Notes for the training overview presentation

Slide 1 Welcome to the volunteer monitoring project! I'm Joan Ehrenfeld, a plant ecologist at Rutgers who has been studying exotic species in northern New Jersey for some years

Slide 2:. In this presentation, I'm going to introduce some of the basic ideas about exotic species - how they fit or don't fit into ecological communities, some of our basic ideas about how ecological communities work and why exotic species can cause problems, what kind of problems they cause, and how they get here. We'll then discuss what can be done about it, and what your role will be.

Slide 3: First off, we need to know what we are talking about. What is an exotic species? An invasive species? Why does it matter?

Slide 4:We define 'native species' as those that have evolved in the place that they are living, and/or that have arrived here by natural - not human- means. That is, their current distribution reflects their response to their environment, and their evolved relationships to that environment.

Slide 5 In contrast, we define exotic or non-native species as those that are living in a place directly because of some human intervention. This may have been purposeful - people bring species from one place to another for many reasons - or it may have been by accident (for example, as a weed mixed into crop seeds, or as ballast water at the bottom of an ocean liner). There are a number of synonymous terms that are used, in addition to 'exotic'.

Slide 6:The difference is important because species that occur naturally together, as natives, have a long evolutionary history together. This may be as predators and prey, or competitors, or in cooperative relationships - the point is that species are continuously reacting to each other, and evolving, over the very long periods of time that they have lived in the same place together. Also, many species change the physical environment around them, and the species that live together in a place are together reacting to - and evolving with respect to these physical changes. A non-native species does not share this evolutionary history with the species that it is newly living with.

Slide 7: We define an 'invasive' species as one that can spread out, occupy much or all of the available habitat, and have large negative effects on the other species living in an area.

Slide 8: It is important to understand that NOT all exotic species are invasive and NOT all invasive species are exotic. Many of our treasured garden plants are not at all invasive; they live in our gardens and yards, as long as we take care of them, but do not spread into natural areas or cause problems by spreading out over everything else. Also, some important invasive species - species that spread rapidly and exclude almost everything else - are native. All invasive species are problem-causing, by definition. While many, or most, are exotic, not all are.

Slide 9: Here are some examples of native, invasive species. Hay-scented fern can become over-abundant in forest understories; it prevents tree seedlings from growing, and excludes pretty much all other understory species, but it is quite native. There are some places in our region that have dense growths of this fern. Similarly, reed canary grass is a native species that can take over wetlands.

Slide 10: In order to understand how exotic species disrupt ecological communities, we first need to understand what an ecological community is. Here are two examples that you are probably familiar with - a typical hardwood forest, and a floodplain wetland. We note that both of them have a diversity of plants present, and, we can assume, a diversity of animals.

Slide 11: In examining how these -or any other natural communities - are put together, several features can be noted. First, there are the various species, which are interaction with each other in a variety of ways (e.g., predators and prey, competitors, facilitators, symbionts, etc.). There are the resources that the species are using - soil and water, for example. And, there is what ecologists call the 'natural disturbance regime' - the set of physical disturbances, such as windstorms or ice storms in the forest, or flooding events in the floodplain, that occur with a frequency that is characteristic for that place. For example, many floodplain forests in our areas experience a flood on average once a year (averaged over many years).

We also identify communities by the fact that a similar set of species is reliably found in particular habitats. For example, you expect the same set of plant species in valleys, along stream corridors, and this set of species is different from the set of species you reliably find along ridgetops. Again, the fact that the set of species - animal, plant, and even microbes - share an evolutionary and environmental history is a very important feature of natural communities.

Slide 12: We can further understand natural ecological communities by observing that the components of a community - the species and their interactions, the resources, and the typical types and frequencies of disturbance ? the features that create a typical composition for the community - also result in typical 'functions' of a community. Let's look at this in a bit more detail.

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Slide 13: By ‘function’, ecologists refer to the processes that take place naturally. Plants grow, dead leaves decompose, water is stored in the soil, dead trees provide nest sites and refuges for animals that need cavities, etc etc. These functions, in turn, are often important to human society. The fact that trees grow means that carbon is taken out of the air, and sequestered, safely, in the tree trunks and the soil; we now value that function as a service to our society. The soils store water; we value that function when streams continue to flow during droughts. Dead leave decompose; this function supplies the nutrients that the plants need to continue growing, which we value for both their carbon-storing and water-storing services. And so on. We can identify a range of ‘ecosystem services’ to human society that have real, dollar value, and that come from the functions, or processes, that are carried out by natural communities.

