

Birds in the Diet of Invasive *Boa imperator* on St. Croix, U. S. Virgin Islands

MITCHELL GILLILAND¹, ANDREW M. DURSO^{2,*}, MATTHEW F. METCALF², OSCAR JOHNSON², SEAN P. KELLY³,
EDWIN M. EVERHAM III¹, AND NICOLE F. ANGELI³

¹*Department of Ecology and Environmental Science, The Water School, Florida Gulf Coast University,
Ft. Myers, Florida, U. S. A.*

²*Department of Biological Sciences, College of Arts & Sciences, Florida Gulf Coast University,
Ft. Myers, Florida, U. S. A.*

³*Division of Fish and Wildlife, Department of Planning and Natural Resources,
Government of Virgin Islands, St. Croix, U. S. A.*

*Corresponding author: amdurso@gmail.com

ABSTRACT—Giant constrictor populations in Florida and the Caribbean have top-down impacts on prey that are still poorly understood. We report opportunistically documented predation events by introduced *Boa imperator* (Central American Boa Constrictor) on four species of native birds on St. Croix, U. S. Virgin Islands, compare these to more detailed dietary studies from Aruba, and encourage detailed studies of *Boa imperator* diet on St. Croix to better understand population and community-level impacts of predation by this invasive snake.

Invasive boa constrictors on the island of St. Croix were first observed in 2012, and the source population has been identified as the Central American *Boa imperator* Daudin, 1803 (Angeli et al. 2019; for the break-up of the species once part of *Boa constrictor* Linnaeus, 1758, see Suárez-Atilano et al. 2014, Card et al. 2016, and Thorpe and Malhotra 2023). Since October 2021, 122 boas have been brought to the Virgin Islands Division of Fish & Wildlife on St. Croix, and an additional ca. 1,000 individuals over the past decade have been removed from the wild by volunteers. Annual capture data suggest a population experiencing exponential growth (St. Croix Snakes 2023) similar to that reported for *B. constrictor* on the island of Aruba (Reinert et al. 2021). *Boa imperator* sightings occur most frequently around the west coast of St. Croix, but the species is confirmed to be established across 30% (61.6 km²) of the island, with an estimated 60% (136.2 km²) of St. Croix being suitable *Boa* habitat (Angeli et al. 2019; Gilliland 2023).

Snakes in the genus *Boa* have not been the subject of many detailed diet studies, but they are known to feed primarily on mammals, birds, and lizards (Vitt and Vangilder 1983; França et al. 2008; Sawaya et al. 2008; Pizzatto et al. 2009; Fiorillo et al. 2021). The diet of introduced *Boa constrictor* on Aruba consisted of 30–40% birds, 35–37% reptiles, and 25–33% mammals (Quick et al. 2005; Reinert et al. 2021). Undocumented

population declines of Burrowing Owls (*Athene cunicularia* (Molina, 1782)), Brown-throated Parakeets (*Eupsittula pertinax* Linnaeus, 1758), and Crested Bobwhite (*Colinus cristatus* (Linnaeus, 1766)) on Aruba have been suggested to be caused by *B. constrictor* predation (Derix et al. 2013; Wells and Wells 2017), and rapid population growth of the endemic Aruban whiptail lizard (*Cnemidophorus arubensis* van Lidth de Jeude, 1887) following *B. constrictor* establishment might be due to a decrease in bird predation (Goessling et al. 2015). Many insular snake populations feed heavily on birds (Lillywhite and Martins 2019), including *Boa* spp. on islands in their native range (Boback 2005; Reed et al. 2007). However, introduced snakes have caused extinction of numerous island bird species worldwide, and are a cause for concern (Savidge 1987; Fritts and Rodda 1998). Here, we document four instances of native bird predation by *B. imperator* on St. Croix, and place these in a broader context of *B. imperator* predation on the island. Two observations come from a social media group called “St. Croix Snakes” (<https://www.facebook.com/stxsnakes/about>), and two are our personal observations.

The first image from the St. Croix Snakes webpage is dated 23 October 2020 (Fig. 1) and shows a *B. imperator* constricting a Zenaida Dove (*Zenaida aurita* (Temminck, 1809)). Zenaida Doves are widespread throughout the Caribbean and are the most common



FIG. 1. A *Boa imperator* constricting a Zenaida Dove (*Zenaida aurita*) on St. Croix, U. S. Virgin Islands. Photo from St. Croix Snakes social media page posted on 23 October 2020.

native dove on St. Croix, although they have declined in relative abundance by an order of magnitude since 1957 (Steadman et al. 2009). They are considered a species of least concern in the Virgin Islands (Platenberg and Valiulis 2018). Their status elsewhere in the Caribbean is not well documented, although they are heavily hunted by humans for food and sport (Baptista et al. 2020).

