



ANTHONY FLAMMIGN

An adult male Green Iguana (*Iguana iguana*) basking on a dock in Hollywood, Broward County, Florida.

Distribution, Natural History, and Impacts of the Introduced Green Iguana (*Iguana iguana*) in Florida

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Abstract.—In this article, we document the geographic distribution, reproduction, potential ecological impacts, and nuisance value of the non-native Green Iguana (*Iguana iguana*) in Florida. We further provide management recommendations for control of this species in Florida. Locality records of *I. iguana* were obtained via the literature and both photographic and specimen vouchers, and also from the field, where specimens were collected and observations made from May 1992 through December 2006. We compiled 3,169 records of *I. iguana* in Florida. *Iguana iguana* was first reported (but not breeding) in Florida in 1966 from Miami-Dade County; however, it is now reproducing and established in much of southern Florida, including many Florida Keys. We observed *I. iguana* mating as early as December and as late as April. Ovipositioning usually takes place in sandy areas. Females were found to have vitellogenic follicles in November, December, and February; carried oviducal eggs between February and April; and we found a single clutch of 41 eggs that was oviposited in April. Neonates were observed from May through August. *Iguana iguana* feeds on a variety of vegetation, as well as insects, tree snails, and possibly small mammals. This species causes considerable damage to landscape vegetation and often is considered a nuisance by land managers and property owners. Burrowing by Green Iguanas causes erosion and undermines sidewalks, foundations, seawalls, berms, and canal banks. They also force vehicular traffic to brake; deposit unsightly and unhygienic defecations on moored boats, seawalls, docks, porches, decks, pool platforms, and inside swimming pools; potentially act as seed dispersers for invasive plant species; and may transmit *Salmonella* to humans. A number of steps can be taken by Florida landowners to help control *I. iguana* in the state: First, vegetation selected for landscaping should lack the showy flowers and colorful fruits that are eaten preferentially by iguanas. Second, trapping and removing live lizards can be undertaken using live traps (e.g., Havahart, Tomahawk), snare traps, and nooses. Third, artificial nesting sites can be easily constructed and monitored during the reproductive season so that iguana eggs can be removed and destroyed. Finally, before purchasing pet iguanas, prospective owners should be educated on the life history details (e.g., large adult size, potential to inflict painful wounds, etc.) and complex husbandry requirements of this lizard, and be made aware that releasing this or any other non-native animal into the wild is illegal in Florida.

Introduction

The Green Iguana, *Iguana iguana* (Linnaeus 1758), was first reported in the 1960s in Florida as occurring, but not breeding, on the southeastern coast from Hialeah, Coral Gables, and Key Biscayne in Miami-Dade County. Over the next few decades, many residents enjoyed watching these large exotic lizards, allowing them to roam unmolested on their properties, and at times even feeding them. By the mid-1990s, however, many residents' attitudes changed as iguana populations exploded, often becoming a nuisance to humans and having a negative impact on the environment. Although many authors have documented the occurrence of *I. iguana* populations in Florida, none fully illustrate this species' expansive geographic distribution or remark on its potential effects. Herein, we document the current geographic distribution using voucher specimens and field observations, potential ecological impacts, and nuisance value of this non-native species in Florida.

Materials and Methods

Locality records of *Iguana iguana* were obtained from the literature and from systematic collections throughout the United States. Fieldwork was conducted from May 1992 through December 2006; *I. iguana* were collected by hand, noosing, and shooting small tapered corks from a blowgun (for neonates only). In addition, photographs were taken and used as vouchers. Specimens were deposited in East Tennessee State University (ETMNH), Indiana State University Vertebrate Collection (ISUVC), Florida Museum of Natural History, University of Florida (UF), United States National Museum (USNM), and Yale Peabody Museum (YPM). All records with locality data were plotted using ArcView v. 3.2 (ESRI).

Distribution and History of Introductions

The native range of *Iguana iguana* extends from southern Mexico to central Brazil and Bolivia (Lazell 1973, Savage 2002),

including the Caribbean islands of Cozumel (J.C. Seitz, pers. obs.), San Andrés and Providencia, Roatán, Utila, Swan Island, Cayo Icacos, Curaçao, St. Vincent and the Grenadines, Grenada, Îles des Saintes, Montserrat, Saba, St. Lucia, and Trinidad and Tobago (Bakhuis 1982, Murphy 1997, Schwartz and Henderson 1991). Green Iguanas have been introduced in Grand Cayman (Seidel and Franz 1994), Guadeloupe (Lever 2003), St. Martin/St. Maarten (Powell et al. 2005), Puerto Rico (Thomas 1999), Hawaii (McKeown 1996), the southern Rio Grande Valley in Texas (Meshaka et al. 2004a, Bartlett and Bartlett 2006), and Florida (Wilson and Porras 1983). The origin of the U.S. Virgin Islands population has been disputed for some time (Lazell 1973), with some authors contending that iguanas were introduced by man (see Thomas 1999).

We compiled 3,169 records of *I. iguana* from southern Florida; 1,088 of these represent preserved specimens and photographic vouchers collected between 1965 and 2006 (Appendix) and 2,081 represent field observations. The species is widely established along the Atlantic Coast in Broward, Martin, Miami-Dade, Monroe, and Palm Beach counties, and along the Gulf Coast in Collier and Lee counties. Although *I. iguana* has been found farther north in Alachua, Highlands, Hillsborough, Indian River, and St. Lucie counties, no voucher specimens exist for these scattered localities (except Alachua, UF 122514) and these individuals are unlikely to represent established populations due to low winter temperatures.

