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Responses by the West Indian Herpetofauna to Human-Influenced Resources

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ABSTRACT.—The West Indian herpetofauna has experienced the impact of human activity for about 5000 years. In that span of time, but primarily with the arrival of Europeans about 500 years ago, humans have introduced a wide range of resources that have been exploited to various degrees by frogs and reptiles. Coconut palms, banana, cacao, coffee trees, introduced rodents, and even buildings have been exploited extensively. Complex habitats are used more frequently than those simplified by man. Introduced orchard trees may simulate some elements of natural vegetation patterns, but habitats associated with clear-cutting are rarely used. Lizards and snakes are more likely to exploit introduced resources, and the herpetofauna of smaller islands (Bahamas, Lesser Antilles) tends to use introduced resources more often than that of larger islands. Lizards, especially of the genera *Anolis* and *Ameiva*, use introduced resources for a wide range of activities (retreats, basking and foraging sites, social interactions), and coconut palms, edifices, and human debris are especially adaptable for these activities. Despite the wide use of human-introduced resources by some members of the West Indian herpetofauna, only 5-10 % of this fauna has benefitted directly from anthropogenic activity, whereas at least half has been negatively impacted. Biologists should study the West Indian herpetofauna in a variety of situations, including those modified (subtlely to flagrantly) by human activity.

INTRODUCTION

West Indian frogs, lizards, and snakes have exploited human-introduced resources and other alterations in their environment since humans first invaded. Amerindians entered the West Indies about 5000 years ago and Europeans arrived just over 500 years ago. The impact of the latter has been felt longer in the West Indies than anywhere else in the Western Hemisphere, and Fosberg (1983) noted that "The impact of European man on islands made the changes due to aboriginal man seem minor by comparison." Shortly after the construction of the first human dwellings on an island, Amerindian huts in the Lesser Antilles or the fort of Columbus' crew at La Navidad on Hispaniola, species of *Anolis* surely began to exploit them. Likewise, a discarded board from a ship or a piece of broken Arawak pottery quickly became hiding places for species of *Ameiva*, *Celestus*, *Alsophis*, or *Antillophis*. As fruit trees were introduced, they became part of the exploitable habitat, as did fence posts and stone walls. Europeans also brought with them rodents that were preyed upon by the larger species of West Indian snakes.

One hundred and fifty years ago, Gosse (1851) recorded in Jamaica hylid frogs (probably *Osteopilus*) in a bedroom at Savanna-le-Mar, the teiid lizard *Ameiva dorsalis* foraging in pastures, the gecko *Aristelliger praesignis* in outbuildings, and anoles (*Anolis*) in the "dwelling-house." He discussed the natural tendency of the boid *Epicrates subflavus* for entering houses (he encountered one in his bedroom at Content), and the colubrid snake *Alsophis ater* was often seen "hanging half out of the loose walls so much used as fences..." Today, *Leiocephalus* lizards in the Bahamas feed on food scraps dropped by diners at a hotel (Schoener et al., 1982), and *Anolis bimaculatus* and *Ameiva griswoldi* on Great Bird Island (Antigua) crawl into cans of beans and tuna fish to feed on scraps (Henderson and

Powell, 1999). Wijffels (1997) suggested that food availability and absence of predators (and therefore a longer life span) contribute to the large size attained by *Anolis bimaculatus* in and around human dwellings on St. Eustatius. Undoubtedly, humans have had great impact on the ecology of the West Indian herpetofauna, constructing new habitat elements (e.g., buildings and rock walls), planting or eliminating vegetation (e.g., planting crops, exotic ornamental plants, and fruit trees, or eliminating trees and creating areas for pasture), and otherwise influencing the quality and nature of many habitats.

Whereas much of the human activity in the West Indies has been detrimental to catastrophic, some appears to have been benign or even beneficial (or beneficial to some species at least some of the time, while having a negative impact on others). Nevertheless, the arrival of humans on oceanic islands initiated profound changes that are still ongoing. Fosberg (1983) attributed large scale changes on islands to four main causes, all directly attributable to humans: (1) the deliberate or accidental introduction of exotic organisms; (2) deforestation; (3) agriculture; and (4) fire. He was uncertain which was the most important, but they certainly are interrelated, and "Together they have drastically changed the island landscape."

Factors such as changing climates (Pounds et al., 1999), excessive ultraviolet radiation (Blaustein et al., 1994), and environmental contamination (Lips, 1998), affect the distribution, life histories, and survival of amphibians and reptiles on a global scale (e.g., Blaustein and Wake, 1995; Gibbons et al., 2000). In this paper we concentrate on the more direct impact of human-influenced resources on the West Indian frog and squamate reptile faunas. In what follows, we make generalizations, often based on anecdotal information, and compare "non-equivalents" not ideally suited for statistical analysis. Despite these and other shortcomings, we hope to provide a catalyst that encourages biologists interested in the West Indian herpetofauna to seek out anthropogenic situations. As the Antilles continue to develop, the study of frogs and reptiles under near-pristine conditions will be increasingly difficult if not impossible, and the need to document the herpetofaunal response to physical alterations of the environment will become increasingly important.