The second image from the St. Croix Snakes webpage is dated 21 October 2020 (Fig. 2) and shows the stomach contents dissected from a *B. imperator*. One of these birds we identified as a Lesser Antillean Bullfinch (*Loxigilla noctis* (Linnaeus, 1766)). Although we cannot be certain, it appears to us that the second bird is the same species. Lesser Antillean Bullfinches are found from the Virgin Islands through Grenada; they are regionally abundant and widespread (Steadman et

al. 2009) and are listed as a species of least concern in the Virgin Islands (Platenberg and Valiulis 2018). They are recent arrivals in the Virgin Islands, first reported on St. John in 1971 (Raffaele and Roby 1977) and on St. Croix in 1979 (Norton 1984), although it is not known whether these populations were a result of a natural or human-assisted introduction (Raffaele and Roby 1977).

A third observation was recorded on 2 August 2023 when a *B. imperator* (total length = 85.6 cm, mass = 600 g) was collected from the garden of a residential home in Jolly Hill (17.734360° N; 64.861110° W) and brought to the St. Croix Division of Fish and Wildlife. After euthanizing the snake for necropsy, an adult Gray Kingbird (*Tyrannus dominicensis* (Gmelin, 1788)) (mass = 60 g) was found in the stomach (Fig. 3). Another observation of predation on an adult Gray Kingbird by a juvenile *B. imperator* (total length ca. 72 cm) from



FIG. 2. Stomach contents dissected from a *Boa imperator* on St. Croix, U. S. Virgin Islands showing a Lesser Antillean Bullfinch (*Loxigilla noctis*) at the top of the photo. Although not positively identifiable, the leg morphology of the bird in the bottom of the photo matches that of *L. noctis*. Photo from St. Croix Snakes social media page on 21 October 2020.

Frederiksted was documented on 27 Oct 2023 on the St. Croix Snakes webpage.

Gray Kingbirds are year-round residents from Hispaniola through the Lesser Antilles, while migratory populations breed in southern Florida, the Bahamas, Cuba, and Jamaica, and winter in northern South America as far south as the extreme northern Amazon (Smith and Jackson 2020). Their populations can be negatively impacted by hurricanes (Askins and Ewert 1991), but there has been little research on their long-term population trends. Gray Kingbirds seem to be relatively tolerant of human disturbance, but coastal development, consumption of insects with pesticide residues, and local hunting are all potential threats (Smith and Jackson 2020). They have not generally been considered threat-

ened or likely to decline in the near future (Rappole et al. 1983; Stotz et al. 1996), and are listed as a species of least concern in the Virgin Islands (Platenberg and Valiulis 2018), but there are few recent quantitative assessments.

A fourth observation, based on circumstantial evidence, was made on 8 April 2021 in a forested dry riverbed near the base of Creque Dam (17.7455° N; 64.8763° W, WGS84) in northwestern St. Croix. A dead Bridled Quail-Dove (*Geotrygon mystacea* (Temminck, 1811)) (Fig. 4) was found on the ground ca. 1.5 m below a tree hollow that contained a live male *B. imperator* (SVL = 175 cm, mass = 465 g). When dissected, the *B. imperator* had two partly digested chicks inside (no photos taken, carcasses not saved). Although the chicks



FIG. 3. Gray Kingbird (*Tyrannus dominicensis*) found 2 August 2023 in the stomach of a *Boa imperator* collected in Jolly Hill, St. Croix, U. S. Virgin Islands. Photos by S. Kelly.

could not be identified and no nest was observed, we suspect that this could represent a case of nest predation that also resulted in, or at least coincided with, the death of one of the parent birds. Bridled Quail-Dove nests are placed 1.3–6 m above the ground in vines, shrubs, and trees (Bond 1941; Chipley 1991; Boal and Madden 2022), which is consistent with the location of our finding. The sum of this circumstantial evidence causes us to include this observation, though the conclusion of predation must be viewed as tentative.

