Arundo: an Introduction

Arundo donax, commonly called "giant reed," is a tall, 6 to 30 foot high, perennial grass found naturally from the western Mediterranean to India (Figure 1). It was widely planted throughout the warmer areas of the U.S. as an ornamental, and in the Southwest it was especially popular for erosion control. It easily escaped cultivation to become established in moist warm environments; as early as 1820 it was so plentiful along the Los Angeles River that it was gathered for roofing material.

A. donax tolerates a wide variety of ecological conditions. It can flourish in all types of soils, from heavy clays to loose sands and gravel; it tolerates salinity and can withstand drought and flooding. It proprogates readily from either rhizome (a rhizome is a horizontal stem of a plant, usually found underground, and often sends out roots and shoots from its nodes) or seed and tends to form pure stands at the expense of other plants. The rapid invasion of this plant into the coastal rivers of California has caused serious ecological and flood management problems as it displaced native vegetation.

Arundo has a growth rate up to five times faster than native plants: growth of over 2 feet per week for several months under favorable conditions are not unusual and annual production can exceed 30 tons per acre. It can burn, but its rhizomes are resistant and can sprout after fires while native plants recover much more slowly. Cutting it down or its removal in floods will only lead to regrowth if parts of the roots survive – and they usually do.

Least I say only bad things about Arundo, I should mention that it has played an important role in western culture for over 5000 years through its influence on the development of music. The most primitive pipe organ, the Pan pipe or syrinx, was made from *A. donax* and reeds for woodwind musical instruments are still made from its stems (no satisfactory substitutes have been found). Beyond its musical qualities, Egyptians used giant reed to line underground grain storage areas and mummies of the Fourth Century A.D. were wrapped in arundo leaves. Other uses include: basket-work, garden fences and trellises, chicken pens, crude shelters, fishing rods, arrows, erosion control, livestock fodder, pulp for paper and ornamental plants. Medicinally, the rhizome has been used as a sudorific (to help you sweat), a diuretic, as an antilactant and in the treatment of dropsy. Boiled in wine with honey, the root or rhizome has been used for cancer – but I doubt your doctor would approve.

Up to now the major Arundo control method has been mechanical removal followed by the use of a broad spectrum herbicide like Roundup. The costs are appreciable: from $9,000-$20,000 per acre (based on removal costs in past eradication programs). These costs are clearly beyond economic reason if the total number of affected acres in southern California are considered. However, there may be an alternative. The following article by Tom Dudley and Adam Lambert (published in The Nature Press, University of California Santa Barbara, Volume 2, June 2007; http://ccber.lifesci.ucsb.edu/newsletter/CCBERPdfs/CCBERNewsletter_Volume002.pdf) will provide some information on the developing possibilities of biological control.

Figure 1. *Arundo donax* stems and leaves.

Natural Enemies of Giant Reed *(Arundo donax)*

Tom Dudley and Adam Lambert

River systems in California depend on periodic natural disturbance, in the form of seasonal cycles of flood scouring, to encourage the development of native riparian woodlands. These woodlands can provide essential wildlife habitat, filter out pollutants that enter waterways, and ameliorate the impacts of flooding and wildfire. The Santa Clara River represents one of the few remaining major waterways in southern California that retains the capacity to support well-developed riparian forests, but at the same time it is one of the systems most affected by invasion of the non-native weed, *Arundo donax*. Also known as giant reed, this bamboo-like grass has overwhelmed native plants from well upstream of Santa Clarita down to the Santa Clara Estuary. *Arundo* has promoted destructive wildfires, its debris clogs riverbanks and beaches, and it is known to be very poor habitat for birds and other sensitive species. Many control efforts have been undertaken using various combinations of mechanical cutting and herbicide treatments. These can be effective if done right but are extraordinarily expensive, as well as disruptive, to nearby native habitat. The results are generally temporary--the next floods distribute the fibrous rhizomes downstream where they regrow if moisture is sufficient, and the problem repeats itself.

