Introduced amphibians and reptiles in the greater Caribbean: Patterns and conservation implications

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Abstract. Non-native species are a growing worldwide conservation problem, often second only to habitat destruction and alteration as a cause of extirpations and extinctions. Introduced taxa affect native faunas through competition, predation, hybridization, transmission of diseases, and even by confounding conservation efforts focused on superficially similar endemic species. The number of known introductions of amphibian and reptilian species continues to grow. Herein, we document the arrival and establishment of alien amphibians and reptiles in the greater Caribbean region and the means by which they arrived. These include 130 species (25 amphibians and 105 reptiles) responsible for 364 individual introductions, of which 70.3% resulted in populations established for at least a short period. The impact of those 256 established populations ranges from minimal (localized effects largely restricted to dramatically altered habitats) to severe (displacement of native species from natural and modified habitats). Although intentional introductions for putative pest control (mostly historical) and food (historical and ongoing) are factors in some instances, the primary pathways for introductions today are inadvertent. Nearly all are associated with either the ever-growing pet trade or stowaways in cargo and ornamental plants. To document the extent of the live animal trade for pets and food, we review the surprisingly large numbers of documented individuals exported from the Caribbean into the United States (US) and from the US to the Caribbean. The extent of such trade and the rates of non-native arrivals continue to increase, and both are related to indices of regional economic activity. Because prevention is by far better — and more economical — than eradication of an established alien, we recommend increased scrutiny of transported goods and animals to and from the islands. An integrated policy response is clearly necessary to address what is a regional issue. Although the region

is highly fragmented both geographically and politically, we urge an increased regional cooperation for fighting invasive species in general and invasive herpetofauna in particular. Precedents for such cooperation include the Caribbean Community and Common Market (CARICOM) and the Caribbean Cooperation in Health initiative.

Key words: Amphibians; Caribbean; economic activity; eradication; introduced species; live animal trade; prevention; regional cooperation; reptiles; urban; vectors.

Introduction

Natural dispersal is a common phenomenon, although long-distance dispersal is typically infrequent (Nathan et al., 2003; Trakhtenbrot et al., 2005). Human-aided dispersal is increasingly common, however, even over great distances. Globally, human-transported non-native species are among the top three causes of biodiversity loss (Clavero and García-Berthou, 2005; McGeoch et al., 2010). The number of amphibians and reptiles being moved to non-native locations is growing (Lever, 2003; Kraus, 2009), as are reports of their ecological and economic impacts (e.g., Bomford et al., 2009), despite the inadequate attention paid to documenting them (McGeoch et al., 2010).

The greater Caribbean region, with extensive tourism in many areas and limited local production of essential items such as food and building materials, is at especially high risk. Herpetological introductions in the region are not new. Félix-Louis L'Herminier, as director of the "Jardin de naturalization de la Guadeloupe" in the early 19th century, had a goal of introducing and acclimating new species to the island (Breuil, 2002, 2003). Among the species he attempted to establish were *Kinixys erosa*, *Kinixys homeana*, and *Pelusios castaneus*, which are native to western Africa and which he might have purchased from slave traders. In addition, his son, François-Joseph, visited Puerto Rico and caught *Trachemys stejnegeri*, which was liberated in Marie-Galante. Other 19th-century reports include Schomburgk (1848), Gosse (1851), Feilden (1889), and Boulenger (1891). Modern reports are numerous and highly dispersed, despite efforts of Lever (2003) and Kraus (2009) to collate them. Our goal in this chapter is to summarize what is known about herpetological introductions in the region, the mechanisms that allow them, and their effects in this wide geographical area.

By their nature, islands are more isolated than mainland sites, yet over-water dispersal still occurs naturally (e.g., Censky et al., 1998; Calsbeek and Smith, 2003). We exclude such instances from the current analysis, which focuses on human-aided extra-limital dispersal events. We hope that the broad patterns that emerge — in particular, the primacy of a small number of arrival mechanisms and the close relation with economic activity — will encourage a coordinated regional policy response and help reduce negative economic and ecological impacts.

Materials and Methods

Regional coverage

We define the "greater Caribbean" to include the West Indies biogeographic region, the oceanic islands of Isla de San Andres and Isla de Providencia (Colombia), and three continental islands off the northern shore of South America (Aruba, Bonaire, Curaçao). For the West Indies, we use the definition of Henderson and Powell (2009) to include the Greater and Lesser Antilles plus the Bahama, Turks and Caicos, Swan, and Cayman islands. We exclude continental islands that have been connected to the mainland until recently and with faunas that reflect that origin. These include Trinidad, Isla de Margarita off South America (SA), and the Honduran Bay Islands off the Central American (CA) coast. We also exclude Tobago, which is functionally a continental island due to its proximity to Trinidad.

Literature review

To develop an overview of all introductions of amphibians or reptiles in the region, we exhaustively reviewed the pertinent literature, much of which was reviewed previously in Kraus (2009) and Henderson and Powell (2009). Unfortunately, records of "benign" non-native arrivals and dispersal are notoriously incomplete (McGeoch et al., 2010). We therefore supplemented the literature accounts with our own personal experiences, collected over several decades of working in the region. Finally, we solicited supplementary information from persons in parts of the region for which data were sparse.

We organize our text taxonomically. Written accounts identify (when known), the arrival mechanism (often as identified in Kraus, 2009), and whether this was a one-time arrival, a repeated incursion, or an established population. However, the origin of some populations — whether they arrived naturally or were human-mediated — remains uncertain. Locations are detailed in appendices 1 and 2, which also provide citations to assist readers seeking information regarding the sources or fates of introductions unrelated (appendix 1) and related to (appendix 2) conservation and research efforts. To avoid unnecessary duplication, we do not consistently distinguish arrivals to single islands within island groups or banks (e.g., Bahamas, Virgin Islands, Grenadines, Guadeloupean Archipelago) from arrivals to an entire island group.

Not all introductions are successful. Reports of one-time arrivals (e.g., Powell et al., 2005; Perry, 2009a) are uncommon in the literature, although they provide valuable information on vectors, propagule pressure, and times of arrival. In some instances, we report the presence of ephemeral populations, although many lasted for only relatively short periods. For example, Powell et al. (1992) documented a population of *Anolis bimaculatus* on St. Maarten that included both adults and juveniles, presumably from St. Eustatius. Subsequent visits to the site where the original observations were made and to nearby areas with presumably ideal habitat failed to reveal additional individuals. When known, we indicate such outcomes.

However, some populations indicated as established may yet fail, and some failures almost certainly have gone undocumented.

The source of introduced populations is only sometimes known, even when the event was recent. Generally, we are even less certain of sources for older introductions. For example, Amerindians and early European colonists almost certainly intentionally transported tortoises (*Chelonoidis carbonaria*) and iguanas (*Iguana iguana*) and possibly rainfrogs (*Eleutherodactylus johnstonei*, albeit inadvertently), from the mainland to islands or from one island to another (e.g., Censky, 1988, 1989; Powell, 2004b; Powell et al., 2005). Descendants of those animals might have interbred with animals descended from ancestors that arrived via natural overwater dispersal and animals introduced more recently, many in association with the burgeoning pet trade. Because of this complex and poorly documented history, whether particular populations of some species were established with human mediation cannot be determined with any certainty. Similarly, house geckos (*Hemidactylus mabouia*) are of African origin (e.g., Kluge, 1969; Vanzolini, 1978). Whether American populations were established as a consequence of natural trans-Atlantic dispersal (see discussion in Mausfeld et al., 2002) or were human-mediated is unknown (e.g., Hedges, 1996). Late Quaternary fossils on Guadeloupe (Pregill et al., 1994) are indicative of a prolonged presence in the region, although Breuil (2002, 2009) noted that only one species of gecko (*Thecadactylus rapicauda*) was known from the region at the time of colonization. However, once established in the Western Hemisphere, populations might have dispersed naturally to Caribbean islands; and such dispersal might have been facilitated by human activities or extant populations might be descendants of ancestors arriving by both means. Herein, we include only peripheral (i.e., Greater Antilles) or recent (Aruba, Bonaire, Curaçao) records, with the implicit assumption that at least some of the Lesser Antillean and Virgin Island populations are natural, although they might frequently be supplemented with individual stowaways.

Economic indicators and the live animal trade

In general, the magnitude of the invasive species problem is proportional to connectivity — the more transport and commerce between two locations, the greater the risk of species being moved (Perry and Vice, 2009, and references therein). This generality has rarely been tested in connection with specific geographic areas (but see Pyšek et al., 2010). To test it for the Caribbean, we compared aggregate arrival data for those species for which such data were available (from Kraus, 2009) to economic indicators for the US and the region for the same period. Although data were not available for the entire time period for which information on introductions is available (1800 onward), we obtained data on the Gross Domestic Product (GDP) during part of this period and the Consumer Price Index (CPI) for the entire period for the mainland US, and the GDP for Puerto Rico (PR), Dominican Republic (DR), and Jamaica (JA) since 1965. Data on US GDP were collected from 1929 onward and obtained from the US Department of Commerce,

Bureau of Economic Analysis (www.bea.gov/national/nipaweb/) and data on US CPI from 1800 onward were obtained from the U.S. Department of Labor, Bureau of Labor Statistics (www.minneapolisfed.org/community_education/teacher/). GDP data for Caribbean economies were obtained from World Bank Reports (http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/). Data on the live animal trade during the years 1998-2008 were obtained from the US Fish and Wildlife Service (USFWS) Law Enforcement Management Information System (LEMIS) database. This database only records animals coming into or exported out of the US, and thus represents an underestimate of the total legal traffic in the region, but is the only available source of such information.

Results

Our literature review and ancillary information provided documentation for 364 introductions of 130 species: 25 amphibians (19.2%) and 105 reptiles (80.8%) in the greater Caribbean (appendices 1 and 2). Of those introductions, 256 (70.3%) resulted in populations that were at least temporarily established. Subsequent failures of populations established for at least short periods of time have been recorded in only 29 instances (including six introductions for research purposes). Excluding unidentified species of *Trachemys* in the Bahamas, for which origins are unknown, and species introduced for conservation or research purposes (all of which originated from within the region), 38 species (33.3%) were native to other Caribbean islands and 76 (66.7%) presumably were native to areas outside the region. Most of the latter originated in CA or SA ($n = 32$; 42.1% of those from beyond the greater Caribbean) or NA ($n = 25$; 32.9%), but 19 (25.0%) were from the Eastern Hemisphere. Some species might have been established by individuals from regional captive-breeding programs supplying the international live animal trade, and some Caribbean populations of *Rhinella marina*, *Iguana iguana*, and *Gymnophthalmus underwoodi* might be native, but their exact origins remain unclear. A growing number of introductions (at least 39; 10.7% of all introductions) represent species that originated in the Caribbean or elsewhere, became established outside their native ranges — most notably in Florida — and were then introduced in the region. Nearly all are attributable to three species (*Osteopilus septentrionalis*, *Anolis sagrei*, *Ramphotyphlops braminus*).

Most species have become established on only one or two islands, but 25 species have been introduced to at least three islands or island groups in the region. Although many of the introduced populations are limited to human-dominated habitats, such as urban areas, at least some (e.g., *Rhinella marina*, *Eleutherodactylus johnstonei*, *Iguana iguana*, *Anolis sagrei*, *Boa constrictor*) have successfully invaded natural habitats. Known effects on native species in the region include predation, competition, hybridization, confounding conservation/education programs, and possibly introducing alien disease vectors.

Strays (documented arrivals of one or a few individuals with no evidence of reproduction) represent 24.2% of all documented introductions. These include 8 introductions of amphibians and 80 of reptiles, plus 3 amphibian and 18 reptilian introductions for which the status is unknown and which are presumed to have been strays. Including those would increase the percentage to 29.9% of all introductions.

Although some introduced populations stem from multiple arrivals and the origins of many are unknown, primary pathways for introduction include inadvertent arrivals in cargo and ornamental plants (ca. 100). However, a substantial number are associated with the pet trade (ca. 65). Some of the latter might have been intentional, but most releases were probably accidental. Tortoises (*Chelonoidis carbonaria*) and iguanas (*Iguana iguana*) are widely distributed throughout the region, and many populations probably have mixed origins, with some tracing their ancestry back to individuals that arrived via natural over-water dispersal, intentional introductions by Amerindians and early European colonists, inadvertent releases of pets, or some combination thereof (e.g., Censky, 1988; Powell, 2004b). Complicating matters further are recent intentional inter-island introductions such as that of *C. carbonaria* onto St.-Barthélemy from Saba after World War II (Breuil, 2004) or within the British Virgin Islands (BVI) for conservation purposes (Lazell, 2002, 2005, 2006; Perry and Gerber, 2006).

Although some unintentional introductions occurred more than a century ago, most are more recent. Intentional introductions fall into four broad categories: for food (10 amphibian introductions plus an undetermined percentage of arrivals of *I. iguana*, *C. carbonaria*, and turtles in the family Emydidae), for pest control ($n = 19$, *R. marina* and several instances involving *Eleutherodactylus* spp.), research ($n = 6$), and conservation ($n = 23$). Unlike recent conservation and research-related introductions (all after 1970), intentional introductions for food and biocontrol almost always occurred earlier, many during the 19th century. Rates of new arrivals of both amphibians and reptiles have markedly increased over time (fig. 1). Using only those data for which arrival dates have been documented, arrival rates of the two groups are highly and significantly correlated with each other (Kendall's tau; $n = 13$, $\tau = 0.60$, $P = 0.005$), although the amphibian data represent a smaller number of species than the more taxonomically diverse reptilian data.

Economic activity and herpetological introductions

Rates of arrival for both amphibians and reptiles are correlated with US GDP (Kendall's tau, $n = 8$, amphibians: $\tau = 0.64$, $P = 0.026$; reptiles: $\tau = 0.69$, $P = 0.018$; both amphibians and reptiles: $\tau = 0.69$, $P = 0.018$) and US CPI (fig. 1; $n = 13$, amphibians: $\tau = 0.61$, $P = 0.003$; reptiles: $\tau = 0.62$, $P = 0.003$; both: $\tau = 0.66$, $P = 0.002$), although numbers of introduced species began increasing before either economic indicator. The relationships with regional economic indicators for PR, the DR, and JA were similar, but not statistically significant, attributable both to the smaller sample sizes and slightly more irregular trends in economic

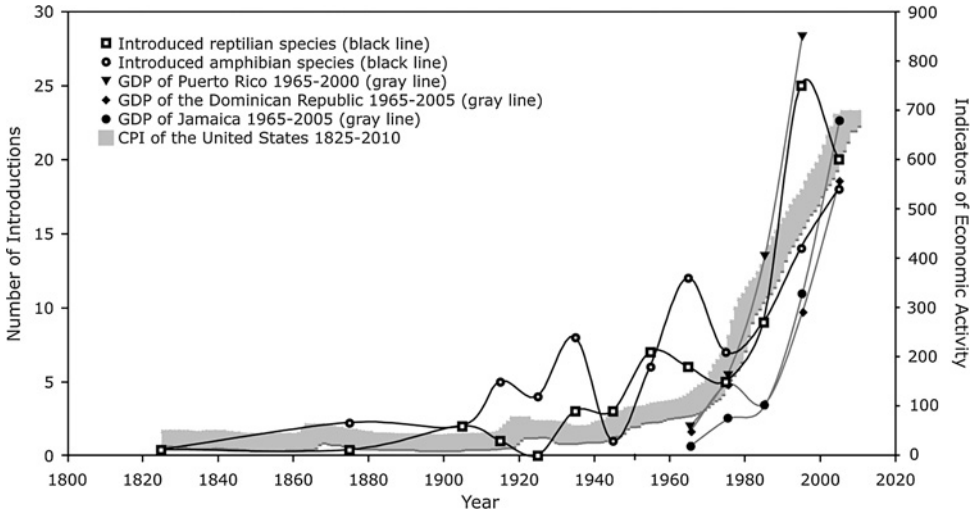

Figure 1. Rates of new amphibian and reptile arrivals (species/decade) for the greater Caribbean from 1825-2005. Note that the first two values for numbers of introductions represent data for fifty-year blocks, the last value is based on pro-rated data for part of the decade, and all of the others are based on data for full ten-year increments. Both amphibian and reptilian arrival rates (black lines) are strongly and significantly correlated with economic activity (broad gray line) in the United States (CPI: consumer price index). Data for the GDP of three Caribbean nations (gray lines) show a similar trend. See text for data sources.

activity. Still, the realities that nearly one-third of the species introduced into the region are from NA and that over 10% of all introductions presumably originated from introduced populations in Florida, in combination with the vast number of amphibians and reptiles transported between the US and the greater Caribbean (see below), suggest that the risk factors for introductions have steadily risen. Consequently, the driving power of US economic activity as a continuously rising source of tourism to the region, a steady destination for regional exports, and a source of imports implicate US and regional economic growth as a major factor directly or indirectly responsible for additional introductions in the future.

Although the Caribbean has never been a large legal export market for amphibians and reptiles for the US, a surprisingly large number of animals are shipped from the US to the Caribbean (appendix 3), the Caribbean to the US (appendix 4), and from the Caribbean to the US and then onwards, including back to the Caribbean (appendix 5). Between 1998 and 2008, approximately 1150 amphibians and 12,650 reptiles were exported each year from the US to the Caribbean. Over that same period, 21 amphibian and 50 reptilian species were exported to the Caribbean, with cumulative numbers of species increasing during that period (fig. 2).

Although some of the species transported from the US into the greater Caribbean (appendix 3) are for conservation purposes (e.g., release of captive-bred *Peltophryne lemur* into PR, where they are native) and others involve trade in species used for food (e.g., *Lithobates catesbeianus* into the DR), a large number are not found in

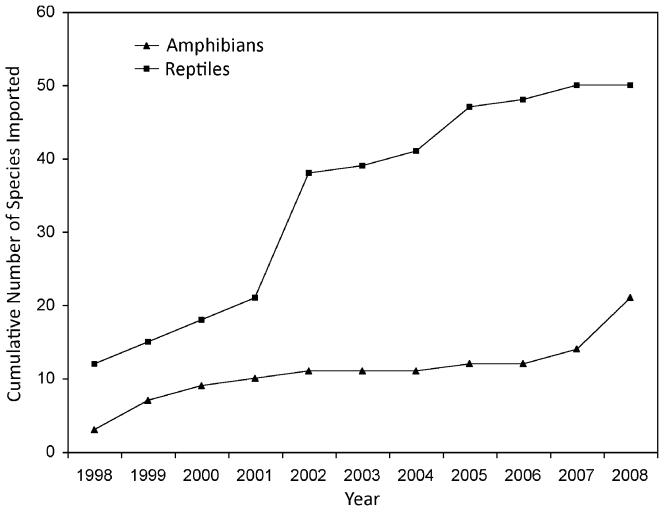

Figure 2. Cumulative number of amphibian and reptilian species exported from the US to the Caribbean between 1998 and 2008. Data are from the USFWS Law Enforcement Management Information System (LEMIS) database.

the region either naturally or as previously introduced populations. Twenty-three species of amphibians (including as many as ten species of salamanders, which are not known to occur naturally on any of the islands) obviously are being shipped to serve the pet/aquarium trade. Although most numbers are relatively modest, 3612 Oriental fire-bellied toads (*Bombina orientalis*) were shipped to the DR in 1999 and 1205 Japanese fire-bellied newts (*Cynops pyrrhogaster*) were sent to the Cayman Islands over a five-year period.

A somewhat similar pattern applied to reptiles exported from the US into the region. A small number are repatriated captive-bred animals, e.g., the *Cyclura nubila* shipped to the Cayman Islands in 1999 are almost certainly *C. lewisi* (then considered a subspecies of *C. nubila*) sent to augment the *in-situ* captive-breeding program. Turtles, which almost certainly represent a combination of animals destined for the pet trade and those destined for food markets, were shipped in the largest numbers, including 12,300 *Pseudemys* sp. sent to the Netherlands Antilles (no indication of whether these are the Leeward or Windward islands of that nation) and 20,066 and 97,910 *Trachemys scripta* shipped to the Bahamas and the DR, respectively. However, 33 transported reptilian species are not currently known to occur on any of the islands, including two cobras (*Naja* sp.) sent to the Bahamas.

