VERTEBRATE UTILIZATION OF RECLAIMED HABITAT ON PHOSPHATE MINED LANDS IN FLORIDA: A RESEARCH SYNOPSIS AND HABITAT DESIGN RECOMMENDATIONS[1]

by

J. H. Kiefer, PE, PWS[2]

Abstract: Several studies have documented the cumulative presence of 348 species of vertebrates (mammals, birds, reptiles, amphibians, fish) on reclaimed phosphate mines in Florida. Many of these species, however, are found at low population densities or on a small number of sites. The studies also provided comparative data for unmined habitat in the region and reported 324 species. About 12% of the species reported for reclaimed habitat were not reported for unmined habitat, while 6% of the species reported for unmined habitat were not reported for reclaimed habitat. Similar numbers of rare and endangered species occur on reclaimed and unmined habitats in the region. Differences in the faunal assemblages of reclaimed and unmined areas can generally be traced to the effects of habitat maturity, wetland hydroperiod, the presence of large lakes, sandy substrates, and dispersal factors. The information suggests that additional species, or more robust populations of particular species, could be recruited to reclaimed habitat if several factors are incorporated into designs. Most reclaimed wetlands were constructed to have relatively stable water levels and extended hydroperiods. More ephemeral marshes should be created. Most uplands are reclaimed with a loamy-overburden soil cap. Large sand lenses should be left at the surface to provide a more suitable medium for fossorial animals. More care should be taken to situate reclaimed habitats to facilitate animal movement between habitat types. Many projects provide only two vegetative strata (trees and groundcover). Additional shrubs, sub-canopy trees, and snags should be introduced to increase vertical heterogeneity. If, in addition to past practices, designers focused on just a small number of key species with very specific requirements, the habitat quality would be improved for a significant number of additional species.

Additional Key Words: endangered species, restoration

Introduction

This study is an evaluation of selected literature concerning the vertebrate utilization of surface-mined lands compared to unmined lands in the central-Florida phosphate district. Differences in the taxa between unmined and mined lands were examined for any unifying themes that could be used to enhance species richness and utilization of mined lands. These differences were also evaluated to determine if some reclamation practices might be positively influencing species richness and utilization of the region.

Prior to 1975, Florida statutes did not require reclamation and phosphate-mined land was left as a series of spoil pile islands separated by water-filled cuts. Companies discarded clay tailings in cuts and often built dams to contain the clays for consolidation. Sand tailings were usually placed close to the beneficiation plant, forming large above-grade sand mounds. Companies seldom reforested land and the spoil piles, clay pits, and sand mounds revegetated passively. Some of these areas have impressive canopies of native vegetation, but exotic plants such as Brazilian pepper (*Schinus terebinthifolius*) and cogon grass (*Imperata cylindrica*) dominate many sites.

The State of Florida began requiring phosphate companies to reclaim land during 1975. Since that time, three major types of landforms are typically created: 1) land-and-lakes, 2) clay-settling areas, and 3) sand-tailings backfill areas. Sand and clay tailings from the beneficiation plant are returned to the surface-mined landscape. Companies pump sands into mine cuts, contour them close to original grade, and traditionally have capped the sand with at least a foot of loamy overburden spoil.

The clay tailings are pumped into impoundments with earthen dams (settling areas) and are allowed to consolidate, usually several feet above original grade. The dam wall is then breached and recontoured. A variation of settling areas is to mix some sand with the clay to improve its permeability and lead to more rapid dewatering and consolidation.

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[2]John H. Kiefer is Chief Environmental Engineer, CF Industries, Inc., Hardee Phosphate Complex, Wauchula, FL, 33873

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Sand/clay mix areas are typically contoured closer to original grade than conventional clay settling areas.

The material balance and final topography of most mine sites results in a deficit of material so not all of the mine cuts can be backfilled with sand and/or clay. The remaining voids are reclaimed as large lakes. Most of the spoil from the lake interior is removed and used to contour uplands and a littoral zone around the lake. Sometimes islands are left in the lakes.

The State requires all of these landforms to be actively revegetated by seeding, sprigging, and/or transplanting. Much of the reclaimed land is used for cattle grazing, agriculture, residential, and commercial sites. Habitats resembling forested and non-forested wetlands, pine plantations, large lakes with significant littoral zones, hardwood hammocks, mixed hardwood and pines, and canopied streams are routinely created as well. Analogues of pyrogenic uplands such as sand-pine scrub and pine flatwoods have only recently been created on any significant scale.

Casual observation reveals that reclaimed habitats attract a variety of wildlife species. Reclaimed lands have been purchased by or donated to the State of Florida to prevent their development, including the Bridgewater site in north Lakeland. Even the simple reclamation projects at the Bridgewater site help support populations of protected species such as Sherman's fox squirrel, woodstorks, bald eagles, and sandhill cranes in a region that is rapidly being developed (American Cyanamid 1994). At least 38 species listed by the Florida Committee on Rare and Endangered Plants and Animals are using reclaimed habitats on mined lands (Appendix A). Some mined lands have become premiere bird-watching, sport-fishing, and hunting destinations, supporting extractive and non-extractive ecotourism in a State with abundant but shrinking opportunities for such activities.

However, what differences occur between the species found on mined and unmined habitats? If differences occur, can they be evaluated in an attempt to improve mainstream reclamation practices for selected species? What typical practices are beneficial to the establishment of sustainable populations? This study attempts to address these questions.

Methods

A literature search was conducted for wildlife studies of central-Florida phosphate properties that had been mined and stabilized by either active reclamation or allowed to passively revegetate. Studies with merely anecdotal observations of wildlife were not used, such as vegetation monitoring projects with incidental observations of animals spotted during the floral evaluation. Data collected from temporary habitats, such as active settling areas and hydraulic systems were not included in the analysis. Only studies conducted by qualified scientists that provided comparisons of mined and unmined habitats were included.

Eight studies were found that met the acceptable criteria. Boody *et al.* (1985) sampled fish populations on reclaimed and natural lakes and recorded observations of birds, reptiles, amphibians, and mammals. Durbin and Godley (1995) trapped small vertebrates such as fish, reptiles, and amphibians in a variety of reclaimed and natural wetlands. Kale (1992) observed birds on several reclaimed sites and included similar observations for a State Park and a Nature Conservancy preserve. Kale and Pritchard (1997) recorded observations of all forms of vertebrates made during brief site visits to reclaimed and natural wetlands. King et al. (1992) surveyed and sampled selected mined and unmined upland habitats for small vertebrates. Mushinsky and McCoy (1996) trapped small vertebrates and observed birds on xeric uplands (mined and unmined). Streever and Crisman (1993) trapped small fish in natural and reclaimed marshes. Zellers-Williams (1980) observed all types of vertebrates during ecological evaluations of lands mined prior to the 1975 reclamation rule. They also incorporated information from bird lists compiled for a reclaimed site and two natural areas (Edscorn 1980).

One of the primary purposes of each study was to evaluate wildlife utilization of mined lands. Some of the studies focused more heavily on reclamation sites than natural sites (Boody et al. 1985, Kale and Pritchard 1997, King et al. 1992, Zellers-Williams 1980). Therefore, care should be taken when comparing the species richness numbers reported for mined and unmined lands. This study does not necessarily provide a comprehensive list of all the vertebrates found in the region, either on mined or unmined habitats. In many cases, a species missing from one land category is probably an indication of low population densities rather than a complete absence of the animal. This is particularly true of the natural habitats. All of the species reported as occurring only on reclaimed habitats obviously occur on natural areas somewhere.

