

Catalogue of American Amphibians and Reptiles.

Les, A. M., and R. Powell. 2014. *Anolis smaragdinus*.

***Anolis smaragdinus* Barbour and Shreve
Bahamian Green Anole**

Anolis principalis var. *porcatus*: Cope 1887 (1888):437 (part). See **Remarks**.

Anolis principalis: Cope 1894:429 (part). See **Remarks**.

Anolis carolinensis: Cope 1900:233 (part, by implication). See **Remarks**.

Anolis porcatus: Barbour 1904:57 (part).

Anolis brunneus: Barbour 1910:99 (part).

Anolis smaragdinus Barbour and Shreve 1935:355. Type locality, "Mortimer's, South Point, Long Island, Bahamas." Holotype, Museum of Comparative Zoology (MCZ) 37983, an adult male collected by T. Barbour in February 1934 (not examined by authors).

Anolis porcatus smaragdinus: Barbour 1937:119.

Anolis cf. *smaragdinus*: Pregill 1982:12. See **Fossil Record**.

CONTENT. Two subspecies are currently recognized: *A. s. smaragdinus* and *A. s. lernerii* (however, see **Remarks**).

DESCRIPTION. *Anolis smaragdinus* (Schwartz and Henderson 1991; Oliver 1948) is a moderately sized green anole (male SVL to 64 mm, female SVL to 51 mm). Head scales are large and moderately keeled, with 1–3 rows of loreals, 0–2 scales between the supraorbitals, 1–3 scales between the interparietal and supraorbital semicircles, 5 postrostrals, and 2–4 postmentals. Suboculars are in contact with the supralabials. Dorsal and ventral scales are similar in size (lateral scales are slightly smaller), roundish, and bluntly keeled, arranged contiguously to slightly overlapping. Supradigital scales are multicarinate (variable). The tail is round



FIGURE 1. An adult male *Anolis smaragdinus smaragdinus* from New Providence Island, Bahamas. Photograph by Joseph Burgess.



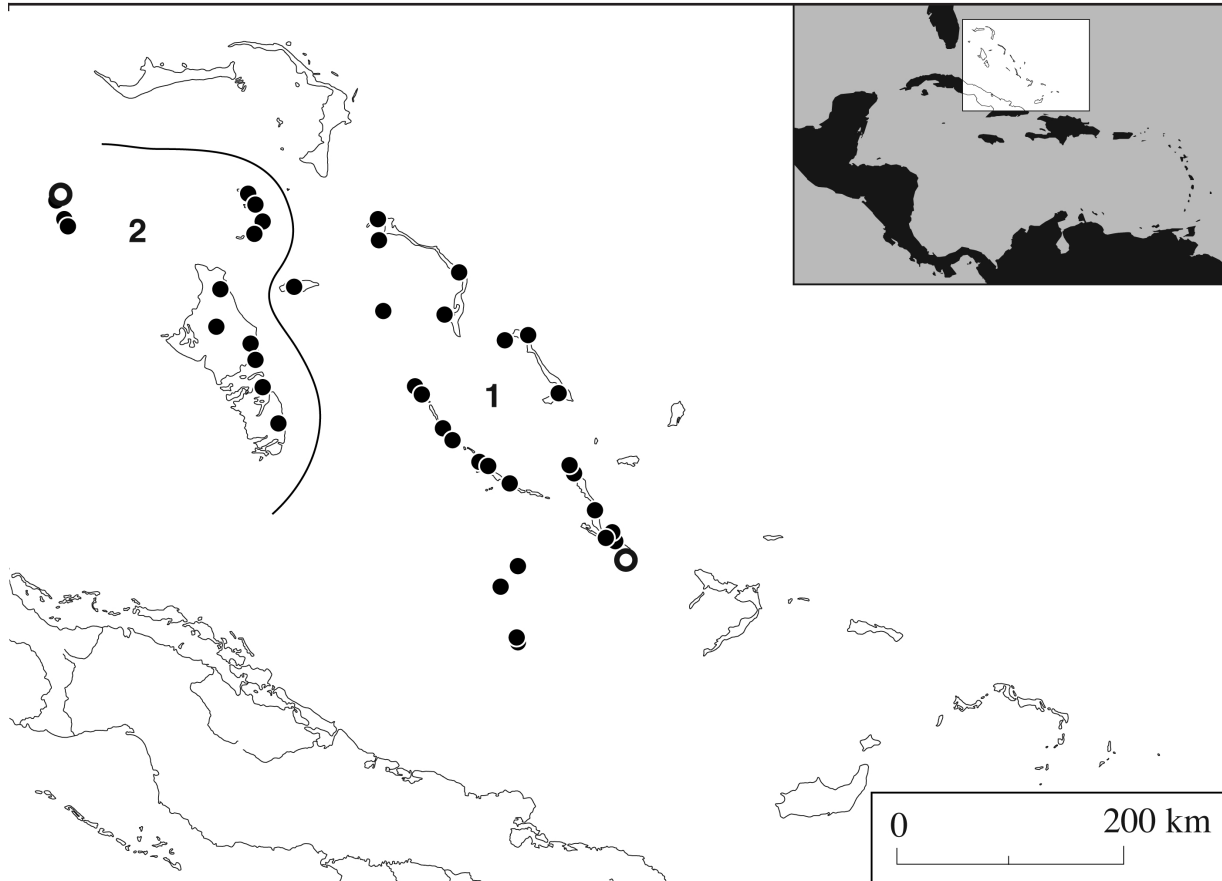
FIGURE 2. An adult male *Anolis smaragdinus smaragdinus* in metachrosis from Abaco Island, Bahamas, where the species is introduced. Photograph by Dustin Owen.



