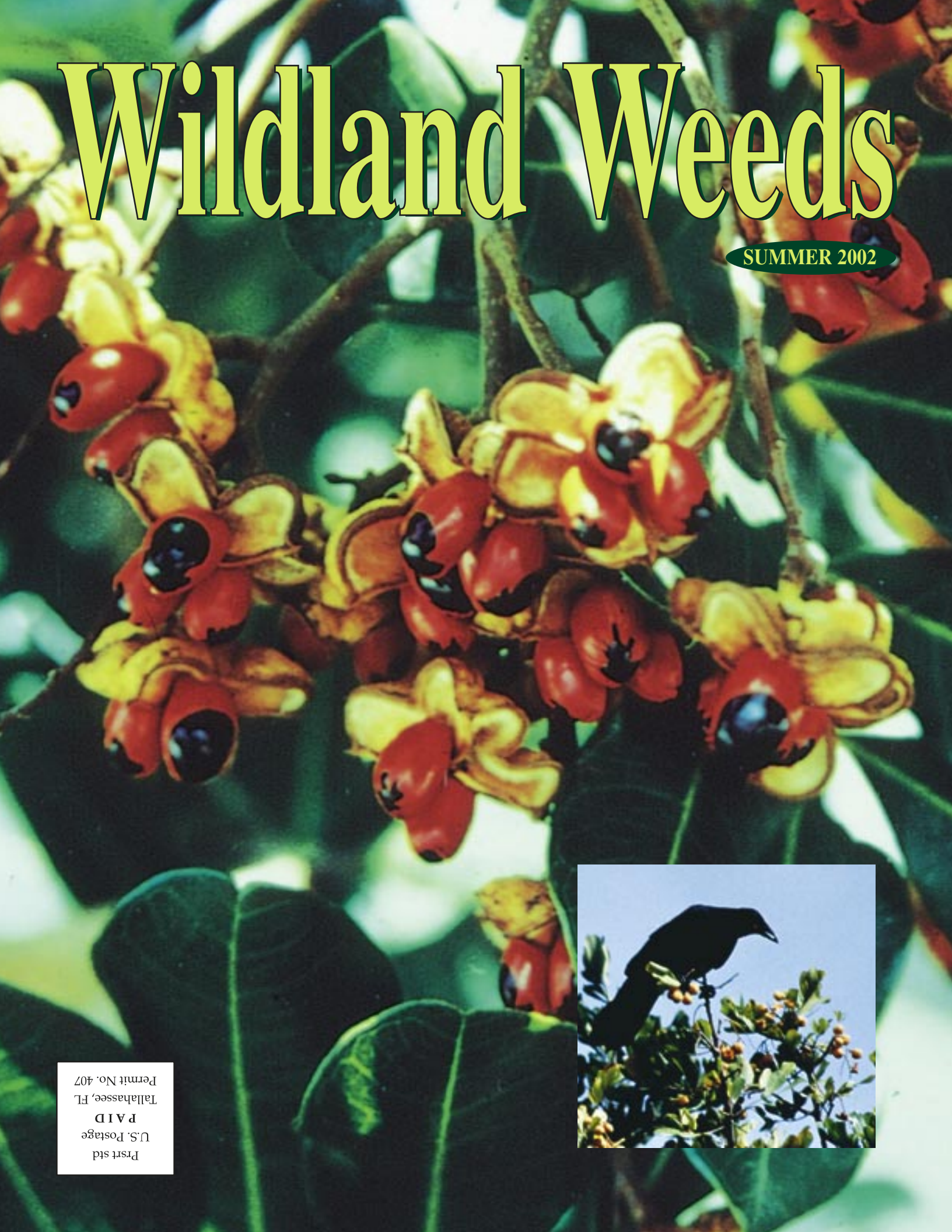


Wildland Weeds

SUMMER 2002



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Cover: Fish crow (*Corvus ossifragus*) with fruit of carrotwood (*Cupaniopsis anacardioides*). But is it dispersing the seed? See article on page 8. Bird photo by Ken Langeland. Fruit photo by Chris Lockhart.

Editor's Note

This issue of *Wildland Weeds* represents my first as editor, with Tom Fucigna as assistant editor. I would like to raise a frosty glass to the able editorship of Amy Ferriter, who began with the Winter 1997 Charter Issue and proceeded all the way through the Spring 2002 issue. *Thank you, Amy, for all of your hard*

work! I look forward to editing *Wildland Weeds* with the energetic assistance of Tom, and hope that we can contribute to this important publication.

My first chosen task was to prepare an index to the issues of *Wildland Weeds* under Amy's editorship. This should prove a useful tool both to Tom and I, as new editors, and to the readers and contributors of *Wildland Weeds*. It also illustrates the wide array of topics

and plant species covered in these pages so far.

I thank those who contributed to this issue and look forward to working with future contributors, the editorial committee, and the members of FLEPPC. Please feel free to contact me regarding ideas you may have for future issues of *Wildland Weeds*.

Karen Brown, Editor

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What role do birds play in dispersal of invasive plants?



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*“Look, that bird is eating a fruit!
But is it dispersing the seed?”*

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Introduction

Plants use various strategies for dispersing seeds and a thorough understanding of how dispersal occurs for invasive, exotic species is essential if we want to understand and control their spread. There may be several reasons why a particular species is designated as a FLEPPC Category I plant, but without a reliable dispersal mechanism, a species will not become a problem beyond a local scale.

We have examined the literature to see what is known about vertebrate-assisted seed dispersal of FLEPPC Category I species, and were surprised to find how few dispersers have been adequately verified. Identification of dispersal agents seems to lean heavily on assumptions and little on testing. Moreover, while there is a basic understanding of this type of dispersal, there often seems to be a lack of knowledge of important subtleties. Consequently, the purpose of this article is to provide a basic explanation of vertebrate-assisted seed dispersal and, using examples from literature involving exotic species, to illustrate when the process has been misapplied or not fully understood.

Vertebrate-assisted seed dispersal

Ecologists recognize several reasons why seed dispersal is important to

plants. First, because sites suitable for growth vary in space and time, plants must be able to colonize new areas as conditions change. Second, dispersal beyond the parental canopy is a means of avoiding competition with the parent and siblings. Finally, dispersal from the parent is important because some predators of seeds (e.g., rodents, insects, or microbes) often concentrate their efforts under parent plants where food density is highest.

For most plants, mechanisms have evolved for their seeds to be dispersed beyond the range of their branches. Usually these are fairly straightforward processes, such as by wind or water. Two strategies involve animals carrying seeds either externally or internally, termed ectozoochory and endozoochory, respectively. Ectozoochoric fruits or seeds attach to animals with hooks, barbs, or sticky secretions, while endozoochoric fruits usually entice animals with a meal of some sort. In the simplest example of endozoochory, an animal eats a fleshy fruit and later expels an undamaged seed away from the parent plant.

Simple, yet confusing, terminology

It is important to remember that the terms *fruit* and *seed* are not synonymous, and that it is confusing when they are used interchangeably in the

literature. Also, fruit consumption does not guarantee seed dispersal. Granivorous birds consume seeds, and this is referred to as predation because the seeds are rendered non-viable. Frugivorous birds consume fruit, which can include the skin, pulp and seed(s). The seeds can be expelled in a viable state and this activity is referred to as seed dispersal if the seed has been carried away from the parent plant.

A loosely coevolved mutualism

Endozoochory is an example of a loosely coevolved mutualism. In this example, loosely coevolved means that most frugivores will eat many different fruits. Tight relationships between a specific fruit and frugivore are unusual, and are not known to occur for invasive plants. Indeed, widespread dispersal is successful for many exotic plant species because endozoochory is loose. Species that are dependent upon a specific disperser probably would not become a problem when introduced beyond their natural range. This type of seed dispersal represents a mutualism because both participants benefit; the frugivore with a meal and the plant with its seeds dispersed.

Following fruit consumption, seeds may be carried away from or dropped

An exceptional plant.

