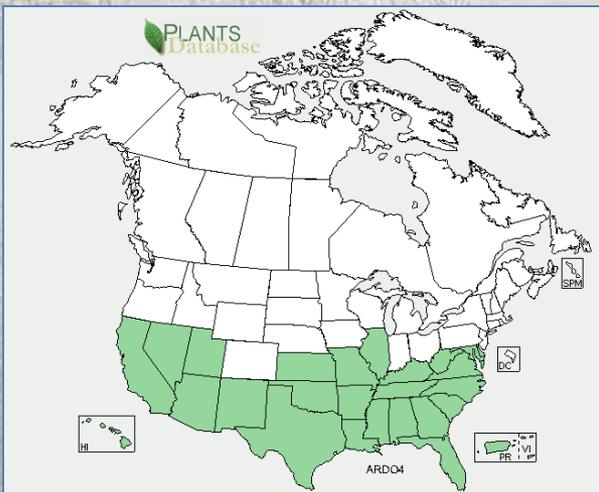


Restoration of riparian ecosystems in the
Southwestern U.S., through biological control of the
pyrogenic invader *Arundo donax*.

Alex Racelis John A. Goolsby, Patrick Moran
USDA-ARS, Beneficial Insects Research Unit
Weslaco, TX, USA

Arundo donax L. (Poaceae)

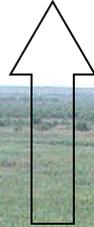
Giant reed, Carrizo (Sp.), Ladron del agua (Mex)



- Native to Eastern Asia, Mediterranean, and N. Africa, used for construction materials and reed instruments
- Largest of grasses, growing 6 to 30 feet
- Reproduces vegetatively by sprouting from rhizomes or plant fragments
- Hydrophyte -- grows best where water tables are near or at the soil surface
- Invasive to N. America (US and Mexico)
- Top 5 invasive species degrading natural ecosystems in California (Cal-IPC 2004)
- Listed as noxious invader in Texas (TDA 2010)
- Considered one of the worst weeds in the world
- Most prolific producers in the world— tenuous target for biofuels*

1. Water loss

(Coffman 2008;
Seawright et al 2009;
Gowda et al 2009;
Watts 2009)



2. Species Displacement/Habitat Loss

(Norris and Minckley 2002;
McGaugh et al. 2006;
Going and Dudley 2008;
Herrera and Dudley 2004;
Rubio et al. 2010)

Etheostoma segrex, Rio Salado Darter



3.Erosion and Impediment to water infrastructures

Frandsen and Jackson 1994; NPS



4. Impacts to private landholders:

- Loss of rangeland used for grazing & hay production
- Of river habitats (buffelgrass pasture and forest stands), arundo found to be most suitable refuge for Cattle Fever Tick (Racelis et al, in prep)



5. Threat to National Security

Laredo, TX

Controlling Carrizo cane is essential if the Border Patrol is to attain effective control of the border.

http://www.cbp.gov/xp/cgov/border_security/border_patrol/border_patrol_sectors/laredo_sector_tx/carrizo_removal/about/affect_cane.xml



Chemical Control

- **Chemical:** It can be controlled using any of several readily available general use herbicides such as glyphosate.
- Used by CBP, parks managers, some ranchers
- Most effective as cut stump treatment, which provides immediate results
- Repeated applications are costly; foliar sprays not arundo specific
- Use contentious along US Mexico border and water conservation stakeholders

updated 3:57 p.m. EDT, Wed March 25, 2009

Feds' plan to poison banks of Rio Grande stalled

By Elliott C. McLaughlin
CNN

(CNN) -- Federal officials postponed poisoning a mile-long stretch of the Rio Grande border. Residents complained that doing so posed health and environmental risks on border.

