E-coli counts in Dry-land Streams; before, during and after arrival and departure of range-cows.

Al Grant, Sage Farm, Rock Creek. Nov 2009

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An ongoing study in which four representative streams are sampled monthly or more and additional streams are tested at irregular intervals.

This stream monitoring program was initiated in Mar 2007 after we became concerned with water quality in another stream as it came off public- land (range-land). In early 2007 when we took our concerns (and water testing results going back 2 years) to Range Branch we were told that "the contamination, if it existed, was likely coming from wildlife or avian sources rather than cows". Range Branch does no water testing.

After some additional testing which appeared to indicate that cows were responsible for most or all of the contamination, we took our concerns to FREP (Forest & Range Evaluation Program). We were advised by several sources in FREP that contamination was likely from sources other than cows. FREP does no water testing.

We sought information from the Forest Practices Board. Although the FPB has produced several reports that expressed concerns about water quality and range-use, FPB do no water testing.
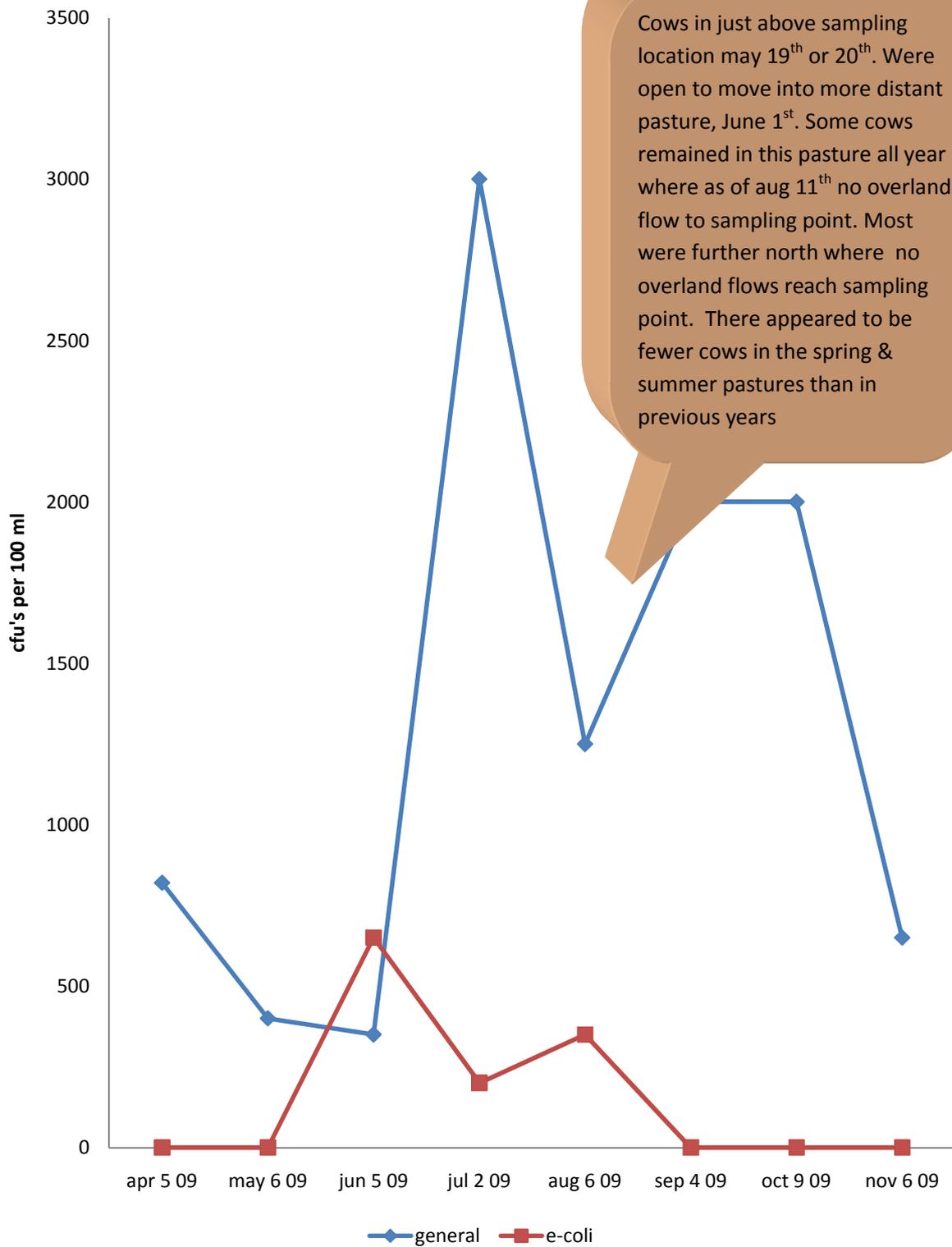
CONCLUSIONS

The attached graphs show e-coli and general coliform numbers and relates these numbers to the presence or absence of range-cows. From these results it can be seen that in the absence of range-cows, ecoli counts are low or mostly non-existent. <u>On the arrival of range-cows e-coli counts jump.</u>

