Western Plant Diagnostic Network

First Detector News

A Quarterly Pest Update for WPDN First Detectors

Fall 2015 edition, volume 8, number 4

In this Issue

Page 1: Editor's note

Pages 2-6: *Xylella fastidiosa*: a bacterium causing multiple diseases

Pages 6-8: Japanese beetle

Pages 9 - 10: Gypsy moth

Page 11: Giant African snail intercepted in Oakland CA

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Dear First Detectors,

The bacterium, *Xylella fastidiosa*, is the causal organism for many plant diseases, from Pierce's disease in grape to oleander leaf scorch. Oregon recently reported it has now been found in pear. The bacterium has made its way to Europe, perhaps in oleander or coffee nursery material, and is causing a rapid decline and death of ancient olive trees in Apulia, Italy. The Japanese beetle and the gypsy moth keep trying to get established in the West. Learn how to identify them and, if found, report it to your local county agricultural commissioner or agent, or to your local farm advisor or university extension specialist. And, once again the Giant African snail (GAS) has been intercepted at the Port of Oakland CA, found with its eggs on pallets from American Samoa. These invasives just want to find a home with us! Best wishes from our WPDN staff for a healthy and peaceful 2016!

Please find the NPDN family of newsletters at:

Newsletters

Art by Auspicious

The bacterium *Xylella fastidiosa*

Now found in Pears in Oregon

Plant pathologists are always asking where do these diseases originate and how do they move? In October, 2015, the presence of the bacterium *Xylella fastidiosa* Wells et al. 1987, was confirmed by the Oregon Department of Agriculture (ODA) in several pear trees growing in the field germplasm collection at the USDA Repository in Corvallis. Preliminary DNA sequence data suggests it is the isolate *X. fastidiosa* subsp. *multiplex*, which can cause a chronic leaf-scorching disease in many different species of woody landscape shrubs and shade trees, including oak, elm, and other trees. Find this report at *Xylella fastidiosa* Response Plan. *X. fastidiosa* was not known to be present in the state of Oregon and pear trees have not been reported as a host in North or South America. So the question is, how did this particular strain of the bacterium infect pear trees in Oregon? *Xylella fastidiosa* is an important plant pathogen that causes phony peach disease in the southern United States, bacterial leaf scorch, oleander leaf scorch, and Pierce's disease (in grapevines), and citrus variegated chlorosis (CVC) and coffee leaf scorch in Brazil. In Europe *X. fastidiosa* subsp. *puaca* has attacked olive trees in the Salento, Apulia, area of southeastern Italy causing the olive quick decline syndrome (OQDS). This was first noticed and diagnosed in October 2013. A disease of ornamentals caused by *X. fastidiosa* subsp. *multiplex* was identified in June 2015 in southern France, first in Corsica, then in the area around Nice. So far it has not been found in olive. The major vector is thought to be the spittlebug. See Professor Giovanni Martelli's April 2015 article on the progress of OQDS in Italy. Symptoms vary according to the host plants but in general, as the bacteria invade xylem vessels and block the transport of water and soluble mineral nutrients, affected plants show drying, scorching, wilting of the foliage, eventually followed by plant death. Professor Alexander "Sandy" Purcell at the University of California, Berkeley, has worked with *X. fastidiosa* throughout his career. His research, together with that of Professor Rodrigo Almeida, can be found at this website:

Sandy Purcell

The Almeida Lab at UC Berkeley

Rodrigo Almeida

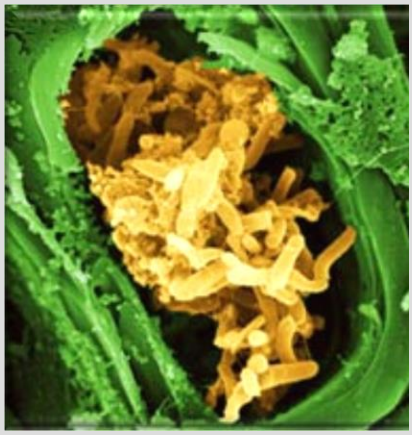


Image courtesy of the UC Berkeley EM Lab

***Xylella fastidiosa* bacteria clogging the xylem vessels of oleander**

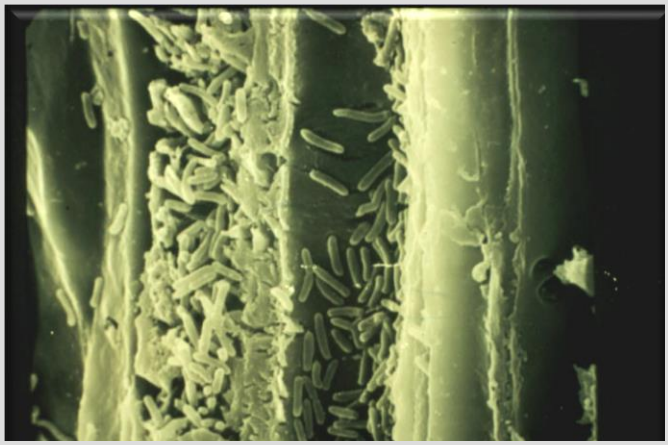


Photo by Doug Cook, Ph.D

***Xylella fastidiosa* clogging the xylem vessels of grapevine**

Photo by M. Scortichini

Pierce's disease on grape

Photo by Pompilid

Oleander scorch

Photo by M. Scortichini

Phony peach

Scorch symptoms on olive branch

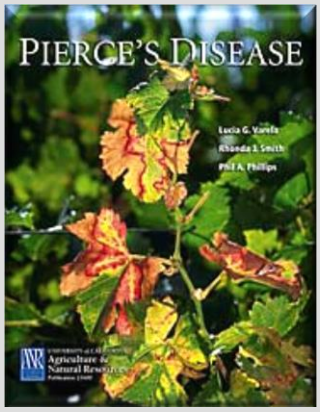
Scorch symptoms in olive tree

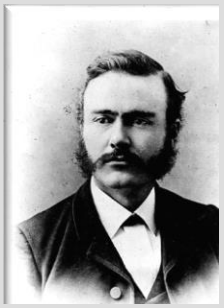
Olive tree death *by X. fastidiosa* and secondary fungi

All olive photos by D. Bosco, F. Nigro, & A. Guario

Xylella fastidiosa Origin and Spread

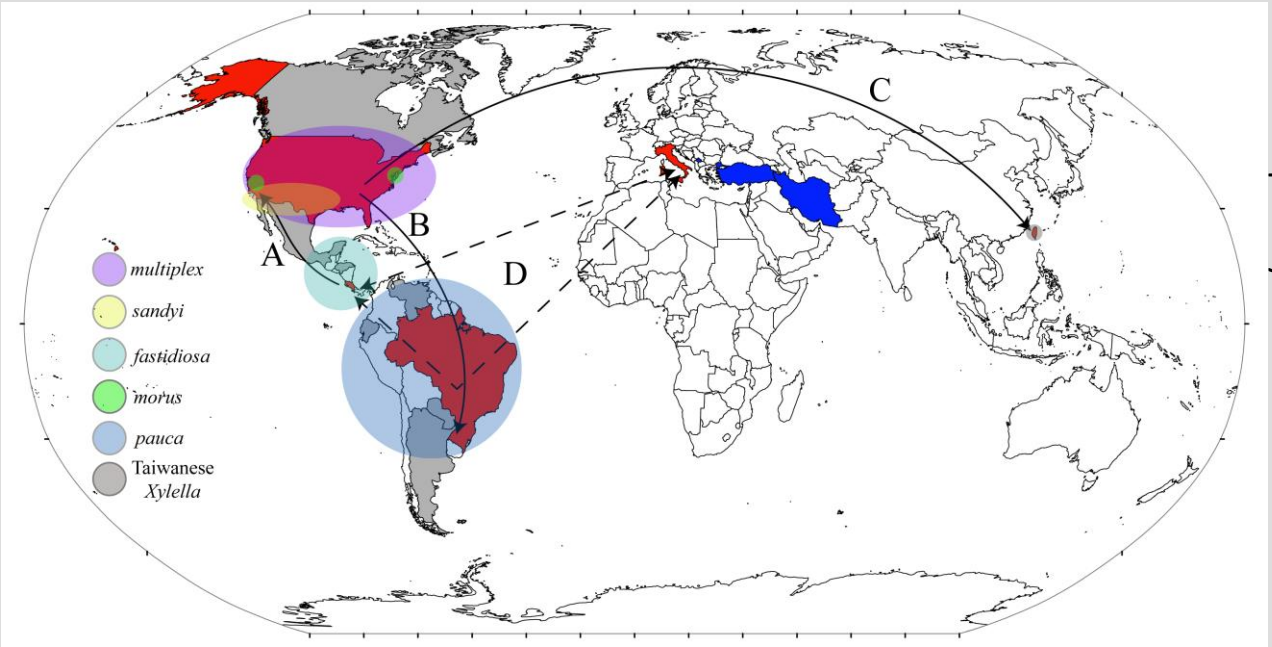
For many years, *X. fastidiosa* remained confined to the Americas. It is probably native to the US southeast and may have been introduced to the western US on infected plant material. Pierce's disease of grapevine was first noticed in California near Anaheim in 1884. German emigrants in San Francisco found land in southern California to establish vineyards. They called it Anaheim, or St. Anne's Home in English, from the Spanish land grant Rancho San Juan Cajon de Santa Ana. See the Anaheim Colony and "A History of Wine in Southern California" for the story of the colony, winegrapes in the greater L.A. area, and grapevine diseases. It was first called "The Anaheim Disease", and later Pierce's disease after Newton B. Pierce, California's first professional plant pathologist, who described it in 1892 as the "California Vine Disease". The disease destroyed more than 50,000 acres of vineyards in the greater Los Angeles area, some of which is now the site of Disneyland. The genus name, *Xylella*, means that in plants it grows strictly in the xylem . The species name, *fastidiosa*, or fastidious, is named because initially it was very difficult to culture. In California *X. fastidiosa* has been spread by native sharpshooters: the green, blue-green, and red-headed. (See page 5 for more information.) The green sharpshooter was the most widespread vector in California. Then the glassy-winged sharpshooter (GWSS), *Homalodisca vitripennis,* was inadvertently introduced into southern California in the early 1990s, perhaps on nursery material. A very extensive quarantine began in 2000 is credited with slowing the movement of GWSS. GWSS is a large sharpshooter that can feed even on the canes of vines. It changed the epidemiology of Pierce's disease in grape growing regions of the west coast. Several strategies have been developed to control the GWSS and prevent it from damaging vineyards.





