GIANT REED (*ARUNDO DONAX*): A CLIMAX COMMUNITY OF THE RIPARIAN ZONE[1]

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*Abstract: Active management of coastal streams is needed to ensure the continued existence of significant riparian systems in Southern California. The concept of a dynamic self-replacing plant community is no longer a truism there. In the past decades one exotic species in particular, the Giant Reed (*Arundo donax *L.) has had an ever-increasing negative role in the succession of riparian systems. The aggressiveness of this exotic has enabled it to invade disturbed areas along many watercourses of Southern California. Giant Reed is also capable of invading mature woodlands, interrupting the cycle of regeneration normally experienced in river systems. Giant Reed stands can become climax communities, replacing natural riparian habitats. Without active management of the vegetation, the survival of many riparian residents, including some endangered species, may be at risk. Mitigation by replacement of lost habitat must be combined with proper management of the areas surrounding those sites lest Giant Reed communities claim much new acreage.*

The floristic structure and composition of riparian forests can provide examples of developmental patterns and successional stages within a biotic community that may be indicative of the system's future. Because vegetation dynamics of a riparian system remain in a state of perpetual succession in part due to the reshaping of the riverbed by storm events and less frequent high flood events, it may follow that plant succession is defined by the presence or absence of individual species.

Disruption of vegetational succession by social, commercial, and agricultural development can alter the physical and biotic composition of a riparian system to the extent that natural regeneration often cannot occur, thus encouraging the proliferation of exotic species. *Arundo donax.*, or Giant Reed, was introduced to the California landscape in the 1800's. Due to the prolific nature of this grass, presence of this species within a riparian community is becoming increasingly common.

Examination of the properties of this invasive plant suggests that proper management of a riparian system which contains Arundo will involve active participation of control and eradication to maintain a heterogeneous plant community.

Methods

Three locations on the San Luis Rey River and the San Diego River in San Diego County were studied. Sites within these locations were chosen for sampling purposes to include riparian vegetation of different known ages and habitat quality.

Frequency and percent cover of Arundo were determined on a stretch of river immediately east of the State Route 76 bridge crossing on the San Luis Rey River. A 610-meter transect was established parallel to the river's edge. Some 40 7.6-meter diameter quadrats were located at random distances away from the river off this transect at 15.2-meter intervals. Measurements were made within the quadrats to estimate frequency, percent cover, and average maximum height of Arundo.

Colony distribution was determined using an aerial photograph (1:600 scale) covering an area approximately 6.1 hectares on the San Luis Rey River. A belt transect 365.9 meters by 15.2 meters (0.56 hectares) was randomly located in each of four equal cells oriented parallel to the river's edge. A digital planimeter calculated the area comprised of Arundo.

Plant maximum heights were measured at several sites on both rivers using a telescoping metric measure rod. Individual stands of Giant Reed were randomly selected and the maximum heights of each stand recorded and averaged. Maximum average heights were not obtained in riparian habitat where A. donax colonies were established 4 years or less. Average growth rates were determined by measuring plant heights at various intervals after existing Arundo stands were cut back to soil level. Ages of Arundo stands were determined from aerial photograph series and personal knowledge of the authors.

More detailed vegetation data were collected on the San Diego River east of Mast Street Bridge adjacent to Mission Trails Regional Park in Santee. Measurements of randomly located circular quadrats and line intercept analysis were used to estimate density, dominance, frequency, and cover values for all species encountered.

[1] Presented at the California Riparian Systems Conference; September 22-24, 1988; Davis, California.

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Results

A. donax growth appears quite rapid at the onset of colony establishment, especially if growth occurs from previously established rhizomes. The average maximum stem height of observed *A. donax* stands of various ages expressed in mean height and standard deviation were as follows:

	Mean[3]	SD
40 days[1]	2.5	0.28
150 days[1]	4.0	0.74
4 years[2]	3.8	1.12
35 years[2]	5.9	1.27

[1] Duration of growth since cutting of established colony.
[2] Original stand.
[3] Height in meters.

A maximum average height of approximately 6 meters was reached in the mature riparian zone which corresponds to maximum heights reported by the University of California Agricultural Extension Service (Fischer 1983).

Growth rates of *A. donax* from established rhizomes averaged 6.25 cm/day (S.D ± 0.7) for 40 days' growth. And 150 days of growth averaged 2.67 cm/day (S.D. 0.49).

The area occupied by *Arundo donax* and its pattern of distribution along a section of the San Luis Rey River is presented in table 1.

Although the area occupied by Giant Reed throughout this stretch of established riparian habitat is relatively small, a dense distribution occurs in the belt transect closest to the riverbank. The belt transect closest to the river incorporated 97.1 percent of the Arundo encountered. Giant Reed occupied 6.0 percent of all transects studied. Quadrats sampled further from the river show a dramatic decrease in presence of Arundo.

Table 1 Distribution and Area of A. donax in transects parallel to San Luis Rey River.

Transect	1	2	3	4
Distance from river (meters)	7.3	39.1	80.3	114.5
Area comprised of Arundo (sq. meters)	1365.6	33.5	0	7.3

Table 2 – Circular quadrat vegetation analysis on the San Diego River.

	Dom.	Rel. Dom. (%)	Freq.	Rel. Freq. (%)	% Cover
Vegetation Group					
Native Trees	0.3	20.0	0.01	1.3	57.0
Native Shrubs and Herbs	0.02	1.4	---	---	11.9
Arundo donax	0.1	6.8	0.9	92.3	26.0
Exotic Shrubs and Herbs	1.5	2.8	0.1	6.4	6.4

If dominance is defined as occupation of the largest basal area per area sampled it is evident that *A. donax* within this riparian zone is dominant only in the vicinity adjacent to the riverbank. On the San Diego River, native flora was dominant and provided the greatest amount of cover of the 4 vegetation groups used to classify the riparian community. However *A. donax* was encountered far more frequently than any other vegetative group. Relative frequency of Giant Reed on the San Luis Rey was approximately 30 percent less than its relative frequency on the San Diego River and provided 10 percent less cover (table 2).

