



The Evolution of Arundo Removal Efforts on Camp Pendleton

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Introduction

In February of 2010, Camp Pendleton completed initial removal efforts on the final 120 acres of arundo (*Arundo donax*) infestations on the Santa Margarita River. Since treatments began in 1995, the methods used to remove arundo have been changed or modified over the years to account for a range of issues, including:

- Site accessibility
- Availability of funding
- Presence/absence of Federally protected wildlife
- Native habitat recovery requirements
- Herbicide usage concerns
- Secondary NIS invasions

In an effort to assess habitat recovery following arundo removal, a monitoring plan incorporating the California Rapid Assessment Method (CRAM) for wetlands was implemented in 2009. Although data only currently exists for one year, there are indications that the chosen removal method may impact the future recovery trajectory of the treated site.

Mow & Foliar Herbicide

In 1997, 87 acres were first mowed on-site between January and March. Resprouts were then treated the following winter with a foliar herbicide. This method would be used in 2009/2010 in conjunction with native plantings.



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| Advantages: | Disadvantages: |
| Minimized herbicide usage; increased efficacy of herbicide; reduction of biomass | Restricted to sites accessible by vehicles; inhibits establishment of native species; possibly opens area to annual weeds |

Mechanical Removal Only

Between 1998 and 2001, 340 acres of arundo were removed by excavators (rhizomes included). The remaining biomass was chipped and removed from the site.



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| Advantages: | Disadvantages: |
| Minimal initial herbicide usage | Costly; restricted to sites accessible by vehicles; high % regrowth from rhizome fragments; mechanical disturbance facilitated annual weed infestations; |

Foliar Herbicide Only

Since 1995, 180 acres of arundo has been treated solely with a foliar herbicide. Field personnel would apply a foliar herbicide mixture to existing arundo foliage with re-treatments occurring for at least 4 years.



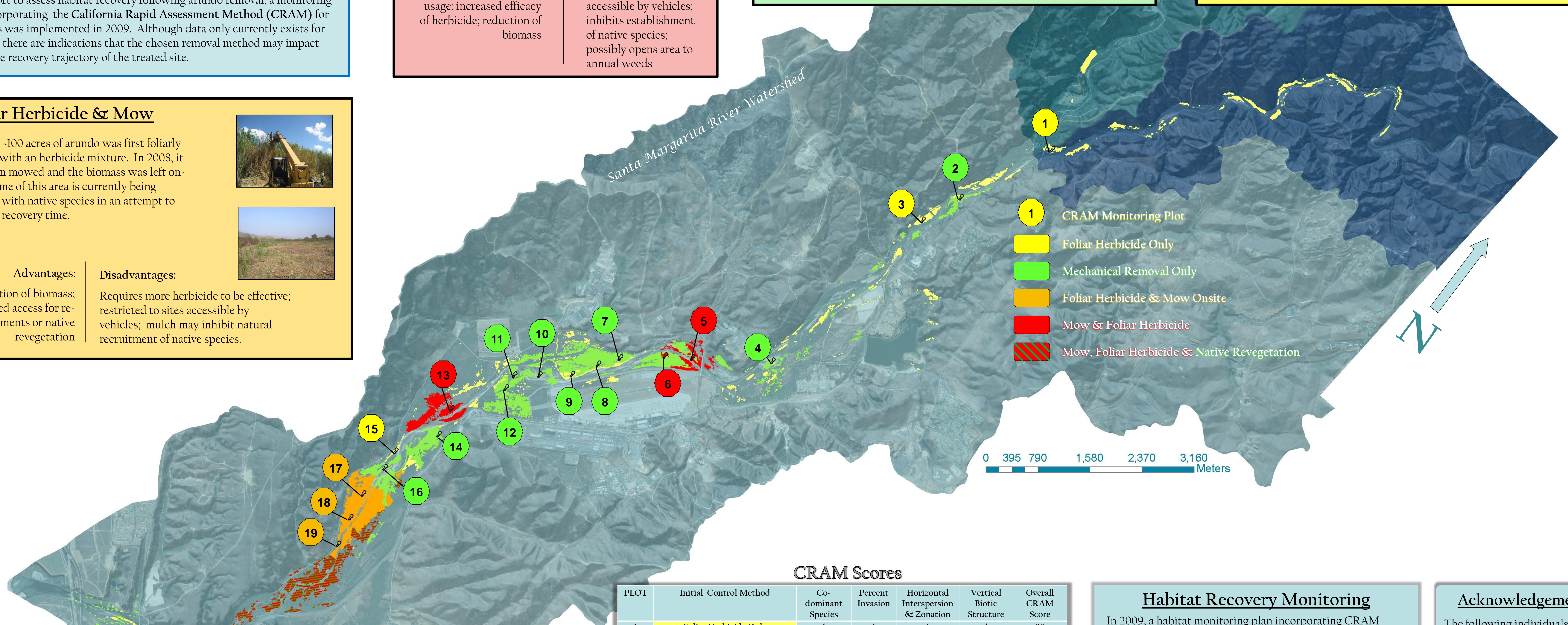
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| Advantages: | Disadvantages: |
| Ease of access; no mechanical disturbance; minimizes impacts to protected bird species | Older individuals require more herbicides; unintended impacts by herbicides; remaining biomass inhibits native species regrowth; high manpower requirements |

