RISING THREATS FROM *ARUNDO DONAX:* AUSTRALIAN CONTRIBUTION TO A SUCCESSFUL US PROJECT

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- AN OPPORTUNITY FOR 'PRE-EMPTIVE' BIOLOGICAL CONTROL

OF *ARUNDO*

IN AUSTRALIA

***Arundo donax* edging an irrigation Canal, Weslaco Texas**

CSIRO

Queensland Government

USDA

ARUNDO DONAX IN ITS NATIVE MEDITERRANEAN RANGE

Spain: open wetland plants or riparian clumps on waterways & embankments

ARUNDO DONAX: AN INVASIVE PERENNIAL GRASS IN USA

- Common names: Giant Reed, Carrizo Cane
- Scientific name: *Arundo donax* (L.) Asch. & Graebn.
- Origin: Mediterranean Region (Spain, France, Italy etc.)
- Riparian invader spread vegetatively via rhizomes
- Invasive in USA, Mexico, South Africa, South Pacific Islands & Australia (e.g. Clarence River, NSW; Brisbane River, Qld)

IMPACTS OF *ARUNDO* IN USA

- Increased water loss from evaporation (2000 l. / sq. m.)
- Blocks right-aways and drains
- Highly flammable: increases fuel loads & intensities of wildfires
- Displaces riparian biodiversity: a major threatening process in National Parks
- Increased waterways maintenance costs

