= Geography and ecology of the Everglades =

The geography and ecology of the Everglades involve the complex elements affecting the natural environment throughout the southern region of the U.S. state of Florida . Before drainage , the Everglades were an interwoven mesh of marshes and prairies covering 4 @,@ 000 square miles (10 @,@ 000 km2) . The Everglades is simultaneously a vast watershed that has historically extended from Lake Okeechobee 100 miles (160 km) south to Florida Bay (around one @-@ third of the southern Florida peninsula) , and many interconnected ecosystems within a geographic boundary . It is such a unique meeting of water , land , and climate that the use of either singular or plural to refer to the Everglades is appropriate . When Marjory Stoneman Douglas wrote her definitive description of the region in 1947 , she used the metaphor " River of Grass " to explain the blending of water and plant life .

Although sawgrass and sloughs are the enduring geographical icons of the Everglades , other ecosystems are just as vital , and the borders marking them are subtle or nonexistent . Pinelands and tropical hardwood hammocks are located throughout the sloughs ; the trees , rooted in soil inches above the peat , marl , or water , support a variety of wildlife . The oldest and tallest trees are cypresses , whose roots are specially adapted to grow underwater for months at a time . The Big Cypress Swamp is well known for its 500 @-@ year @-@ old cypresses , though cypress domes can appear throughout the Everglades . As the fresh water from Lake Okeechobee makes its way to Florida Bay , it meets salt water from the Gulf of Mexico ; mangrove forests grow in this transitional zone , providing nursery and nesting conditions for many species of birds , fish , and invertebrates . The marine environment of Florida Bay is also considered part of the Everglades because its sea grasses and aquatic life are attracted to the constant discharge of fresh water .

These ecological systems are always changing due to environmental factors . Geographic features such as the Western Flatwoods , Eastern Flatwoods , and the Atlantic Coastal Ridge affect drainage patterns . Geologic elements , climate , and the frequency of storms and fire are formative processes for the Everglades . They help to sustain and transform the ecosystems in the Shark River Valley , Big Cypress Swamp , coastal areas and mangrove forests . Ecosystems have been described as both fragile and resilient . Minor fluctuations in water levels have far @-@ reaching consequences for many plant and animal species , and the system cycles and pulses with each change .

= = Shaping processes of ecosystems = =

At only 5 @,@ 000 years of age , the Everglades is a young region in geological terms . Its ecosystems are in constant flux as a result of the interplay of three factors : the type and amount of water present , the geology of the region , and the frequency and severity of fires .

= = = Water = = =

Water is the dominant element in the Everglades , and it shapes the land , vegetation , and animal life of South Florida . The South Florida climate was once arid and semi @-@ arid , interspersed with wet periods . Between 10 @,@ 000 and 20 @,@ 000 years ago , sea levels rose , submerging portions of the Florida peninsula and causing the water table to rise . Fresh water saturated the limestone , eroding some of it and creating springs and sinkholes . The abundance of fresh water allowed new vegetation to take root , and through evaporation formed thunderstorms . Limestone was dissolved by the slightly acidic rainwater . The limestone wore away , and groundwater came into contact with the surface , creating a massive wetland ecosystem . Although the region appears flat , the wearing away of the limestone in some areas created slight valleys and plateaus ? a difference of inches in elevation ? that affected not only the flow of water , but also types of vegetation present .

The Everglades are unique ; no other wetland system in the world is nourished primarilyfkjls from the atmosphere . Before the first attempt at draining the Everglades in 1882 , the entire watershed

extended from Orlando to Florida Bay comprising the Kissimmee ? Lake Okeechobee ? Everglades (KLOE) watershed . Kissimmee River outlets flow into Lake Okeechobee , which sits 18 feet (5 @.@ 5 m) above sea level . Only two seasons exist in the Everglades : wet (May to November) and dry (December to April) . Average annual rainfall in the Everglades is approximately 62 inches (160 cm) , though fluctuations of precipitation are normal . Droughts , floods , and tropical storms are normal occurrences in the area . When Lake Okeechobee exceeds its water storage capacity during the wet season , it pours slowly over the southern rim and flows for 100 miles (160 km) to Florida Bay . The gradient change is so slight that the river moves only 2 feet (0 @.@ 61 m) a minute . Sawgrass thrives in this river , dominates freshwater marshes and sloughs , and is the main characteristic of the region .