Countries within the Caribbean region have exported introduced amphibians and reptiles to the US, as well as countries within the European Union and Asia. Like exports from the US, a few of the species imported from the region into the US (appendix 4) involve conservation programs (e.g., *C.* "*nubila*" from the Cayman Islands), some are destined for the food/restaurant market (e.g., nearly three

million *Lithobates catesbeianus* from the DR), but most almost certainly supply the pet/aquarium trade. Fifteen species are not known to occur in the region, including two cobras (possibly the same animals exported to the Bahamas that same year) and a number of species that are known from the greater Caribbean do not occur on the islands from which shipments into the US originated.

Over half of all 132 records of exports from the US to the region (appendix 3) are to two nations, Barbados with 27 (20.5%) and the Netherlands Antilles with 47 (35.6%). Although a market for pets exists in both nations, active animal vendors are based in those countries, suggesting that many of the exported animals are destined for markets elsewhere. Of 95 records of imports from the region into the US (appendix 4), most come from Barbados (12; 12.6%) and Haiti (26; 27.4%). The former nation, as noted previously, is very active in the pet trade and the latter is a major source of some popular species (e.g., 6720 presumably native *Anolis* spp. and 88,524 *Leiocephalus* spp.) as well as a transshipment center for species from elsewhere within the region (e.g., 56,656 *L. carinatus*, which are not native to Hispaniola) and beyond (e.g., 2623 African *Agama agama*). Of considerable concern are 888 endangered *Osteopilus vastus* shipped from Haiti in a two-year period. These large Hispaniolan endemics are associated with disappearing Hispaniolan gallery forests (Hedges et al., 2004) and have been included among species of special concern in the DR (Powell et al., 2000). The largest number of records of species imported into the US from the region for re-exportation primarily to Europe and Canada (appendix 5) come from Haiti (30 of 49; 61.2%). Although many presumably are native to Hispaniola (e.g., some *Anolis* spp. and *Leiocephalus* spp.), many others (e.g., *Agama agama*, *L. carinatus*) are not. Reinforcing the concept of Haiti, especially, as a transshipment center, several species re-exported from the US are species that are native to that nation.

Taxonomic patterns: Amphibians

Although some urodeles and a variety of frogs are exported to the Caribbean from the US, all amphibians introduced in the region to date have been frogs belonging to six families: Bufonidae, Eleutherodactylidae, Hylidae, Leptodactylidae, Leiuperidae, and Ranidae (until recently, genera in the families Eleutherodactylidae and Leiuperidae were assigned to the family Leptodactylidae). Relatively few genera are represented, most originating from within the region and all from within the Americas. Inadvertent introductions via the nursery trade are the most frequent mechanisms of arrival, although stowaways in cargo are common, as are species arriving via the pet trade and as a consequence of intentional releases for food or biocontrol.

True toads (family Bufonidae). The cane toad (*Rhinella marina*, formerly *Bufo marinus* or *Chaunus marinus*), native to the Neotropics, has been intentionally introduced for biocontol of insect pests in many parts of the world. Although it rarely fulfills that purpose, it feeds voraciously on almost everything else (e.g., Wolcott, 1937; Lynn, 1940; Long, 1974; Breuil, 2002; Meshaka and Powell, 2009),

with broad ecological impacts reported from Australia, Florida, and Hawaii (e.g., Esteal, 1981). Wilson et al. (2010) also reported negative effects on native predators, describing mortality in endemic and threatened Jamaican boas (*Epicrates subflavus*) after ingesting cane toads.

The cane toad is widely established in the Caribbean and some populations might be traced to founders that arrived naturally via over-water dispersal (Henderson and Powell, 2009). These toads are ubiquitous on many islands (e.g., Mallery et al., 2007 for St. Vincent). However, populations have failed to become established on islands that provide few opportunities to breed, such as Anguilla (Hodge et al., 2003; Hodge et al., 2011) and Union Island in the Grenadines (J. Daudin, pers. comm.). Also, despite efforts to establish the species on Cuba, it was uncommon by the early 1970s (Schwartz, 1972) and has since failed (Schwartz and Henderson, 1991; Henderson and Powell, 2009). Claims of its past presence in the British Virgin Islands (BVI; MacLean, 1982) have not been confirmed in recent years (G. Perry, unpubl. data; C. Petrovic, pers. comm.). These toads are common commensals, often utilizing human-created habitats such as parks, gardens, and resort grounds (Powell and Henderson, 2008) and exploiting the artificial night-light niche (Perry et al., 2008).

Treefrogs (family Hylidae). Treefrogs are frequently found in the pet trade in North America (NA), but means of dispersal such as stowing away in cargo and arriving with ornamental plants are much more common in the Caribbean. Several species are now found in the region, the most problematic of them being the Cuban treefrog (*Osteopilus septentrionalis*). These frogs readily act as human commensals and have a catholic diet that includes vertebrates (e.g., Meshaka, 2001; Owen, 2005; Powell and Henderson, 2008). Rödder and Weinsheimer (2010) indicated that the entire Caribbean Basin could provide suitable habitat under current climatic conditions. Severe ecological effects are likely, especially when these frogs invade relatively natural areas. For example, locals in the BVI often associate the arrival of *O. septentrionalis* with the ensuing decline and disappearance of native frogs (Owen, 2005). This species now has a broad Caribbean distribution and has also been established elsewhere in the world. The means of arrival are often complex, as single populations might have multiple temporal and geographic origins (e.g., van Buurt, 2007). The population on Anguilla was traced to containers of ornamental plants from Florida, and a small population had been present for several years before generating wide attention after a series of particularly wet years during the late 1990s. At that time, the frogs spread from localized sites (often on resort grounds) to much of the island, where they used various sources of water, including cisterns associated with residences, for breeding (Townsend et al., 2000; Hodge et al., 2003). A similar scenario played out on St.-Barthélemy, where an initial association with resorts was documented by Breuil (2002), Breuil and Ibéné (2008), and Breuil et al. (2009). In the BVI, a Beef Island nursery was a common cause of dispersal, and the owner stated: "These are my children," and refused to take action against the population (J. Owen, pers. comm.). Populations elsewhere have exhibited similar

patterns, remaining relatively obscure until propitious weather conditions (often associated with hurricanes) result in a population explosion. Cuban treefrogs were relatively rare on St. Maarten/St.-Martin in the 1980s, but had become almost ubiquitous by the early 1990s (e.g., Powell et al., 1992). Similarly, frogs were infrequently encountered on Antigua until they became a plague during a relatively short period in the late 1990s and early 2000s (Daltry, 2007, 2011; R. Powell, unpubl. data). Spread of this species continues (e.g., Powell, 2006, 2007 on Saba, presumably from St. Maarten; Perry, 2009a on Guana in the BVI, almost certainly from Beef Island). More recently, the species might now be established in the Turks & Caicos Islands (Reynolds and Niemiller, 2010; Reynolds, 2011). In dry years, frogs are less evident (Powell and Henderson, 2008; Hodge et al., 2011). Some populations on Anguilla and in the BVI have shrunk or disappeared as a result of management efforts — primarily blocking access to freshwater sources needed for reproduction — and a regional drought in 2009 (Hodge et al., 2011; G. Perry, unpubl. data).

The exact sources of established populations of *Hyla cinerea* on PR and *H. squirella* in the Bahamas are not known, but the source is likely to have been NA, where both are native. *Pseudacris crucifer* is another NA species. Although reported from Cuba, no extant populations are known to exist. *Scinax ruber* has become established in Martinique, PR, and St. Lucia, but the means of arrival remain largely uncertain. The population of this SA native on St. Lucia appears to have resulted from cargo stowaways (Kraus, 2009). The closely related *S. x-signatus*, also SA in origin, was recently reported on several islands in the Guadeloupean Archipelago (Breuil, 2004) and on Martinique (Breuil, 2011).

Rain frogs (family Eleutherodactylidae). Rainfrogs (genus *Eleutherodactylus*) are among the most commonly introduced amphibians, with the genus and two species listed among the most successful colonizers by Bomford et al. (2009). That success is largely attributable to their frequent association with nursery plants (e.g., Kraus, 2009). At least six different species have been introduced within the Caribbean. *Eleutherodactylus antillensis*, native to PR and the Virgin Islands, is established on St. Croix, US Virgin Islands (USVI; Platenberg and Boulon, 2006) and occurs locally on Necker Island (BVI; Perry and Gerber, 2011). The source appears to have been intentional introductions. *Eleutherodactylus coqui* from PR is established in the DR and the USVI. Initially imported with nursery plants, populations often spread as a consequence of locals intentionally introducing individuals into their yards and gardens. Economic and possibly environmental effects from populations established in Hawaii are considerable (e.g., Kaiser and Burnett, 2006), but similar data from the Caribbean are not available.

Eleutherodactylus johnstonei, originally described from an introduced population on Grenada (Barbour, 1914), is widely distributed in the Lesser Antilles (LA) and also has become established outside the region. Although these frogs do not penetrate high-quality closed-canopy forests in Jamaica (Wilson, 2011), introduced populations often are phenomenally successful. Germano et al. (2003) noted that

during a nighttime trip across Grenada, they were out of earshot of calling *E. johnstonei* for only a few seconds in the most densely developed center of St. George's, and Mallery et al. (2007) found calling frogs at every site they sampled on St. Vincent. The nursery trade and stowaways appear to be the primary vectors for dispersal.

Eleutherodactylus lentus, a USVI native, was recently reported from Jost Van Dyke in the BVI (Perry, 2009b). Although the species may have been native there, it most likely is a recent introduction via construction materials. Calling individuals located over multiple years suggest that this population is well established. *Eleutherodactylus martinicensis* from Antigua, Guadeloupe, Dominica, and Martinique was established on St.-Barthélemy as a result of the nursery trade (Kaiser, 1992) and on St. Maarten/St.-Martin, either via the nursery trade or as a stowaway in other cargo (Breuil, 2002). *Eleutherodactylus planirostris* from Cuba and the Bahamas is also broadly established, both within the Caribbean and beyond, including new populations in the Turks & Caicos (Reynolds and Niemiller, 2010; Reynolds, 2011). Although the nursery trade is involved in many instances, unintentional arrival via cargo also has been documented (Kraus, 2009). *Eleutherodactylus cochranae* from PR was introduced for research purposes onto Isla Palominitos, but the introduction did not result in an established population (Levins and Heatwole, 1973). However, *E. schwartzi* was intentionally translocated for conservation purposes within the BVI from Great Dog to Little Thatch Island, where it is now established (Lazell, 2005).

True frogs (family Ranidae). These frogs in the genus *Lithobates* (formerly assigned to the genus *Rana*) are associated with permanent bodies of (often flowing) water and would appear to be poor candidates for introduction. However, five species have been reported from the Caribbean, all of NA origin. The most widely distributed, and also potentially the most damaging, is the American bullfrog (*L. catesbeianus*), which was listed as the fourth most successful colonizing species by Bomford et al. (2009). Populations in the region almost certainly were intentionally introduced for food, although the pet trade has been implicated as a source of some populations in Canada and Europe (Kraus, 2009). The species is a major export out of the Caribbean, presumably also for the food industry. More aquatic than most other anurans in the region, the densest populations often are associated with artificial habitats such as drainage ditches, water hazards on golf courses, and reservoirs (Powell and Henderson, 2008), although they have successfully exploited natural bodies of water as well. Reaching a very large size, this species is capable of ingesting bats (Vogel, 1965) or birds (López-Flores et al., 2003), although much of the diet of West Indian populations is comprised of invertebrates (Pérez, 1951; Mahon and Aiken, 1977; Sampedro Marín et al., 1985, 2003; Montañez Huguez et al., 1996). At least two instances of bullfrogs consuming native West Indian frogs have been documented, *Leptodactylus albilabris* in Puerto Rico (Thomas and Joglar, 1996) and *Osteopilus dominicensis* on Hispaniola (Neils and Bugbee, 2007). Schloegel et al. (2009) implicated bullfrogs as vectors for *Batrachochytrium*

dendrobatidis and ranavirus introduced into the US and elsewhere. Considering the massive numbers of frogs moving from the Caribbean back and forth to the US and other parts of the world, they might very well be the sources of many chytrid infections that are being documented with increasing frequency in the region (e.g., Henderson and Powell, 2009).

The status of *L. clamitans* in the Bahamas remains uncertain (Knapp et al., 2011), but this species also attains considerable size and has the potential to cause ecological damage. *Lithobates grylio* is established in the Bahamas and Puerto Rico, and almost certainly was introduced intentionally as a human food source. *Lithobates sphenocephalus* apparently is established in the Bahamas, but *L. pipiens* failed to become established on St. Croix. The modes of introduction for these populations are unknown, but some were almost certainly intentional.

Narrow-mouthed frogs (family Microhylidae). Frogs in the genus *Gastrophryne* are secretive NA species with which most people are unfamiliar because they are primarily fossorial. One species, *G. carolinensis*, nonetheless succeeded in establishing itself in the Bahamas and on Grand Cayman Island, having arrived with ornamental plants (Seidel and Franz, 1994).

Neotropical frogs (family Leptodactylidae). Native to the Caribbean, the very robust "Mountain Chicken" (*Leptodactylus fallax*) has been introduced on Grenada, Jamaica, Martinique, and Puerto Rico, presumably intentionally as a delicacy (Kraus, 2009). All attempts ultimately failed, although the introduction to Martinique might date to Amerindians (Breuil and Ibéné, 2008; Breuil et al., 2009). Ironically, this species is rapidly declining in its native range (e.g., Garcia et al., 2007). Recent work (Yanek et al., 2006; Camargo et al., 2009) suggested that *L. validus*, long believed to be native to St. Vincent and Grenada, was in fact introduced into the LA with early human arrivals.

South American foam-nesting frogs (family Leiuperidae). *Pleurodema brachyops* is a SA species that has been on Aruba for a long time (its native Caquetío name, Dori Maco, is not used in Venezuela; van Buurt, 2005). The species might be native there, although introduction by Amerindians cannot be ruled out. Populations on Curaçao arrived largely with sand dug from the bottoms of water reservoirs on Aruba, which was used as grit to sandblast steam boilers (van Buurt, 2001, 2005). Those on Bonaire originated on Curaçao, arriving as tadpoles brought back from Curaçao and intentionally released in a small reservoir (van Buurt, 2001, 2005).

Taxonomic patterns: Reptiles

A variety of reptilian taxa has arrived in various Caribbean locations, and disconcertingly large numbers of those have become established. A large proportion of these species is of regional origin, although some originated in the Eastern Hemisphere. The two primary paths of arrival appear to be stowaways in cargo and, more recently, the pet trade, although other sources have been reported.

Crocodilians (families Alligatoridae and Crocodilidae). Such large and obvious animals might seem unlikely to be invasive, since they are not likely to stow away unnoticed. Several species are found in the pet trade, however, and this is the likely source of most records of *Caiman crocodilus*, although the population on Isla de la Juventud, Cuba, was intentionally introduced as a potential source of hides and meat (Soberon et al., 1996; Kraus, 2009). Other observations of non-native crocodilians in the region are of strays (e.g., "an undetermined caiman from Guiana" on Martinique; Breuil, 2009), none of which have become established. In general, such arrivals remain uncommon, both in terms of numbers and geographic scope.

Tortoises (family Testudinidae). South American tortoises in the genus *Chelonoidis* (formerly assigned to the genus *Geochelone*) tend to be large and are introduced primarily via the pet trade or as ornamentals, although their willingness to consume fecal matter renders them useful for cleaning latrines or chicken pens (e.g., Grant, 1937a; Pinchon, 1967). Daudin and de Silva (2007, 2011) indicated that locals in the Grenadines scorn them as food for that very reason. The status of *C. carbonaria* populations on many islands remains unclear (e.g., Censky, 1988; Hodge et al., 2003; Powell et al., 2005; Powell and Henderson, 2005; Fields and Horrocks, 2009), with the ancestors of some likely arriving via natural over-water dispersal, whereas those of others might have been introduced by Amerindians or early colonial Europeans (perhaps for food), and others being more recently moved for conservation (under the assumption that they are declining natives; Lazell, 2002, 2005; Perry and Gerber, 2006) or as pets and for ornamental value (e.g., Breuil, 2002; Powell et al., 2005; Lorvelec et al., 2007). Individuals from Barbados are exported regularly to supply the pet trade (Fields and Horrocks, 2009). The closely related *C. denticulata*, originally from SA, is introduced on Guadeloupe (Pritchard and Trebbau, 1984; Breuil, 2002), although only escaped individuals are known (i.e., no feral population exists). *Centrochelys sulcata* (also previously assigned to the genus *Geochelone*), from northern Africa, is known as a stray on Martinique (Breuil, 2009). The latter has also been brought in as an ornamental on several islands in the BVI (G. Perry, unpubl. data). Early 19th-century attempts to establish two species of *Kinixys* (*K. erosa* and *K. homeana*) on Guadeloupe failed (Breuil, 2002, 2003).

Pond turtles (family Emydidae). Pond turtles of several species are common in the pet trade, which is the primary vector for their worldwide spread, although some populations are exploited for food (e.g., Powell, 2003). *Pseudemys nelsoni* from NA, presumably released pets, were removed from one location in the BVI before they could breed (Perry and Gerber, 2006). *Graptemys pseudogeographica*, also from NA, is known as a stray on Martinique (Breuil, 2009). Much more broadly distributed, however, is *Trachemys scripta*, another NA species. This is one of the most common species in the pet trade and also is marketed for food, to such an extent that multiple arrivals at any given location are not unlikely. Many Caribbean populations, such as those in the Turks & Caicos (Reynolds and Niemiller, 2010;

Reynolds, 2011) and BVI (Perry and Gerber, 2006) appear localized in human-made structures and are unlikely to have extensive impacts on native species. Even where abundant (e.g., St. Maarten/St.-Martin; Powell et al., 2005), severe ecological effects are unlikely where no native congeners occur. Where native sliders occur, however, such as the Bahamas, Cuba, Hispaniola, and Jamaica, hybridization and competition are both of concern (Powell et al., 2000; Powell and Incháustegui, 2009, 2011), as is the possibility that efforts to conserve the native species will be confounded by confusion with invasives that should be controlled. Seidel and Ernst (2006) noted that the extent to which the introduction of *T. scripta* "promotes extirpation or extinction by genetic 'swamping' is an overlooked topic in turtle conservation which deserves attention."

Four other members of the genus *Trachemys* (*T. decorata*, *T. decussata*, *T. stejnegeri*, and *T. terrapen*), all from within the West Indies, have become established at some locations outside their native ranges. Although some introductions have failed (Kraus, 2009), interbreeding "swarms" of hybrids are suggestive of multiple invasions on New Providence, Andros, and Great Exuma islands in the Bahamas (Schwartz and Henderson, 1991; Franz et al., 1993; Lee, 2004, 2005). The status of *Terrapene carolina* in the Bahamas (Lee, 2004, 2005) and on Martinique (Breuil, 2009) is unknown. This terrestrial member of the family originated in NA and Caribbean populations almost certainly are pet-trade related.

Afro-American side-necked turtles (family Pelomedusidae). *Pelusios castaneus* is African in origin and not uncommon in the pet trade. Lescure (1979) indicated that the exact source of the population established on Guadeloupe (e.g., Lescure, 1979, 1983) remains unclear, but Breuil (2003) indicated that it was introduced intentionally by L'Herminier in the early 19th century.

Austro-South American side-necked turtles (family Chelidae). No documented explanation exists for the single *Phrynops geoffroanus* found on Anguilla (Hodge et al., 2011).

