



Determining the Heavy Metal Content of Mussels in Lake Erie and New Hampshire Streams



Staci Herman and Dr. Mary Kate Donais

Saint Anselm College, Department of Chemistry, 100 Saint Anselm College Manchester, NH 03102

Introduction

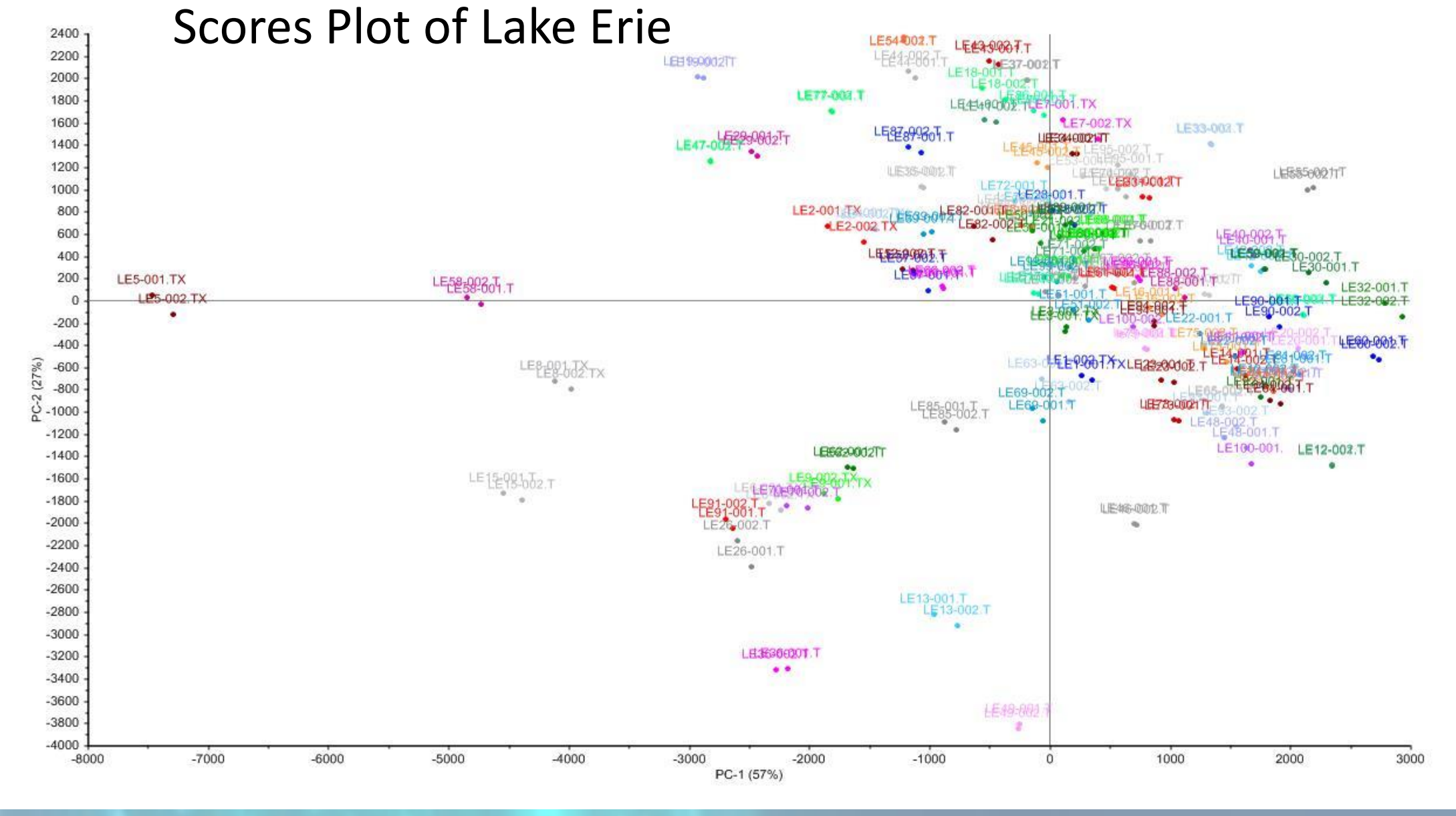
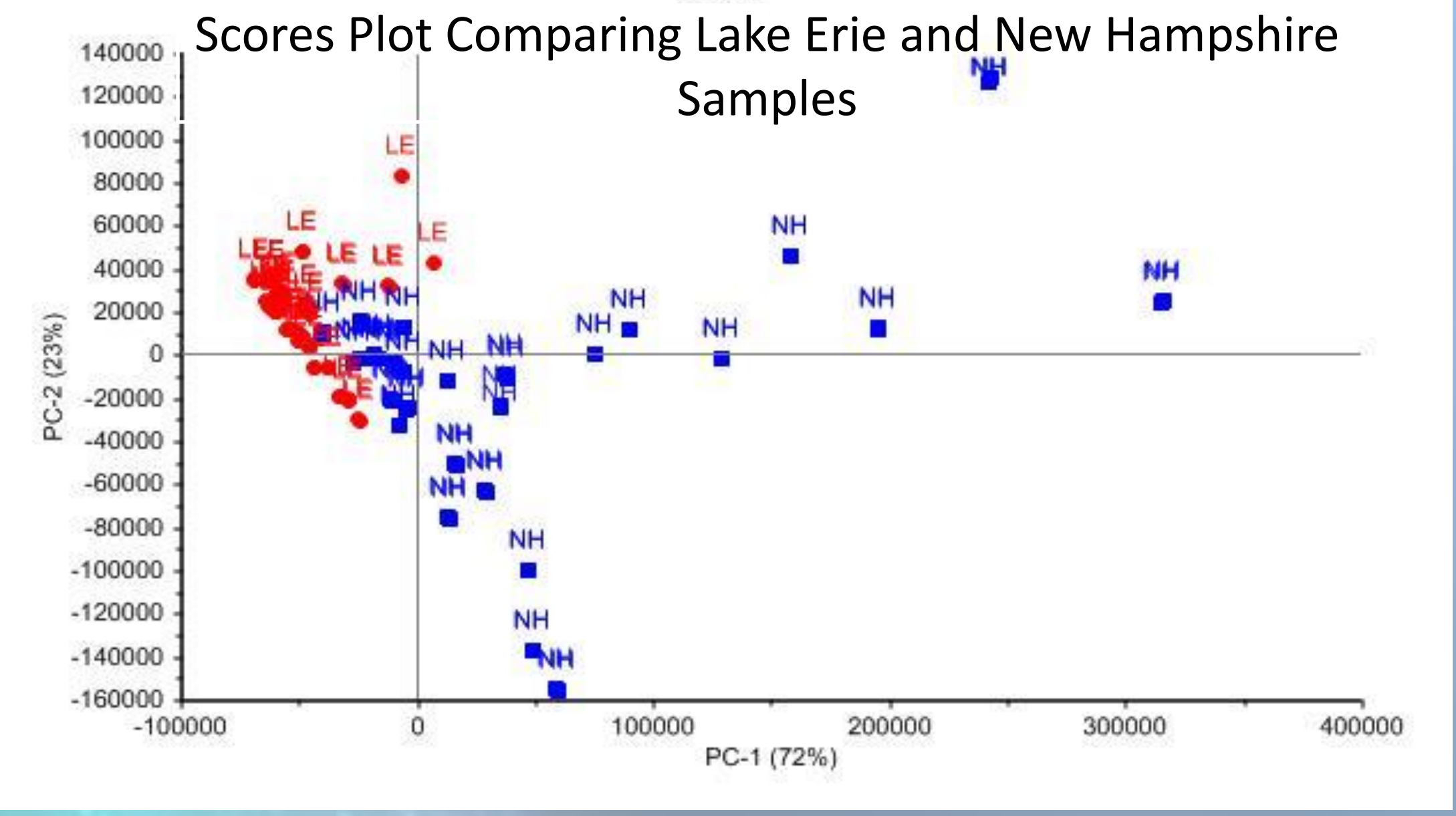