An alternative approach to weed management is the introduction of natural enemies (or herbivores) that feed on the plant in its region of origin, in this case a broad zone from the Mediterranean across to the Indian sub-continent. A collaborative program involving the USDA Agricultural Research Service and various universities is underway to find and develop such biocontrol agents. Overseas co-operators headed by Dr. Alan Kirk of the USDA European Biological Control Lab in France have identified a variety of organisms--a stem-boring wasp, several species of stem damaging fly larvae, and a rhizomefeeding scale insect--that inflict substantial damage to plants in Europe and appear to feed only on *Arundo* without undue risks to native grasses or economic plants. Just this year some of these insects were transferred to a quarantine lab in Texas under the direction of Dr. John Goolsby, so that their impacts, specificity to the target weed, and suitability for handling could be further tested. At the same time, weed biocontrol now involves an exhaustive analysis of the environmental and economic impacts of a weed and the benefits resulting from its control, in order to justify future implementation of the biocontrol program. Part of this includes determining if organisms already in the infested environment can have effects on the weed. These existing “enemies” can be harnessed to do greater damage to the weed,in this case *Arundo*.

We have been studying these relationships over the past year through a grant from the Santa Clara River Trustee Council, coordinated by Dr. Adam Lambert, a post-doctoral researcher with UCSB’s Marine Science Institute and overseen by Denise Steurer of the Ventura field office of the U.S. Fish & Wildlife Service. Besides the ecological and mapping information being developed, we have recently discovered at the Santa Clara River a stem-boring wasp that turns out to be the very same species, *Tetramesa romana*, that USDA is working with in its quarantine programs to see if it is suitable for introduction! We now have an excellent opportunity to learn more about the biology of this insect and under conditions much more realistic than can be

Figure 2. The stem-boring wasp: *Tetramesa romana.*

Figure 3. Damage to *Arundo donax* stems from the *Tetramesa romana* wasp.

Figure 4. (top) Pupae of the *Tetramesa romana* wasp and (bottom) aphids attaching arundo leaves.

simulated in the quarantine lab. In California, *T. romana* has so far only been found from southern Santa Barbara to San Diego County, and does not appear to be present in many other *Arundo* stands statewide. Field studies will continue to verify its distribution. Presumably this is not a native species, but perhaps was a hitch-hiker on *Arundo* when it was transported by Spanish settlers, although the wasp's currently limited distribution may suggest that it's a more recent arrival in the New World. Its larvae feed on the smaller diameter stems and shoots of *Arundo*, sometimes in numbers as high as a dozen or more larvae in a 10 cm section of stem. Mature wasps then vacate the plant, leaving small exit holes, which makes it fairly easy to see if the insect is present in a stand. The 4 mm long adult wasp lives outside the plant, and females insert their eggs into the stem of the plant. This life cycle can be repeated twice or more in one year. The adult population consists almost entirely of females, and since they do not need males for insemination, the potential for population growth can be quite large. In addition, the resulting damage fosters secondary infection by bacteria and other organisms that inflict further damage to the plant, sometimes killing the whole stem.

Initially one would suspect that since this herbivore is present, and so is a LOT of *Arundo*, that it must not be able to do a very effective job of controlling the host weed. However, mass rearing could allow us to produce much larger numbers of insects than normally are present in nature. The insects could then be distributed to attack more plants. There also may be means for enhancing the infections by promoting the microbes that cause the secondary damage. However, our best chance for biocontrol success may lie in bringing in additional insects, and hopefully specialized disease organisms as well, to knock out this extremely noxious plant.

Because this is an ongoing and very active research program, we are interested in hearing from any observers whether they have seen evidence of this wasp, or other organisms causing damage to *Arundo* anywhere in the region. Further information on the program is available at our website (http://rivrlab.msi.ucsb.edu/), including information on a parallel biocontrol program for tamarisk or salt cedar (*Tamarix ramosissima*).