Section 1 - Bureau of Records Completes

Docket No. 060387-EQ Date Docketed: 05/11/2006 Title: Request for approval of contract with a qualifying facility for purchase of firm capacity and energy between Florida Power Corporation d/b/a Progress Energy Florida, Inc. and Florida Biomass Energy Group, L.L.C.

Company: Progress Energy Florida, Inc.

Official Filing Date: _____ Expiration: _____

Last Day to Suspend: _____

Referred to: ("()" indicates OPR)	CCA	CMP	(ECR)	GCL	PIF	RCA	SCR	SGA	
			X	X					

Section 2 - OPR Completes and returns to CCA in 10 workdays.

Program Module A13(a)

Staff Assignments

OPR Staff

Staff Counsel

OCRs

Recommended assignments for hearing and/or deciding this case:

Full Commission ___ Commission Panel ___
Hearing Examiner ___ Staff ___

Date filed with CCA: _____

Initials OPR _____
Staff Counsel _____

Time Schedule

WARNING: THIS SCHEDULE IS AN INTERNAL PLANNING DOCUMENT IT IS TENTATIVE AND SUBJECT TO REVISION. FOR UPDATES CONTACT THE RECORDS SECTION: (850) 413-6770

[0] Current CASR revision level

		Due Dates Previous	Current
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Section 3 - Chairman Completes Assignments are as follows:

- Hearing Officer(s)

Commissioners						Hrg Exam	Staff
ALL	ED	DS	AR	CT	TW		

Prehearing Officer

Commissioners					ADM
ED	DS	AR	CT	TW	

Where panels are assigned the senior Commissioner is Panel Chairman: the identical panel decides the case.
Where one Commissioner, a Hearing Examiner or a Staff Member is assigned the full Commission decides the case.

Approved: _____
Date: _____

DOCUMENT NUMBER-DATE
11821 DEC 28 06
FPSC-COMMISSION CLERK

PSC/CCA015-C (Rev. 01/03) * COMPLETED EVENTS

Case Assignment and Scheduling Record

Section 1 - Bureau of Records Complete

Docket No. 060387-EQ Date Docketed: 05/11/2006 Title: Request for approval of contract with a qualifying facility for purchase of firm capacity and energy between Florida Power Corporation d/b/a Progress Energy Florida, Inc. and Florida Biomass Energy Group, L.L.C.

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			X	X					

Section 2 - OPR Completes and returns to CCA in 10 workdays.

Program Module A13(a)

Staff Assignments

OPR Staff: J Sickel, M Haff, B Windham

Staff Counsel: M Brown

OCRs:

Recommended assignments for hearing and/or deciding this case:

Full Commission X Commission Panel __
Hearing Examiner __ Staff __

Date filed with CCA: 05/18/2006

Initials OPR _____
Staff Counsel _____

Time Schedule

WARNING: THIS SCHEDULE IS AN INTERNAL PLANNING DOCUMENT IT IS TENTATIVE AND SUBJECT TO REVISION. FOR UPDATES CONTACT THE RECORDS SECTION: (850) 413-6770

[0] Current CASR revision level

		Due Dates Previous	Current
1.	Petition Filed	NONE	06/09/2006
2.	Staff Recommendation	NONE	08/03/2006
3.	Agenda	NONE	08/15/2006
4.	PAA Order	NONE	09/05/2006
5.	Consummating Order if No Protest	NONE	09/29/2006
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- Hearing Officer(s)

Commissioners						Hrg Exam	Staff
ALL	ED	DS	AR	CT	TW		
X							

Prehearing Officer

Commissioners					ADM
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Approved: ED/RMS
Date: 05/18/2006

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Company: Progress Energy Florida, Inc.

Official Filing Date: _____ Expiration: _____

Last Day to Suspend: _____

Referred to: ("()" indicates OPR)	CCA	CMP	(ECR)	GCL	PIF	RCA	SCR	SGA	
			X	X					

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Program Module A13(a)

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OPR Staff: J Sickel, M Haff, B Windham

Staff Counsel: M Brown

OCRs:

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Full Commission X Commission Panel __
Hearing Examiner __ Staff __

Date filed with CCA: 05/18/2006

Initials OPR _____
Staff Counsel _____

Time Schedule

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[0] Current CASR revision level

		Due Dates Previous	Current
1.	Revised CASR Due	NONE	10/10/2006
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Commissioners						Hrg Exam	Staff
ALL	ED	DS	AR	CT	TW		
X							

Prehearing Officer

Commissioners					ADM
ED	DS	AR	CT	TW	
	X				

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Where one Commissioner, a Hearing Examiner or a Staff Member is assigned the full Commission decides the case.

Approved: ED [signature]
Date: 05/18/2006

State of Florida

Public Service Commission

CAPITAL CIRCLE OFFICE CENTER • 2540 SHUMARD OAK BOULEVARD
TALLAHASSEE, FLORIDA 32399-0850

-M-E-M-O-R-A-N-D-U-M-

DATE: 5.11.06

TO: John Burnett

FROM: Timolyn Henry, Staff Assistant, Division of the Commission Clerk & Administrative Services

RE: **Acknowledgment of Receipt of Confidential Filing**

DN 04150-06

This will acknowledge receipt of a **CONFIDENTIAL DOCUMENT** filed in Docket No. NCL 060387-EQ or (if filed in an undocketed matter) concerning OF contract, and filed on behalf of Progress Energy / Burnett. The document will be maintained in locked storage.

Any questions regarding this matter should be directed to Kay Flynn at (850) 413-6770.

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PSC/CCA019-C(Rev 12/05)

DOCUMENT NO

11821-06

STATE OF FLORIDA

DIVISION OF THE COMMISSION CLERK &
ADMINISTRATIVE SERVICES
BLANCA S. BAYÓ
DIRECTOR
(850) 413-6770 (CLERK)
(850) 413-6330 (ADMIN)

Public Service Commission

May 17, 2006

John T. Burnett
Progress Energy Florida, Inc.
P.O. Box 14042
St. Petersburg, Florida 33733-4042

Re: Docket No. 060387-EQ

Dear Mr. Burnett:

This will acknowledge receipt of a request for approval of contract with a qualifying facility for purchase of firm capacity and energy between Florida Power Corporation d/b/a Progress Energy Florida, Inc. and Florida Biomass Energy Group, L.L.C., which was filed in this office on May 11th, 2006, and assigned the above-referenced docket number. Appropriate staff members will be advised.

Mediation may be available to resolve any dispute in this docket. If mediation is conducted, it does not affect a substantially interested person's right to an administrative hearing. For more information, contact the Office of General Counsel at (850) 413-6248 or FAX (850) 413-7180.

Bureau of Records

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State of Florida

Public Service Commission

CAPITAL CIRCLE OFFICE CENTER • 2540 SHUMARD OAK BOULEVARD
TALLAHASSEE, FLORIDA 32399-0850

-M-E-M-O-R-A-N-D-U-M-

DATE: 5/25/06

TO: BURNETT / PEF

FROM: Timolyn Henry, Staff Assistant, Division of the Commission Clerk & Administrative Services

RE: **Acknowledgment of Receipt of Confidential Filing**

04562-06

This will acknowledge receipt of a **CONFIDENTIAL DOCUMENT** filed in Docket No. 060387-EQ or (if filed in an undocketed matter) concerning Exh A - Petition, and filed on behalf of PEF. The document will be maintained in locked storage.

Any questions regarding this matter should be directed to Kay Flynn at (850) 413-6770.

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PSC/CCA019-C(Rev 12/05)

State of Florida

Public Service Commission

CAPITAL CIRCLE OFFICE CENTER • 2540 SHUMARD OAK BOULEVARD
TALLAHASSEE, FLORIDA 32399-0850

-M-E-M-O-R-A-N-D-U-M-

DATE: 5.31.06

TO: John T. Burnett

FROM: Timolyn Henry, Staff Assistant, Division of the Commission Clerk & Administrative Services

RE: **Acknowledgment of Receipt of Confidential Filing**

04704-06

This will acknowledge receipt of a **CONFIDENTIAL DOCUMENT** filed in Docket No. 060387-EQ or (if filed in an undocketed matter) concerning Comp. exh. A, and filed on behalf of Progress / Burnett. The document will be maintained in locked storage.

Any questions regarding this matter should be directed to Kay Flynn at (850) 413-6770.

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PSC/CCA019-C(Rev 12/05)

State of Florida

Public Service Commission

CAPITAL CIRCLE OFFICE CENTER • 2540 SHUMARD OAK BOULEVARD
TALLAHASSEE, FLORIDA 32399-0850

-M-E-M-O-R-A-N-D-U-M-

DATE: 5.31.06

TO: Robert Wright

FROM: Timolyn Henry, Staff Assistant, Division of the Commission Clerk & Administrative Services

RE: **Acknowledgment of Receipt of Confidential Filing**

04741-06

This will acknowledge receipt of a **CONFIDENTIAL DOCUMENT** filed in Docket No. 060397-EI or (if filed in an undocketed matter) concerning purchase power agreement, and filed on behalf of BioMass/Wright. The document will be maintained in locked storage.

Any questions regarding this matter should be directed to Kay Flynn at (850) 413-6770.

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State of Florida

Public Service Commission

CAPITAL CIRCLE OFFICE CENTER • 2540 SHUMARD OAK BOULEVARD
TALLAHASSEE, FLORIDA 32399-0850

-M-E-M-O-R-A-N-D-U-M-

DATE: 6/15/06

TO: BURNETT / PEF

FROM: Timolyn Henry, Staff Assistant, Division of the Commission Clerk & Administrative Services

RE: **Acknowledgment of Receipt of Confidential Filing**

05217-06

This will acknowledge receipt of a **CONFIDENTIAL DOCUMENT** filed in Docket No. 060387-EQ or (if filed in an undocketed matter) concerning PETITION, and filed on behalf of PEF. The document will be maintained in locked storage.

Any questions regarding this matter should be directed to Kay Flynn at (850) 413-6770.

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Kay Flynn

060387

From: Donna Jones
Sent: Friday, August 11, 2006 3:59 PM
To: Commissioners & Staffs; All PSC Employees
Subject: Items of Interest at Upcoming Agenda Conference 8/15/06

A news release was distributed to the daily newspapers this afternoon, 8/11/06, and is now available on the PSC web site:

http://www.psc.state.fl.us/home/news/index.aspx?id=147

State of Florida

Public Service Commission

NEWS RELEASE

8/11/2006 **Contact: 850-413-6482**

Items of Interest at Upcoming Agenda Conference 8/15/06

TALLAHASSEE — The following items are among those scheduled for consideration by the Commission at the August 15, 2006, Agenda Conference:

ITEM 7: DOCKET NO. 060415-GU – PETITION FOR MODIFICATION OF ENERGY CONSERVATION PLAN OF FLORIDA PUBLIC UTILITIES, INC., REGARDING FULL HOUSE RESIDENTIAL NEW CONSTRUCTION PROGRAM, RESIDENTIAL APPLIANCE REPLACEMENT PROGRAM AND RESIDENTIAL APPLIANCE RETENTION PROGRAM. The Commission will consider a staff recommendation addressing proposed changes to three of Florida Public Utilities, Inc.'s energy conservation programs.

ITEM 10: DOCKET NO. 060499-TL – IMPLEMENTATION FOR STATUTORY OPTION FOR PRICE REGULATED LOCAL EXCHANGE TELECOMMUNICATIONS COMPANIES TO PUBLISH RATES, TERMS, AND CONDITIONS FOR NONBASIC SERVICES PURSUANT TO SECTION 364.051(5)(a), F.S. The Commission will consider a staff recommendation addressing whether to establish guidelines for both web-based and paper publication of rates, terms, and conditions for nonbasic services.

ITEM 13: DOCKET NO. 060362-EI – PETITION TO RECOVER NATURAL GAS STORAGE PROJECT COSTS THROUGH FUEL COST RECOVERY CLAUSE BY FLORIDA POWER & LIGHT COMPANY. The Commission will consider a staff recommendation regarding Florida Power and Light's request to recover costs associated with its participation in the subsurface natural gas storage facility, MoBay Gas Storage Hub, located in Mobile County, Alabama, through the fuel cost recovery clause.

ITEM 15: DOCKET NO. 060408-EI – PETITION FOR APPROVAL OF REVISIONS TO DEMAND-SIDE MANAGEMENT PLAN BY FLORIDA POWER & LIGHT COMPANY. The Commission will consider a staff recommendation concerning Florida Power and Light's request for approval of two new and seven revised Demand-Side Management (DSM) programs .

ITEM 16: DOCKET NO. 060387-EQ – REQUEST FOR APPROVAL OF CONTRACT WITH A QUALIFYING FACILITY FOR PURCHASE OF FIRM CAPACITY AND ENERGY BETWEEN FLORIDA POWER CORPORATION D/B/A PROGRESS ENERGY FLORIDA, INC. AND FLORIDA BIOMASS ENERGY GROUP, L.L.C. The Commission will consider a Progress Energy Florida request for approval of a negotiated qualifying facility contract for 116 MWs of capacity and energy from Florida Biomass' proposed "e-grass" project, to grow, gasify, and burn in a combustion turbine the biomass from e-grass grown on site.

###

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ENERGY WATER INFORMATION GOVERNMENT

11401 Lamar Avenue
Overland Park, Kansas 66211 USA

Tel: (913) 458-2000

Black & Veatch Corporation

Ms. Hong Wang
Florida Public Service Commission
Bureau of Records
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850
(850) 413-7118

Dear Ms. Wang;

I would like to be placed on the interested party mailing list for the following Docket Numbers:

060387-EQ Request for approval of contract with a qualifying facility for purchase of firm capacity and energy between Florida Power Corporation d/b/a Progress Energy Florida, Inc. and Florida Biomass Energy Group, L.L.C.

My mailing address is:

Myron Rollins
Black & Veatch
11401 Lamar Avenue
Overland Park, KS 66211
(913) 458-7432

Very truly yours,

BLACK & VEATCH CORPORATION

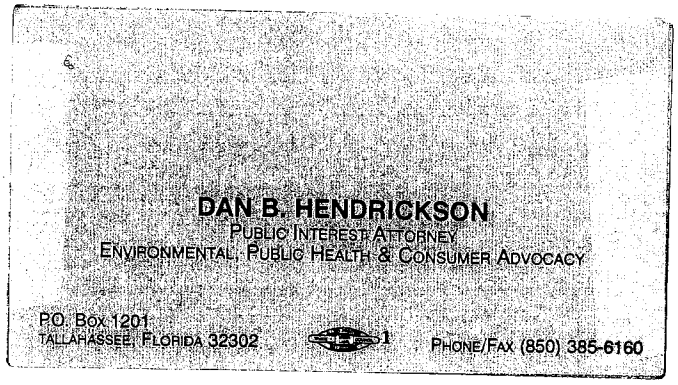
Myron Rollins

MRR/sll

Done 06/07/06 kmp OK

53 pgs.

Handout by
Dan Hendrickson
for Sierra Club
Docket 060387-EQ
Item 16, 8/15/06
Comm. Conference



FACT SHEET: GIANT REED

Giant Reed

Arundo donax L.
Grass family (Poaceae)

NATIVE RANGE

India

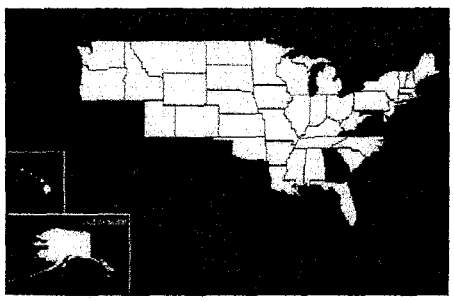
DESCRIPTION

Giant reed, also known as wild cane, is a tall, perennial grass that can grow to over 20 feet in height. Its fleshy, creeping rootstocks form compact masses from which tough, fibrous roots emerge that penetrate deeply into the soil. Leaves are elongate, 1-2 inches wide and a foot long. The flowers are borne in 2-foot long, dense, plume-like panicles during August and September.