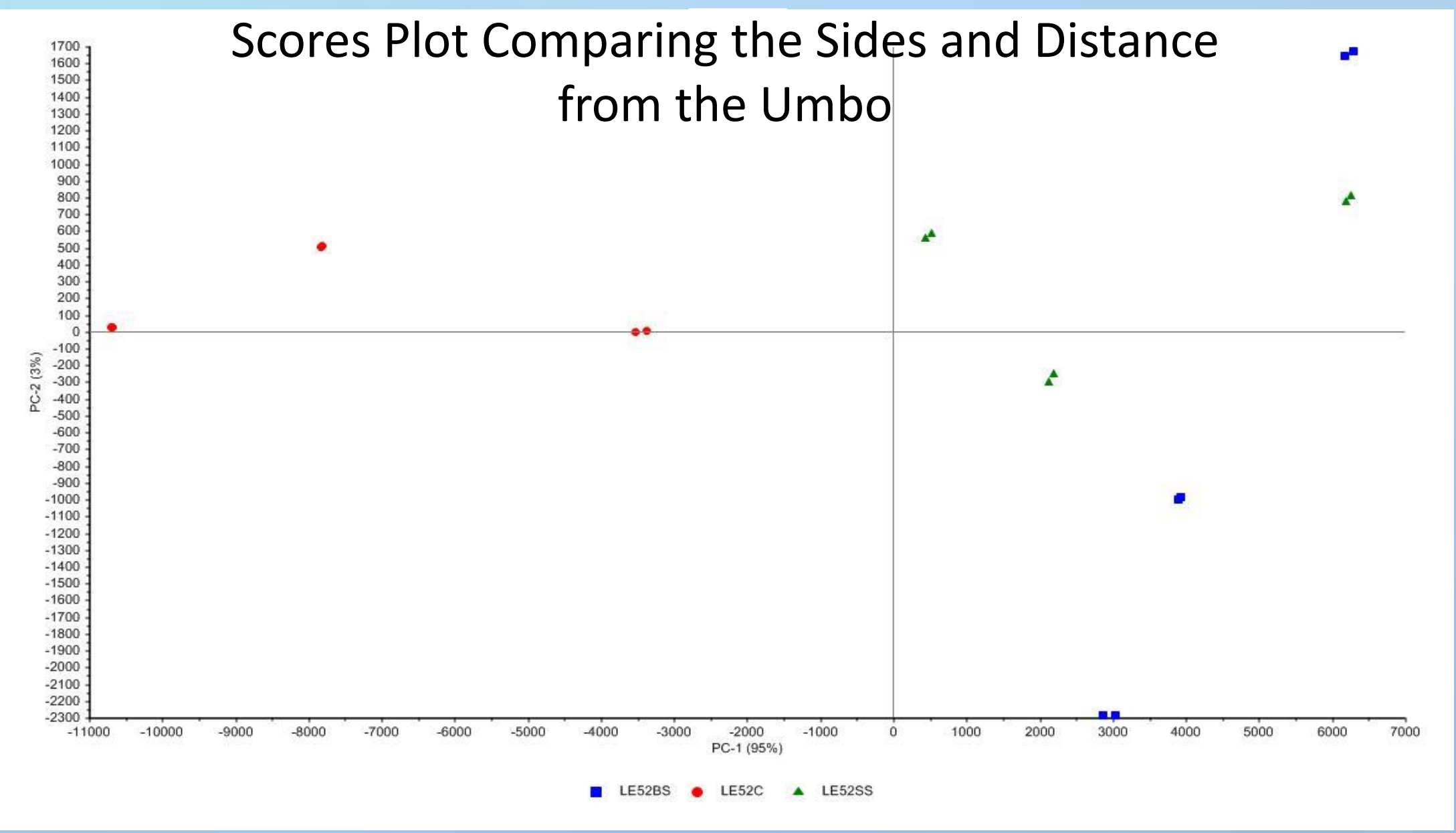
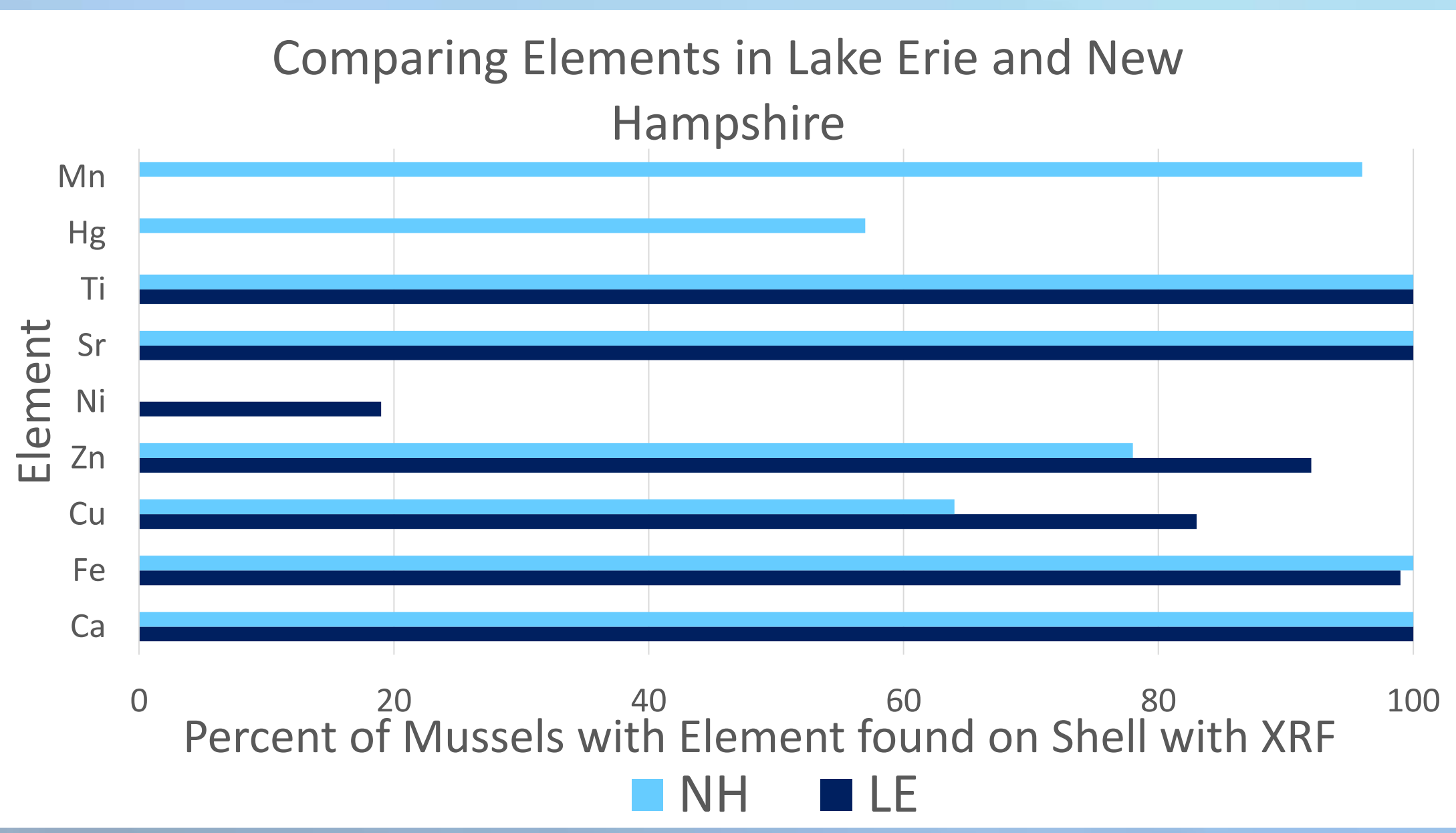
In late August 2013, a bald eagle was found unable to fly in a ditch by the Ottawa National Wildlife Refuge.¹ It was found that the bird was suffering from mercury poisoning.¹ Furthermore, a study conducted in 1997 on zebra and quagga mussels located in Lake Erie and Ontario found that the Lake Erie mussels had high concentrations of Fe, Pb, Mg, Hg, Se, and V, and also contained other heavy metals.² Both of these cases were the result of human interference in the environment. Historically, it has been found that the rivers and streams, specifically the stems and roots of eelgrass at the East Bay Estuary in New Hampshire, contain mercury.³ This gives rise to the hypothesis that heavy metals contaminated the waterways in New Hampshire. In order to determine if there are regional contamination differences, mussels were examined from both New Hampshire and Lake Erie and compared to evaluate the metal contents and in what quantity.

