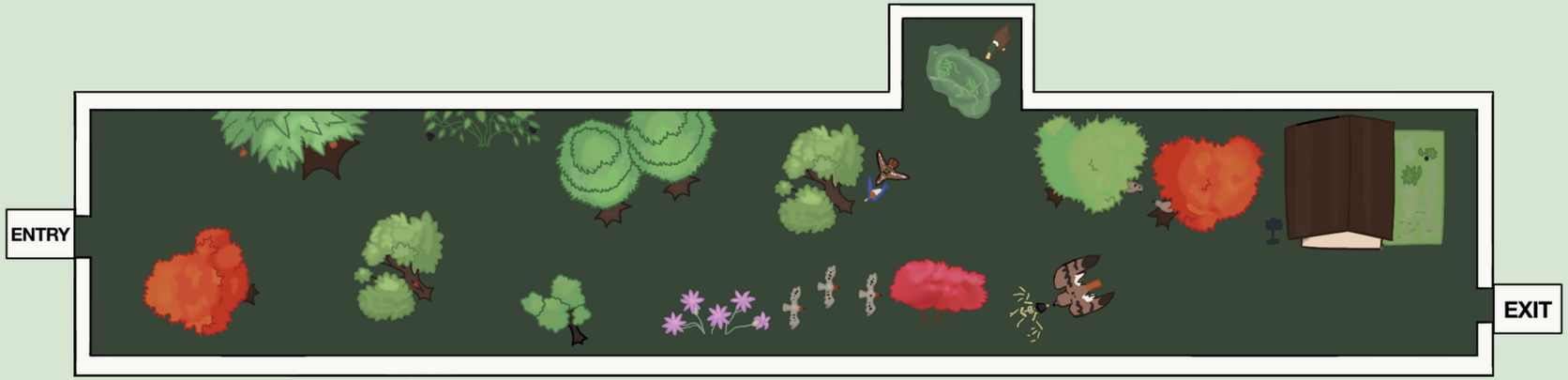
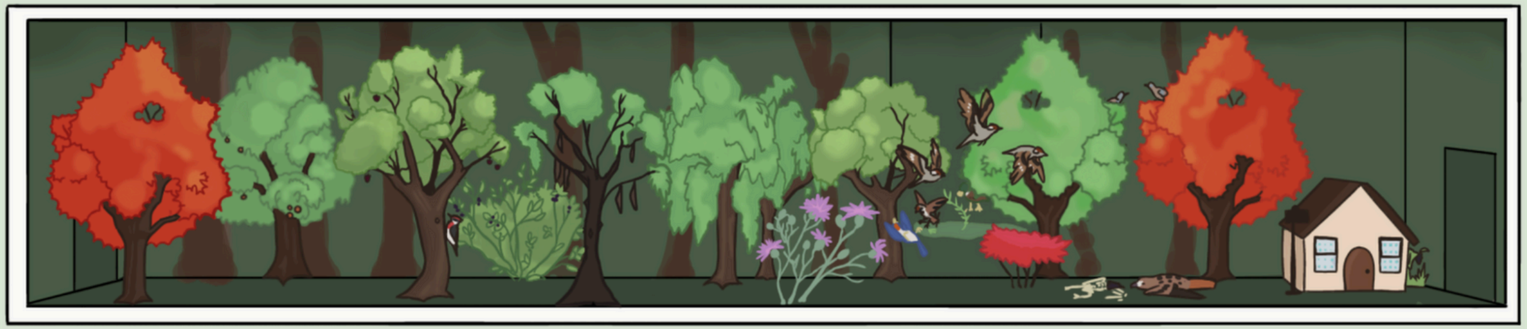
Exhibit Concept: Impact of Invasive Species on New York Native Birds

[Animated Exhibit Map]