King and Krakauer (1966) recorded the first Florida voucher specimen (UF 22910, Table 1) collected in 1965 from Coral Gables, and subsequently reported *I. iguana* as an established, but non-breeding species from four separate areas in Miami-Dade County: East 7th Avenue and West 27th Street in

Hialeah, Caballero Boulevard and Hardee Road in Coral Gables, southwest corner of Miami International Airport, and Key Biscayne. More than 300 individuals were released between May and September 1964 at the Hialeah site (King and Krakauer 1966). Wilson and Porras (1983) reported *I. iguana* from the Miami Seaquarium on Virginia Key, and Butterfield et al. (1997) speculated that this species had probably been breeding in Miami since around 1980. Although *I. iguana* is occasionally observed in Everglades National Park (e.g., nine sightings in 1995–2004), a population has apparently not become established, possibly because of the presence of potential predators and competitors, and the lack of suitable nesting sites (Meshaka et al. 2000, 2004a, 2004b). *Iguana iguana* was first documented from Broward County in Davie (Townsend et al. 2002), and Palm Beach County in Loxahatchee National Wildlife Refuge and Palm Beach Gardens (Krysko et al. 2005). We photographed this species in 2006 in Port Mayaca, Martin County.

Bartlett (1980) first observed *I. iguana* in southwestern Florida in Collier County, but did not identify a specific locality. Krysko et al. (2005) documented the first voucher specimens from Collier County (collected as early as 1998) in Golden Gate. *Iguana iguana* has been established for at least a decade on Marco Island (N. Richie, pers. comm.), and in 2005 this species was observed along the mangrove fringe between Goodland and Goodland Bay (K. Laakkonen, pers. comm.), the Florida Panther National Wildlife Refuge (D. Giardina, pers. comm.), Copeland (within Fakahatchee Strand Preserve State Park), and in Naples. In Lee County, *I. iguana* has been reported from Cape Coral (Bartlett and Bartlett 1999, Krysko et al. 2005), and Bonita Springs between Williams Road and the Imperial River since about 2000 (Spinner 2005).

Duquesnel (1998) first observed *I. iguana* in the upper Florida Keys at John Pennekamp Coral Reef State Park, Key Largo. Krysko et al. (2005) documented this species in the lower Florida Keys from (east to west) Little Torch and Sugarloaf keys, and Stock Island. More recently, these findings have been augmented with voucher specimens from Key Largo, Windley Key, Big Pine Key, Vaca Key, and Key West; and with observations only from Plantation, Duck, Little Crawl, Bahia Honda, Middle Torch, Summerland, Cudjoe, Lower Sugarloaf, Big Coppitt, and Boca Chica keys.

Food Habits and Predators

Neonate and juvenile *Iguana iguana* feed on vegetation (i.e., new shoots, leaves, blossoms, and fruits) and insects such as grasshoppers (Hirth 1963). In addition to these items, adults have been reported to feed on bird eggs (Lazell 1973) and carrion (Loftin and Tyson 1965). In Florida, neonates and juveniles feed on vegetation, insects, and tree snails (Townsend et al. 2005), whereas adults are primarily herbivorous, but may take additional items as well. A juvenile *I. iguana* appeared to be feeding on Firebush (*Hamelia patens*) fruits in a Naples garden (J. Schmid, pers. comm.). Fecal contents of a Homestead, Florida individual included flowers, leaves, and fruits from non-native Jasmine (*Jasminum* sp.) and Washington Fan Palms (*Washingtonia robusta*; Meshaka et al. 2004b). At Bill Baggs Cape Florida State Park (BBCF) on the southern tip of Key Biscayne, we have observed *I. iguana* feeding on Nicker Bean (*Caesalpinia bonduc*),



Records (N = 3,169) of Green Iguanas (*Iguana iguana*) in southern Florida. Open circles indicate preserved specimens and photographic vouchers (N = 1,088) collected between 1965 and 2006, circles with central dots indicate observations (N = 2,081). A circle may represent more than one record.

and we have collected specimens that had eaten tree snails (*Drymaeus multilineatus*; see Townsend et al. 2005) and an adult (UF 137405) found dead-on-road (DOR) with mammal hair in its mouth. At Crandon Park on Key Biscayne, *I. iguana* eats cracked corn supplied to captive waterfowl, and adults removed from an overbrowsed area defecated rat (*Rattus* sp.) hair (G. Ward, pers. comm.). Two Green Iguanas were observed feeding on a Spanish Stopper (*Eugenia foetida*) just before basking on a Strangler Fig (*Ficus aurea*; J.G. Duquesnel, pers. comm.).

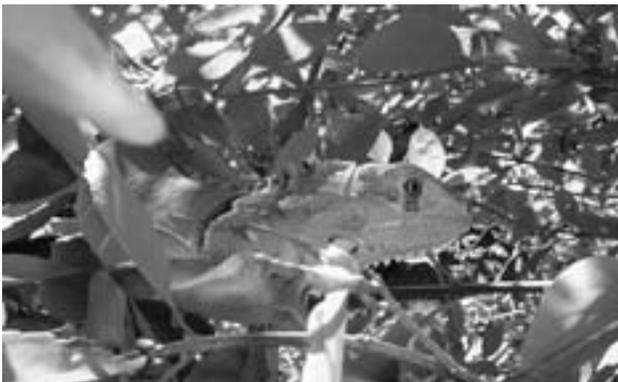
In its native range, *I. iguana* is preyed upon by a variety of reptilian, avian, and mammalian species. In Venezuela, juveniles that had emerged by the thousands over a 14-day period were preyed upon by three crocodylian, two snake, three teiid lizard, nine accipiter, four falcon, one owl, three heron, three cuckoo, two passerine, and six mammalian species, including domestic dog (*Canis familiaris*) and cat (*Felis domesticus*; Antonio Rivas et al. 1998). Some of the predators identified in its native range also occur in southern Florida: Boa Constrictor (*Boa constrictor*), Spectacled Caiman (*Caiman crocodilus*), American Crocodile (*Crocodylus acutus*), Giant Ameiva (*Ameiva ameiva*), Barn Owl (*Tyto alba*), Broad-winged Hawk (*Buteo platypterus*), Swallow-tailed Kite (*Elanoides forficatus*), White-tailed Kite (*Elanus leucurus*), Osprey (*Pandion haliaetus*), American Kestrel (*Falco sparverius*), Crested Caracara (*Caracara cheriway*), Great Egret (*Ardea alba*), and Smooth-billed Ani (*Crotophaga ani*; Antonio Rivas et al. 1998, Greene et al. 1978, Swanson 1950, Wunderle 1981). Cats, Caracaras, and Kestrels are among the most common predators in Venezuela (Antonio Rivas et al. 1998). Juvenile Green Iguanas in Florida are eaten by the Florida Burrowing Owl (*Athene cunicularia floridana*), Yellow-crowned Night-heron (*Nyctanassa violacea*), Yellow Rat Snake (*Elaphe obsoleta*), and domestic dog (Engeman et al. 2005b, McKie et al. 2005, Meshaka et al. 2004b). Potential predators of iguana eggs are the Raccoon (*Procyon lotor*), Spotted Skunk (*Spilogale putorius*), Fish Crow (*Corvus ossifragus*), Black (*Coragyps atratus*) and Turkey (*Cathartes aura*) Vultures, feral pig (*Sus scrofa*), and domestic dog (Hirth 1963, Sexton 1975).