Geckos (family Gekkonidae). Many geckos are common human commensals that have become widely distributed around the globe. The genus *Hemidactylus* and four species (three of which are known from our region) are included among the most successful colonizers (Bomford et al., 2009). Until recently (Weiss and Hedges, 2007), *H. haitianus* was considered a West Indian endemic (Powell et al., 1996). Now known to be conspecific with African populations of *H. angulatus*, the likelihood of a relatively recent human-mediated introduction into the Greater Antilles (possibly with the slave trade) is high. The history and movement of populations within the Greater Antilles is unknown. *Hemidactylus garnotii* is established on several Bahamian islands, having arrived as a stowaway. The most widely distributed "house gecko" within the region, *H. mabouia*, is found on many islands, where it is essentially ubiquitous on buildings and walls (e.g., Howard et al., 2001). Origins are uncertain (e.g., Kluge, 1969; Powell et al., 1998); although some

insular populations might have arrived via natural over-water dispersal from SA (or even Africa), others probably arrived with humans, and some populations are likely mixtures of both. Breuil (2009) recommended studies using molecular markers to identify the origins of insular populations in the region. On Curaçao and Bonaire, these invasives are displacing the native *Phyllodactylus martini*, which is no longer edificarian and is only infrequently encountered in the bush, often in the wood of old candelabra cacti (van Buurt, unpubl. data). House geckos continue to invade additional islands, such as the Turks & Caicos (Reynolds and Niemiller, 2010; Reynolds, 2011). Another member of this genus, the Mediterranean *H. turcicus*, occurs locally on Cuba. Whether that population originated from Europe or from US populations is unknown. Most of the Caribbean populations of all of these species are probably derived from other non-native populations in the region or adjacent mainland areas. *Hemidactylus frenatus*, native to the Eastern Hemisphere, but widely established in the Americas, has recently been found on Hispaniola (Scantlebury et al., 2010) and at the U.S. Naval Base at Guantanamo Bay, Cuba (S. Campbell-Staton, pers. comm.). *Hemidactylus palaichthus* is a Neotropical endemic (Kluge, 1969), with populations in northeastern SA, adjacent continental islands, and on the Maria Islands off St. Lucia (Powell, 1990c). Originally thought to be derived from *H. brookii haitianus* (= *H. angulatus*; see above), its current status is uncertain. Whether the Maria Island population is of natural or anthropogenic origin is unknown.

Intentionally introduced on Martinique (Henderson et al., 1993) and now also known from Guadeloupe (Breuil, 2009), *Gekko gecko* is the only member of this Asian genus to invade the Caribbean.

Dwarf geckos (family Sphaerodactylidae). The genus *Gonatodes* contains mostly diurnal species widely distributed throughout the Neotropics. The founders of some Greater Antillean populations of *G. albogularis* almost certainly reached the islands by natural means, although Crombie (1999) suggested that: "Its distribution around major centers of human habitation in both Jamaica and Hispaniola smacks of an introduction." Populations on Aruba and Curaçao (Wagenaar Hummelinck, 1940) originated in SA, although they probably are no longer extant (Lundberg, 2003; G. van Buurt, unpubl. data). The population on Grand Cayman Island probably came from Cuba (Williams, 1964; Seidel and Franz, 1994). Whether this occurred naturally or with human mediation is unknown. *Gonatodes antillensis*, a species with presumably native populations on Bonaire and Curaçao, might have spread to Aruba via human actions (Odum, 1992), but has not been found there recently (Wagenaar Hummelinck, 1940; van Buurt, 2001, 2005; Lundberg, 2003). *Gonatodes vittatus* is very common on Aruba (where it might be native), but is rarely found on Curaçao. The origin of a single individual on Dominica was probably Venezuela (Malhotra et al., 2007, 2011).

Sphaerodactylus geckos are small, frequently diurnal, often commensal lizards that have speciated widely in the region. Many species occur naturally in the islands, and a few have become invasive, spreading primarily as stowaways in

cargo (Kraus, 2009). These include *S. argus*, *S. copei*, *S. mariguanae*, and *S. microlepis*. Evans (1989) suggested that *S. fantasticus* was introduced on Dominica, but evidence (Jones, 1999; Malhotra et al., 2007, 2011; Thorpe et al., 2008) indicates that *S. fantasticus* is a relatively recent (but probably pre-human) colonizer on Dominica. The population there appears very similar to those on western Basse Terre, Guadeloupe (e.g., Daniells et al., 2010).

Iguanas (family Iguanidae). Although most West Indian populations of *Cyclura* are Endangered or even Critically Endangered (IUCN, 2010), they are sometimes associated with the pet trade. The zoo trade was responsible for a successful introduction of Cuban *C. nubila* on Isla Magueyes off Puerto Rico (e.g., Schwartz and Carey, 1977; Kraus, 2009), but the increased abundance on the main island (M.J. Rivera Rodríguez, pers. comm.) is probably attributable to active dispersal from Isla Magueyes. The same species presumably was introduced to Grand Cayman Island as a food source (Grant, 1940), possibly a response to declining numbers of endemic *C. lewisi*. Tourists apparently are responsible for the relocation of *C. cychlura inornata* from Bahamian cays to nearby, previously unoccupied cays (Hines and Iverson, 2006a, 2006b). Unfortunately, the substrate on many of the latter precludes nesting, rendering the "relocated" populations biologically dead. Other relocations in the Bahamas, Turks & Caicos, and BVI were motivated by conservation concerns and an effort to render remaining populations less vulnerable to stochastic events.

Like some tortoises, West Indian *Iguana iguana* populations include those founded by ancestors that arrived naturally (e.g., St. Lucia, Saba), some of which might now be distinct at the species level (Malone and Davis, 2004; Powell, 2004b). Other founders were transported by Amerindians or early colonists, have arrived recently, or represent mixtures of the above (Powell, 2004b; Henderson and Powell, 2009). Although some early introductions presumably were for food (e.g., Grant, 1937a), the pet trade is the primary culprit responsible for many of the more recent introductions (Powell, 2004b). These animals pose a threat to endemic Lesser Antillean populations of *I. delicatissima*, with which they hybridize (e.g., Breuil and Sastre, 1994; Day and Thorpe, 1996; Breuil, 2002; Breuil et al., 2007, 2010). The presence of *I. iguana* on Grand Cayman confounds efforts to conserve endemic *Cyclura lewisi*, as some residents and many guest workers do not distinguish one kind of iguana from another (Henderson and Powell, 2009). Economic impacts include the interruption of air travel by individuals basking on runways at the international airport in San Juan, Puerto Rico (Engeman et al., 2005). A few recent introductions have been intentional, and, in at least one case in the Virgin Islands, an introduction was actively facilitated by a local wildlife management agency (Perry and Platenberg, 2007). The report of an *I. delicatissima* introduced to Puerto Rico (Lever, 2003) remains unsubstantiated. A population, however, was introduced from Îlet Chancel to Îlet à Ramiers (Martinique) for conservation purposes (Breuil, 2009). The record of *Ctenosaura similis* in the Bahamas (Knapp et al., 2011) is almost certainly related to the pet trade.

Curly-tailed lizards (family Leiocephalidae). *Leiocephalus carinatus* has been introduced experimentally onto small cays with *Anolis sagrei* to test effects of a predator (Schoener et al., 2005 and references therein).

Anoles (family Polychrotidae). Anoles are highly diverse (Losos, 2009), quite adaptable, and often function as human commensals. Many species in the region exploit buildings, ornamental plants, and the night-light niche (e.g., Henderson and Powell, 2001, 2009; Perry et al., 2008; Powell and Henderson, 2008). Some are colorful and available in the pet trade (e.g., Kraus, 2009), but nearly all introductions within our region were inadvertent and attributable to stowaways in cargo such as building materials and ornamental plants.

Anolis cristatellus is native to the Puerto Rico Bank and was the only anole that made the list of most successful colonizing species (Bomford et al., 2009). A population became established in the DR in the early 20th century (Powell and Henderson, 2008 and references therein). It quickly displaced its native ecological counterpart (*A. cybotes*) from the most intensely altered habitats in and around the city of La Romana. These anoles have more recently been introduced into Dominica (Malhotra et al., 2007, 2011), where they are expanding their range and displacing endemic populations of *A. oculatus* along the dry leeward coast, and to St.-Martin (Breuil et al., 2010). Cuban *A. porcatus* became established in Santo Domingo (DR) in the mid-20th century (Powell and Henderson, 2008 and references therein) and, much like *A. cristatellus* in La Romana, has displaced its endemic ecological equivalent (in this instance, *A. chlorocyanus*) from much of the urban area. *Anolis porcatus* also has been reported from Aruba, to which it probably was introduced with a shipment of palm trees from Cuba (Odum and van Buurt, 2009).

Perhaps the most frequently relocated West Indian member of the genus is *A. sagrei*, which is native to the Bahamas, Cuba, and presumably Little Cayman in the lesser Cayman Islands. This species is established in Jamaica, where its presence was documented as early as the mid-19th century (Gosse, 1850). These aggressive lizards can affect other anoles negatively (e.g., Brown and Echternacht, 1991), and have displaced endemic *A. carolinensis* from much of peninsular Florida (Lever, 2003 and references therein). Nothing comparable appears to be occurring on Grenada (Greene et al., 2002) or St. Vincent (Treglia et al., 2008), where populations have become established with building materials, but so far appear to be restricted to only the most intensely altered habitats on those islands. Whether such constraints will continue to constrain expansion in the future or whether they will apply to recently reported populations on Barbados (Fields and Horrocks, 2009), St. Maarten (Fläschendräger, 2010), and Canouan in the Grenadines (M. de Silva, pers. comm.) is unknown. *Anolis sagrei* is comparable in size to the native species there and the potential for competition and possible displacement exists. A population on Aruba might be extirpated (G. van Buurt, unpubl. data).

Populations of *A. carolinensis*, a NA native, have become established inside and outside of the Caribbean. Although the pet trade has been implicated in many instances (Kraus, 2009), the West Indian introductions all appear to be consequences

of arrival with nursery plants (e.g., Eaton et al., 2001; Powell, 2002; Hodge et al., 2003). A number of insular populations initially identified as *A. carolinensis* now are assigned to other species of anoles (Henderson and Powell, 2009).

Anolis extremus from Barbados and *A. wattsi* from Antigua are both established on St. Lucia, where they interact with each other and with endemic *A. luciae* (Lazell, 1972; Gorman, 1976; Henderson and Powell, 2009). Other regional anoles found outside their native ranges include strays (*A. equestris*, *A. garmani*, *A. leachii*) or localized populations not far from their points of origin (*A. distichus*, *A. lineatus*, *A. maynardii*).

The introduction of *A. bimaculatus* in St. Maarten (Powell et al., 1992) appears to be one of the few documented colonization failures in the region (Powell et al., 2005). Researchers intentionally introduced Puerto Rican *A. pulchellus* and *A. stratulus* into Isla Palominitos (Levins and Heatwole, 1973), which is essentially adjacent to both species' native range. Other researchers introduced *A. pogus* from the Anguilla Bank onto Anguillita (Roughgarden et al., 1984). All of those introductions eventually failed.

Ground lizards (family Teiidae). Lizards in the genus *Ameiva* are common on many Caribbean islands. Some species become habituated to human presence and many can be found in urban settings (Henderson and Powell, 2001; Powell and Henderson, 2008). *Ameiva exsul* has become established on St. Croix in the USVI, where it is a source of concern for the critically endangered native congener, *A. polops* (Platenberg and Boulon, 2006). Although St. Croix is part of the USVI, it is not part of the Puerto Rico Bank, which *A. exsul* inhabits. The species can swim and has been seen on cargo barges (Perry et al., 2006), providing a possible transport mechanism. *Ameiva ameiva*, which occurs naturally on the Grenada and St. Vincent island banks, has been documented on Barbados (Fields and Horrocks, 2009), presumably, however, originating from Trinidad. Wagenaar Hummelinck (1940) suggested that *A. bifrontata* was introduced in Aruba, but van Buurt (2001, 2005) indicated that the population might be native, since it was recorded by Cope as early as 1885.

Cnemidophorus lemniscatus, broadly distributed in the Neotropics, has expanded its range onto Aruba by stowing away with cargo (Schall, 1973; van Buurt, 2001, 2005). In contrast, *C. vanzoi* was intentionally introduced to Praslin Island from nearby natural populations, for investigative and conservation purposes (Dickinson and Fa, 2000). The population appears to have successfully colonized its new habitat. *Tupinambis teguixin*, from the Neotropical mainland, has been recorded on Isla de San Andres (Rueda-Almonacid, 1999), but the fate of that introduction is unknown.

Worm lizards (family Gymnophthalmidae). Gymnophthalmids, most occurring in CA or SA, usually are small and many are associated with leaf-litter or live underground (Avila-Pires, 1995). *Gymnophthalmus pleii* is a Lesser Antillean endemic and *G. underwoodi*, which occurs on a number of Lesser Antillean islands,

might have reached many of them via natural over-water dispersal (Powell, 2011). However, at least some populations, certainly those in the central and northern LA, are introduced (Powell, 2011), and some might be competing with or even displacing native populations of *G. pleii* on Martinique (Breuil, 2009) or Dominica (Turk et al., 2010). *Gymnophthalmus underwoodi* was recently found for the first time in the Greater Antilles (Hispaniola; Scantlebury et al., 2010).

This species is parthenogenetic (e.g., Cole, 1975; Hardy et al., 1989), which facilitates colonization because single individuals can establish new populations (e.g., Schwartz and Henderson, 1991; Hodge et al., 2003; Powell et al., 2005). *Tretioscincus bifasciatus*, another SA species, has been recorded from Isla de Providencia (Scott and Ayala, 1984; Ayala, 1986; Schwartz and Henderson, 1991; Rueda-Almonacid, 1999), but the status of that population is unknown.

Alligator lizards (family Anguidae). The only anguid known to have been introduced in the Caribbean, *Ophisaurus ventralis* from NA, was reported from Grand Cayman (Seidel and Franz, 1994), but has not been seen in many years and may be extirpated (A.C. Echternacht, unpubl. data).

Helmeted lizards (family Corytophanidae). *Basiliscus* sp. on New Providence (Bahamas; Knapp et al., 2011) probably represents a stray introduced via the pet trade.

Monitor lizards (family Varanidae). A single *Varanus exanthematicus* was occasionally spotted on Providenciales (Turks & Caicos) until 2004 and was known to be a released pet (Reynolds, 2011).

Amphisaenians (family Amphisbaenidae). Two records of *Amphisbaena fuliginosa* from SA, presumably strays, are known from St. Lucia and Grenada (Murphy et al., 2010).

Blindsnakes (family Typhlopidae). Usually small and spending most of their lives underground, blindsnakes are unfamiliar to the general public and practically unheard of in the pet trade. However, they easily stow away in planters and often are spread by the ornamental plant trade. Originally from Asia, the flowerpot snake (*Ramphotyphlops braminus*) might be the most widely distributed snake in the world. The family Typhlopidae, genus *Ramphotyphlops*, and species *R. braminus* top the respective lists of most successful colonizing taxa (Bomford et al., 2009). Since the first report of the species on Anguilla (Censky and Hodge, 1997), it has been documented widely in the Caribbean, including recent reports from Aruba (van Buurt, 2006, 2011), St. Christopher (Orchard, 2010a), Barbados (Fields and Horrocks, 2009, 2011), Guadeloupe (Breuil and Ibéné, 2008; Breuil, 2009), Mustique (M. de Silva, in litt., 2009), the Turks & Caicos (Reynolds and Niemiller, 2010; Reynolds, 2011), Curaçao (Wallach, 2008), and St. Eustatius (Powell, 2011). A parthenogenetic species, it appears to be ideally pre-adapted to

dispersal by humans (e.g., McKeown, 1996). West Indian populations are almost certainly derived from the introduced population in Florida.

Threadsnakes (family Leptotyphlopidae). *Epictia* (formerly *Leptotyphlops*) *albifrons*, from the SA mainland, is known from Bonaire (van Buurt, 2001, 2005, 2006, 2011).

Boas (family Boidae). Boas are common in the pet trade, which is the primary method of arrival for these species in the Caribbean and elsewhere (Kraus, 2009). Interestingly, Bomford et al. (2009) rated the family Boidae as the least successful colonizing family of reptiles or amphibians. Most records of *Boa constrictor*, presumably from the SA or CA mainland, are of strays that have failed to found populations. The species, however, is breeding in Puerto Rico (Krysko and King, 2010; USFWS, 2010; M.J. Rivera Rodríguez and A.J. Sánchez Muñoz, pers. comm.; R. Reed and G.H. Rodda, pers. comm.) and is successfully established in Aruba (Quick et al., 2005; van Buurt, 2001, 2005, 2006, 2011), where it has become a serious threat to local birds and other animals. The stray found on Terre de Bas (îles de la Petite Terre, Guadeloupe; Barré et al., 1997) might pertain to *Boa nebulosa* (Lorvelec et al., 2011), which is endemic to Dominica. *Epicrates cenchria*, also from SA, is known as a stray on St. Maarten (Powell et al., 2005) and Martinique (Breuil, 2009), and *Eunectes notaeus* has been reported in Puerto Rico (USFWS, 2010; R. Reed and G.H. Rodda, pers. comm.).

Pythons (family Pythonidae). Pythons, like boas, are frequently encountered in the live animal trade. Six records, *Morelia amethistina* on Guadeloupe (Breuil and Ibéné, 2008), *Python curtus* and *P. regius*, both on St. Maarten (Powell et al., 2005), and *P. regius* on Martinique (Breuil, 2009), St.-Barthélemy (Breuil et al., 2010), and Puerto Rico (USFWS, 2010; A.J. Sánchez Muñoz, pers. comm.), document strays. Reports of populations of *P. bivittatus*, *P. reticulatus*, and *P. sebae* in Puerto Rico (ISSG, 2010; USFWS, 2010), and *P. bivittatus* on St.-Barthélemy (Breuil et al., 2010) presumably also pertain to strays. Establishment of any of these species would be worrisome, as it has been in Florida (e.g., Snow et al., 2007; Reed et al., 2010).

Common snakes (family Colubridae). The pet and nursery trades are the primary vectors for arrival of *Pantherophis guttatus* (formerly *Elaphe guttata*) from NA. For example, animals on Little St. James (USVI) arrived in ornamental plants (Perry and Platenberg, 2007), but the pet trade is implicated in most other introductions in the region. The ongoing spread of this very efficient predator is a source of increasing concern, as some populations are showing signs of reproduction (Tolson and Henderson, 2011; Virgin Islands, R. Platenberg, unpubl. data; C. Petrovic, pers. comm.). The status of this species in the Cayman Islands remains unclear (Franz et al., 1987; A.C. Echternacht, unpubl. data). Other records to date document only strays. Another member of the genus, *P. alleghaniensis* (formerly *Elaphe obsoleta*), apparently is breeding in the Bahamas following arrival

via the nursery trade (Buckner and Franz, 1994d; Knapp et al., 2011). Similarly, a stray *Opheodrys aestivus* has been documented in the Bahamas (Knapp et al., 2011) and a stray *Leptophis* sp. arrived as a stowaway on Curaçao (van Buurt, 2001, 2005). *Tantilla melanocephala*, probably of SA origin, has been found on four islands on the Grenada Bank (Henderson and Powell, 2006; Berg et al., 2009; D. Scantlebury and J. Boone, pers. comm.). Its long-term prospects remain unclear. Underwood et al. (1999) reported the presence of *Mastigodryas bruesi*, which occurs naturally on the Grenada and St. Vincent banks, on Barbados.

American rear-fanged snakes (family Dipsadidae). *Diadophis punctatus*, originally from NA, arrived via the nursery trade on Grand Cayman (Seidel and Franz 1994; A.C. Echternacht, unpubl. data) and Curaçao (van Buurt, 2001, 2005). Neither appears to have established a population. Other strays on Curaçao include *Imantodes* sp. and *Leptodeira* sp. (van Buurt, 2001, 2005). Similarly, four strays from within the region, *Alsophis rufiventris* from Saba or St. Eustatius on St. Maarten, *Borikenophis* (formerly *Alsophis*) *portoricensis* from the Puerto Rico Bank on St. Croix, a main-island subspecies of *B. portoricensis* on Little St. James (BVI), and *Hypsirhynchus* (formerly *Antillophis*) *parvifrons* from Hispaniola on Little Inagua Island (Bahamas), failed to establish viable populations; however, *B. portoricensis* has recolonized the eastern end of St. Thomas (USVI) and appears to be expanding westward (Platenberg and Boulon, 2011).

Water snakes (family Natricidae). *Thamnophis cyrtopsis* on Curaçao (van Buurt, 2001, 2005), *T. sirtalis* on St.-Barthélemy (Breuil et al., 2010), and *Storeria dekayi* in the Bahamas (Buckner and Franz, 1998a, 1998b; Lee, 2004, 2005), all from NA, arrived in nursery plants. Only *S. dekayi* seems to have become established. Two stray *Natrix natrix*, from Europe, have been recorded on Martinique (Breuil, 2009).