Chinese tallow (*Sapium sebiferum*) has fruit that seems to be quite unique. The fruits are capsules that at maturity split open to expose three large seeds covered in a white waxy coating. This substance is high in lipids (very energy-rich), and is a fairly good source of protein as well. Birds use the sides of their bills to scrape the wax from the seeds, often using a foot to hold the fruit against a branch. While this is usually done on the parent tree, fruits are occasionally carried to adjacent trees for scraping. The seed is dropped once the nutritious wax has



been removed. This dispersal system means that many seeds are not dispersed, and those that are dispersed may not make it very far. This could be a consideration if one were to attempt to model the speed at which Chinese tallow expands its range. Moreover,

because this is a novel dispersal system, the naive native birds may have taken some time to learn how to utilize this new resource, and therefore contributed to a time lag before the tree became invasive.

Photo by Ken Langeland

near the parent plant, with the latter resulting in no dispersal. Furthermore, studies have found that ingestion may increase (e.g. Braun and Brooks 1987), decrease (e.g. Smith 1975), or have no effect on (e.g. Panetta and McKee 1997) seed germination rates. In all of these instances the frugivore benefits, but for the relationship to be mutualistic, ingestion and seed passage must not have any negative consequences on germination. These two events, seeds either not being moved away from the parent plant or being damaged during consumption, may account for the majority of instances where seed dispersal is not successful.

Why fleshy fruit?

Endozoochoric fruits consist of a digestible outer layer surrounding at least one seed, and in the majority of cases this is a fleshy pericarp consisting of pulp and skin. Alternatively, some fruits possess an aril, a fleshy protruding appendage (e.g., earleaf acacia [*Acacia auriculiformis*]) that in some species completely surrounds the seed (e.g., carrotwood [*Cupaniopsis anacardioides*]).

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Deceptive appearances

Seeds of rosary pea (*Abrus precatorius*) are unusual in that they are mimetic, a trait shared with the native coral bean (*Erythrina herbacea*). The glossy, hard seeds are bright red, and not surrounded by pulp or skin. Instead, they mimic fleshy-pulped fruits in a game of deception, taking advantage of frugivorous birds to disperse their seeds with no compensatory reward.



Seeds of rosary pea (*Abrus precatorius*)

Arillate fruits have their seeds dispersed in the same way as the more typical types (e.g. berries), so the difference may be of most importance to those working with plant anatomy or taxonomy.

The digestible material of a fruit has three main nutritional components: lipids, carbohydrates, and protein. Summer/early fall fruits tend to be higher in carbohydrates and water, while fall/winter fruits generally contain higher levels of lipids. Protein levels are usually low (perhaps nitrogen, a component of protein, is too important to the plant). Both birds and mammals feed on summer and early fall fruits, which are often sweet-tasting, while the lipid-rich fruits of fall and winter are mostly utilized by birds.

Many species of temperate fruiting plants in the Eastern U.S. set fruit in the fall, presumably to take advantage of migrating birds. These birds need energy to fuel migration, and fruits provide an easily assimilable and visible source. However, Florida's natural communities may operate a bit differently because they are subject to the selective pressure of a large overwintering bird population rather than the passage of fall migrants (Skeate

1987). Much of the state has a temperate flora and hence most plant species produce fruit in the early fall. However, greater fruit biomass may be produced in the late fall and winter months (albeit by fewer plant species) when birds such as American robins (*Turdus migratorius*), cedar waxwings (*Bombycilla cedrorum*), gray catbirds (*Dumetella carolinensis*), and yellow-rumped warblers (*Dendroica coronata*) overwinter in Florida.

The time of the year that ripe fruits are on the plant could influence the direction of seed dispersal. For example, an invading plant that fruits in the spring may be most likely to experience a gradual northward population shift due to the spring migration of millions of birds. It should be

remembered that each bird carries seeds a small distance at a time (depending upon flight speed and duration of seed retention), not for the thousands of miles of the whole migration route.

The dispersal process

Seed ingestion. For efficient flight it is essential that birds try to minimize unnecessary weight, for example, by eliminating heavy, indigestible seeds as quickly as possible. There are various mechanisms to get rid of seeds, and frugivorous birds can be divided into two groups: gulpers and mashers (Levey 1987). Gulpers are species that tend to swallow fruits whole, separate the seeds from the pulp internally, and then void the seeds at some distance from the parent plant (e.g., northern mockingbird [*Mimus polyglottos*]). Mashers tend to crush fruits in their bills, separating the seeds from the pulp and swallowing just the pulp (e.g., northern cardinal [*Cardinalis cardinalis*] and boat-tailed grackle [*Quiscalis major*]). Generally, birds with heavier conical bills are mashers while those with thinner bills are gulpers.

Where a masher removes the seed

is important. Birds usually stay in the parent plant to accomplish this task (personal observation), thus seed dispersal has not occurred. But if the bird flies to another perch to remove the seed, seed dispersal will have occurred.

Seed deposition. How a gulper rids itself of seeds is also important relative to plant dispersal. The seed may be separated from the pulp in the stomach with the seed regurgitated, or separation can occur further along the digestive tract with the seed defecated. Birds are adept at this task and can regurgitate seeds that are cleaned of even the most adherent pulp. Since there is great variation among plant species in the adhesion of pulp to the seed, it is possible that the ease of this separation could influence fruit choice by frugivorous birds.

Murray et al. (1994) showed that there is a positive correlation between the distance over which a seed is dispersed and the length of time that a bird carries the seed. Thus, the mechanism of voidance can influence rates of expansion of plant populations because regurgitation is usually much quicker than defecation. Meyer and Witmer (1998) found that after fruit consumption by American robins, the mean seed defecation time of the



Pokeweed (*Phytolacca americana*) seeds left on the parent plant by a masher, the northern cardinal (*Cardinalis cardinalis*)
Photo by Michael Meisenburg

Discouraging predation

Ecologists have long tried to determine why fruits of some plant species are chosen in preference to others. The nutrient content of fruit flesh has an important influence on selection (lipids are particularly important for migrating birds), but many plants also produce distasteful secondary compounds (e.g., tannins, saponins). It seems contradictory that a plant with fleshy fruit that appears to be attractive for frugivores, would contain compounds that deter consumption. However, this deterrence may be intended for another type of organism. Moist fruit pulp is an ideal habitat for a variety of microorganisms which, if unrestrained, may cause seed mortality or make fruits distasteful to potential dispersers. Researchers at the University of Florida (Cipollini & Levey 1997a, 1997b) isolated secondary compounds from different *Solanum* species and tested them on microbes and frugivores. While these distasteful compounds significantly slowed fungal growth, they also discouraged consumption by frugivorous animals.

Although these interactions initially

appear detrimental to the dispersal of a plant, there may be important consequences in the whole plant community. Fruit with secondary compounds may be retained on the plants for many weeks, due to resistance to microbes and distaste to frugivores. Since few plants produce fruit in the spring, those with fruit that persists until then may provide the only food source for birds on their spring migration. Similarly, for non-migratory birds such as northern mockingbirds, these persistent, least-preferred fruits may be crucial for surviving a cold, or extended, north Florida winter.

Other compounds may influence seed dispersal without reducing the consumption of fruit. It has been proposed by Murray et al. (1994) that some fruit may contain laxative compounds that hasten the defecation of seeds before they are damaged in the bird's gut. Also, many plants produce distasteful or toxic chemicals in the seeds themselves, to encourage seed ejection and deter seed predation (e.g., the bitter taste in apple seeds is due to cyanide compounds).

native shrub *Viburnum dentatum* was 58 minutes versus a mean regurgitation time of 19 minutes. Although these authors studied both avoidance methods for one type of seed using a single bird species, it is more typical that each bird species will exclusively either regurgitate or defecate seeds of a particular size. It is likely that birds preferentially regurgitate seeds, so as to eliminate unnecessary weight as quickly as possible. However, smaller seeds are more likely to be defecated because they are not as easily separated from the pulp in the bird's crop.

In our own feeding trials with the fruit of *Ardisia crenata* (containing seeds of approximately 5mm diameter), northern mockingbirds typically regurgitate the seeds, while cedar waxwings will defecate them. Recognizing that many factors in addition to size influence which bird species feed on which fruits (e.g., fruit color, exposure on the plant), it can be hypothesized that as a result of different avoidance methods, the rates of expansion of a plant species could be influenced by which bird species tend to feed on its fruits.

