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.

Background: The Forest Plan anticipated localized, temporary, and limited direct effects on air quality from forest management activities within the Tongass National Forest. These effects on air quality include dust, vehicle and small boat emissions, permitted incinerators, mineral development, and prescribed fire. Indirect effects were anticipated from off-Forest sources such as large cruise ship emissions, pulp mill emissions, and firewood burning. There are no Class I air sheds within or adjacent to the Tongass National Forest. All wilderness areas on the Tongass National Forest are considered Class II.

From 1989-1992 eighty permanent baseline plots were established across the Tongass National Forest using lichens for biomonitoring air quality (Geiser et al. 1994). Such monitoring (ideally in combination with instrument monitoring) offers an economical approach that can provide a sensitive overview of air quality, detect fairly small changes in air quality geographically or over time, and identify areas that might need instrument monitoring. Results indicated that most elemental values for the Tongass (concentration or parts per million dry weight) were within expected ranges for non-industrial locations and were comparable to or lower than values available from other national parks or forests. The elements calcium, magnesium, potassium and manganese were slightly higher than other regions, probably due to marine influences. A preliminary study of lichens around the Sitka pulp mill was also initiated, finding elevated concentrations of sulfur, phosphorous, sodium, copper, nickel and cadmium. In 2005, the Forest completed a three-year effort to re-visit permanent plots in wilderness to monitor changes in air quality through lichen tissue samples and community data. This program also established baseline plots for wilderness areas not visited during the 1989-1992 study.

Juneau's Mendenhall Valley is the only area in Southeast Alaska that is known to have exceeded national ambient air quality standards. This area, including about 5000 acres of Tongass National Forest, was designated a non-attainment area for particulate matter due to wood smoke and road dust in the early 1990s. The Clean Air Act established regulatory authority for air quality within the Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC 2007). ADEC's monitoring strategy is to focus its limited resources on the highest priority areas and pollutants (i.e. areas and pollutants most likely to exceed a public health standard). For Southeast Alaska, ADEC has focused its efforts on monitoring PM10 and PM 2.5 and (particulate matter) in Juneau's Mendenhall Valley. The Forest Plan concluded that EPA and ADEC enforcement of applicable regulations would ensure compliance with air quality standards.

All marine vessels including vessels covered under the State of Alaska's Department of Environmental Conservation (ADEC) Commercial Passenger Vessel Environmental Compliance (CPVEC) program must comply with Alaska's marine vessel emission standard (ADWCD 2007). The vessel smoke stack visible emissions must be no greater than 20% opacity, except when maneuvering to/from anchor or port. Ports in Juneau, Sitka and Ketchikan are near Tongass National Forest boundaries.

Due to concerns about the air quality in downtown Juneau, an ADEC contractor set up ambient air monitors during 2000 and 2001 to measure the level of selected pollutants that are harmful to public health and the environment (i.e. sulfur dioxide, nitrogen dioxide and microscopic particles of PM 2.5). A committee of ADEC scientists, concerned citizens, industry representatives and the U.S. Coast Guard employees selected the air monitor locations. Three downtown ambient air-monitoring stations were installed in 2000: Baranof Hotel, Capital Park, and Marine Way. In 2001, three monitoring stations were installed: Wickersham House, Highlands and Marine Way. Data from these monitors were appreciably below the State and national air quality standards in both 2000 and 2001. ADEC concluded that current air pollution concentrations in Juneau would not result in adverse effects on human health or welfare. Due to the levels being low in 2000 and 2001, ADEC decided to discontinue the monitoring. The ADEC has listened to haze concerns made by local residents but they did not begin any more monitoring in 2006 due to lack of funding (ADWCD 2007).

Question 1: Is air quality meeting state and federal ambient air quality standards?

