Introduced Insects Often Pose Biological and Economic Risks

By Douglas C. Allen

The movement of plants and animals from one continent to another began centuries ago when people travelled in search of trade or migrated to escape unacceptable social conditions. As intercontinental travel increased, first by sea and later by air, so did the frequency with which species were transplanted around the globe. In North America, purposeful and inadvertent introductions that began as a trickle in the 1700s became a torrent by the late 1800s. During the early days of this era, for example, many ships sailing to America from Europe loaded soil as ballast in southwestern England. The soil was unloaded in North America and exchanged for cargo. Along with the soil came many insects. However, many exotic forest pests of the twentieth century were introduced on unprocessed logs, planting stock and in or on ships and cargo. In spite of careful present day monitoring and inspections at all U.S. ports of entry, exotic plants and insects continue to be introduced accidently, though at much lower rates than 50 or so years ago.

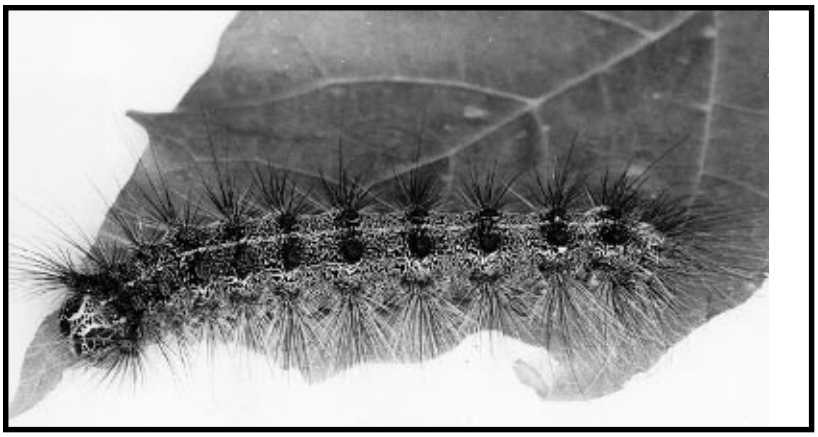

Figure 1. Gypsy moth caterpillar.

Irreversible Effects of Introductions

The consequences of allowing organisms to invade new habitats can be profound. Take California for example. More than 1000 plant species have been introduced on the West Coast, and in some areas of this state as much as 40% of the flora is non-native.

Black and brown rats followed Europeans to all corners of the world. The diminutive house sparrow was introduced purposely, first to New York and then New England, a little over a century ago. Now it is one of the most abundant birds species throughout the North American continent. As populations of these exotics increased, undoubtedly some native species were displaced or at least their populations were diminished.

Many introduced insects have slipped into the states with little fanfare, their disruption or displacement of local fauna going unnoticed. Only when the alien becomes a major agricultural, shade tree or forest pest do we become aware of its presence. However, all introductions have the potential to disorganize assemblages of native organisms and, in doing so, may have important effects on the function and biological diversity of native invertebrate and plant communities. Practically every agricultural crop in the U.S. has at least one introduced pest of economic importance.

Examples from the Forest

Most people who live in the northeast have heard of gypsy moth (Figure 1), and I am sure many New York forest owners know that this defoliator was introduced from Europe. The origin of other forest pests such as European spruce sawfly, European pine sawfly, European elm bark beetle, and European pine shoot moth is revealed by their common names. On the other hand, there are many forest pests whose origin is known only to specialists. It might surprise you to learn that beech scale (the insect component of beech bark disease), balsam woolly adelgid (an aphid-like insect that causes extensive mortality in eastern stands of true fir (*Abies*) winter moth (a looper that defoliates oak and apple in the Canadian maritimes), larch sawfly and larch casebearer (defoliating caterpillars that constitute two of the most important pests of larch), and birch leafminer, for example, are also exotics.

