



## UNIVERSITY OF CALIFORNIA

Division of Agriculture  
and Natural Resources

<http://anrcatalog.ucdavis.edu>

## FOREST STEWARDSHIP SERIES 14

# Exotic Pest Plants

**LAURIE LITMAN**, InfoWright, Stockton, CA; **RICHARD HARRIS**, UCCE Forestry Specialist, Department of Environmental Science, Policy, and Management, University of California, Berkeley

Exotic plants come into California on a continuous basis. Some are introduced intentionally as ornamentals or for other purposes; others stow away on ships, on the tires of vehicles, in packing material, or are introduced by other means. Most remain in limited populations in their new environment, but occasionally a species thrives too well, wreaking havoc on the native ecosystem. When exotic plants are successful in their new environment at the expense of native species and ecosystems, they are known as exotic pest plants or invasive weeds. Of the approximately 1,045 non-native plant species that have become established in California, fewer than 10 percent are serious threats, but even these few have dramatically changed the ecology of the state.

### Objective

Understand the threats to native ecosystems posed by exotic pest plants and the various methods used to control them.

### Competencies

- Ability to identify noxious weeds and exotic pest plants that may occur on your property.
- Awareness of agencies responsible for exotic pest plant control.
- General understanding of how to control exotic pest plants.

### Related Forest Stewardship Series Publications

- *Forest Vegetation Management*, ANR Publication 8236
- *Threatened and Endangered Plants*, ANR Publication 8243
- *Forest Regeneration*, ANR Publication 8237
- *Forest Ecology*, ANR Publication 8233

### DEFINING PEST PLANTS

A simple definition of a pest plant or weed is a plant that grows where it is not wanted. As every gardener knows, native plants can become weeds when they are growing in undesirable locations. Generally, exotic plants become pests because they are aggressive invaders of natural ecosystems; that is, they possess traits that make them better competitors than native plants. Such traits include being able to produce abundant, easily dispersed seed, be spread by vegetative means, quickly dominate disturbed sites, and grow rapidly once established. An exotic plant may also become a pest if it escapes the biological control agents that kept it in check in its native ecosystem. Ecosystems are complex associations of organisms that have evolved together over time with numerous checks and balances that limit the numbers of individual species. When an exotic pest plant is freed from its native control agents—insects, disease organisms, other competing plants, herbivores—it may reproduce unchecked in the new environment, changing the native ecosystem forever.

Exotic pest plants may simply outcompete native plants for nutrients, water, or light. Some may change ecosystem processes such as nutrient cycling, hydrology, wildfire cycles, and erosion rates. While many exotic species become established on disturbed sites, undisturbed ecosystems are also at risk. Rare native species are particularly vulnerable. About 180 of the state's rare plants are experiencing threats from exotic pest plants.

### CATEGORIZING PEST PLANTS

Two widely recognized lists of pest plants in California have been developed, one by the California Exotic Pest Plant Council (CalEPPC) and the other by the California Department of Food and Agriculture (CDFA). The CalEPPC list includes a total of 76 species, of which 27 are on the A-1 list (Most Invasive Wildland Pest Plants: Widespread). The CDFA list, called the Noxious Weed List, divides non-native species into Type A, B, and C categories that are used to determine what action, if any, to use with each species when found. The CDFA list includes not only plants that are a problem for agriculture but also plants that are considered ecologically damaging. This list is a basis for regulation and control.



## WHY SHOULD WE BE CONCERNED?

Exotic pest plant infestations can cause widespread problems in many ways.

### Ecosystem Processes

Exotic pest plants can drastically alter the ecological checks and balances that have developed over thousands of years. Their growth and spread can alter fire regimes, making the frequency and intensity of wildfire more intense than it would be under natural conditions. This altered fire regime can cause major ecosystem changes. Some exotic nitrogen-fixing plant species increase soil nitrogen levels to the disadvantage of native species that have evolved in nutrient-poor soils. Some especially damaging exotic pest plants can invade and dominate aquatic habitats in streams and ponds.