Severe weather , in the form of tropical storms and hurricanes , also affects the structure of the Everglades . Between 1871 and 2003 , 40 tropical cyclones struck the Everglades , usually every one to three years . These storms alter the coastline , flush decaying vegetation from estuaries , strip weakened branches from trees , and disperse seeds , pollen , and plant material . Hurricane Donna in 1960 affected 120 square miles (310 km2) of mangrove forests by depositing marl over the roots and depriving the trees of oxygen . It also eradicated orchids , bromeliads , and other epiphytes that once flourished in the mangroves ; their reappearance may take a century or more . Donna also significantly spread buttonwood , saltwort , and glasswort , and epiphytes began to grow in new areas . Although the lasting effects remain to be seen , Hurricane Andrew in 1992 also destroyed mangrove forests and snapped slash pines in half . However , regrowth occurred quickly , and sand deposited by the storm surge improved nesting conditions for crocodiles and sea turtles .

= = = Geology = = =

A vast marshland could only have been formed due to the underlying rock formations in southern Florida . The floor of the Everglades formed between 25 million and 2 million years ago when the Florida peninsula was a shallow sea floor . The peninsula has been covered by sea water at least seven times since the earliest bedrock formation . The rock that makes up the Everglades floor was created as layers of calcium carbonate were compressed by ocean water , making limestone . Fossilized bryozoans and tiny shells , or ooids , make the limestone porous . Water is stored in the rock , sometimes from one year to the next . The length of time that a region in the Everglades remains flooded , called a hydroperiod , determines what particular soils and vegetation are present .

Shorter hydroperiods of three or four months promote the growth of periphyton : algae and other microscopic organisms covered with calcium carbonate crystals . Periphyton is the basic building block of marl , a calcitic mud . In areas with hydroperiods of longer than nine months , peat builds up over hundreds or thousands of years due to many generations of decaying plant matter . Peat and marl are considered nutrient @-@ poor soils that foster the growth of specialized vegetation depending on the length of the regional hydroperiod .

Five types of peat appear in the Everglades system ; each type supports a specific type of vegetation , such as sawgrass , tree islands , or custard apple trees . Peat buildup is possible because water prevents oxygen from quickly decomposing plant matter . Once peat buildup reaches the surface , oxygen reacts with the microorganisms to decay the peat rapidly in a process called subsidence . Initial attempts at developing agriculture near Lake Okeechobee were successful , but the nutrients in the peat quickly deteriorated by drying , and were broken down by bacteria in the soil . The dried peat burned or was degraded into carbon dioxide and water by microorganisms . Some homes built near early farms had to restructure their foundations on stilts as the peat deteriorated ; other areas lost approximately 8 feet (2 @.@ 4 m) of soil depth . Between the 1880s and 2005 , an estimated 3 @.@ 4 billion metric tons of soil has been lost in the Everglades due to oxidation . Most of that loss occurs in the Everglades Agricultural Area ; the least amount of loss is found in Everglades National Park .

= = = Fire = = =

Fire is another important element in the maintenance of the Everglades . The majority are caused by lightning strikes from thunderstorms during the wet season . Their effects are largely superficial , and serve to foster further plant growth : sawgrass will burn above water , but the roots are preserved . Fire in the sawgrass marshes serves to keep out larger bushes and trees , and releases nutrients from decaying plant matter more efficiently than decomposition . Large burned areas also affect waterflow , since wind and water are undeterred by the eradicated sawgrass ; water may flow two to three times faster in recently burned areas . During the wet season only dead plant matter and the tips of plants are burned ; however , the effects of fire are much more significant in the dry season , as fire may be fed by organic peat and burn deeply , destroying root systems . The only impediment to the spread of fire in the Everglades is the presence of water . It takes around 225 years for one foot (0 @.@ 3 m) of peat to develop , but the peat is not as dense as it should be for the 5 @,@ 000 years of the Everglades ' existence . Scientists point to fire as the reason .