Current Tongass National Forest projects used to determine air quality

Lichen Biomonitoring

To date, 134-biomonitoring plots are established across the Tongass that have provided lichen tissue chemistry data (Figure 1). Of the 134 plots, 54 are in wilderness. Of the 54 plots in wilderness, 13 were revisited during the second monitoring period between 2003 and 2005. Except for the Maurelle Islands, all wilderness areas on the Tongass contain air quality biomonitoring plots (Table 1). Lichen biomonitoring plots were also established at the Greens Creek Mine on Admiralty Island and along an elevation gradient on Mt Roberts in Juneau. Some of the other areas outside wilderness areas where lichen biomonitoring plots have been established are on Baranof, Mitkof, and Revilla Islands, and along Lynn Canal (Figure 1).

From the 1989 to 1992 and 2003 to 2005 data collection periods, threshold levels were determined per lichen species and pollutants from 88 of the 134-biomonitoring plots (Table 2). All of data from the 54 wilderness plots were included. Some of the other plots considered “pristine” are from Pikes Lake Research Natural Area (RNA), Old Toms Creek RNA, Dog Island, Kell Bay, Cape Fanshaw RNA, and Crystal Mountain on Mitkof Island.

Provisional elemental analysis thresholds are levels of elements per lichen species that can be expected at a clean air site on the Tongass National Forest. Levels above threshold might be considered elevated due to anthropogenic or natural processes. Natural processes could be airborne oceanic salt spray or glacial dust. Thresholds were estimated for each element and lichen species by using the non-parametric 97.5% quantile in the lichen tissue data collected from 88 plots considered relatively free of human disturbance and pollution effects. Elemental threshold levels in lichens can be used by land managers to determine if the lichens in an area of concern have elevated levels of pollutants.

