

In addition to the species that are truly unique to Florida, there are several other species that have been found in nearby states, usually southern Georgia, but whose range is substantially restricted to Florida. This is the case for at least 6 species, and possibly others:

<i>Gymnoscirtetes morsei</i> Hebard	Morse's wingless grasshopper
<i>Gymnoscirtetes pusillus</i> Scudder	Little wingless grasshopper
<i>Hesperotettix floridensis</i> Morse	Florida purplestriped grasshopper
<i>Melanoplus furcatus</i> Scudder	Larger forktailed grasshopper
<i>Melanoplus rotundipennis</i> (Scudder)	Roundwing spurthroat grasshopper
<i>Spharagemon crepitans</i> (Saussure)	Cremitating grasshopper

It is interesting that over 90% of the species restricted to Florida (17 of 18 species) or nearly restricted to Florida (5 of 6 species) are in the subfamily Cyrtacanthacridinae, and that most of these are in the genus *Melanoplus*. This genus seems to be prone to speciation, and throughout North America there are species of *Melanoplus* with limited geographic distribution. The southeastern and far western states seem to support a disproportionate number of such species, however, probably due to the type of habitat. The heavily forested southeastern states tend to have an abundance of short-winged species among the precinctive species. Of the 18 precinctive species, only one or two are long-winged and capable of flight. Prevailing thought on the evolution of wing length suggests that grasshoppers occupying open habitats such as grasslands (campestral species) make effective use of long wings, whereas those dwelling in woods and thick underbrush (sylvan species) obtain little advantage from flight, and tend to have short wings. Thus, forested habitat leads to reduced flight, which leads to reduced genetic interchange, resulting in enhanced speciation.

The trend toward frequent speciation among short-winged grasshoppers in Florida may be reinforced by the occurrence of "biological islands." Florida has some isolated plant communities associated with sandy ridges remaining from earlier times when the level of the ocean was higher. The speciation associated with these island remnants rivals the extraordinary pattern of evolution found among finches in the Galapagos Islands, a phenomenon made famous by the pioneering naturalist and evolutionary biologist Charles Darwin. This interesting pattern has not been well documented or popularized in Florida, still awaiting the attention of ambitious local biologists. See the section on "What is a Species?" for further discussion of this topic.

Grasshopper Habitats

There are few habitats in Florida that do not support grasshopper populations. The general rule is that if low-growing plants are present, grasshoppers can be found feeding on them. We are aware of only two habitat types where it is difficult to find grasshoppers. The first is mature, dense forest, especially pine plantations and tropical hardwood forests. In such habitat virtually no light reaches the soil, and there is no understory vegetation on which grasshoppers can feed. This does not mean that grasshoppers are totally absent, because small breaks in the canopy are inevitable, and grasshoppers locate and inhabit these areas where low-growing vegetation exists. Also, some grasshopper species feed on pine or broadleaf tree foliage, but these are not numerous and are difficult to observe.

The other habitat where grasshoppers are rare is swamps, both mangrove swamps and freshwater swamps. Although strong fliers such as the *Schistocerca* species may sometimes be observed within mangroves, they are infrequent. Mangroves inhabit coastal areas, where their roots usually are immersed in water, usually salt water. Freshwater swamps are often associated with rivers, which provide seasonal flooding. Flooding makes swamps inhospitable to grasshoppers, nearly all of which deposit eggs in soil.

The ecosystems of Florida are extremely diverse, and have been classified in several ways depending on the authors assessment of the significance of soil, plant communities, water relations, topography, etc. Some ecosystems represent very small areas of Florida, or differ only slightly from related ecosystems. We present here a synopsis of the principal natural terrestrial ecosystems in Florida, followed by some widespread artificial ecosystems, and a discussion of their suitability for grasshoppers:

1. Upland Ecosystems



Pine flatwoods

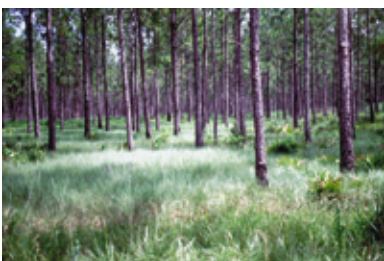
Pine Flatwoods. This is the most extensive of the terrestrial ecosystems in Florida. It is characterized by low, flat topography and poorly drained, acidic, sandy soil. Pine flatwoods are open forests of longleaf or slash pine, with an understory of saw palmetto, gallberry, runner oak, wiregrass, and other forbs and grasses. The pine flatwoods ecosystem is maintained by frequent fire. This habitat is moderately suitable for grasshoppers, depending on the density of understory vegetation, especially palmetto, which may crowd out plants more suitable for grasshopper food.

Dry Prairie. Dry prairies are similar to pine flatwoods, except that the pine overstory is absent. This ecosystem historically was maintained by fire. The plant density apparently is higher now than in pre-settlement times, probably because uncontrolled fires are less frequent. This habitat ranges from moderately suitable to very suitable for grasshoppers. Suitability is directly related to grass and forbs density, because saw palmetto and the other shrubs found in this ecosystem are not very suitable food sources for most grasshoppers.