Researchers have noted that fires appear in cycles associated with those of the hydroperiods . The first cycle is the annual wet @-@ season fires that occur with rapid frequency during the summer , but are quickly extinguished . Dry @-@ season fires are rarer due to the lack of lightning , but their damage may be more pervasive . A longer fire cycle spanning ten to fourteen years coincides with similar water cycles affected by global climate conditions . Fires in this cycle may be numerous and have little effect , or rare and have catastrophic consequences . The third cycle appears in a 550 @-@ year frequency associated with severe drought . Layers of charcoal have been detected inside peat in parts of the Everglades , indicating the region endured severe fires for years at a time , although this trend seems to have abated since the last occurrence around 940 BCE .

= = Ecosystem characteristics = =

The Everglades are dominated by sawgrass in water ; this is the titular " River of Grass " popularized by Marjory Stoneman Douglas in 1947 . This river contains a wide variety of plant and animal life . An early American environmentalist named Gifford Pinchot said of the Everglades , " It is a region so different that it hardly seems to belong to the United States . It is full of the most vivid and most interesting life on land , in the air , and in the water . It is a land of strangeness , separate and apart from the common things we all know so well . "

The sawgrass grows in prairies or strands , in between channels of water in a shallow river 100 miles (160 km) long and 60 miles (97 km) wide flowing from Lake Okeechobee to Florida Bay . Some authors refer to the sawgrass and water combination as the " true Everglades " or just " the Glades " . Prior to the first drainage attempts in 1905 , the sheetflow , or the wide shallow river starting in Lake Okeechobee , occupied nearly a third of the lower Florida peninsula . Though sawgrass remains the main feature of the Everglades , other ecosystems are scattered among the marshes and prairies , and their borders are sometimes imperceptible .

= = = Sawgrass marsh = = =

Most marshes in the Everglades are dominated by the sedge known as Cladium , or sawgrass in common terminology . The sedge is a three @-@ dimensional v @-@ shaped stalk with upward @-@ pointing teeth . Sawgrass thrives in the slowly moving water , but may die if oxygen is unable to reach its roots and is particularly vulnerable to floods immediately after a fire . Some of the sawgrass can grow up to 6 feet (1 @.@ 8 m) tall , and directly south of Lake Okeechobee it has grown to 10 feet (3 @.@ 0 m) . Farther south , where the peat is not as rich , it typically grows 4 feet (1 @.@ 2 m) tall in patches , as opposed to the prairies of the upper glades . The hydroperiod for the marsh is usually nine months but can last longer . In shorter hydroperiods , marl may form instead of peat .

Where sawgrass grows densely , few animals or other plants thrive , although alligators often choose these locations for nesting . Where there is more room , periphyton grows , appearing as mats or brown sausage @-@ shaped chunks . Periphyton is predominantly algae , although over

100 different microorganisms help create it . Larval insects and amphibians are supported by periphyton ; these in turn provide food for birds , fish , and reptiles . Periphyton also absorbs calcium from the water , which creates marl where sawgrass takes root .

= = = Freshwater sloughs = = =

Sloughs are channels of free @-@ flowing water in between the sawgrass marshes . Sloughs are deeper than sawgrass marshes , about 3 feet (0 @.@ 91 m) , and may stay flooded for at least 11 months out of the year if not multiple years in a row . The peat beds that support sawgrass are slightly elevated and may begin abruptly creating ridges of grass . The borders between these systems are called " ridge @-@ and @-@ slough " landscapes . Aquatic animals such as turtles , young alligators , snakes , and fish live in sloughs and they usually feed on aquatic invertebrates , such as the Florida apple snail . Plants grow here , usually submerged or floating like bladderwort (Utricularia) , waterlily (Nymphaeaceae) , or spatterdock (Nuphar lutea) . Major sloughs in the Everglades system include the Shark River Slough draining to Florida Bay , Lostmans Slough bordering The Big Cypress , and Taylor Slough in the eastern Everglades .

= = = Wet prairie = = =

Two kinds of wet prairies thrive in the Everglades : marl and water @-@ marsh community . Wet prairies are slightly elevated like sawgrass marshes , but contain abundant plant diversity . Marl prairies are located where marl covers limestone that may protrude as pinnacles or erode into solution holes : depressions formed by the same processes that create sinkholes . Solution holes , however , do not meet the water table ; they are filled with rain water . The surface is covered only three to seven months of the year , but the water is usually just 4 inches (10 cm) deep . Marl is created by layers of periphyton loosely attached to the limestone , and forms a grey or white crumbly mud when it dries . When flooded , the marl can support a variety of water plants , and dwarf cypresses may grow for hundreds of years though not exceed 10 feet (3 @.@ 0 m) in height . Solution holes may remain flooded even when the prairies are dry , and they support aquatic invertebrates such as crayfish and snails , as well as larval amphibians which feed young wading birds . Where the predominant soil is peat , a water @-@ marsh community exists . Its hydroperiod is longer than the marl prairie , although its plants are less diverse . These regions tend to be on the border between sloughs and sawgrass marshes .

