Everglades Wildlife and Environmental Area (Broward County) Photo by Paul Russo

Slough

Description: Sloughs are the deepest drainageways within swamps and marsh systems. They are broad channels inundated with slow moving or nearly stagnant water, except during extreme droughts. The vegetation structure is variable with some sloughs dominated by floating aquatics, others by large emergent herbs, and still others by a low or sparse canopy. Canopied sloughs are characterized by various swamp species, particularly Carolina ash (*Fraxinus caroliniana*) and coastalplain willow (*Salix caroliniana*), with or without a mixture of large emergent herbs and floating aquatic plants. In south Florida, pond apple (*Annona glabra*) is a frequent canopy component, and can withstand somewhat deeper water than Carolina ash (Austin et al. 1990b). Canopied sloughs in floodplains in the northern Florida peninsula and Panhandle often contain ogeechee tupelo (*Nyssa ogeche*) and planer tree (*Planera aquatica*). Other common woody species include cypress (*Taxodium* spp.) and common buttonbush (*Cephalanthus occidentalis*). Where emergent herbs are present, alligatorflag (*Thalia geniculata*), bandana-of-the-Everglades (*Canna flaccida*), pickerelweed (*Pontederia cordata*), bulltongue arrowhead (*Sagittaria lancifolia*), giant cutgrass (*Zizaniopsis miliacea*), and lizard's tail (*Saururus cernuus*) are common. Deeper sloughs may contain floating and submerged aquatic plants such as American white waterlily (*Nymphaea odorata*), big floatingheart (*Nymphoides aquatica*), yellow pondlily (*Nuphar advena*), frog's bit (*Limnobium spongia*), duckweeds (*Lemna* spp.), and bladderworts (*Utricularia* spp.). In south Florida, submerged plants and algae (including cyanobacteria, known as

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periphyton, found in more alkaline waters) can form mats in sloughs that contribute food and oxygen (Gunderson and Loftus 1993). South Florida pond apple sloughs are ideal, moist, warm habitats for rare and endangered tropical epiphytes. Pond apple branches are often densely covered with such epiphytes as orchids, bromeliads, ferns, and peperomias. Some epiphytic orchids, including several rarely found elsewhere in Florida, may be common in this habitat, especially dingy flowered star orchid (*Epidendrum anceps*), clamshell orchid (*Encyclia cochleata* var. *triandra*), stiff flower star orchid (*Epidendrum rigidum*), and night-scented orchid (*Epidendrum nocturnum*; Owen, pers. comm. 2008).

Sloughs occur in irregular linear arrangements within strand swamp, floodplain swamp, basin swamp, glades marsh, or slough marsh communities, often forming an intricate mosaic of wetland communities. In strand swamps and glades marsh, sloughs are often aligned with the lowest part of troughs in the underlying limestone bedrock. Within floodplain swamps sloughs occur as overflow channels within backswamps off the main river. In basin swamps, they may occur as slow moving to stagnant drains. These channels are formed by flowing water during floods and periods of heavy rainfall. While they may be common features within a swamp, sloughs are usually not described separately from the swamp vegetation. The soils in a slough are peat, unless consumed by catastrophic fires that may occur during droughts.

Characteristic Set of Species: pond apple (in south Florida), Carolina ash, alligator flag, American white waterlily

Rare Species: Many rare epiphytic plants depend on slough for its constant humidity afforded by the long hydroperiod. These include ribbon orchid (*Campylocentrum pachyrrhizum*), powdery catopsis (*Catopsis berteroniana*), nodding catopsis (*Catopsis nutans*), ghost orchid (*Dendrophylax lindenii*), Acuna's epidendrum (*Epidendrum acunae*), night-scented orchid, pendant epidendrum (*Epidendrum strobiliferum*), hanging clubmoss (*Huperzia dichotoma*), delicate ionopsis (*Ionopsis utricularioides*), tiny orchid (*Lepanthopsis melanantha*), hidden orchid (*Maxillaria crassifolia*), cypress peperomia (*Peperomia glabella*), blunt-leaved peperomia (*Peperomia obtusifolia*), frost-flower orchid (*Pleurothallis gelida*), clamshell orchid, and dwarf butterfly orchid (*Prosthechea pygmaea*).

Many rare animals that occur in swamps and marshes are also typical of sloughs. American alligators (*Alligator mississippiensis*) are particularly dependent on sloughs to maintain healthy populations. These animals require open water areas in the larger marsh and swamp systems for breeding, feeding, and, for juveniles, escape paths (Fogarty 1984).

Range: Sloughs are found throughout Florida and the Southeastern coastal plain as features of swamps and marshes. In south Florida, sloughs are larger and more distinctive communities.