Scrub. Scrub is an extremely xeric community with dense vegetation. Typically it consists of scrub oaks and rosemary, with or without a pine overstory, growing on well-drained, sandy, infertile soil. Plant density can be quite high. Dominant species often include sand pine, sand live oak, myrtle oak, Chapman's oak, saw and scrub palmetto, and rosemary. The ground cover consists of litter and lichens on bare soil, and the condition is maintained by infrequent fire. Scrub areas are fairly limited in scope. The largest areas are in the vicinity of Ocala National Forest and in the area just north of Lake Okeechobee, but small areas exist throughout the state, especially along the central east coast and the coastal area of the Panhandle region. Grasshopper density tends to be low in scrub areas, but some of the more interesting and rare species occur in this habitat.



Scrub habitat



*High pine habitats. Top: sandhill.
Bottom: cutthroat seep.*

High Pine. This is an open ecosystem, with longleaf pines providing a fairly open canopy and the soil covered with perennial grasses, commonly wiregrass. High pine areas have well-drained soil and may support oaks, especially turkey oak, at various densities. High pine areas are common throughout northern and central Florida south to about Sebring, near Lake Okeechobee. This ecosystem is maintained by frequent but low intensity fire. High pine habitats support moderate to high densities of grasshoppers because wiregrass and other abundant grasses and forbs are good hosts for many grasshopper species. High pine is also called **sandhill** habitat (top left), which is equally descriptive terminology. Associated with high pine, and to a lesser degree scrub habitat, are relatively small areas with poor drainage that are called **cutthroat seeps** (bottom left). Seeps are characterized by open slash pine forest with a thick understory of grass, including cutthroat grass.



Temperate hardwood

Temperate Hardwood. In Florida, hardwood forests are called “hammocks.” Temperate hardwood forests are located principally along the northern border of Florida in the Panhandle region, and the northwestern region of peninsular Florida south to about Tampa. This ecosystem is highly diverse, with numerous species of trees sharing dominance at any location, and dominance varying among locations. Oaks, southern magnolia, black cherry, dogwood, black gum, sweetgum, pignut hickory and mockernut hickory usually dominate, but pines also may be present. Mature hardwood forest shades out grasses and most other suitable grasshopper food, so densities of these insects tend to be low.

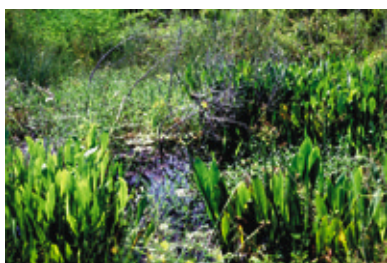
South Florida Rockland. The elevated areas of southern Florida are usually associated with outcroppings of limestone. The soils are organic and only slightly acid. This represents a small area of Florida. Most of this ecosystem between Miami and Homestead, and in the Florida Keys, has been converted to residential or agricultural uses. There are two rather distinct habitats found within this ecosystem: tropical broadleaf hammock and pineland. **Tropical broadleaf hammock** is dominated by evergreen or semievergreen tropical broadleaf trees such as gumbo limbo, pigeon plum, wild tamarind, strangler fig, and live oak. Vines, small trees and shrubs are common, but due to the dense foliage there are few low-growing plants and few grasshoppers. The other habitat is **pineland**, or Everglades flatwoods, which has an open overstory dominated by slash pine, a few shrubs and forbs, and an abundance of grasses such as bluestem, muhly, and windmillgrass. Although low in elevation, these sites remain wet for only brief periods. Pineland is maintained by frequent fire. The pineland habitat, in contrast to the tropical broadleaf habitat, supports an abundance of grasshoppers.

2. Freshwater Wetlands

Swamps. Swamps are characterized by standing water and saturated soil for at least part of the year, and usually are found along rivers. In Florida, swamps may experience fire. Swamps are quite diverse, and difficult to characterize. They are found throughout the state, except for the southeastern region. The most common tree associated with swamps in Florida is cypress, but palms, black gum, red maple, oaks, willow, and punktree are common elements. Various shrubs, vines, epiphytes, and even insectivorous plants can be common in this habitat. Aquatic insects, but not grasshoppers, are common in this wet environment.



Swamp



Marshes

Marshes. Marshes are similar to swamps in that they tend to have standing water for part of the year, and to be dominated by emergent vegetation. However, marshes tend to lack trees and often form in low areas in the absence of rivers. Marshes are most common centrally, from Orlando south to Homestead. They are most expansive south of Lake Okeechobee, an area known as the Everglades.

