ANALYSIS OF LICHEN
BIO-MONITORING DATA

STATISTICAL REPORT

Prepared for

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II. EXECUTIVE SUMMARY

This is a report of the results of analysis of lichen chemistry data from monitoring sites in the Chugach National Forest, Alaska. After consultation with the clients, questions of interest were defined. The report includes a summary of the project, discussion of the structure of the data and explanatory and response variables, and the statistical procedures employed in the analysis. Data set used was provided in several Excel spreadsheets by Karen Dillman, USDA Forest Service, Tongass National Forest, Petersburg, Alaska.

Results are reported in chapters for each species analyzed, arranged by elements. Each analysis includes a summary statistics table for Visit 1 and Visit 2 paired observations. These tables include the minimum, maximum, mean, standard error and 95% confidence interval for the reported means. The results of paired t-tests, where appropriate, are reported. The t-tests are followed by summary statistics tables for all plots and graphs depicting element content by Visit for all plots measured. The graphs include the contaminant thresholds in lichens from Region 10 (see Thresholds VIII, page 53).

A list of Literature Cited is included in the last chapter. This work is in fulfillment of USDA Purchase Order Number AG-120-P-15-0018.

III. INTRODUCTION

Summary of the experiment and objectives

The United States Congress enacted the Clean Air Act (CAA) in 1970 and its amendments in 1977 and 1990 in response to an increased awareness of the nationwide consequences of air pollution and environmental degradation. Biomonitoring can provide a sensitive overview of air quality, detect fairly small changes in air quality geographically or over time (Geiser et al., 1994). Lichens can accumulate pollutants from the air, and studies have shown the usefulness of lichens to monitor air pollutants by translating pollutant concentration numbers to tangible effects on biological systems.

Monitoring sites have been established in the Chugach National Forest where lichen samples can be collected and later analyzed for pollutant concentrations. Sampling was conducted in 1993 and 1994 (Visit 1) on plots CHUG 01 – CHUG 35, and in 2011-2014 (Visit 2) on plots Chug 1, 5, 6, 13, 15, 18, 19, 20, 21, 22, 23, 24, 70, 71, 72, 73, 74, 76, 78, 79, 80, 81, 82, 83, and 84. The samples were evaluated for their chemical composition, and those data were submitted to Pacific Analytics for statistical analysis.

Project objectives are:

1. Investigate the differences between the chemical composition of *Alectoria sarmentosa* collected on plots sampled in both visits.

2. Identify those plots where the element content exceeded the contaminant thresholds in lichens from Region 10 (see Thresholds VIII, page 53).

3. Calculate summary statistics of the element content for three species of lichens, *Alectoria sarmentosa, Lobaria oregana,* and *Platismatia glauca*.

IV. Statistical Procedures

Paired t-tests

Twelve of the sites that were visited during 1993-1994 (Visit 1) were revisited in 2011-2014 (Table IV-1). Paired t-tests of these sites were used to determine if element content in *Alectoria sarmentosa* changed from Visit 1 to Visit 2. Paired t-tests are used where the entities measured in each sample are pairwise dependent. The goal is to test whether the mean difference between paired values is significantly different from zero (Ramsey and Schafer 1997).

Table IV-1. Revisited Sites from which data were used for paired t-tests.

Chug 01	Chug 19
Chug 05	Chug 20
Chug 06	Chug 21
Chug 13	Chug 22
Chug 15	Chug 23
Chug 18	Chug 24

The results of the t-tests are reported for those elements and plots that were examined during both visits. Summary Statistics tables were calculated for element concentrations found in each of the three species of lichens, *Alectoria sarmentosa, Lobaria oregana,* and *Platismatia glauca,* from the twelve revisited plots.

Summary Statistics tables were also calculated for element concentrations found in the lichens from all plots sampled, by sampling round.

Scatter plots were created with all plot data by sampling round, showing the contaminant thresholds in lichens from Region 10 (see Thresholds VIII, page 53). Those sites that exceed the threshold are labelled. Red dots on the plots indicate sampling round means.

Software used for all statistical analyses was R (R Core Team, 2015).

V. SUMMARY OF ALECTORIA SARMENTOSA ANALYSIS

PERCENT SULFUR

Table V-1. Percent Sulfur in paired plots Summary Statistics

S	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	0.02	0.04	0.03	0.00	0.03	0.04
VISIT 2	0.01	0.07	0.04	0.00	0.03	0.05

Paired t-test

```
data:  s.pct[visitno == 1] and s.pct[visitno == 2]
t = -1.742, df = 11, p-value = 0.1094

95 percent confidence interval:
 -0.014487959  0.001686292

mean of the differences
           -0.006400833
```

There is suggestive evidence that the mean Percent Sulfur of those plots measured during both visits was higher during Visit 2 (p-value = 0.1094).

Table V-2. Percent Sulfur in all plots Summary Statistics

S	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	0.020	0.042	0.031	0.001	0.028	0.034
2011-2014	0.013	0.066	0.040	0.003	0.034	0.045

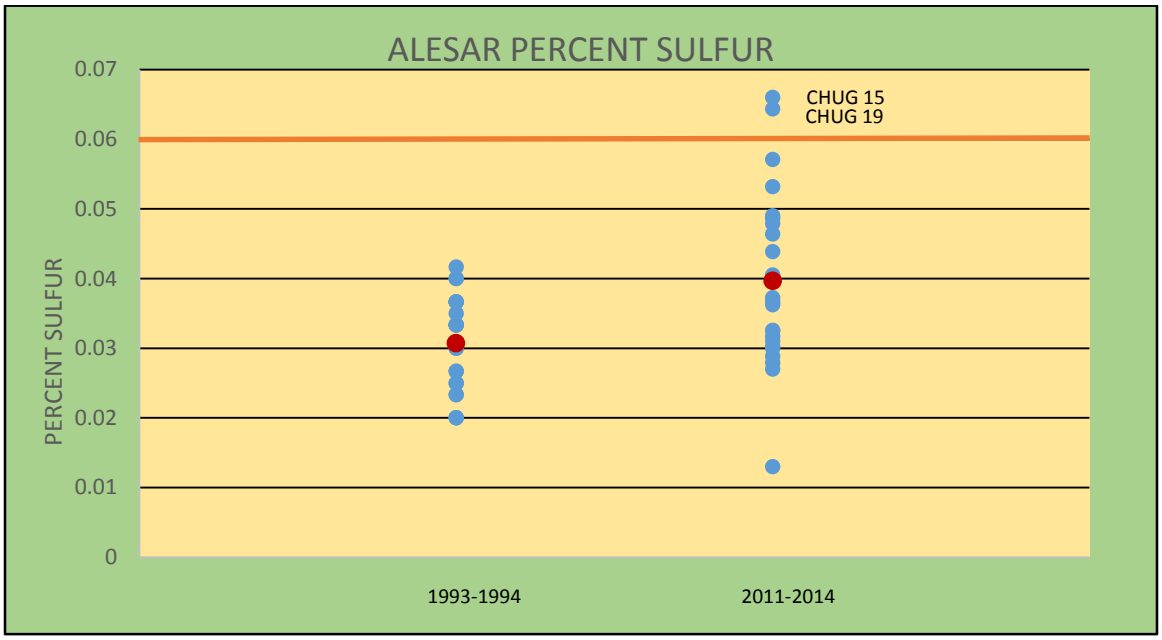

Figure V-1. Scatter plot of Percent Sulfur on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

PERCENT NITROGEN

Table V-3. Percent Nitrogen in paired plots Summary Statistics.

N	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	0.22	0.70	0.41	0.04	0.33	0.49

Paired t-test

```
No test, no data from paired plots during Visit 1.
```

Table V-4. Percent Nitrogen in all plots Summary Statistics.

N	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.222	0.764	0.463	0.027	0.407	0.520

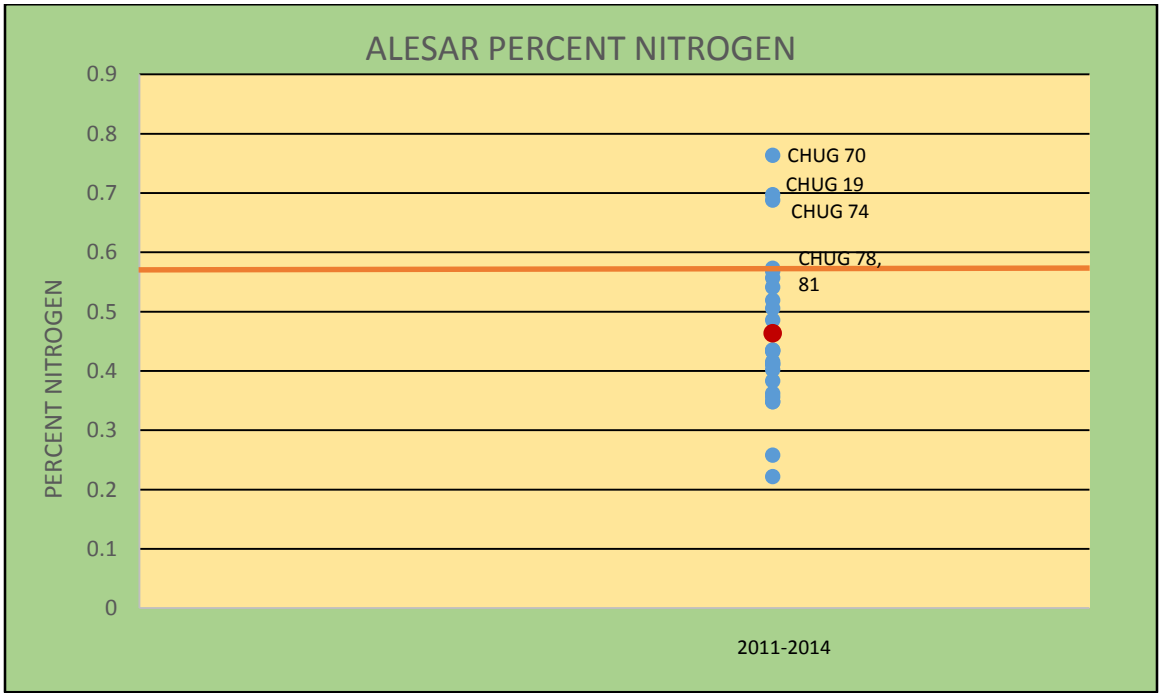

Figure V-2. Scatter plot of Percent Nitrogen on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Al ppm

Table V-5. Al ppm in paired plots Summary Statistics

Al	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	27.34	104.20	55.42	6.72	40.62	70.22
VISIT 2	14.56	150.85	46.70	10.56	23.47	69.93

Paired t-test

```
ata:  al.ppm[visitno == 1] and al.ppm[visitno == 2]
t = 0.683, df = 11, p-value = 0.5087

95 percent confidence interval:
 -19.37873  36.81804

mean of the differences
               8.719655
```

There is no evidence that the mean Al ppm of those plots measured during both visits was different (p-value = 0.5087).

Table V-6. Al ppm in all plots Summary Statistics

AL	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	19.417	107.100	50.026	4.932	39.798	60.254
2011-2014	14.557	527.600	89.538	24.314	39.240	139.836

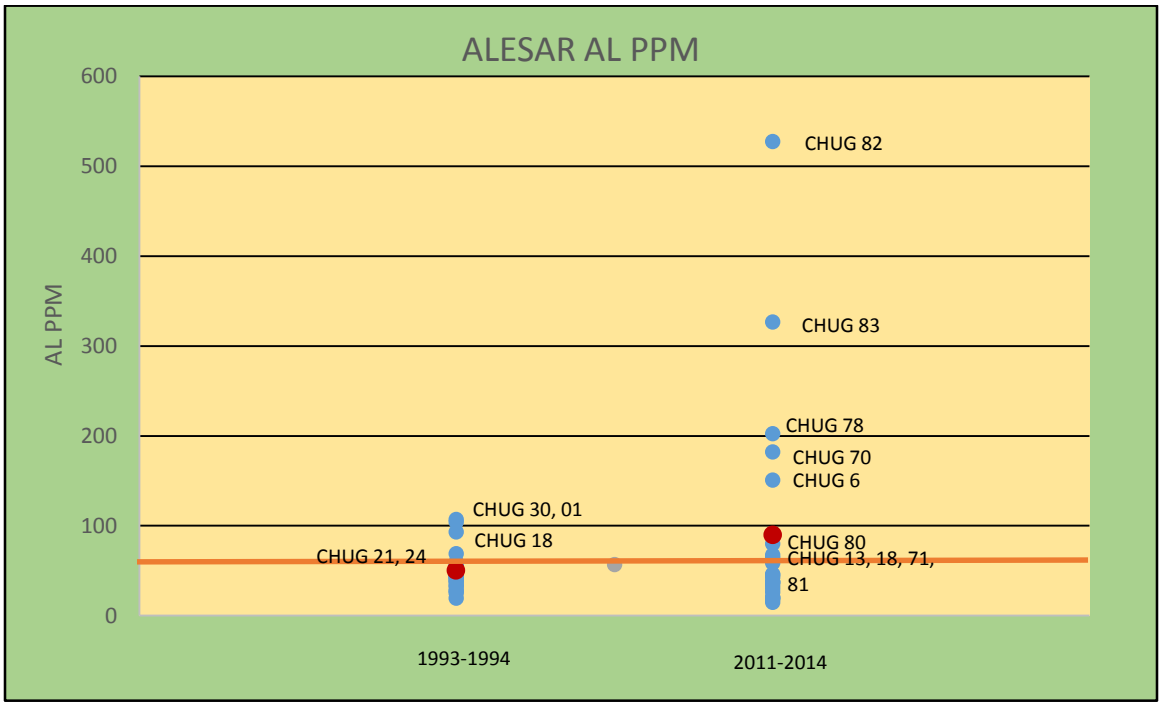

Figure V-3. Scatter plot of Al ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ars ppb

Table V-7. Ars ppb in paired plots Summary Statistics

Ars	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	0.99	1.53	1.35	0.12	0.96	1.74

Paired t-test

```
No test, no data from paired plots during Visit 1.
```

Table V- 8. Ars PPB in all plots Summary Statistics

ARS	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.990	1.983	1.515	0.113	1.263	1.767

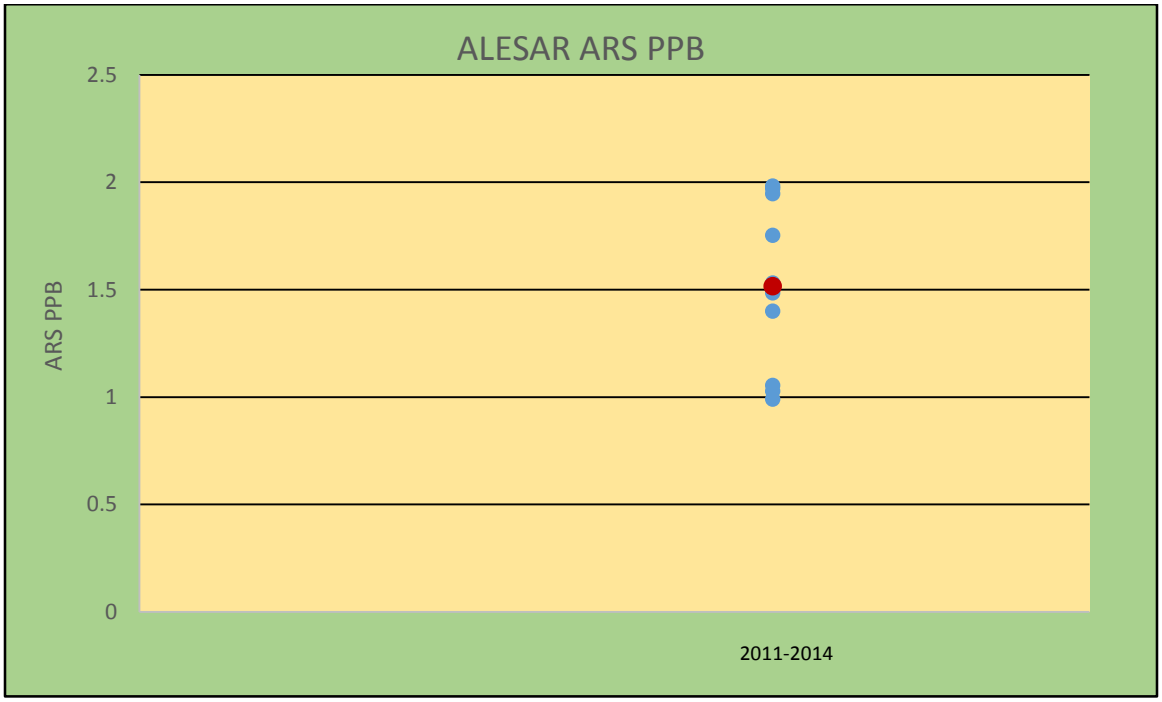

Figure V-4. Scatter plot of Ars PPB on All Plots measured.Sampling Round means are indicated by a red dot.

B ppm

Table V-9. B ppm in paired plots Summary Statistics

B	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	2.22	8.85	4.74	0.58	3.46	6.03
VISIT 2	NA	NA	NA	NA	NA	NA

Paired t-test

No test, no data from paired plots during Visit 2.

Table V-10. B ppm in all plots Summary Statistics

B	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	1.005	8.853	4.069	0.472	3.090	5.047
2011-2014	0.010	14.260	1.695	0.785	0.058	3.332

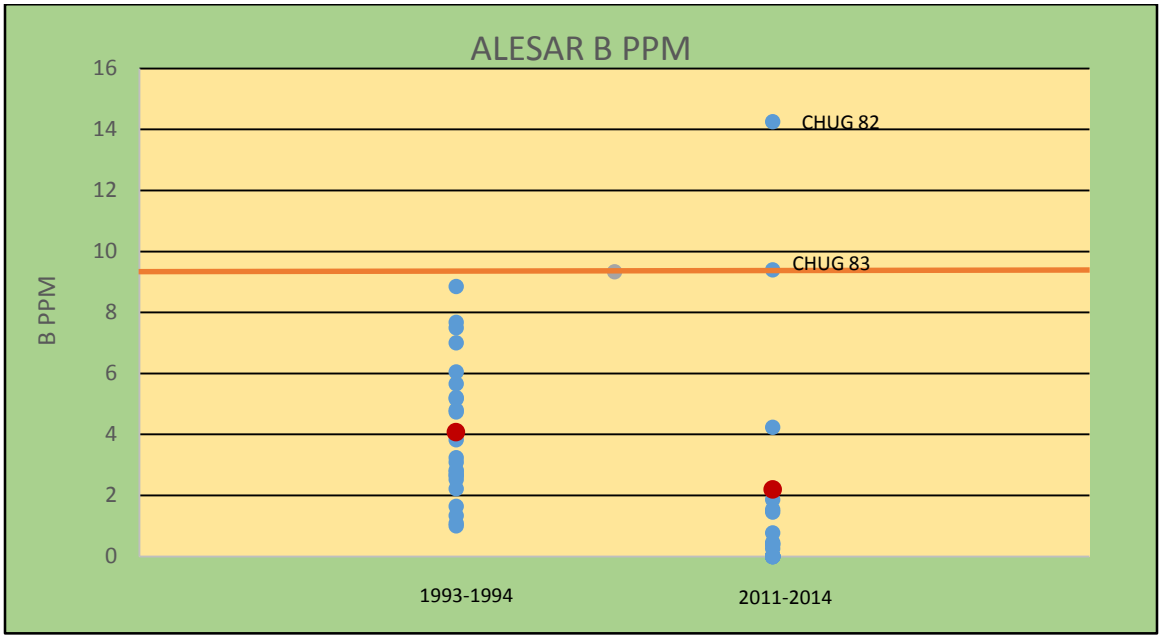

Figure V-5. Scatter plot of B ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ba ppm

Table V-11. Ba ppm in paired plots Summary Statistics

Ba	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	NA	NA	NA	NA	NA	NA

Paired t-test

```
No test, no data from paired plots.
```

Table V-12. Ba ppm in all plots Summary Statistics

BA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.010	24.635	5.171	1.417	2.225	8.118

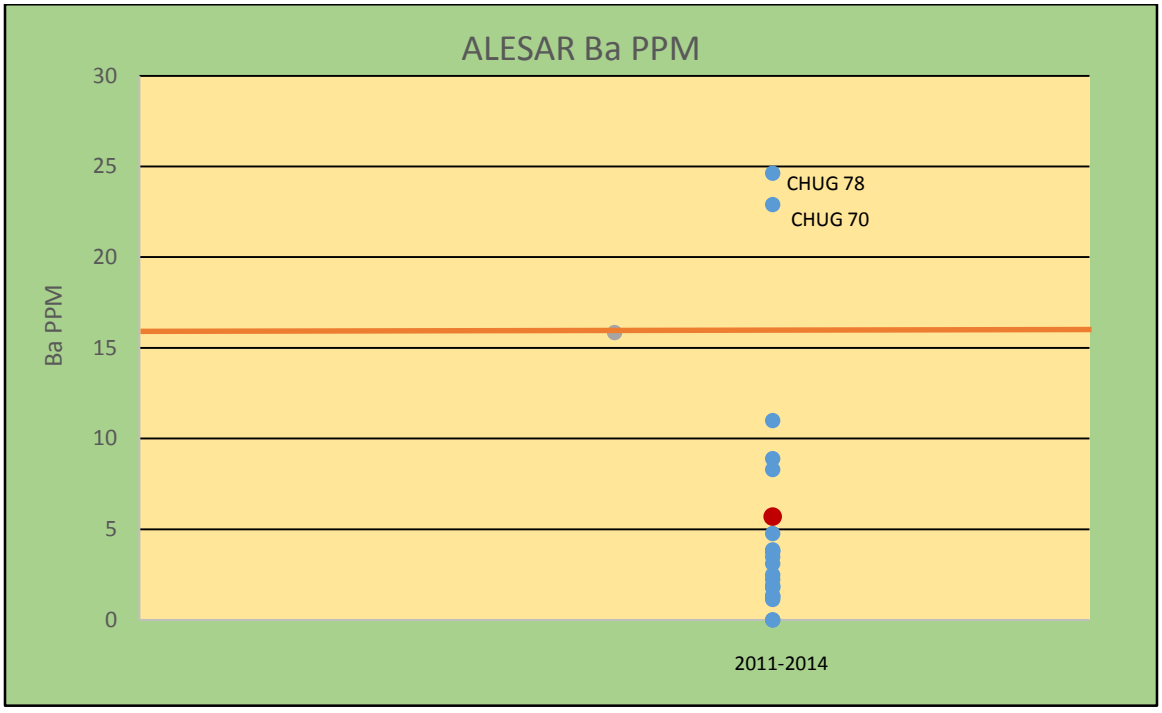

Figure V-6. Scatter plot of Ba ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Be ppm

Table V-13. Be ppm in paired plots Summary Statistics

Be	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	NA	NA	NA	NA	NA	NA

Paired t-test

```
No test, no data from paired plots.
```

Table V-14. Be ppm in all plots Summary Statistics

BE	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.001	0.013	0.007	0.001	0.005	0.009

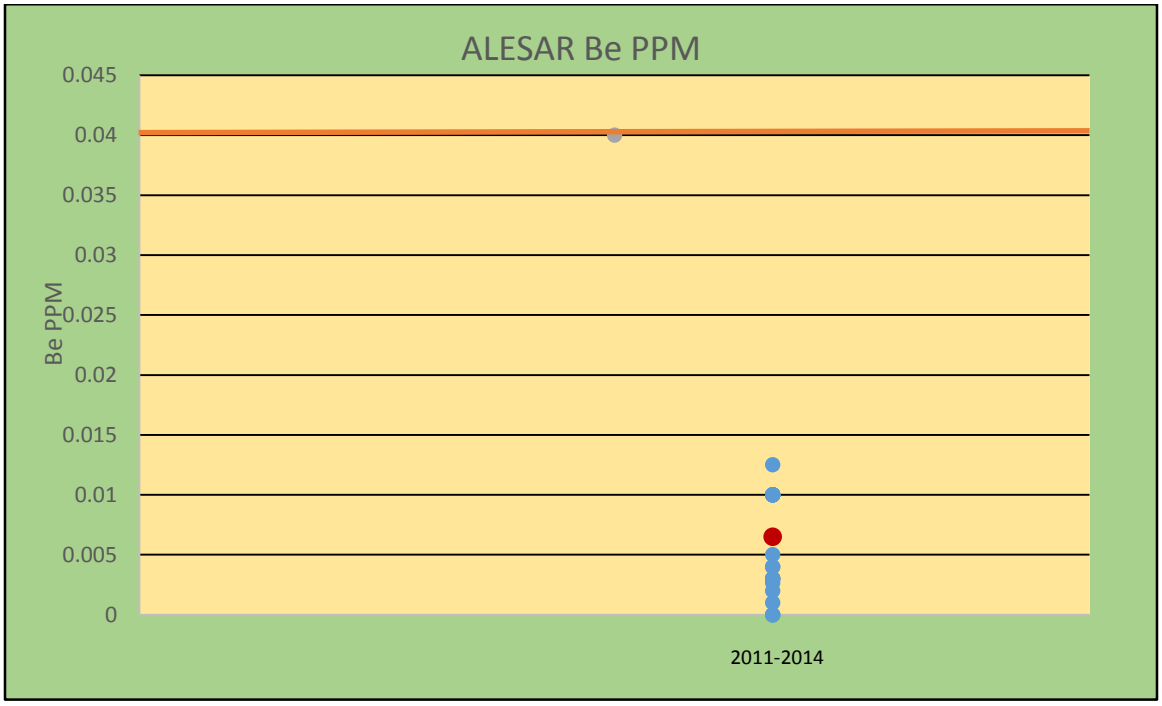

Figure V-7. Scatter plot of Be ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ca ppm

Table V-15. Ca ppm in paired plots Summary Statistics

Ca	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	1356.92	9597.10	4626.99	787.04	2894.74	6359.24
VISIT 2	2396.67	12639.00	6046.49	838.88	4200.13	7892.85

Paired t-test

```
data:  ca.ppm[visitno == 1] and ca.ppm[visitno == 2]
t = -1.8642, df = 11, p-value = 0.08918

95 percent confidence interval:
 -3095.4692   256.4617

mean of the differences
              -1419.504
```

There is suggestive evidence that the mean Ca ppm of those plots measured during both visits was higher during Visit 2 (p-value = 0.0892).

Table V-16. Ca ppm in all plots Summary Statistics

CA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	1356.923	15128.500	5683.085	676.891	4279.298	7086.872
2011-2014	1636.250	12639.000	5349.537	501.388	4312.337	6386.737

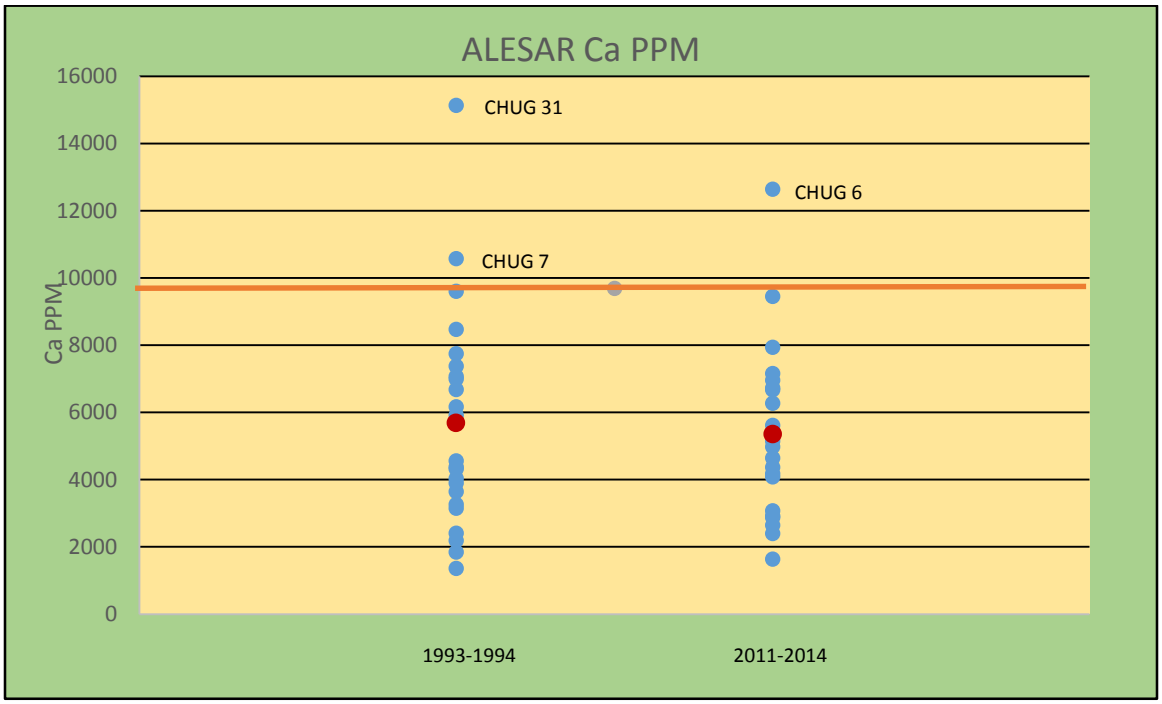

Figure V-8. Scatter plot of Ca ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cd ppm

Table V-17. Cd ppm in paired plots Summary Statistics

Cd	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	0.10	3.70	0.94	0.32	0.25	1.64
VISIT 2	0.01	0.15	0.06	0.01	0.04	0.08

Paired t-test

```
data:  cd.ppm[visitno == 1] and cd.ppm[visitno == 2]
t = 2.7846, df = 11, p-value = 0.01776

95 percent confidence interval:
 0.1857261 1.5865887

mean of the differences
              0.8861574
```

There is evidence that the mean Cd ppm of those plots measured during both visits was higher during Visit 1 (p-value = 0.0178).