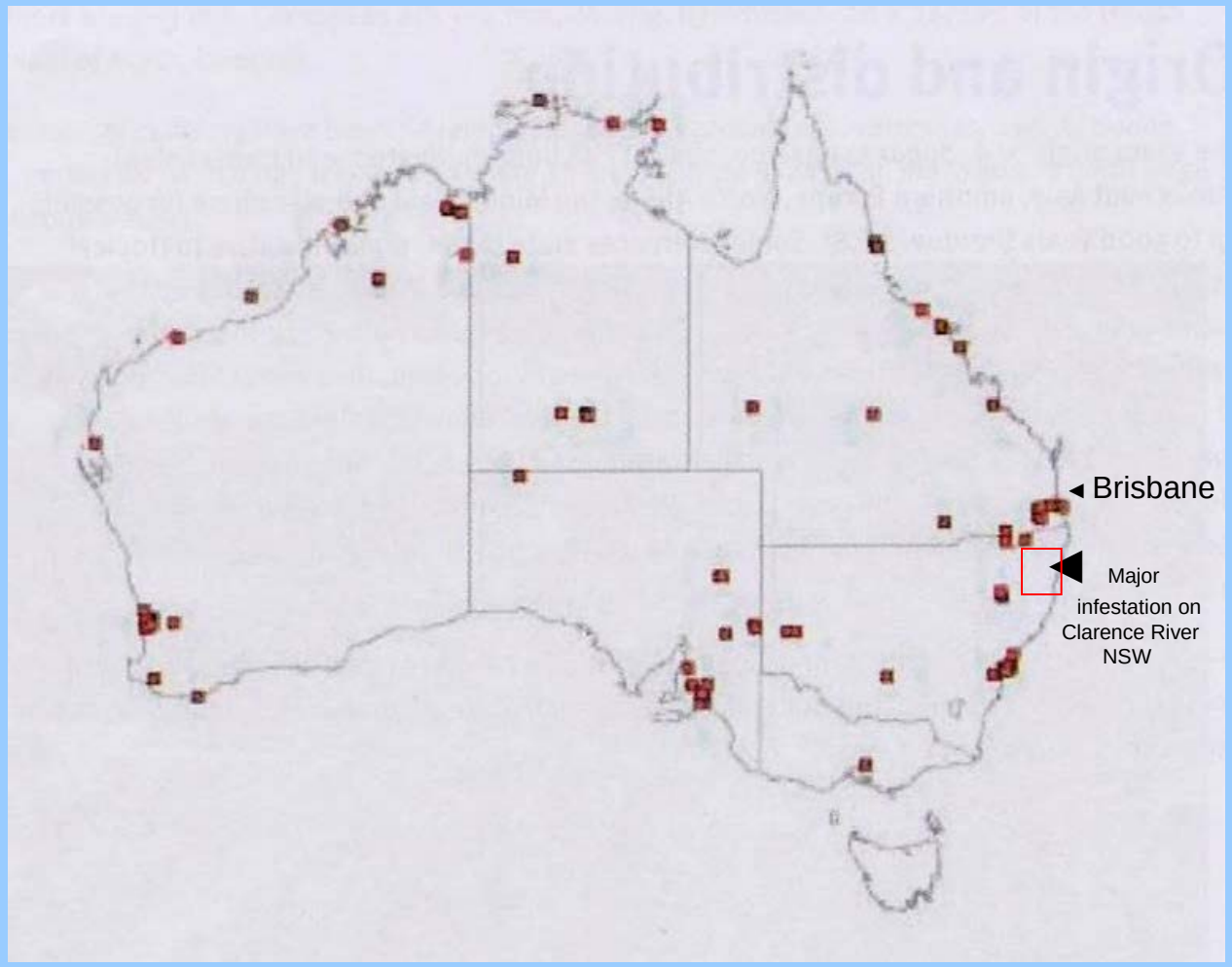
Dead leaves following leafminer attack

WEED STATUS IN AUSTRALIA - DECLARED WEED IN NEW SOUTH WALES (NOXIOUS WEEDS ACT 1993)

YARRAMAN, UPPER BRISBANE RIVER
Sue Riley

- Produces dense impenetrable riparian thickets
- Displaces indigenous vegetation
- Causes embankment collapse, erosion
- Formed damaging floating islands during 2012 flood in Brisbane River

DISTRIBUTION* OF *ARUNDO DONAX* IN AUSTRALIA



* Australian Virtual Herbarium, Csurhes, S. 2009. Weed Risk Assessment. Qld Govt.