Bridled Quail-Doves are found from Vieques to St. Lucia, but northwestern St. Croix might have some of the best remaining populations globally (Boal and Madden 2022). Elsewhere in the Lesser Antilles, habitat loss, hunting, and predation by introduced species are threats. Bridled Quail-Doves initially suffered high mortality from introduced small Indian mongoose (*Urva auropunctata* (Hodgson, 1836), formerly *Herpestes javanicus* (É. Geoffroy Saint-Hilaire, 1818); Veron et al. 2007) on St. Croix through direct and nest predation but seem to have adapted by the early 1960s (Seaman and Randall 1962). These doves were thought to be extirpated from St. Croix following Hurricane

Hugo in 1989 (Wauer and Wunderle 1992), but their populations appear to have recovered (McNair et al. 2005; Yntema et al. 2017). They are considered a high-risk species of greatest conservation need in the Virgin Islands (Platenberg and Valiulis 2018).

Each of the four bird species identified here is widespread across the Caribbean and considered to have stable regional populations. All four of these species have been identified as Least Concern by IUCN global assessments (BirdLife International 2016, 2018, 2020, 2021). Other resident landbirds of conservation concern that might be prey of *B. imperator* on St. Croix include Black-faced Grassquit (*Tiaris bicolor* Linnaeus, 1766), Smooth-billed Ani (*Crotophaga ani* Linnaeus, 1758), and Common Ground-Dove (*Columbina passerine* (Linnaeus, 1758)) (Steadman et al. 2009).

The records that we have outlined here represent the only cases of *B. imperator* predation on native species on St. Croix. Other *B. imperator* prey records from wildlife incident reports within the Division of Fish and Wildlife and from the St. Croix Snakes social media page were of non-native rodents (N = 12), cats (N = 2), mongoose (N = 7), domestic chickens (N = 7), other *B. imperator* (N = 1), and *Iguana iguana* (Linnaeus, 1758)



FIG. 4. Ventral view (A) and dorsal view (B) of Bridled Quail-Dove (*Geotrygon mystacea*) found dead near apparent *Boa imperator* nest predation 8 April 2021 near the base of Creque Dam in northwestern St. Croix. The only other species of similar size found on St. Croix is the Common Ground Dove (*Columbina passerina*), which also has rufous in wings, but has a darker scaled breast and lacks the purple tones visible on the dorsum. Photos by M. Metcalf.

($N = 7$) (iguanas on St. Croix are a mixture of *Iguana iguana melanoderma* Breuil et al., 2020, a native Lesser Antilles lineage, and *Iguana i. rhinolopha*, an introduced continental lineage; Dunn 1934; Lazell 1973; Breuil et al. 2020; de Jesús Villanueva et al. 2021). Notably, no skinks, geckos, teiids, or anoles have yet been documented as *B. imperator* prey on St. Croix, but we suspect that these small lizards would be more difficult to notice than larger prey.

Snakes can be important predators of birds and bird nests (DeGregorio et al. 2014) and birds that have evolved in allopatry with snakes might suffer increased rates of nest predation (Conry 1988). St. Croix's only extant native snake is the blindsnake *Antillotyphlops richardi* (A.M.C. Duméril & Bibron, 1844), but the extinct (since 1898) St. Croix Racer (*Borikenophis sanctaecrucis* (Cope, 1862)) reached ca. 1 m in length. Other species of *Borikenophis* have been reported to depredate bird nests (Norton 1993; Pérez-Rivera and Laboy-Rivera 1996), although they mostly eat lizards and frogs (Henderson and Sajdak 1996). Thus, native landbirds of St. Croix might not be completely evolutionarily naïve to snake predation.

On Aruba, introduced *B. constrictor* (Bushar et al. 2015) initially fed largely on native birds and mammals and have shifted to feed more heavily on “urban sub-

sidies” like domestic chickens and non-native birds, although they still consume native prey (Quick et al. 2005; Reinert et al. 2021). Because the native species assemblage on St. Croix was depleted by post-1500 colonial agriculture (97% of large forests clear cut by 1950; Angeli and Fitzgerald 2021), non-native species such as mongeese, rats, mice, cats and chickens may be subsidizing the *B. imperator* population on St. Croix. It is also possible that *B. imperator* predation on mongeese and rodents on St. Croix might release native birds and lizards from predation pressure from these invasive species, with potential benefits for some native species, as was seen on Aruba (Goessling et al. 2015) and has been anecdotally reported on St. Croix.

