

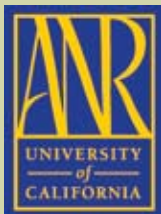
**EXOTIC/INVASIVE PESTS AND  
DISEASES RESEARCH PROGRAM**

UNIVERSITY OF CALIFORNIA

AGRICULTURE AND NATURAL RESOURCES



**2005  
California  
Report**





## 2005 SPOTLIGHT

### RESEARCHER FINDS SOLUTIONS TO CONTROL INVASIVE PESTS THAT THREATEN MARINE ORGANISMS

Many non-native species inhabit California's coastal waters, posing a threat to aquatic ecosystems.

With funding from the UC Exotic/Invasive Pests and Diseases Research Program, ecologist Ted Grosholz conducted research on exotic invasive pests of marine organisms, including European green crabs that literally decimate native oysters and sabellid polychaetes that deform abalone shells.

The European green crab likely arrived in 1993 in boxes of fishing bait from New England. First discovered in the San Francisco Bay in 1989, the European green crab has been reported in water bodies as far north as Coos Bay and parts of Washington. "Specimens have been found in Bolinas Lagoon, Tomales Bay, Drake's Estero, Bodega Bay, and Humboldt Bay," says Grosholz.

This highly adaptable, invasive species thrives in a wide range of temperatures and reproduces quickly. The crab doesn't do well in the open sea but makes its home in bays and estuaries.

Feeding on mussels, clams, oysters, other crabs, small fish, and snails, the green crab disrupts the balance of the ecosystems of bays and their bottoms. Bays support the smallest organisms in the food chain, such as plankton and algae.

Grosholz's research in Bodega Harbor, a small, protected inlet 70 miles north of San Francisco, has developed ways to increase native oysters without increasing green crabs to infestation levels.

"Trapping the crabs in experimental oyster racks is an inexpensive and effective method to significantly improve oyster survival, without increasing the European green crab population," he says.



Grosholz has also identified "hot spots" along the west shore of the inner part of Tomales Bay where oyster density and recruitment is highest and where future native oyster restoration efforts should be focused.

Shellfish growers and natural area managers can employ these methods, although it may take up to three years.

Although not directly life threatening to abalone, the sabellid polychaete is a serious pest of abalone in aquaculture facilities in California. Grosholz's research with this South African, shell-dwelling species reveals that all life stages of the pest can be destroyed by immersing it in freshwater for a minimum of 24 hours. This practice allows abalone culture and aquarium operators to destroy the sabellid in abalone holding units.



UNIVERSITY OF CALIFORNIA

## EXOTIC/INVASIVE PESTS AND DISEASES RESEARCH PROGRAM

Many newly arrived insects, plants, and diseases have become widely established in California, causing an estimated \$3 billion damage annually.

New plant and animal species often have been deliberately and legally introduced for horticultural, novelty, agricultural, or land management purposes, or as pets, only to reveal years or decades later their invasive attributes.

These exotic pests are also referred to as alien, non-native, invasive, or introduced pests. Having evolved in a different ecosystem, these non-native species may have few natural enemies in their new range, which may lead to outbreaks of the pest that eats or competes with native species and, thereby, decimates them. These pests can include insects, mites, mollusks, nematodes, bacteria, fungi, viruses and other microorganisms, vertebrates, and weeds.

For example, in June 2005, the Asian longhorned beetle, a voracious tree borer that has killed thousands of poplars, maples, elms, and mulberries in New York, Chicago, and New Jersey, was reported in Sacramento. These bullet-shaped beetles were discovered in the wood of a pallet of decorative building stone imported from China.

It's the first such incident of Asian longhorned beetle in California and follows an established pattern of the insect hitchhiking to the United States inside wooden packing crates made from infested trees.

The University of California Exotic/Invasive Pests and Diseases Research Program (UC EPDRP) is ahead of the curve, already funding research on exotic longhorned beetles, including the Asian longhorned beetle, to make them easier to detect and eradicate. This research focuses on testing for and identifying pheromones (chemicals an animal gives off to attract a mate), which then could be used in traps to more efficiently find and control the beetles.

Many species other than the Asian longhorned beetle also threaten California's ecosystems. The EPDRP funds projects for prevention, early detection, and rapid development of control or eradication measures leading to improved integrated pest management practices for insects, weeds, crustaceans, plant diseases, and other pests.

The EPDRP is a collaboration between the UC Riverside Center for Invasive Species Research and the UC Statewide IPM Program, with funding from United States Department of Agriculture (USDA)—Cooperative State Research, Education, and Extension Service (CSREES).

To date, USDA-CSREES has provided \$7.1 million to support 82 innovative research and extension projects addressing exotic pests and invasive species. Investigators present their results at an annual research workshop, in scientific papers, and popular articles.

