



Ecology of water quality and rangeland management.

Lewis Reed

Overview

- Background
- Watershed Function and Rangelands in Watersheds
- Livestock as part of the Ecosystem
- Water Quality: Parameters and Livestock Interactions
- Livestock Management Tools and Strategies for Water Quality
- Discussion

What did I do?

- Search Databases
- Books
- Interviews

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***Cryptosporidium parvum* transport from cattle fecal deposits on California rangelands**

KENNETH W. TATE, EDWARD R. ATWILL, MELVIN R. GEORGE, NEIL K. MCMILLIGALD, AND ROYCE E. LARSEN

Authors are: Kenneth W. Tate, Edward R. Atwill, Melvin R. George, Neil K. McMilligald, and Royce E. Larsen are with the California School of Veterinary Medicine, University of California, Veterinary Medicine, University of California, Davis, Calif. 95616-2515; Kenneth W. Tate is with the California School of Veterinary Medicine, University of California, Veterinary Medicine, University of California, Davis, Calif. 95616-2515; Edward R. Atwill is with the California School of Veterinary Medicine, University of California, Davis, Calif. 95616-2515; Melvin R. George is with the California School of Veterinary Medicine, University of California, Davis, Calif. 95616-2515; Neil K. McMilligald is with the California School of Veterinary Medicine, University of California, Davis, Calif. 95616-2515; and Royce E. Larsen is with the California School of Veterinary Medicine, University of California, Davis, Calif. 95616-2515.

Abstract

Cryptosporidium parvum is a fecal borne protozoan parasite that can be carried by and cause gastrointestinal illness in humans, cattle, and wildlife. The illness, cryptosporidiosis, can be fatal to persons with compromised immune systems. A question is the potential for *C. parvum* to erode fecal deposits on rangeland watersheds to contaminate surface water. First, *C. parvum* oocysts must be released from fecal deposits during rainfall, becoming available for transport. In 1996, we examined the transport of *C. parvum* oocysts in overland flow from fecal deposits under natural rainfall and rainfall conditions at the San Joaquin Experimental Range in Madras County, Calif. Our null hypothesis was that *C. parvum* oocysts are not released from fecal pats and transported 1 m downslope as overland flow with rainfall. Paired plots were located on 10, 20, and 30% slope sites. Each plot was loaded with four, 200 g fecal pats dosed with 10^6 oocysts g^{-1} . Pats were placed 1.0 m above the base of each plot. Composite runoff samples from each plot were analyzed for oocyst concentration following each of 4 storm events. Oocysts were transported during each storm. Slope was a significant factor in oocyst transport, with oocyst transport increasing with slope. Although not significant, there was an apparent flushing effect of oocysts across storms, with the majority transported in the first 2 storms. A pilot rainfall simulation experiment also revealed a flushing phenomenon from pats during individual rainfall events. *C. parvum* oocysts in fecal pats on rangeland can be transported from fecal deposits during rainfall events, becoming available for transport to water-bodies. Future studies need to examine surface and subsurface transport of oocysts on rangeland hillslopes for distances greater than 1 m.

Resumen

Cryptosporidium parvum es un protozoario parásito que se transporta en las heces fecales y que puede ser acreedor por humanos, bovinos y fauna silvestre a los que puede causar enfermedades gastrointestinales. Un enfermedad cryptosporidiosis puede ser fatal para personas con un sistema inmunológico débil. Se cuestiona el potencial del *C. parvum* contenido en las heces fecales de bovinos depositadas en las cuencas hidrográficas de rangeland para contaminar las aguas superficiales. Primero, las oocistas del *C. parvum* deben ser liberadas de las heces fecales durante la ocurrencia de lluvias para estar disponibles para ser transportadas. En 1996, en la Estación Experimental de Pastizales de San Joaquin en el condado de Madras, Calif., examinamos el transporte de oocistas de *C. parvum* en el flujo superficial proveniente de áreas con depósitos fecales bajo lluvia natural y en condiciones de simulación. Nuestros hipótesis nula fue que las oocistas de *C. parvum* no son liberadas de los depósitos fecales y transportadas 1 m cuesta abajo como en el flujo superficial de la lluvia. Se localizaron parcelas apareadas en sitios con 10, 20 y 30% de pendientes. En cada parcela se colocaron 4 depósitos fecales de 200 g de dosisadas con 10^6 oocistas g^{-1} , las heces fecales se colocaron 1 m arriba de la base de cada parcela. Se analizaron muestras compuestas del escurrimiento de cada parcela para determinar la concentración de oocistas después de cada uno de 4 eventos de lluvia. Los oocistas fueron transportados durante cada tormenta. La pendiente fue un factor significativo en el transporte de oocistas, incrementándose el transporte al aumentar la pendiente. Aunque no significante, hubo un efecto aparente de lavado de los oocistas a través de las tormentas, es decir la mayoría de ellos se transportaron en las primeras 2 tormentas. Un experimento piloto con simulador de lluvia también reveló un fenómeno de lavado durante eventos individuales de lluvia. Los oocistas de *C. parvum* de heces fecales localizadas en pastizales pueden ser transportadas durante los eventos de lluvia, llegando a ser disponibles para ser transportes a cuerpos de agua. Se necesitan estudios futuros para examinar el transporte superficial y subsuperficial de oocistas en las montañas de pastizal a distancias mayores de 1 m.