Instrumentation

- Two energy dispersive x-ray fluorescence spectrometers (XRF) were used, a Bruker Tracer III-SD and a Bruker Tracer III-V.
 - A Thermo Elemental S Series Atomic Absorption Spectrophotometer (FAAS) with a calcium, iron and strontium hollow cathode lamp was used for the quantitative analyses
- SCP Science DigiPREP Jr. digestion system with 50-mL volumetric digestion vessels was used for sample digestions

Results

| Sample | Ca (ppm) | Fe (ppm) | Sr (ppm) |
|--------|------------|---------------|----------|
| 6/9 | 3590 ± 400 | 0.222 ± 0.02 | 8.46 ± 2 |
| 8/34 | 3790 ± 400 | 0.0881 ± 0.02 | 6.94 ± 2 |
| 15/47 | 3850 ± 400 | 0.154 ± 0.02 | 7.73 ± 2 |
| 17/70 | 4060 ± 400 | 0.217 ± 0.02 | 8.06 ± 2 |
| 39/52 | 4010 ± 400 | 0.160 ± 0.02 | 7.99 ± 2 |



Conclusions

- The mussels do have very similar metal content
- There is clear grouping with the New Hampshire and Lake Erie Mussels with a statistically significant different via a 2-way ANOVA with replicates ($p=0.05$, $F(15.7) > F_{crit}(3.86)$)
- The mussels from Lake Erie are all similar
- There is no special or side effect when testing the mussel's shells due to placement error
- The concentrations of the metals (Sr and Fe) are low

Further Considerations

Use the ICP-AES to test the New Hampshire samples to determine the metal amounts quantitatively

Acknowledgements

- Dr. Donais for helping me undertake this project
- Dr. Wicklow for the New Hampshire mussel samples
- Dr. Steve Hale, and EPSCoR for funding my project
- Dr. Penney for lending me a caliper
- Ohio Department of Natural Resources for granting me a permit to take my Lake Erie samples

Reference

1. Smith, K., Eagle released after recovering from mercury poisoning. Port Clinton News Herald November 17, 2013, 2013.
2. Rutzke, M. A.; Gutenmann, W. H.; Lisk, D. J.; Mills, E. L., Toxic and nutrient element concentrations in soft tissues of zebra and quagga mussels from Lakes Erie and Ontario. Chemosphere 2000, 40 (12), 1353-1356.
3. Pannhorst, T. S.; Weber, J. H., Speciation of mercury in eelgrass (Zostera marina L.): a seasonal study in the Great Bay Estuary, New Hampshire. Appl. Organomet. Chem. 1999, 13 (6), 461-467.