Introduction

The purpose of this guide to the grasshoppers (family Acrididae) found in Florida is to describe and portray the species in a manner that allows ready identification by the reader. It is designed for anyone interested in natural history, not just scientists and future scientists. In striving to make it "user friendly" we have attempted to minimize scientific terminology. Where it was necessary to use scientific terminology, we provide definitions and drawings to increase comprehension and ease of use. Where possible, we have used both the common, or English, name and the scientific name, for both grasshopper species and subfamilies. Most of the common names originate with Blatchley (1920) or Helfer (1972). There is nearly universal agreement on the scientific names, but not the common names. Therefore, it is really better to use the seemingly unpronounceable scientific names, because at least there is some consistency.

The body length measurements provided in the text are total maximum body length, including wings but excluding antennae and legs. Therefore, for long-winged species the measurements are taken from the front of the head to the tip of the folded wings. For short-winged species, of course, the measurements are taken from the front of the head to the tip of the abdomen. All measurements are given in millimeters (mm); if you would like to use inches, just remember that there are 25 mm to the inch.

Grasshoppers are among the largest and most plentiful of insects, yet they are poorly known. With this guide you can identify *all* the grasshopper species that inhabit Florida, and many species also found in nearby states. It appears that there are 70 species in Florida. You also can learn about their natural history, their distribution within the state, and how to collect and preserve them. It is hard to imagine another group of insects so accessible and identifiable, yet providing so exciting a challenge for collectors. To collect examples of all of Florida's grasshoppers, one must be willing to traverse the state from the Panhandle to the Lake Okeechobee area and endure the rigors of Florida's hot, humid, sandy, marshy and densely forested habitats. Because many of Florida's grasshoppers are poorly known, you can make a real contribution to the scientific study of insects by recording where these species are found, what they feed upon, and the time of the year they are abundant.

A central repository for insects and insect biology is the collection of the state insect museum, which consists of over 7 million insects:

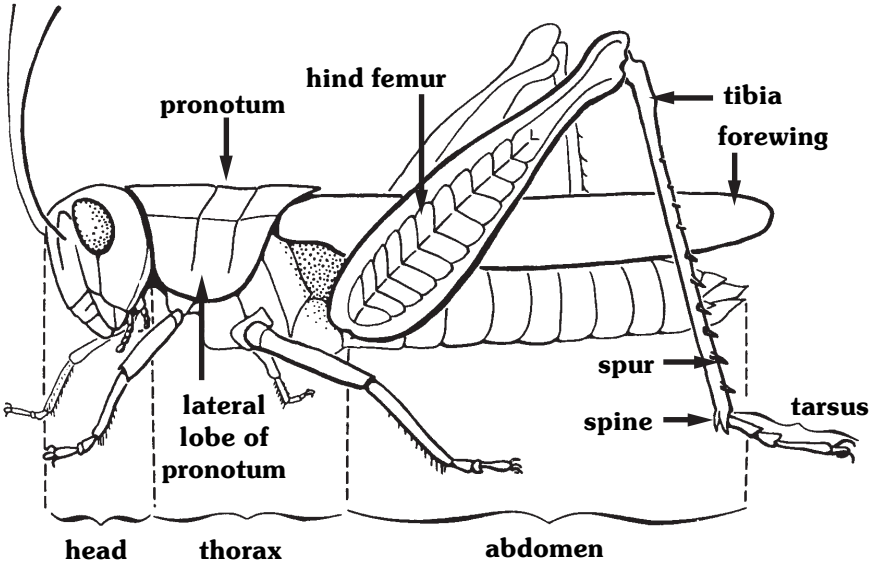
Florida State Collection of Arthropods
Florida Department of Agriculture and Consumer Services
Division of Plant Industry
1911 SW 34th Street
Gainesville, Florida 32608

What is a Grasshopper?

There are several closely related groups of insects in the order Orthoptera that are sometimes called grasshoppers. However, most entomologists and non-entomologists consider only insects in the family Acrididae to mean "grasshopper." Indeed, we consider only members of this family in our treatment of Florida grasshoppers. Acrididae are sometimes referred to as the short-horned grasshoppers, a reference to their relatively short antennae. However, other families that are sometimes thought of as grasshoppers include the Tetrigidae, or pygmy grasshoppers; the Eumastacidae, or monkey grasshoppers; the Tanaoceridae, or desert long-horned grasshoppers; the Tettigoniidae, or long-horned grasshoppers or katydids; the Gryllacrididae, or wingless long-horned grasshoppers; and perhaps other small families. Other than the acridids, only the tettigoniids are known to most people, and they are usually known as katydids or coneheads. Of the grasshoppers and their close relatives, only Acrididae and Tettigoniidae are common in Florida.