### Wildlife

Exotic pest plants may provide poorer habitat for wildlife species and livestock than their displaced native counterparts. For example, tamarisk and Russian olive thickets along rivers may replace native habitats dominated by cottonwood and willow. The native species provide far superior habitat for many bird and mammal species that coevolved with them.

### Agriculture

Exotic pest plants create large economic losses for agriculture in both cropland and rangeland. They can reduce the production of forage for livestock by crowding out palatable species. Species such as St. Johnswort, Russian knapweed, and leafy spurge are actually toxic to livestock.

### Biological Diversity

Competition from exotic pest plants is considered to be a factor contributing to the decline of many endangered plant species in California. Exotic plants can completely overtake natural plant communities. Virtually all California annual grasslands are predominately exotic species introduced with cattle by the Spanish. Some non-native species release substances in the soil that prevent reestablishment of native species. For example, tamarisk can increase the salinity of soils to the point that native willows and cottonwoods can no longer grow.

## MAJOR FOREST EXOTIC PEST PLANTS

Forestland owners should be aware of the exotic pest plants that can harm their property. Some of the most common are described below.

Cape ivy (formerly known as German ivy) (fig. 1) and English ivy grow mostly in coastal watersheds. They form a dense blanket over everything, climb trees, and displace other plants by smothering them and cutting off their light. These plants can become so abundant that their weight will break the stems of shrubs and trees.

Brooms, including French, Scotch, Portuguese, and Spanish (fig. 2), have invaded ecosystems from coastal Southern California to the Sierra foothills and redwood forests. They have all the attributes of a successful weed: fast growth rate, broad physiological tolerances, and prolific seed production. Brooms commonly form impenetrable thickets that exclude other plants. They change the chemistry of the environment by fixing nitrogen and enriching the soil, modifying the environment for plant establishment and growth to their advantage.

Gorse (fig. 3) is a close relative of the brooms but with stiff spines that make it difficult to remove.

Yellow starthistle (fig. 4) is ubiquitous in California. This prolific seeder spreads easily and can be difficult to control. Additional important exotic pest plants common to forest lands include tree of heaven, eucalyptus (fig. 5), and pampasgrass (fig. 6). Tamarisk (fig. 7), purple loosestrife (fig. 8), and giant reed (fig. 9) are widespread in wetlands and riparian areas.



**Figure 1.** Cape ivy (*Delairea odorata*) is often found in riparian habitats in the northern part of the state. Photo: Joseph M. DiTomaso.

## CONTROLLING EXOTIC PEST PLANTS

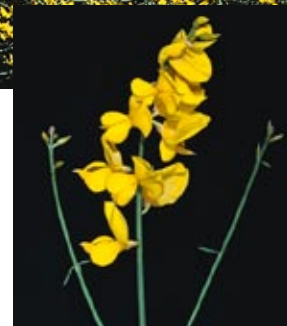
### Prevention

Prevention is the most effective and least costly way to avoid pest plant problems. Some commonsense preventive precautions include

- plan work projects to minimize soil disturbance and reestablish vegetation quickly
- buy construction material from suppliers who guarantee their products to be weed-free
- wash vehicles and equipment before moving them to another area
- close unnecessary roads and trails where possible
- monitor your property to detect new weed populations while they are still small

### Eradication

Eradication is practical and effective only when an infestation is small; it is almost impossible in widespread infestations (see sidebar 1 on next page).



**Figure 2.** French broom (*Genista monspessulana*) (left) and Spanish broom (*Spartium junceum*) (right) are exotic pest plants that have invaded forests and other habitats in California. Members of the pea family, the brooms can be identified by their bright yellow flowers. Photos: Joseph M. DiTomaso.

**SIDEBAR 1**  
**Attack Your Weeds**  
**Like a Wildfire**

Awareness of the damage caused by noxious weeds is becoming widespread, but controlling these pests takes more than awareness—it requires constant vigilance and cooperative efforts.

If you want to concentrate your efforts where they will be most effective, consider this central principle of weed management: small infestations can be eradicated, large infestations can only be controlled.

