

**NEW ENGLAND FOREST HEALTH MONITORING
Work Plan For Bioindicator Data - 1991**

Overview

Air pollutants such as ozone, sulfur dioxide, and hydrogen fluoride can produce a variety of symptoms on forest vegetation. Foliar symptoms on certain species of herbaceous and woody plants are useful indicators of possible air pollution injury. The presence or absence of air pollution injury on indicator species will be recorded in the field. These data can then be used to assess the distribution and severity of air pollution injury on bioindicator species in the vicinity of Forest Health Monitoring (FHM) plots.

The New England Project

Ozone is the most widespread air pollutant in the New England states, causing more plant damage than any other pollutant. Ambient ozone concentrations frequently exceed the National Ambient Air Quality Standard (NAAQS) of 0.12 ppm during the growing season, even in remote areas. Earlier surveys indicate that a number of plant species native to the area are manifesting a visible response to ozone pollution. For these reasons, ozone will be the focus of biomonitoring activities in New England. Several different procedures will be pursued that will more readily allow field personnel to detect ozone injury when it occurs.

For the 1991 field season, the following 3 tasks will be completed:

- I. Reevaluate ozone indicator species on the plots that were established in 1990.
- II. Locate potential open areas for monitoring air pollution bioindicators on future FHM plot revisitation using the National Program Guidelines provided in the 1991 Field Manual.
- III. Select 1 bioindicator plot which will be visited weekly or biweekly in order to monitor symptom development over time and thereby better define the observation window for biomonitoring in subsequent years.

Task I and II will be completed by the field crews during their regularly scheduled visits to the FHM plots. Task III will be completed by a specially named individual for each state; it is not a concern of the field crews. Specific procedures for each task are outlined below. Data sheets will be provided to record the information necessary to complete Task I and III. Information for Task II will be recorded on the PDR.

TASK I. REMEASUREMENT OF BIOINDICATOR PLOTS ESTABLISHED IN 1990

Exact procedures used in 1990 will be adopted for the 1991 field season. At each preestablished bioindicator plot, ozone indicator species will be examined for injury symptoms as part of the normal plot activities. The date of the revisitation will be recorded in addition to the species code for each indicator, the total number of plants observed, and the number of those with symptoms. A maximum of indicator species and a maximum of 10 plants per species will be examined. In those cases (i.e. wild grape and poison-ivy), where it is not possible to distinguish individual plants or stems, an estimated foot square area will be considered representative of a single plant or stem and evaluated as such. Additional descriptive data as to the injury type and severity will be recorded in the notes. If the pre-established plot meets the 1991 criteria for continued biomonitoring this will also be recorded.

TASK II. PLOT ESTABLISHMENT - 1991

Refer to the "Eastern Forest Health Monitoring Field Measurements Guide", 4th Draft, 1991, Section VI, p.28. A new plot will be located only if the bioindicator site selected in 1990 does not meet the criteria for continued biomonitoring as outlined in the field guide.

TASK III. PERIODIC MEASUREMENT OF BIOINDICATOR DATA

Each New England state will select 1 site or preestablished plot to collect periodic measurements of bioindicator data. This site should be within 4 miles of a continuously operating ozone monitor so that it will be possible to examine the relationship between ambient ozone concentrations and injury to the bioindicator species. Specific procedures and calculations are outlined below.

A. Plot Location Criteria:

1. Three acre or larger opening
2. Close to an ozone monitor
3. No major disturbances such as use of herbicides
4. Plants in full sunlight
5. 25% or more of the leaves touchable
6. Maximum of 10 plants per bioindicator
7. Pick the 3 bioindicator species that are highest on the preferred list (see data sheet).
8. Per plant: Estimate percentage of leaves with symptoms.
For symptomatic leaves, record average severity.
Describe the injury type.

B. Data Collection:

Sample plants will be observed a minimum of once every 2 weeks, preferably once a week, from June 24th through August 30th. Each sample plant will be flagged and assigned a number from 1 to 10 so that the same plant is reevaluated at each observation date. The observed plants must have 25% of their leaves within touching height

of the observer to qualify for measurement. For all species, upper and lower leaf surfaces will be observed for ozone injury. For those bioindicator species where it is difficult to distinguish individual plants or stems (i.e. wild grape and poison-ivy), an estimated 2 foot square area will be considered representative of a single plant and evaluated as such.

1. Injury Amount (percentage of leaves affected).

For each plant located, the percent of the leaves affected will be estimated and recorded in one of 3 classes (described on the data sheet). The number of leaves with symptoms is divided by the total number of leaves observed.

2. Injury Severity (average % area per leaf affected).

For each plant with greater than 0% leaves affected, the average of the severity is estimated and recorded in the following classes (described in more detail on the data sheet).

- 1= barely affected - apparent only upon close examination
- 2= readily apparent - apparent from 4 to 6 feet away
- 3= severely affected - apparent from farther than 6 feet away

3. Injury Type

For each plant a "picture" of the affected leaves will be recorded by selecting one of the following descriptions of ozone injury (described in more detail on the data sheet).

