Everglades National Park (Miami-Dade County) Photo by Gary Knight

Glades Marsh

Description: Glades marsh is a primarily herbaceous wetland in South Florida, especially in the Everglades basin, that occurs in broad shallow channels or depressions over a substrate of peat or marl that directly overlies limestone. While commonly a dense, tall monoculture of sawgrass (*Cladium jamaicense*), deeper glades marsh may support an array of emergent plants that includes sparse sawgrass, maidencane (*Panicum hemitomon*), Tracy's beaksedge (*Rhynchospora tracyi*), or Gulf Coast spikerush (*Eleocharis cellulosa*). Various other herbs are common, particularly shortbristle horned beaksedge (*R. corniculata*), other beaksedges, slim spikerush (*E. elongata*), string lily (*Crinum americanum*), alligatorlily (*Hymenocallis palmeri*), creeping primrosewillow (*Ludwigia repens*), bulltongue arrowhead (*Sagittaria lancifolia*), pickerelweed (*Pontederia cordata*), and American cupscale (*Sacciolepis striata*). During periods of high water and in areas transitional to deeper sloughs, floating plants such as big floatingheart (*Nymphoides aquatica*), and bladderworts (*Utricularia* spp.) may be common (Loveless 1959; Wade et al. 1980; Ross et al. 2006). Drought conditions may allow other herbs to temporarily gain importance, such as southern amaranth (*Amaranthus australis*), dogfennel (*Eupatorium capillifolium*), sugarcane plumegrass (*Saccharum giganteum*), broomsedges (*Andropogon* spp.), giant bristlegrass (*Setaria magna*), camphorweeds (*Pluchea* spp.), thistles (*Cirsium* spp.), asters (*Symphyotrichum* spp.), and knotweeds (*Polygonum* spp.). Saltmarsh morning glory (*Ipomoea sagittata*), and white twinevine (*Sarcostemma clausum*) may be found climbing sawgrass blades (Loveless 1959). Woody vegetation is sparse, and generally only found around so-called "gator holes" or near the edges of the many tree islands that dot the landscape of the Everglades. Coastalplain willow (*Salix caroliniana*), coco plum (*Chrysobalanus icaco*), and common buttonbush (*Cephalanthus occidentalis*) are typical of these locations. Cattails (*Typha* spp.) are increasingly abundant in areas of the Everglades where water quality is degraded by agricultural run-off or where water is impounded by roads and canals. In glades marsh with relatively sparse vegetation, mats of algae called periphyton are commonly attached to plants in the water column. This periphyton is often considered calcareous due to the dominance of certain filamentous blue-green algae species (Browder et al. 1994).

Much of the Florida peninsula south of Lake Okeechobee is a flat limestone plain of fairly recent (Pliocene/Pleistocene) origin with peat and marl substrates deposited directly on the limestone platform. Glades marsh is frequently flooded, and water may be slowly flowing, particularly in the Everglades basin. Soils are often deep peats that have been deposited over the limestone, but some marshes may be found on marl (calcitic mud). Hydroperiod is typically at least 6 months (Olmsted and Loope 1984).

Characteristic Set of Species: sawgrass, spikerush, maidencane, beaksedges

Rare Species: Rare species in glades marsh include meadow jointvetch (*Aeschynomene pratensis*) which grows in slightly deeper marsh. South Florida is the only location in the United States for this species. Glades marsh is also important habitat for the American alligator (*Alligator mississippiensis*), considered a keystone species in this community, as the small ponds created or maintained by alligators provide a refuge for fish and invertebrates during droughts (Craighead 1968; Palmer and Mazzotti 2004). The Everglades are critical habitat for the federally endangered snail kite **(***Rostrhamus sociabilis plumbeus*) in Florida, which feeds almost exclusively on apple snails. Other rare birds, such as limpkin (*Aramus guarauna*), and wading birds, particularly great egret (*Ardea alba*), white ibis (*Eudocimus albus*), little blue heron (*Egretta caerulea*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), least bittern (*Ixobrychus exilis*), wood stork (*Mycteria americana*), black-crowned night-heron (*Nycticorax nycticorax*), and glossy ibis (*Plegadis falcinellus*), and two rare mammals, southern mink (*Neovison vison*, southern Florida population) and round-tailed muskrat (*Neofiber alleni*), utilize glades marsh for foraging and nesting. Glades marsh in the Everglades is the major habitat of at least one rare invertebrate, the Everglades sprite (*Nehalennia pallidula*).

