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Invasive Plants of California's Wildland

Arundo donax

Scientific name *Arundo donax*

Additional name information: (L.)

Common name giant reed, giant cane

Synonymous scientific names none known

Closely related California natives 0

Closely related California non-natives: 0

Listed CalEPPC List A-1, CDFA noxious

By: Thomas Dudley

Distribution



HOW DO I RECOGNIZE IT?

Distinctive features:

Giant reed (*Arundo donax*) is a robust perennial grass nine to thirty feet tall, growing in many-stemmed, cane-like clumps, spreading from horizontal rootstocks below the soil, and often forming large colonies many meters across. Individual stems or culms are tough and hollow, divided by partitions at nodes like bamboo. First-year culms are unbranched, with single or multiple lateral branches from nodes in the

second year. The pale green to blue-green leaves, which broadly clasp the stem with a heart-shaped base and taper to the tip, are up to two feet or more in length. Leaves are arranged alternately throughout the culm, distinctly two-ranked (in a single plane). Giant reed produces a tall, plume-like flowerhead at the upper tips of stems, the flowers closely packed in a cream to brown cluster borne from early summer to early fall. Culms may remain green throughout the year, but often fade with semi-dormancy during the winter months or in drought. Giant reed can be confused with cultivated bamboos and corn, and in earlier stages with some large-stature grasses such as *Leymus* (ryegrass), and especially with *Phragmites* (common reed), which is less than ten feet tall and has panicles less than one foot long with long hairs between the florets.

Description: Poaceae. Stems: 30 ft (<9 m) tall, stems erect, hollow, and glabrous 1.6 in (<4 cm) in diameter with somewhat swollen nodes; thick, fleshy rhizomes form creeping rootstocks, yielding dense colonies. Leaves: cauline, sheaths > internodes, ligule thinly membranous and fringed with hairs; blade <3.3 ft (<1 m), 0.8-2.4 in (2-6 cm) wide at base, tapering to a sharp tip, flat or folded, margins scabrous; leaves alternate and conspicuously two-ranked.



Inflorescence: as terminal panicle 1-2 ft (30-60 cm) with branches ascending, silver-cream-brown, the numerous spikelets laterally compressed; glumes > florets, membranous and 3-5 veined; florets 4-5, breaking above glumes; lemma 0.3-0.5 in (8-12 mm) and hairy, nerves ending in slender teeth, the middle forming an inconspicuous awn; palea < lemma, 0.12-0.2 in (3-5 mm); anthers 0.1-0.12 in (2.5-3 mm). It does not form viable achenes in North America (Hickman 1993).

WHERE WOULD I FIND IT?

Giant reed occurs in central and southern California and in Baja California, usually below 1,000 feet (350 m) elevation. It has invaded central California river valleys in San Luis Obispo and Monterey counties, the San Francisco Bay Area, and in the Sacramento and San Joaquin River valleys, and is also increasing in the North Coast region (Dudley and Collins 1995). Giant reed has been the most serious problem in coastal river drainages of southern California, especially in the Santa Ana, Santa Margarita, Santa Clara, Tijuana, and other major and minor watersheds, where it sometimes occupies entire river channels from bank to

bank (Jackson et al. 1994, Bell 1998). Although not currently considered a problem in California deserts, giant reed survives in regularly watered areas of lower-elevation deserts, but does not appear to tolerate high-elevation and continental environments where regular freezing occurs (Sunset 1967).

Giant reed is naturalized and invasive in many regions, including southern Africa, subtropical United States through Mexico, the Caribbean islands and South America, Pacific Islands, Australia, and Southeast Asia (Hafliger and Scholz 1981). In California, the largest colonies occur in riparian areas and floodplains of medium-sized to large streams, from wet sites to dry river banks far from permanent water. Giant reed tends to favor low-gradient (less than 2 percent) riparian areas over steeper and smaller channels, but scattered colonies are found in moist sites or springs on steeper slopes.