Foliar Herbicide & Mow

In 2007, ~100 acres of arundo was first foliarly treated with an herbicide mixture. In 2008, it was then mowed and the biomass was left on-site. Some of this area is currently being planted with native species in an attempt to shorten recovery time.



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| Advantages: | Disadvantages: |
| Reduction of biomass; improved access for re-treatments or native revegetation | Requires more herbicide to be effective; restricted to sites accessible by vehicles; mulch may inhibit natural recruitment of native species. |



CRAM Scores

PLOT	Initial Control Method	Co-dominant Species	Percent Invasion	Horizontal Interspersion & Zonation	Vertical Biotic Structure	Overall CRAM Score
1	Foliar Herbicide Only	A	A	A	A	90
2	Mechanical Removal Only	B	B	B	A	82
3	Foliar Herbicide Only	B	B	B	A	82
4	Mechanical Removal Only	C	B	C	C	69
5	Mow & Foliar Herbicide	B	B	A	B	83
6	Mow & Foliar Herbicide	C	A	C	B	81
7	Mechanical Removal Only	C	B	C	B	79
8	Mechanical Removal Only	B	D	B	B	81
9	Mechanical Removal Only	C	C	A	B	83
10	Mechanical Removal Only	D	A	C	D	76
11	Mechanical Removal Only	B	B	B	B	84
12	Mechanical Removal Only	D	A	B	B	76
13	Mow & Foliar Herbicide	D	C	C	B	77
14	Mechanical Removal Only	C	C	B	B	76
15	Foliar Herbicide Only	B	C	A	A	86
16	Mechanical Removal Only	B	C	A	A	86
17	Foliar Herbicide & Mow Onsite	C	D	C	B	78
18	Foliar Herbicide & Mow Onsite	B	D	C	C	78
19	Foliar Herbicide & Mow Onsite	B	D	C	D	76

RATINGS	Co-dominant Species:	Relative number of co-dominant plant species (native or non-native) within the plot.
A	Percent Invasion:	Relative number of co-dominant plant species that are non-native.
B	Horizontal Interspersion & Zonation:	Measure of the variety and interspersion of horizontal plant "zones."
C	Vertical Biotic Structure:	Measure of the variety and interspersion of vertical plant "zones."
D		

Mow/Foliar Herbicide, Native Revegetation

Between 2010 & 2011, ~70 acres of arundo was mowed and sprayed and ~30 sprayed then mowed. 55 acres were then revegetated with native riparian plants in an effort to lessen native habitat recovery time.



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| Advantages: | Disadvantages: |
| Minimized herbicide usage; increased efficacy of herbicide; reduction of biomass; accelerated native habitat recovery | Restricted to sites accessible by vehicles; sites are prone to annual weed invasions |

2010 Flooding

Heavy rainfall in late 2010 washed mulch from the majority of the treated sites. This opened the sites to annual weeds that are still hindering native plant establishment today.



Arundo mulch collected adjacent to protected tern colonies on Camp Pendleton's beaches. There was concern the debris would attract Argentinian ants that are known to attack tern chicks. The mulch was removed prior to the following breeding season.

Habitat Recovery Monitoring

In 2009, a habitat monitoring plan incorporating CRAM methodology was implemented to assess native vegetation recovery following arundo removal efforts. The table to the left includes select metric scores sorted by initial control method. Although the data is limited, some inferences can be made regarding future effects based on initial control method.

- Foliar Herbicide & Mow - Overall Score 77**
After 3 only years since initial treatment, sites are dominated by annual exotics. Efforts are underway to revegetate w/natives.
- Mechanical Removal only - Overall Score 79**
Lower CRAM scores may point to an issue with the removal method.
- Mow & Foliar Herbicide - Overall Score 80**
Limited sampling points make it difficult to infer causality.
- Foliar Herbicide Only - Overall Score 86**
Initial foliar treatments were usually located in more remote portions of the river, a possible factor in the high overall CRAM score.

Acknowledgements

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