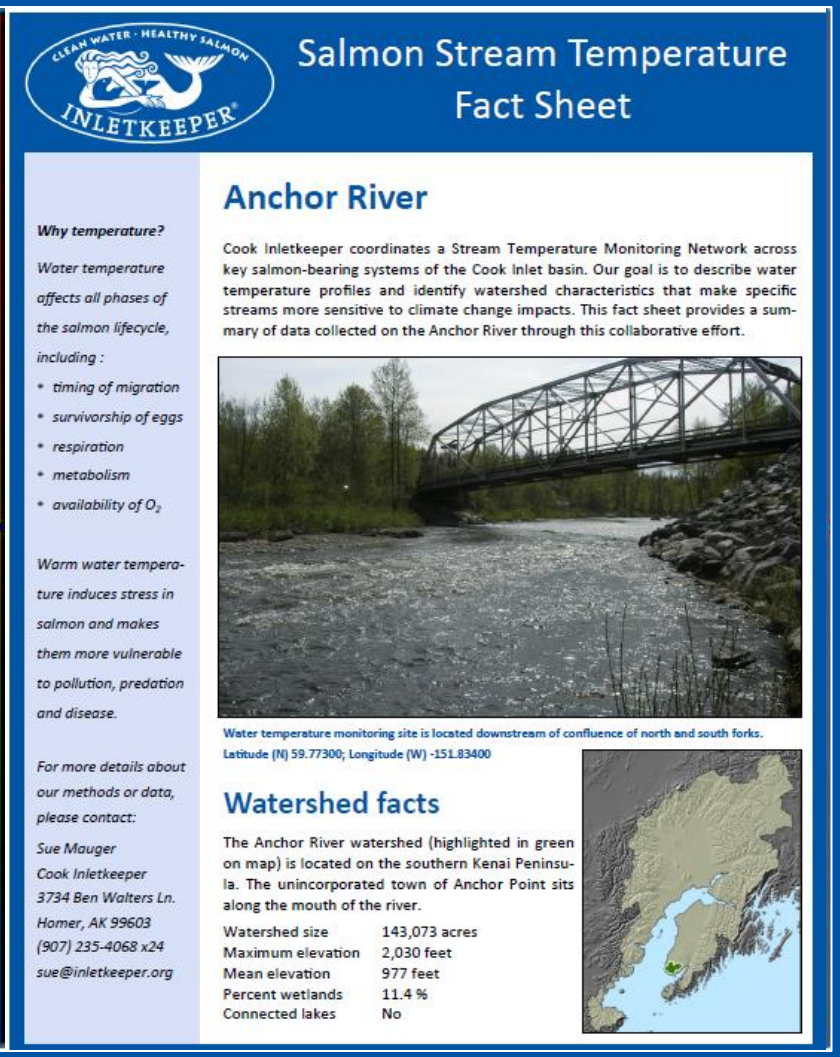
average July water temperature



sensitivity

- Cold Temperature
- High Sensitivity

- Cold Temperature
- Low Sensitivity



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Salmon Stream Temperature Fact Sheet

Why temperature?

Water temperature affects all phases of the salmon lifecycle, including :

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- *metabolism*
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Anchor River

Cook Inletkeeper coordinates a Stream Temperature Monitoring Network across key salmon-bearing systems of the Cook Inlet basin. Our goal is to describe water temperature profiles and identify watershed characteristics that make specific streams more sensitive to climate change impacts. This fact sheet provides a summary of data collected on the Anchor River through this collaborative effort.

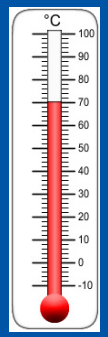
Water temperature monitoring site is located downstream of confluence of north and south forks.
Latitude (N) 59.77300; Longitude (W) -151.83400

Watershed facts

The Anchor River watershed (highlighted in green on map) is located on the southern Kenai Peninsula. The unincorporated town of Anchor Point sits along the mouth of the river.