Boa spp. are opportunistic, generalist predators that would likely eat nearly any bird species. That more bird species have not been identified in their diet reflects the absence of any systematic effort to do so. Our report is a small step in understanding the ecological impacts of the diverse and rapidly changing giant constrictor populations in Florida and the Caribbean (Hanslowe et al. 2018). Further research should attempt to investigate the direct and indirect population-level impacts of predation by this invasive snake on endemic, threatened, and other non-native species on St. Croix and elsewhere.

Acknowledgments—We thank Alex Marsh, Lucas Everham, and the Government of the Virgin Islands, Division of Fish and Wildlife staff for assistance in the field and laboratory, and the administrators and volunteers of St. Croix Snakes. The Florida Gulf Coast University Water School supported travel to St. Croix for MG, MM, and EE.

LITERATURE CITED

- Angeli, N. F., W. Coles, S. McKinley, and D. G. Mulcahy. 2019. Introduction of an exotic constricting snake (*Boa constrictor*) and its establishment on St. Croix, U.S. Virgin Islands. *Herpetological Conservation and Biology* 14: 288–296.
- Angeli, N. F. and L. A. Fitzgerald. 2021. Reintroducing species when threats still exist: assessing the suitability of contemporary landscapes for island endemics. *Oryx* 55: 344–351.
- Askins, R. A. and D. N. Ewert. 1991. Impact of Hurricane Hugo on bird populations on St. John, U.S. Virgin Islands. *Biotropica* 23: 481–487.
- Baptista, L. F., P. W. Trail, H. M. Horblit, P. F. D. Boesman, G. M. Kirwan, and E. F. J. Garcia. 2020. Zenaida Dove (*Zenaida aurita*), version 1.0. In *Birds of the World*. J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana (eds.). Cornell Lab of Ornithology.
- BirdLife International. 2016. *Geotrygon mystacea*. The IUCN Red List of Threatened Species 2016: e.T22690958A93296362. <https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22690958A93296362.en>. Accessed on 10 August 2023.
- BirdLife International. 2018. *Loxigilla noctis*. The IUCN Red List of Threatened Species 2018: e.T22734677A132183438. <https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22734677A132183438.en>. Accessed on 10 August 2023.
- BirdLife International. 2020. *Zenaida aurita*. The IUCN Red List of Threatened Species 2019: e.T22690750A163499479. <https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22690750A163499479.en>. Accessed on 10 August 2023.
- BirdLife International. 2021. *Tyrannus dominicensis*. The IUCN Red List of Threatened Species 2021: e.T22700509A137916521. <https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22700509A137916521.en>. Accessed on 10 August 2023.
- Boal, C. W. and H. M. Madden. 2022. Bridled Quail-Dove (*Geotrygon mystacea*), version 2.0. In *Birds of the World*. P. G. Rodewald (ed.). Cornell Lab of Ornithology.
- Boback, S. M. 2005. Natural history and conservation of island boas (*Boa constrictor*) in Belize. *Copeia* 2005: 879–884.
- Bond, J. 1941. Nidification of the birds of Dominica, B.W.I. *Auk* 58: 364–375.
- Breuil, M., D. Schikorski, B. Vuillaume, U. Krauss, M. N. Morton, E. Corry, N. Bech, M. Jelić, and F. Grandjean. 2020. Painted black: *Iguana melano-derma* (Reptilia, Squamata, Iguanidae) a new melanistic endemic species from Saba and Montserrat islands (Lesser Antilles). *ZooKeys* 926: 95.
- Bushar, L. M., R. G. Reynolds, S. Tucker, L. C. Pace, W. I. Lutterschmidt, R. A. Odum, and H. K. Reinert. 2015. Genetic characterization of an invasive *Boa constrictor* population on the Caribbean island of Aruba. *Journal of Herpetology* 49: 602–610.
- Card, D. C., D. R. Schield, R. H. Adams, A. B. Corbin, B. W. Perry, A. L. Andrew, G. I. M. Pasquesi, E. N. Smith, T. Jezkova, S. M. Boback, W. Booth, and T. A. Castoe. 2016. Phylogeographic and population genetic analyses reveal multiple species of *Boa* and independent origins of insular dwarfism. *Molecular Phylogenetics and Evolution* 102: 104–116.
- Chipley, R. M. 1991. Notes on the biology of the Bridled Quail-dove (*Geotrygon mystacea*). *Caribbean Journal of Science* 27: 180–184.
- Conry, P. J. 1988. High nest predation by brown tree snakes on Guam. *The Condor* 90: 478–482.
- de Jesús Villanueva, C. N., W. Falcón, X. Velez-Zuazo, R. Papa, and C. L. Malone. 2021. Origin of the green iguana (*Iguana iguana*) invasion in the greater Caribbean Region and Fiji. *Biological Invasions* 23: 2591–2610.
- DeGregorio, B. A., S. J. Chiavacci, P. J. Weatherhead, J. D. Willson, T. J. Benson, and J. H. Sperry. 2014. Snake predation on North American bird nests: culprits, patterns and future directions. *Journal of Avian Biology* 45: 325–333.
- Derix, R., G. Peterson, and D. Marquez. 2013. *The national bird count in 2011 in Aruba*. Central Bureau of Statistics (CBS) Aruba, Department of Environ-