Table V-18. Cd ppm in all plots Summary Statistics

CD	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	0.093	3.700	0.614	0.179	0.243	0.985
2011-2014	0.015	0.167	0.058	0.007	0.044	0.073

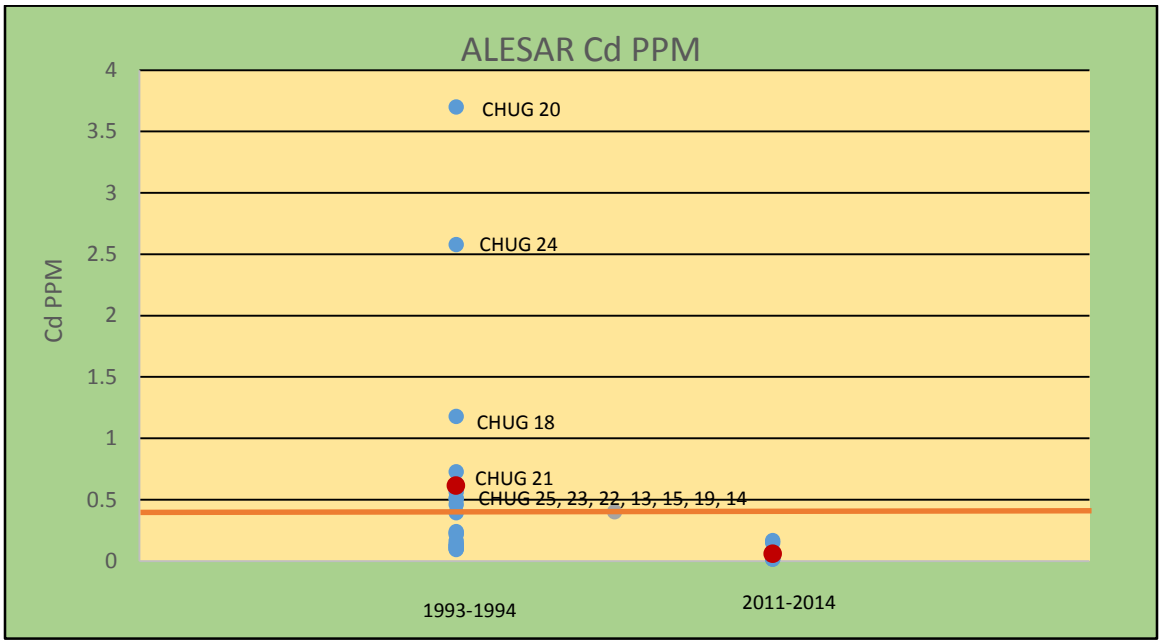

Figure V-9. Scatter plot of Cd ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Co ppm

Table V-19. Co ppm in paired plots Summary Statistics

Co	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	NA	NA	NA	NA	NA	NA

Paired t-test

```
No test, no paired plot data.
```

Table V-20. Co ppm in all plots Summary Statistics

CO	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.010	0.293	0.118	0.017	0.082	0.153

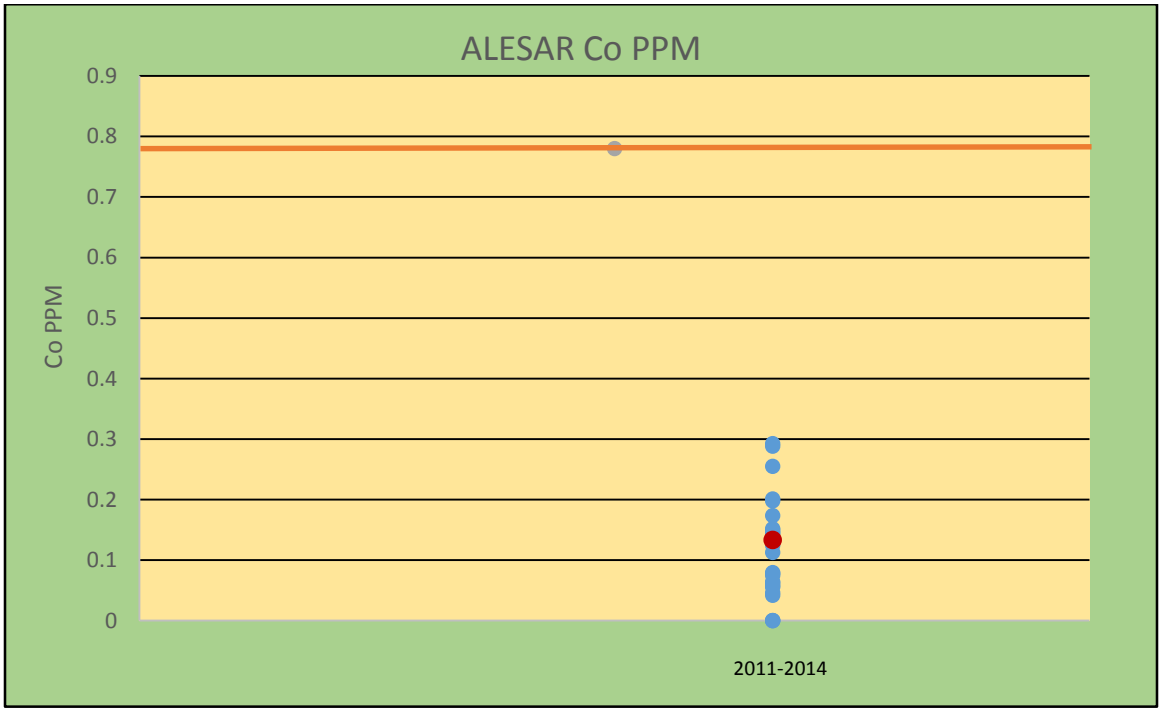

Figure V-10. Scatter plot of Co ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cr ppm

Table V-21. Cr ppm in paired plots Summary Statistics

Cr	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	0.45	2.50	1.08	0.20	0.64	1.52
VISIT 2	0.11	1.38	0.45	0.12	0.20	0.71

Paired t-test

```
data:  cr.ppm[visitno == 1] and cr.ppm[visitno == 2]
t = 2.3391, df = 11, p-value = 0.03923

95 percent confidence interval:
 0.03714154 1.22061309

mean of the differences
              0.6288773
```

There is evidence that the mean Cr ppm of those plots measured during both visits was higher during Visit 1 (p-value = 0.0392).

Table V-21. Cr ppm in all plots Summary Statistics

CR	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	0.280	2.503	0.841	0.122	0.588	1.093
2011-2014	0.111	18.348	1.254	0.748	0.000	2.801

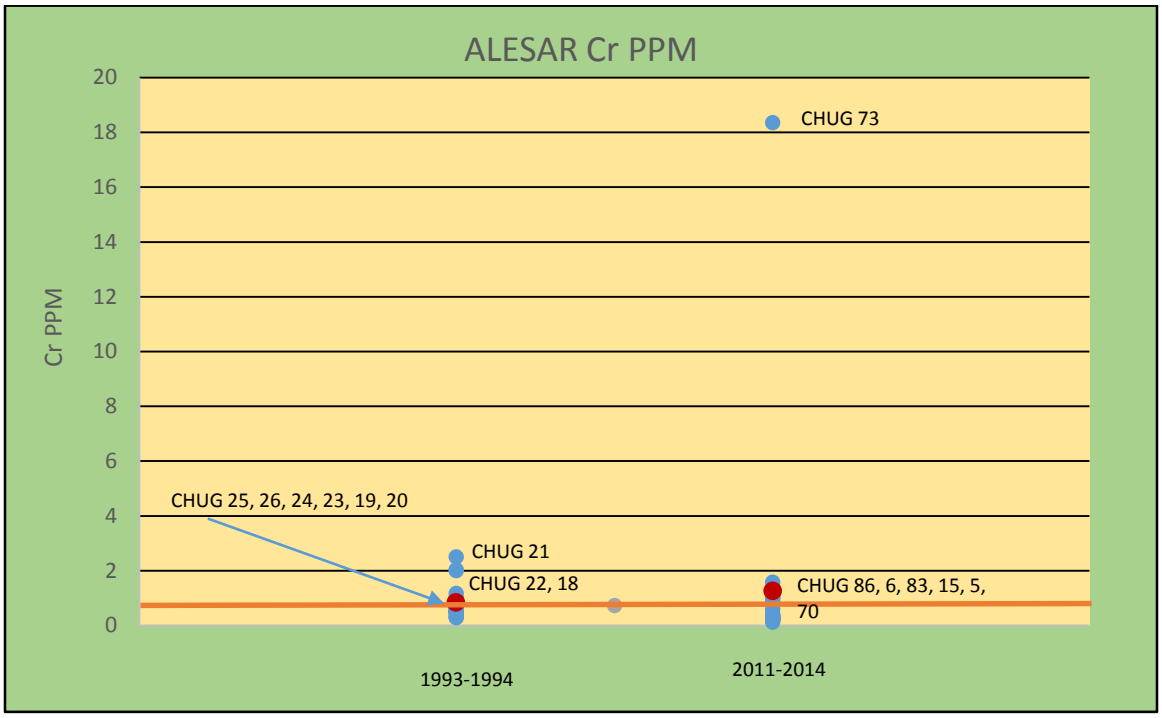

Figure V-11. Scatter plot of Cr ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cu ppm

Table V-23. Cu ppm in paired plots Summary Statistics

Cu	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	1.07	2.75	1.62	0.14	1.30	1.94
VISIT 2	0.17	2.96	1.40	0.26	0.81	1.98

Paired t-test

```
data:  cu.ppm[visitno == 1] and cu.ppm[visitno == 2]
t = 0.8056, df = 11, p-value = 0.4375

95 percent confidence interval:
 -0.3884209  0.8369394

mean of the differences
              0.2242593
```

There is no evidence that the mean Cu ppm of those plots measured during both visits was different (p-value = 0.4375).

Table V-24. Cu ppm in all plots Summary Statistics

CU	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	1.073	20.660	2.573	0.845	0.821	4.326
2011-2014	0.169	2.961	1.467	0.163	1.131	1.804

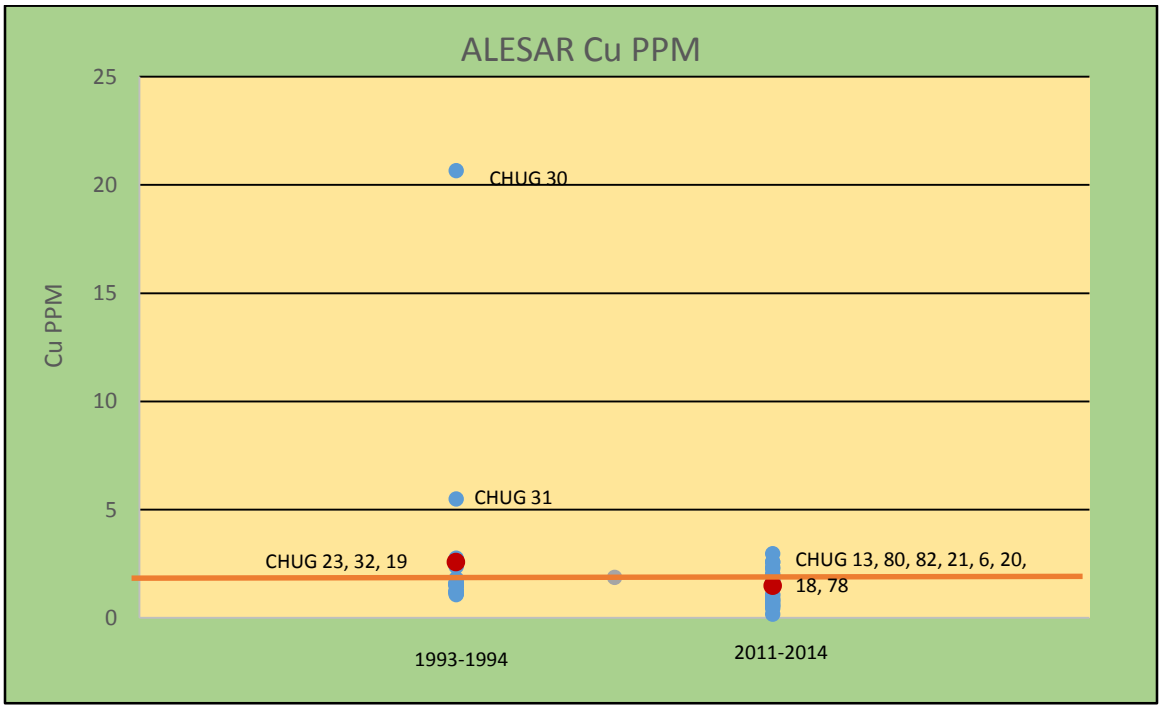

Figure V-12. Scatter plot of Cu ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Fe ppm

Table V-25. Fe ppm in paired plots Summary Statistics

Fe	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	24.35	85.68	47.79	5.65	35.35	60.22
VISIT 2	8.32	171.23	45.36	12.66	17.49	73.24

Paired t-test

```
data:  fe.ppm[visitno == 1] and fe.ppm[visitno == 2]
t = 0.1852, df = 11, p-value = 0.8564

95 percent confidence interval:
 -26.36524  31.21105

mean of the differences
               2.422903
```

There is no evidence that the mean Fe ppm of those plots measured during both visits was different (p-value = 0.8564).

Table V-26. Fe ppm in all plots Summary Statistics

FE	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	18.077	85.677	41.011	3.571	33.605	48.417
2011-2014	8.316	506.475	92.359	24.324	42.041	142.676

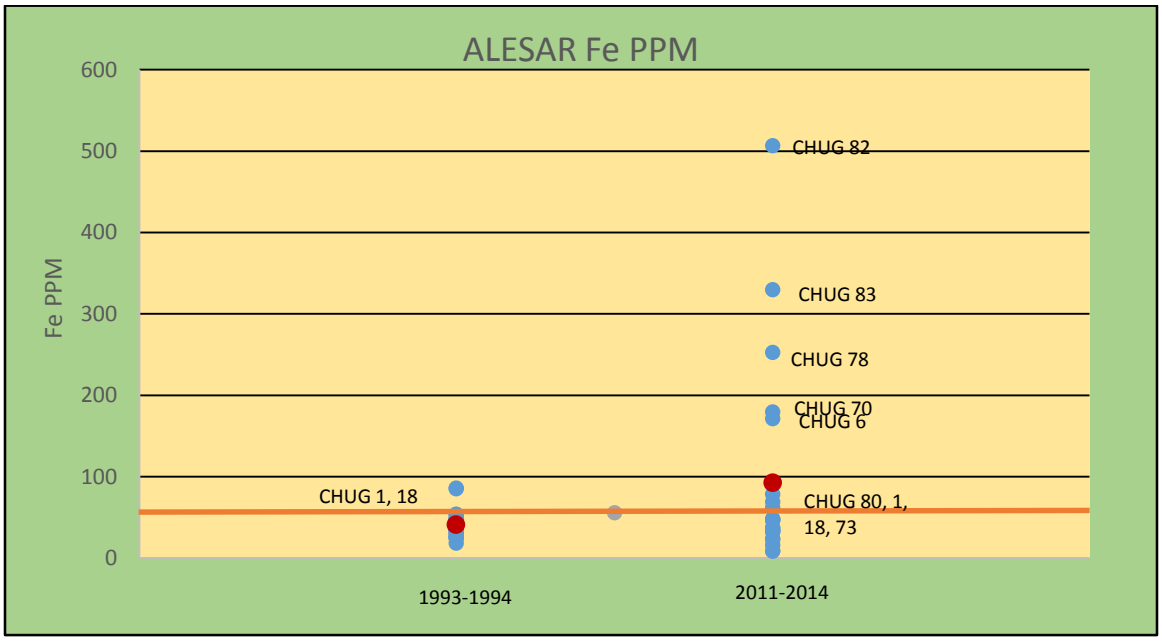

Figure V-13. Scatter plot of Fe ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

K ppm

Table V-27. K ppm in paired plots Summary Statistics

K	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	848.05	1916.70	1295.51	103.68	1067.32	1523.70
VISIT 2	937.32	2535.30	1699.84	142.08	1387.13	2012.54

Paired t-test

```
data:  k.ppm[visitno == 1] and k.ppm[visitno == 2]
t = -4.3555, df = 11, p-value = 0.001145

95 percent confidence interval:
 -608.6486 -200.0058

mean of the differences
              -404.3272
```

There is evidence that the mean K ppm of those plots measured during both visits was higher during Visit 2 (p-value = 0.0011).

Table V-28. K ppm in all plots Summary Statistics

K	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	719.440	1916.700	1277.460	75.010	1121.898	1433.022
2011-2014	937.320	3473.400	1836.531	128.356	1571.007	2102.055

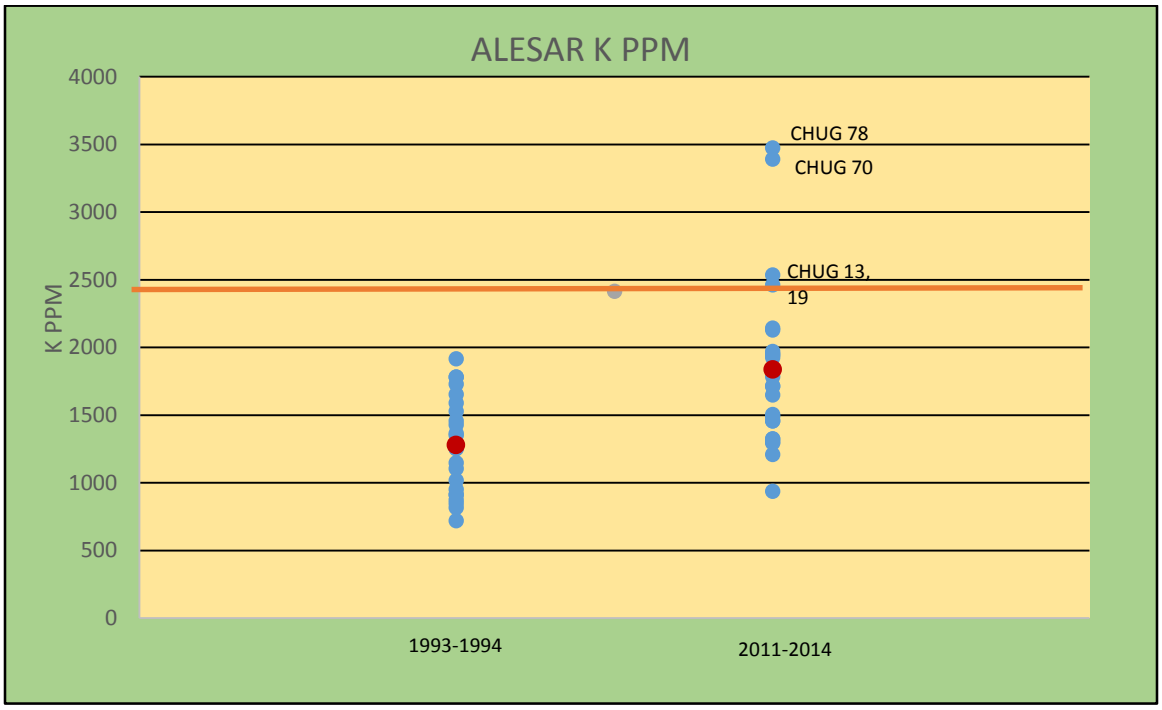

Figure V-14. Scatter plot of K ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Li ppm

Table V-29. Li ppm in paired plots Summary Statistics

Li	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	NA	NA	NA	NA	NA	NA

Paired t-test

No test, no paired plot data.

Table V-30. Li ppm in all plots Summary Statistics

LI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.001	0.313	0.055	0.015	0.023	0.087

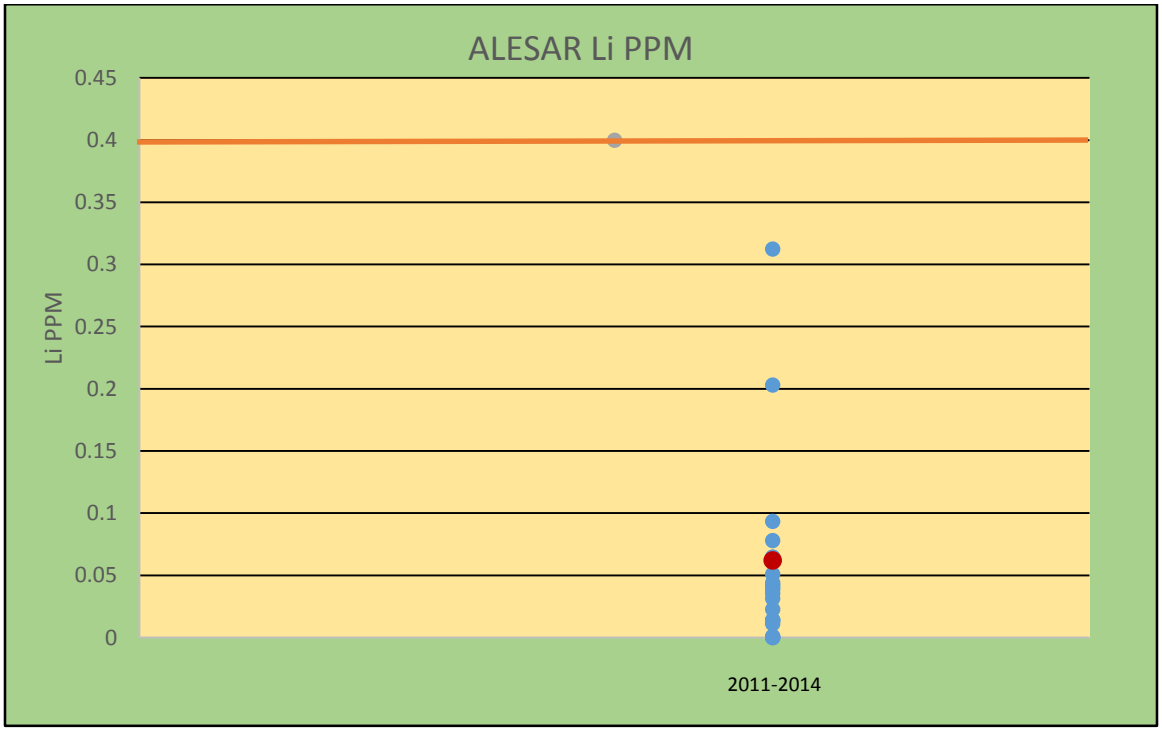

Figure V-15. Scatter plot of Li ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mg ppm

Table V-31. Mg ppm in paired plots Summary Statistics

Mg	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	163.99	593.11	393.37	33.74	319.11	467.63
VISIT 2	251.93	1737.00	509.55	117.32	251.33	767.77

Paired t-test

```
data:  mg.ppm[visitno == 1] and mg.ppm[visitno == 2]
t = -1.1703, df = 11, p-value = 0.2666

95 percent confidence interval:
 -334.6794  102.3161

mean of the differences
              -116.1817
```

There is no evidence that the mean Mg ppm of those plots measured during both visits was different (p-value = 0.2666).

Table V-32. Mg ppm in all plots Summary Statistics

MG	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	163.987	908.427	402.297	30.424	339.201	465.392
2011-2014	251.928	1737.000	499.809	64.587	366.201	633.417

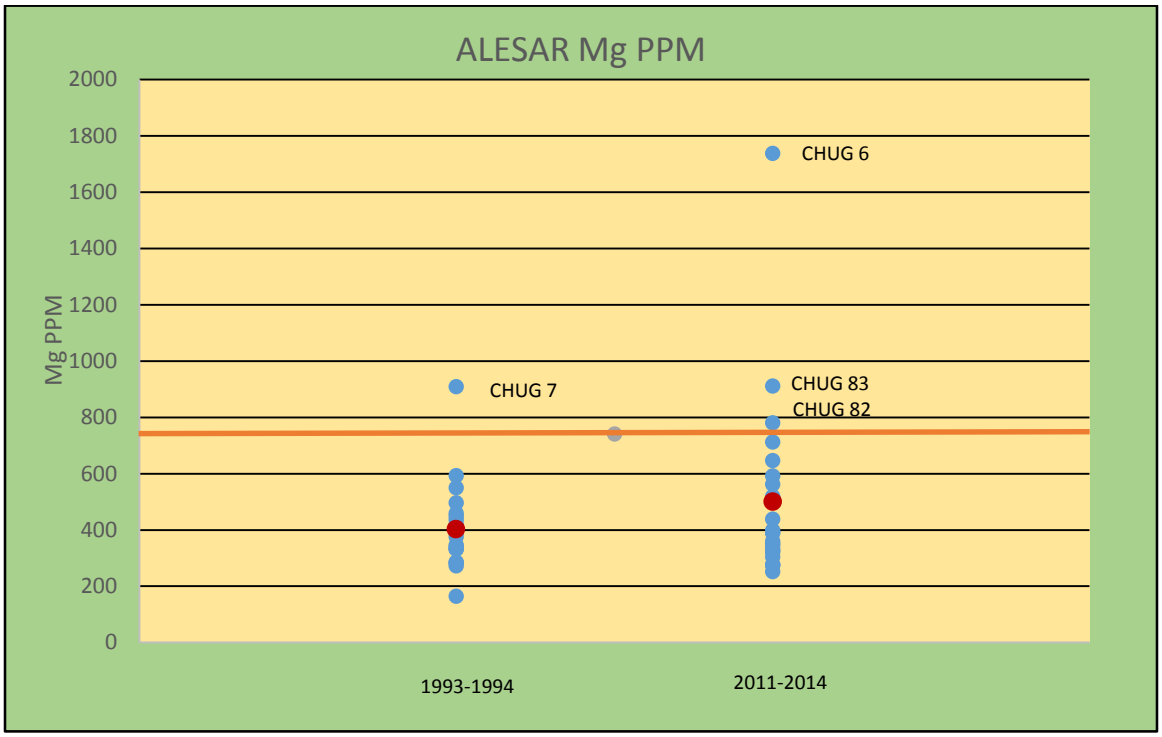

Figure V-16. Scatter plot of Mg ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mn ppm

Table V-33. Mn ppm in paired plots Summary Statistics

Mn	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	22.99	140.38	63.46	9.75	42.00	84.92
VISIT 2	34.23	1036.40	197.04	78.69	23.85	370.23

Paired t-test

```
data:  mn.ppm[visitno == 1] and mn.ppm[visitno == 2]
t = -1.6462, df = 11, p-value = 0.128

95 percent confidence interval:
 -312.17316   45.01558

mean of the differences
              -133.5788
```

There is no evidence that the mean Mn ppm of those plots measured during both visits was different (p-value = 0.1280).

Table V-34. Mn ppm in all plots Summary Statistics

MN	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	8.930	140.380	63.717	8.085	46.949	80.485
2011-2014	29.106	1036.400	152.401	40.769	68.064	236.739

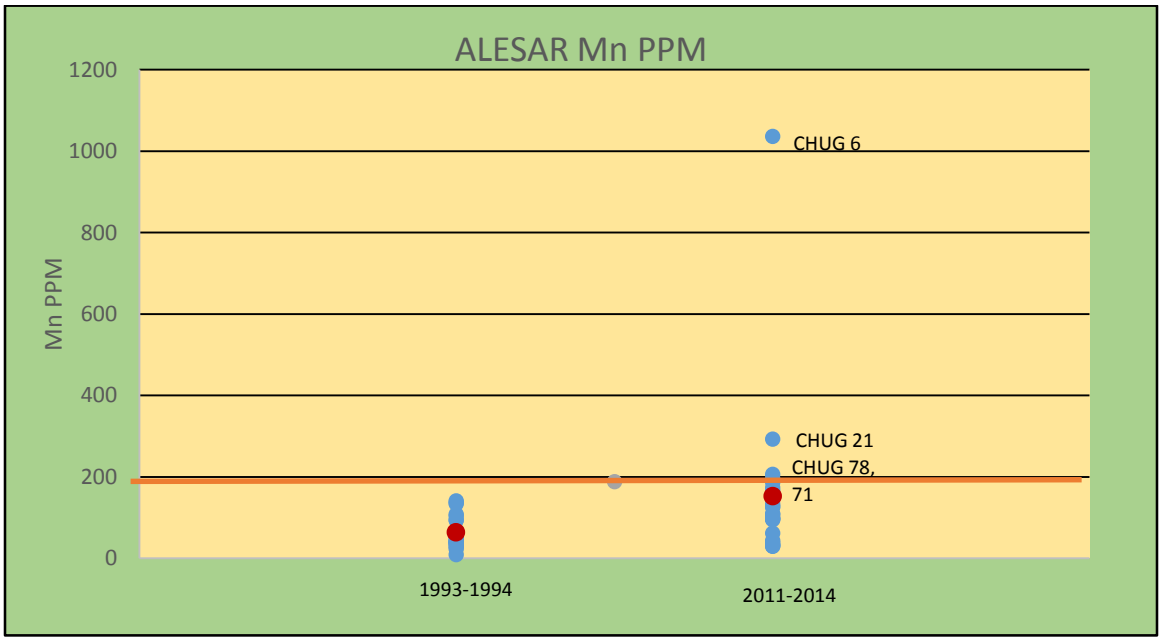

Figure V-17. Scatter plot of Mn ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mo ppm

Table V-35. Mo ppm in paired plots Summary Statistics

Mo	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	NA	NA	NA	NA	NA	NA

Paired t-test

No test, no paired plot data.

Table V-36. Mo ppm in all plots Summary Statistics

MO	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.001	0.452	0.051	0.022	0.006	0.097

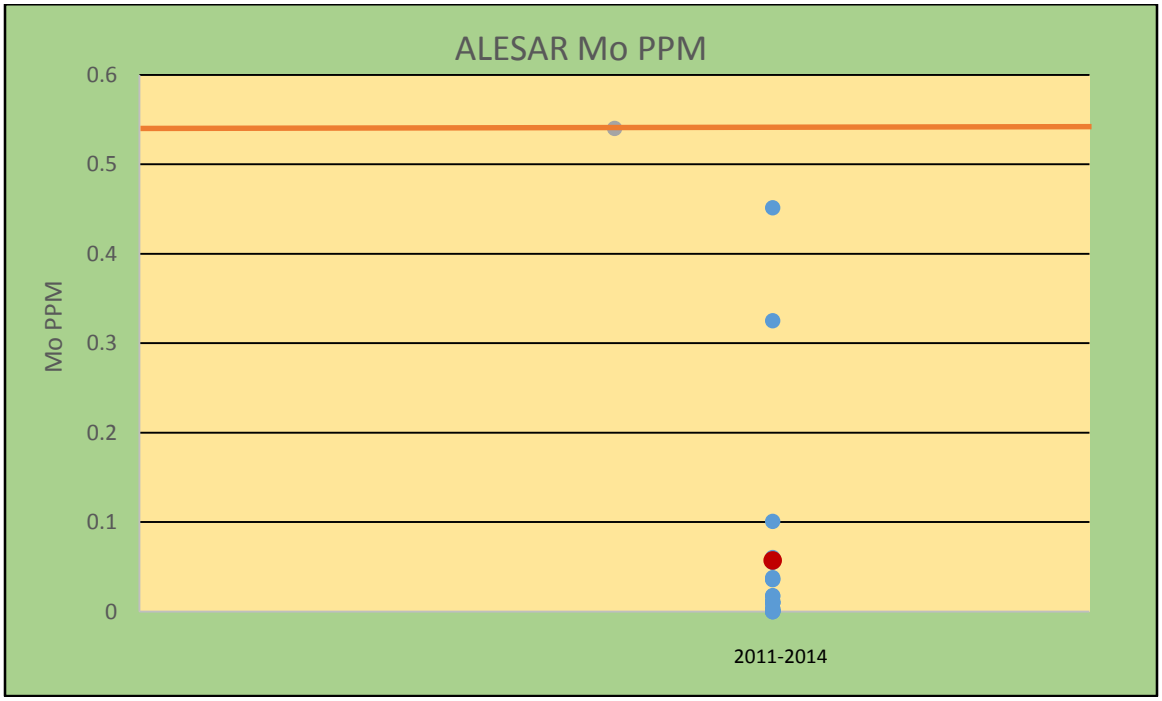

Figure V-18. Scatter plot of Mo ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Na ppm

Table V-37. Na ppm in paired plots Summary Statistics

Na	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	105.99	501.82	208.32	32.89	135.92	280.71
VISIT 2	3.51	356.77	115.00	28.62	52.01	177.99

Paired t-test

```
data:  na.ppm[visitno == 1] and na.ppm[visitno == 2]
t = 3.3686, df = 11, p-value = 0.006268

95 percent confidence interval:
  32.34601 154.29177

mean of the differences
               93.31889
```

There is evidence that the mean Na ppm of those plots measured during both visits was higher during Visit 1 (p-value = 0.0.0063).