Top View



Side View

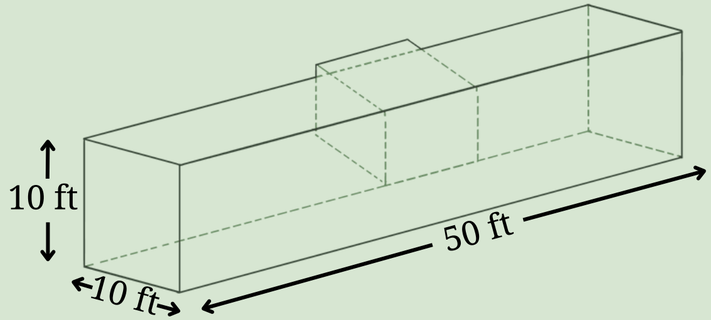
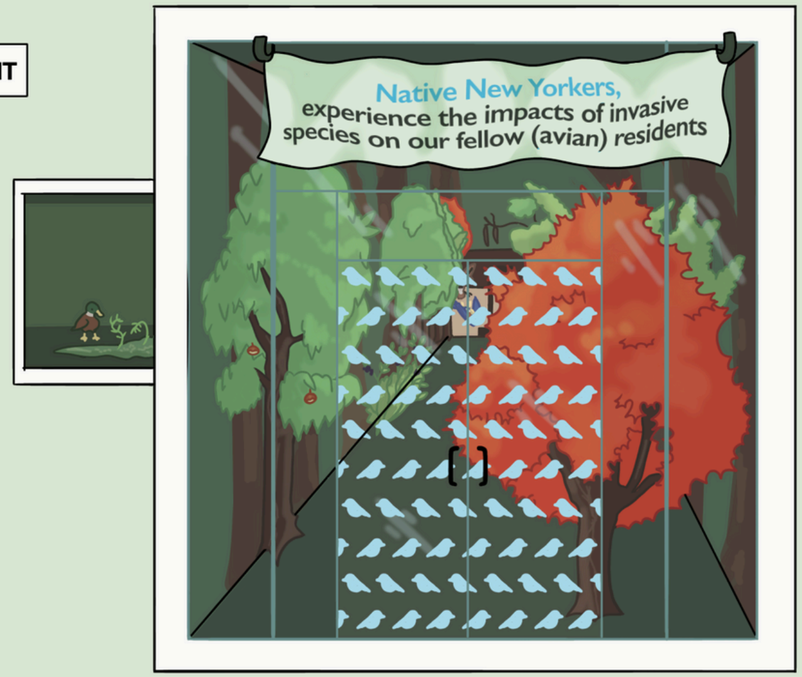


Exhibit Dimensions



Entrance View

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Term Project Summary

Though many animals and plants still dwell within the concrete jungle (or perhaps the concrete temperate deciduous forest) of New York City, wildlife faces myriad threats caused by human activities, including the introduction of invasive species into native ecosystems. Invasive species are any organisms not originally from a particular environment that can thrive in their new environment and have adverse effects on the native species there. In particular, birds native to New York are strongly impacted by invasive flora and fauna. However, naturalistic spaces can be designed to preserve and benefit native bird species. In my term project, I spread awareness about the impact of invasive species by illustrating the overall design of a walkthrough museum exhibit which narrates the arrival and impact of invasive species on endemic ones.

Invasive plant species can hinder native bird populations by outcompeting native plant species, which provide food and shelter for birds. Tree of Heaven (from Asia) inhibits the growth of native plants by emitting toxins, while Garlic Mustard (from Europe and Asia) alter the soil chemistry through processes such as nitrogen fixation (Alden, 2004). Soil chemistry alterations are harmful because Asia and the U.S. have different climates, naturally occurring nutrients, and native plants (which decompose into specific nutrient concentrations), resulting in different soil compositions in these regions. American plants are not accustomed to the new soil created by invasives, causing a vicious cycle in which invasive plants grow, create favorable conditions for themselves, make it more difficult for native species to survive, and repeat.

Invasive species also alter the availability of food and water for birds. Invasive plants can cause eutrophication in freshwater habitats, host no insects that native birds consume, or bear fruit that is not nutritious to birds.(Alden, 2004). Whether they eat fruit, insects, or fish, endemic birds may suffer from a poor diet encouraged by invasive species thriving in the Northeast. Invasive plant species can also affect the behavior of native bird species, often deterring them from inhabiting certain areas. For example, Chipping Sparrows are less likely to return to habitats with invasive spotted knapweed. These sparrows may lose parts of their range if the knapweeds spread uncontrollably (Nelson et al., 2017).

Conversely, invasive flora often attracts invasive avians. According to a study of urban gardens in Tel Aviv, abundance of non-native plant species directly correlates with the abundance of invasive bird visitors; there was also a direct positive correlation between native plants and native bird visitors. This is because invasive birds are more adapted to the services provided by non-native trees, and vice versa (Paker et al., 2014). Though this article does not study New York City (or even the Northeastern U.S.) specifically, it does discuss the widespread effects of plant diversity, which can be applied to any city, including NYC. Growing plants invasive to any city would attract invasive species.

Endemic birds often exacerbate the issue of quickly-spreading invasive plants. For example, the fruit of invasive buckthorns provide no nutrition for birds but rather increases their bowel movements, causing an urge to fill their stomachs with more berries. These fruits contain seeds and are dispersed through the excrement of birds. The seeds then germinate in new regions, causing more birds to spread them even further (Alden, 2004). Consumption is not the only way birds can aid the population of invasive species. Seeds or pieces of plants stick onto birds and other fauna, which inadvertently spread the seeds to wherever they travel (Alden, 2004).

Invasive insects and microorganisms can eradicate native plant species valuable to indigenous birds. Nonnative forest pests are more deadly to native populations of trees than native forest pests; only invasive pests have been recorded driving trees to local extinction. Unfortunately, New York has one of the highest rates of invasive pests per county in the U.S. (Lovett et al., 2016). New York endures one of the strongest impacts of invasive species; therefore, Northeastern forests require the most management of insects and diseases in order for the birds to not be under threat.

