What's Up in the Literature?

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If one were to do a literature search on invasive plant species using most of the better commercial science databases, the number of citations found would be considerable. Why is it, then, that when one tries to find *relevant* references on the invasiveness of these species, one often comes up empty-handed?

What follows is a description of the process that the authors, in a cooperative effort, have gone through in order to begin the comprehensive collection of relevant literature on the FLEPPC Category I list of invasive, non-native species for inclusion in the Aquatic Plant Information Retrieval System (APIRS) database (see Box 1). This collection will include the retrospective (or historical) literature, as well as newly published material. However, for the purposes of this article, we will focus on the literature published prior to December 2000.

As staff members of the University of Florida, we have access to the vast resources of the university's library holdings. These holdings include electronic databases and indexes to the literature. The science databases that we have searched (with the date of earliest records in parentheses) include *Biological Abstracts* (1980), *Cambridge Scientific Abstracts - Plant Science* (1994 - includes URLs), *CAB* (Commonwealth Agricultural Bureau - 1972), *FirstSearch* (specifically the *Agricola* database - 1970), ISI's *Current Contents* (preceding 24 months), *Everglades Digital Network* (1997), *NISC Biblioline* (1971), *Web of Science* (1945), and *Zoological Abstracts* (1978). Each of these databases was searched using the genus *and* species name of the plant (as listed in Table 1). In this compilation, synonyms were not used except for *Pueraria montana* and *P. lobata.*

Initially, Jamey Carter-King compiled aggregate lists of citations by searching the above-named databases, downloading the citations into "Libraries" using the EndNote citation-management software (Niles Software Inc.), and rejecting duplicate and incomplete citations. In addition to the paper's title and source, the EndNote Libraries included abstracts for about 80% of citations. The total number of citations per species (Table 1) varied from 0 for *Jasminum fluminense* (although this species was featured in the Winter 2000 issue of *Wildland Weeds*) to 833 for *Casuarina equisetifolia*. Nine species had no more than 10 citations and the average number of citations was 162 per species.

The numbers of citations found in the APIRS database for aquatic species have been included to complete the table for FL EPPC Category I (3rd column in Table 1.) Of the seven wetland or upland species for which the APIRS collection has been ongoing, only for *Casuarina equisetifolia* and *Sapium sebiferum* were there more citations in the commercial databases. In both of these cases, many papers would not be relevant to APIRS because they focus on phytochemistry, biochemistry, or forestry utilization. For the other five species for which APIRS has more citations, such as *Melaleuca quinquenervia* and *Mimosa pigra*, the extensive APIRS database includes articles from agency reports and conference proceedings (commonly referred to as "gray literature"), journals not covered by commercial databases (especially foreign language ones), and articles published prior to the earliest records of most commercial electronic databases.

To confirm the validity of the extracted citations, Jamey searched the Endnote Libraries by genus *and* species (4th column in Table 1.) For at least two thirds of the species studied, the species name occurred in the title and/or abstract for at least 75% of articles. Of the remaining 18 species, half of them had the genus in at least 75% of titles and/or abstracts. That

What APIRS does

For twenty years, the staff at APIRS has collected, cataloged, stored hard copies, and created a searchable computerized database of the literature on aquatic and wetland plants around the world. More recently, we have begun the collection of literature on upland invasive species in Florida under a grant from the Florida Department of Environmental Protection, Bureau of Invasive Plant Management. Our primary focus in this realm is the FLEPPC Category I and Category II species.

The APIRS database now contains over 53,000 citations. Approximately 2,200 of these citations are related to 44 upland invasive plant species listed on the Category I list. To search the database, go to http://plants.ifas.ufl.edu and click on APIRS Database Online, or contact Karen Brown at *kpb@gnv.ifas.ufl.edu* to have a search performed for you.

leaves 9 species (indicated by * in Table 1) such as *Neyraudia reynaudiana*, *Senna pendula*, *Solanum torvum*, and *Syzygium cumini* for which the reliability of the extracted citations is somewhat suspicious. Commercial databases may include citations that do not include the species name in the title or abstract because some databases: automatically search for synonyms; search whole papers and not just titles and abstracts; or include citations cataloged by scientific name, even if only the common name was used in the article.