We can reasonably conclude that "background" levels of e-coli from wildlife, canine, rodent, avian or other sources are not significant. We might also conclude that the "preferred belief" of Range Branch and FREP, that cattle are not primarily responsible for contamination, should be re-examined and re-evaluated for our local dry-land area.
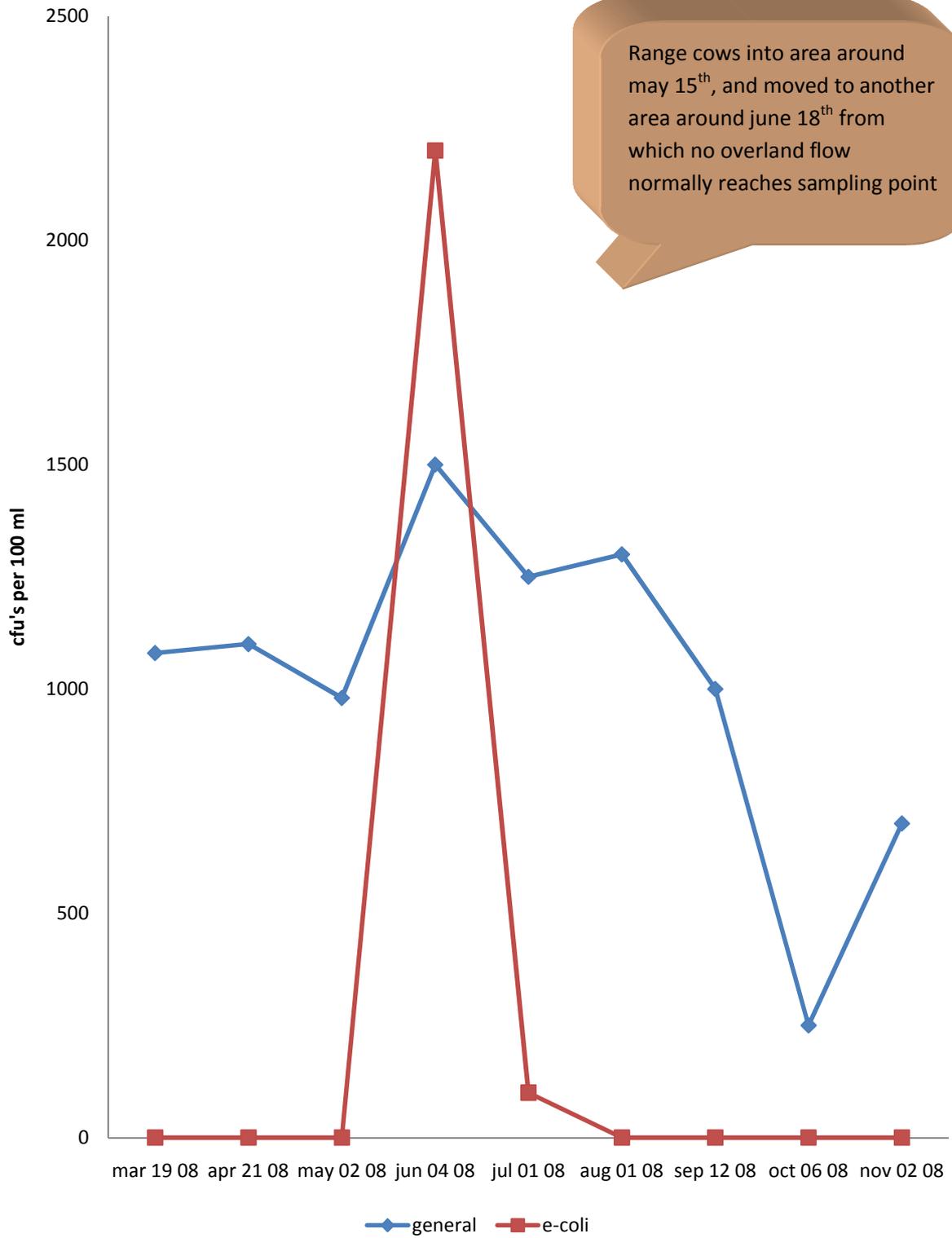
These test results come as no great surprise to us as there is little or no effort in our area by the ranching community or Range Branch to protect water quality by developing or maintaining water sources designed to keep cattle out of streams. In recent years guidelines have been reduced making stream contamination more likely.

