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Effect of Enemy Release and Hybridization on Invasiveness of *Impatiens balfouri and I. glandulifera*

Rachel Roy*

Department of Combustion and Environment Technology, Shanghai Jiao Tong University, Shanghai, China

Corresponding author: Rachel Roy, Department of Combustion and Environment Technology, Shanghai Jiao Tong University, Shanghai, China, E-mail: Roy_R@Le.CN

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Description

The factors that determine invasiveness may be identified by comparing studies with taxonomically and geographically paired alien species that exhibit varying degrees of success in their invasions. In Europe, noninvasive *Impatiens balfourii* and invasive *I. glandulifera* are two such species. We tried to figure out if strong pressure from local enemies could explain *I. balfourii's* low invasiveness in Europe. These two species' hybridization was supported by earlier research. We tried this peculiarity as the possible event of *I. glandulifera* and *I. balfourii* half and halves could advance the development of the obtrusiveness of *I. balfourii*. Insubria's Swiss-Italian border in 2015 yielded seeds for both species, which were used in three experiments: 1) a release test for common garden enemies (leaf damage or pest pressure), 2) a pressure test for general enemies and 3) a hybridization test the amount of leaf damage and the number of pests were used to measure the effect of enemies in the first test. A food choice experiment with *Cepaea snails*, a generalist herbivore, was carried out for the second test. The plants were subjected to self and hand-cross-pollination in a climatic chamber during the hybridization test. *I. balfourii* was subjected to greater enemy pressure than *I. glandulifera*, according to analyses of enemy release and *Cepaea snail* preference; However, the performance of the plants did not reflect this. Although *I. balfourii* was more fertile, *I. glandulifera* was larger. As a result, *I. glandulifera's* success invading was not entirely attributable to its greater degree of release from enemies than that of the noninvasive I. balfourii. In addition, there was no evidence that the two species had crossed paths. As a result, the hypothesis that hybridization with I. *glandulifera* could enhance the evolution of I. *balfourii's* invasiveness did not receive any support from our findings. The Enemy Release Hypothesis (ERH) assumptions were looked at in this study under different climatic conditions in Poland's lowland and mountain regions. In 2010 and 2011, three native (Impatiens noli-tangere, solidago virgaurea and polygonum bistorta) species, two noninvasive (Impatiens *walleriana*, Impatiens *balsamina*) and four invasive (Impatiens glandulifera, Impatiens *parviflora, Solidago gigantea* and *Reynoutria* japonica) species were used in a common garden experiment.

Leaf Damage

The species were examined for invertebrate pest attacks and leaf damage. In every test, pests and leaf damage were more common in the lowlands than in the mountains. Impatiens models and *Solidago* leaf damage models were particularly notable for their differences. For some species (Polygonaceae), the distinction was irrelevant; however, due to the lower taxonomic relations between the studied polygonaceae and the other tested species, these findings should be interpreted with caution. When all of the tests were taken into consideration, the ERH hypothesis's assumptions were confirmed in 6 cases (29 percent), but there was no confirmation in 15 cases-including 7 cases of non-significance and 8 cases where the results were opposite one another. In addition, the comparison of the non-invasive and invasive alien species produced an overall outcome that was in opposition to what the ERH hypothesis had predicted; In more than two thirds of the cases, the enemy's release of invasive alien species was less successful

than that of noninvasive species. In conclusion, the ERH hypothesis's assumptions do not always hold true and the success of alien species' invasions may depend on a variety of factors, including particular local conditions. The shade-tolerant *Abies mariesii* and the less shade-tolerant *Abies veitchii*, which dominate forests at high and low elevations, respectively, in the subalpine zones of central Japan, are examples of how environmental factors change with elevation changes in vegetation. From the perspective of sapling growth and survival, the goal of this study was to determine the factors that contribute to the distinct elevation dominance of these two species. Because sapling leaf mass gradually decreases with time if saplings cannot maintain the current sapling leaf mass, thereby increasing the risk of premature mortality, it is assumed that higher rates of surplus production (the value obtained by subtracting the minimum net production to maintain the current sapling leaf mass from the total net production) result in greater growth and survival of saplings.

Surplus Production Rate

In this regard, our goal was to test our two hypotheses: 1) In the forest understory, the surplus production rate of *A. veitchii* is greater than that of *A. mariesii* at low elevations; (2) In the forest understory and canopy gaps at high elevations, the surplus production rate of *A. Mariesii* is higher than that of *A. veitchii*. Our two stated hypotheses were supported by the findings of this study. Additionally, *A. veitchii*'s rate of height growth in canopy gaps was higher than that of *A. mariesii* at the low elevation site, indicating that *A. veitchii* can dominate after disturbance at low elevations. According to the findings of this study, interspecific differences in surplus production rates account for the disparate elevation distribution of the two Abies species. Predicting how the distribution of vegetation will change as a result of climate change can be aided, in our opinion, by using these findings. The "Evolution of Increased Competitive Ability" (EICA) hypothesis holds that recently introduced populations of alien species are less likely to be attacked, allowing them to invest less in defense and reinvest the savings into improving competitive ability traits. We conducted EICA tests to determine whether the low dispersal potential of Impatiens *balfourii* in Europe is due to the low phenotypic plasticity of this trait or to the limited evolution of its ability to release from enemies.

We compared the levels of enemy pressure in various habitats and tested the species' preferences for habitat. This allowed us to determine whether this species has a European-scale tendency to be found along roadsides and whether this preference is caused by a lower number of enemies in that habitat. It is impossible to rule out the possibility that the species might find it difficult to adapt to life along roads, and the frequent mowing of this habitat could make it into an ecological trap.