Eggs and young Green Iguanas possibly are eaten by a variety of native wildlife species in Florida, and they might provide an important source of food, particularly in areas with dense

iguana populations and few remaining native prey species. Neonate *I. iguana* are frequently found on the ground, in shrubs, or low in trees (Henderson 1974, Hirth 1963, Swanson 1950), exposing them to different predators than adults, which are usually high in trees. In Florida, once *I. iguana* reaches about 60 cm TL, it has few adversaries except humans, possibly domestic dogs, American Alligators (*Alligator mississippiensis*; see Kern 2004), and American Crocodiles, and is frequently found in open areas. Green Iguanas of all sizes are collected by humans for the pet trade, nuisance control, and human consumption.

Reproduction

In its native range, adult male Green Iguanas have larger home ranges (up to 9,000 m²) than females and juveniles (Rand et al. 1989). In Costa Rica, mating occurs in October–November (possibly December in Tortuguero) during the dry season (Hirth 1963). Females are known to travel up to several kilometers to reach suitable nesting sites, where they nest either alone or communally (Alvarez del Toro 1960, Rand 1968, Rand and Dugan 1983). Nesting sites are usually in sandy open areas, such as riverbanks, islands, or beaches (Burghardt et al. 1977, Campos 2004, Haller and Rodrigues 2005, Hirth 1963), and females exhibit nesting site fidelity (Bock et al. 1985). In Panama, *I. iguana* sometimes shares nesting sites with American Crocodiles, whose nest defense behavior may disrupt iguana nesting activities (Bock and Rand 1989); similarly in Honduras, iguana eggs have been uncovered in a Spectacled Caiman nest (Carr 1953). Female *I. iguana* typically dig an egg chamber 10–120 cm deep and 100–463 cm long (Haller and Rodrigues 2005, Rand 1968, Rand and Dugan 1980), but complex nests shared by multiple females may have a system of interconnecting tunnels up to 24 m long (Rand and Dugan 1983). Female *I. iguana* plug the nest tunnel, which is 10–15 cm wide and 7–10 cm high, with substrate using the snout (Rand 1968). Ovipositioning of 10–71 eggs (Campos 2004, Fitch 1985, Haller and Rodrigues 2005, Hirth 1963, Rand 1968, Swanson 1950) occurs in late afternoon (rarely in the morning) between early February and April in Mexico and Central America (Alvarado et al. 1995, Alvarez del Toro 1960, Bock and Rand 1989, Hirth 1963, Swanson 1950). Nesting



JEFFREY R. SCHMID

A juvenile Green Iguana (*Iguana iguana*) on a non-native Golden Dewdrop (*Duranta erecta*) in Naples, Collier County, Florida (photographic voucher UF 146274). This iguana appeared to be foraging on fruit from an adjacent Firebush (*Hamelia patens*).



JAMES G. DUQUESNEL

Two Green Iguanas (*Iguana iguana*) on a Strangler Fig (*Ficus aurea*) on Key Largo, Monroe County, Florida (photographic voucher UF 149986). These iguanas were observed feeding on adjacent Spanish Stopper (*Eugenia foetida*).



ANTHONY FLANAGAN

Two adult male Green Iguanas (*Iguana iguana*) fighting on 24 February 2004 on a dock in Hollywood, Broward County, Florida.



KENNETH E. KRYSKO

Two Green Iguanas (*Iguana iguana*) being fed by humans on a dock on Sugarloaf Key, Monroe County, Florida (photographic voucher UF 131549).

may take place from December to February in the Lesser Antilles (Lazell 1973), from late January to March in Colombia (Muñoz et al. 2003), and September to December in Brazil (Campos 2004, Haller and Rodrigues 2005). Incubation of eggs takes approximately three months (Alvarez del Toro 1960; Swanson 1950). In southern Florida, we observed Green Iguana mating behavior, including male combat, as early as December and lasting through April. Ovipositioning usually takes place in sandy areas, but one known female nested in a mulch pile on Key Largo (J. Duquesnel, pers. comm.). We collected: (1) Four females with vitellogenic follicles (mean = 30.2 ± 4.5 mm, 20–42 mm) from November, December, and February; (2) 22 females with oviducal eggs (mean = 35.5 ± 2.9 mm, 12–62 mm) between February and April; and (3) A single clutch of 41 eggs oviposited in April. Neonates are observed from May to August in both the southern peninsula and Florida Keys.

Nuisance Problems in Florida

From the 1960s through the 1980s, many residents in Miami enjoyed watching the large exotic *Iguana iguana*, allowing them to roam unmolested on their properties and at times even feeding them. Prior to Hurricane Andrew in 1992, *I. iguana* was not generally considered a nuisance species, but populations exploded in the 1990s in many areas of southeastern Florida. In 1992, a large reptile dealer in Hollywood, Broward County, pur-



ANTHONY FLANAGAN

Green Iguanas (*Iguana iguana*) basking on a dock in Hollywood, Broward County, Florida. Note iguana feces covering the deck.

chased few *I. iguana* that were captured locally (R. Van Nostrand, pers. comm.); now this species can be captured by the hundreds in this county and in adjacent Palm Beach County to the north. According to newspaper articles since 2003, *I. iguana* populations have increased markedly to nuisance levels in Pompano Beach, Pembroke Pines, Dania Beach, Plantation, Davie, Delray Beach, and Boca Raton. In the past few years, *I. iguana* began appearing in large numbers in the Keys, sometimes crossing roads and forcing traffic to brake along U.S. 1, which prompted the Florida Keys Invasive Species Task Force to solicit advice from the Florida Fish and Wildlife Conservation Commission and Florida Museum of Natural History on how to control or eradicate these populations.

