

Do Tourists Bug Bacteria?

The Effects of Human Presence and Pollution on Bacterial
Diversity and Distribution in the
Streams of Glacier National Park.

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Background

- Bacterial biodiversity and biogeography not well understood.
- Bacteria play an important role in ecological stability, food webs and health of higher-order organisms. (van der Zaan et al., 2010; Dang et al., 2010)
- Biofilms considered one of the most ecologically important structures.

Study Basis

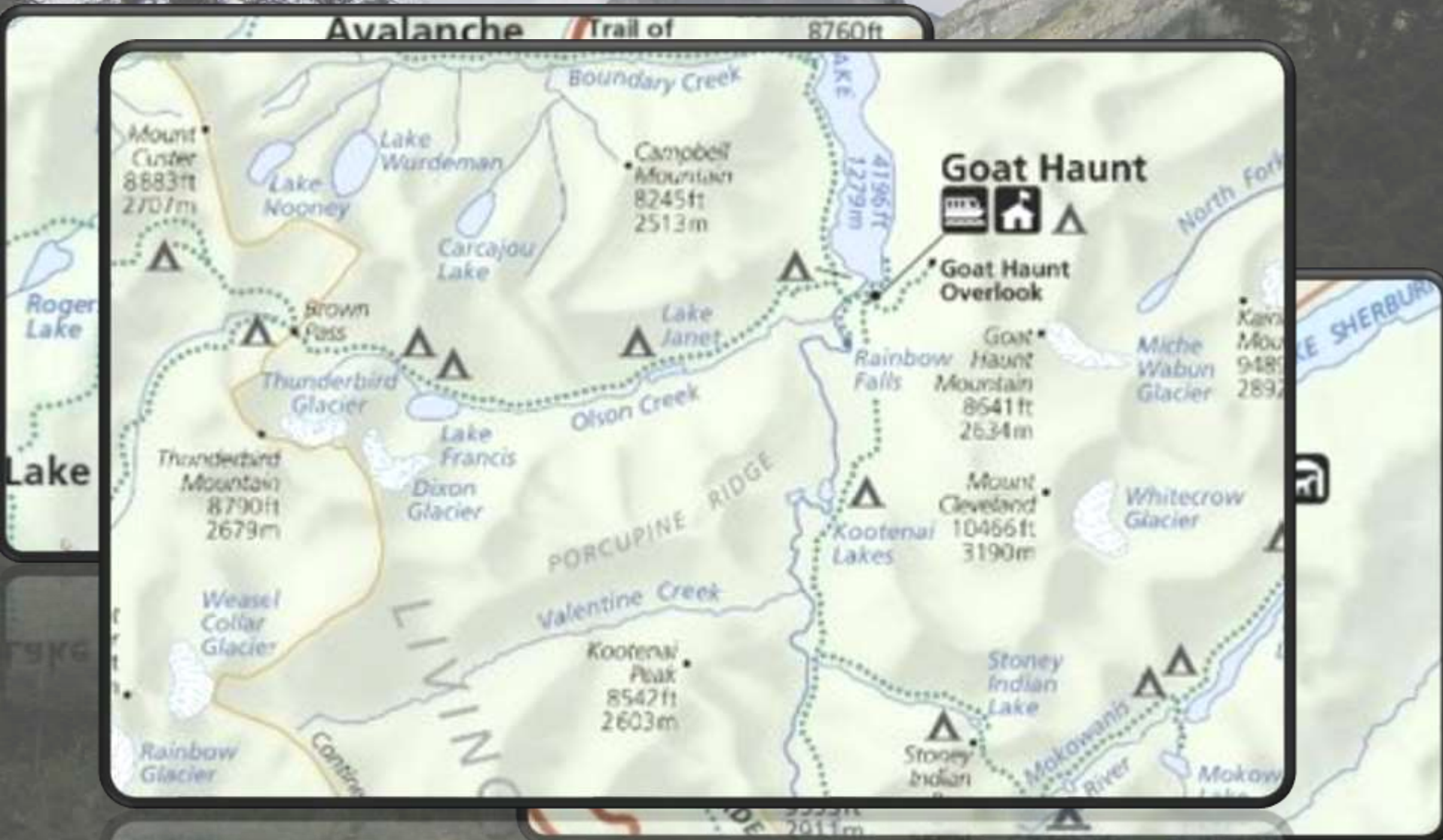
- Glacier National Park contains many pit toilets in the backcountry near streams.
- Amount of leeching from toilets and effect on streams unknown.
- Need for establishment of human presence on biodiversity.



