Wildlife Habitat in the EAA:

Farm land, crops, farming practices and farmers support south Florida wildlife species

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This is the final report summarizing over eight years of wildlife research in the Everglades Agricultural Area, sponsored by landowners of the area through the Everglades Agricultural Area Environmental Protection District (EAA EPD) in recognition of the value of their lands for wildlife habitat. We hope that this report conveys the variety and richness of wildlife to be found in all crops in the area and thank the EAA EPD for their support of this project. We also thank the many cooperating growers/ managers and cooperating scientists.

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Photos: Front page – Common Yellowthroat by Maria Alejandra Millan, second page Bobcat by Elise Pearlstine. Photo credits: Elise Pearlstine, Maria Alejandra Millan, Juan Sebastian Ortiz and US Sugar. Note: for scientific names of animals, see appendices.

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Executive Summary

The Everglades Agricultural Area (EAA) is a 280,000 ha (1081 sq mi) area in south Florida dedicated to growing sugarcane, rice, sod and vegetables. It officially came into being in the 1950s as a result of the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project) of 1948. A study of wildlife in the EAA began in 2001 and was funded by the Everglades Agricultural Area Environmental Protection District to document wildlife presence and abundance in the agricultural fields. Previous to this study, studies in citrus groves (Pearlstine et al 1995), other limited surveys (Sykes and Hunter 1978 and Lodge and Clark 1996), and the experience of local growers indicated that many farms include areas that provide important habitat components for a large and diverse wildlife population. The project was initially focused on sugarcane, and that has remained the main focus, but studies have also been conducted in rice, vegetables, sod, and fallow fields as well as nearby natural areas.

Crops in the EAA are grown on peat and muck soils deposited prior to 1948 by Everglades marshes (Rice et al. 2002). Fields are usually 40 acres and are stitched together by canals and field ditches used to manage water levels according to crop type. Agricultural fields and roadside canals are edged by herbaceous or shrubby vegetation that is generally non-native. Sugarcane is the dominant crop and is grown year-round. Its low input/low disturbance management results in nearly year-round undisturbed dense tall-grass habitat for a variety of wildlife species. Rice is often grown in rotation with sugarcane and provides flooded habitat during the spring, summer and early fall as do flooded fallow fields. Management of rice fields results in water draw-downs during the summer that serve to concentrate fish and may provide important alternate feeding habitat for some wetland species such as storks, herons, and egrets. Sod and vegetable crops have somewhat more limited habitat value for wildlife but sod fields may provide feeding areas for groups such as shorebirds and habitat for eastern meadow-larks, a grassland species. Fields with winter vegetables are often flooded during the summer which benefits a stunning number and variety of ducks, wading birds, shorebirds, terns, gulls, rails, skimmers and others. These areas are likely very important seasonal habitat for such birds. Canals and ditches, though managed mainly for water quality and crop needs, still support a variety of aquatic and semi-aquatic wildlife species such as wading birds, rails, amphibians, fish and turtles. Non-farmed and edge habitat may be found on hundreds if not thousands of acres and is utilized by local and migratory birds, large mammals and other species that may shelter or travel through such areas.

Figure 1. Common nighthawk in roadside habitat

Wildlife surveys were conducted in standard-ized, repeatable protocols that incorporated

habitat features such as crops in the field, edges, ditches, roads and rocks or bare soil. Surveys for birds and amphibians were conducted in sugarcane and associated ditches and canals. These consisted of transects that were randomly placed and contained from a few to 15 or more points along a dirt road in the sugarcane fields. Minnow traps were placed in ditches at each point during the first two years to census fish in these crop types. Surveys in rice field habitat followed similar protocols but also included intensive walking searches through flooded rice fields to search for nests. Other short-term studies included a comparison of dove species in the EAA, with urban areas of Palm Beach and Broward counties, as well as a winter survey of songbirds in sugarcane. Although not specifically studied, reptiles and mammals were recorded as present when observed during other surveys or along roads traveled to and from survey points. Annual herparoos (herpetological surveys) were conducted in the spring to survey for Florida kingsnakes and other reptiles and amphibians.

Figure 2. Native cooter crossing a gravel road

The wildlife community in the EAA is diverse and abundant and includes most of south Florida's wildlife species. Not all species breed in the EAA but many may be present in large numbers after the breeding season Birds, both resident and non-resident, are a dominant feature of the habitat in the fall, winter and spring, and are found in all habitat types. Raptors are especially noticeable during migration and use power-lines and power poles as well as signposts, farm structures and barn owl boxes as perches for hunting. Winter surveys of songbirds found over 22 species in one season in cane and edge habitat. Warblers, sparrows, cardinals, doves, bobolinks and various blackbirds were found during the surveys. Secretive marsh birds have been documented in sugarcane, rice, flooded fields and edges, and will nest in these areas. Whistling-ducks and mottled ducks are abundant in the EAA as are black-necked stilts and common nighthawks; all may be found nesting in or near flooded habitat. Mammals such as bobcats, river otters, marsh rabbits and eastern cottontails may be seen regularly along roadsides and ditches. Snakes, turtles and alligators frequent the canals and ditches. Barn owls frequent the many nest boxes constructed by land owners and local residents (Martin et al. 2008).

To date, our checklist documents 164 species of birds in various habitats of the EAA. Of these at least 36 are known to breed in the area. There are 13 species of amphibian and 22 species of fish. Reptiles number at least 24 species, and mammals 19 species. The most charismatic and recognizable group is the bird group and represents a large portion of birds to be expected in south Florida. Our results indicate that some animals are characteristic of the EAA and may be found in numbers and patterns not seen elsewhere in south Florida. Kingsnakes have declined throughout most of Florida and the Florida kingsnake seems to be in very low numbers in most natural areas of south Florida (Krysko and Smith 2005). Although we cannot

quantify abundance, nearly all yearly surveys for kingsnakes result in multiple observations in areas throughout the EAA. Yellow-crowned night-herons are common in brushy vegetation along canals and ditches where they build their nests. They are not commonly found in natural areas of south Florida. Bobcats, river otters, marsh rabbits and cottontails were seen more frequently in the EAA than in nearby natural areas, illustrating the value of the dense upland habitat of the sugarcane fields that is fronted by ditches and canals.

The EAA has, for over fifty years, provided valuable habitat for wildlife in south Florida and has developed into an agroecosystem that is an important part of the south Florida landscape. The EAA provides large areas of dispersal habitat for birds breeding in surrounding natural habitats and supports a variety of species that require upland habitat for at least part of their life cycle. Rice and flooded fields act as short hydroperiod marshes where birds, amphibians and fish feed and reproduce. Our multi-year studies in the EAA have documented the importance of the EAA on the south Florida landscape.

Key Findings

1. The landscape of fields, ditches, and edges in the Everglades Agricultural Area (EAA) supports a large and diverse wildlife community. During the nine years of this study, a total of 164 species of birds were documented in various habitats of the EAA. Of these at least 36 are known to breed in the area. There were 13 species of amphibian and 22 species of fish. Reptiles number at least 24 species and mammals 19 species.

2. Wildlife in the EAA is more diverse and species-rich in comparison with Arthur R. Marshall Loxahatchee National Wildlife Refuge and natural Everglades habitat. Wildlife in the EAA is not as abundant or species rich year-round as Stormwater Treatment Areas, built on former farmland, but it does support more migratory and resident birds. This means that the avian community found in the EAA is unique, with a different suite of species than most nearby natural or semi-natural habitat. Not only do local species rely on the EAA but migratory birds from outside south Florida regularly use the EAA during their migratory cycle and may be present for six months or more during the year.

Figure 3. Wading birds in a flooded agricultural field

3. There is a unique and diverse community of animals in the EAA that have adapted to the seasons and the various practices of the agricultural ecosystem. Whether they are year-round residents, migrants, wintering birds or wading birds from surrounding natural habitat, the EAA provides life-sustaining resources during at least a portion of their life cycle.

4. Management practices, size and crop types in the EAA are have historically played a role in maintaining wildlife in the area. The highest acreage is dedicated to sugarcane which is a low input, low management crop that is mainly

left alone throughout most of the year. Although harvest activities in sugarcane may be highly disruptive and temporarily alter the landscape, animals have learned to adapt to these changes. Whether predator or prey, large numbers of animals depend on the fields and edges to support local populations. Flooded fields consist of either rice or fallow land and support a diverse population of wading birds and aquatic life. Active management of flooded fields provides foraging habitat for wading birds at a time when natural wetlands habitat has flooded and aquatic prey becomes more difficult to catch. Other crops provide different habitat features such as low-growing grassy areas of sod fields that support shorebirds during migration. Flooded rice and fallow fields provide aquatic habitat during seasonal dry periods when wading birds disperse from surrounding habitat.

Figure 4. Great blue heron hunts near canal in sugarcane fields in the EAA

5. Many of the local habitat features are also important in the support of wildlife species. These features include the many ditches and canals that allow for an important upland/wetland connection for animals that need both an aquatic and terrestrial component during their life history or for their predators. Although there are many roads throughout the EAA, most are unpaved and infrequently traveled and do not seem to contribute to road mortality as is common where wildlife populations are found in areas near high speed roads. The mostly untraveled roads of the EAA provide safe movement corridors for local bobcats, otters, snakes and birds, and allow them to move more safely and freely throughout the area. Larger or more mobile animals may use the roads and roadsides to move between natural habitat to the north and south, east and west.

6. There does not appear to be a greater number of exotic or invasive species in the EAA than in nearby natural habitat with the possible exception of blackbirds that feed in large numbers on rice and corn during certain times of the year. Large numbers seem to result from an influx of migratory populations and numbers peak in fall, winter and spring. Most exotic species are absent from the agricultural fields themselves and are more likely to be found near homes, urban areas or shop buildings.

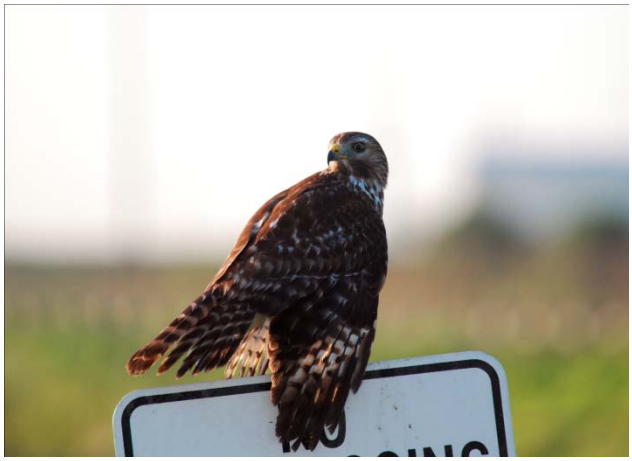

Figure 5. Red-shouldered hawk on a road sign in the EAA

REPORT

Introduction

Agriculture and Wildlife

In most scientific literature, agriculture is generally thought to have low value for wildlife, a high incidence of non-native and/or invasive species and generally lower wildlife diversity and species richness. Before the 1980s there was no reason to expect citrus groves and other agricultural areas in Florida to be any different. In the early 1980s, after a series of freezes throughout much of Florida, citrus was being planted further south in huge groves and there was concern about grove development impacts on wildlife. A three-year study (Mazzotti et al. 1992) found that, while citrus did not have the same wildlife value as the original pine flatwoods and temporary ponds, on a landscape scale, the groves maintained valuable corridors for animal movement, and groves and retention ponds provided valuable wildlife habitat. In fact, snail kites were found to be using grove retention ponds as refuges. Water, in the form of retention ponds or agricultural reservoirs, was most important in determining wildlife presence. Also important was proximity to large natural areas and grove size. Larger groves had more species. Scientists involved in that study, including longtime environmental scientist Dr. Peter Rosendal at Florida Crystals, and EAA farmers, believed that the sugarcane fields and other habitat in the EAA provided a similar valuable role. Individual farmers and landowners knew historically and anecdotally that their farmlands supported a diverse and abundant wildlife population, but prior to this research undertaking there existed no hard data or documented research findings to support these beliefs.

