

According to the Janzen-Connell hypothesis, seeds and seedlings that are close to adults of the same species or are in areas of their high density, suffer increased mortality caused by high activity of natural enemies. These harmful organisms are represented mostly by soil pathogens (usually fungi) that specialize in attacking only one or several closely related species of trees. Recent studies suggest that this phenomenon might play a key role in maintaining high biodiversity of tropical forests: it limits the possibility that one tree species becomes highly dominant because increase in its abundance decreases survival of its own seeds and seedlings! On the other hand, many researchers believe that biological invasions (i.e. proliferation of non-native species that leads to economical and ecological losses) are caused by the release of alien species from natural enemies that control them in their native range. These premises suggest testing whether the Janzen-Connell effect plays a role in biological invasions. If biotic invasions do occur because species are released from their natural enemies, and if these enemies act in the distance- or density-dependent fashion, then the Janzen-Connell effect should not occur in invasive plant species. Lack of the self-limitation caused by the Janzen-Connell effect could explain why certain alien plant species are able to dominate plant communities in invaded areas and displace native species.

In our project, we will compare the strength of Janzen-Connell effect in two species of trees that are native to Poland (the pedunculate oak and the Norway maple), and in two closely related, but invasive tree species (the red oak and the boxelder). We expect that the close neighborhood of adult conspecifics will result in reduced numbers of seedlings of native, but not invasive species. This part of our study will be conducted in the field, at study sites located in Wielkopolska National Park. Furthermore, we will conduct laboratory studies to test whether this pattern is caused by soil pathogens: we will plant seeds and seedlings in soil collected from under adult conspecifics as well as from places located far from adults of the same species. Half of samples will be sterilized to remove potential pathogens. We expect higher mortality rates of seeds and seedlings of native species in soil samples collected under conspecifics than in samples collected at further distance. Furthermore, we expect that this effect will disappear in sterilized samples. However, invasive species should have similar survival rates regardless of soil type and treatment.

Understanding the underlying causes of biological invasions belongs to the most difficult problem in current ecology and nature protection. Studies such as our project are crucial for improved understanding of this process and might provide theoretical basis for future conservation strategies. Finally, our study on the Janzen-Connell effect in Polish forests will help to assess the generality of this mechanism: whether it occurs mostly in tropical forests, or alternatively, if it functions in many areas, regardless of their climate, number of coexisting species, and evolutionary history.