Alligators have created an ecological niche in wet prairies ; they dig at low spots with their claws and snouts and create ponds free of vegetation that remain submerged throughout the dry season . Alligator holes are integral to the survival of aquatic invertebrates , turtles , fish , small mammals , and birds during extended drought periods . Alligators feed upon animals that visit the hole .

= = = Tropical hardwood hammock = = =

Islands of trees featuring dense temperate or tropical trees are called tropical hardwood hammocks . They may rise between 1 and 3 feet (0 @.@ 30 and 0 @.@ 91 m) above water level in freshwater sloughs , sawgrass prairies , or pineland . These islands illustrate the difficulty of characterizing the climate of the Everglades as tropical or subtropical . Hammocks in the northern portion of the Everglades consist of more temperate plant species , but closer to Florida Bay the trees are tropical and smaller shrubs are more prevalent . Tropical trees like the West Indian mahogany (Swietenia mahagoni) were probably spread by birds carrying seeds from the West Indies .

These hammocks form on slightly elevated areas unharmed by deep peat fires or limestone plateaus rising several inches above the surrounding peat . Hardwood hammocks exhibit a mixture of subtropical and hardwood trees that grow in very dense clumps , such as southern live oak (Quercus virginiana) , gumbo limbo (Bursera simaruba) , royal palm (Roystonea) , and willow bustic (Dipholis salicifolia) . Near the bases of hammocks sharp saw palmettos (Serenoa repens)

flourish , making the hammocks very difficult to penetrate . Water in sloughs flow around the islands creating moats . Though some ecosystems are maintained and promoted by fire , hammocks may take decades or centuries to recover ; the moats are therefore essential for protection . Islands vary in size , but most range between 1 and 10 acres (0 @.@ 40 and 4 @.@ 05 ha) ; the water slowly flowing around them limits their size and gives them a teardrop appearance from above . The height of the trees is limited by factors such as frost , lightning , and wind : the majority of trees in hammocks grow no higher than 55 feet (17 m) .

Florida strangler figs (Ficus aurea) are common in hammocks , and find particular ease in rooting at the heads of cabbage palms (Sabal palmetto) . After taking root into the ground , they build complex frameworks around the host tree , eventually squeezing out light and nutrients , and essentially taking its place . A variety of invertebrates including beetles , ants , spiders , and tree snails support a food chain that includes frogs , owls and other birds of prey , snakes , rodents , bobcats , and raccoons . There are more than 50 varieties of tree snails in the Everglades ; the color patterns and designs unique to single islands may be a result of the isolation of certain hammocks .

Tropical hardwood hammocks in the Everglades have been harvested for lumber , particularly by shipbuilders seeking West Indian mahogany and black ironwood (Krugiodendron ferreum) . The largest and most mature of these trees had been removed by the late 18th century . Seminoles made their villages in hammocks in the late 19th and early 20th centuries ; they lived in groups of chickees numbering half a dozen , with one central chickee for cooking and another for eating . Dugout canoes , cookware , stills , and sewing machines may still be found in remote locations .

= = = = Bayheads and willowheads = = = =

Some hammocks are dominated by types of vegetation that grow in relation to the amount of water or type of soil present . The majority of hardwood hammocks create a thin poor soil covering the limestone called humus , made of decaying plant matter and moisture trapped by the structure of the trees . When peat forms the layer atop the limestone of a tree island , bayheads develop , dominated by bay trees such as sweetbay magnolia (Magnolia virginiana) and others like swamp holly (Ilex decidua) , wax myrtle (Myrica cerifera) , and cocoplum (Chrysobalanus icaco) . Willowheads , dominated by willow trees (Salix caroliniana) , take hold where the hydroperiod is long , usually around solution or alligator holes , and may surround the holes , giving them a donut appearance from above .