Study Area



Study Area



Hypotheses

1. The presence of human pollution will have an effect on the bacterial distribution.
2. An increase in *E. coli* abundance will be seen downstream from point sources of pollution and human contact.
3. The increase in *E. coli* concentrations will correlate to a decrease in other important bacterial species.

Hypotheses

- Species of Interest (Feris et al., 2003)
 - *Pirellula staleyi*: Sulfur scavenger
 - *Hyphomicrobium denitrificans*: Denitrifier
 - *Rhodoferax* spp.: Heavy metal removal
 - *Aquabacterium commune*: Biofilms
 - *Chamaesiphon subglobosus*: Nitrogen fixer
 - *Nostoc* spp.: Nitrogen fixer
 - *Xanthomonas* spp.: Biofilm
 - *Escherichia coli*: Human pollution

Field Methods

- Samples taken every 700m
- Stream confluence to approximate headwaters

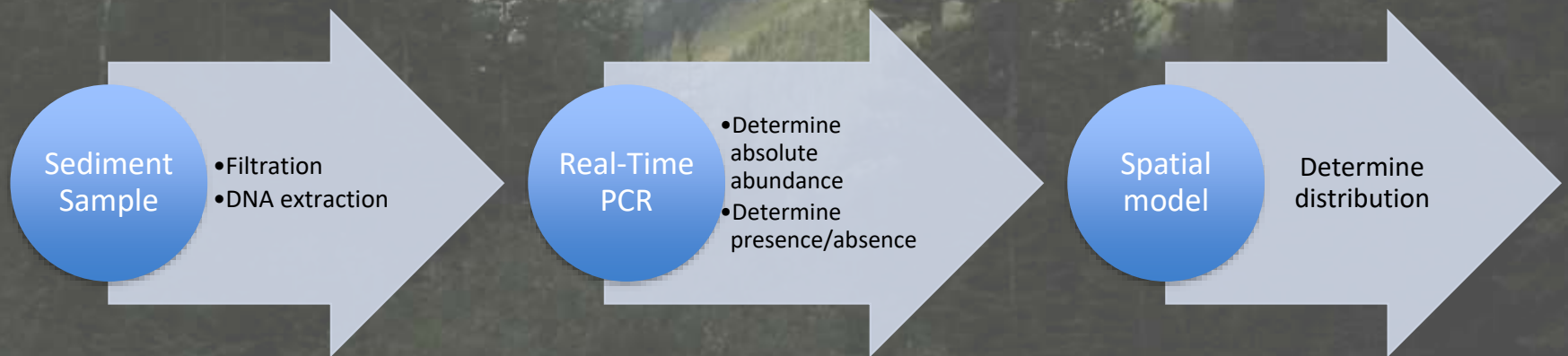


Field Methods

- Sediment samples were collected by aseptic pipetting
 - 3 cm deep samples + 1mL of water
 - Added to 1mL of Amies transport media
- Biofilm samples taken when present