Slide 14: So, the question for us is ‘do invasive species alter ecosystem functions and damage or reduce ecosystem services? If so how do they do this? How important is it? These pictures show some of the species considered most damaging - kudzu in the south, which can cover everything in sight; old-world climbing fern in the Everglades, which threatens to undo the $11 billion dollar restoration effort now underway, and beach grass in Oregon and Washington, which has completely transformed the coast, changing boat channels and port facilities, as well as estuarine fisheries.

Slide 15: Let’s look at a few examples of how exotic invasive species alter ecosystem functions and the services those functions provide to society. Some species, including two of our target species (Norway maple and Japanese honeysuckle) are simply better at competing for light; they shade out native species. This results in a loss of diversity and loss of tree seedlings, which in turn means a loss of forest health. Purple loosestrife similarly outcompetes many wetland plants for light, resulting in a loss of diversity.

Slide 16: Some invasive exotic species alter the physical environment, which in turn alters functions and services. Tamarisk, an Asian species that is widespread now throughout the American west, both consumes vast amount of water, and accumulates sediments, which changes stream channel size and shape. Both of these effects reduce water availability to farmers and ranchers, a major concern in the arid southwest. Phragmites, a common invasive species in the northeast (and readily seen throughout the Hackensack Meadowlands, if you travel to New York on the Turnpike or the train), also accumulates sediments, which eliminates the small pools of water that are essential refuges for young fish from larger predators. As a result, the recruitment of fish to coastal sport and commercial fisheries suffers.

Slide 17: Some invasive species alter soil chemistry, which in turn affects the kinds of plants that can live in the invaded area. Barberry, for example, seems to increase the availability of nitrate, a prime resource for weedy species. Not surprisingly, when barberry is abundant, other weedy species may also become common. A plant called ‘salt-lover’, which grows in Western rangelands, takes up large quantities of salt from the soil. This can poison cattle that feed on it; it also makes the surface soil so salty that desirable rangeland plants can't grow.

Slide 18: Invasive exotic species can alter that 'natural disturbance regime' that I spoke about as being part of natural communities. For example, our target species Oriental bittersweet, through its large, heavy growth into the tree tops, makes trees much more susceptible to the effects of wind and ice. Invaded forests often suffer much greater loss of trees during winter storms than uninvaded forests. In the west, in Hawaii, and in many other places around the world, invasive grasses promote frequent fire, which can convert woodlands and good rangeland to grasses that are useless to cattle.

Slide 19: Finally, invasive exotic species alter the species interactions that are a basic feature of natural ecological communities, as I described before. For example, the bush honeysuckles (common in some places around New Jersey and New York), allow predators to get to bird nests, because of the structure of their stems, unlike the native shrubs that the birds normally nest in. Purple loosestrife lures pollinators away from native plants. Garlic-mustard, one of our target species, releases chemicals from its roots that inhibit native tree seedlings from growing.

Slide 20: So, these examples should help you to understand how invasive species can have multiple negative effects on natural ecological communities, reducing diversity, changing the physical environment, and causing a loss of those functions that are also very important to human society.

Slide 21: There has been some detailed and careful studies trying to put a dollar value on the costs of invasive species in the US. David Pimentel, at Cornell University, has come up with the most recent estimate, which is presented here. Clearly, the effects of invasions are not trivial!

Slide 22: So, we need to touch briefly on how these plants get here? And how do they get out from where people introduce them into natural areas? Answering these questions may help us to prevent new problem species from becoming established, and could help us deal with the species that are already here.

23. Slide 23: One of the major sources of invasive plants is the horticulture industry. Many of the most damaging species have been introduced as ornamentals; one estimate places the number at 85% of 235 invasive woody plants alone. In other countries, between 50 and 65% of invasive species are plants introduced for ornamental purposes. Trade in horticultural plants is, in addition, a major source of new invasive pest species (insects, nematodes, bacteria, fungi).

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Other invasive species arrive as hitchhikers - as contaminants in the soil of horticultural plants, or of seed shipments. Other plants have been purposefully introduced for erosion control (see kudzu, above), or as forage species. It must be pointed out that many of the plant currently being developed for biofuels are already known to be damaging invasive species in some countries.

Slide 24: So, what can be done?? We are obviously in a very sticky, prickery place with this problem!

Slide 25: There are several approaches that are being taken. Where exotic invasive species are already established, removing them and restoring native communities is one tack that is being widely taken. Early detection-rapid response efforts are also very important - if incipient invasions of established species, or beginning invasions of new species can be spotted early, they can be eradicated quickly, before they spread.

