Appendix D1. U.S. Geological Survey 2019 Reptile Survey Locations and Results

Figure D1.1. Locations of glue-board stations used during U.S. Geological Survey reptile surveys at Wake in 2019. (U.S. Air Force, WorldView 3 image taken October 2015).

Figure D1.2. Reptile and yellow crazy ant (YCA) detections on glue-board surveys done by the U.S. Geological Survey at Wake in 2019. (U.S. Air Force, WorldView 3 image taken October 2015).

Figure D1.3. Yellow crazy ant (YCA) detection locations on reptile glue-board surveys and arthropod surveys done by the U.S. Geological Survey at Wake in 2019. (U.S. Air Force, WorldView 3 image taken October 2015).

Figure D1.4. Oceania snake-eyed skink (*Cryptoblepharus poecilopleurus*) detection locations on glue-board surveys done by the U.S. Geological Survey at Wake in 2019. (U.S. Air Force, WorldView 3 image taken October 2015).

Figure D1.5. Azure-tailed skink (*Emoia cyanura*) detection locations on glue-board surveys done by the U.S. Geological Survey at Wake in 2019. (U.S. Air Force, WorldView 3 image taken October 2015).

Figure D1.6. Mourning gecko (*Lepidodactylus lugubris*) detection locations on glue-board surveys done by the U.S. Geological Survey at Wake in 2019. (U.S. Air Force, WorldView 3 image taken October 2015).

Figure D1.7. House gecko (*Hemidactylus frenatus*) detection locations on glue-board surveys done by the U.S. Geological Survey at Wake in 2019. (U.S. Air Force, WorldView 3 image taken October 2015).

Appendix D2. Reptile Specimens Collected by U.S. Geological Survey at Wake Atoll in 2019

Table D2.1. List of reptile specimens collected during reptile surveys done by U.S. Geological Survey at Wake Atoll in 2019.

[All specimens have accompanying tissue samples for future DNA studies. **Observers:** SAH, SA Hathaway; ARB, AR Backlin; JCM, JC Molden. **Species codes:** CRPO, *Cryptoblepharus poecilopleurus* (Oceania snake-eyed skink); EMCY, *Emoia cyanura* (azure-tailed skink); HEFR, *Hemidactylus frenatus* (common house gecko); LELU, *Lepidodactylus lugubris* (mourning gecko). **Abbreviations:** no., number; mm/dd/yyyy, month/day/year; NVES, night visual encounter survey]

Date (mm/dd/yyyy)	Observers	Survey type	Species	RNF no./ Specimen label code	Tissue
			Peale Islet		
05/29/2019	SAH, ARB	Glue board	CRPO	11884	Body
05/29/2019	SAH, ARB	Glue board	CRPO	11885	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11891	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11892	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11893	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11894	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11895	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11896	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11897	Body
05/16/2018	SAH, JCM	Glue board	EMCY	11898	Body
05/29/2019	SAH, ARB	Glue board	EMCY	P1A EMCY	Tail
05/29/2019	SAH, ARB	Glue board	EMCY	P2A EMCY	Tail
05/29/2019	SAH, ARB	Glue board	EMCY	P4A EMCY	Tail
05/29/2019	SAH, ARB	Glue board	EMCY	P13A EMCY A	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI6G	Tail
05/29/2019	SAH, ARB	NVES	HEFR	11878	Body
05/29/2019	SAH, ARB	NVES	HEFR	11879	Body
05/29/2019	SAH, ARB	NVES	HEFR	PNVES1STRT HEFR A	Tail
05/29/2019	SAH, ARB	NVES	HEFR	PNVES1STRT HEFR B	Tail
05/29/2019	SAH, ARB	Glue board	LELU	P10 LELU	Tail
05/29/2019	SAH, ARB	Glue board	LELU	P11 LELU	Tail
05/29/2019	SAH, ARB	NVES	LELU	PNVES1STRT LELU A	Tail
05/29/2019	SAH, ARB	NVES	LELU	PNVES1STRT LELU B	Tail
05/29/2019	SAH, ARB	NVES	LELU	PNVES1STRT LELU C	Tail
05/29/2019	SAH, ARB	NVES	LELU	PNVES1STRT LELU D	Tail
			Wake Islet		
05/31/2019	SAH, ARB	Glue board	CRPO	11883	Body
05/31/2019	SAH, ARB	Glue board	CRPO	11882	Body
06/01/2019	SAH, ARB	Glue board	CRPO	11889	Body
06/01/2019	SAH, ARB	Glue board	CRPO	11888	Body
06/01/2019	SAH, ARB	Glue board	CRPO	11887	Body
06/07/2019	SAH, ARB	Incidental	CRPO	11899	Body
06/07/2019	SAH, ARB	Incidental	CRPO	11900	Body
06/07/2019	SAH, ARB	Incidental	CRPO	11901	Body
06/07/2019	SAH, ARB	Incidental	CRPO	CRPO near dorms building 116	Tail
05/25/2019	SAH, ARB	Glue board	EMCY	11858	Body

Table D2.1. List of reptile specimens collected during reptile surveys done by U.S. Geological Survey at Wake Atoll in 2019.—Continued

[All specimens have accompanying tissue samples for future DNA studies. **Observers:** SAH, SA Hathaway; ARB, AR Backlin; JCM, JC Molden. **Species codes:** CRPO, *Cryptoblepharus poecilopleurus* (Oceania snake-eyed skink); EMCY, *Emoia cyanura* (azure-tailed skink); HEFR, *Hemidactylus frenatus* (common house gecko); LELU, *Lepidodactylus lugubris* (mourning gecko). **Abbreviations:** no., number; mm/dd/yyyy, month/day/year; NVES, night visual encounter survey]