Acridid grasshoppers usually are large insects. Their antennae are relatively short, usually less than half the length of their body. Acridids may be winged or wingless, but if winged they have four wings. Wing size varies considerably. Short-winged forms are flightless, whereas long-winged forms are sometimes strong fliers. The forewings, or first pair of wings, are somewhat thickened and pigmented. They are called tegmina. The hind wings are not thickened, and may range from unpigmented to brightly colored. The hind wings often are large, fan-shaped, and fold up under the forewings when the insect is not in flight. Grasshoppers tend to have long legs. The hind legs are especially elongate and enlarged to facilitate leaping, as well as armed with spines for defense.

Grasshoppers produce sound by rubbing one part of the body against another, though the parts involved may vary. Their hearing is often aided by the presence of **tympana,** auditory organs on the sides of the first abdominal segment. Singing is performed principally by males as part of their courtship ritual.

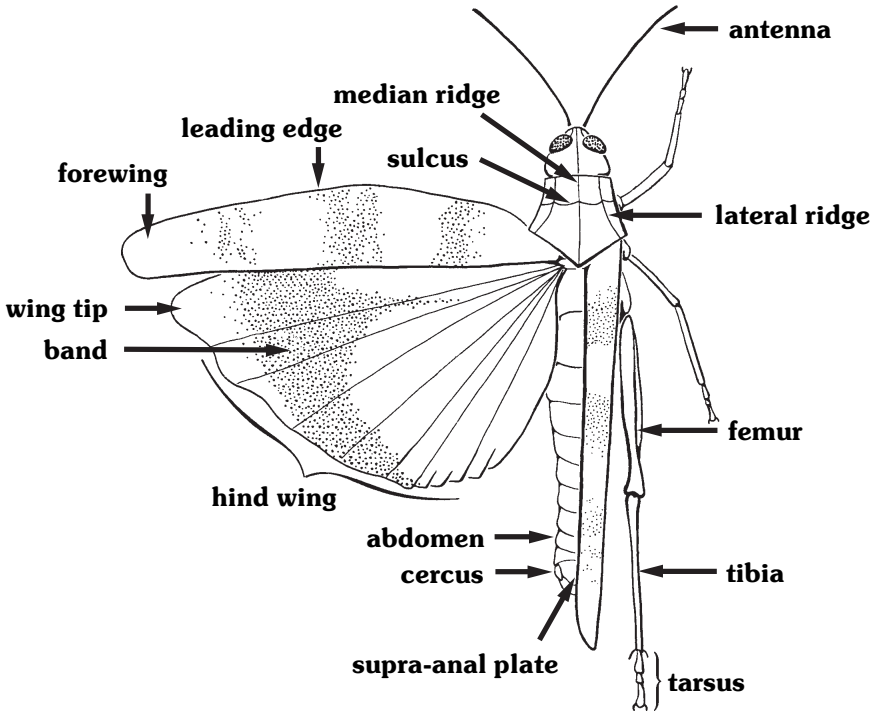


The Parts of a Grasshopper

The morphology, or appearance, of grasshoppers can seem complex, especially because of the foreign-sounding names affixed to many structures. However, one need examine only the color and shape of a few structures to accurately identify grasshoppers. It is not much more difficult than identifying birds, and often does not require great magnification. Grasshoppers can be identified with no more than a 10× hand lens, which is readily available from any hobby shop. We have attempted to simplify the identification of grasshoppers by minimizing the use of terminology and by providing a glossary and drawings of the body parts.

The grasshopper body is divided into 3 basic components: the **head,** which bears the sensory structures such as eyes, antennae, and mouthparts; the **thorax,** which bears the structures associated with movement, namely the legs and wings; and the **abdomen,** which bears the digestive and reproductive structures. A few elements associated with each of these body segments provide the key structures for grasshopper identification.