Recent Headliners of Foreign Origin

Of all the forest health problems that have appeared in the northeast during the last decade, none was more surprising than the outbreak of pear thrips. It attacks the buds and foliage of many broadleaved trees, including sugar maple, black cherry, beech, and a variety of pome fruits. This insect has been in the northeast since at least the early 1900s, yet the first extensive outbreak in eastern North America occurred in 1979. At this time, sugar maple on approximately 300,000 acres across Pennsylvania's northern counties was damaged extensively. The outbreak peaked in 1988 when in Pennsylvania alone more than one million acres were involved. Concurrently, extensive areas of northern hardwood forests in New England and New York also experienced maple damage.

Another forest pest in our region that has grabbed headlines recently is the aphid-like hemlock woolly adelgid; so named because for most of its life this soft-bodied, wingless insect is protected by a secreted woolly wax-like substance. It attacks a variety of native and ornamental hemlocks (*Tsuga spp.*), but survival and reproduction are highest (hence, damage is most likely) on eastern (*T. canadensis*) and Carolina (*T. caroliniana*) hemlocks.

Yes, both pear thrips and hemlock woolly adelgid are alien to North America. They entered on the west coast; thrips from Europe in 1904, and the adelgid from Japan around 1922.

Final Example - Another Gypsy Moth!

It is hard to believe that in our lifetime we could be blessed with not one but two gypsy moths in North America! Around 1981 an Asian strain arrived on the West Coast. To date, three infestations of the Asian gypsy moth (AGM) have been found, two in the United States and one in Canada. Populations of AGM in the U.S. occur in the vicinities of North Portland, Oregon and Tacoma, Washington. The Canadian infestation resides near Vancouver, British Columbia.

(Cont'd)

Figure 2. (right) Gypsy moth female depositing eggs.

In its native Siberia, AGM preferentially feeds on larch, but it fares well on a wider variety of host plants (including many broadleaved species) than the European strain that is so well established in the northeast. If our native larch and other western conifers prove to be suitable hosts, there is an almost continuous food source for AGM from the West Coast to the Great Plains. Additionally, susceptible broadleaved trees and shrubs are present in every western town and adjacent to most riparian areas. Apple and other fruit trees are favored hosts, which is a concern in fruit growing regions of the Pacific Northwest.

AGM apparently came to the West Coast aboard Siberian ships that were infested with egg masses. After these vessels arrived in an American port to load grain, the eggs hatched and the small, hairy, buoyant caterpillars "ballooned" ashore on silken threads that the insects spin instinctively when they are dislodged.

In addition to its broad diet, this strain of gypsy moth has other unsettling features that enhance the likelihood of successful establishment. First of all, female moths can fly, hence there is a potential for rapid dispersal. This dispersal behavior differs from that of the European strain, the females of which, though winged, are unable to fly (Figure 2). Population spread in this case is accomplished solely by passive movement of ballooning larvae. Secondly, as many as 25% of AGM eggs will hatch without exposure to cold, a rare event in populations of the European strain. If AGM enters the southern U.S. (and many ships leaving Russian ports come through the Panama Canal and dock on our southern and eastern coasts), there is further potential for establishment and rapid spread of AGM. Two U.S. Department of Agriculture agencies (Forest Service, and Animal and Plant Health Inspection Service) have embarked on a 28 million dollar eradication program in the Pacific Northwest. We wish them success!

Why Are Some Introduced Insects So Successful?

The likelihood that an introduced insect will develop into a serious pest is determined by several factors; the size of the introduced population (the larger the number, the higher the probability of establishment), aggressiveness (how well it competes with native species), suitable climate, available food, and absence of natural enemies. Outbreaks are attributed mainly to the fact that exotics arrive here without the natural enemy complex (parasites and predators) with which they have coevolved. In the absence of extensive natural mortality and in the presence of suitable climate and abundant food, the insect rapidly attains its maximum reproductive potential.

Populations of introduced insects often are eruptive during the years immediately following their establishment. The maximum reproductive rate is maintained for a number of generations, and the population spreads rapidly away from the point of introduction. After a time the population collapses, often due to starvation and disease that take a heavy toll when insect densities are extremely high. Populations may remain relatively low and stable, or outbreaks may occur periodically thereafter. ▲

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