The companion document, *Pathogens and Protection*, discusses the factors that lead to stream contamination in our dryland area.
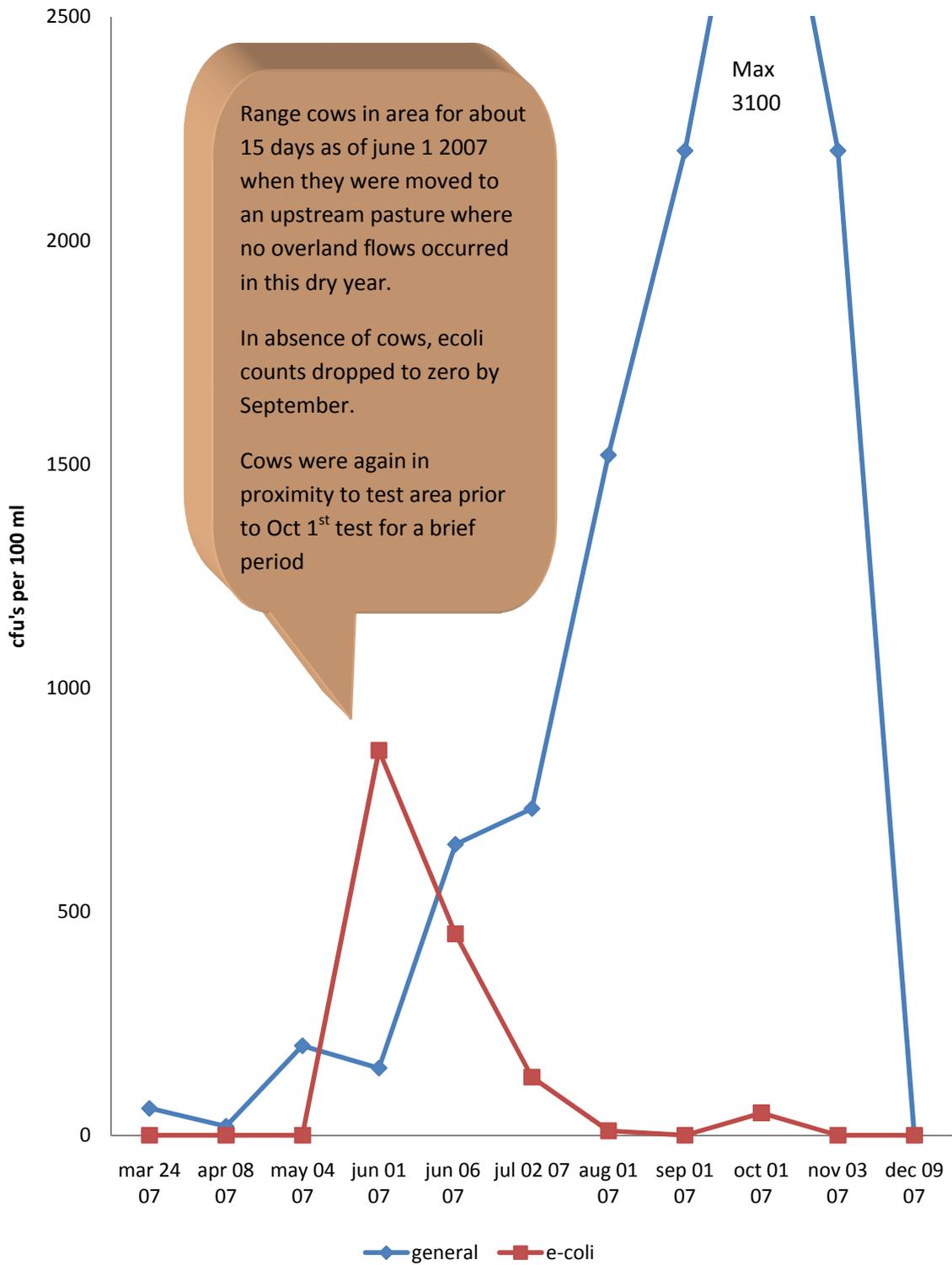
'D' creek 2009

Cows in just above sampling location may 19th or 20th. Were open to move into more distant pasture, June 1st. Some cows remained in this pasture all year where as of aug 11th no overland flow to sampling point. Most were further north where no overland flows reach sampling point. There appeared to be fewer cows in the spring & summer pastures than in previous years