Appendix A depicts a master list of the species reported in each study. This list, along with information in the references on the frequency of occurrence of the species on the list, and the author's direct observations, were used to compare the utilization of mined lands to unmined lands by species. Vertebrates that appear to show preferences for mined

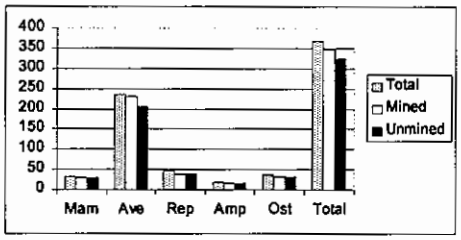
land were evaluated for their habitat requirements. The same was done for vertebrates that appear to prefer unmined habitats. An attempt was made to identify unifying themes, if any, that could be used to improve design practices in terms of enhancing vertebrate utilization of the reclaimed landscape.

Results

Species Richness

In comparative studies, a total of 348 vertebrate species were reported on mined lands and 324 species were reported on unmined lands (Appendix A). The total number of species of fish (Osteichthyes), amphibians (Amphibia), reptiles (Reptilia) and mammals (Mammalia) are similar for both types of habitat (Figure 1). Mined lands supported 26 more bird (Aves) species than unmined habitats (Figure 1).

Figure 1. Number of species reported for mined and unmined habitat by class.



Mam=mammals, Ave=birds, Rep=reptiles, Amp=amphibians, Ost=fish

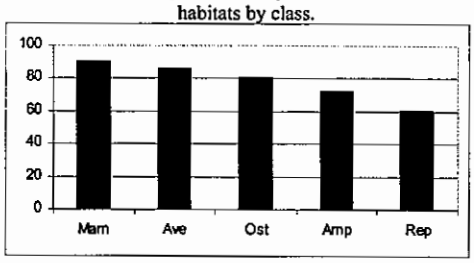
Overlap

Of the 369 total species reported, 303 were found on both mined and unmined lands (82% overlap). The overlap for mammals, birds, and fish were all greater than 80% (Figure 2). Amphibians overlapped below the mean at 72%. Reptile overlap was the lowest among classes at 60%. The Florida Committee on Rare and Endangered Plants and Animals lists about 11% of the species reported for mined lands and 11% of the species reported on unmined habitat as rare, endangered, or of particular concern for endangerment (Appendix A).

Differences

Appendix A lists the species reported for mined and/or unmined habitats, which species may occur at significantly different frequencies or

Figure 2. Percent species overlap for mined and unmined habitats by class.



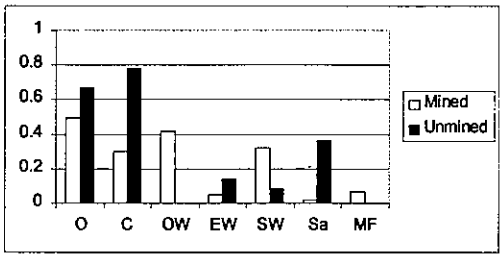
Mam=mammals, Ave=birds, Rep=reptiles, Amp=amphibians, Ost=fish

population densities on unmined land or mined land, and their habitat preferences. This is somewhat subjective, but an attempt was made to look for species that more than one of the reference data sets and/or the author's direct observations suggested different utilization of either mined or unmined habitats, especially for species using a variety of habitat types. A single reference was necessarily relied on for some of the more specialized taxa,, particularly for the herpetofauna of sandy scrubs (Mushinsky and McCoy 1996) and the small fishes of marshes (Streever and Crisman 1993).

The most appropriate of seven typical habitat characteristics were assigned to each species where presence/absence data or other information suggested that the species might be exhibiting a preference for mined or unmined lands. Many species prefer more than one characteristic. The seven characteristics are 1) open, 2) canopied, 3) open water, 4) ephemeral wetlands, 5) stable wetlands, 6) sandy substrate, and 7) mudflats. Open habitats are grasslands, prairies, and/or herbaceous wetlands. Canopied habitats are forests and/or dense scrubs. Open water includes lakes and/or bays. Ephemeral wetlands exhibit hydroperiods of several weeks to a few months, but are completely dry during a significant portion of most years. Stable wetlands are flooded at least throughout the growing season (almost the entire year) during most years. Sandy substrate includes fine sands in xeric habitats characteristic of sandhills, sand-pine scrub, and/or scrubby flatwoods. Mudflats are bare saturated soils that are exposed by tides or seasonal drops in water levels during dry periods.

The relative frequencies of each of these habitat characteristics can be compared for species preferring unmined land to those preferring mined land. For all non-fish vertebrate classes, the species that may prefer unmined lands seem to seek canopy, ephemeral wetlands, and sandy substrate (Figure 3). The species that appear to prefer mined lands seem to seek open water, stable wetlands, and mudflats.

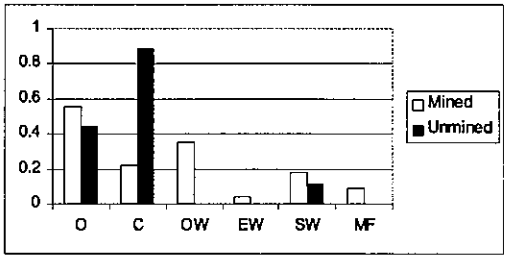
Figure 3. Relative frequencies of habitat characteristics by species possibly preferring mined or unmined lands.



O=open, C=canopy, OW=open water, EW=ephemeral wetland
SW=stable wetland, Sa=sandy substrate, MF=mudflats

Avifauna frequently have different requirements from the flightless classes. Therefore, the relative frequencies of the habitat characteristics for birds were evaluated separately from that of mammals/herpetofauna. The birds better represented on unmined habitats showed strong preferences for canopy (Figure 4). Birds that may prefer mined lands appeared to seek open water and wetland habitats, including mudflats.

Figure 4. Relative frequencies of habitat characteristics by bird species possibly preferring mined or unmined lands



O=open, C=canopy, OW=open water, EW=ephemeral wetland
SW=stable wetland, MF=mudflats

The reptiles, amphibians, and mammals apparently favoring unmined land showed what seem to be pronounced preferences for open habitats, ephemeral wetlands, and sandy substrates and a milder preference for canopy (Figure 5). Species from these classes better represented on mined land showed what appear to be strong preferences for stable wetlands and open water.

Discussion

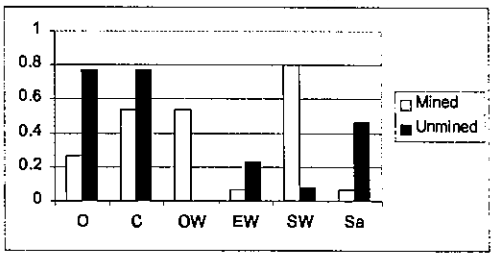
Lakes, Wetlands, and Hydroperiod

The post-reclamation landscape typically has more large lakes and wetlands with extended hydroperiods than unmined landscapes. This increase appears to benefit about 18 species of birds beyond the support provided by the unmined habitats in the region (Appendix A). These include fish-eating species (red-breasted merganser, white pelican, double-crested cormorant, least bittern, glossy ibis, wood stork, bald eagle, osprey), waterfowl (gadwall, Canada goose, horned grebe, American wigeon, mottled duck, ring-necked duck), and shorebirds (semipalmated plover, American avocet, dunlin, stilt sandpiper, short-billed dowitcher). Otters, a fish-eating mammal, appear to benefit from these conditions (Appendix A). Ten reptiles including aquatic turtles (Florida softshell, Florida mud turtle, stinkpot) and semi-aquatic snakes (Florida cottonmouth, rainbow snake, green water snake, banded water snake, brown water snake, striped crayfish snake, black swamp snake) appear to benefit from the increase in permanent pools (Appendix A). The two amphibians that appear to favor these regimes are bronze frog and river frog, both uncommon in central Florida (Appendix A).