The usual approach is to attack large areas of weeds first. The rationale is that small patches are not causing any harm now, so they can be ignored temporarily. But before we know it, the small patches have spread, and we are left with more large weed problems.

We must reverse our priorities and eradicate all small occurrences as quickly as possible. Weed management can be compared to fighting wildfires. Notice the similarities at right.

	Fire	Weeds
<b>1. Build a fireline</b>	One of the first actions taken when fighting a large wildfire is to build a fire line to contain the outbreak within a certain boundary.	Rather than a line on the ground, draw a line on a map delineating the current extent of large weed infestations. Commit to containing the infestation within this boundary.
<b>2. Eliminate spot fires</b>	Any fire that jumps the fireline has top priority and is eliminated as quickly as possible before it has the chance to spread. If allowed to spread, the results can be disastrous: firefighters may be caught between two outbreaks, two large fires will have to be fought rather than one, and many more resources will be needed.	When weeds escape from the boundary you have drawn, they should become top priority. Think of small isolated occurrences as backcountry spot fires. If they are located early and attacked aggressively they can be eradicated before they spread; if ignored they will likely become so large they may never be eliminated entirely.
<b>3. Protect critical areas</b>	Critical areas include places where people or structures are located.	Critical areas include pristine natural sites, critical wildlife habitat, productive rangelands, and rare plant and animal habitat.
<b>4. Control the main outbreak</b>	Often, an expensive investment in resources is required. Even with massive control efforts, large fires may not be stopped until the weather changes and rain or snow stops the fire.	Large infestations require long-term control efforts. Even with years of effort, these occurrences may never be completely eliminated. Unfortunately, their seed banks may be huge, and their natural controls are rarely available. They may require some level of control forever.

Source: Adapted from *Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values* (Denver: Colorado Department of Agriculture, 2000).

**Figure 3.** Gorse (*Ulex europaeus*) plant and flowering stem.  
 Photos: Joseph M. DiTomaso.



### Physical Control

Physical control methods can be quite effective but are often overlooked because they are labor-intensive. Physical control is most practical with small infestations, but it is also very useful in sensitive areas where chemicals could damage resources, such as sites close to waterways. Physical methods can be highly selective, targeting only the pest species, but they can also cause soil disturbance. Methods range from pulling weeds by hand to using brush rakes on bulldozers. Two excellent hand tools are the Weed Wrench and the Root Jack. Mowing can also be an effective control technique for certain species at specific times of the year, especially before seed is dispersed.

### Prescribed Fire

Fire can reduce weed infestations, especially in fire-adapted plant communities. However, in some cases fire can actually favor exotic pest plants. It is important to understand the biology of the native plants involved before using this method of control. Fire also involves the risk of escape. Prescribed burns should be done only under the direction of a trained fire manager. Contact the California Department of Forestry and Fire Protection for more information.

### Mulching

Covering infested areas with mulch such as hay, manure, grass clippings, straw, sawdust, wood chips, rice hulls, black paper, or black plastic is another method of control. Mulching cuts off light, preventing plants from photosynthesizing, and can eliminate small infestations. The most effective mulches are black paper or plastic.

### Solarization

Clear polyethylene plastic sheets placed over moist soil can kill un-germinated seeds of exotic pest plants. The sheets are kept in place for a month or more. Edges of the plastic must be sealed with soil or weights to retain the heated air in order to produce lethal heat and temperatures.