'D' creek 2008

'D' creek 2007

'E' creek 2008

Max
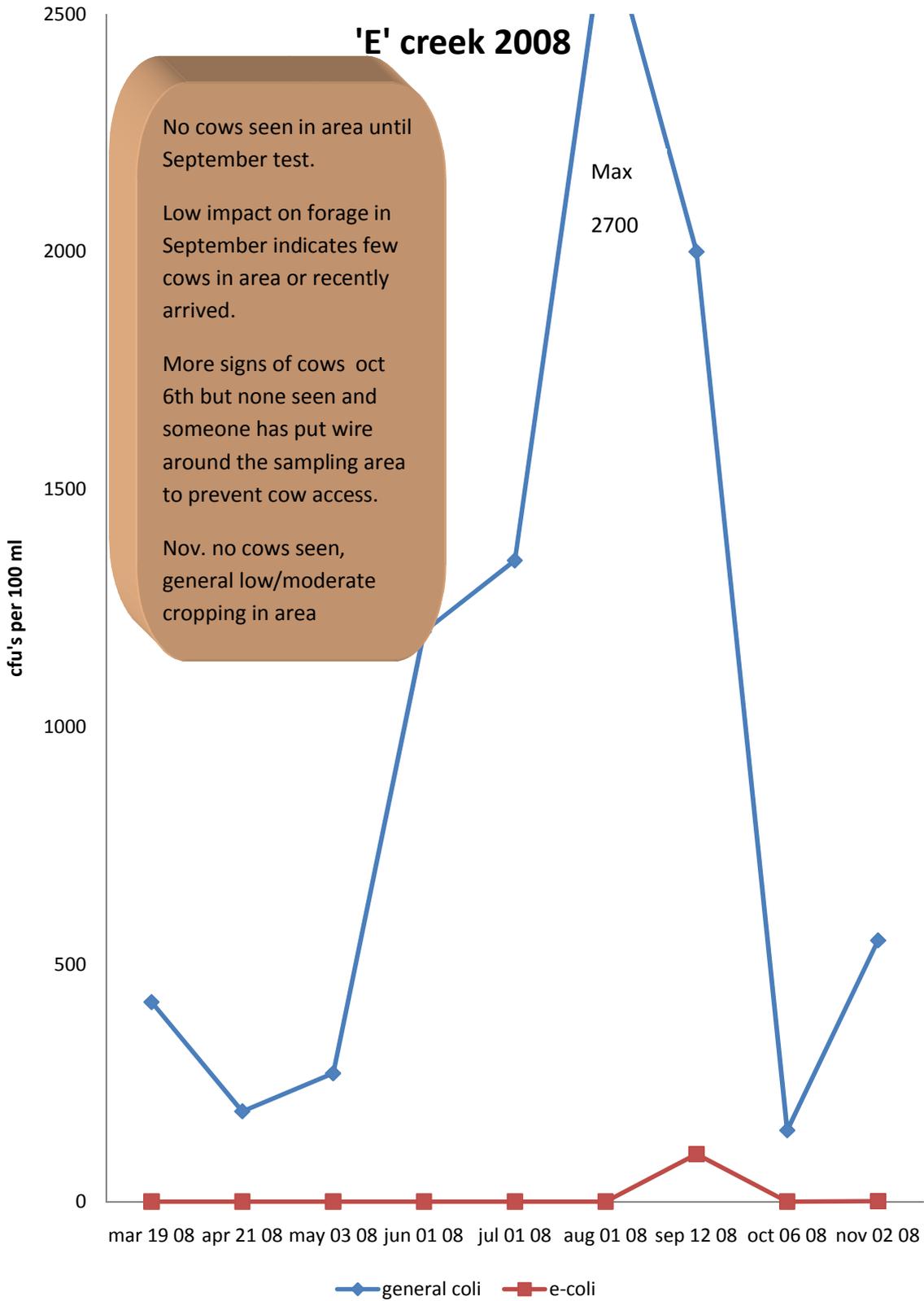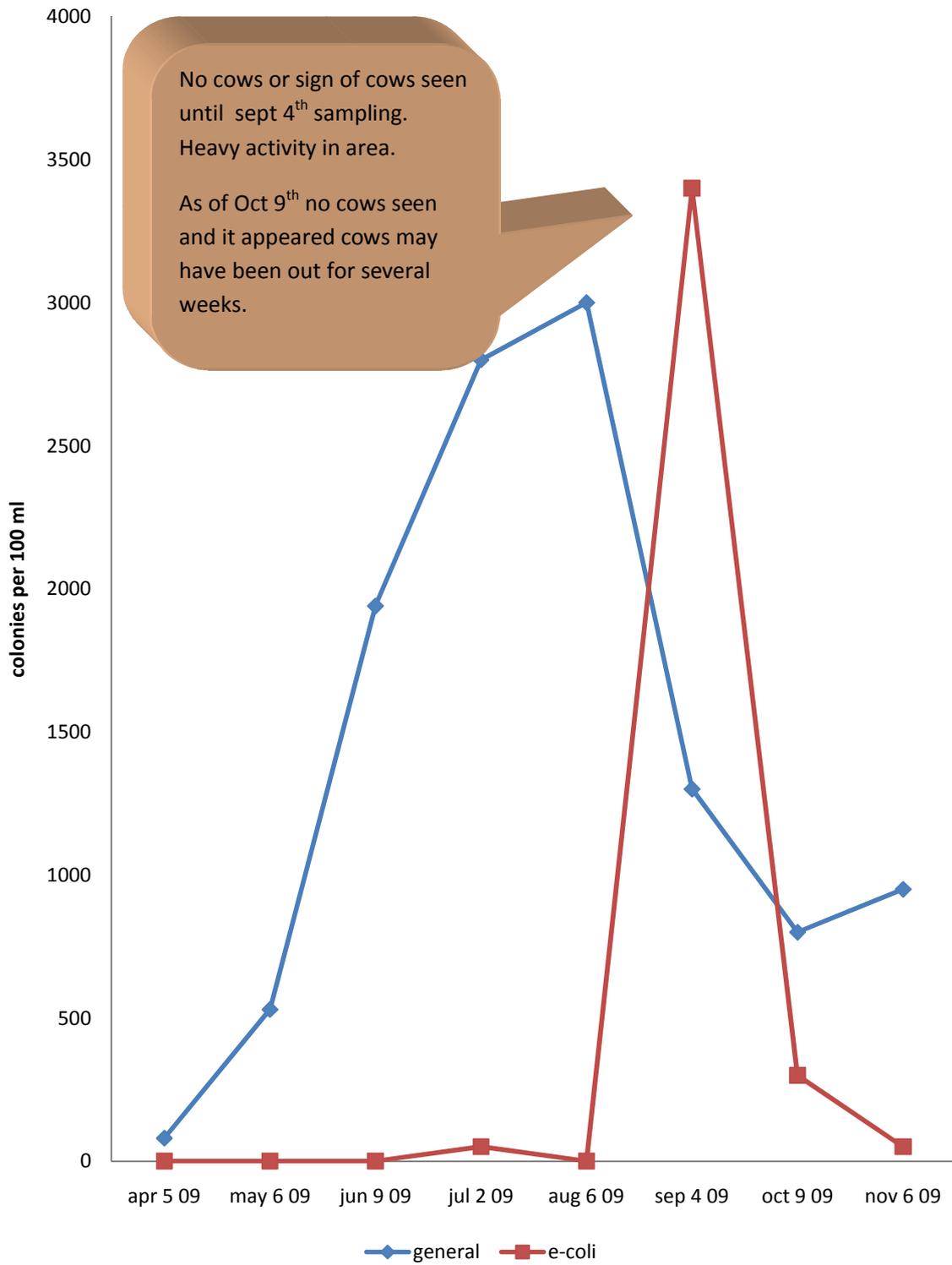
2700

No cows seen in area until September test.

Low impact on forage in September indicates few cows in area or recently arrived.