Coral snakes (family Elapidae). A single individual *Micrurus fulvius*, native to the southeastern US, arrived in the soil of a potted palm on Curaçao (van Buurt, 2001, 2005).

Discussion

The number of introductions and the consequent number of established populations in the Caribbean is alarming, even when we consider our uncertainty regarding the origins of some insular populations (particularly some of those of *Eleutherodactylus johnstonei*, *Rhinella marina*, *Gymnophthalmus underwoodi*, *Hemidactylus* spp., *Iguana iguana*, *Chelonoidis carbonaria*), some of which were almost certainly natural, but others undoubtedly were human-mediated or some combination of the two. Several additional reports arrived as we were working on this review, and the trends shown by both amphibians and reptiles (fig. 1) suggest that the rate of arrivals will continue to increase with time. For example, *Scinax* cf. *x-signatus* has been

found on five new islands (Grande-Terre, Basse-Terre, Désirade, Marie-Galante, Martinique) in the past eight years (Breuil and Ibéne, 2008; Breuil, 2011). In some instances, these frogs are phenomenally abundant. Multiple invasions of the same islands are almost certainly responsible, with wooden houses prefabricated in Brazil and French Guiana apparently serving as the means of introduction.

Given the extent of negative ecological and economic effects documented in the Caribbean and elsewhere, invasive populations of herpetofauna have become a serious conservation issue. Additional deleterious effects probably go unnoticed or unreported, especially when smaller, less obvious species are introduced and their impact is primarily on smaller invertebrates, which are rarely monitored and the impact on which cannot, at this time, be evaluated. The magnitude of existing problems is almost certainly greater than currently realized, and can only get worse. An integrated policy response is clearly necessary to address what is a regional issue.

Amerindians arrived in the Caribbean islands about 6000 years ago (Wilson, 2001) and Europeans about 500 years ago. The impact of the latter has been felt in the region longer than elsewhere in the Western Hemisphere, and Fosberg (1983) observed that: "The impact of European man on islands made the changes due to aboriginal man seem minor by comparison." Only 5-10% of the West Indian herpetofauna has benefited from human activities (Henderson and Powell, 2001). One of the most substantive and frequently deleterious effects has been the increasing number of introductions of plants and animals to islands where they are not native. Although not covered here, many of those introductions, especially of mammalian herbivores (e.g., goats and cattle) and predators (e.g., mongooses, raccoons, oppossums, dogs, cats, and monkeys, the latter on Grenada and Barbados), have had varying degrees of deleterious effects on the regional herpetofauna.

The characteristics of amphibian and reptilian species introduced in the region correspond very closely to those outlined for taxa associated with Caribbean urban areas by Powell and Henderson (2008): they (1) are ecologically versatile and capable of tolerating a broad range of sometimes rapidly and dramatically changing conditions; (2) exhibit edificarian tendencies within and outside of urban areas (e.g., gekkonids, some sphaerodactyls, many anoles); (3) tend to be edge species or, at least, species that are euryoecious, not habitat specialists; (4) are primarily invertebrate predators; (5) are heliotherms if diurnal (e.g., edge-inhabiting anoles); and (6) often are scansorial (e.g., treefrogs, geckos, anoles). These features in turn correlate nicely with those shared by anoles identified by Williams (1969) as successful colonizers, and with the observation that invasive species in general tend to be generalists (Dukes and Mooney, 1999). Our data also support the generalizations that good invaders tend to be small and capable of rapid reproduction (Kolar and Lodge, 2001), have a past record of being invasive elsewhere (Kolar and Lodge, 2001; Marchetti et al., 2004), are highly tolerant of humans (Perry et al., 2008), are related to other documented invaders (Richardson and Pyšek, 2006), and are native

to areas with comparable climates (Bomford et al., 2009) and near possible introduction sites (Marchetti et al., 2004). In contrast, our data do not support the view that taxa that are more distantly related to the native biota are more likely to be invasive (Strauss et al., 2006).

The genera *Eleutherodactylus*, *Hemidactylus*, and *Anolis* comprise a large fraction of the species tabulated in this review. All are relatively small, capable of high reproductive output, often associated with humans and habitats modified by human activities, are naturally or secondarily found within the region, and have become invasive at multiple locations. Specifically, the species that have successfully colonized the most islands either follow that pattern or have been intentionally introduced for perceived economic benefits. Cane toads (*Rhinella marina*; 25 islands or island groups, although some populations might have been established by natural over-water dispersal) were introduced widely for biocontrol, and bullfrogs (*Lithobates catesbeianus*; all of the Greater Antilles) were introduced for food. The latter are still exported from the region in large numbers, providing an economic incentive for further spread. *Eleutherodactylus johnstonei* (28 islands or island groups), Cuban treefrogs (*Osteopilus septentrionalis*; 14), *Hemidactylus mabouia* (11 and possibly many more), *Gymnophthalmus underwoodi* (15), and *Ramphotyphlops braminus* (12) are small human commensals easily transported inadvertently with goods and ornamental plants. The latter two are relatively inconspicuous and benefit further by being parthenogenetic, thus requiring but a single individual to establish a population. They probably occur on many more islands than have been documented. *Iguana iguana* (15) and *Trachemys scripta* (14) break with the pattern in being large and herbivorous or omnivorous, but both are frequently transported from place to place for food (both historically and recently) or as pets. The situation for *I. iguana*, however, is complicated by the presence of endemic populations that might be subjected to hybridization with more recent arrivals, primarily originating from native Neotropical populations or the introduced populations in Florida and within the region. Two other widely introduced species, *Anolis sagrei* (6) and *Pantherophis guttatus* (11, although established populations have been documented in only a few instances) are notable because of the potential for severe negative consequences resulting from potential competition (*A. sagrei*) with or predation (*P. guttatus*) on native species.

In addition, successful invasions tend to be related to propagule pressure (Kolar and Lodge, 2001; Marchetti et al., 2004). Thus, species that are associated with human economic activity, such as the pet or nursery trade, as well as those with access to frequent commerce-related transport, are more likely to be introduced elsewhere and become established. In our data, the rate of overall arrival was strongly correlated with economic activity, supporting this contention.

Although introductions related to biocontrol are largely relegated to history, movements of animals for food markets (especially *Lithobates catesbeianus* and turtles in the genera *Trachemys* and *Pseudemys*) continue on a large scale. However, in terms of numbers of individuals and species, most alarming is the ever-growing

pet trade. The greater Caribbean (especially Haiti) serves as a source of animals, but commercial dealers, particularly in Barbados and the Netherlands Antilles (presumably St. Maarten), undoubtedly pose a greater threat for new introductions into the region. Many of the species moving through the region on their way to and from the US and other markets could easily become established if given the opportunity through escapes or releases. As in Florida (e.g., Meshaka et al., 2004), escapes facilitated by hurricanes and releases, especially by dealers seeking to establish local and easily exploitable populations of popular species, could dramatically change the very nature of the herpetofaunas on a number of islands.

As would be expected from basic principles of island biogeography, the sites subjected to the most introductions tend to be large (or composed of many individual islands), near the sources of many invasives, and/or centers of economic activity. We have documented the most introductions for the Bahamas (32), an archipelago composed of many islands, very close to Florida, and with an active tourist industry. Close behind is Puerto Rico (25), a regional center of commerce, as are Martinique (17), Guadeloupe (16), St.-Martin/St. Maarten (15), and Curaçao (15). The latter also is proximate to the SA mainland, the principal source of introductions to that island. Cuba (9) and Hispaniola (11) are large and have or have had active economic ties to the US.

The success rate (70.3%) for establishing new populations was considerably greater than those calculated by Bomford et al. (2009) for Britain (12 of 51; 23.5%), California (13 of 62; 21.0%), and Florida (47 of 80; 58.8%). Although some of the disparity might be explained by less intensive monitoring in the Caribbean than in Britain or the US, possibly resulting in many colonization attempts going undocumented, much of the success probably is attributable to the hospitable island climates and high incidence of climate-matching with areas where source populations are native (Bomford et al., 2009). The relative paucity of predators, competitors, and pathogens on at least some islands also might contribute to the high rate of successful colonization. In addition, with an increasing number of invasions involving alien species from Florida, the possibility that those species were pre-screened for success by having already established populations outside their native ranges cannot be discounted.

In general, amphibians are less likely than reptiles to successfully colonize islands because of osmotic sensitivity during the dispersal stage and their more stringent ecological requirements during the establishment phase (Vences et al., 2003). In our sample, however, the number of amphibian populations established via human-aided dispersal is sizeable, although the number of reptilian species is considerably greater. The relative abundance of amphibian introductions is largely attributable to four species that are resilient or hardy and have been intentionally introduced or are closely tied to human economic activity. Consequently, species such as *Eleutherodactylus johnstonei*, among the top five most successful colonizing species of amphibians and reptiles (Bomford et al., 2009), *Rhinella marina*, *Scinax*

cf. *x-signatus*, and *Osteopilus septentrionalis* are increasingly ubiquitous in the Caribbean and elsewhere.

As additional species become established in the region, and especially in Florida, which remains the source for much of the ornamental vegetation and construction material used in the Caribbean, we will doubtlessly see additional species reported in years to come. These will likely include several other species of *Eleutherodactylus* and *Hemidactylus frenatus*, one of the most widely distributed species in the world (Bomford et al., 2009). Although only a stray *H. frenatus* has been collected on Hispaniola (Scantlebury et al., 2010), a sizeable population appears to be established at the U.S. Naval Base at Guantanamo Bay, Cuba (S. Campbell-Staton, pers. comm.), and it seems only a matter of time before it becomes widely established in the region. The species is highly aggressive and has been successful at displacing similar species (e.g., Powell et al., 1998; Powell, 2004a; Dame and Petren, 2006), raising serious concerns about possible consequences once it arrives in the region. The list of other potential arrivals is long (Kraus, 2009), and several could become serious ecological or economic pests. In addition, some species already in the region, most notably the increasingly widespread green iguana (*I. iguana*; e.g., Sementelli et al., 2008) and the eastern corn snake (*Pantherophis guttatus*), have the potential to become considerably more damaging than they have hitherto been (e.g., van Buurt, 2006, 2011; Platenberg, 2007). Because of the predominance of Florida as a source for invasive amphibians and reptiles, a concerted effort to sanitize cargo and ornamental plants shipped from there is an urgent need.

Although extended dry periods can preclude many unwanted invasives from becoming established, "garden refugia" are available for some species. Amphibians often cannot survive outside of artificially mesic situations (e.g., gardens, golf courses, hotel and resort grounds) during droughts (e.g., *Eleutherodactylus johnstonei* on Anguilla; Hodge et al., 2011). Even some introduced reptilian populations, such as iguanas, are much more plentiful in inhabited areas than in the bush. For snakes, however, this is rarely an option (diminutive and secretive *Ramphotyphlops braminus* might be an exception). Snakes that cannot survive in relatively natural situations and retreat to "gardens" during dry periods find themselves in a "killing zone," where people and domestic predators (dogs and cats) will see them and kill them (Powell and Henderson, 2008). This is very likely why *Pantherophis guttatus* appears to have been extirpated in Curaçao (van Buurt, 2006, 2011).

Although a few attempts have been made to control or eradicate non-native herpetofauna in the Caribbean, such efforts have been rare — and some existing plans have never been implemented. For example, in April 2006, the Ministry of Ecology, Energy and Sustainable Development of Guadeloupe decided to eradicate *Iguana iguana* to prevent competition and hybridization with *Iguana delicatissima*, but nothing was done. Thus, we expect that both firmly and newly established species will generally persist in the region unless policy and management efforts change, causing the greater Caribbean to become part of international trends toward an enhanced pantropical herpetofauna and impoverished native herpetofaunas.

The need to advance protection quickly, perhaps well ahead of political support, flows from the very poor evidence that any environmental Kuznets curve affects these outcomes. An environmental Kuznets curve loosely predicts that, as incomes rise and standards of living improve, greater social support often evolves to mitigate social, environmental, and ecological hazards (Arrow et al., 1995). If this phenomenon holds for invasions in the Caribbean, fig. 1 should begin to display a declining rate of new introductions as GDP rises. That does not seem to be happening at this time. However, economic theory would not predict that invasives would be among the first items corrected as an economy grows. Although growing GDP may have been responsible for declines in emissions of nitrogen oxides, carbon monoxides, sulfur dioxides, and lead in the 1970s and 1980s, the relationship does not seem to hold for aggressive land use conversions to monocultures or impervious surfaces, energy demand, and overall resource consumption. These "high footprint" activities appear to parallel economic development, which would explain why overall atmospheric carbon emissions do not seem to abate with rising GDP (Wagner, 2008). Issues of biodiversity protection in particular have not shown convincing empirical evidence that any abatement turn is emerging on the development horizon (Mills and Waite, 2009). Invasions in the Caribbean would arguably be far behind the curve — or the bend in the curve, as invasions seem to correlate with the very activities most directly responsible for economic growth and development on many islands. Without a much more diverse set of economic activities contributing to economic development, the draw of the US economy and the developments in agriculture, tourism, shipping, and resource extractive industries would seem to continue to accelerate these threats at least for the near and intermediate terms. Precautionary approaches in the name of acute economic stress or intrinsic ecological deterioration from regional invasions are arguably the strongest motivation for the policies suggested.

Although many governmental agencies in the region have addressed invasive species on a case-by-case basis, only the Bahamas has developed and implemented a national invasive species strategy (BEST, 2003). Even there, however, no amphibians or reptiles are listed among the species targeted for eradication or control. The benefits of eradicating an invasive species — a single injection of funds and effort and the problem is solved — far outweigh the cost of a perennial control program (Gardener et al., 2010 and references therein). Many regional introductions remain localized, often in anthropogenic situations (e.g., gardens and grounds of hotels and resorts), and are therefore easy targets for cost-effective eradication projects. Consequently, the development of eradication programs should be a high priority for agencies responsible for managing biodiversity throughout the greater Caribbean.

Nonetheless, prevention remains by far the best — and most economical — approach (Wittenberg and Cock, 2001; Rödder and Weinsheimer, 2010). In that context, increased scrutiny of the transport to and from the islands (whether cargo where inadvertent stowaways may hide, ornamental plants that often carry hitchhikers, or the pet trade that is the source of so many introductions) seems

especially desirable. This can help reduce the spread of other problem species, such as agricultural pests, that also are a source of concern for local governments.

To address these concerns, we urge an increased regional and global cooperation on fighting invasive species in general and invasive herpetofauna in particular. Although the region is highly fragmented both geographically and politically, precedents for such cooperation exist; these include the Caribbean Community and Common Market (CARICOM) and the Caribbean Cooperation in Health initiative (www.caricom.org/index.jsp). We urge the adoption of a similarly integrated approach that incorporates not only governmental controls but also investments in local response capacity, such as that advocated by Perry and Farmer (2011). Our combined decades of work in the region show a strong need for considerably more monitoring, education, and research in this area.

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Appendix 1. Species of amphibians and reptiles introduced in the greater Caribbean region. Individual islands within archipelagos (e.g., Bahamas, Virgin Islands) are listed only if introductions from other islands within the same archipelago occurred. Status: W = widespread (likely to be encountered within a few minutes of searching), L = localized (likely to be encountered at most sporadically, even in appropriate habitat, although possibly abundant within a few small areas), E = presumably extirpated or failed introduction, S = stray (no indication of a breeding population ever becoming established). Question marks (?) indicate uncertainty about a published record or, in the case of *Eleutherodactylus johnstonei*, the native range. * = at least some individuals probably introduced intentionally. ** = source almost certainly was populations introduced into Florida or other southeastern US states (although some might be secondary introductions from populations established from Florida stock). Most of the following records are included in the database of introductions in Kraus (2009) and are listed in Schwartz and Henderson (1991) and Henderson and Powell (2009). References cited are those that document or confirm an introduction; all references pertaining to introduced populations are not necessarily listed.

Species (native range)	Introduced (status)	Pertinent reference(s)
FROGS		
Amphibia: Anura: Bufonidae		
Rhinella marina[1]	Anguilla (**S**)	Hodge et al., 2003
(Neotropical mainland)	Antigua* (**W**)	Clark, 1916; Lynn, 1957; Esteal, 1981; Esteal et al., 1981
	Aruba* (**W**)	van Buurt, 2001, 2005, 2006, 2011
	Barbados* (**W**)	Schomburgk, 1848; Gosse, 1851; Waite, 1901; Clark, 1916; Tucker, 1940; Bayley, 1950; Grant, 1959; Esteal, 1981; Esteal et al., 1981; Everard et al., 1988; Forde, 2005; Norville, 2005; Fields and Horrocks, 2009; Horrocks and Fields, 2011
	Canouan (Grenadines) (**S**)	Daudin and de Silva, 2007, 2011
	Carriacou (Grenadines) (**S**)	Lever, 2001, 2003; Daudin and de Silva, 2007, 2011
	Cuba* (**E**)	Bruner, 1935; Jaume, 1966; Buide, 1967; Esteal, 1981; Esteal et al., 1981; Garrido and Jaume, 1984; Estrada and Ruibal, 1999
	Culebra (Puerto Rico) (**?**)	Rivero and Joglar, 1979
	Grand Cayman (**E?**)	Burton and Echternacht, 2003
	Dominica (**E**)	Esteal, 1981; Esteal et al., 1981b; Lever, 2001
	Grenada* (**W**)	Barbour, 1914; Esteal, 1981; Esteal et al., 1981; Everard et al., 1980, 1983; Germano et al., 2003
	Guadeloupe* (**W**)	Jourdane and Theron, 1975; Schwartz and Thomas, 1975; Esteal, 1981; Esteal et al., 1981; Nassi and Dupouy, 1988; Breuil, 2002
	Jamaica* (**W**)	Gosse, 1851; Waite, 1901; Barbour, 1914, 1937; Metcalf, 1914, 1923; Dunn, 1926; Lynn and Grant, 1940; Lynn and Dent, 1943; Goin and Cooper, 1950; Thompson, 1950;

[1] Some insular populations might have become established via natural over-water dispersal.

Species (native range)	Introduced (status)	Pertinent reference(s)
		Mettrick and Dunkley, 1968; Esteal, 1981; Esteal et al., 1981; Crombie et al., 1984; Wong and Bundy, 1985; Wilson et al., 2010; Wilson, 2011
	Hispaniola* (**W**)	Mertens, 1938; Cochran, 1941; Williams et al., 1963; Esteal, 1981; Esteal et al., 1981; Powell et al., 1999
	Martinique* (**W**)	Gosse, 1851; Waite, 1901; Barbour, 1937; Esteal, 1981; Esteal et al., 1981; Breuil, 2009
	Montserrat* (**W**)	Barbour, 1914, 1937; Esteal, 1981; Esteal et al., 1981
	Mustique (Grenadines) (**L**)	Paice, 2005; Daudin and de Silva, 2007, 2011
	Nevis* (**W**)	Barbour, 1914, 1937; Esteal, 1981; Esteal et al., 1981; Horwith and Lindsay, 1999; Lever, 2001
	Puerto Rico* (**W**)	Wolcott, 1924, 1934a, 1934b, 1937, 1948, 1950a, 1950b; Danforth, 1925; May, 1926, 1927, 1930; Grant, 1931; Dexter, 1932; Leonard, 1933; Tucker and Wolcott, 1935; van Volkenberg, 1935; Seín, 1937; Hoffman and Janer, 1941; Pérez, 1951; Cofresi-Sala and Rodríguez de Vega, 1963; Heatwole et al., 1968; Rivero, 1978, 1998; Esteal, 1981; Esteal et al., 1981; Carpenter and Gillingham, 1984, 1987; Rivero and Joglar, 1996; Thomas and Joglar, 1996; Burrowes et al., 2004; Vargas-Salinas, 2005
	St. Christopher* (**W**)	Barbour, 1914, 1937; Esteal, 1981; Esteal et al., 1981; Horwith and Lindsay, 1999
	St. Croix* (**W**)	Grant, 1931; Philbosian and Yntema, 1976; Esteal, 1981; Esteal et al., 1981; MacLean, 1982; Platenberg and Boulon, 2006
	St. Lucia* (**W**)	Barbour, 1914, 1937; Esteal, 1981; Esteal et al., 1981
	St. Vincent* (**W**)	Clark, 1916; Esteal, 1981; Esteal et al., 1981; Censky and Kaiser, 1999; Lever, 2001; Treglia, 2006; Mallery et al., 2007; Powell and Henderson, 2007, 2011
	Union (Grenadines) (**S**)	J. Daudin, pers. comm.
	Virgin Islands* (**W**)	Grant, 1931; McManus and Nellis, 1975; Philbosian and Yntema, 1976; Esteal, 1981; Esteal et al., 1981; MacLean, 1982; Platenberg and Boulon, 2006
Amphibia: Anura: Eleutherodactylidae (formerly assigned to the family Leptodactylidae)		
Eleutherodactylus antillensis	Necker Island (BVI)* (**L**)	Perry and Gerber, 2011
(Puerto Rico Bank)	St. Croix* (**E?**)	Grant, 1937b; Grant and Beatty, 1944; Thomas, 1966
Eleutherodactylus coqui	Bahamas[2] (**?**)	BEST Commission, 2003
(Puerto Rico)	Culebra (**W**)	Rivero and Joglar, 1979; Joglar, 1998

[2] This might very well represent a misidentified animal; the only confirmed introduction in the Bahamas of any species of *Eleutherodactylus* is *E. planirostris*.