Funding is available to scientists affiliated with public research institutions, both within and outside of California. Proposals are reviewed, evaluated, and ranked by a scientific review panel, a technical review panel, and a program advisory committee.

### FUNDING RESEARCH ON THESE EXOTIC PESTS AND INVASIVE SPECIES:

#### IN AGRICULTURAL ENVIRONMENTS

ARGENTINE ANTS  
ASIAN CITRUS PSYLLID  
AVOCADO LACE BUG  
AVOCADO THRIPS  
CITRUS PEELMINER  
CITRUS TRISTEZA VIRUS  
CORN LEAFHOPPER  
COTTONY CUSHION SCALE  
CORN STUNT  
CURLY TOP VIRUS  
EARLY AND LATE WATERGRASSES  
EXOTIC NEWCASTLE DISEASE  
FUSARIUM OXYSPORUM  
GLASSY-WINGED SHARPSHOOTER  
MEALY PLUM APHID  
MEDITERRANEAN FRUIT FLY  
MEDUSAHEAD  
OLIVE FRUIT FLY  
PIERCE'S DISEASE  
RICE BLAST  
RYEGRASSES  
TOMATO PSYLLID  
VERTICILLIUM WILT  
VINE MEALYBUG  
WALNUT APHID

#### IN NATURAL ENVIRONMENTS

BARB GOATGRASS  
BARRED TIGER SALAMANDER  
EUROPEAN GREEN CRAB  
EURASIAN WATERMILFOIL  
FOUNTAIN GRASS  
GIANT REED, *ARUNDO DONAX*  
JUBATAGRASS  
MEDUSAHEAD  
PAMPASGRASS  
PITCH CANKER  
RUST  
SABELLID POLYCHAETE  
SAHARA MUSTARD  
SEAWEED, *SARGASSUM MUTICUM*  
SUDDEN OAK DEATH  
WATER PRIMROSE  
WILD PIGS  
YELLOW STARThistle

#### IN URBAN ENVIRONMENTS

ARGENTINE ANT  
ASIAN HACKBERRY WOOLLY APHID  
CERAMBYCID BEETLES  
(ASIAN LONGHORNED BEETLE)  
EUCALYPTUS LONGHORNED BORER  
GERMAN YELLOWJACKET  
MEDITERRANEAN PINE ENGRAVER  
REDHAIRCED BARK BEETLE  
RED IMPORTED FIRE ANT  
SPOTTED GUM PSYLLID  
TUMBLEWEED



## Agricultural Systems

### IDENTIFICATION OF PEST-SPECIFIC PARASITIDS FOR CONTROL OF GLASSY-WINGED SHARPSHOOTER

M. S. Hoddle, Entomology, UC Riverside  
Year 2 of 3

This study is determining which exotic insects used for biological control of the glassy-winged sharpshooter can attack 10 native California sharpshooters. To do this, researchers must know the oviposition preference of native sharpshooters associated with particular host plants and their natural enemy fauna attacking oviposited eggs. Researchers have determined that a native California sharpshooter, the blue-green sharpshooter (BGSS), prefers to lay its eggs in new growth, the succulent stems and tendrils along the grape cane of wild native California grapes in riparian areas. Researchers have also identified two new parasitic wasps that attack the eggs of the BGSS.

### TARGETING THE GLASSY-WINGED SHARPSHOOTER ALIMENTARY TRACT FOR CONTROL OF PIERCE'S DISEASE

B. Federici, Entomology, UC Riverside  
Year 3 of 3

This study looks at the structure and proteins of the glassy-winged sharpshooter's saliva and gut to help identify antibodies that bind to and interfere with the function of these proteins, causing the insects to starve. Proteins have been cloned, and antibodies to interfere with them are being researched.

### CONTROL OF CURLY TOP VIRUS USING TRAP CROPS AND REPELLENTS

G. P. Walker, Entomology, UC Riverside  
Year 2 of 2

To combat curly top virus in a variety of crops, including tomatoes, researchers tested repellents such as reflective-silver and dark-green plastic mulches. In North America, the sole transmitter of the virus is beet leafhopper. The silver reflective plastic mulch treatments in early and late transplant plots had the lowest numbers of beet leafhoppers. Other benefits of both mulches are faster recovery from transplant shock, greater plant growth, and higher yield. Researchers learned that beet leafhoppers distribute themselves throughout the field, so edge treatments alone are not effective.



L. Dunning

### ROLE OF ARTHROPODS IN EXOTIC NEWCASTLE DISEASE

A. C. Gerry, Entomology, UC Riverside  
C. J. Cardona, Veterinary Medicine, UC Davis  
Year 2 of 3

Researchers have collected samples of fly populations at several poultry operations to test for the presence and quantity of exotic Newcastle disease, a contagious and fatal viral disease that affects poultry and other birds. Results of these studies may determine if insects transmit the virus between birds and between infected locations.

