Weeds, why don't we want them?

Fig. 1 – Flowers of purple loosestrife, a serious invader of freshwater ecosystem (photo courtesy of Donald J. Leopold)

Until recently, invasive plant species received little attention. For most of history, people only concerned themselves with weeds that affected crop or livestock health. Invasive species have proved to be one of the main reasons for biodiversity loss in a variety of ecosystems, and the Pine-oak Barren ecosystem is no exception. The Pine-oak Barrens are succumbing to incredible pressure from invasive species for many reasons, one being the elimination of natural disturbance by anthropogenic controls.

Invasive plants can be referred to as weeds, aliens, nonnatives, exotics, aliens, nonindigenous harmful species, and a variety of other names. However you choose to refer to them the same definition applies: *"invasive plants are plants that have been introduced into an environment in which they did not evolve and thus usually have no natural enemies to limit their reproduction and spread… In natural areas, the definition expands to include introduced aggressive plants that produce a significant change in terms of composition, structure, or ecosystem function* (Westbrooks 1998)."

The number of propagules entering the new area, the characteristics of that particular species, and the susceptibility of the ecosystem to the invasive species influences invasion of an ecosystem by a new species. To be able to invade a new ecosystem, weeds have several characteristics that allow them to rapidly invade and out-compete native plants for water, nutrients, and light. The longer a nonnative plant is in a foreign ecosystem, the better chance it has to survive and spread, causing a distortion of the natural ecosystem. Some of these characteristics include:

- Abundant reproduction by seeds and/or vegetative structures
- Seed dormancy during unfavorable conditions
- Rapid maturation
- Preventing the growth of surrounding plants with the production of biological toxins
- Prickles, spines, or thorns that can cause physical injury and repel animals

- Nutrient reserves in the roots or rhizomes
- Ability to produce seeds that survive under stressful environmental conditions (ex. drought)
- High photosynthetic rates

Invasive plants in the Pine-oak Barrens

Invasive species threaten two-thirds of all endangered species. Following habitat destruction, the invasion of nonnative species is now considered to be the second most important threat to biodiversity. With increased habitat destruction and the unique biodiversity present, the Pine-oak barrens could loose a lot of diversity as a result of increased numbers of invasive species. For example, blue lupine is intolerant of shade and noticeably affected by invasive species, such as black locust, that shade out present habitat. With the sustainability of blue lupine affected, the Karner blue and frosted elfin butterflies could loose their larval host plant. We will briefly cover several species of invasive plants that threaten the biodiversity of the Pine-oak barrens.

Spotted Knapweed

Centaurea maculosa Lam.

Spotted knapweed is a biennial (short-lived perennial) herb common to disturbed areas such as roadsides and pastures. An early succession species, spotted knapweed reproduces by seeds and prefers full sun but is tolerant of a variety of soil types.

The inflorescence (flower structures) of spotted knapweed are solitary and made up of numerous pinkish-purple ray flowers. The leaves are pinnately (narrow feather-like segments) divided with the basal (bottom) leaves growing up to six inches long. Spotted knapweed can produce up to 25,000 seeds in September and remain viable for up to eight years. Spotted knapweed reaches a height of 1-3' tall and has multiple branched stems and a stout taproot.

Fig. 2 – An adult Karner blue butterfly on the inflorescence of spotted knapweed (photo courtesy of Donald J. Leopold)

Spotted knapweed was accidentally introduced into the United States from Europe as a contaminant of alfalfa and clover shipments during the1880s. It is now a very serious weed that

rapidly colonizes disturbed sites in the early spring, giving it a head start over native plants. Spotted knapweed has caused a decline in native plants, such as blue lupine and New Jersey tea, because it competes with them for sun, nutrients, and moisture. As a result of a shallow root system, spotted knapweed increases erosion of the soil in areas that have been infested. With minimal natural predators and favorable growth characteristics, knapweed is spreading rapidly throughout the Pine-oak barrens. It is out competing native plants by utilizing the minimal nutrients and moisture available.

Despite all of the problems caused by spotted knapweed, it does serve one good purpose. Spotted knapweed is flowering while the adult Karner blue butterflies are feeding. This endangered butterfly nectars on spotted knapweed as a replacement for a decline in natural flowering species. By eliminating the spotted knapweed, native plants would be able to recolonize the area, including those that provide a nectar source for the butterflies.

Fig. 3 – Black locust in flower
(photo courtesy of Donald J. Leopold)

Black Locust

Robinia pseudoacacia L.

