

1. Introduction

- Air quality is important because of its direct effect on people's quality of life. Specifically, Volatile Organic Compounds (VOCs) are a point of focus in the discussion of air quality. VOCs are compounds which contain carbon and are found as gases due to their low boiling points. VOCs also have the potential to be very harmful. For example, Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX compounds) have been shown to increase rates of cancer with excessive exposure to these compounds. According to the EPA, "[n]o standards have been set for VOCs in non industrial settings" (1). For this reason, it is imperative that outdoor VOC levels be investigated.
- Studying the levels of VOCs in Fort Collins area is necessary due to the city being home to Colorado State University, numerous natural sites, and several areas dedicated to the production of food, drink, and natural gas.
 - The purpose of this study is to determine the amounts of some harmful volatile organic compounds (VOCs) in outdoor settings in and around Fort Collins.

2. Methods

All air samples were collected with canisters. Sampling was performed on two different days (July 1, 2014 and July 22, 2014).

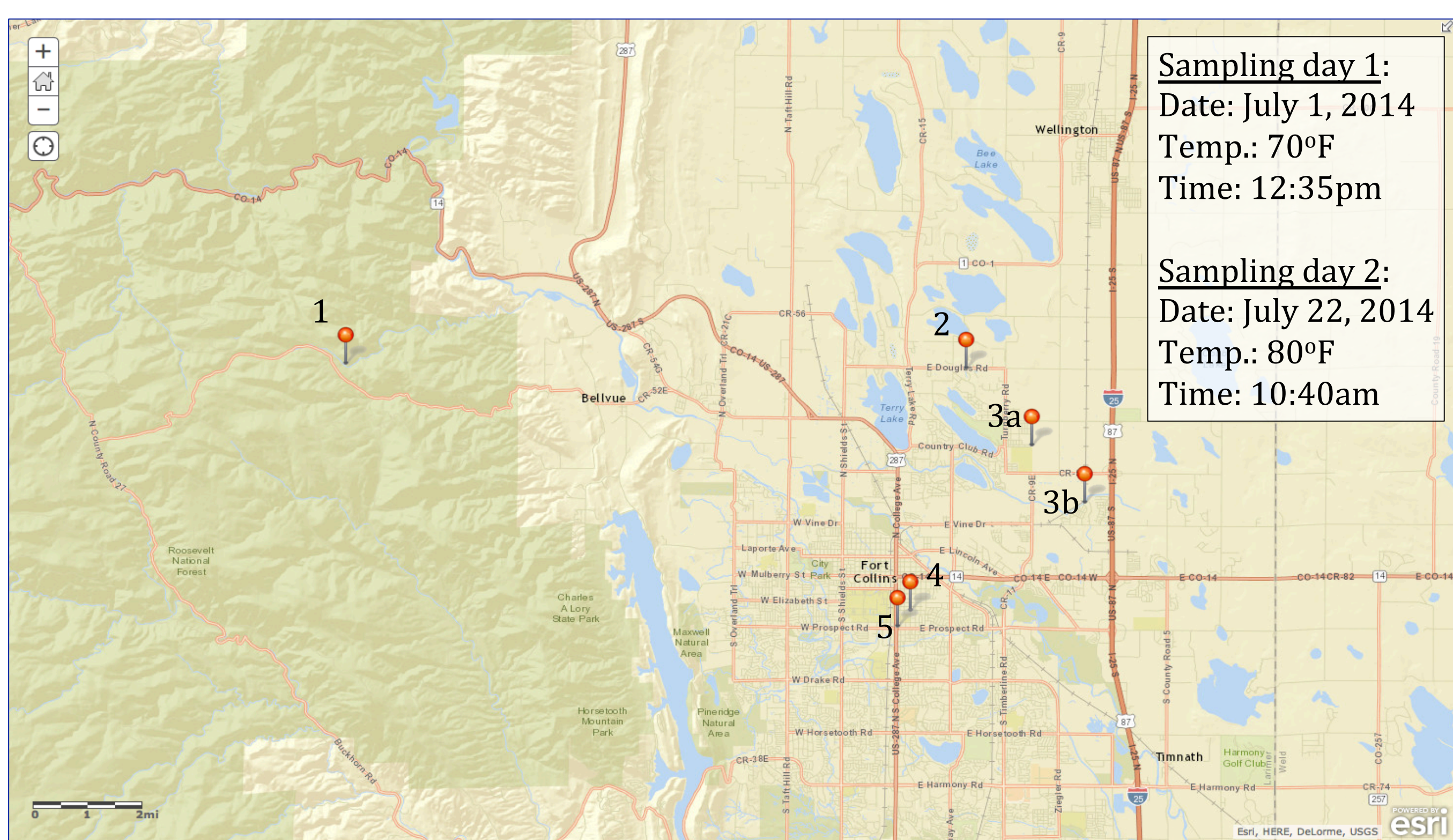


Fig. 1: Map of sampling sites in and around Fort Collins

- Sites:
- 1 - Rist Canyon (biogenic)
 - 2 - Oil and Natural Gas Site
 - 3a/b - Brewery (a - day 1, b - day 2)* (College Ave./Prospect Ave.)
 - 4 - Low/residential traffic
 - 5 - High traffic

*Brewery sample site changed on second day to allow for more representative sample from source

Samples are analyzed with a gas chromatograph-mass spectrometer (GC-MS). Gas chromatography separates compounds in a sample, while mass spectrometry identifies those compounds. The EPA TO-15 method is utilized in this particular GC-MS process.