Methods

We obtained most of the information used for our analyses from the species accounts in Schwartz and Henderson (1991), which were compiled from hundreds of references. We read each account, looking for information that indicated some obvious human influence on the ecology of a species (e.g., use of an introduced fruit tree, a human-made structure, or pastures resulting from the clearing of forest). We used general categories that became more refined as information accumulated; for example, we redefined orchard trees to include banana, mango, nutmeg, breadfruit, citrus, coconut, cacao, coffee, etc. We finally identified 39 categories of conditions that were exploited at least once by one or more species of frog, lizard, or snake. That is, if a species occurred in coffee plantations, was found sleeping on a banana tree, foraging on a fence post, rats comprised part of its diet, buildings provided cover, or it occurred in cisterns or coconut trash at least once, it was scored as exploiting that resource. For species described after the publication of Schwartz and Henderson (1991), we used the recent checklist of Powell et al. (1996a) and the addenda of Powell and Henderson (1999; unpublished). We read descriptions of the new taxa in search of information pertaining to natural history. If the authors made no reference to possible human impact, we assumed that the species did not exploit human-influenced resources. We also obtained additional information from Powell (1999), Henderson (2001a, b), and our own observations. If no natural history information was available for a species, we disregarded it. We ultimately reviewed natural history information for 601 species (167 frogs, 328 lizards, and 106 snakes), or about 90 % of West Indian frogs and squamate reptiles. Because our own field experience has been concentrated largely on Hispaniola and the Lesser Antilles, specific examples are often from these areas.

Species scored as edificarian used buildings (house, banana shack, storage building, etc.) for some type of activity at least occasionally. Scoring does not necessarily imply prolonged or continuous use of a building, as might be the case for some geckos.

Two obvious shortcomings characterize our data set: (1) The percentages in most cases are minimum numbers; merely because information has not been published does not mean that a species does not exploit resources resulting from human activity. (2) Conversely, if a species that almost always occurs in habitat removed from human disturbance was encountered on one occasion in, for example, a coffee grove, we scored it as occurring in coffee. The two shortcomings may offset each other enough to make the data set reasonably accurate, but regardless, we believe that the general trends observed are real. We used StatView II (Abacus Concepts, Inc., Berkeley, CA) for statistical analyses. For all statistical tests, $\alpha = 0.05$.

Results and Discussion

Taxonomic trends.—West Indian frogs and reptiles are associated with a wide spectrum of human-introduced or human-produced habitat variables (Table 1). The most widespread and frequently exploited resource is coconut palms (trunks, fronds, fruit, husk piles, etc.), and lizards and snakes exploit them significantly more frequently than frogs (Contingency table, df = 1, $\chi^2 = 96.1$, $P < 0.0001$; df = 1, $\chi^2 = 86.1$, $P < 0.0001$; respectively). Bananas also are used frequently, with coffee and cacao less so. Fewer than 3 % of the frogs, lizards, and snakes use sugarcane—the crop responsible for much of the historical deforestation in the Antilles. With the exception of pastures, which might contain some scattered vertical structure such as clumps of bushes or isolated trees, areas that imply clear-cutting of trees (i.e., sugarcane, cultivated fields) are rarely exploited as habitat.

TABLE 1. Percentages of West Indian herpetofauna that associates, at least occasionally, with one or more of 39 habitat variables resulting from human impact. Asterisks (*) indicate significant differences (contingency tests).

Variable	Frogs (167 species)	Lizards (328 species)	Snakes (106 species)
Coconut	7.2*	33.5	32.1
Edificarian	3.6*	20.4*	11.3*
Banana	14.4	12.8	21.7
Coffee	7.2	9.5	7.5
Human debris	5.4	8.2	9.4
Cacao	3.6	6.1	6.6
Fence posts	0.0	8.8*	0.9
Pasture	4.2*	1.5*	11.3*
Rock walls	1.2	4.6	2.8
Eats *Rattus/Mus*	0.0	0.0	14.2*
Mango	0.0	3.0	3.8
Sugarcane	2.4	2.1	2.8
Cultivated fields	1.8	1.8	0.9
Corn field	0.6	1.2	2.8
Breadfruit	0.0	1.5	2.8
Citrus	0.0	0.6	4.7*
Gardens	0.6	0.3	3.8
Nutmeg	0.6	0.9	1.9
Cistern	1.2	0.0	1.9
Causarina	0.0	0.9	0.9
Rice field	2.4	0.0	0.0
Guava	0.0	0.0	0.9
Rock piles	0.0	0.3	1.9
Pool	1.2	0.0	0.0
Garbage dump	0.0	0.6	0.0
Water trough	1.2	0.0	0.0
Potted plants	0.0	0.0	0.9
Railroad ties	0.0	0.3	0.9
Papaya	0.0	0.3	1.8
Yam	0.0	0.0	0.9
Strawberry patch	0.0	0.3	0.0
Pineapple	0.0	0.3	0.0
Drain gutter	0.6	0.0	0.0
Mine shaft	0.6	0.0	0.0
Boards/slats	0.0	0.3	0.0
Telephone poles	0.0	0.3	0.0
Dock pilings	0.0	0.0	0.9
Compost pile	0.0	0.0	0.9
Road ruts	0.6	0.0	0.0

Human edifices are used by about 20 % of the lizards (significantly more often than frogs or snakes; df = 1, $\chi^2 = 78.4$, $P < 0.0001$; df = 1, $\chi^2 = 7.3$, $P = 0.0007$; respectively), 11 % of the snakes (significantly more often than frogs; df = 1, $\chi^2 = 16.5$, $P < 0.0001$), and less than 4 % of the frogs. Fence posts are

TABLE 2. Percentage of species in each genus that are at least occasionally associated with one or more of 14 habitat variables.

