Water, Our Voice to the Future:
Climate change adaptation and waterborne disease prevention on the Crow Reservation

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What are the current and projected impacts of climate change on Crow Tribal waters and health?

• Crow Tribal knowledge of climate and ecological changes

• Western science data on past and projected climate changes

• Impacts on groundwater and home well water quality

• Impacts on microbial contamination of surface water
Crow Elders are seeing changes in our local climate and water resources

In winter, the ground used to be consistently snow covered and the temperature stayed below freezing. Now the ground is usually brown in winter and thaws are common.
Interviews with Crow Elders on climate and ecological changes

Bill Lincoln, Tribal Elder harvesting a traditional medicinal plant

Larson Medicine Horse, traditional spiritual leader

15 Elders interviewed to date; work is ongoing.
Crow Tribal Elders’ observations

• In every District of the Reservation, there isn’t nearly as much snow as 50 years ago. The ground used to be snow-covered winter long.
• As kids, we could ice skate winter long – now there are often winter days above freezing.
• Trees are getting killed by mid-winter thaw – freeze cycles that never used to happen.
• Spring ice break-up on the rivers used to be a dramatic event, and now the winter river ice is thinner and just melts quietly away.
• Summers have become more difficult as they have gotten progressively hotter. We have had to adjust our summer activities.
• Various fish species have moved upriver, suspect climate change is causing or contributing to this.
• Many berry species are fruiting earlier than they used to – if they fruit at all. Some berry trees and shrubs are flowering too early, and a later frost then kills the flowers.
• The 2012 fire season was the worst in living memory.
• The nearly back to back 2007 & 2011 spring floods were unprecedented.
The 2012 summer fires were the worst in living memory for the Crow Reservation. On the adjoining Northern Cheyenne Reservation, 60% of their land burned. Across Montana, > 1.2 million acres burned, the second worst season on record. Subsistence hunting of deer and elk is vital on the Crow Reservation; community members are concerned about loss of forage where the fires blistered the ground.
How does the measured climate data compare to local knowledge and memory?

Publically available weather station data: Hardin, MT is the only reasonably complete and ongoing source of weather data within 75 kilometers of Crow Agency, MT.

Regional data: Montana Climate Division 5

Climate Division data is available on-line from the National Climate Data Center
Summers are getting hotter

Number of days with temperatures exceeding 90°F (32°C) in Hardin and Crow Agency MT, plotted from National Weather Service daily records (National Climate Data Center). The red line indicates a linear trend of increasing high temperatures based on the data. (A dip in temperature in the early 1990s corresponds to a cold period produced by the volcanic ash from eruption of Mt Pinatubo.)
Montana Climate Division 5: Warmer summers

Montana CD5 data shows average monthly temperatures over the past 110+ years have been steadily warming for the summer months of June through September, by 0.1° to 0.2°F per decade.
Increase in number of frost free days

Number of frost free days in Hardin, MT, calculated from historic daily observations. (Data source: National Climate Data Center.)
Montana Climate Division 5: Milder winters

The increase in number of frost-free days is consistent with Montana CD5 data showing that over the past 110+ years, average temperatures for the months of January through March have been steadily increasing (by 0.2˚F, 0.4˚F and 0.5˚F per decade respectively).
Increasing average annual temperature

Plot of average temperature for Hardin, MT 1948-2007 (solid triangles) and Crow Agency, MT 1948-1991 (hollow diamonds) showing increase in average temperatures from a mean of 45.6°F in the 1950s to 50.1°F since 2000. Solid black line is 4-year moving average for Hardin data, dashed blue line is 4-year moving average for Crow Agency data. (Data source: National Climate Data Center.)
Total annual snowfall

Annual snowfall in millimeters from Hardin MT (1912-2012) and Crow Agency MT (1895-1990) observation sites, calculated in water years. The trendline is calculated from the average of measurements when both locations had measurements, and on the single site's measurements when only one station was operating. Years with more than one month of missing data were deleted from data plot, except for the earliest records. (Data source: National Climate Data Center.)
Declining annual precipitation

The decline in winter snow pack is not being made up during other seasons; average annual precipitation in MT CD5 has been declining by 0.11” per decade. April’s increase might contribute to flooding?
Is spring runoff occurring earlier?

Decadal averages of daily spring runoff for May and June, Little Bighorn River above Wyola, Montana. Earliest spring runoffs on record occurred in the 1980s and 2000s. (Data source: USGS 2012)
Is stream discharge declining?

Little Bighorn River at Montana/Wyoming state line. Monthly averages of daily mean discharge by decade. Lowest discharge decades were the 1980s and 2000s. (Data source: USGS 2012)
Little Bighorn River flood history

Little Bighorn River at Crow Agency, Montana. Major, back to back floods in 2007 and 2011 have us concerned about future flooding. (Data source: USGS 2012)
How do the historical trends (warmer, drier) compare to projected future climate change?

USGS projected climate change anomalies 1980-1989 vs. 2090-2099 for Big Horn County, MT

Temperature change is projected to accelerate.

<table>
<thead>
<tr>
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<th>Past 80 yrs MCD5</th>
<th>Next 80 yrs MCD5 avg</th>
<th>Next 80 yrs Big Horn</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>+2.22°C</td>
<td>+3.89°C</td>
<td>+3.84°C</td>
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<tr>
<td>Sept</td>
<td>+0.89°C</td>
<td>+4.33°C</td>
<td>+4.30°C</td>
</tr>
</tbody>
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http://regclim.coas.oregonstate.edu/
Conclusions

- Lack of or inadequate environmental monitoring (weather, soil moisture, snowfall...) in Tribal communities means local knowledge is vital in understanding climate and ecological change.
- We have lived and survived in the same place for many generations – so we see and experience climate change impacts that go beyond what science is currently monitoring.
- Native American and other rural communities who rely on the land, e.g. substantial subsistence activities, traditional uses of river water, farming and/or ranching are at particular risk from climate change, and have greater adaptation challenges.
- We need all sources of knowledge to understand, anticipate and plan how we will cope with climate change and its impacts.
- In Crow, we are now looking for and discussing connections between water and health – this is a new discussion for us.
It takes a whole community

Our thanks and appreciation to the many dedicated community members and student interns who have participated or are participating in this project, and to our colleagues with the Crow Tribe, USGS, EPA, USF&WS, IHS, Hopa Mountain and Messengers for Health.
It takes all of us to work on change

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Questions?