Conversely, the data suggests that 5 species of amphibians would benefit by an increased proportion of ephemeral wetlands reclaimed within the landscape (gopher frog, oak toad, pine woods treefrog, squirrel treefrog, eastern spadefoot) (Appendix A).

Seven species of fish appear to favor the mined landscape (flagfish, bluefin killifish, sailfin molly, swamp darter, banded pygmy sunfish, golden topminnow, coastal shiner) verses four species in unmined lakes and wetlands (bluespotted sunfish, redbreast sunfish, tadpole madtom, everglades pygmy sunfish) (Appendix A). Streever and Crisman (1993) found all the fish taxa in reclaimed marshes that they found in natural marshes, but they reported substantially different frequencies in four species. Three of these species favored reclaimed marshes and one favored natural systems. The authors suggested that at least some of these differences might have been

Figure 5. Relative frequencies of habitat characteristics by mammal, reptile, and amphibian species possibly preferring mined or unmined lands.



O=open, C=canopy, OW=open water, EW=ephemeral wetland
SW=stable wetland, Sa=sandy substrate

driven by hydroperiod. All of the reclaimed marshes remained wet throughout the study year, while almost all of the natural marshes were dry during at least one sampling event. Also, two of the three species occurring at greater frequency on reclaimed wetlands, the flagfish and the sailfin molly, eat algae and prefer slightly alkaline, hard water.

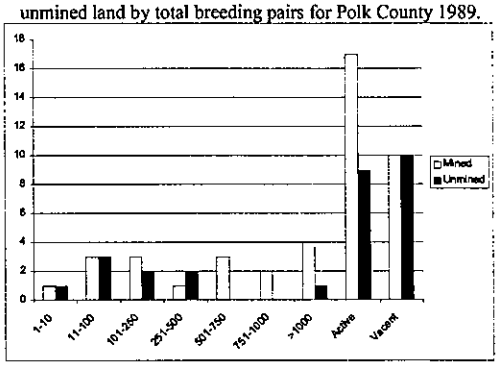
Reclaimed wetlands with extended hydroperiods and deeper water typically support abundant algal communities that raise the pH of these systems to levels typical of slightly alkaline water bodies (Kiefer 1991). This phenomenon also occurs in newly reclaimed marshes during their first two years of development as the macrophytic community is maturing.

The everglades pygmy sunfish was the only marsh species reported by Streever and Crisman (1993) to favor unmined marshes. This fish routinely survives severe conditions, and is known to tolerate a wide range of water quality. The pygmy is often encountered in shallow ditches and other temporary pools, such as ephemeral wetlands.

The habitat preferences of marsh fish seem to reinforce the concept that the net increase of stable wetlands benefits some vertebrate species, but that constructing more ephemeral wetlands could increase certain species. A better balance of stable and ephemeral wetlands should be planned for in the reclaimed landscape to benefit the greatest number of total species. The littoral zones around reclaimed lakes probably provide a net increase of stable wetlands such that if the relative proportion of ephemeral marshes among other constructed wetlands was increased, then additional amphibian and fish species would benefit without significant detriment to species favored by the past reclamation practices.

Reclaimed lakes can also provide valuable nesting habitat for colonial wading birds. Nine of the ten largest heronries reported by Runde *et al.* (1991) in Polk County, Florida during 1989 occurred on mined lands despite the fact that mined lands account for less than one-fifth of the county (Figure 6). Most of the total number of rookeries reported in Polk County from 1976 through 1989 occurred on mined land. Colonial birds favor sites characterized by clusters of shrub- or tree-covered islands surrounded by open water. Therefore, lakes should be reclaimed with at least some of the spoil left in the center protruding above the design water line to facilitate the development of roosting and nesting sites. Multiple islands should be left in each lake. The spoil islands should be densely planted with fast growing native shrubs and trees such as wax myrtle, slash pine, and/or cypress.

Figure 6. Number of wading bird colonies on mined and unmined land by total breeding pairs for Polk County 1989.



Maturity and Snags

Eight of the 9 bird species that may prefer unmined habitats exhibit canopy as one of their primary habitat characteristics (brown-headed nuthatch, black-throated gray warbler, Connecticut warbler, wild turkey, chuck-will's-widow, red-headed woodpecker, great-crested flycatcher, tufted titmouse) (Appendix A). Four of these are cavity nesters (brown-headed nuthatch, red-headed woodpecker, great crested flycatcher, tufted titmouse) (Kale and Maehr 1990). Nine of the 14 reptiles that may prefer unmined habitats select canopy as one of their main habitat characteristics (Florida box turtle, Florida scarlet snake, central-Florida crowned snake, peninsula mole skink, southern hognose snake, scarlet kingsnake, eastern coral snake, pine woods snake, peninsula crowned snake) (Appendix A). Four of these are commonly associated with rotting logs for foraging, shelter, and/or egg laying (scarlet kingsnake, eastern coral snake, pine woods snake, southern fence lizard) (Behler and King 1997). Four of the five mammals favoring unmined lands exhibit a canopy preference (Florida mouse, Sherman's fox squirrel, long-tailed weasel, golden mouse) (Appendix A). For one of these, Sherman's fox squirrel, the best habitat typically contains at least 1 to 2 cavity trees per acre, although this is not a requirement (Whitaker 1998, Humphrey 1992).

Dense and impressive tree canopies can develop on properly reclaimed projects in as little as 20 years. Saddle Creek Park's passively reclaimed canopy has become one of the premiere habitats for neotropical migrants and other migratory birds in central Florida (Edscorn 1980). However, the production of significant amounts of vertical and horizontal snags in a forest probably takes at least several decades. Flatwoods sites in central Florida typically have at least 1 to 4 vertical

snags per acre, and probably several times that number on the ground.

Therefore, at least 9 vertebrate species that appear to favor unmined habitat should benefit by an increase in the amount of dead wood scattered throughout a project (brown-headed nuthatch, red-headed woodpecker, great crested flycatcher, tufted titmouse, scarlet kingsnake, eastern coral snake, pine woods snake, southern fence lizard, Sherman's fox squirrel). A mixture of upright pines, palms, and hardwoods should be set in uplands corresponding to the target community. Individual logs of pines, palms, and hardwoods should be scattered horizontally throughout sites, instead of the more common practice of establishing a few large brush piles. Horizontal hardwood snags should be placed in wetlands and lake edges for reptile basking sites.

Mushinsky and McCoy (1996) state that many of the reclaimed xeric upland sites they studied had a simple two-tiered system (groundcover and trees), and that a variety of vertebrate species would benefit from the deliberate establishment of a three- or four-tiered canopy by adding more shrubs and sub-canopy plants. They also recommended the addition of dead wood, leaves, and substrate crusts/lichens. A variety of upland forest types should benefit from these practices.