Black locust is a hardy, fast growing deciduous tree. An early succession species, black locust grows best in recently disturbed areas with full sun and the well-drained soils of the Pine-oak barrens. Being a common colonizer of urban areas, black locust is frequently planted along streets and in yards.

Reaching 40-100 feet at maturity, black locust is a clonal plant that spreads rapidly by root suckers (buds on the roots). In a stand of black locust, what appear to be many equal size trees actually share the same root system. Black locust has a long and slender trunk with rough bark. Young branches grow rapidly and are armed with heavy, paired thorns (Fig. 4). The leaves are alternate and pinnately compound (leaflets on a common axis) with 7-19, one inch long, leaflets (Fig. 5). Black locust is in the family Fabaceae (see blue lupine module). It has the characteristic leguminous fruit and fragrant butterfly-like flowers. Blooming in June, the white flowers

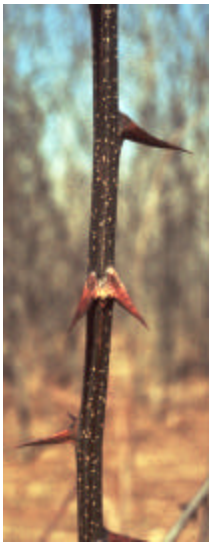


Fig. 4 – Thorns on a black locust twig
(photo courtesy of Donald J. Leopold)

grow in racemes four to eight inches long. Black locust is also a nitrogen fixer (see Plant Adaptations Module).

Fig. 5 – Black locust in fruit (photo courtesy of Donald J. Leopold)

Black locust is native to the lower slopes of the Appalachian Mountains. It has been widely planted across the United States as a nitrogen fixer and a source of lumber. Beekeepers have planted black locust as a source of nectar for honeybees. Since black locust is able to spread rapidly and colonize nutrient depleted soils, it creates dense stands that shade out and compete with the plants of the Pine-oak barrens. Black locust is able to increase the levels of nitrogen in the soils that allows other plants to invade and compete with the vegetation of this delicate ecosystem. The highly fragrant and nectivorous flowers attract pollinating insects and, therefore, compete with native plants for pollination services. Removal of this plant is difficult because it rapidly resprouts after cutting and can only be removed with a herbicide or by destroying the root system.

Tartarian honeysuckle

Lonicera tatarica L.

Tartarian honeysuckle is a non-native plant that is shade intolerant. It is commonly found along forest edges and open habitat, such as the Pine-oak barrens.

Fig. 6 – Tartarian honeysuckle in fruit
(photo courtesy of Donald J. Leopold)

Known for it's bright red berries, Tartarian honeysuckle is a fast growing, deciduous shrub. Tartarian honeysuckle can reach a height of 6 - 15 feet and has hollow, thornless twigs. The leaves are opposite and ovate (egg shaped), appearing in early spring and remaining until the late fall. The

flowers, occurring in pairs, are white-pink in color, very fragrant, and have a tubular shape. Tartarian honeysuckle blooms in early summer and fruits in early fall. The fruits are eaten by many birds and small animals and contribute to the spread of the shrub.

Tartarian honeysuckle is native to Eurasia. Cultivated as an ornamental plant, Tartarian honeysuckle was also used for erosion control and wildlife food. During the mid-1800s, this plant escaped cultivation and spread rapidly throughout the northeast. Tartarian honeysuckle is rapidly growing and can quickly invade an area, forming a dense shrub layer. For the full sun Pine-oak barrens ecosystem this is detrimental to many of the specially adapted plants. Blue lupine, New Jersey Tea, and many other plants are shaded out by the dense foliage and have reduced moisture and nutrients in the soil. By reducing the numbers of these native plants, many of the specialized wildlife of the Pine-oak barrens are left without their host plants.

Experiment – Sampling your plant biodiversity

When plant ecologists want to determine the frequency and presence of plant species in a given area, they will use a method called line-transect sampling. Line-transect sampling is one of the most common methods used to determine plant diversity because it is relatively easy to set up and can be repeated with accuracy from year to year. Plant ecologists will commonly utilize the line-transect sampling method to determine the before and after effects of various land treatments (herbicide, etc.).

Fig. 7 – Using line-transect sampling in the Pine-oak Barrens (photo courtesy of Maija E. Benjamins)

Objectives:

Learn how to set up a line-transect sampling.

Develop an understanding of how common invasive plant species are.

Be able to recognize common native and invasive plant species in your area.