Family Genus (# species)	COC[1]	EDI	BAN	COF	HD	CAC	FP	PAS	ROC	RAT	MAN	SUG	CUL	RIC
Bufonidae (12)														
Bufo (12)	25.0	0.0	16.7	0.0	8.3	8.3	0.0	8.3	0.0	0.0	0.0	8.3	16.7	8.3
Dendrobatidae (1)														
Colostethus (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hylidae (9)														
Hyla (5)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	20.0
Osteopilus (3)	33.3	66.7	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scinax (1)	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leptodactylidae (144)														
Eleutherodactylus (139)	5.8	2.2	14.4	7.9	5.0	3.6	0.0	2.2	1.4	0.0	0.0	1.4	0.7	1.4
Leptodactylus (5)	0.0	0.0	0.0	20.0	20.0	0.0	0.0	40.0	0.0	0.0	0.0	40.0	0.0	0.0
Amphibaenidae (15)														
Amphisbaenia (15)	0.0	6.7	0.0	26.7	6.7	6.7	0.0	13.3	0.0	0.0	0.0	6.7	13.3	0.0
Anguidae (24)														
Celestus (19)	26.3	10.5	5.3	10.5	15.8	21.1	0.0	5.3	10.5	0.0	0.0	0.0	0.0	0.0
Diploglossus (5)	0.0	0.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0
Gekkonidae (99)	41.4	29.3	11.1	8.1	16.2	2.0	0.0	0.0	6.1	0.0	4.0	1.0	1.0	0.0
Aristelliger (7)	85.7	71.4	0.0	0.0	0.0	0.0	0.0	0.0	57.1	0.0	14.3	0.0	0.0	0.0
Gekko (1)	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gonatodes (1)	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hemidactylus (4)	50.0	75.0	0.0	0.0	50.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0
Phyllodactylus (2)	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphaerodactylus (82)	36.6	22.0	12.2	9.8	15.9	2.4	0.0	0.0	1.2	0.0	3.7	1.2	1.2	0.0
Tarentola (1)	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thecadactylus (1)	100.0	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gymnophthalmidae (4)	25.0	25.0	50.0	0.0	25.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0
Bachia (1)	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gymnophthalmus (2)	50.0	50.0	50.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0
Tretioscincus (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Iguanidae (12)	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0
Ctenosaura (1)	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclura (9)	22.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iguana (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0
Polychrotidae (142)														
Anolis (142)	22.5	23.2	15.5	14.1	1.4	7.0	19.7	21.1	2.8	0.0	4.2	1.4	1.4	0.0
Scincidae (2)														
Mabuya (2)	50.0	50.0	100.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0

TABLE 2. Continued.

Family Genus (# species)	COC[1]	EDI	BAN	COF	HD	CAC	FP	PAS	ROC	RAT	MAN	SUG	CUL	RIC
Teiidae (22)	63.6	9.1	13.6	0.0	18.2	9.1	0.0	4.5	4.5	0.0	4.5	9.1	4.5	0.0
Ameiva (19)	63.2	10.5	15.8	0.0	0.0	21.1	0.0	5.3	5.3	0.0	5.3	10.5	5.3	0.0
Cnemidophorus (2)	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kentropyx (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tropiduridae (23)														
Leiocephalus (23)	56.5	8.7	0.0	0.0	4.3	0.0	0.0	0.0	4.3	0.0	4.3	4.3	4.3	0.0
Xantusiidae (1)														
Cricosaura (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Boidae (12)	58.3	33.3	41.7	0.0	8.3	16.7	8.3	0.0	8.3	75.0	16.7	0.0	0.0	0.0
Boa (1)	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Corallus (2)	100.0	100.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0
Epicrates (9)	44.4	22.2	22.2	0.0	11.1	0.0	11.1	0.0	11.1	66.7	0.0	0.0	0.0	0.0
Colubridae (44)	31.8	11.4	27.3	6.8	6.8	4.5	0.0	11.4	6.8	11.4	2.3	0.0	2.2	0.0
Alsophis (11)	45.5	18.2	27.3	0.0	9.1	0.0	0.0	18.2	18.2	27.3	9.1	0.0	0.0	0.0
Antillophis (2)	100.0	50.0	50.0	50.0	50.0	50.0	0.0	0.0	0.0	50.0	0.0	0.0	50.0	0.0
Arrhyton (12)	33.3	0.0	25.0	8.3	0.0	8.3	0.0	25.0	8.3	0.0	0.0	0.0	0.0	0.0
Chironius (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clelia (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0
Coniophanes (1)	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Darlingtonia (1)	100.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hypsirhynchus (1)	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ialtris (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	0.0
Liophis (4)	25.0	25.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mastigodryas (1)	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nerodia (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tretanorhinus (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uromacer (3)	33.0	0.0	33.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leptotyphlopidae (8)														
Leptotyphlops (8)	12.5	0.0	12.5	25.0	0.0	0.0	0.0	12.5	0.0	0.0	12.5	0.0	0.0	0.0
Tropidophiidae (15)														
Tropidophis (15)	13.3	13.3	6.7	6.7	20.0	6.7	0.0	6.7	6.7	6.7	6.7	0.0	0.0	0.0
Typhlopidae (25)														
Typhlops (25)	36.0	0.0	12.0	8.0	12.0	8.0	0.0	20.0	0.0	0.0	0.0	8.0	0.0	0.0
Viperidae (2)														
Bothrops (2)	50.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	50.0	0.0	0.0

[1]COC = coconut palms; EDI = edificarian; BAN = banana plants; COF = coffee; HD = human debris; CAC = cacao; FP = wooden fence posts; PAS = pastures; ROC = Rock walls; RAT = includes *Mus* and/or *Rattus* in its diet; MAN = mango trees; SUG = sugarcane; CUL = cultivated fields; RIC = rice.

used significantly more often by lizards than by snakes (df = 1, $\chi^2 = 69.3$, $P < 0.0001$), and frogs apparently do not use them. Introduced mice and rats are eaten by many of the larger snakes.