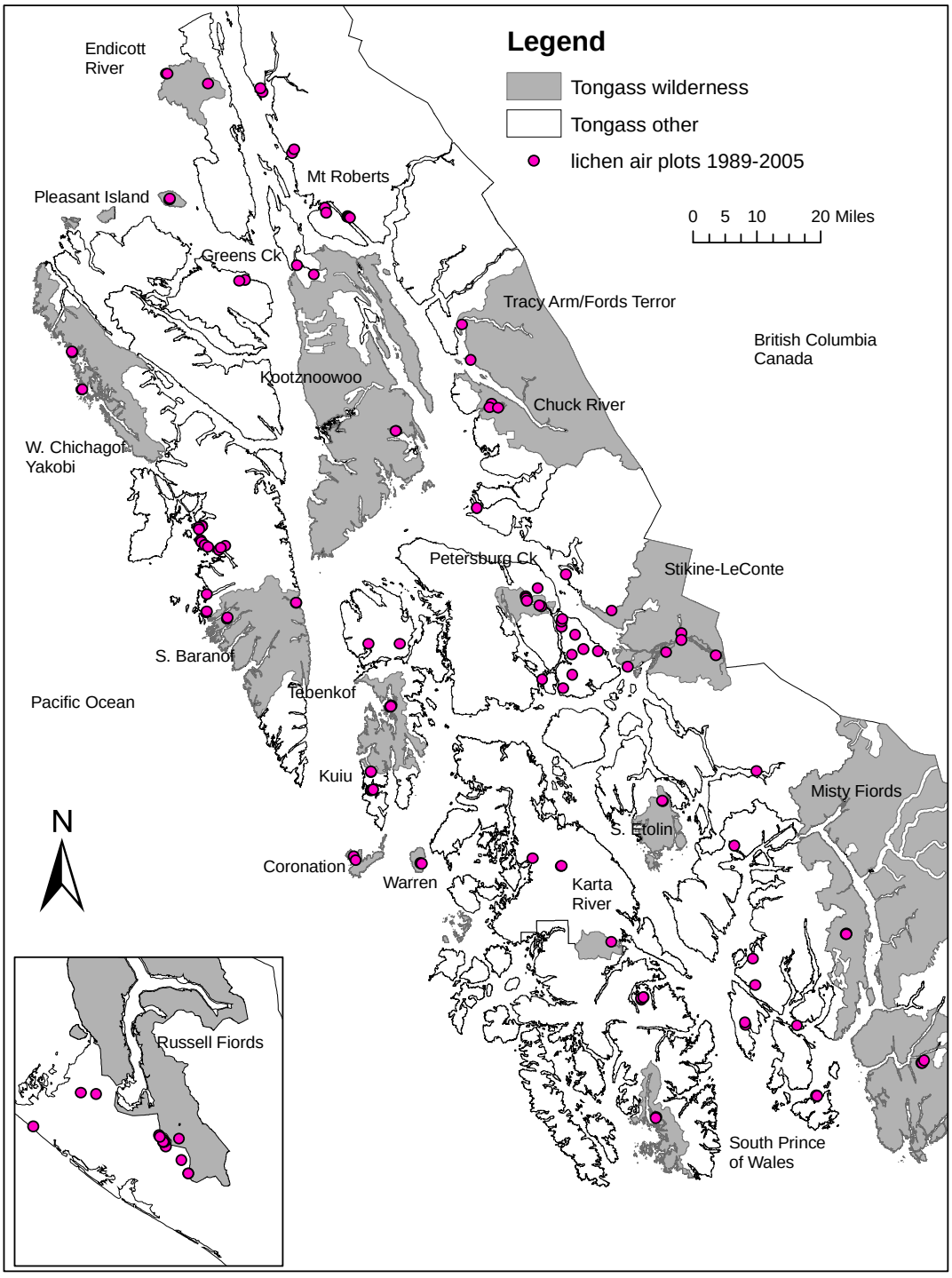

Figure 1. Lichen biomonitoring plots on the Tongass National Forest that contain elemental data.

Table 1. Summary of lichen biomonitoring plots on the Tongass National Forest visited between 2003 and 2005. Site names in bold were first established between 2003 and 2005.

Site Name	**Plot numbers**	**Plots from 1989-91 with tissue data that were revisited**	**Date**
Coronation Island	513, 514	NA	July 14-15, 2005
Chuck River	491, 492, 493	NA	July 19- 20, 2003
Endicott River	506, 507, 508	NA	July 27-28, 2005
Greens Creek Mine	511, 512	NA	July 26, 2005
Karta River	159	159	August 5, 2004
Kootznoowoo	189, 190	189, 190	June 7, 2005
Kuiu	498, 499	NA	August 23, 2004
Misty Fjords	86, 88	86, 88	May 19, 2005
Mt. Roberts-Juneau	1000, 1001, 1002,1003,1004	NA	July 29, 2005
Petersburg Creek/Duncan Salt Chuck	116, 57	116	August 26, 2004
Pleasant Island	145, 146	145, 146	July 28, 2004
Russell Fjords and Pikes Lake RNA	213, 69	69	July 4-5, 2005
South Baranof	487, 488, 489, 490	NA	May 17, 2004
South Etolin	496, 497	NA	August 18, 2004
South Prince of Wales	515, 516	NA	June 15, 2005
Stikine-LeConte	30, 31, 195, 494, 495,503	30, 31	August 16-17 and 25, 2004
Tebenkof	33, 500	33	August 24, 2004
Tracy Arm/Fords Terror	504, 505	NA	September 15, 2003
Warren Island	509, 510	NA	July 13, 2005
West Chichagof-Yakobi	98, 99, 100, 101,	101	May 18, 2004

Table 2. Threshold levels for four lichen species and elements in pristine areas of the Tongass National Forest. All elements, except nitrogen (N) and sulfur (S) are reported in ppm (parts per million). Nitrogen and sulfur are presented in percent (%) of dry weight. Alesar=*Alectoria sarmentosa*, Hypog= *Hypogymnia* species, Lobore=*Lobaria oregana*, Plagla=*Platismatia glauca.*

Al=aluminum, B=boron, Ba=barium, Be=beryllium, Ca=calcium, Cd=cadmium, Co=cobalt, Cr=chromium, Cu=copper, Fe=iron, K=potassium, Li=lithium, Mg=magnesium, Mn=manganese, Mo=molybdenum, Na=sodium, Ni=nickel, P=phosphorus , Pb=lead, Rb=rubidium , Si=silicon , Sr=strontium , Ti=titanium, V=vanadium, and Zn=zinc.