Mechanical/Manual Control

- **Grazing:** cows and goats eat arundo in absence of other grasses
- Used by *some* ranchers
- Poor nutritional value



Mechanical/Manual Control

- **Mowing**: periodic mowing necessary.
- Used by IBWC, US Border Patrol, some ranchers
- Provides immediate *temporary* control, especially for USBP and IBWC
- “Mowing don’t do Jack...” -- Landowner, Quemado Texas

Mar 2010



Apr 2010



Mechanical/Manual Control

- **Mowing**: periodic mowing necessary.
- Used by IBWC, US Border Patrol, some ranchers
- Provides immediate *temporary* control, especially for USBP and IBWC
- “Mowing don’t do Jack...” -- Landowner, Quemado Texas



Mechanical/Manual Control

- **Burning:**

”...and burning don't do squat.” –Same Landowner, Quemado Texas

- Arundo infested areas along the river commonly burn, *unintentionally or intentionally*, usually in private lands



Mar 2010

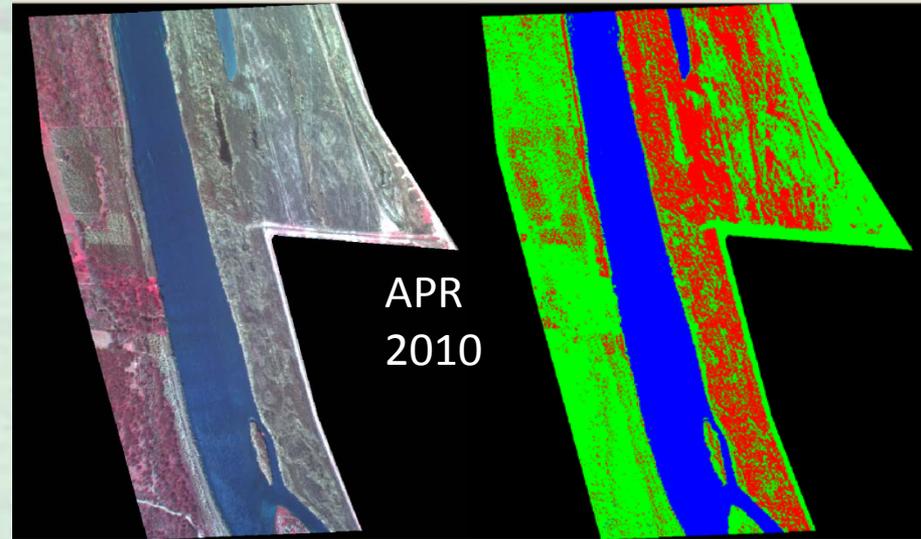
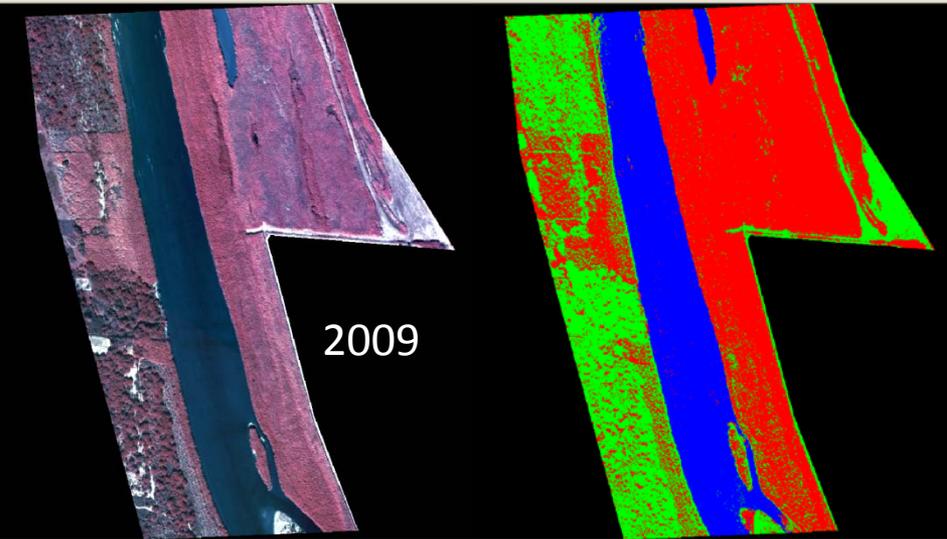


