

# 1. Air Quality

**Goal:** Maintain the current air resource condition to protect the Forest’s ecosystems from on- and off-Forest air emissions sources.

**Objective:** Attain national and state ambient air quality standards Forest-wide.

## Air Quality Question: *Is air quality being maintained?*

To answer this monitoring question, both annually and every five years, several other factors must first be considered. Ultimately, we want to know how to protect resources from deleterious effects from air contaminants from on- and off-Forest emission sources.

### Evaluation Criteria

- ADEC and EPA data
- Air quality biomonitoring data

### Monitoring Results

**ADEC and EPA review for 2014:** (Is air quality for human health concerns being maintained and if not, how will non- attainment of certain pollutants impact natural resources on adjacent NSF lands?)

**PM<sub>10</sub>:** The City of Juneau was designated non-attainment for National Ambient Air Quality Standard (NAAQS) particulate matter PM<sub>10</sub> in 1990. Over the years, efforts have been taken to minimize road dust through paving as well as educating the public to limit woodstove use and open burning during certain periods. Within the past few years, the Alaska Department of Environmental Conservation (ADEC) submitted a new maintenance plan to EPA. These efforts have allowed Juneau to be re-designated as a maintenance area with the US Environmental Protection Agency (EPA) in 2009. In July 2013, the EPA approved the maintenance plan and Juneau is considered in maintenance status (<http://dec.alaska.gov/air/anpms/SIP/akrevisions1.htm>). As of December 2014, nothing has changed in this maintenance status.

**PM<sub>2.5</sub>:** In 2006, the EPA strengthened its air quality standards for fine particulates or PM<sub>2.5</sub> to 35 g/m<sup>3</sup>. As federal standards became stricter, the City of Juneau also tightened ordinances that originally dated from the 1980’s and increased public education and compliance efforts. Data from 2006-2008 indicate that Juneau has met federal air quality standards for PM<sub>2.5</sub> (ADEC 2010). No changes to this designation are present in 2014, but the ADEC website states that Juneau is close to nonattainment for PM<sub>2.5</sub> (ADEC 2014).

**Contaminant thresholds in lichens for 2014:** (How to determine the current air resource condition?)

As part of the Wilderness Challenge six lichen biomonitoring plots were revisited in 2014 within three wilderness areas to determine the air quality condition and gather data for trends in contaminant and nutrient accumulation (Table 1, Figures 1 and 2).

**Air Table 1.** Lichen biomonitoring plots revisited in 2014 in wilderness

Plot Number	Location	Wilderness Area	First Established	Visit Number
513	Egg Harbor	Coronation	2005	2
514	Windy Pass	Coronation	2005	2
189	Gambier Bay	Kootznoowoo	1989	3
190	Gambier Bay	Kootznoowoo	1989	3

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Plot Number	Location	Wilderness Area	First Established	Visit Number
496	J-lake ridge	S. Etolin	2005	2
497	J-lake shore	S. Etolin	2005	2

A total of 14 lichen tissue samples were collected, processed and sent to the University of Minnesota analytical lab for analysis of contaminants including Nitrogen, Sulfur, and heavy metals. Results will be entered into the USDA Forest Service National database (USDA 2006). Results will be compared to the thresholds established for the Tongass National Forest in four target lichen species (Table 2).

**Air Table 2.** Contaminant thresholds in lichens from the Tongass National Forest (from Dillman et al. 2007). 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			

Elemental analysis takes several months from the time the samples are collected and prepared for the lab. Therefore, elemental analysis results for the six lichen biomonitoring plots revisited in 2014 will be presented in the 2015 annual monitoring report. This report provides the lichen data for those plots above

threshold that were revisited within three wilderness areas in 2013: Stikine-LeConte, Tebenkof and Petersburg Lake-Duncan Salt Chuck (Table 3).

**Air Table 3.** Plots revisited in 2013 for air quality biomonitoring in wilderness. Elements or contaminants above Tongass thresholds are reported.