The 7 compounds that are the focus of this study are separated into two different groups:

- | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. Cancer-causing compounds</p> <ul style="list-style-type: none"> • Benzene • Toluene • Ethylbenzene • Xylene | <p>2. Central Nervous System-threatening compounds</p> <ul style="list-style-type: none"> • Acetone • Benzyl Chloride • Carbon Disulfide |
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3. Hypothesis

Areas with more anthropogenic activity (specifically, the high traffic site) will have higher levels of harmful VOCs.

4. Results

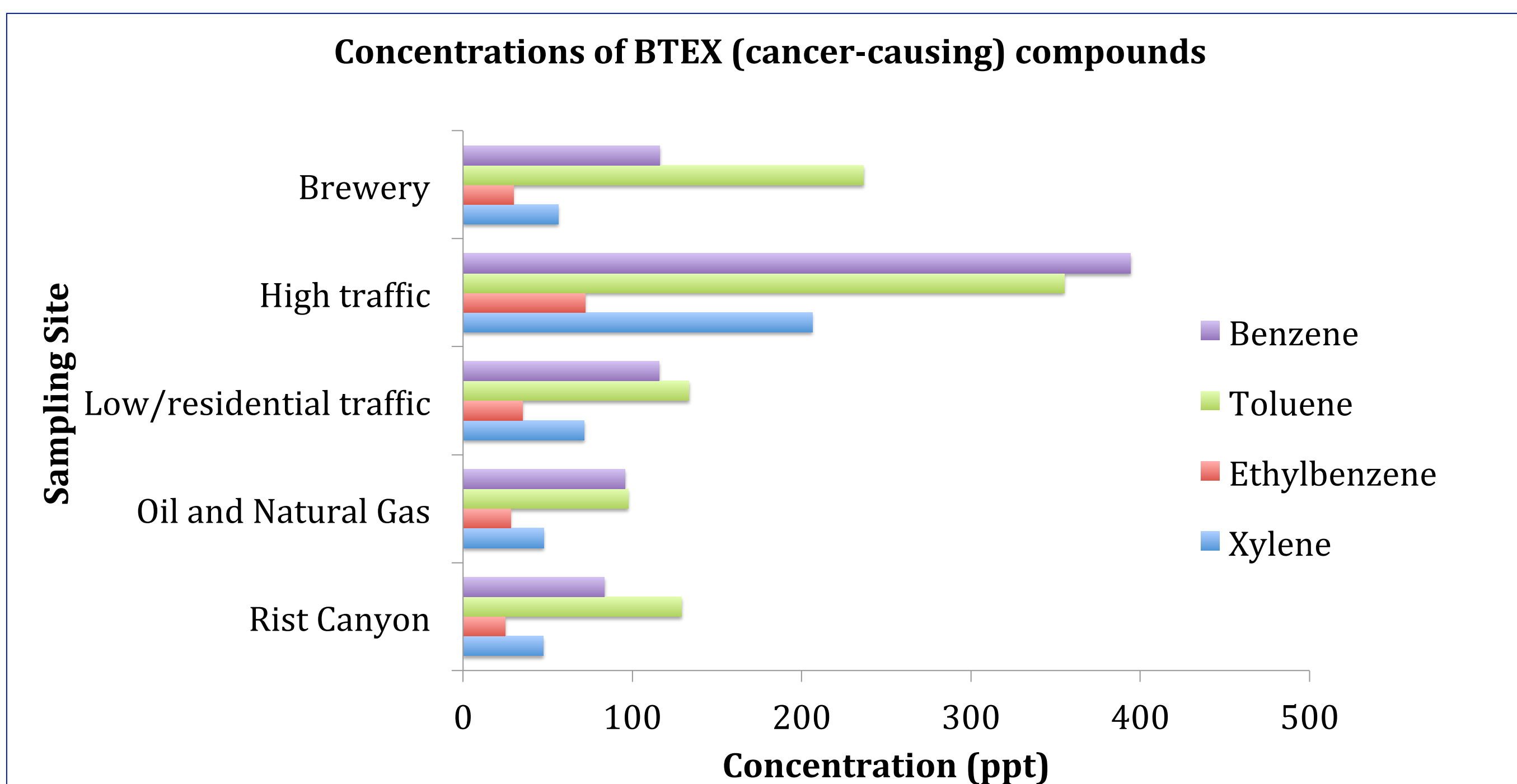


Fig. 2 (left):