More signs of cows oct 6th but none seen and someone has put wire around the sampling area to prevent cow access.
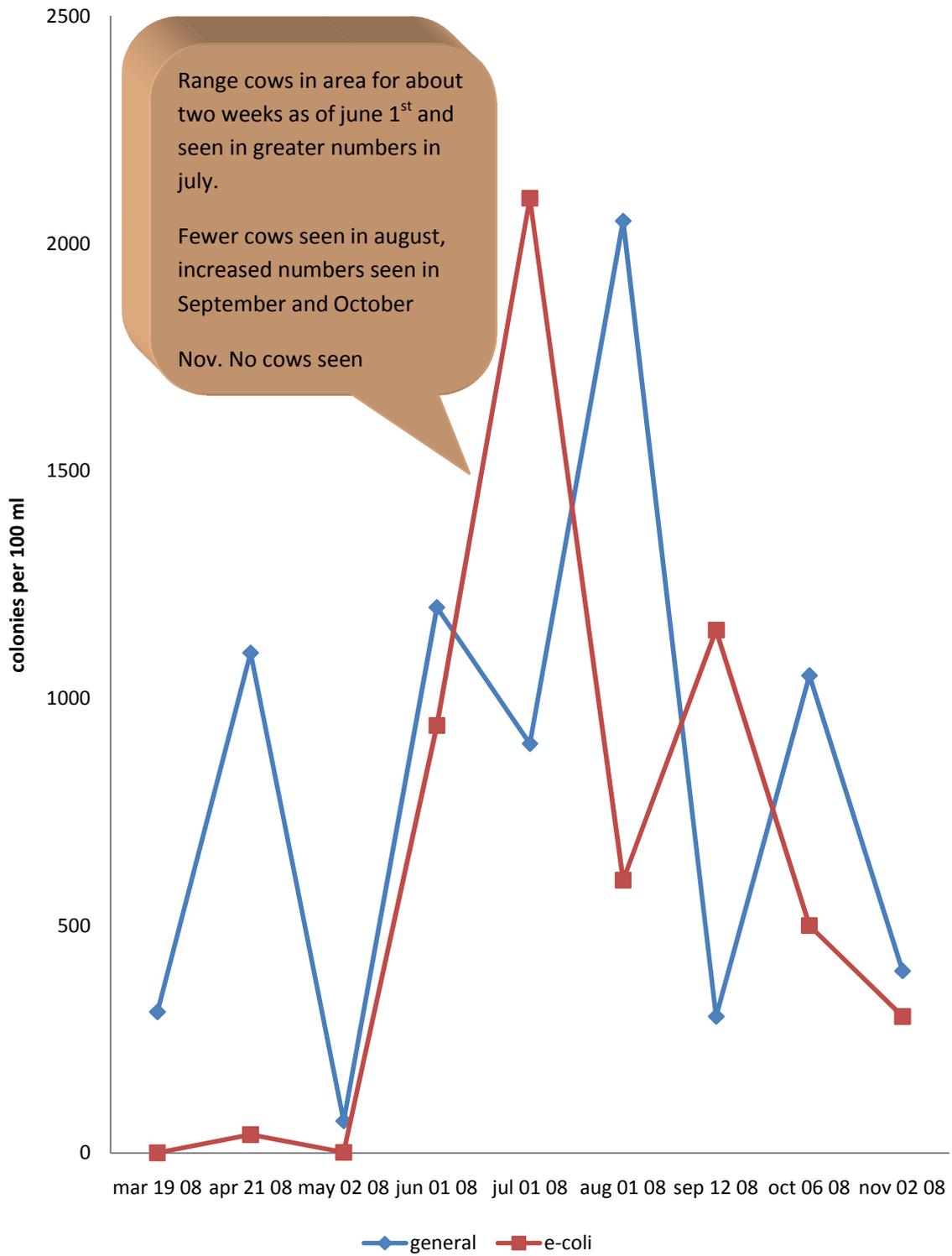
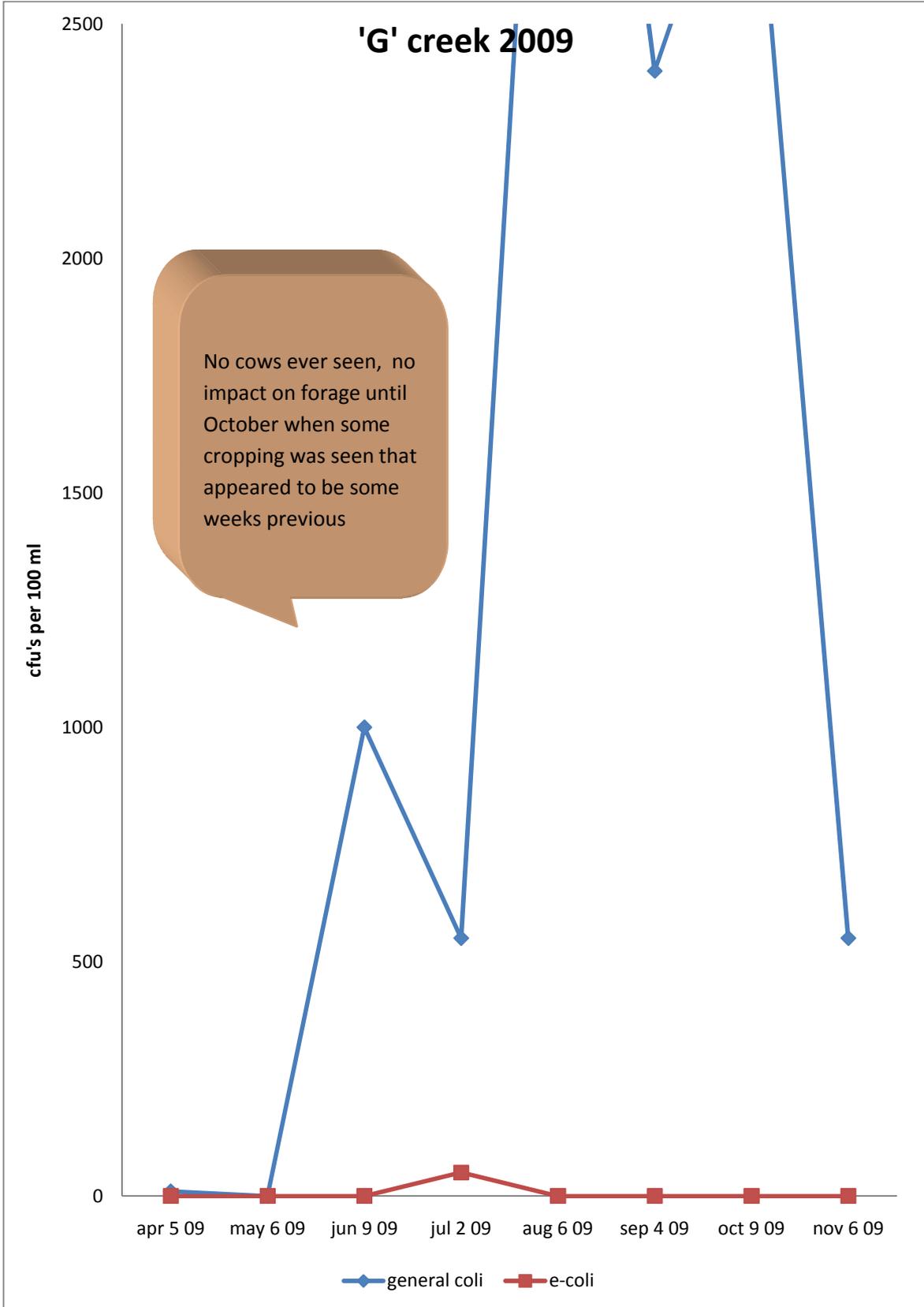Nov. no cows seen, general low/moderate cropping in area