Lab Methods



Lab Methods

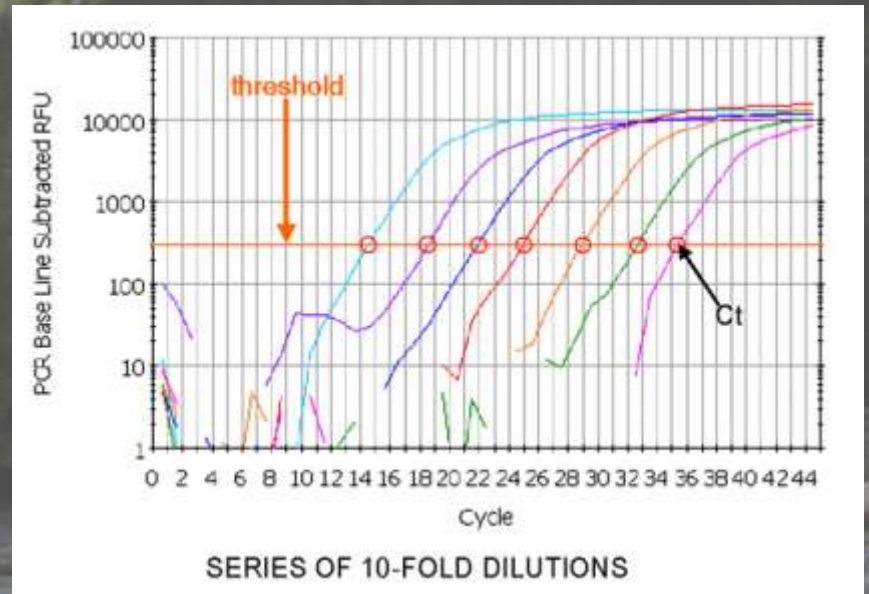
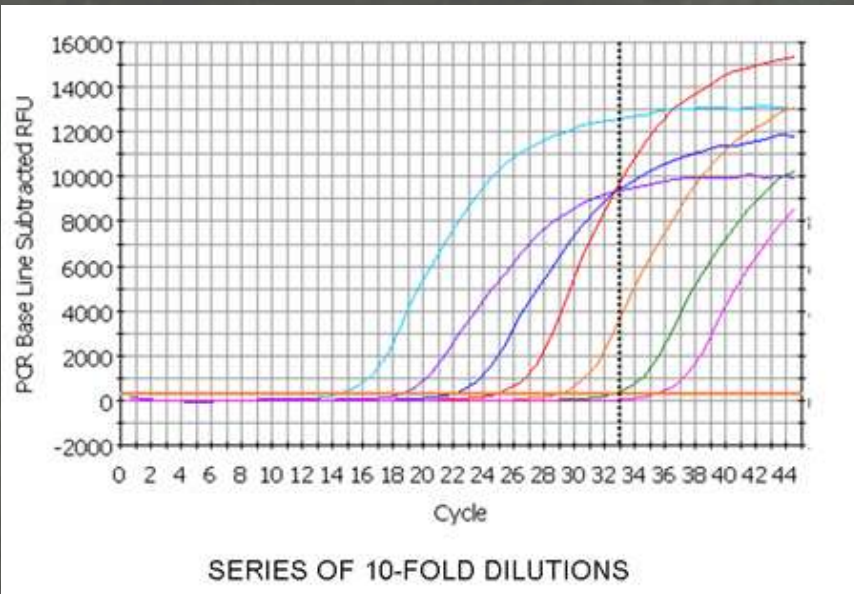


Lab Methods

SYBR Green-Based Real Time Quantitative PCR



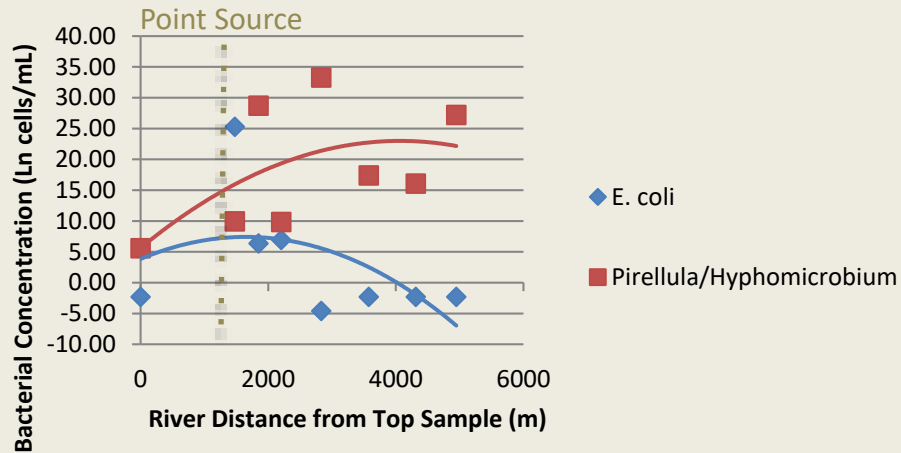
<http://www.sigmaaldrich.com/life-science/molecular-biology/pcr/quantitative-pcr/sybr-green-based-qpcr.html>