Watershed size	143,073 acres
Maximum elevation	2,030 feet
Mean elevation	977 feet
Percent wetlands	11.4 %
Connected lakes	No

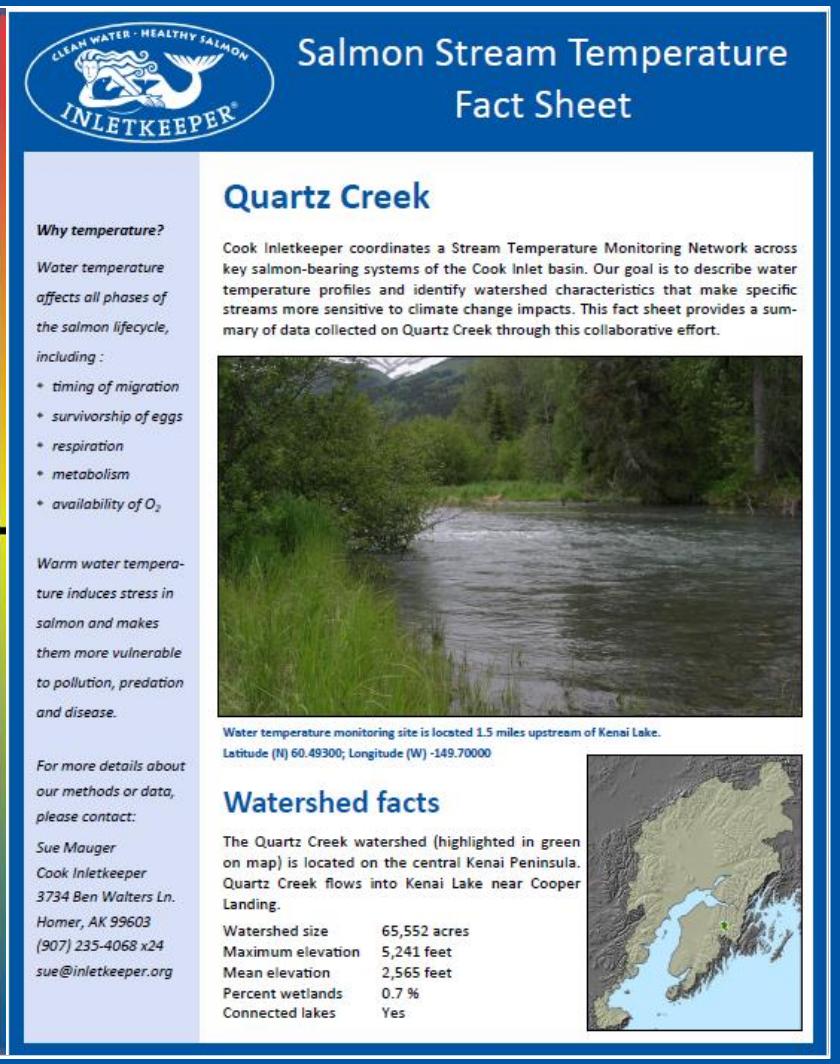
average July water temperature



sensitivity

- Cold Temperature
- High Sensitivity

- Cold Temperature
- Low Sensitivity



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Salmon Stream Temperature Fact Sheet

Why temperature?

Water temperature affects all phases of the salmon lifecycle, including :

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- *metabolism*
- *availability of O_2*

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Quartz Creek

Cook Inletkeeper coordinates a Stream Temperature Monitoring Network across key salmon-bearing systems of the Cook Inlet basin. Our goal is to describe water temperature profiles and identify watershed characteristics that make specific streams more sensitive to climate change impacts. This fact sheet provides a summary of data collected on Quartz Creek through this collaborative effort.