FIGURE 3. An adult male *Anolis smaragdinus smaragdinus* from Eleuthera Island, Bahamas. Photograph by Angela M. Les.

(circular in cross-section) with enlarged dorsal scales.

Dorsal ground color usually is a bright grass-green dorsum with a whitish to yel-



MAP 1. Distribution of *Anolis smaragdinus*. Circles mark type localities and dots denote other records. Some symbols may represent multiple proximate locations. Guide to subspecies (numbered and demarcated by solid line): 1. *A. smaragdinus smaragdinus*, 2. *A. s. leneri* (modified from Schwartz and Henderson 1991).

low-green to greenish venter. In metachrosis, the dorsum turns brown and the venter often is also marked irregularly with brown. Labials usually are immaculate whitish (only occasionally speckled with darker pigment or invaded by the surrounding ground color), continuing to form a short, whitish streak between the angle of the jaw and the eye. No dark postorbital blotch is present, but in some populations (more commonly *A. s. smaragdinus*) a small dark axillary spot is present. The dewlap is deep rosy pink.

DIAGNOSIS. *Anolis smaragdinus* can be distinguished from its six native Bahamian congeners by having bluntly keeled ventrals and a tail round in cross-section (ventrals are distinctly keeled and the tail is laterally

compressed in *A. sagrei*), a lack of two paramedian rows of paired scales on the snout (present in *A. distichus*), lack of an elongate black spot above the forelimb insertions (present in *A. brunneus*, with which *A. smaragdinus* has frequently been confused; see **Remarks**), an elongate snout and relatively slender habitus (snout not elongate and “chunky” habitus in *A. scriptus*), dorsum green (brown in metachrosis) and dewlap pink or red (dorsum never green, tan or brown, dewlap peach to pale tan in *A. angusticeps*), and dorsum without scattered white spots (present in *A. fairchildi*) (Schwartz and Henderson 1985). *Anolis smaragdinus* differs from *A. equestris*, which is not native but has been introduced in the Bahamas (Buckner et al. 2012), by smaller size (*A.*



FIGURE 4. Mating *Anolis smaragdinus* on Staniel Cay (Exuma Chain), Bahamas. Note the female in metachrosis. Photograph by Todd M. Palmer.

equestris can reach SVLs of 188 mm in males and 170 mm in females [Schwartz and Garrido 1972]), bluntly keeled ventrals (smooth in *E. equestris*), and lack of a prominent cranial bony casque (present in *A. equestris*).

Many populations (and individuals) of *A. smaragdinus* can be distinguished from *A. carolinensis*, with which it frequently has been confused (see **Remarks**), by often having a greenish venter and usually lacking a dark postocular spot (never greenish and usually with a postocular spot in *A. carolinensis*), but this will not apply in all instances. Oliver (1948), in his description of “*A. carolinensis leneri*,” indicated that *A. carolinensis* can be distinguished by having more prominently keeled dorsal scales, a shorter, broader snout, and a laterally compressed tail (oval in cross section) compared to a round tail in what is

now recognized as *A. s. leneri*, but he failed to provide sufficient data to distinguish *A. s. smaragdinus* from *A. carolinensis*, to both of which he attributed a shorter, broader snout than in *A. s. leneri* (although that of *A. carolinensis* is generally less “pointy” than that of either subspecies of *A. smaragdinus*). Consequently, *A. smaragdinus* and *A. carolinensis* often cannot be distinguished by morphological, meristic, or color differences, so a definitive diagnosis is dependent on electrophoretic or genetic distinctions (e.g., Buth et al. 1980; Glor et al. 2005).