Date (mm/dd/yyyy)	Observers	Survey type	Species	RNF no./ Specimen label code	Tissue
Wake Islet—Continued					
05/25/2019	SAH, ARB	Glue board	EMCY	11862	Body
06/03/2019	SAH, ARB	Glue board	EMCY	11890	Body
05/31/2019	SAH, ARB	Glue board	EMCY	WS3G EMCY A	Tail
05/31/2019	SAH, ARB	Glue board	EMCY	WS4G EMCY	Tail
05/31/2019	SAH, ARB	Glue board	EMCY	WS6G EMCY	Tail
05/31/2019	SAH, ARB	Glue board	EMCY	WS7G EMCY	Tail
05/31/2019	SAH, ARB	Glue board	EMCY	WC2 EMCY A	Tail
05/31/2019	SAH, ARB	Glue board	EMCY	WC2 EMCY B	Tail
05/25/2019	SAH, ARB	Incidental	EMCY	Mess Hall	Tail
05/25/2019	SAH, ARB	Glue board	HEFR	11860	Body
05/25/2019	SAH, ARB	Glue board	HEFR	11851	Body
05/25/2019	SAH, ARB	Glue board	HEFR	11852	Body
05/25/2019	SAH, ARB	Glue board	HEFR	11861	Body
06/03/2019	SAH, ARB	Incidental	HEFR	11886	Body
05/25/2019	SAH, ARB	NVES	HEFR	11840	Body
05/25/2019	SAH, ARB	NVES	HEFR	11841	Body
05/25/2019	SAH, ARB	NVES	HEFR	11842	Body
05/25/2019	SAH, ARB	NVES	HEFR	11843	Body
05/25/2019	SAH, ARB	NVES	HEFR	11844	Body
05/31/2019	SAH, ARB	Glue board	HEFR	WL6L HEFR	Tail
05/25/2019	SAH, ARB	NVES	HEFR	WN1VESBag2 HEFR A	Tail
05/25/2019	SAH, ARB	NVES	HEFR	WN1VESBag2 HEFR B	Tail
05/25/2019	SAH, ARB	NVES	HEFR	WN1VESBag2 HEFR C	Tail
05/25/2019	SAH, ARB	Glue board	LELU	11859	Body
05/25/2019	SAH, ARB	Glue board	LELU	11857	Body
05/25/2019	SAH, ARB	NVES	LELU	11874	Body
05/25/2019	SAH, ARB	NVES	LELU	11875	Body
05/25/2019	SAH, ARB	NVES	LELU	11876	Body
05/25/2019	SAH, ARB	NVES	LELU	11877	Body
05/25/2019	SAH, ARB	NVES	LELU	WN1VESBag2 LELU A	Tail
05/25/2019	SAH, ARB	NVES	LELU	WN1VESBag2 LELU B	Tail
05/25/2019	SAH, ARB	NVES	LELU	WN1VESBag2 LELU C	Tail
05/25/2019	SAH, ARB	NVES	LELU	WN1VESBag2 LELU D	Tail
05/25/2019	SAH, ARB	NVES	LELU	WN1VESBag2 LELU E	Tail
05/28/2019	SAH, ARB	NVES	LELU	WIN2VES LELU A	Tail
05/28/2019	SAH, ARB	NVES	LELU	WIN2VES LELU B	Tail

Table D2.1. List of reptile specimens collected during reptile surveys done by U.S. Geological Survey at Wake Atoll in 2019.—Continued

[All specimens have accompanying tissue samples for future DNA studies. **Observers:** SAH, SA Hathaway; ARB, AR Backlin; JCM, JC Molden. **Species codes:** CRPO, *Cryptoblepharus poecilopleurus* (Oceania snake-eyed skink); EMCY, *Emoia cyanura* (azure-tailed skink); HEFR, *Hemidactylus frenatus* (common house gecko); LELU, *Lepidodactylus lugubris* (mourning gecko). **Abbreviations:** no., number; mm/dd/yyyy, month/day/year; NVES, night visual encounter survey]

Date (mm/dd/yyyy)	Observers	Survey type	Species	RNF no./ Specimen label code	Tissue
			Wilkes Islet		
05/28/2019	SAH, ARB	Glue board	CRPO	11873	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11855	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11864	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11865	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11866	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11867	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11870	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11871	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11872	Body
05/26/2019	SAH, ARB	Glue board	EMCY	11856	Body
05/26/2019	SAH, ARB	Glue board	EMCY	WI1 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI6 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI7 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI8 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI9G EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI11G	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI13 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI13 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI13 EMCY B	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI19 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI20 EMCY A	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI20 EMCY B	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI21 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI21 EMCY	Tail
05/26/2019	SAH, ARB	Glue board	EMCY	WI23 EMCY	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI32 EMCY A	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI32 EMCY B	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI32G	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI33 EMCY	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI33 EMCY	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI37 EMCY	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI37 EMCY A	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI37 EMCY B	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI37 EMCY A	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI37 EMCY B	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI39 EMCY A	Tail
05/28/2019	SAH, ARB	Glue board	EMCY	WI39 EMCY B	Tail
05/26/2019	SAH, ARB	Glue board	HEFR	11853	Body

Table D2.1. List of reptile specimens collected during reptile surveys done by U.S. Geological Survey at Wake Atoll in 2019.—Continued

[All specimens have accompanying tissue samples for future DNA studies. **Observers:** SAH, SA Hathaway; ARB, AR Backlin; JCM, JC Molden. **Species codes:** CRPO, *Cryptoblepharus poecilopleurus* (Oceania snake-eyed skink); EMCY, *Emoia cyanura* (azure-tailed skink); HEFR, *Hemidactylus frenatus* (common house gecko); LELU, *Lepidodactylus lugubris* (mourning gecko). **Abbreviations:** no., number; mm/dd/yyyy, month/day/year; NVES, night visual encounter survey]

Date (mm/dd/yyyy)	Observers	Survey type	Species	RNF no./ Specimen label code	Tissue
Wilkes Islet—Continued					
05/26/2019	SAH, ARB	Glue board	HEFR	11850	Body
05/26/2019	SAH, ARB	Glue board	HEFR	11868	Body
05/28/2019	SAH, ARB	Glue board	HEFR	11880	Body
05/25/2019	SAH, ARB	NVES	HEFR	11845	Body
05/25/2019	SAH, ARB	NVES	HEFR	11846	Body
05/25/2019	SAH, ARB	NVES	HEFR	11847	Body
05/25/2019	SAH, ARB	NVES	HEFR	11848	Body
05/25/2019	SAH, ARB	NVES	HEFR	11849	Body
05/28/2019	SAH, ARB	Glue board	HEFR	WI33T HEFR	Tail
05/26/2019	SAH, ARB	Glue board	LELU	11863	Body
05/26/2019	SAH, ARB	Glue board	LELU	11854	Body
05/26/2019	SAH, ARB	Glue board	LELU	11869	Body
05/28/2019	SAH, ARB	Glue board	LELU	11881	Body
05/28/2019	SAH, ARB	Glue board	LELU	WI34T	Tail

Appendix D3. Field Guide to the Herpetofuana of Wake Atoll

Photographs and descriptive summaries of native and introduced reptile species that have been recorded on Wake Atoll and amphibian and reptile species that have higher potential to arrive.