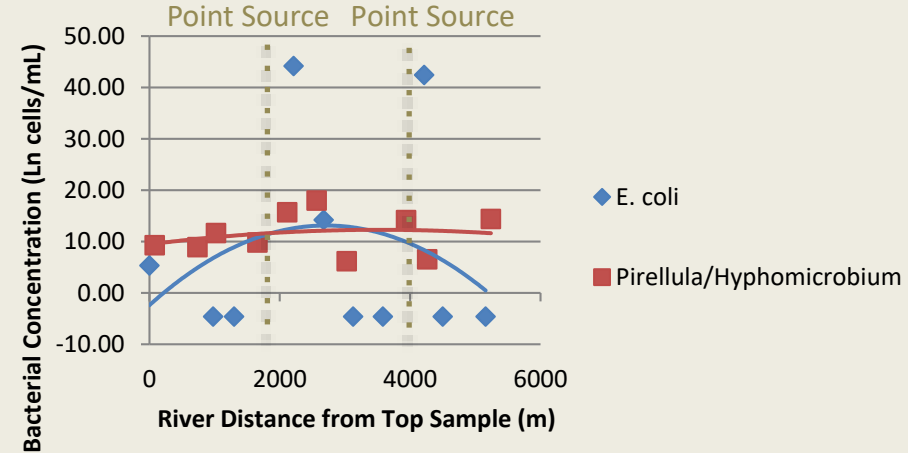
<http://pathmicro.med.sc.edu/pcr/realtime-home.htm>

Results: Denitrifier and Sulfur Scavenger

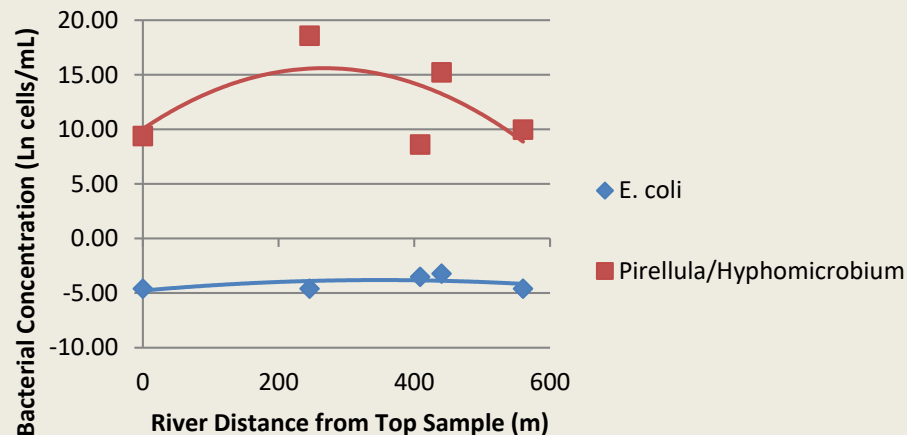
Avalanche Creek (High Impact)



Swift Current Creek (High Impact)



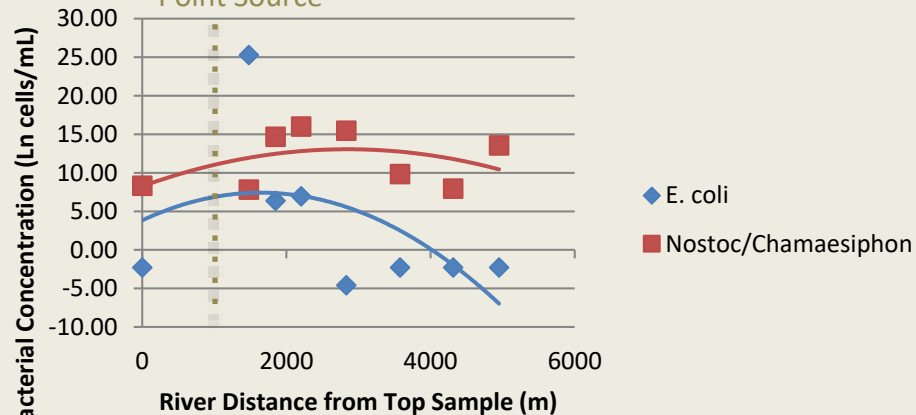
Valentine (Low Impact)