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Added complexities

Although we tend to classify vertebrates as frugivores or granivores and assume that they may be responsible for seed dispersal and predation, respectively, this often oversimplifies the situation. Species such as squirrels that store certain seeds for later consumption often fail to recover all their cache. Surviving seeds that are able to germinate will have been successfully dispersed, even though the disperser is usually regarded as a seed predator. In an

even more complicated relationship, acorns of the red oak group are high in tannins, but the tannins are concentrated in the lower half of the acorn. Squirrels often will eat only the top half of the nut and drop the bottom half. However, the lower half contains the embryo and will germinate, thereby establishing a mutualism in what would otherwise be interpreted as a predatory event.

Seed viability. The mutualism is only complete if an undamaged, viable seed is dispersed. Seeds may be damaged either in the bill or digestive tract. Such damage may improve germination for hard-coated seeds that need scarification before they can germinate, or it can cause seed mortality. The severity of damage may increase with the length of time a seed is retained in the bird's

digestive tract (Murray et al. 1994). Thus, there may be a trade-off for the plant between the distance seeds are carried prior to defecation (improving seed dispersal), and the proportion of seed remaining viable (reducing seed dispersal).

In addition to frugivorous birds feeding on fruit pulp, granivorous birds may feed on the seeds of fruits. The house finch (*Carpodacus mexicanus*) is

historically a western U.S. species that, following introduction into New York City in the 1940's, expanded its range into Florida. These finches are granivorous, and as such are seed predators. While they are commonly observed feeding on fruits, often they are actually cracking the seeds and feeding on the entire fruit (skin, pulp, and seeds). Similarly, with a gizzard that is capable of crushing pecans and acorns, wild turkeys (*Meleagris gallopavo*) and other members of the order Galliformes often digest the seeds, rendering them non-viable. An observation of these species feeding on fruits can easily be misinterpreted as seed dispersal rather than seed predation.

Seed dispersal verification

Thus, a conclusive determination of endozoochoric seed dispersal by birds requires verification that the seeds are 1) ingested, 2) carried away from the parent plant, and 3) voided in a viable condition. Observation of fruit consumption does not distinguish between seed dispersal and



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Table 1.

Predominant dispersal mechanism for FL EPPC Category I plants described in the literature (not including ferns). (Other mechanisms may predominate as a method of reproductive increase.)

Dispersal mechanism

Wind	{ <i>Casuarina</i> spp.} <i>Macfadyena unguis-cati</i> <i>Neyraudia reynaudiana</i>	<i>Imperata cylindrica</i> <i>Melaleuca quinquenervia</i>
Water	<i>Colubrina asiatica</i> (<i>Hydrilla verticillata</i>) <i>Hymenachne amplexicaulis</i> <i>Mimosa pigra</i> <i>Solanum tampicense</i>	(<i>Eichhornia crassipes</i>) (<i>Hygrophila polysperma</i>) <i>Ipomea aquatica</i> (<i>Pistia stratiotes</i>) <i>Thespesia populnea</i>
Vertebrate: Verified	<i>Ardisia crenata</i> <i>Ligustrum</i> spp. <i>Schinus terebinthifolius</i>	<i>Jasminum</i> spp. <i>Sapium sebiferum</i> <i>Solanum viarum</i>
Vertebrate: Observations only	<i>Abrus precatorius</i> <i>Ardisia elliptica</i> <i>Bischofia javanica</i> <i>Cinnamomum camphora</i> <i>Eugenia uniflora</i> <i>Lantana camara</i> <i>Melia azedarach</i> <i>Paederia</i> spp. <i>Rhodomyrtus tomentosa</i> <i>Schefflera actinophylla</i> <i>Syzygium cumini</i>	<i>Acacia auriculiformis</i> <i>Asparagus densiflorus</i> <i>Cestrum diurnum</i> <i>Cupaniopsis anacardioides</i> <i>Ficus microcarpa</i> <i>Lonicera japonica</i> <i>Nandina domestica</i> <i>Psidium</i> spp. <i>Scaevola sericea</i> <i>Solanum toroum</i>
Vegetative expansion	<i>Colocasia esculenta</i> <i>Panicum repens</i> <i>Pueraria montana</i>	<i>Dioscorea</i> spp. <i>Pennisetum purpureum</i> <i>Urochloa mutica</i>
Other / unknown	<i>Albizia</i> spp. <i>Calophyllum antillanum</i> <i>Tradescantia</i> spp.	<i>Bauhinia variegata</i> <i>Senna pendula</i>

Parentheses indicate dispersal of vegetative propagules or fragments rather than seeds.

{Reported in error as vertebrate dispersed}; For citations, contact authors, or review Langeland and Burks (1998). Please let the authors know of literature or unpublished data that support a different category for a particular species.

seed predation (van der Pijl 1972). However, documentation of seedlings distant from the rest of the plant population and in sites frequented by birds (e.g., under tree roosts; along fence lines) is an indication that bird

dispersal is likely (McDonnell and Stiles 1983).

Categories of verification

In an attempt to determine how

many vectors of vertebrate-assisted seed dispersal for FLEPPC Category I plants have been verified, we searched the literature but were disappointed to find the evidence somewhat limited. Literature searches were aided by using Langeland and Craddock Burks *Identification & Biology of Non-Native Plants in Florida's Natural Areas* (1998). We used their species accounts to find citations pertaining to seed dispersal, and performed our own searches for additional references. Though by no means complete, we believe our list is a representative sample of what exists in the literature. These accounts were then assigned to categories based on the dispersal mechanism and extent of verification. Of the 62 species covered by Langeland and Craddock Burks, 30 produce fruits that appear to be (mostly) endozoochoric, making this dispersal mechanism the most utilized by Category I species (Table 1). For seeds thought to be dispersed by birds or mammals, our categories were based on whether: 1) seed viability was assessed for voided seeds, 2) claims of dispersal agents were based only on observations of fruit consumption, or 3) they contained probable erroneous information.

Dispersal and viability confirmed

Dispersal vectors have been studied in detail for species such as Brazilian pepper (*Schinus terebinthifolius*) (Panetta and McKee 1997, Ewel et al. 1982), tropical soda apple (*Solanum viarum*) (Akanda et al. 1995), and Chinese ligustrum (*Ligustrum sinense*) (Montaldo 1993). Panetta and McKee (1997) fed Brazilian pepper fruits to captive birds and compared germination rates of defecated seeds to those that were manually depulped, finding no difference. Ewel et al. (1982) observed Brazilian pepper seedlings sprouting in mammal scat but, while verifying mammals as dispersal agents, such reports often fail to distinguish the mammalian species. Mammal scat, whether from raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), red fox (*Vulpes vulpes*), or gray fox (*Urocyon cinereoargenteus*), is difficult to key out to species, especially when consisting of seeds.

Observations of fruit consumption

Another category is of simple reports of fruit consumption. For example, Martin et al. (1951) and Handley (1945) report consumers for Japanese honeysuckle (*Lonicera japonica*) fruits, Kellum (1997) for nandina (*Nandina domestica*), and Nelson (1994) for Chinaberry (*Melia azederach*) fruits. However, of these reports, not one mentions subsequent seed dispersal. Reports such as these should be interpreted with caution, because consumption does not necessarily imply seed dispersal. As a case in point, Langeland and Burks (1998) cited Morton (1980) as reporting that Australian pine (*Casuarina equisetifolia*) is dispersed by birds (especially exotic parrots and parakeets). However, what Morton wrote is that the birds feed on the seeds of these trees, and this is the correct statement. Australian pine seeds are winged samaras (like maple fruit) that implies wind dispersal, and as such these seeds lack a fleshy coating. Parrots or any other birds feeding on these seeds would be responsible for seed predation rather than dispersal.

Missing or erroneous evidence

There are also authors that report birds as seed dispersers, but with no mention of any direct evidence, as Morton (1982) did for day jessamine (*Cestrum diurnum*), and Cronk and Fuller (1995) for strawberry guava (*Psidium cattleianum*). What information such statements are based upon is unclear, but they may rely on uncited or unpublished material, untested assumptions, or lack of knowledge of the complexities of bird - plant interactions.