Key Words: pathogens, water quality, fate and transport, buffer strip

Cryptosporidium parvum (Texas 1912), a faecal-borne protozoan parasite, is an important etiologic agent of gastroenteritis in humans. *C. parvum* appears to be infectious for and is shed by humans, domestic animals, and wildlife species (Clayton et al. 1987). Waterborne transmission in humans has emerged as a leading public health problem here and abroad (McCormick et al. 1994).

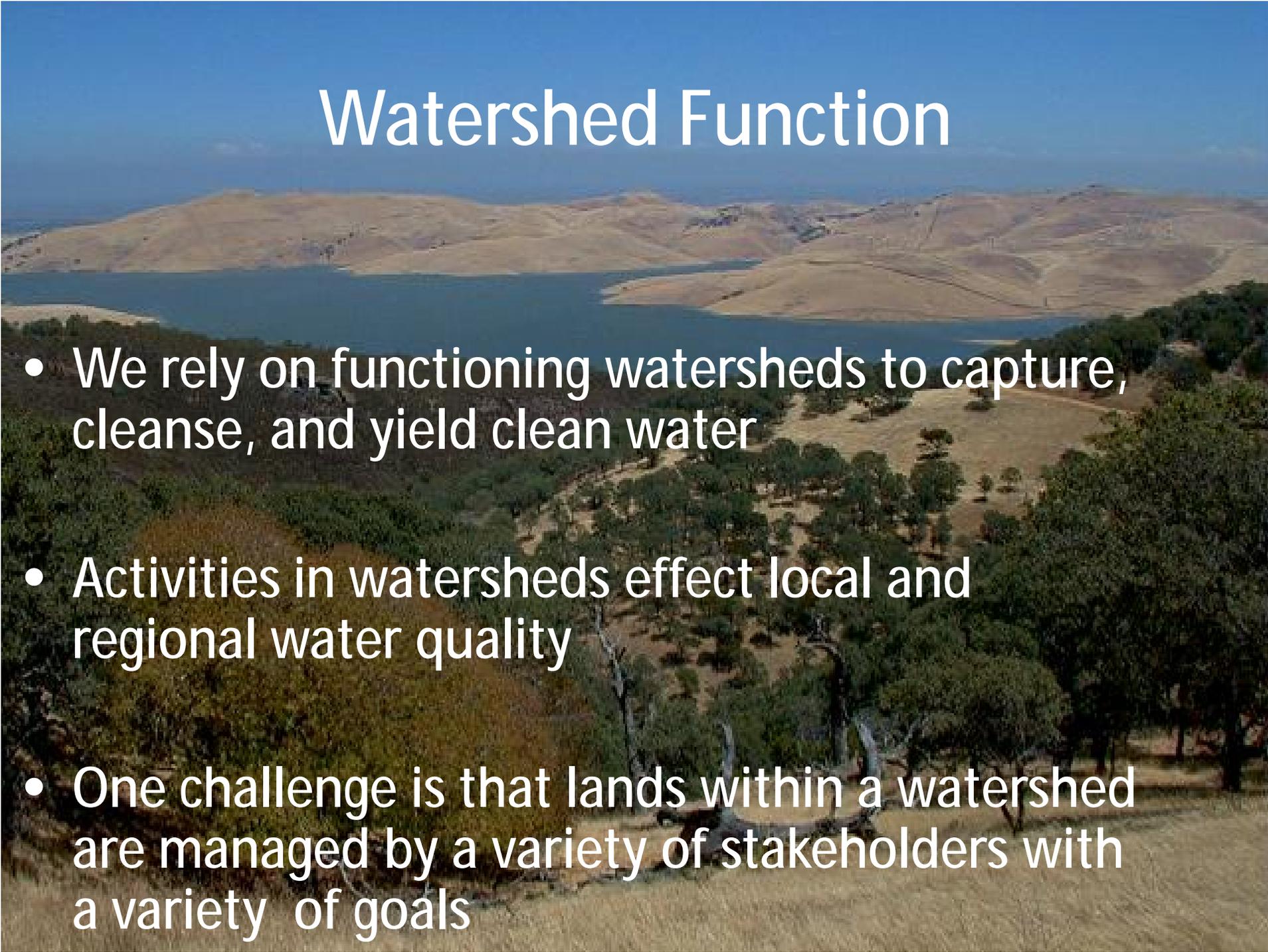
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1999. LeChevallier and Norton 1995). Public health officials have considered cattle as possible sources of this parasite because of *C. parvum* infection within cattle populations (McCormick et al. 1994). In 1993, the City of San Francisco, Calif. proposed to terminate long-standing grazing leases and ban cattle from 12,000

