

Mile High Chemistry

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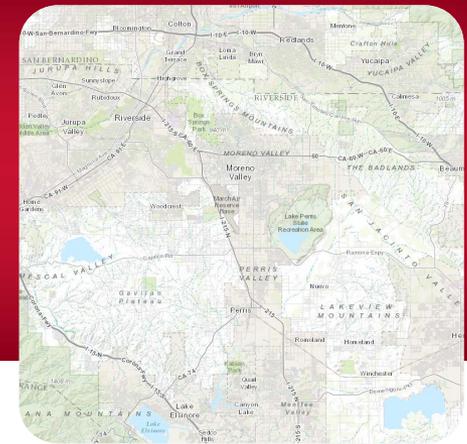


The Context



- Dr. Rebecca Lyons conducts research with undergraduate students on the distribution of trace nonpolar pollutants such as endocrine disruptors—remnants of herbicides, pesticides, fertilizers, and other industrial products—that mimic the activity of hormones in humans and animals.
- The effects of endocrine disruptors on animals can be quite dramatic: birth defects, deformation of sexual organs, sex changes in individuals, and development of intersex characteristics have been documented in the wild.

Going Spatial



- After taking a faculty position at the University of Redlands, Dr. Lyons involved her environmental chemistry students in testing for trace pollutants in the lakes around Redlands. Largely “by mistake,” they found 4-nonylphenol (4NP) (an endocrine disruptor) everywhere.
- Searching for a control lake to use for comparing the Southern California lakes, the researchers turned their attention to lakes in the High Sierra Mountains of California. They found some High Sierra Lakes to be free of endocrine disruptors, but not others.

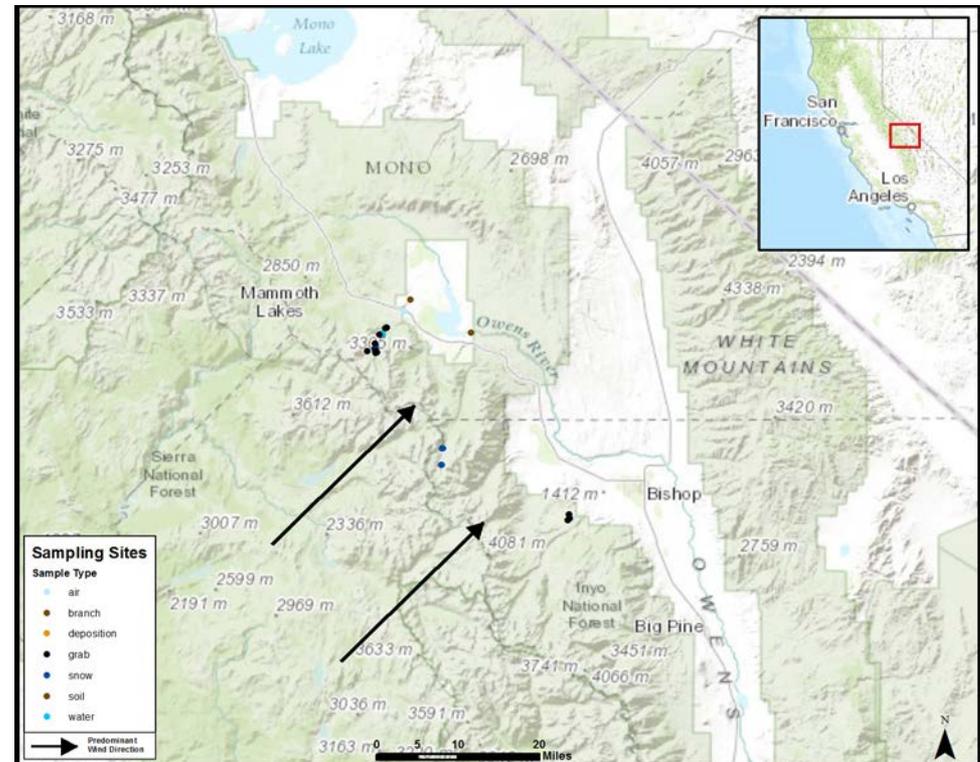
Hypotheses:



- Source: Agricultural operations in California's central valley
- Spatial Distribution: Unsheltered lakes
- Temporal/Seasonal Aspects: Winter
- Transport Mechanism: Wind

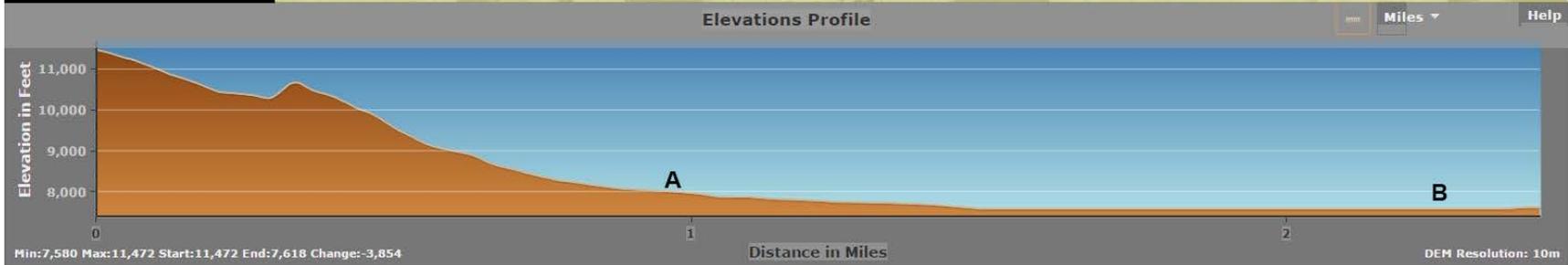
Spatially Enabled Sampling

- ArcGis 10.1 was used to choose sampling sites with elevations between 1800 and 3000 m.
- Analysis with digital elevation model, slope, aspect, vegetation cover, wind pattern, and upwind pollution source feature classes helped the researchers visualize the unique features experienced around each sampling site.



Sheltering

A profile drawn in the direction of prevailing winds across Convict Lake in the Sierras illustrates the sheltering provided by topographic relief. A sampling site closer to the highest point of the cirque (e.g., A) will experience greater sheltering from contamination than a sampling site that is farther away (e.g., B).



Publication

Environmental Pollution 195 (2014) 123–132



ELSEVIER

Contents lists available at [ScienceDirect](#)

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol



Deposition patterns and transport mechanisms for the endocrine disruptor 4-nonylphenol across the Sierra Nevada Mountains, California



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ARTICLE INFO

Article history:

Received 10 June 2014
Received in revised form
4 August 2014
Accepted 7 August 2014
Available online

Keywords:

Transport
Pollutants

ABSTRACT

Dust and particulate distribution patterns are shifting as global climate change brings about longer drought periods. Particulates act as vehicles for long range transport of organic pollutants, depositing at locations far from their source. Nonylphenol, a biodegradation product of nonylphenol polyethoxylate, is a known endocrine disruptor. Nonylphenol polyethoxylate enters the environment as an inert ingredient in pesticide sprays, potentially traveling great distances from its application site. This is of concern when a highly agricultural region, California's Central Valley, lies adjacent to sensitive areas like the Eastern Sierra Nevada Mountains. The distribution and transport mechanisms for 4-nonylphenol were investigated in Eastern Sierra Nevada canyons. Regions close to canyon headwalls showed trace amounts of 4-nonylphenol in surface water, snow, and atmospheric deposition. Exposed areas had yearly average

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Student Impacts



Environmental chemistry data can be overwhelming and uninformative when only viewed as Excel spreadsheets. Tabulated data is made more meaningful with a visual representation of sampling locations. Spatial tools help with data organization and place it into a more informative context. A map allows students to develop more informed hypotheses and thus more efficiently conduct science. Students can use GIS to engage with and explore a region before conducting field research in it.

The use of a spatial perspective did in fact change how I saw chemistry. From this perspective I was able to see how the different chemical laws and concepts overlapped in real world practical applications.



Thanks



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