ECOLOGICAL THREAT

Giant reed chokes riversides and stream channels, crowds out native plants, interferes with flood control, increases fire potential, and reduces habitat for wildlife, including the Least Bell's vireo, a federally endangered bird. The long, fibrous, interconnecting root mats of giant reed form a framework for debris dams behind bridges, culverts, and other structures that lead to damage. It ignites easily and can create intense fires.

Giant reed can float miles downstream where root and stem fragments may take root and initiate new infestations. Due to its rapid growth rate and vegetative reproduction, it is able to quickly invade new areas and form pure stands at the expense of other species. Once established, giant reed has the ability to outcompete and completely suppress native vegetation.



DISTRIBUTION IN THE UNITED STATES

Giant reed is distributed from Arkansas and Texas to California, where it is found throughout the state, and in the east, from Virginia to Kentucky and Missouri and generally southward.

HABITAT IN THE UNITED STATES

Giant reed becomes established in moist places such as ditches, streams, and riverbanks, growing best in well drained soils where abundant moisture is available. It tolerates a wide variety of conditions, including high salinity, and can flourish in many soil types from heavy clays to loose sands.

BACKGROUND

Giant reed was probably first introduced into the United States at Los Angeles, California in the early 1800's. Since then, it has become widely dispersed into all of the subtropical and warm temperate areas of the world, mostly through intentional human introductions. Today, giant reed is widely planted throughout the warmer areas of the United States as an ornamental and in the Southwest, where it is used along ditches for erosion control.

Giant reed has a variety of uses ranging from music to medicine. Primitive pipe organs were made from it and the reeds for woodwind instruments are still made from its culms, for which no satisfactory substitutes are known. It is also used in basketry, for fishing rods, livestock fodder, medicine, and soil erosion control.

BIOLOGY & SPREAD

Reproduction of giant reed is primarily vegetative, through rhizomes which root and sprout readily. Little is known about the importance of sexual reproduction in giant reed, or about its seed viability, dormancy, and germination, and seedling establishment. Research on these topics may yield some additional improvements in the management of giant reed.

Plant Conservation Alliance's Alien Plant Working Group
Weeds Gone Wild: Alien Plant Invaders of Natural Areas
http://www.nps.gov/plants/alien/

MANAGEMENT OPTIONS

Areas infested with giant reed are best restored through chemical means. Mechanical control (e.g., repeated mowing) may be somewhat effective, but if small fragments of root are left in the soil, they may lead to reestablishment.

Chemical

Systemic herbicides, such as glyphosate (e.g., Rodeo®), may be applied clumps of giant reed, after flowering, either as a cut stump treatment or as a foliar spray. When applying herbicides in or around water or wetlands, be sure to use products labeled for that purpose to avoid harm to aquatic organisms.

Fire

Prescribed burning, either alone or combined with herbicide applications, may be effective if conducted after flowering.

Once giant reed has been reduced sufficiently, native plants may be seeded or transplanted at the treated site.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS

For more information on the management of giant reed, please contact:

- Team Arundo del Norte; http://www.ceres.ca.gov/tadn
- Tom Dudley; tdudley at socrates.berkeley.edu

SUGGESTED ALTERNATIVE PLANTS

Native plant species that are adapted to local conditions should be used in restoration projects and as a substitute for giant reed in landscapes and erosion control practices.

OTHER LINKS

- http://www.invasive.org/search/action.cfm?q=Arundo%20donax
- http://www.hear.org/starr/hiplants/images/thumbnails/html/arundo_donax.htm

AUTHORS

Nancy Benton, The Nature Conservancy, Arlington, VA
Gary Bell, The Nature Conservancy, Santa Fe, NM
Jil M. Swearingen, National Park Service, Washington, DC

PHOTOGRAPHS

John M. Randall, The Nature Conservancy, Davis, CA
Forest & Kim Starr, US Geological Survey, HI

REFERENCES

Hoshovsky, Marc. 1996. Element Stewardship Abstract: *Arundo donax*. The Nature Conservancy, Arlington, Virginia.

Perdue, R.E. 1958. Arundo donax - source of musical reeds and industrial cellulose. Economic Botany 12(4):368-404.

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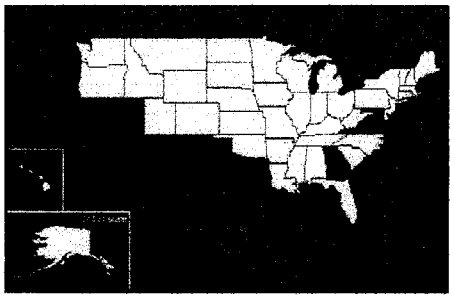

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AUTHORS

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PHOTOGRAPHS

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Tidwell, B. 1995. Native Habitat Restoration: Controlling *Arundo donax*. Monsanto Company.

Arundo donax

Giant reed
Poaceae

Forest Starr, Kim Starr, and Lloyd Loope
United States Geological Survey--Biological Resources Division
Haleakala Field Station, Maui, Hawai'i

January, 2003

OVERVIEW

Arundo donax, native to the Mediterranean region, has long been cultivated throughout the world for use in making mats, roofing material, erosion control, and as an ornamental (Neal 1965, Wagner et al. 1999). *A. donax* has become invasive in several places where it has been planted, such as California and Florida, where it invades riparian areas and over-runs native plants and riverside habitat (Bodle 1998, Dudley 1998). Large control programs have been established to control *A. donax* infestations in these areas. On Maui, *A. donax* was sparingly planted in several locations from sea level up to 3,500 ft (1,067 m) elevation. Plantings at higher and more arid climates are usually small patches that appear unhealthy, especially during dry periods. Plantings at lower elevations near sea level and closer to the water table appear healthier and generally these patches cover larger areas. In Hawai'i, plants spread vegetatively from underground rhizomes and have also spread in infested dirt moved by heavy machinery. Because of the limited distribution of *A. donax* on Maui, coupled with the evidence of its invasiveness elsewhere, the Maui Invasive Species Committee (MISC) has targeted this species for eradication. It is also being targeted for eradication on Moloka'i by the Moloka'i Invasive Species Committee (MOMISC) and on Kaua'i by the Kaua'i Invasive Species Committee (KISC).

TAXONOMY

Family: Poaceae (Grass family) (Wagner et al. 1999).
Latin name: *Arundo donax* L. (Wagner et al. 1999).
Synonyms: None.
Common names: Giant reed, Spanish reed, giant cane, giant feather-reed grass (GRIN 2001, Riffle 1998, Wagner et al. 1999).
Taxonomic notes: *Arundo* is a genus comprised of three species from Asia and the Mediterranean regions (Wagner et al. 1999).
Nomenclature: The latin name, *Arundo*, translates to the English word for cane (Wagner et al. 1999).
Related species in Hawai'i: The variety, *A. donax* var. *variegata* or *A. donax* var. *versicolor*, with leaves striped yellow or white is also cultivated in Hawai'i (Neal 1965) and elsewhere in the world (Riffle 1998, PLANTS 2001).

DESCRIPTION

"Large perennials; culms erect or arching, up to 8 m tall, unbranched or branched above, arising from thick, scaly rhizomes, nodes glabrous, usually concealed, internodes hollow,

up to 4 cm in diameter. Leaves strongly distichous, distributed rather uniformly along culm except on old stems; sheaths longer than internodes and strongly overlapping , glaucous, glabrous to sometimes sparsely long-villous at throat; ligule a thin, whitish or brownish, minutely ciliate membrane, 1-1.5 mm long; blades thick and coriaceous, 45-60 cm long, 4-6 cm wide, glabrous, glaucous, striate, margins scabrous, leaf bases broader than sheaths, with prominent, triangular, brownish flanges, ciliate along margins. Inflorescences paniculate, ovoid, 40-70 cm long, plumose, dense, the branches stiffly ascending; spikelets densely clustered along secondary or tertiary branches, 13-17 mm long, 4-5 flowered, rachilla glabrous; glumes hyaline, brownish or purplish, 11-13 mm long, narrow, acuminate, scabrous on the indistinct keel; lemmas membranous, lanceolate-ovate, 8-15 mm long, tapering to a short straight awn arising between 2 delicate lateral teeth, 3-7 nerved, usually 3 major ones anastomosing with midnerve, lower portions on dorsal surface of lemma heavily bearded with long silky whitish hairs, the hairs 8-10 mm long; palea whitish, membranous, 5-10 mm long, ca. 1/2 as long as lemma, scabrid on keels and pubescent near base between them, hyaline truncate. Caryopsis elongate, 1-1.5 mm long." (Wagner et al. 1999).

BIOLOGY & ECOLOGY

Cultivation: *A. donax* has long been associated with humans and has various uses and cultural significance. In the Mediterranean region, the plant has been used for medicine, lattices, mats, fish poles, and for parts in instruments such as the clarinet (Neal 1965). In Egypt, the giant reed was common and can be identified from temple drawings, often representing the letter "A" (Neal 1965). *A. donax* was useful for a variety of reasons and was brought from the Mediterranean region to many parts of the world. It does well in sand and is commonly used in seacoast gardens (Greenlee 1992). Today, it is cultivated for roofing material, erosion control, windbreaks, and as an ornamental.

Invasiveness: This tall reed spreads by underground rhizomes forming dense stands in moist to wet sites. It is invasive in the United States, particularly in southern and western states such as Florida and California, where it is a problem along riparian areas and roadsides. The large amounts of vegetation interferes with flood control, displaces native plants and animals, and is a potential fire hazard. *A. donax* propagates itself through vegetative growth and is able to form dense pure stands that can out-compete other vegetation (Wells et al. 1980). Plants spread downstream in flooding events. Giant reed is capable of rapid growth and has been reported to have growth rates up to .7 m per week over a period of several months in favorable conditions (Perdue 1958). In infested areas of the United States, native plants, such as willows and cottonwoods that provide shade along rivers, are replaced by tall vertical grassy shorelines affecting water temperature, interfering with water flow, and displacing riverside habitat (Bodle 1998). In addition, once established, *A. donax* is hard to kill.

Pollination: Uncertain, probably wind pollinated.

Propagation: *A. donax* can be propagated by seeds. Though in most areas where giant reed is cultivated, viable seeds are not produced (Perdue 1958). *A. donax* is most often propagated throughout the world by planting root rhizomes which readily sprout. On

Maui, flowering *A. donax* has been observed in a few low elevation sites, including Kihei, Kahului, and Spreckelsville, though it is uncertain whether these seeds are viable or not. No seedlings have been observed to date and most spread on Maui seems to be vegetative.

Dispersal: Plants spread downstream in flooding events. Humans spread the plant in horticulture, mostly by breaking off an underground rhizome and replanting somewhere else. Machinery, such as bulldozers, can spread the plant.

Pests and Diseases: According to Brickell and Zuk (1997), rust is sometimes a problem.

DISTRIBUTION

Native range: *A. donax* is native to the Mediterranean region (Wagner et al. 1999).

Global distribution: *A. donax* is widely cultivated and now naturalized in warm temperate to tropical areas. It is apparently an ancient introduction to Europe. *A. donax* was introduced to California by the Spanish mission fathers and planted up and down the state (Greenlee 1992). It was reported as abundant in Los Angeles, California as early as 1820 (Robbins et al. 1951). It now occupies many southern states from the east to the west coast and as far north as Maryland (PLANTS 2001).

State of Hawai'i distribution: In Hawai'i, *A. donax* is cultivated and reported as naturalized in coastal areas, often in thickets, on Kaua'i, O'ahu, Maui, and Hawai'i (Wagner et al. 1999). It is also known from Moloka'i, located at Kaunakakai, from a single garden planting, and occupies about 800 sq. ft. (Tina Lau pers. comm.).

Island of Maui distribution: During baseline surveys in 2000-2001, about 20 sites of *A. donax* were observed. Of these, about half were at mid elevations up to 3,500 ft (1,067 m) in residential areas of Kula and the other half were at lower elevations near the coast in both residential areas, garden shops, beaches, and waste areas. Most of the larger naturalized sites were located at lower elevations near the coast, where the water table is closer, allowing plants to thrive. The site at the sand dunes at the end of the Kahului airport runway appears to have been moved about with heavy machinery as several patches occur within the localized area.

CONTROL METHODS

Physical control:

Manual removal: Smaller infestations can be removed manually, though is often extremely labor intense as all underground rhizomes must be removed for complete eradication (Dudley 1998). Hand pulling of younger plants, especially in looser soils after a rain, works for new seedlings less than 2 m in height. Hand pulling is also very selective and can be done when native plants are nearby. Rhizomes can be dug up using picks and shovels, making sure to remove all parts.

Mechanical removal: Larger machines can be used to remove aboveground vegetation and dig up underground rhizomes. Vegetation can be chopped or trimmed back with a

tractor. This non-selective method works well in monotypic stands of undesirable plants where there are no native plants nearby. This is often done in preparation of removal of underground rhizomes or prior to chemical treatment.

Prescribed burns: Flame throwers or weed burner devices can be used as spot treatment to heat girdle stems at the base of plants. This technique is sometimes used instead of chemical girdling as it is cheaper and can be done in wet weather (Hoshovsky 1998). Though, Dudley (1998) does not suggest burning be used as a treatment because it does not kill the underground rhizomes and probably favors giant reed over native plants.

Chemical control:
Foliar application: The most common herbicide used to treat giant reed is glyphosate, mostly in the form of Roundup or Rodeo (in wetlands). The standard treatment is a foliar spray application of 1.5% by volume glyphosate with a .5% v/v non-ionic surfactant (Monsanto 1992). Small patches can be treated using backpack or towed sprayers, and major infestations have been treated using helicopters (Dudley 1998). A common method is to cut or mow a patch to allow regeneration before foliar application is made.

Cut stump: This method reduces herbicide costs and helps to avoid drift to desirable plants. Concentrated glyphosate solution (50% to 100% Rodeo or Roundup, or 27-54% glyphosate) is applied to cut stems (within 5-10 cm) of the substrate. Treat plants immediately after cutting for efficient translocation. In California, this treatment proved more successful than the foliar method. Finn et al. (1990) report, "Foliar spray methods showed a 10 to 90 percent success rate for killing plants, compared to a 100 percent success rate for the cut-stem method."

Follow up: The importance of follow treatment is stressed by Dudley (1998) who reports that some professional applicators suggest 6 return spot treatments over 6 months.

Biological control: No biological controls have been introduced for *A. donax* and probably won't be in the future due to the commercial value of the plant (Hoshovsky 1998).

Cultural control: In parts of California, Angora and Spanish goats are being used to control *A. donax* (Daar 1983). Other animals such as sheep and even geese may be used in weed control.

Noxious weed acts: *A. donax* is listed by the California Exotic Pest Plant Council as an "A" list weed species. This is defined as, "Most Invasive Wildland Pest Plants; documented as aggressive invaders that displace natives and disrupt natural habitats."

MANAGEMENT RECOMMENDATIONS
A. donax is a nuisance in the United States and requires much time and money to control. Controlling the few sites we have here on Maui now may save time and money in the future. MISC should continue to eradicate all known locations on Maui and continue to refine control methods. Monitoring current locations and searching for new locations

should also continue. In addition, prevention of spread to vulnerable habitats such as estuaries, reservoirs, coastal areas, and streams needs to happen through public education. *A. donax* could also be placed on the state noxious weed list to discourage future use of the plant in Hawai'i. Information on distribution on other Hawaiian Islands is needed.

