Characterizing the risk of *E. coli* contamination from animal agriculture and wildlife

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Under what conditions do these populations pose a risk to microbial water quality?

Multiple processes need to occur:
- fecal (pathogen) loading
- transport: rainfall → runoff, direct deposition (wildlife)
- survival: solar and drying

How much is in host populations?
How far does it move (how far back to place a fence)?
How long does it survive (when to rotate livestock out)?
**Shiga-toxin producing *E. coli* in CA cattle**

*Hussein-UNR; Atwill-UCD; UCCE Livestock Advisors*

<table>
<thead>
<tr>
<th>Group</th>
<th>Stx1 or Stx2</th>
<th>Feed</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedlot cattle</td>
<td></td>
<td>2.5%</td>
<td>640</td>
</tr>
<tr>
<td>Cow-calf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated</td>
<td></td>
<td>3.5%</td>
<td>638</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>5.8%</td>
<td>774</td>
</tr>
<tr>
<td>Dairy cattle</td>
<td></td>
<td>1.9%</td>
<td>721</td>
</tr>
</tbody>
</table>

Out of 2773 fecal samples, none were O157:H7
Rangeland cattle

<table>
<thead>
<tr>
<th>Season</th>
<th>Stx1 or Stx2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>3.7%</td>
<td>n=219</td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>4.7%</td>
<td>n=190</td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>13.6%</td>
<td>n=198</td>
<td></td>
</tr>
<tr>
<td>Spring</td>
<td>1.0%</td>
<td>n=167</td>
<td></td>
</tr>
<tr>
<td>Cows</td>
<td>3.0%</td>
<td>n=403</td>
<td></td>
</tr>
<tr>
<td>Calves</td>
<td>8.1%</td>
<td>n=271</td>
<td></td>
</tr>
</tbody>
</table>

O antigen serotypes: O26, O86, O111, O125, O127, O146, O158, O166
Characterizing vertebrate sources

\[
\text{No. of pathogens} \times \frac{\text{Kg feces}}{\text{animal unit}} = \frac{\text{Kg feces / day}}{\text{animal unit}}
\]

\[
\text{No. of pathogens / day} \times \text{animal density} = \frac{\text{Pathogens / day}}{\text{animal unit}}
\]

\[
\text{No. of pathogens / day / geographical area}
\]
Spatial pattern of fecal deposition
~proportion of feces that are relevant to transport~
Rangeland buffers on hillslopes appear to retain ≈95% *E. coli* in winter and spring; >99.9% achievable under certain conditions. Extreme rain events move the majority of pathogens.
Key processes governing microbial risks: waterborne transport between locations

- Maximum pathogen load (pathogens / Kg feces)
- Distance between load and water
- Buffer retention as a function of buffer width and other covariates
- Rate of inactivation versus replication
- Removal processes during downstream transport (shallow stream versus a hardened irrigation ditch)
A microbe’s journey between two locations is subject to numerous attenuating and inactivating processes. Despite the difficulty, connectivity occurs.