Arundo donax comprises a significant proportion of the riparian habitat on the San Luis Rey and San Diego rivers of San Diego County. Regardless of quadrat distribution, more than half of the quadrats sampled along both drainages contained Arundo. Both areas sampled were within established riparian zones however the amount of disturbance and degradation varied between drainages.

Discussion

A. donax does not invest large amounts of energy in the development of an extensive woody root or branch system which may account for its rapid rate of growth. Growth rates of 1.02 to 1.52 cm/day were recorded for *Salix goodingii* and *Salix laevigata* on the Kern and Lower Colorado River in California (B. Anderson, telephone communicatin). Recorded growth rates for *A. donax* are 2.1 to 4.9 times faster.

The physical presence of Arundo can inhibit to some degree the establishment or growth rate of native and exotic species often resulting in pure stands of Giant Reed. This situation can be observed readily along all the major river drainages in San Diego county. The fast growth rate and ability to attain heights of between 2.5 and 4.0 meters in less than a complete growing season assures a competitive advantage over slower growing native species. By comparison, willow trees on the Sweetwater River in San Diego county were reported

to have grown 1.5 to 1.8 meters in one growing season (Rieger 1988).

Flowering in Giant Reed occurs after intervals of several years, thus propagation is primarily vegetative. Open colonies or groves are established as shoot-producing rhizomes are spread extensively underground (Bailey 1976). New growth can also be established by simple division of the colony; as older stems fall to the earth or are torn from the ground, stem segments can reestablish themselves, producing a new colony.

Within a river system the distribution of establishment does not appear to be random (table 1). The highest concentration of colonies occur closest to the river. Frequency and magnitude of the river flow is most likely the major contributing factor influencing this pattern of distribution. Strahan (1983) found that distribution and development of riparian vegetation is regulated by erosion, deposition, and lateral channel migration. River currents create a constant process of erosion with deposition of eroded material occurring further downstream. Flooding, scouring and debris sedimentation serve to promote expansion of *A. donax* colonies along this zone of frequent inundation.

Disruption of a stream system by natural events (flooding) is not the only avenue available to Giant Reed for its establishment into a system. Disturbance from earth-moving activity can encourage the spread of *A. donax* (fig. 1) even in areas far removed from the water table. Where earth-moving equipment is used the colony can actually spread at a much faster rate than by rhizome growth alone. Evidence can be found in newly graded restoration projects or other constuction sites (Rieger 1988). For years Camp Pendleton had a program of clearing the riparian habitat as part of a water conservation program. Giant Reed present within the community was distributed throughout the area which had been denuded. Expansion of the existant population occurred when this practice had been eliminated thus increasing the area previously occupied by the species (Rieger, pers.obs.).

Arundo donax occupies a substantial portion of the riparian system. It far exceeds all other exotic species on the San Diego River and it occurs with a very high frequency on both drainages studied. This high frequency indicates a greater presence within the vegetation community than cover alone would imply. This suggests that the invasive ability of Giant Reed is high regardless of the nature of the existing habitat, though establishment of *A. donax* is probably limited in more dense and mature riparian stands (fig. 2).

Although a few bird species have been observed utilizing the plant for nesting purposes (Kreager, pers.obs.), the presence of Giant Reed essentially creates a zone devoid of wildlife. The dry climate of San Diego precludes extensive decomposition of its vegetation, therefore even dead, arundo remains and continues to preclude encroachment by plant species with wildlife values.

Figure 1 – In a newly graded site along the First San Diego River Improvement Project *Arundo donax* has become established before native species. Another exotic, the Castor-bean *(ricinus communis)* can be seen in the foreground.

Figure 2– Arundo colonies at the edges of riparian habitats on the San Diego River.

Several significant differences between *A. donax* and other perennial exotics exist. Very few form expanding contiguous colonies or attain large heights as do several native species. The dependence of Arundo upon flooding and vegetative propagules has acted as a limiting factor for its invasion into a habitat. The low rainfall and infrequent flooding in Southern California has kept arundo dispersal rates down, however the slowness of dispersal compared to other exotic species is compensated by its permanence following colonization.

Conclusions

Arundo donax is an extremely fast growing perennial plant reaching mature heights within the first growing season. Dispersal is primarily by vegetative means of stem and rhizome fragments. Flooding is considered the primary natural mechanism of dispersal. Grading and other construction activity can greatly increase the area occupied by Arundo colonies. Restoration sites are easily and quickly invaded especially if the plant was present on site prior to preparation. Arundo is found throughout the river drainages studied. This distribution is viewed as being potentially disastrous for the overall habitat quality of the riparian system.

Recommendations

Loss of riparian habitats has prompted increased interest in them. The presence of Arundo and its ability to compete successfully in riparian systems indicate a future decline in the habitat quality of riparian systems. The end result may be riparian habitat comprised of large percentages of *A. donax* with greatly reduced habitat quality. Several California endangered bird species are dependent upon riparian habitat, therefore it is extremely important that active Giant Reed management be implemented.

Successful techniques have been developed for eradication of Saltcedar *(Tamarix spp.)*(Kerpez and Smith, 1987) from significant areas in the desert. Eradication principles must be applied for the management and control of *A. donax* as well if the many endangered and other sensitive species dependent upon riparian communities are to proliferate.

Acknowledgments

We thank Kathryn J. Baird for her assistance in data collection and editorial comments; and John A. Beezley for his editorial comments.

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