### IDENTIFYING EFFECTIVE PARASITOID BIOTYPES FOR BIOLOGICAL CONTROL OF MEALY PLUM APHID

N. J. Mills, Insect Biology, UC Berkeley  
Year 2 of 3

DNA analysis shows that mealy plum aphids collected in California and the Mediterranean differ based on their host plant: peach or apricot, plum, or almond. Initial results identified Spain as the likely source of California's invasive mealy plum aphids, and Spain is, therefore, probably the best place to search for effective parasites against it.



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### USING MOLECULAR MARKERS TO TRACE HERBICIDE RESISTANCE IN EARLY AND LATE WATERGRASSES IN RICE

M. A. Jasieniuk and A. J. Fischer, Plant Sciences, UC Davis  
Year 1 of 3

Early and late watergrasses have evolved resistance to three of four major herbicides used for their control. Researchers are testing watergrass seedlings for resistance or susceptibility to four herbicides. In addition, researchers have identified several molecular markers to be used to characterize resistance genes. Results will be used to identify genetic factors that are important in selection and spread of herbicide resistance within and among rice fields, and to help design resistance management strategies to prevent further invasions of early and late watergrasses.

### A BAITING PROGRAM FOR ARGENTINE ANTS FOR USE IN ORGANIC CITRUS

J. H. Klotz and M. K. Rust, Entomology, UC Riverside  
Year 1 of 2

The Argentine ant causes significant economic losses in agricultural environments by protecting other insects that remove nutrients from the food-conducting tissue of plants. This study will develop a baiting program using low-toxic borate baits and

commercial liquid bait delivery systems to control Argentine ants in organic citrus orchards.

### ORIGINS OF CALIFORNIA CITRUS PEELMINER POPULATIONS

R. Stouthamer and D. Vickerman, Entomology, UC Riverside  
Year 1 of 1

Growers have seen outbreaks of citrus peelminer in the Coachella Valley since the mid-1990s, but no study has shown how this pest has recently expanded to numerous hosts in the San Joaquin Valley. Researchers have discovered differences in the DNA of citrus peelminer that distinguish the San Joaquin Valley and Mexico populations from the Coachella population. This suggests that the San Joaquin Valley strain could have originated in Mexico. The study also developed molecular techniques to distinguish citrus peelminer from other mining species with which it may be confused.

### ORIGINS AND MANAGEMENT OF TOMATO PSYLLID

J. T. Trumble and R. Stouthamer, Entomology, UC Riverside  
Year 2 of 3

Researchers concentrated their efforts on a management strategy for tomato (or potato) psyllids. Two environmentally safe chemicals, imidacloprid and pyriproxyfen, controlled tomato psyllids consistently well on all varieties tested. Scientists noted that several commonly grown tomato varieties were vulnerable to tomato psyllids. They also observed that one wild type of tomato has nearly complete resistance to the pest, which has been brought to the attention of commercial tomato breeders.



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### AN EDUCATIONAL PROGRAM ON IDENTIFICATION AND DAMAGE POTENTIAL OF ASIAN CITRUS PSYLLID

E. E. Grafton-Cardwell, Entomology, UC Riverside  
K. E. Godfrey, Biocontrol Program, California Department of Food and Agriculture  
M. E. Rogers, C. C. Childers, and P. A. Stansly, Entomology, University of Florida  
Year 1 of 2

The Asian citrus psyllid, a pest of citrus and carrier of citrus greening disease, is established in South and Central America. Since 1998, it has infested most of the citrus growing regions of Florida. This educational program supports efforts to keep it from becoming established in California. California researchers have developed a brochure, Web site, and slide presentation to educate California citrus growers, the ornamental nursery industry, and regulatory agency staff about Asian citrus psyllid.

## IMPACTS OF HYPERPARASITOIDS AND PREDATORS ON BIOLOGICAL CONTROL OF WALNUT APHID

N. J. Mills, Insect Biology, UC Berkeley  
Year 1 of 3

The walnut aphid is an invasive species originating from the Middle East. The successful introduction of a parasitoid from Iran in 1969 has provided sustained control of this devastating pest for more than 30 years. However, within the last 5 years, localized outbreaks of walnut aphid have occurred in the Central Valley. Researchers will investigate the potential role of hyperparasitoids (parasites that attack the original parasitoid from Iran) and predators in the recent failure of this biological control program through seasonal monitoring of their activity and laboratory investigations on the indirect effects of hyperparasitism.