REFERENCES

Brickell, C. and J. D. Zuk. 1997. *The American Horticultural Society A-Z Encyclopedia of Garden Plants*. DK Publishing, Inc., NY.

Finn, M., H. Martin, and D. Minnesang. 1990. Control of giant reed grass in a southern California riparian habitat. *Restoration & Management Notes* 8(1): 53-54.

Bodle, M. 1998. *Arundo* the world in (at least) eighty ways. *Wildland Weeds* Vol. 1, Number 3.

Daar, S. 1983. Using goats for brush control. *The IPM Practioner* 5 (4): 4-6.

Dudley, T. L. 1998. Noxious Wildland Weeds of California: *Arundo donax*. In: *Noxious Wildland Weeds of California*. C. Bossard, J. Randall, and M. Hoshovsky, eds. Available: http://www.ceres.ca.gov/tadn/arundoWW.html (Accessed: May 12, 1998).

Greenlee, J. 1992. *The Encyclopedia of Ornamental Grasses*. Michael Friedman Publishing Group, Inc., NY.

GRIN (Germplasm Resources Information Network). 2001. Online Database. United States Department of Agriculture, Agricultural Research Service, National Germplasm Resources Laboratory, Beltsville, MD. Available: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?4439 (Accessed: September 12, 2001).

Hoshovsky, M. 1998. The Nature Conservancy Element Stewardship Abstract: *Arundo donax*. TNC, Arlington, Virginia.

Monsanto Corp. 1992. Native habitat restoration: controlling *Arundo donax*. Monsanto Co. Application Guide Circular No. 170-92-06.

Neal, M. C. 1965. *In Gardens of Hawai'i*. Bernice P. Bishop Museum Special Publication 40, Bishop Museum Press, Honolulu, HI.

PLANTS (National Plants Database). 2001. Online database. United States Department of Agriculture, Natural Resources Conservation Services, National Plant Data Center, Baton Rouge, LA. Available: http://plants.usda.gov (Accessed: September 12, 2001).

Perdue, R.E. 1958. *Arundo donax* - source of musical reeds and industrial cellulose. *Econ. Bot.* 12(4): 368-404.

Rezk, M.R. and T. Edany. 1979. Comparative responses of two reed species to water table levels. *Egypt. J. Bot.* 22(2): 157-172.

Riffle, R. L. 1998. *The Tropical Look.* Timber Press, Inc., Portland, OR.

Robbins, W. W., M. K. Bellue, and W. S. Ball. 1951. *Weeds of California.* Calif. Dept. of Agric., Sacramento.

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Wells, M.J., K. Duggan, and L. Henderson. 1980. Woody plant invaders of the central Transvaal. *Proc. 3rd National Weeds Conf. South Africa* 11-23.

Arundo donax

Giant reed
Poaceae

Forest Starr, Kim Starr, and Lloyd Loope
United States Geological Survey--Biological Resources Division
Haleakala Field Station, Maui, Hawai'i

January, 2003

OVERVIEW

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Dudley, T. L. 1998. Noxious Wildland Weeds of California: *Arundo donax*. In: *Noxious Wildland Weeds of California.* C. Bossard, J. Randall, and M. Hoshovsky, eds. Available: http://www.ceres.ca.gov/tadn/arundoWW.html (Accessed: May 12, 1998).

Greenlee, J. 1992. *The Encyclopedia of Ornamental Grasses.* Michael Friedman Publishing Group, Inc., NY.

GRIN (Germplasm Resources Information Network). 2001. Online Database. United States Department of Agriculture, Agricultural Research Service, National Germplasm Resources Laboratory, Beltsville, MD. Available: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?4439 (Accessed: September 12, 2001).

Hoshovsky, M. 1998. The Nature Conservancy Element Stewardship Abstract: *Arundo donax.* TNC, Arlington, Virginia.

Monsanto Corp. 1992. Native habitat restoration: controlling *Arundo donax.* Monsanto Co. Application Guide Circular No. 170-92-06.

Neal, M. C. 1965. *In Gardens of Hawai'i.* Bernice P. Bishop Museum Special Publication 40, Bishop Museum Press, Honolulu, HI.

PLANTS (National Plants Database). 2001. Online database. United States Department of Agriculture, Natural Resources Conservation Services, National Plant Data Center, Baton Rouge, LA. Available: http://plants.usda.gov (Accessed: September 12, 2001).

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Wells, M.J., K. Duggan, and L. Henderson. 1980. Woody plant invaders of the central Transvaal. *Proc. 3rd National Weeds Conf. South Africa* 11-23.

Dan Hendrickson

From: <LMcshe2001@aol.com>
To: <danbhendrickson@comcast.net>
Sent: Sunday, July 30, 2006 2:04 PM
Subject: ALERT Invasive Arundo Donax proposal 15,000 acres

To Dan Hendrickson: ALERT

Memo on arundo donax

from

December McSherry
Agriculture Chair Sierra Club, Fl Chapter
National Agriculture Committee,Sierra Club

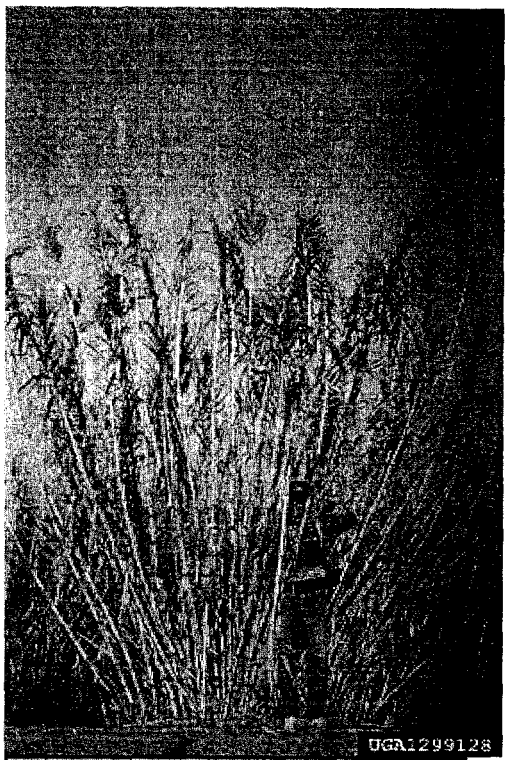
Progress Energy Company of Florida plans to build the 130-megawatt **biofuel** power plant in Florida.

The power company proposes to contract a 15,000 acre farm to plant, grow and harvest ***Arundo donax***, a nonnative invasive plant. Biomass Investment Group, Inc. is currently getting a patent on this plant and has committed to the large-scale production of arundo donax resources for Progress Energy.
http://www.egrass.com.

USDA identifies arundo donax as a nonnative invasive plant at the National Invasive Species Center and Nonnative Invasive Plants of Southern Forests

Arundo donax dramatically alters the ecological/successional processes in riparian systems and ultimately moves most riparian habitats towards pure stands of this alien grass.

Arundo donax is an agressive fierce invader of freshwater ecosystems. Bits of Arundo can break off and travel down creeks and streams san readily start new infestations.



Fish and wildlife specialists, water-district managers and other streamkeepers throughout the United States are waging a battle to control Arundo donax

http://www.ars.usda.gov/research/programs/programs.htm?np_code=304&docid=1392&page=8

There is an Arundo donax Eradication and Coordination Program, sponsored by Team Arundo del Norte (TAdN), a network of local, state and federal organizations dedicated to the eradication of Arundo donax (giant reed) where it threatens rivers, creeks, and wetlands in Central

and Northern California started in March 28 2006.

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Nonnative Invasive Plants of Southern Forests - A Field
Guide for Identification and Control Arundo donax appears
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and natural resource departments.
Invasive Species: Aquatic Species - Giant Reed (Arundo donax)
Invasive Plants of the Thirteen Southern States
UC Davis Weed Science Program - Arundo donax is a pervasive
invader of riparian sytems http://search.usda.gov/search?q=arundo+donax&btnG=Go%
21&filter=0&as_sitesearch=ars.usda.gov&ie=&output=xml_no_dtd&client=usda&lr=&proxystylesheet=ARS&oe=&t
UC trip to Katmandu Stem boring beetle larvae
http://search.usda.gov/search?q=arundo+donax&btnG=Go%
21&filter=0&as_sitesearch=ars.usda.gov&ie=&output=xml_no_dtd&client=usda&lr=&proxystylesheet=ARS&oe=&t

Arundo donax is an aggressive plant competitor. All evidence
indicates that A. donax provides neither food nor habitat for
native species of wildlife.

Flood events break up clumps of A. donax and spread the
pieces downstream. Fragmented stem nodes and rhizomes
take root and establish as new plant clones. Thus invasion
and spread of A. donax is essentially a downstream phenomenon.

Arundo donax dramatically alters the ecological/successional
processes in riparian systems and ultimately moves most riparian
habitats towards pure stands of this alien grass. The removal of
A. donax from these systems provides numerous downstream
benefits in terms of native. The greatest threat to the remaining
riparian corridors today is the invasion of exotic plant species,
primarily Arundo donax. species habitat, wildfire protection,
water quantity and water quality.

ECOLOGY AND MANAGEMENT OF ARUNDO DONAX, AND
APPROACHES TO RIPARIAN HABITAT RESTORATION IN
SOUTHERN CALIFORNIA.
Biological invasions in California wetlands and riparian zones.
Santa Margarita - San Luis Rey Weed Management Area,
Team Arundo del Norte and http://ceres.ca.gov/tadn/
We can not let an invasion of this invasive noxious giant
water-drinking reed into central Florida. The floodplain and
low lying lands are headwaters of the Everglades wetland
system. Arundo donax is a threat to the Everglades and the
restoration. It is impossible to get rid of it
http://search.yahoo.com/search?p=arundo+donax+power+plant+in+florida&sm=Yahoo%21+Search&fr=FP-tab-web-t&toggle=1&cop=&ei=UTF-8invasive
species working group august 14,2003 ; the roots go three feet deep.
organophosphorus herbicides Monsanto Rodeo C6H17N2O5P
glyphosate-isopropylammonium is used to control spread of
Arundo donax off property. 1/2 life is 174 days.
Glyphosate treatment has reduced populations of beneficial
insects, birds, and small mammals by destroying vegetation
on which they depend for food and shelter. Roundup causes genetic
damage in laboratory animals and in human blood cells.

Glyphosate exposure has been linked to reproductive problems in humans
Glyphosate has been found in both ground and surface water

Repeated applications of glyphosate reduce the growth of earthworms.

The International Organization for Biological Control found that exposure to freshly dried Roundup killed over 50 percent of three species of beneficial insects: a parasitic wasp, a lacewing, and a ladybug. Over 80 percent of a fourth species, a predatory beetle, was killed.

The toxicity of the surfactant (detergent-like ingredient) in Roundup is 20 to 70 times more toxic to fish than glyphosate itself

The first carcinogenicity study submitted to EPA (1981) found an increase in testicular tumors in male rats at the highest dose tested as well as an increase in the frequency of a thyroid cancer in females. Both results occurred at the highest dose tested (30 mg/kg of body weight per day). 75, 76 The second study (1983) found an increasing trend in the frequency of a rare kidney tumor in male mice.77 The most recent study (1990) found an increase in pancreas and liver tumors in male rats together with an increase of the same thyroid cancer found in the 1983 study in females.78

Toxicity effects
· green algae, Green algae (Selenastrum capricornutum) Chemical Toxicity Studies
· Selenastrum capricornutum
· Crustaceans, http://www.chbr.noaa.gov/easi/contamdetail.aspx?contamid=159Daphnia Magna
· Fish, Bluegill, Rainbow trout
The Ecological Assessment Project - Contaminant Details: CAS# 38641-94-0
Arundo donax crowds out native plants, reduces habitat for wildlife, chokes riversides, stream channels and wetlands. Arundo donax can quickly invade new areas and form pure stands at the expense of other species. Once established, giant reed has the ability to outcompete and completely suppress native vegetation.

http://www.egrass.com/

http://www.progress-energy.com/aboutus/news/article.asp?id=14062

http://tncweeds.ucdavis.edu/moredocs/arudon01.html
The U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program
Southern Florida Study Unit http://fl.water.usgs.gov/Sofl/

http://www.chbr.noaa.gov/easi/pestmaps/159.pdf http://www.pesticideinfo.org/List_AquireAll.jsp?Species=486&Effect='No+Effect+Coded'
http://www.chemindustry.com/chemicals/848957.html
Florida Geology http://aquat1.ifas.ufl.edu/guide/geology.html
Geology SW Florida http://sofia.usgs.gov:8765/query.html?qt=arundo+donax&col=sofiapub&qc=sofiapub
Geology Central Florida
http://sofia.usgs.gov:8765/query.html?qt=geology+central+florida&col=sofiapub&qc=sofiapub
Orange County http://www.floridacountiesmap.com/orange_county.shtml
Lake County http://www.floridacountiesmap.com/lake_county.shtml

ECOLOGY AND MANAGEMENT OF *ARUNDO DONAX*, AND APPROACHES TO RIPARIAN HABITAT RESTORATION IN SOUTHERN CALIFORNIA.

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Abstract

By far the greatest threat to the dwindling riparian resources of coastal southern California is the alien grass species known as *Arundo donax*. Over the last 25 years the riparian forests of coastal southern California have become infested with *A. donax* which has spread by flood-fragmentation and dispersal of vegetative propagules. *Arundo donax* dramatically alters the ecological/successional processes in riparian systems and ultimately moves most riparian habitats towards pure stands of this alien grass. By current estimates there are tens of thousands of acres of *A. donax* along the major coastal drainage systems of southern California, including the Santa Ana, Santa Margarita, Ventura, Santa Clara, San Diego, and San Luis Rey rivers. The removal of *A. donax* from these systems provides numerous downstream benefits in terms of native species habitat, wildfire protection, water quantity and water quality.

Introduction

Arundo L. is a genus of tall perennial reed-like grasses (Poaceae) with six species native to warmer parts of the Old World. *Arundo donax* L. (giant reed, bamboo reed, giant reed grass, arundo grass, donax cane, giant cane, river cane, bamboo cane, canne de Provence), is the largest member of the genus and is among the largest of the grasses, growing to a height of 8 m (Fig. 1). This species is believed to be native to freshwaters of eastern Asia (Polunin and Huxley 1987), but has been cultivated throughout Asia, southern Europe, north Africa, and the Middle East for thousands of years and has been planted widely in North and South America and Australasia in the past century (Perdue 1958, Zohary 1962). It was intentionally introduced to California from the Mediterranean in the 1820's in Los Angeles area as an erosion-control agent in drainage canals, and was also used as thatching for roofs of sheds, barns, and other buildings (Hoshovsky 1987). Subsequent plantings have been made for the production of reeds for a variety of musical instruments including bassoons and bagpipes. Today it is an invasive pest throughout the warmer coastal freshwaters of the United States, from Maryland to northern California.

Arundo donax is a hydrophyte, growing along lakes, streams, drains and other wet sites. It uses prodigious amounts of water, as much as 2,000 L/meter of standing *A. donax*, to supply its incredible rate of growth (Purdue 1958; Iverson 1994). Under optimal conditions it can grow more than 5 cm per day (Purdue 1958). *Arundo donax* stands are among the most biologically productive of all communities. Under ideal growth conditions they can produce more than 20 tons per hectare above-ground dry mass (Perdue 1958).

