Nature's Laboratory: Research at the Harvard Forest

By Jenny Lu

Among the diverse array of laboratories at Harvard, one of them stands unique from the rest. Unlike the fume hoods and pipettes that characterize some of the more standard laboratory instruments, the Harvard Forest is the university's own ecological laboratory where nature is observed at an ecosystem level.

The Harvard Forest is an area of over 3000 acres located in Petersham, Massachusetts utilized for research, education, and conservation (1). The Forest was created in 1907, only four years after a department of forestry was instituted. For the first thirty years of its existence, silviculture and sustainable tree farming was one of the main goals of the Forest. However, a category 3 hurricane in 1938 inflicted significant damage to over half of the Forest, after which silviculture was largely abandoned and the Forest was devoted more to fieldwork studies. From 1937 to 1988, research at the Forest was supported mainly from a gift from the Cabot Foundation. Since 1988, the Forest has been designated a National Science Foundation Long-Term Ecological Site, where researchers from a myriad of institutions cooperate on studies (2).

▲ **Figure 1.** A view of the Harvard Pond, located in the Tom Swamp Tract in the Harvard Forest.

credit: Yvette Leung, 2011

What kind of research is being done at the forest? Allowed to regenerate on its own over the last hundred or more years in a process called ecological succession, the forest has been untouched by commercialization or other disruptive human factors. As a result, many long-term experiments examining biodiversity, atmospheric changes, invasive species, and other ecological fields can be conducted.

One example of the long-term research conducted is the study of climate change on arthropod populations. In a study published in May 2011, Shannon Pelini and colleagues observed the effects of warming on ant populations at two locations: a northern site at the Harvard Forest and a southern site at the Duke Forest (3). By passively heating or cooling chambers 1 meter by 1 meter in size placed in the forests, the authors altered conditions on the ground and then noted changes in ant population dynamics and behavior. The scientists noticed that at the northern site, changes were not very significant in either species dynamics or behavior. On the other hand, at the southern site at the Duke Forest, the most abundant ant species became even more dominant as warming increased. In addition, at the southern site, increases in temperature appeared to reduce ant behaviors such as foraging. These observations are important in understanding how temperature increases might affect the viability of ant species

Figure 2. The egg sacs of the hemlock woolly adelgid, an invasive species that attacks the Eastern hemlock.

that survive in limited temperature ranges. Furthermore, by comparing the experiment results between the Harvard Forest and the Duke Forest, the scientists can better understand the potential effects of warming based on climate and location latitude (3).

At a larger ecosystem level, scientists at the Harvard Forest are also studying the effect of the removal of a foundation species from an ecosystem. Forest foundation species are a dominant tree species that can largely influence and define the ecological dynamics and characteristics of the forest (4). Understanding how the loss of foundation species may alter the ecosystem is particularly relevant in the context of the current spread of invasive species that can cause widespread harm to important species. Here at the Harvard Forest, scientists are studying the Eastern hemlock, a foundation tree species in the New England forests (5). This is especially important as the hemlock woolly adelgid, an exotic introduced species, is currently invading North American forests and killing hemlock trees. By simulating conditions for a number of situations such as adelgid infestation and logging, scientists are able to conduct a controlled, long-term experiment. Such experiments are remarkable in the field of ecology, where controlling for variables can be difficult on large scales as ecosystems, especially in comparison to the easily controlled microliter test tubes in sciences such as molecular biology.

These two studies are just a small sampling of the hundreds of studies that are in the process of being completed at the Harvard Forest. The fieldwork is extensive, and the results are important. By understanding the dynamics of the natural world around us, we can better understand how to preserve our natural surroundings through conservation and land management policies. H

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