Table V-38. Na ppm in all plots Summary Statistics

NA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	60.993	811.840	229.702	33.519	160.187	299.216
2011-2014	0.180	356.770	116.196	18.108	78.736	153.655

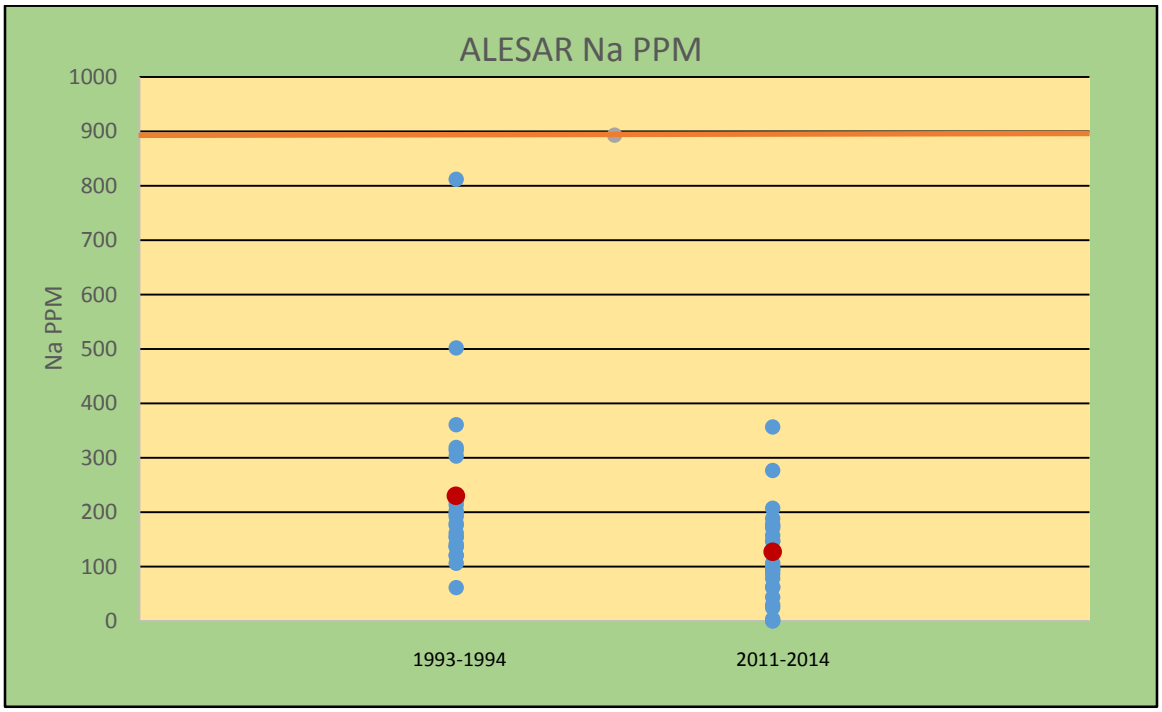

Figure V-19. Scatter plot of Na ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ni ppm

Table V-39. Ni ppm in paired plots Summary Statistics

Ni	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	0.35	1.59	0.79	0.11	0.55	1.03
VISIT 2	0.04	0.36	0.21	0.03	0.15	0.28

Paired t-test

```
data:  ni.ppm[visitno == 1] and ni.ppm[visitno == 2]
t = 5.2112, df = 11, p-value = 0.0002894

95 percent confidence interval:
 0.3333635 0.8208541

mean of the differences
              0.5771088
```

There is evidence that the mean Ni ppm of those plots measured during both visits was higher during Visit 1 (p-value = 0.0003).

Table V-40. Ni ppm in all plots Summary Statistics

NI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	0.250	1.587	0.744	0.074	0.590	0.898
2011-2014	0.036	11.035	0.796	0.468	0.000	1.767

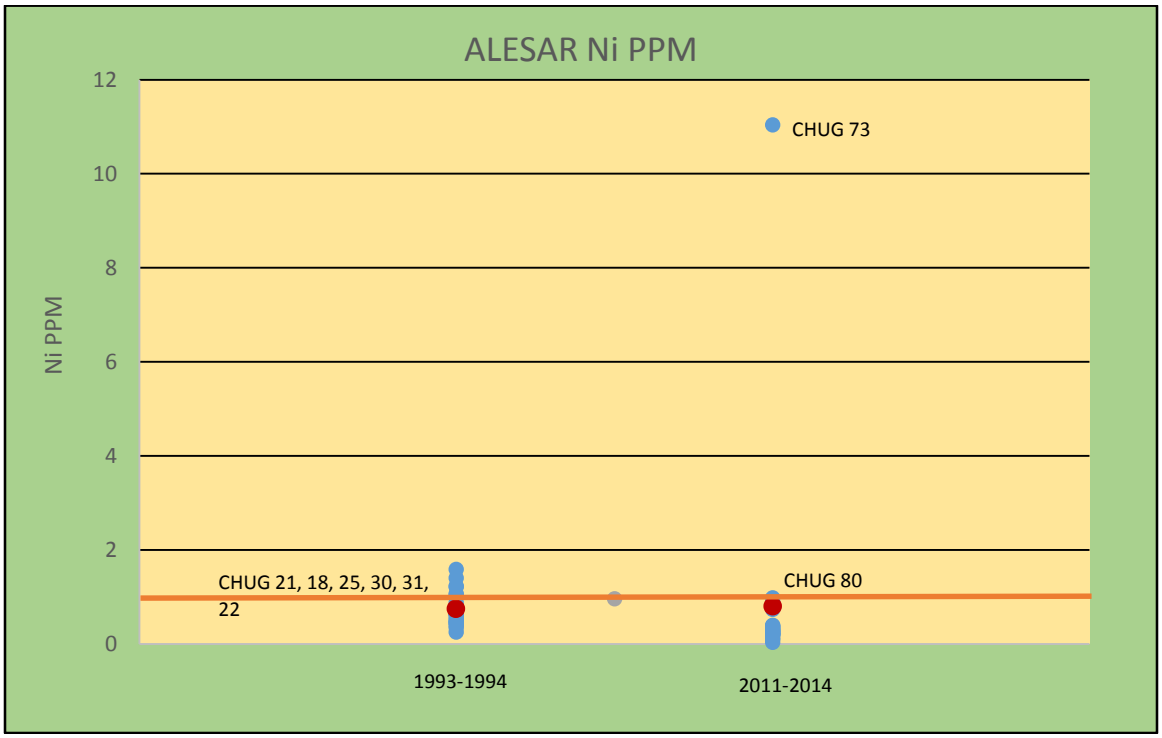

Figure V-20. Scatter plot of Ni ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

P ppm

Table V-41. P ppm in paired plots Summary Statistics

P	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	150.57	896.31	441.53	63.11	302.62	580.45
VISIT 2	207.37	965.63	507.66	71.76	349.73	665.60

Paired t-test

```
data:  p.ppm[visitno == 1] and p.ppm[visitno == 2]
t = -1.4007, df = 11, p-value = 0.1889

95 percent confidence interval:
 -170.04118   37.78474

mean of the differences
              -66.12822
```

There is no evidence that the mean P ppm of those plots measured during both visits was different (p-value = 0.1889).

Table V-42. P ppm in all plots Summary Statistics

P	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	140.070	961.340	442.213	48.525	341.578	542.847
2011-2014	207.370	1373.050	534.042	57.717	414.646	653.439

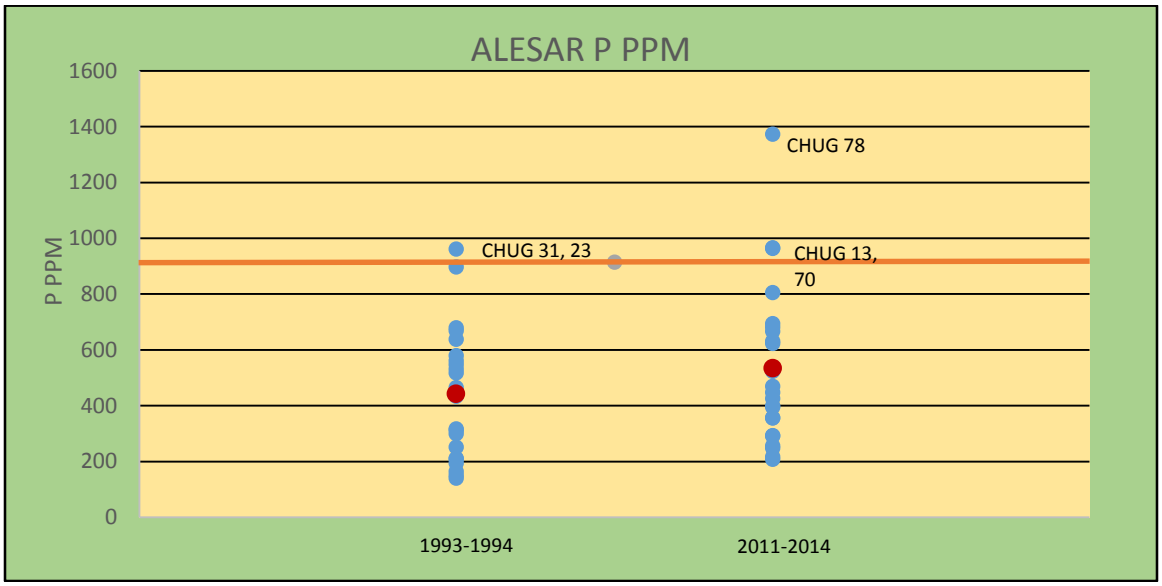

Figure V-21. Scatter plot of P ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Pb ppm

Table V-43. Pb ppm in paired plots Summary Statistics

Pb	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	0.86	3.79	2.56	0.27	1.97	3.15
VISIT 2	0.35	1.83	0.90	0.13	0.61	1.18

Paired t-test

```
data:  pb.ppm[visitno == 1] and pb.ppm[visitno == 2]
t = 6.9589, df = 11, p-value = 2.395e-05

95 percent confidence interval:
 1.138286 2.191418

mean of the differences
               1.664852
```

There is evidence that the mean Pb ppm of those plots measured during both visits was higher during Visit 1 (p-value < 0.0001).

Table V-44. Pb ppm in all plots Summary Statistics

PB	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	0.860	3.787	2.463	0.169	2.114	2.813
2011-2014	0.259	2.382	0.871	0.101	0.662	1.080

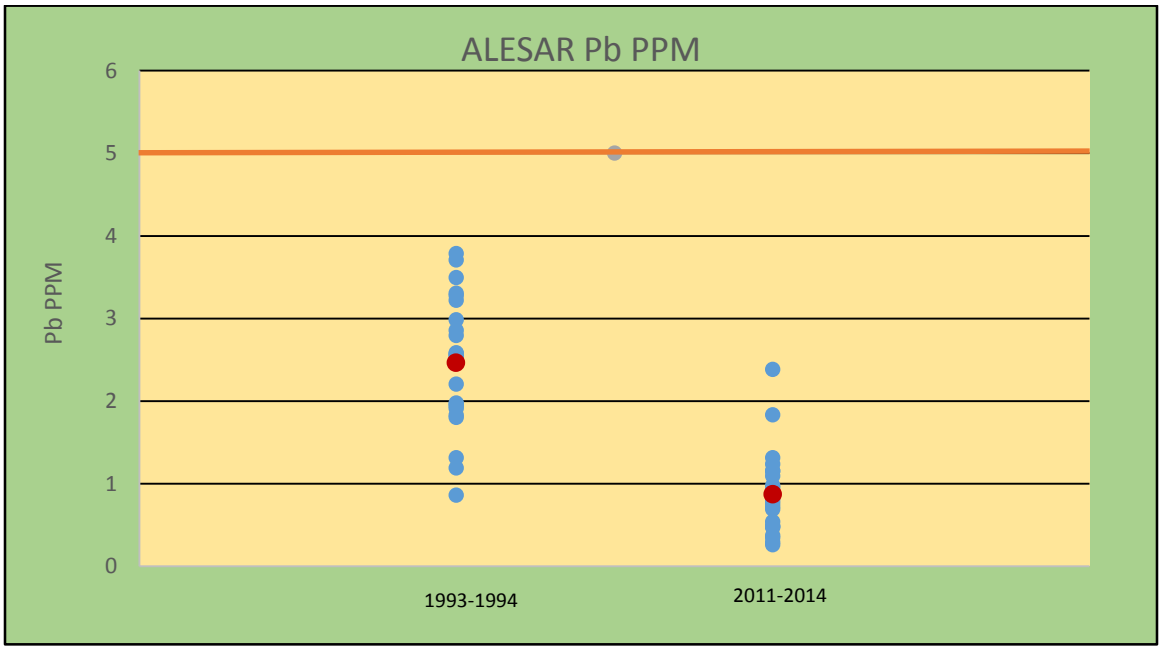

Figure V-22. Scatter plot of Pb ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Rb ppm

Table V-45. Rb ppm in paired plots Summary Statistics

Rb	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	13.61	383.50	86.32	43.53	0.00	189.25

Paired t-test

No test, no paired plot data

Table V-46. Rb ppm in all plots Summary Statistics

RB	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	10.176	383.500	66.629	27.302	7.144	126.114

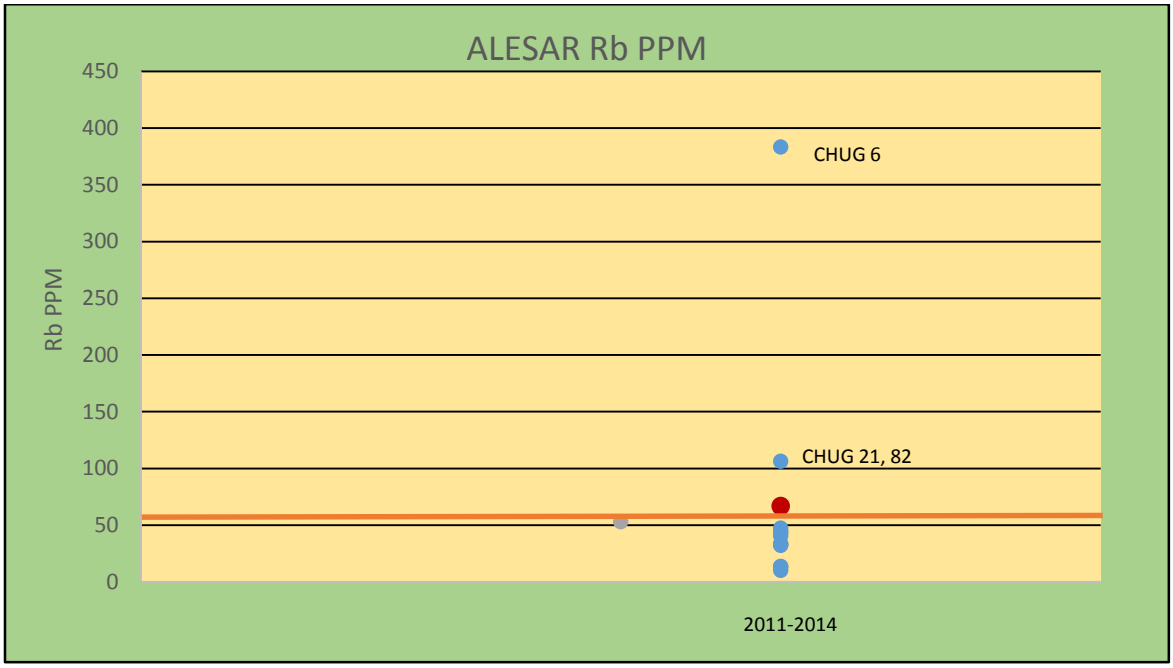

Figure V-23. Scatter plot of Rb ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Si ppm

Table V-47. Si ppm in paired plots Summary Statistics

Si	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	15.50	126.00	55.48	8.57	36.62	74.34

Paired t-test

No test, no paired plot data.

Table V-48. Si ppm in all plots Summary Statistics

SI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	15.500	275.000	86.868	14.976	55.889	117.848

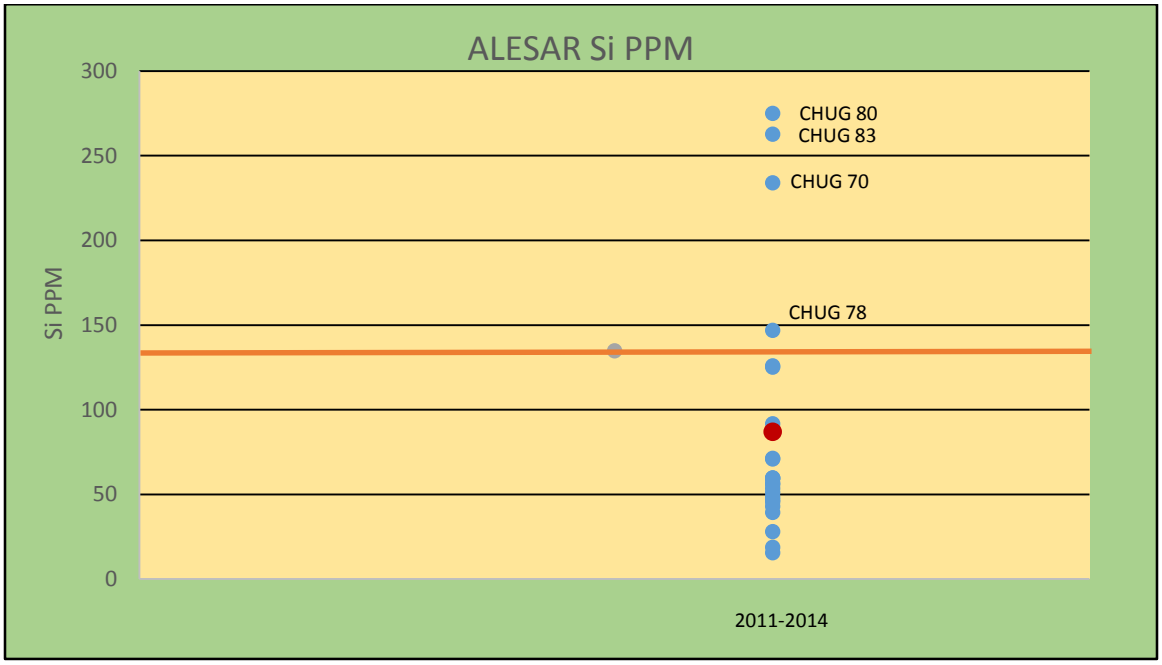

Figure V-24. Scatter plot of Si ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Sr ppm

Table V-49. Sr ppm in paired plots Summary Statistics

Sr	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	6.43	35.70	16.29	3.58	7.81	24.76

Paired t-test

No test, no paired plot data.

Table V-50. Sr ppm in all plots Summary Statistics

SR	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	6.430	35.700	16.691	2.550	11.134	22.248

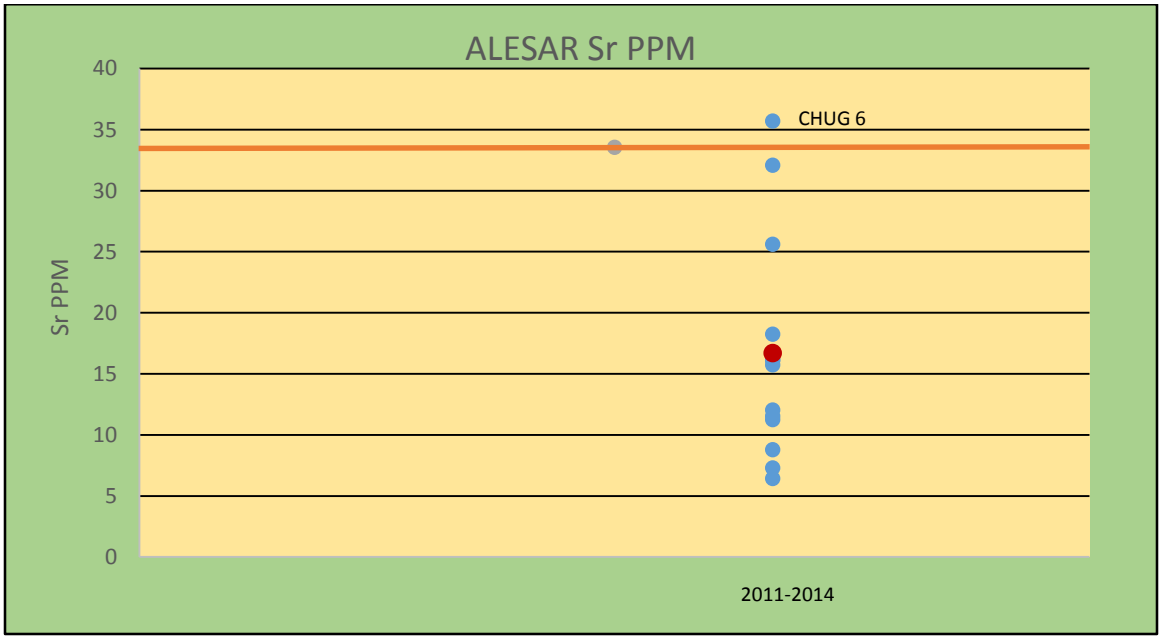

Figure V-25. Scatter plot of Sr ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ti ppm

Table V-51. Ti ppm in paired plots Summary Statistics

Ti	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	0.53	4.93	1.80	0.35	1.03	2.57

Paired t-test

```
No test, no paired plot data.3
```

Table V-52. Ti ppm in all plots Summary Statistics

TI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.532	15.541	3.659	0.875	1.850	5.469

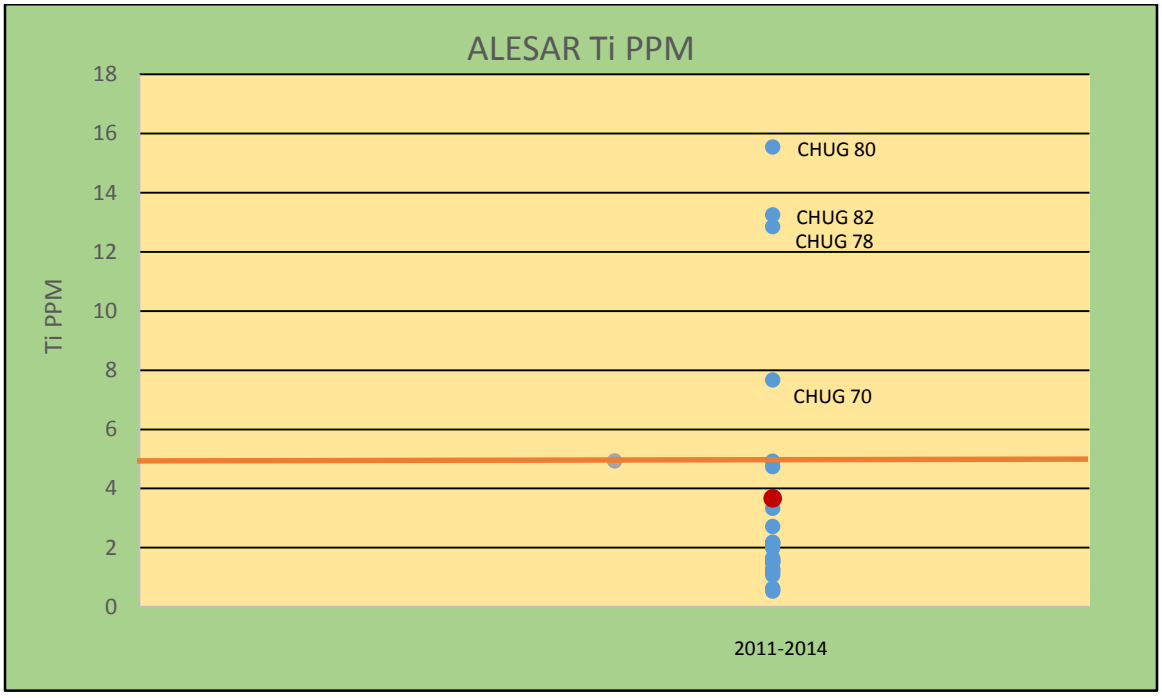

Figure V-26. Scatter plot of Ti ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

V ppm

Table V-53. V ppm in paired plots Summary Statistics

V	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	NA	NA	NA	NA	NA	NA
VISIT 2	0.010	0.760	0.160	0.060	0.040	0.280

Paired t-test

No test, no paired plot data.

Table V-54. V ppm in all plots Summary Statistics

V	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	NA	NA	NA	NA	NA	NA
2011-2014	0.010	1.003	0.213	0.052	0.105	0.322

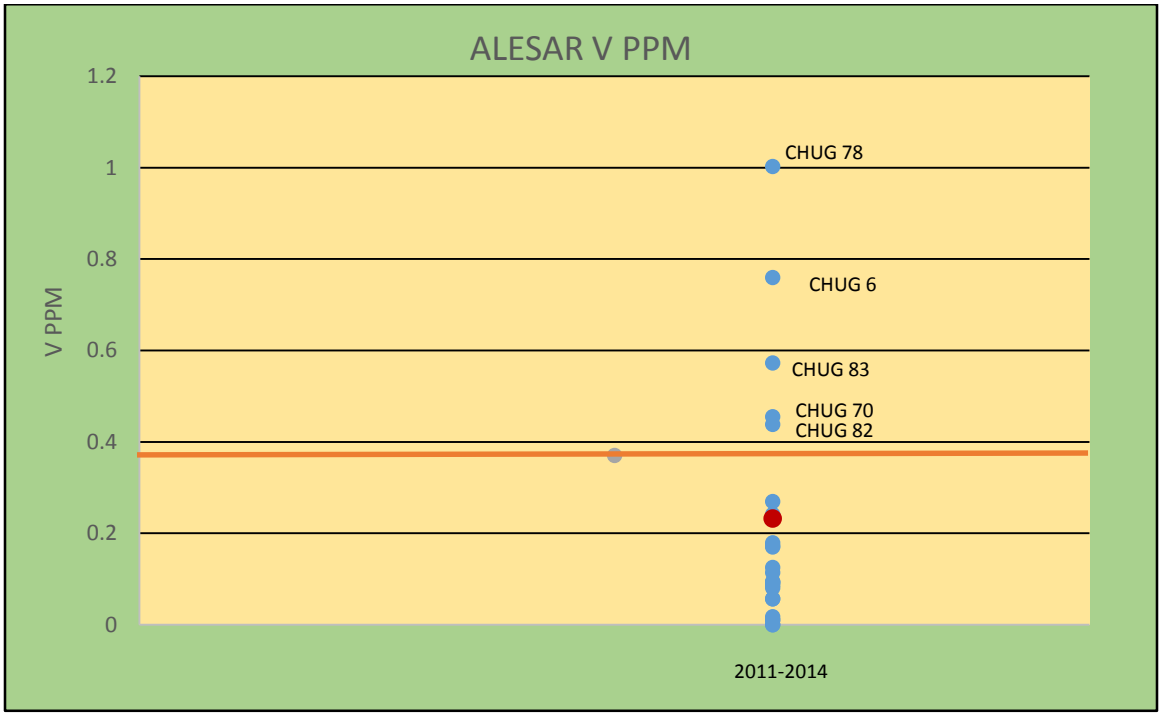

Figure V-27. Scatter plot of V ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Zn ppm

Table V-55. Zn ppm in paired plots Summary Statistics

Zn	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
VISIT 1	16.35	35.50	22.86	1.45	19.67	26.05
VISIT 2	12.35	53.63	26.48	3.30	19.23	33.74

Paired t-test

```
data:  zn.ppm[visitno == 1] and zn.ppm[visitno == 2]
t = -0.9976, df = 11, p-value = 0.3399

95 percent confidence interval:
 -11.618509   4.371399

mean of the differences
              -3.623555
```

There is no that the mean Zn ppm of those plots measured during both visits was different (p-value = 0.3399).