Aside from the documented presence of prominent species of water birds (Lodge and Clark 1996; Pimentel *et al.* 1992; Townsend 2000) little was known about wildlife in the EAA and there were perceptions that the area lacked significant wildlife resources or that the area was detrimental to wildlife. Efforts at restoring wildlife populations as part of the restoration of Greater Everglades ecosystems have concentrated on improving and restoring remaining natural areas in the Everglades region (e.g. Everglades Forever Act). However, the use of the EAA as a foraging area for wading birds, a rest stop for migratory birds, and as habitat supporting complete life cycles of many species, combined with its size and the strategic location between Lake Okeechobee and the Water Conservation Areas, make the EAA an important component of a South Florida landscape that can be both economically and ecologically sustainable.

The Everglades Agricultural Area

The Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project) of 1948 designated a large area of the northern Everglades, south of Lake Okeechobee, to be managed for agriculture. Only a small portion of land near the lake had been developed, leaving much room for agricultural expansion in what was a vast, nearly unbroken expanse of sawgrass. Designated by Florida Statute as the Everglades Agricultural Area, it encompassed about 27% of the historic Everglades. Creating this dedicated agricultural area was a major factor in the economic justification of the C&SF Project.

Figure 6. Map of south Florida with EAA and natural areas (top left), vegetation map of south Florida (top right) showing the same areas, and a closeup aerial view of the EAA (bottom left)

The EAA covers an area of 280,000 ha (1081 sq. mi.) in southern Florida surrounding the southern end of Lake Okeechobee. It occupies former marsh habitat that was drained beginning at the turn of the century. Installation of water control structures and pump stations allowed for formation of the EAA in the middle of the last century. Agricultural activities occur on approximately 200,000 ha of the EAA, with sugarcane representing about 80% of land use. Rice, vegetables and sod are also grown in smaller quantities on the remaining land. Due to its unique combination of highly productive soils and tropical temperatures, the EAA provides much of the winter vegetables for the eastern United States. The EAA is located in the midst of natural areas such as Holey Land and Rotenberger Wildlife Refuges, Arthur R. Marshall Loxahatchee National Wildlife Refuge, Lake Okeechobee, Everglades National Park, Big Cypress National Park and a number of state water management areas.

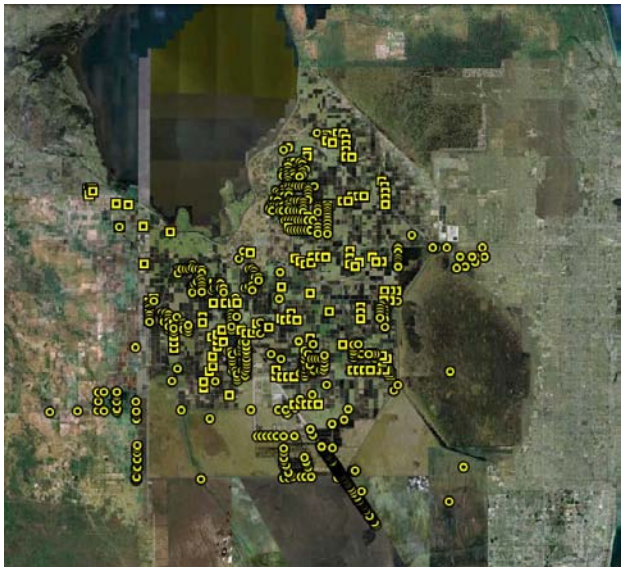

Figure 7. Map of survey points

The EAA Everglades Protection District (EPD)

At the request of area landowners, the "Everglades Agricultural Area Environmental Protection District" (EAA EPD) was established by the State Legislature as a special taxing district representing landowners within the EAA Basin for the purposes of ensuring environmental protection by means of conducting scientific research on environmental matters related to air, water, and land management practices, and to implement the financing, construction, and operation of works and facilities designed to prevent, control, abate or correct environmental problems, and improve the environmental quality of air and water resources. In effect, the farmers agreed to tax themselves to provide funding for environmental research.

In 2001, the EAA EPD funded a three year approximately $450,000 study of wildlife in the EAA to document wildlife presence and abundance in the agricultural fields, primarily sugarcane. The aim of this study was to define the habitat characteristics of the EAA, describe the wildlife found there and to ascertain common farm management practices and their effect, if any, on wildlife.

We made comparisons with impoundments containing natural habitat actively managed for wildlife in the nearby Arthur R. Marshall Loxahatchee National Wildlife Refuge (LOX). Results showed that more species of mammals, birds, reptiles, amphibians and fish were seen in these active agricultural fields than wildlife impoundments. There were significantly more bird individuals in agricultural fields than in impoundments and an equal number of fish in agricultural ditches and canals when compared with impoundments at LOX. Exotic/invasive species were not more common in the agri-

cultural fields than natural habitat of the impoundments. This was the first long-term study of wildlife in the EAA and also the first to show through standardized, scientific protocols that species richness and individual numbers were at least equal and sometimes greater than in nearby impoundments being actively managed for wildlife habitat. It also showed the EAA to be a unique agroecosystem. Continued studies have supported this initial work and continue to demonstrate the value of the EAA as wildlife habitat.

Since 2001, work has continued to document wildlife abundance, diversity and distribution throughout the EAA in a variety of seasons and habitats. Studies have involved research scientists from the University of Florida, US Geological Survey, and Florida Atlantic University, as well as various technicians and graduate students. Scientific publications and annual reports have documented the findings of this work. Research subjects have included wintering raptors, wintering songbirds, habitat use, foraging wading birds, barn owl biology and ecology, urban vs. agricultural doves, and annual reptile and amphibian surveys. Many of our transect survey points have been in the same areas for the full eight years of our work in the EAA and provide a source of long-term ecological data.

Description of Habitats

Crops in the EAA are grown on former Everglades marsh characterized by peat and muck soils (Rice et al. 2002). Associated with these agricultural activities are canals, ditches and hundreds of acres of associated non-agricultural edge habitat. Canals are dug into the limestone where they are fed by groundwater and tend to retain water throughout the year. Ditches are characterized by temporary flooding in response to particular crop needs. Non-agricultural vegetation grows at the edges of fields, ditches and canals. Edge vegetation may be herbaceous or brushy.

Figure 8. Typical sugarcane field just a few months after harvest

Sugarcane. Sugarcane is the dominant crop in the EAA and is grown year-round. It is harvested during the winter between October and April, with some fields being cut and allowed to re-grow (a ratoon crop) and some being completely harvested and re-planted. Fields are generally arranged in sets of eight or twelve and are about 40 acres each. Each field is separated from the next by a shallow 'field ditch' and there are deeper canals surrounding larger sets of fields.

Sugarcane itself is a tall grass that may grow 12-15 feet tall with a thick, dense canopy. As grown in the EAA, fields of sugarcane are surrounded by water and other vegetation at the edges. Roads are generally narrow and unpaved with extremely low levels of traffic throughout the year. Because the land is in private ownership, public access is generally limited—prohibiting hunting, pet collecting, harassment of wildlife or littering/polluting of the waterways. Rice, fallow fields or vegetables may occur in rotation with sugarcane.

As a crop, sugarcane is generally considered environmentally friendly as it requires much less chemical assistance in the form of fertilizer and pesticides as compared to other crops or land uses. Fields are planted on average, once every four years, harvested once a year, and need relatively little human or vehicle traffic to disrupt wildlife patterns. Bobcats and rabbits are plentiful in sugarcane fields and river otters are often found in ditches and canals of the fields. Common yellowthroats sing from every field and are present throughout the year.

Figure 9. Ditch in sugarcane field with northern harrier in the background

Canals and ditches. There are hundreds of miles of canals and ditches throughout the EAA forming a dense matrix of aquatic habitat that is closely tied to the upland sugarcane fields. While canal management is more focused on water quality than wildlife habitat, in many areas the canals support a diverse population of aquatic and semi-aquatic species such as ducks, river otters, turtles, alligators, amphibians, reptiles and fish. The field canals are often shallow and filled with aquatic vegetation and may serve as nursery areas for a variety of fish species and for frog and toad larvae. Aquatic animals generally move freely between field ditches and flooded fields.

Flooded fields and Rice. Fields are often flooded in rotation with sugarcane or vegetables to maintain soil health and control pest insects and weeds. These flooded fields are either left fallow or are planted in rice. Both types of flooded habitat are important to wildlife in the EAA and are generally colonized quickly by a variety of aquatic insects, small or larval fish and tadpoles. Such communities are able to grow in number and size throughout the spring and summer and are recognized by wading birds, ducks and other aquatic species as a source of food. Rice fields can also be considered flooded fields and provide habitat that is similar to short hydroperiod marshes in the Everglades (Pearlstine et al. 2007). A number of water birds nest in rice and nearly every wading bird native to south Florida can be found foraging in or adjacent to EAA rice fields at some time. During harvest, water in rice fields is drawn down and drained into adjacent canals and ditches that are then emptied. This serves to concentrate aquatic prey in high numbers that are readily accessible to birds and other predators. Drawdowns often occur during the summer when water levels in natural Everglades systems are high and aquatic prey is dispersed and thus may provide an important source of food for birds that have dispersed from those areas.

Figure 10. Flooded rice field

Edges. Edges are known to be of great importance in agricultural habitat and may serve as refugia, movement corridors, nesting and sheltering habitat and also help prevent runoff from fields and roads. The edges of fields and ditches/canals in the EAA are often vegetated and provide these very functions. They may be most important during the sugarcane harvest when the fields are swiftly changed from dense tall grasses to fallow fields. Rabbits and songbirds take refuge in the edge vegetation at this time. At all seasons snakes, rabbits, amphibians and many birds use the brushy edges as primary habitat and benefit from proximity to both water and shelter in surrounding crops.

Figure 11. Green heron on field edge

Non-farmed. There are many places in the agricultural area that are wetlands, cypress hammocks or other landscapes not well-suited to cultivation. It is estimated that approximately 15% of the farmlands are left unplanted and provide valuable wildlife havens. Anhingas and cormorants may be found nesting in brushy flooded areas along with alligators and ducks. Bobwhite, quail and other birds may forage in fallow fields that have been left untilled. Undisturbed wetlands, uplands and cypress hammocks exist within the sugarcane matrix. These provide unique areas of native habitat that may be very valuable to some wildlife species.

Other crops. Other crops grown in the EAA include rice (see flooded fields), vegetables and sod. Small quantities of specialty crops may also be grown in varying amounts. Eastern meadowlarks are often found in sod fields and temporarily flooded areas will be utilized as foraging habitat by shorebirds, particularly black-bellied plovers.

Figure 12. Lettuce field in winter

Farmers/managers and wildlife

While farmers in the EAA implement Best Management Practices (BMPs) for the reduction of phosphorus as required by the 1994 Everglades Forever Act, these BMPs also provide benefits for wildlife. For example, BMPs to reduce soil erosion call for allowing natural weeds to grow along the miles of canal and ditch banks. The brushy weeds provide safe habitat for wildlife, particularly during harvest season. Other BMPs, such as sediment control, result in large backhoes removing rich, nutrient-laden soil from the bottoms of canals and ditches. Numerous small aquatic creatures are piled along with the soil on nearby fields, providing an easy meal for area birds and other wildlife to enjoy. Holding higher water tables in

sugarcane fields also provides enhanced habitat for some animals and may preserve the peat soil.

In addition, the normal agricultural practices of these farms provide opportunities for wildlife to feed and thrive. Annual sugarcane harvests include flash burning of cane fields, similar to wildfires in the natural Everglades. Farmers' humane practices call for leaving an open side when setting these fields afire, allowing wildlife a safe avenue to escape. Several species of predators take advantage of this opportunity and await the movement of wildlife out of the fields. In particular, predatory birds, including the bald eagle, vultures, crested caracaras, and cattle egrets follow harvesting equipment into the fields to await the fires that will bring their prey out into the open. Even primarily coastal birds like sea gulls make their way into the EAA during sugarcane harvest season to take advantage of the harvest. Sugarcane harvests are accomplished with huge mechanical harvesters similar to giant lawn mowers. The heavy equipment vibrates or shakes the soils, unearthing large numbers of insects (worms, crickets, grasshoppers and moths) that are quickly captured by waiting predators and migratory songbirds.

