

Bromeliad Weevils in Florida

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Slides should be self-explanatory, but some additional background information is provided here, given by slide. The program should be suitable for the general public or for more specific audiences. The following explanations can be used as a script or simply as a guide.

1.) This program will provide an overview of the effect of the Mexican bromeliad weevil (nicknamed the "evil weevil" by bromeliad lovers) on Florida's native bromeliads. It will show damage to bromeliad populations and how to spot damage in individual plants, plus explain management solutions and what everyone can do to become involved in stopping this highly destructive pest.

2.) Most bromeliads are epiphytic, growing attached to tree trunks and branches, without harming the host tree. Their roots serve only to anchor the plant to the tree. They absorb through their leaves the water and nutrients they need from the air and rain that falls through the canopy and becomes enriched with nutrients along the way (called throughfall). Water accumulates between leaf axils in the larger tank bromeliads, and many small animals live in what to them are like ponds. Several insect and worm species depend on bromeliads in Florida for their survival, and larger animals such as frogs, snakes and salamanders use these plants for protection and as a water source in drier months. There are at least 15 known species of insects and other small animals (invertebrates) that would not survive in Florida without the bromeliads in whose tanks they live. Bromeliads also contribute to the diversity of plants found in south Florida's unique ecosystems. Some of Florida's bromeliad species exhibit differences depending on where their populations are found, and some of Florida's bromeliads are distinct from the same species in other places.

3.) In addition to their important ecological roles, Florida's bromeliads are an aesthetic addition to the state's many parks and natural areas. Florida's State Parks recently received an award designating the park system as among America's Best State Parks. The unusual form and colorful flowers of Florida's bromeliads add to the beauty of the many parks in which they are found, and it is the natural features of the parks that attract millions of visitors each year. In addition, the state's native bromeliads provide a hands-on teaching tool for teachers and environmental educators. So Florida's native bromeliads are important to the health of the ecosystems in which they occur and also to the people and educators who visit the parks where they are found. The loss of our bromeliads would be a real tragedy for the state.

4.) Many of Florida's native bromeliad species have been on the state's list of threatened and endangered species for years because their populations have been so low. Development in south Florida continues to reduce the habitat available for bromeliads, and several species are now found only on state and federal protected lands. Even bromeliads on protected lands are not

immune to illegal collection, another threat to their existence. But a new threat has appeared more recently, one which is much more dangerous because it does not distinguish park boundaries, and park rangers can't stop it. The newer, deadlier threat is an invasive pest weevil that attacks bromeliads, the Mexican bromeliad weevil.

5.) In the American tropics (Neotropics), at least 26 species of weevils live in bromeliads. Most (17 species) are in the genus [plural=genera] *Metamasius*. In their native lands, these bromeliad weevils do not threaten the bromeliad populations in which they live.

6.) Florida has one species of bromeliad weevil that is thought to be native. The scientific name of the Florida bromeliad weevil is *Metamasius mosieri*. This weevil tends to attack small plants and does not threaten native bromeliad populations. It is an occasional minor pest on ornamental bromeliads but is rarely found either in cultivated bromeliads or in natural areas of Florida. No other bromeliad weevils are native to Florida.

7.) However, non-native species frequently enter the state, and those that become established are considered invasive. With ever-increasing transportation and commerce, there are more and more opportunities for non-native insects to enter the state. There are about 450 million ornamental plants shipped into the U.S. each year, and close to 85% of those arrive through the port of Miami. Inspectors from the U.S. Department of Agriculture/APHIS (Animal and Plant Health Inspection Service) intercept over 18,000 insects on imported plants each year, but they are able to inspect less than 2% of imported shipments. As a result, non-native insects are continually reported in Florida. Between 1970 and 1990, there were 271 new reports of non-native insect species in Florida. That represents an average of 13 species immigrating per year, and that includes an average of one major pest per year. Florida receives many bromeliad imports each year, and those are just as susceptible. Between 1973 and 1987, USDA inspectors intercepted *Metamasius* species weevils on bromeliads entering the state 122 times, and that included 14 interceptions of *Metamasius callizona*, the Mexican bromeliad weevil.