= = Flatwoods and the Atlantic Coastal Ridge = =

The prairies and sloughs of the Everglades system are bordered by two areas of poorly drained sandy soil on both sides of Lake Okeechobee : the Eastern Flatwoods and the Western Flatwoods just north of Big Cypress Swamp . The predominant ecosystem in the Flatwoods is pine forest , but there are also cypress swamps and sloughs in the Eastern Flatwoods . Along the eastern border of the Everglades is the Atlantic Coastal Ridge , rising 20 feet (6 @.@ 1 m) in elevation , and curving to the southwest , gradually decreasing in elevation until it meets Taylor Slough . The Coastal Ridge prevents Everglades water from flowing into the Atlantic Ocean to the east , directing it southwesterly into Florida Bay . The South Florida metropolitan area is located on a portion of the Atlantic Coastal Ridge , and much of the landscape has changed drastically within the past 100 years as a result of urban growth .

= = = Pine rockland = = =

Pine rocklands (also called pinelands) are found on uneven limestone substrates that contain pinnacles and solution holes . There are three primary locations of pine rocklands : the Miami Ridge , which runs from Miami into Long Pine Key near the main entrance of Everglades National Park ; the lower Florida Keys ; and the Big Cypress Swamp . The most significant feature of the pine rockland ecosystem is the South Florida slash pine (Pinus elliotti var densa ; also called Dade

County pine) that reaches a height of 22 feet (6 @.@ 7 m) . Pine rockland communities require fire for maintenance ; they have adapted to promote and resist fire at the same time . These communities are located in the highest part of the Everglades with little to no hydroperiod , although some floors may have flooded solution holes or puddles for a few months at a time . The sandy floor of the pine rocklands is covered with dry pine needles that are highly flammable . South Florida slash pines are insulated by their bark to protect them from heat . Fire eliminates competing vegetation on the forest floor , and opens pine cones to germinate seeds . A period without significant fire can turn pineland into hardwood hammock as larger trees overtake the slash pines . The understory shrubs in pine rocklands include fire @-@ resistant species like saw palmetto (Serenoa repens) , cabbage palm (Sabal palmetto) , and West Indian lilac (Tetrazygia bicolor) . The most diverse group of plants in the pine community are herbs , of which two dozen species exist . These plants contain tubers and other mechanisms allowing for quick sprouts after charring .

Wildlife in pine rockland communities is diverse . In some forests , 15 species of birds can be found . Common among them are the pine warbler (Dendroica pinus) , the red @-@ bellied woodpecker (Melanerpes carolinus) , and the eastern meadowlark (Sturnella magna) . More than 20 species of reptiles and amphibians have been noted , such as the green anole (Anolis carolinensis) , southern leopard frog (Rana sphenocephala) , and southern black racer (Coluber constrictor priapus) . Mammals such as the critically endangered Florida panther (Puma concolor coryi) , Florida black bear (Ursus americanus floridanus) , and several types of bats also live in the pine rocklands .

Before urban development of the South Florida region , pine rocklands covered around 161 @,@ 660 acres (654 @.@ 2 km2) in Miami @-@ Dade County . Pine forests were extensively cleared by urban developers and the lumber industry in the 1930s and 1940s . Within Everglades National Park , 19 @,@ 840 acres (80 @.@ 3 km2) of pine rockland communities are protected , but outside the park , 1 @,@ 780 acres (7 @.@ 2 km2) of pine forests remain as of 1990 , averaging 12 @.@ 1 acres (0 @.@ 049 km2) in size . Dade County pine has a remarkable longevity and has proven to be termite @-@ resistant , though dense enough to make driving nails difficult . In 1984 they were protected by a county ordinance , after many pine areas had been depleted . A misunderstanding of fire 's role also played a part in the disappearance of pine forests , as natural fires were put out and pine rocklands transitioned into hardwood hammocks . Today prescribed fires occur in Everglades National Park in pine rocklands every three to seven years .

= = The Big Cypress = =

West of the sawgrass prairies and sloughs lies the Big Cypress Swamp , commonly called " The Big Cypress " , referring to its size rather than the height or diameter of its trees . It takes up the majority of Collier County ; at its most limited measurement , the swamp measures 1 @,@ 200 square miles (3 @,@ 100 km2) , but its hydrological boundary is nearly twice as large . The Big Cypress is slightly elevated at 22 feet (6 @.@ 7 m) at its highest point and slopes gradually to the coastline for approximately 35 miles (56 km) . Because the defining feature of The Big Cypress is the abundance of trees it is considered a swamp , rather than a marsh where grass is the main characteristic .