Table V-56. Zn ppm in all plots Summary Statistics

ZN	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI Upper
1993-1994	14.323	39.855	23.280	1.353	20.475	26.085
2011-2014	12.331	53.634	26.470	2.001	22.330	30.609

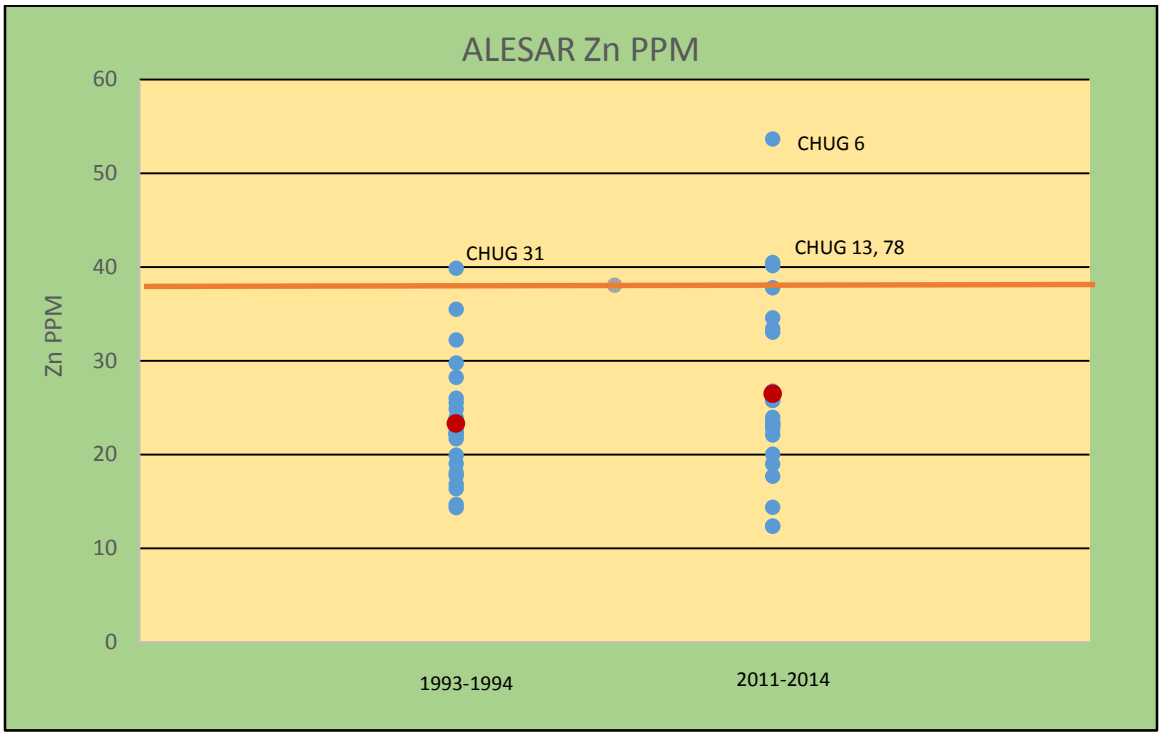

Figure V-28. Scatter plot of Zn ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

VI. SUMMARY OF LOBARIA OREGANA DATA ANALYSIS

Percent S

Table VI-1. Percent Sulfur ppm in all plots Summary Statistics

S	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	0.110	0.141	0.128	0.005	0.115	0.141

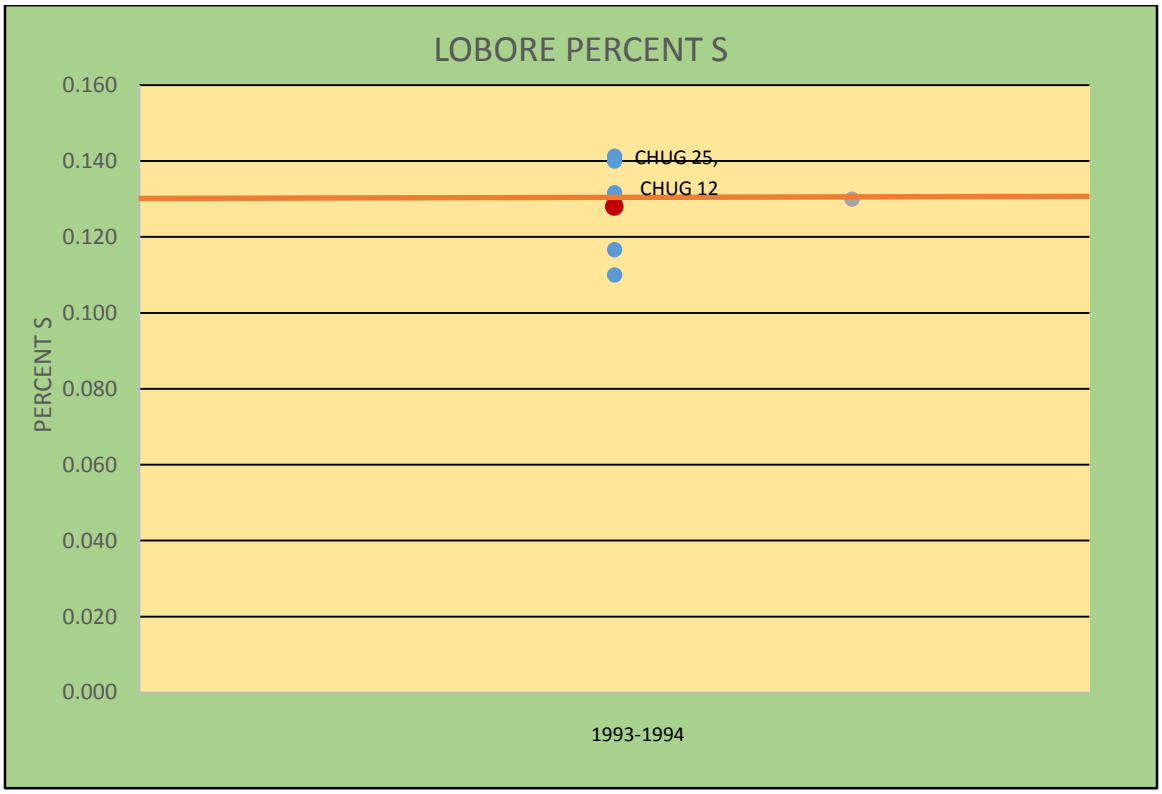

Figure VI-1. Scatter plot of Percent S on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Al ppm

Table VI-2. Al ppm in all plots Summary Statistics

AL	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	145.613	609.045	392.048	62.087	232.447	551.649

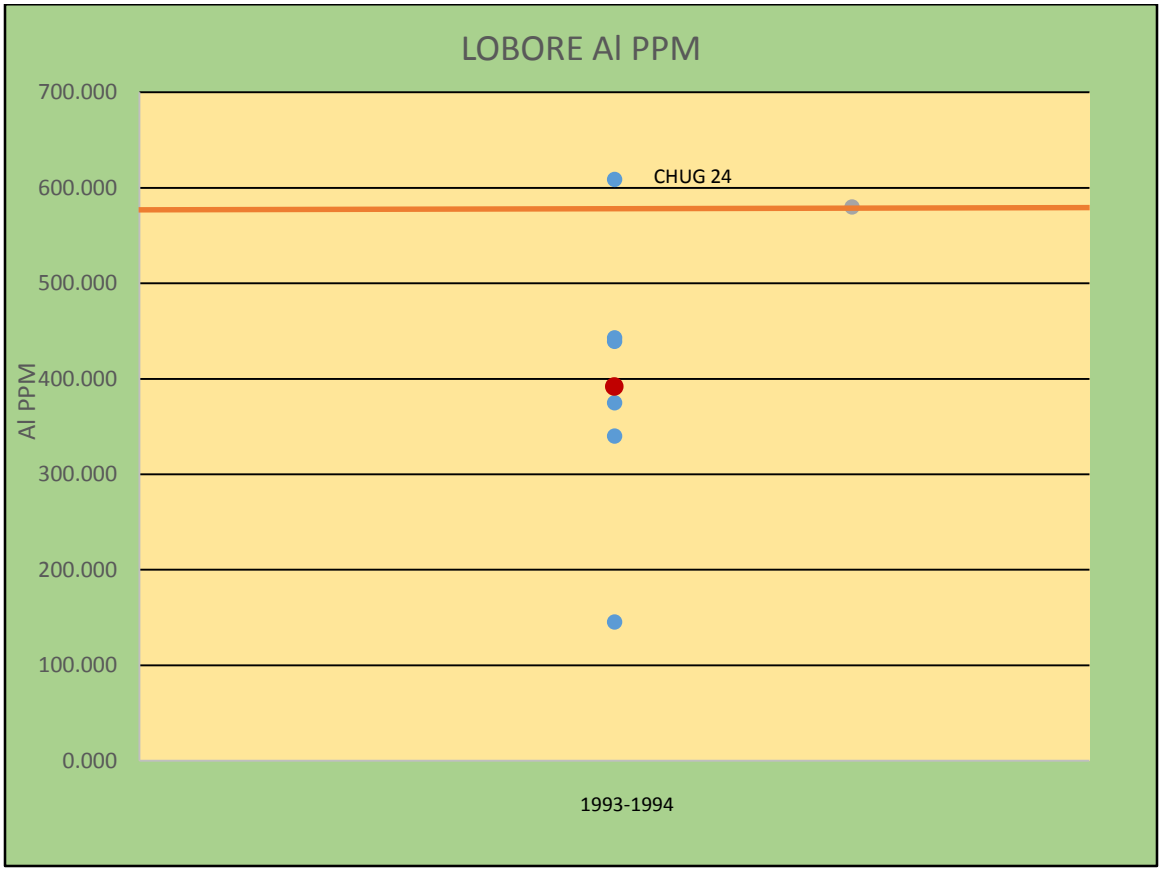

Figure VI-2. Scatter plot of Al ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

B ppm

Table VI-3. B ppm in all plots Summary Statistics

B	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	1.873	8.525	4.118	1.264	0.868	7.369

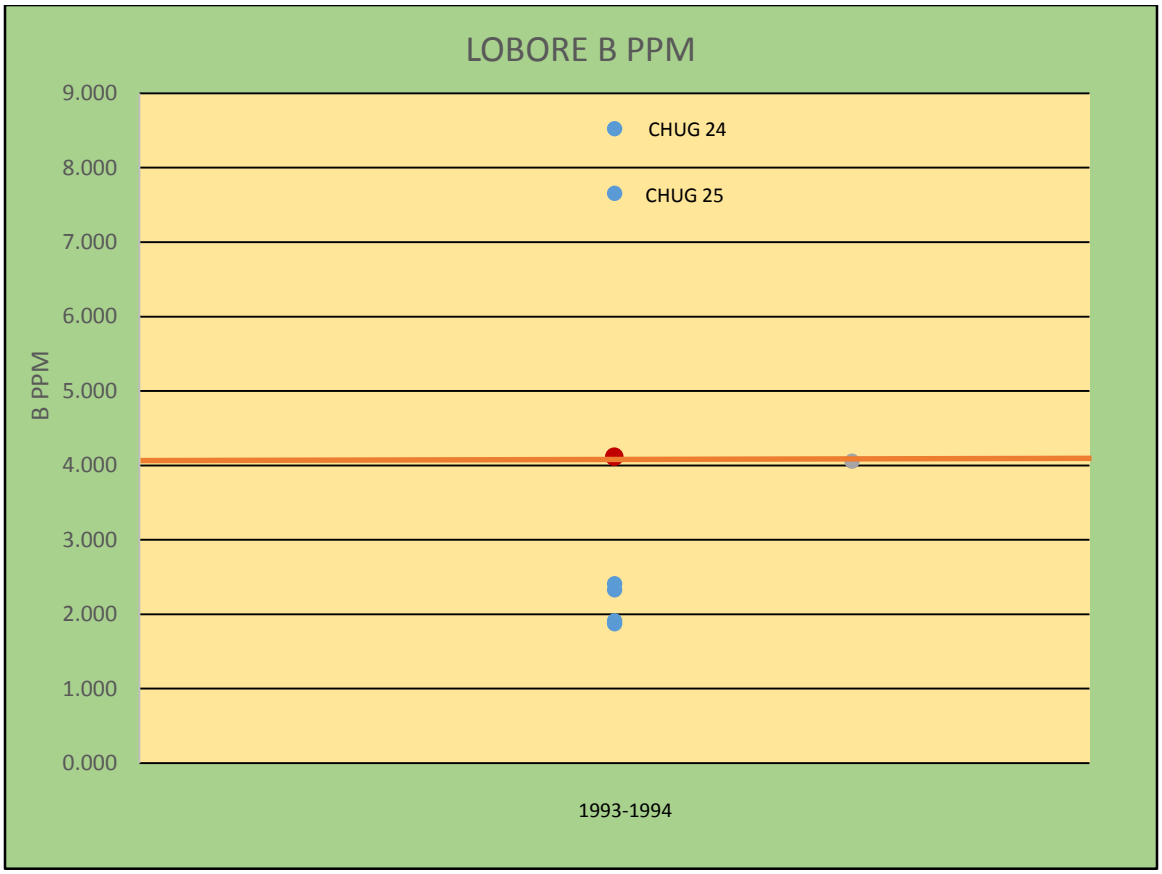

Figure VI-3. Scatter plot of B ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ca ppm

Table VI-4. Ca ppm in all plots Summary Statistics

CA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	467.557	1341.417	887.317	137.496	533.874	1240.761

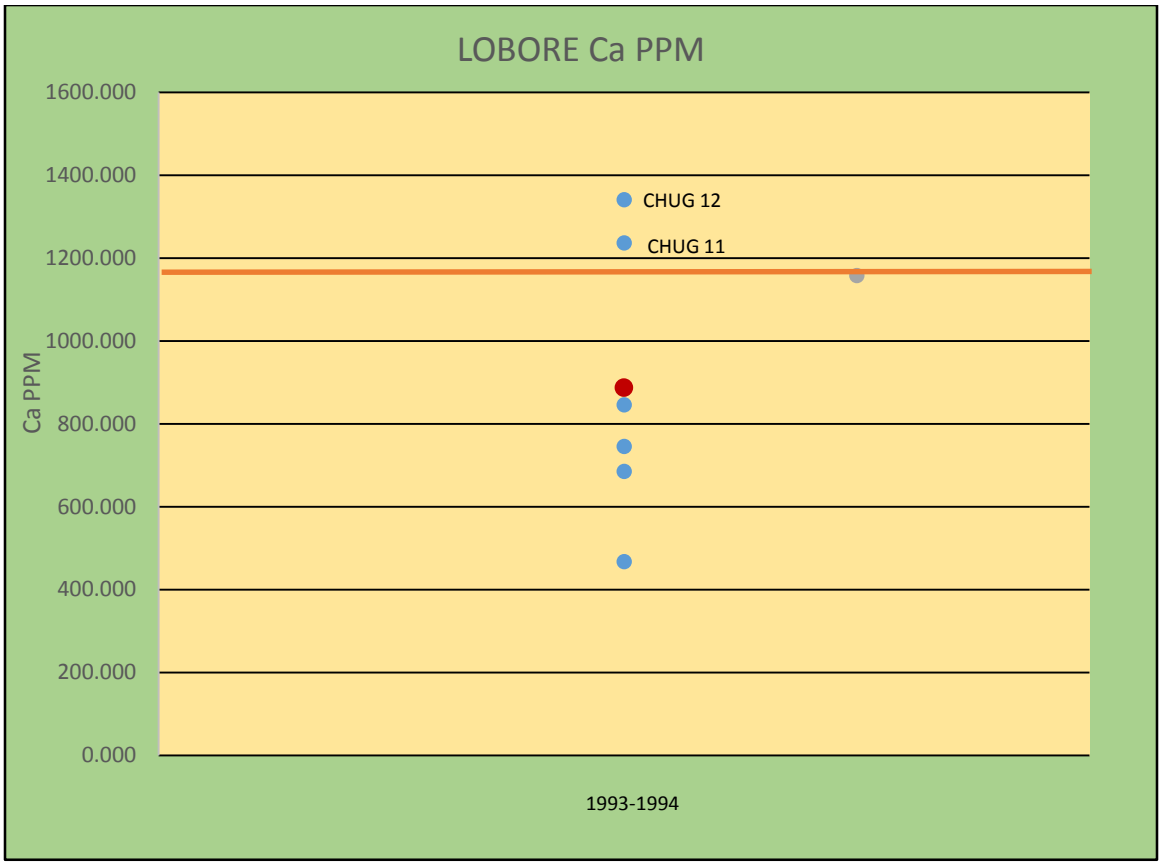

Figure VI-4. Scatter plot of Ca ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cd ppm

Table VI-5. Cd ppm in all plots Summary Statistics

CD	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	0.090	1.738	0.512	0.257	0.000	1.172

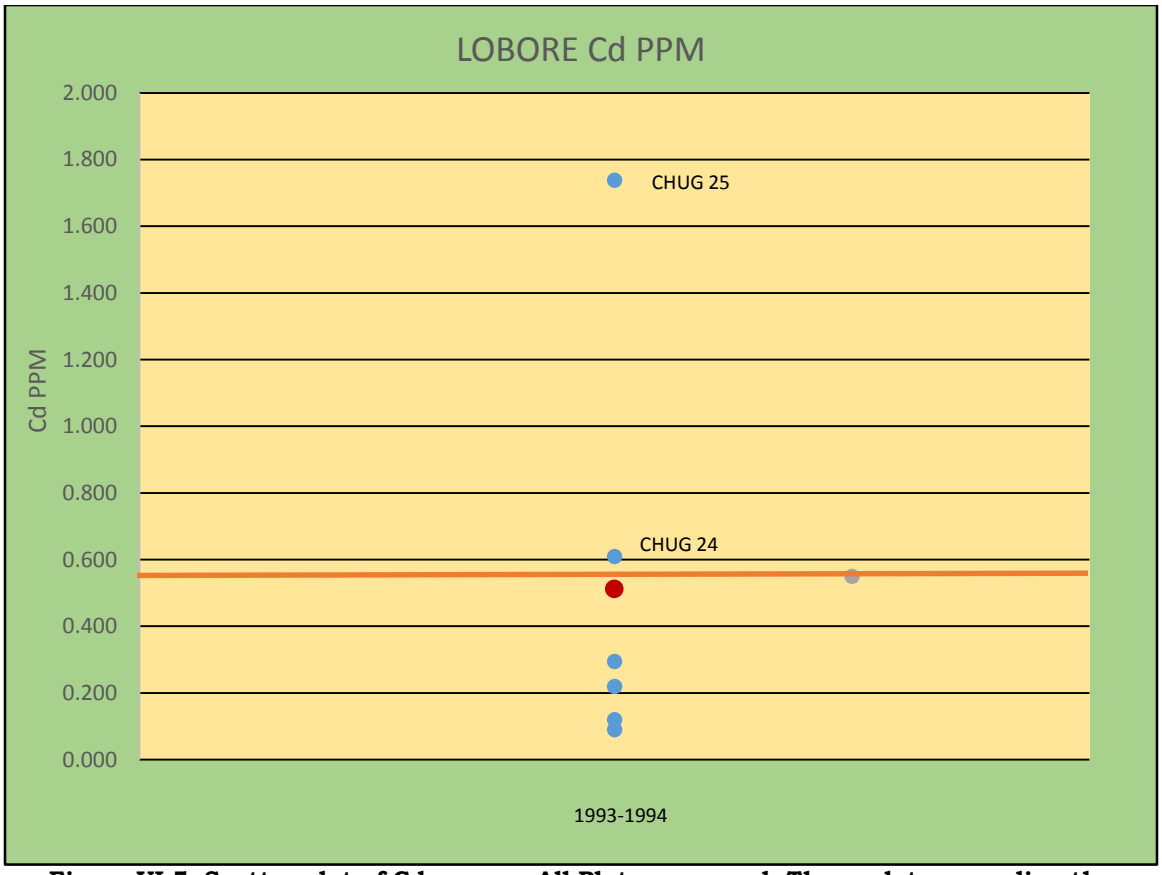

Figure VI-5. Scatter plot of Cd ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cr ppm

Table VI-6. Crn ppm in all plots Summary Statistics

CR	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	0.643	2.360	1.613	0.252	0.965	2.262

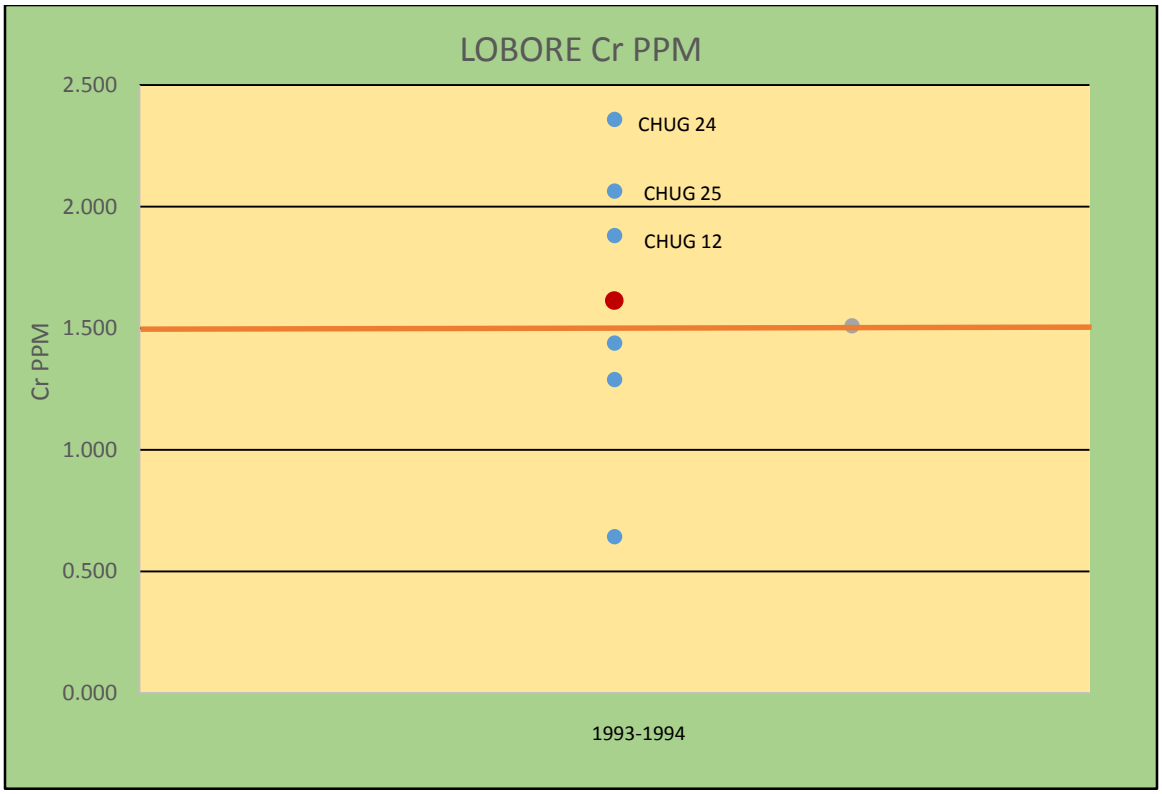

Figure VI-6. Scatter plot of Cr ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cu ppm

Table VI-7. Cu ppm in all plots Summary Statistics

CU	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	5.953	9.970	7.422	0.696	5.633	9.212

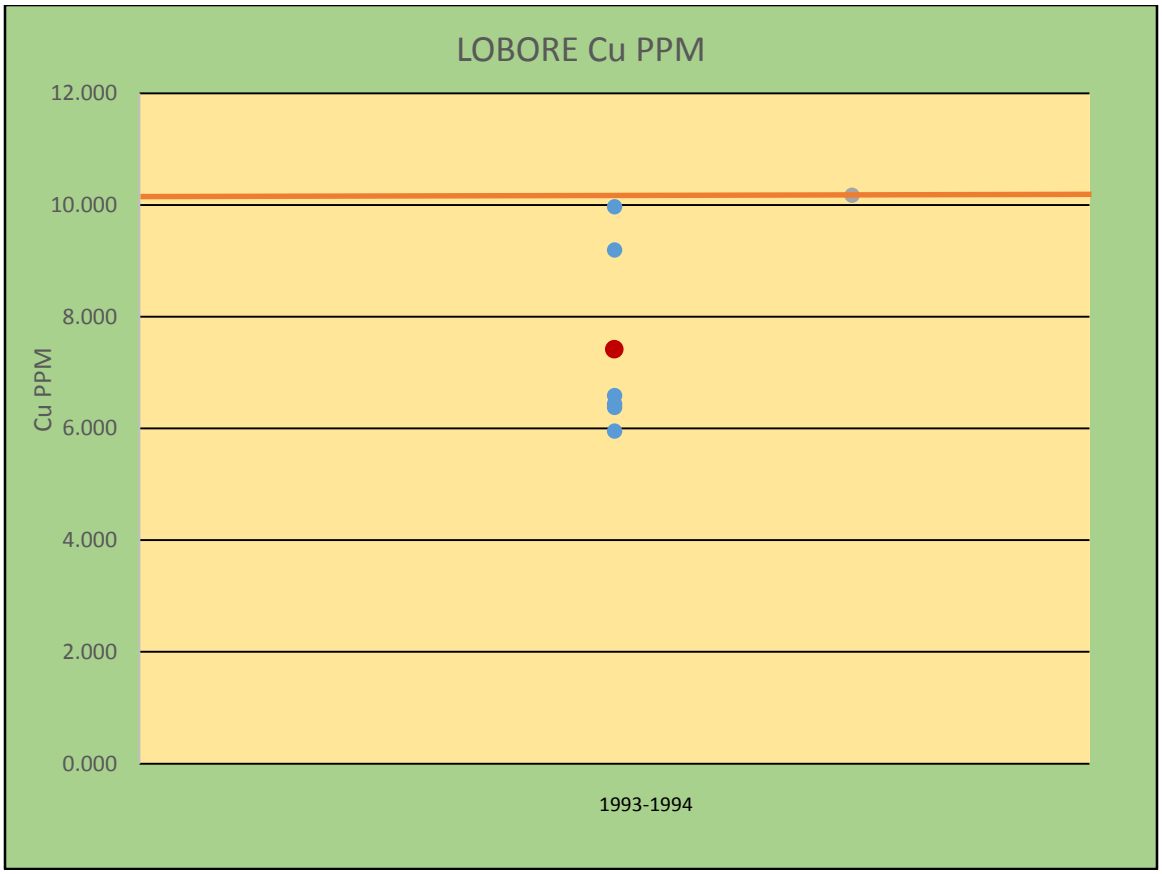

Figure VI-7. Scatter plot of Cu ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Fe ppm

Table VI-8. Fe ppm in all plots Summary Statistics

FE	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	231.257	630.179	450.574	67.503	277.053	624.095

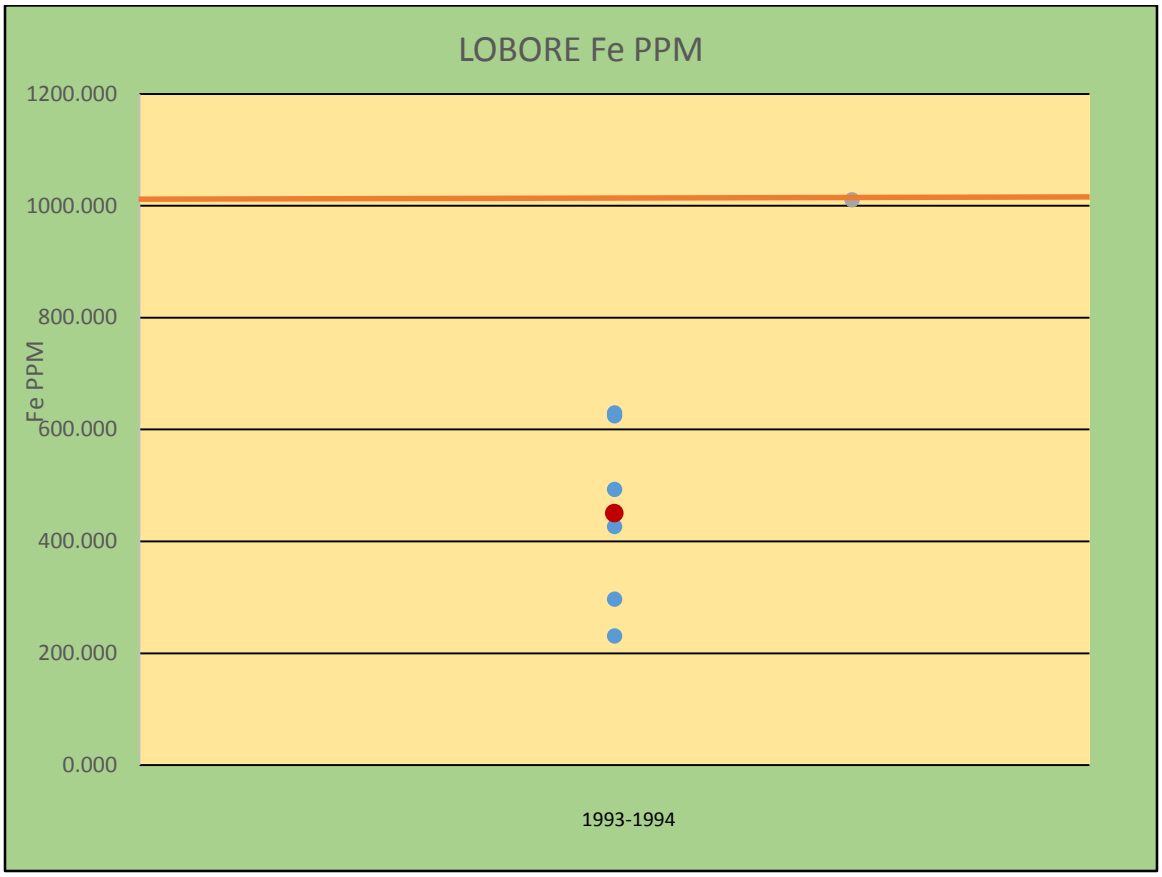

Figure VI-8. Scatter plot of Fe ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

K ppm

Table VI-9. K ppm in all plots Summary Statistics

K	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	4661.900	7645.600	6036.990	395.318	5020.793	7053.187

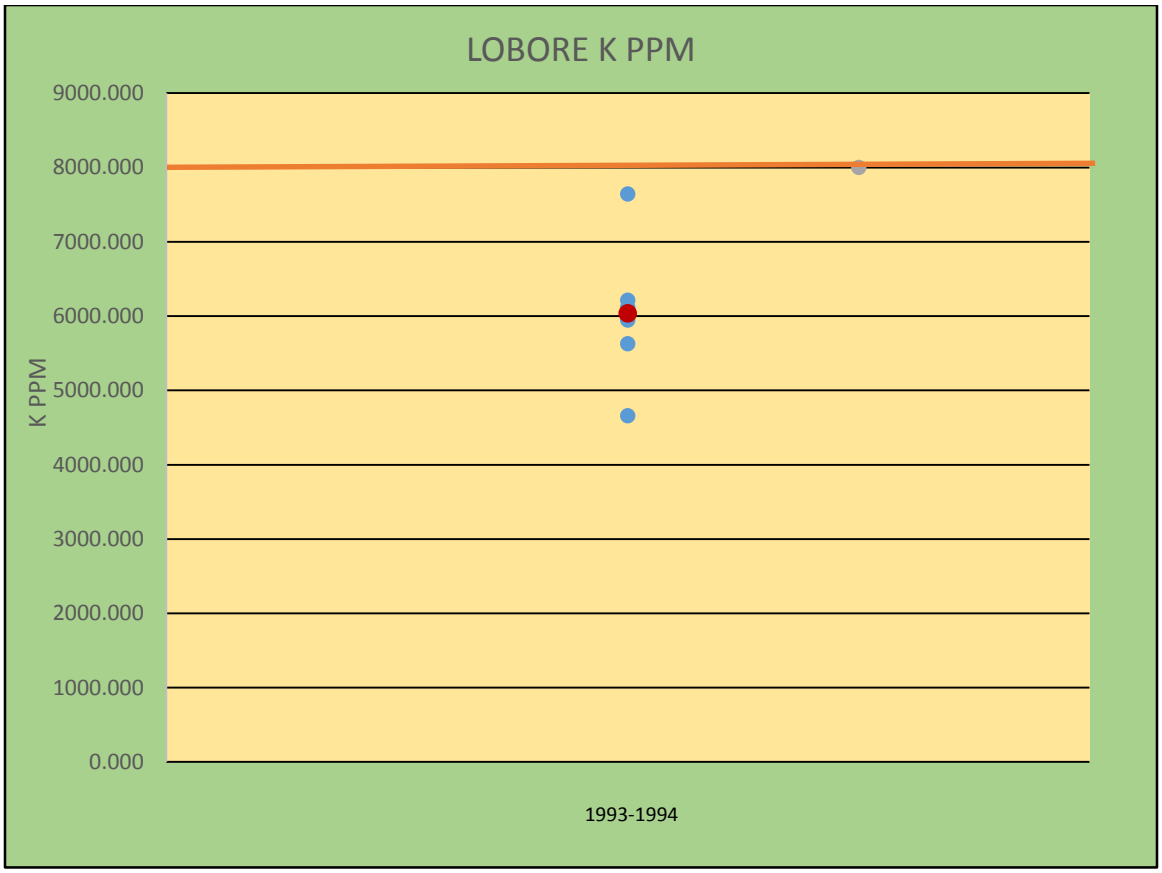

Figure VI-9. Scatter plot of K ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mg ppm

Table VI-10. Mg ppm in all plots Summary Statistics

MG	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	430.420	685.093	558.773	46.607	438.967	678.580

