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# Florida's Introduced Reptiles: Brown Anole (*Anolis sagrei*)[1]

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## Introduction

Florida has the unfortunate distinction of being the global epicenter for nonnative reptiles, due to the intentional or unintentional actions of people. The state's mild climate, abundant rainfall, expansive areas modified by humans, numerous international ports of entry (sea and air), as well as a thriving exotic pet trade all contribute to reptile invasions. Historically, the introduction of reptiles into Florida was unintentional; reptiles were stowaways in shipments of cargo. The first documented reptile introduction to Florida was that of the brown anole (*Anolis sagrei*) in the late 1800's (1). This small lizard likely arrived accidentally in a shipment of cargo originating from Cuba. Since then, more than 150 additional nonnative reptile species have been documented in Florida, the vast majority of which were brought here through the pet reptile trade (2).

Although most introductions do not result in the establishment of breeding populations of nonnative reptiles, many do. Of those species that become established, some thrive and expand, eventually becoming invasive. We define an invasive species of reptile as one that a) is not native to a specific geographic area (in this case the state of Florida), b) was introduced by the intentional or unintentional actions of humans, and c) does or can cause harm to the environment, economy, or human quality of life (3). A well-known example of an invasive reptile in Florida is the Burmese python. This large species of snake was imported for the exotic pet trade, and by way of escapes and/or purposeful releases of pets, became established in the Everglades. Scientific studies have shown invasive pythons have caused severe declines of native mammals in the Everglades (4, 5) and have introduced parasites affecting Florida's native snakes (6, 7). Further, state and federal agencies have spent millions of dollars to manage additional impacts of pythons and prevent them from expanding their range farther north in the Peninsula and south into the Florida Keys.

This publication summarizes general knowledge about the brown anole in Florida. It's one in a series of similar publications showcasing a suite of commonly seen or unique introduced reptiles that are established in the state. The biology and impacts of some of these species are well known, whereas others are poorly studied. This fact sheet and others in the series were produced by undergraduate students in the course *Invasion Ecology of Amphibians and Reptiles*, which was taught in fall semester 2020 at the University of Florida. The target audience for all the documents in the series is homeowners and other residents and visitors who are curious about Florida's diverse wildlife. Our goal is to increase knowledge and raise awareness about the many introduced and invasive reptiles in Florida, as well as to motivate people to take action in the fight to curtail the spread of introduced reptiles in the Sunshine State.

## Identifying Brown Anoles

The brown anole (pronounced uh-NOLE), also known as the Cuban brown anole, is a small lizard that grows to a total length (snout to tail tip) of 5 to 9 inches (8). The sexes differ in size, with mature females being slightly smaller than mature males. Hatchlings are about 1.5 inches long and resemble adult females in pattern (9). Brown anoles, while usually brown, can vary their shade by lightening or darkening their skin, and colors range from brown to gray to black, and some are even red or have a reddish head (Figure 1). They often have intricate patterns on their back and sides, such as stripes, triangles, spots, and dashes of lighter and darker colors (Figure 2). Females almost always have a light-colored stripe running down the middle of their back (Figure 3) and are more boldly patterned than males. Males can erect a smooth-edged crest on their neck, back, and tail (Figure 4). Males also have a bright, reddish-orange throat fan (i.e., dewlap) bordered by yellow, which they extend to signal their presence (Figure 5).



Figure 1. Brown anoles (*Anolis sagrei*), such as this individual from MacArthur Beach State Park in Palm Beach County, sometimes have reddish-colored heads.
Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 2. Brown anoles (*Anolis sagrei*), especially adult females, may be boldly patterned.
Credit: Jim Davis, UF/IFAS



Figure 3. Female brown anoles (*Anolis sagrei*) have a light-colored line down the center of their back, though it's not always as well demarcated as this individual.
Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 4. Male brown anoles (*Anolis sagrei*) may erect a dorsal crest as a territorial display. Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 5. Male brown anoles (*Anolis sagrei*) advertise their presence by extending and retracting their dewlap (i.e., throat fan). The dewlap in this species is orange with a yellow border. Adult females also have a dewlap, but it is quite small. Credit: Dr. Steve A. Johnson, UF/IFAS