Perhaps as much as 90% of the historic riparian habitat in the southern part of California has been lost to agriculture, urban development, flood control, and other human-caused impacts (Jones & Stokes 1987; Katibah 1984). The greatest threat to the remaining riparian corridors today is the invasion of exotic plant species, primarily *Arundo donax*. This alien grass readily invades riparian channels, especially in disturbed areas, is very competitive, difficult to control, and to the best of our knowledge does not provide either food or nesting habitat for native animals. *Arundo* competes with native species such as *Salix* (willows), *Baccharis salicifolia* (mulefat), and *Populus* (cottonwoods) which provide nesting habitat for the federally

endangered bird, the least Bell's vireo (*Vireo bellii pusillus*), the federally threatened bird, the willow flycatcher (*Empidonax traillii eximus*) and other native species (Hendricks and Rieger 1989; Franzreb 1989; Zembal 1986 and 1990).

Ecological value of native riparian systems

Like most riparian systems, the cottonwood/willow riparian forest is a dynamic community, dependent upon periodic flooding to cycle the community to earlier successional stages (Warner and Hendrix 1985). Periodic floods of large magnitude and migration of the river channel are essential to depositing fresh alluvium where seeds and vegetative propagules of *Baccharis*, *Salix*, and *Populus* can germinate and take root (Gregory et al. 1991; Richter and Richter 1992). Adequate moisture and an absence of subsequent heavy flooding is critical to the survival of the young trees through their first year. As these seedlings mature they increase channel roughness and alter flow during small flood events, increasing sediment deposition (Kondolf 1988; Richter and Richter 1992; Stromberg *et al.* 1993). Sediment deposition builds river terraces and, as they elevate, other plant species colonize resulting in further diversification in the floodplain community (Richter and Richter 1992).

When *Populus/Salix* riparian scrub, which may include such species as *Baccharis salicifolia*, *Vitis californica*, *Rubus ursinus*, and *Urtica dioica* ssp. *holosericea*, reaches four or five years of age, it begins to exhibit the structural diversity required for breeding by the bird, the least Bell's vireo (Franzreb 1989, Hendricks and Rieger 1989). Least Bell's vireo, along with the riparian birds, southwestern willow fly-catcher, yellow-breasted chat (*Icteria virens*), yellow warbler (*Denroica petechia*), and many other species may continue to use this diverse community for another ten to twenty years. Gradually the canopy of the maturing willows and cottonwoods begins to shade out the diverse understory of vascular plants required by these birds. Older riparian gallery forests will continue to be used by western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), Cooper's hawk (*Accipiter cooperii*), warbling vireo (*Vireo gilvus*) and other species (Zembal 1990; Zembal *et al.* 1985), but as the stand ages the diversity of the flora and fauna within the forest declines. Annual flooding, channel migration, and occasional large flood events maintain this cycle of succession and therefore maintains a mosaic of diverse natural communities (Gregory *et al.* 1991).

***Arundo donax* as a competitor**

Within its introduced range, *A. donax* is an aggressive competitor. *Arundo donax* flowers in late summer with a large, plume-like panicle. Fortunately for California land managers, the seeds produced by *A. donax* in this country are seldom, if ever, fertile. It is not known if this is because of clonal isolation or because of the physiological effects of climate as has been observed in the related *Phragmites communis* (common reed) (Haslam 1958; Rudescu et al. 1965). *Arundo donax* is well adapted to the high disturbance dynamics of riparian systems as it spreads vegetatively. Flood events break up clumps of *A. donax* and spread the pieces downstream. Fragmented stem nodes and rhizomes can take root and establish as new plant clones. Thus invasion, spread, and therefore management, of *A. donax* is essentially an intrabasin and downstream phenomenon.

Once established *A. donax* tends to form large, continuous, clonal root masses, sometimes covering several acres, usually at the expense of native riparian vegetation which cannot compete. Root masses, which can become more than a meter thick, stabilize stream banks and terraces (Zohary and Willis 1992), altering flow regimes. *Arundo donax* is also highly flammable throughout most of the year, and the plant appears highly adapted to extreme fire events (Scott 1994). While fire is a natural and beneficial process in many natural communities in southern California it is a largely unnatural and pervasive threat to riparian areas. Natural wild fires usually occur during rare lightening storm events in late fall, winter, and early spring. Under these conditions the moist green vegetation of riparian areas would normally act as a fire break. Human-caused wild fires, in contrast, often occur during the driest months of the year (July through October). Drier conditions in riparian zones at this time of year make them more

vulnerable to fire damage. Because *A. donax* is extremely flammable, once established within a riparian area it redirects the history of a site by increasing the probability of the occurrence of wildfire, and increasing the intensity of wildfire once it does occur. If *A. donax* becomes abundant it can effectively change riparian forests from a flood-defined to a fire-defined natural community, as has occurred on the Santa Ana River in Riverside County, California. *Arundo donax* rhizomes respond quickly after fire, sending up new shoots and quickly out-growing any native species which might have otherwise taken root in a burned site. Fire events thus tend to help push riparian stands in the direction of pure *A. donax*. This results in river corridors dominated by stands of giant reed with little biological diversity.

Arundo donax as habitat

All evidence indicates that *A. donax* provides neither food nor habitat for native species of wildlife. *Arundo donax* stems and leaves contain a wide array of noxious chemicals, including silica (Jackson and Nunez 1964), tri-terpines and sterols (Chandhuri and Ghosal 1970), cardiac glycosides, curare-mimicking indoles (Ghosal *et al.* 1972), hydroxamic acid (Zuñiga *et al.* 1983), and numerous other alkaloids which probably protect it from most native insects and other grazers (Miles *et al.* 1993, Zuñiga *et al.* 1983). Areas taken over by *A. donax* are therefore largely depauperate of wildlife. This also means that native flora and fauna do not offer any significant control mechanisms for *A. donax*. It is uncertain what the natural controlling mechanisms for this species are in the Old World, although infestations of corn borers (Eizaguirre *et al.* 1990), spider mites (El-Enany 1985) and aphids (Mescheloff and Rosen 1990) have been reported in the Mediterranean. In the United States a number of diseases have been reported on giant reed, including root rot, lesions, crown rust, and stem speckle (USDA 1960), but none seems to have seriously hindered the advance of this weed.

Recent studies by the Santa Ana Watershed Project Authority (Chadwick and Associates 1992) suggest that *A. donax* also lacks the canopy structure necessary to provide significant shading of bank-edge river habitats, resulting in warmer water than would be found with a native gallery forest of *Populus* or *Salix*. As a result, riverine areas dominated by *A. donax* tend to have warmer water temperatures, which results in lower oxygen concentrations and lower diversity of aquatic animals, including fishes (Dunne and Leopold 1978). In the Santa Ana River system this lack of streambank structure and shading has been implicated in the decline of native stream fishes including *Gila orcuttii* (arroyo chub), *Gasterosteus aculatus* (three-spined stickleback), *Rhinichthys osculus* (speckled dace), and *Catostomus santaanae* (Santa Ana sucker). This lack of stream-side canopy structure may also result in increased pH in the shallower sections of the river due to high algal photosynthetic activity. In turn, high pH facilitates the conversion of total ammonia to the toxic unionized ammonia form which further degrades water quality for aquatic species and for downstream users (Chadwick and Associates 1992).

Control Methods

A suite of methods is needed to control *A. donax* depending upon the presence or absence of native plants, the size of the stand, the amount of biomass which must be dealt with, the terrain, and the season.

The key to effective treatment of established *A. donax* is killing of the root mass. This requires treatment of the plant with systemic herbicide at appropriate times of the year to ensure translocation to the roots. Only one herbicide is currently labeled for wetlands use by the EPA; Rodeo®, a tradename formulation of glyphosate, produced by Monsanto Corporation. Glyphosate is a broad-spectrum herbicide which can be used on *A. donax*, *Tamarix ramosissima* (saltcedar), and most other monocots and dicots. It has proven very effective against *A. donax* (Finn and Minnesang 1990; Jackson 1994; USDA Forest Service 1993). Other herbicides might also be used as labels and conditions allow. Monocot-specific chemicals, such as Fusilade-DX® (fluazapop-butyl) and Post® (Sethoxidan), might be particularly useful for treating *A. donax* in stands with a substantial component of native dicots; however, neither is currently labeled for wetlands use.

The most effective treatment on *A. donax* is the foliar application of a two-to-five percent (2-5%) solution of Rodeo applied post-flowering and pre-dormancy at a rate of 0.5 to 1 L/hectare. During this period of time, usually mid-August to early November, the plants are actively translocating nutrients to the rootmass in preparation for winter dormancy which results in effective translocation of herbicide to the roots. Recent preliminary comparison trials on the Santa Margarita River (Omori. 1996) indicate that foliar application during the appropriate season results in almost 100% control, compared with only 5-50% control using cut-stem treatment. Two to three weeks after foliar treatment the leaves and stalks brown and soften creating an additional advantage in dealing with the biomass: cut green stems might take root if left on damp soil and are very difficult to cut and chip. Treated stems have little or no potential for rooting and are brittle. They may be left intact on the ground or chipped *in situ* for mulch.

Cut-stem treatment requires more time and manpower than foliar spraying and requires careful timing. Cut stems must be treated with concentrated herbicide within one to two minutes in order to ensure tissue uptake (Monsanto 1989). This treatment is also most effective post-flowering. The chief advantage of the cut-stem treatment is that it requires less herbicide that can be more-or-less surgically applied to the stem. Because of its reduced efficacy, and due to the labor required, it is rarely cheaper than foliar spraying except on very small, isolated patches or individual plants.

A popular approach to dealing with *A. donax* has been to cut the stalks and remove the biomass, wait three to six weeks for the plants to grow to about one meter tall, then apply a foliar spray of herbicide solution. The chief advantage of this approach is that less herbicide must be applied to treat the fresh growth compared with tall, established plants, and that coverage is often better because of the shorter and uniform-height plants. However, cutting of the stems may result in the plants returning to growth-phase, drawing nutrients from the rootmass. As a result there is less translocation of herbicide to the roots and less root-kill. Therefore many follow-up treatments must be made which negates any initial savings in herbicide and greatly increases the manpower costs.

Pure stands (>80% canopy cover) of *A. donax* or *T. ramosissima* are most efficiently treated by aerial application of an herbicide concentrate, usually by helicopter. Helicopter application can treat at least 50 hectares per day. Special spray apparatus produces extremely fine droplets (400 microns) of concentrated herbicide which actually reduces herbicide use, minimizes over-spray, and results in greater kill.

In areas where helicopter access is impossible, where *A. donax* makes up the understory, where patches are too small to make aerial application financially efficient, or where weeds are mixed with native plants (<80% cover), herbicides must be applied by hand. Street-vehicles with 400 liter spray tanks are a good alternative where road access is available, but small "quad-runner" vehicles equipped with 60 liter sprayers are the preferred approach where the streambed is not so rocky as to prevent access. Twenty liter backpack sprayers are the final alternative where the vegetation is too dense, or the landscape too rugged for vehicles to be effective.

Methods for vegetation removal include use of prescribed fire, heavy machinery (e.g. bulldozers), handcutting by chainsaw or brushcutter, hydro-axe, chipper, biomass burning or removal by vehicle. Removal of the biomass should only be done where the weed cover is so dense as to prevent recovery by native vegetation after treatment, or where cut vegetation might create a debris-dam hazard during flood events. Prescribed fire, or burning piles of stacked biomass, is the most cost-effective way of removing biomass as long as it does not threaten native vegetation or other resources. Chipping is more costly in terms of equipment and labor, and cut, dried chips pose no threat for regeneration or for forming debris dams. Hauling of biomass by vehicle is extremely expensive and should only be done as a last resort. Most landfills will not accept *A. donax* and those that do will only accept if cut into short lengths and bagged into plastic trash bags, making the labor costs far too great. The use of heavy machinery such the Hydro-ax® is extremely expensive. The machines are very slow - a Hydro-ax can only cut about 3-4 acres per day.

Riparian restoration and management

One of the prime incentives for riparian habitat restoration has been endangered species recovery, including the federal Endangered Species Act (ESA). The ESA has focused attention on declining species and sought to protect those species in greatest risk by provisions against take (Under the ESA the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.). Focus of the legislation has been on individual protected species with little attention given to the dynamics of the natural systems of which these species are a part. There are important historical and legislative reasons for this approach. In the 1970s, when the ESA was drafted, ecologists and wildlife managers were highly focused on single species; system-oriented approaches were not widely applied. In addition, it is far easier to attach legal definition to something tangible, such as an individual animal, than it is to the more vague concept of ecological processes (Gregory *et al.* 1991).

The concept of habitat restoration developed in response to the "take" provisions of the ESA as a means of mitigating site-specific damage. While revegetation has been carried out in a wide variety of natural community types, its earliest successes and its greatest application has been in mitigation of losses of riparian forests. In southern California, riparian revegetation has been pursued as an ever-evolving artform in response to the perceived need for replacement of habitat for the federally and state endangered least Bell's vireo (*Vireo bellii pusillus*) and a suit of other endangered or candidate species including the western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and the willow flycatcher (*Empidonax traillii*) (Anderson and Miller 1991; Baird and Rieger 1989; Parra-Sjizz 1989; RECON 1988).

It may be argued that the main reason why riparian revegetation has received so much attention is because it is so relatively easy to achieve. This ease is a result of the very dynamics of riparian systems - they are high-disturbance systems composed of flood-adapted and resilient species. *Salix, Populus, Baccharis,* and other riparian plant species establish easily by fragmentation in flood events in addition to seeding in flood-washed sediment beds. As a result riparian revegetation essentially requires only plant material (cuttings or rooted stock) and water (irrigation). However, such revegetation projects can be extremely expensive.

It is also important to recognize that revegetation does not necessarily equate with habitat restoration. While the matrix plant species of habitats are relatively easy to establish, the dynamics of native riparian communities are poorly understood. Establishing a *Salix/Populus* stand on a streamside terrace will probably not provide the community diversity of a natural stand or the dynamic processes required to establish it. While some revegetation programs have been successful in terms of establishing a matrix of riparian habitat which is used by some native species, revegetating is the not necessarily the best way to create habitat.

The best way to address habitat loss in southern California riparian systems is

through a comprehensive program of eradication of *A. donax, T. ramosissima*, and other invasive aliens, and relying on natural physical processes, especially flood dynamics, for the recovery of native natural communities and species. This approach might be just as easily argued for other high disturbance-adapted communities.

This strategy is based upon two of important factors. First, riparian habitats are flood-dynamic communities, dependent upon natural cycles of flood scouring and sediment deposition to create the proper conditions for community establishment (Gregory *et al.* 1991; Richter and Richter 1992; Stromberg *et al.* 1991). The Santa Ana, Santa Margarita, San Luis Rey, and many other southern California streams have all of the factors necessary for the recovery and maintenance of healthy riparian communities and riparian species. These watersheds retain flood regimes sufficient to move and sort sediment and extensive sources of seed and vegetative propagules for *Salix* and other native riparian plants. Second, the only real threats to the integrity of the system are (1) habitat fragmentation by development and (2) introduced exotic species which have altered the successional dynamics and stability of the natural communities. In other words, the native riparian communities of the Santa Ana and other major riparian corridors (and thus riparian-dependent species such as least Bell's vireo) are limited, not by the capacity of the community to regenerate, or the available area of riparian zones, but by the capacity of native species to compete with aggressive invasive exotic species, chiefly *A.*

donax.