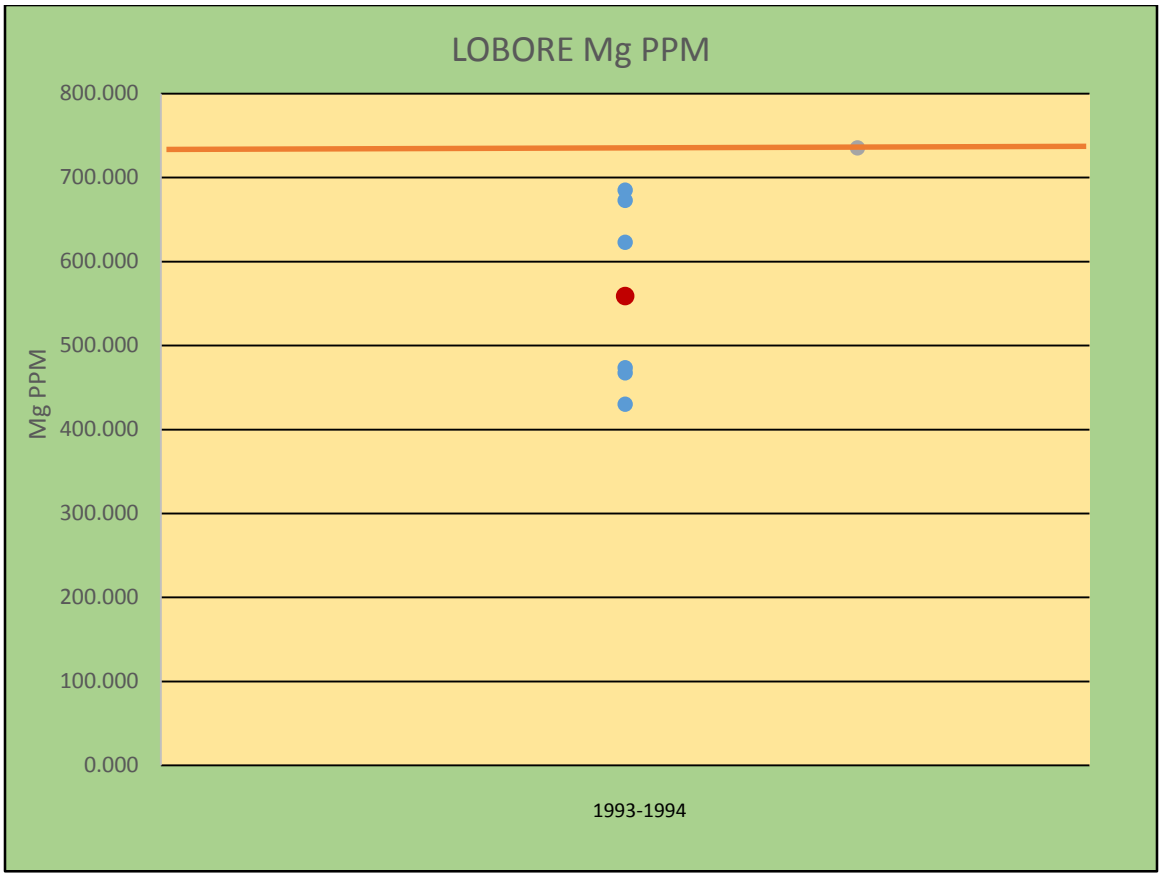

Figure VI-10. Scatter plot of Mg ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mn ppm

Table VI-11. Mn ppm in all plots Summary Statistics

MN	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	30.037	96.240	57.397	12.514	25.229	89.565

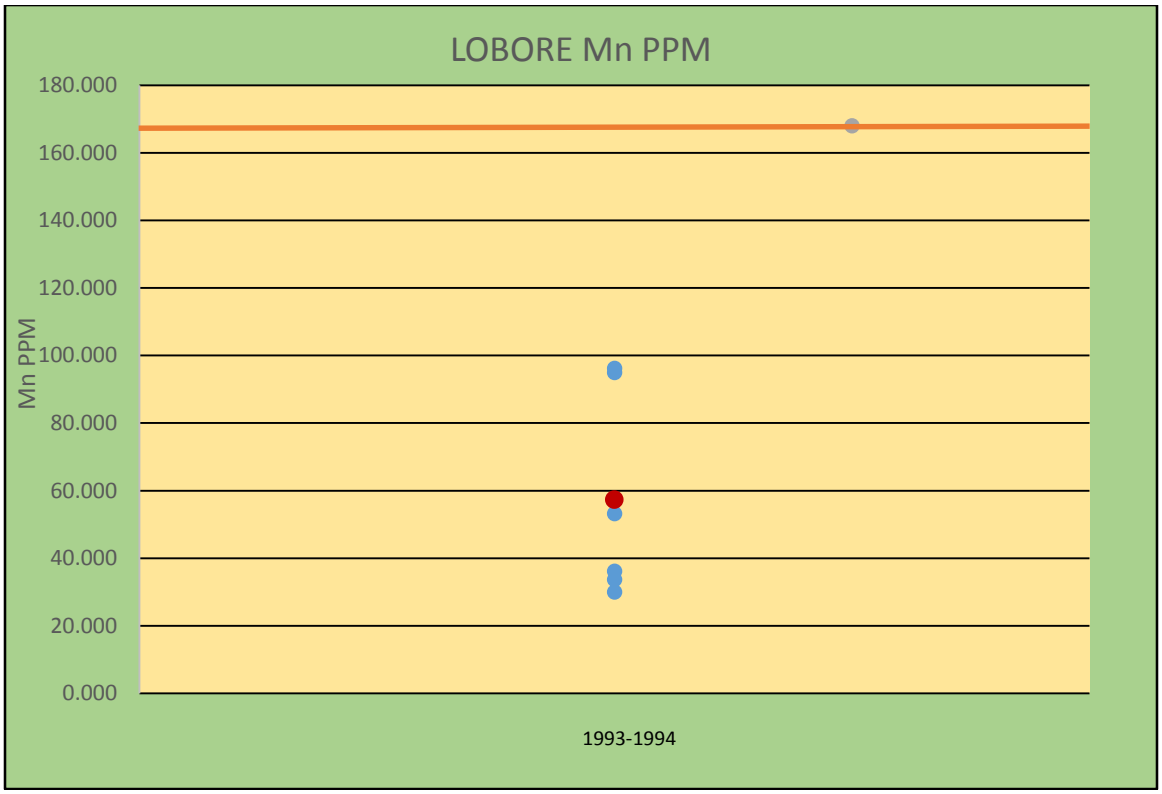

Figure VI-11. Scatter plot of Mn ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Na ppm

Table VI-12. Na ppm in all plots Summary Statistics

NA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	194.283	610.185	336.739	71.420	153.148	520.329

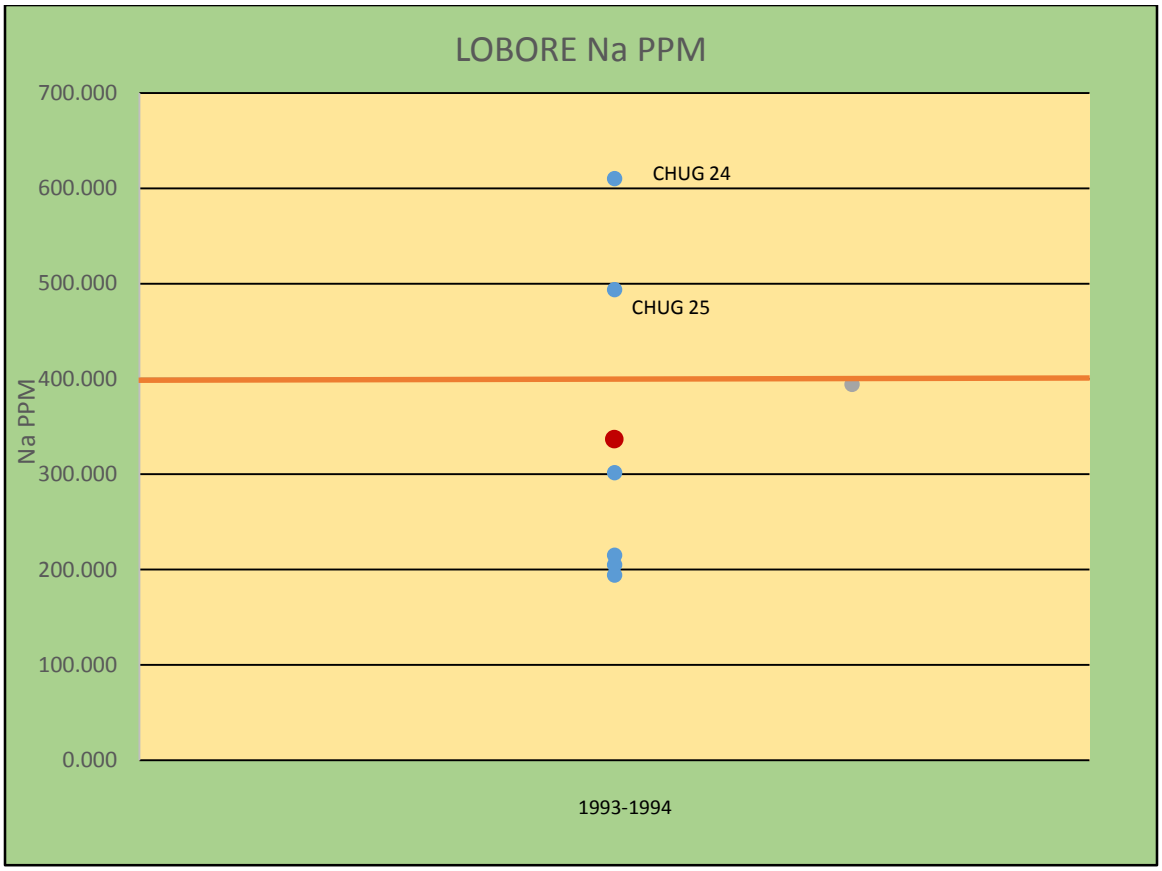

Figure VI-12. Scatter plot of Na ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ni ppm

Table VI-13. Ni ppm in all plots Summary Statistics

NI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	0.837	1.677	1.306	0.116	1.006	1.605

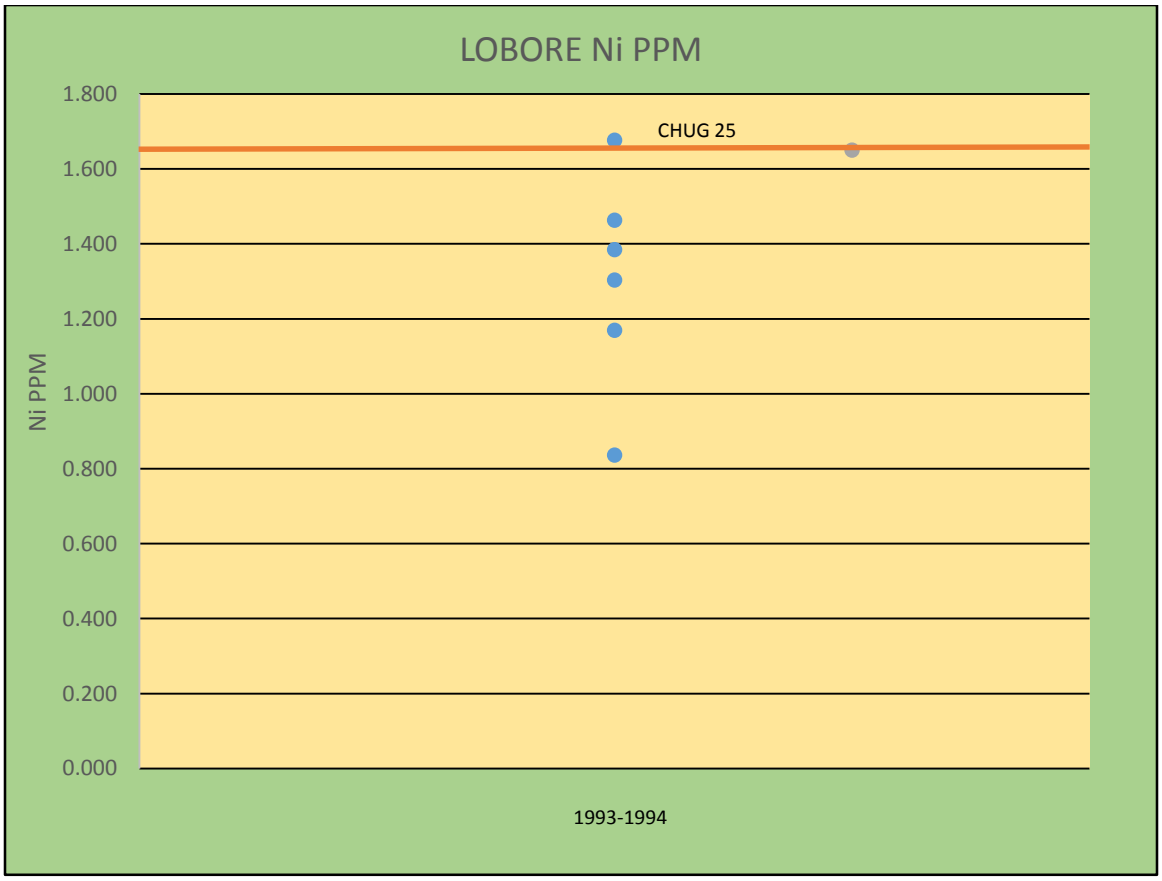

Figure VI-13. Scatter plot of Ni ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

P ppm

Table VI-14. P ppm in all plots Summary Statistics

P	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	1460.850	2824.467	1907.679	204.081	1383.071	2432.287

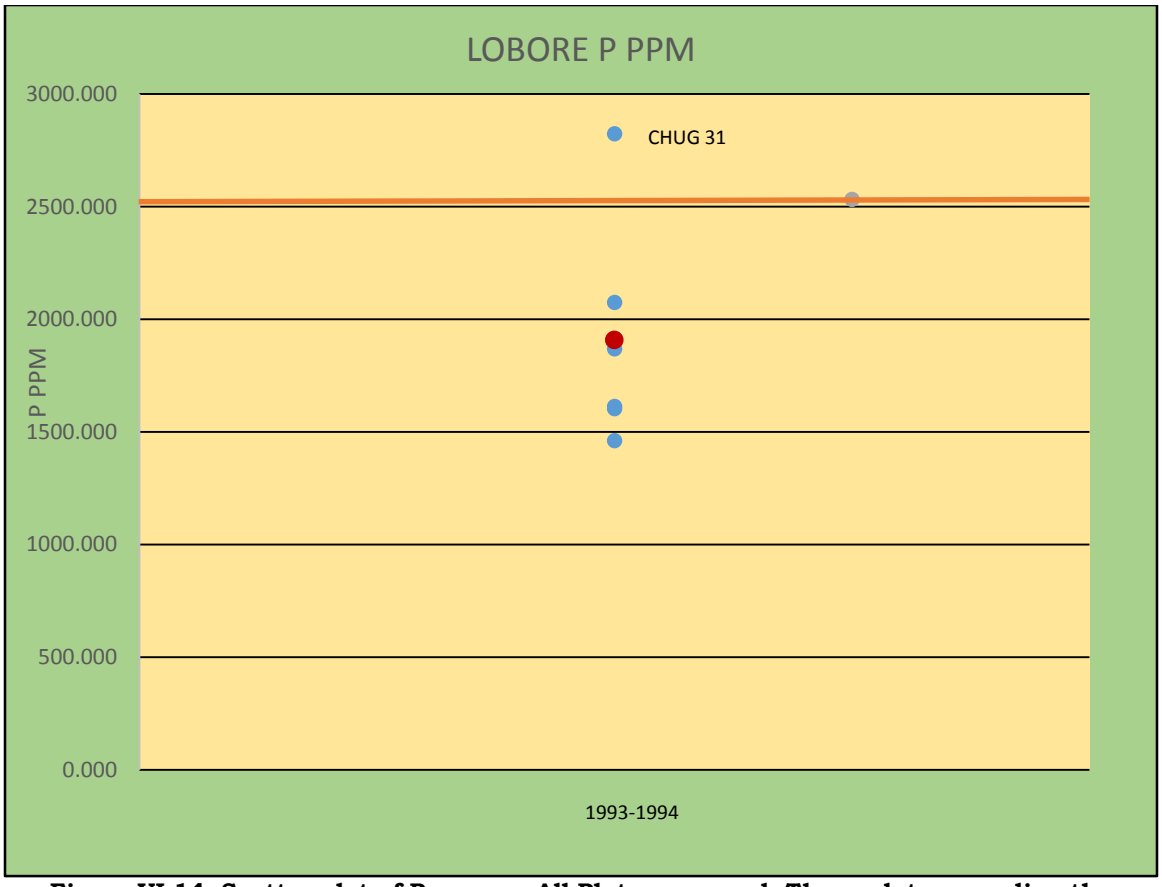

Figure VI-14. Scatter plot of P ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Pb ppm

Table VI-15. Pb ppm in all plots Summary Statistics

PB	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	0.840	1.680	1.224	0.148	0.844	1.604

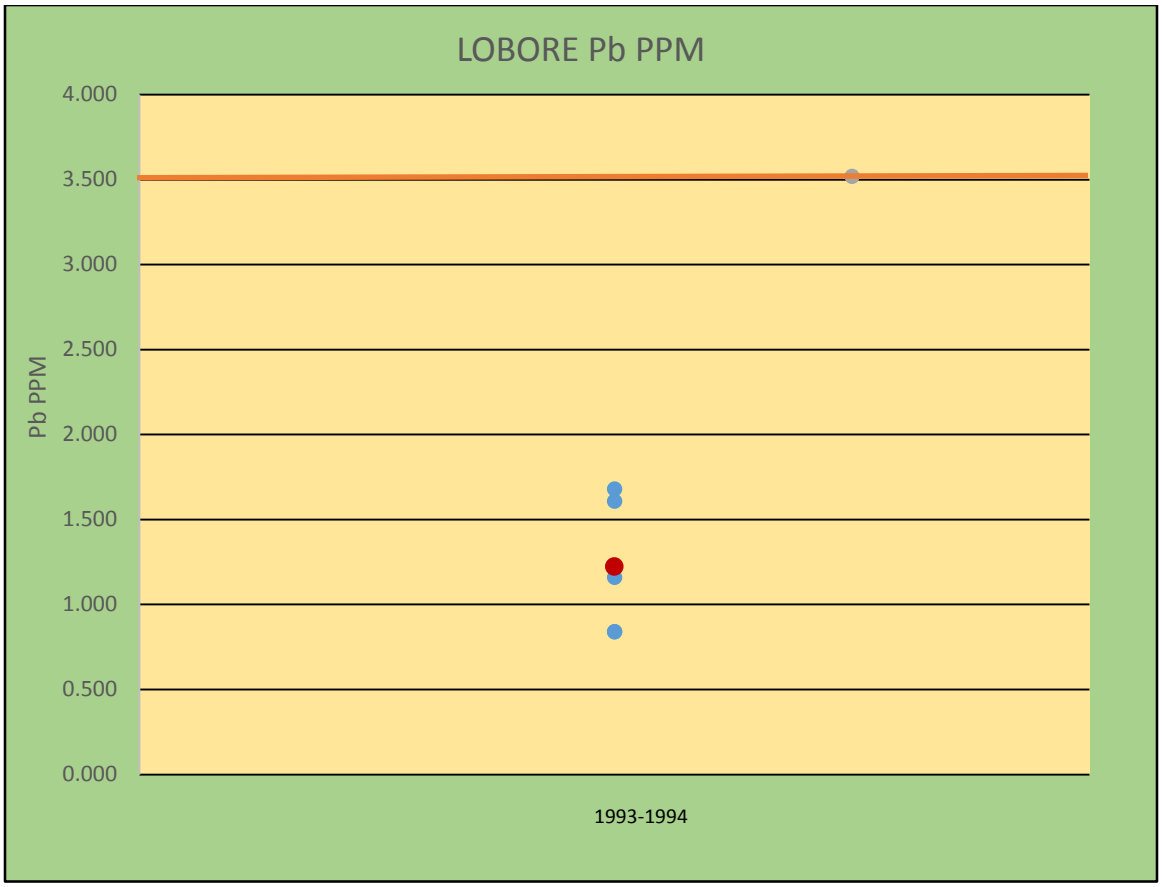

Figure VI-15. Scatter plot of Pb ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Zn ppm

Table VI-16. Zn ppm in all plots Summary Statistics

ZN	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
1993-1994	40.145	67.555	54.675	4.548	42.983	66.367

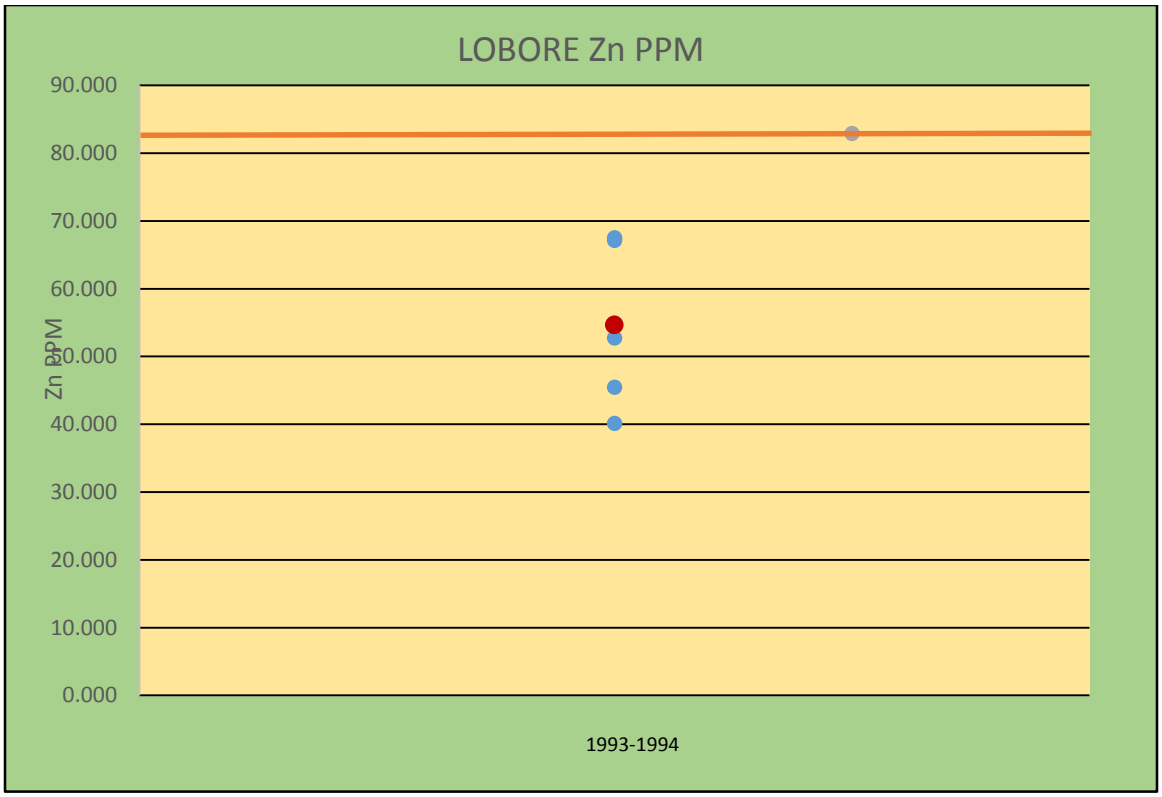

Figure VI-16. Scatter plot of Zn ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

VII. SUMMARY OF PLATISMATIA GLAUCA DATA ANALYSIS

PERCENT S

Table VII-1. Percent Sulfur in all plots Summary Statistics

S	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.014	0.068	0.050	0.003	0.044	0.056

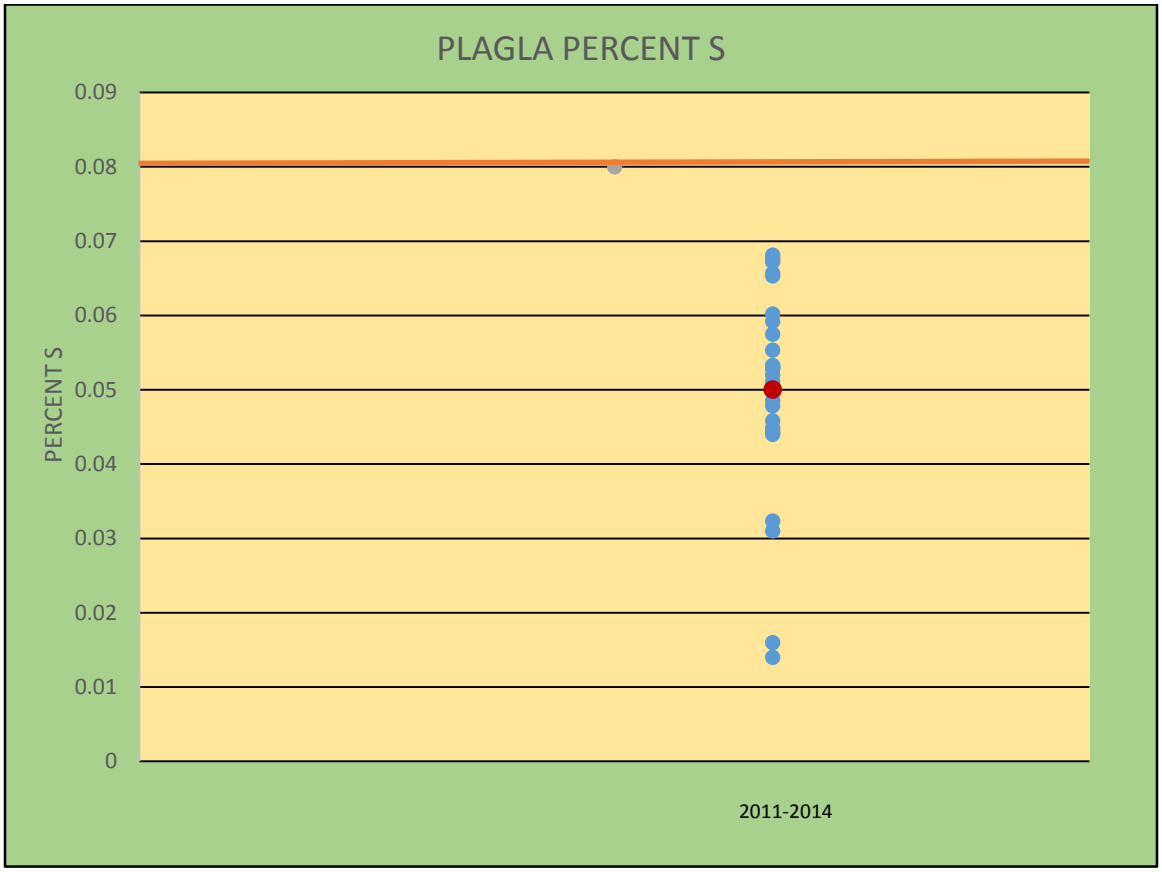

Figure VII-1. Scatter plot of Percent S on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

PERCENT N

Table VII-2. Percent Nitrogen in all plots Summary Statistics

N	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.238	0.692	0.514	0.024	0.466	0.563

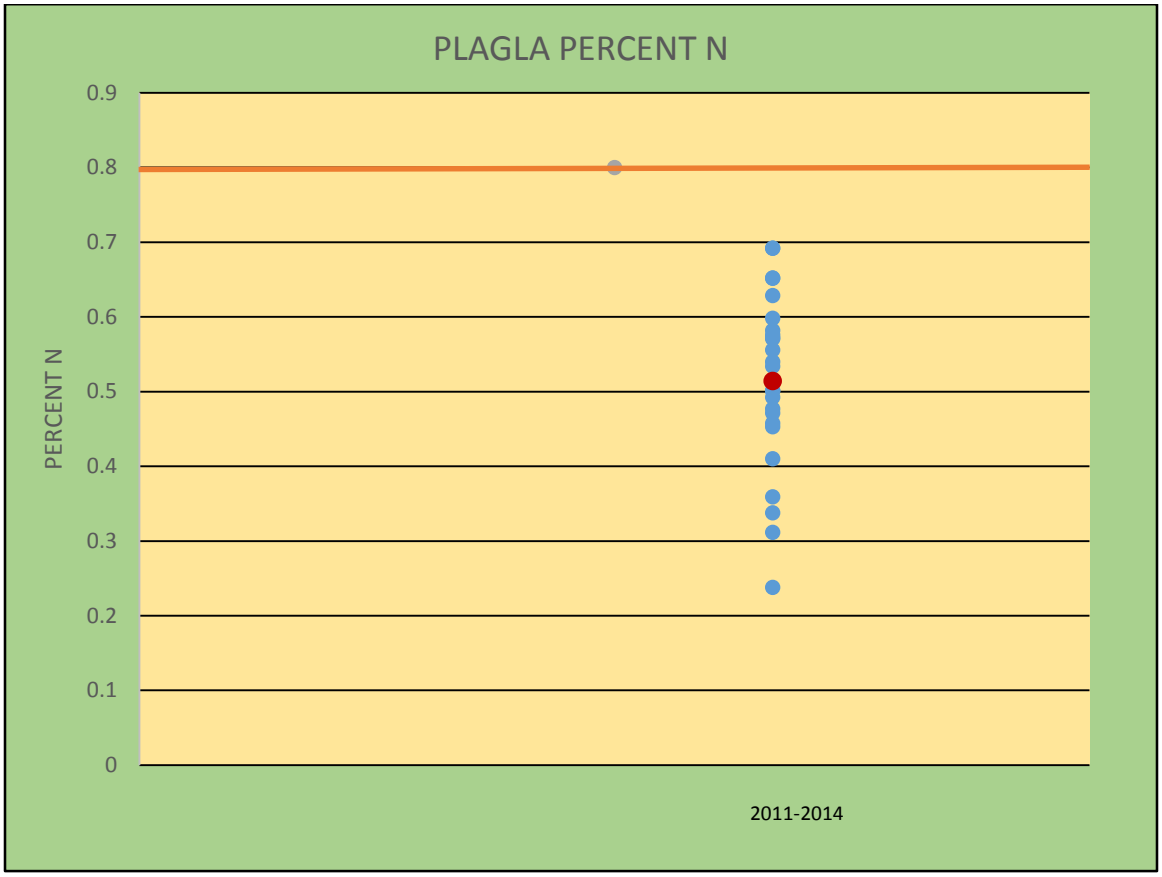

Figure VII-2. Scatter plot of Percent N on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Al ppm

Table VII-3. Al ppm in all plots Summary Statistics

AL	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	11.550	1156.000	562.922	67.465	423.682	702.162