The basin for The Big Cypress receives on average 55 inches (140 cm) of water in the rainy season . Most of The Big Cypress sits atop a bedrock covered by a thin layer of limestone that contains quartz , creating a sandy soil that hosts a variety of vegetation . The majority of trees are bald cypress (Taxodium distichum) and not true cypresses (Cupressaceae) . Cypresses are conifers that are uniquely adapted to thrive in flooded conditions , with buttressed trunks and root projections that protrude out of the water , called " knees " .

Cypress trees in the area can live for hundreds of years ; some giants grow to 130 feet (40 m) and are 500 years old . Still , they may be only seventh- or eighth @-@ generation cypresses . Few massive trees survived the logging operations that took place in the 1930s and 1940s . As a result , much of The Big Cypress is protected by various federal or state agencies that include Big Cypress National Preserve , Corkscrew Swamp Sanctuary , Fakahatchee Strand State Preserve and two Indian reservations .

= = = Cypress head = = =

Although The Big Cypress is the largest growth of cypress swamps in South Florida , such swamps ? as well as portions of sawgrass marshes ? can be found near the Atlantic Coastal Ridge and between Lake Okeechobee and the Eastern flatwoods . Hardwood hammocks and pineland are often interspersed with the cypress ecosystem . Much like tree islands that are colloquially referred to as " heads " , cypress trees grow in formations that resemble domes , with the tallest and thickest trunks in the center , rooted in the deepest peat . As the peat thins out , cypresses continue to grow , but are smaller and thinner , giving the small forest the appearance of a dome . They also grow in strands , slightly elevated on a plateau of limestone and surrounded on two sides by sloughs . Other hardwood trees can be found in cypress domes , such as red maple (Acer rubrum) , swamp bay (Persea palustris) , and pop ash (Fraxinus caroliniana) . If cypresses are removed , hardwoods take over , and the ecosystem is recategorized as a mixed swamp forest .

Because the cypress domes and strands retain moisture and block out much of the sunlight , plants such as orchids , bromeliads , and ferns thrive in cypress domes and strands . Orchids bloom throughout the year in cypress heads , and bromeliads appear in many varieties ; on Fakahatchee Strand alone , thirteen species have been documented . Bromeliads collect moisture from rain and humidity in the bases of their leaves , which also nurture frogs , lizards and various insects . Wood storks (Mycteria americana) nest almost exclusively in cypress forests and in the past 100 years have seen a dramatic decline , probably due to lack of reproduction tied to controlled water . Wood storks ' reproductive cycles coincide with the dry season , when small fish and amphibians are trapped in shallow pools and puddles . When water from canals or locks is released too soon or not at all , storks are unable to find enough food for themselves and their offspring . An estimated 20 @,@ 000 wood storks nested in The Big Cypress in the 1930s , but by the 1990s less than 2 @,@ 000 were counted .

= = Mangroves and coastal prairie = =

Water from Lake Okeechobee and The Big Cypress eventually flows to the ocean . At a transitional zone where fresh water meets salt water , mangrove trees thrive , adapted as they are to both kinds of water . This brackish mixture of water and mangrove systems , crisscrossed by hundreds of tidal creeks , harbors a very productive ecosystem . The depth of these zones is dependent on how much water flows from the Everglades . In the wet season , fresh water pours into Florida Bay and sawgrass appears near the coastline . In dryer years , salt water creeps inland to the coastal prairie , an ecosystem that buffers the freshwater marshes by absorbing sea water . Mangrove trees grow in fresh water ecosystems when the salt water flows far enough inland . The Everglades have the most extensive contiguous system of mangroves in the world . The mangrove forests of the Ten Thousand Islands cover almost 200 @,@ 000 acres (810 km2) .

= = = Mangroves = = =

Three species of mangrove trees exist in the region : red (Rhizophora mangle) , black (Avicennia germinans) , and white (Laguncularia racemosa) , although all are from different families . All have the same characteristics : they are tolerant of salt , brackish , and fresh water ; they grow in oxygen @-@ poor soil ; and they can survive drastic water @-@ level changes . Black and white mangroves excrete salt from under their leaves , and red mangroves filter the salinity of sea water . All species are integral to coastline protection during severe storms . Red mangroves , for example , have far @-@ reaching roots that trap sediments . The trees not only stabilize coastlines , but add land as more sand and decaying vegetation is trapped in the root systems . All three mangroves also absorb the energy of waves and storm surges .