Finally, there are reports that are likely in error. Cronk and Fuller (1995) reported that kudzu (*Pueraria lobata*) is dispersed by birds and mammals, but it is likely that neither disperses the seeds. As many legumes do, kudzu produces fruits in the form of a pod that splits open when dry to release its seeds. While it is possible that seeds could be dispersed by mammals grazing on the plant, there is no reason for birds to eat the pods. Conversely, rooting at the nodes along the creeping branches and intentional planting by

humans are the primary modes of dispersal in the U.S. (D. Orr, North Carolina State University, 2001 personal communication). Any seed dispersal occurring may be accomplished by the plant alone: with branches up to sixty feet long, the plant is capable of delivering seeds at a significant distance from its own roots. However, it is considered that nearly the entire seed crop produced by kudzu falls prey to beetles. Consequently, in the U.S. seed production in the field is insignificant (D. Orr, pers. comm.).

Conclusion

How a plant disperses its propagules beyond the reach of its branches is a problem that most species must solve. Animals are dispersal vectors for many plant species, ferrying seeds either internally or externally. Unlike the species-specific relationships that are sometimes seen with plants and their pollinators, dispersal relationships are usually general in nature. Thus, when a plant that relies upon endozoochory for seed dispersal is introduced outside its native range, it is likely that suitable vertebrate dispersers will be available. However, it should be remembered that not all occurrences of fruit-eating result in seed dispersal. A better understanding of the process may lead to greater objectivity in the conclusions that we draw from our observations.

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Literature Cited

- Akanda, R.U., J.J. Mullahey, and W.F. Brown. 1995. Tropical soda apple (*Solanum viarum*) seed survivability in the rumen. Proceedings of the Weed Science Society of America. 35:27.
- Braun, J. and G.R. Brooks. 1987. Box turtles (*Terrapene carolina*) as dispersal potential agents for seed dispersal. American Midland Naturalist. 177:312-318.
- Cipollini, C.L. and D.J. Levey. 1997a. Why are some fruits toxic? Glycoalkaloids in *Solanum* and fruit choice by vertebrates. Ecology 78:782-798.
- Cipollini, C.L. and D.J. Levey. 1997b. Antifungal activity of *Solanum* fruit glycoalkaloids: Implications for frugivory and seed dispersal. Ecology 78:799-809.

- Cronk, Q.C.B. and J.L. Fuller. 1995. Plant invaders. London: Chapman and Hall. 241 p.
- Ewel, J.J., D.S. Ojima, D.A. Karl, and W.F. Debusk. 1982. *Schinus* in successional ecosystems of Everglades National Park. Homestead (FL): South Florida Research Center. Report number T-676.
- Handley, C.O. 1945. Japanese honeysuckle in wildlife management. Journal of Wildlife Management. 9:261-264.
- Kellum, J. 1997. Another look at nandina. Southern Living 32:393-397.
- Langeland, K.A., and K. Craddock Burks, 1998. eds. Identification & biology of non-native plants in Florida's natural areas. Gainesville: University of Florida, Institute of Food and Agricultural Sciences. 165 p.
- Levey, D.J. 1987. Seed size and fruit-handling techniques of avian frugivores. American Naturalist. 129:471-485.
- Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. New York: Dover Publications. 500 p.
- McDonnell and Stiles. 1983. The structural complexity of old field vegetation and the recruitment of bird-dispersed plant species. Oecologia. 56:109-116.
- Meyer, G.A., and M.C. Witmer. 1998. Influence of seed processing by frugivorous birds on germination success of three North American shrubs. American Midland Naturalist. 140:129-139.
- Montaldo, N.H. 1993. Dispersión por aves y éxito reproductivo de dos especies de *Ligustrum* (Oleaceae) en un relicto de selva subtropical en la Argentina. Revista Chilena de Historia Natural. 66:75-85.
- Morton, J.F. 1980. The Australian pine or beefwood (*Casuarina equisetifolia* L.), an invasive "weed" tree in Florida. Proceedings of the Florida State Horticultural Society. 93:87-95.
- Morton, J.F. 1982. Plants poisonous to people in Florida and other warm areas. Stuart: Southeast Printing Co. 170 p.
- Murray, K.G., S. Russel, C.M. Picone, K. Winnett-Murray, W. Sherwood, and M.L. Kuhlmann. 1994. Fruit laxatives and seed passage rates in frugivores: Consequences for plant reproductive success. Ecology 75:989-994.
- Nelson, G. 1994. The trees of Florida. Sarasota: Pineapple Press. 338 p.
- Panetta, F.D. and J. McKee. 1997. Recruitment of the invasive ornamental, *Schinus terebinthifolius*, is dependent upon frugivores. Australian Journal of Ecology. 22:432-438.
- Skeate, S.T. 1987. Interactions between birds and fruits in a North Florida hammock community. Ecology 68:297-309.
- Smith, A.J. 1975. Invasion and ecesis of bird-disseminated woody plants in a temperate forest sere. Ecology 56:14-34.
- van der Pijl, L. 1972. Principles of dispersal in higher plants. Berlin: Springer-Verlag. 161 p.

Invasive Weeds

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– Bureau of Land Management Environmental Education Homepage, www.blm.gov/education/weed/intro.html

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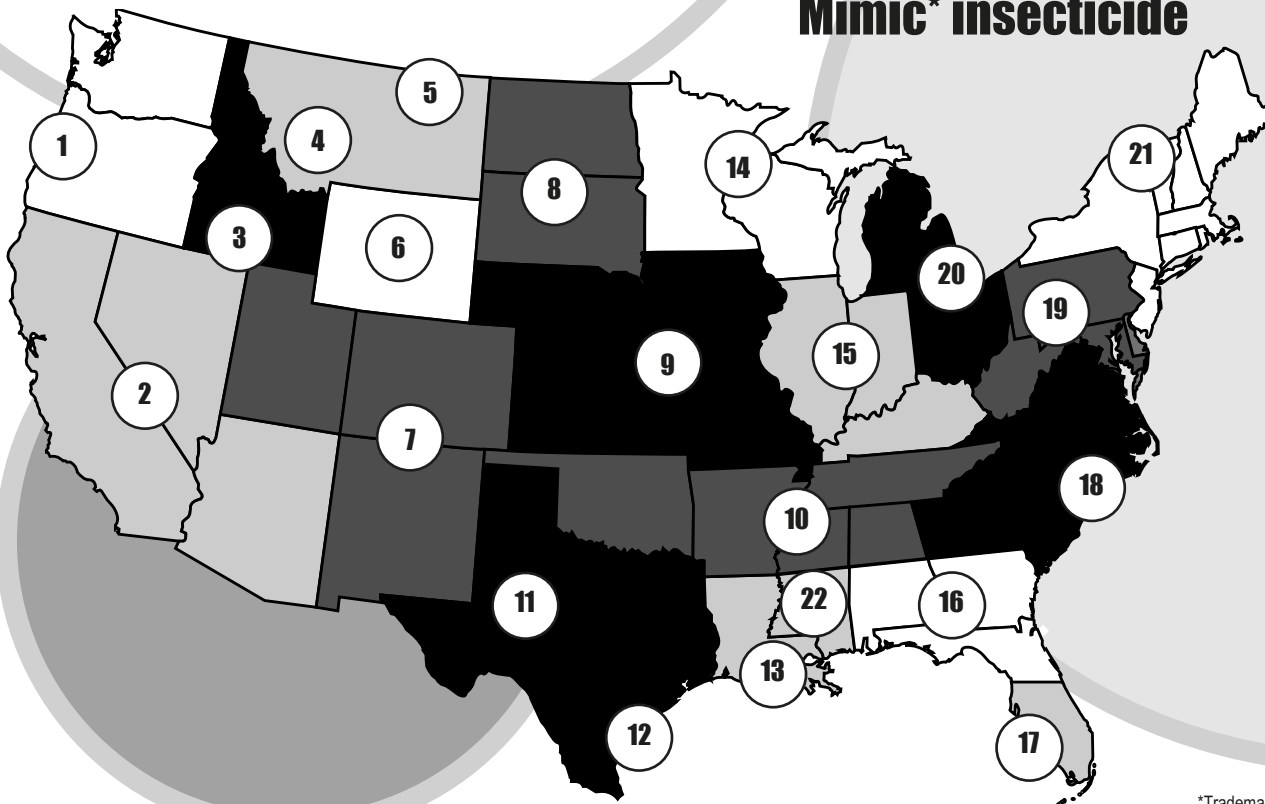
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Proper Uses of FLEPPC's List of Invasive Species

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Introduction

Floridians' awareness of problems caused by invasive plant species is rapidly increasing as a result of public education efforts by the Florida Exotic Pest Plant Council (FLEPPC) and others. We must now accept the responsibility to ensure that information pertaining to invasive plant species is factual and correctly interpreted, and to maintain constructive relationships with others who may be affected, such as the horticulture industry.