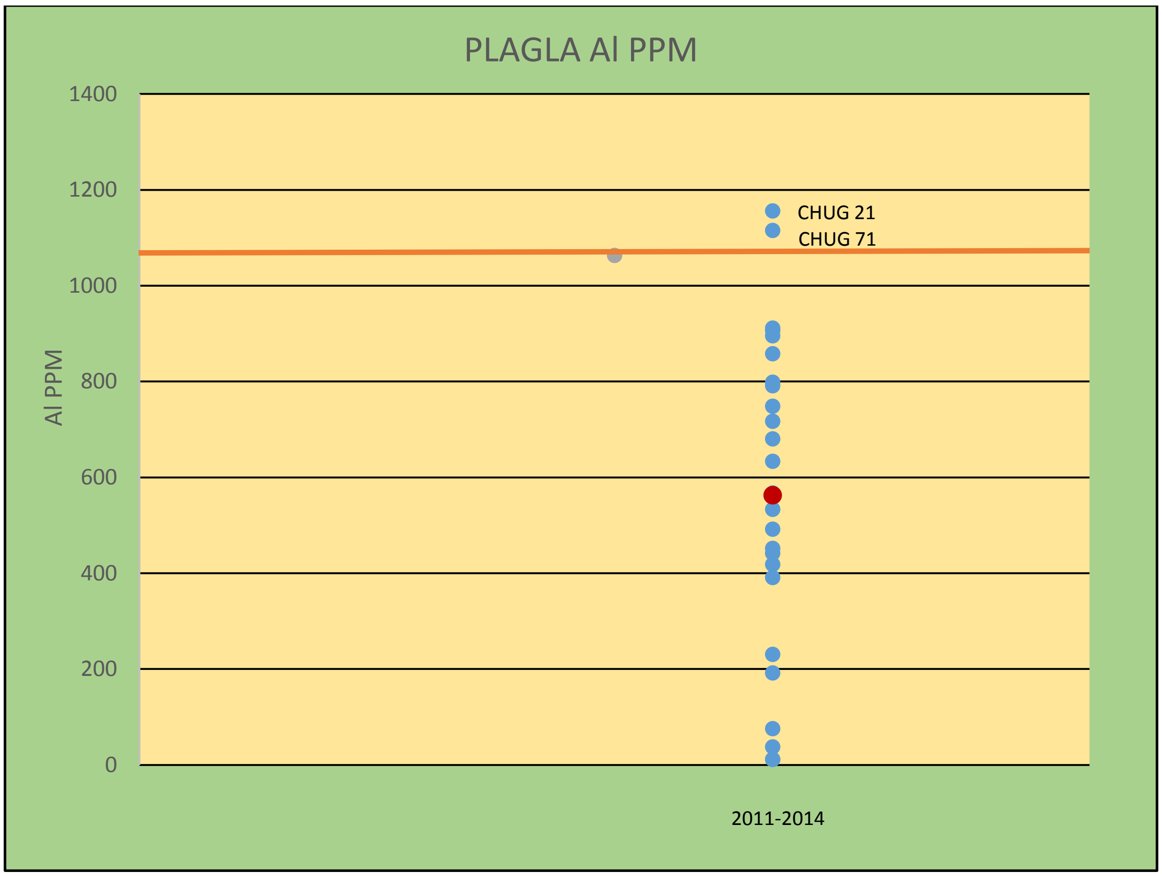

Figure VII-3. Scatter plot of Al ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ars ppm

Table VII-4. Ars ppm in all plots Summary Statistics

ARS	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	1.191	1.972	1.536	0.079	1.361	1.711

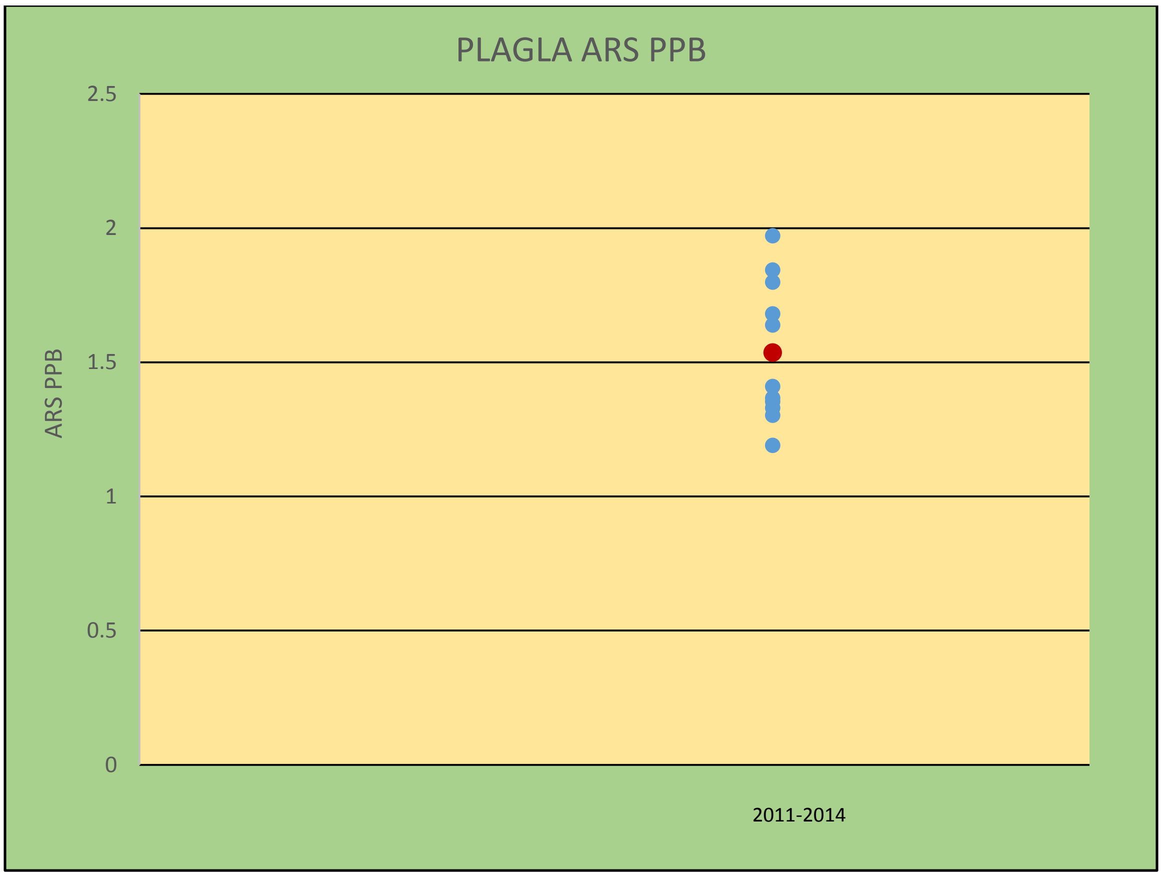

Figure VII-4. Scatter plot of Ars ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

B ppm

Table VII-5 B ppm in all plots Summary Statistics

B	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.070	4.444	1.825	0.291	1.222	2.427

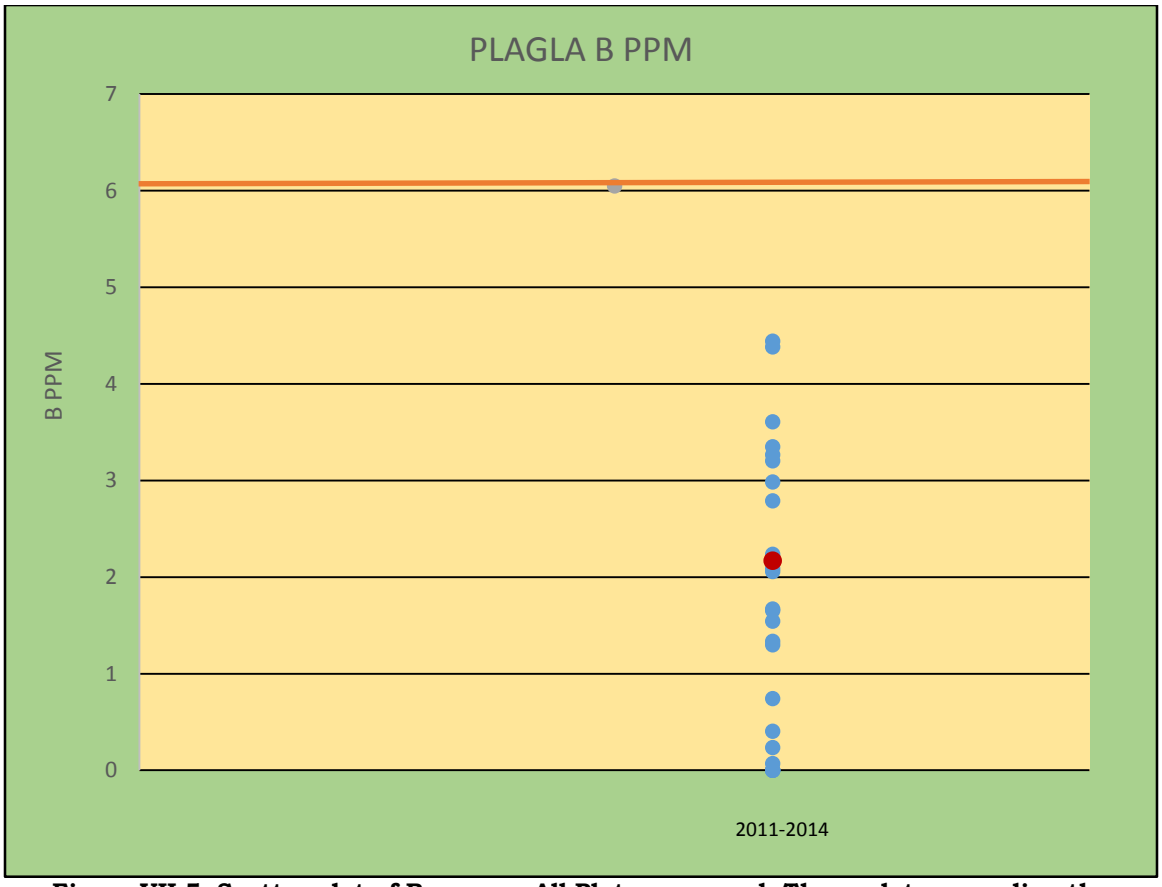

Figure VII-5. Scatter plot of B ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ba ppm

Table VII-6. Ba ppm in all plots Summary Statistics

BA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.010	34.800	11.348	2.104	7.006	15.689

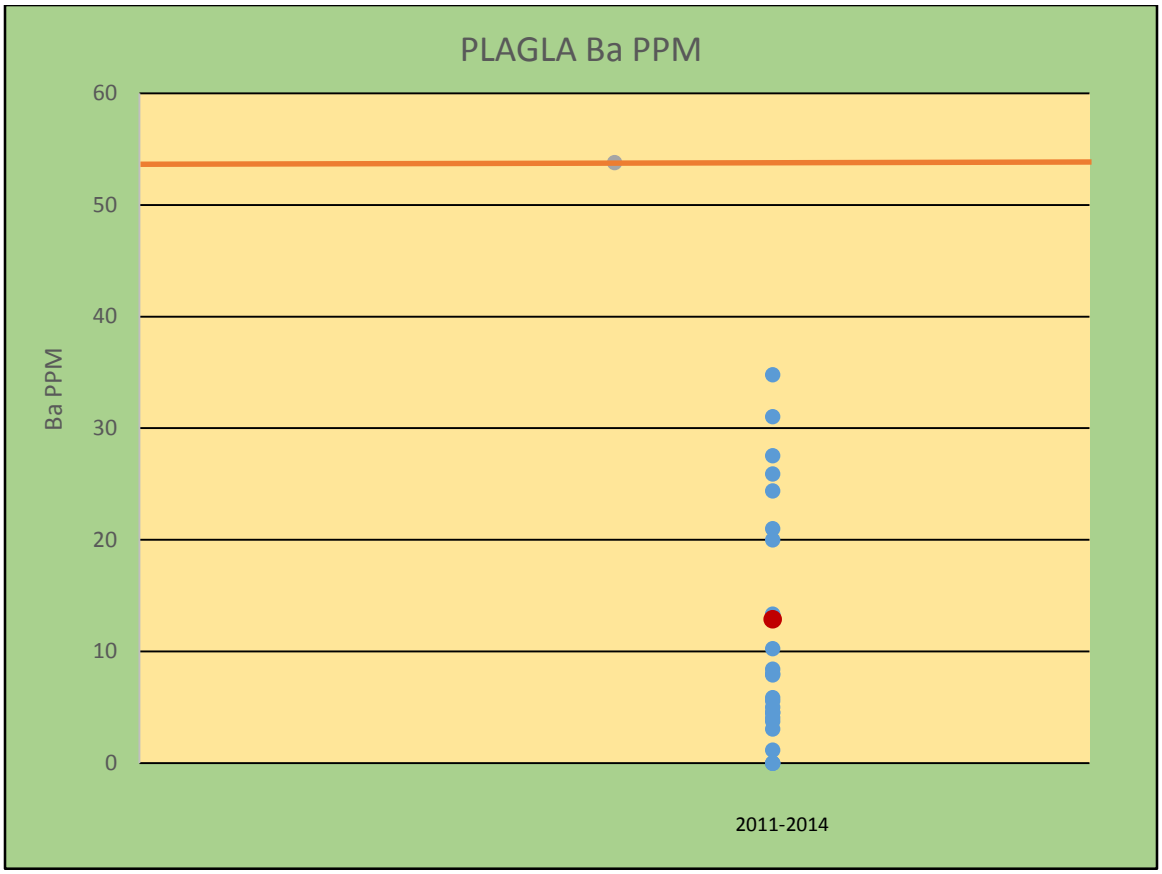

Figure VI-16. Scatter plot of Ba ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Be ppm

Table VII-7. Be ppm in all plots Summary Statistics

BE	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.002	0.055	0.010	0.002	0.006	0.014

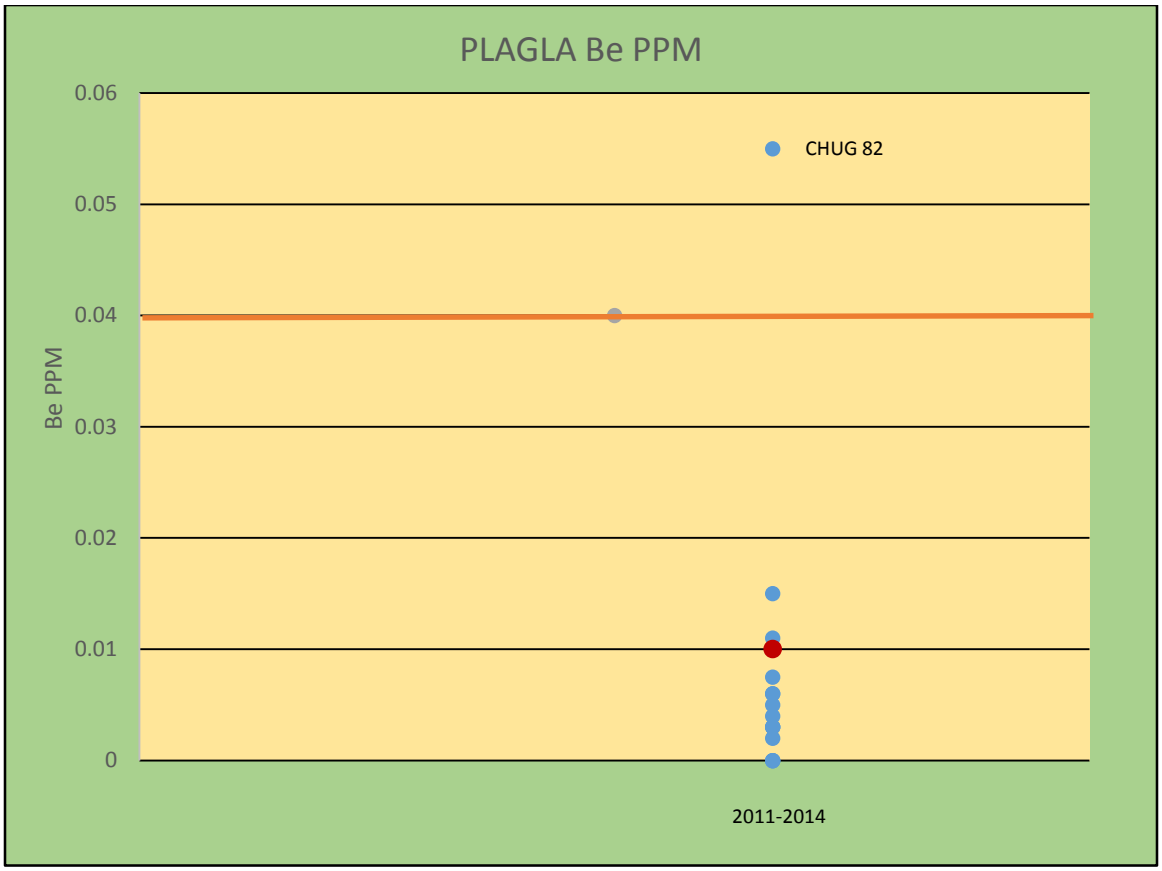

Figure VII-7. Scatter plot of Be ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ca ppm

Table VII-8. Ca ppm in all plots Summary Statistics

CA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	1471.630	13727.000	3316.983	579.118	2121.742	4512.224

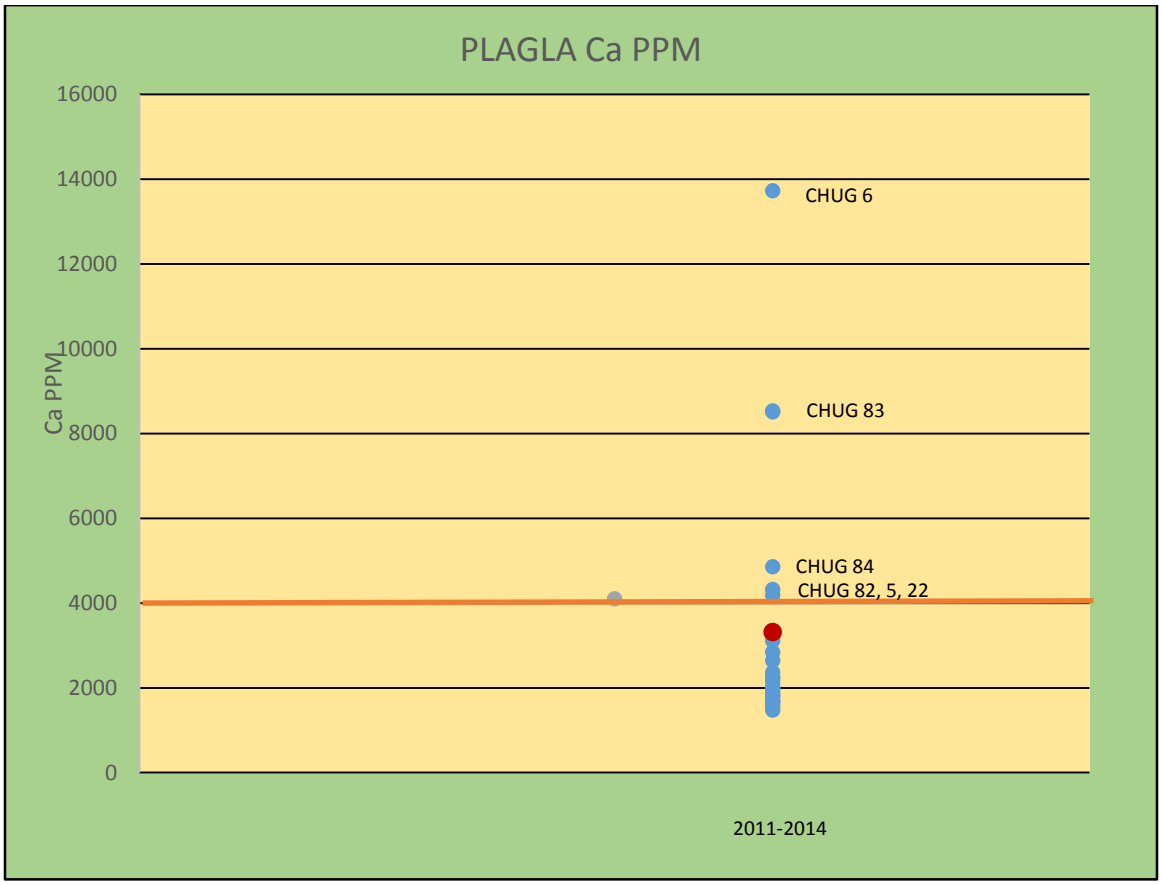

Figure VII-8. Scatter plot of Ca ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cd ppm

Table VII-9. Cd ppm in all plots Summary Statistics

CD	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.035	0.345	0.073	0.014	0.044	0.101

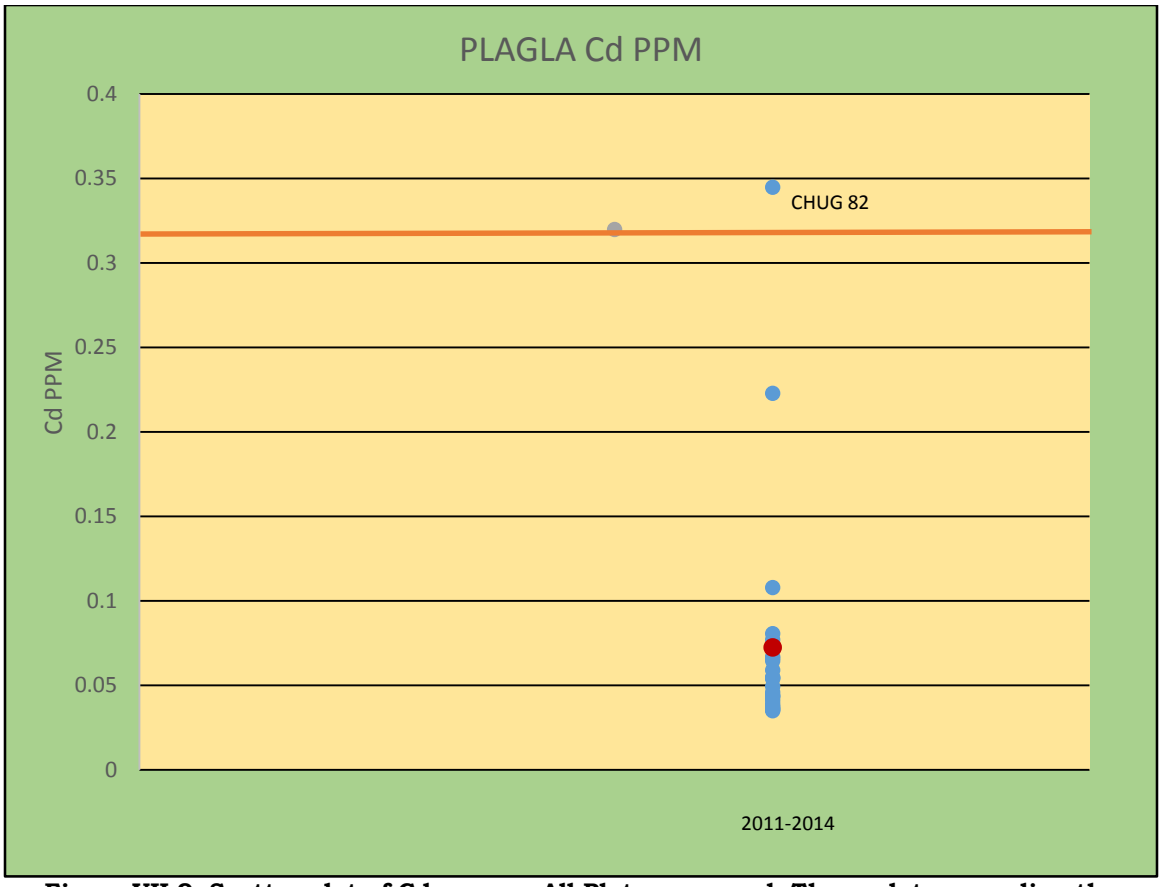

Figure VII-9. Scatter plot of Cd ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Co ppm

Table VII-10. Co ppm in all plots Summary Statistics

CO	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.010	0.488	0.258	0.027	0.201	0.314

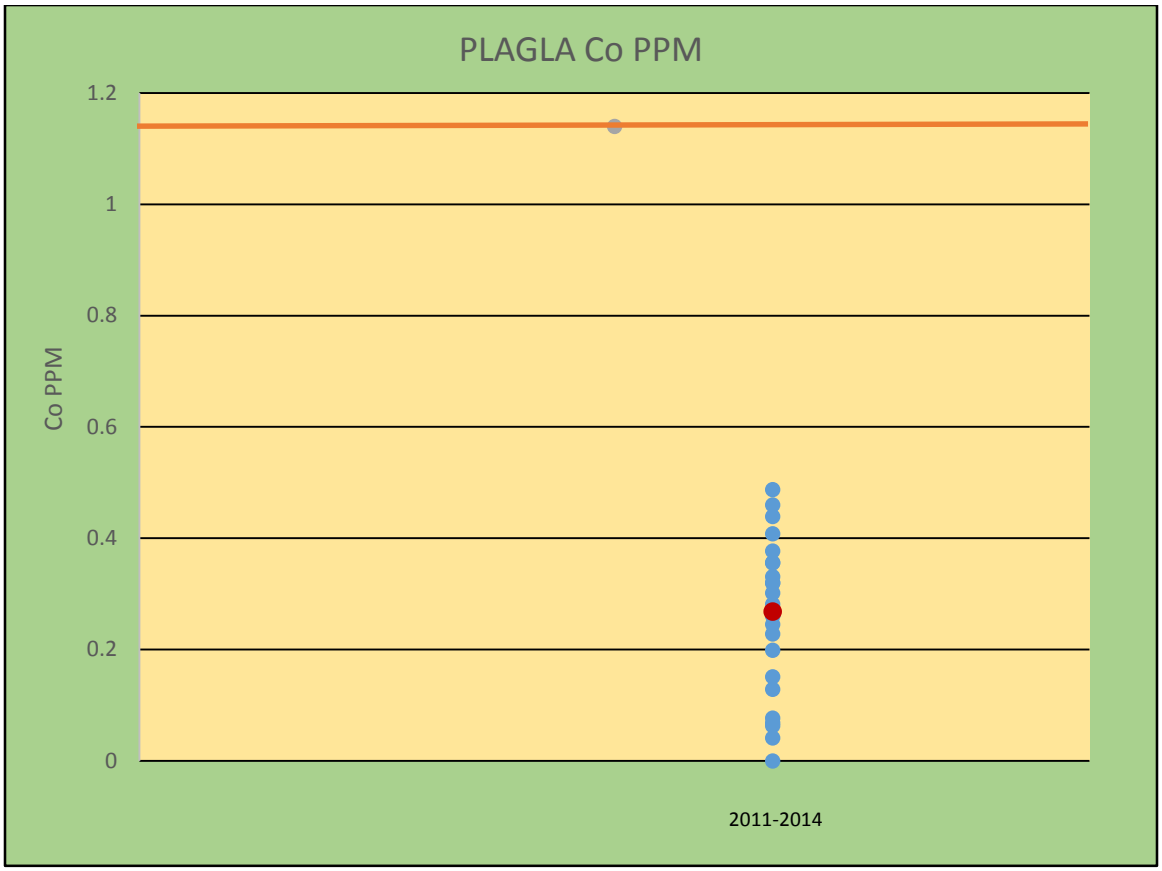

Figure VII-10. Scatter plot of Co ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cr ppm

Table VII-11. Cr ppm in all plots Summary Statistics

CR	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.290	1.553	0.966	0.063	0.836	1.097

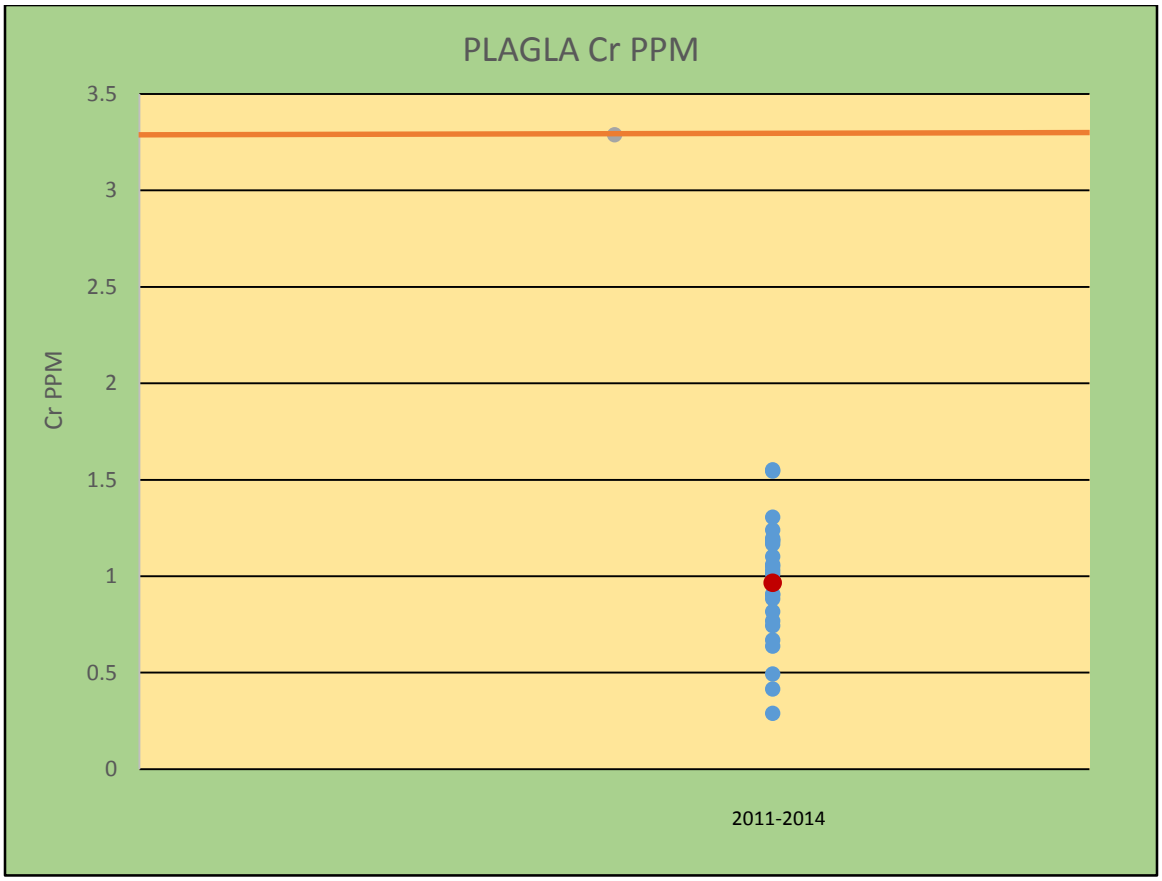

Figure VII-11. Scatter plot of Cr ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Cu ppm

Table VII-12. Cu ppm in all plots Summary Statistics

CU	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.240	10.155	3.063	0.368	2.304	3.822