In general, reptiles exploit human impact much more frequently than frogs (Table 1), but great variation occurred among genera (Table 2). *Eleutherodactylus*, the most speciose frog genus, seems especially intolerant of human impact, although some common species (e.g., *E. coqui*) frequently occur in gardens and about 14 % of 139 species occurred occasionally in banana groves. Gekkonid lizards often are associated with coconut palms and human edifices. Teiid lizards are often (63.6 %) associated with coconut palms, as are boid (58.3 %), colubrid (31.8 %), and typhlopid (36.0 %) snakes. Among colubrids, *Alsophis* is frequently associated with *Cocos* (45.5 % of 11 species) and edificarian situations (18.2 %).

Cocos is exploited by 26 % of West Indian frogs and squamate reptiles (156 of 601 species in our sample), and it is exploited more on some islands or island groups (Tables 3 and 4). The most detailed work about the relationship of coconut husk piles and an element of the West Indian herpetofauna is that of Stewart and Martin (1980) on Jamaican *Eleutherodactylus*. They found that: (1) husks split for harvest provide many more cavities and fibrous surfaces than did unsplit nuts; (2) husk piles were a especially favorable habitat during dry periods; (3) new husk piles were barren, but older husk piles supported a wide variety of organisms (including *Bufo*, *Eleutherodactylus*, *Aristelliger*, *Sphaerodactylus*, *Celestus*, *Anolis*, *Typhlops*, and *Arrhyton*); (4) husk piles harbored more frogs than other types of habitats, including leaf litter in dry and moist

TABLE 3. Percentages of herpetofauna from seven islands or island groups that are at least occasionally associated with one or more of 14 habitat variables. Habitat use by frogs, lizards, and snakes on all islands or island groups differs significantly (Contingency Tests, $P < 0.05$), as does habitat use between islands and island groups, except the use of coffee and pasture between lizards and snakes (df = 3, $\chi^2 = 2.2$, $P = 0.53$; df = 5, $\chi^2 = 11.0$, $P = 0.051$; respectively), the use of cacao between frogs and lizards (df = 2, $\chi^2 = 4.2$, $P = 0.12$), and the use of cultivated fields between frogs and snakes (df = 1, $\chi^2 = 1.7$, $P = 0.20$). Abbreviations are as defined in Table 2.

Island or Island group (# species)	COC	EDI	BAN	COF	HD	CAC	FP	PAS	ROC	RAT	MAN	SUG	CUL	RIC
BAHAMAS														
Frogs (2)	100.0	50.0	100.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lizards (28)	75.0	39.3	17.9	0.0	14.3	0.0	33.3	0.0	0.0	0.0	3.6	3.6	3.6	0.0
Snakes (9)	33.0	11.1	11.1	0.0	33.3	0.0	0.0	11.1	0.0	33.3	0.0	11.1	0.0	0.0
CAYMAN ISLANDS														
Frogs (2)	100.0	50.0	100.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lizards (5)	100.0	60.0	0.0	0.0	40.0	0.0	20.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
Snakes (5)	60.0	20.0	20.0	0.0	20.0	0.0	0.0	0.0	20.0	20.0	0.0	0.0	0.0	0.0
CUBA														
Frogs (52)	7.7	1.9	11.5	3.8	5.8	1.9	0.0	3.8	1.9	0.0	0.0	0.0	3.8	3.8
Lizards (95)	17.9	17.9	1.1	5.3	7.4	0.0	10.5	1.1	2.1	0.0	1.1	3.2	1.1	0.0
Snakes (27)	11.1	11.1	14.8	3.7	14.8	7.4	0.0	14.8	7.4	11.1	0.0	3.7	3.7	0.0
HISPANIOLA														
Frogs (61)	1.6	1.6	9.8	11.5	3.3	1.6	0.0	4.9	0.0	0.0	0.0	0.0	1.6	1.6
Lizards (108)	27.8	13.0	11.1	17.6	11.4	7.4	6.5	0.9	1.9	0.0	0.9	0.0	0.9	0.0
Snakes (28)	25.0	7.1	21.4	17.9	7.1	10.7	3.6	10.7	3.6	14.3	7.1	3.6	0.0	0.0
JAMAICA														
Frogs (22)	13.6	0.0	27.3	0.0	0.0	0.0	0.0	4.5	4.5	0.0	0.0	0.0	0.0	0.0
Lizards (22)	45.5	27.3	13.6	0.0	9.1	0.0	13.6	13.6	4.5	0.0	0.0	0.0	0.0	0.0
Snakes (7)	71.4	0.0	14.3	0.0	0.0	14.3	0.0	42.9	0.0	14.3	0.0	0.0	0.0	0.0
PUERTO RICO BANK														
Frogs (20)	5.0	0.0	0.0	5.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
Lizards (37)	29.7	10.8	8.1	16.2	0.0	0.0	8.1	0.0	0.0	0.0	2.7	2.7	0.0	0.0
Snakes (11)	45.5	0.0	27.3	18.2	9.1	0.0	0.0	18.2	18.2	9.1	0.0	0.0	0.0	0.0
LESSER ANTILLES														
Frogs (12)	25.0	33.3	33.3	0.0	25.0	16.7	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0
Lizards (44)	61.4	47.7	45.5	2.3	6.8	27.3	20.5	2.3	13.6	0.0	13.6	9.1	2.3	0.0
Snakes (23)	34.8	30.4	34.8	0.0	4.3	13.0	0.0	8.7	8.7	21.7	8.7	4.3	0.0	0.0

TABLE 4. Percentages of species in selected genera or families from six islands or island groups that are at least occasionally associated with one or more of 14 habitat variables. Abbreviations are as defined in Table 2.