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## GENE CHIPS TO DETECT AND PREVENT ESTABLISHMENT OF CITRUS TRISTEZA VIRUS

D. E. Ullman, Entomology, UC Davis  
B. W. Falk, Plant Pathology, UC Davis  
Year 1 of 1

Citrus tristeza virus is widespread throughout southern California, but so far it is at very low levels in the San Joaquin and desert valleys. This research will develop a rapid detection tool for the pathogen. Distinguishing trees with highly transmissible citrus tristeza virus isolates will help growers eradicate only those trees that pose the biggest threat as a source for further transmission to the rest of an orchard.

## USING GINGER ROOT OIL TO ENHANCE MATING COMPETITIVENESS OF MASS-REARED MEDITERRANEAN FRUIT FLY MALES

T. E. Shelly, USDA-APHIS  
Year 1 of 1

Mating tests showed that exposure to ginger root oil boosts the mating success of sterile male medflies 50 percent above that recorded for control males. This research provides a simple and inexpensive way to increase the mating competitiveness of sterile male medflies used to eradicate developing infestations of this notorious pest. The study will benefit fruit and vegetable growers, as well as state government-sponsored Preventative Release Programs.



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## USING OLIVE-ASSOCIATED YEAST TO ATTRACT OLIVE FRUIT FLY

K. L. Boundy-Mills, Food Science and Technology, UC Davis  
F. G. Zalom, Entomology, UC Davis  
Year 1 of 1

Since the 1998 invasion of the olive fruit fly, statewide monitoring, as well as insecticide bait spraying and bait trapping, has begun to limit fruit damage. Monitoring traps typically contain common yeasts. Studies hope to determine whether yeasts commonly found on olives may be better lures for the olive fly. Preliminary results demonstrate that olive flies carry and consume yeasts, and that olive flies are attracted to different yeast species, rather than to a generic protein source. Researchers will identify yeasts that most strongly attract olive flies and compare their effectiveness to yeast species used in commercial attractants. Results can help to improve monitoring and control methods.

## FATE OF VINE MEALYBUG IN WINERY WASTE

L. G. Varela, UC IPM Program, Sonoma Co.  
R. J. Smith, UCCE, Sonoma Co.  
Year 1 of 1

Vine mealybug, spread from initial infestations in southern California, was first found in North Coast vineyards in California in 2002. After going through a whole-cluster press, the pest can survive in winery waste piles. Studies showed that covering small, round waste piles with clear plastic for two weeks almost eliminated the vine mealybugs; piles containing more skins reached higher temperatures and killed more insects. Researchers have developed new recommendations for managing winery waste based on the project results.

## Natural Systems

### IMPACTS AND CONTROL OF AN INVASIVE SEAWEED, *SARGASSUM MUTICUM*

J. H. Goddard and C. A. Blanchette,  
Marine Science Institute  
Year 3 of 3

Researchers have compared light intensity in surfgrass beds, with and without this invasive seaweed, to see if it significantly reduces light reaching the surfgrass. Removing the seaweed manually two to three times a year effectively reduces the abundance of this large, canopy-forming brown alga. Researchers are drafting a pamphlet for reserve managers of Marine Protected Areas in California on the impacts of this invasive pest.

### MANAGING EUROPEAN GREEN CRAB IN COASTAL ESTUARIES

E. D. Grosholz, Environmental Science and Policy, UC Davis  
Year 3 of 3

European green crabs prey on native oysters, seriously reducing their population. Researchers have developed ways to increase native oysters without increasing green crabs to infestation levels.

They have identified "hot spots" along the west shore of the inner part of Tomales Bay where oyster density and recruitment is highest and where future native oyster restoration efforts should be focused.

## IMPACTS AND CONTROL OF GIANT REED IN RIPARIAN HABITATS

J. S. Holt, Botany and Plant Sciences, UC Riverside  
Year 3 of 3

Experiments comparing nitrogen use of giant reed and two native species show that giant reed grew larger overall under both high and low nitrogen conditions. Willow benefited the most from added nitrogen, suggesting that giant reed removal could promote willow growth, particularly in areas near water containing nitrogen. Experiments are under way to determine when and how much giant reed removal is needed to restore native species in riparian areas.

## INTENSIVE GRAZING AND REVEGETATION TO CONTROL MEDUSAHEAD

E. A. Laca and M. R. George, Agronomy and Range Science, UC Davis  
Year 3 of 3

This study shows that "precision" grazing can control medusahead. This type of grazing requires a large number of animals grazing for short periods to maximize the pressure on medusahead and avoid detrimental impacts on desirable species. Researchers advise grazing in late spring. These control methods can be used on rangelands grazed by domestic livestock and can potentially reduce dependency on chemical and fire control methods in these areas.

