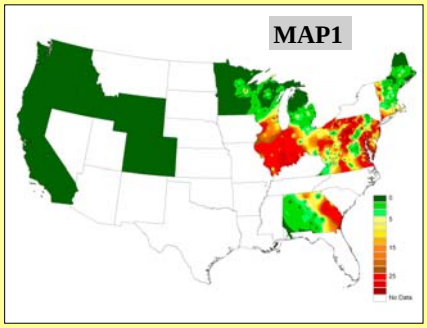
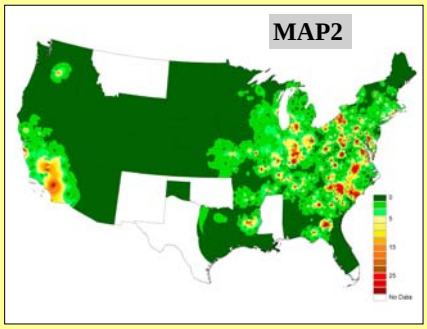
OZONE AND FOREST HEALTH - USDA FOREST SERVICE

DATA COLLECTION AND ANALYSIS

BIOSITE MAPS





SAMPLING METHODS AND ESTIMATION

Sampling rules

1. Biosites are wide open areas, at least 1 acre in size, alongside forested areas that contain at least 30 individual plants of two bioindicator species.
2. Biosites must be free of significant soil compaction and other man-made disturbance.
3. Individual plants are selected at random for injury evaluations.
4. Each plant is rated for the percent of the plant that is injured and the average severity of injury using a modified Horsfall-Barrett scale.
5. Pressed leaves with symptoms are collected for each species for expert validation of the ozone injury symptom.

Estimation procedures

1. Plant injury data from each biosite is quantified by calculating a biosite index (BI).
2. The BI at each biosite is averaged across years. In the example to the left, MAP1 = 1994 to 1998 and MAP2 = 1999 to 2002.
3. Geostatistical procedures are used to create an interpolated bioindicator response surface across the landscape.
4. The interpolated map is classified into gradations of response ranging from low (green) to moderate (yellow) to high (red).

Change estimation = Estimates derived from consecutive 5-year periods (e.g., MAP1 and MAP2) are used to evaluate long-term trends in bioindicator response.

OZONE RISK ASSESSMENT

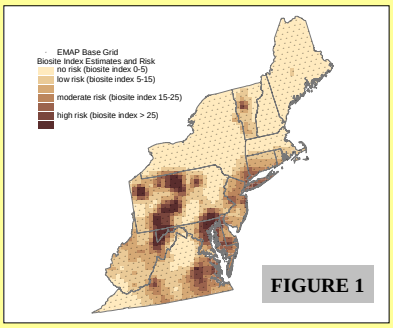


FIGURE 1: An interpolated bioindicator response surface along with intersecting FIA P3 plot locations. Dark areas indicate where conditions are favorable for ozone-induced plant injury.

Intensified sampling is recommended in those areas where high ozone risk coincides with the spatial distribution of ozone-sensitive tree species.

Interpolating the ozone data allows analysts to generate a predicted biosite index value for all P2 and P3 ground plots so that ozone data can be related directly to tree growth and other indicators of tree health and condition.

References: (1) Coulston et al. *Environmental Monitoring and Assessment* 83: 113-127, 2003. (2) Skelly et al. PSIE 2003-5 FHM Evaluation Monitoring Project. Penn State Institute and USDA FS.

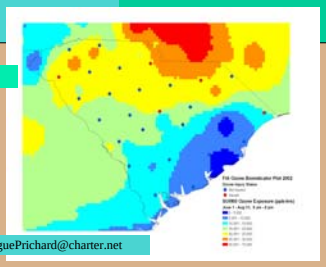
REPORTING

Summary Statistics for State Reports

1. Counts of biosites, plants, and species. Mean Biosite Index score (ozone injury value).
2. Map of biosite distribution showing presence or absence of ozone injury.

Biosite Summary Statistics	ABC Region	State1
Number of biosites evaluated	xx	xx
Number of biosites with injury	xx	xx
Average biosite index score	x.x	x.x
Number of plants evaluated	xxx	xxx
Number of plants injured	xx	xx
Percent plants by injury severity score	xx.x	xx.x
No.of plants evaluated (injured) by species:		
Black cherry	xx	xx
Ponderosa pine	xx	xx
etc.		

SOUTH CAROLINA

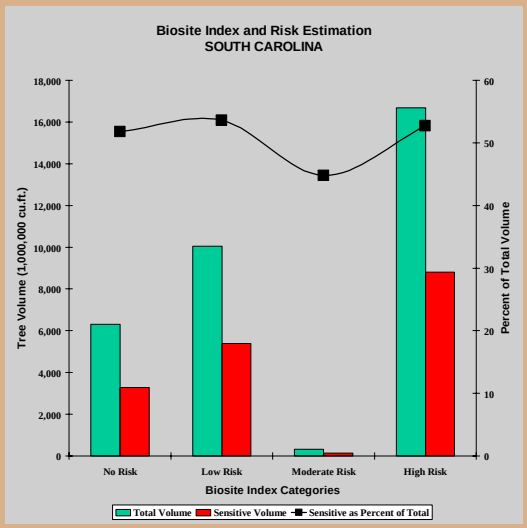


Maps available from TeaguePrichard@charter.net

Population Estimates for State Reports

Derived from interpolated data:

1. Acres of forestland at risk for ozone impact.
2. Volume of susceptible species at risk for ozone impact.



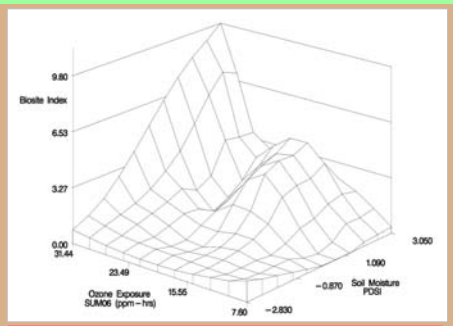
Biosite Index Categories on the X axis represent the risk of probable ozone injury to ozone sensitive tree species. In this example of state-level results, over 16 million cubic feet of tree volume falls into the high risk zone in South Carolina and 53 percent of this total includes tree species that are ozone sensitive.

Why Does the Biosite Index (BI) Work?

The graph below shows the relationship among ozone-induced foliar injury to bioindicator species (Biosite Index), ambient ozone exposures (SUM06) and soil moisture availability (PDSI).

Elevated ozone exposure results in an increase in the BI when soil moisture levels are above normal (PDSI > 0). When PDSI values are less than zero (i.e, drought conditions), increasing ozone exposures do not result in increased injury. Drought conditions mean plant stomates close, ozone in the air cannot get into the plant, and no injury occurs. The relationship among ozone, soil moisture, and injury means the Biosite Index provides a meaningful indication of ozone stress; how much ozone the plants "see" rather than how much is in the air.

Ref: *Environmental Monitoring and Assessment* 87: 271-291, 2003.



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Web Page and Data Access: fiaozone.net