The majority of the limited resources available for riparian management on these rivers should therefore be directed at managing for the process of riparian systems: removing the key perturbation from the system, thereby allowing natural flood dynamics to operate and the natural communities to recover. Attempts to revegetate riparian species in floodplains that retain both native riparian species and flood regimes are redundant, and resources spent to this end are largely wasted. This is not to imply that riparian (and other habitat) revegetation efforts should not be applied; however, they should be applied judiciously and only in situations where specific management goals are achieved by carrying out a revegetation project (e.g. closing up an important corridor or reestablishing native species in a depauperate watershed). Relying on natural processes for the recovery of the riparian communities has the following major benefits:

a. Cost-effectiveness. Riparian forest restoration is extremely expensive, often on the order of tens of thousands of dollars per hectare. This necessarily limits the size, and therefore the biological value, of any funded restoration project. *Arundo donax* can be removed from most areas of a river for a fraction of the cost of revegetation, opening up areas for natural re-colonization by native riparian species.

b. Biological value. As indicated above, the high cost of revegetation limits the size of restoration projects. Additionally, artificially-produced riparian habitat lacks the high stem densities characteristic of naturally regenerating riparian habitat, making the actual biological value of revegetated sites questionable. Much higher value may be achieved by removing invasive exotics such as *A. donax* from the system. Areas opened up for recolonization which are subsequently flood-scoured and naturally seeded or "planted" with vegetative propagules spread by the flood are more likely to recover in high stem density habitat.

c. Natural vulnerability. Riparian systems are, by nature, dynamic. The natural flood process that produces the conditions for natural riparian establishment also puts artificially (and naturally) created habitat areas in flood jeopardy. This makes riparian revegetation a high-risk investment of limited resources. Several expensive revegetation projects on the Santa Margarita and Santa Ana Rivers were damaged or lost to flood scouring in January 1993. Some of these areas recovered with high stem-density *Salix* scrub when *A. donax* was controlled. Other sites, without such weed control efforts, succeeded to high density *A. donax* colonies.

Summary

By virtue of its growth characteristics, adaptations to disturbance, especially fire, its lack of natural predators and competitors in North America, and its unsuitability as food or habitat for native wildlife, *Arundo. donax* has established itself as one of the primary threats to native riparian habitats in the western United States.

Control and management of giant reed within a watershed requires a coordinated, watershed-wide approach. *Arundo donax* should be removed from the watershed beginning in the upper tributaries to prevent reinfestation of treated downstream sites from upstream sources. Removal of *A. donax* requires treatment with systemic herbicides in order to kill the large root mass.

Past practices of riparian restoration have focused on revegetation of small sites without consideration of natural riparian processes. Resources should be spent on managing for the natural dynamic processes of these systems on a watershed-wide scale. In coastal southern California the primary perturbation to the natural riparian succession process in invasion by *A. donax*, and its removal from river systems will have a far greater beneficial effect on most riparian species than planting of riparian vegetation.

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References

Anderson, B. W. and E. Miller. 1991.Analysis of revegetation on the Kern River Preserve 1986- 1990. Prepared for The Nature Conservancy, San Francisco, CA.

Baird, K. and J. Rieger. 1989. A restoration design for least Bell's vireo habitat in San Diego County. USDA Forest Service Gen. Tech. Rep. PSW-110.

Chadwick and Associates. 1992. Santa Ana River use attainability analysis. Volume 2: Aquatic biology, habitat and toxicity analysis. Santa Ana Watershed Project Authority, Riverside, CA

Chandhuri, R.K. and S. Ghosal. 1970. Triterpines and sterols from the leaves of Arundo donax. Phytochemistry 9: 1895-1896.

Dunne, T. and L.B. Leopold. 1978. Water in environmental planning. W.H. Freeman and Company, New York.

El-Enany, M.A.M. 1985. Life history studies on Aponychus solimani Zaher, Gomaa and El- Enany, with firest desriptions of adult male and immature stages. (Acari: Tetranychidae). Zool. Soc. Egypt Bull. 35: 86-91.

Eizaguirre, M, R. Albajes, P.F. Galichet. 1990. A note on the presence in Catalonia (Spain) of a parasitic system bound to the Tachinid fly Lydella thompsoni Hertig, a parasitoid of corn borers. Investigacion Agraria Produccion y Proteccion Vegetales 5: 345-348.

Finn, M. and D. Minnesang. 1990. Control of giant reed grass in a southern California riparian habitat. Restoration & Management Notes 8: 53-54.

Franzreb, K. 1989. Ecology and conservation of the endangered least Bell's vireo. U.S. Fish and Wildlife Service, Biological Report 89(1). 17 pp.

Ghosal, S., R.K. Chandhuri, S.K. Cutta, S.K. Bhattachaupa. 1972. Occurrence of curarimimetic indoles in the flowers of Arundo donax. Planta Med. 21: 22-28.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. Bioscience 41: 540-551.

Haslam, S.M. 1958. Biological flora of the British Isles: Phragmite communis Trin. (Arundo phragmites L., ? Phragmites australis (Cav.) Trin. ex Steudel). List Br. Vasc. Plants No. 665. J. Ecol. 60: 585-610.

Hendricks, B. and J. Rieger. 1989. Description of nesting habitat for the Least Bell's Vireo. USDA Forest Service Gen. Tech. Rep. PSW-110.

Hitchcock, A.S. and A. Chase. 1950. Manual of the grasses of the United States. Misc. Publ. 200, U.S. Dept. of Agriculture, Washington, D.C. , 1051 pp.

Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Non-game Heritage Division, California Department of Fish and Game, Sacramento, 156 p.

Hoshovsky, M. 1987. Arundo donax. Element Stewardship Abstract. The Nature Conservancy, San Francisco, CA, 10 pp.

Iverson, M.E. 1994. The impact of Arundo donax on water resources. In: Jackson, N.E., P. Frandsen, S. Douthit (eds.), November 1993 Arundo donax workshop proceedings, pp 19-25. Ontario, CA.

Jackson, G.C. and J.R. Nunez. 1964. Identification of silica present in the giant reed (Arundo donax L.). J. Agric. Univ. (Puerto Rico) 48: 60-62.

Jackson, N.E. 1994. Control of Arundo donax: techniques and pilot project. In: Jackson, N.E., P. Frandsen, S. Douthit (eds.), November 1993 Arundo donax workshop proceedings, pp 27- 33. Ontario, CA.

Jones and Stokes Associates. 1987. Sliding toward extinction: the state of California's natural heritage, 1987. Sacramento, CA.

Katibah, E.F. 1984. A brief history of riparian forests in the Central Valley of California. In: R.E. Warner and K.E. Hendrix (eds.), California riparian systems: ecology, conservation, and productive management, pp. 22-29. University of California Press, Berkeley, CA.

Kondolf, G. M. 1988. Hydrologic and channel stability considerations in stream habitat restoration. In: John Berger (ed.), Environmental restoration; science and strategies for restoring the earth: selected papers from Restoring The Earth Conference, pp. 214-227. Island Press, Covelo, CA.

Mescheloff, E. and D. Rosen. 1990. Biosystematics studies on the Aphidiidae of Israel (Hymenoptera: Ichneumonoidea). 3. The genera Adialytus and Lysiphlebus. Israel J. Entomol. 24: 35-50.

Miles, D.H, K. Tunsuwan., V. Chittawong, U. Kokpol, M. I. Choudhary, J. Clardy. 1993. Boll weevil antifeedants from Arundo donax. Phytochemistry (Oxford): 34: 1277-1279.

Monsanto. 1989. Label for Rodeo® aquatic herbicide. Monsanto Company, St. Louis, MO.

Parra-Sjizz, E. A. 1989. Revegetation in the Sepulveda Wildlife Reserve: a seven year summary. Proceedings of the Society for Ecological Restoration Annual Conference,

Omori. G. 1996. Eradicating the giant reed (Arundo donax) in riparian areas of Marine Corps Base, Camp Pendleton, California. Unpublished report to Environmental Security, Marine Corps Base, Camp Pendleton, California and The Nature Conservancy. Agri Chemical & Supply, Inc, Oceanside, CA, 7 pp.

Perdue, R.E. 1958. Arundo donax - source of musical reeds and industrial cellulose. Economic Bot. 12: 368-404.

Polunin, O. & A. Huxley. 1987. Flowers of the Mediterranean. Hogarth Press, London.

RECON (Regional Environmental Consultants). 1988. Draft comprehensive species management plan for the least Bell's vireo (Vireo bellii pusillus). Prepared for San Diego Association of Governments, San Diego, 212 pp + Append.

Richter, B.D. and H.E. Richter. 1992. Development of groundwater and ecological models for protecting a southwestern riparian system. In: Proceedings, First

International Symposium on Groundwater Ecology, Tampa, FL.

Rudescu, L. C. Niculescu, and I.P. Chivu. 1965. Monografia stufului den delta Dunarii. Editura Academiei Republicii Socialiste, România.

Scott, G. 1994. Fire threat from Arundo donax. In: Jackson, N.E., P. Frandsen, S. Douthit (eds.), November 1993 Arundo donax workshop proceedings, pp 17-18,.Ontario, CA.

Stromberg, J., D.T. Patten, and B.C. Richter. 1991. Flood flows and dynamics of Sonoran riparian forests. Rivers 2: 221-235.

Stromberg, J., B.D. Richter, D.T. Patten, and L.G. Wolden. 1993. Response of a Sonoran riparian forest to a 10-year return flood. Great Basin Nat. 53: 118-130

USDA 1960. Index of plant diseases in the United States. USDA Crop Research Div., Agricultural Research Service, Handbook 165. US Government Printing Office, Washington, DC.

USDA Forest Service. 1993. Eradication of Arundo donax, San Francisquito and Soledad Canyons. Environmental Assessment. USDA Forest Service, Angeles National Forest, CA.

Warner, R.E. and K.M. Hendrix. 1985. Riparian resources of the Central Valley and California Desert. California Department of Fish & Game, Resources Agency, Sacramento, CA.

Zembal, Richard. 1986. The Least Bell's Vireo in the Prado Basin and environs, 1985. Unpublished report, U.S. Fish and Wildlife service, Laguna Niguel, CA.

Zembal, R. 1990. Riparian habitat and breeding birds along the Santa Margarita and Santa Ana Rivers of southern California. In: A.A.Schoenherr (ed.), Endangered plant communities of southern California, pp. 98-114. Southern California Botanists, Special Publ. No. 3, Fullerton, CA.

Zembal, R., K.J. Kramer and R.J. Bransfield. 1985. Survey of vegetation and vertebrate fauna in the Prado Basin and the Santa Ana River Canyon, California. U.S. fish and Wildlife Service, Laguna Niguel, CA.

Zohary, M. 1962. Plant life of Palestine. Ronald Press, New York.

Zohary, M. & A.J. Willis. 1992. The vegetation of Egypt. Chapman & Hall, London.

Zúñiga, G.E., V.H. Argandoña, H.M. Niemeyer, and L.J. Corcuera. 1983. Hydroxamic acid content in wild and cultivated Gramineae. Phytochemistry 22: 2665-2668.

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Meeting Highlights Summary
Invasive Species Working Group
August 14, 2003
Florida Dept. of Environmental Protection Carr Building
Tallahassee, FL

The Invasive Species Working Group (ISWG) held a meeting on August 14, 2003 at the Florida Dept. of Environmental Protection Carr Building. Those ISWG members and staff who attended the meeting were, William Torres, Scott Hardin, and Dr. Allison Fox as proxy for Dr. Ken Langeland, Don Schmitz, Sherman Wilhelm, Bob Heeke, John Valenta, and Jeff Castor. Brian Nelson and Dan Thayer attended via teleconference. Others who attended the meeting were Charles Ashton, Peggy Mathews, Tracy McCord, Jim Newman, Doria Gordon, Steven Bell, John Teem, Eric Draper, and Bonnie Basham. The ISWG met from 10:05 am to 3:30 pm. The highlights of the meeting are summarized below.

1. The Meeting was called to order at 10:05 am

Presentation – The Challenge of Managing Monk Parakeets in South Florida –Ms. Tracy McCord and Mr. Jim Newman, Florida Power and Light (FPL), Environmental Services, Juno Beach, FL. Monk Parakeets build stick nests in power line structures causing power outages. The public generally considers the monk parakeets favorably. About 1,500 nests have been observed within electrical structures as of this date. It is speculated that Hurricane Andrew may have been responsible for the parakeets imprinting electrical power structures for nesting sites due to the destruction of trees following the storm. It was also brought up that the removal of citrus trees under the canker eradication effort may be a factor too. The parakeets are long lived, approximately 30 years. It appears the nesting activities are expanding although no good population estimate exists. These nests may ultimately cost FPL several million dollars a year. Various control methods have been tried or considered by FPL including predatory birds, nest removal, trapping, repellent chemicals, alternative nesting platforms, enclosures, physical deterrents, biological controls (a protozoan), and poison bait.

However, FPL has been reluctant to destroy the birds themselves because of negative public outcry. FPL is looking for public awareness about the problem and also looking for guidance from the ISWG. FPL would also like support from the Florida Fish and Wildlife Conservation Commission (FWC) about whether the removal of the monk parakeet nests is the right thing to do. Mr. Hardin said he will bring this problem before the FWC and discuss what actions, if any, the agency should take based on available information.

It was proposed that maybe the ISWG write a letter to FWC about the monk parakeet problem. Mr. Wilhelm expressed concern about making any recommendations to an agency regarding a specific species and asked is this going to be a pest of the month advisory body? Mr. Nelson countered that when there is no policy procedure or existing available direction regarding a specific species, then maybe the ISWG should be involved with it. The monk parakeet problem is an example of a non-native species that is not an invasive species in agricultural areas or environmental areas but causing economic harm in Florida. There was an extended discussion about what role the ISWG should have in terms of being an advisory body and how the ISWG should deal with issues such as the monk parakeet.

FPL is in the process of gathering more data to support their efforts in the removal of the monk parakeet nests from their electrical structures. It was also noted by Mr. Newman that monk

parakeets are using citrus material in the construction of their nests and might be a potential vector in the spread in citrus canker.

2. ISWG Business

The agenda as written was accepted by the ISWG. The minutes from the June 19, 2003 was reviewed and approved by the ISWG. Mr. Torres discussed the status of the draft ISWG strategic plan and it appears the Governor's office is going to approve the plan and a letter from them is in the works.

3. *Arundo donax* discussion

Dr. Doria Gordon and Dr. Allison Fox introduced the Arundo donax sub-working group report from Dr. Ken Langeland into the meeting (see report below). Dr. Gordon pointed out that there was no precedent about sub-working reports and asked if the report's format was acceptable by the ISWG. There were no objections. The sub-working group reached a consensus and there was a brief review of the amount of information that was evaluated along with its completeness. Dr. Fox also pointed out the limitations of current data about this species. The FDACS report indicates *Arundo donax* is low to moderate risk to Florida but established populations are difficult to control. There was a discussion about how invasive this species could be and the present regulatory framework that exists for this plant in Florida. Presently, no permit is required to plant *Arundo donax* in Florida

The ISWG adopted a motion for the Acting Chair, Eva Armstrong, to write a cover letter to FDACS Division of Plant Industry sharing Dr. Ken Langeland's report along with the ISWG endorsement of the report.

***Arundo donax* sub-working group report:**

You've been provided with responses to Ken Langeland's query from the *Arundo donax* sub-working group, seen Mark Garland's assessment and the responses distributed by Don Schmitz, and heard from Allen Sharpe at the last meeting.

Arundo donax has been in FL since the late 1800s and now has sporadic, mainly ornamental populations, or persisting from planting. The Florida Exotic Pest Plant Council (FLEPPC) has not found evidence that the species should be listed as invasive in Florida under current conditions. This conclusion is supported by the work done by Mark Garland of FDACS.

Arundo donax is apparently sterile and expands slowly in the absence of mechanical or environmental disturbance. Where disturbance breaks up the rhizomes and, with lower frequency, stem sections, the species has been invasive in other places. For example, we know it is an extreme problem in CA, both in terms of invasion and control. In Florida, managers at Cape Canaveral and Washington Oaks Garden State Park have not been able to control *Arundo donax* despite repeated efforts. Also, while it hasn't been invasive in Florida from small, scattered populations, large-scale populations could have very different dynamics, with much more extensive propagule pressure. Therefore, we recommend that the appropriate regulatory agency, most likely FDACS, regulate industrial, agricultural, and commercial planting of *Arundo donax* in Florida.