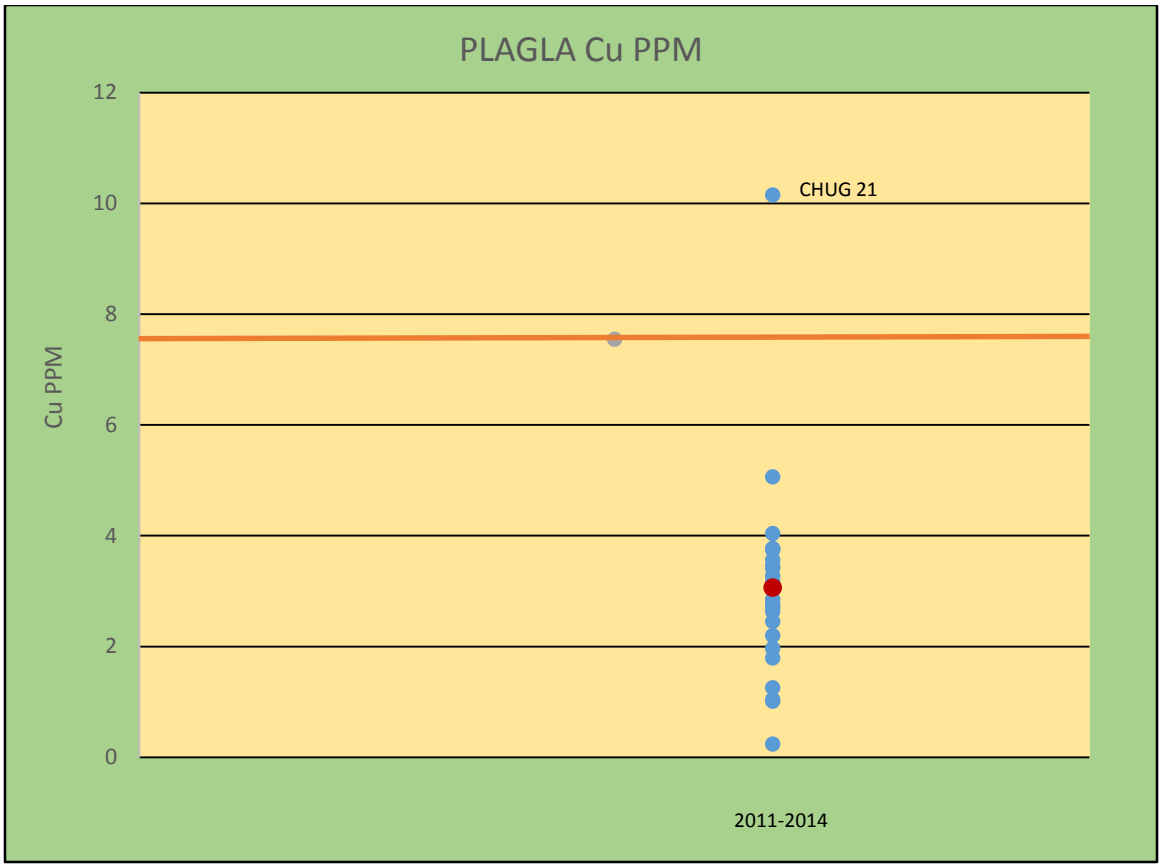

Figure VII-12. Scatter plot of Cu ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Fe ppm

Table VII-13 Fe ppm in all plots Summary Statistics

FE	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	8.920	931.890	448.231	53.949	336.886	559.575

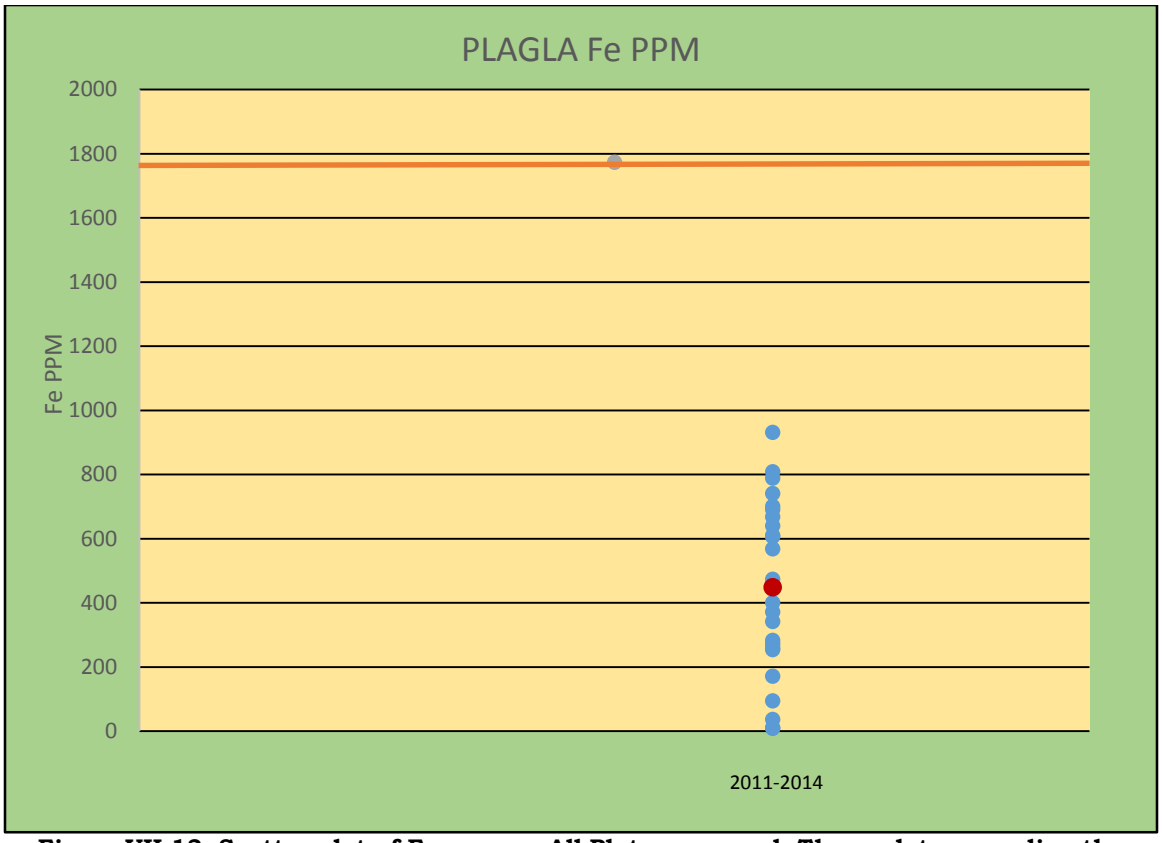

Figure VII-13. Scatter plot of Fe ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Hg ppb

Table VII-14. Hg ppb in all plots Summary Statistics

HG	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	113.414	283.488	193.611	22.704	139.925	247.296

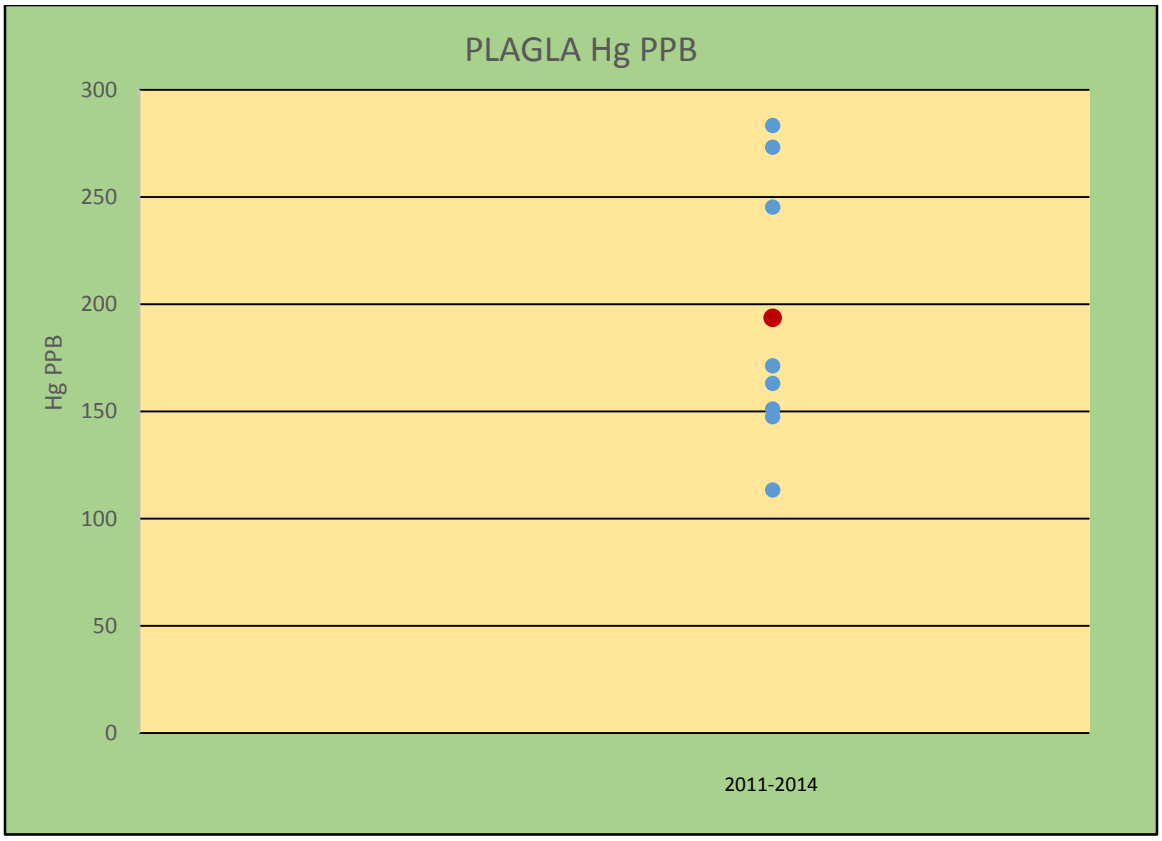

Figure VII-14. Scatter plot of Hg ppb on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

K ppm

Table VII-15. K ppm in all plots Summary Statistics

K	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	1005.400	3276.000	1941.907	107.791	1719.437	2164.377

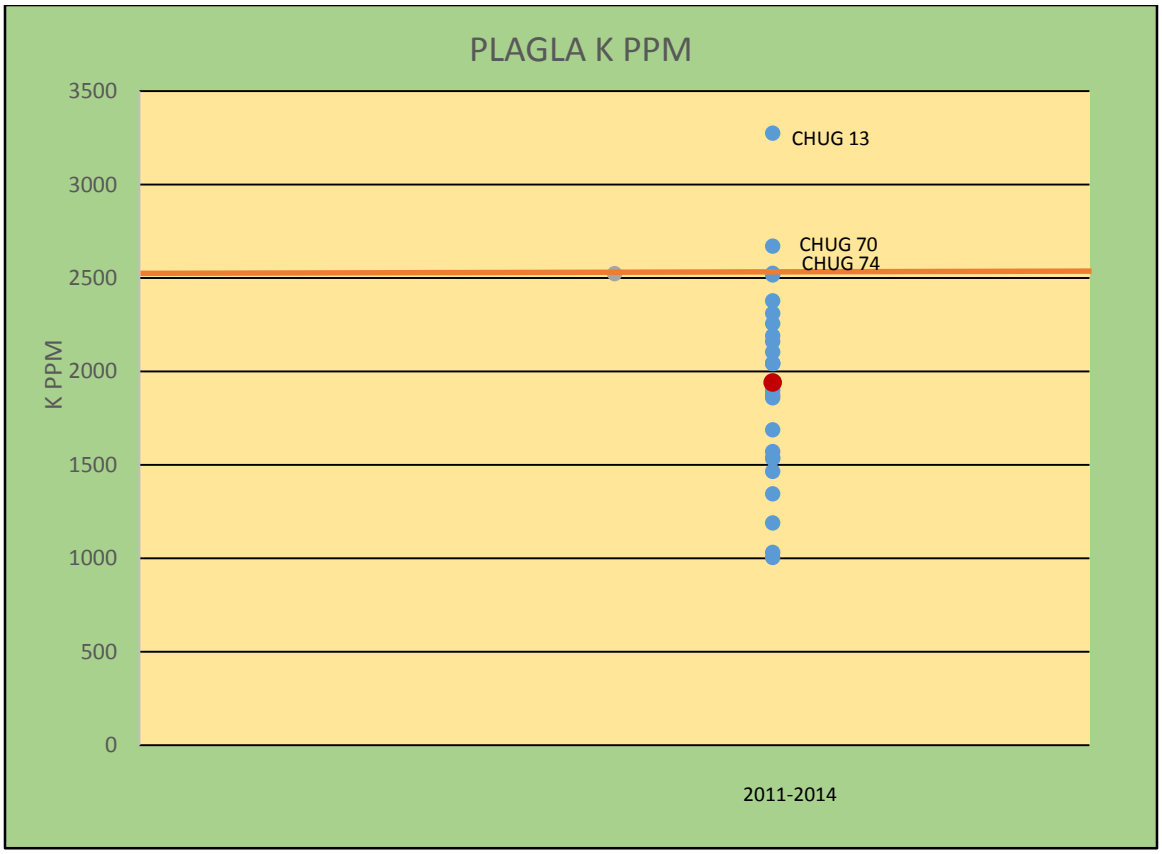

Figure VII-15. Scatter plot of K ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Li ppm

Table VII-16. Li ppm in all plots Summary Statistics

LI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.010	0.602	0.256	0.035	0.185	0.327

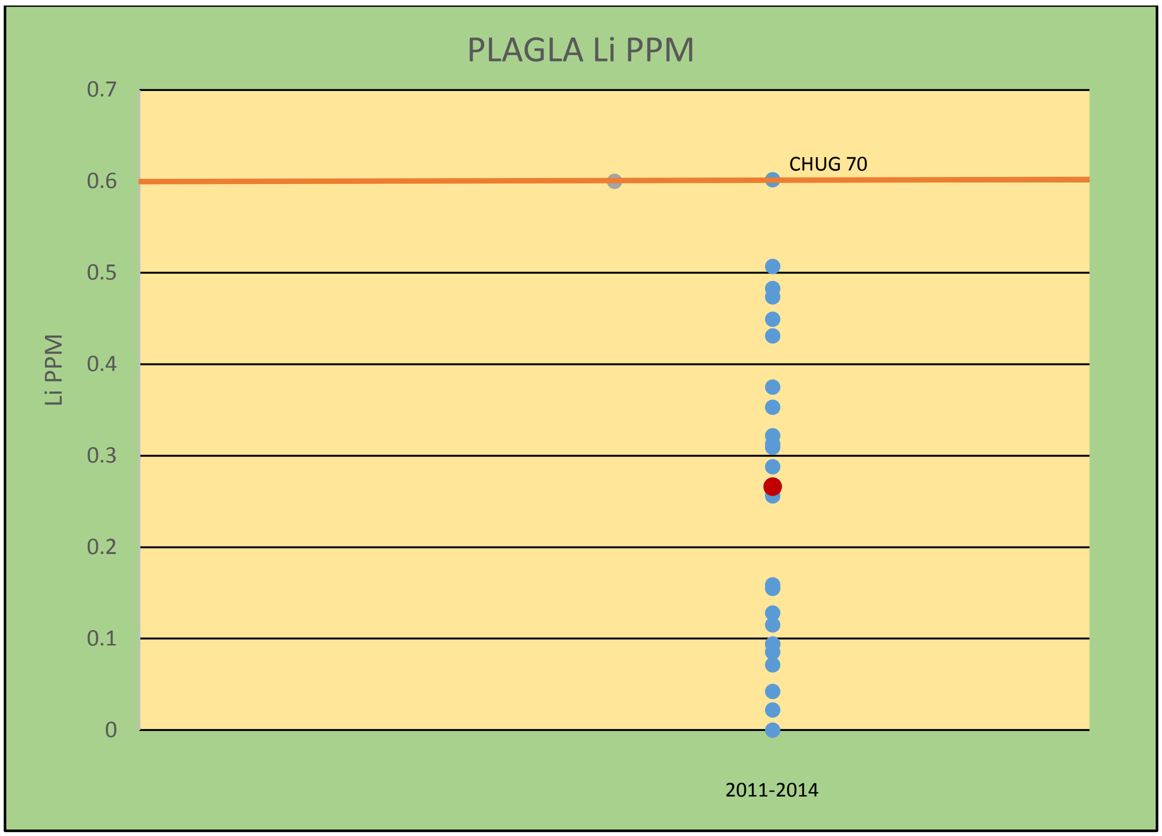

Figure VII-16. Scatter plot of Li ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mg ppm

Table VII-17. Mg ppm in all plots Summary Statistics

MG	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	324.680	1630.074	852.045	85.362	675.867	1028.224

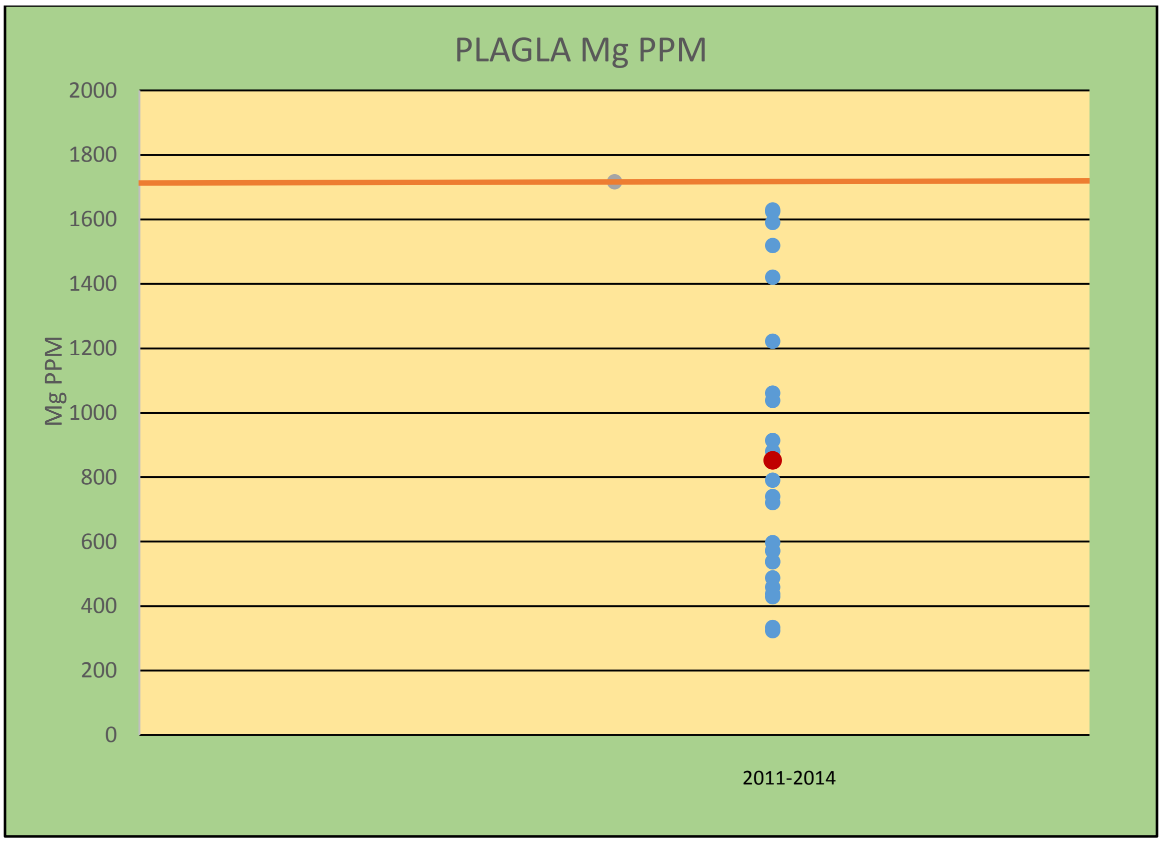

Figure VII-17. Scatter plot of Mg ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mn ppm

Table VII-18. Mn ppm in all plots Summary Statistics

MN	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	21.400	1037.500	181.018	41.715	94.922	267.114

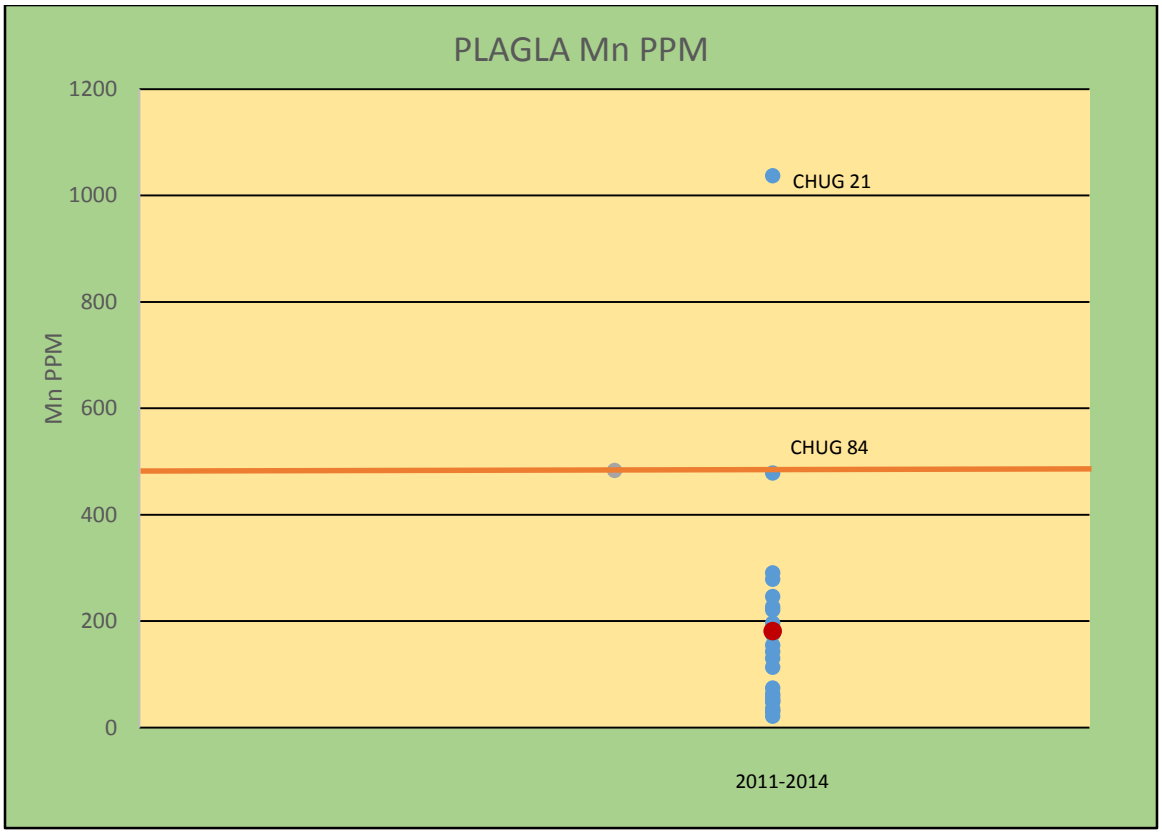

Figure VII-18. Scatter plot of Mn ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Mo ppm

Table VII-19. Mo ppm in all plots Summary Statistics

MO	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.001	1.438	0.130	0.070	0.000	0.275

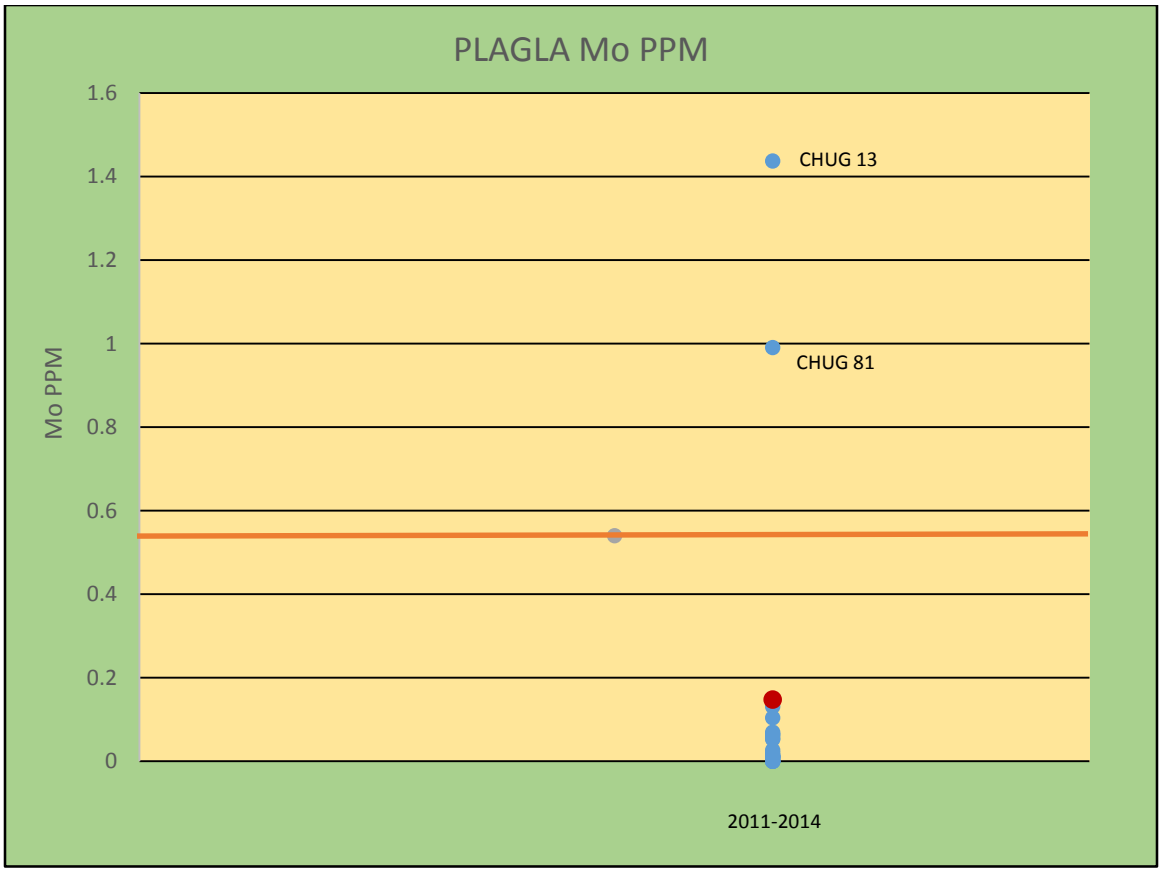

Figure VII-19. Scatter plot of Mo ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Na ppm

Table VII-20. Na ppm in all plots Summary Statistics

NA	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	45.405	480.410	197.757	23.846	148.541	246.972

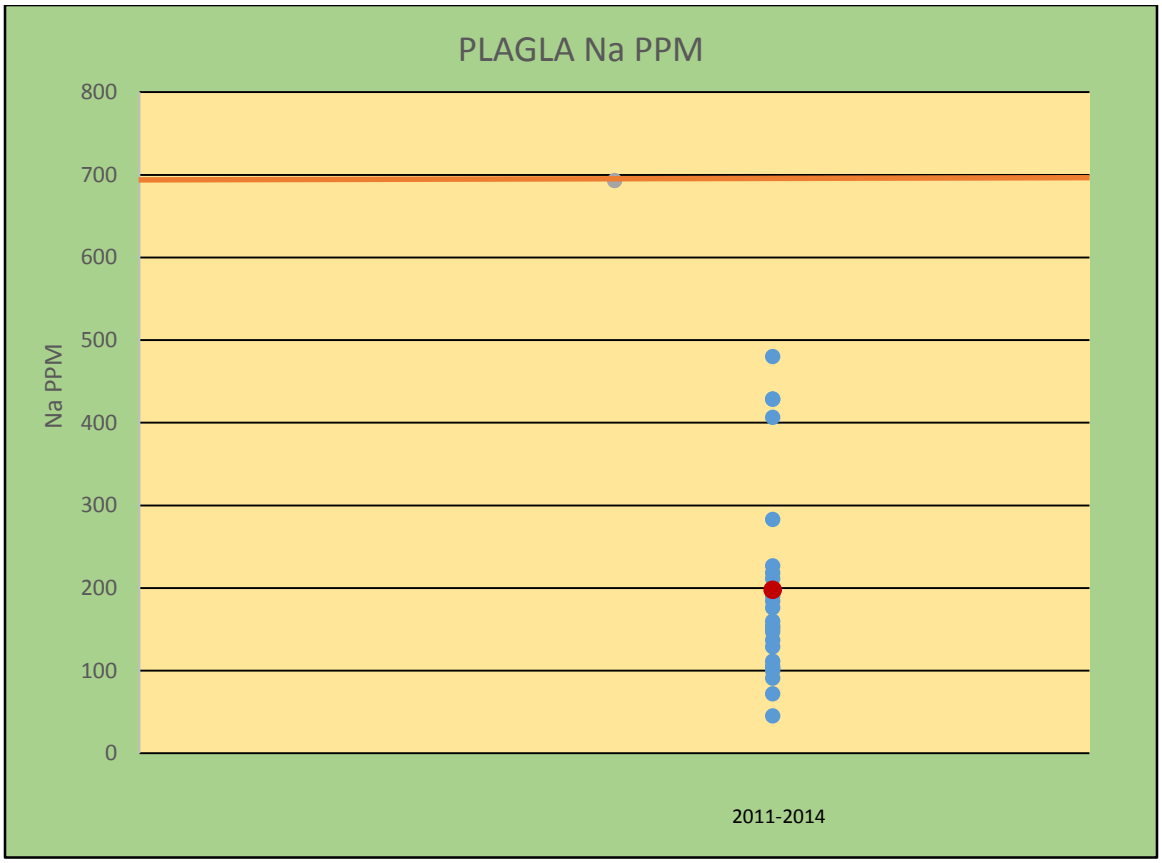

Figure VII-20. Scatter plot of Na ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ni ppm

Table VII-21. Ni ppm in all plots Summary Statistics

NI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.020	1.485	0.777	0.082	0.606	0.947

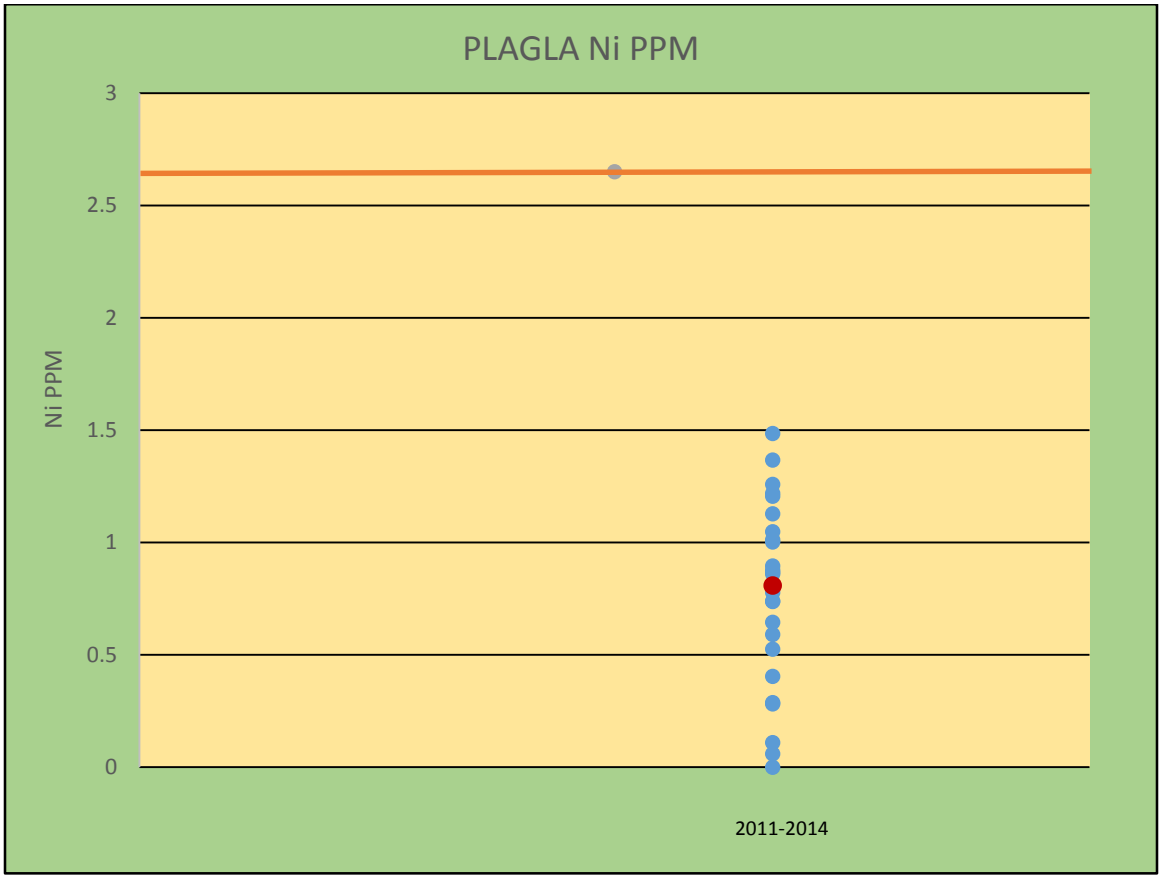

Figure VII-21. Scatter plot of Ni ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