ARUNDO ON THE CLARENCE RIVER NEW SOUTH WALES

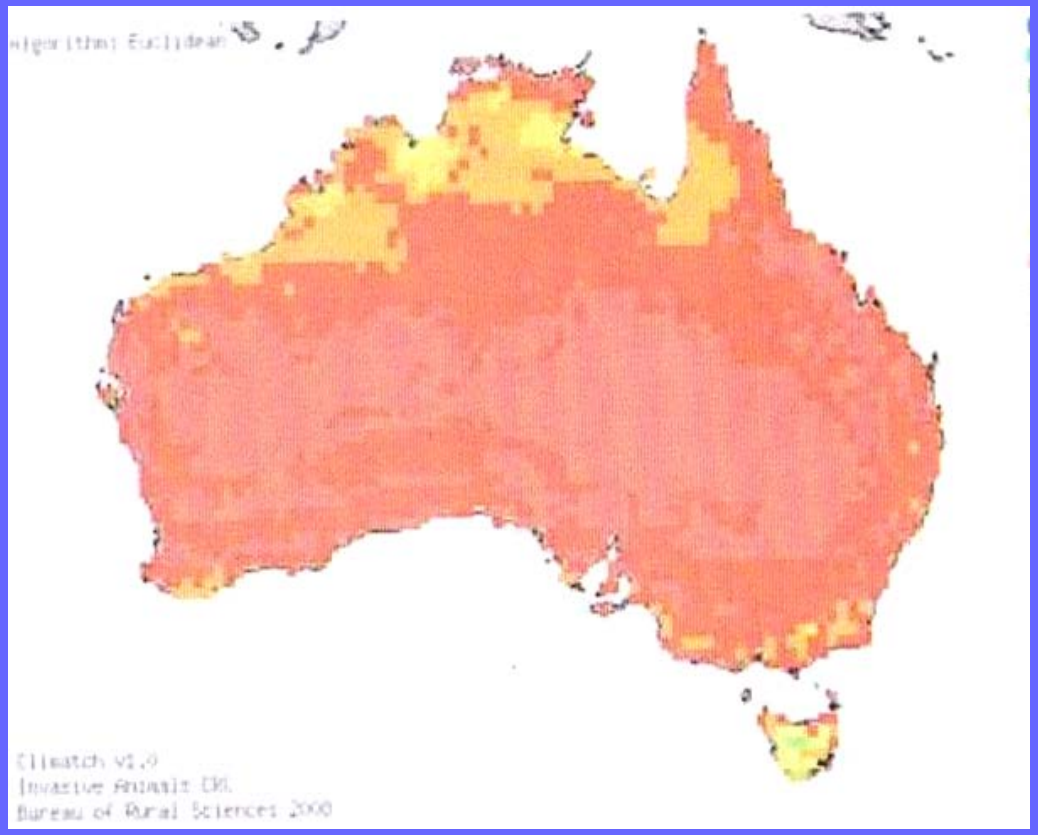
TYNDALE, CLARENCE RIVER NEW SOUTH WALES

SHARK CREEK, CLARENCE RIVER NEW SOUTH WALES

TYNDALE, CLARENCE RIVER
NEW SOUTH WALES

PREDICTED* DISTRIBUTION OF *ARUNDO DONAX* IN AUSTRALIA

Invasive potential in Australia



Green: unsuitable regions

Yellow / orange: marginally suitable

Red: highly suitable

* From Martin Hannan-Jones &
Csurhes, S. 2009. Weed Risk Assessment. Qld Govt.

SOME USES (Australia *)

- Ornamental for gardens including: vars. *variegata, versicolor, macrophylla*
- Waste water treatment
- Windbreaks, mostly for crops with high water-tables
- Woodwind instruments
- Biofuel – ***see next slide***

DETRIMENTAL EFFECTS

- Develops dense mono-stands & impenetrable riparian thickets
- Invades sugar cane farms
- Displaces indigenous ecosystems & threatens biodiversity
- Causes embankments to collapse
- Forms massive floating islands broken free after flooding
- Alternative host for beet virus, sugar cane mosaic virus, maze dwarf mosaic virus (in USA)

Giant reed, a fuel for super hot, giant fires

Proposals to plant giant reeed (*Arundo donax*) as a biofuel in Australia combine two of ISC's major concerns in recent years – hot-burning invasive grasses and weedy biofuels.

Gamba grass (*Andropogon gayanus*) and other large invasive grasses produce very hot fires when they burn, often killing shrubs and trees, and facilitating further invasion of the grasses via a fire-driven cycle of invasion. In recent reports about climate change and fire (see Bradstock 2010 and Williams et al. 2009), the potential of these grasses to increase fire risk has received much emphasis.

Weedy biofuels have the potential to invade vast areas because enormous plantings will be needed to make any dent in greenhouse gas emissions. The two crops concerning us most have been giant reed and jatropha (*Jatropha curcas*) (see ISC's report on weedy biofuels by Low and Booth 2007).

Giant reed is a much larger grass than gamba grass, and we have been aware of it fuelling very large fires in California, a problem that has now been properly documented. In a recent article in Biological Invasions, Gretchen Coffman and two colleagues at the University of California assessed its success following fire.

After a 2003 wildfire burned through riparian woodlands along the Santa Clara River, Coffman and colleagues found that recovering giant reed grew 3-4 times faster than native woody plants, reaching 2.5 metres height within three months of the fire.

'One year post-fire, *A. donax* density was nearly 20 times higher and productivity was 14–24 times higher than for native woody species,' they reported.

Giant reed resprouted much faster than native plants, making good use of the nutrients released by ash. A year after the fire it made up 99% of the post-fire vegetation.

Giant reed is valued as a biofuel because it grows so fast – as much as 10cm in a day – which also explains its success as a weed. The finding that it is a fire-exploiting grass provides another reason not to grow it.

In 2009 the South Australian government ended trials of giant reed after a series of complaints from ISC (see *Feral Herald* 24), but interest has emerged from other quarters.

In January 2010, Norwegian company ENEnergy was reported on ABC News to be proposing to plant more than 300,000 hectares of giant reed in northern Australia. The company's website lists three field development projects underway or in planning in Australia.

Australia has the most flammable vegetation in the world, and the most to fear from an increased fire risk under climate change. But climate change has become a justification to grow a flammable grass, when it should be an additional reason to ban it. Giant reed is on the IUCN list of '100 of the World's Worst Invasive Alien Species'.

Giant reed, proposed as a biofuel in Australia, has been fuelling very large fires in California. Photo: John Sullivan, http://www.flickr.com/photos/mollivan_jon/

References

Coffman, G.C, Ambrose, R.F. and Rundel, P.W. (2010) Wildfire promotes dominance of invasive giant reed (Arundo donax) in riparian ecosystems. Biol Invasions (2010) 12:2723–2734

Bradstock RA. 2010. A Biogeographic Model of Fire Regimes in Australia: Current and Future Implications. Global Ecology and Biogeography 19(2): 145-158.