Species (native range)	Introduced (status)	Pertinent reference(s)
	Hispaniola* (**L**)	Joglar and Rios-López, 1998
	St. Croix (**L**)	Thomas, 1966; Philbosian and Yntema, 1976, 1977; MacLean, 1982; Platenberg and Boulon, 2006; Waddle et al., 2006
	Vieques (**W**)	Joglar, 1998
	Virgin Islands (**L**)	Thomas, 1966; Philbosian and Yntema, 1976, 1977; MacLean, 1982; Platenberg and Boulon, 2006; Waddle et al., 2006
Eleutherodactylus johnstonei (Antigua Bank?)	Anguilla (**L**)	Censky, 1989; Kaiser and Hardy, 1994; Hodge et al., 2003
	Aruba[3] (**L**)	van Buurt, 2001, 2005, 2006, 2011
	Barbados[4] (**W**)	Feilden, 1889, 1903; Bayley, 1950; Grant, 1959; Schwartz, 1967; Lemon, 1971; Marsh, 1983; Everard et al., 1990; Ovaska, 1991a, 1991b, 1992; Ovaska and Hunte, 1992; Kaiser and Hardy, 1994; Kaiser, 1997; Fields and Horrocks, 2009; Horrocks and Fields, 2011
	Barbuda (**L**)	Kaiser, 1997
	Bequia (Grenadines)*(**L**)	Lazell and Sinclair, 1990; Kaiser and Hardy, 1994; Lazell, 1994; Daudin and de Silva, 2007, 2011
	Bonaire[3] (**L**)	van Buurt, 2001, 2005
	Canouan (Grenadines) (**L**)	Daudin and de Silva, 2007, 2011
	Carriacou (Grenadines) (**L**)	Daudin and de Silva, 2007, 2011
	Curaçao[3] (**W**)	Hardy and Harris, 1979; Kaiser and Hardy, 1994; van Buurt, 2001, 2005, 2006, 2011
	Dominica (**E**[5])	Bullock and Evans, 1990; Corke, 1992; Kaiser, 1992, 1997; Kaiser and Hardy, 1994; Kaiser and Wagenseil, 1995; Daniells et al., 2008
	Grenada (**W**)	Barbour, 1914; Schwartz, 1967; Kaiser and Hardy, 1994; Kaiser and Henderson, 1994; Kaiser, 1997; Goldberg et al., 1998a; Williamson et al., 2002; Germano et al., 2003; Sander et al., 2003; Henderson and Berg, 2005, 2006, 2011
	Guadeloupe (**W**)	Schwartz et al., 1978; Hardy and Harris, 1979; Hardy, 1985; Henderson et al., 1992; Kaiser and Hardy, 1994; Kaiser and Henderson, 1994; Kaiser, 1997; Breuil, 2002; Breuil et al., 2009

[3] Source almost certainly was populations introduced into Venezuela.
[4] Marsh (1983) indicated that this species was native to Barbados.
[5] See Daniells et al. (2008) and Carter et al. (2009).

Species (native range)	Introduced (status)	Pertinent reference(s)
	Jamaica (**W**)	Barbour, 1910; Dunn, 1926; Lynn and Grant, 1940; Perkins, 1942; Lynn and Dent, 1943; Jeffrey-Smith, 1946; Goin and Cooper, 1950; Schwartz and Fowler, 1973; Pough et al., 1977; Stewart, 1977; Stewart and Martin, 1980; Schwartz and Henderson, 1991; Kaiser and Hardy, 1994; Kaiser and Henderson, 1994; Kaiser, 1997; Wilson, 2011
	Les Îles de Saintes (**W**)	Breuil, 2002
	Marie-Galante (**W**)	Henderson et al., 1992; Kaiser and Hardy, 1994; Breuil, 2002; Breuil et al., 2009
	Martinique (**W**)	Lescure, 1966; Kaiser and Henderson, 1994; Lescure and Marty, 1996; Kaiser, 1997; Breuil, 2009; Breuil et al., 2009
	Montserrat (**?**)	Kaiser and Hardy, 1994
	Mustique (Grenadines) (**L**)	Henderson et al., 1992; Kaiser and Hardy, 1994; Daudin and de Silva, 2007, 2011
	Nevis (**?**)	Kaiser and Hardy, 1994; Horwith and Lindsay, 1999
	Petit St. Vincent (Grenadines) (**L**)	Daudin and de Silva, 2007, 2011
	Saba (**W**)	Kaiser and Hardy, 1994; Powell et al., 2005; Powell, 2006
	St.-Barthélemy (**L**)	Kaiser, 1992; Breuil, 2002; Lorvelec et al., 2007; Breuil et al., 2009
	St. Christopher (**?**)	Kaiser and Hardy, 1994; Horwith and Lindsay, 1999
	St. Eustatius (**L**)	Kaiser and Hardy, 1994; Powell et al., 2005; Powell, 2006
	St. Lucia (**L**)	Lescure and Marty, 1996; Lescure, 2000
	St.-Martin/St. Maarten (**L**)	Kaiser and Hardy, 1994; Breuil, 2002; Powell et al., 2005; Powell, 2006
	St. Vincent (**W**)	Lescure, 2000; Treglia, 2006; Mallery et al., 2007; Powell and Henderson, 2007, 2011
	Tortola (BVI) (**L**)	Perry and Gerber, 2011
Eleutherodactylus lentus (USVI)	Jost Van Dyke (BVI)[6] (**W**)	Perry, 2009b; Perry and Gerber, 2011
Eleutherodactylus martinicensis (Antigua, Guadeloupe, Dominica, Martinique)	St.-Barthélemy (**L**)	Kaiser, 1992; Breuil et al., 2009
	St.-Martin/St. Maarten (**L**)	Breuil, 2002; Breuil et al., 2009
Eleutherodactylus planirostris	Great Inagua Island (Bahamas) (**L**)	Schwartz and Henderson, 1991

[6] This species might have been native to the BVI, but an introduction is a more likely explanation (Perry, 2009b).

Species (native range)	Introduced (status)	Pertinent reference(s)
(Cuba, Little and Grand Bahama banks)	Grenada (**S**[7])	Kaiser, 1992; Kraus et al., 1999
	Jamaica (**W**)	Lynn, 1937; Lynn and Grant, 1940; Lynn and Dent, 1943; Goin, 1947; Goin and Cooper, 1950; Schwartz and Fowler, 1973; Schwartz, 1974; Pough et al., 1977; Stewart, 1977; Stewart and Martin, 1980; Wilson, 2011
	Turks & Caicos (**W**)	Schwartz and Henderson, 1991; Reynolds and Niemiller, 2010; Reynolds, 2011
Eleutherodactylus sp. (?)	Guadeloupe (**S**)	Breuil, 2002
	Union Island (Grenadines) (**L**[8])	Henderson et al., 1992; Kaiser and Hardy, 1994; Kaiser and Wagenseil, 1995; Kaiser, 1997; Daudin and de Silva, 2007, 2011
Amphibia: Anura: Hylidae		
Hyla cinerea (Southeastern US)	Puerto Rico (**L**)	Philbosian and Yntema, 1977; Rivero, 1978; Meshaka, 1996; Thomas and Joglar, 1996
Hyla squirella (Southeastern US)	Bahamas (**L**)	Crombie, 1972; Campbell, 1978; Lee, 2004, 2005; Knapp et al., 2011
Osteopilus septentrionalis (Cuba, Bahamas, Cayman Islands)	Anguilla** (**W**)	Townsend et al., 2000; Hodge et al., 2003
	Antigua** (**W**)	Daltry, 2007, 2011
	Bonaire** (**L**)	van Buurt, 2005, 2006, 2011
	Curaçao (**L**)	van Buurt, 2001, 2005, 2006, 2007, 2011
	Dominica** (**S**)	Malhotra et al., 2007, 2011
	Great Inagua (Bahamas) (**W**)	Schwartz, 1968
	Nevis** (**L**)	Lever, 2003; Horwith and Lindsay, 1999
	Puerto Rico** (**W**)	Duellman and Crombie, 1970; Rivero, 1978; Joglar and Rios-López, 1995; Thomas and Joglar, 1996, 1998; Vargas-Salinas, 2006a, 2006b, 2006c
	Saba** (**S**)	Powell, 2006, 2007
	St. Croix** (**W**)	Schwartz and Thomas, 1975; Philbosian and Yntema, 1976, 1977; MacLean, 1982; Waddle et al., 2005; Platenberg and Boulon, 2006

[7] This is almost certainly a spurious record based on an unpublished observation promulgated in the literature.
[8] This frog usually is represented in the literature as *Eleutherodactylus johnstonei*.

Species (native range)	Introduced (status)	Pertinent reference(s)
	St.-Barthélemy** (**W**)	Breuil, 2002; Hodge et al., 2003; Breuil et al., 2009
	St.-Martin/ St. Maarten** (**W**)	Powell et al., 1992[9], 2005; Kaiser and Henderson, 1994; Townsend et al., 2000; Breuil, 2002; Hodge et al., 2003; Breuil et al., 2009; Lorvelec et al., 2011
	Turks & Caicos (**W**)	Reynolds and Niemiller, 2010; Reynolds, 2011
	Virgin Islands** (**W**)	Schwartz and Thomas, 1975; Philbosian and Yntema, 1976, 1977; MacLean, 1982; Meshaka, 1996; Lever, 2003; Owen, 2005; Owen et al., 2005a, 2006; Waddle et al., 2005; Perry and Gerber, 2006, 2011; Perry et al., 2006; Platenberg and Boulon, 2006, 2011; Perry, 2009a
Pseudacris crucifer (Eastern US)	Cuba (**E**[10])	Schwartz and Thomas, 1975; Schwartz and Henderson, 1988, 1991; Estrada and Ruibal, 1999
Scinax ruber (Neotropical mainland)	Martinique (**W**)	Breuil, 2002, 2009; Breuil et al., 2009
	Puerto Rico (**L**)	Thomas and Joglar, 1996; Rivero, 1998; Rios-López, 1999, 2000
	St. Lucia (**L**)	Boulenger, 1891; Barbour, 1914, 1937; Corke, 1992; Kaiser and Henderson, 1994; Censky and Kaiser, 1999
Scinax x-signatus (Neotropical mainland)	Guadeloupe (**W**)	Breuil, 2004; Lorvelec et al., 2007, 2011; Breuil and Ibéné, 2008; Breuil et al., 2009
	Marie-Galante (**L**)	Breuil and Ibéné, 2008; Lorvelec et al., 2011
	Martinique (**L**)	Breuil et al., 2009; Breuil, 2011
Amphibia: Anura: Leiuperidae (formerly assigned to the family Leptodactylidae)		
Pleurodema brachyops (Aruba)	Bonaire, Klein Bonaire (**W**)	Wagenaar Hummelinck, 1940; van Buurt, 2001, 2005
	Curaçao (**W**)	Wagenaar Hummelinck, 1940; van Wijngaarden, 1988; van Buurt, 2001, 2005
Amphibia: Anura: Leptodactylidae		
Leptodactylus fallax (Dominica, Montserrat)	Grenada* (**E**)	Groome, 1970
	Jamaica* (**E**)	Proctor, 1973; Crombie, 1999
	Martinique* (**E**)	Lescure, 1983; Breuil and Ibéne, 2008; Breuil, 2009
	Puerto Rico* (**E**)	May, 1930; Grant, 1931, 1932b; Barbour, 1937; Rivero, 1978; Thomas and Joglar, 1996
Leptodactylus validus (Northern SA)	Bequia (Grenadines) (**L**)	Hardy et al., 2004; Yanek et al., 2006; Camargo et al., 2009
	Grenada (**W**)	Hardy et al., 2004; Yanek et al., 2006; Camargo et al., 2009

[9] Previously listed by Schwartz and Henderson (1991), but misidentified as *Scinax ruber*.
[10] Cuban populations have not been documented and should be removed from lists of West Indian amphibians and reptiles (Powell and Henderson, 1999).

Species (native range)	Introduced (status)	Pertinent reference(s)
	St. Vincent (**W**)	Hardy et al., 2004; Treglia, 2006; Yanek et al., 2006; Camargo et al., 2009
Amphibia: Anura: Microhylidae		
Gastrophryne carolinensis (Southeastern US)	Bahamas (**L**)	Jacobs, 1973a; Crother, 1985; Lee, 2004, 2005; Knapp et al., 2011
	Grand Cayman (**L**)	Schwartz and Henderson, 1991; Seidel and Franz, 1994
Amphibia: Anura: Ranidae		
Lithobates catesbeianus (Eastern US)	Cuba* (**W**)	Hoffman and Noble, 1927; Martínez, 1948; Neill, 1964; Jaume, 1966; Buide, 1967; Odening, 1968; Peters, 1974; Martínez et al., 1982; Coy Otero and Ventosa, 1984; Garrido and Jaume, 1984; Sampedro Marín et al., 1985, 1986, 2003; Coy Otero and Martínez, 1987; de Armas et al., 1987; Novo Rodríguez et al., 1988; Sampedro Marín and Montañez Huguez, 1993; Escobar Herrera, 1995; Montañez et al., 1996; Rueda-Almonacid, 1998, 1999; Estrada and Ruibal, 1999
	Hispaniola* (**W**)	Schwartz and Thomas, 1975; Garrido and Jaume, 1984; Welcomme, 1988; Schwartz and Henderson, 1991; Powell et al., 1999; Neils and Bugbee, 2007
	Jamaica* (**W**)	Grant, 1946; Proctor, 1973; Mahon and Aiken, 1977; Wilson, 2011
	Puerto Rico* (**W**)	Pérez, 1951; Philbosian and Yntema, 1977; Rivero, 1978; Thomas and Joglar, 1996; Joglar, 1998; López-Flores et al., 2003
Lithobates clamitans (Southeastern US)	Bahamas (**S?**)	Lee, 2004, 2005; Knapp et al., 2011
Lithobates grylio (Southeastern US)	Bahamas* (**L**)	Neill, 1964; Schwartz, 1968; Campbell, 1978; Schwartz and Henderson, 1991; Franz et al., 1996; Lee, 2004, 2005; Knapp et al., 2011
	Puerto Rico* (**L**)	Rios-López and Joglar, 1999
Lithobates pipiens (?) (Eastern US)	St. Croix (**E?**)	Grant, 1937
Lithobates sphenocephalus (Southeastern US)	Bahamas (**L**)	Jacobs, 1973b; Lee, 2004, 2005; Knapp et al., 2011
LIZARDS		
Reptilia: Squamata: Anguidae		
Ophisaurus ventralis (Southeastern US)	Grand Cayman (**S**)	Schwartz and Henderson, 1991; Seidel and Franz, 1994

Species (native range)	Introduced (status)	Pertinent reference(s)
Reptilia: Squamata: Corytophanidae		
Basiliscus sp. (Central America)	Bahamas** (**S?**)	Knapp et al., 2011
Reptilia: Squamata: Gekkonidae		
Gekko gecko (Southeastern Asia)	Guadeloupe (**L**)	Breuil, 2004, 2009; Breuil and Ibéné, 2008; Breuil et al., 2010; Lorvelec et al., 2011
	Martinique* (**L**)	Henderson et al., 1993; Breuil, 2009; Breuil et al., 2010
Hemidactylus angulatus (Western Africa)	Cuba (**W**)	Kluge, 1969; Powell and Maxey, 1990; Rodríguez Schettino, 2000; Weiss and Hedges, 2007
	Hispaniola (**W**)	Kluge, 1969; Powell and Maxey, 1990; Powell et al., 1999; Weiss and Hedges, 2007
	Puerto Rico (**W**)	Grant, 1932a; Kluge, 1969; Rivero, 1978; Powell and Maxey, 1990; Weiss and Hedges, 2007
Hemidactylus frenatus (Africa, Southeastern Asia)	Cuba (**L**)	S. Campbell-Staton, pers. comm.
	Hispaniola (**?**)	Scantlebury et al., 2010
Hemidactylus garnotii (Indo-Pacific Region)	Bahamas** (**L**)	Buckner and Franz, 1994a; Meshaka, 1995, 1996; Lee, 2004, 2005; Knapp et al., 2011
Hemidactylus mabouia[11] (Africa, Neotropics)	Aruba (**L**)	Lundberg, 2003; van Buurt, 2005, 2006, 2011
	Bahamas (**L**)	Franz et al., 1993; Buckner and Franz, 1994b; Lee, 2004, 2005; Krysko and Borgia, 2005; Krysko and Thomas, 2007; Knapp et al., 2011
	Bonaire, Klein Bonaire (**L**)	van Buurt, 2001, 2005, 2006, 2011
	Cuba (**L**)	Barbour, 1937; Buide, 1967; Kluge, 1969; Coy Otero and Baruš, 1979; Schwartz and Henderson, 1991; Powell et al., 1998; Estrada and Ruibal, 1999; Martínez Rivera et al., 2003
	Curaçao (**W**)	van Buurt, 2001, 2005, 2006, 2011
	Grand Cayman (**L**)	Echternacht and Burton, 2002

[11] At least some populations in the Lesser Antilles and Virgin Islands might have been established as a consequence of natural over-water dispersal, although such populations might frequently be supplemented by stowaways moving about islands with human mediation; we list only peripheral or recently documented arrivals in this appendix.

Species (native range)	Introduced (status)	Pertinent reference(s)
	Hispaniola (**L**)	Schwartz and Henderson, 1991; Powell et al., 1998, 1999
	Jamaica (**L**)	Fläschendräger, 1999; Wilson, 2011
	Puerto Rico (**W**)	Powell et al., 1998; Mayer, 1999; Thomas, 1999; Martínez Rivera et al., 2003
	Turks & Caicos (**?**)	Minton and Minton, 1975; Reynolds and Niemiller, 2010; Reynolds, 2011
	Virgin Islands (**W**)	Maclean, 1982; Powell et al., 1998; Perry and Gerber, 2011
Hemidactylus palaichthus (Northeastern SA)	Maria Island (off St. Lucia) (**L**)	Kluge, 1969; Powell, 1990c
Hemidactylus turcicus (Mediterranean Region)	Cuba** (**L**)	Leavitt, 1933; Barbour, 1937; Buide, 1967; McCoy, 1970; Baruš and Coy Otero, 1974; Coy Otero and Baruš, 1979; Estrada and Ruibal, 1999; Rodríguez Schettino, 2000
	Puerto Rico** (**S**)	Conant and Collins, 1991
Reptilia: Squamata: Gymnophthalmidae		
Gymnophthalmus underwoodi[12] (Neotropical mainland)	Antigua (**L**)	Powell and Lindsay, 1999; Daltry, 2007, 2011
	Barbados[13] (**W**)	Grant, 1958; Fields and Horrocks, 2009
	Barbuda (**?**)	Censky and Lindsay, 1997
	Bequia (Grenadines) (**?**)	Lazell and Sinclair, 1990
	Dominica (**L**)	Brooks, 1983 (as "*G. pleei*"); Daniells et al., 2008
	Grenada (**L**)	Hardy, 1982
	Guadeloupe (**W**)	Schwartz and Thomas, 1975; Breuil, 2002; Breuil et al., 2010
	Hispaniola (**?**)	Scantlebury et al., 2010
	Marie-Galante (**W**)	Breuil, 2002; Breuil et al., 2010
	Martinique (**L**)	Breuil, 2002, 2009; Breuil et al., 2010
	St. Christopher (**L**)	Orchard, 2010c
	St.-Martin/St. Maarten (**L**)	van Buel and Powell, 2006; Breuil, 2009; Breuil et al., 2010; Lorvelec et al., 2011; Powell, 2011
	St. Vincent (**W**)	Schwartz and Thomas, 1975; Treglia, 2006
	Union Island (Grenadines) (**L**)	RP, RWH, pers. obs.