P ppm

Table VI-22. P ppm in all plots Summary Statistics

P	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	206.310	1418.600	751.320	61.903	623.559	879.081

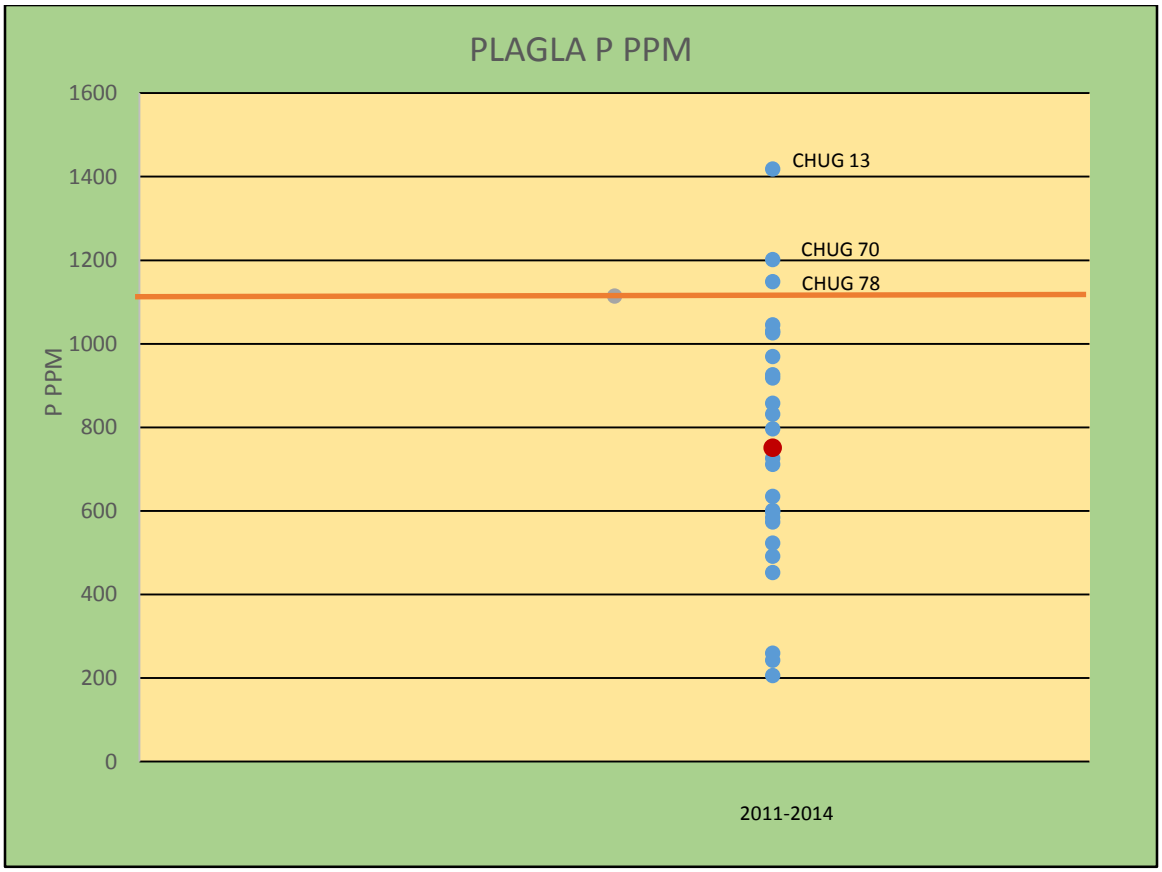

Figure VII-22. Scatter plot of P ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Pb ppm

Table VII-23. Pb ppm in all plots Summary Statistics

PB	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.370	5.580	1.345	0.263	0.803	1.887

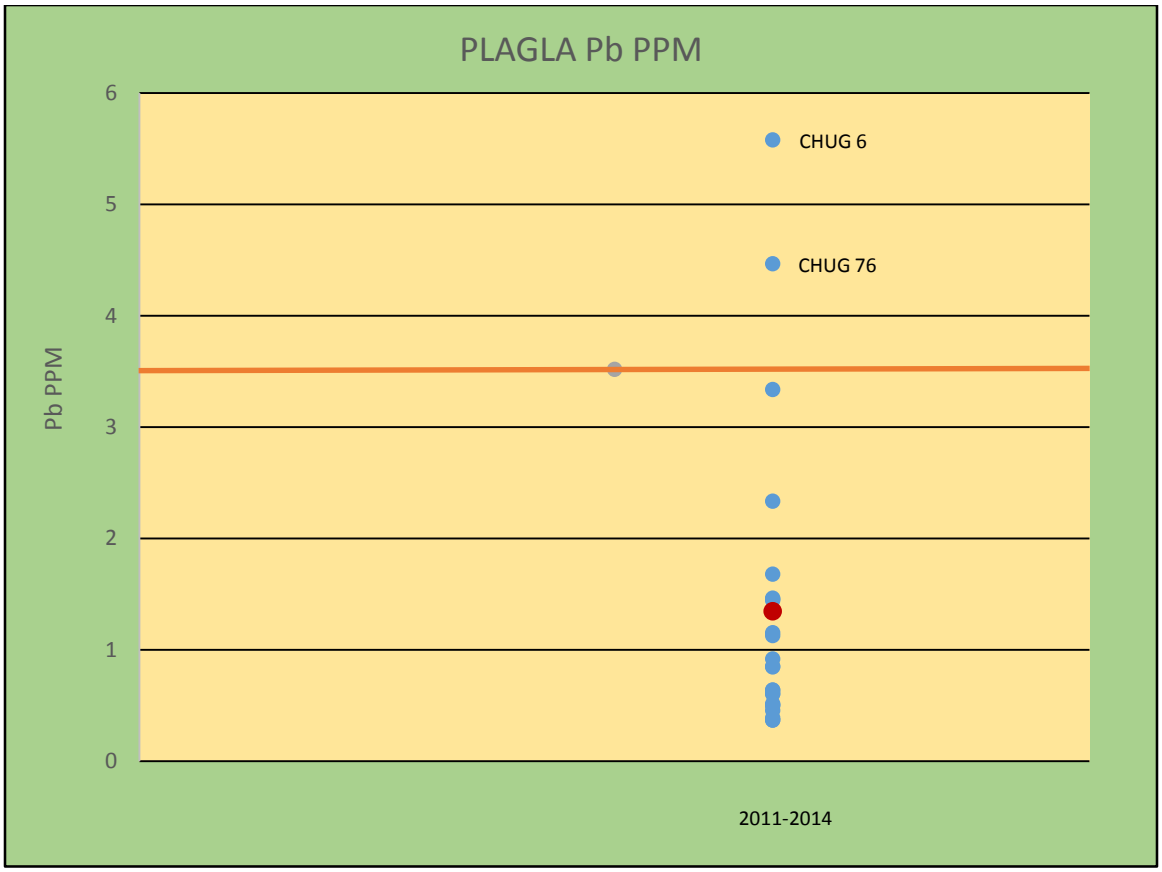

Figure VII-23. Scatter plot of Pb ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Rb ppm

Table VII-24. Rb ppm in all plots Summary Statistics

RB	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	14.510	373.910	76.980	25.608	21.657	132.302

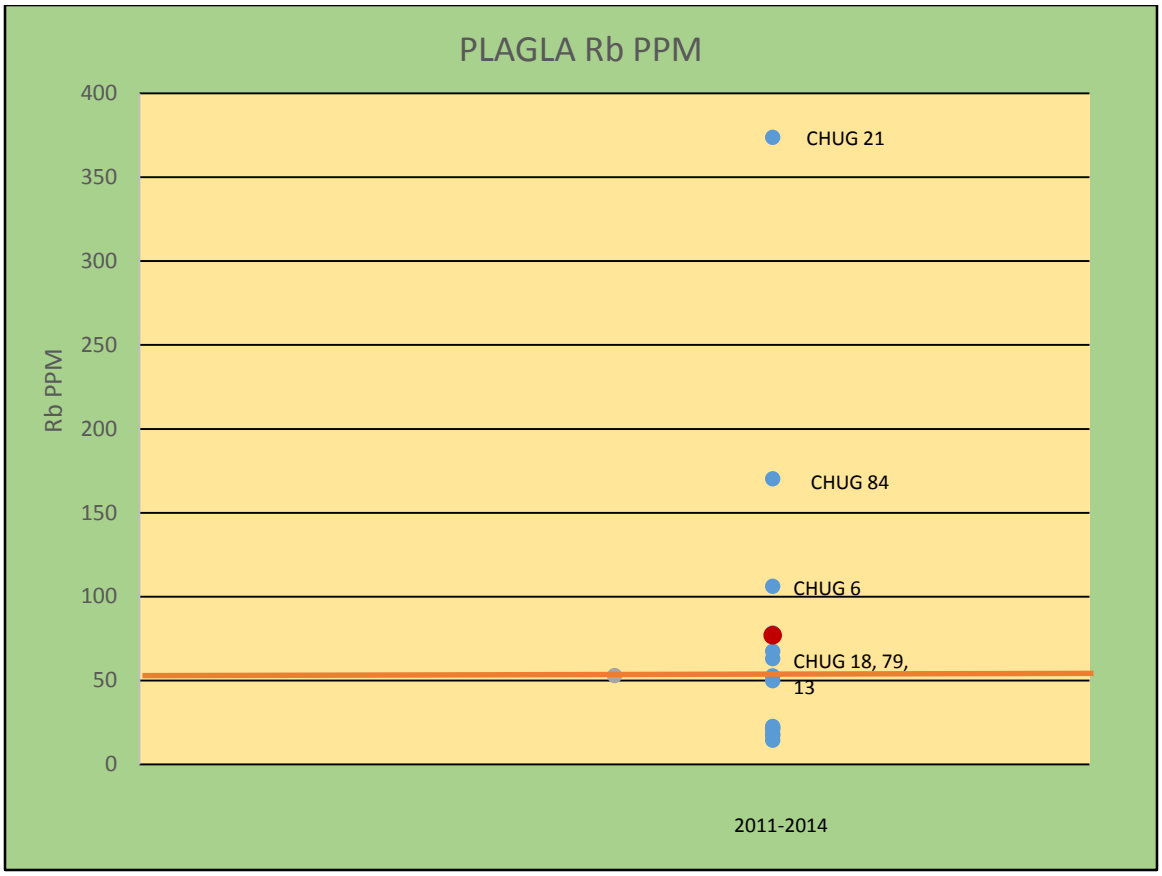

Figure VII-24. Scatter plot of Rb ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Si ppm

Table VII-25. Si ppm in all plots Summary Statistics

SI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	23.800	599.000	312.954	33.927	242.932	382.977

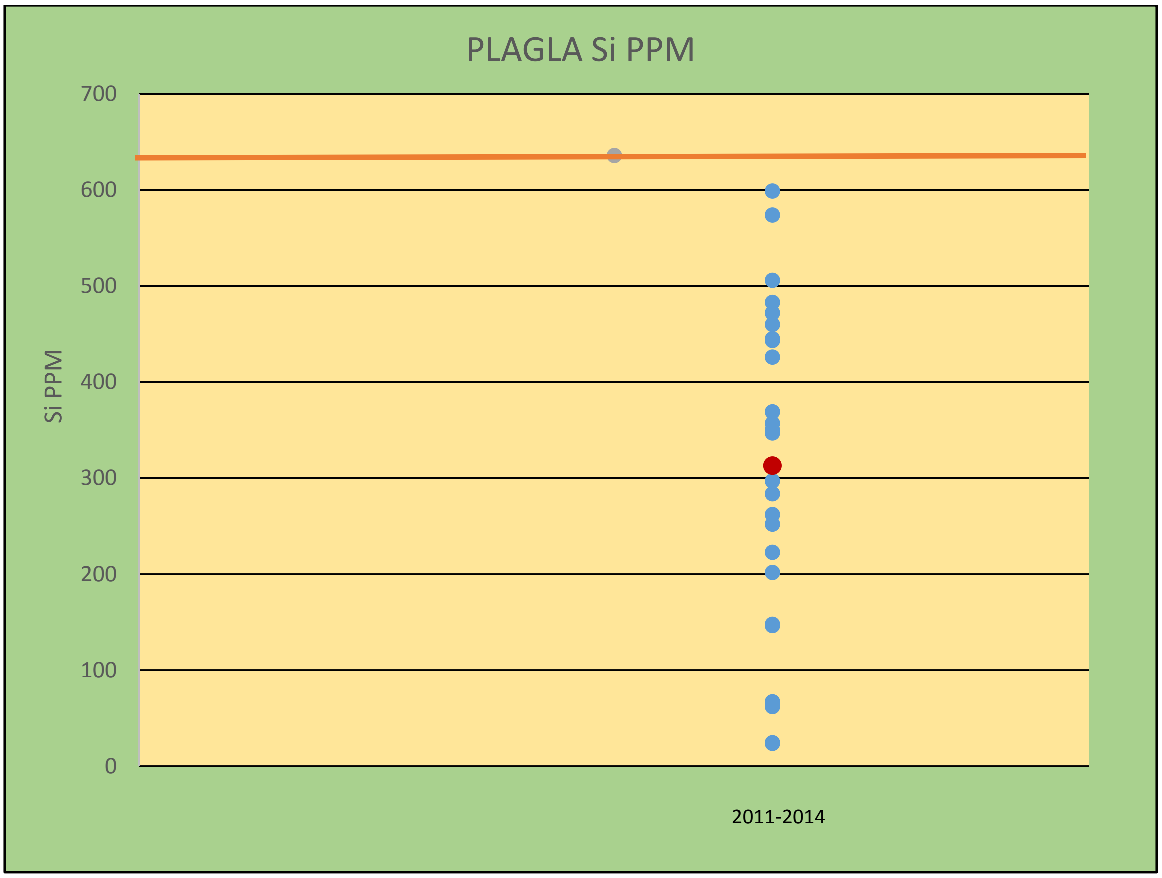

Figure VII-25. Scatter plot of Si ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Sr ppm

Table VII-26. Sr ppm in all plots Summary Statistics

SR	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	7.260	38.900	15.641	2.266	10.747	20.536

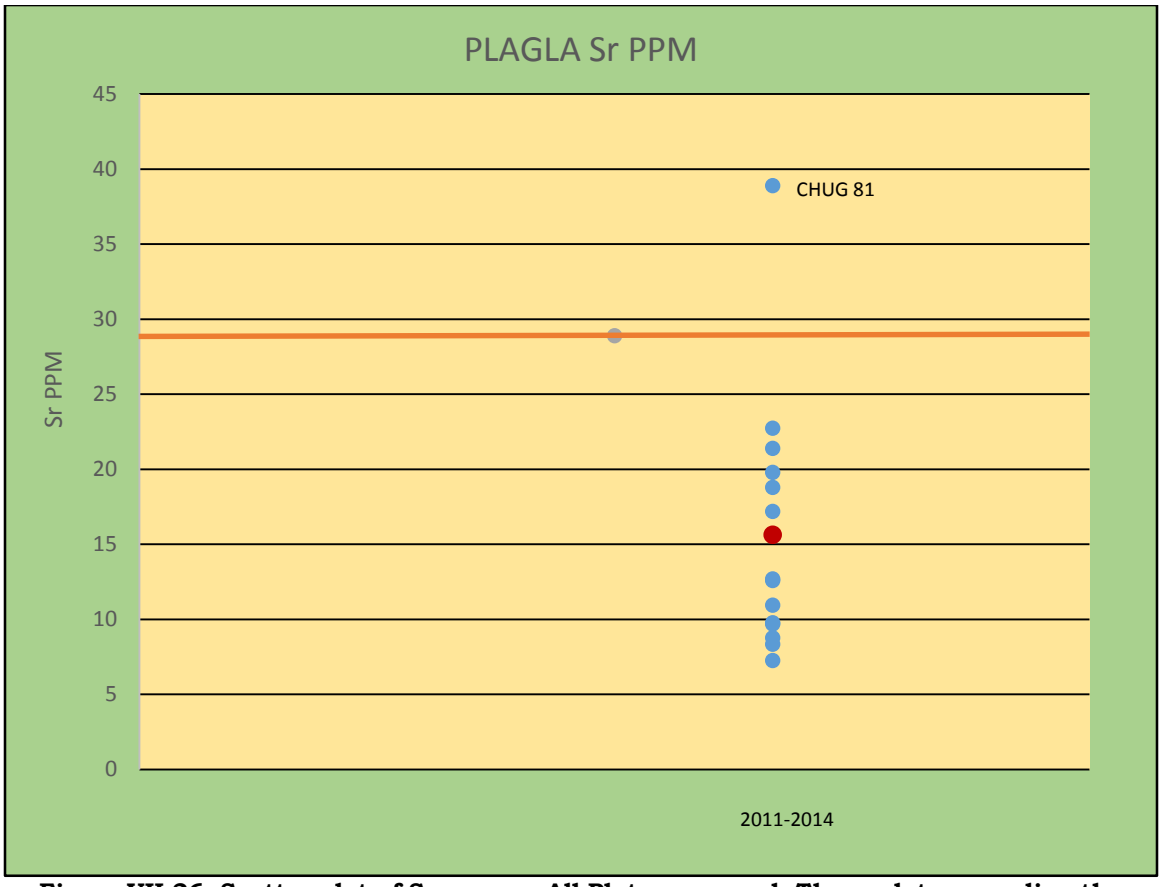

Figure VII-26. Scatter plot of Sr ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Ti ppm

Table VII-27. Ti ppm in all plots Summary Statistics

TI	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.495	29.587	15.109	1.687	11.627	18.591

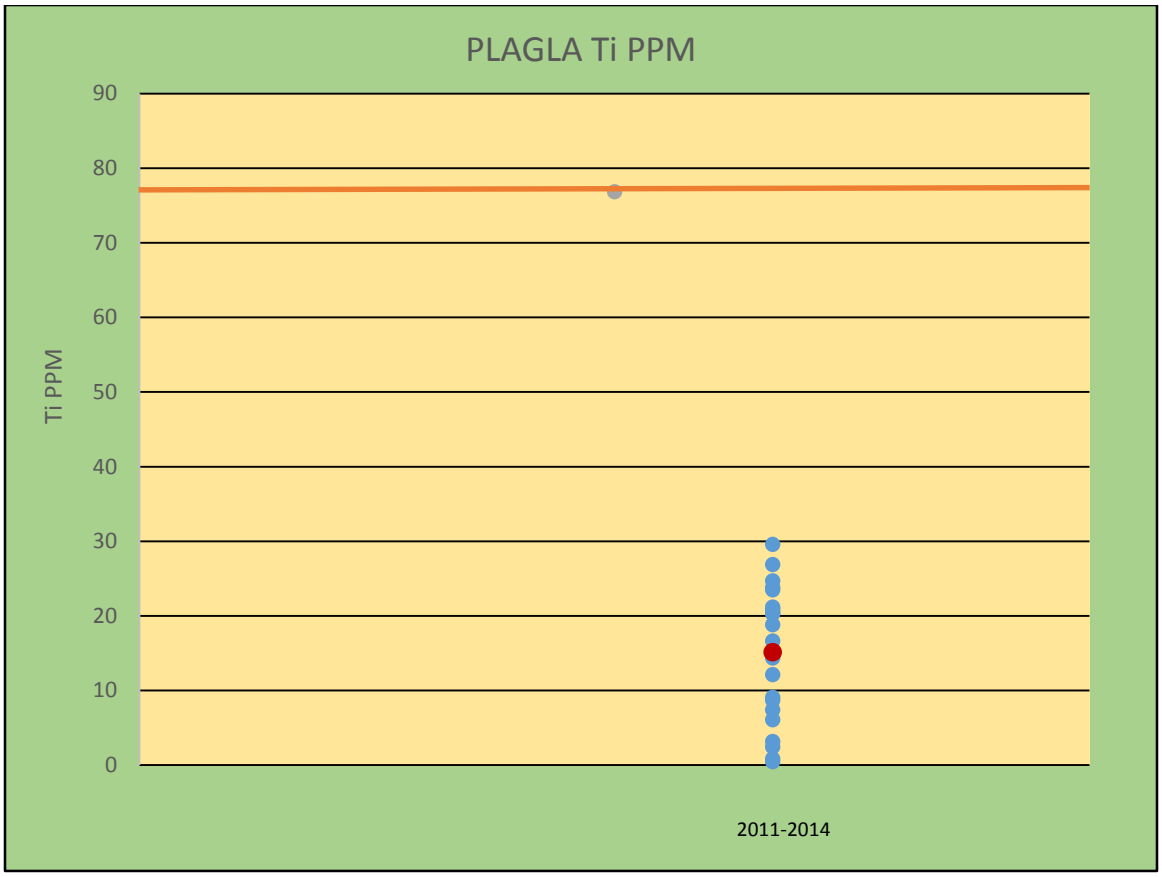

Figure VII-27. Scatter plot of Ti ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

V ppm

Table VII-28. V ppm in all plots Summary Statistics

V	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	0.010	1.378	0.744	0.079	0.581	0.908

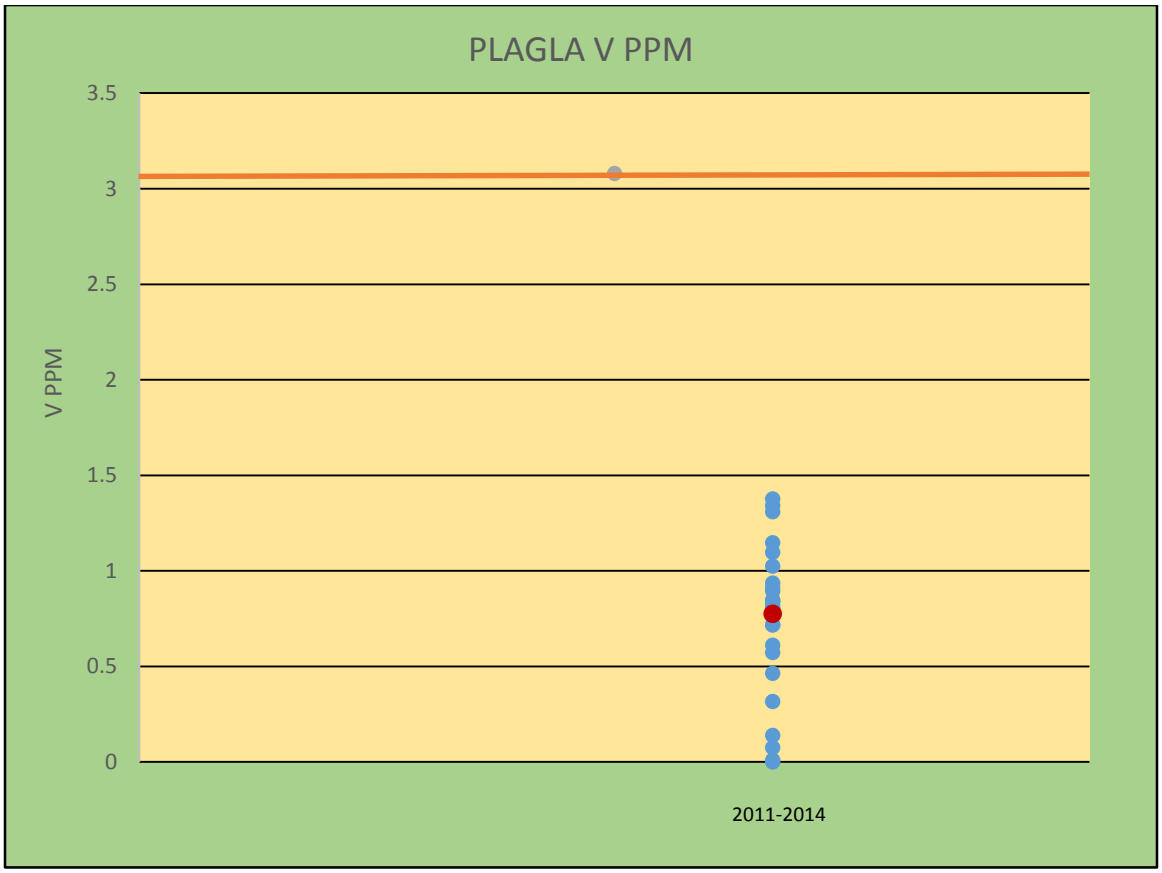

Figure VII-28. Scatter plot of V ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

Zn ppm

Table VII-29. Zn ppm in all plots Summary Statistics

ZN	MIN	MAX	MEAN	SE	95% CI LOWER	95% CI UPPER
2011-2014	14.725	60.285	28.222	2.019	24.055	32.388

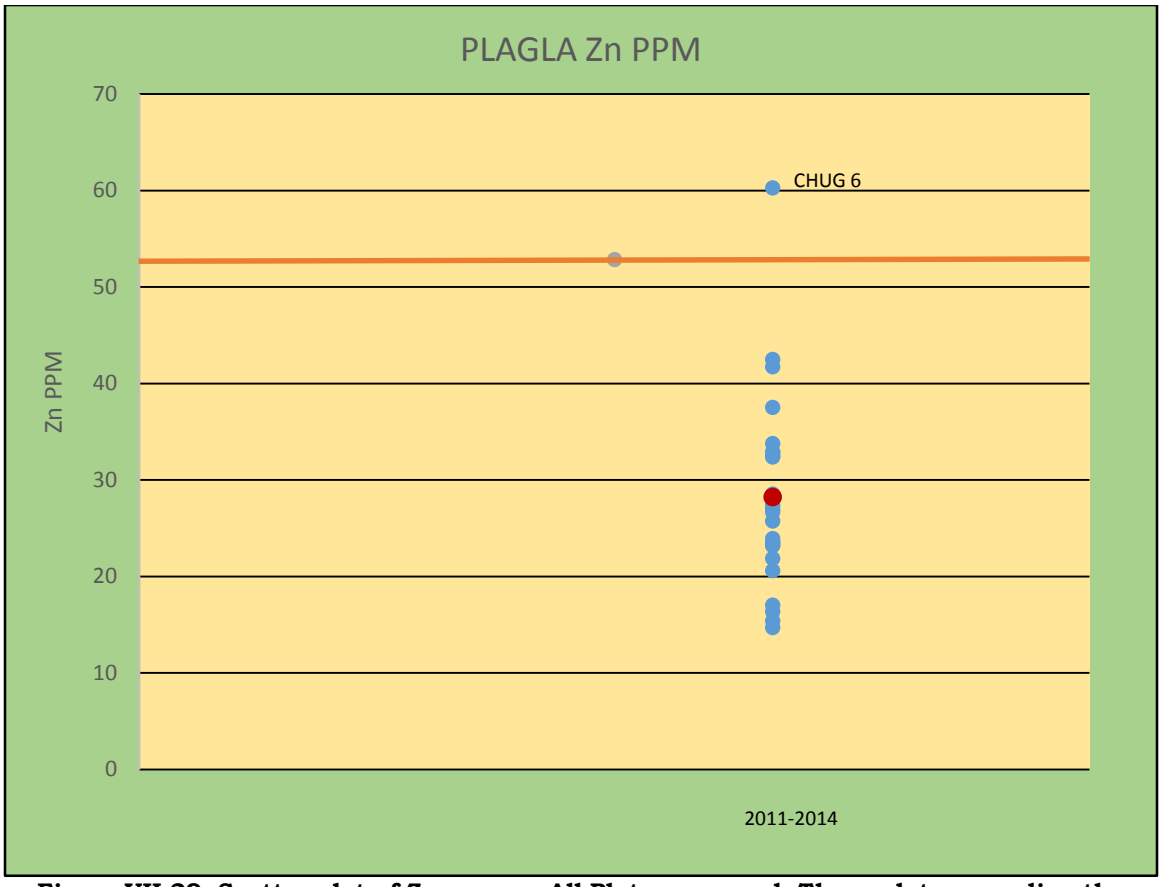

Figure VII-29. Scatter plot of Zn ppm on All Plots measured. Those plots exceeding the established contaminant thresholds in lichens from Region 10 are labeled.Sampling Round means are indicated by a red dot.

VIII. THRESHOLDS

Contaminant thresholds in lichens from Region 10.Species of lichens are: *Alectoria sarmentosa* (ALESAR), *Hypogymnia* species (HYPOG), *Lobaria oregana* (LOBORE) and *Platismatia glauca* (PLAGLA).

Species	S	N	Al	B	Ba	Be
Alesar	0.06	0.56	56.78	9.33	15.84	0.04
Hypog	0.09	0.88	1126.44	9.47	76.62	0.04
Lobore	0.13	NA	580.03	4.06	16.46	0.04
Plagla	0.08	0.80	1063.57	6.05	53.80	0.04

Species	Ca	Cd	Co	Cr	Cu	Fe
Alesar	9689.25	0.40	0.78	0.73	1.86	55.64
Hypog	24671.17	0.61	1.25	2.38	31.31	1990.78
Lobore	1158.10	0.55	0.83	1.51	10.18	1010.97
Plagla	4104.48	0.32	1.14	3.29	7.55	1773.56

Species	K	Li	Mg	Mn	Mo	Na
Alesar	2413.25	0.40	740.83	188.24	0.54	893.16
Hypog	3284.34	0.71	2127.70	860.85	0.54	929.13
Lobore	8001.57	0.59	735.79	168.00	0.54	394.30
Plagla	2523.88	0.60	1717.08	483.70	0.54	693.21

Species	Ni	P	Pb	Rb	Si	Sr
Alesar	0.96	913.75	5.00	53.00	134.75	33.56
Hypog	4.26	1597.23	10.13	53.00	563.82	61.26
Lobore	1.65	2532.49	3.52	53.00	681.18	6.30
Plagla	2.65	1115.00	3.52	53.00	635.83	28.91

Species	Ti	V	Zn
Alesar	4.93	0.37	38.06
Hypog	62.42	2.99	70.20
Lobore	45.30	2.42	82.93
Plagla	76.86	3.08	52.85

IX. LITERATURE CITED

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