Sept 2010

Feb 2009

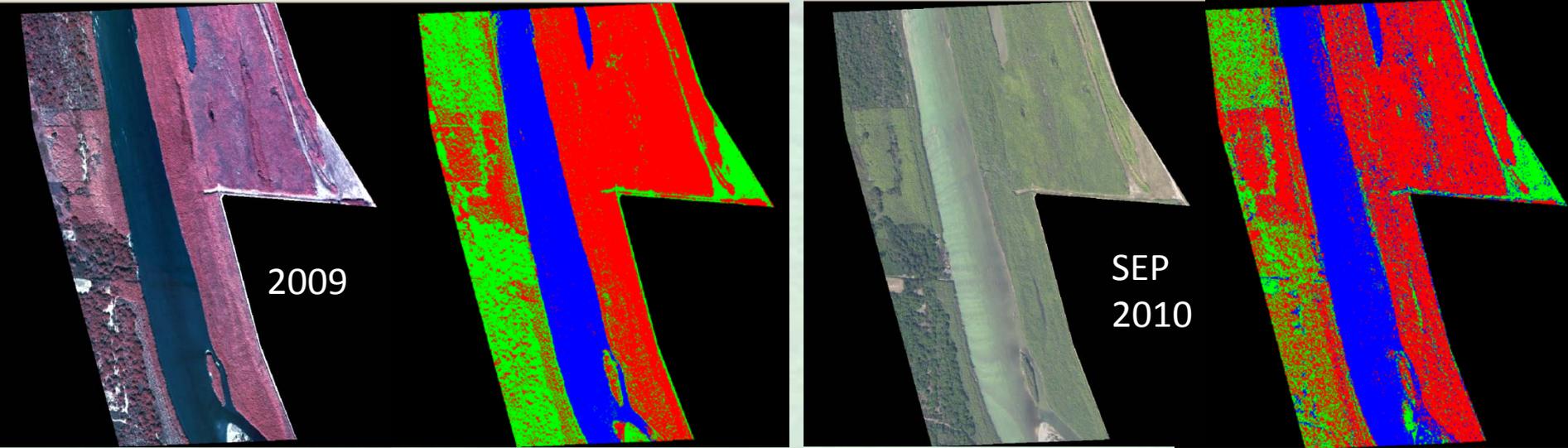


1. Effects of fire on arundo survival



Cover	2009 (Ha)	APR 2010 (Ha)	% Change
Arundo	22.5	12.0	-53%
Water	9.9	10.6	+ 6%
Other	12.8	22.6	+77%
Total	45.2	45.2	

1. Effects of fire on arundo survival



Cover	2009 (Ha)	SEP 2010 (Ha)	% Change
Arundo	22.5	22.7	+ < 1%
Water	9.9	13.6	+ 37 %
Other	12.8	8.9	- 31%
Total	45.2	45.2	--

