Aliens

Douglas Tallamy

Although I chose entomology as a profession, I understand the thrill of growing exotic plants. In graduate school, I took a class in woody landscape plants from the noted horticulturist Robert Baker. I left that course with an intense desire to plant as many of the species I had just learned about as possible. The only thing that slowed me down was that, as an apartment dweller, I had no place to plant them. Still, I gathered seeds from many of the ornamentals on campus, germinated them in the greenhouse, and planted the seedlings all over the yards of my parents and relatives.

I now find it ironic that, at the same time that Professor Baker was turning me on to alien ornamentals, I was taking courses about interactions between plants and insects. These were the classes that explained why most insect herbivores can eat only plants with which they share an evolutionary history. All of the information I needed to realize that covering the land with alien plant species might not be such a good idea had been neatly and simultaneously placed in my lap during those months in graduate school, but it was twenty years before I made the connection: the vast majority of our native insects cannot use plant species that evolved outside of their local food webs.

In 2000 my wife and I moved to ten acres in Pennsylvania. The area had been farmed for centuries, before being subdivided and sold to people like us who wanted a quiet rural setting close

Native trees—particularly oak, maple, and willow—are required food for caterpillars of the polyphemus moth (*Antheraea polyphemus*). Photograph by Douglas Tallamy.

to work. We got the rural setting we sought, but it was not the slice of nature we had hoped for. At least 35 percent of the vegetation on our property (yes, I measured it) consisted of aggressive plant species from other continents. We quickly agreed to make it a family goal to rid the property of alien plants and to replace them with species that had evolved within the eastern deciduous forests.

Early on in my assault on the aliens in our yard, I noticed a rather striking pattern. The alien plants that had taken over our land—multiflora rose, autumn olive, privet, oriental bittersweet, Japanese honeysuckle, Amur honeysuckle, Bradford pear, Norway maple—all had very little or no insect-caused leaf damage, while the red maples, black and pin oaks, black cherries, black gums, black walnuts, and black willows had obviously been eaten by many insects. This was alarming, because it suggested a consequence of the alien invasion occurring all over North America that was under the radar. If our native insect fauna cannot, or will not, use alien plants for food, then insect populations in areas with many introduced plants will be smaller than those in areas with all natives. Because so many animals depend partially or entirely on insect protein for food, a land with fewer insects is a land with fewer forms of higher life. Birds would suffer most, because 96 percent of our terrestrial bird species rear their young on insects.

Ecologists suggest three reasons why most native insects do not eat introduced plants. First, many of the invasive plants that have succeeded in North America were imported specifically because of their unpalatability to insects. As Michael Dirr repeatedly emphasizes in his acclaimed books on ornamental plants, species that are "pest free" are favored by the ornamental industry. Unfortunately, 85 percent of the invasive woody plant species in the United States are escapees from our gardens!

The second reason is that it takes time—long evolutionary time spans, rather than short ecological periods—for most insects to adapt to the specific chemical mix that characterizes dif-

Like most songbirds, the white-eyed vireo (*Vireo griseus*) rears its young on insects. Photograph by Douglas Tallamy.

ferent plants. The literature is replete with evidence that the number of insect herbivores associated with transplanted aliens is only a small fraction of the number associated with these plants at home. In Europe, for example, *Phragmites* (the common reed) supports more than 170 species of phytophagous insects, while only five species of our native herbivores feed on this plant in North America. Similarly, since the introduction of melaleuca to Florida in the early 1900s, only eight species of arthropods have been recorded eating the leaves of this Australian native; in its home region, 409 species are known to eat it. Similarly, *Eucalyptus stellulata*, an introduced tree touted as supplying nectar for bees in California, supports forty-eight species of insect herbivores in Australia, but only one native insect herbivore in California. These examples demonstrate that adaptation to non-native plants by our native insects occurs, but is a slow process indeed.

The third reason that native insects shun aliens is that most phytophagous insects feed on plants with which they share an evolutionary history. Leaders in the field of plant/insect interactions such as Dan Janzen, Doug Futuyma, Fred Gould, and Elizabeth Bernays have all estimated that 90 percent of phytophagous insects have evolved associations with no more than a few plant lineages. (It is important to highlight that these predictions focus on how insect *herbivores* use plants. They are not predictions about pollinators, parasitoids, or predators that visit flowers for nectar or pollen.)

How do we know the actual extent to which our native insects are eating introduced plants? My students and I have been working to fill this gap in our knowledge. One of the first things we did was to compile information about Lepidoptera larvae collected from every plant genus—all 1,385 of them—in the mid-Atlantic states. We focused on Lepidoptera because host records for moths and butterflies are far more complete than those for other types of insect herbivores, and because caterpillars are disproportionately important food sources for birds. Two years and more than four hundred references later, we were able to rank mid-Atlantic plant genera, both natives and naturalized aliens, in terms of their ability to support the larvae of 2,909 Lepidoptera species.