Island or Island group Genus (# species)	COC	EDI	BAN	COF	HD	CAC	FP	PAS	ROC	RAT	MAN	SUG	CUL	RIC
BAHAMAS														
Eleutherodactylus (1)	100.0	0.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphaerodactylus (8)	62.5	50.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anolis (6)	100.0	83.3	42.9	0.0	0.0	0.0	42.9	0.0	0.0	0.0	14.3	0.0	0.0	0.0
Colubrid snakes (1)	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
CUBA														
Eleutherodactylus (43)	2.3	0.0	7.0	7.0	4.7	0.0	0.0	2.3	2.3	0.0	0.0	0.0	0.0	2.3
Sphaerodactylus (20)	20.0	25.0	0.0	5.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anolis (57)	8.8	8.8	1.8	7.0	1.8	0.0	17.5	3.5	0.0	0.0	1.8	1.8	1.8	0.0
Colubrid snakes (12)	16.7	8.3	25.0	0.0	8.3	8.3	0.0	16.7	0.0	8.3	0.0	0.0	8.3	0.0
HISPANIOLA														
Eleutherodactylus (53)	1.9	1.9	9.4	13.2	3.8	1.9	0.0	1.9	0.0	0.0	0.0	0.0	1.9	0.0
Sphaerodactylus (33)	42.4	12.1	18.2	15.2	12.1	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0
Anolis (41)	12.2	9.8	7.3	29.3	0.0	7.3	17.1	2.4	0.0	0.0	2.4	0.0	0.0	0.0
Colubrid snakes (11)	36.4	9.1	18.2	27.3	9.1	9.1	0.0	0.0	0.0	27.3	9.1	0.0	0.0	0.0
PUERTO RICO BANK														
Eleutherodactylus (18)	5.6	0.0	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0
Sphaerodactylus (11)	45.5	18.2	9.1	18.2	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0
Anolis (15)	13.3	6.7	6.7	20.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colubrid snakes (2)	100.0	0.0	100.0	50.0	0.0	0.0	0.0	50.0	50.0	50.0	0.0	0.0	0.0	0.0
JAMAICA														
Eleutherodactylus (18)	16.7	0.0	38.9	0.0	0.0	0.0	0.0	5.6	5.6	0.0	0.0	0.0	0.0	0.0
Sphaerodactylus (6)	83.3	33.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anolis (6)	16.7	50.0	33.3	0.0	0.0	0.0	50.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0
Colubrid snakes (4)	75.0	0.0	25.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0
LESSER ANTILLES														
Eleutherodactylus (7)	28.6	28.6	57.1	0.0	14.3	57.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphaerodactylus (8)	75.0	37.5	25.0	0.0	25.0	12.5	0.0	0.0	12.5	0.0	12.5	12.5	0.0	0.0
Anolis (16)	68.8	87.5	75.0	6.3	0.0	43.8	56.3	0.0	25.0	0.0	25.0	6.3	0.0	0.0
Colubrid snakes (12)	25.0	25.0	25.0	0.0	8.3	0.0	0.0	8.3	16.7	8.3	0.0	0.0	0.0	0.0

forests, banana trash, banana leaf axils, pastures, bromeliads, and stone walls; and (5) the rapid spread of the introduced *Eleutherodactylus johnstonei* and *E. planirostris* throughout Jamaica was "facilitated by the presence of coconut husk-piles which have provided suitable refugia for those species." Stewart (1977) examined the ecology of introduced frogs in Jamaica, and found "no frogs in cane fields and clean gardens, but in banana and coconut walks, where grass, weeds and old husks and leaves provided ground cover, frogs were abundant."

Geographic trends.—Resource use by frogs, lizards, and snakes differed significantly between the seven major islands or island groups (Table 3). A higher proportion of frogs and reptiles on smaller islands (Bahamas, Lesser Antilles) appear to be more tolerant of human impact than species on the Greater Antilles. Resource use by frogs, lizards, and snakes within islands or island groups differed significantly in almost every instance (exceptions are noted in the caption to Table 3). However, regardless of island or island group, many reptiles and frogs are associated with *Cocos*. In the Greater Antilles, frogs, lizards, and snakes on Jamaica are more likely to exploit human-introduced habitat resources than are frogs and reptiles on Cuba, Hispaniola, and Puerto Rico.

Frogs and reptiles are more frequently associated with *Coffea* on Hispaniola than elsewhere, and *Musa* provides habitat for many frogs and reptiles in the Lesser Antilles. Lizards are more often associated with edificarian situations than frogs or snakes (Table 3).

We attribute the high incidence of herpetofaunal associations with coffee on Hispaniola to the widespread planting of shade-loving varieties. In such situations, coffee trees mimic the lower tier of moist upland forests and are widely used by many forest species (e.g., anoles; Lenart et al., 1997). Coffee groves also may mimic forest edge or recently disturbed forest, thereby providing habitat for species adapted to those conditions. Monocultures of sun-loving coffee varieties imported from Central and South America are being planted with increasing frequency on clearcut slopes of Hispaniola's Cordillera Central, and these areas, like sugarcane fields, are homogeneous, and their faunal diversity is very low.

Based on the percentages calculated here, and with the exceptions of the Bahamas and Cayman Islands, where no more than two native species (*Osteopilus septentrionalis*, *Eleutherodactylus planirostris* or both) occur on a single island, frogs are much less likely to exploit habitats with a strong human influence than are squamate reptiles. Both *O. septentrionalis* and *E. planirostris* exhibit considerable ecological plasticity, colonizing attributes, and ability to exploit human-introduced elements. In the Lesser Antilles, where most islands harbor only a single native species of *Eleutherodactylus*, that species tends to be geographically widespread.