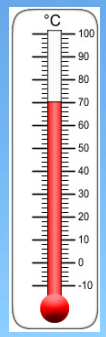
Water temperature monitoring site is located 1.5 miles upstream of Kenai Lake.
Latitude (N) 60.49300; Longitude (W) -149.70000

Watershed facts

The Quartz Creek watershed (highlighted in green on map) is located on the central Kenai Peninsula. Quartz Creek flows into Kenai Lake near Cooper Landing.

Watershed size	65,552 acres
Maximum elevation	5,241 feet
Mean elevation	2,565 feet
Percent wetlands	0.7 %
Connected lakes	Yes

average July water temperature



Summary of Water Temperature Impacts

- ✓ Sensitive non-glacial streams are likely to continue to warm and increase thermal stress to salmon (40%)
- ✓ Cold insensitive streams will likely remain favorable for salmon and continue to provide important cold-water habitat in the decades ahead (45%)
- ✓ Glacial systems will provide cold water during warm months but will likely contribute increased turbidity

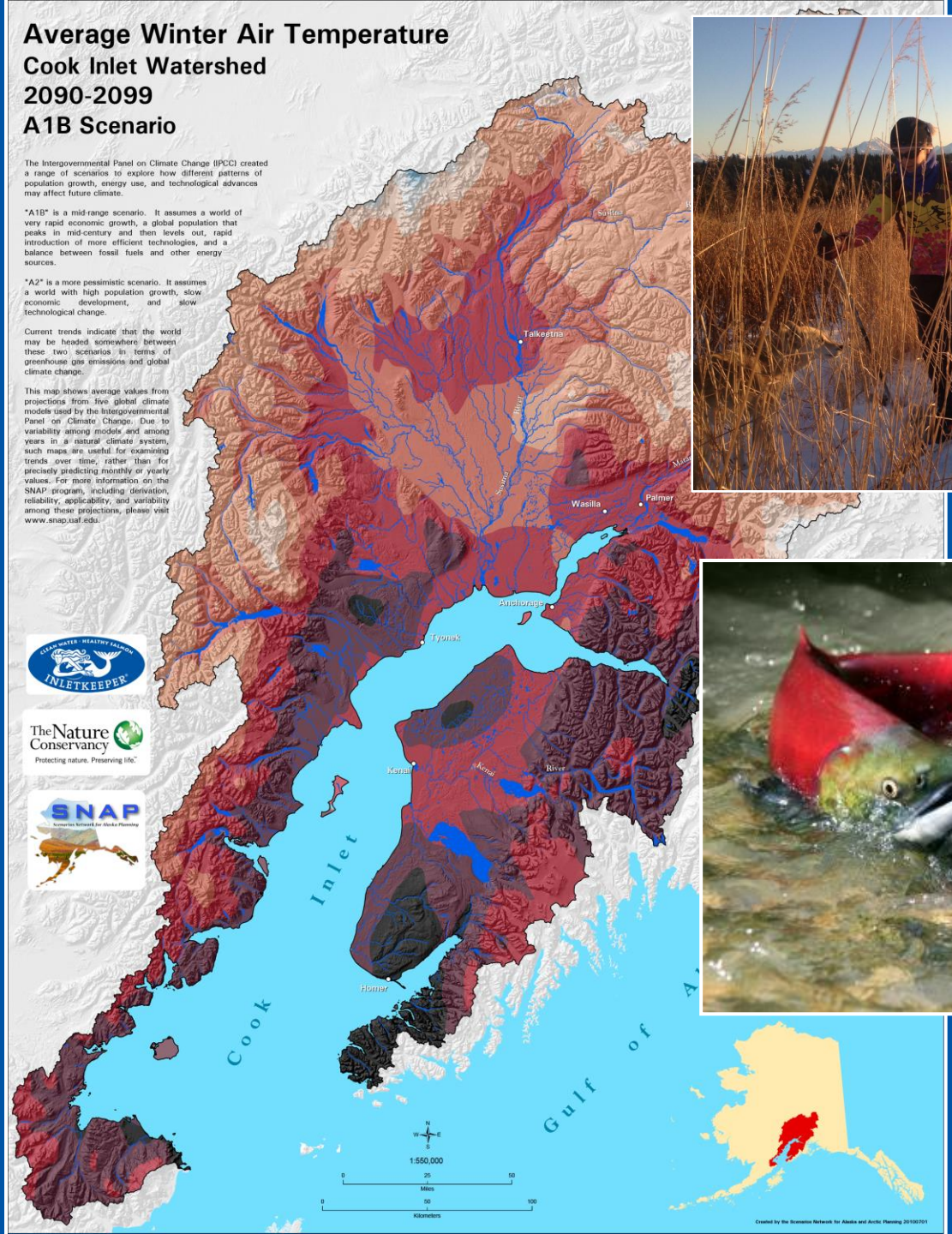
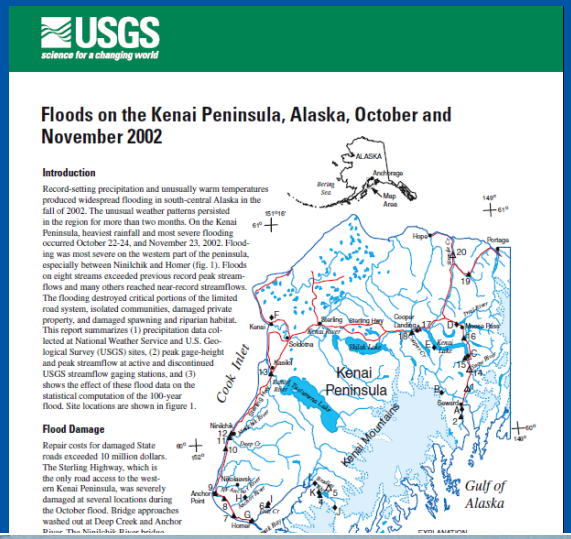