2. Arundo ability to regrow following fire



2. Arundo ability to regrow following fire



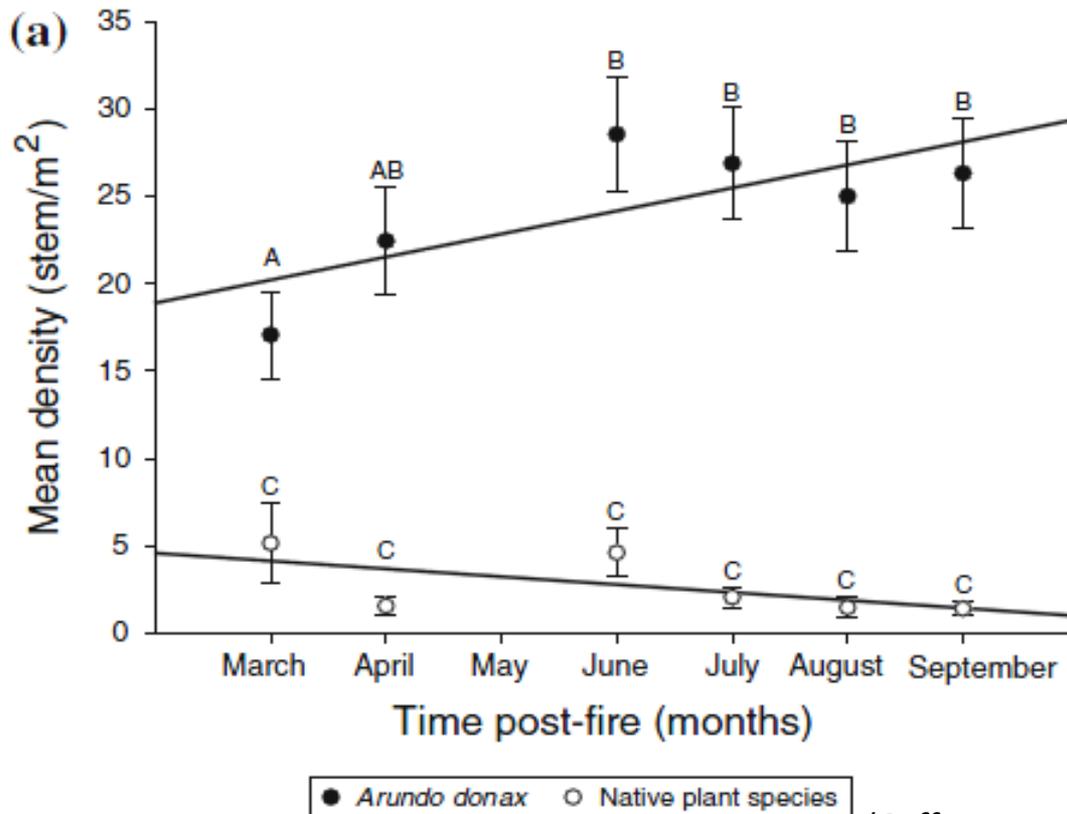
Table 1. Characteristics of *Arundo donax* in burned, cut, and control plots, 1 month after treatment

	TOTAL STEMS/ m ²	DISTRIBUTION OF STEMS/ M ² *			Average HT (cm)
		Alive	Dead	Fresh	Fresh Shoots
Burn	42.93 a	2.93	13.87	27.73	117.18 b
Cut	31.46 a	5.60	6.13	19.47	111.17 b
Untreated	27.20 a	20.80	5.87	0.53	4.06 c

*Distribution of types of stems significantly different, Chi-square= 145.139, df=4 (P = <0.001)

3. Ability of arundo to recolonize following fire and competition with native species

Wildfire promotes dominance of invasive giant reed (*Arundo donax*) in riparian ecosystems



(Coffman et al 2010)

Arundo donax grew an average of 3–4 times faster than native woody riparian plants -- reaching up to 2.3 m in height less than 3 months after the fire. (Coffman 2007, p. 248)

4. Effects on fire regime

- Tamaulipan scrub (most common along Rio Grande) and riparian systems are not fire adapted: **fire not recommended for restoration** (TNC-Texas)
- Arundo alters fuel types and loads, especially when it invades riparian ecosystems near fire-prone shrub lands (Scott 1994; Brooks et al. 2004)
- Fires (intentional and unintentional) are unavoidable, many occurring on private lands—thus should be considered in the future of management of arundo
- *Which biocontrol agent would work best given this reality?*

Integration of Biological Control

KEY AGENTS:

Arundo wasp (*Tetramesa romana* Walker)



- Galls do not show evidence of survival to canopy burns
- May integrate best with grazing or mowing

Arundo scale (*Rhizospidiotus donacis*)