Natural Processes: Sloughs may be formed by floodplain processes associated with meandering riverbeds in North and Central Florida that create variation in topography within the floodplain. The water in these sloughs is slow moving, and sloughs may dry completely during droughts.

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In South Florida, some sloughs have formed from the burning of underlying peat layers in strand swamps and glades marsh during droughts. These depressions then fill with water when the site is once again flooded. As such, these can be shifting communities, with old sloughs eventually filling in with peat while new ones are created by peat fires. Coastalplain willow is a common colonizer when fires have consumed soils in the Everglades (Gunderson and Loftus 1993). Alligators further create heterogeneity in sloughs by wallowing and digging in the peat substrate, excavating "gator holes" which may then provide a refuge for fish during droughts (Craighead 1968; Palmer and Mazzotti 2004).

Despite the vulnerability of some South Florida sloughs to fire, the high humidity and long hydroperiod of sites dominated by pond apple provide frost and fire protection. These factors, in turn, allow for the proliferation of large populations of tropical epiphytes, including many endangered species (Austin et al. 1990a). Some of these sloughs may never experience fire, as evidenced by peat core samples dating back 6,000 years at a site in the Fakahatchee Strand Preserve State Park (Owen, pers. comm. 2008).

Community Variations: Variation in the community structure of sloughs is mainly attributable to climate, fire, and substrate differences across the state. Due to the abundance of rare plants, a variant is recognized and described below.

Variant: POND APPLE SLOUGH – Found exclusively in South Florida, these are canopied sloughs dominated by pond apple, often with abundant epiphytes.

Associated Communities: Slough occurs in swamp (strand, floodplain, or basin) or marsh, and often closely resembles these communities. The distinction between slough and blackwater stream is obscure, with no absolute characters distinguishing the two types. Sloughs are relatively shallow, often with vegetation throughout. They are inundated with slow-moving or nearly stagnant water, except during periods of extreme drought when they may dry out entirely. Blackwater streams, by contrast, have constantly moving water and are rarely covered in vegetation.

Management Considerations: Sloughs are extremely vulnerable to hydrologic disturbances and must have a reliable water source to persist. In pond apple sloughs, the maintenance of a natural hydrology is important to sustain epiphyte diversity. The mosaic of habitats formed by sloughs, marshes, and strand swamps in South Florida is critical for wildlife, especially wading birds that rely on an abundance of aquatic prey (Fleming et al. 1994). In sloughs that have been overly drained due to water management practices, bird populations have decreased following a decline in invertebrates, fishes, frogs, and turtles (Ogden 2005). Maintaining deep water in sloughs is also necessary for alligator populations (Craighead 1968).

Watershed disturbance from the creation of canals and roads can cause ponding in some areas, and unnatural drought conditions in others. This can result in increased soil oxidation and fire frequency (Ogden 2005). Canals also provide a portal through which exotic fish, amphibian, and snail species may invade natural slough habitats (Ferriter et al. 2006). Floating and submerged invasive aquatic plants such as water-lettuce (*Pistia stratiotes*), water hyacinth (*Eichhornia crassipes*), and hydrilla (*Hydrilla verticillata*), can

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also encroach from canals. Other exotic plant species, mainly melaleuca (*Melaleuca quinquenervia*), are occasionally found in slough, but seem to prefer ecotones between slough and glades marsh. Emergent plant growth may be negatively impacted by continual airboat use that forms trails and may break up mats of vegetation in sloughs (Duever et al. 1986). Poaching of epiphytes is also an ongoing threat along pond apple sloughs (Owen, pers. comm. 2008).

Reference Sites: Fakahatchee Strand Preserve State Park (Collier County), Corkscrew Swamp Sanctuary (Collier County), Big Cypress National Preserve (Collier, Monroe, and Miami-Dade Counties), Everglades National Park (Miami-Dade, Monroe, and Collier Counties), Rock Bluff Scenic Area in Ochlockonee River floodplain in Apalachicola National Forest (Leon County)

Global and State Rank: G3/S3

Crosswalk and Synonyms: The term slough is often used in the literature to refer to any broad shallow channel regardless of the dominant vegetation, particularly in the flatlands of the central and southern peninsula. This classification restricts slough to deep water marsh or open water. Other communities that occupy broad shallow channels in this region include slough marsh, glades marsh, and strand swamp.

Kuchler	113/Southern Floodplain Forest
Davis	7/Cypress Swamp Forests
SCS	17/Cypress Swamp
	21/Swamp Hardwoods
Myers and Ewel	Freshwater Swamp Forests - sloughs and strands
SAF	101/Baldcypress
FLUCCS	621/Cypress

Other synonyms: flag pond, gator hole

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