Microbial Pollutants, Grazing, and Rangeland Water Quality
Time to create knowledge from research

Presented to the California Cattlemen's Association
Annual Conference
Educational Forum
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Ken Tate and Rob Atwill, UC Davis

1995 vs. 2010 the issue is the same, cows and microbial water quality

1995 a lack of research information to answer basic questions
2010 translate a huge amount of research information to ranchers, regulators, and the public in a manner that is helpful

We are working to get the science organized, translated, and available

Microbial Water Quality & CA Range Watersheds
The Big Picture

Sources
- human
- wildlife
- livestock
- companion animals

Outbreaks
- recreational contact
- drinking water
- irrigated fresh food crops
- shellfish consumption

surface water polluted

Rangeland Watershed Microbial Pollutants

Fecal Indicator Bacteria (FIB) are non-pathogenic indicators regulated with intent to keep pathogens and outbreaks low. More>>
Pathogens are microbes which can create disease/outbreaks and thus pose a real threat to human health. More>>
FIB are generally determined to be poorly correlated with the occurrence of pathogens in surface waters. More>>

Pathogen Correlation to FIB Water Quality Standards
100+ samples analyzed for pathogens and FIB at grazed and irrigated mountain meadow systems

EPA E. coli standard → “safe” vs. “danger”

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>Number of Positive Samples/Total</th>
<th>1995</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em> O157:H7</td>
<td>4/95</td>
<td>2/21</td>
<td></td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>9/75</td>
<td>3/27</td>
<td></td>
</tr>
<tr>
<td><em>Campylobacter</em></td>
<td>0/75</td>
<td>0/27</td>
<td></td>
</tr>
</tbody>
</table>

Microbial Water Quality & Cattle Grazing
Organize Knowledge

Factors that increase risk of water pollution with pathogens

Factors that reduce risk of water pollution with pathogens

Manage Cattle
- Decrease cattle grazing
- Reduce cattle grazing near well water and shallow water, and near cattle watering wells
- Reduce cattle grazing on irrigated pastures near water, and near shallow water wells
- Reduce cattle grazing near drinking water sources
- Reduce cattle grazing near animal holding areas

Manage Cattle Distribution
- Reduce cattle grazing in non-irrigated areas
- Reduce cattle grazing near well water and shallow water wells
- Reduce cattle grazing in non-irrigated areas near shallow water wells
- Reduce cattle grazing in non-irrigated areas near animal holding areas
- Reduce cattle grazing near drinking water sources

Manage Grazing Time
- Reduce cattle grazing in non-irrigated areas near shallow water wells
- Reduce cattle grazing in non-irrigated areas near animal holding areas
- Reduce cattle grazing near drinking water sources
- Reduce cattle grazing in non-irrigated areas near shallow water wells
- Reduce cattle grazing in non-irrigated areas near animal holding areas

Moderate Grazing
- Reduce cattle grazing in non-irrigated areas near shallow water wells
- Reduce cattle grazing in non-irrigated areas near animal holding areas
- Reduce cattle grazing near drinking water sources
- Reduce cattle grazing in non-irrigated areas near shallow water wells
- Reduce cattle grazing in non-irrigated areas near animal holding areas
Cryptosporidium dynamics in wildlife and livestock

<table>
<thead>
<tr>
<th>Animal</th>
<th>% infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>range bee cow</td>
<td>6-8*</td>
</tr>
<tr>
<td>range bee calve &lt; 4 mo</td>
<td>10-20*</td>
</tr>
<tr>
<td>back country pack stock</td>
<td>0</td>
</tr>
<tr>
<td>feral pig</td>
<td>4-13*</td>
</tr>
<tr>
<td>ground squirrel</td>
<td>7-15*</td>
</tr>
</tbody>
</table>

*C. parvum is rare

Over 60% of cattle fecal loading is near livestock attractants in summer

We can position salt, feed, water to attract cattle and pathogens to “safe” areas – not near streams or runoff areas