Range: Glades marsh in Florida (and the United States) is restricted to South Florida in four physiographic divisions following Brooks (1981). It is mainly located in the Everglades basin (Everglades Province), in the associated Taylor Slough and the "southeast saline" marshes (Silver Bluff-Coastal Marsh Terrace Subdivision), and historically in several low-lying sloughs that once traversed the Atlantic Coastal Ridge and provided drainage from the basin eastward during floods. It is also found to a lesser extent in the Florida Keys and Big Cypress Provinces, including Fakahatchee Strand and Picayune Strand. Similar marshes may be found elsewhere in the Caribbean, particularly on the Zapata peninsula in Cuba.

Natural Processes: The Everglades system is relatively young, less than 6,000 years old, as evidenced by the earliest layers of peat deposited in the Holocene. As sea level rose and local rainfall increased, the large depression of the Everglades basin became flooded with freshwater which was confined by the Atlantic Ridge to the east and the higher elevation Big Cypress region to the west (Gleason and Stone 1994). The broad, slightly sloped Everglades basin is commonly called a "River of Grass," and while water does move in a general northeast to southwest direction, the rate is slow due to the extremely gentle slope that averages only a three centimeter drop per kilometer over the length of the basin (Kushlan 1990).

The near constant flooding of glades marshes, combined with the warm sub-tropical climate, contributes to a lush growth of sawgrass on slightly higher "ridges" and waterlily (*Nymphaea* sp.) in the lowest sloughs and ponds. The long hydroperiod (>6 months) creates an anaerobic soil environment in which the breakdown of organic material is impeded, and sediments from dead vegetation continually accumulate, forming the characteristic peat soil. This peat deposition is known to have begun at least 5500 years ago near the south end of Lake Okeechobee (Gleason and Stone 1994). The earliest peat layers are deposited over a layer of marl, indicating a gradual increase in hydroperiod as local rainfall increased and sea levels rose following the Wisconsin glacial maximum (Gleason and Stone 1994). Although most glades marsh is located on accumulated peat, sometimes several meters thick, the substrate may vary due to soil oxidation, fire, or other factors. Peat layers may be thin or absent, particularly in the southern Everglades, with emergent plants growing directly on marl or sand/marl mixtures.

Periphyton, an algal mat found throughout the Everglades, is an important component of the entire ecosystem. Certain blue-green algae species function to precipitate calcium carbonate and will form a marl substrate. However, the long hydroperiod and deep water of most examples of glades marsh tend to favor non-calcareous rather than calcareous periphyton, and generally leads to a buildup of peat, rather than marl substrates (Browder et al. 1994).

Fire is a natural component of the glades marsh landscape. Sparse stands of spikerush and beaksedge do not burn frequently (Wade et al. 1980); however Robertson (1953) noted early observations of lightning strikes that frequently started wildfires in sawgrass and tree islands. Natural fires are most common during the summer months as the frequency of lightning strikes peaks in July, although the largest fires occur in May before water levels are high (Gunderson and Snyder 1994). However, even during periods of inundation, sawgrass may carry a fire over water. Estimations of the natural fire return interval in the Everglades range from 3 to 10 years with much variability depending on seasonal and longer term weather patterns (Wade et al. 1980; Gunderson and Snyder 1994). Most dominant herbaceous plants in the Everglades, particularly sawgrass, maidencane, and bulltongue arrowhead, grow vigorously following fire under normal conditions, i.e. when water levels are still near the soil surface (Loveless 1959). Under drought conditions, however, wildfires may burn down the peat layer, destroying sawgrass roots and converting these areas to lower elevation emergent communities or to deeper water sloughs (Wade et al. 1980). Coastalplain willow, described by Loveless (1959) as a "fire follower" can quickly become established around burned out peat holes, and its ability to withstand most low intensity fires also can allow it to replace other trees and shrubs destroyed by fire on tree islands.

