# The Impact of Soil Composition on Invasive Species Migration


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## Introduction

The goal of this research is to identify soil preferences associated with the spread of *Lonicera morowii* (Figure 1a.) and *Lythrum salicaria* (Figure 1b.), two invasive species found in the Tri-State area. We used Google Maps and Google Earth to trace Brooklyn Botanical Garden (BBG) herbarium specimens back to the source location and the USDA Web Soil Survey to retrieve the soil characteristics for each specimen's coordinates. Using ArcMaps, we created a map to represent both species locations and soil data and plan to analyze soil suborder trends using additional maps over the next year. Our future plan consists of collecting more soil data and retrieving additional soil maps to analyze overall soil trends. The research hypothesis is that there is an association between soil type and exotic plant invasion. Preliminary research suggests *L. morowii* prefers well-drained soils and disturbed areas and *L. salicaria* prefers estuary/wetland soil types. The importance of the results is that when the preferable and unfavorable soil suborders for species growth and proliferation can be identified, one can then identify areas where each invasive species is likely and not likely to migrate in the future.

Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface and occupies space. A soil type refers to the different sizes of mineral particles in a particular sample and their relative order. The largest particles, sand, determine aeration and drainage characteristics, while the tiniest, sub-microscopic clay particles are chemically active, binding with water and plant nutrients. The ratio of these sizes determines soil type: clay, loam, clay-loam, silt-loam, and so on. People consider soil important because it supports plants that supply food, fibers, drugs, and other human needs. In addition, soil filters and recycles waste.

Figure 1a. *L. morrowii*

Figure 1b. *L. salicaria*

An exotic invasive is an organism that grows and out-competes native plants for space and resources in a foreign region. Numerous researchers have theorized a dramatic change in biodiversity due to invasions of exotic species. For example, they can spread quickly and damage natural areas, alter ecosystem processes, breed with natives and change their genetic makeup, and support other non-native plants, animals and bacteria. To migrate to new areas, plants have developed several successful strategies. Some seeds are shot explosively from their pods, while others are carried by wind and water or on the fur/feathers of passing animals. In addition to these natural mechanisms, the transportation of invasive plants by human for medicinal and ornamental purposes has been significant in the migration of some invasive species; for example *L. salicaria* and *L. morrowii* were initially introduced into the U.S. for ornamental reasons. The initial introduction of a new species is not always problematic; however, when a plant in a new area does not have the same limitations as native plants, they gain an ecological advantage that can allow they to spread rapidly. One strategy used by *L. morrowii* is that the plant leafs out earlier than native plants can within the same habitat. The current distribution of L. morrowii is shown in Figure 2a.

*L. morrowii* is native to Japan and it was first discover by Dr. James Morrow around 1862 to 1864. Most recent studies believe it was first introduce into the U.S between the 1870s and 1890s through cargo brought from east Asia. *L. morrowii's* physical characteristics are very complex. This plant's height could be 8' to15' tall and have around 8' to 10' radius. The leaves of this plant are elliptical, 1–2" long, softly hairy and slightly gray green. The flower colors of this plant are white and turned yellow with age and are 3/4 to 1" long. The fruit of Morrow's honeysuckle ripens late June–early August and have juicy red or orange berries. One reason for *L. morrowii's* success as an invasive species is attributed to its early sprouting. *L. morrowii* is commonly found at the forest edge and in abandoned fields pastures, roadsides and other open areas. These locations are typically disturbed areas or associated with well drained soils. If *L. morrowii* tends to grow in disturbed areas and well drained soil types, then it will most likely spread and increase its population in those areas.

Figure 2a. *L. morrowii* Distribution

Figure 2b. *L. salicaria* Distribution

Purple Loosestrife *(Lythrum salicaria)* is a plant of European origin that has spread and degraded temperate North American wetlands and estuaries since the early nineteenth century. Wetlands may be on the edge of a lake or pond with vegetation growing out of the water and in soils at the lake margins. Most wetland soils have a higher amount of organic material than terrestrial soils, even those that are based on mineral soils like marshes. An estuary is a semi-enclosed coastal body of water with one or more rivers or streams flowing into it, and with a free connection to the open sea. In the early 20th century, *L. salicaria* was used as medicinal herb for treatment of diarrhea, dysentery, bleeding, wounds, ulcers and sores.