[12] Some insular populations might have become established via natural over-water dispersal.
[13] Fields and Horrocks (2011) implied that the population on Barbados is native.

Species (native range)	Introduced (status)	Pertinent reference(s)
	Virgin Islands (**?**)	Cole et al., 1990
Tretioscincus bifasciatus (Neotropics)	Isla de Providencia (**?**)	Scott and Ayala, 1984; Ayala, 1986; Schwartz and Henderson, 1991; Rueda-Almonacid, 1999
Reptilia: Squamata: Iguanidae		
Ctenosaura similis (Central America)	Bahamas** (**L**)	Knapp et al., 2011
Cyclura cychlura inornata (Leaf and U Cays, Exuma Islands, Bahamas)	Allen Cay (**E**)	Hines and Iverson, 2006a, 2006b
	Cays between Allen and Robert's cays (Exuma Islands)* (**S**)	Hines and Iverson, 2006a, 2006b
Cyclura nubila nubila (Cuba, Lesser Caymans)	Grand Cayman (**E**)	Grant, 1940; Schwartz and Carey, 1977; Seidel and Franz, 1994
	Isla Magueyes (Puerto Rico) (**W**)	Schwartz and Carey, 1977; Rivero, 1978; Christian, 1986; Christian et al., 1986; Christian and Lawrence, 1991; Thomas and Joglar, 1996; Martins and Lamont, 1998; Pérez-Buitrago et al., 2006
	Puerto Rico (L)	M.J. Rivera Rodríguez, pers. comm.
Iguana delicatissima (Lesser Antilles)	Puerto Rico (**S**)	Lever, 2003
Iguana iguana (Neotropics)	Anguilla[14] (**L**)	Censky et al., 1998; Hodge et al., 2003, 2011; Powell, 2004b
	Antigua (**S**)	Powell, 2004b; Powell et al., 2005
	Bahamas** (**L**)	Knapp et al., 2011
	Barbuda (**S**)	Powell, 2004b; Powell et al., 2005
	Grand Cayman (**W**)	Seidel and Franz, 1994; Lever, 2003; Powell and Henderson, 2008
	Guadeloupe[15] (**W**)	Day and Thorpe, 1996; Breuil, 2002; Day et al., 2000; Powell, 2004b; Breuil et al., 2007, 2010
	Les Îles de Saintes[15] (**W**)	Breuil, 2000, 2002; Powell, 2004b; Breuil et al., 2007, 2010

[14] Anguillian populations include released/escaped pets (Hodge et al., 2003) and descendants of animals that arrived via natural rafting (Censky et al., 1998).
[15] The population might or might not be introduced or may consist of descendants of animals that arrived naturally and of others that were introduced.

Species (native range)	Introduced (status)	Pertinent reference(s)
	Marie Galante[15] (**L**)	Breuil, 2002; Powell, 2004b; Breuil et al., 2007, 2010; Lorvelec et al., 2007
	Martinique[15] (**W**)	Breuil, 2000, 2002, 2009; Powell, 2004b; Breuil et al., 2007, 2010; Lorvelec et al., 2007
	Puerto Rico (**W**)	Rivero, 1978; McCoid, 1995; Thomas and Joglar, 1996; Dyer et al., 1999; Thomas, 1999; Engeman et al., 2005; Powell and Henderson, 2008
	St.-Barthélemy (**S**)	Breuil, 2009; Breuil et al., 2010; Lorvelec et al., 2011
	St. Croix[16] (**W**)	Grant, 1937; MacLean, 1982; Thomas and Joglar, 1996; Platenberg and Boulon, 2006
	St.-Martin/St. Maarten (**W**)	Breuil, 2002; Powell, 2004b; Powell et al., 2005; Breuil et al., 2007, 2010; Lorvelec et al., 2007; Powell and Henderson, 2008
	Turks & Caicos** (**S**)	Reynolds and Niemiller, 2010; Reynolds, 2011
	Virgin Islands (**L**)	MacLean, 1982; Thomas and Joglar, 1996; Lazell, 2005; Perry and Gerber, 2006, 2011; Platenberg and Boulon, 2006
Reptilia: Squamata: Polychrotidae		
Anolis bimaculatus (St. Christopher Bank)	Dominica (**S**)	A. James, pers. comm.
	St.-Martin/St. Maarten (**E**)	Powell et al., 1992, 2005
Anolis carolinensis (Southeastern US)	Anguilla (**L**)	Eaton et al., 2001; Hodge et al., 2003
	Grand Bahama (**L**)	Losos et al., 1993
	Grand Cayman (**S**)	Powell, 2002
Anolis cristatellus (Puerto Rico Bank)	Dominica (**L**)	Powell and Henderson, 2003; Malhotra et al., 2007, 2011; Daniells et al., 2008; Ackley et al., 2009
	Dominican Republic (**L**)	Williams, 1969, 1977; Fitch et al., 1989; Schwartz and Henderson, 1991; Zani et al., 1993; Goldberg et al., 1998b; Kolbe et al., 2007a; Powell and Henderson, 2008
	St.-Martin/St. Maarten (**L**)	Breuil et al., 2010
Anolis distichus (Bahamas)	Grand Bahama (**W**)	Dundee, 1990; Schwartz and Henderson, 1991; Losos et al., 1993
	Great Abaco (**L**)	Losos et al., 1993
Anolis equestris (Cuba)	Bahamas** (**L**)	Knapp et al., 2011
	Grand Cayman** (**S**)	Dacosta-Cottam et al., 2010
	Turks & Caicos** (**S**)	Reynolds and Niemiller, 2010; Reynolds, 2011

[16] The current population is almost certainly introduced, but a natural population or animals imported by Amerindians might once have existed.

Species (native range)	Introduced (status)	Pertinent reference(s)
Anolis extremus (Barbados)	St. Lucia (**L**)	Underwood, 1962; Lazell, 1972; Gorman, 1976; Gorman et al., 1978; Corke, 1992; Giannasi et al., 1997
Anolis garmani (Jamaica)	Grand Cayman (**S**)	Schwartz and Henderson, 1991; Seidel and Franz, 1994
Anolis leachii (Antigua Bank)	Virgin Islands (**S**)	Perry, 2005
Anolis lucius (Cuba)	Archipielago de los Canarreos (**L**)	Schwartz and Henderson, 1991
Anolis maynardii (Little Cayman)	Cayman Brac (**L**)	Franz et al., 1987; Seidel and Franz, 1994; Goldberg and Bursey, 1996
Anolis porcatus (Cuba)	Aruba (**L**)	Odum and van Buurt, 2009
	Dominican Republic (**L**)	Arias Cornielle, 1975; Schwartz and Thomas, 1975; Haneline, 1977; Williams, 1977; Vance, 1987; Powell, 1990a, 1990b, 1992; Powell et al., 1990; Powell and Parmerlee, 1991; Parmerlee et al., 1992; Gifford et al., 2002; Kolbe et al., 2007a
Anolis sagrei (Cuba, Bahamas, Lesser Cayman Islands)	Barbados** (**L**)	Fields and Horrocks, 2009, 2011
	Canouan (Grenadines) (**L**)	M. de Silva, pers. comm.
	Grand Cayman** (**W**)	Minton and Minton, 1984; Franz et al., 1987; Lee, 1992; Losos et al., 1993; Seidel and Franz, 1994; Goldberg et al., 1995; Gerber and Echternacht, 2000; Kolbe et al., 2004, 2007a, 2007b
	Grenada** (**L**)	Greene et al., 2002; Germano et al., 2003; Kolbe et al., 2004
	Jamaica (**W**)	Gosse, 1850; Underwood and Williams, 1959; Williams, 1969; Schoener and Schoener, 1971; Landwer et al., 1995; Bundy et al., 1987; Landwer and Ferguson, 2002; Kolbe et al., 2004; Wilson, 2011
	St.-Martin/ St. Maarten** (**L**)	Fläschendräger, 2010
	St. Vincent** (**L**)	Henderson and Powell, 2005; Treglia, 2006; Mallery et al., 2007; Powell and Henderson, 2007, 2011; Treglia et al., 2008
Anolis wattsi (Antigua)	St. Lucia (**L**)	Underwood, 1959, 1962; Lazell, 1972; Gorman, 1976; Corke, 1992

Species (native range)	Introduced (status)	Pertinent reference(s)
Reptilia: Squamata: Sphaerodactylidae		
Gonatodes albogularis (Neotropics, Cuba?)	Aruba (**E**)	Wagenaar Hummelinck, 1940; van Buurt, 2001, 2005
	Grand Cayman (**L**)	Williams, 1964; Seidel and Franz, 1994
	Curaçao (**E**)	Wagenaar Hummelinck, 1940; van Buurt, 2001, 2005
	Hispaniola (**L**)	Crombie, 1999
	Jamaica (**L**)	Crombie, 1999; Wilson, 2011
Gonatodes antillensis (Bonaire, Curaçao)	Aruba (**E**)	Odum, 1992; van Buurt, 2001, 2005
Gonatodes vittatus (Neotropics, Aruba?)	Aruba (**W**)	Wagenaar Hummelinck, 1940; Lundberg, 2003; van Buurt, 2001, 2005
	Curaçao (**L**)	Wagenaar Hummelinck, 1940; van Buurt, unpubl. data
	Dominica (**E**)	Malhotra et al., 2007, 2011
Sphaerodactylus argus (Cuba, Jamaica)	Bahamas (**W**)	Barbour, 1937; Schwartz, 1968; Thomas, 1975
	Cuba (**L**)	Barbour, 1937; Savage, 1954; Buide, 1967; Thomas, 1975; Estrada and Ruibal, 1999
Sphaerodactylus copei (Hispaniola)	Bahamas** (**L**)	Schwartz, 1968; Franz et al., 1996; Lee, 2004, 2005; Knapp et al., 2011
Sphaerodactylus mariguanae (Mayaguana and Booby Cay)	Grand Turk (Turks & Caicos) (**E?**)	Schwartz and Henderson, 1991; Reynolds and Niemiller, 2010; Reynolds, 2011
Sphaerodactylus microlepis (St. Lucia)	Dominica (**S**)	Evans, 1989; Malhotra and Thorpe, 1999
Sphaerodactylus notatus (Bahamas, Cuba?)	Great Inagua (Bahamas) (**?**)	Schwartz, 1965, 1970, 1973
	Morant Cays (Jamaica) (**?**)	Schwartz, 1965, 1970, 1973
Reptilia: Squamata: Teiidae		
Ameiva ameiva (Trinidad?)	Barbados (**L**)	Corrie, 2001; Watson, 2008; Fields and Horrocks, 2009, 2011
Ameiva exsul (Virgin Islands)	St. Croix (**L**)	Platenberg and Boulon, 2006

Species (native range)	Introduced (status)	Pertinent reference(s)
Cnemidophorus lemniscatus (Neotropics)	Aruba (**L**)	Schall, 1973; van Buurt, 2001, 2005
Tupinambis teguixin (Neotropics)	Isla de San Andres (**?**)	Rueda-Almonacid, 1999
Reptilia: Squamata: Varanidae		
Varanus exanthematicus (Africa)	Turks & Caicos (**S**)	Reynolds, 2011
AMPHISBAENIANS		
Reptilia: Squamata: Amphisbaenidae		
Amphisbaena fuliginosa (SA and Trinidad)	Grenada (**S**?)	Murphy et al., 2010
	St. Lucia (**S**?)	Murphy et al., 2010
SNAKES		
Reptilia: Squamata: Boidae		
Boa constrictor (Neotropics)	Aruba (**L**)	Quick et al., 2005; van Buurt, 2001, 2005, 2006, 2011
	Bonaire (**S**)	van Buurt, 2001, 2005
	Curaçao (**S**)	van Buurt, 2001, 2005, 2006, 2011
	Guadeloupe*[17] (**S**)	Barré et al., 1997; Breuil, 2002; Breuil et al., 2010
	Martinique (**S**)	Breuil, 2009; Breuil et al., 2010
	Puerto Rico (**L**)	Krysko and King, 2010; USFWS, 2010; M.J. Rivera Rodríguez and A.J. Sánchez Muñoz, pers. comm.; R. Reed and G.H. Rodda, pers. comm.
	St.-Martin/St. Maarten (**S**)	Powell et al., 2005
Epicrates cenchria (Neotropics)	Martinique (**S**)	Breuil and Ibéné, 2008; Breuil, 2009; Breuil et al., 2010
	St.-Martin/St. Maarten (**S**)	Powell et al., 2005
Eunectes notaeus (SA mainland)	Puerto Rico (**S**)	USFWS, 2010; R. Reed and G.H. Rodda, pers. comm.
Reptilia: Squamata: Colubridae		
Leptophis sp. (SA mainland)	Curaçao (**S**)	van Buurt, 2001, 2005

[17] This record might pertain to *Boa nebulosa* (Lorvelec et al., 2011).

Species (native range)	Introduced (status)	Pertinent reference(s)
Mastigodryas bruesi (Grenada or St. Vincent bank)	Barbados (**L**)	Underwood et al., 1999; Greene et al., 2003; Powell and Henderson, 2007, 2011; Fields and Horrocks, 2009, 2011
Opheodrys aestivus (Eastern US)	Bahamas (**L**)	Knapp et al., 2011
Pantherophis alleghaniensis[18] (Eastern US)	Bahamas (**L**)	Buckner and Franz, 1994d; Lee, 2004, 2005; Knapp et al., 2011
Pantherophis guttatus (Southeastern US)	Anguilla (**S**)	Hodge et al., 2003
	Antigua (**S**)	Powell and Henderson, 2003
	Bahamas (**L**)	Buckner and Franz, 1994c; Lee, 2004, 2005; Knapp et al., 2011
	Bonaire (**S**)	Perry et al., 2003; van Buurt, 2001, 2005, 2006, 2011
	Curaçao (**E?**)	Perry et al., 2003; van Buurt, 2001, 2005, 2006, 2011
	Grand Cayman (**L**)	Franz et al., 1987; Schwartz and Henderson, 1991; Seidel and Franz, 1994; Tolson and Henderson, 2011
	Martinique (**S**)	Breuil, 2009; Breuil et al., 2010
	St.-Barthélemy (**S**)	Breuil, 2002; Hodge et al., 2003; Breuil et al., 2010
	St.-Martin/St. Maarten (**S**)	Powell et al., 2005; Breuil et al., 2010
	Turks & Caicos (**S**)	Reynolds and Niemiller, 2010; Reynolds, 2011; Tolson and Henderson, 2011
	Virgin Islands (**L**)	Hodge et al., 2003; Perry et al., 2003, 2011; Platenberg and Boulon, 2006; Tolson and Henderson, 2011
Tantilla melanocephala (Trinidad, SA)	Carriacou (Grenadines) (**S**)	D. Scantlebury and J. Boone, pers. comm.
	Grenada (**L**)	Berg et al., 2009; Tolson and Henderson, 2011
	Mustique (Grenadines)	Henderson and Powell, 2006; Berg et al., 2009; Tolson and Henderson, 2011
	Union (Grenadines)	Berg et al., 2009; Tolson and Henderson, 2011
Reptilia: Squamata: Dipsadidae		
Alsophis rufiventris (Saba, St. Eustatius)	St.-Martin/St. Maarten (**S**)	Powell et al., 2005

[18] This species also has been assigned to the genus *Scotophis*.

Species (native range)	Introduced (status)	Pertinent reference(s)
Borikenophis portoricensis (Puerto Rico Bank)	St. Croix (**S**) St. Thomas (USVI)[19] (**W**)	Perry and Platenberg, 2007 Platenberg and Boulon, 2011
Diadophis punctatus (NA mainland)	Curaçao (**S**) Grand Cayman (**S**)	van Buurt, 2001, 2005 Schwartz and Henderson, 1991; Seidel and Franz, 1994
Hypsirhynchus parvifrons (Hispaniola)	Little Inagua (Bahamas) (**S**)	Schwartz and Thomas, 1975
Imantodes sp. (SA mainland)	Curaçao (**S**)	van Buurt, 2001, 2005
Leptodeira sp. (SA mainland)	Curaçao (**S**)	van Buurt, 2001, 2005
Reptilia: Squamata: Elapidae		
Micrurus fulvius (Southeastern US)	Curaçao (**S**)	van Buurt, 2001, 2005
Reptilia: Squamata: Leptotyphlopidae		
Epictia albifrons (SA)	Bonaire (**L**)	Wagenaar Hummelinck, 1940; van Buurt, 2001, 2005, 2006, 2011
Reptilia: Squamata: Natricidae		
Natrix natrix (Europe)	Martinique (**S**)	Breuil and Ibéné, 2008; Breuil, 2009; Breuil et al., 2010; Lorvelec et al., 2011
Storeria dekayi (Eastern US)	Bahamas (**L**)	Lee, 2004, 2005; Knapp et al., 2011; Tolson and Henderson, 2011
Thamnophis cyrtopsis (Southwestern NA)	Curaçao (**S**)	van Buurt, 2001, 2005
Thamnophis sauritus (Eastern US)	Bahamas (**S**)	Buckner and Franz, 1998a; Lee, 2004, 2005; Knapp et al., 2011

[19] This was identified as a "recolonization" (Platenbergy and Boulon, 2011).

Species (native range)	Introduced (status)	Pertinent reference(s)
Thamnophis sirtalis (Eastern US)	Bahamas (**S**)	Buckner and Franz, 1998b; Lee, 2004, 2005; Knapp et al., 2011
	St.-Barthélemy (**S**)	Breuil et al., 2010
Reptilia: Squamata: Pythonidae		
Morelia amethistina (Indonesia, Papua New Guinea, Australia)	Guadeloupe (**S**)	Breuil and Ibéné, 2008; Breuil et al., 2010; Lorvelec et al., 2011
Python bivittatus (Southeastern Asia)	Puerto Rico (**S**)	ISSG, 2010; USFWS, 2010; R. Reed and G.H. Rodda, pers. comm.
	St.-Barthélemy (**S**)	Breuil et al., 2010
Python curtus group (Malaya, Indonesia)	St.-Martin/St. Maarten (**S**)	Powell et al., 2005
Python regius (West-central Africa)	Martinique (**S**)	Breuil, 2009; Breuil et al., 2010
	Puerto Rico (**S**)	USFWS, 2010; R. Reed and G.H. Rodda, pers. comm.
	St.-Martin/St. Maarten (**S**)	Powell et al., 2005
	St.-Barthélemy (**S**)	Breuil et al., 2010
Python reticulatus (Southeastern Asia)	Puerto Rico (**S**)	USFWS, 2010; R. Reed and G.H. Rodda, pers. comm.
Python sebae (Subsaharan Africa)	Puerto Rico (**S**)	USFWS, 2010; R. Reed and G.H. Rodda, pers. comm.
Reptilia: Squamata: Typhlopidae		
Ramphotyphlops braminus (Southeastern Asia)	Anguilla** (**L**)	Censky and Hodge, 1997; Hodge et al., 2003
	Aruba** (**L**)	van Buurt, 2006, 2011
	Barbados** (**W**)	Hedges, 2008; Fields and Horrocks, 2009, 2011
	Curaçao** (**L**)	Wallach, 2008
	Grand Cayman** (**L**)	Echternacht and Burton, 2003; Hodge et al., 2003; Tolson and Henderson, 2011
	Guadeloupe** (**L**)	Breuil and Ibéné, 2008; Breuil, 2009; Breuil et al., 2010; Lorvelec et al., 2011
	Mustique (Grenadines)** (**?**)	M. de Silva, in litt., 2009
	St.-Barthélemy** (**L**)	Breuil, 2002; Hodge et al., 2003; Breuil et al., 2010
	St. Christopher** (**?**)	Orchard, 2010a

Species (native range)	Introduced (status)	Pertinent reference(s)
	St. Eustatius** (**L**)	Powell, 2011
	St.-Martin/St. Maarten** (**L**)	Breuil, 2002; Hodge et al., 2003; Powell et al., 2005; Breuil et al., 2010
	Turks & Caicos** (**W**)	Reynolds and Niemiller, 2010; Reynolds, 2011; Tolson and Henderson, 2011
TURTLES		
Reptilia: Testudines: Chelidae		
Phrynops geoffroanus (SA)	Anguilla (**S**)	Hodge et al., 2011
Reptilia: Testudines: Emydidae		
Graptemys pseudogeographica (Central US)	Martinique (**S**)	Breuil, 2009; Breuil et al., 2010
Pseudemys nelsoni (Florida)	Virgin Islands (**S**)	Owen et al., 2005b; Perry and Gerber, 2006
Terrapene carolina (Eastern US)	Bahamas (**S?**)	Lee, 2004, 2005; Knapp et al., 2011
	Martinique (**S**)	Breuil, 2009; Breuil et al., 2010
Trachemys decorata (Hispaniola)	Bahamas (**L**)	Lee, 2004, 2005; Knapp et al., 2011
Trachemys decussata (Cuba)	Grand Cayman (**L**)	Dunson and Seidel, 1986; Alderton, 1988; Seidel, 1988, 1990, 1996, 2003; Seidel and Franz, 1994
Trachemys scripta (Eastern US)	Aruba (**L**)	van Buurt, 2005
	Bahamas (**L**)	Lee and Carey, 2001; Lee and Ross, 2001; Mealey et al., 2002; Lee, 2004, 2005; Knapp et al., 2011
	Barbados (**S**)	Fields and Horrocks, 2011
	Grand Cayman[20] (**S**)	Lever, 2003
	Hispaniola (**W**)	Powell et al., 2000; Powell and Incháustegui, 2009, 2011
	Guadeloupe (**S**)	Schwartz and Thomas, 1975; Lescure, 1979; Schwartz and Henderson, 1988, 1991; Breuil, 2002; Breuil et al., 2010

[20] Possibly a misidentified *Trachemys decussata*.