- mental Statistics, Oranjestad, Aruba.
- Dunn, E. R. 1934. Notes on *Iguana*. *Copeia* 1934: 1–4.
- Fiorillo, B. F., J. H. Maciel, and M. Martins. 2021. Composition and natural history of a snake community from the southern Cerrado, southeastern Brazil. *ZooKeys* 1056: 95.
- França, F. G. R., D. O. Mesquita, C. C. Nogueira, and A. F. B. Araújo. 2008. Phylogeny and ecology determine morphological structure in a snake assemblage in the central Brazilian Cerrado. *Copeia* 2008: 23–38.
- Fritts, T. H. and G. H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: A case history of Guam. *Annual Review of Ecology, Evolution, and Systematics* 29: 113–140.
- Gilliland, M. 2023. The Isle of Misfit Species: Ecology of the invasive *Boa* on St. Croix, U.S. Virgin Islands. M.S. thesis. Florida Gulf Coast University, Ft. Myers, Florida.
- Goessling, J. M., W. I. Lutterschmidt, H. K. Reinert, L. M. Bushar, and R. A. Odum. 2015. Multiyear sampling reveals an increased population density of an endemic lizard after the establishment of an invasive snake on Aruba. *Journal of Herpetology* 49: 358–363.
- Hanslowe, E. B., J. G. Duquesnel, R. W. Snow, B. G. Falk, A. A. Y. Adams, E. F. Metzger III, M. A. M. Collier, and R. N. Reed. 2018. Exotic predators may threaten another island ecosystem: A comprehensive assessment of python and boa reports from the Florida Keys. *Management of Biological Invasions* 9: 369–377.
- Henderson, R. and R. Sajdak. 1996. Diets of West Indian racers (Colubridae: *Alsophis*): composition and biogeographic implications. Pp. 327–338 in *Contributions to West Indian Herpetology: A Tribute to Albert Schwartz*. R. Powell and R. W. Henderson (eds.). Society for the Study of Amphibians and Reptiles.
- Lazell, J. D., Jr. 1973. The lizard genus *Iguana* in the Lesser Antilles. *Bulletin of the Museum of Comparative Zoology at Harvard College* 145: 1–28.
- Lillywhite, H. B. and M. Martins (eds.). 2019. *Islands and Snakes: Isolation and Adaptive Evolution*. Oxford University Press.
- McNair, D. B., L. D. Yntema, C. D. Lombard, C. Cramer-Burke, and F. W. Sladen. 2005. Records of rare and uncommon birds from recent surveys on St. Croix, United States Virgin Islands. *North American Birds* 59: 536–551.
- Norton, R. L. 1984. West Indies Region. *American Birds* 38: 1064–1065.
- Norton, R. L. 1993. *Alsophis portoricensis richardii* (Ground Snake). Feeding. *Herpetological Review* 24: 34.
- Pérez-Rivera, R. A. and M. A. Laboy-Rivera. 1996. Aspectos de la conducta de un individuo de *Alsophis portoricensis* y pichones y adultos de reinita (*Coccyzus erythrophthalmus*) durante un episodio de depredación. *Caribbean Journal of Science* 32: 432–433.
- Pizzatto, L., O. A. Marques, and K. Facure. 2009. Food habits of Brazilian boid snakes: overview and new data, with special reference to *Corallus hortulanus*. *Amphibia-Reptilia* 30: 533–544.
- Platenberg, R. J. and J. M. Valiulis (eds.). 2018. United States Virgin Islands Wildlife Action Plan. Final report to the USVI Department of Planning and Natural Resources Division of Fish and Wildlife. University of the Virgin Islands and St. Croix Environmental Association, US Virgin Islands. 2 vol.
- Quick, J. S., H. K. Reinert, E. R. de Cuba, and R. A. Odum. 2005. Recent occurrence and dietary habits of *Boa constrictor* on Aruba, Dutch West Indies. *Journal of Herpetology* 39: 304–307.
- Raffaele, H. A. and D. Roby. 1977. The Lesser Antillean Bullfinch in the Virgin Islands. *Wilson Bulletin* 89: 338–342.
- Rappole, J. H., E. S. Morton, T. E. Lovejoy, III, and J. S. Rous. 1983. *Nearctic Avian Migrants in the Neotropics*. U.S. Fish and Wildlife Service.
- Reed, R. N., S. M. Boback, C. E. Montgomery, S. Green, Z. Stevens, and D. Watson. 2007. Ecology and conservation of an exploited insular population of *Boa constrictor* (Squamata: Boidae) on the Cayos Cochinos, Honduras. Pp. 388–403 in *Biology of the Boas and Pythons*. R. W. Henderson and R. Powell (eds.). Eagle Mountain Publishers.
- Reinert, H. K., A. E. Leto, J. A. Tumaliuan, S. Jackrel, W. I. Lutterschmidt, L. M. Bushar, and R. A. Odum. 2021. A long-term dietary assessment of invasive *Boa constrictor* on Aruba. *Herpetological Conservation and Biology* 16: 211–224.
- Savidge, J. A. 1987. Extinction of an island forest avifauna by an introduced snake. *Ecology* 68: 660–668.