Results: Nitrogen Fixers

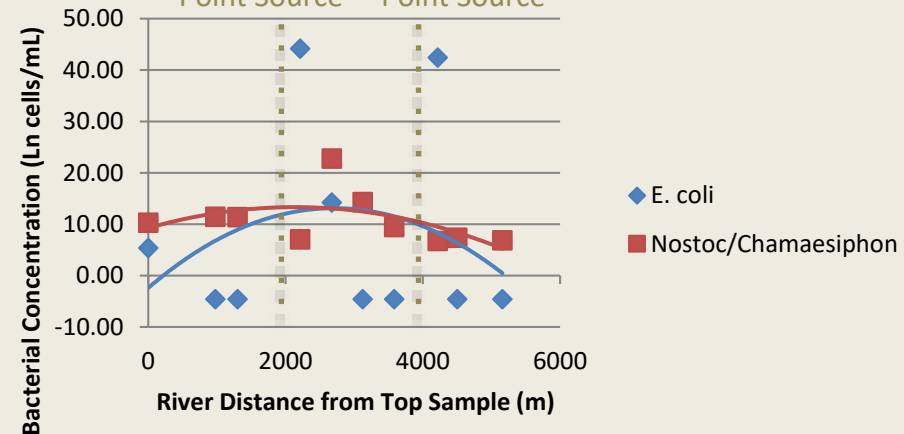
Avalanche Creek (High Impact)

Point Source

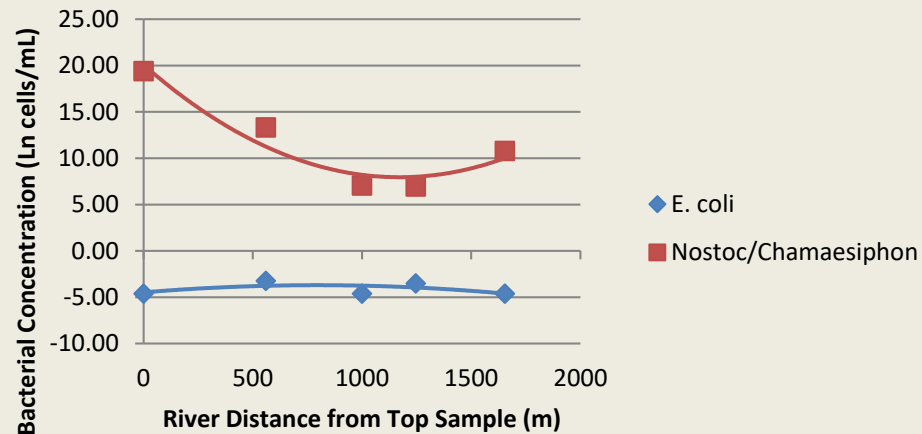


Swift Current Creek (High Impact)

Point Source Point Source

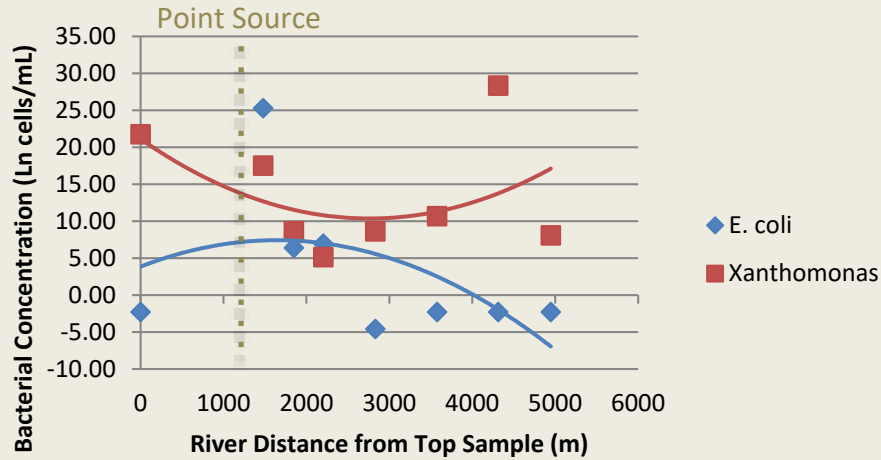


Valentine (Low Impact)