## Similar-Looking Species

All of Florida's anoles have expanded toe tips with a small claw, which makes them excellent climbers, and there are several species of anoles in the state that may be confused with the brown anole. All but one of these species was introduced by people. The only native anole species in the United States is the green anole (*Anolis carolinensis*), which is sometimes mistakenly referred to as a "chameleon" because it can change color. True chameleons, which are not native to Florida, are members of an entirely different group of lizards than the anoles. As their name implies, native green anoles are often green, but they can quickly change to brown or gray. Invasive brown anoles are never green. Although green anoles may be various shades of brown or green (Figure 6), they lack the extensive markings of brown anoles. Green anoles have a longer, pointier snout than brown anoles, and males in most of the state have a pink dewlap (Figure 7). Males in southwestern Florida usually have a gray or dull-green dewlap. Female green anoles have a thin, light stripe down the center of their back (Figure 8). Another similar-looking species to the brown anole is the crested anole (*Anolis cristatellus*). The males are brown and usually have a thin, jagged crest along their backs and/or tail (Figure 9). Male crested anoles display a dewlap that is orange with a yellow center (Figure 10). Crested anoles occur mainly in Miami-Dade County. Another introduced anole species that may be confused with the brown anole is the bark anole (*Anolis distichus*). This species lacks the bold markings of the brown anole, instead having mottled light and dark patterns across the body. Males bark anoles have pale yellow to pale green dewlaps that may have a light orange spot (8) (Figure 11). This species is also much smaller than the brown anole and only occurs near the coastline in southern Florida.



Figure 6. Florida's only native anole, the green anole (*Anolis carolinensis*), can change color from green to brown and vice versa. Despite this ability, they are not true chameleons, which are an entirely different family of lizards. Although green anoles may be brown, brown anoles (*Anolis sagrei*) are never green.
Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 7. Male green anoles (*Anolis carolinensis*) in most of Florida have a pink dewlap (i.e., throat fan).
Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 8. Like female brown anoles (*Anolis sagrei*), female green anoles (*Anolis carolinensis*) also have a light-colored line down the center of their back.
Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 9. Crested anoles (*Anolis cristatellus*), another introduced species in Florida, look like brown anoles. Crested anoles get their name from the jagged-edged crest on the adult males.
Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 10. The dewlap of male crested anoles (*Anolis cristatellus*) has a yellow-colored center. This species occurs primarily in south Florida in Miami-Dade County
Credit: Dr. Steve A. Johnson, UF/IFAS



Figure 11. Male bark anoles (*Anolis distichus*), also introduced in Florida, have a whitish or light-yellow dewlap, in contrast to the bold orange dewlap of male brown anoles.
Credit: Dr. Steve A. Johnson, UF/IFAS

## Native Range

The brown anole is native to Cuba, the Bahamas, and other islands of the West Indies (10). It is not native to Florida, despite being very common.

## Mode of Introduction to Florida

The brown anole was the first introduced reptile species documented in Florida. They were accidentally introduced to Florida in Key West in the late 1800s likely as stowaways on cargo ships coming from Caribbean islands, where the species is native (1, 2). Genetic analyses indicate that brown anoles have been introduced to Florida at least eight times from various locations in their native range, and Florida is the likely source of brown anoles introduced elsewhere, such as Hawaii and Taiwan (10). Although the specific pathways for these numerous introduction events are unknown, brown anoles likely arrived unintentionally with shipments of cargo, and some appear to be escapes or intentional releases of pets (11). Additional spread in Florida is the result of local expansion of isolated populations and so-called “jump dispersal” where the lizards are accidentally moved longer distances over short periods of time while hidden in ornamental plants and vehicles (12). People also inadvertently disperse brown anoles that are sheltering in canoes and kayaks, yard debris (e.g., limbs of pruned shrubs), and other items. Brown anole eggs may be accidentally dispersed in potted plants.