## CONTROLLING PERENNIAL WEED INFESTATIONS IN THE LAKE TAHOE BASIN

M. Renz, Plant Sciences, New Mexico State University  
W. E. Frost, UCCE, El Dorado Co.  
Year 2 of 3

This study confirms the effectiveness of a new, environmentally sensitive herbicide delivery system that simultaneously clips weeds and deposits herbicide on the remaining stems. This method will help to eradicate small, establishing infestations of perennial weeds while minimizing drift of herbicide to other plants and into the soil. The system was more effective on younger plants than older plants.

## MODELING RANGE AND ABUNDANCE OF VINE MEALYBUG AND ITS NATURAL ENEMIES

A. P. Gutierrez, Ecosystem Science, UC Berkeley  
K. M. Daane, Insect Biology, UC Berkeley  
Year 2 of 2

A tool based on geographic information systems will help to predict changing vine mealybug populations. The tool uses physiological models and regional analysis of crop-pest problems to predict statewide mealybug seasonal abundance and damage and natural enemies in each region, and it estimates the pest's climatic and geographic limits.

## FACTORS CONTRIBUTING TO INVASIVENESS OF JUBATAGRASS AND PAMPASGRASS

M. A. Jasieniuk and J. M. DiTomaso, Plant Sciences, UC Davis  
Year 2 of 3

Research results show that all jubatagrass populations in California consist of a single clone, identical to the single one found in Hawaii. In contrast, California pampasgrass populations show high levels of genetic differentiation. Although jubatagrass has already been officially listed as a noxious weed in California, this work will provide CDFA with information about the invasive potential of pampasgrass varieties as it considers whether to classify pampasgrass as a noxious weed.

## PARASITIC POLYCHAETE DETECTION IN NATIVE GASTROPODS AND CONTROL IN ABALONE

E. D. Grosholz, Environmental Science and Policy, UC Davis  
J. Moore, Medicine and Epidemiology, UC Davis  
Year 2 of 2

Studies reveal that all life stages of the sabellid polychaete that deforms abalone shells can be destroyed by immersing it in freshwater for a minimum of 24 hours. This practice allows abalone culture and aquarium operators to assuredly destroy sabellid in abalone holding units. Experiments also show that sabellid polychaete can be transmitted from one turban snail to another, although the rate of transmission is much lower than the rate between abalone.

## RELATIONSHIPS AMONG THE SUDDEN OAK DEATH PATHOGEN, NATIVE BEETLES, AND DECAY FUNGI IN OAKS

D. L. Wood, Insect Biology, UC Berkeley  
Year 1 of 3

Sudden oak death is killing thousands of oaks in California woodlands. *Phytophthora ramorum* is a fungus-like pathogen that destroys tanoak and several oak species, as well as Douglas-fir, rhododendron, California bay laurel, and camellia. This study will determine whether bark and ambrosia beetles carry *P. ramorum* from tree to tree, and the contribution of ambrosia beetles to the death of trees infected by sudden oak death.

## EVALUATION OF SUDDEN OAK DEATH INCIDENCE IN COASTAL FOREST TYPES

R. B. Standiford, Center for Forestry, UC Berkeley  
N. M. Kelly, Ecosystem Science, UC Berkeley  
Year 2 of 3

This study identifies tree species that are susceptible to sudden oak death. Researchers found that, for all species studied, the larger a tree stem's diameter, the more likely the tree will be infected with sudden oak death. Experiments may indicate that more mature forests are at greatest risk since older trees are more likely to become infected.

## NITROGEN DEPOSITION AND SOIL TYPE IMPACTS ON INVASIVE ANNUALS IN THE MOJAVE DESERT

E. B. Allen, Botany and Plant Sciences, UC Riverside  
Year 1 of 3

The Mojave Desert is experiencing an increase in invasive annual plants that may be caused by air pollution that increases nitrogen in the soil. This study examines soil types that are most susceptible to nitrogen accumulation and weed invasion in the area. Study results will give land managers another tool to control invasive annual grasses and help protect the desert ecosystem.

## ESTABLISHMENT OF PITCH CANKER IN THE SIERRA NEVADA

T. R. Gordon, Plant Pathology, UC Davis  
Year 1 of 3

Pitch canker now affects pines in native and urban forests in 19 coastal counties in California. Researchers will evaluate factors that influence the extent to which a recently discovered pitch canker infestation in the Sierra Nevada foothills is likely to damage stands of susceptible pines and Douglas-fir trees. They will study the potential for other conifers to serve as carriers of pitch canker and evaluate possible insect carriers.

