

= Fauna of Puerto Rico =

The fauna of Puerto Rico is similar to other island archipelago faunas , with high endemism , and low , skewed taxonomic diversity . Bats are the only extant native terrestrial mammals in Puerto Rico . All other terrestrial mammals in the area were introduced by humans , and include species such as cats , goats , sheep , the small Asian mongoose , and escaped monkeys . Marine mammals include dolphins , manatees , and whales . Of the 349 bird species , about 120 breed in the archipelago , and 47 @. @ 5 % are accidental or rare .

The most recognizable and famous animal of Puerto Rico is probably the common coquí , a small endemic frog , and one of the 86 species that constitute Puerto Rico 's herpetofauna . Some native freshwater fish inhabit Puerto Rico , but some species , introduced by humans , have established populations in reservoirs and rivers . The low richness @-@ high diversity pattern is also apparent among invertebrates , which constitutes most of the archipelago 's fauna .

The arrival of the first people about 4 @, @ 000 years ago and , to a larger extent , of Europeans more than 500 years ago , had a significant effect on Puerto Rico 's fauna . Hunting , habitat destruction , and the introduction of non @-@ native species led to extinctions and extirpations (local extinctions) . Conservation efforts , the most notable being for the Puerto Rican parrot , began in the second half of the 20th century . According to IUCN , as of 2002 , there were 21 threatened species in Puerto Rico : two mammals , eight breeding birds , eight reptiles , and three amphibians. i

= = Origin of Puerto Rican fauna = =

The Caribbean Plate , an oceanic tectonic plate on which Puerto Rico and the Antilles (with the exception of Cuba) lie , was formed in the late Mesozoic . According to Rosen , when South America separated from Africa , a volcanic archipelago known as " Proto @-@ Antilles " was formed . It later divided into the present @-@ day Greater and Lesser Antilles because of a new fault line in the " Proto @-@ Antilles " . Geologically , the archipelago of Puerto Rico is young , having formed about 135 Ma (million years) ago . The prevailing hypothesis , proposed by Howard Meyerhoff , posits that the Puerto Rican Bank , consisting of Puerto Rico , its outlying islands , and the Virgin Islands with the exception of St. Croix , was formed from volcanism in the Cretaceous Period . Rock samples from Sierra Bermeja in southwestern Puerto Rico , dated to the late Jurassic / early Cretaceous period , confirm this theory .

There is ongoing debate over when and how the ancestors of vertebrate fauna colonized the Antilles ? particularly whether the Proto @-@ Antilles were oceanic islands or whether they once formed a land connection between South and North America . The first , and prevailing , model favors overwater dispersal from continental , primarily South American , fauna ; the other suggests the vicarization of proto @-@ Antillean fauna . Hedges et al. conclude that dispersal was " the primary mechanism for the origin of West Indian biota " . Vertebrate terrestrial genera such as *Eleutherodactylus* dispersed in a " filter " effect among the islands before any vicarization event occurred . However , other fauna such as the endemic Antillean insectivores (*Nesophontes* sp . , *Solenodon marcanoi* and others) and freshwater fish appear to have colonized the West Indies earlier through other means . Woods provides evidence to support this hypothesis by analyzing the arrival of ancestors of the Antillean capromyids and echimyids , concluding that an ancient echimyid must have arrived on the Greater Antilles from South America either by island @-@ hopping through the Lesser Antilles or by rafting either to Puerto Rico or Hispaniola .

MacPhee and Iturralde provide an alternate hypothesis that the initiators of land mammal clades arrived on the Proto @-@ Antilles by the mid @-@ Tertiary period , approximately at the Eocene ? Oligocene boundary . A short @-@ lived (~ 1 Ma) landmass named " GAARlandia " (Greater Antilles + Aves Ridge land) connected northwestern South America with three of the Greater Antilles (Cuba , Hispaniola and Puerto Rico) during this period . Afterwards , during the fragmentation of the Proto @-@ Antilles , divergence of vacariated lines would have begun .

The last major changes in Puerto Rican fauna occurred about 10 @, @ 000 years ago as a result of

the post @-@ Ice Age rise in sea level and associated environmental changes . Puerto Rico 's transformation from a dry savanna environment to its present moist , forested state led to mass extinctions , especially of the vertebrate fauna . Around this time , the Puerto Rican Bank ? a single landmass comprising the archipelago of Puerto Rico (except for Mona , Monito and Desecheo) and the Virgin Islands (except for St. Croix) ? became separated . The Puerto Rican Bank has never been connected to its closest eastern bank , St. Maarten .