Many times, farm managers will adjust farm activities when possible to protect resident wildlife. For example, a pair of bald eagles has nested on the same U.S. Sugar field for more than 50 years. Sixty acres of land surrounding the nest were set aside and not farmed to provide an undisturbed home for the pair. In other instances, farmers will protect nesting pairs and newborns from predators.

Figure 13. Nesting bald eagle in EAA

Methodology

Ecological surveys are generally designed to sample individuals or populations using a random design. Randomly placed surveys are less likely to suffer from bias and thus more appropriate for sampling patterns in the environment and animal life as they actually occur. The nature of the EAA makes random placement of all points nearly impossible due to the linear nature of roads and density or impassability of the fields. All surveys in the EAA consisted of randomly located points that occur on or near a road (almost always dirt or gravel). These served as starting points for transects consisting of multiple points where actual sampling occurred. Sampling consisted of bird counts, auditory call counts of amphibians, or placement of minnow traps in canals and ditches to sample fish populations. We also conducted visual surveys for snakes and other reptiles. Depending on the type of survey, points were located at least 50 meters apart and were generally at least .5 km apart. It is important to separate points far enough to be certain that individuals counted at one point are not able to move to adjacent points during a particular survey and thus get counted twice. Avian and amphibian surveys were generally conducted with amphibian surveys at night and

bird surveys the following morning for each transect.

Figure 14. Deer in edge habitat

Bird surveys. Surveys for birds were always conducted from just before dawn until at least two hours after sunrise. In most cases, surveys did not continue longer than about three hours due to heat in the summer or high wind in winter when birds generally seek shelter and are not detectable. Most surveys consisted of visual and auditory counts but only those birds with easily recognizable calls were included in auditory counts; common yellowthroats and red-winged blackbirds are two such species. During 2008 and 2009 bird surveys conducted in cooperation with scientists from Florida Atlantic University included a second observer and a distance metric. These were to account for detectability of birds as influenced by observer and distance. Field type, edge vegetation height, canal and ditch water levels, and other environmental parameters were recorded. Weather, temperature, wind and noise measurements were also taken.

We conducted limited surveys of nesting birds including surveys in rice fields to assess species presence and nest characteristics. We were unable to follow any of these nests to completion in order to measure nest success. Another study of nesting birds included birds nesting adjacent to flooded fields. The most abundant bird in this survey was the black-necked stilt but we were also able to gather data on killdeer and common nighthawks. More seasons of study of these birds are necessary to understand nest success in flooded habitats in the EAA. We have also been documenting the presence and possible breeding of the exotic purple swamphen, an invasive bird.

Amphibian surveys. Amphibian (anuran) surveys were conducted at night and consisted of call counts for individuals and breeding choruses as well as intensive searches within the vicinity of each point. Frog and toad species were identified by call and by number of individuals or a general descriptor of chorus size (i.e. small, medium or large). This method works well for some species such as tree frogs and pig frogs, but leopard frogs and small frogs such as greenhouse frogs are more reliably counted using visual searches of vegetation, roads and ditches.

Fish surveys. Fish surveys were conducted during the first two years of our work in the EAA and consisted of minnow and Breder (plexiglass) traps placed in canals, ditches and flooded fields to census small fish populations. Traps were left in the water with some air at the top either overnight (minnow traps) or for twenty minutes (minnow and Breder). They were then checked, fish were identified, and counted and released back at the point of capture. Master's student Grant Sizemore (Sizemore 2009) used throw traps to further identify species and relative abundance in some flooded fields.

Figure 15. Technician Maria Alejandra Millan with a nest in a rice field

Reptile surveys. We did not conduct any regular, structured surveys of reptiles in the EAA but have been able to conduct a yearly "Herparoo" or kingsnake survey. Herparoos consisted of volunteers walking ditch and canal banks during morning and evening hours searching for reptiles. Most reptiles encountered were snakes and all were identified to species. We attempted to capture kingsnakes and measure length as well as identify sex where possible. Habitat variables such as location of capture and substrate type were also recorded for kingsnakes. We have an extensive list of reptiles occurring in the EAA and a database of kingsnake occurrence locations.

Mammal surveys. We conducted no structured mammal surveys but recorded locations of bobcats when observed during other surveys. We have a database of bobcat occurrence and location. Doctoral student Jason Martin conducted small mammal trapping during a study of barn owl populations in the EAA (Martin 2009).

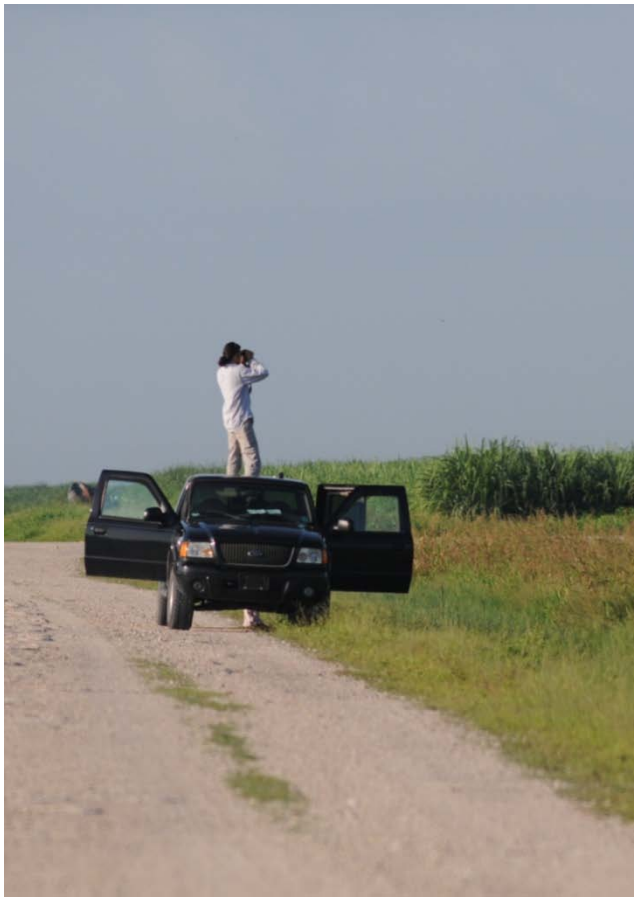

Figure 16. Technician Juan Sebastian Ortiz conducting surveys in tall and short sugarcane

Animal Communities and Diversity

The EAA supports a diverse and abundant wildlife population and provides important habitat for many of south Florida's species. Some birds like fulvous and black-bellied whistling ducks and mottled ducks may find breeding habitat in and adjacent to flooded fields. Purple gallinules, common moorhens, least bitterns and black-necked stilts breed in flooded rice and fallow fields. Songbirds, doves

and northern bobwhites find suitable breeding habitat in sugarcane fields and in brushy and wooded canals and edges. A number of mammals are well-adapted to the cycles of growth and harvest in sugarcane and other crops, especially marsh rabbits and cottontails and their bobcat predators. Although not popular with some workers, snakes abound in the EAA, especially the threatened Florida kingsnake which preys on other snake species including cottonmouths. Fish and amphibians (frogs and toads) find their homes in the ditches, canals and flooded fields.

Animal communities are, in many ways, similar to those found in other areas of southern Florida. Small wading birds, bobcats, ducks, alligators and turtles are all able to find breeding habitat and produce young in the EAA. Other animals, such as wood storks, crested caracaras, white-tailed deer and bald eagles have more specialized needs and do not generally breed in the EAA in noticeable numbers but may find important dispersal or wintering habitat in fields as crops are being grown, flooded or harvested. Fish communities are very similar in species composition to those found in short-hydroperiod marshes in the Everglades. Exotic species are present but not in higher numbers than elsewhere in natural habitats of south Florida. Some characteristic and important groups of animals are described below. See appendices for a complete list of species observed in the EAA.

Raptors. A large number of raptors are to be found wintering and migrating through the EAA from late summer through spring. Many may spend as much as six months or more on this alternative habitat. Northern harriers are especially apparent as they course over tall and short cane fields hunting the ditches and edges. Red-tailed hawks and American kestrels utilize perches provided by power poles and power-lines to hunt prey in roadsides and fields. Thirteen species of raptor were observed during a roadside survey comparing natural wetland habitat with sugarcane fields in Broward and Palm Beach County (Pearlstine et al. 2006). For the seven most abundant species, there was an average of 1.13 individuals per kilometer in agricultural habitat compared with 0.61 individuals per km in natural habitat. Species richness and diversity were comparable between natural and agricultural habitat for the species studied and four of the seven species were more commonly seen in agricultural habitat. Individuals were more commonly found on artificial perches such as power poles and were often seen hunting in edges and fields. The study concluded that “agricultural lands in south Florida may provide important habitat for wintering and migrating raptors.” Availability of perches, sugarcane harvest, open landscape and canals are all important habitat components for this suite of wildlife species.

Figure 17. Red-shouldered hawk on a power pole

Songbirds and other small birds. Over 22 species of songbirds were observed during one

season of winter surveys. Our checklist (Pearlstine et al. 2005 and edis.ifas.ufl.edu) contains 45 species of passerines or songbirds. One of the most abundant birds is the common yellowthroat, present all year, nesting in sugarcane and edge habitats. Its characteristic warbling call can be heard throughout the EAA wherever there is tall cane and/or tall edge vegetation. Migrating warblers and other small birds are present in nearly all habitats and include the palm warbler, several species of sparrow and swallows. Blackbirds, grackles, cardinals, meadowlarks, catbirds, bobolinks and crows can also be seen. Blackbirds and grackles may act as pests on crops such as rice in summer/fall and corn in winter but in other seasons are likely to consume insects and weed seeds that may prove harmful to some crops. Both mourning doves and common ground-doves are plentiful in and around the cane fields. While mourning doves may be found in many locations throughout south Florida, common ground-doves are scarce in most other habitats. The highly invasive, exotic Eurasian collared-dove, while common in urban and suburban habitats of Palm Beach County, is rarely seen in the agricultural fields.

Wading birds and shorebirds. This group of birds includes the large and charismatic wood stork, great egrets, roseate spoonbills, smaller egrets and herons of Florida's wetlands, and a variety of small shorebirds that find their homes on muddy or sandy shores. These easily recognizable birds are found throughout the year but utilize a variety of habitats during different growing seasons. It may be that flooded fields and ditches provide important dispersal habitat for individuals that have bred in natural Everglades habitat. As the rainy season begins in south Florida, water levels rise and fish populations are able to disperse making them harder to catch. At this same time, fields in the EAA are being flooded and rice is being planted. Ditches are flooded and/or drained for water management. As the summer progresses, some fields are drained for insect control or for harvest, and fish populations that have been growing in these fields are concentrated in adjacent ditches. These high concentrations of fish quickly attract storks, herons, egrets and ibises that are in the area. Hundreds of birds may be present at the time of rice harvest in some areas. Flooded former vegetable fields are left fallow and water remains through the summer and into early fall providing food and shelter for thousands of wading birds and shorebirds in addition to terns and black skimmers. While sod fields do not provide habitat for many animals, during the fall, winter, and spring they may support large numbers of shorebirds that will feed on insects in the short grass, especially if there are flooded areas. Black-bellied plovers especially may occur in large numbers. Black-necked stilts are one of the few shorebirds to breed in the EAA and may be found on gravel shores of flooded fields and in berms surrounding rice fields.