- Sawaya, R. J., O. A. V. Marques, and M. Martins. 2008. Composição e história natural das serpentes de Cerado de Itirapina, São Paulo, sudeste do Brasil. *Biota Neotropica* 8: 127–149.
- Seaman, G. A. and J. E. Randall. 1962. The mongoose as a predator in the Virgin Islands. *Journal of Mammalogy* 43: 544–546.
- Smith, G. A. and J. A. Jackson. 2020. Gray Kingbird (*Tyrannus dominicensis*), version 1.0. In *Birds of the World*. A. F. Poole and F. B. Gill (eds.). Cornell Lab of Ornithology.
- St. Croix Snakes. 2023. <<https://www.facebook.com/stxsnakes/about>>
- Steadman, D. W., J. R. Montambault, S. K. Robinson, S. N. Oswalt, T. J. Brandeis, A. G. Londoño, M. J. Reetz, W. M. Schelsky, N. A. Wright, J. P. Hoover, J. Jankowski, A. W. Kratter, A. E. Martínez, and J. Smith. 2009. Relative abundance, habitat use, and long-term population changes of wintering and resident landbirds on St. John, US Virgin Islands. *The Wilson Journal of Ornithology* 121: 41–53.
- Suárez-Atilano, M., F. Burbrink, and E. Vázquez-Domínguez. 2014. Phylogeographical structure within *Boa constrictor imperator* across the lowlands and mountains of Central America and Mexico. *Journal of Biogeography* 41: 2371–2384.
- Stotz, D. F., J. W. Fitzpatrick, T. A. Parker, III, and D. K. Moskovits. 1996. *Neotropical Birds: Ecology and Conservation*. University of Chicago Press.
- Thorpe, R. S. and A. Malhotra. 2023. Systematics and biogeography of snakes of the genus *Boa* in the Lesser Antilles. *Caribbean Herpetology* 88: 1–14.
- Veron, G., M.-L. Patou, G. Pothet, D. Simberloff, and A. P. Jennings. 2007. Systematic status and biogeography of the Javan and small Indian mongooses (Herpestidae, Carnivora). *Zoologica Scripta* 36: 1–10.
- Vitt, L. J. and L. D. Vangilder. 1983. Ecology of a snake community in northeastern Brazil. *Amphibia-Reptilia* 4: 273–296.
- Wauer, R. H. and J. M. Wunderle. 1992. The effect of hurricane Hugo on bird populations on St. Croix, United States Virgin Islands. *The Wilson Bulletin* 104: 656–673.
- Wells, J. V. and A. C. Wells. 2017. *Birds of Aruba, Bonaire, and Curaçao*. Cornell University Press.
- Yntema, L. D., D. B. McNair, C. Cramer-Burke, F. W. Sladen, J. M. Valiulis, C. D. Lombard, A. O. Lance, and S. L. Fromer. 2017. Records and observations of breeding waterbirds, rare and uncommon birds, and marked individuals on St. Croix, U.S. Virgin Islands. *Journal of Caribbean Ornithology* 30: 88–127.