For a preliminary screening of citations, Jamey used the titles and abstracts to assign relevant category designations from the following list (terms in bold used as abbreviations in Table 1): **taxon**omy, morphology, and identification; **life**-history; **abiotic** ecology; **biotic** ecology; economic impacts; **eco**logical **imp**acts; chemical control; biological control; mechanical control; cultural control; **uses; physi**ology and biochemistry; and genetics.

Several categories may be assigned to each citation and they were interpreted very broadly (e.g., a paper with information about the toxicity of a plant to birds would be included under "physiology and biochemistry" and "ecological impacts" because of likely impacts on wildlife). Most of these categories are similar to the major categories used by APIRS (see Box 2) but the full list of categories and keywords used for cataloging citations in APIRS is much more detailed and is applied to the entire paper, as opposed to just the title and abstract, by APIRS science reader/cataloger, Mary Langeland.

The most commonly allocated of Jamey's categories was physiology and biochemistry, being assigned to an average of 68% of citations. In fact, a third of all species had at least 90% of their citations assigned to this category (5th column in Table 1.) For species such as *Sapium sebiferum* this emphasis could be explained by a characteristic of the species, such as potential toxicity, that is important to humans. At the other extreme, the categories of economic impacts and control methods were assigned to an average of less than 5% of citations. By including more of the gray literature, the control categories are likely to be better represented in APIRS than in the commercial databases.

When adding a new species to the APIRS database list for collection, Mary Langeland further culls Jamey's aggregate list of citations for relevant references. Why is this necessary? The articles selected for inclusion in the APIRS database address not only the invasiveness of the plant, but other basic research on physiology, ecology, morphology, reproduction, etc. Although researchers and administrators alike want "everything there is" on a weedy species, the fact is that much, and in some cases, most of the literature has little to do with a plant's weediness or basic biology.

We are proceeding through the FLEPPC Category I list alphabetically. For the purposes of providing examples for this article, we review some of the genera starting with 'A'. These examples demonstrate the rather small percentage of articles found to be relevant for our purposes, and why they are, or are not, relevant.

Abrus precatorius

Searching on *Abrus precatorius* in the commercial databases produced a list of nearly 300 citations. However, approximately 245 of them specifically studied phytochemistry/biochemistry, especially toxicity to animals and pharmacology. For example, *Activity of Abrus precatorius L. extracts against*

APIRS Subject Categories

The APIRS list of major categories is quite long. The categories are further subdivided into sub-categories. Some of them, such as lakes and eutrophication, are mostly specific to aquatic species, since our roots are in the water. The categories that we most often use for upland invasive species are as follows:

- **Control** (biological (including insects, pathogens, etc.); chemical; cultural (including hand-removal, cutting, etc); mechanical; integrated (combinations of strategies); government (legislation, regulation, permitting, agency reports, etc.))
- **Ecology** (ecosystem; host plants; nutrient cycling; phenology (life history, senescence, fruiting, dormancy); plant succession; primary production; productivity;)
- **Economics** (economic impacts of invasives; costs of management; values of areas or preservation)
- **Morphology** (cytology; histology)
- **Physiology** (photosynthesis; transpiration; respiration)
- **Remote Sensing** (GPS; GIS; aerial surveys)
- **Reproduction** (flowering; germination)
- **Review** (does not contain original research)
- **Survey**
- **Taxonomy**
- **Toxic Plants** (lethal; irritant; allelopathic)
- **Utilization**

Plant names mentioned in the text are *always* part of the cataloged record. If there are more than 40, we list a representative selection and use the keyword phrase 'over 40 species'.

Any significant word from the text can be used as a keyword when cataloging citations in the APIRS database. Examples include illustrations (used when a reference contains good plant drawings or photographs); chemical control methodologies (such as basal bark method or cut stump method); habitat (used when plant habitat is described, or when the plant species provides habitat for other species); community response (for example, the ecological response of a plant community to the removal of an exotic species); competition; flooding or disturbance or drought (the effects of); restoration; natural areas management; seed dispersal; range; naturalized species; endangered species; biomass; herbivory; prescribed burns; population studies; seedling establishment; genetics; and many, many more.

More detailed explanations of our subject categories and keyword combinations can be found within the database section of our website: http://plants.ifas.ufl.edu/categor.html

Table 1. Data related to citations found in commercial electronic databases and the APIRS database for FL EPPC category I species. (Aquatic species were not searched in the commercial databases because APIRS has covered them for many years.)

	Commercial databases	APIRS database[1]	% naming species[2]	Most cited category[3] (%)		2nd most cited category[3] (%)	
Abrus precatorius	294		90	Phys	99	Ecol imp	52
Acacia auriculiformis	718		79	Uses	53	Phys	32
Albizia julibrissin	154		86	Phys	97	Ecol imp	29
Albizia lebbeck	414		81	Phys	99	Abiotic	44
Ardisia crenata	33		76	Phys	91	Ecol imp	48
Ardisia elliptica	4		75	Abiotic	75	Ecol imp	50
Asparagus densiflorus	78		44	Phys	90	Abiotic	38
Bauhinia variegata	189		77	Phys	98	Uses	46
Bischofia javanica	85		94	Phys	85	Uses	47
Calophyllum antillanum	5		80	Taxon	80	(Several)	20
Casuarina equisetifolia	833	100	94	Phys	94	Abiotic	54
Casuarina glauca	216		63	Phys	98	Uses	72
Cestrum diurnum	43		88	Phys	100	Ecol imp	60
Cinnamomum camphora	212		91	Phys	93	Ecol imp	41
Colocasia esculenta	*not incl.*	301					
Colubrina asiatica	13	16	85	Abiotic	54	Phys	54
Cupaniopsis anacardioides	13	40	69	Phys	85	Abiotic	62
Dioscorea alata	440		75	Uses	46	Life	45
Dioscorea bulbifera	122		81	Phys	53	Taxon	49
Eichhornia crassipes	not incl.	4,064					
Eugenia uniflora	103		84	Uses	44	Ecol imp	34
Ficus microcarpa	86		92	Taxon	40	Biotic	30
Hydrilla verticillata	*not incl.*	3,022					
Hygrophila polysperma	*not incl.*	134					
Hymenachne amplexicaulis	*not incl.*	37					
Imperata cylindrica	467		97	Phys	88	Ecol imp	80
Ipomoea aquatica	not incl.	241					
Jasminum dichotomum		3	33*	Taxon	67	(Several)	33
Jasminum fluminense	0						
Lantana camara	25		76	Ecol imp	68	Phys	40
Ligustrum sinense	49		69	Taxon	45	Ecol imp	40
Lonicera japonica	244		77	Phys	55	Ecol imp	42
Lygodium japonicum	90		73	Life	74	Phys	69
Lygodium microphyllum	17		65*	Taxon	47	Ecol imp	47
Macfadyena unguis-cati	9		78	Phys	50	Taxon	40
Melaleuca quinquenervia	155	384	79	Ecol imp	60	Taxon	59
Melia azedarach	697		86	Phys	90	Uses	66
Mimosa pigra	191	323	88	Ecol imp	94	Taxon	55
Nandina domestica	85		93	Phys	79	Uses	55
Nephrolepis cordifolia	38		71	Taxon	78	Abiotic	78
Nephrolepis multiflora	7		43*	Abiotic	100	Taxon	86
Neyraudia reynaudiana	13		8*	Ecol imp	79	Abiotic	64
Paederia cruddasiana	10		30*	Ecol imp	100	Taxon	60
Paederia foetida	40		62	Ecol imp	87	Phys	74
Panicum repens	*not incl.*	355					
Pennisetum purpureum	676		92	Phys	95	Uses	83
Pistia stratiotes	*not incl.*	1,049					
Psidium cattleianum	51		92	Phys	77	Ecol imp	50
Psidium guajava	829		91	Phys	98	Uses	72
Pueraria montana	312		86	Phys	94	Ecol imp	59
Rhodomyrtus tomentosa	13		100	Phys	77	Abiotic	69
Rhoeo spathacea	57		91	Phys	86	Life	70
Sapium sebiferum	139	84	96	Phys	95	Ecol imp	50
Scaevola sericea	24		83	Phys	83	Abiotic	75
Schefflera actinophylla	66		59	Phys	92	Abiotic	71
Schinus terebinthifolius	125	285	85	Phys	92	Ecol imp	64
Senna pendula	18		28*	Abiotic	100	Ecol imp	78
Solanum tampicense	6		67	Ecol imp	100	Taxon	60
Solanum torvum	239		44*	Phys	79	Life	39
Solanum viarum	93		98	Phys	82	Ecol imp	45
Syzygium cumini	20		10*	Phys	90	Life	75
Tectaria incisa	5		40*	Taxon	100	Abiotic	100
Thespesia populnea	100		91	Phys	94	Ecol imp	34
Tradescantia fluminensis	82		87	Phys	98	Taxon	45
Urochloa mutica	*not incl.*	90					

[1] Data included only for species for which APIRS has been collecting for several years. APIRS collections are in progress for all FL EPPC Category I species but partial data are inconclusive and quickly out-dated.

[2] Percentage of articles for which the species name is found in the title and/or abstract when searched using EndNote software. * indicates that less than 75% of citations included the genus in the title and/or abstract.

[3] Full names of Jamey's categories are listed in the text.

the two-spotted spider mite Tetranychus urticae Koch (Acari: Tetranychidae) by S.A.A. Amer, et al in Acarologia (1989) 30(3):209-216 would not be considered relevant and would not be collected. There were no references specifically on the invasiveness of *Abrus precatorius*. There were 55 references that Mary deemed relevant and they fell into the following subject categories: physiology, utilization (human medical needs), reproduction (seed germination), morphology, taxonomy, ecology, and weed control (in citriculture).

Acacia auriculiformis

Searching *Acacia auriculiformis* in the commercial databases produced a list of 718 total citations. Of these, 491 focused on phytochemistry and forestry/reforestation in other countries (mostly propagation for forestry; nitrogen-fixation; wood characteristics; utilization for erosion control for disturbed, saline or mined areas). For example, *Comparison of volume production, basic density and stem quality between Acacia mangium and Acacia auriculiformis grown in Zanzibar* by M.S. Ali, et al in Journal of Tropical Forest Science (1997) 10:10-17 would not be acquired, nor would *Growth of three multipurpose tree species on tin tailings in Malaysia* by K. Awang in Journal of Tropical Forest Science (1994) 7:106-112. An example of a phytochemistry article that would not be collected is *Enhancement of membrane damage by saponins isolated from Acacia auriculiformis* by S. Babu Santi Prasad in the Japanese Journal of Pharmacology (1997) 75(4):451-454. There were 234 relevant citations in the following areas: physiology (transpiration, photosynthesis), ecology (primary production, phenology, host plants, nutrient cycling, plant succession), invasiveness (2), reproduction (germination, flowering, ontogeny, micropropagation), morphology (genetics, identification, root nodes), taxonomy, toxic plants (nematicide), and fire. An example of a relevant article on the invasiveness of Acacia is *The earleaf acacia, a fast growing, brittle exotic "weed" tree in Florida* by J.F. Morton in the Proceedings of the Florida State Horticultural Society (1985) 98:309-314.