On Key Biscayne, the post-Hurricane Andrew *I. iguana* population explosion was possibly due to opening up of the canopy, subsequent replanting of non-native landscape vegetation favored as food by iguanas (see Meshaka et al. 2004a), and creation of suitable nesting areas. This aggressive replanting of ornamental vegetation occurred throughout southeastern Florida after the widespread destruction caused by the hurricane. Before the hurricane, Bill Baggs Cape Florida State Park (BBCF) was extensively vegetated by non-native Australian Pines (*Casuarina equisetifolia*), thus iguana food and iguanas were scarce. After most of the Australian Pines were destroyed by the hurricane, BBCF park staff eventually began efforts to restore natural habitats and native vegetation. Fallen trees and other hurricane debris at BBCF and the county-owned Crandon Park to the north on Key Biscayne were mulched and bulldozed into piles, creating exposed, well-drained mounds that served as ideal sites for *I. iguana* to dig nesting burrows. *Iguana iguana* became so common at BBCF that, in 2003 alone, 824 iguanas were removed, mostly by one of us (EMD; see also Townsend et al. 2003), who also compiled these records into the park database. Meshaka et al. (2004a) attempted to illustrate increasing and high population densities of *I. iguana* at BBCF based solely on records maintained in the park database from 1 July 1998 through 30 June 2003 (reported therein as 0, 0, 1, 12, 384, respectively); however, the park database records are incomplete. Although we also believe that *I. iguana* has increased there (and other areas) since the late 1990s, the values reported for 2003 are elevated solely because of the collecting effort by EMD, who focused on removing non-native wildlife beginning in 2003 and ending upon leav-

ing BBCF in March 2004. If one were to calculate and expand on the actual numbers of *I. iguana* removed from BBCF from 1998 through 2006 (0, 0, 0, 9, 57, 824, 265, 189, and 89, respectively), after the point in which EMD left BBCE, this would erroneously illustrate a severe population crash.

Iguana iguana can cause considerable damage to residential and commercial landscape vegetation and is now often considered a nuisance by land managers and property owners, who sometimes have to install wire mesh or even electric fences around herbs, shrubs, and trees to protect them from these voracious lizards. Vulnerable young trees, and older trees with foliage or flowers particularly attractive to iguanas, can be protected from climbing lizards by encasing part of their trunks with sheet metal, as long as other trees are not within leaping distance. For many years, staff at Fairchild Tropical Botanic Garden in Miami tolerated *I. iguana* and prohibited their removal, until escalating populations started eating prized orchids (Orchidaceae) and the historic Hibiscus (*Hibiscus* spp.) garden was overgrazed to the ground and had to be relocated to a safer location. Other favored food plants include Impatiens (*Impatiens* spp.), Rose (*Rosa* spp.), Nasturtium (*Tropaeolum majus*), Caladium (*Caladium* spp.), Purple Heart (*Tradescantia* [*Setcreasea*] *pallida*), Bougainvillea (*Bougainvillea* spp.), and Hong Kong Orchid Tree (*Bauhinia blakeana*; see Kern 2004, Johnson 2006). *Iguana iguana* will eat

most fruits (except citrus) and flowers, tender new growth, and almost anything planted in a vegetable garden (Kern 2004). In the 2000s, *I. iguana* ate most of the recently planted butterfly garden at the Key Deer National Wildlife Refuge on Big Pine Key (C. Bergh, pers. comm.).

Iguana iguana also is considered a nuisance by homeowners in part due to unsightly and unhygienic defecations on docks, moored boats, seawalls, porches, decks, pool platforms and inside swimming pools. *Iguana iguana* can transmit the infectious bacterium *Salmonella* to humans through their feces, which conceivably could occur if iguanas defecate in swimming pools or on food while people are eating outside. Some *I. iguana* dig burrows that are used as refugia, which can be accompanied by erosion that undermines sidewalks, foundations, seawalls, berms, and canal banks (Kern 2004, Johnson 2006). Although *I. iguana* usually uses burrows only as temporary refugia when away from water, over 100 iguana burrows (up to 4.5 m long) were observed in a seasonally flooded borrow pit in Venezuela; these were used as nocturnal refugia despite the presence of numerous trees (Rodda and Burghardt 1985). In treeless habitats in Florida, such as cleared canal banks and vacant lots, normally arboreal lizards seek shelter in burrows, culverts, drainage pipes, and rock or debris piles.

Large *I. iguana* basking on airport runways could pose a hazard to planes. At least five known records document airplanes colliding with iguanas at the international airport in San Juan, Puerto Rico, where this species was introduced, and large iguanas would have a relative hazard score equivalent to ducks and pelicans (Engeman et al. 2005a). *Iguana iguana* also can be observed basking and grazing on golf course fairways in Florida, but these lizards generally do not pose a hazard to golfers.

Iguana iguana is responsible for more complaints to the FWC than any other non-native reptilian species in Florida. Numbers of complaints continue to increase as iguanas expand their range into new areas, and additional homeowners experience the dubious thrill of having the reptilian version of a sheep devouring their landscape. Although many people enjoy watching *I. iguana* as long as they do not damage valued plants or property, many other people are afraid of these large lizards, especially visitors or new residents, who are not accustomed to such large prehistoric-looking animals living in their neighbor-



KEVIN M. ENGE

Adult male Green Iguana (*Iguana iguana*) above a culvert on a canal bank along U.S. 27 in Medley, Miami-Dade County, Florida (photographic voucher UF 150123).