Populations also occur in the upper estuaries of coastal streams. It is often found along drainage ditches, where the plant has been used for bank stabilization, and in other moist sites, including residential areas where giant reed is used horticulturally. While it is usually associated with rivers that have been physically disturbed and dammed upstream, giant reed also can colonize within native stands of cottonwoods, willows, and other riparian species, even growing in sites shaded by tree canopy. Plants establish primarily in streamside sites, but expand beyond the margins of riparian vegetation.

Soil preferences are broad, as giant reed is known from coarse sands to gravelly soil to heavy clays and river sediments. It grows best in well drained soil with ample moisture, from freshwater to semi-saline soils at margins of brackish estuaries. In Egypt, Rezk and Edany (1979) found that *Arundo donax* tolerates both higher and lower water table levels than *Phragmites australis*, which is native to California.

WHERE DID IT COME FROM AND HOW IS IT SPREAD?

Three species of *Arundo* occur worldwide in tropical to warm temperate regions. *A. donax* is often considered indigenous to the Mediterranean Basin (Hickman 1993) or to warmer regions of the Old World, but apparently it is an ancient introduction into Europe from the Indian sub-continent (Bell 1998). In Eurasia it similarly inhabits low-gradient river courses and may provide useful wildlife habitat in greatly altered river deltas (Granval et al. 1993, He 1991).

Giant reed was brought to North America quite early, as it was abundant by 1820 in the Los Angeles River, where it was harvested for roofing material and fodder. This plant has played an important role in the development of music, as the cane was the source of the original Pan pipe or syrinx, and remains the source of reeds for woodwind instruments (Perdue 1958). Commercial plantations exist in California for musical instrument production, and other commercial possibilities are being explored. Horticultural propagation is widely conducted, and varieties of *Arundo* are available and commonly used in gardens or for erosion control (Sunset 1967). Invasive populations almost certainly resulted from escapes and displacement of plants from managed habitats. It spreads vegetatively either by rhizomes or fragments.

WHAT PROBLEMS DOES IT CAUSE?

Giant reed displaces native plants and associated wildlife species because of the massive stands it forms (Bell 1994, Gaffney and Cushman 1998). Competition with native species has been shown to result from monopolization of soil moisture and by shading (Dudley unpubl. data). It clearly becomes a dominant component of the flora, and was estimated to comprise 68 percent of the riparian vegetation in the Santa Ana River (Douthit 1994). As giant reed replaces riparian vegetation in semi-arid zones, it reduces habitat and food supply, particularly insect populations, for several special status species such as least Bell's vireo, southwestern willow flycatcher, and yellow-billed cuckoo (Frandsen and Jackson 1994, Dudley and Collins 1995). Unlike native riparian plants, giant reed provides little shading to the in-stream habitat, leading to increased water temperatures and reduced habitat quality for aquatic wildlife. At risk are protected species such as arroyo toad, red-legged frog, western pond turtle, Santa Ana sucker, arroyo chub, unarmored three-spined stickleback, tidewater goby, and southern steelhead trout, among others (Franklin 1996). In the Sacramento-San Joaquin Delta region *Arundo donax* interferes with levee maintenance and wildlife habitat management (Perrine, pers. comm.).

Giant reed is also suspected of altering hydrological regimes and reducing groundwater availability by transpiring large amounts of water from semi-arid aquifers. It alters channel morphology by retaining sediments and constricting flows, and in some cases may reduce stream navigability (Lake, pers. comm., TNC 1996).

Dense growth presents fire hazards, often near urbanized areas, more than doubling the available fuel for wildfires and promoting post-fire regeneration of even greater quantities of giant reed (Scott 1994, Gaffney and Cushman 1998). Uprooted plants also pose clean-up problems when deposited on banks or in downstream estuaries (Douthit 1994) and during floods create hazards when trapped behind bridges and other structures. Although often planted for erosion control, giant reed can promote bank erosion because its shallow root system is easily undercut and bank collapse may follow.