PHYLOGENETIC RELATIONSHIPS. *Anolis smaragdinus* is assigned to the *A. carolinensis* subgroup (Burnell and Hedges 1990), which corresponds to the *A. carolinensis* superspecies of Williams (1976). As currently recognized (Glor et al. 2005), it is comprised of four species occurring on small islands or island banks (*A. brunneus*, *A. longiceps*, *A. maynardi*, *A. smaragdinus*), one species from the continental United States (*A. carolinensis*), and two species from Cuba (*A. allisoni* and *A. porcatius*). The group’s origin is Cuba (Buth et al. 1980; Williams 1969), and *A. smaragdinus* appears to be derived from *A. porcatius* stock originating in eastern Cuba (Campbell-Staton et al. 2012; Glor et al. 2005).

PUBLISHED DESCRIPTIONS. Other than the original descriptions, a detailed description is in Schwartz and Henderson (1991). Rosén (1911) described morphological differences between two distinct forms that he observed on Andros and New Providence.

ILLUSTRATIONS. **Color photographs** are in Bahamas National Trust Education Office (2009), Bimini Biological Field Station (2004), Hedges (2013), Losos (2007), Pringle (2014), and Uetz and Hošek (2013), and a color photograph of the type specimen is included in the entry on the species in the Encyclopedia of Life (EOL 2013). **Colored illustrations** are in Schwartz and Henderson



FIGURE 5. Aggressive behavior by two male *Anolis smaragdinus* on Staniel Cay (Exuma Chain), Bahamas. Photograph by Naomi Man in t Veld.

(1985, both subspecies). **Black and white photographs and illustrations** are found in Attrill et al. (1983), Gape and Sweeting (2004), Oliver (1948, lower jaw scalation in *A. s. lernerii*), and Rosén (1911, specimens from Andros and New Providence islands). *Anolis smaragdinus* was featured on a 15-cent Bahamian stamp released on 3 September 1996 (Boysen 2012).

DISTRIBUTION. *Anolis smaragdinus* is known from the Conception (Little San Salvador Island, Cat Island) and Great Bahama Island banks in the Bahamas, and has been introduced to the islands of Abaco and, possibly, Grand Bahama (Schwartz and Henderson 1991; Henderson and Powell 2009). The records from the Grand Bahama Bank (Losos et al. 1993; Lever 2003; Kraus

2009; Powell et al. 2011) have been attributed to *A. carolinensis* (see **Remarks**), and some uncertainty remains about the identity of these lizards (e.g., J.B. Losos in Buckner et al. 2012). Detailed island-by-island records are in Buckner et al. (2012). The range is illustrated in EOL (2013), Hedges (2013), Schwartz and Henderson (1991), and Uetz and Hošek (2013).

FOSSIL RECORD. Late Pleistocene material from New Providence Island (Etheridge 1966, as *A. carolinensis*; Pregill 1982) included 112 dentaries, 19 maxillae, and three frontals from individuals averaging 60 mm SVL. Fossils were attributed to *A. smaragdinus* on the basis of locality rather than osteological distinctions. Jaws were large and elongate with short, round teeth with blunt crowns. Fossil dentaries differ from contemporary specimens in having a less expansive coronoid scar on the labial surface of the jaw and slightly smaller, less numerous teeth.