About this Guide

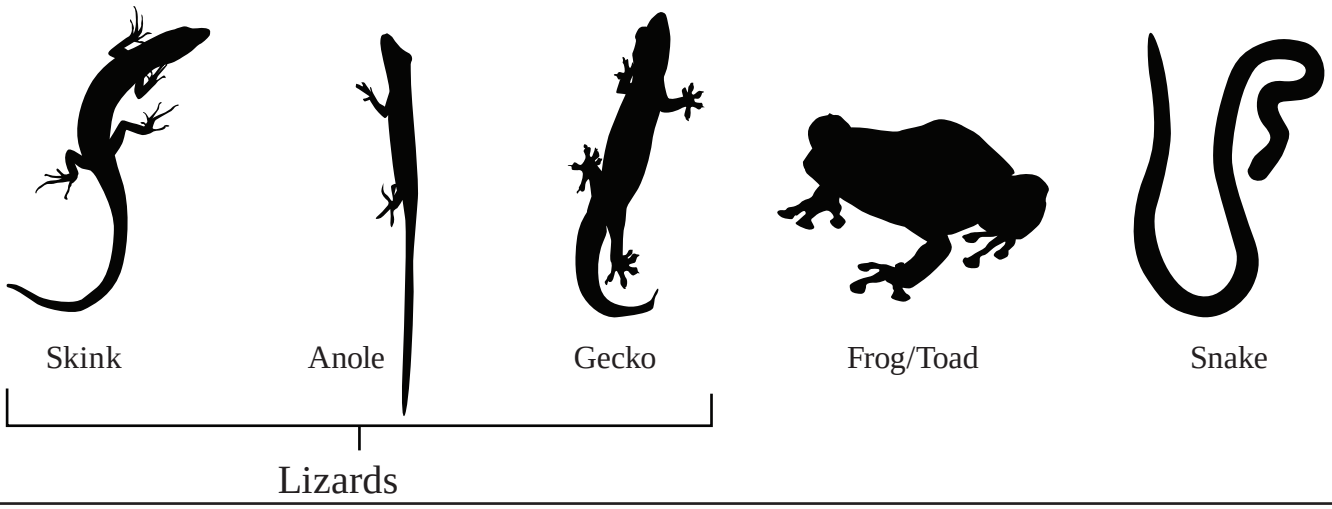
We attempted to make this guide simple and easy to use. We include basic information on the species recorded (here this means a physical voucher, such as a specimen or photograph) and a short list of "horizon" species we consider to be the most likely reptile species ("on the horizon") to arrive at Wake Atoll (hereafter referred to generally as "Wake"). As such, species could be observed at Wake that are not included in this guide. Identification to species level often requires close up details of the animal. As a result, it is ideal to capture, contain, or at minimum photograph an animal if there is question of identification.

We included a quick reference guide, beginning with the species that have been recorded at Wake, with a recent (1923 to 2019) physical voucher (specimen or photograph) followed by species that have the highest likelihood of arriving unintentionally through human movement. This guide includes abbreviated information regarding the status for Wake, that is to say, whether they are considered to be native, endemic, adventive or invasive, or no record; their four-letter species code (the first two letters of their genus combined with the first two letters of their specific epithet) for ease of reference; their size, as indicated by the range of adult snout vent length (SVL); and the time they are most active (day or night). More information regarding status is provided in the "Species Accounts for Taxa Recorded at Wake Atoll" section.

Photographs for the "Quick Reference Guide" section were provided by A.R. Backlin, C.W. Brown, R.N. Fisher, S. Fisher, S.A. Hathaway, and J.Q. Richmond, U.S. Geological Survey. Graphics and illustrations were created by C.J. Hitchcock, U.S. Geological Survey.

Information for Reference

General Shapes:



Definitions

Dorsal	upper side or "back" region of an individual
Ventral	underside or "belly" region of an individual
Lateral	along the sides of the body of an individual
SVL	snout vent length; the distance between the tip of the snout and the cloaca (opening on underside near base of tail) of an individual
Lamellae	thin plates or scales on underside of toes of lizards
Adventive	a species persisting outside its native range after arrival by human activity directly or indirectly, intentionally, or accidentally
Invasive	adventive but has the potential to become a problem economically or ecologically at the site locally
Endemic	a species that exists only at the site locality
Native	a species that naturally inhabits the site locality

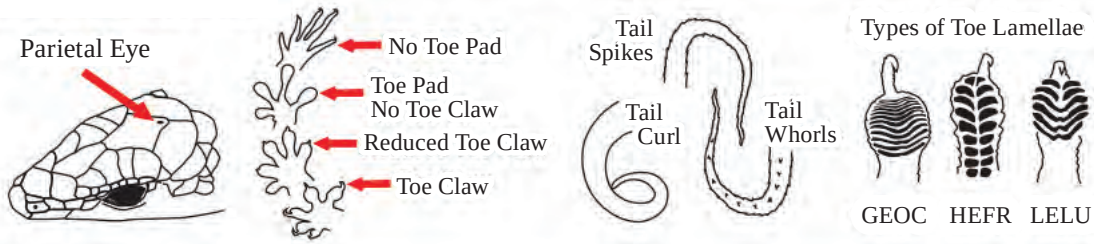
Risk Assessment

Low (Risk)	likely not to be an economic or ecological problem
Medium (Risk)	could pose a moderate economic or ecological problem
High (Risk)	Likely to pose an economic or ecological problem

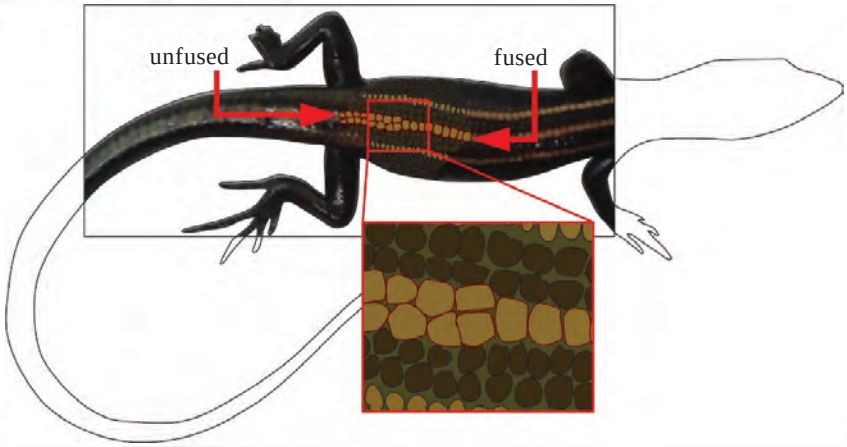
Management Feasibility

Very low (Feasibility)	highly unlikely to be effectively eradicated or controlled
Low (Feasibility)	unlikely to be effectively eradicated or controlled
Medium (Feasibility)	moderate likelihood to be effectively eradicated or controlled
High (Feasibility)	likely to be effectively eradicated or controlled

Diagnostic Characters:



Example of fused and unfused scales:

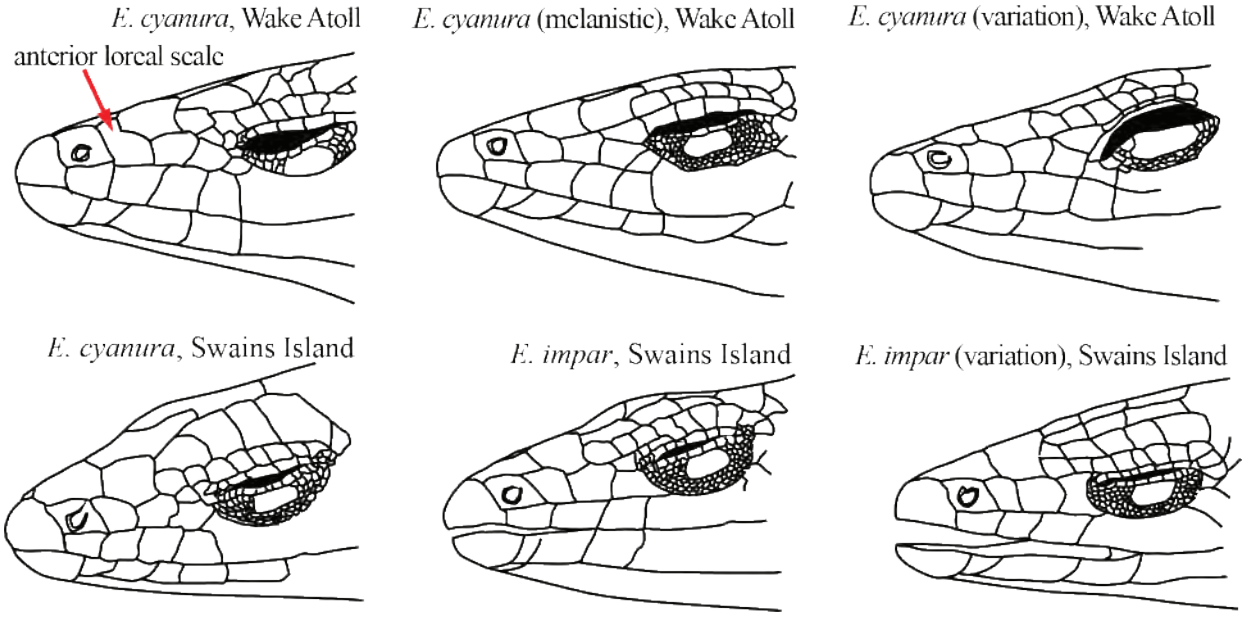


Graphics and illustrations were created by C.J. Hitchcock, U.S. Geological Survey.

Anterior Loreal Guide

The two skinks *Emoia cyanura* and *Emoia impar* can be difficult to tell apart, so we highlight specific distinguishing characters. Typically, although not always, *E. cyanura* has a visible parietal eye, which *E. impar* lacks. *Emoia impar* generally has one or more points with paired dorsal scale fusion along the midline where it has its central stripe, and *E. cyanura* does not have this feature. *Emoia cyanura* has a white underside, and *E. impar* has a grey/dusky belly. The last main character that separates the two species is the anterior loreal scale. Because we did not capture any *E. impar* during our survey, and there is only one museum specimen of the species at the Bernice Pauahi Bishop Museum from the Tanager Expedition, we do not know the variance in the shape of this scale in Wake across both species. This difference is subtle; it requires the capturing of the animal and close examination with a strong hand lens or microscope while measuring with calipers to distinguish. This practice is not practical for most rapid field assessments. Typically, *E. cyanura* has an anterior loreal scale that is "wider than tall," and *E. impar* has an anterior loreal scale that is "taller than wide." When we looked at the scales for the *E. cyanura* on Wake, we did not find them to be typical, so we have included a diagram to reduce confusion. In the three examples from Wake shown on the figure, the anterior loreal scales are not longer than tall but are convex posteriorly. This shape makes using the loreal scale as a character difficult. We also illustrate one *E. cyanura* and two *E. impar* from Swains Atoll for comparison. These illustrations show that the *E. cyanura* from Swains Atoll has a similar anterior loreal scale to specimens from Wake, but the difference in shape for *E. cyanura* is striking compared to *E. impar* in which the anterior loreal scale is more angular and "taller than wide." The one museum specimen of *E. impar* from Wake has a scale that is similar to the *E. impar* from Swains Atoll, and thus, we accept that identification. Although we did not detect *E. impar* at Wake, the previous identification indicates that continuing the search is reasonable.

Anterior loreal scale illustrations:



Graphics and illustrations were created by C.J. Hitchcock, U.S. Geological Survey.

Components of Species Accounts:

Photograph by A.R. Backlin, U.S. Geological Survey

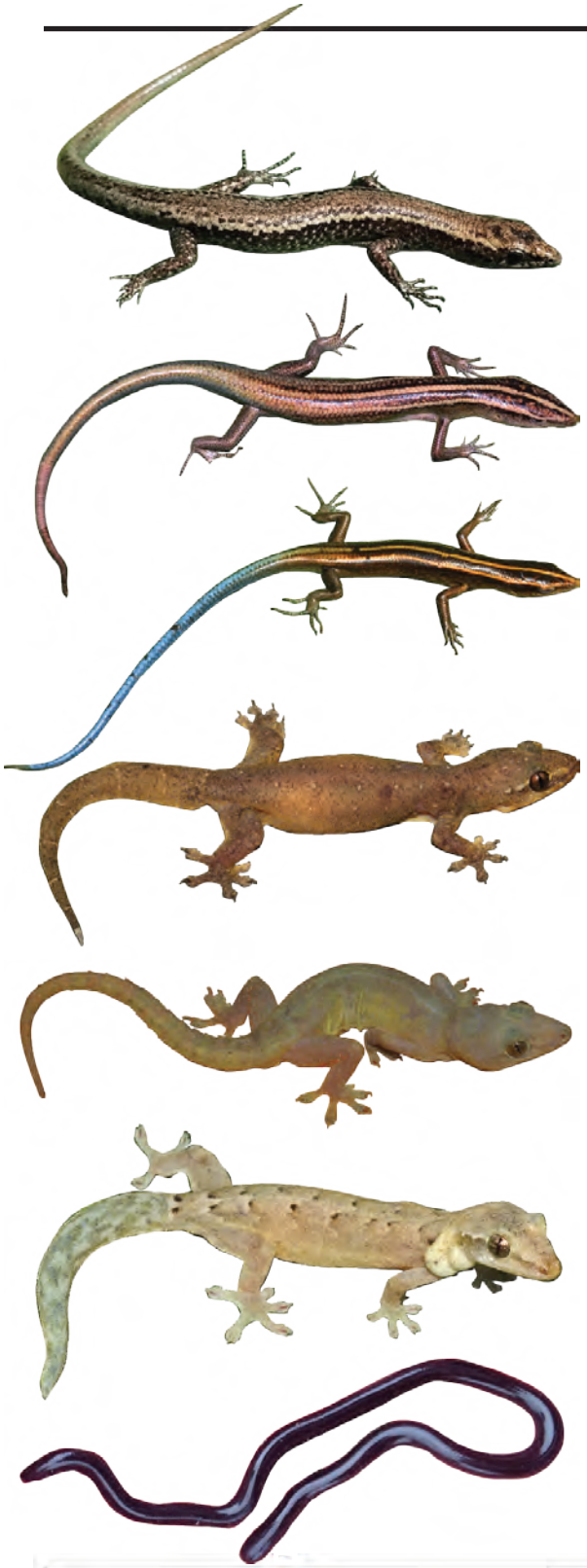
Description: A general description and photographs of species' characteristics to help in identification. We point out species that are often difficult to distinguish from each other and highlight features to assist with correctly identifying them. Note: Lizards can regrow their tails when lost to predators or injury. References to tail descriptions in this guide assume that it is the original tail, not one that has regenerated (see example of regrown tail in the photograph shown).