Low T and Booth C. 2007: The Weedy Truth About Biofuels. Melbourne, Invasive Species Council.

Williams R, Bradstock R, Cary G, Enright N, Gill A, Liedloff A, Lucas C, Whelan R, Andersen A, Bowman D, Clarke P, Cook G, Hennessy K and York A. 2009. Interactions between Climate Change, Fire Regimes and Biodiversity in Australia - a Preliminary Assessment. Department of Climate Change and Department of the Environment, Water, Heritage and the Arts.

Feral Herald
25, Sept. 2010

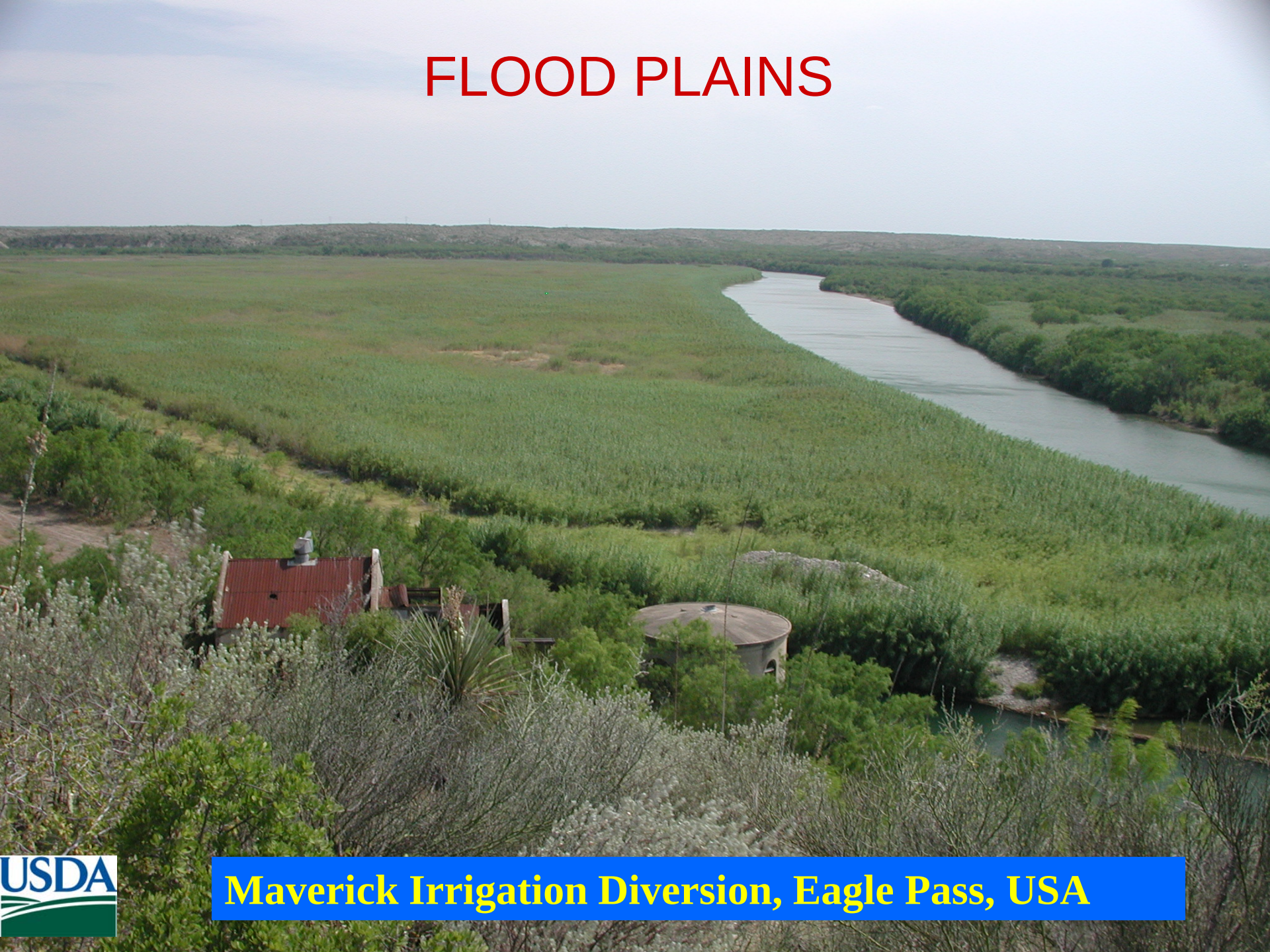
US: FLOATING MASSES CAUSE DAMAGE TO INFRASTRUCTURES

WETLANDS

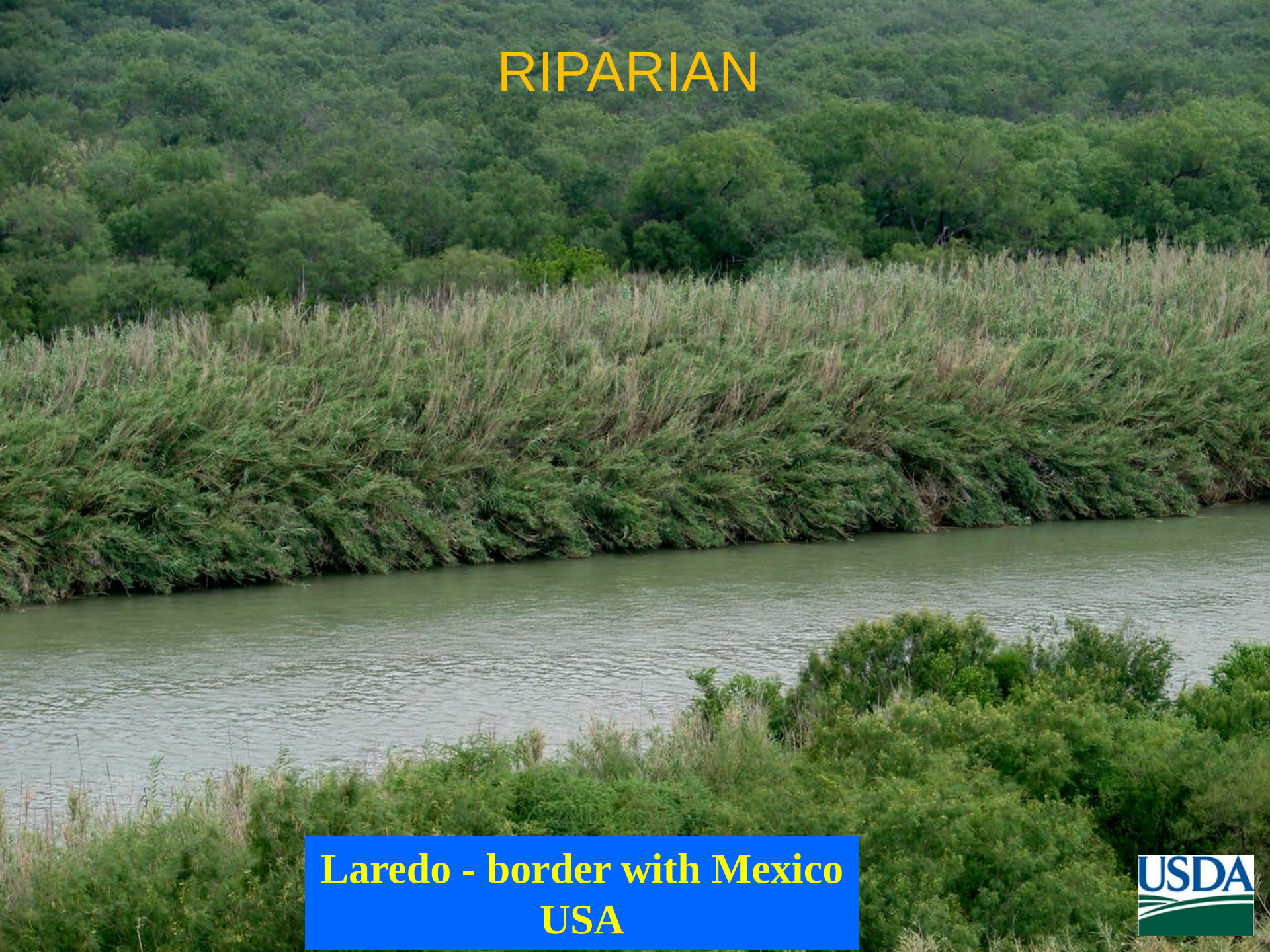
- Floating island biomasses collapse into rivers & damage bridges
- Promotes streambank erosion
- Provides habitats for cattle tick & cattle fever
- Impedes law enforcement on the USA / Mexico border