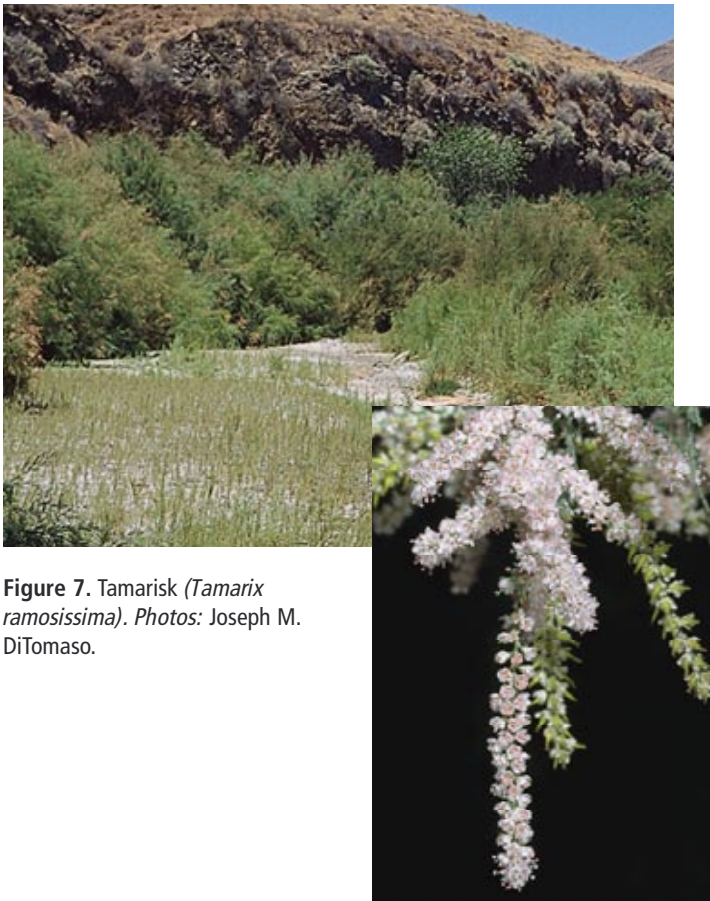
Figure 4. Yellow starthistle (*Centaurea solstitialis*). Photo: Joseph M. DiTomaso.



Figure 5. Eucalyptus (*Eucalyptus* spp.) has invaded the riparian zone of this stream. Once established, some eucalyptus can crowd out other native species because of their profuse sprouting and tremendous litter production. Eucalyptus also produces "allelopathic" substances in its roots and leaves that are toxic to some plants. Photo: Richard Harris.



**Figure 6.** Pampasgrass (*Cortaderia selloana*) is an aggressive invader of openings along roads and in harvest areas on the north coast. It is intolerant of shade and will be eliminated by establishment of a forest canopy. Photo: Richard Harris.



**Figure 7.** Tamarisk (*Tamarix ramosissima*). Photos: Joseph M. DiTomaso.

## Biological Control

Biological control involves importing one or more natural enemies of an exotic pest plant to help control it in its new environment. This strategy can be very effective and self-sustaining when successful. On the other hand, major failures have occurred when an imported control agent attacks native species and becomes a pest in its own right. For this reason, careful studies, generally over many years, must be conducted before a biological control agent can be released. Another type of biocontrol involves mass release of pathogens that would not normally exist in numbers large enough to control a pest.

## Competition and Restoration

In some cases native plants can outcompete exotic pest plants if they are given a little help. This can work in cases such as the reestablishment of a forest following harvest. Seedlings or cuttings should be collected from nearby sources to maintain the locally adapted plants.

## Grazing or Browsing

Grazing or browsing by animals such as cattle, sheep, goats, geese, and chickens may control or suppress exotic pest plants in some cases, but in others these animals can promote undesirable species by spreading weed seeds in their droppings or exposing soil.

## Chemical Control

Herbicides are chemicals that kill or inhibit plant growth. They can be very effective forms of weed control and are often the least expensive option when treating a large area. However, used inappropriately they may harm nontarget organisms. In some communities the use of herbicides is very controversial. All herbicides must be used with care and only after consideration of all treatment options. When choosing a herbicide, try to use one that is selective for the target plant and one that degrades rapidly after application. Choose an application method that delivers the pesticide to the target and avoids nontarget organisms. Avoid use near waterways. Mix a dye with the herbicide so that its coverage is visible. Follow all label instructions (see sidebar 2 on next page).

## SIDEBAR 2

### Warning: Use Chemicals Cautiously

- Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label.
- Store all chemicals in the original labeled containers in a locked cabinet or shed, away from foods or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.
- Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.
- Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse containers. Make sure empty containers are not accessible to children or animals.
- Never dispose of containers where they may contaminate water supplies or natural waterways. Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides. Never burn pesticide containers.

