INVASIVE SPECIES

BY TRISTAN WANG

Invasive species can be found everywhere. Scattered across the world, they have traveled by air, water, and land and may have even landed in your backyard. Because invasive species are often associated with the disappearance of native species, they have garnered a dreadful reputation as being "foreign" by the public and scientists alike. Some have received a lot of attention from the media, such as the brown tree snakes in Guam, zebra mussels clogging the Great Lakes, rabbits overrunning Australia, and the kudzu or "the vine that ate the South." Their success has baffled many, but recent studies in the past decade have pointed to a new factor that may potentially be crucial to the spread of invasive species: phenotypic plasticity.

Phenotypic plasticity refers to the ability for organisms to adapt to environmental changes through changes in physical traits or phenotype. This phenomenon draws indirectly from genotype, which are the genes that dictate a particular phenotype. In order for natural selection to act on these species, populations of invasive species must act upon a genetic substrate. Often times, an initial lag is observed before the explosion of a species because of the need of sufficient additive genetic variance (AGV). This allows the accumulation of genetic substrate for phenotypic expression on which the environment acts (1). Changes in phenotype may give organisms a higher fitness level compared to those with static phenotypes (2).

Moreover, higher levels of phenotypic plasticity enable colonization in new environments. Invasive species often come into new environments with low genetic diversity because of small population sizes, but high phenotypic plasticity may aid the species to cope with new stresses through rapid evolution (2). Plasticity helps organisms express advantageous phenotypes in a wide range of environments, supporting the positive correlation between ecological breadth and phenotypic plasticity observed in some species (3,4). Coupled with hybridization, plasticity facilitates further genetic variance and novel gene interactions (1).

When invasive species arrive in new habitats, organisms with dispersal capacity or high physiological tolerance are favored by evolution, driving the selection for beneficial traits that natural enemies may have suppressed (1,5). In fact, it has been noted that in foreign habitats compared to native habitats, invasive plants tend to proliferate more vigorously by producing more seeds—an example of the changing reaction norm, or expression of phenotypes by a particular genotype (5). As an example of the evolution of phenotypic plasticity, the velvetleaf (*Abutilon theophrasti*) has evolved a number of distinct strategies to proliferate in the presence of different sources of competition ever since it was introduced to the United States in the 17th century (1). Specifically, velvetleaf populations tend to be plastic in response to light quality in order to outgrow soybeans, but plasticity is not advantageous to these plants in the presence of the taller corn plants (5).

Phenotypic plasticity can be considered a problem because it allows invasive species to evolve resistance against human attempts at eradication, such as pesticides and herbicides. Policies regarding invasive species often overlook the consequences of resistance caused by poorly designed efforts at eradication. As a result, further studies should be directed toward elucidating the phenotypic changes that lead to the development of resistance in response to methods used to control invasive pests. Such investigations can allow us to tackle the challenge of eradicating invasive species while minimizing the potential to cause more harm than good.

Figure 1: Velvetleaf plant
Photo courtesy of Wikimedia Commons.

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References

1. C. E. Lee Evolutionary Genetics of Invasive Species. *Trends in Ecology and Evolution* 17.8 , 386-91 (2002).
2. A. M. Davidson, M. Jennions, and A. B. Nicotra. Do Invasive Species Show Higher Phenotypic Plasticity than Native Species And, If So, Is It Adaptive? A Meta-analysis. *Ecology Letters* 14.4, 419-31 (2011).
3. C. L. Richards, O. Bossdorf, N. Z. Muth, J. Gurevitch, and M. Pigliucci. Jack of All Trades, Master of Some? On the Role of Phenotypic Plasticity in Plant Invasions. *Ecology Letters* 9.8, 981-93 (2006).
4. C. L. Pohlman, A. B. Nicotra, and B. R. Murray. Geographic Range Size, Seedling Ecophysiology and Phenotypic Plasticity in Australian Acacia Species. *Journal of Biogeography* 32.2, 341-51 (2005) .
5. B. Blossey and R. Notzold. Evolution of Increased Competitive Ability in Invasive Nonindigenous Plants: A Hypothesis. *Journal of Ecology* 83.5, 887-889 (Oct., 1995).