Figure 18. Wood storks in a flooded vegetable field

Ducks, rails and secretive marsh birds. Mottled ducks, whistling-ducks (both black-bellied and

fulvous), common moorhens, purple gallinules and king rails make their nests in rice fields and in brushy habitat near canals and other flooded habitat. A recently invasive species, the purple swamphen, has also been seen nesting in rice in the EAA. Secretive marsh birds such as soras (migrant), black rails, and least bitterns are also found in and around flooded fields. Rails and bitterns build their nests as rice grows tall and strong and most will also construct a ramp for access to the nest. They also build observation platforms and brood nests. Rail nests are often sheltered from the sun by a canopy formed from rice stalks bent over the nest. Duck nests are most often observed in thicker, brushy habitat or in sugarcane itself. Both species of whistling-duck have increased greatly in recent years, likely due to the presence of rice and flooded fields that provide food and habitat. The exotic purple swamphen has been recently found in the EAA. Although birds and nests are common in nearby Stormwater Treatment Areas (STAs), purple swamphen nests have not been found in the EAA. These large and aggressive birds are an agricultural pest as in old world countries where they are native.

Mammals. Three species seem to characterize the mammals of the EAA, cottontail and marsh rabbits and their predator, bobcats. All three species thrive in sugarcane fields and use ditch and canal banks for shelter and movement corridors. Populations of rabbits breed and find shelter in tall, dense sugarcane and increase throughout the growing season. During harvest, they are able to leave bare fields and use ditch or canal banks, brushy areas and unharvested fields for shelter as the sugarcane quickly grows back. Bobcats prowl the edges of the fields and shelter within the tall cane as they prey on rabbits and rodents which are often agricultural pests. River otters are commonly seen throughout the canals and ditches in the EAA and prey on crayfish and shellfish in the ditches and canals.

Figure 19. Cottontail rabbit in edge habitat

Reptiles. A large and diverse population of reptiles occurs in the EAA and is mainly characterized by snakes (Casler et al. 2004) and turtles. Alligators are present but in lower numbers than in their natural habitat. Florida kingsnakes can be regularly found prowling canal banks in search of a mate or prey. They are known predators of other snakes and may help keep populations of poisonous snakes such as cottonmouths in check. Florida kingsnakes are rarely found outside the EAA and may be in danger of disappearing from southern Florida (Krysko and Smith 2005). Garter snakes, racers and yellow rat snakes are

commonly seen moving across roads and along field edges. The absence of traffic in the EAA and very low number of paved roads likely contribute to the health of the snake populations since road mortality is thought to be a contributor to population decline in many reptiles. Turtles are also protected from high road mortality and can often be seen in and alongside larger canals feeding on weedy vegetation in the water.

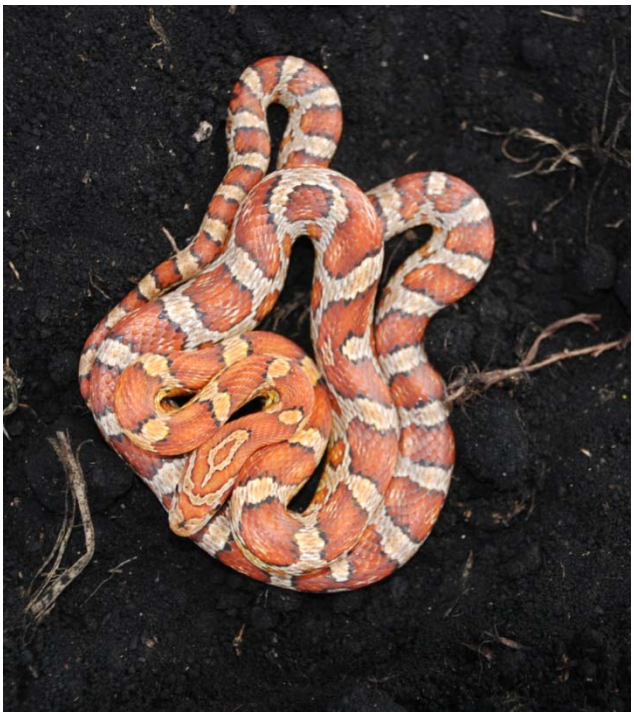

Figure 20. Corn snake in the rich black soil of the EAA

Amphibians. At least 13 species of anurans are found in the EAA and most occur in flooded habitat (Casler et al. 2004). Slow-moving ditches and flooded fields provide shelter for tadpoles. Tree frogs can be heard chorusing from both rice and sugarcane fields and pig frogs are regularly heard in larger, permanent water bodies in the EAA.

Fish. Small fishes that are accustomed to reproducing within a short time frame populate canals, ditches and flooded fields (Pearlstine et al. 2007). As fields are flooded, adults are able to gain access through flood gates and maybe even through pumps. Young fish quickly appear and grow in this new habitat, eating insects and aquatic plants. This environment is similar to the short hydroperiod marshes that characterize some of southern Florida wetlands. Fish populations in the EAA are very similar to fish communities elsewhere in south Florida and the number of non- native fish is higher than any other vertebrate group in the EAA.

Figure 21. Tree frog on a no-trespassing sign

Animals unique to the EAA. There are no animals that are only found in the EAA but the large expanses of relatively undisturbed habitat seem to support some upland species at apparently higher numbers than elsewhere in south Florida. Florida kingsnakes are rarely found in the wild outside the EAA but yearly surveys documented up to a dozen depending on effort. Yellow-crowned night herons nest in Brazilian pepper trees that line the canals. They are rarely found in heronries in south Florida outside the EAA. River otters and

bobcats are commonly seen in and adjacent to sugarcane fields. Our studies did not find any of either species at LOX, leading us to believe they are rare in natural habitat, but it is unclear how the numbers in the EAA compare with conservation and other areas in south Florida.

Figure 22. Florida kingsnake in edge habitat near a canal

EAA as part of the south Florida landscape

Urbanization and conversion of natural and agricultural landscapes in south Florida continue to degrade and consume wildlife habitat. Current agricultural practices and crops provide important primary and secondary habitat for much of the wildlife in the area and in surrounding natural habitats. More than eight years of study have documented the importance of the EAA for many wildlife species that occur in Florida south of Lake Okeechobee and that come to the area from other parts of North America. It is likely that the EAA will become increasingly important to maintain the diversity and abundance of native, migratory, and wintering species that depend on the region to sustain their natural populations.

Project and Annual Reports

Years 1 – 3

Wildlife Habitat Relations of the Everglades Agricultural Area, Florida. A Final Report 2002-2004. Elise V. Pearlstine, Frank J. Mazzotti, Michelle L. Casler, Wendy M. Bear and Kenneth G. Rice. January 2005.

Executive Summary

Objectives

The goal of the initial study, funded in 2000 was to document the presence and diversity of wildlife species in the EAA.

Method

In a three year study of wildlife habitat relations in the Everglades Agricultural Area (EAA) near Belle Glade, Florida, we studied the distribution and habitat affinities of vertebrate species in agricultural fields. The EAA is planted mostly in sugarcane (about 80%) but also supports rice fields, vegetables and sod. Agricultural fields are organized around a system of canals and ditches that provide irrigation and allow for flooding of rice and fallow fields. Field edges are left brushy or may be sprayed or mowed to control vegetation. There are very few trees in the agricultural fields themselves but some in the vicinity of outbuildings and houses. The purpose of the study was to determine wildlife habitat relations, diversity and abundance in the EAA; to assess effects of habitat management; and to produce educational material regarding wildlife in the EAA.

We surveyed fish, anurans (frogs and toads), and birds in standardized, repeatable surveys of sugarcane, rice and fallow fields. Our observations of reptiles and mammals were incidental as we conducted other surveys and drove to and from study sites in the area. We conducted similar surveys of the same taxa in the impoundments of Arthur R. Marshall Loxahatchee National Wildlife Refuge for purposes of comparison. Rice field surveys lasted two years and sugarcane surveys for two years; they overlapped for one year.

Results

Our surveys found significantly more bird individuals in agricultural fields than in non-agricultural impoundments (Table 1). There were an equal number of fish in agricultural and impoundment areas and fewer anurans in agriculture than impoundments (Table 2). Although we could not statistically test for differences we observed more individual reptiles and mammals in agriculture than in impoundments.

We observed more species of every taxon in agricultural areas than in impoundments. These included animals that are wetland dependent as well as those that occupy upland habitat. Many animal species

utilized edges between agricultural fields and canals or ditches. We did not observe a greater number of exotic species in agriculture than in impoundments. There were no noticeable negative impacts of cultivation practices on animal populations.

Table 1. Numbers of individuals (I), species (S) and diversity measures (D), Simpson's diversity is the first number, Shannon-Wiener is the second for each field type including impoundments. Number in parentheses is exotic species.

Taxon	Agriculture	Sugarcane	Rice	Fallow	Impoundment
Fish	I: 8.49 S: 21(7) D: 0.40/0.39	I: 5.15 S: 19(6) D: 0.5/0.5	I: 12.17 S: 19(4) D: 0.3/0.3		I: 6.07 S: 14(3) D: 0.37/0.38
Birds	I: 4.99 S: 98(3) D: 0.9/1.3	I: 4.38 S: 72(2) D: 0.8/1.0	I: 5.23 S: 56(1) D: 0.9/1.3	I: 6.5-7.0 S: 61(1)	I: 3.32 S: 63(3) D: 0.9/1.4

Table 2. Number of species found in agriculture and impoundment.

Taxon	Agriculture	Impoundment
Anurans	S: 13(3)	S: 11(2)
Reptiles	S: 22(1)	S: 8(1)
Mammals	S: 12(2)	S: 6(1)

Agricultural habitat of the EAA is large in scale, of fairly low input and contains an abundance of edge and aquatic habitat that supports a large population of diverse wildlife. When compared with impoundments at LOX that are managed for wildlife we found that wildlife is generally more abundant and species rich in the EAA although diversity did not appear to be different between the two habitats. Management of the EAA, although directed towards agricultural yield, supports extensive wildlife habitat. Our goal is to provide information that will assist managers in maintaining and improving wildlife habitat in conjunction with agricultural operations.