Habitat: A general description of what types of habitats a species is likely to prefer and in which habitats they are likely to be detected.

Historical Status and Distribution: Refers to when a species was first documented and possibly last seen at Wake, on which islets (if known), whether a species is considered native, endemic, adventive, or invasive, and remarks about its relative abundance.

Risk Assessment: We carried out a preliminary risk assessment for individual taxa (plants, arthropods, and reptiles) to rank species established at Wake according to their invasive effect (known or potential) and management feasibility for prioritizing integrated pest management at Wake (Hathaway and others, 2022). Species' invasive effect was ranked high, medium, or low based on published risk assessments, when available, or based on effects of similar species.

We include a datasheet at the back of this guide (Supplemental D.1) for reporting any potential observations of species not known to be native or already established on Wake.



Quick Reference Guide

SPECIES RECORDED

Cryptoblepharus poecilopleurus
Oceania Snake-eyed Skink
Status: native or endemic
4-Letter Code: CRPO
SVL: 37-51 mm (1.5-2 inches)
DAY

Emoia cyanura
Azure-tailed Skink
Status: adventive or native
4-Letter Code: EMCY
SVL: 39-56 mm (1.5-2.2 inches)
DAY

Emoia impar
Dark-bellied Copper-striped Skink
Status: adventive or native
4-Letter Code: EMIM
SVL: 40-47 mm (1.5-1.85 inches)
DAY

Gehyra insulensis
Pacific Stump-toed Gecko
Status: adventive
4-Letter Code: GEIN
SVL: 36-50 mm (1.4-2 inches)
NIGHT

Hemidactylus frenatus
Common House Gecko
Status: invasive
4-Letter Code: HEFR
SVL: 42-60 mm (1.6-2.4 inches)
NIGHT

Lepidodactylus lugubris
Mourning Gecko
Status: native
4-Letter Code: LELU
SVL: 33-49 mm (1.3-2 inches)
NIGHT

Ramphotyphlops braminus
Brahminy Blindsnake
Status: adventive
4-Letter Code: RABR
SVL: 98-170 mm (3.9-6.7 inches)
NIGHT

Photographs for the "Quick Reference Guide" section were provided by A.R. Backlin, C.W. Brown, R.N. Fisher, S. Fisher, S.A. Hathaway, and J.Q. Richmond, U.S. Geological Survey. Graphics and illustrations were created by C.J. Hitchcock, U.S. Geological Survey.

Quick Reference Guide

SPECIES WHICH MAY ARRIVE

Rhinella marina
Cane Toad
Status: no record
4-Letter Code: RHMA
SVL: 80-238 mm (3.1-9.25 inches)
NIGHT

Eleutherodactylus coqui
Coqui Frog
Status: no record
4-Letter Code: ELCO
SVL: 35-60 mm (1.4-2.4 inches)
NIGHT

Lampropholis delicata
Metallic Skink
Status: no record
4-Letter Code: LADE
SVL: 30-45 mm (1.2-1.8 inches)
DAY

Lipinia noctua
Moth Skink
Status: no record
4-Letter Code: LINO
SVL: 35-45 mm (1.4-1.8 inches)
DAY

Carlia ailanpalai
Admiralty Brown Skink
Status: no record
4-Letter Code: CAAI
SVL: 48-60 mm (1.9-2.4 inches)
DAY

Nactus pelagicus
Pacific Slender-toed Gecko
Status: no record
4-Letter Code: NAPE
SVL: 50-75 mm (2-3 inches)
NIGHT

Quick Reference Guide

SPECIES WHICH MAY ARRIVE

Gehyra oceanica
Oceanic Gecko
Status: no record
4-Letter Code: GEOC
SVL: 60-85 mm (2.4-3.4 inches)
NIGHT

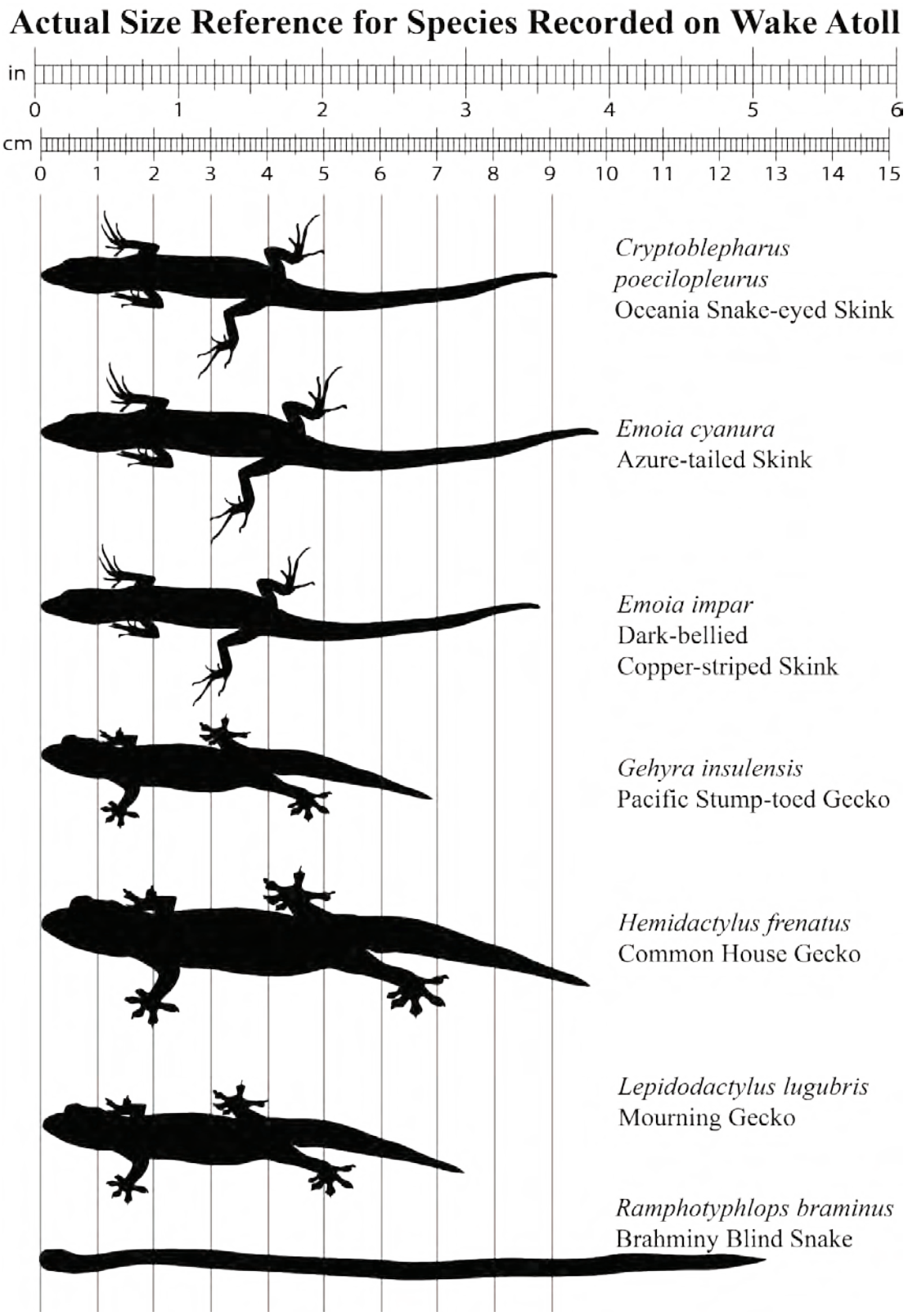
Phelsuma laticauda
Gold-dust Day Gecko
Status: no record
4-Letter Code: PHLA
SVL: 45-60 mm (1.8-2.4 inches)
DAY