Since so many invasive species, both plant and animal, come about through trade, one way to help is to buy and plant the right species. There are now many resources available to help buyers identify which species should be avoided, and which are safe to plant (very unlikely to become problems). Encouraging and educating friends and neighbors to shop responsibly for garden and yard plants can also help. Finally, supporting the organizations that carry out control activities - as well as volunteering to help with control and restoration activities - can make a big difference. There are many great success stories from around the country to show that this approach can actually work.

Slide 26: In our region, and for the species that invade forest, we first have a big problem: where are these species lurking? Looking out over the forest (this photo was taken from the Culver firetower on the AT, in the Kittatinnies), how can we know which exotics are present, and where we should direct our efforts for monitoring or for control and restoration?? We can’t detect them from air photos, or satellites, like the grasses in the west! And there is too much land for park and forest managers to begin to be able to create maps and data bases of exotic species. I know, because I hiked the trails from this point to the lake in the valley below, that much of the forest, at least along the trails, were free of noxious species, but that there were several areas in which they were abundant. But, much as I’d like to, I can’t spend all my time hiking! This is where YOU come in. By having many people, who know what they are looking for, survey many miles of trail, we can begin to understand how these species are distributed in our region.

Slide 27: One of the reasons I’d like to get good data on where invasive species occur within the forest communities of our region is that there are a variety of scientific questions about their ecology that I can't answer without such data. These are some of the questions - what are the patterns of abundance? Are there differences among parks and forests in the Highlands region? Are particular species associated with particular physical conditions of soil, slope, drainage, etc.? How important is the trail network? Trail heads and road intersections? How important is a history of agricultural use of the land? (we think, from studies in other regions, that it may be very important).

Slide 28: Now, we hope to use the data that you will help collect for scientific analyses of these questions. But there are several aspects to 'doing science' that should be made clear. First of all, we need to be sure that the data collection methods are completely random with respect to the data we plan to collect. This will ensure that there is no bias in the results. For example, if we only sampled near trailheads and roads, we couldn't say anything about the importance of these features on invasion, as we would have a biased sample. So, we will be collected data at arbitrarily-determined intervals - 0.1 miles. We have no reason to think that the occurrence of exotics will in any way be related to this unit of distance. The distance was chosen simply as a matter of convenience and as a way of dividing a 2 mile hike into a manageable number of samples. We also have to take into account the fact that there is ALWAYS some error in making measurements. No matter how careful, no matter how expensive the instrumentation or well trained the scientist, there is always error. So, don't feel that your data has to be perfect, or you've somehow failed. All of us - me, the other validators, Rebecca - will also make some mistakes in collected the data. Given that absolute fact, one of the jobs of the scientist is to obtain some measure of the amount of error. That tells us how reliable our results are - how likely that a number is really different from zero, or the how likely that the 'true' value of a number is near the number we have measured. Replication is one way of measuring that error, and of reducing it; the more measurements we have of the same item, the more likely that we'll have a measurement with small error. So, we have the 'validation trail' - a set of sample points that everyone will sample. The variability in the data at each point will give us a good measure of how variable the data are, and how much error there may be in the data points that are measured only by you, or by you and the validators. Finally, with this kind of measurement of accuracy, we will be able to statistical techniques to determine the probability that patterns of occurrence of the exotics are not just due to chance.

Slide 29: So, the rest of this training program will be devoted first to learning to identify a group of common invasive plants and a couple of recently arriving species that threaten to cause major problems, and then learning a protocol for collecting data on both the exotics, and also on the legacy of agricultural land use that is apparent in the vegetation.

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Slide 30: Each of you will be assigned a two-mile section of trail, either in the Wawayanda region (NJ) or the Bear Mtn-Harriman State Park region (NY). You will receive a copy of the Trail conference trail map, with your segment shown in color. You will collect data along that trail, as we will show you shortly.

Slide 31: Following your collection of the data, trained botanists from Rutgers (Wes Brooks, David Mellor, graduate students, as well as myself, Rebecca Jordan, and David Howe) will take the same data at half of your data points. This will allow us to determine the accuracy of your data; we will also do additional sampling off the trails that will allow us to test hypotheses about the association of exotics with trail corridors. Finally, we will use GIS - geographical information systems - to look at the spatial distribution of the exotics, and test their association with various aspects of the physical environment, as well as the apparent land-use history.

Slide 34: It will then be our job to write up the results for publication, and to present the findings at scientific conferences and meetings of conservation groups, as we have been doing with the preliminary results from the first two years of the project.

Slide 35: Well, have fun, don’t eat too many blueberries, and enjoy the new perspective on forests that you may gain from participating in the project!