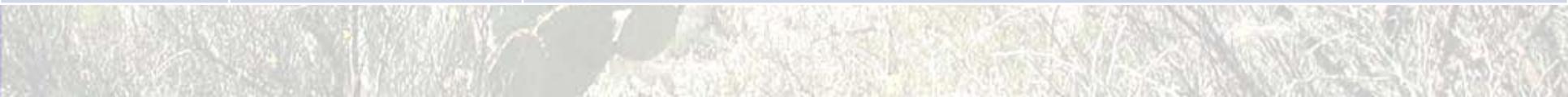
- Root feeders may integrate best with other management options
- Fires don't kill rhizomes where scales colonize
- Can survive minor flooding

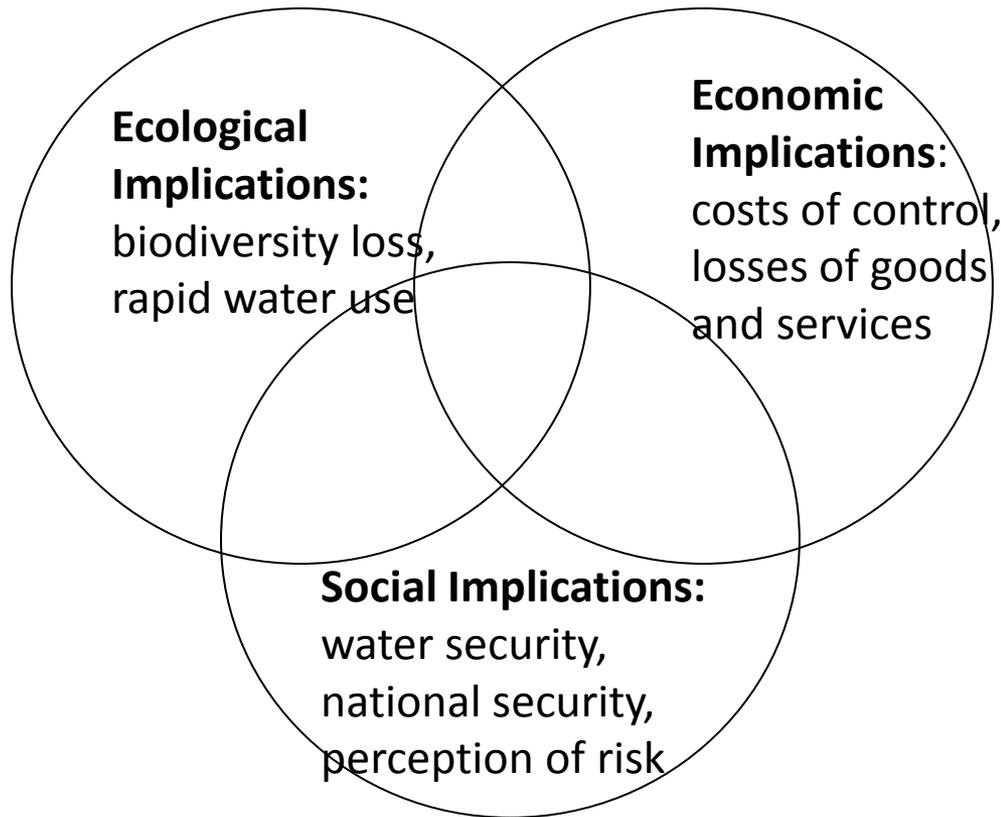
KEY IMPACTS OF ARUNDO	KEY STAKEHOLDERS	RATIONALE FOR CONTROL
WATER LOSS	<ul style="list-style-type: none"> • AGRICULTURE AND OTHER WATER USERS; • MEXICO(IMTA) • IBWC 	<i>INCREASE WATER SECURITY AND QUALITY, ESPECIALLY IN LIGHT OF CLIMATE CHANGE</i>
SPECIES and HABITAT DISPLACEMENT	<ul style="list-style-type: none"> • NPS • TNC • NABA • SEMARNAT 	<i>REDUCE INVASIBILITY TO ALLOW FOR RESTORATION OF NATIVE HABITAT, REMOVAL FROM WILD & SCENIC AREAS</i>
EROSION AND IMPACTS TO WATER INFRA-STRUCTURE	<ul style="list-style-type: none"> • IBWC • NPS • WATER MANAGEMENT DISTRICTS 	<i>REDUCTION OF BIOMASS AND DENSITY</i>
NATIONAL SECURITY	<ul style="list-style-type: none"> • USBP • DHS 	<i>BORDER VISIBILITY</i>
INVASION OF PRIVATE LAND	<ul style="list-style-type: none"> • PRIVATE LANDHOLDERS, RANCHERS 	<i>RESTORE RANGELAND FOR PRODUCTION</i>