Anolis carolinensis
Green Anole
Status: no record
4-Letter Code: ANCA
SVL: 50-70 mm (2-2.8 inches)
DAY

Anolis sagrei
Brown Anole
Status: no record
4-Letter Code: ANSA
SVL: 45-70 mm (1.8-2.8 inches)
DAY

Boiga irregularis
Brown Tree Snake
Status: no record
4-Letter Code: BOIR
SVL: 80-250 cm (31.5-98.5 inches)
NIGHT

Pituophis catenifer
Gopher Snake
Status: single record
4-Letter Code: PICA
SVL: 76-153 cm (30-60 inches)
DAY



Graphics and illustrations were created by C.J. Hitchcock, U.S. Geological Survey.

Species Accounts for Taxa Recorded at Wake Atoll

Diagnostics for species accounts for taxa recorded at Wake Atoll and for horizon species were based our own data as well as drawn from Buden, 2009; Tonione and others, 2011; Zug, 2013; and Buden and Taboroši, 2016.

Lizards (Skinks and Geckos)

Oceania Snake-eyed Skink, *Cryptoblepharus poecilopleurus* (Weigmann, 1836)

Description: The Oceania snake-eyed skink is small to midsized, with slightly elongate-body, short limbs, and a long sub-cylindrical tapering tail. The head is ovate and barely distinguishable from the neck. This species does not have eyelids. The eyes are protected by a clear scale. The dorsum color is variable but consistent within local populations from golden tan to coppery brown with dark flecks on top and cream spots on the sides. The tail is typically a lighter shade than the body. The underside can be bluish white to creamy tan. Adult SVL ranges from 37 to 51 millimeters (mm) and hatchlings from 21 to 23 mm.

Habitat: This species is typically detected in beach habitats of rock shorelines and beach side trees and shrubs. Most active during daytime.

Historical Status and Distribution: Native or endemic. First recorded in 1871, last recorded in 2019 (U.S. Geological Survey) on Wake, Wilkes, and Peale Islets.

Risk Assessment: Not applicable.

Photographs by A.R. Backlin, U.S. Geological Survey

Azure-tailed Skink, *Emoia cyanura* (Lesson, 1830)

Description: The azure-tailed skinks' dorsal ground color is black to dark copper, overlain by three bright cream-to-copper stripes. The mid-dorsal stripe extends from the tip of the snout to the tail. In "melanistic" individuals, stripes are often lacking, and the skin is dark copper. The tail is bluish in some small juveniles but typically greenish brown in juveniles and adults, although more often brown in adults. The underside is white with coppery overtone and may be tinged with green near the vent. This species may have a distinct parietal eye. Adults range from 39 to 56 mm SVL, and hatchlings range from 20 to 23 mm SVL. The tail is 150–175 percent of the SVL.

Habitat: This species is predominantly terrestrial but forages occasionally on the low bases of trees and in the lower branches of trees or axils of palms and pandanus. The azure-tailed skink prefers open-sky habitat, such as lawns and shrubby areas within urban landscapes or grassy beach-sides, gardens, and open-canopied, secondary-growth forests. Most active during daytime.

Historical Status and Distribution: Adventive or native. First recorded in 1923 (Tanager Expedition), last recorded in 2019 (U.S. Geological Survey) on Wake, Wilkes, and Peale Islets.

Risk Assessment: Low.

Photographs by C.W. Brown and A.R. Backlin, U.S. Geological Survey

Dark-bellied Copper-striped Skink, *Emoia impar* (Werner, 1898)

Description: The dark-bellied copper-striped skink has a dorsal ground color of black to dark copper, overlain by three bright copper-color stripes, which are usually distinct to the anterior trunk and fading thereafter. The mid-dorsal stripe extends from the tip of the snout to the tail. In "melanistic" individuals, stripes are generally absent, and the skin is dark copper. The tail is bright blue in juveniles and fading but distinctly blue in adults. The mid-dorsal paired row of scales almost always has some pairs fused into larger single scales. The underside is a gray/dusky color. Adult SVL ranges from 40 to 47 mm, and hatchling SVL is about 22 mm. The tail is usually 125–175 percent of the SVL.

Habitat: This species is generally shade-loving, detected mainly in strong canopied forest or at forest edges. This skink is predominantly terrestrial but forages occasionally on the bases of trees and in the lower branches of trees or axils of palms and pandanus. Most active during daytime.

Historical Status and Distribution: Adventive or native. Only one record from 1923 (Tanager Expedition); no additional location description beyond "Wake Island."

Risk Assessment: Low.

Photographs by C.W. Brown U.S. Geological Survey

Pacific Stump-toed Gecko, *Gehyra insulensis* (Girard, 1857)

Description: The Pacific stump-toed gecko is usually unicolor dorsally from light gray to medium brown, often with brown blotches, and occasionally, white spots with the tail often alternating lighter and darker bands. The underside tends to be pale gray or yellow. Toe pad lamellae are broad and divided. The tail is usually a thick, slightly flattened cylinder, tapering to a blunt tip. Adult SVL ranges about 36–50 mm, and hatchlings range about 21–23 mm SVL. The skin is loosely attached and often peels when captured.

Habitat: Outside of its native range, this species is most often detected with human habitation and less often in forests. Most active during nighttime.

Historical Status and Distribution: Adventive. First recorded in 1923 (Tanager Expedition) on Wilkes Islet, and also the last record with a specimen; a verbal record on Wilkes Islet with no supporting documentation was last made in 1998.

Risk Assessment: Medium.