= = Mammals = =

The richness of mammals in Puerto Rico , like many other islands , is low relative to mainland regions . The present @-@ day native terrestrial mammal fauna of Puerto Rico is composed of only 13 species , all of which are bats . 18 marine mammals , including manatees , dolphins and whales , occur in Puerto Rico . Fossil records show the existence of one shrew (Puerto Rican shrew , *Nesophontes edithae*) , one sloth (Puerto Rican sloth) , three additional leaf @-@ nosed bats (*Macrotus waterhousii* , *Monophyllus plethodon* , and *Phyllonycteris major*) , and five rodents (one giant hutia : *Elasmodontomys obliquus* , one hutia : *Isolobodon portoricensis* and three spiny rats : *Heteropsomys antillensis* , *Heteropsomys insulans* , and *Puertoricomys corozalus*) . Woods suggests a reason for their extinction : " Taxa evolving in isolation on oceanic islands without competition or predators may not be able to adapt to rapidly changing conditions , such as the extensive climatic fluctuations of the Ice Ages or sudden competition or predation from introduced animals " .

Other terrestrial mammals have been introduced throughout the history of Puerto Rico . Indigenous settlers first introduced dogs and guinea pigs from South or Central America . Afterwards , Taínos introduced hutias as a food source from Hispaniola . When the Spanish colonized the island in the early 16th century , they introduced domesticated animals such as dogs , cats , goats , pigs , cattle , horses , and donkeys . Other species such as black rats (*Rattus rattus*) , Norway rats (*Rattus norvegicus*) and house mice (*Mus* sp .) have been unintentionally introduced as stowaways , possibly since Christopher Columbus 's arrival in 1493 . More recently , species have been introduced as a means of biological pest control . For example , the small Asian mongoose (*Herpestes javanicus*) was introduced in the 19th century to control the damage caused by rats in sugar cane plantations . The introduction was a failure : the mongoose failed to control the rat population and instead contributed to the decline of native fauna such as the yellow @-@ shouldered blackbird and possibly the elfin @-@ woods warbler .

As part of a study on adaptation , 57 rhesus macaques (*Macaca mulatta*) were introduced to the island of Desecheo and other southern off @-@ shore islands and cays in 1967 . Prior to the introduction , Desecheo was the largest nesting colony of the brown booby , but mainly as a result of egg predation by the introduced macaques , no bird species presently nests in the island . Efforts to trap and remove the species have been unsuccessful and it has expanded its range to southwestern Puerto Rico . Other primates also have established populations in Puerto Rico . As a result of vandalism , 107 squirrel monkeys escaped from a research station at Sabana Seca in the late 1970s . The latest estimate for this population is 35 individuals .

Arguably the best known of aquatic mammals occurring in Puerto Rican waters is the Antillean manatee (*Trichechus manatus manatus*) which is listed as vulnerable by the IUCN . The archipelago 's waters are one of the species ' main breeding areas . Manatees gathered local media attention when a two @-@ month manatee nicknamed Moisés was rescued and raised for 27 months by the Caribbean Stranding Network (CSN) . Moisés was the first successful release of an orphaned , captive @-@ raised manatee to the marine environment in the Caribbean . The animal became a Puerto Rican cultural , as well as scientific , icon when Tony Croatto wrote a song titled " Moisés " . A municipality of Puerto Rico , Manatí is believed to be named after the species .

Puerto Rico 's waters are also an important breeding site for the humpback whale during the Northern Hemisphere 's winter . Humpback whale watching is a popular tourist attraction in the municipality of Rincón in western Puerto Rico .

== Bats ==

Extant bats of Puerto Rico belong to five families (Noctilionidae , Mormoopidae , Phyllostomidae , Vespertilionidae , and Molossidae) and include a total of 13 species , of which six subspecies are endemic to the archipelago . Seven of the 13 species are insectivores , four can be considered frugivores , one species feeds on nectar and another on fish . The species total is a relatively low number in comparison to the other Greater Antilles . Jamaica , for example , with an area approximately 1 @. @ 2 times that of Puerto Rico , has 21 species (1 @. @ 6 times that of Puerto Rico) . A possible explanation for this is the comparatively large distance between the archipelago and the mainland dispersion areas . Jamaica , for example , is closer to Cuba and Hispaniola which are themselves closer to the mainland dispersion areas of North and Central America .