South of Eagle Pass USA

FLOOD PLAINS



Maverick Irrigation Diversion, Eagle Pass, USA


RIPARIAN
Laredo - border with Mexico
USA

MEDITERRANEAN BIOLOGICAL CONTROL AGENTS OF *ARUNDO DONAX* EVALUATED FOR IMPORTATION INTO THE USA

- Gall-forming wasp (*Tetramesa romana*)
- Diaspid scale insect (*Rhizaspidiotus donacis*)
- Leaf-sheath miner dipteran (*Lasioptera donacus)* + symbiotic fungus

* Exploration by USDA for agents for *Arundo* began in the indigenous range in the wetlands of France and Spain.

PROMISING EUROPEAN AGENTS

Arundo wasp

Tetramesa romana
(Eurytomidae)
larvae feed in stems & side shoots forming galls

Released April 29, 2009

MAJOR WIDESPREAD IMPACTS

Arundo scale

Rhizaspidiotus donacis
(Diaspididae)
Females feed on rhizomes and side shoots, males On leaves

Released Dec. 17, 2010

EARLY LOCAL IMPACT

Arundo leafminer

Lasioptera donacis
(Ceccidomyidae)
Larvae are leaf sheath miners - cause defoliation

Not yet released

OVERCOMING PROBLEMS WITH CULTURES AND HOST RANGE TESTING

- **Gall-forming wasp**: failed to reproduce in white cages
- **Diaspid scale**: healthy scales difficult to separate from parasitised scales or those with predatory mites
- **Leaf-sheath dipteran**: difficult to culture on plants; identification needed for its symbiotic fungus

IN AUSTRALIA - SINGLE COCCIDS & DIASPIDS REMOVED FROM PLANTS REPRODUCED IN GELATINE CAPSULES

Ceroplastes rubens

Ceroplastes destructor

Single gravid scales are transferred to capsules

Gelatine capsule + scale pinned to test plant.

↑ Cap removed when crawlers emerge

IN US - INDIVIDUAL ARUNDO SCALES REPRODUCED IN GELATIN CAPSULES

Capsules

- enable separation of predators (esp. mites) & parasitised scales from crawlers
- Provide newly-hatched crawlers for infesting test plants
- Can be pinned to plant tissues with scales producing crawlers inside for host acceptance/ host range tests
- Enabled estimates of crawlers per scale & per test

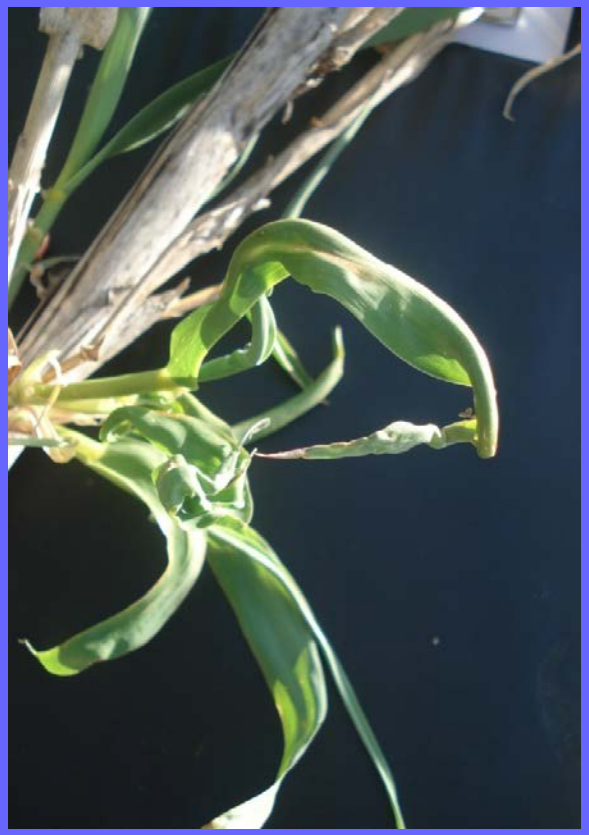
Capsules used in quarantine lab. studies of biology and no-choice host range tests