Banded tussock moth (*Halysidota tessellaris*) caterpillars feed on a range of native trees from July to October. Photograph by Douglas Tallamy.

We learned much from this effort. Even among natives there is tremendous variation in the ability to support cater-

The spun glass moth (*Isochaetes beutenmuelleri*) caterpillar is a specialist of oaks. Photograph by Douglas Tallamy.

pillars. Oaks supported the most species (534), followed by native cherries (456), willows (455), and birches (413), while there were some natives, such as sweetspire (*Itea*) and yellowwood (*Cladastris*), on which no Lepidoptera were recorded. As predicted, favorite landscape plants that evolved elsewhere such as forsythia, golden raintree, *Zelkova*, and *Metasequoia*, supported few or no caterpillar species. All members of the thirty-eight most productive genera were native to the mid-Atlantic region, with the exception of pear (*Pyrus*), an agricultural genus. Among ornamental plants, natives supported on average seventy-four species of native Lepidoptera, while aliens supported fewer than five—just one-fifteenth as many.

These results have been supported by a large study in which we compared how well introduced plants support native insects. In a replicated common garden experiment, my students and I showed that alien plants significantly reduce the abundance and diversity of both generalist and specialist Lepidoptera. Alien plants that are congeners—close relatives—of a common native species reduced Lepidoptera communities by 50 percent, while an alien plant that is not closely related to any local species reduced Lepidoptera abundance and diversity on average by 75 percent! We know that most bird populations are limited by the amount of food they can find, so if there are dramatically fewer caterpillars in neighborhoods dominated by introduced ornamentals, it is no wonder that our birds are struggling.

Many people justify the use of an introduced ornamental—or inaction against an invasive alien—by contending that it supports a particular butterfly, beetle, or bee. This approach, however, considers what is gained from a plant without considering what is lost through its presence. Kudzu provides an excellent example. When an acre in Virginia is overrun with kudzu, the silver-spotted skipper (*Epargyreus clarus*) can still find larval food because it is able to add kudzu to its list of leguminous host plants. But the meadow fritillary (*Boloria bellona*), variegated fritillary (*Euptoieta claudia*), and great spangled fritillary (*Speyeria cybele*) would no longer be able to reproduce in that field because their violet host plants are lost. Similarly, monarch butterflies (*Danaus plexippus*) would lose their milkweed host plants, as the two hundred or more species of moths that feed on goldenrod and asters would lose theirs. Trees are not immune to kudzu, and the oaks, cherries, and willows that each support four or five hundred species of moths and butterflies would be smothered. Many more genera of native plants would be elimi-

nated on that acre, as would the hundreds of insect species they support.

We needn't limit this discussion to invasive species. We have replaced diverse native plant communities in thousands of square miles of suburbia with ornamental plants from Asia. Most of these plants are not currently invasive, yet if planted everywhere they have a similar impact on insect herbivores. Imagine a neighborhood in which native pines are replaced by Deodar cedars from the Himalayas. The pine white butterfly (*Neophasia menapia*) is able to develop on Deodar cedars, but more than two hundred other species of pine specialists would lose their host plants.

Great spangled fritillaries (*Speyeria cybele*) nectar on many flowers, but their caterpillars eat only violets. Photograph by Douglas Tallamy.

By favoring native plants over aliens in the suburban landscape and by working to minimize the abundance of invasive plants in our natural areas, we can do much to sustain the biodiversity that has been one of this country's richest assets. Native plants support and produce more insects than alien plants do, and therefore more numbers and species of other animals. Somehow we have come to expect an artificial perfection in our gardens and the greater landscape: the plastic quality of flowers is now seen as normal and healthy. It is neither. Instead, it is a clear sign of a garden that is no longer a living community; a garden in which any life form other than the desired plants is viewed as an enemy and quickly eliminated. In essence, we have demoted plants to mere decorations in our unnatural landscapes.

To sustain biodiversity we will ultimately need to improve the complexity and stability of insect-based food webs, both in our yards and in local natural areas. Although some insects can meet their needs with introduced plants, most cannot. This illustrates the real costs associated with replacing native plant communities with alien plants but also suggests ways to reverse the losses in biodiversity that have characterized our times.

Doug Tallamy is a professor and the chair of the Department of Entomology and Wildlife Ecology and director of the Center for Managed Ecosystems at the University of Delaware in Newark, where he has taught courses for thirty years and authored seventy-three research articles. This essay was adapted from his book Bringing Nature Home.

WINGS

ESSAYS ON INVERTEBRATE CONSERVATION

THE XERCES SOCIETY SPRING 2011