The vegetative composition of marshes varies considerably. Highland marshes tend to have greater diversity, possessing maidencane, cordgrass, beakrush, saw grasses, water lily, arrowhead, and many others. At the other end of the spectrum is the Everglades, where a number of species occur, but saw grasses dominate. Marsh plants, particularly saw grass, are well adapted to fire. Marsh plants are exploited by certain species of grasshoppers, including some that seem to be well adapted for feeding on emergent grasses.

3. Coastal Ecosystems



Salt marsh

Salt Marsh. Salt marshes occur along both the Atlantic and Gulf coasts, but only in limited areas. Along the Atlantic coast they occur south to about Merritt Island, or the latitude of Orlando. Along the west coast they occur north of Tampa, especially in the Big Bend region, and intermittently west to Pensacola. East coast marshes are dominated by smooth cordgrass, whereas Gulf coast marshes contain mostly black needlerush. Salt marshes provide good habitat for a few species of grasshoppers, which can be moderately abundant.

Mangrove Swamp. Mangrove swamps tend to replace salt marshes in the southern portion of the state, although mangroves may occur along most of Florida's coast. Mangrove swamps are especially extensive in southwest Florida. The dominant plants in this habitat are red, black, and white mangroves. Regular immersion of mangrove swamps by salt water and lack of favored host plants make this environment relatively unsuitable for grasshoppers.



Mangrove swamp



*Coastal uplands. Top: beach dune.
Bottom: coastal strand.*

Coastal Uplands. Along most of Florida's seacoast can be found dynamic, shifting **beach dune** areas (top left). Inland from these are stabilized berms or **coastal strand** (bottom left). The more unstable areas are characterized by grasses such as sea oats, beach cordgrass, sand spur, panic grass, and seashore paspalum, and broadleaf plants such as beach morning glory, railroad vine, beach sunflower, and sea rocket. Slightly inland, shrubby plants such as sea grape, cabbage palm, evening primrose, prickly pear, Spanish bayonet, and wax myrtle also occur. Farther inland, other salt tolerant shrubs dominate, including saw palmetto, cabbage palm, yaupon, sea grape, lantana, and woody goldenrod. Plant density increases from the beach area inland. Grass-dominated areas often support a wide array, and moderate number, of grasshoppers. As is the case with most plant communities, however, as the density gets high and low-growing plants are shaded out, grasshopper abundance decreases.

4. Agricultural or Developed Ecosystems

Crops and Pastures. Crop and pasture habitats consist of a monoculture of introduced plants. However, both systems often have grass and broadleaf weeds interspersed among the cultivated plants. There also may be a considerable amount of bare soil present, particularly in row crops. Crop and pasture environments range from temporary to long duration. In Florida, it is often possible to grow two or even three crops annually on the same plot of ground, but perennial crops such as citrus and pasture may persist



*Above: tomato crop.
Right: citrus grove.*





*Above: citrus grove.
Right: pasture.*



relatively unchanged for a decade or more. It is difficult to generalize about the suitability of crops and pastures for grasshoppers, but often crops are not particularly good hosts. Pastures are usually slightly better, sometimes good hosts, although mostly for grass-feeding species. A key element determining the abundance of grasshoppers in crops, and to a lesser extent in pastures, is the abundance of weeds among the cultivated plants and adjacent areas. Weedy crops and pastures, and crops adjacent to abandoned cropland or weedy fence rows and irrigation ditches, tend to contain more grasshoppers.

Urbanized Land. Urbanization, whether due to construction of roads, recreation fields, or homes, has an effect on grasshoppers not unlike the aforementioned crop and pasture habitats. Grasshopper species associated with lawns, recreational fields, and roadsides often are the same grass-feeders associated with grass pastures. If broadleaf weeds are allowed to invade the grass habitats, or the grass remains unmowed all season, then additional species and higher numbers of grasshoppers develop.



Urbanized land



Fallow land

Fallow and Disturbed Land. Crops in Florida often are subject to soilborne disease and nematode problems. A common practice to alleviate these problems is to move the crop to land that has not supported crops for a period of years. Thus, there often is considerable acreage that supported crops in previous years but is currently idle. This is called fallow land. The fallow land may be plowed periodically to suppress weeds, but often is left unattended for long periods, allowing annual grasses and weeds, and eventually perennial plants, to grow. A nearly identical process occurs when land is temporarily disturbed, as when

trees are harvested, new pine plantations are established, or soil is removed for construction. This invasion of annual plants is the first stage of ecological succession. Such weedy land may develop moderate to high grasshopper population densities. Certain grasshopper species tend to exploit disturbed habitats and the weed flora associated with these sites, and many can disperse into nearby crops and cause injury.



Old field

Old Fields. Within a few years of cultivation or disturbance, if the land is not again disturbed, the early successional annual and perennial plants will be invaded by shrubs and trees. This complex mixture of vegetation, which can be moderately dense but not excessively tall or shaded, is called an old field habitat, and is a later stage of succession. This habitat often supports the most diverse assemblage of grasshopper species, and the highest density of grasshoppers, of any habitat. As the shrubs and trees mature, however, the habitat becomes less suitable for grasshoppers.