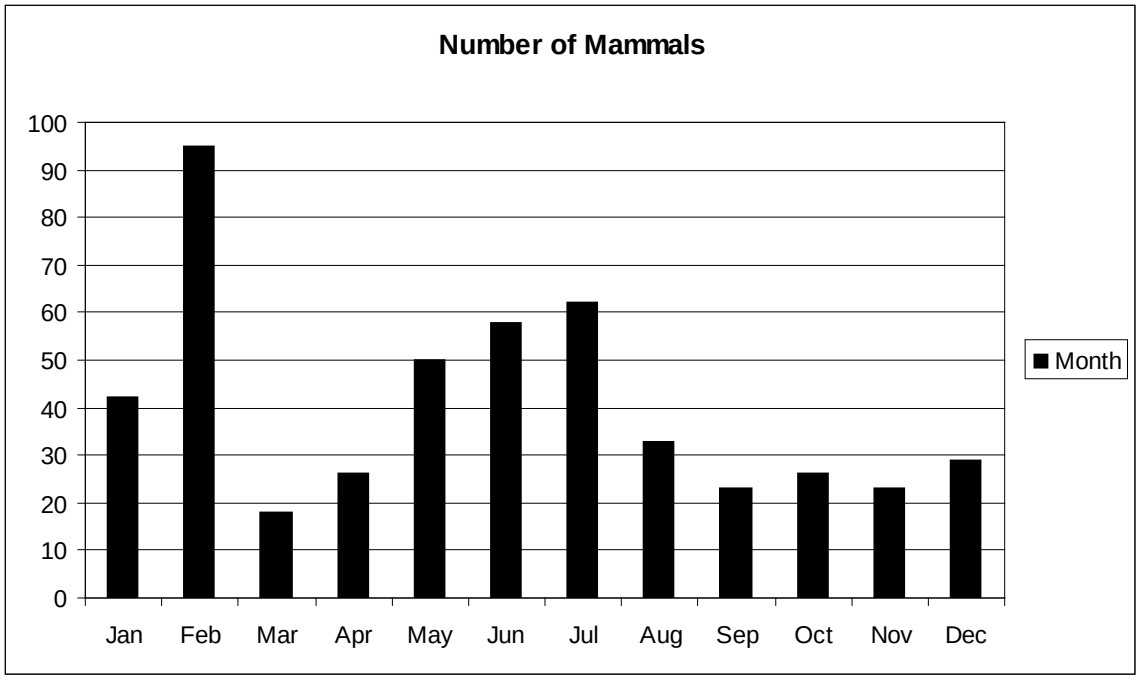

Figure 23. Total number of mammals observed by month

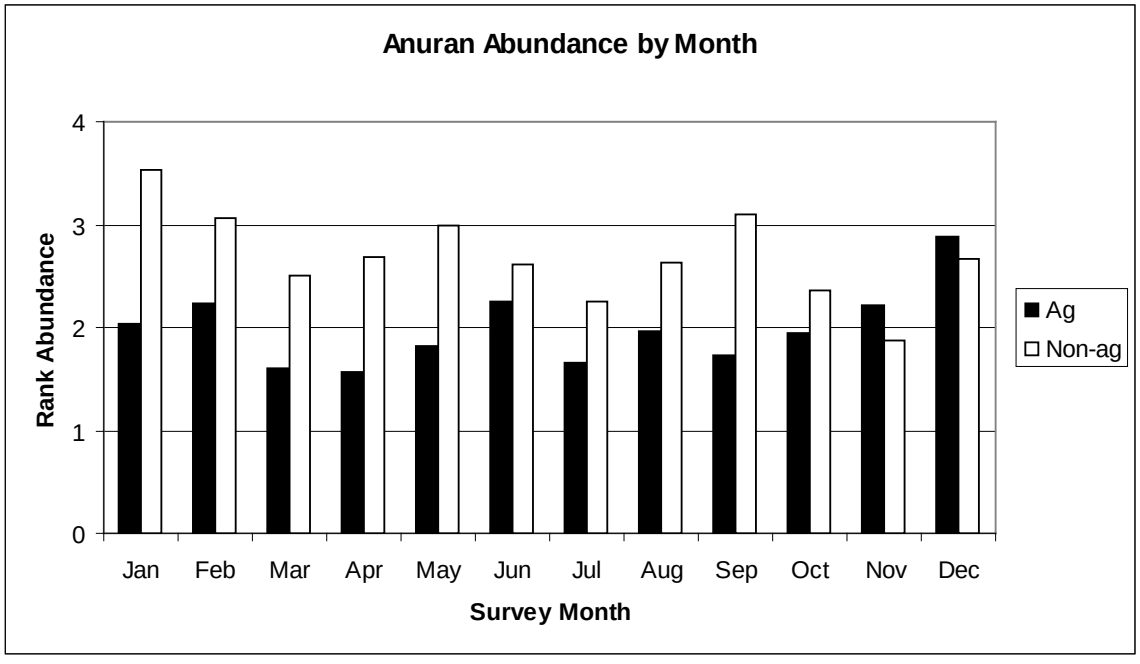

Figure 24. Numbers of anurans by month in agricultural and non-agricultural habitat

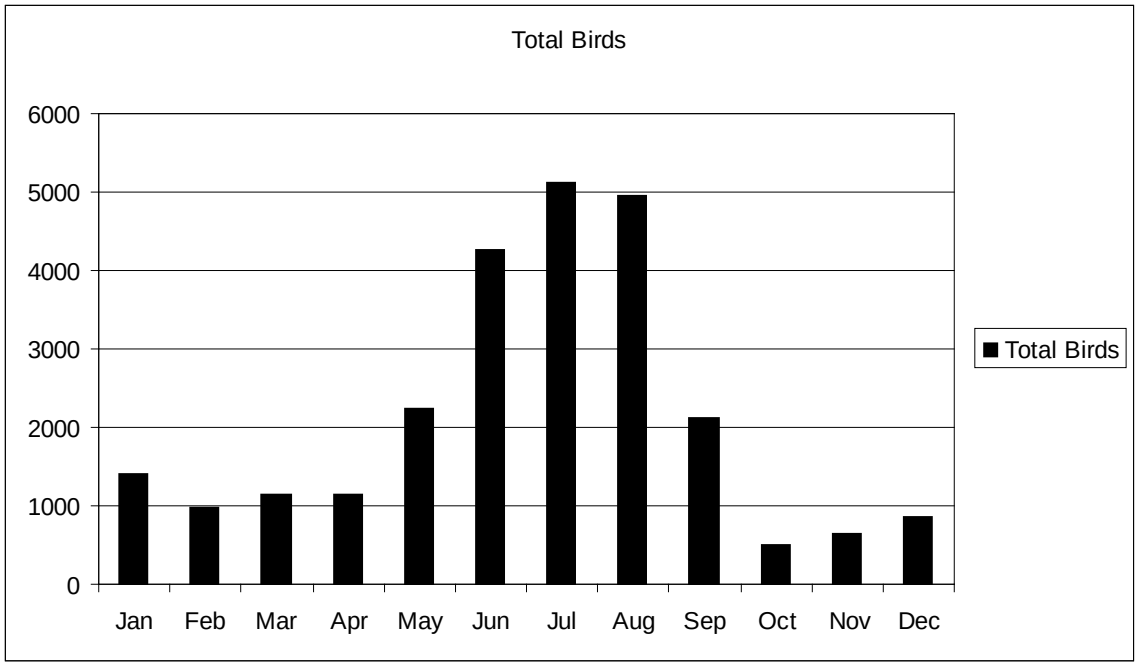

Figure 25. Bird totals by month in the EAA

Conclusions from the three-year study

Benefits, challenges and characteristics of the EAA as wildlife habitat

Benefits:

- Nutrient input increases growth of crops and probably provides benefits for edge and other vegetation as well. More lush growth such as this often supports more wildlife.
- Cultivation of crops – A number of animal species benefit from cultivation of crops such as rice. This is probably the most important wildlife crop in the EAA because it provides wetland habitat for a large number of birds and fish. Cultivation of sugarcane and other crops are beneficial to animals that forage in these crops, follow machinery during planting and harvest, and prey on animals that live in these fields.
- The massive size of the EAA is such that even unplanted areas such as canals, ditches, unfarmed areas, and edges provide a large amount of habitat for a variety of wildlife.
- Most of the boundary of the EAA is adjacent to natural landscapes or reclaimed wetlands such as the Water Conservation Areas (WCAs) and Stormwater Treatment Areas (STAs). Animals from these localities may find dispersal or migratory habitat in the EAA.
- Agricultural fields of the EAA are extensive and are accessed by unpaved roads that are usually gated. This limits access to most of the area and provides habitat that is relatively undisturbed by human use.

- Flooded fields of the EAA provide surrogate wetland habitat for many birds and other animals. Canals and ditches are also important for aquatic animals.
- The ability to manage water flow and flooding of the fields is an opportunity to provide for the benefit of wildlife. Flooding and draining (recession) occurs in the spring and summer and is opposite the natural system. Food resources provided by these activities may support dispersing wading birds as they leave the Everglades at the start of the rainy season.
- Sugarcane and rice are both fairly low input agricultural crops. A small percentage of the EAA is cultivated in higher input crops such as vegetables and sod.
- The presence of managers on the EAA and restricted access limits the possibility of human disturbances such as hunting or harassment of wildlife, collecting for pets, and littering/polluting.

Challenges presented by habitat in the EAA are generally related to agricultural practices and may be, in some cases, the same as the benefits.

Challenges:

- While nutrient input here is relatively low for commercial agriculture, it is still an alteration of the natural Everglades system and has undoubtedly resulted in some artificial habitat and encouraged the proliferation of weedy and non-native species of plants.
- Cultivation of agricultural crops carries with it a set of intrinsic dangers to wildlife. The use of machinery is a disturbance and is sometimes fatal to animals that inhabit and breed in the fields. Heavy machinery compacts soil, plowing and sowing disturb soil and may contribute to erosion. Harvesting, including the use of fire, is a high disturbance period in the cultivation cycle. Yearly growth and plowing cycles are detrimental to some species such as round-tailed muskrat that require longer periods of stable habitat. However, this study found that over time most species of wildlife in the EAA have adapted to the agricultural cycle.
- Application of chemicals such as herbicides is not desirable in areas where animals are feeding and reproducing. BMPs are in place and farmers are working to reduce phosphorus and other chemicals through lower use and more on-field water retention.
- Decisions relating to water management have as their first priority the benefit of crops. Thus, water may be withdrawn from fields at a critical point in the reproductive or migratory cycle of animals that are dependent on aquatic habitat. Flooding and drying of fields is also out of sync with natural wetlands in the area (however, this may also be beneficial). Nearby STAs also experience fluctuations in response to other demands (water cleaning and maintenance) as well.
- Crop type and rotation decisions are made with economic basis, not wildlife. The fluctuating price of rice determines the amount of habitat available for wetland nesting and dispersing birds.
- Fire control, management styles and control of weedy plants contribute to the clearing of brushy habitat on the edges of fields and ditches. Management also discourages the growth of trees on upland habitat. The absence of trees in natural clumps and groups does not allow for roosting and breeding of many tree or woodland/forest dependent species.

Attributes

- Agricultural fields of the EAA are large and extensive in area. Sugarcane is essentially undisturbed for nearly a year between harvest activities and covers hundreds of thousands of acres. Rice is present during three to six months of the spring and summer and covers thousands of acres. Row crops are present on a small percentage of land in rotation with sugarcane or rice. Fallow fields are flooded following harvest of vegetables in the spring, an activity that helps maintain soil health. Sod is generally grown in the same fields year after year on a low number of acres.
- Ditches and canals intersect and connect all habitats of the EAA. They are continuous with Lake Okeechobee to the north and the Everglades to the south. Large canals are flooded throughout the year; smaller canals and ditches generally experience a lowering of water level or complete drydown during the year. Management consists of dredging and removal of aquatic vegetation.
- There is little urbanized habitat within the EAA itself. Farm buildings, barns and pump houses dot the landscape. The towns of Belle Glade and South Bay are located on the south end of Lake Okeechobee and Clewiston is to the north and west of these.
- The landscape of the EAA is changing and dynamic, characterized by growing and harvest of crops, plowing and tilling of the land, burning of sugarcane, rotation of crops and flooding and drying of some fields and ditches.
- Upland and wetland habitat exist in close proximity to each other. Upland habitat is characterized by narrow strips of mostly non-native species that are found on the edges of fields and along ditches and canals. The vegetation is usually brushy or herbaceous. Wetland habitat is usually associated with rice cultivation or flooding of fallow fields and is connected by a network of ditches and canals.

Management recommendations arising from the current study

- Wherever possible we recommend that managers maximize the attractiveness of edge and uncultivated fields for wildlife. Leaving edges un-mowed and untreated while allowing brushy vegetation to grow encourages a variety of wildlife. Many species using these edge habitats may be predators of agricultural pests such as rodents and small mammals in sugarcane fields. Herbaceous and brushy growth on the edges of canals also decreases runoff from the fields into these water bodies.
- Where there are larger areas of edge or upland that are not in cultivation we recommend planting native trees and plants for the benefit of wildlife.
- Water in ditches and in the fields is also a significant habitat for wildlife. Wherever possible, in keeping with overall water management needs, fields should be flooded and rice should be grown where appropriate. It is also desirable to keep water in as many ditches and small canals as possible throughout the year.
- We encourage continued limited use of chemical fertilizers and pesticides with the investigation into alternative practices to further limit use of these chemicals.

- We believe that limited access to the fields has had benefits for a number of wildlife species, especially those that are sensitive to disturbance such as nesting birds and those that may be collected for the pet trade such as the Florida kingsnake. Our experience has been that access is controlled and that managers are very aware of activities in their fields. We encourage the continuation of this practice, especially in the springtime when animals are breeding.
- Many of the mammal species that are found in or adjacent to sugarcane fields may benefit from longer rotations in some fields and from lower intensity harvesting activities. We encourage this in fields where economical and management considerations allow.
- We recognize that not all these suggestions are economically or practically feasible and yet we hope that managers and owners who value wildlife on their property will find a way to incorporate at least some of them into their management strategies. While agricultural operations cease to exist if they do not prove profitable, they are also a part of the greater landscape and of a local culture in which wildlife is intrinsically valuable. Therefore, we hope that our studies have had and will continue to have practical application for the benefit of wildlife in the EAA.