KENNETH L. KRYSKO

Residence on Big Pine Key, Monroe County, Florida, with wire mesh installed around flowering plants to protect against Green Iguanas (*Iguana iguana*).

hood. Neighbors who were once friendly to each other have even become rivals and no longer speak, as some families decide to feed and protect iguanas while other families want to rid these lizards from their properties (C.D. May, pers. comm.). Nonetheless, *I. iguana* will continue to be a common sight in neighborhoods because of the tolerance of some residents who feed them, coupled with a scarcity of predators, abundance of palatable ornamental vegetation (some vegetation with thorns may ward off potential predators), sunny nesting sites, and the presence of canals, lakes, and swimming pools for drinking water and escape cover. Furthermore, the profusion of man-made canals serve as dispersal corridors that allow iguanas to colonize new areas.

Potential Impacts on Other Species

On Marco Island, *Iguana iguana* occasionally uses burrows of the Florida Burrowing Owl (N. Richie, pers. comm.), a “Species of Special Concern” in Florida. At Crandon Park, *I. iguana* sometimes shares the same burrow as another non-native species, the Black Spiny-tailed Iguana (*Ctenosaura similis*), but most Green Iguanas utilize trees, particularly those in and around ponds and canals. The stomach of a juvenile *I. iguana* from Key Biscayne contained 12 tree snails (*Drymaeus multilineatus*), suggesting that it had selectively eaten them (Townsend et al. 2005). This snail species is common; however, iguanas could potentially impact other more rare tree snails (Townsend et al. 2005).

The species composition of the plant community might eventually be altered in areas with dense populations of *I. iguana* due to excessive grazing and defoliation of vegetation, resulting in death or lack of reproduction. In Mexico, *I. iguana* helps maintain forest diversity by consuming and dispersing seeds of many tree species (Morales-Mávil 1997). *Iguana iguana* is selective in its diet, and ingested seeds typically have higher germination rates than uneaten seeds (Benítez-Malvido et al. 2003). In Florida, *I. iguana* may be an important seed disperser of non-native invasive plant species, carrying seeds from people’s yards into adjacent natural areas and hindering invasive vegetation control efforts. *Iguana iguana* at BBCF feed on Nicker Bean, an important food plant for larvae of the Endangered Miami Blue Butterfly (*Hemiargus thomasi bethunebakeri*).

Population Control in Florida

Iguana iguana is now common in many urban areas of the southern peninsula and Florida Keys, and may be flourishing in larger natural areas of coastal Florida. Green Iguanas are extremely popular in the pet trade and sometimes escape or are intentionally (and illegally) released by owners when they grow too large. Many pet enthusiasts are unaware (or unwilling to accept) that releasing non-native animals, including *I. iguana*, in Florida is illegal and potentially detrimental to the environment. Future illegal introductions of non-native animals can be ameliorated by incorporating pet owner education into the invasive species management process. Prospective iguana owners should be educated on the life history details (e.g., large size of adults, potential for inflicting painful wounds) and the complex husbandry requirements of this species before a purchase. In an attempt to facilitate disposal of unwanted exotic pets, the FWC now allows people to return animals (as long as they do not



CARL MAY

Adult male Green Iguana (*Iguana iguana*) at the front door of a residence in Fort Worth, Palm Beach County, Florida.



CARL MAY

Juvenile Green Iguana (*Iguana iguana*) on a non-native Silk Floss (*Chorisia speciosa*) tree in Lake Worth, Palm Beach County, Florida (photographic voucher UF 149868).



KEVIN MENGE

Two non-native Green Iguanas (*Iguana iguana*) and a non-native Red-eared Slider (*Trachemys scripta elegans*) on non-native Melaleuca (*Melaleuca quinquenervia*) along a canal in Opa-Locka, Miami-Dade County, Florida (photographic voucher UF 150122). Two discarded automobile tires and other debris litter the man-made canal bank.

profit from the transaction by receiving more money than what was originally paid) to the pet store where purchased without requiring a costly license to sell wildlife.

Iguana iguana populations at the northern extent of their introduced range in Florida, as well as individual escapees farther north, are controlled by cold winter temperatures, except when thermal refugia or urban heat islands are available. When temperatures drop below 10 °C (50 °F), sluggish iguanas can be easily plucked from trees or collected after falling from trees, especially at night or on overcast days when basking does not increase body temperature quickly. Well-established populations in southern Florida appear to have exceeded the point of human control, and many animal control officers and nuisance trappers no longer respond to iguana complaints. Even if removal of *I. iguana* is successful, more lizards will repopulate the site from adjacent areas or when eggs hatch. Some private trappers charge upwards of \$100 to visit an iguana-infested site, and they usually will not guarantee success in catching and removing lizards. However, David Johnson, “The Iguana Trapper,” claims to specialize in removing *I. iguana* from overpopulated residences and subdivisions (Johnson 2006). During the past four years in his Pelican Harbor neighborhood along the C-15 Canal in southern Palm Beach County, Johnson (2006) has removed 406 iguanas, and during one week in April 2006, he caught 54 iguanas at one residence in Pompano Beach. Some residents have taken matters into their own hands; because *I. iguana* is a non-native species, it is not afforded protection in Florida, and it is legal to catch, trap, and humanely kill these lizards. However, permits or permission must be obtained before collecting wildlife, including non-native species, from a county, state, or national park and other public land. Once a Green Iguana is captured, it cannot legally be released again in Florida, limiting the captor to choose between killing the iguana humanely, keeping it in captivity, or selling it. Selling iguanas is no longer lucrative due to the availability of inexpensive farm-raised iguanas from Latin America; some pet stores sell imported neonate iguanas for less than \$10 each. Wild-caught adult Green Iguanas seldom become tame, but zoos and other exhibits are sometimes interested in acquiring large individuals (especially orange-colored males) for display purposes, and foreign buyers may pay up to \$300 for exceptional specimens (G. Ward, pers. comm.).