## USING TREE RINGS TO ASSESS VULNERABILITY OF FORESTS TO EXOTIC PATHOGENS

J. J. Battles, Environmental Science, Policy, and Management, UC Berkeley  
Year 1 of 2

Pitch canker is infecting Douglas-fir trees in the Eldorado National Forest. This research will develop a model to predict the vulnerability of Sierran forests to an exotic pathogen, as well as to native causes. The model will help managers determine the health of different stands and their relative vulnerability to invasion by exotic pathogen before taking action.

## MANAGING INSECT VECTORS OF PITCH CANKER

D. L. Wood, Insect Biology, UC Berkeley  
Year 3 of 3

Researchers are studying movement of the pitch canker pathogen by wood-infesting insects. They have determined the number of propagules of the pathogen carried by each of several beetle species. Managers will be able to give priority to controlling insect species identified as most important in transmitting the pathogen between trees.



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## RISK OF PITCH CANKER TO SUSCEPTIBLE PINES

T. R. Gordon, Plant Pathology, UC Davis  
Year 2 of 3

Results of this study show that trees in areas where pitch canker existed for a long time tend to be less susceptible to the disease than trees in areas where pitch canker has recently been established. This finding confirms disease remission through induced resistance. It also indicates that not all diseased trees need to be removed, since not all infected trees will suffer significant damage and, in fact, many will recover.

## PHYSIOLOGICAL BASIS FOR INVASIVENESS OF SAHARA MUSTARD IN SOUTHWESTERN DESERTS

J. S. Holt, Botany and Plant Science, UC Riverside  
Year 1 of 3

Sahara mustard is a weedy annual species native to the Mediterranean region that has recently begun to expand widely in the Mojave, Sonoran, and southern Great Basin deserts where it suppresses native annual species and increases fire hazard. Researchers will compare Sahara mustard's characteristics with two related mustards that have not invaded desert areas. Studies will also help to predict the impacts of Sahara mustard on native species, diversity, and ability to reproduce. Results will be used to develop control strategies for Sahara mustard and focus efforts on the most vulnerable sites.

## A RANKED INVENTORY OF INVASIVE PLANTS THAT THREATEN WILDLANDS

J. A. Randall, The Nature Conservancy  
J. M. DiTomaso, Plant Sciences, UC Davis  
Year 1 of 2

The goal of this project is to create a ranked, scientifically defensible inventory of the state's invasive weeds that will contain extensive information useful to land managers. The ranking will be based on the severity of ecological impact, biological potential for invasion, and the extent of distribution of each plant. Researchers will also use the list to identify important knowledge gaps in understanding impacts and invasive potential of current, non-native plants.

## ECOLOGICAL INFLUENCES ON INVASION SUCCESS OF INTRODUCED GENES IN CALIFORNIA TIGER SALAMANDERS

H. B. Shaffer, Evolution and Ecology, UC Davis  
Year 1 of 2

Pure native California tiger salamanders are protected under the Endangered Species Act, while the introduced barred tiger salamanders are not. This project will help eliminate confusion regarding which populations are to be protected. Researchers will analyze which pond habitats native tiger salamanders prefer and whether some habitats make them more vulnerable to displacement by introduced and hybrid salamanders.



## Natural Systems—continued

### RISK ASSESSMENT AND EXPANSION DYNAMICS OF WILD PIGS IN OAK WOODLAND ECOSYSTEMS

R. A. Weitzer and R. E. Loggins, Biology,  
University of North Dakota

Year 1 of 3

Wild pigs have long been considered a threat to native species and especially native plants in California. Using records of hunting tags, this study identifies areas in California where this exotic pest poses a risk to California natural areas and agriculture, as well as threatened or endangered plants and animals. Researchers are developing an economic impact survey to identify habitats, species, and areas currently exposed to damage by wild pigs. The survey will help determine which unoccupied areas are vulnerable to invasion.

### ECOLOGY AND MANAGEMENT OF EURASIAN WATERMILFOIL

J. M. DiTomaso and D. F. Spencer, Plant Sciences,  
UC Davis

Year 1 of 3

Eurasian watermilfoil is one of the most invasive aquatic weeds in North America. In flowing water systems, it contributes to flooding. This study will enhance understanding of how the weed invades natural areas, predict its potential to invade, and support development of effective nonherbicide management strategies.

## Urban Systems

### CONTROLLING ARGENTINE ANT INFESTATIONS IN BUILDINGS

L. Greenberg and J. H. Klotz, Entomology,  
UC Riverside

Year 3 of 3

Studies indicate that water indoors is the strongest predictor of Argentine ant infestation. In addition, the number of ants outside of buildings does not predict infestation indoors. Scientists are testing changes to the surrounding landscape to see if they can help control indoor infestations.