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Watershed Function



- We rely on functioning watersheds to capture, cleanse, and yield clean water
- Activities in watersheds effect local and regional water quality
- One challenge is that lands within a watershed are managed by a variety of stakeholders with a variety of goals

Rangelands

- In central coastal CA, much of our watersheds are used as range
- Private ranches
- Public lands managed with livestock
- Rangeland managers are water resource stewards!



Ecosystem Functions of Livestock

- Livestock have a niche
- Important primary consumers
- Redistribution of nutrients
- Effects on vegetation and plant growth form



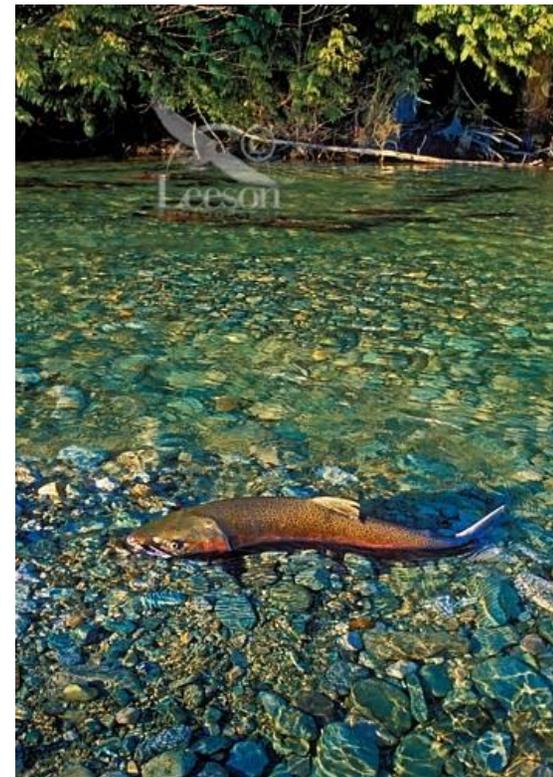
Water Quality

- Physical Properties
 - Sediment
- Chemical Properties
 - Nitrogen
 - Phosphorus
- Biotic Properties
 - Pathogens
 - Algae



Physical: Sediment Transport

- Filling of stream channels and ponds
- Conversion of substrate textures (spawning fish)



Physical: Sediment Transport



A.



B.

