Effects of English ivy and ivy removal on macro- and microinvertebrate diversity in Lullwater

Background

English ivy (*Hedera helix*) is an non-native, invasive plant in forest ecosystems in the southeastern United States. It is especially pervasive in disturbed ecosystems. As a result, English ivy is quite common throughout many parts of Lullwater. Where ivy is present, it excludes most herbaceous plants found on the forest floor. In addition, it can cause serious damage to trees that it climbs.

Because of its invasive qualities and the damage that it can do to forest ecosystems, it is advantageous to remove the ivy when possible. The method that has the lowest environmental impact is removing the ivy by hand. However, because so much of the forested area at Lullwater has been invaded by ivy, such an approach is not feasible there. Therefore, herbicides may be needed to control the ivy. Currently on Emory's campus, herbicides are only used to control ivy in Baker Woods.

Although herbicides will have direct effects on the ivy and other vegetation that is sprayed, they also may have significant indirect effects on other components of the forest ecosystem. One such indirect effect may be on invertebrates. Herbicides have been found to have a range of effects on soil microinvertebrates (Freemark and Boutin 1995). For example, some herbicides such as MCPA have no effect, whereas others like atrazine had significant negative effects. Interestingly, dalapon and TCA application were found to lead to an increase in soil invertebrate numbers. In contrast, herbicides have an almost universal negative effect on macroinvertebrates, especially arthropods (Freemark and Boutin 1995). By reducing the number of macroinvertebrates, herbicide application may negatively impact other organisms higher up the food chain due to reduced food availability (Moreby and Southway 1999). Although the current evidence seems to suggest that herbicides can have negative indirect effects, studies have been limited to agricultural systems. As a result, the effect of herbicide application on invertebrates in forest ecosystems is unknown.

The purpose of this study is to examine the effect of herbicide application for the removal of ivy on macro- and microinvertebrates in a forest ecosystem. The results from this experiment could be used by the facilities management division at Emory to make an informed decision as to whether to spray herbicides to control ivy at Lullwater.

Methods

To determine the effect of herbicide application on macro- and microinvertebrate diversity, we will sample three different plot types: (1) ivy plots with herbicide applied, (2) ivy plots without herbicide, and (3) plots without ivy. A comparison of the ivy plots will allow us to draw conclusions about the effects of herbicide diversity. By comparing both ivy plots to plots without ivy, we will be able to determine how ivy effects invertebrate diversity and whether herbicide spraying will allow plots to return to their original invertebrate composition once ivy is removed.

We will sample three plots of each plot type. Within each plot, we will run a transect through the middle of the plot and sample three sites along the transect. One sample site will be at the center point of the transect. The other two sites will be 10m in either direction along the transect. At each site, we will sample both macro- and microinvertebrates. Although plots will be assigned randomly, we will control for initial differences among plots by measuring sampling

prior to spraying. In addition, because the effect of herbicide spraying may change over time, we will sample each site twice after spraying, once as soon after spraying as is safe and once several weeks later.

To sample macroinvertebrates, at each sample site measure a $1m^2$ quadrat and mark the corners with survey flags. Carefully sift through the leaf litter until you reach the soil surface. Identify and count all macroinvertebrates in the quadrat. To sample microinvertebrates, take three soil cores with film canisters at each sample site by pressing the cannister into the soil and extracting the soil core.. We will extract the microinvertebrates from the soil cores using a Berlese funnel. Place the contents of the three canisters in a single Berlese funnel for microinvertebrate extraction. Label a vial of picric acid with the site, date, and name and place it under the funnel. The apparatus heats and dries out the log contents slowly, driving the microinvertebrates down into the vials. Extract the samples for 7 days.

The microinvertebrates will either sink or float. So, you can classify and count the microinvertebrates under a dissecting scope. Classify the species using a morphological species concept.

Statistical analysis

Before we can analyze the data, we need to put them in some meaningful form. For the current study, we are interested in invertebrate diversity. Therefore, we need to use some measure of diversity. See the handout on measures of diversity. Based on the descriptions, choose the one of the measures that you think is most appropriate. You should treat the macro- and microinvertebrates separately.

After you have calculated a diversity index for each sampling site you can use the values of the diversity indices for your analysis. Because you have measured diversity at the same sites at three different times, those samples are not independent. Therefore, you need to use a repeated measures analysis of variance. In fact, you will use a two-way repeated measures analysis of variance. One factor is time and the other is the plot type. A significant time effect suggests that diversity changed over the course of the study. A significant effect of plot type suggests that there may be an effect of herbicide treatment on invertebrate diversity.

Outcome

Based on the data that you collect and your statistical analysis, you should formulate a policy statement on whether spraying of herbicide to remove ivy is justified.

Literature Cited

Freemark, K. and C. Boutin. 1995. Impacts of agricultural herbicide use on terrestrial wildlife in temperate landscapes: A review with special reference to North America. Agriculture, Ecosystems, and Environment **52**:67-91.

Moreby, S.J. and S.E. Southway. 1999. Influence of autumn applied herbicides on summer and autumn food available to birds in winter wheat fields in southern England. Agriculture, Ecosystems, and Environment **72**:285-297.