cfu's per 100 ml

2500
2000
1500
1000
500
0

mar 19 08 apr 21 08 may 03 08 jun 01 08 jul 01 08 aug 01 08 sep 12 08 oct 06 08 nov 02 08
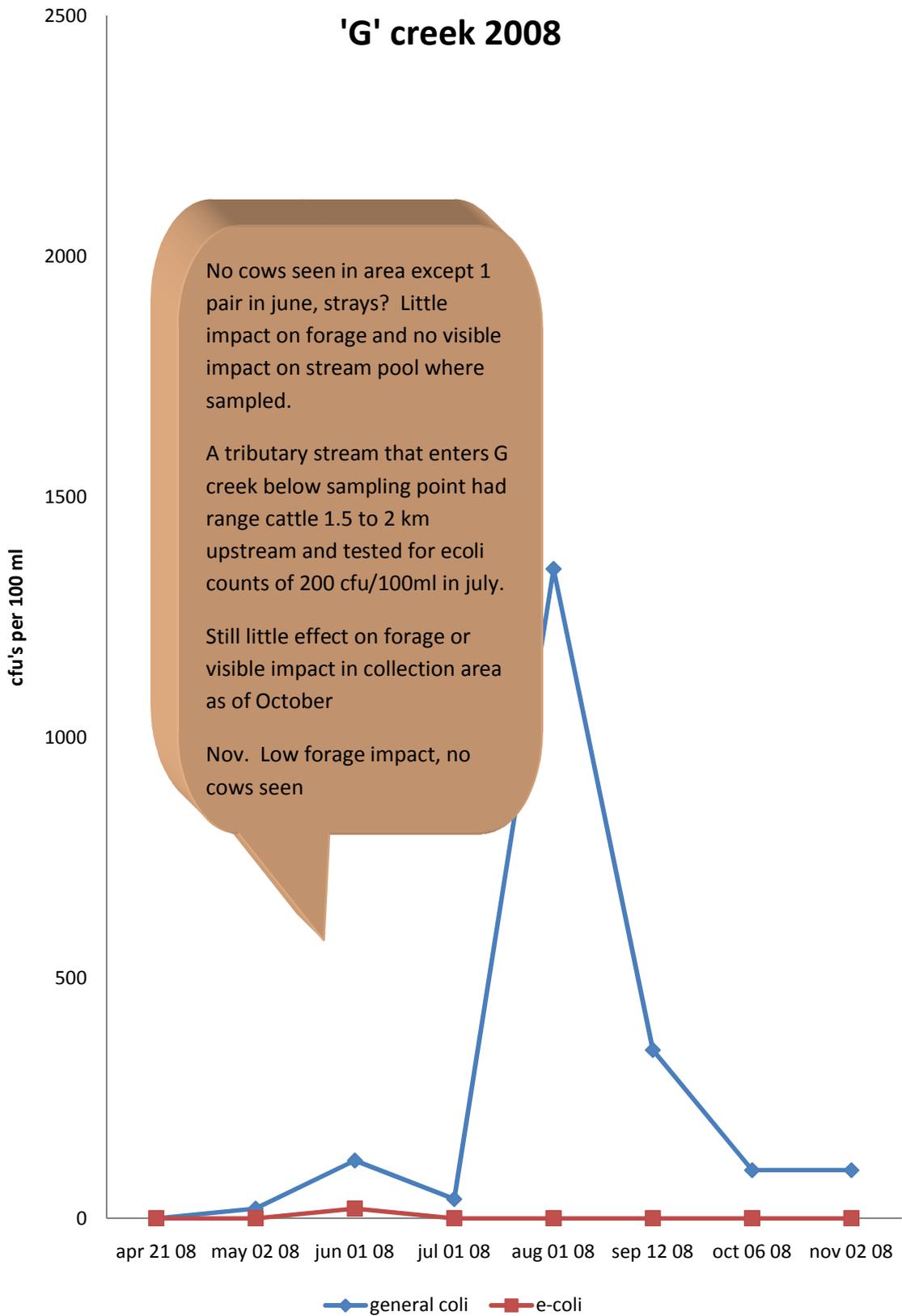
general coli ♦   e-coli ■

'F' creek 2009

'F' creek 2008

The following article, Pathogens & Protection, is the first in a series of articles to come which will examine cattle range-use in our sensitive dryland area, and the consequences to water quality, riparian zones, sensitive grasslands and habitat. Future articles will cover the abuses of public-lands from range cow overload, the give-away of the public lands, the efforts of the ranching sector to obtain greater control over these public lands, and the cost to the public of maintaining the present range tenure system.

Pathogens & Protection

Health authorities advise that stream water and open water sources should not be considered safe for drinking (unless treated) as these sources are open to contamination from a variety of sources. Water from wells close to streams and open water may also be at risk, depending on the effectiveness of ground filtration, and may also need treatment to provide protection from a variety of pathogens. Large communities and some smaller "community wells" chose to provide treatment with chlorine and sometimes filtration to protect against some pathogens that can survive chlorine treatment; e.g. Giardia, Cryptosporidium. Individual well owners are 'on their own' with the expense and maintenance of a treatment system. Failure of treatment can result in the consequences seen in 2000 in Walkerton, Ontario[i1] where 7 died and half of the population of 5000 were sickened. Protection will see later comment.
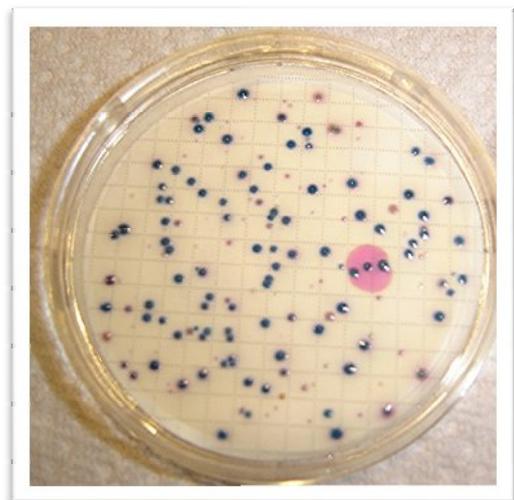
A sample of a test on streamwater approx two weeks after range cattle occupied upstream area. 10/100 ml dilution. Dark blue represents a fecal coliform count of approx 860 colonies per 100 ml

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[1] Failure of the water system operators to properly test & disinfect highly contaminated source water, poorly sited wells and contamination of the water source by cattle all contributed to this outbreak. The outbreak was primarily reported as caused by e-coli 0157 however 67% of those tested also were infected by Campylobacter. The

What is important for our area is an evaluation of the local sources and potential sources of contamination. Factors generally affecting contamination include weather events that can flush distant fecal deposits (from wild or domestic animals, birds, rodents,) into water courses or water bodies. Overflow from sewage plants or leaking septic systems and leaching or wash-off of manures, and densities of wild or domestic animals with direct access to water bodies. Other factors include dilution by stream volumes and "purity" and volume of receiving waters. Much of the research and statistics available are reflective of areas where most or all of the above factors are in play.

In our "dry-land" arid area, which we have in common with much of the American west, **fewer of these factors are in play**. Here, where the heavy rainfall or rapid melt required to transport distant fecal deposits seldom occurs, where no sewage plants are discharging to upland streams and where water sampling is taken above human settlement, only a few factors are usually in play. The primary factors affecting these streams are therefore:

   a. Amount of time spent in or about the stream by wildlife and cattle.
   b. Density of fecal contributing populations and relative fecal volumes of contributing populations
   c. Stream volumes, gradient and turbulence affecting dilution and deposition

Re: (a) where few or no working water sources have been constructed or maintained, cattle can spend 80% or more of their time in riparian zones even though these zones occupy only about 2% of the range. In most of these riparian zones their presence is apparent in the form of pugged and hummocked areas and fecal deposits that significantly outnumber or obscure evidence of other wildlife presence. That unfettered access also means that fecal contaminants that might settle out in sediments are constantly redisturbed and redistributed into streams. Although studies have shown that off-stream water sources can reduce cattle impacts on streams by 80% to 90%, little or no effort has been made over the years by ranchers or Range Branch to reduce the impacts on riparian zones. As a result, water quality is degraded, streams are degraded and riparian vegetation is overgrazed. The habits of cattle, fecal deposits and loafing in streams has been studied[ii].An abundance of other studies have identified the benefits of off-stream watering devices to riparian zones, water quality and the health of cattle.[iii]

Re: (b) to state the obvious; fecal volumes are in proportion to volume of feed consumed. When it is observed that wildlife use of riparian zones is occasional and fleeting, compared to cattle; when testing for fecal contamination in stream water

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estimated cost of this outbreak is over $155 million dollars. As a result of a class-action suit against the Government, compensation of $65.5 million has been paid plus $13 million to the adjusters so far, with numerous claims still to settle,.. (all at taxpayer expense).

shows background levels, (before cattle arrive) to be low or nonexistent, where wildlife numbers are seen to be fairly steady seasonally, except for increased winter use in some areas by ungulates, it is reasonable to expect that the large animals (cattle) in the watershed, are responsible for the great majority of fecal contamination that shows up in streams shortly after their arrival.

Re: (c) rapid melt or heavy rain could affect dilution, particularly in spring and affect water testing results by diluting "background levels". No such events occurred in the week(s) prior to our testing. Turbulence at all testing was very low.

