Linking North Slope Climate, Hydrology, and Fish Migration

Erica Betts
Water and Environmental Research Center
University of Alaska Fairbanks
April 4, 2011
Outline

- Introduction
- Hydrology
- Fish Migration
- Climate Change
- Research
- Results
- Next Steps
Background

- Climate change impacts on fish and wildlife populations?
  - Important pathways?
  - Mechanisms?
- Linkages important to arctic environments
Hydrologic Response

Hydrologic Connectivity

(a) 14 June 2000, (b) 21 June 2000, (c) 5 July 2000, (d) 22 July 2000, and (e) 7 September 2000

<table>
<thead>
<tr>
<th>Date</th>
<th>Saturated Extent</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 June 2000</td>
<td>315 km$^2$</td>
<td></td>
</tr>
<tr>
<td>21 June 2000</td>
<td>129</td>
<td>73 percent</td>
</tr>
<tr>
<td>5 July 2000</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>22 July 2000</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>7 Sept. 2000</td>
<td>84</td>
<td></td>
</tr>
</tbody>
</table>

Fish Migration

Ublutuoch River

Shallow Lake

Arctic grayling migration

- After break-up grayling leave overwintering sites for spawning grounds
- Utilize smaller ponds and streams for rearing or feeding grounds
- Must migrate back to overwintering sites before freeze up
Climate Change

Climate Change


WildREACH conference proceedings, USFWS, November 17-18, 2008 http://www.arcus.org/alaskafws/, courtesy of Peter Larson
Research Location
Barriers to Migration

- Hyporheic flow
  - Spatial and temporal exchange of channel water with associated riverine and floodplain sediments.
- In the arctic, hyporheic zone constrained by active layer depth below stream channel
- During periods of low stream flow – areas with strong hyporheic flow appear dry

“Dry” event occurs when streamflow becomes 100% hyporheic
Results

![Graph showing comparison between two sites and regression line]

**Upper Kuparuk Gage vs. Kuparuk "dry" Site**

- Stage vs. Stage
- Linear (Stage vs. Stage)

**Observed vs. Calculated Stage Values (2010)**

- Upper Kuparuk Gage
- Kuparuk "dry" site (Calc)
- Kuparuk "dry" site (Obs)

Date Range:
- 6/12
- 6/22
- 7/2
- 7/12
- 7/22
- 8/1
- 8/11
- 8/21
- 8/31

Equation:
\[ y = 1.388x - 1.882 \]

Coefficient of Determination:
\[ R^2 = 0.896 \]
Results

Number of Days Per Summer With No Stream Flow

Average Number of Days With No Stream Flow (1996-2009)

Bars = ±1/2 (STD)
What’s Next?

- Collect stage data from all three “dry” locations
- Install piezometers at one or more locations
- Determine atmospheric drivers of “dry” conditions
- Assess impact on Arctic grayling
Next Steps
Acknowledgements

- **Committee Members**
  - Doug Kane, UAF/WERC
  - Amy Tidwell, UAF/WERC
  - Amanda Rosenberger, UAF/SFOS
  - Jeff Adams, FWS
  - David Atkinson, Uvic/IARC

- **Collaborators**
  - Philip Martin, FWS
  - Fairbanks FWS Fisheries Staff including Nicole Legere
  - Linda Deegan, Woods Hole Marine Biological Lab

- **Funding**
  - USFWS, NFWF, WWF, WERC

- **Field Work**
  - Joel Homan, John Mumm, Fabien Rigault
QUESTIONS?