HOW DOES IT GROW AND REPRODUCE?

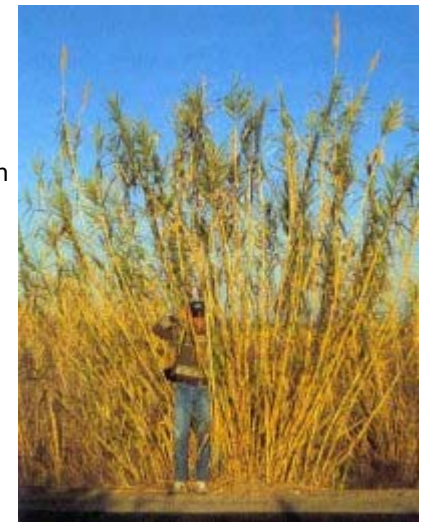
Plants in North America do not appear to produce viable seed, and seedlings are not seen in the field. Population expansion here occurs through vegetative reproduction, either from underground rhizome extension of a colony or from plant fragments carried downstream, primarily during floods, to become rooted and form new clones. Horticultural propagation is routinely done by planting rhizomes, which readily establish, but stems with no basal material are less likely to root. Fresh stems form roots at nodes under laboratory conditions, but survival is poor (Zimmerman and Bunn unpubl. data), and root formation does occur where an attached culm has fallen over and is in contact with the substrate.



[ip/management/ipcw/images/4981.jpg]

New shoots arise from rhizomes in nearly any season, but are most common in spring. Growth likewise occurs in all seasons, but is highly sensitive to temperature and moisture (Perdue 1958). During warm months with ample water culms are reported to attain growth rates of 2.3 feet (70 cm) per week or about four inches (10 cm) per day, putting it among the fastest growing terrestrial plants. Biomass production has been estimated at 8.3 tons dry weight per acre (Perdue 1958). Young stems rapidly achieve the diameter of mature canes, with subsequent growth involving thickening of the walls (Perdue 1958).

(click on photos to view larger image)



[ip/management/ipcw/images/4983.jpg]

Age of individual culms is certainly more than one year, and branching seems to represent stem growth in later years, while rhizomes show indeterminate growth. Branches also form when a stem is cut or laid over. Dieback is infrequently observed, but culms fade or partially brown out during winter, apparently becoming dormant under cold conditions. The outstanding growth trait of this plant is its ability to survive and grow at almost any time under a wide variety of environmental conditions.

HOW CAN I GET RID OF IT?

Studies of giant reed invasion in California are underway, so more data on its biology and management will be available soon. For further information about monitoring and managing infestations, contact Team Arundo in southern California or Team Arundo del Norte in central and northern parts of the state (see Resources section).

Physical control:

Manual methods: Minor infestations can be eradicated by manual methods, especially where sensitive native plants and wildlife may be damaged by other methods. Hand pulling is effective with new plants less than six feet (2 m) in height, but care must be taken that all rhizome material is removed. This may be most effective in loose soils and after rains have made the substrate workable. Plants can be dug up using hand tools (pick-ax, mattock, and shovel), especially in combination with cutting of stems near the base with pruning shears, machete, or chainsaw. Stems and roots should be removed or burned on site to avoid re-rooting, or a chipper can be used to reduce material, although clogging by the fibrous material makes chipping difficult (Dale, pers. comm.). For larger infestations on accessible terrain, heavier tools (rotary brush-cutter, chainsaw, or tractor-mounted mower) may facilitate biomass reduction, followed by rhizome removal or chemical treatment. Such methods may be of limited use on complex or sensitive terrain or on slopes over 30 percent, and may interfere with reestablishment of native plants and animals.

Mechanical methods: Mechanical eradication is extremely difficult, even with a backhoe, as rhizomes buried under three to ten feet (1-3 m) of alluvium readily resprout (R. Dale, pers. comm., Else et al. 1996). Removal of all such material is infeasible, especially where extensive soil disturbance would be disruptive.