Sandy Soils

Nine of the 21 herpetofauna that may prefer unmined lands exhibit a reliance on sandy soils (peninsula mole skink, Florida scrub lizard, eastern hognose snake, southern hognose snake, pine woods snake, Florida scarlet snake, central-Florida crowned snake, eastern spadefoot, oak toad) (Appendix A). Most of these species are highly fossorial, spending much of their lives underground. Two of the five mammals favoring unmined land also rely on sandy burrows (southeastern pocket gopher, Florida mouse) (Appendix A). These fossorial vertebrates could benefit from the use of sandy substrates such as sand tailings or sandy native topsoil instead of an overburden or clay cap at the surface. Whenever feasible, areas designed as analogues to pine flatwoods should incorporate at least some large lenses of sand at the surface. Since coastal sand dunes formed the geological origin of sand-pine scrub and sandhill, this would appear to be a requirement of establishing an analogue to such areas to an even greater degree.

Dispersal

Even if the within-site habitat characteristics are ideal, the area will not provide much benefit if barriers to dispersal prevent some vertebrates from reaching the site. There is currently a strong movement to create corridor/node complexes of interconnected natural and reclaimed habitats. Even so, it is important to recognize that habitat that is a corridor for some species may not be for others.

This may be particularly true for species that rely heavily on naturally fragmented habitats such as relict sand dunes or isolated ephemeral marshes. Such species frequently can disperse, but their dispersal range is limited if suitable "islands" of habitat are spread too far apart. It is important to properly scatter such small, insular systems at appropriate spacing for species of concern.

An anecdotal example of this may involve sandy habitats at Tenoroc Fish Management Area, a former phosphate mine that was mined before reclamation rules went into effect. In the eastern portion of the park is a natural remnant of the Winter Haven ridge that was left unmined and is supporting a population of pocket gophers. On the western portion of the park is a large grass-covered sand-tailings mound, with scattered sand pines. This mound has some gopher tortoises but no pocket gophers. A two-mile wide series of lakes and clay-substrate wetlands with small densely canopied spoil islands separates these two sandy areas. During active mining it would have been possible to reclaim a "corridor" between these two sandy hills that involved a continuous band of pine flatwoods interspersed with sandy mounds that would draw pocket gophers across the property.

Template Species Examples

Ecological systems are complex and reclamationists face a daunting task of trying to balance the sometimes-conflicting habitat requirements of one group of species against another. The central-Florida landscape is so fragmented, artificially drained, and fire-suppressed by development, exotic species invasion, and agriculture, that the condition of a mine prior to mining does not necessarily offer an appropriate design template for habitat reclamation. One valuable tool is to identify species that have a special set of requirements that if met, will benefit a wide range of other species and then check your post-reclamation landscape and habitat characteristic design for suitability from the template species perspective. Two brief examples are given.

Gopher frog (*Rana capito*).

Gopher frogs live in the burrows of other fossorial animals, particularly gopher tortoises. They

breed in ephemeral wetlands, within a mile from their sandy burrows (Moler 1992). Designing habitat for gopher frogs should create suitable conditions necessary for a dozen or so other species of herpetofauna, mammals, and fish that appear to prefer unmined lands over mined lands (especially species requiring sandy habitats and/or ephemeral wetlands) (Appendix A).

Woodstorks (*Mycteria americana*).

Woodstorks require dense fish concentrations during the dry season to breed successfully. Although this is true of almost all wading birds, storks are particularly sensitive to this because they forage by feel rather than by sight (Rodgers *et al.* 1996). Storks need a variety of wetlands within the landscape that drawdown during different parts of the dry season to space out foraging opportunities during chick rearing. They also need at least a few wetlands or lakes within the region that remain permanently wet during most years. Reclaiming a landscape with a relatively broad mix of water regimes for storks should benefit other wading birds, reptiles, amphibians, and fish that utilize wetlands across different portions of the hydroperiod spectrum.

Conclusions

The mined and reclaimed landscapes created in the past have demonstrated the capacity to support vertebrate species richness that rivals that of unmined lands in the central-Florida phosphate district. However, populations of species with low occurrence on mined lands could be enhanced by continuing to develop design trends that carefully consider the amount of dead wood, sandy substrate, understory plant species, and ephemeral wetlands that are incorporated into the landscape. Another area of focus includes evaluating the spatial patterns of isolated habitat types within broader corridors or nodes necessary to facilitate species recruitment.

Reclamationists in the phosphate industry are always looking for cost effective means to improve upon past practices, no matter how successful. Hopefully this paper will assist in promoting such endeavors.

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Literature Cited

American Cyanimid Company. 1994. Bridgewater D.R.I. application for development approval. Submitted to: Central Florida Regional Planning Council, Bartow, Florida.

Behler, J.L. and F.W. King. 1997. National Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf, New York, New York.

Boody, O.C., Pollman, C.D., Tourtellotte, G.H., Dickenson, R.E., and A.N. Arcuri. 1985. Ecological considerations of reclaimed lakes in central Florida's phosphate region. Florida Institute of Phosphate Research, Pub. No. 03-018-029, Bartow, Florida.

Durbin, D.J. and J.S. Godley. 1995. Faunal investigation of selected reclaimed and natural aquatic systems at the CF Industries, Inc. Hardee Phosphate Complex. Biological Research and Associates, Tampa, Florida.

Edscorn, J.B. 1980. Birds of Saddle Creek Park (includes a bird list comparison of a mined area to non-mined areas). p.A57-A72 In: Evaluation of pre-July 1, 1975 disturbed phosphate lands, appendices. Dept. of Nat. Res., Div. of Res. Management, Bur. Of Geology, Tallahassee, Florida.

Gilbert, C.R. 1992. Rare and endangered biota of Florida, II. fishes. University Press of Florida, Tampa, Florida.

Humphrey, S.R. 1992. Rare and endangered biota of Florida, I. mammals. University Press of Florida, Tampa, Florida.

Kale, H.W. 1992. A two-year study of the avifauna of reclaimed and unreclaimed mined lands of IMC Fertilizer, Inc., Polk County, Florida. Florida Audubon Society, Casselberry, Florida.

Kale, H.W. and D.S. Maehr. 1990. Florida's birds, a handbook and reference. Pineapple Press, Sarasota, Florida.

Kale, H.W. and P.C.H. Pritchard. 1997. Wildlife. p.7(1)-7(76) In: Evaluation of constructed wetlands on phosphate mined lands in Florida. Florida Institute of Florida Research, Pub. No. 03-103-139, Bartow, Florida.

Kiefer, J.H. 1991. Chemical functions and water quality in marshes reclaimed on phosphate mined lands in central Florida. M.E. Thesis. University of Florida, Gainesville, Florida.

King, T., Toland, B., and J. Feiertag. 1992. An evaluation of xeric habitat reclamation at a central Florida phosphate mine. Florida Game and Fresh Water Fish Commission, Lakeland, Florida.

Moler, P.E. 1992. Rare and endangered biota of Florida, III. amphibians and reptiles. University Press of Florida, Tampa, Florida.

Mushinsky, H.R. and E.D. McCoy. 1996. Habitat factors influencing the distribution of small vertebrates on unmined and phosphate-mined uplands in central Florida. Florida Institute of Phosphate Research, Pub. No. 03-100-129, Bartow, Florida.

Rodgers, J.A., Kale, H.W., and H.T. Smith. 1996. Rare and endangered biota of Florida, V. birds. University Press of Florida, Tampa, Florida.

Runde, D.E., Gore, J.A., Hovis, J.A., Robson, M.S., and P.D. Southall. 1991. Florida atlas of breeding sites for herons and their allies, update 1986-1989. Fla. Game and Fresh Water Fish Comm., Tallahassee, Florida.