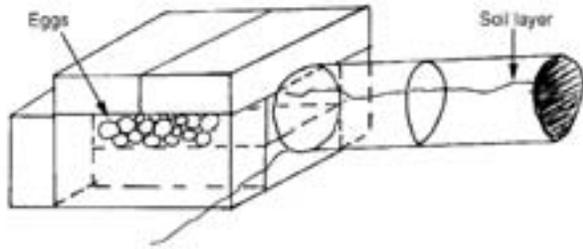
KEVIN M. ENGE

Adult male Green Iguana (*Iguana iguana*) basking on a fallen tree during a cool day at Crandon Park on Key Biscayne, Miami-Dade County, Florida (photographic voucher UF 150121). Non-native Senegal Date Palms (*Phoenix reclinata*) can be seen in the background.

Trapping methods for *I. iguana* include the use of live traps (e.g., Havahart, Tomahawk) baited with fruit, such as bananas or mangoes, or locking snares that can be set during the daytime at burrow entrances, at holes under fences, or along seawalls (Kern 2004), canals, and ponds. Johnson (2006) used a semicircular mesh trap with a snare at each end (D-I-Y trap) and bait in the center. However, the most common capture method is by noosing with a long pole, especially while lizards are sleeping at night or torpid during cold weather. Some commercial *I. iguana* catchers use boats to noose lizards from trees at night, sometimes stretching out nets to catch iguanas jumping from trees to the water below (G. Ward, pers. comm.). Persistent harassment may encourage *I. iguana* to move to the next-door neighbor’s yard; this can be accomplished by launching pebbles or palm fruits at them using a slingshot (Kern 2004), spraying them with a hose, or through the use of loud vocalizations on the part of a person or a dog combined with quickly approaching the lizard. Shooting firearms is outlawed in residential areas.

Over the past few years, we have established a cooperative effort with personnel at Crandon Park on Key Biscayne to reduce their abundant *I. iguana* population. Despite our efforts and those of commercial collectors, who have additionally removed hundreds of iguanas annually, this species is still a common sight. People have been caught illegally releasing their pet iguanas at Crandon Park because they thought it was an “iguana nursery.” “Iguana crossing” signs were once posted on Key Biscayne to advise motorists of a potential driving hazard. Over time, heavily harvested *I. iguana* populations can be expected to have lower densities, smaller individuals, and smaller clutch sizes than unharvested populations (Muñoz et al. 2003).

Female Green Iguanas are known to travel up to several kilometers to nest (see Alvarez del Toro 1960; Rand 1968; Rand and Dugan 1983), suggesting that females return to the same suitable nesting sites year after year. Desirable nesting sites can be heavily used by females. A clearing about 6 x 7 m in size on a 0.3-ha islet (not normally inhabited by *I. iguana*) in a Panamanian lake attracted as many as 150–200 females annually (Burghardt et al. 1977). In the Florida Keys, where *I. iguana* is expanding its range and is a nuisance, limestone is often near the surface, and nesting sites are usually limited to sandy microhabitats along beaches or soil and mulch piles brought in from the mainland for landscaping. Besides removing *I. iguana* from the wild whenever possible, in areas where suitable nesting areas are limited, we recommend establishing artificial nesting sites and removing the eggs. Suitable nesting mounds using sand, soil, or mulch can be placed in key problem areas for the express purpose of luring female iguanas. Monitoring these sites during the nesting season might help control the population, but care must be taken to locate and remove all iguana eggs. An easier solution than laboriously searching a mound of dirt for eggs would be to construct a small artificial nest box that would concentrate iguana eggs. Werner and Miller (1984) designed a simple but successful nest box using six concrete blocks 40 x 20 x 10 cm (15 x 8 x 4 in) and two clay tubes 30 cm long x 20 cm outside diameter (12 x 8 in). The interior of the nest chamber is 40 cm long, 20 cm wide, and 10 cm high (15 x 8 x 4 in) and filled with loose soil. The 60-cm (24 in) long entrance tube, which has a 15-cm (6 in) interior diameter, is one-third to half



An artificial nest box constructed using concrete blocks and clay tubes (illustrated after Werner and Miller 1984). Note that the tubes are originally half filled with a layer of dirt; the layer of dirt (observable by looking into the tube from the outside) will exceed the half-full mark when female iguanas excavate a nest chamber inside the box. Illustration by Audrey K. Owens.

filled with a 7-cm (2.75 in) layer of dirt; iguanas will fill this tube while excavating the nest chamber, indicating that nesting females or eggs are present and can be removed. This nest box is set on the surface of the ground and covered with 3 cm (1 in) of dirt; and the nest chamber is checked for eggs by removing one or both of the concrete blocks that form the roof. In an artificial nesting chamber, Werner and Miller (1984) believed that substrate composition is relatively unimportant (iguanas have been observed nesting in different mixtures of soil and sand, and even in ashes and refuse in garbage dumps), but solid walls and a roof are essential. These artificial nest sites should be monitored during the nesting season and all eggs or iguanas removed before refilling the nest chambers with displaced dirt from the entrance tubes. We recognize that this type of artificial nest box cannot be moved easily once constructed. Thus, we suggest using lighter-weight materials such as a similarly sized plastic, rubber, or fiberglass shell (for the chamber) and PVC tube (for the entrance), which will allow the nest box to be moved easily to different sites. Furthermore, these artificial boxes can be used to remove adult Green Iguanas as well as Spiny-tailed Iguanas (*Ctenosaura* spp.), as both species utilize burrows throughout the year.