8.) All it takes is one uninspected plant infested with weevils, and apparently the Mexican bromeliad weevil immigrated to Florida in that way. The weevil's scientific name is *Metamasius callizona*. It has no official common name, although it has been called both the Mexican bromeliad weevil (because of its origin) and the "evil weevil" (because of the destruction it has caused to Florida's bromeliads). The weevil was first discovered in 1989, in a nursery in Fort Lauderdale (Broward County). The nursery was treated, but by the time it was discovered, the weevil had become established in nearby natural areas. It is believed to have entered Florida on a shipment of Tillandsias from Veracruz, Mexico. Once established in Broward County, it has moved throughout southern Florida both by natural dispersal and by the movement of infested plants.

9.) Since its first appearance, the weevil has been reported in 18 Florida counties, and as of the summer of 2002 it is found in 17 counties. It was present in Miami-Dade County before Hurricane Andrew, which destroyed the plants in which it was found, and it has not been seen in that county since then. From its appearance in Broward County it moved quickly to Palm Beach County. It was next detected in Lee County, probably the result of an infested plant being moved across the state. It has steadily moved up and down both coasts since then and is now moving inland. The sightings on the map represent only what is known about the weevil's spread. Extensive survey work has not been conducted, so the weevil may be in many more areas than is currently known.

10.) The weevil is infesting bromeliads in many important natural areas, including 6 state parks (Savannas Preserve, Myakka River, Highlands Hammock, Koreshan Historic Site, Lake

Kissimmee, and most recently Fakahatchee Strand). It is destroying bromeliads in the Loxahatchee National Wildlife Refuge (Boynton Beach, Palm Beach County) and has recently been found in Audubon's Corkscrew Swamp Sanctuary. Its presence in the Fakahatchee Strand makes the situation even more critical, since the Fakahatchee contains populations of Florida's rarer bromeliad species. The Fakahatchee is home to 14 of Florida's 16 native bromeliad species, including one species found nowhere else in the U.S. It is only a matter of time before the weevil also reaches Big Cypress National Preserve and Everglades National Park, the other places where Florida's rare bromeliads are found.

11.) Mexican bromeliad weevil is easily distinguished from the Florida bromeliad weevil in the adult stage. It is black and has a single band across its back, which is usually yellow but may be reddish or orange. Rarely the band is not visible. Florida bromeliad weevil is smaller and is red and black with 2 black spots. The immature larvae (grubs) of the two look alike. When found in a bromeliad, it is best to keep them on a plant and wait until they reach the adult stage to know which species it is.

12.) The weevil's attack on native bromeliads in their natural setting has so far included 6 species, *Tillandsia utriculata* (giant airplant), *Tillandsia fasciculata* (cardinal airplant), *Tillandsia flexuosa* (twisted airplant), *Tillandsia paucifolia* (potbelly airplant), *Guzmania monostachia* (West Indian tufted airplant) and *Tillandsia balbisiana* (northern needleleaf). Two of these, *Tillandsia utriculata* and *Tillandsia fasciculata*, have been placed on the state's list of endangered species as a direct result of their destruction due to weevil attack. *Tillandsia paucifolia*, *Tillandsia flexuosa*, and *Guzmania monostachia* were already on the endangered list, and *Tillandsia balbisiana* was already considered threatened. The weevil is now further threatening their already precarious existence.

13.) There are several other native bromeliads in Florida that have not yet been attacked by the weevil because of their more isolated occurrence, but which will probably be susceptible once the weevil reaches them. These are *Catopsis berteroniana* (powdery strap airplant), *Catopsis floribunda* (Florida strap airplant) and *Catopsis nutans* (nodding strap airplant), all of which are already endangered, as well as *Tillandsia variabilis* (leatherleaf airplant), which is threatened, *Tillandsia pruinosa* (fuzzywuzzy airplant), which is also endangered, and *Tillandsia simulata* (broad needleleaf), which is not listed as threatened but is found nowhere else but in Florida.