Species	**S**	**N**	**Al**	**B**	**Ba**	**Be**	**Ca**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**
Alesar	0.06%	0.56%	56.78	9.33	15.84	0.04	9689.25	0.40	0.78	0.73	1.86	55.64
Hypog	0.09%	0.88%	1126.44	9.47	76.62	0.04	24671.17	0.61	1.25	2.38	31.31	1990.78
Lobore	0.13%	NA	580.03	4.06	16.46	0.04	1158.10	0.55	0.83	1.51	10.18	1010.97
Plagla	0.08%	0.80%	1063.57	6.05	53.80	0.04	4104.48	0.32	1.14	3.29	7.55	1773.56
Species	**K**	**Li**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**	**Rb**	**Si**	**Sr**
Alesar	2413.25	0.40	740.83	188.24	0.54	893.16	0.96	913.75	5.00	53.00	134.75	33.56
Hypog	3284.34	0.71	2127.70	860.85	0.54	929.13	4.26	1597.23	10.13	53.00	563.82	61.26
Lobore	8001.57	0.59	735.79	168.00	0.54	394.30	1.65	2532.49	3.52	53.00	681.18	6.30
Plagla	2523.88	0.60	1717.08	483.70	0.54	693.21	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									

IMPROVE

In 2003, the Air Executive Committee funded the installation of an Interagency Monitoring of Protected Visual Environment (IMPROVE) aerosol sampler near Petersburg (Figure 2). The IMPROVE program is a cooperative air quality monitoring effort between federal land managers; regional, state and tribal air agencies; and the Environmental Protection Agency (IMPROVE, 2007). Along with a greater understanding of regional patterns of air pollutants, the Petersburg site will provide more information about the trans-Pacific contribution of air pollutants to the loadings seen in the Pacific Northwest and in Alaska. The aerosol data are made publicly available approximately one year after collection. In addition, seasonal and annual data reports, special study data reports, technical publications and other data are prepared from the network of IMPROVE sites nationwide. All of these IMPROVE resources about the Petersburg site can eventually be obtained from the website:

http://vista.cira.colostate.edu/improve/data/IMPROVE/summary-data.htm

Tracy Arm Cruise Ship Emissions Visual Monitoring

The Forest Service signed an MOU with the ADEC in 2002 to monitor visual emissions from cruise ships in wilderness areas. Cruise ship visits have increased on the Tongass over the past few years, and particularly in Tracy Arm/Fords Terror Wilderness (Figure 3). In 2006, there were 283 cruise ship vessels that entered the narrow Tracy Arm and carried tourists to view the glacier and fiord, as compared to 209 in Glacier Bay National Park and 54 in Misty Fiords National Monument and Wilderness.

Western Airborne Contaminants Assessment Project (WACAP)

The Western Airborne Contaminants Assessment Project (WACAP) was initiated in 2002 to determine the risk to ecosystems and food webs in western national parks and wilderness areas from the transport of airborne contaminants (NPS 2007). WACAP is designed and implemented by the National Park Service's Air Resources Division in cooperation with many western national parks, U.S. Environmental Protection Agency, U.S. Geological Survey, USDA Forest Service and several universities.

Airborne contaminants can pose serious health threats to wildlife and humans. Some toxic compounds "biomagnify" meaning that small concentrations in air, water, snow and plants can result in larger concentrations at higher levels of the food web like fish and mammals. Biological effects of airborne contaminants include impacts on reproductive success, growth, behavior disease and survival. The contaminants to be detected in this assessment are persistent organic pollutants (POPs), mercury, and semi-volatile organic pollutants (SOCs).