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### BIOLOGICAL CONTROL OF SPOTTED GUM PSYLLID IN EUCALYPTUS

T. D. Paine, Entomology, UC Riverside  
K. M. Daane, Insect Biology, UC Berkeley

Year 3 of 3

Studies suggest that the parasitoid, *Psyllaephagus* nr. sp. *hirtus* should be selected for mass rearing and release in a statewide biological control program against the spotted gum psyllid, a pest of eucalyptus. Researchers found that psyllid populations in southern California peak annually in late spring and summer and fall, which will help to time releases of the parasitoid more effectively.

### DIFFERENTIAL SUSCEPTIBILITY OF EUCALYPTUS LONGHORNED BORERS TO AN EGG PARASITOID

J. G. Millar and T. D. Paine, Entomology,  
UC Riverside

Year 3 of 3

The eggs of some species of wood-boring beetles (as with other insects) can defend themselves against the eggs and developing larvae of parasitic wasps that can successfully attack other closely related insects. This project aims to understand this process to devise strategies to improve parasite efficacy. Researchers discovered that the eggs of the borer coated and suffocated the eggs of the parasite, which is a common defense in insect larvae, but not before shown in insect eggs.

### DISTRIBUTION AND CONTROL OF THE GERMAN YELLOWJACKET

P. K. Visscher, Entomology, UC Riverside

Year 3 of 3

Researchers found that using fipronil mixed with ground-chicken baits eliminated German yellowjackets within hours. Early-season testing demonstrated that queens and early-season workers also scavenge ground-chicken baits, showing that it is possible to control yellowjackets early in the year before populations reach troublesome levels.

### BIOLOGY, MONITORING, AND TREATMENT OF ASIAN HACKBERRY WOOLLY APHID

A. B. Lawson, Plant Science, California State  
University, Fresno

P. M. Geisel, UCCE, Fresno Co.

Year 1 of 2

The Asian hackberry woolly aphid, introduced into California in 2002, has spread quickly to Chinese hackberry trees throughout the state. The aphid creates a honeydew nuisance, causing complaints in many urban settings. This project seeks to develop effective and efficient monitoring procedures using water-sensitive cards and foliar sampling to relate honeydew production to the number of aphids present. The study will also document aphid life cycle and existing natural enemies. These steps aim to facilitate improved management and reduce



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insecticide use to control the aphid.

### USING PHEROMONES TO DETECT EXOTIC CERAMBYCID BEETLES

J. G. Millar, Entomology, UC Riverside  
Year 1 of 3

Cerambycid beetles such as the Asian longhorned beetle have killed thousands of trees in New York, Chicago, and New Jersey. Warehouse detections of this pest have been made in most states in the northeastern portion of the United States, as well as in California beginning in 1996. The pest kills poplars, maples, elms, and mulberries. This study focuses on testing for and identifying pheromones (chemicals that animals give off to attract a mate) for exotic longhorned beetles. Effective pheromones then could be used in traps to more efficiently find and control the beetles.

### PATTERNS OF INVASIVE SPECIES INTRODUCTION ON EUCALYPTUS

T. D. Paine, Entomology, UC Riverside  
Year 1 of 1

This project is attempting to link distribution patterns of invasive pests found on eucalyptus in Australia with when and where they were introduced into California. Patterns of introduction of insects into California were compared to other regions of the world in which eucalyptus is commonly grown. Researchers found that, of the 14 pest species introduced into California, only two have been introduced to other eucalyptus-growing regions of the world. This suggests that eucalyptus pests establishing in California are coming directly from Australia.

### FLIGHT BEHAVIOR OF RED IMPORTED FIRE ANT

M. K. Rust and L. Greenberg, Entomology,  
UC Riverside

Year 1 of 1

A current eradication program is aimed at red imported fire ants in California. Researchers are studying the flight capabilities of these pests as related to humidity. If flight duration is limited by southern California's dry, desert-like conditions, then the buffer zones around known infestations could be reduced in size, thereby reducing survey costs and minimizing the areas under quarantine. Results of this study will be used to make recommendations to state and national fire ant authorities.

### IDENTIFYING TUMBLEWEED SPECIES AND HYBRIDS

D. R. Strong, Evolution and Ecology, UC Davis  
Year 1 of 1

Five distinct kinds of tumbleweed in California encroach on roadways, rangelands, and vacant lots in urban areas. The plant's tumbling habit causes it to be a traffic hazard and to pile up along fence lines where it is also a fire hazard. The goal of the research is to develop nuclear DNA markers that can distinguish among the five forms of tumbleweed and reveal hybridization, if it exists. For control efforts to begin, or to determine if control is necessary, it is critical to understand the among-species reproductive and ecological behaviors of these pest plants.