P. Moran, USDA

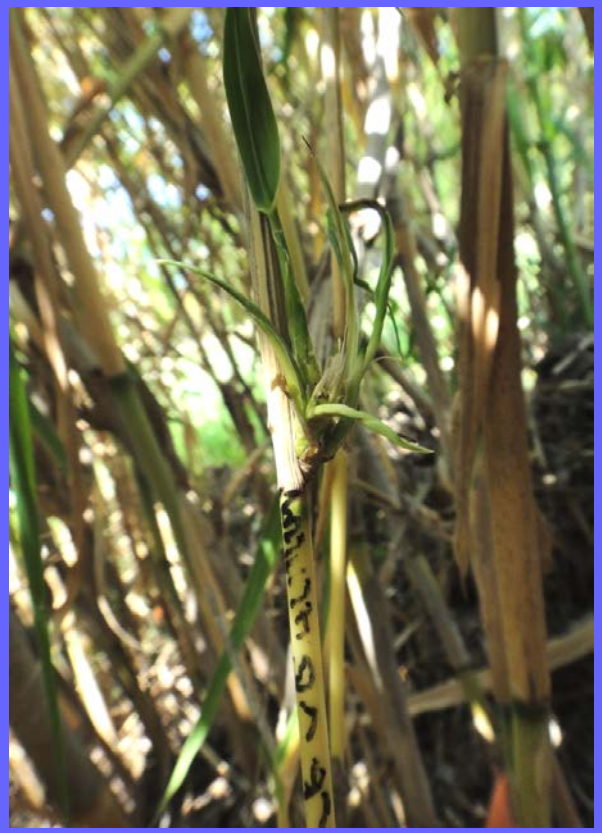
DAMAGE TO *ARUNDO* BY SCALE

In native range:
Ceret, France

In quarantine: Texas



After release:
Del Rio, Texas



SCALES CAUSE DISTORTION & DEATH OF NODES AND SHOOTS

IN AUSTRALIA - BLACK CAGES HELPED OVERCOME REARING PROBLEMS

White or coloured cages can disrupt:

- Mating & finding mating sites
- Host recognition in parasitic insects
- Plant host recognition in phytophagous insects
- Habitat-substrate searching behaviour

Black used to overcome above problems:

- Gall-forming & scale parasitoids (Hymenoptera)
- Pentatomid parasitoids (Diptera)
- Stem boring moths (Ceccidae)

IN US BLACK CAGES INDUCED NORMAL *ARUNDO* WASP BEHAVIOUR

The *Tetramesa* wasp in greenhouses with *Arundo*.
Black cages promoted mating and oviposition

THIRD AGENT: LEAF-SHEATH MINING DIPTERAN (*LASIOPTERA DONACUS*)

Damage to potted *Arundo* plant ►

Larva in sheath ▼

SUMMARY

A diaspid scale & a gall-forming wasp from Europe are showing promise as agents for *Arundo donax* in the US

An opportunity for 'pre-emptive' biological control of *Arundo donax* in Australia

- **US are investigating prospects for biological control of several African grasses – some invasive in Australia**
- **Should a range of invasive grasses be targeted for biological control projects? (current Victorian program on Chilean Needle Grass)**
- **Should conflicts of interest (e.g. values as pastures) be carefully assessed to identify benefits of biological control of many other invasive in Australia?**

OTHER INVASIVE & FLAMMABLE GRASSES - SUITABLE TARGETS FOR BIOCONTROL IN AUSTRALIA

Flammability

- Gamba grass (*Adropogon gayanus)* ++++

Indigenous understory displaced – northern rangelands; NT and N. Qld

- Buffel grass (*Cenchrus ciliatus)* +++

Indigenous grasses displaced – inland rangelands; NSW, Qld, NT & WA

- Love grass (*Eragrostis curvula)* ++

Pastures displaced – central-southern rangelands; Vic, NSW, Qld

- Panic, Guinea grass (*Panicum maximum)* +++

Indigenous understory displaced – east coast grasslands & woodlands; Qld, NT

- Signal grass (*Brachiaria decumbens)* ++

Understory displaced – east coast slopes & hilltops; coastal N. NSW & S. Qld

- Molasses grass (*Melinis minutiflora)* ++++

Understory displaced - east coast slopes , woodlands; N. NSW & S. Qld