Streever, W.J. and T.L. Crisman. 1993. A comparison of fish populations from natural and constructed freshwater marshes in central Florida. Journal Freshwater Ecology 8:149-153.
https://doi.org/10.1080/02705060.1993.9664845

Whitaker, J.O. 1998. National Audubon Society field guide to North American mammals. Alfred A. Knopf, New York, New York.

Zellers-Williams, Inc. and Conservation Consultants, Inc. 1980. Evaluation of pre-July 1, 1975 disturbed phosphate lands, appendices. Dept. of Nat. Res., Div. of Res. Management, Bur. Of Geology, Tallahassee, Florida.

APPENDIX A. Species reported by eight studies comparing mined and unmined lands in central-Florida

SPECIES	COMMON NAME	HAB	CHAR	LIST[9]	REFERENCES
MAMMALIA					
Marsupiala					
Didelphis virginiana	Opossum	B			3,8,A
Insectivora					
Blarina brevicauda	Shorttail shrew	B			1,3
Cryptotis parva	Least shrew	B			1,3
Scalopus aquaticus	Eastern mole	B			3,8,A
Carnivora					
Canis latrans	Coyote	B			4,A
Felis concolor	Panther	R	O,C	US-E	4
Lutra canadensis	River otter	B(r)	OW,SW		3,4,5,A
Lynx rufus	Bobcat	B			3,4,8,A
Mephitis mephitis	Striped skunk	B			3,8,A
Mustela frenata	Long-tailed weasel	N	O,C		3
Procyon lotor	Raccoon	B			3,4,8,A
Spilogale putorius	Spotted skunk	B			3
Urocyon cinereoargenteus	Gray fox	B			3,8,A
Vulpes vulpes	Red fox	B			8
Rodentia					
Geomys pinetis	Southeastern pocket gopher	B(n)	O,Sa		8,A
Mus musculus	House mouse	B			3,8
Myocaster coypus	Nutria	B			8
Neofiber alleni	Round-tailed muskrat	B		FC-S	A
Ochrotomys nuttalli	Golden mouse	N	C		1
Oryzomys palustris	Rice rat	B			3,4,A
Peromyscus gossypinus	Cotton mouse	B			1
Peromyscus polionotus	Oldfield mouse	B			1,3,8
Podomys floridanus	Florida mouse	B(n)	O,C,Sa	FL-S	1
Sciurus carolinensis	Gray squirrel	B			8,A
Sciurus niger shermani	Sherman's fox squirrel	B(n)	C,O	FL-S	A
Sigmodon hispidus	Cotton rat	B			1,3,4,8,A
Lagamorpha					
Sylvilagus floridanus	Eastern cottontail	B			3,4,8,A
Sylvilagus palustris	Marsh rabbit	B			4,A
Artiodactyla					
Odocoileus virginianus	White-tailed deer	B			4,8,A
Sus scrofa	Feral pig	B			4,8,A
Xenarthra					
Dasypus novemcinctus	Nine-banded armadillo	B			3,4,8,A
AVES					
Podicipedidae					
Podiceps auritus	Horned grebe	R	OW		3
Podilymbus podiceps	Pied-billed grebe	B			2,3,4,5,8,A
Pelecanidae					
Pelecanus erythrorhynchos	American white pelican	B(r)	OW		2,3,4,5,8,A
Phalacrocoracidae					
Phalacrocorax auritus	Double-crested cormorant	B(r)	OW		2,3,4,5,8,A
Anhingidae					
Anhinga anhinga	Anhinga	B			2,3,4,5,8,A
Ardeidae					
Ardea alba	Great egret	B		FC-S	2,3,4,5,8,A
Ardea herodias	Great blue heron	B			2,3,4,5,8,A
Botaurus lentiginosus	American bittern	B			2,8,A
Bubulcus ibis	Cattle egret	B			2,3,4,5,8,A
Butorides virescens	Green heron	B			2,3,4,5,8,A
Egretta caerulea	Little blue heron	B		FL-S	2,3,5,8,A
Egretta thula	Snowy egret	B		FL-S	2,3,4,5,8,A
Egretta tricolor	Tricolored heron	B		FL-S	2,3,4,5,8,A
Ixobrychus exilis	Least bittern	B(r)	OW,SW	FC-S	2,3,4,8,A
Nyctanassa violacea	Yellow-crowned night-heron	B		FC-S	8,A
Nycticorax nycticorax	Black-crowned night-heron	B		FC-S	2,3,5,8,A
Threskiornithidae					
Ajaia ajaja	Roseate spoonbill	B		FL-S	2,A
Eudocimus albus	White ibis	B		FL-S	2,3,4,5,8,A
Plegadis falcinellus	Glossy ibis	B(r)	SW,EW	FC-S	2,3,4,5,8,A
Ciconiidae					
Mycteria americana	Wood stork	B(r)	OW,SW, EW	US-E	2,3,4,5,8,A

APPENDIX A. Species reported by eight studies comparing mined and unmined lands in central-Florida

SPECIES	COMMON NAME	HAB	CHAR	LIST[9]	REFERENCES
Anatidae					
Aix sponsa	Wood duck	B			2,5,8,A
Anas acuta	Northern pintail	B			2,8,A
Anas americana	American wigeon	B(r)	OW,SW		2,8,A
Anas clypeata	Northern shoveler	B			2,8,A
Anas crecca	Green-winged teal	B			2,5,A
Anas discors	Blue-winged teal	B			2,3,4,5,8,A
Anas fulvigula	Mottled duck	B(r)	OW,SW		2,3,4,8,A
Anas platyrhynchos	Mallard	B			2,5,8,A
Anas rubripes	American black duck	B			5
Anas stepera	Gadwall	R	OW,SW		5,A
Aythya affinis	Lesser scaup	B			2,8,A
Aythya collaris	Ring-necked duck	B(r)	OW,SW		2,4,5,8,A
Aythya valisineria	Canvasback	B			2,4,8
Branta canadensis	Canada goose	R	SW,O		4
Cairina moschata	Muscovy duck	B			5,A
Chen caerulescens	Snow goose	B			8,A
Lophodytes cucullatus	Hooded merganser	B			2,3,4,8,A
Mergus serrator	Red-breasted merganser	R	OW		2,3
Oxyura jamaicensis	Ruddy duck	B			2,8
Cathartidae					
Cathartes aura	Turkey vulture	B			1,2,3,4,5,8,A
Coragyps atratus	Black vulture	B			2,3,4,5,8,A
Accipitridae					
Accipiter cooperii	Cooper's hawk	B		FC-S	2,3,4,A
Accipiter striatus	Sharp-shinned hawk	B			2,3,8,A
Buteo brachyurus	Short-tailed hawk	B		FC-R	8
Buteo jamaicensis	Red-tailed hawk	B			1,2,3,4,5,8,A
Buteo lineatus	Red-shouldered hawk	B			2,3,4,8,A
Buteo platypterus	Broad-winged hawk	B			2,3,8
Buteo swainsoni	Swainson's hawk	R	O		3
Circus cyaneus	Northern harrier	B(r)	O		2,3,4,5,8,A
Elanoides forficatus	Swallow-tailed kite	B		FC-T	2,A
Haliaeetus leucocephalus	Bald eagle	B(r)	OW,C	US-E	2,3,4,5,8,A
Ictinia mississippiensis	Mississippi kite	B			8
Pandion haliaetus	Osprey	B(r)	OW	FL-S	2,3,4,5,8,A
Falconidae					
Falco columbarius	Merlin	B		FC-U	3,8
Falco peregrinus	Peregrine falcon	B		US-E	3,A
Falco sparverius	American kestrel	B			1,2,3,4,5,8,A
Phasianidae					
Meleagris gallopavo	Wild turkey	B(n)	C		8,A
Odontophoridae					
Colinus virginianus	Northern bobwhite	B(r)	O,C		1,2,3,4,5,8,A
Rallidae					
Fulica americana	American coot	B			2,3,4,5,8,A
Gallinula chloropus	Common moorhen	B			2,3,4,5,8,A
Porphyrula martinica	Purple gallinule	B			2,3,8,A
Porzana carolina	Sora	B			2,3,4,8,A
Rallus elegans	King rail	B			2,3,4,8,A
Rallus limicola	Virginia rail	B			2,3
Aramidae					
Aramus guarauna	Limpkin	B		FL-S	2,5,8,A
Gruidae					
Grus canadensiS (pratensis)	Sandhill crane	B(n)	O,SW	(FL-T)	2,4,8,A
Charadriidae					
Charadrius semipalmatus	Semipalmated plover	R	OW,MF		2
Charadrius vociferus	Killdeer	B			2,3,4,5,8,A
Recurvirostridae					
Himantopus mexicanus	Black-necked stilt	B(r)	O		2,3,4,8,A
Recurvirostra americana	American avocet	R	O,OW	FC-S	2,A
Scolopacidae					
Actitis macularia	Spotted sandpiper	B			2,4,8
Bartramia longicauda	Upland sandpiper	R	O		8
Calidris alpina	Dunlin	R	OW,MF		2
Calidris himantopus	Stilt sandpiper	R	OW,MF		2,3
Calidris mauri	Western sandpiper	B			2,8
Calidris minutilla	Least sandpiper	B			2,4,8,A
Gallinago gallinago	Common snipe	B			2,3,4,5,8,A
Limnodromus griseus	Short-billed dowitcher	R	OW,MF		2
Limnodromus scolopaceus	Long-billed dowitcher	B			8,A
Scolopax minor	American woodcock	B			2,8
Tringa flavipes	Lesser yellowlegs	B			2,3,4,8,A