## Agricultural Systems

### MANAGING CORN LEAFHOPPER AND CORN STUNT DISEASE

C. G. Summers, Entomology, UC Davis  
2 years, \$61,627

### DETECTING *FUSARIUM OXYSPORUM* IN COTTON SEED AND SOIL

R. M. Davis, Plant Pathology, UC Davis  
3 years, \$133,867

### CHARACTERIZING GLYPHOSATE RESISTANCE IN RYEGRASSES

M. A. Jasieniuk, Plant Sciences, UC Davis  
3 years, \$125,059

### TRAINING TO IDENTIFY PREDACEOUS MITES FOUND IN CALIFORNIA

E. E. Grafton-Cardwell, Entomology, UC Riverside  
3 years, \$113,817

### ECONOMIC INJURY LEVEL FOR COTTONY CUSHION SCALE

E. E. Grafton-Cardwell and J. T. Trumble, Entomology, UC Riverside  
2 years, \$47,111

### MANAGING AVOCADO LACE BUG IN CALIFORNIA

M. S. Hoddle and J. G. Morse, Entomology, UC Riverside  
R. Stouthamer, Entomology, UC Riverside  
3 years, \$252,074

### CHARACTERIZING INVASIVE ISOLATES OF VERTICILLIUM WILT

K. V. Subbarao, Plant Pathology, UC Davis  
1 year, \$36,600

### RESPONSE OF RICE BLAST TO A RESISTANT RICE CULTIVAR

T. R. Gordon, Plant Pathology, UC Davis  
3 years, \$91,970

## Natural Systems

### INVESTIGATING CAUSES OF A FUNGAL DISEASE IN AMPHIBIANS

C. J. Briggs, Integrative Biology, UC Berkeley  
2 years, \$86,738

### EVALUATING HOW FIVE BEETLE SPECIES SPREAD PITCH CANKER

D. L. Wood, Insect Biology, UC Berkeley  
T. R. Gordon, Plant Pathology, UC Davis  
3 years, \$155,704

### A PROTOCOL FOR SCREENING POTENTIALLY INVASIVE WOODY SPECIES

M. Rejmanek, E. Grotkopp Kuo, and J. Erskine Ogden, Evolution and Ecology, UC Davis  
3 years, \$143,342

### USING MOLECULAR MARKERS TO DESCRIBE THE SPREAD OF WATER PRIMROSE IN FRESHWATER WETLANDS

M. A. Jasieniuk, Plant Sciences, UC Davis  
2 years, \$135,242

### IMPACT OF BARB GOATGRASS ON SOIL NUTRIENTS AND SOIL ORGANISMS IN GRASSLANDS

W. R. Horwath, Land, Air and Water Resources, UC Davis  
2 years, \$88,632

### EFFECTS OF RUST FUNGUS ON YELLOW STARHISTLE

J. M. DiTomaso, Plant Sciences, UC Davis  
A. J. Fisher, USDA-ARS  
D. M. Woods, California Dept. of Food and Agriculture  
3 years, \$131,351

### ARTIFICIAL DIETS FOR REARING NEW BIOLOGICAL CONTROL AGENTS OF YELLOW STARHISTLE AND OTHER EXOTIC WEEDS

L. Smith, USDA-ARS, Western Regional Research Center  
2 years, \$102,752

## Urban Systems

### MEDITERRANEAN PINE ENGRAVER AND REDHAIRD BARK BEETLE IN URBAN PINES

M. L. Flint, Entomology, UC Davis  
S. J. Seybold, USDA-Forest Service, Pacific Southwest Research Station  
3 years, \$128,000

### EFFECTS OF ENVIRONMENT ON MATING DURING SWARMING OF RED IMPORTED FIRE ANT

M. K. Rust and L. Greenberg, Entomology, UC Riverside  
1 year, \$45,863

### IMPLEMENTING A STATEWIDE BIOLOGICAL CONTROL PROGRAM FOR THE SPOTTED GUM PSYLLID IN EUCALYPTUS

T. D. Paine, Entomology, UC Riverside  
K. M. Daane, Insect Biology, UC Berkeley  
3 years, \$150,000

## The Exotic/Invasive Pests and Disease Research Program cosponsored these workshops in 2004-2005!

California Invasive Plant Council  
2004 Symposium,  
Oct. 7 to 9, 2004, Ventura, CA

Exotic/Invasive Pests and Diseases Research  
Program Annual Research Workshop,  
Oct. 13 to 14, 2004, Emeryville, CA

Sudden Oak Death Symposium,  
"The State of our Knowledge,"  
Jan. 18 to 21, 2005, Monterey, CA

Eighth Annual Exotic Fruit Fly Symposium,  
March 7 to 9, 2005, Riverside, CA

For more information about the Exotic/Invasive Pests and Diseases Research Program and each funded project, see  
[www.ipm.ucdavis.edu/EXOTIC/](http://www.ipm.ucdavis.edu/EXOTIC/) or contact

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