Prescribed burning: In most circumstances burning of live or chemically treated material should not be attempted, as it cannot kill the underground rhizomes and probably favors giant reed regeneration over native riparian species (Gaffney and Cushman 1998). Burning in place is problematic because of the risks of uncontained fire, the possibility of damage to beneficial species, and the difficulties of promoting fire through patchily distributed stands. There may be some cases where burning of attached material can be done, but only if other means of reducing biomass cannot be carried out. Cut material is often burned on site, subject to local fire regulations, because of the difficulty and expense involved in collecting and

removing or chipping all material.

Biological control:

Insects and fungi: No biological control agents against *Arundo donax* have been approved by the USDA, although some invertebrates are known to feed on the grass in Eurasia/Africa (Tracy and DeLoach 1999). The green bug (*Schizaphis graminum*) has been observed to feed on giant reed in winter (Zuniga et al. 1983). In France *Phothedes dulcis* caterpillars may feed on it. The insect *Zyginidia guyumi* uses giant reed as an important food source in Pakistan (Ahmed et al. 1977). A moth borer (*Diatraea saccharalis*) has been reported to attack it in Barbados. A USDA evaluation of the potential benefits of biological control against giant reed ranked it as a promising candidate and suggested several insects and pathogens as possible control agents (Tracy and DeLoach 1999).

Grazing: Vertebrate grazers such as cattle and sheep may be useful in controlling giant reed, and Angora goats have been partially successful in reducing this plant and other brush in southern California (Daar 1983). Grazers are unlikely to reduce population size sufficiently to eliminate the risks posed. Likewise, management of native plants to increase competition with giant reed probably provides insufficient control, and in fact seems to offer little resistance against the invading reeds.

Chemical control:

In many, if not all, situations it may be necessary to use chemical methods to achieve eradication, especially in combination with mechanical removal. The most common herbicidal treatment against giant reed is glyphosate, primarily in the form of Rodeo® (Round-Up® can be used away from water). Because glyphosate is a broad-spectrum herbicide, care should be taken to avoid application or drift onto desirable vegetation. The standard treatment is a foliar spray application of 1.5 percent by volume glyphosate with a 0.5 percent non-ionic surfactant (Monsanto 1992). Most effective application is post-flowering and pre-dormancy, usually late August to early November when plants are translocating nutrients into root and rhizomes (TNC 1996). Foliar uptake and kill may be achieved by spray application during active growth periods, primarily late spring through early fall (Monsanto 1992). Small patches can be treated from the ground using backpack or towed sprayers, and major infestations have been aerially sprayed using helicopters.

Direct treatment to cut culms can reduce herbicide costs and avoid drift onto desirable plants, with fair results year-round and best kill in fall, although it appears to be more successful in shaded sites (Else et al. 1996, Vartanian, pers. comm.). Concentrated glyphosate solution (50 percent to 75 percent Rodeo, or 27 percent to 40 percent glyphosate is applied to stems, cut within two to four inches (5-10 cm) of the substrate, by painting with a cloth-covered wand or a sponge or spraying with a hand mister. It may be helpful to add a dye or food coloring to the solution to identify treated material. Solution must be applied immediately following cutting because translocation ceases within minutes of cutting; a five-minute maximum interval is suggested (TNC 1996).

New growth is sensitive to herbicides, so a common alternative is to cut or mow a patch and allow

regeneration, returning three weeks to three months later when plants are three to six feet (1-2 m) tall to treat new growth by foliar spraying of glyphosate. Promoting regrowth causes nutrients to be drawn from the roots, potentially reducing the movement of glyphosate to the roots (TNC 1996). With all methods, follow-up assessment and treatment should be conducted, and some professional applicators suggest six return spot treatments over six months (Van Diepen, pers. comm.). Other chemical control methods have been tested, including paraquat and triclopyr compounds (Arnold and Warren 1966, Horng and Leu 1979, Franklin 1996), but are not recommended near water.

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