Albizia lebbeck

Albizia lebbeck had a total of 414 citations in the commercial databases, primarily on forestry/reforestation, use as forage/fodder, and phytochemistry. There were 108 relevant citations on physiology, ecology, invasiveness, allelopathy, reproduction, morphology and taxonomy. Research which focuses on insects or pathogens of the plant is usually selected for inclusion. Such articles offer studies on herbivory, larval damage to the plant, disease symptoms, etc. which could lay the groundwork for biological control research. A good example is *Losses in Albizia lebbek due to leaf spot and pod diseases caused by Colletotrichum dematium and their control* by T. Mohd, et al (1996) in Impact of Diseases and Insect Pests in Tropical Forests; the IUFRO Symposium, Peechi, India, pp. 81-84. Another relevant article would be Julia Morton's *Woman's tongue, or cha-cha (Albizia lebbeck Benth.), a fast-growing weed tree in Florida, is prized for timber, fuel, and forage elsewhere* in the Proceedings of the Florida State Horticultural Society (1983) 96:173-178. This article describes the natural range

for *Albizia lebbeck*, the history of its introduction into Florida, its distribution around the world, its utilization in the Old World, and its growth habits in south Florida as of 1983. The article also provides information on the climatic and soil requirements of the plant, nitrogen fixation, propagation, growth rate, economic uses and a valuable list of 76 references in the literature cited. As an interesting aside, Ms. Morton suggested that the common name of 'chacha' be adopted as "brief, pronounceable in any language, pleasantly expressive, and inoffensive to females." *[The authors support this adoption.]* She claimed that the various common names have been inspired by the "clatter of the persistent dry pods."

Ardisia crenata

Ardisia crenata had a total of only 33 citations in the commercial databases, most of which were about phytochemistry and utilization as an ornamental plant. While phytochemistry is considered physiology research, these references often comprise the bulk of the total literature available on a species. They are easily found in specific journals (for example, Phytochemistry) and are well indexed in electronic databases for those interested in this research. Also, there usually is a general lack of applicability to research conducted for control or management of invasive species. Some examples of such physiology / phytochemistry articles are *New bergenin derivatives from Ardisia crenata* by Z. Jia, et al, Natural Medicines (1995) 49(2):187, or *Minor triterpenoid saponins from Ardisia crenata* by K. Koike, Chemical and Pharmaceutical Bulletin (1999) 47(3):434-435. Much of this research is geared toward finding new products such as medicines, or antifeedants in stored crops. If the research appears to be about the allelopathic effects of an invasive species on other plant species, which would potentially be an invasive trait, it is of course deemed relevant. This type of research could be used to support the designation of a species as invasive.

Articles that deal with the horticultural propagation of *Ardisia crenata* are selected because they usually contain research on basic physiology of the plant. For example, *The study of photosynthetic CO2 exchange as a measure of the growth and yield of agricultural, ornamental, and horticultural plants* by R. Ceulemans and I. Impens, Revue de l'Agriculture (1982) 12(4):1-3 might be acquired if available. Articles are not selected if they deal with methodology and are directed toward the ornamental plant industry, for example, *Production and use of Ardisia crenata as a potted foliage plant* by C.A. Conover, et al, Foliage Digest (1989) 12(4):1-3.

Seemingly vague articles such as *Short comments on Ardisia (Myrsinaceae) of eastern Asia* by Y.P. Yang, Botanical Bulletin of Academia Sinica (Taipei) (1989) 30(4):297-298 are acquired because they offer valuable information about the plant in its native habitat or range.

Another good example of a relevant plant pathogen article would be *Foot rot of Ardisia crenata caused by Fusarium solani* by C. Fu, Taiwan Journal of Forest Science (1999) 14(2):223-227.