Year 4

Elise V. Pearlstine, Frank J. Mazzotti, 2005. Wildlife Habitat Relations in the Everglades Agricultural Area Annual Report. University of Florida, Ft. Lauderdale Research and Education Center, Davie, FL 33314

Objectives

To continue surveys of wildlife in the EAA and to focus on rice and flooded fields. We also surveyed for blackbird abundance and distribution.

Methods

We surveyed flooded fields weekly, rotating through about 20 rice fields and one large area of flooded fallow fields. We considered a rice field an area of contiguous rice that consisted of from 2 to 10 sub-fields of 25 to 40 acres each. We walked through the rice sub-fields in standardized transects as well as walked around the edges. For each visit a sub-field was randomly chosen for survey and was not visited again. If the number of a particular sub-field was chosen a second time on subsequent visits we went to a different randomly selected sub-field. We surveyed the edges of the fallow flooded fields either using a vehicle or by walking. All bird nests and broods (adult with flightless young) were censused and recorded. We took photos where possible. Nest site and nest characteristics were recorded to determine placement of nests and to help in identifying the species of bird that built the nest. We censused blackbirds, red-winged blackbirds and boat-tailed grackles as part of a separate study to determine the nesting and foraging patterns of these birds. We also visited other areas such as canals with tree cover, fallow areas and roadsides that might provide nesting or roosting habitat. We documented nesting or roosting birds that were utilizing this habitat.

Results

We documented nesting or reproduction by at least 14 species of birds in rice fields, flooded fields or adjacent habitat. The most abundant was the common moorhen followed by black-necked stilt and purple gallinule (Table 1). Common moorhens and purple gallinules nested in rice itself and black-necked stilts nested on bare berms in the rice or on bare soil adjacent to flooded fields. Least bitterns also nested in the rice. Boat-tailed grackles and red-winged blackbirds nested in rice and in various other habitat types. Small herons and egrets as well as night-herons require trees to nest in and prefer them to be over water. We found two small rookeries, one consisting solely of yellow-crowned night-herons and one of mixed herons and egrets (with one least bittern). Both were in non-native tree/brush cover, predominantly Brazilian pepper, hanging over fairly large canals. Mourning doves, common nighthawks and killdeer all nested on or adjacent to roads. We did not find any common nighthawk nests but other scientists in the area have reported seeing them. Our later surveys in 2008 and 2009 found nighthawk nests.

Table 3. Number of birds nesting by abundance of nests found.

Species Name	**Total**
Common Moorhen	56
Black-necked Stilt	34
Purple Gallinule	21
Least Bittern	9
Boat-tailed Grackle	8
Red-winged Blackbird	6
Yellow-crowned Night Heron	6
Little Blue Heron	4
Green Heron	3
Mottled Duck	3
Tricolored Heron	3
King Rail	1
Marsh Wren	1
Mourning Dove	1

Year 5

Elise V. Pearlstine, Frank J. Mazzotti , 2006. Wildlife Studies on Lake Okeechobee and Stormwater Treatment Areas, Annual Report October 2006. University of Florida, Ft. Lauderdale Research and Education Center, Davie, FL 33314

Objectives

To determine what wildlife studies are being conducted and have been conducted on the lake and in the STAs. To determine what wildlife is found in both STAs and other EAA habitat through literature review and targeted wildlife surveys. To determine the roles that Lake Okeechobee and the STAs play in wildlife population dynamics in south Florida.

Methods

Point counts on transects located at targeted areas in STAs and agricultural fields. Repeated visits to bird nests to document nest success.

Results

We completed targeted surveys of most STAS, concentrating in STA2, STA3/4 and STA5. STAs are filter marshes constructed on former EAA cropland. We completed a literature review of wildlife species in STAs and Lake Okeechobee. Other surveys were conducted in sugarcane and created wetlands in the EAA; each survey is either summarized or published separately. Overall, more than 100 surveys were completed at random upland sites for breeding birds such as mourning doves, common ground doves and northern bobwhites. Locations were documented through GPS for other notable species such as bobcats and Florida kingsnakes. We gathered data on distribution, breeding, foraging and other habitat use for more than 10 species that utilize upland habitat such as sugarcane and edge habitat such as canal and ditch banks. Separate surveys documented birds breeding in created wetlands such as flooded fallow fields and rice fields. Information gained from nesting surveys included limited data on nest success for breeding black-necked stilts and other breeding waterbirds in rice.

Year 6

Elise V. Pearlstine, Frank J. Mazzotti, 2007. Wildlife Studies on Lake Okeechobee and Stormwater Treatment Areas, Annual Report December 2007. University of Florida, Ft. Lauderdale Research and Education Center, Davie, FL 33314

Objectives

To prepare for avian lift surveys in EAA and STAs to be conducted next year. Also to continue EAA surveys and literature reviews.

Methods

Organizational Tasks

- Study Design and Implementation
    - Applied for necessary permits and keys to gain access to STA
    - Developed study design for survey activities for upcoming fieldwork
    - Met with SFWMD personnel regarding STA work
    - Began mapping locations of STAs
    - Began development of survey protocols for STAs
    - Copied and archived datasheets from winter fieldwork
    - Updated databases and developed new database of incidental observations
    - Trained and supervised technician in fieldwork methods, bird identification and database maintenance

Data Management

- Organized and proofed data on wildlife studies
- Analyzed data from previous work to include in report and publications
- Organized and entered data from current surveys in STAs and in sugarcane fields
- Data entry and management of birds in sugarcane project
- Organized budget, tasks and projects database
- Organized and proofed data on wildlife studies

STA surveys and other work

- Visits at least once a month to STA2 and STA5, twice a month to STA3/4. These included visits to:
    - Familiarize myself with the layout and accessibility of each STA
    - Conduct general bird surveys
    - Check for species of interest including Snail Kite, Roseate Spoonbill and Purple Swamphen
- Communication and visits with Hendry County Audubon Society STA5 committee regarding their visits, bird list and birds of interest
- Organized and maintained data on bird survey results in the STAs
- Developed bird checklist for STAs

Year 7

Dr. Elise V. Pearlstine, 2008. Wildlife Studies on Lake Okeechobee and Stormwater Treatment Areas, Annual Report October 2008. University of Florida, IFAS, Everglades Research and Education Center, Belle Glade, FL.

Objectives

To conduct matching standardized surveys in agricultural fields and STAs to determine the amount of environmental lift obtained from creation of treatment wetlands in former sugarcane fields.

Methods

We conducted avian surveys in the agricultural fields of the EAA in cooperation with scientists from Florida Atlantic University (FAU) to compare avian diversity in natural marsh, stormwater treatment areas (STAs) and sugar, sod and fallow fields. The goal of the study was to determine whether the STAs provided a benefit to avifauna (avian lift) of south Florida in addition to their primary purpose of water treatment. We located transect sites at three field types, making sure to include sugarcane, sod and fallow fields. At each site we delineated a number of points at which to conduct the surveys. Each point was at least 1 km distant from each other point. At these points we surveyed all birds seen for a distance of 200 meters using two observers. The primary observer described the birds seen and was responsible for counting all birds. The secondary observer would then record any birds seen that were not noted by the first observer. This double observer method allows for determination of detectability of the birds in the fields. A matching set of surveys was conducted by FAU in adjacent stormwater treatment areas (created marsh) and in natural marsh habitat (water conservation area [WCA] 3A).

Results

In winter we visited 24 sites and 107 points during the months of February and March 2008. We observed 38 species and 2,244 individuals. Of the sites visited, 16 were in sugarcane, 3 were sod, 2 were mixed sugar and sod, 2 were fallow and 1 was shrubby. There were 82 points in sugarcane, 15 in sod, 7 in fallow and 3 in shrubs.

Year 8

Elise V. Pearlstine 2009. Wildlife Studies on Lake Okeechobee and Stormwater Treatment Areas: Annual Report November 2009. University of Florida, IFAS, Everglades Research and Education Center, Belle Glade, FL

Objectives

To conduct matching standardized surveys in agricultural fields and STAs to determine the amount of environmental lift obtained from creation of treatment wetlands in former sugarcane fields.

Methods

We conducted avian surveys in the agricultural fields of the EAA in cooperation with scientists from Florida Atlantic University (FAU) for the purpose of comparison of avian diversity in natural marsh, stormwater treatment areas (STAs) and sugar, sod and fallow fields. The goal of the study was to determine whether the STAs provided a benefit to avifauna of south Florida in addition to their primary purpose of water treatment.

Our study design in the agricultural fields was to determine a site at a particular field type making sure to include sugarcane, sod and fallow fields. At each site we delineated a number of points at which to conduct the surveys. Each point was at least 1 km distant from each other point. At these points we surveyed all birds seen for a distance of 200 meters using two observers. The primary observer described the birds seen and was responsible for counting all birds. The secondary observer would then record any birds seen that were not noted by the first observer. This double observer method allows for determination of detectability of the birds in the fields. A matching set of surveys was conducted by FAU in adjacent stormwater treatment areas (created marsh) and in natural marsh habitat (water conservation area [WCA] 3A).

Results

Between October 1, 2008 and September 30, 2009 we surveyed 431 points on 94 transects in sugarcane and sod fields and counted a total of 17,003 individuals. Highest bird counts were in fall and winter with 5,502 individuals counted in September and 5,049 in December and January. The lowest count was in the summer with 2,523 counted in May and June. Spring visits yielded counts of 3,929 individuals. Species richness was also highest in fall and winter with 41 and 42 species respectively. The most abundant birds were those associated with agriculture, grassland and agricultural crops and included Red-winged blackbirds and boat-tailed grackles. Killdeer, tree swallows, black-bellied plovers; barn swallows were the next most common.

Scientific Results

Bird Diversity and Habitat Use

Pearlstine, Elise V., Frank J. Mazzotti, Kenneth g. Rice, and Anna Liner 2004. Bird observations in five agricultural field types of the Everglades Agricultural Area in Summer and Fall. Florida Field Naturalist 32(3): 75-84.

Results: Early work in the EAA consisted of surveys of 18 sites in five agricultural field types for bird presence and abundance. We also conducted comparison surveys at Arthur R. Marshall Loxahatchee National Wildlife Refuge (LOX). The largest number of birds and greatest diversity was found in flooded fields. Terrestrial habitats such as sugarcane, sod and fallow fields were less diverse and abundant but supported unique assemblages of species. We concluded that avian diversity in the EAA is enhanced by the variety of agricultural and landscape types in the area and recommended increasing flooded habitats where possible. We counted 4,005 individuals of 72 species overall in this study in EAA and LOX habitats. We observed a seasonal effect of crop management on bird presence and abundance. Rice flooding and harvest had the most effect on birds as they came to forage in drained and flooded fields.

Pearlstine, Elise V., Michelle L. Casler and Frank J. Mazzotti 2005. A Checklist of Birds of the Everglades Agricultural Area. Florida Scientist, 68: 84-96.

This paper documents the diversity of birds in the EAA and the habitats in which each species is generally found. Habitats surveyed included sugarcane, rice, vegetables, sod and other associated habitat. For these surveys we documented 138 species of birds and noted that abundance was higher in rice fields. Forty-two species were indicated as breeding or potentially breeding. This paper also documented the presence in the EAA of all species of wading birds that may be expected to occur in south Florida as well as nearly all species of raptor. Upland birds and birds of open habitat were especially noted while birds of forested and woodland habitat were less frequent. Edges were utilized by a variety of birds. Rice was observed to be an important component of the EAA and supports a variety of water birds. The EAA is described as having a large and diverse population of birds that use it for dispersal, migratory and breeding habitat. The study notes the importance of the EAA as a part of the south Florida landscape, both natural and urbanized.

Townsend, Sara E., Elise V. Pearlstine, Frank J. Mazzotti and Chris W. Deren 2006. Wading birds, shorebirds, and waterfowl in rice fields within the Everglades Agricultural Area. Florida Field Naturalist 34(1): 9-20.