Materials:

-5 pieces of sturdy string 10’ long

-10 wooden stakes approximately 1’ long

-yard stick

-compass

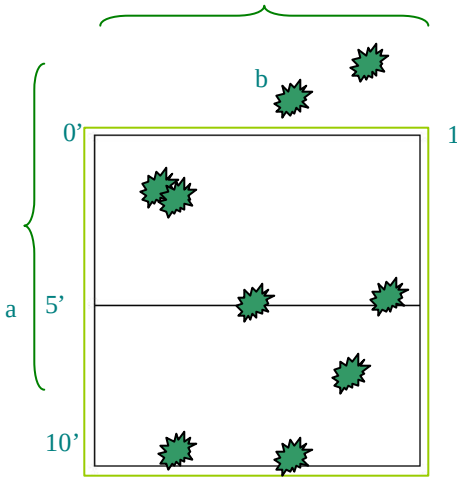
-notebook and pen

-basic plant field guide suggestions:

flowers - Newcomb's Wildflower Guide by Laurence Newcomb

trees - A Field Guide to Trees and Shrubs: Northeastern and North-Central US and Southeastern and South-Central Canada (The Peterson Field Guides) by George A. Petrides

Methods:



1) Consult with the adult supervisor and select an area to carry out this experiment. For beginners, start with an area that is relatively open (suggestion: a field) with many flowers in bloom for easy identification.
2) Attach a stake to both ends of all 5 pieces of string.
3) Using two pieces of your 10' string, lay out two sides of a box (see box sides 'a'&'b'). Check to make sure that the two sides are at a right angle by using the compass. Take a bearing of side 'b' while standing at the 0' mark, add 90 degrees to that number, and make sure that side 'a' matches the number that you just calculated. If it doesn't, have one person stand at the 10' mark of side 'a' and reposition the side until it is at the correct bearing. Push the stakes in the ground to secure the strings.

Fig. 8 – Adjusting the transect around vegetation in the Pine-oak Barrens (photo courtesy of Donald J. Leopold)

4) Following the same methods used in step 3 to set up the remaining two sides of the square. Make sure that each of the sides is at 90-degree angles of each other.
5) Using the yardstick, measure out 5' from the 0' corner. Using the remaining 10'string, bisect the box you just made. Make sure this line is also at a 90-degree angle.

6) You have now set up your sampling box. There are three transects to sample in this 10' by 10' box. They are at 0', 5', and 10'. Divide up into three groups to begin analyzing the transect lines.

Fig. 9 – Walking along a transect in the Pine-oak Barrens (photo courtesy of Donald J. Leopold).

7) Beginning at side 'a,' slowly walk along your transect (be careful not to trample all of the plants around you) and look for any plants that are overlapping your transect line (even it is just by a single leaf). Using your plant guide and notebook, look up and record what type of plant it is. Continue along the transect line and record all of the plants that intersect your line and how frequently each plant appears.
8) When each group is finished sampling their respected transect line, compile all three lists together and total how often each plant occurs in your plot.
9) Using the World Wide Web or a plant guide, determine and label whether each plant is an invasive or native species.

Plant Percentages	N (Native spp.)	I (Invasive spp.)	S (Sum of N & I)	N/S x 100	I/S x 100
Total # of different spp.	8	3	11	72.70%	27.30%
Total # of plants	16	19	35	45.70%	54.30%

10) Tally all of the numbers for your native and invasive species and calculate the percentages as is done on the chart above. This is your relative abundance of species and total plants. What is more common in your plot? In this sample plot, 72.7% of the species are native, but 54.3% of the total number of plants are invasive. This means that there is a greater diversity of native plants, but invasive plants dominate the plot. These numbers can also be calculated for single plant species.
11) Put together a paper encompassing your objectives, methods, results, and conclusions from this experiment.
12) As an extension of this project, leave a permanent marker in two of the corners of your plot and revisit the same area the following year. How much has the diversity changed? Are there more or less native plants?

Websites:

http://www.glifwc.org/epicenter/
http://www.ipcnys.org/index.html
http://www.inpaws.org/plants.html
http://aquat1.ifas.ufl.edu/welcome.html
http://www.canoe.ca/CNEWSScience9909/28_alien4.html
http://www.stolaf.edu/depts/biology/mnps/papers/beza.html
http://aquat1.ifas.ufl.edu/glossary.html
http://www1.union.edu/~rices/bob/Intro.htm

Websites with pamphlets on invasive plant species:
http://www.glifwc.org/epicenter/
http://www.ipcnys.org/Insert2.pdf

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