C. parvum survival in cow pats on range

<table>
<thead>
<tr>
<th>Days until &gt;90% dead</th>
<th>Fecal Pat Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>50</td>
</tr>
<tr>
<td>29</td>
<td>68</td>
</tr>
<tr>
<td>5</td>
<td>86</td>
</tr>
<tr>
<td>&lt;1</td>
<td>104</td>
</tr>
</tbody>
</table>

Organize Knowledge

Factors that increase risk of water pollution with pathogens

- Failures if water quality during rainy season
- Grazing patterns
- Presence of water
- Cattle defecation in rainwater
- Cattle defecation in runoff
- Cattle feeding during rainy season
- Grazing patterns

Factors that reduce risk of water pollution with pathogens

- Keep cattle calm by avoiding water at night
- Feeding during rain
- Grazing patterns
- Grazing patterns

Microbial Water Quality & Cattle Grazing

Research Result

Streams & runoff areas

Management Implication

- Keep pats out of creeks.
- Move cattle, pats away from critical areas with distribution tools.
- Narrow buffer strips are effective.
- Maintain soil infiltration rates.
- Moderate stocking rates.

Cattle, C. parvum

Organize Knowledge

Once temperature in a cow fecal pat exceeds 104 °F all of the C. parvum in that pat die within a matter of hours. Fecal pats in direct sun can achieve 104 °F once air temperature reaches 78 °F.

An additional 70% to 99.9% trapped within 1 yard of pat

Research Result

C. parvum

Microbial Water Quality & Cattle Grazing

Manage Grazing Time

- Reduce cattle grazing near water during rainy season
- Move cattle prior to and during rainfall

Manage Grazing

- Keep cattle numbers in balance with forage production
- Enhance past canopy

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Microbial Water Quality & Cattle Grazing
Organize Knowledge

Factors that increase risk of water pollution with pathogens

- Factors of cattle
  - Defecate in water
  - Carry pathogens
  - Defecate in runoff

Factors that reduce risk of water pollution with pathogens

- Manage Cattle
  - Reduce cattle numbers in behavior
  - Reduce cattle numbers in stocking rate
  - Reduce cattle numbers in time

- Manage Distribution
  - Provide all livestock water
  - Manage rotational fluid

- Manage Grazing Time
  - Reduce cattle grazing
  - Reduce cattle grazing
  - Reduce cattle grazing
  
Grazing Intensity E. coli

No Grazing 310
 Moderate Grazing 425
 Heavy Grazing 1250

EPA Standard = 126

Stocking rate increases WQ risk, background is not zero

We are working to get the science organized, translated, and available

California Rangeland Watershed Laboratory
http://rangelandwatersheds.ucdavis.edu

Grazing for Ecosystem Services
which includes raising cattle

K. Tate, L. Roche, B. Cutts, V. Eviner, J. Derner, T. O’Geen, M. Lubell, M. George

Reality: we manage for many goals, not just one, nor one at a time

Forage and Livestock Production
Weed Control – Diversity
Wildlife and their Habitat
Productive and Healthy Soils
Water Quality and Quality

Mail survey to 2000 CA and WY ranchers

Your knowledge about grazing to achieve your agricultural and ecological goals

Information you need to manage for your goals

Best way to get information to you

Make research and outreach relevant and available to you and the public

We need your help
In collaboration with CCA

Mark Lubell, Tracy Schohr, Bethany Cutts

Mailed from CCA
Confidential
Jan-Feb 2011
Please participate

Mail survey to 2000 CA and WY ranchers about their perceptions, and use, of conservation practices
On ranch survey of conservation practice implementation and rangeland health

Ten year, 3000 acre adaptive grazing management experiment at UC SFREC

Develop on-line support information

California Rangeland Watershed Laboratory
http://rangelandwatersheds.ucdavis.edu

Center for Environmental Policy and Behavior
http://environmentalpolicy.ucdavis.edu

Talk to Bethany Cutts, or myself during the convention
Watch your mail from CCA for updates, the survey, survey reminders, etc.