Photo: Kathy Sarns Irwin



USGS
science for a changing world

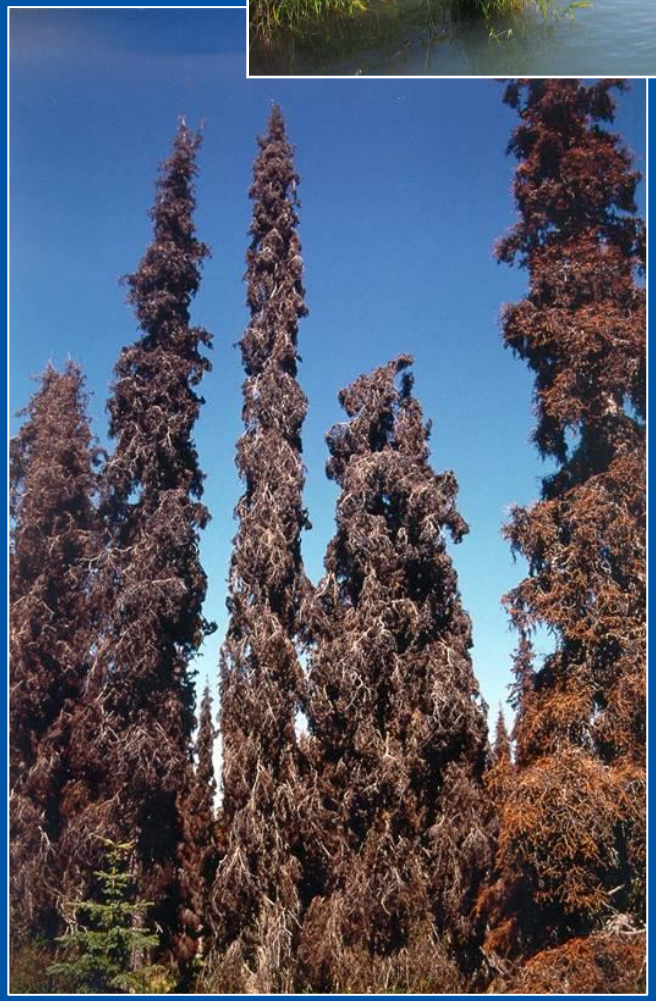
Floods on the Kenai Peninsula, Alaska, October and November 2002