During 1998 we conducted 300 surveys in 14 rice fields to determine number and relative abundance, impacts of management activities and characterization of waterbird activities. We observed 41 species of waterbirds in all rice fields with numbers ranging from 12 to 28 per survey site. During drawdown of field water levels, wading bird and shorebird numbers increased significantly. Wading birds, shorebirds

and waterfowl used fields differently and use varied with water level and rice height. Birds primarily used the rice fields for foraging followed by resting. Less than 1% of observations were of nesting birds. Ratooning the rice crop provided additional drawdown phases which seemed to benefit waterbirds. In many parts of the world rice is an important artificial wetland that provides habitat for many waterbirds. It seems to play the same role in south Florida and we recommend devoting greater area to rice and to ratoon the crop as often as possible for the benefit of local and migratory waterbirds.

Pearlstine, Elise V., Frank J. Mazzotti and Mary Hudson Kelly 2006. Relative Distribution and Abundance of Wintering Raptors in Agricultural and Wetland Landscapes of South Florida. Journal of Raptor Research 40(1) 81-85.

Other research studies have shown the importance of south Florida as wintering and migratory habitat for a variety of raptors (falcons, hawks, eagles and vultures). This study examined the distribution and relative abundance of raptors along a major road (US 27) traveling through natural wetland habitat and through sugarcane fields in Broward and Palm Beach counties. The natural areas consisted of Everglades wetland communities alongside this major road. Because of the availability of perches, both natural in the form of trees, shrubs or dead snags, and artificial in the form of powerlines and power poles, a roadside survey was used to easily census perched birds and assess habitat preference for natural or agricultural landscapes. Twelve species of raptor were seen in all surveys with seven observed frequently enough to conduct statistical analyses. Of the seven species, American kestrel, northern harrier, red-tailed hawk and turkey vulture were seen most commonly in agricultural habitat and black vulture, osprey and red-shouldered hawk in natural habitat. Other species seen during the surveys included bald eagle, crested caracara, merlin, peregrine falcon, sharp-shinned hawk and short-tailed hawk. Of all species, only ospreys and turkey vultures used natural perches more frequently than powerlines or poles. Highest overall numbers were in agricultural habitat.

Other Wildlife Species

Pearlstine, E.V., Wendy M. Bear, Frank J. Mazzotti and Kenneth G. Rice 2007. Checklist of fish in rice and sugarcane fields of the Everglades Agricultural Area. Florida Scientist 70: 113-119.

We conducted three years of fish surveys in rice and sugarcane fields throughout the EAA. Both minnow and Breder traps were set in ditches, canals and rice field edges. We caught or observed 22 species of fish, 14 native and 8 non-native. Of the five most common species, eastern mosquitofish (77%) had the highest number. Other small fish included sailfin molly (10%), flagfish (5%), least killifish (4%), and bluefin killifish (2%). We found species composition of fish in rice fields to be similar to those found in other studies in short hydro-period marshes of south Florida. Although there were a number of exotic species, they did not numerically dominate any community.

Theoretical and Statistical Research

Fujisaki, Ikuko, Elise V. Pearlstine and Frank J. Mazzotti 2010. The rapid spread of invasive Eurasian Collared Doves Streptopelia decaocto in the continental USA follows human-altered habitats. Ibis 152: 622-632..

This study examined habitat and environmental variables that may influence the spread of the invasive species, the Eurasian Collared Dove. We included variables such as vegetation, human influence, distance from site of introduction, precipitation, minimum winter temperature, road density, elevation, rivers and coastlines. Collared doves spread rapidly throughout Europe in the early 1900s and followed human settlements and agriculture. They also exhibited a strong northwestward direction of colonization. As with other invasive species, they exhibited jump dispersal in which individuals will be found ahead of the invasion front and then the population will fill in at these sites. We found a similar pattern in North America as the birds followed coastlines and human-influenced landscapes. They also respond to environmental variables such as precipitation and temperature. An unpublished study in the EAA (Miller and Pearlstine) found Eurasian collared doves in the EAA only in areas where there were buildings or in towns. The collared-dove was virtually absent from most of the agricultural area itself. Statistical models included a zero-inflated Poisson to account for high zero counts in Breeding Bird Survey data which was used for collared dove counts.

Miller, Mark W., Elise v. Pearlstine, Robert M. Dorazio and Frank J. Mazzotti 2010. Occupancy and Abundance of Wintering Birds in a Dynamic Agricultural Landscape. Journal of Wildlife Management, in press.

Our study of wintering songbirds in the EAA examined the effects of sugarcane harvest and edge vegetation on populations of wintering songbirds in the EAA. We used repeated visits to estimate abundance of songbirds throughout the harvest season as tall, dense sugarcane fields give way to bare, fallow fields. In addition, we developed a variation of existing statistical models to account for the extreme variation in habitat on both spatial and temporal scales and how that affected avian abundance. The three most common species of songbird were palm warbler, common yellowthroat and red-winged blackbird. Abundance of resident common yellowthroats varied between fields with differing sugarcane height and edge height. The highest abundance was in tall sugarcane with tall edges and the least was in short sugarcane with short edges. However, abundance of the similar-sized palm warbler did not vary with either sugarcane or edge state. Red-winged blackbirds seemed to be more abundant in tall cane than short cane. Each of these three species shows a general affiliation with wetland habitat to some extent, especially areas with tall grasses such as cattails. Our model may be expanded to other dynamic landscapes where habitat changes abruptly over a short period of time.

EDIS Extension Materials

Birds of the Everglades Agricultural Area – edis.ifas.ufl.edu/uw179

Anurans of the Everglades Agricultural Area – edis.ifas.ufl.edu/uw210

Snakes of the Everglades Agricultural Area – edis.ifas.ufl.edu/uw211

A Natural History of the Purple Swamphen (*Porphyrio porphyrio*) – edis.ifas.ufl.edu/uw317

Florida's Wading Birds – edis.ifas.ufl.edu/uw309

Barn Owl (*Tyto alba)* – edis.ifas.ufl.edu/u2216

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Checklist of the Birds of the Everglades Agricultural Area

Abundance: A=ABUNDANT, C=COMMON, R=RARE, *=ACCIDENTAL, +BREEDING, # NON-NATIVE			
Common Name	**Species Name**	**Abundance**	**Guild**
Black-bellied Whistling-Duck+	*Dendrocygna autumnalis*	C	Waterfowl
Fulvous Whistling-Duck+	*Dendrocygna bicolor*	C	Waterfowl
Snow Goose	*Chen caerulescens*	*	Waterfowl
Mute Swan	*Cygnus olor*	*	Waterfowl
Wood Duck	*Aix sponsa*	*	Waterfowl
Gadwall	*Anas strepera*	*	Waterfowl
American Wigeon	*Anas americana*	*	Waterfowl
Mottled Duck+	*Anas fulvigula*	C	Waterfowl
Blue-winged Teal	*Anas discors*	C	Waterfowl
Northern Shoveler	*Anas clypeata*	R	Waterfowl
Green-winged Teal	*Anas crecca*	R	Waterfowl
Ring-necked Duck	*Aythya collaris*	R	Waterfowl
Greater Scaup	*Aythya marila*	*	Waterfowl
Hooded Merganser	*Lophodytes cucullatus*	*	Waterfowl
Red-breasted Merganser	*Mergus serrator*	*	Waterfowl
Ruddy Duck	*Oxyura jamaicensis*	*	Waterfowl
Northern Bobwhite+	*Colinus virginianus*	R	Quail
Wild Turkey	*Meleagris gallopavo*	R	Turkey
Pied-billed Grebe+	*Podilymbus podiceps*	R	Waterfowl
American Flamingo	*Phoenicopterus ruber*	R	Flamingo
American White Pelican	*Pelecanus erythrorhynchos*	C	Pelican
Brown Pelican	*Pelecanus occidentalis*	*	Pelican
Double-crested Cormorant+	*Phalacrocorax auritus*	C	Cormorant
Anhinga+	*Anhinga anhinga*	C	Anhinga
American Bittern	*Botaurus lentiginosus*	R	Bittern
Least Bittern+	*Ixobrychus exilis*	C	Bittern
Great Blue Heron+	*Ardea herodias*	C	Heron/Egret
Great White Heron	*Ardea herodias*	*	Heron/Egret
Great Egret	*Ardea alba*	A	Heron/Egret
Snowy Egret+	*Egretta thula*	C	Heron/Egret
Little Blue Heron+	*Egretta caerulea*	C	Heron/Egret
Tricolored Heron+	*Egretta tricolor*	C	Heron/Egret
Reddish Egret	*Egretta rufescens*	*	Heron/Egret
Cattle Egret+	*Bubulcus ibis*	A	Heron/Egret
Green Heron+	*Butorides virescens*	C	Heron/Egret
Black-crowned Night-Heron+	*Nycticorax nycticorax*	C	Heron/Egret
Yellow-crowned Night-Heron+	*Nyctanassa violacea*	C	Heron/Egret
White Ibis+	*Eudocimus albus*	A	Ibis

Glossy Ibis	*Plegadis falcinellus*	A	Ibis
Roseate Spoonbill	*Platalea ajaja*	C	Spoonbill
Wood Stork	*Mycteria americana*	A	Stork
Black Vulture	*Coragyps atratus*	R	Raptor
Turkey Vulture	*Cathartes aura*	A	Raptor
Osprey	*Pandion haliaetus*	R	Raptor
Swallow-tailed Kite	*Elanoides forficatus*	R	Raptor
White-tailed Kite	*Elanus leucurus*	*	Raptor
Snail Kite	*Rostrhamus sociabilis*	R	Raptor
Mississippi Kite	*Ictinia mississippiensis*	*	Raptor
Bald Eagle	*Haliaeetus leucocephalus*	R	Raptor
Northern Harrier	*Circus cyaneus*	C	Raptor
Sharp-shinned Hawk	*Accipiter striatus*	R	Raptor
Cooper's Hawk	*Accipiter cooperii*	R	Raptor
Red-shouldered Hawk+	*Buteo lineatus*	C	Raptor
Broad-winged Hawk	*Buteo platypterus*	R	Raptor
Short-tailed Hawk	*Buteo brachyurus*	R	Raptor
Swainson's Hawk	*Buteo swainsoni*	*	Raptor
Red-tailed Hawk	*Buteo jamaicensis*	C	Raptor
Crested Caracara	*Caracara cheriway*	R	Raptor
American Kestrel	*Falco sparverius*	C	Raptor
Merlin	*Falco columbarius*	R	Raptor
Peregrine Falcon	*Falco peregrinus*	R	Raptor
Black Rail	*Laterallus jamaicensis*	*	Rail
King Rail+	*Rallus elegans*	C	Rail
Sora	*Porzana carolina*	R	Rail
Purple Swamphen + #	*Porphyrio porphyrio*	R	Rail
Purple Gallinule+	*Porphyrio martinica*	C	Rail
Common Moorhen+	*Gallinula chloropus*	A	Rail
American Coot	*Fulica americana*	C	Rail
Limpkin	*Aramus guarauna*	R	Limpkin
Sandhill Crane+	*Grus canadensis*	R	Crane
Black-bellied Plover	*Pluvialis squatarola*	C	Shorebird
Wilson's Plover	*Charadrius wilsonia*	*	Shorebird
Semipalmated Plover	*Charadrius semipalmatus*	R	Shorebird
Killdeer+	*Charadrius vociferus*	A	Shorebird
Black-necked Stilt+	*Himantopus mexicanus*	C	Shorebird
American Avocet	*Recurvirostra americana*	R	Shorebird
Spotted Sandpiper	*Actitis macularius*	R	Shorebird
Solitary Sandpiper	*Tringa solitaria*	C	Shorebird
Greater Yellowlegs	*Tringa melanoleuca*	C	Shorebird
Willet	*Tringa semipalmata*	*	Shorebird
Lesser Yellowlegs	*Tringa flavipes*	C	Shorebird