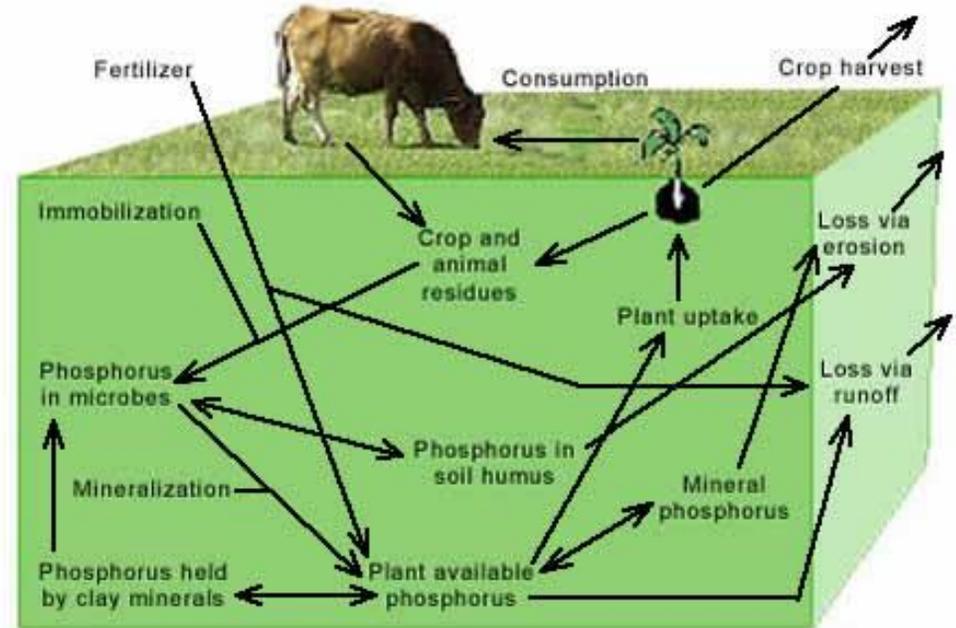
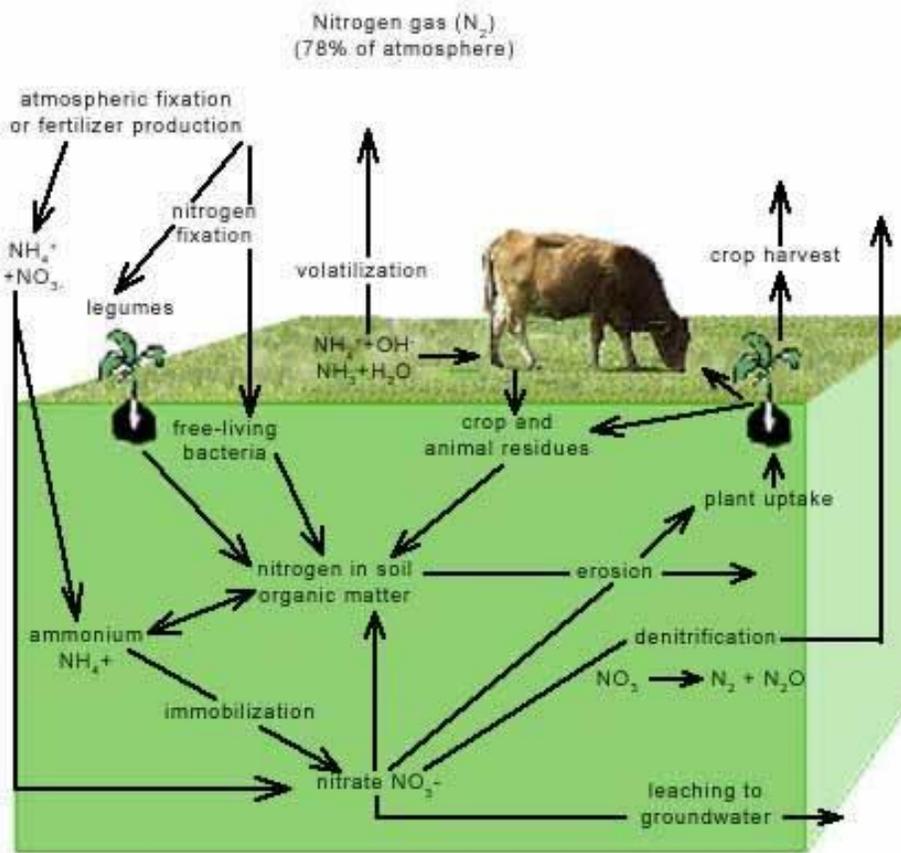