County and City Commissions are increasingly asked to help protect natural areas from invasive plant species by adopting into ordinance the entire "Florida Exotic Pest Plant Council's List of Invasive Species" (FLEPPC List) or certain species because they are on the list. These measures may take the form of exemptions to tree cutting ordinances, plant species prohibited from inclusion in landscaping plans, or mandatory removal of certain species. FLEPPC is often asked to provide support in the form of letters or expert witness when adoption of such measures is being considered. The purpose and appropriate uses of the FLEPPC List in tree and landscape ordinances are discussed in this article.

History and Purpose of the FLEPPC List

FLEPPC's early focus was on organizing to manage melaleuca, but efforts soon evolved into a broader focus on all invasive exotic plant species in the state. The FLEPPC List Committee was established to bring plant experts together to list and prioritize all of the state's invasive plant species. The first list was made public in 1991 and has been refined and revised every two years as more information has been collected. The purpose of the FLEPPC List has been clearly stated since its publica-

tion and has always been published along with each subsequent printing and update. In general, the stated purpose is to focus attention on the problems associated with invasive plant species, inform resource managers about which species need to be monitored, and to help managers set priorities for management. Although certain plants on the FLEPPC List are regulated by local, state, or federal statute, it is not intended that all species on the List should be prohibited everywhere in Florida. Certainly, species on the FLEPPC List may be worth considering for inclusion in a local ordinance, but additional information should always be gathered during the decision-making process for a particular city or county.

Prohibited Plant Lists

Prohibiting species from sale or use can cause economic hardship and changes of well-established cultural practices. Before prohibiting species from sale or use, it is imperative that adequate information exists on the degree of invasiveness, the local threat to the environment, and the economic and cultural impacts. Species are placed on the FLEPPC List after being nominated and voted upon by the FLEPPC List Committee because they have been observed to be invasive in natural areas of the state, particularly in parks and preserves. The statement, "... does not rely on economic severity or geographic range of the problem," means that an invasive species does not have to be extremely costly to control or occur in all regions before it is listed. Also, the FLEPPC List does not address the economic importance of a species to the horticulture trade. Species to be addressed in local regulation should be considered on the basis of locally developed criteria, such as the species' local occurrence, severity, or potential to spread further, plus the local economic and cultural impacts.

When asked to assist with identifying plant species to be prohibited by local ordinance, FLEPPC encourages the use of the FLEPPC List as a first

step to identify species, with additional information then included in making any final decision. FLEPPC members should assist local staff in determining those species from the FLEPPC List that are invasive within the jurisdiction of the particular ordinance or in nearby natural areas, and species that are potentially invasive in that geographic region. The FLEPPC occurrence database is a good source of information to determine geographic range and occurrence. A second useful source is the University of South Florida's online *Atlas of Florida Vascular Plants*.

Local growers and landscapers, as members of a potentially affected constituency, should be involved in determining what plant species are listed in local ordinances. While prohibiting invasive plant species from landscapes to limit the source of propagules is one method of protecting natural areas, the economic impact of prohibiting a commercially important species and the cultural impact of eliminating a popular landscape species is of concern to growers and landscapers. These groups understandably will raise opposition to prohibiting these economically or culturally important species. It is important for land managers to work together with local staff, growers and landscapers to find compromises to present to their lawmaking bodies as a unified voice. When agreement cannot be reached, it is then up to the lawmaking body to decide what compromises to make based on economic and environmental considerations.

Since its first public availability, the FLEPPC List has caused concern within the horticulture industry because some species that occur on the list are also important in the trade. The FLEPPC/FNGA Liaison Committee has made great strides in working with the nursery industry to discourage sales of certain plant species on the FLEPPC List, including ones that are still sold commercially but are not considered important in the trade. These plants, hopefully, can be easily agreed upon at the local level as plants to be prohibited. Additional species could be agreed upon based on discussions

between natural resource managers and growers/landscapers at the local level.

Mandatory Removal

Ordinances that require mandatory removal of invasive species will invoke economic and, possibly, cultural hardships on citizens. Therefore, (as in the case of prohibiting invasive species from landscape plans) FLEPPC should encourage the use of the FLEPPC List as a first step to identify species. However, additional information beyond that needed for a species to be placed on the FLEPPC List is necessary for requiring mandatory removal of invasive species. Certain invasive species are very expensive to control; for others, methods may not be available that give consistent results. FLEPPC can assist local governments by providing information on severity of invasiveness, distribution, and the most cost effective control methods for species being considered for mandatory removal.

Exemption from Tree Removal

Many local governments have tree-

cutting ordinances that require property owners to obtain permits before removing trees of certain size. If invasive exotic tree species are included, the ongoing efforts to encourage property owners to remove invasive plants from their property may be deterred. FLEPPC encourages local governments to eliminate such impediments by exempting exotic pest plants from tree-cutting permit requirements. Because tree removal in this case is a voluntary action and will not impose hardship on anyone, the entire FLEPPC List could be exempted from any tree-cutting permit ordinance. Even if species listed are not invasive in the specific region of Florida, these ordinances simply provide property owners with greater flexibility regarding their property.

FLEPPC Policy on Use of its Invasive Species List in Ordinance

While great care has been taken to formulate the FLEPPC list, care also must be given to how it is interpreted and used. FLEPPC encourages the use of the Invasive Species List for

prioritization and implementation of management efforts by natural resource managers, in environmental education programs, and in voluntary removal programs. When species are to be prohibited in some capacity, or removal is to be required by law, FLEPPC encourages the use of its invasive species list as a first step to identify species to be considered. FLEPPC does not promote regulating species for the sole reason that they occur on the list. FLEPPC will continue to work with the horticulture and other industries to develop recommendations that discourage the sale and use of invasive species on the FLEPPC List. FLEPPC also will continue to develop and disseminate information pertaining to these invasive species. FLEPPC will encourage additions to the Florida Noxious Weed List and the Prohibited Aquatic Plant List for certain invasive plant species that are clearly threatening Florida's natural communities and native species, incurring significant ecological and economic losses to the citizens of Florida.

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Agave sisalana Perrine

by Karen Brown,

University of Florida, Center for Aquatic and Invasive Plants, 7922 N.W. 71st Street, Gainesville, FL 32653; kpb@mail.ifas.ufl.edu

Introduction

Agaves are often associated with the alcoholic beverages *tequila* (produced from *A. tequilana*) and *mescal* (produced from *A. salmiana* and other species). *Agave sisalana* Perrine is known for its fiber production, and is commonly known as “sisal” or “sisal hemp”. It is the primary agave cultivated for fiber in eastern Africa, Brazil, India, and various countries in Asia. In the first half of the twentieth century, sisal supplied about 70 percent of the world’s long hard plant fibers (Nobel 1994). The fibers run the entire length of the leaves, which can grow to five feet, and have been used for rope, twine, nets, upholstery padding, carpet pads, blankets, baskets, jewelry, sandals, clothing, fish stringers, musical instruments, ceremonial objects, construction material, paper pulp, and even dart boards (Nobel 1994). Although sisal is native to Mexico, commercial hard fiber from Mexico is produced primarily from henequen (*A. fourcroydes*) and lechuguilla (*A. lechuguilla*). According to Nobel (1988), *A. sisalana* was exported from Mexico in the 19th century and formed the basis of fiber industries in Indonesia, the Philippines and, in the

Agave sisalana

This somewhat startling picture is taken from a postcard photographed at Bridon Fibres, Gateshead, UK. It depicts fibers extracted from sisal leaves (*Agave sisalana*) that are “...combed and carded and loosely twisted into... slivers before being spun into rope.” (copyright, Trustees, Royal Botanic Gardens, Kew. Used with permission.)