Newton B. Pierce

Xylella fastidiosa Origin, con't.



Map courtesy of the Almeida Lab

Map showing the North and South American origins of the six subspecies of *X. fastidiosa* and its spread into Europe and Asia

Based on current knowledge, *X. fastidiosa* is primarily a species of the Americas, as one can see in the above map. A distant relative is found in Taiwan but should probably be classified as a separate species. Two other exceptions that must yet be confirmed, and for which no genetic information is available, are reports from Iran and Turkey. Lastly, the recent introduction of *X. fastidiosa* into Italy is an important change to its geographical distribution. The American representatives were initially divided into three subspecies, subsp. *fastidiosa, multiplex*, and *pauca*, based on DNA-DNA hybridization data. Multi-Locus Sequence Typing (MLST) data confirmed the status of these subspecies, and suggested a fourth, subsp. *sandyi*, which was not present among three earlier strains that were tested. Subsequent sampling and analysis based on MLST has indicated that these subspecies evolved in geographical isolation with subsp. ***pauca*** native to South America, subsp. ***multiplex*** native to temperate and subtropical North America, subsp. ***fastidiosa*** found in Costa Rica and presumed to be native to southern Central America, and subsp. ***sandyi*****,** which has only been detected in southern regions of the United States, but its sudden appearance in the USA strongly suggests that its unknown home of origin is south of the United States. Subspecies ***morus*** represents a new proposal. Historical geographic isolation of the original four subspecies is consistent with the known biology of *X. fastidiosa*. This bacterium can only invade a new region by long-distance dispersal of infected insects or infected plants. In the absence of human intervention, the former is very unlikely and the latter is close to impossible. However, it has become apparent that in the recent past, human-mediated invasion is the primary driver of economically costly *X. fastidiosa* introductions. We discuss three main pathways leading to the emergence of *X. fastidiosa* diseases. *X. fastidiosa* is no longer a plant pathogen limited to a few countries in the Western Hemisphere, where its geographical distribution ranges from Canada to Argentina. The long-term presence of *X. fastidiosa* in Taiwan raises questions about its potential distribution in Asia. Its introduction into Europe and a recent report from Iran will dramatically broaden its geographic range. Is this bacterium present elsewhere? To read the entire article by Rodrigo Almeida and Leonard Nunney, please go to: How Do Plant Diseases Caused by *Xylella fastidiosa* Emerge?

Vectors of *Xylella fastidiosa*

The specific vectors of *X. fastidiosa* are xylem-sap sucking insects, sharpshooter leafhoppers and spittlebugs. Cicadas may be vectors as well. In the western United States, sharpshooter insects are the dominant vector. Disturbed sharpshooters will slip quickly behind branches and stems to avoid predators, an action not unlike the behavior of army sharpshooter riflemen who would hide behind the trunks of trees to avoid detection by the opposition as they passed by their position, hence the common name. As with all leafhoppers , they have piercing-sucking mouthparts and closely spaced rows of fine spines on their hind legs. The nymphs feed by inserting their needle-like mouthparts into the xylem of the small stems on the plant where the eggs are deposited. After several molts, the nymphs become adult glassy-winged sharpshooters. The adults have wings and are highly mobile, and most feed on a variety of different plant species. Both nymphs and adults filter a huge volume of dilute liquid through their digestive system to extract the trace nutrients, and much of the water and carbohydrates are discharged forcibly away from the body in a fine stream of droplets. The University of Florida Institute of Food and Agricultural Sciences has an excellent website in its series "Featured Creatures," illustrating and describing many sharpshooters together with their egg and nymphal stages. Great for identification, First Detectors!