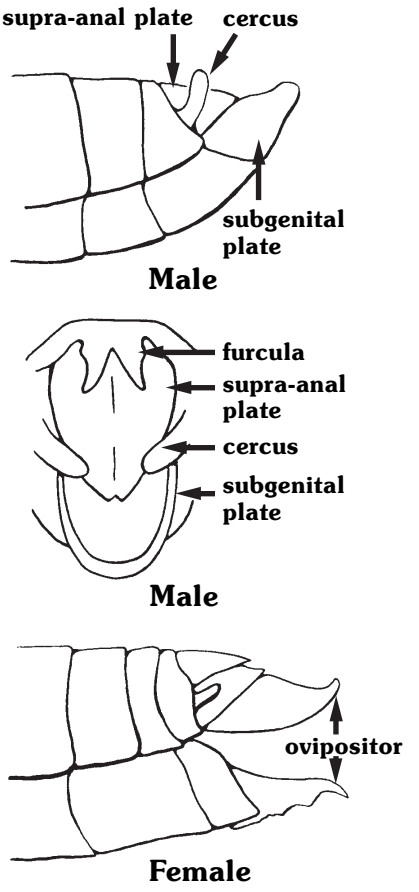
On the grasshopper **head,** the principal structures used for identification are the **antennae,** sensory structures attached to the front of the head between the eyes. Most grasshopper antennae consist of a string of small, barrel-like segments, although the individual segments are sometimes quite elongate. Some species, however, have flattened antennal segments, and many have flattened segments that are larger toward the base of the antenna and smaller toward the tip. Such antennae are said to be sword-shaped. A feature that is important in a few species is the shape of the vertical, flattened, elevated structure on the front of the head, called the **frontal ridge.**



The **thorax** consists of three segments, although this is not readily apparent because the first of the three segments, the **prothorax,** is enlarged and covers the other segments when viewed from above. The prothorax often bears longitudinal ridges, sometime called carinae. The shape of the medial or central ridge, or the paired lateral ridges, is sometimes diagnostic. The ridges may be cut by crevices, called sulci. One pair of **legs** is attached to each of the thoracic segments, with the third pair, or hind legs, enlarged. The important hind leg segments, from the perspective of identification, are the large, thickened **femur** (plural, femora) and the long, thin **tibia** (plural, tibiae). Attached to the second and third thoracic segments are the wings (if they are present). The **forewings,** also called tegmina, attach to the middle, or second, thoracic segment, and tend to be narrow, thickened and pigmented. The forewings overlay the **hind wings,** which are attached to the posterior, or third, thoracic segment. The hind wings usually are broad, thin, and transparent. The hind wings provide most of the lift used for flight, and remain folded and unseen until the insect flies. Wing length varies within some species, but is commonly used to distinguish among species. Species that inhabit open environments where flight is easy, such as pastures and marshes, usually are long-winged (macropterous). In contrast, species that inhabit dense vegetation and undergrowth, where flight is perhaps more difficult, are more likely to be short-winged (brachypterous).

The **abdomen** is the largest and hindmost component of the grasshopper body. It bears the reproductive structures terminally. In some groups, small paired appendages called **cerci** are species-specific in shape among males. Another structure that aids identification is the **furcula,** a forked organ in which only the two tips of the fork are visible, making it appear that there are two structures rather than one. In males, the furcula rests on a broad, flat, dorsal plate near the tip of the abdomen called a **supra-anal plate.** The tip of the abdomen in males is called the **subgenital plate.** It is mostly a ventral and apical structure, topped dorsally by the supra-anal plate. The shapes of both the supra-anal plate and subgenital plate sometimes have diagnostic value. Beneath the supra-anal plate of males is the aedeagus, or penis. We do not describe this structure because it is internal, and examination requires difficult manipulation of the specimen and significant magnification. However, the form of the aedeagus may be critical in sexual compatibility, and its shape is an excellent indicator of identity in some grasshoppers.

In females, the tip of the abdomen is dominated by the **ovipositor.** It consists of curved, pointed structures that open upwards and downwards. The ovipositor is inserted into the soil and used to dig a hole to prepare for egg laying. The ovipositor has great diagnostic value in distinguishing the sex, but very limited value in species identification.



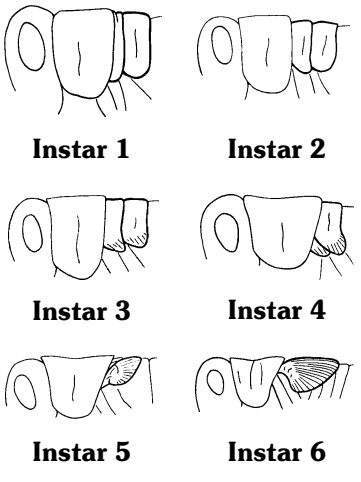
Tip of abdomen in adult male and female grasshoppers.