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Literature Cited

- Alvarado, J., L. Ibarra, I. Suazo, G. Rodriguez, and R. Zamora. 1995. Reproductive characteristics of a Green Iguana (*Iguana iguana*) population of the west coast of Mexico. *Southwestern Naturalist* 40:234–237.
- Alvarez del Toro, M. 1960. *Los Reptiles de Chiapas*. Instituto Zoología Estado. Tuxtla Gutierrez, Chiapas, Mexico. 248 pp.
- Antonio Rivas, J., Ramon Molina, C., and T. Manuel Vila. 1998. *Iguana iguana* (Green Iguana). Juvenile predation. *Herpetological Review* 29:238–239.
- Bakhuis, W.L. 1982. Size and sexual differentiation in the lizard *Iguana iguana* on a semi-arid island. *Journal of Herpetology* 16:322–325.
- Bartlett, R.D. 1980. Non-native reptiles and amphibians in Florida. *Indigo, News Bulletin of the Florida Herpetological Society* 1:52–54.
- Bartlett, R.D. and P.P. Bartlett. 1999. *A Field Guide to Florida Reptiles and Amphibians*. Gulf Publishing Company, Houston, Texas. 278 pp.
- Bartlett, R.D. and P.P. Bartlett. 2006. *Guide and Reference to the Crocodiles, Turtles, and Lizards of Eastern and Central North America (North of Mexico)*. University Press of Florida, Gainesville, Florida. 344 pp.
- Benítez-Malvido, J., E. Tapia, I. Suazo, E. Villaseñor, and J. Alvarado. 2003. Germination and seed damage in tropical dry forest plants ingested by iguanas. *Journal of Herpetology* 37:301–308.
- Bock, B.C. and A.S. Rand. 1989. Factors influencing nesting synchrony and hatchling success at a Green Iguana nesting aggregation in Panama. *Copeia* 1989:978–986.
- Bock, B.C., A.S. Rand, and G.M. Burghardt. 1985. Seasonal migration and nesting site fidelity in the Green Iguana. *Contributions to Marine Science* 27:435–443.
- Burghardt, G.M., H.W. Greene, and A.S. Rand. 1977. Social behavior in hatchling Green Iguanas: Life at a reptile rookery. *Science* 195:689–691.
- Butterfield, B.P., W.E. Meshaka, Jr., and C. Guyer. 1997. Nonindigenous amphibians and reptiles, pp. 123–138. In D. Simberloff, D.C. Schmitz, and T.C. Brown (eds.), *Strangers in Paradise: Impact and Management of Nonindigenous Species in Florida*. Island Press, Washington, D.C.
- Campos, Z. 2004. *Iguana iguana* (Sinimbu, Green Iguana). Reproduction. *Herpetological Review* 35:169.
- Carr, A. 1953. *High Jungles and Low*. University of Florida Press, Gainesville, Florida. 226 pp.
- Duquesnel, J. 1998. Keys invasion by alien lizards continues. Florida Department of Environmental Protection, Florida Park Service, *Resource Management Notes* 10:9.
- Engeman, R.M., H.T. Smith, and B. Constantin. 2005a. Invasive iguanas as airstrike hazards at Luis Muñoz Marín International Airport, San Juan Airport, Puerto Rico. *Journal of Aviation/Aerospace Education and Research* 14:45–50.
- Engeman, R.M., E.M. Sweet, and H.T. Smith. 2005b. *Iguana iguana* (Green Iguana). Predation. *Herpetological Review* 36:320.
- Fitch, H.S. 1985. *Variation in Clutch and Litter Size in New World Reptiles*. University of Kansas Museum of Natural History, Miscellaneous Publication No. 76. 76 pp.
- Greene, H.W., G.M. Burghardt, B.A. Dugan, and A.S. Rand. 1978. Predation and the defensive behavior of Green Iguanas (Reptilia, Lacertilia, Iguanidae). *Journal of Herpetology* 12:169–176.
- Haller, É.C.P. and M.T. Rodrigues. 2005. *Iguana iguana* (Green Iguana). Nests and nesting. *Herpetological Review* 36:319–320.
- Henderson, R.W. 1974. Aspects of the ecology of the juvenile Common Iguana (*Iguana iguana*). *Herpetologica* 30:327–332.
- Hirth, H.F. 1963. Some aspects of the natural history of *Iguana iguana* on a tropical strand. *Ecology* 44:613–615.
- Johnson, D.F. 2006. The Iguana Trapper. (<http://www.iguana-trapper.com/>).
- Kern, W.H., Jr. 2004. *Dealing with Iguanas in the South Florida Landscape*. Fact Sheet ENY-714, Entomology and Nematology, Florida Cooperative Extension Service, Institute of Food and Agricultural Science, University of Florida, Gainesville, Florida. 7 pp.
- King, W. and T. Krakauer. 1966. The exotic herpetofauna of southeast Florida. *Quarterly Journal of the Florida Academy of Sciences* 29:144–154.
- Krysko, K.L., K.M. Enge, J.H. Townsend, E.M. Langan, S.A. Johnson, and T.S. Campbell. 2005. New county records of amphibians and reptiles from Florida. *Herpetological Review* 36:85–87.