The sharpshooters acquire the bacteria during feeding on infected plants. The pathogen multiplies in the foregut of the insect and is apparently limited to this area of the gut; nymphs lose infectivity after molting when the cuticular lining of the foregut is shed, and have to feed on infected plant tissue to regain the bacterium.

See these videos: Glassy-winged Sharpshooter in California

Photo by Chris Tipping, UFL

***Homalodisca vitripennis,* glassy-winged sharpshooter (GWSS)**

Photo by Katja Schulz

***Graphocephala atropunctata*, blue-green sharpshooter**

Photo by Jack Kelly Clark UCB

Draeculacephala minerva – green sharpshooter

Photo by Jack Kelly Clark

***Xyphon fulgida* – red-headed sharpshooter**

Photo by Phil Phillips, UCCE

Vineyard in Temecula CA infected with Pierce's disease

Control of Sharpshooters

The principal reason for controlling the sharpshooters is to prevent the spread of the *Xylella fastidiosa* bacterium to susceptible plants. Because very low numbers of sharpshooters can spread the disease, it is not known how effective insecticides applied to suppress sharpshooters will be in controlling disease spread; research is currently underway to study this issue. In areas where sharpshooters are established, efforts are underway to introduce biological control agents for long-term management and several effective egg parasites are present in California. Chemical treatments can be applied to reduce sharpshooter numbers, but are generally not required to protect the health of plants not susceptible to the *X. fastidiosa* bacterium and have limited application in residential landscapes.

The most important biological control agents are small wasps that are egg parasites in the *Gonatocerus* genus that attack glassy-winged sharpshooter egg masses starting in spring. In some areas these parasites have been providing quite effective control. The rate of parasitism gradually increases over the season. During the first period of egg laying in spring, parasitism is usually between 10 to 50%, but during the second egg-laying period in late summer and early fall, it can reach as high as 90 to 100%. Eggs parasitized by these tiny wasps are easily identified by pinpoint holes found at one end of the egg. Spiders, assassin bugs, and praying mantis are predators of motile glassy-winged life stages. Lacewing larvae will eat sharpshooter eggs. Work is currently under way to find additional biocontrol agents.

Photo courtesy of UC Riverside

***Gonatocerus fasciatus* on a parasitized GWSS egg mass**

Photo by Reyes Garcia III

Gonatocerus fasciatus

Photo by L.J. Rhodes

Lacewing larva *Chrysoperla carnea*

The Ongoing Challenge - the Japanese beetle in the West

As the name suggests, the Japanese beetle, *Popilla japonica*, is native to Japan. The insect was first found in the United States in 1916 in a nursery near Riverton, New Jersey. It is thought the beetle larvae entered the United States in a shipment of iris bulbs prior to 1912, when Plant Protection and Quarantine inspections of commodities entering the country began. "The first Japanese beetle found in Canada was in a tourist's car at Yarmouth, arriving in Nova Scotia by ferry from Maine in 1939. During the same year, three additional adults were captured at Yarmouth and three at Lacolle in southern Quebec." Japanese beetles have been found in the Azores since the 1970s. In 2014 the first population in mainland Europe was discovered near Milan in Italy. The life cycle of the Japanese beetle is typically one year in most parts of the United States, but this can be extended in cooler climates; for instance, in its native Japan, the beetle's life cycle is two years long as a result of the higher latitudes of the grasslands required for the larval stage. During the larval stage, the white grubs can be identified by their V-shaped raster pattern. The larva is similar to many other scarab beetles, so this raster pattern is essential for accurate identification.

