Teamwork Kills Arundo in Cost-effective Manner

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Introduction

Arundo donax, or giant reed, is a bamboo-like grass that is one of the most problematic exotic plants that has invaded southern Californian riparian systems. *Arundo* is a threat because it replaces native vegetation and does not provide the equivalent structure and functioning in the ecological community.

Arundo is present on the Santa Margarita River (San Diego county, CA) at densities ranging from scattered clumps to dense stands. The Navy is carrying out an *Arundo* control project along a section of the Santa Margarita River near Fallbrook. This project began in September 1995 and will continue for five years. Rather than replanting wetland species to replace functions and values lost during the flood control actions, this project relies on removing the exotics and allowing natural processes to revegetate the site.

This project began as separate mitigation for three separate flood control projects that occurred on Marine Corps Base Camp Pendleton in San Diego County. The mitigation was located downstream and varied in terms of length of effort. Information learned from the work of The Nature Conservancy and other agencies that have performed *Arundo* control has shown that to effectively diminish the threat of reinvasion of *Arundo,* control must start at the uppermost infected reaches and work down river. The Army Corps of Engineers (ACOE) and the Navy worked closely and quickly together starting in the spring of 1995 to convert the requirements to a five year project in an upstream location. The ACOE's interest and assistance at this point was key in pulling the project together.

The ACOE permit requires that other exotics that could threaten the structure and function of the riparian system be controlled as well to allow natural succession to take place. Additionally a success criteria was included that required 11 acres formerly dominated by *Arundo* to have at least 50% cover of native wetland species at the end of 5 years. These permit requirements are sensible and flexible and to date are resulting in a cost effective, biologically effective project.

Mapping

Exact acreages were needed to verify the attainment of mitigation requirements. Precise mapping in advance of the control effort would have been difficult and costly because of poor visibility and accessibility due to the density and size of the *Arundo.* For detailed mapping our biological monitor mapped on air photos as the pesticide treatment proceeded. The maps were then transferred to a geographical information system (GIS) database for accurate calculation of acreages. The acreages were calculated and totaled weekly so we knew when our acreage requirements were met. Daily mapping was accompanied by detailed records kept by the pesticide applicator so that we could calculate costs for treating various configurations of *Arundo*.

A global positioning system (GPS) was originally tried but did not work out because of the lack of real time correction and difficulties encountered using the available base station. In the future we anticipate that the most accurate method of mapping will be using a GPS with real time correction.

Arundo Removal Treatments

The first application of treatments was begun on September 16th, 1995. *Arundo* was treated by cutting the stems and applying Rodeo® herbicide (glyphosate) to the stumps, or by foliar spraying the leaves and stems without any cutting. The *Arundo* plants that resprouted after the first treatment received a second application of herbicide in November 1995. A third application was carried out in September 1996 on plants that resprouted after the second treatment.

Monitoring

Transects were set up to monitor the vegetation that recovered after *Arundo* removal, and to determine the success of the two *Arundo* removal treatments. Transects were located in areas of dense *Arundo* (n = 16) and areas with scattered clumps of *Arundo* (n = 25). Aerial cover was recorded using the point intercept method. Ground cover and species present in a 1 m belt were also recorded. Sampling was carried out in October 1995 and May 1996. Ideally, the first sampling should be carried out before the *Anindo* is removed so one can make before and after comparisons. However, due to the thick, impenetrable nature of the *Arundo*, this was not feasible. Estimates of percent *Arundo* cover present before removal were made along each transect.

In all areas of dense *Arundo* resprouting occurred after the cut and spray treatment. However, we estimate that only about 20% of the isolated *Arundo* clumps that were cut and sprayed resprouted. This difference is probably due to the smaller rhizome mass in the isolated clumps compared to the dense stands. Foliar spraying of glyphosate has, to date, been the most effective method in killing *Arundo*. Only scattered cases of resprouting have occurred.

Although *Arundo* resprouting occurred after the cut and spray treatment, the cover of *Arundo* was still much less than was present before removal treatments were applied. On the dense *Arundo* transects, aerial cover of *Arundo* decreased by 40% after the first treatment.

Native and exotic species have colonized areas where *Arundo* was removed. In the 1996 sample of the dense *Arundo* transects 13% of the points on the transect line had no vegetation cover. Of the 87% with vegetation cover, 51% of the plant intersections were native species, 28% were native wetland species, and 49% were exotic species (*Arundo* included). In the 1996 sample of the clump transects (excluding the controls) 23% of the points on the transect line had no vegetation cover. Of the 77% of the points with vegetation cover, 66% of the plant intersections were native species, 48% were native wetland species, and 34% were exotic species (*Arundo* included).

Biomass Removal

Removing the *Arundo* stem biomass turned out to be almost as expensive as the pesticide application. The cut stems were stacked no more than 6" deep on dry soil and allowed to dry. In areas of dense biomass the stalks were hand carried to a central site and chipped. Much of the cost stemmed from poor access to the site and the difficulty in transporting cut stems to a location where the chipping could take place.

Since the cut stems do have the potential to sprout from the nodes, there were initial fears that if the cut stems were left in place they would produce new individuals. However, our observations indicate that ample moisture is necessary for sprouting of cut stems to occur. Of the thousands of stems left to dry on the project site in the first year, only two were found to have sprouted and both were located in water. Our analysis is that the following situations may warrant the removal of the cut stems:

1. If the *Arundo* plant being treated is near water or a very moist area in which the cut stems may fall
2. If the post-treatment weather conditions are such that a storm may cause a substantial swell in the river that may wash the newly cut stems downstream where they may land in a situation favorable for growth
3. If the treated *Arundo* plants are located close to the river channel where floods will likely carry the cut stems downstream during winter flooding, and if the buildup of the cut stems around bridges or other areas is of concern
4. If the layer of stems is so thick that no species would be able to grow through it. In this situation, enough stems could be removed to allow some light to penetrate the ground. We do not recommend completely clearing all the stems. Where this did occur on the field site in 1995 it was observed that mostly exotic herbs colonized.

Conclusions

So far the foliar application of herbicide appears more successful in killing *Arundo* than the cut and spray method, however, further monitoring is necessary to be certain the foliar sprayed *Arundo* is definitely dead and will not be able to resprout in the future. We hypothesize that absorption of the herbicide is greater through the leaves than through the cut stem, and that the process of cutting initiates the resprouting response. However, since the application of foliar spray cannot be used in areas where native species are interspersed with *Arundo*, the cut and spray application is necessary in some areas. Results from experiments currently being carried out may give information on the best protocol for application using the cut and spray method.

Overall, native species have recovered well after the removal of *Arundo*. Although exotic species have also established after removal of *Arundo* there were still, overall, more intersections of native species along the transects than exotics. We expect the cover of native species to increase as further removal of resprouting *Arundo* is carried out.

Removing exotics on a system level is an effective way of restoring riparian systems. To effectively control *Arundo*, the eradication efforts must start in the uppermost reaches of the watershed and work down river. This organized approach takes much coordination between many different river stakeholders and agencies. The Nature Conservancy has been able to help coordinate *Arundo* projects in the Santa Margarita River watershed by using this coordinated approach.