SPECIES	COMMON NAME	HAB	CHAR	LIST[9]	REFERENCES
Tringa melanoleuca	Greater yellowlegs	B			2,3,4,8,A
Tringa solitaria	Solitary sandpiper	B			2,8
Laridae					
Chlidonias niger	Black tern	B			2
Larus argentatus	Herring gull	B			2,5,8
Larus atricilla	Laughing gull	B			2,3,4,5,8,A
Larus delawarensis	Ring-billed gull	B			2,3,4,5,8,A
Larus philadelphia	Bonaparte's gull	B			3,8
Rynchops niger	Black skimmer	B			2,8
Sterna antillarum	Least tern	B		FL-T	2,3,4,8,A
Sterna caspia	Caspian tern	B		FC-S	2,3,4,8,A
Sterna forsteri	Forster's tern	B			2,3,4,5,8,A
Sterna hirundo	Common tern	B			3,5
Sterna maxima	Royal tern	B		FC-S	2,4,A
Sterna sandvicensis	Sandwich tern	B		FC-S	2,4
Columbidae					
Columba livia	Rock dove	B			2,3,8
Columbina passerina	Common ground dove	B			1,2,3,5,8,A
Zenaida macroura	Mourning dove	B			1,2,3,4,5,8,A
Cuculidae					
Coccyzus americanus	Yellow-billed cuckoo	B			2,3,4,8,A
Coccyzus erythropthalmus	Black-billed cuckoo	B			8
Tytonidae					
Tyto alba	Barn owl	B			2,3,4,8,A
Strigidae					
Bubo virginianus	Great horned owl	B			2,3,8,A
Otus asio	Eastern screech-owl	B			3,8
Strix varia	Barred owl	B			2,4,8,A
Caprimulgidae					
Caprimulgus carolinensis	Chuck-will's-widow	B(n)	C		1,2,3,8,A
Caprimulgus vociferus	Whip-poor-will	B			2,8
Chordeiles minor	Common nighthawk	B			1,2,3,4,8,A
Apodidae					
Chaetura pelagica	Chimney swift	B			2,3,8,A
Trochilidae					
Archilochus colubris	Ruby-throated hummingbird	B			2,8,A
Alcedinidae					
Ceryle alcyon	Belted kingfisher	B			2,3,4,5,8,A
Picidae					
Colaptes auratus	Northern flicker	B			1,2,4,8,A
Dryocopus pileatus	Pileated woodpecker	B			1,2,4,8,A
Melanerpes carolinus	Red-bellied woodpecker	B			1,2,4,5,8,A
Melanerpes erythrocephalus	Red-headed woodpecker	B(n)	C,O		8,A
Picoides pubescens	Downy woodpecker	B			1,2,3,4,8,A
Picoides villosus	Hairy woodpecker	B			8,A
Sphyrapicus varius	Yellow-bellied sapsucker	B			2,8,A
Tyrannidae					
Contopus virens	Eastern wood-peewee	B			8
Empidonax flaviventris	Yellow-bellied flycatcher	R	C		8
Empidonax minimus	Least flycatcher	R	O		8
Empidonax virescens	Acadian flycatcher	B			8
Myiarchus crinitus	Great crested flycatcher	B(n)	C		2,4,8,A
Sayornis phoebe	Eastern phoebe	B			1,2,3,4,5,8,A
Tyrannus tyrannus	Eastern kingbird	B			2,3,8,A
Tyrannus verticalis	Western kingbird	B			8
Laniidae					
Lanius ludovicianus	Loggerhead shrike	B(r)	O		1,2,3,4,5,8,A
Hirundinidae					
Hirundo rustica	Barn swallow	B			2,3,4,8
Petrochelidon pyrrhonota	Cliff swallow	R	O,OW		3
Progne subis	Purple martin	B			2,3,4,8,A
Riparia riparia	Bank swallow	B			2
Stelgidopterix serripennis	Northern rough-winged swallow	R	O		2,3,8
Tachycineta bicolor	Tree swallow	B			2,3,4,5,8,A
Corvidae					
Aphelocoma coerulescens	Florida scrub-jay	B		US-T	8,A
Corvus brachyrhynchos	American crow	B			3,5,8,A
Corvus ossifragus	Fish crow	B			2,3,4,5,8,A

APPENDIX A. Species reported by eight studies comparing mined and unmined lands in central-Florida