Photo by David Cappaert

Japanese beetle Lifecycle

Photos courtesy USDA-APHIS

Pupa

Larva

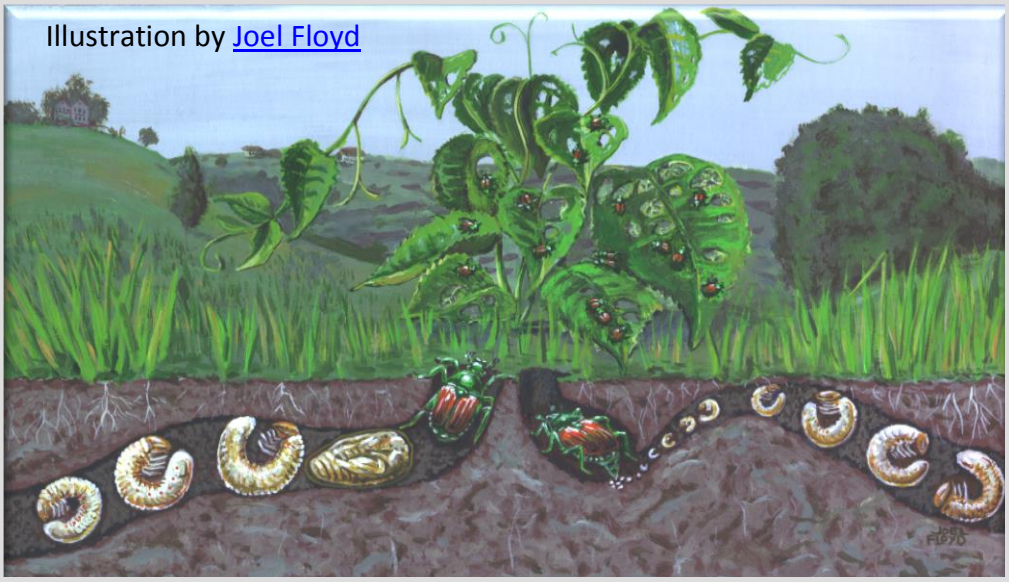


Photo by D. Gordon E. Robertson

Adults mating

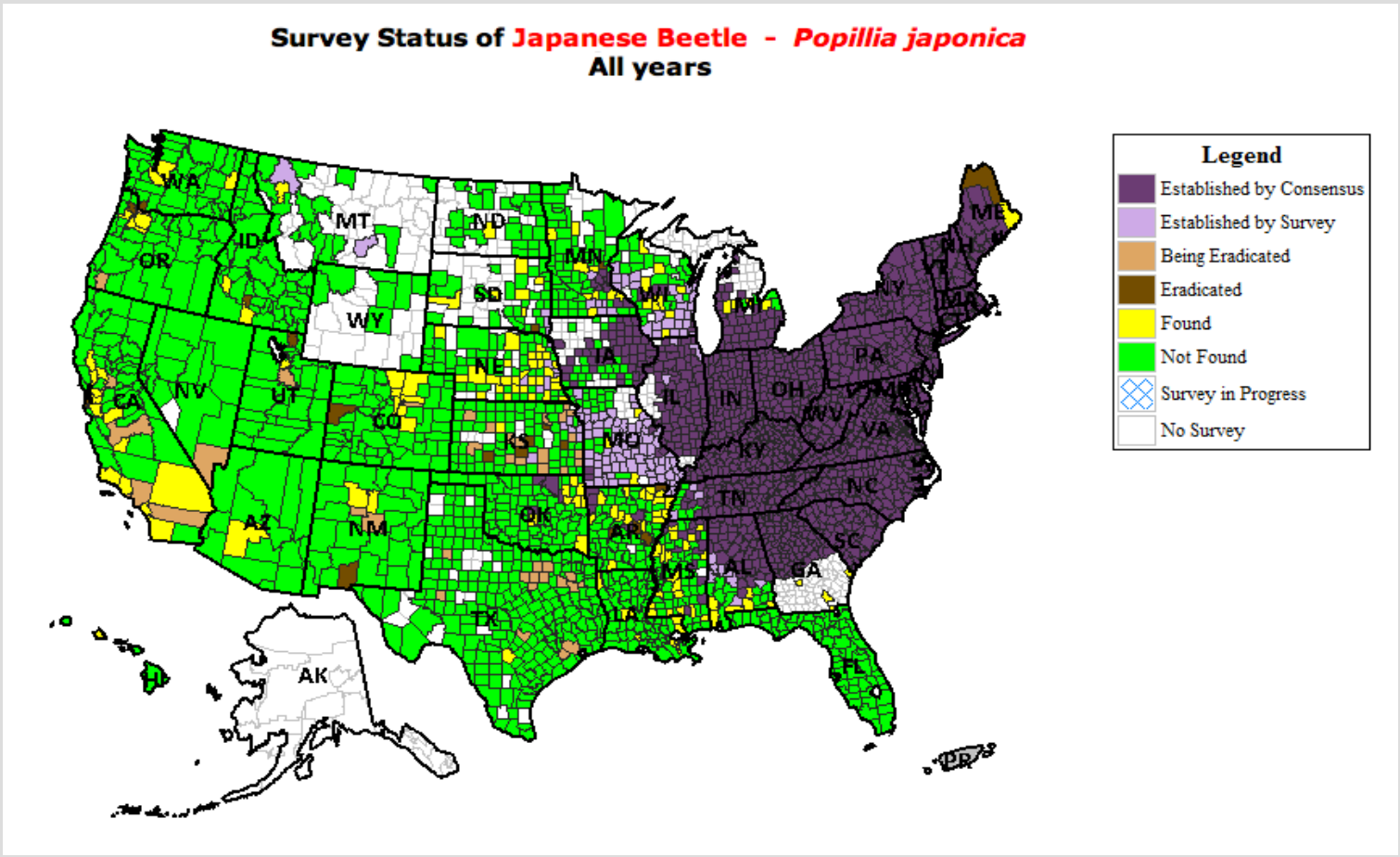
Eggs

Life cycle of the Japanese beetle: on the right side of the illustration, the female beetle lays eggs in summer that slowly develop into ever-growing larvae. The larvae feed on roots, preferable grass roots. The last larval stage undergoes metamorphosis, becoming a pupa that in turn hatches into a mature beetle in June. The mature beetles feed on leaves and fruit.