Photographs by R.N. Fisher, C.W. Brown, and A.R. Backlin, U.S. Geological Survey

Common House Gecko, *Hemidactylus frenatus* Schlegel, 1836

Description: The common house gecko is a midsized, moderately robust, slightly flattened lizard with well-developed limbs. Coloration is light to medium gray to dusky brown. There may be a lateral brown stripe from the snout to the hind limb. The underside may be whitish to dark beige. Toe lamellae are divided except near the base of the toe. The tail is strongly segmented with large, flattened cone-shaped scales. Adult SVL ranges from 42 to 60 mm, with the tail about equal length to the body. Hatchlings' SVL ranges from 19 to 26 mm.

Habitat: This species is rarely detected away from human structures, but on Wake, it has recently (2019) been reported throughout the atoll. This gecko species may be seen or heard during daytime but most often at night.

Historical Status and Distribution: Invasive. First recorded 1953, last recorded 2019 (U.S. Geological Survey) on Wake, Wilkes, and Peale Islets.

Risk Assessment: High.

Common house gecko (top, bottom left, and middle in bottom right). All other geckos (bottom) are mourning geckos. Photographs by C.W. Brown, A.R. Backlin, and S.A. Hathaway, U.S. Geological Survey

Mourning Gecko, *Lepidodactylus lugubris* (Duméril and Bibron, 1836)

Description: The mourning gecko is a small, moderately robust lizard with short, well-developed limbs and tail. Color is generally light to medium brown with variable dorsal patterns that may be unicolor to dark and may have chevrons or dark blotches. The underside is white to light beige. Only the distal two or three lamellae are divided. The tail is thick and flattened tapering to a blunt tip. Adult SVL ranges from 33 to 49 mm, with the tail longer than body, and hatchlings range from 14 to 20 mm SVL.

Habitat: This species is commonly associated with humans, but its habitat ranges from shrubs bordering beaches to secondary forest, and it is generally less abundant in gardens, disturbed forest, and rock outcrops. This species is seen or heard most often at night.

Historical Status and Distribution: Native. First recorded 1923 (Tanager Expedition), last recorded 2019 (U.S. Geological Survey) on Wake, Wilkes, and Peale Islets.

Risk Assessment: Not applicable.

Photographs by C.W. Brown and R.N. Fisher, U.S. Geological Survey

Snakes

Brahminy Blindsnake, *Ramphotyphlops braminus* (Daudin, 1803)

Description: The Brahminy blindsnake is a tiny snake that resembles an earthworm and has a rounded head with vestigial eyes that are difficult to see and a pointed tail with a tiny spur at the end. Total length is 98–170 mm.

Habitat: This species lives in soil and can be detected in leaf litter, rocks, and debris. This snake is occasionally seen on the surface, especially after rain.

Historical Status and Distribution: Invasive. First recorded 1998 on Wake Islet, last recorded 2017 on Peale Islet.

Risk Assessment: Low.

Photographs by A.J. Louros, U.S. Geological Survey

Horizon Species: Descriptions

Frogs and Toads

Cane Toad, *Rhinella marina* (Linnaeus, 1758)

Description: The cane toad has variable coloration from tan to reddish, brown to gray, with dark spots. This species has large prominent glands on its shoulders and ridges on the top of its head. Adults range from 80 to 238 mm.

Habitat: Cane toads can be detected near human habitation and will breed in the vegetated areas of any freshwater habitat. This species is most active during nighttime.

Historical Status and Distribution: No record on Wake.

Risk Assessment: Not assessed. Invasive on many islands, including Hawai`i and Guam.

Photographs by C.W. Brown, C.J. Hitchcock, and A.R. Backlin, U.S. Geological Survey

Coqui Frog, *Eleutherodactylus coqui* Thomas, 1966

Description: The coqui frog is a relatively small frog that is highly variable in coloration, including tan, yellow, orange, red, and dark brown. Coloration may have no pattern, one or two cream stripes, or patterns ranging from spots, blotches, v-shaped marks, or an "M" between the shoulders. Eyes are gold to brown. Coqui frogs are often identified (and detected) by the distinctive call "Ko-Kee" made by adult males. Adult SVL ranges from 35 to 60 mm, and froglets start at about 5 mm SVL.

Habitat: Coqui are habitat generalists and can be detected on the forest ground and varying heights using trees, shrubs, and leaf litter. This species is most active during nighttime.

Historical Status and Distribution: No record on Wake.

Risk Assessment: Not assessed. Invasive on Hawai`i and Guam.

Photographs by C.W. Brown, U.S. Geological Survey

Lizards (Skinks, Geckos, and Anoles)

Metallic Skink, *Lampropholis delicata* (De Vis, 1888)

Description: The metallic skink is a small typically brown or bronze skink often with a rainbow iridescence. Some individuals have a stripe down the back. The underside is whitish with gray striations on the throat. Adults range from 30 to 45 mm SVL. The tail is much longer than the body.

Habitat: The metallic skink is ground dwelling and uses leaf litter across a variety of habitats from urban to farmland and scrub to forest. This species is most active during daytime.

Historical Status and Distribution: No record on Wake.

Risk Assessment: Not assessed. This invasive species is now the dominant invasive skink on the island of Hawai`i.

Photographs by C.W. Brown, U.S. Geological Survey

Moth Skink, *Lipinia noctua* (Lesson, 1830)

Description: The moth skink is a small and slender lizard with a cylindrical tail. The body color is light to medium brown. The head is triangular with a light spot which transforms into a mid-dorsal stripe. It has a dark brown stripe that starts before the eye and runs down to base of the tail. Adult SVL ranges from 38 to 47 mm, and hatchling SVL ranges from 15 to 17 mm.

Habitat: This species prefers forest floor to scrubby forest and edge habitat in some areas but is strongly arboreal in open areas and less-disturbed areas. This species is most active during daytime.

Historical Status and Distribution: No record on Wake.

Risk Assessment: Not assessed.

Photographs by C.W. Brown, U.S. Geological Survey

Admiralty Brown Skink, *Carlia ailanpalai* Zug, 2004

Description: The Admiralty brown skink is mid-sized and stockier/bulkier than skinks known to inhabit Wake. It has normal shaped limbs and a thick tail. This species has only four toes on its forelimbs. No other skinks currently (2019) recorded on Wake have only four toes. The dorsum color is pale orangish, brown, or smokey grey. It has a lighter orange or pinkish underside and lacks striping seen in skinks at Wake, with the exception of melanistic azure-tailed skinks. Adult SVL ranges from 48 to 60 mm and hatchlings range from 22 to 25 mm SVL.

Habitat: This species is quite broad in its habitat use, including extremely urban areas and even walking into the open doors of buildings. It is sometimes called the curious skink due to this behavior. Most active during daytime.

Historical Status and Distribution: No record for Wake.

Risk Assessment: High. This species is considered invasive where it has been introduced, including Guam, Palau, and in the Federated States of Micronesia on Yap and Chuuk (Buden, 2009). If observed, rapid action is warranted.