14.) The remainder of bromeliads native to Florida, *Tillandsia bartramii* (Bartram's airplant), *Tillandsia setacea* (southern needleleaf), *Tillandsia recurvata* (ball moss), and *Tillandsia usneoides* (Spanish moss), are not considered likely to be attacked by the weevil, which prefers larger plants that have enough material at the base for larvae to complete their development.

15.) From greenhouse host range tests and grower observations, the weevil has been found to develop on bromeliads in 13 genera in Florida: Aechmea, Ananas, Canistrum, Cryptanthus, Dyckia, Guzmania, Hohenbergia, Neoregelia, Nidularium, Orthophytum, Quesnelia, Tillandsia, and Vriesia. Not all genera and species have been tested, so the weevil's range may prove to be much wider. Additional host range tests are planned.

16.) Adults feed mainly on leaves but they may also feed on the inflorescence. Females lay their eggs in slits they make in the leaves, close to where they feed. After hatching from the egg, the young larvae eat through the leaf tissue, making their way down to the stem. As they grow, larvae tunnel into the base of the plant, forming large holes. When mature, the larva develops into the

pupal stage (the resting stage before its final molt to the adult), surrounding itself with a cocoon it has constructed from shredded stem material.

17.) All life stages, the egg, larva, pupa and adult, can be found on the same plant. The development of the weevil from egg to adult is completed in about 8 weeks under laboratory conditions. In south Florida, the weevil continues to mate and reproduce all year long. Each generation is estimated to take 13-17 weeks to complete, so there are probably 3-4 generations each year in south Florida. There are still many things that are unknown about this weevil, especially about how its populations develop and disperse in natural settings. The time between a female adult emerging and beginning to lay eggs, and the maximum number of eggs laid per female are also unknown.

18.) The weevils kill the plant by destroying the base of the stem with the tunnels produced by the larvae. The damaged stem base separates from the plant and falls to the ground. The most typical symptom of weevil damage is the decomposition of leaves at the base, with the middle of the plant becoming so loose it can easily be removed.

19.) Larvae may also tunnel up the inflorescence, and damage to flowering plants is especially harmful to the population. In addition to the tunnels made in the stem base, there are several other symptoms of weevil damage. When damaged, the plant produces a clear gel that may serve as the plant's defense mechanism. The adult's feeding marks can also be seen on the plant's leaves, and the leaves turn brown as their base is destroyed.

20.) The weevil is as destructive to bromeliad populations as it is to individual plants. When the weevils move into an area, they infest the larger plants, which comprise the breeding population. Once the larger plants are gone, the weevil can remain in an area attacking smaller plants. The weevil has been most devastating to *Tillandsia utriculata* populations. In general, *Tillandsia fasciculata* populations have been somewhat more resistant to weevil attack.

21.) In many county and state parks, bromeliads are disappearing at an alarming rate. For example, in the Savannas Preserve State Park in St. Lucie County, an area of terrestrially growing *Tillandsia utriculata* was reduced to debris within a matter of months, and the weevil continues to destroy the epiphytic bromeliads in the park. In Myakka River State Park, the weevil is currently decimating populations of *Tillandsia utriculata* and *Tillandsia fasciculata*. In a study at Deer Prairie Slough in Myakka River State Park, 18% of bromeliads along a study transect were killed in just 15 weeks, and 39% of those in a densely populated host tree were killed. After being present in Highlands Hammock State Park since 1999, the weevil began to inflict more serious damage in 2001. The weevil's presence in the Fakahatchee Strand Preserve State Park was confirmed in March of 2002, and it is already attacking both *Tillandsia utriculata* and *Guzmania monostachia* there.

22.) In Loxahatchee National Wildlife Refuge, the weevil is attacking *Tillandsia fasciculata* and *Tillandsia balbisiana* on the cypress swamp boardwalk and surrounding areas. Refuge volunteers have been monitoring bromeliads to keep track of the weevil's damage.