Upland Sandpiper	*Bartramia longicauda*	*	Shorebird
Ruddy Turnstone	*Arenaria interpres*	R	Shorebird
Semipalmated Sandpiper	*Calidris pusilla*	C	Shorebird
Western Sandpiper	*Calidris mauri*	R	Shorebird
Least Sandpiper	*Calidris minutilla*	C	Shorebird
White-rumped Sandpiper	*Calidris fuscicollis*	R	Shorebird
Pectoral Sandpiper	*Calidris melanotos*	C	Shorebird
Stilt Sandpiper	*Calidris himantopus*	R	Shorebird
Ruff	*Philomachus pugnax*	*	Shorebird
Short-billed Dowitcher	*Limnodromus griseus*	R	Shorebird
Long-billed Dowitcher	*Limnodromus scolopaceus*	R	Shorebird
Wilson's Snipe	*Gallinago delicata*	R	Shorebird
Wilson's Phalarope	*Phalaropus tricolor*	R	Shorebird
Laughing Gull	*Leucophaeus atricilla*	C	Gull
Ring-billed Gull	*Larus delawarensis*	C	Gull
Herring Gull	*Larus argentatus*	R	Gull
Least Tern	*Sternula antillarum*	C	Tern
Gull-billed Tern	*Gelochelidon nilotica*	C	Tern
Caspian Tern	*Hydroprogne caspia*	R	Tern
Black Tern	*Chlidonias niger*	C	Tern
Common Tern	*Sterna hirundo*	R	Tern
Forster's Tern	*Sterna forsteri*	*	Tern
Royal Tern	*Thallasseus maximus*	*	Tern
Sandwich Tern	*Thallasseus sandvicensis*	R	Tern
Black Skimmer	*Rynchops niger*	C	Skimmer
Rock Pigeon #	*Columba livia*	R	Pigeon
Eurasian Collared-Dove #	*Streptopelia decaocto*	R	Dove
Mourning Dove+	*Zenaida macroura*	C	Dove
Common Ground-Dove+	*Columbina passerina*	C	Dove
Barn Owl+	*Tyto alba*	C	Owl
Great Horned Owl	*Bubo virginianus*	R	Owl
Burrowing Owl	*Athene cunicularia*	R	Owl
Barred Owl	*Strix varia*	R	Owl
Short-eared Owl	*Asio flammeus*	R	Owl
Common Nighthawk+	*Chordeiles minor*	C	Goatsucker
Belted Kingfisher	*Megaceryle alcyon*	C	Kingfisher
Red-bellied Woodpecker	*Melanerpes carolinus*	R	Woodpecker
Pileated Woodpecker	*Dryocopus pileatus*	R	Woodpecker
Eastern Phoebe	*Sayornis phoebe*	C	Songbird
Vermilion Flycatcher	*Pyrocephalus rubinus*	*	Songbird
Great Crested Flycatcher	*Myiarchus crinitus*	R	Songbird
Eastern Kingbird	*Tyrannus tyrannus*	R	Songbird
Gray Kingbird	*Tyrannus dominicensis*	*	Songbird

Scissor-tailed Flycatcher	*Tyrannus forficatus*	*	Songbird
Loggerhead Shrike+	*Lanius ludovicianus*	R	Songbird
Blue Jay	*Cyanocitta cristata*	R	Songbird
American Crow	*Corvus brachyrhynchos*	R	Songbird
Fish Crow	*Corvus ossifragus*	R	Songbird
Purple Martin+	*Progne subis*	C	Songbird
Tree Swallow	*Tachycineta bicolor*	A	Songbird
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	C	Songbird
Bank Swallow	*Riparia riparia*	R	Songbird
Barn Swallow	*Hirundo rustica*	C	Songbird
Carolina Wren	*Thryothorus ludovicianus*	R	Songbird
House Wren	*Troglodytes aedon*	R	Songbird
Sedge Wren	*Cistothorus platensis*	R	Songbird
Marsh Wren	*Cistothorus palustris*	R	Songbird
Blue-gray Gnatcatcher	*Polioptila caerulea*	R	Songbird
American Robin	*Turdus migratorius*	R	Songbird
Gray Catbird+	*Dumetella carolinensis*	C	Songbird
Northern Mockingbird	*Mimus polyglottos*	C	Songbird
European Starling #	*Sturnus vulgaris*	R	Songbird
Yellow Warbler	*Dendroica petechia*	R	Songbird
Yellow-rumped Warbler	*Dendroica coronata*	C	Songbird
Prairie Warbler	*Dendroica discolor*	*	Songbird
Palm Warbler	*Dendroica palmarum*	A	Songbird
American Redstart	*Setophaga ruticilla*	*	Songbird
Swainson's Warbler	*Limnothlypis swainsonii*	R	Songbird
Common Yellowthroat+	*Geothlypis trichas*	A	Songbird
Eastern Towhee	*Pipilio erythrophthalmus*	R	Songbird
Chipping Sparrow	*Spizella passerina*	R	Songbird
Savannah Sparrow	*Passerculus sandwichensis*	C	Songbird
Grasshopper Sparrow	*Ammodramus savannarum*	R	Songbird
Song Sparrow	*Melospiza melodia*	R	Songbird
Lincoln's Sparrow	*Melospiza lincolnii*	R	Songbird
Swamp Sparrow	*Melospiza georgiana*	R	Songbird
Northern Cardinal+	*Cardinalis cardinalis*	C	Songbird
Indigo Bunting	*Passerina cyanea*	*	Songbird
Bobolink	*Dolichonyx oryzivorus*	A	Songbird
Red-winged Blackbird+	*Agelaius phoeniceus*	A	Songbird
Eastern Meadowlark+	*Sturnella magna*	C	Songbird
Common Grackle	*Quiscalus quiscula*	R	Songbird
Boat-tailed Grackle+	*Quiscalus major*	A	Songbird
Abundance: A=ABUNDANT, C=COMMON, R=RARE, *=ACCIDENTAL, + BREEDING, # NON-NATIVE			

Fish and Other Aquatic Species in Canals and Ditches Caught in Minnow Traps or Throw Nets *non-native			
Common Name	Scientific Name	Relative Abundance	Taxon
American Flagfish	*Jordanella floridae*	Common	Fish
Armored Catfish*	*PterygoplichRarethys multiradiatus*	Rare	Fish
Black Acara*	*Cichlasoma bimaculatum*	Rare	Fish
Blue Tilapia*	*Oreochromis aureus*	Rare	Fish
Bluefin Killifish	*Lucania goodei*	Common	Fish
Bluegill Sunfish	*Lepomis machrochirus*	Rare	Fish
Bluespotted Sunfish	*Enneacanthus gloriosus*	Rare	Fish
Brook Silverside	*Labidesthes sicculus*	Rare	Fish
Brown Hoplo*	*Hoplosternum littorale*	Rare	Fish
Bullhead sp.	*Ameiurus sp.*	Rare	Fish
Dollar Sunfish	*Lepomis marginatus*	Rare	Fish
Eastern Mosquitofish	*Gambusia holbrooki*	Abundant	Fish
Everglades Crayfish		Common	Invertebrate
Florida Gar	*Lepisosteus platyrhincus*	Uncommon	Fish
Glass Shrimp		Common	Invertebrate
Golden Topminnow	*Fundulus chrysotus*	Rare	Fish
Largemouth Bass	*Micropterus salmoides*	Rare	Fish
Least Killifish	*Heterandria formosa*	Common	Fish
Mayan Cichlid*	*Cichlasoma urophthalmus*	Rare	Fish
Oscar	*Astronotus ocellatus*	Rare	Fish
Redear Sunfish	*Lepomis microlophus*	Rare	Fish
Sailfin Molly	*Poecilia latipinna*	Common	Fish
Spotted Tilapia*	*Tilapia mariae*	Rare	Fish
Walking Catfish*	*Clarias batrachus*	Rare	Fish

Amphibians of the EAA * non-native			
Common Name	Scientific Name	Relative Abundance	Group
Cuban Treefrog*	*Osteopilus septentrionalis*	Uncommon	Treefrog
Eastern Narrow-mouthed Toad	*Gastrophryne carolinensis*	Common	Toad
Green Treefrog	*Hyla cinerea*	Common	Treefrog
Greenhouse Frog*	*Eleutherodactylus planirostris*	Common	Frog
Little Grass Frog	*Pseudacris ocularis*	Rare	Frog
Cane Toad*	*Rhinella marina*	Uncommon	Toad
Oak Toad	*Anaxyrus quercicus*	Uncommon	Toad
Pig Frog	*Lithobates grylio*	Common*	Frog
Southern Chorus Frog	*Pseudacris nigrita*	Uncommon	Frog
Southern Cricket Frog	*Acris gryllus*	Uncommon	Frog
Southern Leopard Frog	*Lithobates sphenocephalus*	Common	Frog
Southern Toad	*Anaxyrus terrestris*	Common	Toad
Squirrel Treefrog	*Hyla squirella*	Common	Treefrog

Reptiles of the EAA

*non-native

Common Name	Scientific Name	Relative Abundance	Group
American Alligator	*Alligator mississippiensis*	Common	Crocodilian
Banded Watersnake	*Nerodia fasciata fasciata*	Common	Snake
Cuban Brown Anole*	*Anolis sagrei*	Abundant	Lizard
Brown Watersnake	*Nerodia taxispilota*	Common	Snake
Dusky Pygmy Rattlesnake	*Sistrurus miliarius barbouri*	Uncommon	Snake
Cottonmouth	*Agkistrodon piscivorus*	Common	Snake
Eastern Gartersnake	*Thamnophis sirtalis*	Common	Snake
Eastern Ribbonsnake	*Thamnophis sauritus*	Uncommon	Snake
Eastern Slender Glass Lizard	*Ophisaurus attenuates longicaudus*	Rare	Lizard
Eastern Ratsnake	*Pantherophis alleghaniensis*	Common	Snake
Florida Box Turtle	*Terrapene carolina*	Rare	Turtle
Florida Red-bellied Cooter	*Pseudemys nelsoni*	Uncommon	Turtle
Florida Kingsnake	*Lampropeltis getula floridana*	Common	Snake
Florida Softshell	*Apalone ferox*	Uncommon	Turtle
Florida Watersnake	*Nerodia fasciata pictiventris*	Common	Snake
Green Anole	*Anolis carolinensis*	Rare	Lizard
Common Five-lined Skink	*Plestiodon fasciatus*	Rare	Lizard
Peninsular Cooter	*Pseudemys peninsularis*	Rare	Turtle
Pond Slider*	*Trachemys scripta*	Common	Turtle
Red Cornsnake	*Pantherophis guttatus*	Common	Snake
Ring-necked Snake	*Diadophis punctatus*	Rare	Snake
Rough Greensnake	*Opheodrys aestivus*	Rare	Snake
Snapping Turtle	*Chelydra serpentina*	Rare	Turtle
Southern Black Racer	*Coluber constrictor*	Common	Lizard

Mammals of the EAA

* Non-native

Common Name	Scientific Name	Relative Abundance	Group
Armadillo	*Dasypus novemcinctus*	Rare	Armadillos
Bobcat	*Lynx rufus*	Uncommon	Cats
Cotton Rat	*Sigmodon hispidus*	Common	Rodent
Coyote	*Canis introns*	Rare	Carnivore
Feral Pig	*Sus scrofa*	Uncommon	Ungulate
Gray Squirrel	*Sciurus carolinensis*	Rare	Squirrel
House Mouse	*Mus musculus*	Common	Rodent
Marsh Rabbit	*Sylvilagus palustris*	Common	Rabbits
Nine-banded Armadillo	*Dasypus novemcinctus*	Rare	Armadillo
Northern Cottontail	*Sylvilagus floridanus*	Common	Rabbits
Raccoon	*Procyon lotor*	Uncommon	Carnivore
Red Fox	*Vulpes vulpes*	Rare	Carnivore
Rice Rat	*Oryzomys palustris*	Rare	Rodent
River Otter	*Lutrus canadensis*	Uncommon	Weasels/Skunks
Roof Rat	*Rattus rattus*	Common	Rodent
Round-tailed Muskrat	*Neofiber alleni*	Rare	Rodent
Southern Short-tailed Shrew	*Blarina carolinensis*	Rare	Insectivore
Virginia Opossum	*Didelphis virginiana*	Rare	Opossums