## Florida Range and Habitats

Since their introduction to Key West in the late 1800s, brown anoles have expanded throughout Florida. By the early 2000s, they were documented in every county of the Peninsula (12). Based on records from the Florida Museum of Natural History and the invasive species reporting site EDDMapS, brown anoles are now established along much of the coast of the Panhandle, as well as in the area around Tallahassee (Figure 12). Brown anoles occur in a wide variety of habitats, such as hammocks and pinelands, but they are most common in areas modified by or dominated by humans. These include school yards, golf courses, vegetated areas of parking lots at gas stations, grocery stores, shopping malls, and, especially, suburban neighborhood yards. In fact, brown anoles are the most commonly encountered lizard in much of Florida. They are frequently seen on the ground and perched on tree trunks, fences, and the walls of buildings.

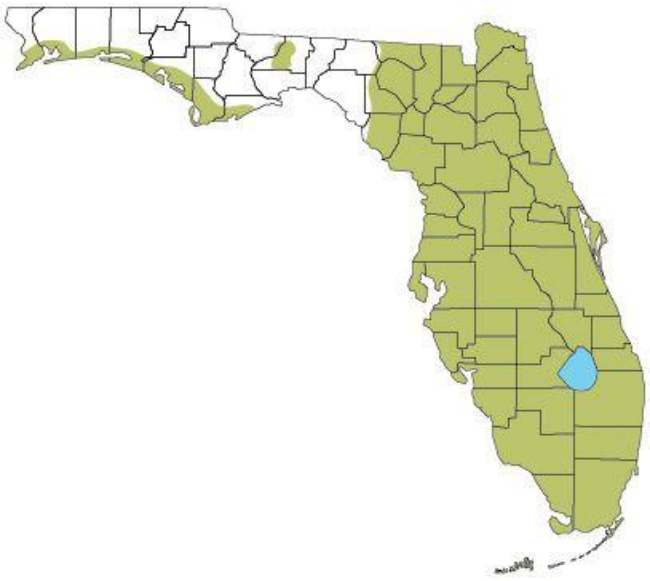


Figure 12. Brown anoles (*Anolis sagrei*) occur throughout Florida's Peninsula as well as in coastal areas and around Tallahassee in the Panhandle (see green shaded areas). Should you see a brown anole outside of the shaded areas indicated on the map, please take a digital picture of the lizard and report your observation to EDDMapS.org. Credit: Tracy Bryant, UF/IFAS

## Ecology

Among anole species, the brown anole is known as a "trunk-ground ecomorph" because it occurs mostly on the ground and lower in vegetation than many other anoles (13). Brown anoles are normally active during the day and prefer open, sunny areas. However, some are active at night, feeding on insects attracted to lights. They sleep stretched out on limbs of small trees and shrubs. They also shelter in confined places like gaps behind storm shutters and rain gutters of suburban homes. Brown anoles feed mostly on insects and other invertebrates, but they will also eat vegetation and small lizards, including their own species and the green anoles native to Florida (8, 14, 15). In Florida, brown anoles reproduce in spring and summer (16). Males advertise their territories and display to attract mates by extending and retracting their orange throat fan, bobbing their head, and doing push-ups. Like other species of anoles, female brown anoles lay one egg at a time on multiple occasions during the reproductive season—egg laying occurs every 4–6 days (17, 18, 19). The eggs have brittle shells and are hidden under leaf litter, rocks, and other debris. The incubation period of brown anole eggs depends on temperature, and eggs normally hatch in 30–45 days (8, 19). Wild brown anoles normally live less than two years (16) but can live much longer in captivity (9). Because they are small and can be very abundant, especially in suburban areas, many animals prey upon brown anoles in Florida. Their predators include larger lizards, outdoor cats, snakes (e.g., black racers, *Coluber constrictor*, and corn snakes, *Pantherophis guttatus*) and birds. It's not uncommon to see Egrets stalking brown anoles in parking lots of Florida shopping centers and other urban areas.