Primary WACAP locations collected samples from lichens, conifers, fish and mammals, and from lake sediments and snow. These primary locations were in ten National Parks across the country including Denali National Park in Alaska. The Tongass National Forest has participated in this program as one of ten secondary sampling locations where only lichens and spruce needles were collected. The geographic position of the Tongass acts as a bridge between interior Alaska and the lower 48 for data collection and interpretation of results.

The analysis of the samplers will help determine the annual deposition rate of POPs and SOCs and at which elevation they are most accumulating in the wilderness. The vegetation

analysis will be completed at the Oregon State University chemistry lab where the technology has been developed for the WACAP program.

Monitoring Results (2006)

ADEC and EPA monitoring

Since 1998, the Forest Service has reported an annual summary of ambient air quality monitoring data collected by ADEC in the vicinity of the Tongass National Forest (EPA 2007). During 2006, ADEC analyzed the content of particulate matter (PM_{10} and $PM_{2.5}$) in the air in Juneau. Out of the 89 days monitored in 2006, there were 80 days of good Air Quality Values and 9 moderate days. The main pollutant was $PM_{2.5}$ with a small percent of PM_{10}.

The higher the AQI value is, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 represents good air quality with little potential to affect public health, while an AQI value over 300 represents hazardous air quality. An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered unhealthy - first for certain sensitive groups of people, then for everyone as AQI values get higher.

Cruise Ship Emissions Visual Monitoring

ADEC contractors monitored visible emissions from vessel smoke stacks and performed 64 opacity readings during 2006, with 19 different cruise ship vessels. ADEC issued no Notices of Violations (NOV) in 2006. Observations took place in Whittier, Seward, Skagway and Juneau.

In 2006, USFS wilderness rangers monitored only 5% of cruise ships in Tracy Arm. The summer of 2006 was not a good year for opacity observations by the wilderness rangers due to the higher than normal rainfall and generally bad weather. Of the eleven readings in Tracy Arm, USFS wilderness rangers reported two readings of interest. The two readings of interest resulted in two warning notices to the cruise ship vessels (ADEC 2007). As of the date of this report, ADEC is working with the cruise ship companies to resolve the readings.

Lichen Biomonitoring

In October 2005, lichen tissues were sent to the University of Minnesota and analyzed. Results were returned to the Forest Service in May of 2006. A statistical analysis of pollution trends was conducted in 2006. A summary report will be available in 2007.

As stated above, threshold levels were determined per lichen species and elements from 88 of the 134-biomonitoring plots. Most of the lichens collected from wilderness areas on the Tongass contained elements below threshold levels. However, some lichen samples were above threshold for nitrogen, sulfur and certain heavy metals. The majority of the higher levels were near known pollution sources such as downtown Juneau above the cruise ship dock and Greens Creek mine portal and tailing pile. The higher levels of some elements do not necessarily indicate future lichen mortality or deteriorating ecosystem health. The lichen species used in this biomonitoring program are tolerant of elevated levels of many elements. However, it does indicate that elements are concentrating in the environment near some

polluted areas on the Tongass. It is unknown how this apparent exposure to pollution affects other organisms.

IMPROVE

Data filters were successfully retrieved during the 2006 sampling period. Data filters were sent to the University of California- Davis, Crocker Laboratory. Results for 2006 will not be available for some time, as the lab is at least a year behind in the analysis for the IMPROVE program.

WACAP

Results from the WACAP study consisting of final databases, interpretive reports and publications (that include the Tongass data) are scheduled for 2007 and will be generated by the National Park Service.

Evaluation of Results

ADEC has continuously analyzed the content of particulate matter in air in Juneau's Mendenhall Valley since 1997. Intermittent data have also been collected in Ketchikan and from other sites in Juneau. No state or federal ambient air quality standards have been exceeded. The last time particulate matter standards were exceeded in Juneau was in 1993.

ADEC's and EPA's network analysis indicates that the Juneau station is below the standards set by ADEC and the EPA, but with dubious applicability beyond the Mendenhall Valley (EPA, 2007). For over six years now, the Juneau data reflect very low levels of particulate matter in a residential/urban setting. It is very unlikely that this station could detect even lower levels of particulate matter originating from or affecting the Tongass National Forest at the Forest scale.