The process of obtaining full copies of articles for cataloging and entry into the APIRS database is another undertaking altogether. Only a small part of the retrospective literature has actually been collected, cataloged and added to the APIRS database. For the

rest, newer articles may be available online or in current printed journals carried by the university library. Older items may be found in older printed journals in the library stacks. Where author addresses are available and current, articles can be requested in writing. But in some cases such as very old articles or those in obscure journals, articles simply may not be available. Articles that seem strongly relevant but can not be obtained may be cited in the database as 'citation only', and hopefully may be found in someone's collection at a later date. Because the truth is, bibliographies and indexes, even when cataloged, annotated or with abstracts, are not always useful to researchers unless the text of the document is available.

What we ultimately hope to create is a comprehensive collection of *relevant* references on Florida's invasive, non-native plant species, cataloged and computerized for easy searching of the literature, with hard copies available for research purposes. APIRS has done this for aquatics. Now we've taken on the task of upland invasives. It's a big job but, together, we're working on it!

A Note on "Growth Inhibition by *Schinus terebinthifolius*"

Karen Brown

Over the years here at APIRS, we have had numerous requests for the above titled paper by G.J. Gogue, C.J. Hurst and L. Bancroft. It is one of the very few publications on the allelopathic effects of *Schinus terebinthifolius*. The paper is cited in a few publications: one by Julia F. Morton in 1978 (*Brazilian Pepper - Its Impact on People, Animals and the Environment* - Economic Botany 32(4):353-359), and one by John J. Ewel, D.S. Ojima, D.A. Karl and W.F. DeBusk in 1982 (*Schinus in Successional Ecosystems of Everglades National Park*, Rept. T-676). Ms. Morton cites it as "Paper presented at annual meeting of American Society for Horticultural Science, Guelph, Ontario, Canada. Aug. 14, 1974," and Ewel cites it as Amer. Soc. Hort. Sci. 9:45. (1974). I could not find a copy of this paper. After numerous attempts, I finally checked with the American Society for Horticultural Science (ASHS) some time ago and their editor at the time could find no record of it. I determined that it was probably never published, but merely presented at one of the ASHS annual meetings as cited by Ms. Morton. But people kept asking me for it, and they kept asking Ken Langeland for it (who, in turn, asks me for it), so I decided to give it one more shot before writing a note for *Wildland Weeds* stating that the paper in question unequivocally does not exist.

There is a Journal of the ASHS, but it was not there. There is a Proceedings of the ASHS, but it was not there. There is a Proceedings of the Annual Meeting of the ASHS, but these were all from the 1920's, and it was not there. Finally, during a chance conversation with a researcher in horticultural science, it was pointed out that one of the official journals for the ASHS is *HortScience*. I decided to give it a try and thumbed through the 1974 issues of *HortScience* at the University of Florida's Marston Science Library. I found that Volume 9, Number 3 had two sections published, the second of which was the Program and Abstracts of the 71st Annual Meeting in Canada. On page 45 of the program, which is also page 301 of the journal, I found the coveted abstract by Dr. Gogue. It may be somewhat of an anticlimax, but the abstract is reprinted here with permission from the American Society for Horticultural Science.

Growth inhibition by *Schinus terebinthifolius,* by G.J. Gogue, C.J. Hurst and L. Bancroft. HortScience Vol. 9(3) Section 2:301. 1974.

Brazilian pepper tree (*Schinus terebinthifolius*), a woody ornamental, has demonstrated seasonal allelopathic effects in Everglades National Park. Water leachates from various *Schinus* parts, i.e. fruit, fresh leaves, litter, stems, etc. reduced germination of *Bromus rigidus* when the leachate supplied the moisture in germination studies. Radical elongation was also suppressed by the leachate. The greatest inhibition in both germination percent and radical elongation occurred from the fruit leachate. With thin layer chromatography, the fruit leachate was separated into nine components. The spots were removed and used in a bioassay with *B. rigidus* as a test plant. The results indicated that three spots contained allelopathic materials. Identification of these spots with a mass spectrometer showed galic and ferulic acid derivitives to be present.