The trend for a higher proportion of frogs and squamate reptiles on smaller islands to be more tolerant or adaptable to human impact is not surprising. Islands in the Lesser Antilles harbor only one or two species of *Anolis* and *Sphaerodactylus*. Species that are the sole representatives of a genus on an island often exhibit island-wide distributions and tend to be ecological generalists. Lacking congeneric competition, they have had the opportunity to move into and adapt to a wide range of habitats (including those that have been radically altered by human activity). On the main islands of the Greater Antilles, where *Eleutherodactylus*, *Sphaerodactylus*, and *Anolis* are represented by many species, one or a few species exhibit island-wide or nearly island-wide distributions, but the vast majority of species are restricted in distribution and exploit a narrow range of habitats. For example, on Cuba, only one of 43 species of *Eleutherodactylus* (*E. varleyi*) has a close-to-island-wide distribution. Similarly, of 57 species of *Anolis*, only *A. sagrei* has a close-to-island-wide distribution (with *A. allisoni*, *A. equestris*, *A. homolechis*, and *A. porcatus* exhibiting wide, but disjunct, distributions). Rodríguez Schettino (1999) described *A. sagrei* as a lizard that "lives in almost all vegetation zones of Cuba, in plantations and urban areas, although it is more frequent in places modified by humans." No Cuban species of *Sphaerodactylus* is close to having an island-wide distribution.

Conversely, on the single-anole Lesser Antillean islands of Guadeloupe, Martinique, and Dominica, for example, *Anolis marmoratus*, *A. roquet*, and *A. oculatus*, respectively, have virtually island-wide distributions (absent only from areas of greatest elevation), and occur in many human-altered habitats. On two-anole islands (e.g., Antigua, St. Eustatius, St. Christopher, St. Vincent, Grenada), both species may have virtually island-wide distributions, and both species are conspicuous in fruit orchards and edificarian situations. The Anguilla Bank endemic *A. gingivinus* occurs alone on Anguilla but with *A. wattsi* on St. Martin/St. Maarten. *Anolis gingivinus* is essentially ubiquitous on both islands and is abundant in both natural and altered habitats. Conversely, *A. wattsi* has a small, fragmented distribution, although it also lives under both relatively natural and severely altered conditions.

Trends among taxonomically diverse genera and colubrid snakes.—Concentrating on the three most taxonomically and ecologically diverse genera (*Eleutherodactylus*, *Sphaero-*

dactylus, *Anolis*) and the most taxonomically and ecologically diverse family of snakes (Colubridae) on the major islands and island groups, the most obvious result was the low percentage of *Eleutherodactylus* exploiting human impact throughout the region (with the exception of the Bahamas) (Table 4). Again, smaller islands harbor a higher proportion of species apparently more tolerant or more capable of exploiting human impact. *Cocos*, edificarian situations, and *Musa* groves are especially important to species in the Lesser Antilles, *Musa* is important in Jamaica, and *Coffea* is perhaps critical on Hispaniola.

Use of human-influenced resources.—Table 5 indicates how members of five genera and one family use resources resulting from human agency. Using the 13 resource variables and five categories of activities (basking, foraging, etc.), a genus or family could achieve a maximum score of 65 if all categories were used for all activities. *Anolis* had a score of 53 (81.5 % of available options), followed by *Ameiva* (69.2 %) and colubrid snakes (66.2 %). *Eleutherodactylus*

TABLE 5. Potential use of human impact resources by frogs and squamate reptiles. A + indicates that the resource is exploited by at least some members of the genus for the particular activity. Abbreviations are as defined in Table 2.

Use	COC	EDI	BAN	COF	HD	CAC	FP	PAS	ROC	MAN	SUG	CUL	RIC
Sleep/Hide site													
Eleutherodactylus	+	+	+	+	+	+				+			+
Sphaerodactylus	+	+	+	+	+	+			+				
Anolis	+	+	+	+	+	+	+	+	+	+	+	+	
Ameiva	+	+	+		+	+			+	+	+		
Leiocephalus	+	+			+				+	+	+		
Colubrid snakes	+	+	+	+	+	+		+	+	+	+		
Basking site													
Eleutherodactylus													
Sphaerodactylus													
Anolis	+	+	+	+	+	+	+	+	+	+	+	+	
Ameiva	+	+	+		+	+		+	+	+	+	+	
Leiocephalus	+	+			+				+	+	+	+	
Colubrid snakes	+	+	+	+	+	+			+	+			
Egg-laying site													
Eleutherodactylus	+											+	
Sphaerodactylus	+	+	+		+	+			+				
Anolis	+	+	+	+	+	+			+				
Ameiva	+	+	+	+	+	+			+				
Leiocephalus	+	+			+				+				
Colubrid snakes	+	+	+	+	+	+			+				
Foraging site													
Eleutherodactylus	+	+	+	+	+	+						+	
Sphaerodactylus	+	+	+	+	+	+			+	+			
Anolis	+	+	+	+	+	+	+	+	+	+	+	+	
Ameiva	+	+	+		+	+		+	+	+	+	+	
Leiocephalus	+	+			+				+	+	+	+	
Colubrid snakes	+	+	+	+	+	+		+	+	+			
Social interactions													
Eleutherodactylus	+	+	+	+	+	+						+	
Sphaerodactylus	+	+	+	+	+	+				+			
Anolis	+	+	+	+	+	+	+	+	+	+			
Ameiva	+	+	+		+	+		+	+	+	+	+	
Leiocephalus	+	+			+				+	+			
Colubrid snakes	+	+	+	+	+	+		+	+	+			

(36.9 %) had the lowest score, suggesting less ecological versatility.

