

**PATHOGEN POLLUTION PROJECT (P3) TERRESTRIAL ANIMAL FECAL STUDY:
PRELIMINARY RESULTS FOR CENTRAL CALIFORNIA COAST BEEF CATTLE**

Background

Fecal samples were collected from three central California coast beef cattle ranches during 2007-08 as part of a broader fecal pathogen pollution study. During the dry (May-October) and wet seasons (November-April), 101 and 100 fecal samples were collected, respectively. Feces were analyzed for prevalence of bacterial pathogens (*Campylobacter*, *E. coli* 0157, *Salmonella*, and *Vibrio* species) and protozoal parasites (*Cryptosporidium* and *Giardia* species). These single-celled organisms inhabit the gastrointestinal tract of mammals and can cause enteric disease.

Bacterial pathogens and fecal parasites can cause diarrhea in humans and animals as well as reducing growth performance and milk production in adult cattle¹. *Cryptosporidium parvum* has been associated with waterborne disease outbreaks in humans²⁻³ and can cause severe diarrhea and mortality in calves, as well as, immunocompromised individuals⁴⁻⁵. A related parasite, *Cryptosporidium andersoni* (*muris*) was thought to be responsible for weight-loss (0.5 kg/day) in feedlot cattle⁶. In another study, cows shedding *C. andersoni* oocysts were reported to produce significantly less milk (approximately 3.2 kg/day)⁷. *Giardia duodenalis* and fecal bacteria also cause enteric disease and can be transmitted directly from host to host, indirectly by ingestion of food or water contaminated with fecal pathogens, or by living in a contaminated environment.

Preliminary Results

Ranch 1

Season	Samples Tested	Bacteria	Protozoa
Dry	50	3 positive for <i>Campylobacter</i> (6%)	4 positive for <i>C. parvum</i> -like oocysts (8%), 3 positive for <i>C. andersoni</i> (6%), 31 positive for <i>Giardia</i> (62%)
Wet	50	All were negative for <i>Campylobacter</i> , <i>E. coli</i> 0157, <i>Salmonella</i> , <i>Vibrio</i>	14 positive for <i>C. parvum</i> -like oocysts (28%), 3 positive for <i>C. andersoni</i> (6%), 33 positive for <i>Giardia</i> (66%)

Ranch 2

Season	Samples Tested	Bacteria	Protozoa
Dry	40	1 positive for <i>Campylobacter</i> (5.5%) ^a	4 positive for <i>C. parvum</i> -like oocysts (10%), 12 positive for <i>Giardia</i> (30%)
Wet	50	1 positive for <i>Campylobacter</i> (2%)	1 positive for <i>C. andersoni</i> (2%), 6 positive for <i>Giardia</i> (12%)

^a Results only reported for 18 of 40 samples.

Ranch 3

Season	Samples Tested	Bacteria	Protozoa
Dry	11	All were negative for <i>Campylobacter</i> , <i>E. coli</i> 0157, <i>Salmonella</i> , <i>Vibrio</i> ^b	1 positive for <i>C. parvum</i> -like oocysts (9%), 1 positive for <i>Giardia</i> (9%)
Wet	0	---	---

^b Results only reported for 4 of 11 samples.

Bacterial Pathogens

No *E. coli*-0157, *Salmonella*, or *Vibrio* spp. were detected to date. *Campylobacter* spp. were detected in 2.5% of adult cattle fecal samples tested. The *Campylobacter* species typically responsible for enteric disease include *C. jejuni* and to a lesser extent *C. coli*. *Campylobacter* infections are generally self-limiting with symptoms (thick, mucoid diarrhea with occasional flecks of blood, with or without a fever) resolving in 3-7 days. Animals can be infected asymptotically and contaminated food and water are often the source of infection.

Campylobacter jejuni and *C. coli* can infect cattle, sheep, chickens, turkeys, dogs, cats, mink, ferrets, pigs, and humans⁸⁻⁹. Previous studies of beef cattle operations reported 5-89.4% of fecal samples tested were positive for *Campylobacter* spp¹⁰⁻¹³. The *Campylobacter* isolates obtained during our study have been identified preliminarily and their pathogenic potential is unknown.