PERTINENT LITERATURE. Literature pertaining to this species (under various names, see **Remarks**) is listed by topic: **biogeography** (Schwartz 1968), **comparison with *A. fairchildi*** (Buden and Schwartz 1968), **cranial morphology** (Pregill 1982; Smith 2006, 2009, 2011; Sanger et al. 2012, 2013), **dispersal** (Losos and Spiller 2005), **ecology and natural history (including ecomorphology and evolutionary ecology)** (Gerber 1999; Henderson and Powell 2009; Lister 1976a, 1976b; Losos 2007, 2009; Losos and Irschick 1996; Losos and Spiller 1999; Losos et al. 1994, 2001; Mattingly and Jayne 2004; Oliver 1948; Schoener 1968, 1975, 1979; Schoener and Schoener 1980a, 1980b, 1982; Schwartz and Henderson 1991), **evolution, phylogeny, and taxonomy** (Burnell and Hedges 1990; Buth et al. 1980; Campbell-Staton et al. 2012; Etheridge 1960 [“1959”]; Glor et al. 2005; Nicholson et al. 2005, 2012; Webster et al. 1972), a **“growth”** of unknown origins (Pringle 2014), and **in-**

roductions (Kraus 2009; Latella et al. 2011; Lever 2003; Losos and Spiller 1999; Losos et al. 1993; Powell et al. 2011).

The species (under various names, see **Remarks**) is included in general works, checklists, guides, and keys (some of which might include brief descriptions and illustrations) by Barbour (1904, 1910, 1914, 1930a, 1930b, 1935, 1937), Barbour and Loveridge (1946), Barbour and Shreve (1935), Bartlett (1987 [1988]), Beolens et al. (2011), Buckner (1993), Buckner et al. (2012), Buden (1981), Butterfield et al. (1997), Cochran (1934), Cope (1885, 1887 [1888], 1894, 1900), del Rosario Castañeda and de Queiroz (2011), Dodd (2003), Dodd and Franz (1996), Edwards (2007), Etheridge (1960 [“1959”]), Fläschendräger and Wijffels (1996, 2009), Franz and Buckner (1998), Franz et al. (1993, 1996), Gape and Sweeting (2004), Guyer and Savage (1987 [“1986”]), Hedges (2012), Henderson and Powell (2009), Hertz et al. (2013), Heselhaus and Schmidt (1990), Hutchins et al. (2003), Huyghe et al. (2007), Irschick et al. (1997), Janes et al. (2010), Johnson (2007), Johnson et al. (2008, 2010 [“2009”]), Knapp et al. (2011), Kusumi et al. (2011), Losos (1994, 2009), Losos et al. (2005), MacLean et al. (1977), MobileReference (2008), Nicholson and Richards (2011), Pavlidis and Darville (1994), Poe (1998, 1999, 2004, 2005), Powell et al. (1996), Pringle (2012), Pyron et al. (2013), Rosén (1911), Savage and Guyer (1989), Schmidt (1936), Schochat and Dessauer (1981), Schoener (1969, 1975, 1988), Schoener and Adler (1991), Schoener and Schoener (1983), Schoener and Spiller (1987), Schwartz and Henderson (1985, 1988, 1991), Schwartz and Thomas (1975), Schwartz et al. (1978), Shedlock (2006), Shedlock et al. (2007, 2008), Spiller and Schoener (1988), Stamps et al. (1997), Stejneger (1905), Sutcliffe (1952), Vance (1991), Vanhooydonck et al. (2009), Velasco and Herrel (2007), Wang and Lercher (2009, 2010), Williams (1969, 1976), and Wrobel (2004).

By implication or as part of the *A. carolinensis* species group, *A. smaragdinus* was included in the following additional studies examining generic relationships among anoles: Cannatella and de Queiroz (1989), Guyer and Savage (1992), Hass et al. (1993), Jackman et al. (1999), Savage and Guyer (1991), and Williams (1989).

REMARKS. Although Rosén (1911) listed “*Lacerta principalis* L.” as a synonym of *Anolis porcatius* (to which he assigned Bahamian specimens now recognized as *A. smaragdinus*), presumably based on Duméril and Bibron (1837), that name was not applied to lizards from the Bahamas until Cope (1887 [1888], 1894).

Anolis smaragdinus has frequently been confused with Cuban *A. porcatius*, mainland *A. carolinensis*, and *A. fairchildi* and *A. brunneus* from the Cay Sal and Crooked-Acklins banks (Bahamas), respectively (e.g., Barbour 1910). Although he did not include Bahamian populations, Boulenger (1885) initiated the confusion by placing *Anolius* [*sic*] *porcatius* Gray and *A. principalis* Gray into the synonymy of *Anolis carolinensis* (essentially following Duméril and Bibron 1837; see also Cope 1900). Cope (1887 [1888]) compounded the problem by listing *Anolis principalis* var. *porcatius* from Abaco, where *A. smaragdinus* is considered introduced (Buckner et al. 2012). Cope (1894) exacerbated the issue by listing *Anolis principalis* from New Providence and Eleuthera islands and describing *Anolis principalis brunneus* from Crooked Island. Cope (1900), without mentioning any Bahamian specimens or islands, subsequently placed *A. porcatius* and *A. principalis* into the synonymy of *A. carolinensis*, by implication including Bahamian populations. Barbour (1904) then placed all Bahamian green anoles into *A. porcatius*. In 1910, he placed them all in *A. brunneus*, which he now recognized as distinct from Cuban and mainland forms. Then, with Shreve (Barbour and Shreve 1935) he coined the name *A. smaragdinus*, which