Using the five categories of activities and the five genera and one family considered, a maximum score of 30 existed for each resource. Coconut palms (score = 28, 93.3 %) are used for more activities by more taxa than any other human-influenced resource. Banana and cacao (both 73.3 %), mango (63.3 %), and coffee (56.7 %) trees also are exploited extensively. Edifices and human debris (both 90 %) and rock walls (76.7 %) are used frequently. Habitats that involve the absence or near absence of trees are used much more rarely (pasture, 33.3 %; sugarcane, 36.7 %; cultivated fields, 36.7 %; rice fields, 3.3 %).

Coconut, banana, cacao, and mango trees are widely distributed in the West Indies, and large tracts of land on many islands are devoted to coconut and banana production. Whether *Cocos* and *Musa* are frequently exploited by frogs and squamate reptiles because they are so widespread and occur over great areas (compared to, for example, mango, cacao, and coffee), or because they are especially attractive to frogs and reptiles is uncertain, but a combination of the two factors is most likely responsible. Coconut palms provide trunks, crowns, fruit, husks, dead fronds, trash, etc. for foraging, basking, nesting, roosting sites, hiding places, and social interactions (e.g., territorial displays and courtship). Similarly, banana trees provide trunks, very large leaves, bunched fruit, fruit and leafy trash, moist leaf axils, etc. for the same activities as do coconut palms. Conversely, mango and cacao trees do not occur in large tracts, do not provide clumped fruit for retreats, have much smaller leaves, and the trash probably does not provide as many activity sites as are associated with *Cocos* and *Musa*. Coffee is mostly restricted to the Greater Antilles and to higher elevations on those islands, thereby precluding its exploitation by species that occur only at lower elevations.

Specific observations.—Many associations of the herpetofauna with introduced trees may be more attributable to modifications of structural habitat than to inherent benefits provided by the new tree species. For example, Sifers et al. (2001) documented a strong association between anoles (*Anolis bahorucoensis*, *A. coelestinus*, *A. cybotes*, and *A. distichus*) and edges created by human activities in a high-elevation cloud forest on Hispaniola. They suggested that this community evolved in transitory habitats created by intermittent natural events (e.g., hurricanes), but had thrived and expanded when presented with a bonanza of suitable conditions along roads, pastures, and cultivated fields. Conversely, *A. barbouri*, a litter-dwelling anole restricted largely to densely shaded areas, and *A. barahonae*, a crown-dwelling giant dependent on high canopy trees, undoubtedly have experienced declines (Powell et al., 2000) as a consequence of the same human activities that benefitted the other species.

Although all ecologically widespread species in the West Indies are successful exploiters of human alterations of their habitats, a species does not need an island-wide distribution (or close to it) to use human-influenced resources. Prime examples are frogs in the hylid genus *Osteopilus*. *Osteopilus septentrionalis* has a disjunct distribution on Cuba, but it is closely associated with human activity, frequently invading houses, outbuildings, and cisterns. It is similarly associated with human dwellings in the Bahamas and Puerto Rico, and it was recently introduced onto the Lesser Antillean island of Anguilla. Anguilla is xeric with almost no surface water except brackish lagoons and tidal basins. Although seemingly inhospitable to an amphibian, *O. septentrionalis* is well-established in gardens and resorts, where it is considered a pest on hotel grounds, entering guest rooms, swimming pools, cisterns, lobbies, etc. (Townsend et al., 2000). *Osteopilus dominicensis* similarly exploits buildings and fountains on Hispaniola (Bowersox et al., 1994; RP, pers. obs.).

In response to the many insects attracted to lights around buildings at night, some traditionally diurnal reptiles have extended the amount of time spent foraging (Table 6). *Anolis sagrei* feeds on light-attracted insects until at least 2230 h in the Bahamas (Schwartz and Henderson, 1991), and *A. cristatellus* has been observed feeding at

TABLE 6. Traditionally diurnal West Indian squamate reptiles known to use the night-light niche.

Species	Location	Source
Gekkonidae		
Sphaerodactylus macrolepis	Guana Island, B.V.I.	Perry and Lazell, 2000
Polychrotidae		
Anolis bimaculatus	Antigua	Schwartz and Henderson, 1991
Anolis brevirostris	Hispaniola	Bowersox et al., 1994
Anolis cristatellus	Puerto Rico	Garber, 1978; RP, pers. observ.
	Guana Island, B.V.I.	Perry and Lazell, 2000
Anolis cybotes	Hispaniola	RP, pers. observ.
Anolis gingivinus	St. Maarten	Powell and Henderson, 1992
Anolis marmoratus	Guadeloupe	Schwartz and Henderson, 1991
Anolis sabanus	Saba	Schwartz and Henderson, 1991
Anolis sagrei	Bahamas	Schwartz and Henderson, 1991
Colubridae		
Alsophis portoricensis	Guana Island, B.V.I.	Perry and Lazell, 2000

Guamá, San German, Puerto Rico, until at least 2300 h (E. H. Williams, in litt.). Anoles are especially opportunistic regarding the night-light niche; all those noted in Table 6 are geographically and ecologically widespread on their respective island(s) and are frequently associated with human-altered habitats. Perry and Lazell (2000) observed nocturnal predation of a diurnal anole by the diurnal colubrid snake *Alsophis portoricensis*, thus providing documentation of a secondary predator successfully exploiting the night-light niche. Some West Indian anurans also exploit the niche; e.g., *Bufo marinus* on Guadeloupe (RWH, pers. observ.), *Osteopilus septentrionalis* on Anguilla (pers. observ.), and *Eleutherodactylus coqui* on Puerto Rico (M. M. Stewart, in litt.). All are ecologically versatile species.