23.) The weevil is also spreading through the Sebastian, St. Lucie, Indian River, Loxahatchee, Peace, Caloosahatchee, Myakka, and Manatee River Systems. Along a stretch of the St. Lucie River, the once abundant *Tillandsia fasciculata* have all but been destroyed.

24.) The weevil is spreading throughout south Florida and is destroying populations of several species of bromeliads in its path. It is imperative that we stop it before it gets to Florida's rarest bromeliads in the Everglades region. One factor in managing the weevil is preventing inadvertent human contributions to its further spread. This is important both for management in natural areas and for private collections and nurseries. Much of the county-to-county spread of the weevil has been aided by the movement of infested plants.

25.) Therefore, it is important to minimize movement of ornamental bromeliads whenever possible. In addition, plants should be inspected before being moved. It is particularly important to monitor newly acquired plants for weevil presence. Ideally, plants should be subjected to a pesticide dip or spray before being moved off a property or upon being received.

26.) Another important management consideration is the prevention of the establishment of additional non-native bromeliad weevils in Florida. At the same time that plants are monitored for Mexican bromeliad weevil, they should be monitored for any other weevils that may have escaped detection at the port. Finding immigrant bromeliad weevils before they become established would avoid repeating the problems that have been caused by the Mexican bromeliad weevil. All imported bromeliads should also be treated with a chemical dip or spray. Finally, importing only seeds of bromeliads would also avoid the risk of further immigrations, since weevil eggs in bromeliads cannot be detected during inspections and are protected from pesticides. If you travel to Latin America, never bring back bromeliad plants, since they may be infested with bromeliad weevils not currently present in Florida.

27.) Any of the 23 bromeliad weevils not presently found in Florida could potentially immigrate in imported bromeliads, but some are more likely than others to enter. USDA/APHIS inspectors and growers importing plants to Florida have intercepted individuals of *Metamasius flavopictus*, *Metamasius cincinnatus*, *Metamasius dimidiatipennis*, and *Metamasius sellatus*.

28.) In addition, *Metamasius quadrilineatus*, *Metamasius nudiventris*, and *Metamasius rugipectus* could all potentially immigrate. If you find any weevil in your bromeliads that is not the Mexican bromeliad weevil or the Florida bromeliad weevil, immediately notify a Plant Inspector from the Florida Department of Agriculture and Consumer Services (DOACS), Division of Plant Industry (DPI).

29.) In terms of managing the Mexican bromeliad weevil in Florida, we can't use chemical controls, because the epiphytic habit of the plants makes access from the ground difficult. More importantly, the weevil inhabits parks and other natural areas, where the use of chemical pesticides would be inappropriate because of the effects on the surrounding ecosystem. And finally, since pesticides would have to be applied by air, the economic cost of aerial sprayings over 18 counties would be extremely high. The weevil has been so destructive in part because it came into Florida without the natural enemies that keep it under control in its homeland. So the most appropriate course of action in this case is to use biological control.

Biological control, also called biocontrol, involves the use of a living organism to keep a pest's population below a damaging level. There are several different ways in which biological control can be used, but the type most appropriate for this situation is classical biological control, in which natural enemies of the pest are imported from the region where the pest originated. Even though the related Florida bromeliad weevil is thought to be native to Florida, no other insects have been found in Florida that attack either weevil, so we have to import a natural enemy from the pest's homeland. Once it is determined that release of the natural enemy will have no detrimental effects

except on the pest population, a release permit is issued. Releases are made where the pest population is highest and, if successful, the natural enemy, or biological control agent, becomes established. The goal is not to completely eradicate the pest population, but to maintain it at a very low level so that damage is minimized.

30.) The weevil's place of origin is Mexico and Central America, and therefore explorations have been made to Mexico, Panama, Honduras and Guatemala in search of a natural enemy. Natural enemies of the weevil have been very difficult to find on exploration trips. One natural enemy, a potential biological control agent, was found attacking a related weevil species in Honduras.