WHICH STRATEGY/MANAGEMENT OPTION WORKS BEST?



KEY IMPACTS OF ARUNDO	KEY STAKEHOLDERS	ATTITUDES TOWARDS MANAGEMENT OPTIONS
WATER LOSS	<ul style="list-style-type: none"> •AGRICULTURE AND OTHER WATER USERS; •MEXICO(IMTA) •IBWC 	<ul style="list-style-type: none"> •MOWING AND FIRE SHORT TERM CONTROL •CHEMICAL CONTROL SPOT USE; LARGE SCALE USE CONTENTIOUS •BIOLOGICAL CONTROL FEASIBLE WHEN PROPERLY VETTED AND INTEGRATED WITH RESTORATION PLANNING
SPECIES and HABITAT DISPLACEMENT	<ul style="list-style-type: none"> •NPS •TNC •NABA •SEMARNAT 	<ul style="list-style-type: none"> •MOWING COSTLY WITH HIGH IMPACTS, DIFFICULT IN RIPARIAN AREA •FIRE NOT RECOMMENDED, ESP. IN RIPARIAN AREAS/TAMAULIPAN SCRUB •CHEMICAL CONTROL UNDESIRED •BIOCONTROL A GOOD STRATEGY, ESP WHEN WITH ENRICHMENT PLANTING
EROSION AND IMPACTS TO WATER INFRA-STRUCTURE	<ul style="list-style-type: none"> •IBWC •NPS •WATER MANAGEMENT DISTRICTS 	<ul style="list-style-type: none"> •REPEATED MOWING USED FOR ACCESS, GOOD STRATEGY FOR SMALL AREAS •DEBRIS /FLOTSAM PROBLEM •FIRE NOT EFFECTIVE •CHEMICAL NOT EFFECTIVE •BIOLOGICAL CONTROL MAY BE USEFUL
NATIONAL SECURITY	<ul style="list-style-type: none"> •USBP •DHS 	<ul style="list-style-type: none"> •MOWING/MECHANICAL PROVIDES BEST SHORT TERM RESULTS, BUT COSTLY •CHEMICAL USE CONTENTIOUS •FIRE NOT RECOMMENDED •BIOLOGICAL CONTROL BEST LONG TERM STRATEGY
INVASION OF PRIVATE LAND	<ul style="list-style-type: none"> •PRIVATE LANDHOLDERS, RANCHERS 	<ul style="list-style-type: none"> •“MOWING DON’T DO JACK AND FIRE DON’T DO SQUAT” •FIRES SEEM TO BE COMMON IN PRIVATE LANDS •REMOVAL STRATEGIES THAT CAN OPEN LAND FOR PRODUCTIVE USE •RECEPTIVE TO BIOLOGICAL CONTROL, WILLING TO TRY ANYTHING





- Clues for appropriate management approach comes at the confluence of ecological, economic and social implications
- Whole systems approach to invasive species management reveals the tradeoffs and usefulness of each management option

We must be able to protect the goods and services ecosystems provide, and that requires knowing what they mean to us--including the value of whole ecosystems.



Restoration of riparian ecosystems in the
Southwestern U.S., through biological control of the
pyrogenic invader *Arundo donax*.

Alex Racelis John A. Goolsby, Patrick Moran
USDA-ARS, Beneficial Insects Research Unit
Weslaco, TX, USA