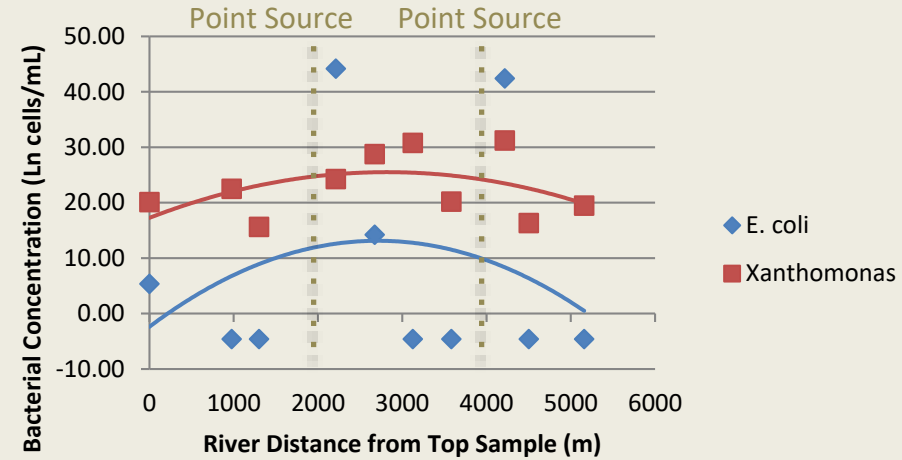


Results: Biofilm Former

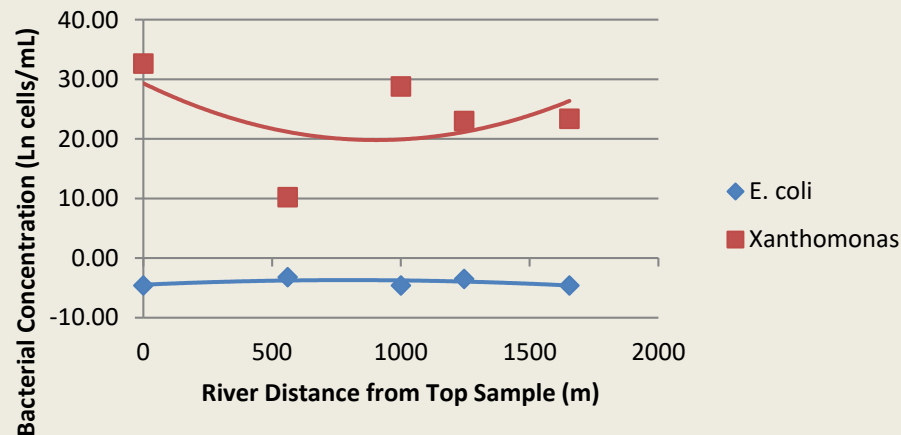
Avalanche Creek (High Impact)



Swift Current Creek (High Impact)

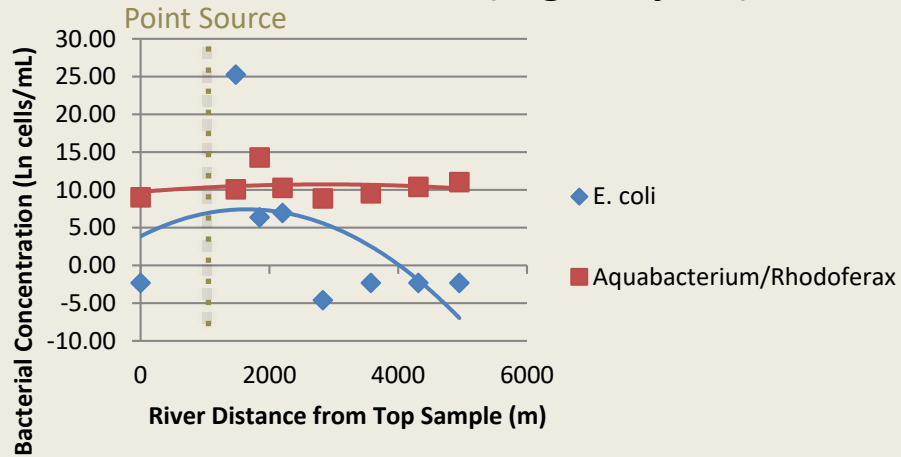


Valentine (Low Impact)