Our test results were contrary to the preferred belief of many in Range Branch who appear to be guided by a study, financed by Cattlemen, that suggests that cattle are well down the list as contamination sources. That study, conducted in an area where the precipitation and contamination sources were all in play, (not our dryland version) has no application here. It may well be

that the study has no useful relevance anywhere, as the area of the study had numerous offstream watering places, both man-made and natural, some riparian fencing and appears to have stocking numbers of range cattle well below norms.

We are expanding our testing in 2008 to several more streams to better establish contamination levels in the presence and absence of range cows.

Fairly typical broken down cattle waterer that has not been maintained. Poor location in stream bed has resulted in washout.

Waterhole (dugout) created for cattle. Fecal coliform counts can be 16,000 cfu or higher per 100 ml. These levels are unhealthy for cattle, unhealthy for wildlife and unhealthy for anyone whose water source is nearby.

Pathogen Sources

The sources and types of pathogens are well described in the reference link, Rosen Article, USDA. That report however has limited its incidents to "waterborne disease outbreaks" and as a result, numerous outbreaks that had a contaminated water component; e.g. recent lettuce, spinach contamination outbreaks in the U.S. that were tied to cattle contaminated water, are classed as "food-borne" and therefore not in the reports stats.

The Rosen article describes human campylobacter outbreaks due to livestock as "uncommon". The Center for Disease Control in the U.S. however reports that Campylobacter is one of the most common of diarrheal illness in the U.S. and that virtually all cases occur as isolated, sporadic events and are not part of large outbreaks. The CDC estimates that it affects over 1 million/year, many undiagnosed or reported and that 40% of Guillain-Barre in the U.S. may be triggered by Campylobacter. In Canada, Campylobacter has been described as the most common cause of gastroenteritis [iv] and its association with cattle is better known thanks to Walkerton and studies in Alberta[v].

E-coli 0157 is one of the more common types of toxin producing e-coli, and a common cause of diarrheal illness and subsequent complications in some. 0157 has been linked to a number of beef recalls, lettuce and spinach recalls. Although the illness prompting these recalls is usually called "foodborne" the e-coli 0157 generally originated in cattle contaminated water or irrigation water or in cattle as a result of watering and feed practices that encourage the growth or spread of e-coli 0157[vi].[vii] .

The Membrane Filter testing methods generally used to test water for fecal and general coliforms are unable to detect e-coli 0157. It is therefore possible that water that meets potability tests could be contaminated by 0157, however it is generally accepted that 0157 is unlikely to be found in the absence of other fecal coliforms.

Protection

All systems that remove pathogens from water have weaknesses. In addition to innate weakness in the process, failure to adequately maintain systems can result in inadequate treatment.

Chlorine treatment (which is somewhat ineffective on Giardia & Cryptosporidium) can be compromised by turbidity in the water. Reverse Osmosis can allow a fraction of the living bacteria to pass thru minor imperfections in membranes or seals. UV effectiveness can be reduced by accumulating deposits on lamp glass. No visual

inspection of water that has been through "treatment" can determine that the water is safe. For home-owner systems, "disinfection" by whatever method can require additional continuing expense to filter or condition water so that "disinfection" is effective. In most installations it would be too expensive to provide more than a "house system", and outside water for animals or for watering gardens would therefore be untreated. California produce growers are increasingly aware of the danger of contaminated water on produce.

The quality of the "source water" remains a concern, regardless of treatment. If that source water is being contaminated by range cows, and there is no effort being made by ranchers or Range Branch to reduce, control or eliminate the contamination, it is unreasonable, unacceptable and contrary to guidelines and objectives in legislation governing range use.

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[ii] U of Cal. *Fact Sheet # 25 Manure Loading into Streams from Direct Fecal Deposits*
http://danr.ucop.edu/uccelr/h25.htm

[iii] S McIver. *Using Off Stream Water Sources as a Beneficial Management Practice in Riparian Areas-A literature Review*. Agriculture Canada, Aug 2004.
 Water Quality & Cattle-Importance of Water Quality to Cattle. Agriculture Canada.
http://www.agr.gc.ca/pfra/water/wqcattle_e.htm
Viera D. *Improving Cattle Access to Clean Water*. Agriculture Canada, Lethbridge Research Centre & *Water Wisdom Boosts Cattle Performance, Protects the Environment*. both in Mar 2003 Farm & Ranch Guide

[iv] Mauro, William et al, *Campylobacter from animal & faecal & water samples*.... Public Health Agency of Canada

[v] Inglis, Doug, of Agri-Food Canada in article from Canada Alberta Beef Industry Development Fund. "been limited research in Canada but implicated in Walkerton and the high prevalence in the Chinook Health Region of Southern Alberta, along with high densities of Cattle, suggest cattle as a reservoir. Ignoring the contamination of water and food by this group of bacteria from bovine sources and their adverse impacts on human populations will in all likelihood severely damage public confidence in the safety of the Canadian Beef Industry"

[vi] Rosen, B – *Waterborne Pathogens in Agricultural Watersheds*. USDA Watershed Science Institute Jun 2000
ftp://ftp-fc.sc.egov.usda.gov/WSI/pdffiles/Pathogens_in_Agricultural_Watersheds.pdf

  Hoorman J. *Livestock & Streams-Pathogenic Effects of Livestock Grazing Riparian Areas.* Ohio State U, Extension Factsheet http://ohioline.osu.edu/ls-fact/pdf/0005.pdf

[vii] Benbrook, Dr Charles- *Published Research on the Sources & Spread of e-coli 0157.* The Organic Center Sept 2006 www.organic-center.org