Species (native range)	Introduced (status)	Pertinent reference(s)
	Marie-Galante (**S**)	Breuil, 2002
	Martinique (**S**)	Servan and Arvy, 1997; Breuil, 2002
	St. Croix (**L**)	Platenberg and Boulon, 2006
	St. Eustatius (**S**)	Powell et al., 2005
	St.-Martin/St. Maarten (**W**)	Powell et al., 2005
	Turks & Caicos (**L**)	Reynolds and Niemiller, 2010; Reynolds, 2011
	Virgin Islands (**L**)	Owen et al., 2005b; Perry and Gerber, 2006, 2011; Platenberg and Boulon, 2006; Perry et al., 2007
Trachemys stejnegeri (Turks & Caicos, Hispaniola, Puerto Rico)	Bahamas (**L**)	Hodsdon and Pearson, 1943; Campbell, 1978; Groombridge, 1982; Seidel and Adkins, 1987; Seidel, 1988; Lee and Ross, 2001; Knapp et al., 2011
	Culebra (Puerto Rico) (**S**)	Seidel, 1988
	Dominica (**E**)	Fritz, 1991; Seidel, 1996
	Guadeloupe (**W**)	Breuil, 2002, 2003; Breuil et al., 2010
	Les Îles de Saintes* (**L**)	Breuil, 2002
	Marie-Galante (**L**)	Seidel and Adkins, 1987; Seidel, 1988; Ernst and Barbour, 1989; Breuil, 2002, 2003; Breuil et al., 2010
	Vieques (Puerto Rico) (**?**)	Seidel, 1988
	Turks & Caicos (**E?**)	Reynolds and Niemiller, 2010; Reynolds, 2011
Trachemys terrapen (Bahamas, Jamaica?)	New Providence (Bahamas) (**L**)	Campbell, 1978: Pritchard, 1979; Groombridge, 1982; Ross, 1982; Seidel and Adkins, 1987; Seidel, 1988, 1996; Lee and Ross, 2001; Knapp et al., 2011
Trachemys sp. (?)	Bahamas (**L**)	Franz et al., 1993; Seidel, 1996; Knapp et al., 2011
Reptilia: Testudines: Pelomedusidae		
*Pelusios castaneus**[21] (Western Africa)	Guadeloupe (**W**)	Lescure, 1979, 1983; Schwartz and Henderson, 1991; Iverson, 1992; Breuil, 2002, 2003; Breuil et al., 2010
Reptilia: Testudines: Testudinidae		
Centrochelys sulcata	Necker & Guana islands (BVI) (**S**)	G. Perry, unpubl. data

[21] Previously misidentified as *Pelusios subniger*.

Species (native range)	Introduced (status)	Pertinent reference(s)
(Northern Africa)	Martinique (**S**)	Breuil, 2009; Breuil et al., 2010
Chelonoidis carbonaria (Neotropics)	Barbados (**L**)	Fields and Horrocks, 2009, 2011
	Saba (**S**)	Powell et al., 2005
	St.-Barthélemy* (**L**)	Breuil, 2004
	St. Christopher (**L**)	Horwith and Lindsay, 1999; Orchard, 2010b
	St. Eustatius* (**S**)	Powell et al., 2005
Chelonoidis denticulata (Neotropical mainland)	Guadeloupe (**L**)	Pritchard and Trebbau, 1984; Breuil, 2002; Breuil et al., 2010
*Kinixys erosa** (Western Africa)	Guadeloupe (**E**)	Breuil, 2002, 2003
*Kinixys homeana** (Western Africa)	Guadeloupe (**E**)	Breuil, 2002, 2003
CROCODILIANS		
Reptilia: Crocodilia: Alligatoridae		
Alligator mississippiensis (Southeastern NA)	Bahamas (**S**)	Carey, 2002; Lee, 2004, 2005; Knapp et al., 2011
Caiman crocodilus (Neotropics)	Carriacou (Grenadines) (**S**)	Devas, 1964; Groome, 1970
	Isla de la Juventud (Cuba)* (**L**)	Varona, 1976, 1980, 1981; Groombridge, 1982; Garrido and Jaume, 1984; Escobar Herrera, 1995; Estrada and Ruibal, 1999
	Isla de San Andres (**S**)	Rueda-Almonacid, 1999
	Puerto Rico (**S**)	Schwartz and Henderson, 1985, 1991; Thomas and Joglar, 1996; Thomas, 1999
	Vieques (Puerto Rico) (**S**)	Thomas, 1999
Reptilia: Crocodilia: Crocodylidae		
Crocodylus acutus? (Neotropics)	Klein Curaçao (**S**)	van Buurt, 2001, 2005
Crocodylus intermedius (SA)	Grenada (**S**)	Groome, 1970

Appendix 2. Species of amphibians and reptiles introduced in the greater Caribbean region for research or conservation (including restorations). Individual islands within archipelagos (e.g., Bahamas, Virgin Islands) are listed only if introductions from other islands within the same archipelago occurred. Status: W = widespread (likely to be encountered within a few minutes of searching), L = localized (likely to be encountered at most sporadically, even in appropriate habitat, although possibly abundant within a few small areas), E = presumably extirpated or failed introduction. Most of the following records are included in the database of introductions in Kraus (2009) and listed in Henderson and Powell (2009). References cited are those that document or confirm an introduction; all references pertaining to introduced populations are not necessarily listed.

Species (native range)	Introduced (status)	Pertinent reference(s)
FROGS		
Amphibia: Anura: Eleutherodactylidae (formerly assigned to the family Leptodactylidae)		
Eleutherodactylus cochranae (Puerto Rico)	Puerto Rico (Isla Palominitos) (**E**)	Levins and Heatwole, 1973
Eleutherodactylus schwartzi (Great Dog Island, BVI)	Little Thatch Island (BVI) (**L**)	Lazell, 2002, 2005; Perry and Gerber, 2006
LIZARDS		
Reptilia: Squamata: Iguanidae		
Cyclura carinata (Turks & Caicos)	Cays in the Turks & Caicos[22] (**L**)	G. Gerber, in litt., 2010
Cyclura cychlura figginsi (Exuma Islands)	Pasture Cay (**L**)	Knapp, 2002
Cyclura cychlura inornata (Leaf and U Cays, Exuma Islands, Bahamas)	Alligator Cay (**L**) Flat Rock Reef Cay (**L**)	Iverson, 2000; Knapp and Malone, 2003; Iverson et al., 2006 Hines and Iverson, 2006a, 2006b
Cyclura pinguis (Anegada Island, BVI)	Guana Island (BVI) (**W**)	Kirby, 1986; Goodyear and Lazell, 1994; Lazell, 2002, 2005; Perry and Gerber, 2006, 2011
(Necker Island)	Moskito (BVI) (**L**)	Perry and Gerber, 2011
(Guana Island)	Necker Island (BVI) (**W**)	Lazell, 1995, 2000, 2002, 2005, 2006; Perry and Gerber, 2006, 2011

[22] These efforts involve relocation of animals from an island or islands that are to be intensely developed to islands that currently lack iguanas, although whether or not they supported populations in the past is unknown.

Species (native range)	Introduced (status)	Pertinent reference(s)
Cyclura rileyi nuchalis (Acklin Bight, Bahamas)	Bush Hill Cay (**L**)	Hayes et al., 2004
Iguana delicatissima (Îlet Chancel, Martinique)	Îlet à Ramiers (Martinique) (**L**)	Breuil, 2009
Reptilia: Squamata: Leiocephalidae		
Leiocephalus carinatus (Bahamas)	Bahamian Cays[23] (**E**)	Schoener and Spiller, 1996; Spiller et al., 1998; Schoener et al., 2001, 2002, 2005
Reptilia: Squamata: Polychrotidae		
Anolis lineatus (Curaçao)	Klein Curaçao (**L**)	van Buurt, 2006, 2011
Anolis pogus (Anguilla Bank)	Anguillita (**E**)	Roughgarden et al., 1984
Anolis pulchellus (Puerto Rico)	Isla Palominitos (**E**)	Levins and Heatwole, 1973
Anolis sagrei (Bahamas)	Bahamian Cays[24] (**L**)	Calsbeek and Smith, 2007; Calsbeek et al., 2008; Calsbeek, 2009
Anolis stratulus (Puerto Rico)	Isla Palominitos (**E**)	Levins and Heatwole, 1973
Reptilia: Squamata: Teiidae		
Ameiva polops (St. Croix)	Buck Island (St. Croix) (**E**)	Philibosian and Ruibal, 1971; Philibosian and Yntema, 1976; Dodd, 1978; Platenberg and Boulon, 2011
	Ruth Island (St. Croix) (**L**)	Knowles, 1990, 1997; McNair and Mackay, 2005
Cnemidophorus vanzoi (Maria Major, St. Lucia)	Praslin Island (**W**)	Dickinson and Fa, 2000

[23] Small cays with *Anolis sagrei* present, but previously without *L. carinatus*.
[24] Lizards (*A. sagrei*) were removed and/or translocated to manipulate population densities.

Species (native range)	Introduced (status)	Pertinent reference(s)
SNAKES		
Reptilia: Squamata: Dipsadidae		
Alsophis sajdaki	Green and Rabbit islands (**L**)	Daltry, 2007, 2011
(Great Bird Island, Antigua)		
TURTLES		
Reptilia: Testudines: Testudinidae		
Chelonoidis carbonaria	Guana Island (BVI) (**W**)	Lazell, 2002, 2005; Perry and Gerber, 2006
(Tortola and Water Island)	Necker Island (BVI) (**L**)	Lazell, 2002, 2005, 2006; Perry and Gerber, 2006

Appendix 3. Species exported from the US to the countries indicated. Those marked with an asterisk (*) do not occur (native or introduced) in the country to which it is being exported (USFWS LEMIS database). Those marked with a double-asterisk (**) do not occur in the greater Caribbean. A&B = Antigua and Barbuda, CI = Cayman Islands, DR = Dominican Republic, NA = Netherlands Antilles, PR = Puerto Rico, T&C = Turks & Caicos Islands, USVI = US Virgin Islands.

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Peltophryne (= *Bufo*) *lemur*	PR	–	–	–	–	–	–	–	–	–	700	–	–	700
*Bombina orientalis***	DR	–	3612	–	–	–	–	–	–	–	–	–	–	3612
	NA	–	–	–	–	150	–	–	–	–	–	–	–	150
Bombina sp.**	DR	10	–	–	–	–	–	–	–	–	–	–	–	10
*Cryptophyllobates azureiventris***	NA	–	–	–	–	–	–	–	–	–	–	30	–	30
*Dendrobates auratus***	NA	–	–	–	–	–	–	–	–	–	–	15	–	15
*Dendrobates azureus***	NA	–	–	–	–	–	–	–	–	–	–	105	–	105
*Dendrobates imitator***	NA	–	–	–	–	–	–	–	–	–	–	6	–	6
*Dendrobates tinctorius***	NA	–	–	–	–	–	–	–	–	–	–	80	–	80
*Dendrobates ventrimaculatus***	NA	–	–	–	–	–	–	–	–	–	–	20	–	20
*Phyllobates terribilis***	NA	–	–	–	–	–	–	–	–	–	–	15	–	15
*Hyla cinerea**	NA	12	–	–	–	25	–	–	–	–	–	–	–	37
Hyla sp.*	PR	–	–	–	–	–	–	–	1	–	–	–	–	1
*Ceratophrys cranwelli***	NA	–	–	–	–	25	–	–	–	–	–	–	–	25

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
*Ceratophrys ornata***	Jamaica	45	–	–	–	–	–	–	–	–	–	–	–	45
*Hymenochirus curtipes***	Bahamas	–	15	6	–	–	–	–	–	–	–	–	–	21
	Barbados	–	–	–	–	–	–	–	50	–	–	–	–	50
	CI	–	–	–	–	–	12	–	–	–	–	–	–	12
*Xenopus laevis***	Bahamas	–	45	–	–	–	–	–	–	–	–	–	12	57
	Barbados	–	–	–	–	200	–	–	–	–	–	–	–	200
	DR	–	–	–	20	–	–	–	–	–	–	–	–	20
Lithobates catesbeianus (= *Rana catesbeiana*)	DR	4900	–	–	–	–	–	–	–	–	–	–	–	4900
Ambystoma sp.**	Bahamas	–	–	–	24	–	–	–	–	–	–	–	–	24
	CI	–	6	12	–	–	–	–	–	–	–	–	–	18
*Ambystoma tigrinum***	Bahamas	–	–	10	–	–	–	13	–	–	–	–	–	23
	CI	–	–	6	12	20	–	–	–	–	–	–	–	38
	DR	–	–	–	22	–	–	–	–	–	–	–	–	22
*Necturus maculosus***	Barbados	–	–	–	–	–	–	–	20	–	–	–	–	20
*Cynops pyrrhogaster***	Bahamas	–	35	16	–	12	12	12	–	6	–	–	–	93
	Barbados	–	–	–	–	–	30	–	–	–	20	–	–	50
	CI	–	12	1012	24	73	84	–	–	–	–	–	–	1205
Cynops sp.**	Bahamas	–	–	–	–	–	–	12	–	6	12	–	–	30
	Barbados	–	–	–	–	–	–	–	–	40	–	–	–	40
Notophthalmus sp.**	Bahamas	–	–	–	–	–	–	–	–	12	–	–	–	12
	CI	–	–	–	–	–	12	–	–	–	–	–	–	12
*Notophthalmus viridescens***	CI	–	–	–	12	12	12	–	–	–	–	–	–	36
*Paramesotriton hongkongensis***	Barbados	–	–	–	–	–	–	–	–	–	100	–	–	100
Taricha sp.**	CI	–	–	–	12	–	–	–	–	–	–	–	–	12
*Taricha torosa***	Bahamas	–	–	–	–	–	12	–	–	6	–	–	–	18
	Barbados	–	–	–	–	–	–	–	–	20	–	–	–	20
	CI	–	–	511	–	24	–	–	–	–	–	–	–	535
	DR	–	–	–	–	–	–	–	–	40	–	–	–	40
Non-CITES entry (amphibian)	Bahamas	–	–	–	–	–	–	–	–	56	48	84	–	188
	DR	35	–	–	–	–	–	–	–	–	–	–	–	35

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Alligator mississippiensis	Bahamas	12	–	–	–	–	–	–	–	–	–	–	–	12
*Furcifer pardalis***	Dominica	–	–	–	–	–	–	6	–	–	–	–	–	6
*Coleonyx mitratus***	NA	–	–	–	–	6	–	–	–	–	–	–	–	6
*Eublepharis macularius***	Barbados	–	–	–	–	–	–	–	12	–	–	–	–	12
*Gekko gecko**	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
Gekko sp.**	Barbados	–	–	–	–	–	1	–	24	–	–	–	–	25
Hemidactylus sp.	NA	–	–	–	–	100	–	–	–	–	–	–	–	100
Ptychozoon sp.**	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
*Basiliscus plumifrons***	NA	1	–	–	–	–	–	–	–	–	–	–	–	1
*Basiliscus vittatus***	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
*Corytophanes cristatus***	NA	2	–	–	–	–	–	–	–	–	–	–	–	2
Cyclura nubila	CI	–	2	–	–	–	–	–	–	–	–	–	–	2
*Iguana iguana**	Bahamas	–	–	–	–	–	4	–	–	–	–	–	–	4
Iguana iguana	NA	–	–	–	–	25	–	–	–	45	20	–	–	90
	PR	–	–	1	–	–	–	–	–	–	–	–	–	1
*Leiocephalus carinatus**	Haiti	–	–	250	–	–	–	–	–	–	–	–	–	250
Leiocephalus sp.	Haiti	–	–	200	–	–	–	–	–	–	–	–	–	200
*Sceloporus malachiticus***	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
*Sceloporus olivaceus***	NA	–	–	–	–	4	–	–	–	–	–	–	–	4
*Sceloporus variabilis***	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
Takydromus sp.**	NA	–	–	–	–	100	–	–	–	–	–	–	–	100
*Anolis equestris**	NA	2	–	–	–	–	–	–	–	–	–	–	–	2
*Anolis carolinensis**	NA	–	–	–	–	100	–	–	–	–	–	–	–	100
Anolis sagrei	NA	–	–	–	–	100	–	–	–	–	–	–	–	100
Anolis sp.	NA	–	–	–	–	6	–	–	–	–	–	–	–	6
Novoeumeces (= *Eumeces*) *schneideri***	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
*Ameiva ameiva**	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
Cnemidophorus lemniscatus	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
*Boa constrictor**	Dominica	–	–	–	–	–	8	–	–	–	–	–	–	8
	DR	–	1	–	–	–	–	–	–	–	–	–	–	1
	NA	–	–	–	–	–	–	–	–	5	–	–	–	5

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
*Corallus caninus***	Barbados	–	–	–	3	–	–	–	–	–	–	–	–	3
*Corallus hortulanus***	Barbados	–	–	–	1	–	–	–	–	–	–	–	–	1
*Epicrates cenchria**	A&B	2	–	–	–	–	–	–	–	–	–	–	–	2
	Barbados	–	–	–	2	–	–	–	–	–	–	–	–	2
*Eunectes murinus***	Barbados	–	–	–	1	–	–	–	–	–	–	–	–	1
Pantherophis guttatus (= *Elaphe guttata*)*	Barbados	–	–	–	–	–	–	–	6	–	–	–	–	6
Pantherophis guttatus (= *Elaphe guttata*)	NA	–	–	–	–	6	–	–	–	–	–	–	–	6
*Pantherophis obsoletus** (= *Elaphe obsoleta*)	Barbados	–	–	–	–	–	–	–	3	–	–	–	–	3
*Elaphe quadrivirgata***	Barbados	–	–	–	–	–	–	–	1	–	–	–	–	1
Pantherophis vulpinus (= *Elaphe vulpina*)***	NA	–	–	–	–	11	–	–	–	–	–	–	–	11
*Lampropeltis calligaster***	Barbados	–	–	–	–	–	–	–	1	–	–	–	–	1
*Lampropeltis getula***	NA	–	–	–	–	–	–	–	–	–	4	–	–	4
Lampropeltis sp.**	Barbados	–	–	–	–	–	–	–	1	–	–	–	–	1
	NA	–	5	–	–	–	–	–	–	–	–	–	–	5
*Lampropeltis triangulum***	Barbados	–	–	–	–	–	–	–	4	–	–	–	–	4
*Lamprophis fuliginosus***	Barbados	–	–	–	–	–	–	–	2	–	–	–	–	2
*Opheodrys aestivus***	NA	–	–	–	–	12	–	–	–	–	–	–	–	12
*Spalerosophis diadema***	CI	–	–	–	–	–	–	3	–	–	–	–	–	3
*Spilotes pullatus***	Barbados	–	–	–	–	3	–	–	–	–	–	–	–	3
*Thamnophis sirtalis**	NA	–	–	–	–	11	–	–	–	–	–	–	–	11
Naja sp.**	Bahamas	–	–	–	–	–	–	–	–	2	–	–	–	2
*Morelia spilota***	A&B	5	–	–	–	–	–	–	–	–	–	–	–	5
Python molurus (probably *P. bivittatus*)*	Barbados	–	–	–	1	1	–	–	–	–	–	–	–	2
	DR	–	1	–	–	–	–	–	–	–	–	–	–	1
	Jamaica	–	1	–	–	–	–	–	–	–	–	–	–	1
	NA	–	2	–	–	2	–	–	–	4	–	–	–	8
*Python regius**	A&B	500	–	–	–	–	–	–	–	–	–	–	–	500
	NA	–	–	–	–	1	–	–	–	8	4	–	–	13
Chrysemys sp.**	Barbados	–	–	–	–	–	–	25	–	–	–	–	–	25
	CI	–	–	–	–	–	8	–	–	–	–	–	–	8