## INTEGRATED WEED MANAGEMENT

No single control method will solve all exotic pest plant problems—each situation must be evaluated individually based on the biology and ecology of the threatened plant community. Generally, multiple management actions are required for effective control. Integrated weed management (IWM) is a strategy by which a combination of management techniques (biological, chemical, physical, and cultural) control a particular species or infestation efficiently and effectively with minimal adverse impacts to nontarget organisms. IWM differs from ordinary weed management in attempting to address the ultimate causes of weed infestation, rather than simply controlling existing weeds. Although focusing on the fundamental causes of weed invasion is more demanding than simply spraying existing weeds, the rewards can be far greater and are worth the effort if future weed problems are reduced or eliminated.



Figure 8. Purple loosestrife (*Lythrum salicaria*). Photo: Joseph M. DiTomaso.



Figure 9. Giant reed (*Arundo donax*). Photo: Joseph M. DiTomaso.

IWM is species specific, site specific, tailored to exploit the weaknesses of a particular weed species, and designed to be practical with minimal risk to nontarget organisms and their habitats.

## **DEVELOP AN EXOTIC PEST PLANT MANAGEMENT PLAN**

Every landowner should have a management plan for controlling exotic pest plants. One reason for preparing and implementing such a plan is to be a good neighbor by being alert for new infestations and to control existing infestations while they are small and limited in extent. Control efforts are also much more successful if neighbors join together to prevent enlargement of infestations. Although private landowners and public land managers may have different perspectives, they share the common goal of protecting their property or management area from the negative effects of exotic pest plants.

Basic steps in developing an integrated exotic pest plant management plan are to

- describe the property
- inventory the property for exotic pest plants
- formulate management goals and objectives
- set priorities for management
- select management actions
- develop a monitoring plan
- control infestations

## **EXOTIC PEST PLANT PREVENTION BEST MANAGEMENT PRACTICES**

### **Be Informed**

- Become aware of the problem and spread the word that exotic pest plants are everyone's concern.
- Learn to identify high-priority species in the field so you can spot them while performing other land management activities. Learn to distinguish native species from exotic pest plants, especially native thistles.
- Report new infestations and those not previously found in the area to the local agricultural commissioner's office.

### **Detect Exotic Pest Plants Early**

- Periodically inspect roads to detect new infestations on disturbed areas. Inspect ditch and stream banks where running water could spread seeds. Inspect high-traffic areas such as developed trailheads, parking areas, campgrounds, and other heavily used sites.
- Pay particular attention to riparian areas and salt licks that are heavily used by livestock and wildlife.
- Be extra vigilant where gravel or fill material is brought in from elsewhere. Exotic pest plant seeds in this material can start new infestations, and bare soil is ideal for establishment.



### **Limit Dispersal**

- Don't transport flowering plants you cannot identify.
- Avoid transporting seeds stuck on clothing, gear, pets, or livestock.
- Place unwanted seeds in a plastic bag or similar container and dispose of properly.
- Avoid driving in infested areas. Inspect vehicles for seeds stuck in tire treads or mud on the vehicle. Don't clean infested vehicles in areas that are free of weed infestation.
- Inspect maintenance or other equipment for seeds before it enters the property. Require that such equipment be cleaned first to remove seeds before being allowed entry. Clean equipment (especially mowers) used in infested areas before moving it to another area.
- Always use hay, straw, or mulch that has been certified free of exotic pest plant seeds.
- Confine livestock for a day or two in a small, noninfested pasture before moving it to another noninfested pasture.
- Make sure that pack animals used in back country areas are fed hay that is certified free of exotic pest plant seeds. Before leaving an area, remove seeds from pack animals by brushing them thoroughly and cleaning their hooves. Post signs to this effect for visiting riders.
- If you find a small number of isolated exotic pest plants that have no flowers or seeds, pull them and leave them where you found them to dry out. If flowers or seeds are present, place the plants in a plastic bag or similar container and dispose of them properly.