SPECIES	COMMON NAME	HAB	CHAR	LIST[9]	REFERENCES
Cyanocitta cristata	Blue jay	B			1,2,3,4,5,8,A
Paridae					
Baeolophus bicolor	Tufted titmouse	B(n)	C		2,4,8,A
Poecile carolinensis	Carolina chickadee	B			8
Sittidae					
Sitta pusilla	Brown-headed nuthatch	N	C,O		2
Troglodytidae					
Cistothorus palustris	Marsh wren	B		FC-S	2,3,4,8,A
Cistothorus platensis	Sedge wren	B			2,3,4
Thryothorus ludovicianus	Carolina wren	B			1,2,3,4,5,8,A
Troglodytes aedon	House wren	B			1,2,3,4,8
Troglodytes troglodytes	Winter wren	R	C		8
Regulidae					
Regulus calendula	Ruby-crowned kinglet	B			2,4,8
Sylviidae					
Polioptila caerulea	Blue-gray gnatcatcher	B			1,2,3,4,5,8,A
Turdidae					
Catharus fuscescens	Veery	B			8
Catharus guttatus	Hermit thrush	B			2,8
Catharus minimus	Gray-cheeked thrush	B			8
Catharus ustulatus	Swainson's thrush	B			8
Hylocichla mustelina	Wood thrush	B			8
Sialis sialis	Eastern bluebird	R	O,C		8,A
Turdus migratorius	American robin	B			2,4,5,8,A
Mimidae					
Dumetella carolinensis	Gray catbird	B			1,2,3,4,5,8,A
Mimus polyglottos	Northern mockingbird	B			1,2,3,4,5,8,A
Toxostoma rufum	Brown thrasher	B			1,2,3,8,A
Sturnidae					
Sturnus vulgaris	European starling	B			2,8,A
Motacillidae					
Anthus rubescens	American pipit	B			3
Bombycillidae					
Bombycilla cedrorum	Cedar waxwing	B			2,8,A
Vireonidae					
Vireo flavifrons	Yellow-throated vireo	B			8
Vireo gilvus	Warbling vireo	R	C		8
Vireo griseus	White-eyed vireo	B			1,2,3,4,8,A
Vireo olivaceus	Red-eyed vireo	B			2,8,A
Vireo philadelphicus	Philadelphia vireo	B			8
Vireo solitarius	Blue-headed vireo	B			2,8,A
Emberizidae					
Aimophila aestivalis	Bachman's sparrow	R	C,O		3
Ammodramus savannarum	Grasshopper sparrow	R	O		3,8
Dendroica caerulescens	Black-throated blue warbler	B			8
Dendroica castanea	Bay-breasted warbler	B			8
Dendroica cerulea	Cerulean warbler	B			8
Dendroica coronata	Yellow-rumped warbler	B			1,2,4,5,8,A
Dendroica discolor	Prairie warbler	B			2,3,8,A
Dendroica dominica	Yellow-throated warbler	B			2,3,8,A
Dendroica fusca	Blackburnian warbler	B			8
Dendroica magnolia	Magnolia warbler	B			8
Dendroica nigrescens	Black-throated gray warbler	N	C,O		8
Dendroica palmarum	Palm warbler	B			1,2,3,4,5,8,A
Dendroica pensylvanica	Chestnut-sided warbler	B			3,8,A
Dendroica petechia	Yellow warbler	B			2,8,A
Dendroica pinus	Pine warbler	B			2,8,A
Dendroica striata	Blackpoll warbler	B			8,A
Dendroica tigrina	Cape may warbler	B			8
Dendroica virens	Black-throated green warbler	B			8
Geothlypis trichas	Common yellowthroat	B			2,3,4,5,8,A
Helmitheros vermivorus	Worm-eating warbler	B		FC-R	8
Icteria virens	Yellow-breasted chat	R	O		2,3,8
Limnothlypis swainsonii	Swainson's warbler	B			8
Melospiza georgiana	Swamp sparrow	B			2,3,4,8
Melospiza melodia	Song sparrow	B			3,8
Mniotilta varia	Black-and-white warbler	B			2,4,8,A
Oporornis agilis	Connecticut warbler	N	C		8

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SPECIES	COMMON NAME	HAB	CHAR	LIST[9]	REFERENCES
Oporornis formosus	Kentucky warbler	B			8
Parula americana	Northern parula	B			2,4,8,A
Passerculus sandwichensis	Savannah sparrow	B			2,3,4,5,8
Passerina cyanea	Indigo bunting	R	O		2,4
Pipilo erythrophthalmus	Eastern towhee	B			1,2,3,4,8,A
Pooecetes gramineus	Vesper sparrow	R	O		3,8
Protonotaria citrea	Prothonotary warbler	B			2,8,A
Seiurus aurocapillus	Ovenbird	B			2,4,8
Seiurus noveboracensis	Northern waterthrush	B			4,8
Seiurus motacilla	Louisiana waterthrush	B		FC-R	8
Setophaga ruticella	American redstart	B		FC-R	2,4,5,8,A
Spizella passerina	Chipping sparrow	B			1,8
Spizella pusilla	Field sparrow	B			2,8
Vermivora celata	Orange-crowned warbler	B			2,8
Vermivora chrysoptera	Golden-winged warbler	B			8
Vermivora peregrina	Tennessee warbler	B			8
Vermivora pinus	Blue-winged warbler	B			8
Vermivora ruficapila	Nashville warbler	B			8
Wilsonia canadensis	Canada warbler	B			8
Wilsonia citrina	Hooded warbler	B			8
Wilsonia pusilla	Wilson's warbler	B			8
Zonotrichia albicollis	White-throated sparrow	R	O,C		3,8
Zonotrichia leucophrys	White-crowned sparrow	B			8
Thraupidae					
Piranga olivacea	Scarlet tanager	B			8
Piranga rubra	Summer tanager	B			8,A
Cardinalidae					
Cardinalis cardinalis	Northern cardinal	B			1,2,3,4,5,8,A
Guiraca caerulea	Blue grosbeak	B			8
Passerina ciris	Painted bunting	B			8
Passerina cyanea	Indigo bunting	B			8
Pheucticus ludovicianus	Rose-breasted grosbeak	B			8
Icteridae					
Agelaius phoeniceus	Red-winged blackbird	B			2,3,4,5,8,A
Dolichonyx oryzivorus	Bobolink	B(r)	O		2,3,8,A
Euphagus carolinus	Rusty blackbird	R	O,C		3,8
Icterus galbula	Baltimore oriole	B			8
Icterus spurius	Orchard oriole	B			8
Molothrus ater	Brown-headed cowbird	R	O,C		2,5
Quiscalus major	Boat-tailed grackle	B			2,3,4,5,8,A
Quiscalus quiscula	Common grackle	B			2,3,4,5,8,A
Sturnella magna	Eastern meadowlark	B			2,3,4,5,8,A
Xanthocephalus xanthocephalus	Yellow-headed blackbird	R	O		2
Fringillidae					
Carduelis pinus	Pine siskin	R	O,C		8
Carduelis tristis	American goldfinch	B			2,4,8,A
Carpodacus purpureus	Purple finch	R	O,C		8
Passeridae					
Passer domesticus	House sparrow	B			8
REPTILIA					
Crocodylia					
Alligator mississippiensis	American alligator	B			3,4,5,8,A
Testudines					
Chrysemys floridana peninsularis	Peninsula cooter	B			3,4,5,8,A
Chrysemys nelsoni	Florida red-bellied turtle	B			3,4,8,A
Deirochelys reticularia chrysea	Florida chicken turtle	B			3,8,A
Kinosternon subrubrum steindachneri	Florida mud turtle	R	SW,EW		4
Gopherus polyphemus	Gopher tortoise	B		FL-S	1,3,4,8,A
Sternotherus odoratus	Stinkpot	R	OW,SW		7
Terrapene carolina bauri	Florida box turtle	B(n)	C,O		8,A
Trionyx ferox	Florida softshell	B(r)	OW		3,4,5,8,A
Squamata					
Anolis c. carolinensis	Green anole	B			1,4,8,A
Cnemidophorus s. sexlineatus	Six-lined racerunner	B			1,3,8,A
Eumeces egregius onocrepis	Peninsula mole skink	N	O,C,Sa		1
Eumeces inexpectatus	Southeastern five-lined skink	B			1,8,A
Eumeces laticeps	Broad-headed skink	B			8
Ophisaurus ventralis	Eastern glass lizard	N	O		1
Ophisaurus attenuatus longicaudus	Eastern slender glass	N	O		1