During the adult beetle's feeding period, females intermittently leave plants, burrow about 3 inches into the ground—usually into turf—and lay a few eggs. This cycle is repeated until the female lays 40 to 60 eggs. By midsummer, the eggs hatch, and the young grubs begin to feed. Each grub is about an inch long when fully grown and lies in a curled position. In late autumn, the grubs burrow 4 to 8 inches into the soil and remain inactive all winter. This insect spends about 10 months of the year in the ground in the larval stage. In early spring, the grubs return to the turf and continue to feed on roots until late spring, when they change into pupae. In about 2 weeks, the pupae become adult beetles and emerge from the ground. This life cycle takes a year

The Japanese beetle is not very destructive in Japan, where it is controlled by natural predators, quite typical of other invasives. However in North America it is a serious pest of about 200 species of plants, including rose bushes, grapes, hops, canna, crape myrtles, birch trees, linden trees and others. These insects damage plants by skeletonizing the foliage (i.e., consuming only the leaf material between the veins), and may also feed on fruit on the plants if present. Today, the Japanese beetle is the most widespread turf-grass pest in the United States. The grubs develop in the soil, feeding on the roots of various plants and grasses and often destroying turf in lawns, parks, golf courses, and pastures. You are most likely to see the adults in late spring or early summer. See this video from Wisconsin Cooperative Extension: Japanese beetle in Corn and Soybean

Homeowner efforts to control the larval and adult stages are estimated to cost more than $460 million a year. Losses attributable to the larval stage alone have been estimated at $234 million per year—$78 million for control costs and an addition- al $156 million for replacement of damaged turf. Please see the USDA-APHIS publication: Managing the Japanese beetle: A Homeowner's Handbook



As you can see from the yellow-colored counties on the map, the Japanese beetle has tried to get into the Western US several times, and keeps trying. The biggest threat of introduction of Japanese beetle in the West is via hitchhiking beetles on aircraft. Each year, state departments of agriculture inspectors intercept hundreds of these beetles on aircraft originating from airports in infested states. High risk trap grids placed around airports have detected Japanese beetles, indicating they can successfully fly from aircraft and are capable of establishing in the West after their trip from the east. There was a major outbreak of the beetle in the Sacramento, CA area in the mid-1960s. Presently there are two areas being treated in California, at Fair Oaks and Carmichael in Sacramento County. See JB infestations in California to get an idea of the seriousness of this pest. Montana's first JB detection was in 2002 and the eradication effort is ongoing. Utah had an infestation in 2006 and was declared eradicated in 2014. Oregon has had infestations and has on ongoing trapping and monitoring program, as has had Washington. New Mexico found JB in a nursery in the Albuquerque metropolitan area in Bernalillo County in1998. The area around the nursery was treated. More were found in 2002, but after intensive soil fumigation program and trapping. After 2004, no JB have been found. See the Pest Tracker page for the Japanese beetle CAPS surveys from 2006 through 2015 to see where JB has been found.