Bats play an important role in forest and cave ecology in Puerto Rico and help control mosquito populations . Most species (10 of 13) are cave @-@ dwellers with low reproductive rates ; the area with the highest species richness is the Caribbean National Forest , where eleven species occur . The red fig @-@ eating bat (red fruit bat) , endemic to the Puerto Rican Bank , plays an important role in the ecology of tabonuco forest in the Luquillo Mountains since it is believed to be the only seed disperser of bulletwood (*Manilkara bidentata*) . Cave ecosystems are enhanced by bat feces (guano) since many of the invertebrate cave fauna are either guano scavengers , detritivores or predators of the former two .

The bat species that occur in the archipelago of Puerto Rico are : greater bulldog bat (*Noctilio leporinus*) , Antillean ghost @-@ faced bat (*Mormoops blainvillii*) , Parnell 's mustached bat (*Pteronotus parnellii*) , sooty mustached bat (*Pteronotus quadridens*) , Jamaican fruit bat (*Artibeus jamaicensis*) , Antillean fruit bat (*Brachyphylla cavernarum*) , buffy flower bat (*Erophylla sezekorni bombifrons*) , Leach 's single leaf bat (*Monophyllus redmani*) , red fruit bat (*Stenoderma rufum*) , big brown bat (*Eptesicus fuscus*) , eastern red bat (*Lasiurus borealis*) , velvety free @-@ tailed bat (*Molossus molossus*) , and Mexican free @-@ tailed bat (*Tadarida brasiliensis*) .

== Birds ==

The avifauna of Puerto Rico is composed of 349 species , 18 of which are endemic to the archipelago . Almost half of the species (166) are accidental , meaning that they have been sighted only once or twice , and 42 of the species have been introduced , either directly or indirectly (mainly through habitat alteration) , by humans . Approximately 120 species , including both native and introduced , breed regularly in the archipelago .

The avifauna of the West Indies is predominantly of tropical North American (southern North America and Central America) origin with aggressive South American species having colonized the area only recently . The South American families occurring in the Greater Antilles are the hummingbirds (Trochilidae) , tyrant flycatchers (Tyrannidae) , bananaquit (Coerebidae) and tanagers (Thraupidae) , all of which are represented in Puerto Rico . The prevailing theory suggests that bird fauna colonized the West Indies by transoceanic dispersal during the glacial periods of the Pleistocene . The most primitive West Indies birds are the todies which have an endemic representative in Puerto Rico , the Puerto Rican tody .

Puerto Rico 's avifauna has diminished due to extinction and extirpation , either by natural forces or human intervention . For example , fossil evidence was discovered for a species of swift , *Tachornis uranocetes* , dated to the late Pleistocene (between 17 @,@ 000 and 21 @,@ 000 years ago) . The species is believed to have become extinct as a result of habitat alteration after the Wisconsin glaciation . At least six endemic species have become extinct in the last millennia : Puerto Rican barn owl (*Tyto cavatica*) , Puerto Rican caracara (*Polyborus latebrosus*) , Puerto Rican conure (*Aratinga chloroptera maugei*) , Puerto Rican woodcock (*Scolopax anthonyi*) , Puerto Rican quail @-@ dove (*Geotrygon larva*) , and the Antillean cave rail (*Nesotrochis debooyi*) . With a population of 13 individuals in 1975 , the Puerto Rican parrot almost became the seventh , but conservation efforts helped save the species from extinction . However , it is still one of the ten most critically endangered birds in the world . Four Puerto Rican birds , the Hispaniolan parakeet , the

white @-@ necked crow , the Cuban crow , and the limpkin , became extirpated after Puerto Rico 's population expansion in the latter half of the nineteenth century and three more species , the black @-@ bellied whistling duck , the black rail , and the greater flamingo , no longer breed in the archipelago .

= = Amphibians and reptiles = =

Puerto Rico 's herpetofauna consists of 25 amphibian species and 61 reptile species . The majority of West Indian terrestrial reptile clade is believed to have arrived by flotsam dispersion from South America . Little evidence exists to support the alternative hypothesis of proto @-@ Antillean vicariance . Other terrestrial herpetofauna are believed to have arrived to the West Indies (and Puerto Rico) by the same method and subsequently undergone vicarization by banks or islands . As a result , Puerto Rico , and the Caribbean in general , has one of the highest percentages of endemism among amphibians and reptiles in the world . Amphibian species in Puerto Rico belong to four families : Bufonidae (2 species) , Hylidae (3) , Leptodactylidae (18) and Ranidae (2) . Reptiles include turtles (freshwater and marine) , lizards , worm lizards , snakes and a caiman .

All species of Ranidae and Hylidae occurring in Puerto Rico are introduced . One species from the family Bufonidae , the cane toad , is introduced while the other , the Puerto Rican crested toad , is endemic and critically endangered . The cane toad was introduced to Puerto Rico in the 1920s to control the populations of white @-@ grub (*Phyllophaga* spp .) , a sugar cane pest . All species from the family Leptodactylidae are native to the region . Of the 18 Leptodactylidae species , 17 are from the genus *Eleutherodactylus* and are commonly known in Puerto Rico as coquíes . Three of these , the web @-@ footed coquí , the golden coqui and the mottled coqui , are likely to be extinct . The golden coqui is the only live @-@ bearing species from the family Leptodactylidae and Cook 's robber frog (*E. cooki*) is the only *Eleutherodactylus* sp. that exhibits sexual dimorphism in both size and color . The common coquí (*Eleutherodactylus coqui*) is an unofficial national symbol of Puerto Rico and an important aspect of Puerto Rican culture . Since 14 of the 17 coquíes are endemic to the archipelago , a common phrase used by Puerto Ricans to assert their national pride is " De aquí como el coquí " (From here Puerto Rico like the coquí) .

Puerto Rico 's turtle fauna includes both freshwater (5 species , including two extinct species) and marine turtles (5) . Two of these species , the hawksbill turtle and the leatherback sea turtle , are critically endangered . Threats to these species include habitat destruction and illegal capture of eggs and individuals . The spectacled caiman , an introduced species , is the only representative of the order Crocodilia in Puerto Rico .

The 11 snake species occurring in Puerto Rico are generally considered non @-@ venomous , although research has concluded that at least one species , the Puerto Rican racer (*Alsophis portoricensis*) , secretes venom . These species belong to 3 families and 4 genera : Typhlopidae (*Typhlops* genus) , Boidae (*Epicrates*) and Colubridae (*Alsophis* and *Arrhyton*) . The largest snake in Puerto Rico is the endemic Puerto Rican boa (*Epicrates inornatus*) with a maximum length of 12 ft (3 @. 7 m) . The diet of snakes in Puerto Rico consists of reptiles (*Ameiva* , *Anolis* , geckos) , coquíes and other frogs , and , to a lesser extent , mice , birds and bats (exclusively by the Puerto Rican Boa) .

The largest terrestrial lizard of the archipelago of Puerto Rico is the Mona ground iguana (*Cyclura cornuta stejnegeri*) . A subspecies of the rhinoceros iguana (*Cyclura cornuta*) , it is endemic to Mona Island , located in the Mona Passage between the main island of Puerto Rico and the Dominican Republic . Another *Cyclura* species of similar size , the Anegada ground iguana (*Cyclura pinguis*) , once occurred in the archipelago but it became extirpated due to predation by dogs , cats , and humans , habitat destruction , and competition from goats and pigs , and is now restricted to Anegada . The most common lizard in Puerto Rico is the sharp @-@ mouthed lizard (*Anolis pulchellus*) . The *Anolis* lizards of Puerto Rico , and the Greater Antilles in general , represent an interesting case of adaptive radiation . *Anolis* lizards in the Greater Antilles are more closely related to other species within the same island than to species of adjacent islands . Surprisingly , even though species divergence occurred independently on each island , the same set of ecomorphs (

habitat specialists) have evolved on each island .

= = Fish = =

The first fish descriptions from Puerto Rico were compiled by Cuvier and Valenciennes in 1828 . They reported 33 taxa for the archipelago . Puerto Rico has few native freshwater fish species ; however , there are over 30 introduced species , mainly originating from Africa , South America and the southeastern United States , have established populations , and 60 marine species use Puerto Rico 's freshwater bodies intermittently during the year . Introductions have been intentional and accidental . The purposes of intentional introductions have been sport fishing for recreation and food , mosquito control , and to provide baitfish for largemouth bass . Accidental introductions , such as the sailfin armored catfish (*Pterygoplichthys multiradiatus*) , are mainly attributed to the release of aquarium fish . Since 1936 , the Puerto Rican Department of Natural and Environmental Resources runs a hatchery at the municipality of Maricao . About 25 @, @ 000 fish , including largemouth bass , peacock bass , and channel catfish , and some turtle species are raised annually to stock Puerto Rico 's reservoirs and rivers .

Three types of habitats , mangroves , reefs and seagrasses , are found in Puerto Rico 's ocean waters . A total of 677 fish species live in these habitats ; 242 being reef species . Fish species found in Puerto Rican reefs are representative of the general Caribbean fauna . Common reef fishes include wrasses , damselfishes , white grunts (*Haemulon plumieri*) , bluestriped grunts (*Haemulon sciurus*) , queen parrotfish (*Scarus vetula*) , and sharks (family *Carcharhinidae*) . Sea breams (*Archosargus rhomboidalis*) and yellowfin mojarras (*Gerres cinereus*) are some of the species commonly found in mangrove habitats . Other species of interest include flatfishes , with 21 recorded species , and sharks , with more than 20 species . Oceanic whitetip sharks and silky sharks are common in the Mona Passage .

= = Invertebrates = =

The invertebrate fauna of Puerto Rico is high in richness but low in diversity relative to mainland neotropical faunas of similar size and habitat diversity . Puerto Rico , in comparison to other Antillean islands , is the most extensively studied in regards to invertebrates .

Puerto Rico 's insect fauna , similar to the majority of major invertebrate taxa in the archipelago , is considered depauperate when compared to its mainland counterparts . For example , approximately 300 species of butterfly occur in Puerto Rico , in contrast to more than 600 species in Trinidad and more than 1 @, @ 500 species documented from a 7 @. @ 5 km² region in Brazil . As of 1998 , out of the estimated 925 @, @ 000 described insect species , only 5 @, @ 573 were documented from Puerto Rico . In terms of diversity , of the 31 extant insect orders , 27 have representatives in Puerto Rico . The orders without reported representatives are Microcoryphia , Grylloblattaria , Plecoptera , and Mecoptera . The largest insect depository in Puerto Rico resides at the Museo de Entomología y Biodiversidad Tropical (Museum of Entomology and Tropical Biodiversity) , part of the Agricultural Experimental Station of the University of Puerto Rico .

Arachnids are important to the forest ecology , as both predators and prey . In some forest types , such as tabonuco forest , they are the major arboreal invertebrate predators ; spiders being the most abundant representative . The Maricao Commonwealth Forest 's 27 spider species belong to five families : Uloboridae , Pholcidae , Theridiidae , Linyphiidae and Araneidae . *Theotima minutissima* , a small spider species found in abundance in the Caribbean National Forest , is believed to be parthenogenetic , meaning that it reproduces without fertilization by a male .

Other terrestrial invertebrates described from Puerto Rico include earthworms and cave dwelling animals . Eighteen native species of earthworm have been described , with 11 species belonging to the family Glossoscolecidae , 3 to the family Megascolecidae , and 4 to the family Exxidae . Seventy @- @ eight invertebrate species are known to inhabit Puerto Rico 's caves . Six of these species are restricted to the Antilles , 23 come from North America and 23 are endemic to Puerto Rico . Only two of the species are confirmed as troglobites , or restricted to caves . Forty @- @ five percent of

the species are predators while the remaining 55 % are guano scavengers , detritivores and herbivores . It is believed that most of this fauna arrived at Puerto Rico in the Pleistocene .

The marine invertebrate fauna of Puerto Rico is composed of 61 sponges , 171 cnidarians , 8 nemerteans , 1 @,@ 176 mollusks , 129 annelids (polychaetes) , 342 crustaceans , 165 echinoderms , 131 bryozoans , 117 hard corals , 99 soft corals and gorgonians , 13 corallimorphs , and 8 hydrocorals . Coral species found in Puerto Rican reefs are representative of the general Caribbean fauna . Commonly occurring corals include boulder star coral (*Montrastrea annularis*) , finger coral (*Porites porites*) , and elkhorn coral (*Acropora palmata*) .

Invertebrate introductions have had an observable effect on Puerto Rican fauna . Native freshwater snails such as *Physa cubensis* have been adversely affected by introduced species . Currently , the most abundant freshwater snail in Puerto Rico is the Quilted Melania (*Tarebia granifera*) , an introduced species . Another invertebrate introduced to Puerto Rico is the honeybee . This animal competes with the endangered Puerto Rican parrot for secondary nesting cavities at the Caribbean National Forest . Africanized bees , which pose an even greater threat for secondary cavity nesters , have recently extended their range to Puerto Rico . Other introductions include 18 species of ant , one of the most abundant taxa in leaf litter habitats .

= = Human effect and conservation = =

The fauna of Puerto Rico has been subjected to human influence since the arrival of the Ortoiroid , Puerto Rico 's first settlers , approximately 4 @,@ 000 years ago . The native fauna was used by the island 's indigenous population as a source of food , while others were used for skins and trade . Significant declines in the populations and diversity of the islands fauna are believed to have begun after the arrival of European settlers in the sixteenth century . Habitat destruction , primarily as a result of forest clearing for sugar cane plantations , had a devastating effect on Puerto Rican fauna during the latter half of the nineteenth century . Furthermore , human @-@ introduced species such as rats , cats , the small Asian mongoose , and the cane toad have had a profound effect on the native fauna of Puerto Rico . Rats on Monito Island are believed to be a limiting factor on the abundance of the endemic Monito gecko , feral cats on Mona Island have been documented attacking common ground doves and endemic reptiles , and have been associated with the reduction of Mona ground iguana juveniles , and mongooses have been documented preying on Puerto Rican parrot fledglings .

Conservation efforts include both land and species protection . Approximately 8 @.@ 95 km² (equal to 3 @.@ 4 % of total land area) divided among 34 reserves are protected in Puerto Rico . According to the IUCN there are 21 threatened species in Puerto Rico : 2 mammals , 8 breeding birds , 8 reptiles , and 3 amphibians . The U.S. federal government lists 5 mammals , 2 amphibians , 8 birds , and 10 reptiles under the Federal Endangered Species Act . The Puerto Rican government , through the Department of Natural and Environmental Resources (DNER) , produces its own threatened species list which includes 18 critically endangered species (3 amphibians , 7 birds , 3 reptiles , 2 fish and 3 invertebrates) , and 14 endangered species . The DNER follows the IUCN classification scheme for species ' priority assignment .

Birds currently receive the greatest attention in regards to conservation . Arguably the most successful fauna recovery plan in Puerto Rico was the Puerto Rican Parrot Recovery Plan . Initiated in 1968 , its main objective was to downlist the Puerto Rican parrot 's status from critical to threatened by 2020 . Other objectives include the establishment of two separate , effective , wild populations (500 or more individuals for 5 years) , the protection of habitat for those populations and the control of predators , parasites and competitors of the species . Currently , the total wild parrot population is estimated at 44 individuals , and 105 birds are in captivity . This program was fundamental in raising ecological awareness in Puerto Rico .

The Puerto Rico Breeding Bird Survey (PRBBS) , established in 1997 , is a program with the purpose of monitoring the status and trends of Puerto Rican breeding bird populations . The information gathered by these surveys is used by the U.S. Fish and Wildlife Service (USFWS) to assess bird conservation priorities . Other conservation programs by the USFWS include the Puerto

Rico and U.S. Virgin Islands Migratory Bird Conservation and the maintenance of 5 wildlife refuges at Cabo Rojo , Laguna Cartagena , Vieques , Culebra and Desecheo . Other institutions supporting bird conservation in Puerto Rico are the Puerto Rican Ornithological Society and the Puerto Rico National History Association .

Marine conservation has recently garnered support in Puerto Rico . The archipelago has an estimated 700 miles (1 @, @ 126 @. @ 5 km) of coastline and 1 @, @ 300 mi² (3 @, @ 370 km²) of coral reef communities . The Department of Natural Resources of Puerto Rico maintains 25 areas with marine components but only two of these (11 km²) are designated as no @-@ take zones . All turtle species occurring in Puerto Rico 's waters are classified as either endangered or threatened . Earthwatch @-@ supported turtle conservation programs and U.S. federal programs have raised local awareness and have contributed to the decline of egg @-@ poaching and turtle meat consumption .