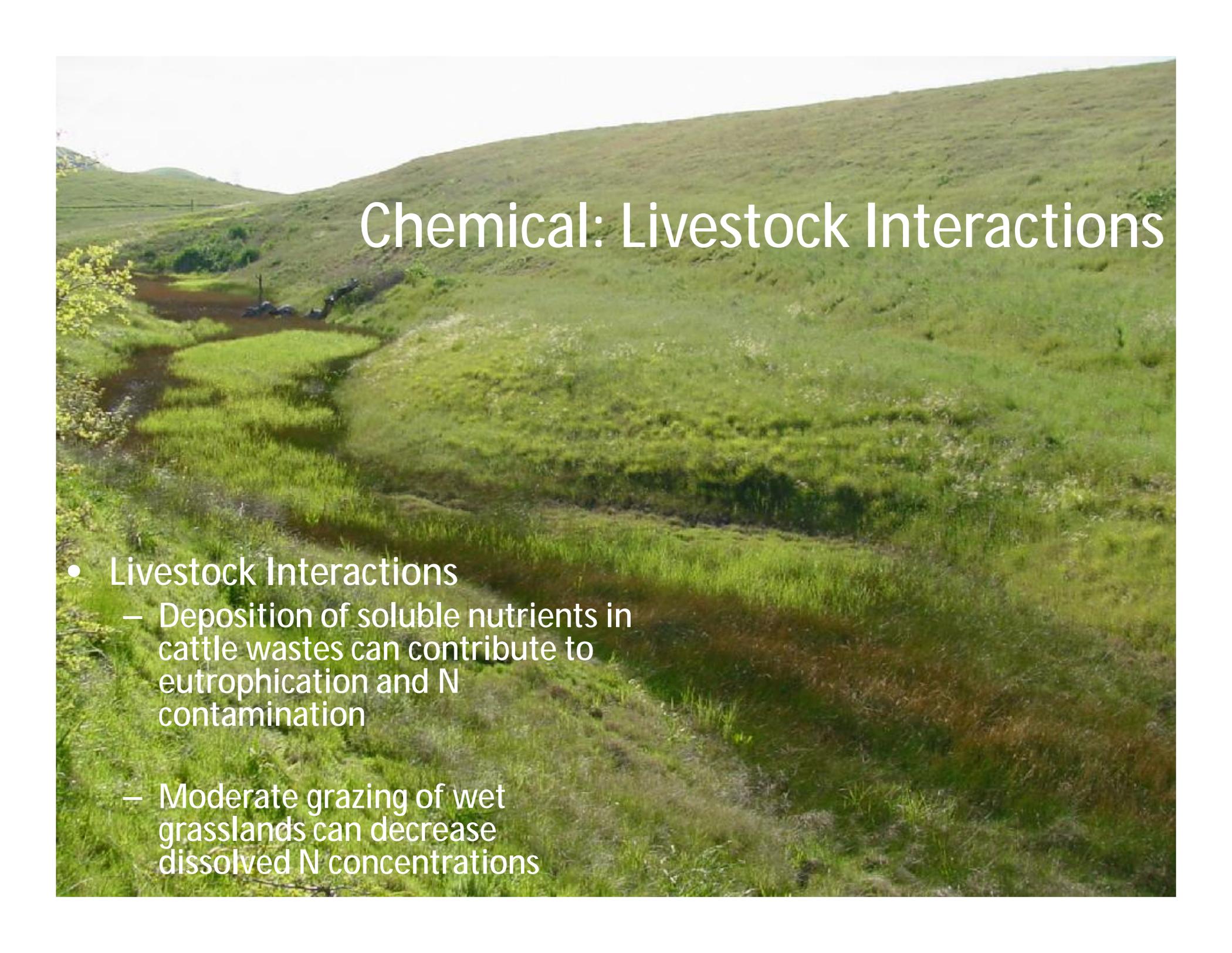
Chemical: Nutrient Dynamics

- Focus on Nitrogen and Phosphorus
- Pulses of highly labile limiting nutrients may cause eutrophication.



Chemical: Nutrient Dynamics





Chemical: Livestock Interactions

- Livestock Interactions
 - Deposition of soluble nutrients in cattle wastes can contribute to eutrophication and N contamination
 - Moderate grazing of wet grasslands can decrease dissolved N concentrations

Biotic: Pathogens and Algae

- Pathogens
- Algae (toxic vs. eutrophication)



Biotic: Livestock Interactions

- Fecal contact with water sources
- Nutrient inputs to water sources





Summary

Conclusion

- Rangelands comprise a large portion of the watersheds we rely on for local and regional water supply.
- Livestock management may contribute to or mitigate affects of non point water contamination.
- Strategies for one goal may be at odds with others: adaptability and responsiveness are the key.



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