Photo by Ronald L. Kelly

Photo courtesy of University of WI

JB adults feeding on foliage

Photo courtesy of U of Minnesota

JB larvae damage to turf

The European Gypsy Moth

Lymantria dispar, order Lepidoptera, family Erebidae, Linnaeus 1758

Male GM – note the feathered antennae

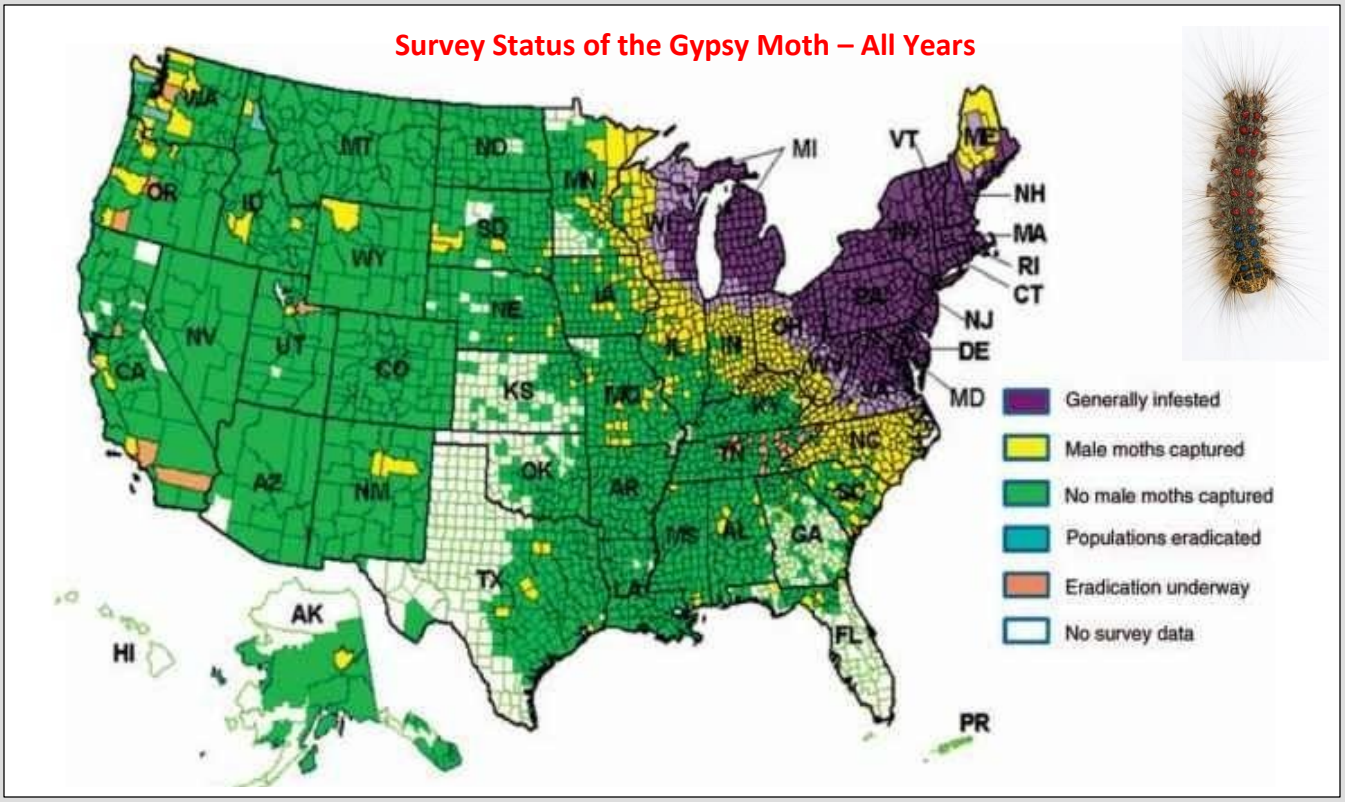
Male gypsy moth

Female gypsy moth

GM larva 5th instar

Gypsy moth eggs

Another invasive species that keeps trying to find a home in the West is the gypsy moth . The genus name, *Lymantria*, means destroyer, and the species name, *dispar*, means unequal, because the male and female are different colors, as one can see in the images above. The gypsy moth was introduced into North America in 1869 from Europe. Étienne Léopold Trouvelot imported the moths, with the intent of interbreeding gypsy moths with silk worms to develop a silkworm industry. The moths were accidentally released from his residence in Medford, Massachusetts. The gypsy moth was considered a nuisance just ten years after their release. The first major outbreak occurred in 1889, and Forbush and Fernald recount the extent of devastation: all the trees being defoliated and caterpillars covering houses and sidewalks and raining down upon residents. At first it was uncertain what species was responsible for the outbreak, but after the caterpillar was identified by entomologist Maria Elizabeth Fernald an eradication program began in 1890.



Notice the areas in yellow in the western United States. On the west coast there is a concentration around ports. Shipping is one mode of movement of the Gypsy moths.