The estuaries act as fisheries for fry and nurseries for crustaceans . Shrimp , oysters , crabs , whelks , cockles , and snails thrive in these waters , as do primordial horseshoe crabs (Limulus

polyphemus) . The region supports a $ 59 million @-@ a @-@ year Tortugas pink shrimp (Farfantepenaeus duorarum) industry , and a $ 22 million @-@ a @-@ year stone crab (Menippe mercenaria) industry . Between 80 and 90 percent of species that are harvested commercially in Florida are born or spend time in the shallow waters near the Everglades . Oysters and mangroves work in tandem to build up the coastline . The sand around the coastline has minute white particles of quartz and fine shells . When currents are right , oysters grow in colonies or beds , and deposit their shells , reinforcing the bed . Mangrove seeds , called propagules , are full embryos and float in water until they reach a favorable location and take root , often on oyster beds . They shed skin and litter , ensuring other trees will not compete for space and nutrients .

Mangroves also serve as excellent rookeries for birds . Wading birds , such as roseate spoonbills (Platalea ajaja) , egrets , and tricolored herons (Egretta tricolor) use the mangroves as a nursery , due to the proximity of food sources and the protection offered from most prey . Thousands of birds can nest in the mangroves at once , making a noisy and messy colony , but their droppings fertilize the mangrove trees . Shorebirds like rails , terns and gulls ; diving birds such as pelicans and grebes ; and birds of prey such as ospreys , hawks and vultures are among the more than 100 species of birds that use Everglades mangrove trees to raise their young .

= = Florida Bay = =

Because much of the coast and inner estuaries are built by mangroves ? and there is no border between the coastal marshes and the bay ? the ecosystems in Florida Bay are considered part of the Everglades . More than 800 square miles (2 @,@ 100 km2) of Florida Bay is protected by Everglades National Park , representing the largest body of water in the park boundaries . There are approximately one hundred keys in Florida Bay , many of which are mangrove forests . Larger islands may be taken over by hardwood hammocks . The outer rims of the Ten Thousand Islands and Cape Sable share characteristics of the intertwining saltwater bays and fresh water marshes .

The fresh water entering Florida Bay from the Everglades creates ideal conditions for vast beds of turtle grass and algae formations that foster animal life in the bay . Sea turtles and manatees (Trichechus manatus latirostris) eat the grass , while invertebrates such as worms , clams , and other mollusks consume algae formations and microscopic plankton . Female sea turtles return annually to nest on the shore , and manatees spend the winter months in the warmer water of the bay . The Calusa Indians had various uses for shells of marine invertebrates , due to the lack of dense rock with which to make tools . They used the horse conch (Pleuroploca gigantea) , left @-@ handed whelk (Busycon contrarium) , and the Florida crown conch (Melongena corona) as drinking vessels , picks , hammers , knives and awls .

Sea grasses stabilize sea beds and protect shorelines from erosion by absorbing energy from waves . Shrimp , spiny lobsters , and sea urchins live in and among the grasses and feed on phytoplankton ; they in turn feed larger predators such as sharks , rays , barracuda , and king mackerel (Scomberomorus cavalla) . Due to shallow water and abundant sunlight , Florida Bay hosts communities of coral reefs and sponges , although the majority of the state 's reefs are closer to the Florida Keys . Everglades keys that foster mangroves also support nurseries for wading birds such as the Great white heron (Ardea herodias) , which was almost wiped out in the Labor Day Hurricane of 1935 (only 146 were counted afterward) . After recovering to number more than 2 @,@ 000 , they were further endangered by Hurricane Donna in 1960 , which decreased their numbers by 35 to 40 percent .

Sea floor patterns of Florida Bay are formed by currents and winds . However , since 1932 , sea levels have been rising at a rate of 1 foot (0 @.@ 30 m) per 100 years . Though mangroves serve to build and stabilize the coastline , seas may be rising more rapidly than the trees are able to build .