The Life History of Grasshoppers

The life history of grasshoppers is relatively simple, although it varies somewhat among different species. The principal stages are the egg, nymph, and adult. Grasshoppers undergo gradual **metamorphosis** (i.e., the nymph gradually changes to the adult form), in contrast to the higher insects, which undergo complete metamorphosis (i.e., there is a pupal stage between the immature and adult stages).

Adult females produce **eggs,** which are deposited in clusters, usually in the soil. Clusters of eggs are usually held together by a frothy secretion that, when dry, forms a rigid covering over the eggs. The eggs and frothy secretion are collectively known as an egg pod. A pod may contain 4 to over 100 eggs, depending on the grasshopper species. Grasshoppers typically pass winter in the egg stage. In Florida, however, many species survive the winter months in the nymphal and adult forms. This is especially true in the southern half of the state.

When a grasshopper egg hatches, the young grasshopper digs its way through the soil to the surface and molts into an active form capable of walking, hopping, and eating. The active stage between hatching and adulthood is called a **nymph.** This first active form is known as the first instar. It is followed by additional molts until it has experienced (usually) 5 or 6 instars, and is ready for its final molt to the adult form. The principal reason that insects molt, or shed their old body covering, is because the covering is not elastic and inhibits growth. Thus, each time the grasshopper nymph molts it produces a larger body covering, and the nymph gets larger and larger. As grasshopper nymphs grow the wings begin to develop, but they are not fully formed until the adult stage. Sexual structures, such as the ovipositor in females, also develop as the grasshoppers grow. These, too, are not fully formed until the adult stage.



Anterior region of grasshopper nymphs showing wing characters that are used to distinguish instars in "typical" species.

The nymphal instars can be distinguished by the shape of the wing pads. The wing pads initially are very short and broadly rounded, but become slightly elongated in instar 2. Instars 3 and 4 have more elongate, downward pointing wing pad tips, and display some weak wing veins. In instars 5 and 6 the wing pads are inverted; they point upward or back instead of downward, and only one pair of wings is visible. In grasshoppers with only five instars, the pattern is much the same, but the fourth nymphal stage is absent from the developmental sequence.

Adult grasshoppers can reproduce, and have fully formed sexual organs, some of which are visible externally. They also have fully formed wings. Many species are macropterous, or long-winged, which means that the wings extend nearly to the tip of the abdomen or beyond. Many of Florida's grasshoppers, however, are brachypterous, or short-winged, in the adult stage. Such wings are typically oval and extend only about one-third the length of the abdomen. A few species are wingless, or nearly so, in the adult stage. It can be difficult to distinguish between immatures and adults when adults can be long-winged, short-winged, and wingless! However, if you look for obvious, fully formed genitalia, and wings extending at least one-third the length of the abdomen, you will identify most adults accurately. Only in a few species are adults likely to look like immatures, and they are easily recognized from pictures.

In the **"typical" grasshopper life cycle,** eggs hatch in the spring, nymphs develop through the summer, adults mate and produce eggs in the late summer and autumn, and the winter is passed in the egg stage. How many grasshoppers conform to this scenario? In northern Florida, most species seem to conform. In southern Florida it is not uncommon to have nymphs and adults present nearly year round. Unfortunately, grasshoppers have been poorly studied in Florida, so in most cases we do not know much about seasonal development. In the case of *Schistocerca americana* we know that there are two generations annually, with adults overwintering. Clearly this is not a "typical" grasshopper, but how many other species have interesting and unusual biology? Your field observations may help us learn the biologies of other species.

The Ecological Significance of Grasshoppers

Grasshoppers often appear to be the most abundant aboveground insects. This is especially true in open, sunny, dry habitats such as prairies and pastures, but it also sometimes applies to open woods, salt marshes, and disturbed areas such as crop fields. Grasshoppers exert ecological impact and may be the dominant **herbivores,** or plant-feeders, in some communities.

Plant feeding by grasshoppers can deplete plant biomass and damage crops. It can shift plant-community structure due to differential plant preference by grasshoppers. In extreme cases, herbivory can cause ecosystem damage. This can occur directly, from disruption of habitat by loss of vegetation, or indirectly, through increased erosion caused by reduced vegetation. Such habitat damage is rare, however, especially in areas with high rainfall, such as the southeastern states.