Photographs by R.N. Fisher, U.S. Geological Survey

Pacific Slender-Toed Gecko, *Nactus pelagicus* (Girard, 1858)

Description: The Pacific slender-toed gecko is a mid-sized gecko with a circular tail. It lacks wide toepads. The body and head are brownish grey with white spots along the labial scales and darker blotches or crossbands on the back. This species has rough skin with rows of elevated scales in parallel following its dorsal surface. The eyelids are yellowish, and the eyes are gold and red. The tail is banded. The underside is purplish grey but can change color to whitish. Adult SVL ranges from 48 to 75 mm.

Habitat: This species typically roams across the forest floor and stays low in trees and bushes and can sometimes be detected on the walls of houses. This species can be detected under rocks and coconuts during daytime. Most active at night.

Historical Status and Distribution: No record on Wake.

Risk Assessment: Low. This species is known to be in Guam and across the Federated States of Micronesia. This species is not known to be invasive anywhere; however, it is parthenogenic, so one female may start a new population on Wake if she arrives there.

Photographs by C.W. Brown and J.Q. Richmond, U.S. Geological Survey

Oceanic Gecko, *Gehyra oceanica* (Lesson, 1830)

Description: The oceanic gecko is a fairly robust lizard with short limbs. This species is usually unicolor dorsally from light or dark olive-brown to gray, with the tail often alternating lighter and darker bands. A pale stripe may extend from the snout through the eye to above the ear opening. The underside tends to be uniformly grayish olive or yellow. The toe lamellae are thin and undivided. The tail is usually a thick, slightly flattened cylinder, tapering to a blunt tip. Adult SVL ranges 59–84 mm, and hatchlings range 28–34 mm SVL. The tail is about the same length as the body.

Habitat: This species uses a range of habitats, including gardens, forests, and buildings. They are mostly seen at night but may be out in shade during the day. They particularly like banana plants.

Historical Status and Distribution: No record on Wake.

Risk Assessment: Low. Widespread in the central Pacific. There are no known invasive populations of this species. If this species established at Wake, it might only persist around the populated areas where there is more moisture.

Photographs by C.W. Brown, U.S. Geological Survey

Gold-dust Day Gecko, *Phelsuma laticauda* (Boettger, 1880)

Description: The gold-dust day gecko is a mid-sized gecko that is dorsally flattened and has a flat tail. The head is large and flattened. This species lacks claws on any of its toes. It is dorsally green with blue stripes on its head and red cross bands. It has three red streaks on its back and yellow/gold dusty coloration on the back of its head, neck, and shoulders. It has a blue ring around its eye and a red iris. Adult SVL ranges from 45 to 60 mm, and hatchlings range from 38 to 42 mm SVL.

Habitat: This species is invasive around houses on garden plants and can be detected on buildings and along rock walls as well as in scrubby habitats; however, it is not often seen on the ground. Most often active during daytime but can be detected near lights on buildings at night.

Historical Status and Distribution: No record on Wake.

Risk Assessment: Not assessed. This invasive species has been rapidly spreading and replacing all other lizards on islands in Hawai`i for the last 25 years. It has been detected in Moorea (at least since 2006) and in California (in 2017); it has been detected in a few nurseries. This species is considered invasive in Hawai`i and could become damaging to species in Wake if it arrived and spread.

Photographs by C.W. Brown, U.S. Geological Survey

Green Anole, *Anolis carolinensis* Voigt in Cuvier and Voigt, 1832

Description: The green anole is a mid-sized lizard with an elongated body, very pointed head, and a long and slender tail. This species has toe pads like some geckos. Coloration is uniformly green above but can be brown depending on the background substrates, and it has a white stripe along its dorsal mid-line. The underside is pure white and lacks any other color patterning. Adult SVL ranges from 50 to 70 mm, and hatchlings are about 21 mm SVL.

Habitat: This species is typically detected off the ground, on plants in gardens, and on the walls of houses. It will change colors to match its background. Most active during daytime but can be active near lights at night.

Historical Status and Distribution: No record on Wake.

Risk Assessment: High. This species is invasive in Hawai`i, some islands in Japan, the southern Mariana Islands, and Palau and Yap in the Caroline Islands. Because this species has affected the Oceania snake-eyed skink in Japan, we consider it a species of concern if it arrives in Wake.

Photographs by C.W. Brown and S. Fisher, U.S. Geological Survey

Brown Anole, *Anolis sagrei* Cocteau in A. M. C. Duméril and Bibron, 1837

Description: The brown anole is a mid-sized lizard and has a squat body and long limbs with a long tail. Coloration is brown with various possible patterns but typically has a white dorsal stripe. Males have an orange dewlap (a flap of skin that hangs beneath the lower jaw often brightly colored and used for territorial or mate signaling). The tail is dorso-laterally flattened. Adult SVL is from 45 to 70 mm, and hatchlings range 15–16 mm SVL.

Habitat: This species can be detected on various substrates on the ground and low on trees and bushes and rock and brick walls. Most active during daytime but can be active near lights at night.

Historical Status and Distribution: No record on Wake.

Risk Assessment: High. This species has been rapidly replacing many other lizards on islands in Hawai`i during the last decade and seems to have displaced Oceania snake-eyed skinks on Hawai`i in their nearshore habitats. This species has the potential to displace Oceania snake-eyed skinks because it utilizes the same habitats, and this species is much more aggressive and larger.

Photographs by S. Fisher, U.S. Geological Survey

Snakes

Brown Tree Snake, *Boiga irregularis* (Bechstein, 1802)

Description: The brown tree snake is a large and slender snake. It has vertical pupils and a large triangular head. It is brown or greenish yellow with some cross banding. Adult SVL ranges from 80 to 250 cm, and hatchlings are about 330-mm SVL.

Habitat: These snakes live in trees and shrubs but can be detected on houses, in the eves and other building features, in vehicles, and generally anywhere. They are active at night.

Historical Status and Distribution: No record on Wake.

Risk Assessment: High. These snakes have been a highly problematic invasive species in Guam, affecting biodiversity and economic health for more than 60 years (Rodda and Savidge, 2007; Soto and others, 2022). This species could decimate the birds and lizards of Wake if it arrived and could be difficult or impossible to eradicate if established.

Photographs by J.Q. Richmond and R.N. Fisher, U.S. Geological Survey

Gopher Snake, *Pituophis catenifer* (Blainville, 1835)

Description: The gopher snake is a heavier bodied snake with a tapering tail. It is tan with blotches across its dorsum. It has rounded pupils. Adult SVL ranges from 76 to 153 cm.

Habitat: The species is typically detected on the ground and will hide under surface objects. It is often active during daytime.

Historical Status and Distribution: There was one record at Wake from 1948.

Risk Assessment: Low. The species does not appear to be invasive anywhere. Because it is not a tropical species, it might not be able to establish in this environment.

Photographs by A.R. Backlin and C.W. Brown, U.S. Geological Survey

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