Invasion of *L. salicaria* into a wetland can reduce the native plant population to its adapting area and the wetlands that they grow near. *L. salicaria* has endangered native wetland plants by taking over their natural foods and cover that serves as the habitat for fauna. If our results show that *L. salicaria* tends to grow in estuary/ wetland type soils, then prediction models will indicate *L. salicaria* migrating to similar soil types. The plant's current distribution is shown in Figure 2b.

## Methods

Initial data was collected with the help of Kimberly Chase from the BBG using their specimen catalog. Ms. Chase obtained all herbarium records for the two species that provided the pressed sample, the species name, and other occurrence data. Secondary data was collected using the location descriptions provided on herbarium records. Although some records provided coordinate data, the descriptions occurred mostly in narrative form. This description was typed into Google Earth and a visual of the location, and background information of where the plant tends to grow, was used to determine where the pin icon was dragged. The pin showed the exact coordinates of a location, and these coordinates are than place in a data table. After all coordinates were collected, they were then entered into the USDA Web Soil Survey to get the specific soil type in that coordinate. After this step, the data table contained the catalog number, the latitude and longitude of the location in DMS and the soil code for each herbarium record.

After translating the coordinates to decimal format in MS Excel, we used the location and soil data, to create a map of the specimen coordinates and their associated soil code with ArcMaps. Figure 3a. and 3b. show the specimen locations and the associated soil codes. Our next step is to collect additional soil classification data. Currently, the soil codes are too detailed to show any soil-base connection among the specimens. Our expectation is that soil suborder and order information will allow us to make better generalizations about soil types that may be associated with our plants.

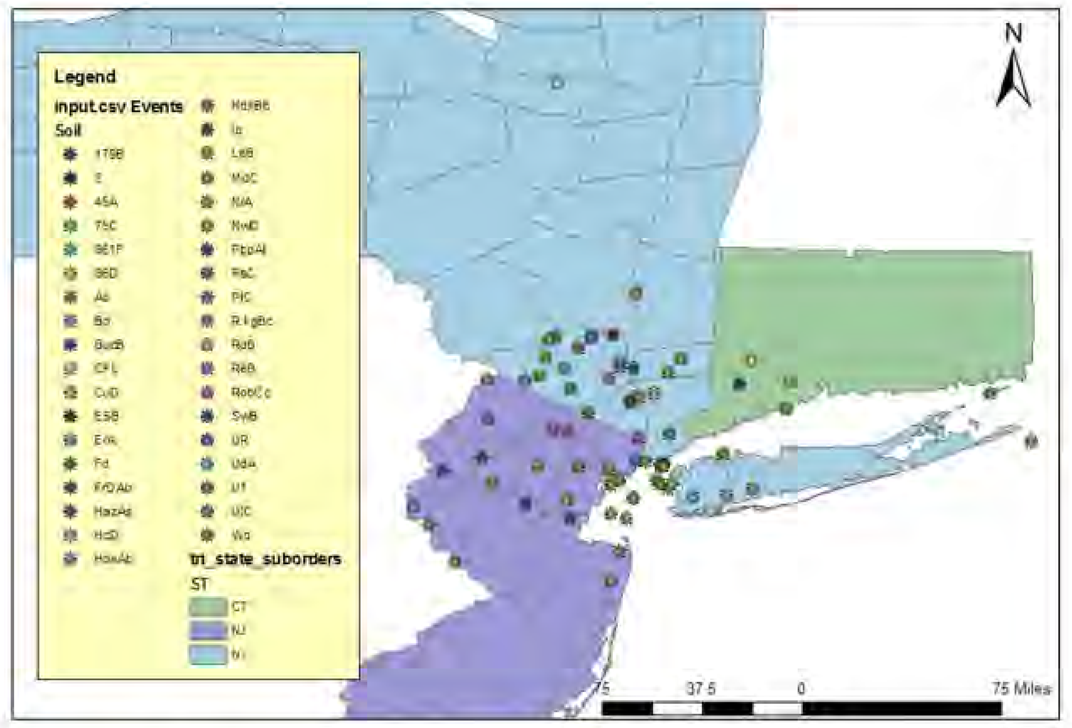

Figure 3a. Locations and Associated Soil Codes for *L. salicaria* Specimens

After we collect soil suborder and order information, we will generate some descriptive statistics to further guide our analysis. Then, building on our original map, we will add a layer created by the U Penn Environmental Informatics group. The data on this map shows each soil suborder in the Tri-State area and its representation by county in square acres. We will look for both negative and possitive associations between soil suborder and species occurance data in order to determine where the invasive species is lilely or not likely to spread.