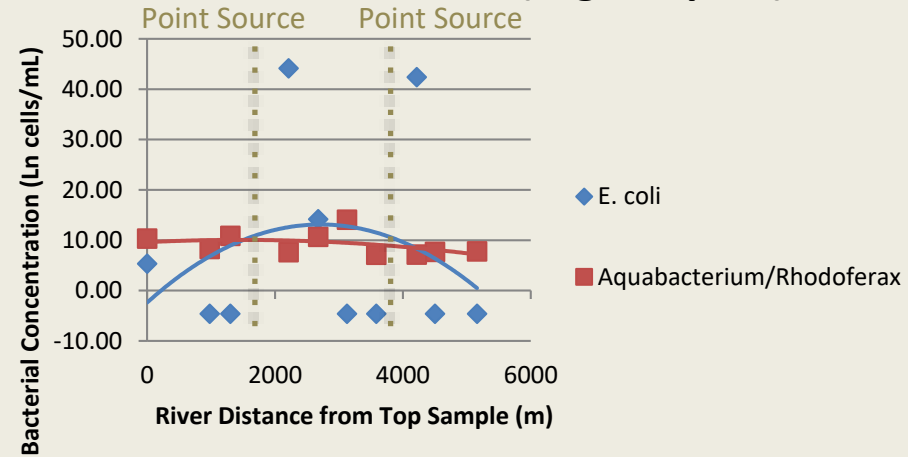


Results: Biofilm Bacteria and Heavy Metal Scavenger

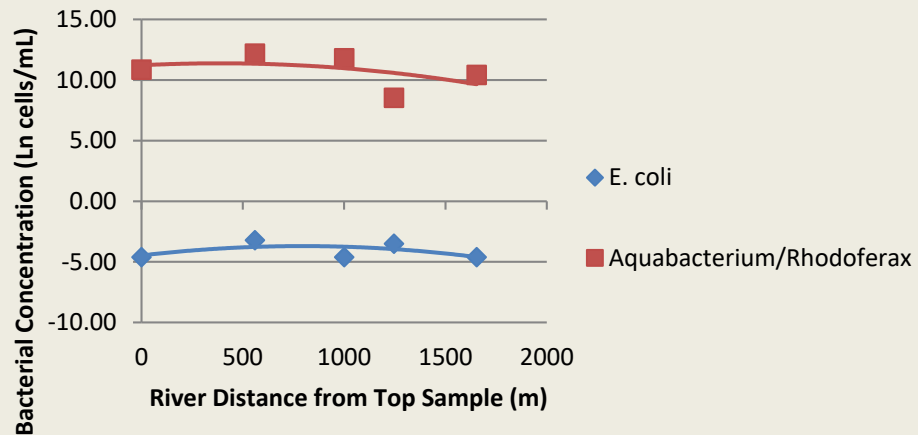
Avalanche Creek (High Impact)



Swift Current Creek (High Impact)