More specifically, we recommend that FDACS require both demonstration of control methods and estimation of control costs for established populations of *Arundo donax* in wet and dry habitats in Florida prior to any large-scale use. We envision this would take research on established populations (ideally of at least 1 ac in size - perhaps at Cape Canaveral, along the St.

John's River, Pensacola Bay area, Cumberland Island) that demonstrates unambiguous eradication from treated plots. Best management practices need to be developed for plantings of *Arundo donax* and should be required by the regulatory agency. Control cost data should be used by the regulatory agency to develop bond requirements of any entity cultivating the species. The amount of the bond should be sufficient to remediate ecological damage caused by the planting or use of *Arundo donax.*

Given that the ISWG has not set a precedent of how action evolves from sub-working group recommendations:

> This sub-working group proposes that the Working Group adopt a motion that reflects our recommendations, or recommendations modified by the Working Group, and request a regulatory agency to move forward with this action.

4. MOU Discussion

There was a discussion about including the definition of invasive species in the MOU that is in the Statewide Invasive Species Strategic Plan for Florida. The concerns are that the definition in the plan is too restrictive and depends too much on data when most acknowledged environmental invasive species lack specific data. On the other hand, the business community believes without this data, species can be labeled invasive arbitrarily and capriciously when no data exists. After considerable discussion, it was agreed that the definition would not be in the MOU because it is already in the plan.

Florida's Sunshine Laws were also discussed in regard to communications between ISSG Members. There were some additional minor changes to the draft MOU. The ISWG agreed to accept it with the minor changes. The MOU will be sent out within the next month to the agency heads with a cover letter describing the minor changes that have been made along with a brief explanation.

5. Discussion of implementing the strategic plan and ISWG housekeeping

The timeline was discussed and modified for implementing the strategic plan's action items. Assuming the acceptance of the plan by the Governor's Office, the strategic plan will reflect these new dates that were agreed upon by the ISWG members. Because of high cost for printing numerous copies of the plan, the final plan will be distributed on mini-disks.

New subworking groups were discussed along with their logistics in accomplishing the strategic plan's action items. It was concluded that before any new subworking groups could be created, it is vital that the ISWG establish a clear leadership structure. The ISWG agreed at the next meeting that an official chair and vice-chair would be elected. It was also recommended that ISWG members e-mail the ISWG staff their suggestions for any new subworking groups along with subworking group staffing recommendations.

Staff will draft by-laws or operational procedures for the next meeting. Mr. Brian Nelson will forward to staff existing advisory group by-laws for staff to use as an example.

The frequency of ISWG meetings was discussed. It was generally agreed that in the future, the ISWG Chair would have to set the agenda and the frequency of meetings.

6. New Business

Mr. Scott Hardin asked if any of the ISWG members want to comment on a grant proposal, "Assessing the risk of exotic species to native communities: new tools for resource managers" that his agency (FWC) is commenting on. Dr. Doria Gordon expressed concern about this

information violating confidentially of the scientist's proposed work and it was agreed that this proposal would not be widely distributed.

7. Public comment

Ms. Bonnie Basham, Standing Watch - a boating coalition with 20,000 members, is trying to expand their waterway concerns (other than manatees) in Florida. Specifically, they are interested in invasive aquatic species and have a good outreach mechanism to get information to the boating community. Ms. Basham offered her organization's assistance. Their request will be forwarded to DEP's Bureau of Invasive Plant Management.

Mr. Steven Bell, a specialist in environmental restoration, addressed the ISWG asking to become an official cooperator. There was a discussion about what a cooperator's actual role would be in the ISWG. It was agreed that a decision about his request and the role of official cooperators would be made once the ISWG elects a chair. Mr. Bell also asked if the ISWG would request the authorities that control the rail corridors in south Florida work with local governments regarding invasive plant removal. Mr. Bell was asked to put his concerns in writing and request the ISWG take up his concerns at a future meeting. However, it was emphasized that the ISWG is more generalized at this point and may not consider specific items that are more local in nature.

Next ISWG meeting date was suggested for October to be held in Gainesville.

Meeting adjourned at 3:30 pm.

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ELEMENT STEWARDSHIP ABSTRACT
for

Arundo donax

Giant Reed

To the User:

Element Stewardship Abstracts (ESAs) are prepared to provide The Nature Conservancy's Stewardship staff and other land managers with current management-related information on those species and communities that are most important to protect, or most important to control. The abstracts organize and summarize data from numerous sources including literature and researchers and managers actively working with the species or community.

We hope, by providing this abstract free of charge, to encourage users to contribute their information to the abstract. This sharing of information will benefit all land managers by ensuring the availability of an abstract that contains up-to-date information on management
techniques and knowledgeable contacts. Contributors of information will be acknowledged within the abstract and receive updated editions. To contribute information, contact the editor whose address is listed at the end of the document.

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Authors of this Abstract:
Marc Hoshovsky

The Nature Conservancy
Element Stewardship Abstract
For *Arundo donax*

I. IDENTIFIERS

Common Name: GIANT REED Global Rank: G5

General Description:
Arundo donax is a tall, erect, perennial cane- or reed-like grass, 2 to 8 meters high. It is one of the largest of the herbaceous grasses. The fleshy, almost bulbous, creeping root stocks form compact masses from which arise tough, fibrous roots that penetrate deeply into the soil. The culms reach a diameter of 1 to 4 cm and commonly branch during the second year of growth. These culms are hollow, with walls 2 to 7 mm thick and divided by partitions at the nodes. The nodes vary in length from 12 to 30 cm. The leaves are conspicuously two-ranked, 5 to 8 cm broad at the base and tapering to a fine point. The bases of the leaves are cordate and more or less hairy-tufted, persisting long after the blades have fallen (Perdue 1958).

The flowers are borne in large (3 to 6 dm long) plume-like terminal panicles between March and September. The spikelets are several-flowered, approximately 12 mm long with florets becoming successively smaller. The rachilla is glabrous and disarticulates above the glumes and between the florets. The more or less unequal glumes are membranaceous, narrow and 3-nerved. They are also slender, pointed and as long as the spikelet. Lemmas are thin, 3-nerved and pilose. These are narrowed upward with the nerves ending in slender teeth; the middle one becomes an awn.

II. STEWARDSHIP SUMMARY

Although arundo has been widely cultivated for a long time, little information on its biology or ecology has been published. Its rapid growth rate and strong vegetative competitive ability enables it to quickly invade new areas and dominate local vegetation. Very little has been published regarding effective ways of controlling arundo and it is difficult at this point to suggest the best strategy for managing the species.

III. NATURAL HISTORY

Range:
Arundo donax is a native to the countries surrounding the Mediterranean Sea. From this area it has become widely dispersed, mostly through intentional introduction by man, into all of the subtropical and warm temperate areas of the world.

Habitat:

Arundo donax has been widely planted throughout the warmer areas of the U.S. as an ornamental. It is especially popular in the Southwest where it is used along ditches for erosion control (Perdue 1958). In California, giant reed has escaped cultivation and has become established in moist places, such as ditches, streams, and seeps in arid and cismontane regions (Robbins et al. 1951). As early as 1820 it was so plentiful along the Los Angeles River that it was gathered for roofing materials (Robbins et al. 1951). A. donax tolerates a wide variety of ecological conditions. It is reported to flourish in all types of soils, from heavy clays to loose sands and gravelly soils.

Plants grow best in well-drained soils where abundant moisture is available (Perdue 1958). It can spread from the water's edge up the banks and far beyond the zone previously occupied by riparian woody vegetation (Wells et al. 1980). Arundo donax was observed to grow well where water tables were close to, or at, the soil surface (Rezk and Edany 1979). Individual plants can tolerate excessive salinity (Perdue 1958).

Giant reed can be seriously retarded by lack of moisture during its first year, but drought causes no great damage to patches two- to three-years old (Perdue 1958). Individuals will survive extended periods of severe drought accompanied by low-pressure humidity or periods of excessive moisture (Perdue 1958). Arundo's ability to tolerate or even grow well under conditions of extreme drought is due to the development of coarse, drought-resistant rhizomes and deeply penetrating roots that can reach moisture at depth. A. donax can survive very low temperatures when dormant but is subject to serious damage by frosts after the start of spring growth (Perdue 1958).

Giant reed has played an important role in the culture of the western world through its influence on the development of music, which can be traced back 5000 years. The basis for the origin of the most primitive pipe organ, the Pan pipe or syrinx, was made from A. donax. Reeds for woodwind musical instruments are still made from the culms and no satisfactory substitutes have been developed (Perdue 1958).

Even before its musical qualities were appreciated, Egyptians used giant reed as early as 5000 B.C. to line underground grain storage. Mummies of the Fourth Century A.D. were wrapped in arundo leaves. Other uses for giant reed include: basket-work, garden fences and trellises, chicken pens, crude shelters, fishing rods, arrows, erosion control, livestock fodder, pulp and ornamental plants. Medicinally, the rhizome has been used as a sudorific, a diuretic, as an antilactant and in the treatment of dropsy (Perdue 1958).

Reproduction:
Very little information is available in the literature regarding the biology of A. donax.

Perdue (1958) reports that arundo does not produce viable seeds in most areas where it is apparently well-adapted, although plants have been grown in scattered locations from seed collected in Asia.

Wind dispersal of seeds is facilitated by having a dense seed head on the end of a tall, flexible culm, presumably catapulting the seeds a fair distance. The importance of sexual reproduction to the species, as well as seed viability, dormancy, germination and seedling establishment, have yet to be studied and published.

Much of the cultivation of arundo throughout the world is initiated by planting rhizomes which root and sprout readily. Wild stands in the U.S. have been reported to yield 8.3 tons of oven-dry cane per acre (Perdue 1958).

Giant reed grows rapidly. Growth rates up to 0.7 meters/week over a period of several months under favorable conditions is not unusual. Young culms develop the full diameter of mature canes; further growth involves thickening of the walls. The new growth is soft, very high in moisture and has little wind resistance (Perdue 1958).

IV. CONDITION

Threats:
Arundo can rapidly invade streambanks and roadside habitats from a few planted individuals. When established, it has a strong ability to outcompete and completely suppress native vegetation. Because it propagates vegetatively, it can form rather pure stands, often at the expense of other plants (Wells et al. 1980). In some areas it may so totally invade irrigation ditches as to reduce their water-carrying capacity (Robbins et al. 1951).

A survey of 48 public agencies listed arundo as one of the top 53 weed species of concern (Armer 1964). Arundo was nominated for Element Stewardship Abstract research by preserve managers from Santa Rosa Plateau and Creighton Ranch.

Restoration Potential:
With proper management, areas infested with arundo may be restored to more desirable vegetation. Since arundo may be spread primarily by dispersal of rhizome fragments along watercourses, removal of the entire rootstock may be adequate to eradicate the plant. Research is needed to determine the importance of sexual reproduction in this species.

V. MANAGEMENT/MONITORING

Management Requirements:
Weed control involves three fundamental objectives: prevention, eradication and control.

From a practical viewpoint, methods of weed management are commonly categorized under the following categories: physical, thermal, managerial, biological, and chemical (Watson 1977). Physical methods include both manual and mechanical methods. Thermal methods include both broadcast burning or spot treatment with a flame thrower. Managerial methods include the encouragement of competitive displacement by native plants and prescribed grazing. Biological control is usually interpreted as the introduction

of insects or pathogens which are highly selective for a particular weed species. Chemical control includes both broadcast and spot application.

The most desirable approach is that of an integrated pest management plan. This involves the optimum use of all control strategies to control weeds. This approach is generally accepted as the most effective, economical, and environmentally sound long- term pest control strategy (Watson 1977). In cases where more than one control technique is used, the various techniques should be compatible with one another. Broadcast herbicide application, for example, may not work well with certain managerial techniques (i.e., plant competition).

PHYSICAL CONTROL The two types of physical control methods discussed below, manual and mechanical, produce slash debris that can be disposed of by several techniques. If cut before seeds are produced, debris may be piled and left for enhancement of wildlife habitat (i.e., cover for small mammals). Debris may be fed through a mechanical chipper and used as mulch during revegetation procedures. Care should be taken to prevent vegetative reproduction from cuttings. Burning the slash piles is also effective in disposing of slash.

MANUAL CONTROL Manual methods use hand labor to remove undesirable vegetation. These methods are highly selective and permit weeds to be removed without damage to surrounding native vegetation.

The Bradley Method is one sensible approach to manual control of weeds (Fuller and Barbe 1985). This method consists of hand weeding selected small areas of infestation in a specific sequence, starting with the best stands of native vegetation (those with the least extent of weed infestation) and working towards those stands with the worst weed infestation. Initially, weeds that occur singly or in small groups should be eliminated from the extreme edges of the infestation. The next areas to work on are those with a ratio of at least two natives to every weed. As the native plant stabilizes in each cleared area, work deeper into the center of the most dense weed patches. This method has great promise on nature reserves with low budgets and with sensitive plant populations. More detailed information is contained in Fuller and Barbe (1985).

Hand Pulling: This method may be used to destroy seedlings or plants up to two meters tall. Plants or seedlings are best pulled after a rain when the soil is loose. This facilitates removal of the rooting system, which may resprout if left in the ground. Plants should be pulled as soon as they are large enough to grasp but before they produce seeds.

Hand Digging: The removal of rootstocks by hand digging is a slow but sure way of destroying weeds which resprout from their roots. The work must be thorough to be effective. Every piece of root that breaks off and remains in the soil may produce a new plant. Such a technique is only suitable for small infestations or around trees and shrubs where other methods are not practical.

MECHANICAL CONTROL Mechanical methods use mechanized equipment to remove above ground vegetation. These methods are often non-selective in that all vegetation on a treated site is affected. Mechanical control is highly effective at controlling woody vegetation on gentle topography with few site obstacles. Most mechanical equipment is not safe to operate on slopes over 30 percent. It is also of limited use where soils are highly susceptible to compaction or erosion or where excessive soil moisture is present. Site obstacles such as rocks, stumps or logs also reduce efficiency.

Chopping, Cutting or Mowing: Arundo donax may be trimmed back by tractor-mounted mowers on even ground or by scythes on rough or stony ground. Unwanted vegetation can be removed faster and more economically in these ways than by manual means and with less soil disturbance than with scarification. However, these methods are non-selective weed eradication techniques. They reduce biological control potential (other plants outcompeting arundo) and may open up new niches for undesirable vegetation. In addition, wildlife forage is eliminated. Another disadvantage of chopping, cutting or mowing is that perennial weeds usually require several cuttings before the underground parts exhaust their reserve food supply. If only a single cutting can be made, the best time is when the plants begin to flower. At this stage the reserve food supply in the roots has been nearly exhausted, and new seeds have not yet been produced.

PRESCRIBED BURNING Flame Thrower: A flame thrower or weed burner device can be used as a spot treatment to heat-girdle the stems at the base of arundo plants. This technique has advantages of being less costly than basal and stem herbicide treatments and is suitable for use during wet weather; it cannot be used during periods of wildfire hazard. Its effectiveness is comparable to manual cutting. The timing of the treatment may affect resprouting behavior (Jones and Stokes Associates 1984).

Broadcast Burning: Large areas of weed infestation may be burned in order to remove the standing mature plants. This may be accomplished with or without a pre-spray of herbicides to kill and desiccate plants, Notably flammable plants usually do not require any pre-spray treatment. Used alone this method will not prevent resprouting from root crowns. Burning is best followed by 1) herbicide treatment of stumps, 2) subsequent burning to exhaust soil seed bank and underground food reserves, and/or 3) revegetation with fast growing native species. Other considera- tions for the use of prescribed burning include the time and cost of coordinating a burn, and the soil disturbance resulting from firebreak construction.