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
	NA	–	–	–	–	–	–	–	–	–	1075	–	–	1075
*Cuora amboinensis***	NA	–	–	–	–	20	–	–	–	–	–	–	–	20
*Cyclemys dentata***	Bahamas	–	–	–	–	–	3	–	–	–	–	–	–	3
*Graptemys geographica***	Barbados	–	–	–	–	–	–	–	–	10	–	–	–	10
*Graptemys nigrinoda***	NA	50	–	–	–	–	–	–	–	–	–	–	–	50
*Graptemys pseudogeographica**	NA	–	–	–	–	–	–	–	–	–	925	–	–	925
*Pseudemys floridana***	NA	100	–	–	–	–	100	–	–	–	–	–	–	200
*Pseudemys nelsoni**	NA	200	–	–	–	–	1000	–	–	–	–	–	–	1200
Pseudemys sp.*	Barbados	–	–	–	–	–	–	–	–	505	–	–	–	505
	DR	–	–	–	–	5000	–	–	4000	–	–	–	–	9000
	NA	5000	–	1000	1500	–	500	1000	1000	1200	1100	–	–	12300
	Bahamas	–	–	–	–	12	–	–	–	30	20012	12	–	20066
	Barbados	–	–	–	–	–	100	100	–	70	49	–	–	319
Trachemys scripta	Aruba	–	–	–	50	–	–	6	–	–	–	–	–	56
	DR	1800	4000	11500	15110	10500	9000	6000	8000	10000	16000	6000	–	97910
	Grenada	–	–	–	–	–	1	–	–	–	–	–	–	1
	Jamaica	–	–	100	–	–	–	–	–	–	–	–	–	100
	NA	850	500	–	–	200	2000	–	–	550	1200	4500	–	9800
	PR	–	–	–	–	–	–	–	–	–	–	50	–	50
	T&C	–	–	–	–	–	–	–	–	100	–	–	–	100
Trachemys sp.	Dominica	8	–	–	–	–	–	–	–	–	–	–	–	8
	DR	–	–	–	–	3000	–	–	–	–	–	–	–	3000
	Grenada	–	–	–	–	100	–	–	–	–	–	–	–	100
Apalone ferox	NA	100	–	–	–	–	–	–	–	–	–	–	–	100
Chelonoidis (= *Geochelone*) *carbonaria*	Barbados	–	–	41	–	–	–	–	–	–	–	–	–	41
	PR	–	–	–	–	–	–	–	100	300	–	–	–	400
Non-CITES entry (reptiles)	NA	–	–	–	–	4	–	–	–	–	–	–	–	4

Appendix 4. Species imported into the US from the countries indicated (USFWS LEMIS database). Those marked with an asterisk (*) do not occur (native or introduced) in the country of origin. Those marked with a double-asterisk (**) do not occur in the greater Caribbean. BVI = British Virgin Islands, CI = Cayman Islands, DR = Dominican Republic, NA = Netherlands Antilles, T&C = Turks & Caicos Islands.

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Rhinella marina	Barbados	–	–	–	–	–	80	–	–	35	–	285	400
(= *Bufo marinus*)	DR	–	200	422	–	–	–	–	–	–	–	–	622
*Hyla cinerea**	Haiti	–	–	–	–	–	–	–	–	–	–	27	27
Hyla sp.	Haiti	–	–	–	222	15	1713	1931	352	316	73	26	4648
Osteopilus vastus	Haiti	–	–	–	–	–	–	–	–	–	489	399	888
(= *Hyla vasta*)													
Osteopilus sp.	CI	–	–	–	1	–	–	–	–	–	–	–	1
Scinax sp.*	T&C	–	2	–	–	–	–	–	–	–	–	–	2
Eleutherodactylus sp.	Barbados	–	–	–	–	50	–	–	–	484	–	–	534
	Grenada	–	–	–	–	–	–	–	20	–	–	–	20
	Jamaica	30	–	–	–	–	18	–	–	–	–	–	48
	T&C	–	3	–	–	–	–	–	–	–	–	–	3
Leptodactylus fallax	Dominica	–	–	–	7	–	–	–	–	–	–	–	7
*Lithobates catesbeianus**	Dominica	–	6280	–	–	5000	–	–	–	–	–	–	11280
(= *Rana catesbeiana*)	DR	689324	1087716	392363	218788	5218	2797	130000	5500	47930	78296	167550	2825482
	BVI	–	–	–	–	6000	–	–	–	–	–	–	6000
*Rana latastei***	DR	–	–	–	369	–	–	–	–	–	–	–	369
Lithobates sp.	DR	35750	9938	781	–	–	–	–	–	–	5550	1590	53609
(= *Rana* sp.)													
Notophthalmus	Haiti	–	–	–	–	886	–	–	–	–	–	–	886
*viridescens***													
Non-CITES entry	DR	–	–	–	1	–	–	–	–	–	–	–	1
(amphibian)													
	Haiti	–	–	–	335	49	66	160	–	–	–	–	610
	Barbados	–	–	–	–	–	–	–	–	7	–	–	7
	Haiti	–	–	–	–	–	–	6	–	–	–	–	6
Alligator mississippiensis	Bahamas	–	–	–	–	–	–	–	–	–	–	1	1
*Crocodylus siamensis***	Haiti	–	–	–	–	–	–	–	–	–	132	–	132

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
*Agama agama***	Haiti	–	–	–	–	–	–	–	2537	86	–	–	2623
Uromastyx sp.**	Haiti	400	–	–	–	–	–	–	–	–	–	–	400
Diploglossus sp. (probably *Celestus* sp.)	Haiti	–	–	–	5	20	9	4	–	–	–	–	38
*Chamaeleo bitaeniatus***	BVI	–	–	–	–	–	–	–	–	–	50	–	50
*Chamaeleo dilepis***	BVI	–	–	–	–	–	–	–	–	–	25	–	25
*Chamaeleo ellioti***	BVI	–	–	–	–	–	–	–	–	–	50	–	50
*Chamaeleo hoehnelii***	BVI	–	–	–	–	–	–	–	–	–	75	–	75
Alsophylax sp.**	CI	–	–	–	2	–	–	–	–	–	–	–	2
Gekko sp.*	Barbados	–	–	–	–	–	1	–	–	–	–	–	1
Gonatodes albogularis	Haiti	–	–	–	–	–	–	–	200	–	–	–	200
Gonatodes sp.	Haiti	–	–	–	–	–	–	125	–	125	–	–	250
Hemidactylus mabouia	Barbados	–	–	–	–	12	–	–	–	5	–	–	17
Hemidactylus sp.	Barbados	–	–	–	–	–	–	–	–	12	–	–	12
	CI	–	–	–	4	–	–	–	–	–	–	–	4
	T&C	–	3	–	–	–	–	–	–	–	–	–	3
*Hemidactylus turcicus**	Jamaica	–	–	–	–	–	10	–	–	–	–	–	10
Sphaerodactylus sp.	CI	–	–	–	5	–	–	–	–	–	–	–	5
	T&C	–	9	–	–	–	–	–	–	–	–	–	9
Tarentola sp.*	Haiti	–	–	–	–	–	–	–	50	–	–	–	50
*Anolis carolinensis**	CI	–	–	–	1	–	–	–	–	–	–	–	1
	Haiti	–	–	–	54	–	–	125	–	–	–	–	179
Anolis chlorocyanus	Haiti	–	–	–	–	–	–	–	250	–	–	–	250
*Anolis equestris**	Barbados	–	–	–	–	–	–	–	–	75	–	–	75
Anolis sagrei	CI	–	–	–	5	–	–	–	–	–	–	–	5
	Jamaica	–	–	–	–	–	10	–	–	–	–	–	10
Anolis sp.	Barbados	–	–	–	–	20	22	–	–	100	–	–	142
	CI	–	–	–	5	–	–	–	–	–	–	–	5
	DR	–	–	–	10	–	–	–	–	–	–	–	10
	Haiti	–	–	–	900	–	863	2055	2082	575	245	–	6720
	Jamaica	–	–	121	14	45	–	–	–	–	–	–	180

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
	T&C	–	3	–	–	–	–	–	–	–	–	–	3
Cyclura nubila	CI	–	4	–	–	–	–	–	10	–	–	–	14
Iguana iguana	CI	–	–	–	–	–	2	–	–	–	–	–	2
	BVI	1	–	–	–	–	–	–	–	–	–	–	1
*Leiocephalus carinatus**	Haiti	–	–	–	3000	3050	13425	15476	4100	2500	7875	7230	56656
Leiocephalus personatus	Haiti	–	–	2260	1136	3270	14100	19422	3850	2650	7461	7500	61649
Leiocephalus schreibersii	Haiti	–	–	4711	3244	–	–	1610	4010	500	–	–	14075
Leiocephalus sp.	Haiti	–	–	6100	6700	–	–	–	–	–	–	–	12800
	T&C	–	3	–	–	–	–	–	–	–	–	–	3
Sceloporus sp.**	Haiti	–	–	–	–	–	53	25	–	–	–	–	78
Lacerta sp.**	NA	–	9	–	–	–	–	–	–	–	–	–	9
Mabuya sp.	T&C	–	3	–	–	–	–	–	–	–	–	–	3
Ameiva ameiva	Barbados	–	–	–	–	–	–	–	–	22	–	1	23
Ameiva sp.	Jamaica	3	–	–	–	–	–	–	–	–	–	–	3
Boa constrictor	Aruba	–	–	–	–	–	2	–	–	–	–	–	2
Epicrates chrysogaster	T&C	–	1	–	–	–	–	–	–	–	–	–	1
Epicrates fordii	Haiti	–	–	–	40	–	28	–	–	–	–	–	68
Epicrates gracilis	Haiti	–	–	–	91	–	9	–	–	–	–	–	100
Epicrates striatus	Haiti	–	–	–	66	–	23	226	88	–	–	–	403
Lampropeltis sp.**	DR	–	1	–	–	–	–	–	–	–	–	–	1
Naja sp.**	Bahamas	–	–	–	–	–	–	–	–	2	–	–	2
*Python molurus** (probably *P. bivittatus*)	Aruba	–	–	–	–	–	–	–	–	–	1	–	1
Tropidophis greenwayi	T&C	–	1	–	–	–	–	–	–	–	–	–	1
Tropidophis haitianus	Haiti	–	–	–	15	–	42	396	90	–	–	–	543
Typhlops sp.	T&C	–	2	–	–	–	–	–	–	–	–	–	2
Bothrops sp.	St. Lucia	–	–	–	2	–	–	–	–	–	–	–	2
Chrysemys sp.*	Cuba	–	–	–	1	–	–	–	–	–	–	–	1
*Mauremys caspica***	Cuba	–	–	1	–	–	–	–	–	–	–	–	1
Pseudemys sp.*	Cuba	1	–	–	2	–	–	–	–	–	–	–	3
Terrapene sp.*	NA	–	2	–	–	–	–	–	–	–	–	–	2

Species	Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Trachemys scripta	CI	–	–	–	–	–	4	–	–	–	–	–	4
	DR	3000	–	–	–	–	2	–	–	–	–	–	3002
	Jamaica	–	–	–	–	–	–	–	–	–	2	–	2
Trachemys sp.	Cuba	–	–	–	1	–	–	–	1	–	–	–	2
Chelonoidis carbonaria	Barbados	98	–	20	451	20	40	–	–	8	1	25	663
(= *Geochelone carbonaria*)	BVI	–	–	–	–	–	–	–	–	–	400	–	400
*Pyxis arachnoides***	Martinique	–	–	–	–	–	–	2	–	–	–	–	2
Non-CITES entry (reptile)	Barbados	–	–	–	–	–	–	–	–	9	–	–	9
	DR	–	–	–	–	2724	–	–	–	–	–	–	2724
	Haiti	–	–	–	20	3	10	5	3	–	–	–	41
	T&C	–	1	–	–	–	5	–	–	–	–	–	6

Appendix 5. Species exported from the shown country, imported to the US, then re-exported mostly to European, Canadian, some Asian markets, and a few are re-exported to countries in the greater Caribbean (USFWS LEMIS database). Those marked with an asterisk (*) do not occur (native or introduced) in the country of origin. Those marked with a double-asterisk (**) do not occur in the greater Caribbean. DR = Dominican Republic, NA = Netherlands Antilles, PR = Puerto Rico, T&C = Turks & Caicos Islands, USVI = US Virgin Islands.

Species Exported to the US	Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Peltophryne (= *Bufo*) *lemur*	PR	1	–	–	–	–	–	–	–	–	–	1
Rhinella marina (= *Bufo marinus*)	Barbados	–	–	–	–	–	–	–	–	–	6	6
	DR	146	80	–	–	–	–	–	–	–	–	226
Hylidae (listed as *Hyla* sp.)	Bahamas	–	–	32	–	–	–	–	–	–	–	32
	Haiti	–	–	–	3	85	151	27	23	3	6	298
Osteopilus vastus (= *Hyla vasta*)	Haiti	–	–	–	–	–	–	–	–	56	30	86
Osteocephalus sp.**	Cuba	–	–	–	–	–	–	–	–	–	6	6
Phyllomedusa sp.**	PR	2	–	–	–	–	–	–	–	–	–	2
*Tlalocohyla loquax***	Haiti	–	–	–	–	–	–	–	–	4	–	4
*Cynops orientalis***	Haiti	–	–	–	–	–	–	100	–	–	–	100
Reptile (?)	Haiti	–	–	–	–	–	3	–	–	–	–	3
*Agama agama***	Haiti	–	–	–	–	–	40	2950	300	–	–	3290

Species Exported to the US	Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Japalura sp.**	Haiti	–	–	–	–	–	6	–	–	–	–	6
*Physignathus cocincinus***	USVI	–	–	–	50	–	–	50	–	–	–	100
Diploglossus sp. (probably *Celestus* sp.)	Haiti	–	–	–	–	2	3	–	–	–	–	5
*Eublepharis macularius***	Haiti	–	–	–	–	500	–	–	–	–	–	500
*Gekko gecko**	USVI	–	–	12	–	–	–	–	–	–	–	12
Gonatodes albogularis	Haiti	–	–	–	–	–	–	69	–	–	–	69
Gonatodes sp.	Haiti	–	–	–	–	–	65	30	–	–	–	95
Hemidactylus sp.	Haiti	–	–	–	–	–	–	100	–	–	–	100
*Ptychozoon kuhli***	Haiti	–	–	–	–	–	–	24	–	–	–	24
Tarentola sp.*	Haiti	–	–	–	–	–	–	52	–	–	–	52
*Anolis bimaculatus**	Haiti	–	–	–	–	–	–	30	–	–	–	30
*Anolis carolinensis**	Haiti	–	–	–	–	–	3	25	–	–	–	28
Anolis chlorocyanus	Haiti	–	–	–	–	–	97	169	31	58	10	365
*Anolis roquet**	Haiti	–	–	–	–	–	–	–	–	–	38	38
Anolis sp.	Haiti	–	–	–	–	97	835	273	32	70	91	1398
	Jamaica	–	–	3	–	–	–	–	–	–	–	3
Leiocephalus carinatus	Bahamas	–	–	–	–	11	57	–	–	–	–	68
*Leiocephalus carinatus**	Haiti	–	125	937	934	3215	4497	1030	25	637	318	11718
*Leiocephalus personatus**	Bahamas	–	–	5	–	–	–	–	–	–	–	5
Leiocephalus personatus	Haiti	6	150	163	12	1662	3728	989	1227	3546	4068	15551
*Leiocephalus schreibersii**	Bahamas	–	–	–	–	200	–	–	12	–	–	212
Leiocephalus schreibersii	Haiti	–	237	296	126	2051	4156	1461	1215	2367	2776	14685
Leiocephalus sp.	Haiti	–	20	765	59	1024	902	598	414	86	136	4004
Polychrus sp.**	PR	4	–	–	–	–	–	–	–	–	–	4
*Takydromus sexlineatus***	Haiti	–	–	–	–	–	–	100	–	–	–	100
*Riopa fernandi***	Haiti	–	–	–	–	–	–	–	–	–	25	25
Epicrates striatus	Haiti	–	–	–	–	–	42	2	–	–	–	44
*Lampropeltis getula***	Haiti	–	–	–	–	–	–	–	–	–	1	1
*Opheodrys aestivus***	Haiti	–	–	–	–	–	69	–	–	–	–	69
*Pseustes poecilonotus***	NA	–	–	–	–	–	2	–	–	–	–	2

Species Exported to the US	Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Thamnophis sauritus	Bahamas	–	–	1	–	–	–	–	–	–	–	1
Tropidophis haetianus	Haiti	–	–	–	–	–	34	5	–	–	–	39
*Terrapene carolina**	Montserrat	–	–	–	–	–	–	–	–	3	–	3
*Terrapene ornata***	Montserrat	–	–	–	–	–	–	–	–	2	–	2
Chelonoidis (= *Geochelone*) *carbonaria*	Barbados	–	–	10	–	–	–	2	–	–	–	12
*Testudo horsfieldii***	Montserrat	–	–	–	–	–	–	–	–	5	–	5
Non-CITES entry (reptile?)	Haiti	–	–	6	–	–	54	1	37	–	–	98
Rhinella marina (= *Bufo marinus*)	PR	–	–	–	1	–	–	–	–	–	–	1
Afrixalus sp.**	PR	12	–	–	–	–	–	–	–	–	–	12
Phyllomedusa sp.**	PR	9	–	–	–	–	–	–	–	–	–	9
Eleutherodactylus sp.	PR	–	50	–	–	–	–	–	–	–	–	50
Lithobates catesbeianus (= *Rana catesbeiana*)	DR	1450	–	–	–	–	–	–	–	–	–	1450
Lithobates sp. (= *Rana* sp.)	DR	–	–	–	–	–	–	–	–	1260	–	1260
*Cynops orientalis***	St. Lucia	–	–	100	–	–	–	–	–	–	–	100
Diploglossus sp. (probably *Celestus* sp.)	Haiti	–	–	–	–	–	–	1	–	–	–	1
Anolis sp.	Jamaica	–	4	–	–	–	–	–	–	–	–	4
*Leiocephalus carinatus***	Haiti	–	–	25	–	–	–	–	–	–	–	25
Leiocephalus schreibersii	Haiti	–	–	50	–	–	–	–	–	–	–	50
Leiocephalus sp.	Haiti	–	–	25	–	–	–	–	–	–	–	25
Atheris sp.**	T&C	–	–	–	–	11	–	–	–	–	–	11
Trachemys decussata	Jamaica	–	–	–	–	–	1	–	–	–	–	1
Trachemys stejnegeri	DR	–	–	–	–	–	1	–	–	–	–	1
Chelonoidis (= *Geochelone*) *carbonaria*	Barbados	–	–	–	–	–	–	1	–	–	–	1
Non-CITES entry (reptile?)	NA	–	–	–	–	13	–	–	–	–	–	13