- 1= upper-leaf-surface stipple
- 2= bifacial flecking
- 3= white pine chlorotic mottling

4. Site Factors

General site conditions will be recorded in order to provide useful interpretive data for between site comparisons. Elevation, slope facing, and approximate size of plot opening will be recorded on the data sheet. Approximate distance to the ozone monitor will also be recorded.

5. Visibility or Weather Conditions

Weather conditions at the time of observation can have a significant impact on injury values. For example, it is much easier to see ozone symptoms on grey days than on bright sunny days. Weather conditions will be recorded using the following 3 classes.

- 1= overcast or grey day (good visibility)
- 2= bright and sunny
- 3= wet and rainy

6. Ambient Ozone Concentrations

Mean hourly ozone concentrations will be used to characterize the dose to which the indicator plants have been exposed during the

exposure period prior to the observation date. Recording this data may be postponed to the Fall when it will probably be easier to obtain the necessary information.

For the 1 or 2 weeks prior to the observation date the total number of hours when ozone concentrations were equal to or greater than 0.08 ppm will be recorded. In addition, the peak ozone concentration during that same exposure period will be noted. The value of 0.08 ppm used to be the NAAQS for ozone and is still considered by many scientists to be an appropriate standard to protect plant health.

C. Training:

Training will be provided on plot location procedures, species identification, ozone symptomatology, and injury measurements. Individual crew members will be tested on their ability to recognize the ozone symptom. In addition, each crew will be equipped with the reference manual "Diagnosing Injury to Eastern Forest Trees: A manual for identifying damage caused by air pollution, pathogens, insects, and abiotic stresses" for use during the field season..

INJURY CODE SHEET FOR PERIODIC MEASUREMENTS

Percentage: Percentage of injured area is determined by estimating the proportion of live crown or leaf area injured relative to the total leaf area. Record value on a scale of 1 to 3 as follows:

- 1= 1 to 10% of the crown or leaf area with symptoms
- 2= >10% and <50%
- 3= >50%

Severity: For each plant with greater than 0% leaves affected, the average of the severity is estimated and recorded in the following classes:

- 1= 1 to 10% of the upper leaf surface with symptoms. Most of the leaves show trace amounts of injury; May be apparent only upon close examination.
- 2= >10% and <50% of the upper leaf surface with symptoms. Most leaves show moderate injury; May be apparent while standing at arms length from plant.
- 3= >50% of the leaf surface with injury. Most leaves are severely affected. Injury may be apparent from a distance (i.e. beyond 6 feet)

Type: Select the numbered code which BEST describes the injury type. Not all descriptors may apply on the same date.

- 1= Upper-leaf-surface stipple visible as tiny purple-red to black spots. Midaged to older leaves are affected. Leaf area affected is between veins or across whole leaf surface. Leaf yellowing or premature fall coloration/leaf drop may develop late in the season.
- 2= Small white to tan flecks are visible on midaged to older leaves. Both upper and lower leaf surface may be affected. Leaf area affected is between veins or across whole leaf surface. Affected leaf may turn brown and be invaded by secondary organisms.
- 3= Chlorotic fleck or mottle on white pine and other narrow-leaf plants. Injury appears as tiny white to yellow spots on young and older needles. Current year needles may show yellow to red-brown tips with all needles in a fascicle affected equally. Needle length may be reduced. Premature defoliation of older needles may occur.



NEW ENGLAND FOREST HEALTH MONITORING
Periodic Measurements of Bioindicator Plants

LOCATION:

EVALUATOR:

ELEVATION:

SLOPE FACING:

APPROXIMATE SIZE OF OPENING:

Bioindicator Species: Select only three for evaluation. Examine up to 10 plants per species. The species are listed below in order of preferred selection.

- | | | |
|------------------|---------------|------------------------|
| 1. milkweed | 6. poison-ivy | 10. flowering dogwood |
| 2. yellow poplar | 7. green ash | 11. eastern white pine |
| 3. blackberry | 8. white ash | 12. red maple |
| 4. black cherry | 9. sassafras | 13. quaking aspen |
| 5. wild grape | | |

DATE OF OBSERVATION	WEATHER CONDITIONS	NUMBER OF HOURS >.08 ppm	HIGHEST CONC. ppm

WEATHER CONDITIONS: 1= overcast or grey day (good visibility)
 2= bright and sunny
 3= wet and rainy

OZONE DATA: Calculate the total number of hours the mean hourly ozone concentrations were equal to or greater than 0.08 ppm and the peak ozone concentration for the 2 week exposure period up to but not including the observation date.

NEW ENGLAND FOREST HEALTH MONITORING
 Periodic Measurements of Bioindicator Plants

DATE:

Plant Number

SPECIES	INJURY	1	2	3	4	5	6	7	8	9	10
	Percentage										
	Severity										
	Type										

SPECIES	INJURY	1	2	3	4	5	6	7	8	9	10
	Percentage										
	Severity										
	Type										

SPECIES	INJURY	1	2	3	4	5	6	7	8	9	10
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	Severity										
	Type										

COMMENTS:

