Conserving the Puerto Rican herpetofauna

Rafael L. Joglar[1,*], Alberto O. Álvarez[2], T. Mitchell Aide[1], Diane Barber[3], Patricia A. Burrowes[1], Miguel A. García[2,4], Abimael León-Cardona[5], Ana V. Longo[1], Néstor Pérez-Buitrago[1,4], Alberto Puente[1,2], Neftalí Rios-López[1], Peter J. Tolson[6]

[1] Department of Biology, University of Puerto Rico, PO Box 23360, San Juan, Puerto Rico 00931-3360
*Corresponding author; e-mail: rjoglar@uprrp.edu
[2] Division of Wildlife, Department of Natural and Environmental Resources, P.O. Box 366147, San Juan, Puerto Rico 00906
[3] Fort Worth Zoo, 1989 Colonial Parkway, Fort Worth, Texas 76110, USA
[4] Center for Applied Tropical Ecology and Conservation (CATEC), University of Puerto Rico–Río Piedras, San Juan, Puerto Rico 00931
[5] Aquatic Toxicology Program, University of California-Davis, VetMed:APC, 1321 Haring Hall, Davis, California 95616, USA
[6] Conservation Department — Toledo Zoo, Ohio 43614, USA

Abstract. With a total area of 8900 km^2, Puerto Rico is the smallest of the Greater Antilles. It is divided in three physiographic regions or areas of relief: the mountainous interior, the karst region, and the coastal plains and valleys. The island comprises six ecological life zones: subtropical dry forest, subtropical moist forest, subtropical wet forest, subtropical rain forest, lower montane wet forest and lower montane rain forest. The herpetofauna of Puerto Rico consists of 25 species of amphibians (19 native, six introduced) and 56 species of reptiles (52 native, four introduced). The goal of this paper is to describe some of the present studies directed towards the conservation of Puerto Rican herpetofauna. *Eleutherodactylus karlschmidti*, *E. jasperi* and *E. eneidae* have not been seen or heard since 1976, 1981 and 1990, respectively, and are probably extinct. Since 2000, the potential causes of amphibian declines in Puerto Rico have been studied, and a synergistic interaction between climate change (increased dry periods) and disease (chytridiomycosis) have been proposed as an explanation for the patterns observed. Recovery efforts for *Peltophryne lemur* include a captive-breeding program, reintroductions island-wide educational outreach, protection and restoration of existing habitat, and the creation of new breeding ponds. Among reptiles, the first conservation efforts to protect *Epicrates inornatus* were limited to trying to halt collection and hunting. However, current strategies to preserve the boa include gathering basic biological information, habitat conservation, and educational outreach. Recent efforts for the conservation of *Trachemys s. stejnegeri* combine three research approaches to clarify the status of local populations: a mark-recapture-release study, field monitoring of reproductive activity (i.e., nocturnal patrolling to identify nesting activity), and field assessment of the potential impact of introduced species, particularly identification of predatory species and exotic turtles. Recovery initiatives for *Cyclura stejnegeri* include management of invasive

mammals, a headstart program for hatchling iguanas, and the assessment of the etiology of a condition causing blindness in adult iguanas. A reforestation project aimed at recovering a local herpetofaunal assemblage after disturbances in a limestone valley in northern Puerto Rico is discussed. As population sizes of common colonizers such as *Eleutherodactylus* and *Anolis* increased, larger forest-interior and predatory species like *Epicrates inornatus*, *Alsophis portoricensis* and *Anolis cuvieri* followed. Finally, the Mona Island marine turtle monitoring program is discussed and compared to other similar programs in Puerto Rico. As these and other similar conservation efforts provide scientifically based management recommendations, we hope to succeed in conserving the diverse herpetofauna that characterizes Puerto Rico.

Key words: Amphibian; biodiversity; Caribbean; chytrid; climate change; conservation; Puerto Rico; reptile; West Indies.

Introduction

Puerto Rico is the easternmost of the Greater Antilles and it is located between 18°35′–17°55′N and 67°15′–65°35′W. It is the smallest of the Greater Antilles with a total area of 8900 km^2, 12.9, 8.6 and 1.3 times smaller than Cuba, Hispaniola, and Jamaica, respectively. It is 179 km long and 58 km wide, and its highest peak is Cerro Punta in Jayuya (elevation 1338 m). The highest peaks on Cuba, Hispaniola, and Jamaica, respectively, are 1.5, 2.3 and 1.7 times higher than Cerro Punta. The three largest Puerto Rican satellites islands are Vieques (138 km^2) and Culebra (27 km^2) in the east, and Mona (57 km^2) in the west.