The Tongass National Forest Ecology program has the responsibility for monitoring the air resource. Responding to the needs of the wilderness managers of the Forest, ecologists have begun to re-monitor permanent lichen plots established in wilderness areas across the Forest and have established plots in wilderness areas that had no permanent lichen air monitoring plots. A report will be generated in 2007 summarizing results and comparing some elemental levels to the 1989-1992 baseline study. The threshold levels generated for elements found in Tongass lichens will be useful tools for land managers to determine if a pollution source is potentially causing high concentrations of certain elements of interest in the surrounding environment.

The IMPROVE site in Petersburg is collecting data on the type of particles that affect visibility and air quality (PM 2.5, PM10, organics and elemental carbon, and sulfates, nitrates and chloride ions). Through sample analysis, the particle size, chemical composition, and concentration will be characterized. The Petersburg data is stored at the IMPROVE website, but runs at least one year behind collection (IMPROVE 2007). Once they are at the IMPROVE website, reports of air quality can be generated upon request for the region. The first quarter results for the year 2005 indicate that the Petersburg station is sensitive to regional pollutants such as smoke from forest fires originating in other areas. No data are available for the remainder of 2005 or 2006 until the end of 2007 and 2008.

Action Plans

No corrective action is recommended with respect to current air resource conditions on the Tongass National Forest.

Direct effects of Forest Plan implementation activities on air quality are likely to be temporary, limited and highly localized. There are no Class I areas within or near the Tongass National Forest. Therefore, the Tongass National Forest is held to the same ambient air quality standards as the rest of Southeast Alaska. ADEC, in consultation with EPA, has a long-term strategy for air quality monitoring that is responsive to emissions and community concerns. Their network analysis does not identify any concerns related to the Tongass National Forest near their stations (EPA, 2007).

The following specific actions are recommended for consideration with respect to this monitoring question:

1. Continue to summarize the annual data from ADEC and EPA from the areas in proximity to the Tongass National Forest such as Juneau, Ketchikan, and Sitka.
2. Consider incorporating air quality monitoring activities such as biomonitoring with lichens into wilderness air monitoring at the Forest Plan scale, and/or project or program monitoring below or above the Forest Plan scale as appropriate. Thresholds have been established for Tongass lichens for many elements. Managers can use the thresholds for comparison with future lichen samples from areas with pollution concerns. Lichen biomonitoring can detect nitrogen and sulfur levels. These two pollutants can cause ecosystem and human health deterioration. *Trends in pollution levels can only be established through regular monitoring every 5 to 10 years.*
3. For the next five years, use the annual results from the Petersburg IMPROVE program for evaluation criteria of achieving ambient air quality standards across the Tongass National Forest and for a regional and global perspective of $PM_{2.5}$, PM_{10}, organics and elemental carbon, and sulfates, nitrates and chloride ions. After five years, the project can be re-evaluated and decisions made to continue or discontinue participation in the program. Nitrogen emissions are expected to increase in Asia over the next 25 years as coal-generated power facilities are built. With this program, the Trans-pacific pollution can eventually be detected if the monitoring continues long enough for trends to be established.
4. Continue smoke-emissions monitoring in Tracy Arm/Fords Terror Wilderness in conjunction with ADEC.
5. Encourage and continue collaboration with the National Park Service WACAP and cruise-ship-emission studies in Skagway and Glacier Bay.

Recommendations are to review the management of the Tongass National Forest and direction for air quality monitoring as a Forest Plan monitoring activity. Air quality in the Tongass National Forest and Southeast Alaska in general is more likely to be affected by long-range transport and global processes that are much broader in scale than the Forest Plan. Effects on air quality are more appropriately addressed through programmatic baseline monitoring in wilderness and/or by participating in broader regional or national air quality monitoring efforts like IMPROVE and WACAP.

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