Grasshoppers are significant due to their numbers and to their role in **nutrient cycling.** Grasshoppers consume large amounts, often eating their body weight in plant tissue daily. The consumption of plant tissue affects the relative abundance of different plant species in an area, due to selective feeding behavior by grasshoppers. Grasshoppers also hasten the degradation of cellulose and other materials by breaking up the plants into smaller pieces that can be attacked by soil flora and fauna. Grasshopper fecal material, in particular, is easily degraded, resulting in increased solubility of chemical nutrients essential for plant growth. Degradation of fecal material and clipped foliage causes rapid release of nutrients into the soil, favoring new

plant growth. Without plant feeders such as grasshoppers, much of the nutrients in an area would be bound up in dead plant tissue, insoluble, and unavailable for plant uptake. Nutrient cycling is especially important in the warm, sandy soils commonly found in Florida, because they are inherently nutrient-poor.

Grasshoppers are also ecologically significant because they convert plant tissue into large "bite-sized" units of animal material, and serve as **food** for vertebrate animals. Animal tissue is much more nutritious than plant material, especially for young and rapidly growing animals which need the high levels of protein and lipids found in grasshoppers. Grasshoppers are large enough, and abundant enough, that they attract the attention of large numbers of vertebrate animals such as reptiles, birds, skunks, raccoons, foxes, and mice, which regularly consume them. For insect-feeding birds, such as meadowlarks and cattle egrets, grasshoppers are often the principal element of the diet, and their survival and reproductive efficiency may be directly related to abundance of grasshoppers. Other species, such as kestrels and bluebirds, feed extensively on grasshoppers, but readily switch to other insects if grasshoppers are in short supply. Some birds, such as sparrows, feed heavily on vegetable matter, principally seed, but feed their young on insects almost exclusively.

Grasshoppers are large enough and abundant enough that hunting exclusively for grasshoppers is an energetically efficient activity for many bird species. Grasshoppers are 50–75% crude protein. Without grasshoppers to consume, many vertebrate animals would suffer from lack of a suitable source of animal protein. In some parts of the world, such as sub-Saharan Africa, grasshoppers are also a component of the human diet.

Many of Florida's grasshoppers contribute substantially to **biodiversity.** In fact, 18 of the grasshopper species found in Florida are **precinctive** (sometimes called **endemic** or **indigenous**) — found nowhere else in the world. The species unique to Florida are:

Eotettix palustris (Morse)	Swamp eastern grasshopper
Eotettix signatus Scudder	Handsome Florida grasshopper
Eritettix obscurus (Scudder)	Obscure slantfaced grasshopper
Hesperotettix osceola Hebard	Osceola's grasshopper
Melanoplus adelogyrus Hubbell	St. Johns' spurthroat grasshopper
Melanoplus apalachicolae Hubbell	Apalachicola spurthroat grasshopper
Melanoplus davisi (Hebard)	Davis' oak grasshopper
Melanoplus forcipatus Hubbell	Toothcercus spurthroat grasshopper
Melanoplus gurneyi Strohecker	Gurney's spurthroat grasshopper
Melanoplus indicifer Hubbell	Spinecercus spurthroat grasshopper
Melanoplus nanciae Deyrup	Ocala clawcercus grasshopper
Melanoplus ordwayae Deyrup	Trail ridge scrub grasshopper
Melanoplus puer (Scudder)	Florida least spurthroat grasshopper
Melanoplus pygmaeus Davis	Pygmy spurthroat grasshopper
Melanoplus withlacoocheensis Squitier and Deyrup	Withlacoochee grasshopper
Melanoplus symmetricus Morse	Symmetrical spurthroat grasshopper
Melanoplus tequestae Hubbell	Tequesta spurthroat grasshopper
Schistocerca ceratiola Hubbell and Walker	Rosemary grasshopper

Thus, about 25% of Florida's grasshoppers are unique to Florida. They are a rich biotic resource that is not readily available to other peoples of the world. Florida's citizens and government agencies that are concerned about biotic diversity should recognize the ecological significance of this poorly known group of animals. Unlike many other groups of insects, currently there are no **exotic** or **introduced** species among Florida's grasshoppers. Many species of grasshoppers found in Florida have a fairly wide geographic range, often the southeastern states or the entire area east of the Rocky Mountains.