MANAGERIAL CONTROL Prescribed grazing: Giant reed is not very palatable to cattle, but during the drier seasons the animals do not hesitate to graze this species. The younger shoots are eaten first, followed by the upper parts of the older plants (Wynd et al. 1948).

In many areas of California the use of Angora and Spanish goats is showing promise as an effective control for Arundo donax (Daar 1983). In the Cleveland National Forest goats are herded for firebreak management of brush species on over 79,000 acres of land. Goats are less costly to utilize than mechanical and chemical control methods. They can

negotiate slopes too steep to manage with machines and do not pose the environmental dangers inherent with herbicides (Andres 1979).

A pioneer in the use of goats for weed control in urban settings is Richard Otterstad, owner of Otterstad's Brush Clearing Service (718 Adams St., Albany, CA 94706, (415) 524-4063). The primary weed control "tools" utilized by Otterstad's company are Angora goats and light-weight flexible fencing reinforced with electrified wire. Angora's are preferred over Spanish goats because their smaller size makes them easier to transport (Otterstad uses a pickup truck). Dairy goats were abandoned when Otterstad found them to be "goof-offs" when it came to eating (Daar 1983).

Goats prefer woody vegetation over most grasses or forbs; Angoras have a higher tolerance for non-woody species than do Spanish goats. Since goats will trample or browse virtually any vegetation within a fenced area, any desirable trees or shrubs must be protected.

Sheep are more selective than goats in their food choices but function well in grazing down a variety of plants. Sheep in feeding experiments may survive for extended periods on a strict diet of Arundo donax (Frattegglani-Bianchi 1963), thus sheep may be another practical alternative to mowing.

It is important to properly manage sheep grazing to prevent soil compaction problems which may occur when sheep are allowed to graze an overly damp area. Sheep are valuable not only for weed control but also for additional income from the sale of their wool and their contribution of fertilizer to the soil. However, it is possible that seed re-introduction may occur from the sheep droppings.

Geese, especially the more wild breeds, are known to be very active and effective weeders of grass and sedges (Andres 1979). This suggests that making an area attractive to waterfowl might contribute to arundo control efforts.

BIOLOGICAL CONTROL The term "biological control" is used here to refer to the use of insects or pathogens to control weeds. The introduction of exotic natural enemies to control plants is a complex process and must be thoroughly researched before implementation to prevent biological disasters. Such tools are not normally suitable for preserve managers to implement.

Little is known about the actual effects of various pathogens and insects on the growth and reproduction of A. donax. However, numerous insects are known to feed on this species. The green bug (SCHIZAPHIZ GRAMINUM) has been observed to feed on arundo during the winter (Zuniga et al. 1983). In France PHOTHEDES DULCIS caterpillars may feed on it (Dufay 1979). ZYGINIDIA GUYUMI uses A. donax as an important food source in Pakistan (Ahmed et al. 1977). A moth borer (DIATRAEA SACCHARALIS) has been reported to attack it in Barbados (Tucker 1940). Although these insects may eventually prove to be effective in controlling arundo, it is unlikely that

insects or pathogens will be introduced as controlling agents because arundo is widely cultivated as a commercial crop.

Please notify the California Field Office of The Nature Conser- vancy of any field observations in which a native insect or pathogen is seen to have detrimental effects on arundo. These reports will be used to update this Element Stewardship Abstract. Management techniques which may encourage the spread of such species-specific agents may be desirable in controlling arundo.

CHEMICAL CONTROL Detailed information on herbicides are available in such publications as Weed Science Society of America (1983) or USDA (1984), and will not be comprehensively covered here. The Weed Science Society publication gives specific information on nomenclature, chemical and physical properties of the pure chemical, use recommendations and precautions, physiological and biochemical behavior, behavior in or on soils and toxological properties for several hundred chemicals. In applying herbicides it is recommended that a dye be used in the chemical mixture to mark the treated plants and thus minimize waste.

Dowpon-C-grass-killer, based on sodium salts of dalapon and TCA, is applied as a full coverage foliar spray to control deep rooted perennial grasses. Arnold and Warren (1966) used it at a rate of 15 pounds per 100 gallons (plus 2 quarts of surfactant) in late spring and summer on A. donax. This rate gave good top growth kill in 2 to 4 weeks. A small amount of regrowth was evident in 6 months. Fall applications at the same rates resulted in no regrowth the following spring. Horng and Leu (1979) studied the effects of several herbicides on arundo in Taiwan. Glyphosate at 2-3 kg/ha showed slow control, effecting over 95% kill 3 months after application. 2,2 DPA at 6-8 kg/ha gave 80% kill within 25 days. Following either glyphosate or 2,2 DPA application with doses of paraquat showed much faster and more complete control. Paraquat alone at 0.72 kg/ha effectively controlled arundo. Two applications of paraquat was just as effective as a single application. Asulam did not adequately control A. donax.

Monitoring Requirements:
Monitoring is needed to determine the effectiveness of management practices.

Detailed observations focused on the vegetational change of the affected area over time will help to determine what method of control would be most efficient.

Monitoring Programs:
No quantitative monitoring studies of arundo were discovered in this research.

VI. RESEARCH

Research Needs (General):
Much more information on seed biology, seedling establishment, growth patterns, and synecology needs to be gathered about arundo. ^Of great interest is the importance of

sexual reproduction over vegetative propagation in the establishment of the plant in new locations. Does arundo produce viable seed in California?

Management Research Needs:
What are the most appropriate means of controlling arundo in riparian areas with minimal disturbance to the surrounding native vegetation?

VII. ADDITIONAL TOPICS

VIII. INFORMATION SOURCES

Bibliography:

Ahmed, M., A. Jabbar, and K. Samad. 1977. Ecology and behavior of Zyginidia guyumi (Typholocyloinae:Cicadellidae) in Pakistan. Pak. J. Zool. 9(1): 79-85.

Andres, L. 1979. Untitled. Unpublished manuscipt. Copy on file at the Nature Conservancy, California Field Office, 785 Market Street, 3rd Floor, San Francisco, CA 94103.

Armer, A. 1964. Report by the statewide control committee of the California State Chamber of Commerce.

Arnold, W. J. and L. E. Warren. 1966. Dowpon C. Grass Killer - a new product for controlling perennial grasses such as Johnson grass and Bermuda grass. Down to Earth 21(4):14-16.

Cozzo, D. 1972. [Initial behavior of Ailanthus altissima in experimental plantation]. Revista Forestal Argentina 16(2):47-52 (in Spanish).

Daar, S. 1983. Using goats for brush control. The IPM Practioner 5(4):4-6.

Dufay, C. 1979. [Phothedes dulcis, new record for the French fauna (Lepidoptera: Noctuidae)]. Alexanor 11(2):82-84 (in French).

Fratteggiani-Bianchi, R. 1963. [Possibilities of using the leaves of the common cane (A. donax) in animal feeding]. Riv. Zootec., Milano 36(6):343-353.

Fuller, T. C. and G. D. Barbe. 1985. The Bradley method of eliminating exotic plants from natural reserves. Fremontia 13:(2): 24-26.

Horng, L. C. and L. S. Leu. 1979. Control of five upland perennial weeds with herbicides. Pp. 165-167 in Proc. 7th Asian-Pacific Weed Sci. Soc. Conference.

Jones and Stokes Associates. 1984. Transmission right-of-way vegetation management program: analysis and recommendations. Prepared for Seattle City Light, Seattle, Washington. Copy on file at The Nature Conservancy, California Field Office, 785 Market Street, 3rd Floor, San Francisco, CA 94103.

Perdue, R. E. 1958. Arundo donax - source of musical reeds and industrial cellulose. Econ. Bot. 12(4):368-404.

Rezk, M. R. and T. Edany. 1979. Comparative responses of two reed species to water table levels. Egypt. J. Bot. 22(2):157-172.

Robbins, W. W., M. K. Bellue, and W. S. Ball. 1951. Weeds of California. California Dept. Agric., Sacramento.

Tucker, R. W. E. 1940. An account of Dicatraea saccharalis with special refernce to its occurrence in Barbados. Trop. Agric., Trinidad 17:133-138.

United States Department of Agriculture. 1984. Pesticide background statements. Vol. I: Herbicides. Agric. Handbook No. 633, U.S. Government Printing Office, Washington, D.C.

Veselack, M. S. and J. J. Nisbet. 1981. The distribution and uses of Arundo donax (abstract). Proc. Indiana Acad. Sci. 90:92.

Watson, H. K. 1977. Present weed control projections for the year 2001. Unpublished manuscript. Copy on file at The Nature Conservancy, California Field Office, 785 Market Street, 3rd Floor, San Francisco, CA 94103.

Weed Science Society of America. 1983. Herbicide handbook.

Wells, M. J., K. Duggan, and L. Henderson. 1980. Woody plant invaders of the central Transvaal. Pp. 11-23 in Proc. 3rd National Weeds Conf. South Africa.

Wynd, F. L., G. P. Steinbauer, and N. R. Diaz. 1948. Arundo donax as a forage grass in sandy soils. Lloydia 11(3):181-184

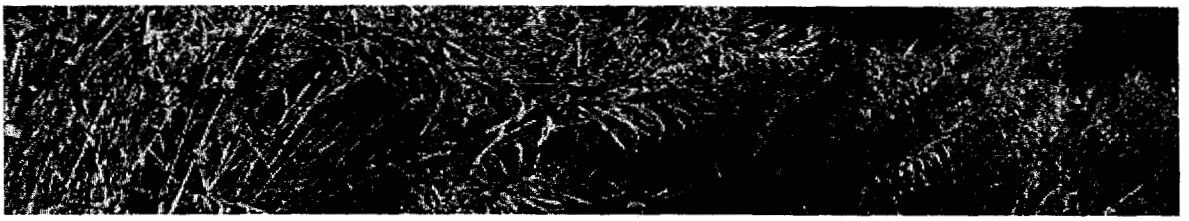
Zuniga, G.E., V. H. Argandona, H. M. Niemeyer, and L. J. Corcuera. 1983. Hyroxamic content in wild and cultivated Gramineae. Phytochemistry 22(12):2665-2668.

IX. DOCUMENT PREPARATION & MAINTENANCE

Edition Date: 86-09-03

Contributing Author(s): Marc Hoshovsky, CAFO

Team Arundo del Norte



Team Arundo del Norte is a forum of local, state, and federal organizations dedicated to the control of *Arundo donax* (giant reed), where it threatens rivers, creeks, and wetlands in Central and Northern California. The organization formed in the summer of 1996 (see TAdN History). The Team meets several times per year in the Sacramento area to explore opportunities for information exchange and partnerships in support of the ongoing work of eradication of this harmful weed. This website is an important part of the Team's mission to facilitate networking. We hope you find useful information and contacts at this site and by joining the discussions on the TAdN email listserv.

Arundo Eradication and Coordination Program

- Program Description, Partner Locations
- Arundo Eradication and Restoration Planning Packet
- Partner Documents
- Arundo Surveying and Monitoring Protocol

Networking Resources

- E-Mail Listserv -- Subscribe yourself!
- Arundo Experts Database
- Arundo Projects Inventory (Calweed Database), Natural Resource Projects Inventory (NRPI)
- Archived TAdN Meeting Minutes
- Links to Arundo Organizations

Arundo Map Server

Educational Materials

Resources from AECP

The TAdN Arundo Digital Reference Library

- Bibliographic Resources
- Mapping and Remote Sensing

- **Arundo: A Landowner Handbook**
- **Arundo: Streamside Invader (brochure)**
- **Controlling Arundo in Your Watershed: A Guide for Organizations**
- **Controlling Arundo in Your Watershed (video)**
- **Arundo Ecology and Impact**
- **Arundo Control and Management**
  - **Herbicides**
  - **Permitting**
  - **Equipment**
- **Research Programs**

Other Resources

- **Giant Reed *(Arundo donax)* Arundo: Invasive Weed Fact Sheet**

Comments or questions? Email them to Team Arunde del Norte at
arundo@sonomaecologycenter.org

Strategic Plan Implementation Report
College of Agricultural, Human, and Natural Resource Sciences
February 2006

Academic Plan Area of Emphasis: Scholarship and Research Foci (Environmental and Natural Resources)

Activity: Positioning WSU to Respond to the State's Challenges in the Development of a Biofuels Industry.

Escalating energy prices have revived interest from consumers, policy makers, and industry in the potential for developing bioenergy resources, specifically liquid biofuels, which can supplement petroleum-based gasoline and diesel. Recent developments in the state have demonstrated a rapidly growing market for refined products, as well as an emerging processing infrastructure. The expectation is that biofuels will provide an increasing share of the total fuel consumption in Washington. WSU has been identified by Governor Gregoire to provide leadership in research and development activities required to make these visions become reality. CAHNRS is actively positioning itself to make significant contributions to the State's efforts in increasing its consumption of biofuels. Furthermore, as heard in the President's State of the Union Message and as documented by his budget proposal for the Departments of Energy and Agriculture, significant new biofuel and bioproducts research funds will be available, if passed by Congress.

Center for Bioproducts and Bioenergy

CAHNRS is providing leadership in the creation of a Center for Bioproducts and Bioenergy. This interdisciplinary center of excellence will establish Washington State University as a national leader in research and educational programming in this emerging industrial biotechnology area. Ultimately, the Center's main deliverable will be research that can be applied across all bio-sectors (agriculture, forest, municipal, and industrial) leading to state and national goals of sustainability, energy security, and business, job and market development. Specific objectives of the Center include: (1) developing systems and technologies that grow and utilize regional biomass to produce chemicals, materials, pharmaceuticals, nutraceuticals, fuels, and energy; (2) catalyzing technology transfer and developing business models for establishing a bioproducts and bioenergy industry in the state; and (3) establishing a world-class research and education program in bioproducts and bioenergy at WSU. The proposal for establishing the Center is currently being deliberated in the Faculty Senate. Ongoing research and educational programs continue to grow in response to this growing need for the State.

Faculty Positions

Although CAHNRS already has a number of scientists working in the area of biofuels an bioproducts research, additional faculty resources are being allocated to this high priority area. A search is ongoing in the Department of Biological Systems Engineering for a faculty member in the area of biofuels and bioproducts. In addition, two news positions are being allocated in

the Department of Crop and Soil Science and the Institute of Biological Chemistry for the purpose of enhancing research focusing on the introduction of value-added characteristics (e.g., high oil production) in plants.

Bio-Fuels Rapid Response Team

In response to the immediate need for objective, research-based information related to biofuels, CAHNRS and WSU Extension have formed a rapid response team to provide educational programming on issues related to biofuels. This team was developed to connect with and draw upon the biofuels research and education expertise that exists both within WSU, as well as outside the University (e.g., Pacific Northwest National Laboratory, the National Renewable Energy Laboratory, the Idaho National Engineering Laboratory, USDA-ARS, other Land Grant universities) in developing and disseminating information to agricultural producers, citizens, and policy makers.

On-Going Research

WSU and CAHNRS have more than two decades of activities supportive of sustainable, bioenergy development in the state. Three recent research accomplishments of high profile are:

Anaerobic Digester. Dr. Shulin Chen, Department of Biological Systems Engineering, and a team of WSU researchers are developing improved processes for anaerobic digestion, which can capture methane from dairy farms that is normally lost to the atmosphere, and convert it into heat or electricity. The first two anaerobic digesters of this design in the state were developed in collaboration with WSU scientists and are now operational.