20th century, East Africa. Later, Mexico prohibited the export of the plant to protect its own fiber industry but, by then, plants were available in Florida, having been imported and established by Dr. Henry Perrine (Morton 1952, Nobel 1994, Trelease 1913). Nobel reports that 1,000 bulbils were sent from Florida to Germany in 1893. Bulbils are young plantlets, usually at least four inches in length, that occur on

the inflorescence and can be planted directly in the soil. Approximately 200 bulbils survived the trip and 62 survived the ensuing trip to German East Africa (now Tanzania). Within five years, these plants multiplied into 63,000 starter plants for large plantations in Tanzania, Kenya, Mozambique and Uganda. These plantations eventually supplied approximately half of the world’s hard fiber (Nobel 1988, 1994). By the early 20th century, *A. sisalana* also was cultivated in India, Southeast Asia, many Pacific islands, and Australia (Nobel 1988).

Field reports

Agave sisalana Perrine, commonly known as sisal hemp, is on the FL-EPPC Category II list of invasive species. According to a FL-EPPC database search in January 2002, there were 24 field reports for this species, with the most reports coming from Dade County (7), followed by Monroe County (5), Martin (4), Palm Beach (3), Lee (2), Broward (2) and Sarasota (1). Lee County leads in acreage reported at 600 acres, followed by Martin at 84, Monroe at 34, and Broward at 19. However, only 7 of the 24 field reports included estimates of acreage. Of the 15 density estimates provided, one “dense monoculture” was reported in Dade County, one in Sarasota County, and one in Monroe County. All other density estimates were “scattered plants.” The University of South Florida’s online *Atlas of Florida Vascular Plants* (www.plantatlas.usf.edu/), which is based on vouchered herbarium specimens, lists *Agave sisalana* in Brevard, Manatee, Lee, Collier, Monroe, Dade and Martin counties, (i.e. it lists specimens in 3 counties *not* listed in FL-EPPC field reports (Brevard, Manatee, and Collier), while FL-EPPC has field reports for 3 counties *not* listed in the online atlas (Palm Beach, Broward, and Sarasota).)

Origin of *Agave sisalana*

The genus *Agave* was established by Linnaeus in 1753 and contains approximately 136 species in the Agavaceae family (Nobel 1988). Agaves are native to North America, with their center of origin in present-day Mexico (Gentry 1982, Nobel 1988). Gentry reports that the “origin of *Agave sisalana* is uncertain. Because it was originally exported from Mexico via the port of Sisal in Yucatan, it has long been erroneously reported as of

Yucatan origin. However, no botanical collections of the plant have ever been made in Yucatan, and botanists who have worked in Yucatan have told me they did not find the plant there."

Fiber plantations in Yucatan are reported to be henequen, *Agave fourcroydes*. Residents in the neighboring state of Chiapas grow *Agave sisalana* as fence rows and for fiber, which is made into rope, nets, hammocks, and other functional items. Gentry states that the "occupation appeared indigenous and, since this is the only area in which *A. sisalana* has been observed and regularly employed in the village complex, I regard the area as a likely place of origin."

Growth of Agave

Gentry describes *Agave sisalana* as a sexually sterile clone, probably of hybrid origin, due to its general inability to produce seed and by its chromosomes. He also notes that night temperatures of 24-25° F (-5° C) often cause leaf "burn" and dieback. Nobel (1994) reports that sisal grows best on free-draining non-saline soils, and that in regions of Kenya and Tanzania with 1200 millimeters of rainfall per year (similar to Florida's range of from 1000 to 1,500 millimeters per year), *A. sisalana* has a total above-ground dry weight productivity of about 20 tons per hectare per year. Under plantation conditions, *A. sisalana* produces about 220 leaves per plant before the emergence (referred to as "bolting") of the 5-6 meter high inflorescence at about



Control

Agave sisalana has not been the focus of major control efforts in Florida, although it has been a minor component of a few projects (G. Jubinsky, personal communication, Jan. 30, 2002.) However, thousands of *Agave* understory plants covering approximately thirty acres on Loggerhead Key were destroyed after *Casuarina equisetifolia* was burned off in a prescribed fire treatment. For plants not controlled by the fire, Tony Pernas reports that good results were obtained by breaking the "heart" from the main plant and spraying with 20% Garlon 4 herbicide. Smaller plants were removed by hand. (personal communication, Feb. 11, 2002) (See *Dry Tortugas National Park - Loggerhead Key Exotic Plant Management & Island Restoration Project*, T. Pernas, et al., *Wildland Weeds* (2001) 4(4):13-17.)



Sisal plantation on the Perrine Grant, ca. 1920. The plantation ultimately failed. (Used with permission from the Historical Museum of Southern Florida.)

seven years of age (Nobel 1994). Leaves can be harvested after two years of age, which will postpone the "bolting" for 15-20 years. After "bolting", the plant dies.

The United States Sisal Trust

The United States Sisal Trust was a company (ca. 1919) organized to develop and grow sisal commercially in south Florida. According to a brochure for the company, 22,400 acres

Mature sisal plant with bloom stalk, ca. 1920. (Used with permission from the Historical Museum of Southern Florida.)

Described by Gentry (1982) as "forming rosettes 1.5-2 m tall with stems 4-10 dm long, suckering with elongate rhizomes; leaves ensiform. . . fleshy, finely fibrous, smooth, the margins of mature leaves usually toothless, the young leaves with a few minute teeth; spine 2-2.5 cm long, dark brown . . . panicle 5-6 m tall with 10-15 lateral branches of umbellate clusters in upper half, bulbiferous after flowering; flowers 55-65 mm long, greenish yellow, malodorous . . ."

of land in Dade County (Florida City) were to be developed into a plantation, 10,000 acres of which was to be devoted to sisal production. 750,000 plants were grown in a nursery to supply the first unit of 1,000 acres. The expected market for the sisal was American farmers who needed "binder twine, rope and other cordage." The brochure for this company states that 220,000 tons were imported into the U.S. in one year, primarily from Mexico, Cuba and the Bahama Islands. The company intended to capitalize on this market. The brochure goes on to describe the introduction of sisal into south Florida:

"The first sisal plants in Florida were introduced at Indian Key in the year 1826 by Dr. Henry Perrine, American Consul at Campeche, Yucatan, who applied for and received from the United States Government a grant of a township of land conditioned upon its being planted to this product. Later the Indians murdered him and drove his family away. A few years later Mrs. R.V.S. Carpenter, who lives four miles south of Miami gathered a number of these plants from the Perrine grant and planted them at her home overlooking Biscayne Bay at Coconut Grove. From these original plants others have been set out as ornaments all over Dade County, and as far north as Jupiter. A large number being recently planted for ornamental purposes at the entrance of the palatial home of James Deering in the city of Miami, where they are seen to thrive on rock walls and fences without practically any soil."

The advent of synthetic fibers during and after World War II severely depressed the natural fiber industry and many plantations failed or were converted to other crops. Current attempts to boost the economic returns of sisal cultivation include research

into uses for leaf pulp by-products and sap.

Agave in the Literature

Following are some of the more interesting and unusual citations found on *Agave sisalana* in the scientific journal literature. The wide ranging list covers research from Oribatid mites to the invasion of sandy beachfronts to electrical behavior of fibers to permethrin-impregnated sisal curtains to mushroom cultivation to toothbrush sticks to an Olduvai skull.

Aoki, J.I., Wang, H.F. (1986) Two Oribatid mites injurious to economic plants *Acari-formes oribatida*. *Acta Zootaxonomica Sinica* 11(4):375-377. "Another species collected from Guandong and Guangxi Provinces formed many spots on the leaf surface of *Agave sisalana* which were cultured in the field."

Banerjee, A.K. (1972) Trial of *Agave* species in lateritic areas of West Bengal. *Indian Forester* 98(7):432-436.

Batianoff, G.N., Franks, A.J. (1997) Invasion of sandy beachfronts by ornamental plant species in Queensland. *Plant Protection Quarterly* 12(4):180-186. "In this study, the most important factors contributing to ornamental weed invasions are human assisted plant introductions through the dumping of garden plants into native vegetation."

Bos, J.J., Lensing, F.H.G. (1973) A new cultivar in sisal from East Africa: *Agave sisalana* Perr. ex Engelm. cv. *hildana*. *East African Agricultural and Forestry Journal* 39(1):17-25.