In areas with a shortened hydroperiod and lack of fire, wax myrtle (*Myrica cerifera*), dahoon (*Ilex cassine*), coastalplain willow, and groundsel tree (*Baccharis halimifolia*) are common invaders and may colonize areas of decadent sawgrass (Alexander and Crook

1984). Historically, this shift in vegetation may be responsible for the formation of large, cigar-shaped, dahoon-dominated bayheads (Gleason and Stone 1994).

Topographic variation may result not only from severe fires, but also from highs and lows in the underlying limestone bedrock, or from the formation of peat batteries. These batteries are most common in the northeastern Everglades where solid masses of peat become dislodged from the floor of the marsh and drift to a new location, eventually reattaching to the bottom. The topographic high created by the peat formation may become colonized with woody vegetation, especially swamp bay (*Persea palustris*), and can ultimately become a bayhead, while the hole left behind will become a much deeper slough (Gleason and Stone 1994).

The Everglades is an oligotrophic system (Noe et al. 2001). Sawgrass is adapted to low-phosphorus conditions and thus tends to outcompete other plants in these environments (Newman et al. 1996; Ross et al. 2006). The porous limestone surface underlying the basin allows for some interaction between surface water and ground water within the limestone, leading to a slightly basic surface water environment with high calcium levels (Noe et al. 2001). These conditions lower phosphorus bio-availability and tend to perpetuate sawgrass dominance (Ross et al. 2006).

Salinity is a limiting factor in the southern Everglades, and species composition shifts to halophyte-dominated vegetation of salt marsh or mangrove swamp near Florida Bay (Olmsted and Loope 1984). As sea level rises, the freshwater environments of the southernmost Everglades are being replaced by mangroves or salt marsh, as likely happened during the high sea levels of the last interglacial period (Gleason and Stone 1994), although decreasing freshwater flow caused by water control measures over the past century may also have lead to mangrove expansion (Ross et al. 2000).

Community Variations: Species composition can vary with slight differences in hydroperiod and maximum water depth. Tall, dense sawgrass stands occur at peat elevations only slightly higher than sparse sawgrass and spikerush stands, amounting to a nine centimeter difference in mean high water level (Ross et al. 2006). Cattails are common in and near the Everglades Agricultural Area, but there is little historical evidence for this plant being frequent prior to drainage of that area (Gleason and Stone 1994).

One geographically restricted variant of glades marsh occurs within Florida.

Variant: KEYS FRESHWATER MARSH – Sawgrass dominated marsh occupying limestone depressions, primarily in the Lower Keys. Soils are deep peats or calcitic muds that have collected within the limestone basin. Although these wetlands are freshwater habitats for most of the year, they may become saline during the dry season, which allows the establishment of white mangrove (*Laguncularia racemosa*) and buttonwood (Ross et al. 1992).

Associated Communities: Glades marsh frequently grades into marl prairie. These prairies are distinguished from glades marsh by having a shorter hydroperiod (<6 months), a shorter and more regular fire return interval, usually a dominance of Gulf hairawn muhly (*Muhlenbergia sericea*) or short sawgrass, and a higher diversity of associated species than are found in glades marsh (Olmsted et al. 1980). Glades marsh often occurs around or adjacent to sloughs, which are deeper drainage ways that remain underwater almost year round and are dominated by waterlily. Glades marsh, marl prairie and slough may be closely associated and form complex mosaics.

All freshwater marsh communities in Florida, including glades marsh, are similar in vegetation composition, and other marsh types may have flowing water, especially during periods of heavy rainfall. However, other freshwater marshes are typically located on sand or peat overlying sand, rather than peat or marl deposited directly on limestone. In the increasingly saline environment towards the coast, glades marsh and marl prairie grade into salt marsh and mangrove swamp, sometimes forming large zones of overlap where red mangrove (*Rhizophora mangle*) and/or buttonwood (*Conocarpus erectus*) becomes increasingly frequent or where the freshwater marsh species are gradually replaced by upper salt marsh halophytic herbs such as cordgrasses (*Spartina* spp.), saltgrass (*Distichlis spicata*), and shoreline seapurslane (*Sesuvium portulacastrum*; Drew and Schomer 1984; Ross et al. 2000).