Physiography and general ecology

Puerto Rico is divided in three physiographic regions or areas of relief: (1) the mountainous interior; (2) the karst region; and (3) the coastal plains and valleys (Cruz and Boswell, 1997; Gannon et al., 2004).

The mountainous interior is the largest of the three regions, and it is the cradle of the main rivers of the island. This 'backbone' or mountainous spine is composed of the Cordillera Central and the Sierra de Luquillo. The Cordillera Central extends in an east-west direction from Sierra de Cayey in the southeast running almost without interruptions to Mayagüez, which lies close to the west coast. Sierra de Luquillo, an isolated upland region in the northeast, and the largest natural protected area of Puerto Rico, shelters montane rainforests at lower elevations and cloud forests and elfin woodland at the highest elevations; one of the largest tracks of elfin woodland in the Caribbean is found in these mountains (Hedges, 1999).

The Puerto Rican karst region includes two separate zones: (1) the northern karst, which ranges from Loiza in the northeast to Aguadilla in the northwest; and (2) the southern karst, which extends from Juana Díaz (east of Ponce) to Guayanilla to the west (Cruz and Boswell, 1997; Lugo, 2005). The Puerto Rican northwestern karst topography is similar to that in Cockpit Country of Jamaica, Los Haitises of Hispaniola, and the Viñales region of western Cuba (Hedges, 1999).

According to the Holdridge system of classification, Puerto Rico has been divided into six ecological life zones: (1) subtropical dry forest; (2) subtropical moist forest; (3) subtropical wet forest; (4) subtropical rain forest; (5) lower montane wet forest; and (6) lower montane rain forest (Ewel and Whitmore, 1973). Average annual rainfall is 60-110; 100-220; 200-400 cm in the first three zones, respectively, with a lower rainfall limit of 380 cm in the fourth zone, and with elevations over 1000 m in the lower montane wet forest and lower montane rain forest. An alternative system has been proposed by Lugo (2005), in which geological data were incorporated with temperature, precipitation, and elevation information of the Holdridge system to generate ten geoclimatic zones or forest types for Puerto Rico.

Conservation in Puerto Rico

Because Puerto Rico is a US Territory governed by a commonwealth, state and federal agencies and their laws are involved in the island's conservation practices. At the state level, the Planning Board, the Environmental Quality Board, the Department of Agriculture, the Department of Natural and Environmental Resources, and all 78 municipalities through their Territorial Arrangement Plan, deal with corresponding conservation issues (Quevedo, in press). The main state agency actively engaged in conservation in Puerto Rico is the Department of Natural and Environmental Resources (DNER). Established in 1972, this agency has the difficult responsibility of protecting and managing Puerto Rican natural resources, including biodiversity. Among many other responsibilities, the DNER is in charge of endangered species, forest reserves, wildlife refuges, and corridors. The DNER's capacity to accomplish these goals and responsibilities are seriously limited by (1) political pressures, (2) budget and (3) excessive responsibilities. At the federal level, the two most important agencies involved in conservation are (1) the U.S. Fish and Wildlife Service (USF&WS) as part of the US Department of Interior (USDI), and (2) the U.S. Forest Service (USFS) as part of the U.S. Department of Agriculture (USDA). Other federal agencies such as the U.S. Environmental Protection Agency (EPA), the USDA Natural Resources Conservation Service (NRCS) and the U.S. Corps of Engineers, are also involved. The USF&WS is responsible for endangered species and their habitats and for managing several federal wildlife refuges, such as Desecheo, Vieques and Cabo Rojo. The USFS is responsible for protecting and managing El Yunque, the largest forest reserve in Puerto Rico. Within the USFS, the International Institute of Tropical Forestry (IITF) is in charge of research and management of forest resources. As in the Continental USA, in Puerto Rico the USF&WS has not been effective at listing endangered species and declaring and protecting critical habitat for listed species. This shows that political pressures and budget limitations for conservation agencies are also a problem at the federal level.

Puerto Rico's history of protecting areas for conservation purposes goes back to 1876, when the Spanish Crown protected areas in El Yunque and Utuado. Laws of the Spanish Crown protected forests, mangroves and water resources. Since then, Puerto Rico has created a system of forest reserves that includes 21 forest reserves