- High traffic site registered the highest levels of all 4 BTEX compounds

Interesting observation:

- Both Rist Canyon and brewery collection sites showed higher levels of Toluene than the Oil and Natural Gas Site

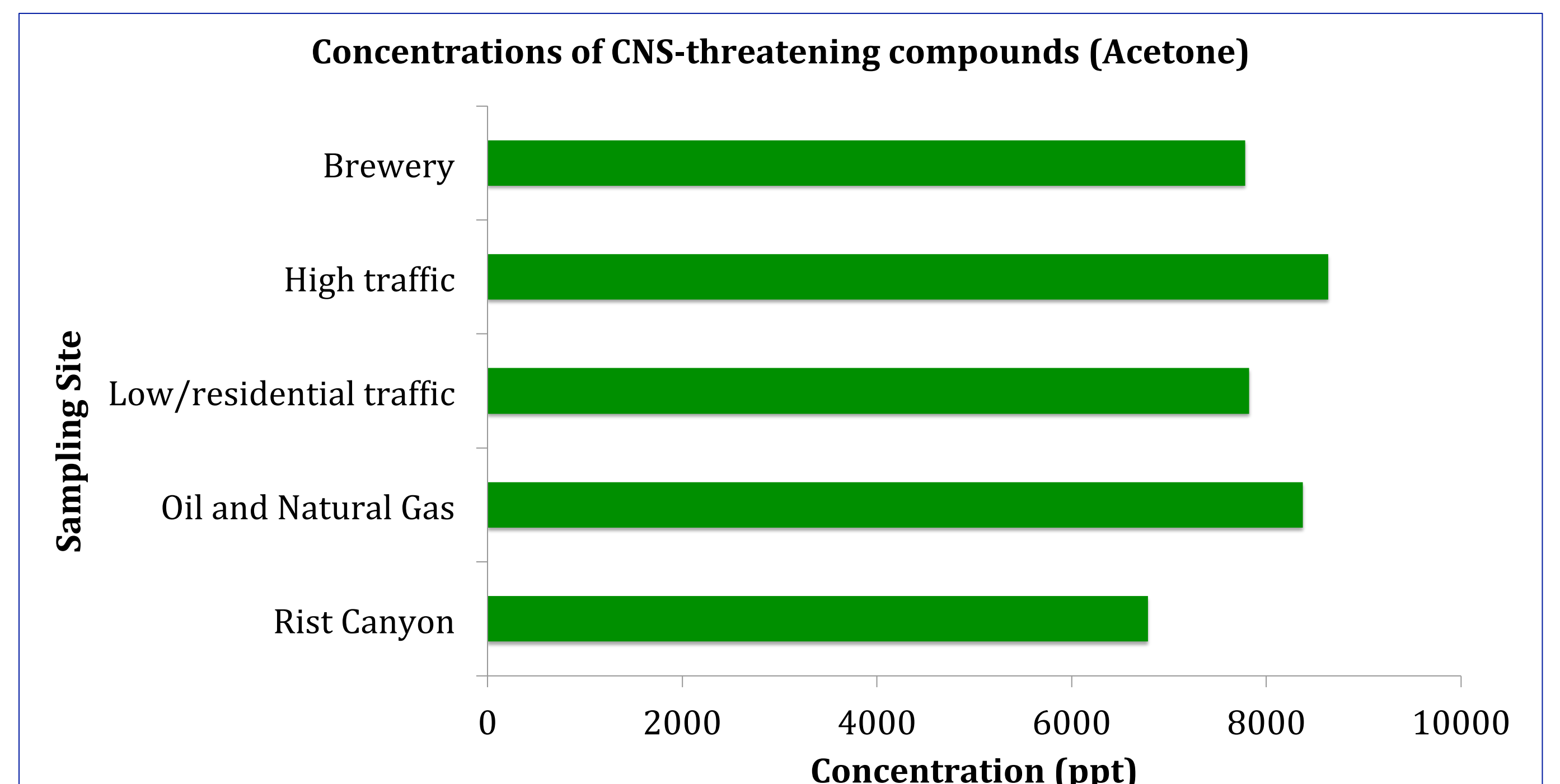


Fig. 3 (above):

- Acetone found abundantly in nature, thus yielding higher concentrations than other VOCs
- High traffic site had highest amount of Acetone among 5 sites