The small larvae of the gypsy moth take to the air and are carried by the wind. The larvae spin silken threads and hang from them, waiting for the wind to blow. The light larvae have long hairs that increase their surface area, which are suitable for being carried aloft. The natural spread is slow, but transportation of the moth has led to isolated gypsy moth populations, with accidental transport of the eggs helping to spread the moths. The gypsy moth brings one of the largest impacts in defoliation of deciduous trees in the Northern Hemisphere. Since its introduction in to the United States in 1868 or 1869, it has spread both west and south, now taking over most of the hardwood forests in the eastern United States and Canada. Gypsy moth larvae consume the leaves of over 500 species of trees, shrubs and plants. The gypsy moth is one of the most destructive pests of hardwood trees in the eastern United States. Firewood is a common way to transport eggs, since the moths will lay their eggs on dead wood. Firewood should be purchased and used locally, within 50 miles of where it is cut, to prevent the spread of the moths. The website Don't Move Firewood offers useful information about pests, like the gypsy moth, that can be transported specifically by firewood. In the eastern US, the gypsy moth prefers oaks, aspen, apple, sweetgum, speckled alder, basswood, gray, paper birch, poplar, willow, and hawthorns, among other species. Gypsy moth caterpillars have huge appetites! About every ten years, gypsy moth populations grow very large and can completely strip trees of their leaves. If they attack a tree for two or three years, it may die. Gypsy moth caterpillars sometimes consume the leaves of hundreds of acres of forest at a time, destroying important timber and shade trees, and costing millions of dollars in damage. Thousands of feeding caterpillars can cause allergic reactions in people and can make huge messes in yards. Gypsy moth feeding is also bad for other forest animals, like birds, that make their homes in the trees too. Fortunately, scientists have developed control methods to slow this forest destroyer down, and helpful natural enemies of the gypsy moth have spread to keep the hungry caterpillars in check. In neighborhoods, the impact of gypsy moth can be reduced by hunting for and destroying egg masses in wintertime to make sure caterpillars don't eat leaves in the spring. Burlap hiding bands on tree trunks or certain insecticide treatments can be used to control caterpillars in the springtime. Larvae will climb up any object in their path in search of food, including telephone poles, vehicles, even people! See Gypsy moth lifecycle and control from Clinton County, Pennsylvania.

Gypsy moth undergoes four developmental life stages; these are the egg, larva (caterpillar), pupa, and adult. Gypsy moth females lay from 500 to 1,000 eggs in sheltered areas such as underneath the bark of trees. The egg mass is approximately 1.5 inches long and 0.75 inches wide. The eggs are the overwintering stage of the insect. Eggs are attached to trees, houses, or any outdoor objects. The eggs hatch in spring (April) into caterpillars. In early summer (June to early July), Gypsy moth caterpillars enter a pupal or transitional stage. The pupae are dark brown, shell-like cases approximately two inches long and covered with hairs. They are primarily located in sheltered areas such as tree bark crevices or leaf litter. Adult Gypsy moths emerge from the pupae in 10 to 14 days. They are present from July into August. Females have white to cream-colored wings, a tan body, and a two-inch wingspan. Female Gypsy moths cannot fly. More to come in the Winter 2016 edition!

Gypsy moth caterpillar feeding on an oak leaf

Photo by Buckley Tree Service

Photo by U of MD CE

Female Gypsy moths laying eggs on the bark of a tree

Giant African Snail intercepted in Oakland CA

Excerpted from Chip Johnson, San Francisco Chronicle, December 18, 2015

Giant African snail eggs

Photos courtesy of USDA-APHIS-PPQ

”You’d think a pair of snails found on wooden pallets at the Port of Oakland wouldn’t amount to a national threat. These were live Giant African snails (GAS) and no need to wonder about the name. They’re ravenous land snails that can grow to 8 inches in length and 5 inches in diameter, and they eat 500 types of plants, paint and stucco and carry disease that can cause meningitis in humans. So yes, they can eat your house. But they can also threaten California agriculture, so authorities from Homeland Security are doing everything they can to make sure they don’t invade the Golden State.

The invasive species was found at the Port of Oakland this month — with a bunch of eggs — by U.S. Customs and Border Protection agents who were inspecting the docks. They were found on wooden pallets that originated in American Samoa, said Frank Falcon, a spokesman for the federal agency. The specimens were sent to the U.S. Department of Agriculture for tests, Falcon said. The container carrying the snails was sealed and sterilized before being off-loaded, he added “.

This beautifully marked snail, originally from coastal East Africa, has a voracious appetite and leaves behind disgusting slime in its path. GAS devastates agriculture, ecosystems, commerce, and human health. The snail can carry a nematode causing deadly meningitis, the rat lungworm. It has been recognized as number 2 on the list of top 100 invasive species in the world, according to the Global Invasive Species Database. It is known to eat hundreds of different kinds of ornamental and food plant species. It has been spreading around the world, either intentionally (as pets or food) or accidentally. An adult fertilized GAS can lay enough eggs to produce a new colony. Eggs are laid within 8-20 days after copulation. Egg clutches can reach 500 or more eggs, which hatch within 1-17 days, depending on the temperature. Individual GAS can live for 4-5 years, and 9 years in captivity. They will literally eat most plant life. Because GAS grows so rapidly, it needs calcium to construct its shell. In Miami, FL, where there is presently an infestation, GAS is eating the stucco off the exterior of houses to source calcium!

Please read further about invasive snails and slugs in the Winter-Spring 2013 WPDN newsletter and an earlier interception of GAS at LAX in the Summer 2014 newsletter.