- Lazell, J.D., Jr. 1973. The lizard genus *Iguana* in the Lesser Antilles. *Bulletin of the Museum of Comparative Zoology* 145:1–28.
- Lever, C. 2003. *Naturalized Reptiles and Amphibians of the World*. Oxford University Press, New York, New York. 318 pp.
- Loftin, H. and E.L. Tyson. 1965. Iguanas as carrion eaters. *Copeia* 1965:515.
- Mckie, A.C., J.E. Hammond, H.T. Smith, and W.E. Meshaka, Jr. 2005. Invasive Green Iguana interactions in a Burrowing Owl colony in Florida. *Florida Field Naturalist* 33:125–127.
- McKeown, S. 1996. *A Field Guide to Reptiles and Amphibians in the Hawaiian Islands*. Diamond Head Publishing, Los Osos, California. 172 pp.
- Meshaka, W.E., Jr., W.F. Loftus, and T. Steiner. 2000. The herpetofauna of Everglades National Park. *Florida Scientist* 63:84–103.
- Meshaka, W.E., Jr., R.D. Bartlett, and H.T. Smith. 2004a. Colonization success by Green Iguanas in Florida. *Iguana* 11:154–161.
- Meshaka, W.E., Jr., B.P. Butterfield, and J.B. Hauge. 2004b. *The Exotic Amphibians and Reptiles of Florida*. Krieger Publishing Company, Malabar, Florida. 155 pp.
- Morales-Mávil, J.E. 1997. *Viabilidad de Semillas Ingeridas por la Iguana Verde (Iguana iguana L.) en la Zona de la Palma, Region de Los Tuxtlas, Veracruz*. M.S. thesis, Instituto de Neuroetología, Universidad Veracruzana, Xalapa, Veracruz, Mexico.
- Muñoz, E.M., A.M. Ortega, B.C. Bock, and V.P. Páez. 2003. Demography and nesting ecology of Green Iguana *Iguana iguana* (Squamata: Iguanidae), in two exploited populations in Depresión, Momposina, Colombia. *Revista de Biología Tropical* 51:229–240.
- Murphy, J.C. 1997. *Amphibians and Reptiles of Trinidad and Tobago*. Krieger Publishing Company, Malabar, Florida. 245 pp.
- Powell, R., R.W. Henderson, and J.S. Parmerlee, Jr. 2005. *Reptiles and Amphibians of the Dutch Caribbean: St. Eustatius, Saba, and St. Maarten*. St. Eustatius National Parks Foundation, Gallows Bay, St. Eustatius, Netherlands Antilles.
- Rand, A.S. 1968. A nesting aggregation of iguanas. *Copeia* 1968:552–561.
- Rand, A.S. and B. Dugan. 1980. Iguana egg mortality within the nest. *Copeia* 1980:531–534.
- Rand, A.S. and B. Dugan. 1983. Structure of complex iguana nests. *Copeia* 1983:705–711.
- Rand, A.S., E. Font, D. Ramos, D.I. Werner, and B.C. Bock. 1989. Home range in green iguanas (*Iguana iguana*) in Panama. *Copeia* 1989:217–221.
- Rodda, G.H. and G.M. Burghardt. 1985. *Iguana iguana* (Green Iguana). Terrestriality. *Herpetological Review* 16:112.
- Savage, J.M. 2002. *The Amphibians and Reptiles of Costa Rica: A Herpetofauna between Two Continents, between Two Seas*. University of Chicago Press, Chicago, Illinois. 954 pp.
- Schwartz, A. and R.W. Henderson. 1991. *Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History*. University of Florida Press, Gainesville, Florida. 718 pp.
- Seidel, M.E. and R. Franz. 1994. Amphibians and reptiles (exclusive of marine turtles) of the Cayman Islands, pp.407–434. In M.A. Brunt and J.E. Davies (eds.), *The Cayman Islands: Natural History and Biogeography*. Kluwer Academic Publishers, Netherlands.
- Sexton, O.J. 1975. Black vultures feeding on iguana eggs in Panama. *American Midland Naturalist* 93:463–468.
- Spinner, K. 2005. Bonita area becoming a haven for iguanas. *Naples Daily News*. (<http://www.naplesnews.com/news/2005/may>).
- Swanson, P.L. 1950. The Iguana *Iguana iguana iguana* (L.). *Herpetologica* 6:187–193.
- Thomas, R. 1999. The Puerto Rico area, pp. 169–180. In B.I. Crother (ed.), *Caribbean Amphibians and Reptiles*. Academic Press, San Diego, California.
- Townsend, J.H., K.L. Krysko, A.T. Reppas, and C.M. Sheehy, III. 2002. Noteworthy records for introduced reptiles and amphibians from Florida, USA. *Herpetological Review* 33:75.
- Townsend, J.H., K.L. Krysko, and K.M. Enge. 2003. Introduced iguanas in southern Florida: a history of more than 35 years. *Iguana* 10:111–118.
- Townsend, J.H., J. Slapcinsky, K.L. Krysko, E.M. Donlan, and E.A. Golden. 2005. Predation of a tree snail *Drymaeus multilineatus* (Gastropoda: Bulimulidae) by *Iguana iguana* (Reptilia: Iguanidae) on Key Biscayne, Florida. *Southeastern Naturalist* 4:361–364.
- Werner, D.I. and T.J. Miller. 1984. Artificial nests for female Green Iguanas. *Herpetological Review* 15:57–58.
- Wilson, L.D. and L. Porras. 1983. *The Ecological Impact of Man on the South Florida Herpetofauna*. University of Kansas Museum of Natural History, Special Publication No. 9. 89 pp.
- Wunderle, J.M., Jr. 1981. Avian predation upon *Anolis* lizards on Grenada, West Indies. *Herpetologica* 37:104–108.

Appendix. Voucher specimens of *Iguana iguana* examined from Florida counties.

Alachua: UF 122514; *Broward*: UF 123126–27, 134066, 146556, 149568–69, 149979–81, 150124; *Collier*: UF 141486, 146036, 146067, 146273–74, 149612; *Lee*: UF 133209–10; *Miami-Dade*: ETMNH-CC 418–32; ISUVC 3846–47, 3849–53, 3855–92; UF 22910, 131544–47, 131556–60, 131764–66, 132864–83, 133838–41, 134203–10, 134231, 134910, 135083–91, 135093–94, 135294, 135470–71, 135485–89, 135494–500, 135538–63, 135616–22, 135624, 135896, 135907–23, 135925–46, 137405, 140562–65, 140579–82, 140740, 141040–41, 141098, 141101–03, 141109–19, 141220–23, 141225–27, 141230–31, 141233–34, 141236–39, 141248–49, 141487–96, 141498, 141609–17, 141766–68, 141897–99, 141902–03, 141953, 142317, 142333–42, 142344–54, 142551–74, 142591–95, 142625–80, 142722–24, 142731, 142812, 142817–19, 142897–904, 143602, 143605, 143607–08, 143946–48, 144060, 144239–41, 144261–65, 144268–97, 144310, 144312–23, 144343–471, 144575, 145202–14, 145218–333, 145335–57, 149715–32, 149734–810, 149873, 149892–978, 149982, 150002–13, 150121–23; USNM 245339; YPM 13950–52; *Monroe*: UF 131549, 133862, 134836, 137214, 141212, 145524, 149864, 149985–86, 150065, 150093; *Palm Beach*: UF 137086, 137183, 146557–72, 149863, 149868–70, 150079.



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This Panther Chameleon (*Furcifer pardalis*) in Ankify was a highlight of a trip to Madagascar.
See article on p. 184.