Introduction

Record-setting precipitation and unusually warm temperatures produced widespread flooding in south-central Alaska in the fall of 2002. The unusual weather patterns persisted in the region for more than two months. On the Kenai Peninsula, heaviest rainfall and most severe flooding occurred October 22-24, and November 23, 2002. Flooding was most severe on the western part of the peninsula, especially between Ninilchik and Homer (fig. 1). Floods on eight streams exceeded previous record peak streamflows and many others reached near-record streamflows. The flooding destroyed critical portions of the limited road system, isolated communities, damaged private property, and damaged spawning and riparian habitat. This report summarizes (1) precipitation data collected at National Weather Service and U.S. Geological Survey (USGS) sites, (2) peak gage-height and peak streamflow at active and discontinued USGS streamflow gaging stations, and (3) shows the effect of these flood data on the statistical computation of the 100-year flood. Site locations are shown in figure 1.

Flood Damage

Repair costs for damaged State roads exceeded 10 million dollars. The Sterling Highway, which is the only road access to the western Kenai Peninsula, was severely damaged at several locations during the October flood. Bridge approaches washed out at Deep Creek and Anchor River. The Ninilchik River bridge



Carbon-related stressors

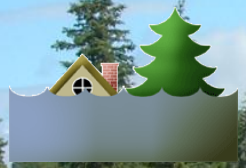
Increase in carbon will affect:

Ocean acidity

Courtesy of David Littschwager/National Geographic Society

Photo: Alan Parks

Summary of Additional Impacts



- ✓ Less water storage in winter
- ✓ Fish passage issues
- ✓ Increase scour, decrease egg survival
- ✓ Less marine derived nutrients to feed the watershed
- ✓ Forest health and changes in vegetation may alter nutrient pathways into streams

Salmon Stressors

- ✓ What are the major climate-related stressors?
- ✓ How will they impact Kenai Peninsula streams?
- What can we do to build resilience?

What can we do?

Reduce non-climate stress

- Maintain stream-side vegetation for shade
- Maintain groundwater connections
- Maintain wetlands for water storage
- Maintain/restore culverts for fish passage
- Limit invasive species expansion

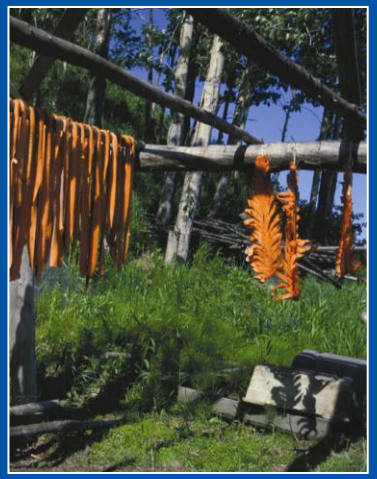
Prioritize

Develop local information

Coordinate efforts

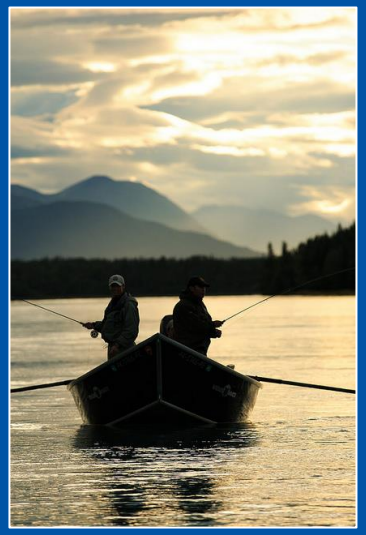
KENAI PENINSULA FISH HABITAT PARTNERSHIP

Way of Life



Food Security

Identity



Thank you!