Pictured: Oil and Natural Gas Site
Photo courtesy of Andrea Clements

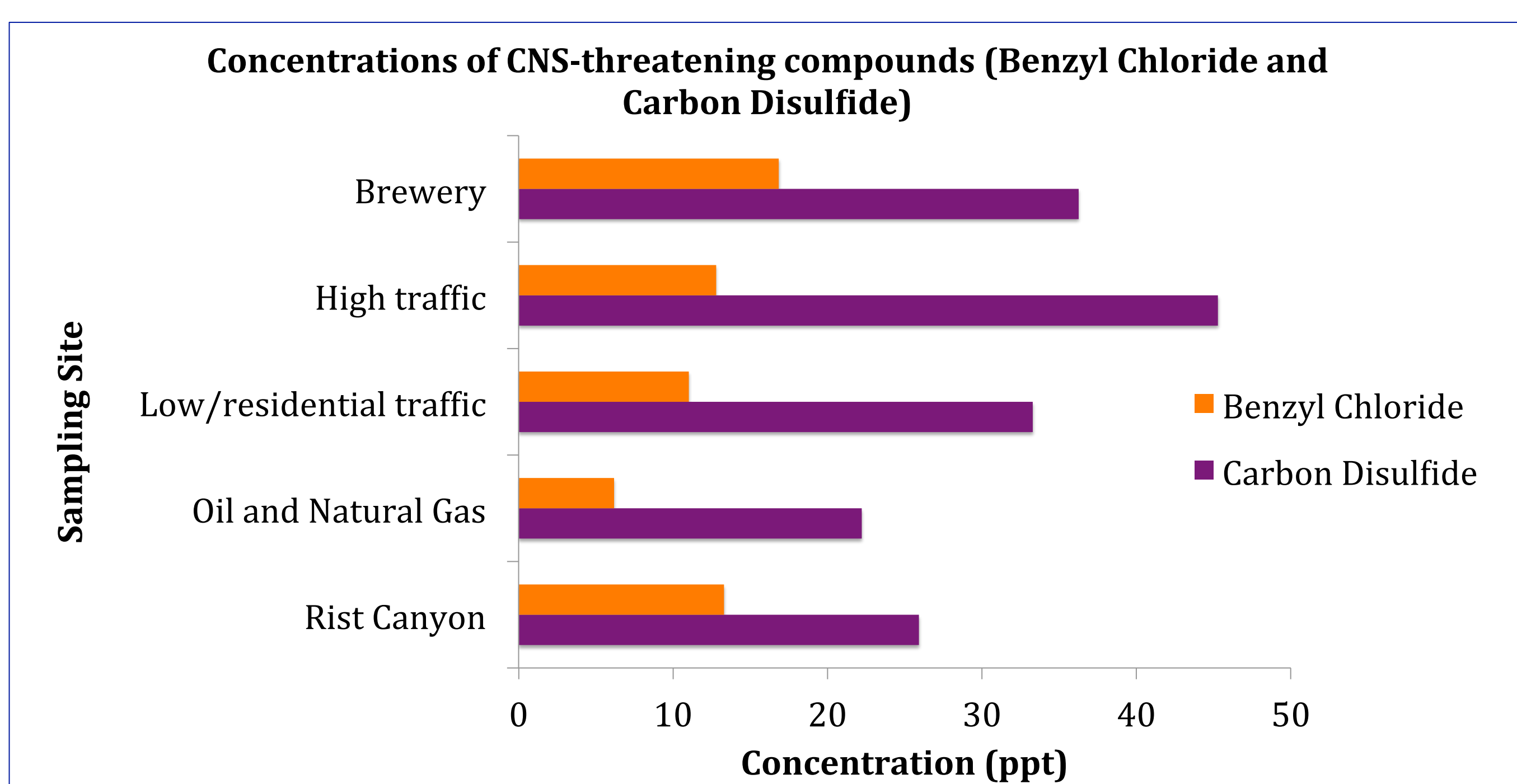


Fig. 4 (left):

- Carbon Disulfide found in higher concentrations than Benzyl Chloride at every sampling site
- Brewery had higher amounts of Benzyl Chloride than high traffic site

5. Conclusions

- "High traffic" site tends to have higher amounts of harmful VOCs. However, this was not true for Benzyl Chloride.
 - Weather conditions did not appear to contribute to concentration differences between the two sampling days.
- *Note: Conclusions limited to two days of sampling—future work would involve more sampling

6. Reference

- "An Introduction to Indoor Air Quality: Volatile Organic Compounds (VOCs)." EPA. Environmental Protection Agency, n.d. Web. 2 June 2014.

7. Acknowledgements

Thank you to Arsineh Hecobian and Amy Sullivan for your guidance and assistance with sampling. Thank you also to Melissa Burt for this opportunity and for your support and encouragement throughout this process.

This work has been supported by the National Science Foundation Science and Technology Center for Multi-Scale Modeling of Atmospheric Processes, managed by Colorado State University under cooperative agreement No. ATM-0425247.