Plot Number	Location	Wilderness Area	Elements above threshold/lichen species	Change from last visit
503	Thunder Mt.	Stikine-LeConte	aluminum, potassium, phosphorus/ <i>Hypogymnia enteromorpha</i>	Increase in concentration of these elements from 2005 to above thresholds in 2013.
33	Elena Bay	Tebenkof	copper/ <i>Alectoria sarmentosa</i>	Cu only element remaining above threshold from 2005 visit, others now below.
116	Petersburg Lake	Petersburg Lake/Duncan Salt Chuck	manganese and zinc/ <i>Hypogymnia duplicata</i>	In this lichen, both elements above threshold. This is a new development. Mn was elevated in <i>Alesar</i> in 2005.

## Evaluation of Results

### Wilderness Areas with Lichens Above Threshold

In 2013, three wilderness areas were revisited to collect lichen tissue and conduct a lichen community inventory at the plots established during earlier monitoring periods 8 years ago. All three wilderness areas contained some changes in lichen tissue concentrations in elements above thresholds for aluminum, copper, manganese, potassium, phosphorus, and zinc (Table 2). The other plots visited in this monitoring period contained no elements above thresholds during this visit or the previous visit in 2005 (plots 57 from Petersburg Lake and 500 from Tebenkof).

In 2005, lichens from the Thunder Mountain location (plot 503) were not above thresholds for any elements, but were elevated above thresholds in 2013 for aluminum, potassium and phosphorus (Table 2) (Dillman et al 2007). This location is on the mainland, 5 miles from Petersburg, and possibly is influenced periodically from nearby glacial and Stikine River loess, particularly during dry years (such as 2013). Phosphorus and potassium are elements found naturally in the earth’s crust, sea water and bird guano. Yet this plot is high elevation and not expected to be high in K or P due to distance from the ocean or sea birds. However, these elements are also emitted with wood burning, and it is possible that burning wood at the Petersburg dump on occasion drifts into the air currents and travels over to the mainland. Smoke from the Petersburg dump has been observed lingering over Frederick Sound during certain time periods over the years. The plot is in a small exposed Mt Hemlock stand, isolated from other stands that birds such as ravens or eagles may find refuge.

Lichens from the Tebenkof Bay location (Plot 33) were elevated in copper in 2013, as well as in 2005. Copper is a naturally occurring element in rocks, and may be part of the natural variation in the Tebenkof area. However, only plot 33



*Air Quality Photo 1. Collecting lichen tissue for contaminant analysis in South Etolin Wilderness.*



*Air Quality Photo 2. Lake in S. Etolin Wilderness near where permanent air quality lichen biomonitoring plots reside.*

had copper elevated in the lichens, the other plot about ¼ mile away did not. Other elements elevated above threshold in 2005 were not above threshold during this round (sulfur, aluminum, potassium, phosphorus) Therefore, this illustrates the importance of monitoring to determine trends in certain elements of concern.

Plot 116 in the muskeg around Petersburg Lake (approximately 10 miles from Petersburg) was above thresholds in manganese and zinc. This site was above thresholds for Mn in 2005, but in a different lichen species. Both of these elements are found naturally in rock and soil. However, this location is also on the flight path from Petersburg for glacier sightseeing tours in the summer months. Manganese is released in the air when fossil fuels are burned.

### Conclusions

In summary, the City of Juneau, Mendenhall Valley area is in maintenance status for PM 10 and is not on the national list for nonattainment for PM 2.5 National Ambient Air Quality Standards (NAAQS). The wilderness plots that were visited in 2014 assisted in achieving a higher score for the air element in

the Chief's 10-Year Wilderness Stewardship Challenge. This work was completed through a grant from the WO. The 2014 lichen results will be presented in 2015. The consistent monitoring every ten years allows wilderness managers to gather trend data and to be aware of the environmental conditions that represent the wilderness character for air quality. The plots that contain contaminants of concern elevated above threshold may be monitored in 8 to 10 years to determine the trend in concentrations and any effects to the lichen community at those sites.

### Citations

Alaska Department of Environmental Conservation. 2014. Personal communication with ADEC air quality specialist. November.

Alaska Department of Environmental Conservation. 2014. New data shows Juneau meets federal air quality standards. <http://dec.alaska.gov/air/index.htm> [Accessed August 13, 2015]

USDA. 2006. National lichens and air quality database and clearinghouse. <http://gis.nacse.org/lichenair/> [Accessed August 13, 2015]