Castorena-Sanchez, I., Escobedo, R.M., Quiroz, A. (1991) New cytotoxicological determinants recognized in six taxa of *Agave* in the sections Rigidiae and Sisalanae. *Canadian Journal of Botany* 69(6):1257-1264.

Chand, N. (1991) Electrical behaviour of sisal fibre. *Indian Journal of Fibre and Textile Research* 16(4):287-288. "Electrical properties such as dielectric, constant, dissipation factor and resistivity of sisal fibre have been determined."

Ding, Y., Chen, Y.Y., Wang, D.Z., et al (1989) Steroidal saponins from a cultivated form of *Agave sisalana*. *Phytochemistry* 28(10):2787-2791.

El-Gamassy, A.M., El-Rahman, A.A.A., Hassib, M., et al.

(1974) Vegetative patterns and water economy of *Agave sisalana* in saline soils. *Zeitschrift fuer Acker- und Pflanzenbau*. 139(3):165-171.

Ewusie, J.Y., Ghatak, J. (1972) Studies on reproduction and cytology of sisal (*Agave sisalana* Perrine ex Engelm.) *Ghana Journal of Science* 12(1):42-50.

Githeko, A.K., Adungo, N.I., Karanja, D.M., et al (1996) Some observations on the biting behavior of *Anopheles gambiae* s.s., *Anopheles arabiensis*, and *Anopheles funestus* and their implications for malaria control. *Experimental Parasitology* 82(3):306-315. "Studies were carried out in three villages in western Kenya on the biting behavior of *Anopheles gambiae* s.s., *Anopheles arabiensis*, and *Anopheles funestus*. . . . Under the influence of permethrin-impregnated sisal curtains placed under the eaves of village houses, there was a marked egress of blood-fed *A. funestus* and *A. gambiae* s.s."

Grob, K., Artho, A., Biedermann, M., et al (1993) Contamination of hazelnuts and chocolate by mineral oil from jute and sisal bags. *Zeitschrift fuer Lebensmittel Untersuchung und Forschung* 197(4):370-374. "Before spinning, jute and sisal fibres are treated with a batching oil commonly consisting of a raw material oil fraction. Such oil is transferred to foods packed into jute or sisal bags, i.e. primarily cocoa beans, hazelnuts, coffee, almonds, oil seeds, and rice."

Gupta, R.K., Agarwal, M.C., Joshie, P. (1997) Phenotypic stability of *Agave* species on bouldery wastelands (riverbed) of Doon Valley. *Indian Forester* 123(4):331-337. "*Agave sisalana* was found to be the only stable *Agave* species and hence could be recommended for mass adoption on bouldery wastelands of Doon Valley."

Harkonen, M., Saarimaki, T., Mwasumbi, L. (1993) Tanzanian mushrooms and their uses 2. An edible species of *Coprinus* section *Lanatuili*. *Karstenia* 33(1):51-59. "*Coprinus cinereus* s. lat. is commonly grown in waste heaps of sisal (*Agave sisalana*) processing factories in Tanzania."

Hartemink, A.E. (1997) Input and output of major nutrients under monocropping sisal in Tanzania. *Land Degradation and Development* 8(4):305-310. "Much more nitrogen was lost from the topsoil than can be explained by the nutrient balance, indicating significant losses."

Ilanaga, C., Ramos, J., Young, R.A., et al. (2001) Biomechanical pulping of *Agave sisalana*. *Holzforschung* 55(1):42-46.

Inguine, M., Mayoral, M.L., Mays, E., Olivares, E., et al (1995) Effect of seasonal drought and cactus X virus infection on the crassulacean acid metabolism of *Agave sisalana* plants growing in a neotropical savanna. *Journal of Experimental Botany* 46(287):639-646. "Healthy and cactus X virus infected *Agave sisalana* plants were collected during the dry and rainy seasons in two contrasting savanna sites."

Kassu, A., Dagne, E., Abate, D., et al (1999) Ethnomedical aspects of the commonly used toothbrush sticks in Ethiopia. *East African Medical Journal* 76(11):651-653. "Twenty different species of plant[s] used as toothbrush[es] were collected and their botanical identity determined. . . . All the extracts showed antibacterial activity against *Staphylococcus aureus* and *Bacillus cereus* by agar diffusion method."

McLaughlin, S.H., Shud, S.M. (1991) Fiber properties of several species of Agavaceae from the southwestern United States and northern Mexico. *Economic Botany* 45(4):480-486.

Ludlow, W., Wachs, C., et al (1983) Pollen of the genus of *Agave* from the Yucatan peninsula Mexico. *Boletin de la Sociedad Botanica de Mexico* 44:29-42.

Mukerjee, N. (1970) A preliminary report on the root-rot of *Agave*



Agave decipiens, false sisal
Photo by Sherryl Furnari

NOT Targets for Control in Florida: Two Endemic Agaves

Natural resource managers in central and south Florida may encounter the invasive exotic *Agave sisalana*, sisal hemp, in coastal middens, thickets, or hammocks, the common habitats of two uncommon native agaves: false sisal, *Agave decipiens*, and wild century plant, *Agave neglecta*. With only a little practice, though, the target invasive is easily distinguished from these endemics.

False sisal, found in the Keys and mostly the southwest peninsular coast, has relatively narrow leaves (5-10 cm), and the leaves are concave or cupped, with margins bearing regularly spaced, conspicuous recurved (hooked) prickles. The more rare wild century plant, known from three counties, has broad leaves (20-25 cm wide) that are concave, with straight margins bearing numerous close, minute prickles. Sisal hemp leaves are around 10 cm wide, flat, and usually smooth on the margin, with no prickles, or just a few tiny ones. Other characters differ as well, but these are easy ones for novice agave lovers and haters.

– K.C. Burks, Invasive Plant Mgt., Florida DEP

- sisalana* (sisal). *Indian Phytopathology* 23(1):125-127.
- Nikam, T.D. (1997) High frequency shoot regeneration in *Agave sisalana*. *Plant Cell Tissue and Organ Culture* 51(3):225-228. "The capacity for shoot regeneration remained constant in the callus for more than 32 months."
- Nobel, P.S., McDaniel, R.G. (1988) Low temperature tolerances, nocturnal acid accumulation and biomass increases for seven species of *Agave*. *Journal of Arid Environments* 15(2):147-156.
- Parsche, F. (1993) Peculiarities on the incisors in the mandible of the skull Olduvai I. *Homo* 44(1):30-36. "This can be interpreted as an indication that at least this individual used his teeth as a "tool" for treating plant fibres."
- Pires, M.D.F.C., Purchio, A. (1991) Mycological evaluation of filtrated juice of *Agave sisalana* Perrine's leaf. *Revista de Microbiologia* 22(3):272-275. "... the filtrated juice of *Agave sisalana*'s leaf contains a compound capable of inhibiting *Aspergillus flavis* and *Aspergillus parasiticus* growth..."
- Sahu, G.C., Mishra, A. (1994) Morphology, characteristic and classification of soils under sisal (*Agave sisalana*) cultivation. *Journal of the Indian Society of Soil Science* 42(1):111-114.
- Salgado, A.L.D.B., Deuber, R., Forster, R. (1980) Weed control and herbicide selectivity to sisal *Agave sisalana*. *Bragantia* 39(1):7-14. "None of the herbicides affected the growth of sisal plants during the period of 600 days."
- Zuskin, E., Mustajbegovic, J., Kaneljak, B., et al (1992) Follow-up study of respiratory symptoms and ventilatory capacity in sisal workers. *Arhiv za Higijeno Rada I Toksikologiju* 43(4):339-347. "The prevalence of acute and chronic respiratory symptoms and ventilatory capacity was studied in 50 textile workers exposed to sisal dust."

Herbarium Specimens

The paucity of herbarium specimens for *Agave sisalana* is likely due to the difficulty of preparing a specimen from a large succulent plant with sharp one inch points on the tips of leaves that grow up to five feet long. In addition, the inflorescence can grow to thirty feet tall and six to eight feet in diameter. To learn how to prepare such a difficult specimen, go to the web site of Southern Illinois University Herbarium: Botanical Potpourri (www.science.siu.edu/herbarium/potpouri/prepare.htm) where detailed instructions are available under the heading "Suggested Techniques for Preparing Hard to Prepare Herbarium Specimens." A section on succulent xerophytes covers *Agave* specimens. Use caution when working with *Agave*; the juice or sap, which contains saponin and oxalic acid, is reported to cause skin irritation and eye damage (Perkins 1978; Morton 1995).