### **Minimize Disturbances**

- Restrict travel to established roads and trails whenever possible.
- Don't drive through infested areas.
- Limit the formation of social trails and dispersed campsites.
- Avoid leaving piles of exposed soil in construction areas. Cover exposed soil with plastic and revegetate with native species as soon as possible.
- If possible, spread material excavated during trail construction back on the trail instead of piling it on the side.
- Avoid overgrazing, especially in sensitive areas.
- Move salt licks frequently and keep salt in a shallow container to minimize soil disturbance.

### **Establish and Maintain Native Plant Communities**

- Reseed drastically disturbed areas immediately after the disturbance ends. Native perennial grasses are especially valuable for reseeding.
- Defer livestock grazing on reseeded areas for at least one growing season to permit desirable plants to establish.
- Limit the use of fertilizers when reseeding; their use may favor exotic pest plants over native species.

## RESOURCES

There is a growing awareness of the dangers of exotic pest plants to our California ecosystems, and numerous organizations have joined in the struggle to control these species. The California Native Plant Society, California Exotic Pest Plant Council, The Nature Conservancy, and numerous local groups are concerned with exotic pest problems. Some groups organize work parties that actually do control work.

Weed Management Areas (WMA) are local organizations consisting of private landowners along with city, county, state, and federal land managers that meet to coordinate work to control invasive weeds. All but five California counties now participate in the WMA program, which is generally initiated by a county agricultural commissioner's office. New legislation provides funding to WMAs that is being used for a variety of projects.

### Bibliography

DiTomaso, J. M., and E. A. Healy. Weeds of California and other western states. 2 vols. Oakland: University of California Agriculture and Natural Resources Publication 3488. ANR CS Web site, <http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=3488>.

UC Integrated Pest Management Guidelines: Weeds. UC IPM Web site, <http://www.ipm.ucdavis.edu/PMG/menu.weeds.html>.

USDA Natural Resources Conservation Service (NRCS) PLANTS Database, <http://plants.usda.gov/>.

## FOR FURTHER INFORMATION

To order or obtain printed ANR publications and other products, visit the ANR Communication Services online catalog at <http://anrcatalog.ucdavis.edu>. You can also place orders by mail, phone, or FAX, or request a printed catalog of our products from:

University of California  
Agriculture and Natural Resources  
Communication Services  
6701 San Pablo Avenue, 2nd Floor  
Oakland, California 94608-1239  
Telephone: (800) 994-8849 or (510) 642-2431  
FAX: (510) 643-5470  
E-mail inquiries: [danrcs@ucdavis.edu](mailto:danrcs@ucdavis.edu)

An electronic version of this publication is available on the ANR Communication Services Web site at <http://anrcatalog.ucdavis.edu>.

Publication 8244

ISBN-13: 978-1-60107-464-5

© 2007 by the Regents of the University of California, Division of Agriculture and Natural Resources. All rights reserved.

The University of California prohibits discrimination or harassment of any person on the basis of race, color, national origin, religion, sex, gender identity, pregnancy (including childbirth, and medical conditions related to pregnancy or childbirth), physical or mental disability, medical condition (cancer-related or genetic characteristics), ancestry, marital status, age, sexual orientation, citizenship, or status as a covered veteran (covered veterans are special disabled veterans, recently separated veterans, Vietnam era veterans, or any other veterans who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized) in any of its programs or activities. University policy is intended to be consistent with the provisions of applicable State and Federal laws.

Inquiries regarding the University's nondiscrimination policies may be directed to the Affirmative Action/Staff Personnel Services Director, University of California, Agriculture and Natural Resources, 300 Lakeside Drive, 6th Floor, Oakland, CA 94612-3550 (510) 987-0096. For a free catalog of other publications, call (800) 994-8849. For help downloading this publication, call (530) 297-4445.

To simplify information, trade names of products have been used. No endorsement of named or illustrated products is intended, nor is criticism implied of similar products that are not mentioned or illustrated.



This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Natural Resources.

pr-12/07-SB/RW