Anolis porcatus and *A. cristatellus*, widely distributed species on Cuba and the Puerto Rico Bank, respectively, have become established in the Dominican Republic. Dominican populations of both species are restricted to urban areas, in which they have largely displaced their native ecological equivalents (*A. chlorocyanus* and *A. cybotes*, respectively) (Fitch et al., 1989; Powell et al., 1990). However, the native species still occur in pockets usually associated with native vegetation, resulting in a situation in which these severely altered urban environments actually support a greater anoline diversity than more natural habitats.

Construction sites and stacks of concrete blocks are elements of nearly every urban and many rural landscapes in the West Indies. Lizards in the genera *Anolis*, *Celestus*, *Hemidactylus*, *Leiocephalus*, and *Sphaerodactylus*, and colubrid snakes in the genera *Alsophis* and *Antillophis* take full advantage of the complex habitats and abundant refugia provided by unfinished concrete block walls and piles of building materials. Similarly, teiid lizards in the genus *Ameiva* forage in cleared construction sites and often take up residence in yards and gardens after construction is complete.

Humans inadvertently provide many reptiles with ideal basking sites, propitiously near cover. *Leiocephalus* often perch on elevated walkways or walls, and retreat into cracks and crevices when disturbed. We encountered Anguillian *Alsophis rijgersmaei* more commonly in rock walls than in any other single habitat, and some *A. rufiventris* basked on the steps at Mt. Scenery on Saba (Henderson, 2001a).

Human refuse can provide habitat conditions that are exploited by some species. Some *Ameiva* forage in trash and garbage around restaurants and hotels (Schell et al., 1993; RP, pers. obs.). Powell et al. (1996b) described a lizard community inhabiting a dry river bed near Baní in the Dominican Republic. During that study, the site became a dumping ground for trash and garbage generated by the growing city. Subsequently, gravel mining, previously localized, came to dominate the site. The combination of trash (intermittently burned), debris accumulated as a consequence of the mining operation, and the associated human activity has rendered the area unworkable, but all the species documented in the study are present and at least *Leiocephalus semilineatus* and *Ameiva chrysolaema* appear to be thriving. The reptile community is apparently taking advantage of insects attracted to the garbage and the ample cover provided by the burgeoning piles of trash, while being able to tolerate the instability of the constantly fluctuating conditions as rocks are crushed, piles of debris are burned or moved, and more is added to the mix on a daily basis.

Henderson (2001b) and Henderson et al. (1996) observed on Grenada that the arboreal boid *Corallus grenadensis* successfully exploited many non-native trees (e.g., mango, cacao, breadfruit, citrus, banana, coconut) and preyed on introduced mice and rats. These snakes occur in residential areas, may forage on hotel grounds, and occasionally enter banana shacks and peoples' homes. *Corallus grenadensis* may be more common now than it was in pre-Columbian Grenada.

CONCLUSIONS

The arrival of humans and their subsequent activity on West Indian islands has had a profound impact on the distribution, ecology, and evolution of some members of the herpetofauna. Catastrophic consequences correlated with human activity (e.g., Introduction of the mongoose, cats, and dogs) have been documented (e.g., Iverson, 1978; Case et al., 1992; Henderson, 1992). Unsettled, however, is the question of how many members of the West Indian herpetofauna have benefitted from human activity.

The most obvious and significant criterion for determining whether a resource has had a positive or negative impact on a species is population density. Based on this criterion and what we know about the natural history of individual species that seem to do very well in disturbed situations (e.g., *Bufo marinus*, *Osteopilus septentrionalis*, *Eleutherodactylus johnstonei*, *Anolis cristatellus*, *A. sagrei*, *Corallus grenadensis*), we estimate that at most 5-10 % of the West Indian herpetofauna has benefited from the presence of human-influenced resources. Conversely, and conservatively, we estimate that human activity has negatively impacted more than half of the herpetofauna.

Frogs in general, and species of *Eleutherodactylus* in particular, are less likely to exploit human resources. Hence, as more habitats are altered, frog species become seriously impacted (e.g., Hedges, 1993, 1999; Fong, 1999). Ranges become fragmented and shrink, populations drop, and local extirpations occur; perhaps followed by extinctions. Especially vulnerable are frogs and reptiles with restricted ranges and those that are ecologically, physiologically, and morphologically specialized (e.g., Joglar and Burrowes, 1996; Rodríguez-Schettino, 1999). As human populations grow and development for the tourist industry increases, more frogs, lizards, and snakes will, perhaps of necessity, exploit protrusive human impact on their environments.

Although we need a strong conservation initiative in the West Indies to prevent further habitat loss, we also need to assess the responses of the herpetofauna to past and present changes. Quantitative ecological data are available for only a small portion of the herpetofauna (about 12 % of 650 species, according to Powell and Henderson, 1999), and few studies have focused on species in conspicuously disturbed habitats (e.g., Rand, 1967; Henderson and Winstel, 1995; Powell et al., 1996b). Likewise, we know little about the physiological ecology of West Indian frogs and lizards, but evidence indicates that some species (e.g., *Eleutherodactylus coqui*, *Anolis cristatellus*, *A. cybotes*) that appear ecologically tolerant of human activity have at least some physiological versatility (e.g., Hertz and Huey, 1981; Pough et al., 1983; Dmi'el et al., 1997; Perry et al., 2000). The processes resulting in change and impoverishment of the West Indian biota will not slow down. Although coconut, banana, cacao, and other orchard trees may simulate natural habitat, they cannot duplicate native forests. They can sustain a certain proportion of the West Indian herpetofauna, but the absence of vegetational diversity, habitat complexity, and associated invertebrate fauna preclude occupation by some species. A small proportion of the West Indian herpetofauna is adaptable and opportunistic, and will persist under almost any conditions, but the species that lack those characteristics may well be doomed to extinction.

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