References:

- Gentry, H.S. (1982). *Agaves of continental North America*. University of Arizona Press, Tucson.
- Morton, J.F. (1995). *Plants poisonous to people in Florida and other warm areas*. Hallmark Press, Miami.
- Morton, J.F., Ledin, R.B. (1952). *400 plants of south Florida*. Text House (Florida) Inc., Coral Gables.
- Nobel, P.S. (1988). *Environmental biology of agaves and cacti*. Cambridge University Press.
- Nobel, P.S. (1994). *Remarkable agaves and cacti*. Oxford University Press.

- Perkins, K.D., Payne, W.W. (1978). *Guide to the poisonous and irritant plants of Florida*. University of Florida, IFAS, Cooperative Extension Serv., Gainesville, Circular 441.
- Trelease, W. (1913). *Agave in the West Indies*. *Memoirs of the National Academy of Sciences*, Vol. XI, Washington.
- United States Sisal Trust. (1919?). *Sisal: the coming industry of Florida*. Hefty Press, Miami. Part of *Papers relating to economic endeavors, 1917-1919* by James Franklin Jaudon in the *Reclaiming the Everglades series* (2000), digitized from papers at the Historical Museum of Southern Florida, Miami [electronic resource].

NOTES FROM THE DISTURBED EDGE



Chapter 5

"Well... Once, upon a morning dreary, I walked with something on my head and though I sought to ignore the source, I wound up talking to the bird instead, I chatted with the fowl who fouled my head.

There, upon that humid morning, standing at the shallow shore
 Came a raven, droop-seed dropping, defecating on the forest floor
 Seeds were dropping, seedlings popping, falling to the forest floor
 Sternly, I addressed the raven: Drop those seeds here nevermore!
 Poop not upon this forest floor!

But lo, he looked at me and laughed – cawed, guffawed and queried me
 'Dare you command us creatures who, led by hunger, take our succor
 of a tree that you abhor?
 I must do what I must do, and so I feast and fill my crop,
 and when digested, I must drop, droppings to the forest floor.
 No harm intending, just a meal ending. The seeds fall to the forest floor'

But I rebuffed him – 'Nevermore!
 'This tree that feeds you and the seeds you, uh, deposit on the forest floor
 do not belong here, they are wrong here,
 they take the place of trees of yore...'

The Raven only laughed once more, and croaked these words:
 'You men dishevel nature and expect me to ignore?
 This fruit is sweet and I must eat. I'll eat the fruits that I adore.
 It's you must yank them evermore. It's you must plant them nevermore...'

He dropped this scat upon my hat
 and then flew off to eat some more...

So I stand here, hat in hand, a crappy-hatted soggy man,
 and although the raven I implored, that bird will listen never more
 The answer's clear, the seed is here, the raven spreads it ever more.
 It's time for man the truth to see - that only we can stop that tree..."

"Number 46?"

"Yep, that's me" – he stepped forward and picked up his tray, tipping his encrusted cap to the wide-eyed boy behind the counter.

She coughed insistently, and he turned to listen. "Thank you for that very complete and ever-so-artistic response," she muttered through clenched teeth. "Now, would you please go outside and scrape that off your hat?"

Sheepishly, he grinned and complied. No doubt, the surrounding patrons (inching towards the door) would never see a carrotwood tree or a water-bound crow in the same way. She stepped forward to retrieve her lunch off the counter, and thought "What a wonderful fool that mortal be..."

- J.A.

An excerpt from "The Adventures of Hack Garlon and his buxom sidekick Squirt."

"Rescuing Our Natural Heritage"

The fourth annual Southeast Exotic Pest Plant Council (SE-EPPC) Symposium was hosted by the Tennessee EPPC April 3-5 in Nashville. The focus of the symposium was "Rescuing Our Natural Heritage." Gordon Brown gave the keynote address on **Implementation of the National Management Plan**. Mr. Brown serves as liaison with the U.S. Department of Interior Bureaus and the National Invasive Species Council. He works with international, state and private partners to build support for local action. In his address, he described how policy is being developed to recognize and address the ways in which species alien to American ecosystems are harming our natural systems, economic enterprises, and human health.

In recounting the recent history of invasive plant policy development, Mr. Brown stated that scientists' letters to vice president Gore in 1998 spurred the 1999 Executive Order on Invasive Species. The Executive Order authorized a federal interagency task force that is continuing to develop and recommend actions regarding invasive species.

He further reported how invasive species are transforming the American landscape as native species are replaced with alien species. Ecological systems and cycles that we take for granted are shutting down. Financial and ecological damage is estimated at \$137 billion per year (Pimentel, Bioscience, Jan 2000). The greatest impacts to our natural areas have been ranked as habitat loss, alien species, pollution, over-harvesting, and disease (Wilcove, *Rebuilding the Ark*, 1996). Alien invasions are held to be the second greatest cause of endangered species listings. Brown held that bringing stakeholders together is crucial. The problem is bad and getting worse.

The Executive Order spurred existing Executive Office departments to examine their programs to determine whether their activities are contributing to this issue. The National Invasive Species Council (NISC) was created

from federal departments and was mandated to draft a management plan that will be updated every two years. The NISC is directed to provide leadership on these issues; promote actions at local, state, tribal and ecosystem levels; and to recommend measures to enhance international cooperation. Another goal is development of National Environmental Policy Act (NEPA) guidelines related to invasive species.

Among the finished management plan's recommendations are implementation of effective detection and rapid response, prevention, leadership and cooperation. Also, the Invasive Species Advisory Committee recommended creation of an invasive species "czar," a \$50 million fund for early detection and rapid response, and screenings for invasive species. The screening program is expected to be ready in two years and, like current security inspection, much of the screening will take place overseas before invasive species enter the US. Other goals include closing authorities gaps; establishing competitive grants programs; using public lands as models for stewardship; developing incentives for international help with invasive species management, including reviews of existing foreign assistance; increasing educational and information management programs; and establishing industry codes of conduct for invasive species.

Further information on the national invasive species initiatives can be found at: www.invasivespecies.gov.

Elsewhere during the three day symposium, field trips illustrated invasive species management programs in various settings, and other speakers reported on federal, state, and local invasive species management and research programs. Attendees successfully networked during an excellent evening social enhanced with live jazz accompaniment. Also, when the podium went dark, attendees enjoyed Nashville's spirited entertainment and nightlife.

Internodes—

MARK YOUR CALENDAR

First Latin-American Short-Course on Biological Control of Weeds, **June 24-28, 2002**. Montelimar, Nicaragua. Contact: Julio Medal, medal@gnv.ifas.ufl.edu.

Aquatic Plant Management Society 42nd Annual Meeting, **July 21-24, 2002**. Keystone Resort, Colorado. Contact: www.apms.org

Society for Ecological Restoration 14th Annual International Conference held jointly with the Ecological Society of America. **August 4-9, 2002**. Tucson, AZ. Contact: www.ser.org.

European Weed Research Society 11th International Meeting on Aquatic Weeds, **September 2-6, 2002**. Moliets, France. Contact: ewrs.2002@bordeaux.cemagref.fr.

2002 Natural Areas Conference, **October 2-5, 2002**. Renaissance Asheville, NC. Contact: Jeff DeBlieu, ideblieu@tnc.org, www.natareas.org, 252-441-2525.

The SE-EPPC board of directors modified the group's bylaws as follows: representation on the board of directors was changed to one representative from each active chapter; the SE-EPPC coordinator position was abolished; \$2,000 in funds left by the coordinator was dedicated for any member to attend future meetings representing SE-EPPC. Brian Bowen was elected president and Kristen Gounaris was elected secretary. The vice president and treasurer positions need nominations (which can be sent to president Bowen at bbowen@mail.state.tn.us).

Great efforts by the conference committee resulted in a highly informative and, hopefully, formative 4th symposium. All are to be commended for helping guide SE-EPPC into its future.

Mike Bodle
Roving Reporter

SePRO full page

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