= = Biodiversity = =

Ecosystems in the Everglades have been described as both fragile and resilient . Author Michael

Grunwald wrote about the observations of the Everglades ' first American visitors : " If the Grand Canyon was a breathtaking painting , the Everglades was a complex drama , and everything in it had a role . " An estimated 11 @,@ 000 species of seed @-@ bearing plants and 400 species of land or water vertebrates live in the Everglades , but slight variations in water levels affect many organisms and reshape land formations . The health and productivity of any ecosystem relies on the number of species present : the loss of one species weakens the entire ecosystem .

For example , Florida apple snails (Pomacea paludosa) are an amphibious fresh water mollusk . They have a single gill and lung , and live on stalks of sawgrass in water depths no more than 20 inches (51 cm) . They are the primary food of the endangered Everglades snail kite (Rostrhamus sociabilis) and limpkin (Aramus guarauna) as well as the raccoon , otter , and young alligator . Apple snails lay their eggs on sawgrass stalks about 6 inches (15 cm) above the water line , and they are intolerant of being submerged for long periods of time . When the eggs hatch , young snails must enter the water quickly or face death . When water levels are too low or rise too quickly while snail eggs are developing , apple snails do not flourish , affecting the many reptiles , mammals , and birds that feed on them . With regard to the ecology of trophic dynamics , or food chains , the 174 species of invertebrates play a vital role in the Everglades . Crayfish , insects , scorpions , and other invertebrates also support a web of animals .

The group of animals most integral to the overall success of Everglades wildlife is freshwater fish . Few places in the Everglades stay submerged from one year to the next , so alligator holes and deep clefts in the limestone are vital to the survival of fish , and the animal community as a whole . Freshwater fish are the main diet of most wading birds , alligators , and otters , and require large areas of open water in order to repopulate . Young amphibians also play an important role in the food chain . Tadpoles spread quickly in isolated areas where fish do not have the time or access to reproduce in numbers necessary to support larger animals . Hundreds of species of amphibians are found in the Everglades , and their availability helps support wildlife during short hydroperiods or in remote locations .

These smaller animals support communities of larger animals , including 70 species of land birds that breed within the Everglades , and 120 water birds , of which 43 breed in the area . Many of these birds go on to migrate through the West Indies and North America . Several dozen species of mammals also thrive in the region , from tiny bats and shrews to midsize raccoons (Procyon lotor) , otters (Lontra canadensis) , opossums (Didelphis virginiana) , and foxes . The largest include white tailed deer (Odocoileus virginianus) , the Florida black bear , and the Florida panther .

Although slight changes in water level affect many species , the system as a whole also cycles and pulses with each change . Some transformations to the diversity of plant and animal life are natural , caused by fire or storms , and some are induced by humans , such as urban encroachment , the introduction of exotic species , and rapid global warming . Environmental conditions in the Everglades favor no particular species . Some species , such as snail kites and apple snails , do well in wet conditions , but wood storks and Cape Sable seaside sparrows (Ammodramus maritimus mirabilis) do well in dryer circumstances .

= = Human impact = =

= = = Development = = =

People have lived in the Everglades region for thousands of years . Within the past 100 years however , they have changed the natural landscape dramatically . Settlement of urban areas in South Florida was facilitated by large drainage projects intended to create more land . The drainage was often implemented without a full understanding of the intricacies of ecosystems and shaping processes of the Everglades . The South Florida metropolitan area grew exponentially , causing problems in ecosystems throughout the Everglades . By the 1990s , the diminishing quality of life in many of these urban areas was linked to the degraded local environment . The State of Florida and the U.S. government devised and passed a plan in 2000 to restore as much of the Everglades to pre

@-@ drainage conditions as possible . It is the costliest and most comprehensive environmental restoration project in history .

= = = Invasive species = = =

Humans have also adversely impacted the ecology of the Everglades by introducing numerous invasive species , which may prey on or compete with native species . A spectacular and particularly damaging example of this phenomenon is the recent proliferation of the Burmese python in the Everglades , as well as elsewhere in Florida . First observed in the wild in 1979 and not again until 1995 , they have increased alarmingly since 2000 . By 2011 , decreases of 87 @.@ 5 % , 94 @.@ 1 % , 98 @.@ 9 % and 99 @.@ 3 % in sightings of bobcats , white @-@ tailed deer , opossums and raccoons , respectively , were reported in park road surveys , while rabbits were no longer being seen at all .