two years later (Barbour 1937) he relegated to a subspecies of *A. porcatatus* (which he did for essentially all of the taxa presumably derived from *A. porcatatus*, but now recognized as distinct species; e.g., Glor et al. 2005).

Schwartz et al. (1978), citing a lack of meristic differences and differences in chin and throat patterns apparent only in life, only tentatively refrained from considering *A. s. leneri* a synonym of *A. smaragdinus*, which would have rendered the species monotypic.

The conservation status of the species has not been assessed for the IUCN Red List (IUCN 2013).

ETYMOLOGY. The name *smaragdinus* is from the Latin for “emerald,” an obvious allusion to the bright green ground color of this species. The name *leneri* is a patronym honoring Michael Lerner, founder of the Lerner Marine Laboratory on Bimini, Bahamas (Oliver 1948).

**1. *Anolis smaragdinus smaragdinus* Barbour and Shreve
Bahamian Green Anole**

Anolis principalis var. *porcatatus*: Cope 1887 [1888]:437 (part). See species synonymy; see also **Remarks**.

Anolis principalis: Cope 1894:429 (part).

Anolis carolinensis: Cope 1900:233 (part, by implication). See **Remarks**.

Anolis porcatatus: Barbour 1904:57 (part). See species synonymy.

Anolis brunneus: Barbour 1910:99 (part). See species synonymy.

Anolis smaragdinus Barbour and Shreve 1935:355. See species synonymy.

Anolis porcatatus smaragdinus: Barbour 1937:119. See species synonymy.

Anolis carolinensis smaragdinus: Etheridge 1959 [1960]:205.

Anolis cf. *smaragdinus*: Pregill 1982:12. See species synonymy.

Anolis smaragdinus smaragdinus: Schwartz

and Thomas 1975:104. First use of trinomial.

DESCRIPTION. This subspecies is characterized by smaller size, a shorter and wider snout (width of snout to width of head 50.73) than *A. s. leneri* (Oliver 1948). Scales in the frontal and supraorbital ridges are relatively larger and more regularly arranged than in *A. s. leneri* (Oliver 1948, but see **Remarks**). *Anolis s. smaragdinus* usually has a small but distinct dark axillary spot and has well-defined dark markings on the chin and throat (Schwartz et al. 1978).

**2. *Anolis smaragdinus leneri* Oliver
Bimini Green Anole**

Anolis carolinensis leneri Oliver 1948:7. Type locality, “Southern end of North Bimini Island, Bimini, Bahamas, British West Indies.” Holotype, American Museum of Natural History (AMNH) 68535, an adult male collected by J. A. Oliver on 29 September 1947 (not examined by authors).

Anolis leneri: Williams 1969:356.

Anolis smaragdinus leneri: Schwartz and Thomas 1975:105. First use of present combination.

DESCRIPTION. This subspecies is characterized by larger size (male SVL to 64.1 mm), with a longer and narrower snout (width of snout to width of head 43.19) than *A. s. smaragdinus* (Oliver 1948). Scales in the frontal and supraorbital ridges are relatively smaller and irregularly arranged than in *A. s. smaragdinus* (Oliver 1948, but see **Remarks**). *Anolis s. leneri* usually lacks the dark axillary spot and lacks well-defined dark markings on the chin and throat (Schwartz et al. 1978).

ADDITIONAL VERNACULAR NAMES. Bahama Green Anole, used in Gape and Sweeting (2004) and Bahamas National Trust Education Office (2009); Green Tree Lizard or

Green Lizard (used locally); South Point Anole (Frank and Ramus 1995; Wrobel 2004).

ACKNOWLEDGMENTS. Work on this account was funded by a grant from the National Science Foundation (USA) to RP (DBI-0851610).

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Primary editors for this account, Christopher J. Bell and Travis J. LaDuc.

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