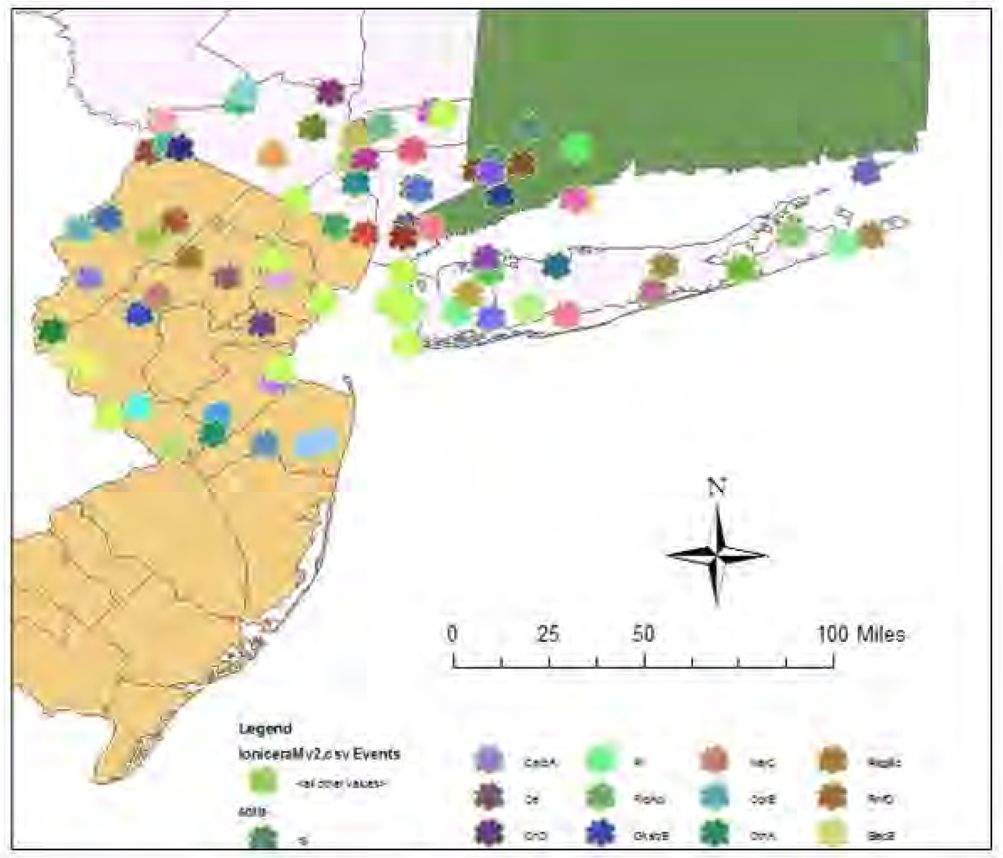

Figure 3a. Locations and Associated Soil Codes for *L. morrowii* Specimens

## Discussion

Our study is ongoing and we will continue with our research plan over the next year. The goal is for our work to assist in the determination of where an invasive plant may proliferate according to its pattern in soils. It is important to predict where invasive species may or may not end up because exotic plants can out-compete native plants, and possibly cause irreversible damage to a new environment. Invasive plants can take over native plants areas, and reduce the availability of them. Many native pants are often a habitat or food for fauna. If critical native plants were eliminated, the fauna they support may also become endangered. Herbivores and other animals that eat or live in the native plants may not fulfill the same needs with the invasive plant. These changes in the ecology of the area can compromise the food chain and biodiversity. In drastic measures, certain species, may become endangered or extinct. If scientists could predict where an exotic invasive may migrate, based on soil characteristics, then they would be able to identify areas to focus remediation efforts and protect some native plants at risk of becoming endangered.

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