31.) This candidate biological control agent is a specialist fly parasitoid in the family Tachinidae and genus *Lixophaga*. As a specialist, it only attacks bromeliad weevils, and it may only attack a few very closely related species of those. It was formerly thought to be in the genus *Admontia*, so it is referred to as *Admontia* species in older articles. In Honduras, this fly attacks the larvae of the closely related weevil species *Metamasius quadrilineatus*. When it was imported to the quarantine facility in Florida, it was found to attack *Metamasius callizona* (Mexican bromeliad weevil) as well. Once the fly colony is established in quarantine, non-target testing must be carried out to determine if the fly will attack anything else. For the non-target testing, species most closely related to the target pest are tested first, by exposing them to the biological control agent to see if they would be parasitized as well. Besides the target pest *Metamasius callizona* (Mexican bromeliad weevil), there are only 2 other species of *Metamasius* weevils in Florida at this time: the native Florida bromeliad weevil, (*Metamasius mosieri*), and the silky cane weevil (*Metamasius hemipterus*), which is a non-native pest of sugarcane and ornamental palms in south Florida. If the biological control agent (the fly) does not attack these related species, it will not attack any other organisms in the environment. Once non-target testing shows that the fly will not harm other species, application will be made for a release permit. At that point, the fly could be removed from quarantine to rear it in high numbers and release it in areas of high weevil concentration. Its effect on weevil populations would then be evaluated to plan further releases.

32.) The fly had never been studied before, and there is still much information lacking about its biology. There are many conditions that must be met for this fly to successfully parasitize the weevil and to become established in south Florida after it is released. Most insects lay eggs, but in this fly the eggs hatch while still inside the adult female. The fly deposits the newly hatched larvae, which are called maggots since they are flies, at the entrance to the weevil tunnel. Each fly maggot crawls down the tunnel looking for a weevil larva, and when it finds one and enters it, the maggot feeds from inside until it is fully developed. When a maggot is ready to pupate (change its form to the resting stage just before the adult stage), it comes out of the weevil larva, which dies at that point. The fly then creates a puparium, a hardened case, around itself. The weevil larva is also fully grown at that point, and may even have formed the cocoon around itself, in preparation for its own transformation or molt. The fly pupates within the plant, at the base of the leaves, very close to where the weevil larva was found. A few weeks later, the adult fly emerges and comes out of the plant to mate, find more weevil tunnels, and lay its own maggots.

33.) Biological control is safe for both people and the environment. The state only issues a release permit when studies have shown that the biological control agent will affect only the targeted pest. For this project, once the *Lixophaga* species fly or another biological control agent has been issued a release permit, releases will be made in natural areas in south Florida, with state parks and other protected areas as priority, where weevil populations are highest. The long-term goal is not to eradicate the weevil completely but to reduce its damage enough that bromeliad populations in Florida are no longer threatened by its presence.

34.) After the weevil is under control, areas previously affected by the weevil need to be repopulated with the bromeliads that were there previously. To this end, a seed collection project has been organized to collect seeds now of bromeliad species at risk from weevil attack. Volunteers associated with state parks and with the Florida Council of Bromeliad Societies are collecting small amounts of bromeliad seeds under permits to harvest endangered plants issued by the Florida Department of Agriculture's Division of Plant Industry. Based on detailed collection records maintained in a database, seedlings grown from those seeds will be returned to their respective places of collection, once the weevil is no longer a threat to native bromeliads.

35.) We can all play a role in the important effort to save Florida's native bromeliads, by volunteering for the collecting project or to monitor bromeliads in natural areas, or by supporting the research into a solution through biological control. It is also important to continue to work to prevent the future immigration of other bromeliad-eating weevils and to continue to make everyone aware of the importance of maintaining Florida's native bromeliad populations.

36.) The Save Florida's Native Bromeliads project, a collaboration between the Florida Council of Bromeliad Societies, the University of Florida, and the Florida Department of Agriculture and Consumer Services, has received additional support from the U.S. Department of Agriculture, the Florida Park Service, the U.S. Environmental Protection Agency, the Florida Division of Forestry, and Gulfstream Environmental and Recreational Trust program.