SPECIES	COMMON NAME	HAB	CHAR	LIST[9]	REFERENCES
	lizard				
Sceloporus u. undulatus	Southern fence lizard	B(n)	O		1,8,A
Sceloporus woodi	Florida scrub lizard	N	O,Sa		3
Scincella laterale	Ground skink	B			1,8,A
Serpentes					
Agkistrodon piscivorus conanti	Florida cottonmouth	B(r)	OW,C,O SW		5,8,A
Cemophora c. coccinea	Florida scarlet snake	B(n)	C,O,Sa		1
Coluber constrictor priapus	Southern black racer	B			1,3,4,8,A
Crotalus adamanteus	Eastern diamondback rattlesnake	B			3,4,5,8,A
Drymarchon corais couperi	Eastern indigo snake	B		US-T	8,A
Elaphe g. guttata	Corn snake	B			1,3,A
Elaphe obsoleta quadrivittata	Yellow rat snake	B			8,A
Farancia e. erytrogramma	Rainbow snake	R	C,O,OW SW,Sa		5
Heterodon platyrhinos	Eastern hognose snake	N	O,Sa		1
Heterodon simus	Southern hognose snake	N	O,Sa,C		3
Lampropeltis getulus floridana	Florida kingsnake	B			1,3
Lampropeltis triangulum elapsoides	Scarlet kingsnake	N	C,O		3
Masticophus f. flagellum	Eastern coachwhip	B			1,3
Micrurus f. fulvius	Eastern coral snake	N	C		1
Nerodia cyclopion floridana	Florida green water snake	R	SW		3,8
Nerodia e. erythrogaster	Red-bellied water snake	B			8,A
Nerodia f. fasciata	Banded water snake	R	OW,C SW		8
Nerodia fasciata pictiventris	Florida water snake	B			3,8
Nerodia taxispilota	Brown water snake	R	OW,SW, C		4,8
Opheodrys aestivus	Rough green snake	B			1,A
Pituophis melanoleucus mugitus	Florida pine snake	B		FC-U	1
Regina alleni	Striped crayfish snake	R	SW		3
Rhadinaea flavilata	Pine woods snake	N	O,C,Sa		1
Seminatrix pygaea	Black swamp snake	R	SW,C		8
Sistrurus milarius	Dusky pigmy rattlesnake	B			3,A
Tantilla relicta neilli	Central florida crowned snake	B(n)	C,O,Sa		1
Tantilla r. relicta	Peninsula crowned snake	N	O,C,F		1,3
Thamnophis sauritus sackeni	Peninsular ribbon snake	B			8
Thamnophis s. sirtalis	Eastern garter snake	R	O,C		3
AMPHIBIA					
Caudata					
Amphiuma means	Two-toed amphiuma	N	C,SW		7
Notophalamus viridescens	Red-spotted newt	N	SW,C		7
Siren lacertina	Greater siren	B			7
Anura					
Acris gryllus dorsalis	Florida cricket frog	B			3,4,8,A
Bufo terrestris	Southern toad	B			1,3,8,A
Bufo quercicus	Oak toad	B(n)	C,Sa, EW		1,3,A
Eleutherodactylus p. planirostris	Greenhouse frog	B			1
Gastrophryne carolinensis	Eastern narrow-mouthed frog	B			1,3
Hyla cinerea	Green treefrog	B			3,8,A
Hyla femoralis	Pine woods tree frog	B(n)	C,EW		8,A
Hyla squirella	Squirrel treefrog	B(n)	C,EW,O		1,3,8,A
Rana capito	Gopher frog	N	O,F,C, EW	FL-S	1,A
Rana catesbeiana	Bullfrog	B			3,5,7,8
Rana c. clamitans	Bronze frog	R	OW,SW		3
Rana grylio	Pig frog	B			3,4,5,7,8,A
Rana heckscheri	River frog	R	C,SW		4
Rana sphenocephala	Southern leopard frog	B			3,4,5,7,8,A
Scaphiopus h. holbrookii	Eastern spadefoot	B(n)	EW,C,O Sa		1

SPECIES	COMMON NAME	HAB	CHAR	LIST[9]	REFERENCES
OSTEICHTHYES					
Ameiurus catus	White catfish	B			5
Ameiurus natalis	Yellow bullhead	B			5,7,A
Ameiurus nebulosus	Brown bullhead	B			5
Ameiurus punctatus	Channel catfish	B			5
Amia calva	Bowfin	B			5
Clarius batrachus	Walking catfish	B			7,A
Dorosoma cepedianum	Gizzard shad	B			5
Dorosoma petenense	Threadfin shad	B			5
Etheostoma fusiforme	Swamp darter	R			7
Elassoma evergladei	Everglades pygmy sunfish	B(n)			6,7
Elassoma zonatum	Banded pygmy sunfish	R			7
Enneacanthus gloriosus	Bluespotted sunfish	N			5
Erimyzon sucetta	Lake chubsucker	B			5
Fundulus chrysotus	Golden topminnow	R			7
Fundulus rubrifrons	Redface topminnow	B			6
Fundulus seminolis	Seminole killifish	B			5,6
Gambusia holbrooki	Eastern mosquitofish	B			5,6,7,A
Heterandria formosa	Least killifish	B			5,6,7,A
Jordanella floridae	Flagfish	B(r)			5,6
Labidesthes sicculus	Brook silverside	B			5
Lepisosteus platyrhincus	Florida gar	B			5,A
Lepomis auritus	Redbreast sunfish	N			5
Lepomis gulosis	Warmouth	B			5,7
Lepomis macrochirus	Bluegill	B			5,7,A
Lepomis marginatus	Dollar sunfish	B			5
Lepomis microlophus	Redear sunfish	B			5
Lepomis punctatus	Spotted sunfish	B			5
Lucania goodei	Bluefin killifish	B(r)			6
Micropterus salmoides	Largemouth bass	B			5,A
Notemigonus crysoleucas	Golden shiner	B			5
Notropis maculatus	Taillight shiner	B			5
Notropis petersoni	Coastal shiner	R			7
Noturus gyrinus	Tadpole madtom	N			5
Poecilia latipinna	Sailfin molly	B(r)			6,7
Pomoxis nigromaculatus	Black crappie	B			5
Tilapia aurea	Blue tilapia	B			5,A

HAB=land type preference: B=reported on mined and unmined land, (r)=may prefer mined land, (n)=may prefer unmined land. R=only reported on mined land, N=only reported on unmined land.

CHAR=preferred habitat characteristics: O=open, C=canopy, Sa=sandy substrate, MF=mudflats, OW=open water, SW=stable wetlands, EW=ephemeral wetlands.

1. Mushinsky and McCoy 1996
2. Kale 1992
3. King *et al.* 1992
4. Kale and Pritchard 1997
5. Boody *et al.* 1985
6. Streever and Crisman 1993
7. Durbin and Godley 1995
8. Zellers-Williams 1980
9. Humphrey 1992, Moler 1992, Rodgers *et al.* 1996, Gilbert 1992

A. Author has also positively identified species within the study region.

US=US Fish & Wildlife Service
FL=Florida Fish and Wildlife Conservation Comm.
FC=Florida Committee on Rare & Endangered Plants and Animals

E=endangered, T=threatened, S=species of special concern, R=rare, U=status undetermined