## Negative Ecological Effects

There is a widely held notion that when brown anoles invade an area, native green anoles completely disappear. Althoughsome scientific studies have shown or suggested declines of green anoles where brown anoles are present, none concluded that brown anoles caused the local extinction of green anoles (20, 21, 22, 23). However, where the two species co-occur, the invasive brown anole affects the behavior of the native green anole. In these situations, green anoles shift their habitat use to higher above the ground (20, 24, 25). When green anoles move to higher habitats (such as in tree canopies) they are less likely to be observed, thus giving the casual observer the impression they are gone, though they are still present.That said, if there is no tree canopy or suitable higherhabitat that green anoles can occupy, they could decline and ultimately become locally extinct. Thereare two likely reasons green anoles move to higher habitat locations when brown anoles invade: a) they are avoiding competing for food with brown anoles, and b) the brown anoles are aggressively driving them upward (20). In addition to harm to green anoles from competition and

aggression, brown anoles are documented predators of green anoles. In fact, in a controlled experiment, adult brown anoles were much more likely to eat juvenile native green anoles than adult green anoles were to eat juvenile brown anoles (26). Because they can occur in very high densities, it's also possible that brown anoles compete for food with other native Florida wildlife. Additional research may identify other negative, indirect impacts on natural ecosystems by brown anoles.

## Impacts to People and Pets

There are no known direct hazards to people caused by brown anoles, but they can be a nuisance. Because they are small and are accomplished climbers, they can invade homes, storage sheds, garages, screened rooms, etc. This can be unsettling for someone who is afraid of reptiles. Once inside, they are difficult to capture because they are quick and can escape into confined spaces. Once captured, they can be handled without risk of injury to the captor, but they may deliver a noticeable bite. Domesticated cats are skilled hunters and often capture brown anoles. While these lizards are not toxic and unlikely to cause much of an adverse reaction, there is potential to cause your pet to vomit or have an upset stomach. Additionally, most people do not enjoy finding a partially eaten lizard carcass on the floor (Figure 13), or, even worse, a bedroom pillow.



Figure 13. Domestic cats are efficient predators, and brown anoles (*Anolis sagrei*) are enticing prey.
Credit: Dr. Steve A. Johnson, UF/IFAS

## You can help!

Because brown anoles are so widespread and abundant, there is little chance they can be eradicated from Florida. However, efforts can be made to slow future spread, especially in the Panhandle and beyond. For example, you can inspect ornamental plants before transporting them and remove any brown anoles. Also, you can thoroughly examine confined spaces and storage compartments of canoes, kayaks, and other boats to prevent transporting brown anoles into Florida's natural areas such as state parks. You can create a wildlife-friendly yard with a diversity of appropriate plants that provide food and shelter for native wildlife. To make your yard more suitable for native green anoles, ensure it has areas of dense vegetation to increase availability of invertebrate food sources and hiding places for hatchling native green anoles. Also, maintain or plant trees to provide vertical habitat and canopy for green anoles to occupy when brown anoles are present. Although they are difficult to catch, hand-capture and euthanasia of brown anoles is another way to help keep their numbers in check around your yard. To humanely euthanize a brown anole, place it in a sealable container or plastic bag, put that in a refrigerator for 2–3 hours, and then transfer it to the freezer for 24 hours. Chilling physically anesthetizes the lizard, and freezing ensures a humane death. Dispose of euthanized lizards in the trash (if sealed in a bag) or just remove the lizard from the container and toss it your yard to decay naturally. And finally, if you observe a brown anole in Florida's Panhandle outside of the area shown on the map in Figure 12, take a digital image of it and report your observation at EDDMapS.org. iNaturalist is also a good place to report brown anole observations.

## Additional Information

The Texas Invasive Species Institute has a fact sheet on the brown anole found here:
http://www.tsusinvasives.org/home/database/anolis-sagrei

The University of Florida has a helpful document for non-native reptile identification:
https://edis.ifas.ufl.edu/uw336

*Field Identification Guide for the Anole Lizards of Miami* by Kolbe, Feeley, Battles, and Stroud is a great reference for the six most common species of anole lizards in south Florida. Use the guide title to search the internet for a copy.

EDDMapS.org and iNaturalist.org are great places to report observations of brown anoles. Both sites have a feature that allows the user to view a map of previously reported sightings.

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