Protozoal Parasites

Cryptosporidium parasites were detected in 14% of fecal samples overall and *Giardia* parasites were detected in 41% of the overall samples. The protozoal species typically responsible for infection of dairy and beef cattle include *Cryptosporidium parvum*, *C. andersoni*, and *Giardia duodenalis* (assemblages A, E)¹⁴. Symptoms of protozoal infections generally include profuse watery diarrhea lasting up to several weeks. Previous studies have reported prevalence rates ranging between 1-70% for *Cryptosporidium* spp.^{12, 15-21} and between 7-82% for *Giardia* spp^{12, 21-23}. These values depend on the type and age-class of cattle and management practices. Dairy cattle typically have greater prevalence rates than beef cattle¹⁵. Calves are more susceptible to protozoal infection than adults because of their still developing immune system. One study reported an average prevalence rate of 49% for *Giardia* in calves <6 months, with the prevalence on individual farms ranging from 0 to 82%²⁴. Management practices such as length of calving season, age at weaning, pasture location, or stocking density also may play a significant role in prevalence rates¹².

Further testing is required to determine the source(s) of protozoal infection of the cattle grazing at each ranch. It is possible that cattle were infected before being moved onto their current pastures. Cattle also may have been exposed to fecal pathogens from natural water sources contaminated from upstream activities, previously contaminated pastures, infected individuals within the herd, or from wildlife.

How Can Pathogen Infection Be Prevented?

Beneficial (or best) management practice (BMPs) have been used by ranchers across the United States and Canada to improve livestock health and to reduce environmental loading and transport of fecal pathogens to water sources^{17, 25-27}. Some BMPs work by minimizing the amount of time cattle spend in natural water sources, thereby reducing the cattle's risk of ingesting pathogenic organisms and reducing the fecal contamination of the environment. Other BMPs such as vegetative buffers can remove pathogens from overland runoff and thereby improve water quality. Many BMPs are easy to implement and cost effective. These practices can include:

- Providing clean alternative water sources such as troughs.
- Amending the design of existing troughs (e.g., trough height) to exclude waste materials from entering the clean water source.
- Placing supplemental feed away from natural water sources.

- Excluding cattle from areas identified as high risk.
- Planting vegetative filter strips or increasing the distance between grazing cattle and waterways. Vegetation acts as natural buffer, filtering out pathogenic organisms before they enter the water.

Summary

Understanding and managing fecal pathogen pollution is a challenging and complex undertaking. The public often thinks that because cattle produce large amounts of manure, they are the main contributors to fecal pathogen pollution. However, recent studies have shown that livestock, domestic animals, wildlife, and humans all contribute to fecal loading in coastal watersheds²⁸. Studies have shown that beef cattle herds often have a very low prevalence of fecal pathogens, and molecular epidemiology suggests that cattle are not as significant of a reservoir for human infections as was once believed. For example, most *Giardia duodenalis* from cattle (Assemblage E) is different from that found in humans (Assemblage A and B) and *Cryptosporidium andersoni* has been found to only infect cattle¹⁴. In order to best manage fecal wastes for the prevention of enteric disease in both cattle and humans, reducing herd prevalence as well as implementing on-farm BMPs is important, and can be used strategically to improve health while minimizing costs.

In this study, *Campylobacter* spp. were detected in beef cattle at low levels during the wet and dry season and on two of the three ranches. *Cryptosporidium* and *Giardia* were detected in both the wet and dry seasons and on all three ranches. The highest prevalence of *Cryptosporidium* and *Giardia* (up to 66% of cattle shedding parasites) was observed on Ranch 1. The prevalence rates of the bacterial and protozoal pathogens observed at all three ranches during this study are similar to what has been reported previously in the literature. Further testing is needed to determine the zoonotic potential of the *Campylobacter*, *Cryptosporidium*, and *Giardia* isolates that were obtained. Results from this study will be used in a broader fecal pathogen project and it is our policy that participating ranches remain anonymous. We look forward to the opportunity to discuss the study findings and plans for future work in more detail.

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