Invasive bird species can be just as detrimental as other invasive organisms; they compete with native birds for nesting sites and food. Native Eastern bluebirds are common victims of nest and food theft by aggressive House Sparrows. In fact, both sparrows and bluebirds eat insects House Sparrows have been found surrounding fatally wounded bluebirds, killing bluebird nestlings, and even nesting on top of the remains of bluebirds (Gowaty, 1984). In addition, both the invasive sparrows and bluebirds eat insects and fruit, forcing these birds into another aspect of competition, with House Sparrows often remaining the victor. The effects of invasive birds can travel up the trophic pyramid. European Starlings are often poisoned by humans attempting to manage them, but native birds of prey may consume the toxic starlings and die as the poison accumulates inside them (Linz et. al, 2007).

Living organisms are not the only invaders of native birds' habitats; birds are also threatened by buildings, which contain hazardous glass and aren't found in nature. Glass is hazardous to birds because glass can reflect the surrounding open environment, reveal an open space inside a building, or resemble a nesting cavity. Unaware of the invisible barrier between two safe spaces, birds will hit glass at normal flying speed, resulting in serious injury or death (Sheppard & Phillips, 2015). Clearly, glass in its

default state perplexes and leads birds into a false sense of security, so the most effective way to prevent collisions is to make the glass seem like an inaccessible space.This can be achieved when opaque window decorations are placed regularly, a few inches apart from each other, creating sections of glass small enough that even the most diminutive birds will not attempt to pass through (Sheppard & Philips, 2015).

Light pollution, which is prevalent in New York City, can also be harmful to birds. According to Sheppard and Philips (2015), artificial lights contain waves that may interfere with the magnetic directional capabilities of birds and cause collisions or confuse the birds by resembling sunlight. Since both birds and humans can benefit from less lighting, city structures should use minimal light at night. If lights are necessary, then light fixtures should cover the top of the lightbulb to prevent excess light from escaping.

My term project incorporated the concepts of how invasive plants undermine native plants which are needed by birds, encourage other members of invasive species, harbor disease, affect the reproductive behavior of native birds, and alter the land which avifauna inhabit. I also displayed how invasive bird species compete with native bird species for food and nesting sites, kill native birds, and indirectly harm native birds of prey. People can aid native birds by planting native plants, using natural or covered light fixtures, and placing patterned or opaque glass onto buildings. I incorporated these scientific ideas through the design of the term project product, an illustration of an exhibit concept (and a map that shows how a visitor would travel through the exhibit) that depicts New York ecosystems before the arrival of invasive species, shows the impact of native species, and then provides insights on how to preserve native species.

The exhibit begins with an untouched New York forest, showing once-common species (such as the Yellow-Bellied Sapsucker and American Chestnut) that have suffered population declines due to the impacts of invasive species. Then, visitors walk through a section which is overrun by non-native plants and birds. In order to convey what these invasive species are and how they impact native species, I created an animated map with arrows; as each arrow stops near an invasive plant, a brief description of the species that details how it impacts natives appears on screen. These descriptions are equivalent to blurbs that would be seen alongside each species in the museum.

Similarly, I incorporated the concept of how invasive bird species compete with and harm native birds through writing that accompanies different bird species on the animated map. Because I included both endemic and invasive species, each description details whether a bird is invasive or native as well as how they harm native species or how they are affected by invasive species, respectively. Through the illustrations of the exhibit, I created interactions between invasive species and native birds. For example, I depicted a House Sparrow fighting–and appearing to outcompete–an Eastern Bluebird near a tree, which provides a nesting site.

The final section of an exhibit concludes with an example of how to protect native species. Although I imagine that a real version of the exhibit to be deep within the

museum, facing no external windows, the glass entrance doors and a downscaled house model within the exhibit both have patterned stickers. These stickers serve as a way for those entering the exhibit to see how they can make their own living spaces home safe. Additionally, the model house has a singular external light fixture, which is covered at the top and sides to prevent excess light from escaping into the environment and confusing any avian neighbors. Finally, the house has a garden full of plants originally from New York; through the text on my animation map, I named these native plants and explained that they encourage native birds to thrive.

The term project is intended to appeal to and educate people of all ages, as anyone can be inspired to take action towards conservation of native wildlife. However, since the central focus of the term project research is New York City and nearby regions, New Yorkers are this project's primary audience. A banner in the entrance of the exhibit specifically addresses New Yorkers, calling them to realize how the birds that share the city with them are impacted by invasive species as the people walk through the exhibit. By demonstrating the various ways in which New York ecosystems have changed (due to the arrival of invasives) and how native species are harmed, I hope to educate New Yorkers on the vulnerability of native species, garner sympathy among the museum visitors, and inspire action to safeguard native birds.

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