Management Considerations: The Everglades has a long history of anthropogenic manipulation of natural processes. Maintenance of a more natural hydrologic regime is the single most critical factor in preserving/restoring glades marsh. Drainage of the historic Everglades began in the late 1800s, evolving over time into an extensive system of canals and levees that provide flood protection and create agricultural land (Snyder and Davidson 1994; Light and Dineen 1994). Immediately south of Lake Okeechobee, the deep peat soils have been cultivated in vegetables, sugarcane, and sod for most of the last century. Roughly 50 percent of the original extent of the Everglades has been converted to agricultural land or development, while the remaining wetlands have been compartmentalized by roads and canals (Davis et al. 1994).

Armentano (2006) noted that changes in vegetation dominance can occur quickly as water levels and hydroperiod are altered. North of Tamiami Trail in the Water Conservation Areas, an increase in hydroperiod and water depth has altered the historic spatial extent of Everglades vegetation by converting large areas of former sawgrass to emergent vegetation and sloughs, and creating favorable conditions for the spread of cattails (Alexander and Crook 1984). A combination of deeper flooding and increased phosphorus as a result of altered hydrology and surface water run-off from agricultural areas encourages the growth of cattails. Newman (1996) demonstrated that cattails show a greater increase in growth than either sawgrass or spikerush under both higher water levels and increased phosphorus concentrations. This growth differential subsequently leads to a shift in dominance and expansion of cattail marshes. Conversely, further south, in the Shark River Slough, decreased flow has lead to the expansion of sawgrass into historically wetter areas (Olmsted and Armentano 1997). Increased phosphorus levels also have an effect on periphyton growth, causing a shift from calcareous blue-green algae to filamentous green algae (McCormick and O'Dell 1996).

Modification to the amount and timing of natural flow in the Everglades is also implicated in bird population declines. Nesting wading bird populations (great egret, wood stork, tricolored heron, white ibis, snowy egret) have decreased by as much as 90 percent from the 1930s to the 1980s (Ogden 1994). Snail kites that rely almost entirely on apple snails for food have also declined. Bennetts et al. (1994) suggest that snail kites benefit from a hydrologic regime that maintains open water to promote apple snail populations, but that is not so wet as to eliminate woody vegetation entirely.

Fire is usually beneficial, not only in promoting sawgrass growth, but also by benefiting wildlife (Wade et al. 1980). However, evidence suggests that drainage-induced shifts in hydrology have lead to more severe, peat destroying fires, particularly in southern Everglades where flow has been reduced (Olmsted and Loope 1984).

Hydrologic alteration has also facilitated the spread of invasive exotic plants. Brazilian pepper (*Schinus terebinthifolius*) is a widespread exotic that has gone from being almost absent in the mid-1950s to a severe threat, forming monotypic stands, particularly in agricultural areas (Alexander and Crook 1984). Melaleuca (*Melaleuca quinquenervia*), introduced in the early 20th century as part of the overall plan for draining the Everglades, underwent explosive growth, forming large monotypic stands in a variety of habitats including glades marsh. Two insects have been released as biological control agents for melaleuca and have been shown to be effective in reducing growth of this exotic (Tipping et al. 2009). Mechanical, physical, and herbicidal methods of removal are also required for the control of these species (Bodle et al. 1994).

Exemplary Sites: Everglades National Park (Miami-Dade and Monroe counties), Everglades and Francis Taylor Wildlife Management Area (Miami-Dade, Broward, and Palm Beach counties)

Global and State Rank: G3/S3

Crosswalk and Synonyms: A source of confusion in the literature is the use of the term "wet prairie" to refer to longer hydroperiod marshes (Loveless 1959; Wade et al. 1980). The FNAI classification restricts the use of the term "prairie" to communities with a shorter hydroperiod than most marshes. See USFWS (1999) for further discussion on this terminology.

Kuchler	92/Everglades
Davis	16a/Everglades Saw Grass Marshes
	16b/Everglades Region Marshes, Sloughs, Wet Prairies, and Tree Islands
SCS	24/Sawgrass Marsh
Myers and Ewel	Freshwater Marshes - swale
SAF	NA
FLUCCS	641/Freshwater Marshes
	643/Wet Prairies

Other synonyms: wet prairie (Loveless 1959), slough, river of grass, glades

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