Cropping Systems. Scientists from the Department of Crop and Soil Science, Department of Biological Systems Engineering, Center for Sustaining Agriculture and Natural Resources, Department of Natural Resource Sciences, WSU Extension and the School of Economic Sciences are conducting research and extension programs to identify viable alternative crops for biofuels production. These crops include hybrid poplar, canola, rapeseed, switchgrass, Arundo donax, safflower, and various mustards.

Biomass Inventory. WSU and the Washington Department of Ecology just completed a state-wide biomass inventory that estimated by county the source and amount of biomass available for potential conversion to biofuels. This study is receiving considerable attention across the state and provides timely and important information for the state to develop a comprehensive biofuels strategy which will effectively utilize its unique biomass portfolio.

Academic Plan Area of Emphasis: Scholarship and Research Foci (Health and Life Sciences)

Activity: Advancing Life Sciences Research in Food System Plant and Animal Biotechnology

One of three strategic research priorities of the College of Agricultural, Human, and Natural Resource Sciences is to advance research and graduate programs in the area of Food System Plant and Animal Biotechnology. Several events over the past six months demonstrate the

College's commitment to this area.

Occupation of Plant Sciences Building

In August 2005, faculty began occupying the newly constructed Plant Biosciences Building. This world-class facility provides over 89,000 sq ft of lab space for plant sciences research at WSU. The building houses faculty from four CAHNRS departments (Plant Pathology, Natural Resources Sciences, Crop and Soil Sciences and Horticulture and Landscape Architecture), as well as researchers from the College of Sciences and USDA-ARS. Seventeen CAHNRS faculty occupy 17 labs within the building.

Faculty Positions

Through recent faculty hiring and ongoing searches, CAHNRS continues to build strength in the area of plant and animal biotechnology. Two recent hires have added considerable strength in this area. Dr. Dorrie Main, former Director of Bioinformatics at Clemson University's Genomics Institute, was hired to provide leadership in bioinformatics. Dr. Scott Hulbert, a leading crop biotechnologist from Kansas State University, was hired to fill the R. James Cook Chair in Cropping Systems Research. On-going searches include positions in horticultural genomics (Department of Horticulture and Landscape Architecture), animal molecular biology (Department of Animal Sciences), plant biotechnological sciences with an emphasis in bioproducts (Department of Crop and Soil Sciences), and plant biochemistry (Institute of Biological Chemistry).

Recent Discovery

Lead investigator Professor B.W. (Joe) Poovaiah and research associate Liqun Du recently discovered a way to control the ultimate size of a plant. By altering a specific gene, they were able to change the size of the plant that grew from an experimental seed. Different alterations led to different size plants, showing that plants might be "size-engineered" to fit the needs of growers. Their findings were recently reported in the prestigious journal *Nature*, and a patent is pending on this process.

Academic Plan Area of Emphasis: The Undergraduate Experience

Activity: Developing an Integrated Undergraduate Experience in the Agricultural Sciences.

CAHNRS has embarked upon a revolutionary path of re-engineering its curriculum to better meet the needs of students studying in the areas of agriculture and natural resources. Two recent accomplishments to this end are the development of the Agricultural and Food Systems degree and the integration of curricula in Horticulture and Crop and Soil Sciences.

Agricultural and Food Systems Degree

As we prepare the next generations of leaders in agriculture and natural resources, programs must be developed to meet a broader educational needs of students. Students cannot be trained along single disciplinary lines, but instead must be able to think and problem solve in an interdisciplinary context, understanding the complex interactions that exist within the food and agriculture system. The recently developed "Agricultural and Food Systems" degree (passed by Faculty Senate in February 2006) is designed to provide a more relevant educational and leadership experience and meet the evolving needs of students, agriculture, and society.

Agricultural and Food Systems have been described as "a specified group of components, operational functions, and processes that are integrated to accomplish a well-defined purpose; and, a complex system which can include systems within a system." This approach integrates the human, economic, chemical, biological, ecological, and educational components to accomplish the defined goal. Because of the diversity of this program, it is much more than a collection of courses. It is a series of coordinated, integrated experiences that foster critical thinking and communication skills, develop industry specific knowledge, and cultivate diversity of thought. The proposed degree is interdisciplinary and therefore does not fall within a single discipline. The objective of having students learn a systems approach to a given area (major/option) will afford the students the opportunity to develop the tools, abilities, and understanding of how various factors influence the performance of an integrated system.

The new degree, with its major options, will be a move forward in the academic program offerings and delivery of undergraduate programs in CAHNRS. This is the first step CAHNRS is undergoing in significant curriculum changes to move its programs forward. The program replaces five separate disciplinary degrees and/or majors with a single holistic curriculum. In addition, faculty faculty tenure homes and staff positions have been reassigned to more efficiently support and administer the proposed Agricultural and Food Systems degree.

Integration of Curricula in Horticulture and Crop and Soil Sciences

Complementary to the new Agricultural and Food Systems degree and moving forward with CAHNRS academic program offerings, we have integrated parts of the Horticultural and Crop and Soil Sciences curricula. The courses offered at the 101 and 201 levels by both departments were merged into single courses and renumbered 102 and 202. The enrollments in the new merged courses were larger than the aggregate enrollments in the stand alone individual courses. In the Fall 2005 the merged 102 course had an enrollment of 37 and in the Spring 2006 the 202 course offering had an enrollment of 43. This type of synergy will be sought as CAHNRS continues to review its entire curriculum.

Providing Students New Opportunities Through Experiential Learning

Since first offering HD 205 in the Spring of 2004 under the leadership of Kim Kidwell , the course has become a very popular course on campus and it fills part of the General Education Requirements in the area of communications. The course is designed as a hands-on course on the principals of experiential learning, communication, and team skills, while at the same time fostering connections between students, their peers, and the larger community. The course has

filled early in registration – mostly through student word-of-mouth. Starting in the Fall 2006, CAHNRS will expand the number of sections offered to 12 which is a 200% increase over the Spring 2004. The expansion has been possible as a result of support from the Provost's office and the reallocation of CAHNRS resources to support temporary instructors. Plans are being made to involve Extension in HD 205 by providing the opportunity for the students to work with Extension faculty in the experiential aspects of the student's educational experience.

Kay Flynn

060387

From: Donna Jones

Sent: Tuesday, August 15, 2006 1:32 PM

To: All PSC Staff; Commissioners & Staffs

Subject: Commissioners Clear the Path For Innovative Commercial Biomass Plant

A news release was distributed to the daily newspapers this afternoon, 8/15/06, and is now available on the PSC web site:

http://www.floridapsc.com/home/news/index.aspx?id=150

State of Florida

Public Service Commission

NEWS RELEASE

8/15/2006 **Contact: 850-413-6482**

Commissioners Clear the Path for Innovative Commercial Biomass Plant

TALLAHASSEE — The five-member Florida Public Service Commission (PSC) has taken a critical step to further development of the world's first commercial-scale power plant fueled with crops grown on site.

The Commissioners voted to approve a petition for Progress Energy Florida (Progress) to buy energy produced by the Florida Biomass Energy Group, LLC (Florida Biomass).

Florida Biomass plans to build and operate an electric generating plant on a 15,000-acre farm near Lake Okeechobee. The plant will produce power from a tall, bamboo-like grass. The crop will be grown and harvested in a continuous cycle and converted into a liquid fuel that will be used in a traditional combined cycle generator. The plant will also feature groundbreaking ways to process the plant material, using unique harvesting and material-handling systems. The biomass plant is slated to begin operation no later than December 2009.

The plant is expected to generate 116 megawatts of power, which would be the largest amount of power generated by a renewable fuel plant in the state of Florida. Projections indicate the energy would be slightly less expensive than the average cost of electric power from other sources. The plant will also contribute to the diversity of the fuel mix for electrical generation in Florida.

The agreement between Progress and Florida Biomass includes flexible targets, since the project incorporates numerous innovative designs. Projections for the plant indicate Progress ratepayers could see a benefit of $39 million in savings over a 25-year period.

###

CCA OFFICIAL DOCUMENT...

Kimberley Pena

From: Kimberley Pena
Sent: Friday, September 29, 2006 2:35 PM
To: Martha Brown
Subject: RE: Dkt. 060387

Thank you.

-----Original Message-----
From: Martha Brown
Sent: Friday, September 29, 2006 2:34 PM
To: Kimberley Pena
Subject: RE: Dkt. 060387

Scherf is probably right.

-----Original Message-----
From: Kimberley Pena
Sent: Friday, September 29, 2006 2:33 PM
To: Martha Brown
Subject: FW: Dkt. 060387

Clarification on Mr. Schoaf. Second protest reflects Scherf.

-----Original Message-----
From: Kimberley Pena
Sent: Friday, September 29, 2006 2:15 PM
To: Martha Brown
Subject: RE: Dkt. 060387

Will do. Thanks for your help.

-----Original Message-----
From: Martha Brown
Sent: Friday, September 29, 2006 2:14 PM
To: Kimberley Pena
Subject: RE: Dkt. 060387

I think Fusaro is correct.

-----Original Message-----
From: Kimberley Pena
Sent: Friday, September 29, 2006 2:12 PM
To: Martha Brown
Subject: RE: Dkt. 060387

Done 09/29/06 .P

****CCA OFFICIAL DOCUMENT...****

Mr. Ben Fuszro's name was changed on the second protest to Mr. Fusaro. I need clarification as to what is the correct name.

I'm looking at the second protest because it provides complete mailing addresses.

-----Original Message-----
From: Martha Brown
Sent: Friday, September 29, 2006 2:03 PM
To: Kimberley Pena
Subject: FW: Dkt. 060387

Kim, these people should be parties also.

1. Petitioners Karen Orr and Dick Stokes, 715 NE 2nd Street, Gainesville, Florida, Ben Fuszro, 203 Ridgeland road, Tallahassee, Florida 32312, Brian Schoaf, 1060 Tyler Street, Hollywood, Florida, and, Lee and December McSherry, 15212 SW 79th Avenue, Archer, Florida, each have substantial interests which are harmed by the proposed agency action in the above-styled matter.

-----Original Message-----
From: Kimberley Pena
Sent: Friday, September 29, 2006 1:58 PM
To: Martha Brown
Subject: RE: Dkt. 060387

Per this e-mail and our discussion, we will only add Mr. Hendrickson, protest filed on 09/22/06.

-----Original Message-----
From: Martha Brown
Sent: Friday, September 29, 2006 1:19 PM
To: Kimberley Pena
Subject: RE: Dkt. 060387

The persons named in the first protest should be included. Hold off on the persons only named in the amended protest. It was filed after the protest period had passed.

-----Original Message-----
From: Kimberley Pena
Sent: Friday, September 29, 2006 1:17 PM
To: Martha Brown
Subject: Dkt. 060387
Importance: High

We have received a protest and amended protest for this docket. Please let me know if the persons should be reflected as Parties of Record.

CCA OFFICIAL DOCUMENT...

Kimberley Pena

From: Kimberley Pena
Sent: Monday, October 23, 2006 7:59 AM
To: Martha Brown
Subject: RE: Dkt. 060387

Per this e-mail, we will change their status. Thank you.

-----Original Message-----
From: Martha Brown
Sent: Saturday, October 21, 2006 11:12 AM
To: Kimberley Pena
Subject: RE: Dkt. 060387

Hi, Kim,
Yes, I think you should make that change.

-----Original Message-----
From: Kimberley Pena
Sent: Friday, October 20, 2006 12:45 PM
To: Martha Brown
Subject: Dkt. 060387
Importance: High

Martha, we have received a Notice of Voluntary Dismissal of Protest in this Docket. Please let me know if you would like us to change the status of the persons, involved in this protest, from Party of Records to Interested Persons.

Done 10/23/06 mf

dkt file

STATE OF FLORIDA

DIVISION OF THE COMMISSION CLERK &
ADMINISTRATIVE SERVICES
BLANCA S. BAYÓ
DIRECTOR
(850) 413-6770 (CLERK)
(850) 413-6330 (ADMIN)

Public Service Commission

October 25, 2006

(CERTIFIED MAIL NO. 7005-1160-0003-8789-6168)

John T. Burnett, Associate General Counsel
Progress Energy Service Company, LLC
Post Office Box 14042
St. Petersburg, Florida 33733-4042

Re: Return of Confidential Documents to the Source, Docket No. 060387-EQ

Dear Mr. Burnett:

Commission staff have advised that confidential Document Nos. 04150-06, 04562-06, 04704-06, 05217-06, and 06725-06, filed on behalf of Progress Energy Florida, Inc., can be returned to the source. The documents are enclosed.

Please do not hesitate to contact me if you have any questions concerning return of this material.

Sincerely,

Kay Flynn

Kay Flynn
Chief of Records

KF:mhl
Enclosure

cc: Jeanette Sickel, Division of Economic Regulation
Martha Brown, Office of the General Counsel

STATE OF FLORIDA

DIVISION OF THE COMMISSION CLERK &
ADMINISTRATIVE SERVICES
BLANCA S. BAYÓ
DIRECTOR
(850) 413-6770 (CLERK)
(850) 413-6330 (ADMIN)

Public Service Commission

October 25, 2006

(CERTIFIED MAIL NO. 7005-1160-0003-8789-6168)

John T. Burnett, Associate General Counsel
Progress Energy Service Company, LLC
Post Office Box 14042
St. Petersburg, Florida 33733-4042

FPSC, CLK - CORRESPONDENCE
☑ Administrative ☐ Parties ☐ Consumer
DOCUMENT NO. 11821-06
DISTRIBUTION: ECR; GCL

Re: Return of Confidential Documents to the Source, Docket No. 060387-EQ

Dear Mr. Burnett:

Commission staff hav
04704-06, 05217-06, and 0
returned to the source. The

Please do not hesitate
material.

KF:mhl
Enclosure

SENDER: *COMPLETE THIS SECTION*
- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse ıat we can return the card to you.
ch this card to the back of the mailpiece, n the front if space permits.

ıcle Addressed to: 04150-06; 04562-06; 04704-06; 05217-06; 06725-06

N T BURNETT ASSOC GEN COUNSEL
GRESS ENERGY SERVICE CO LLC
BOX 14042
ETERSBURG FL 33733-4042

COMPLETE THIS SECTION ON DELIVERY

A. Received by *(Please Print Clearly)* | B. Date of Delivery

C. Signature
X
☐ Agent
☐ Addr.

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

ST. PETERSBURG, FL 33733
OCT 27 2006
CAPITAL CIRCLE

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number
(Transfer from service label) 7005 1160 0003 8789 6168

PS Form 3811, March 2001 Domestic Return Receipt 102595-01

cc: Jeanette Sickel, Division of Economic Regulation
Martha Brown, Office of the General Counsel

DOCUMENT NO. DATE
11821-06 10/25/06
FPSC - COMMISSION CLERK

STATE OF FLORIDA

DIVISION OF THE COMMISSION CLERK &
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BLANCA S. BAYÓ
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(850) 413-6770 (CLERK)
(850) 413-6330 (ADMIN)

Public Service Commission

October 25, 2006

Robert Scheffel Wright, Esquire
Young Van Assenderp, P.A.
Post Office Box 1833
Tallahassee, Florida 32302-1833

Re: Return of Confidential Document to the Source, Docket No. 060387-EI

Dear Mr. Wright:

Commission staff have advised that Confidential Document No. 04741-06, filed on behalf of Florida Biomass Energy Group, L.L.C., can be returned to the source. The document is enclosed.

Please do not hesitate to contact me if you have any questions concerning return of this material.

Sincerely,

Kay Flynn
Chief of Records

KF:mhl
Enclosure

cc: Jeanette Sickel, Division of Economic Regulation
Martha Brown, Office of the General Counsel

RECEIVED _____ DATE 12/7/06
(Burton)