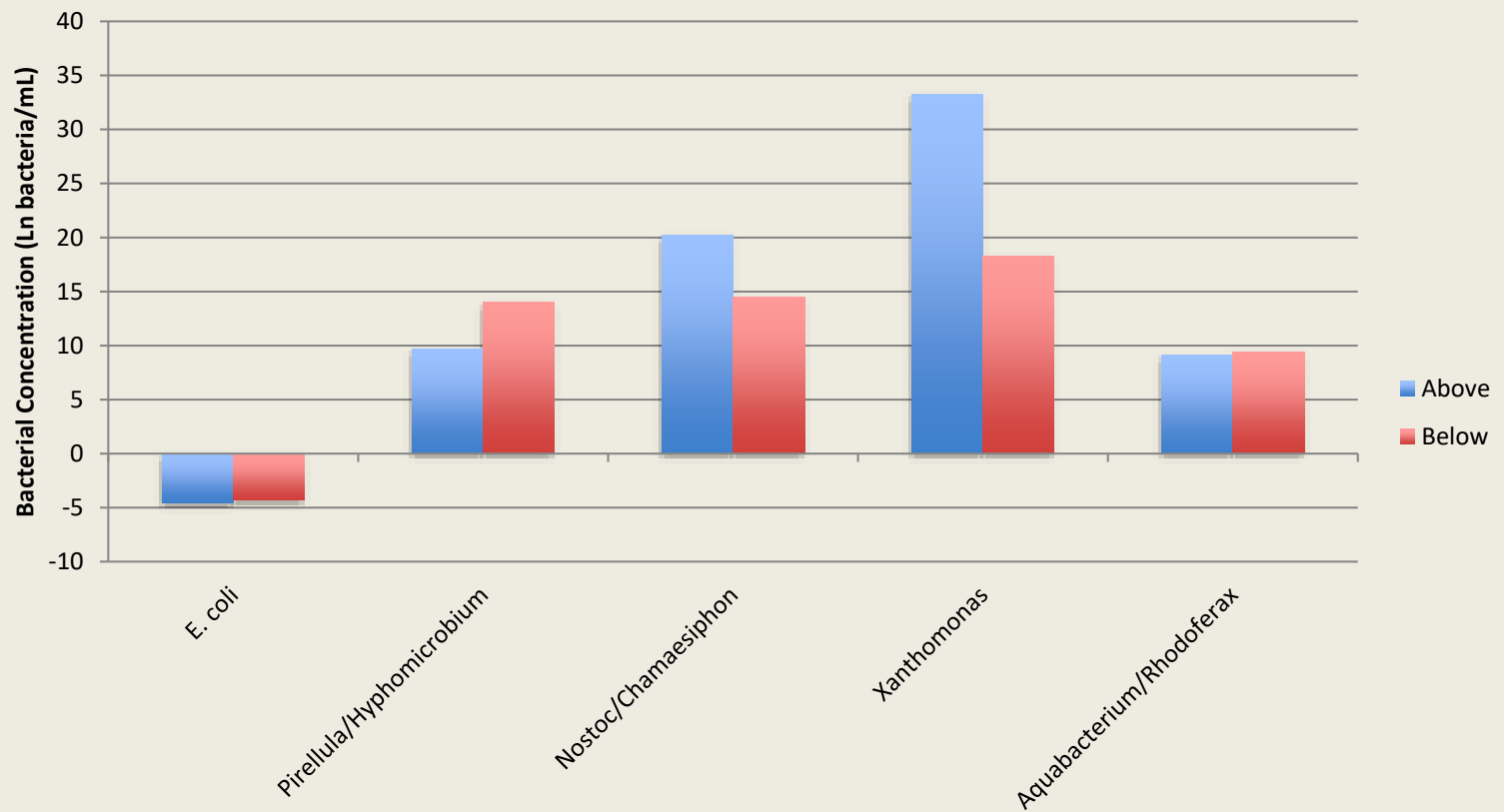


Valentine (Low Impact)



Results: Biofilm

**Species Average Concentration Above and Below Point
Source Pollution**



Conclusions

- Peak in coliform abundance around point source
 - Coliforms may be very transient
 - Effect of campground and pit toilet
- Bacterial distribution is being affected by human pollution and presence
 - Effect depends on species
 - Small changes in *E. coli* may have consequences
 - Greatest effect on *Xanthomonas* for both high use areas.
 - Other factors associated with pollution may be the cause

Future Questions

- Greater understanding of bacterial biogeography
 - What influences sediment bacteria the most?
 - Is bacterial distribution predictable?
- Better method for detecting bacterial diversity
- Are we seeing differences in diversity reflected at higher levels?
- Detect human fecal coliforms versus animal

Acknowledgments

A background image of a bison resting in a river, surrounded by green grass and trees. The bison is partially submerged in the water, with its head and back visible. The background is slightly blurred, emphasizing the text in the foreground.

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Lab Methods

- Samples were diluted and plated on MacConkey and LB agar
 - 10^4 through 10^8 dilutions
 - Spread plate method
- No growth, samples determined unviable



Lab Methods

