

**Natural Resources
Conservation Service –
Caribbean Area**

Wetland Wildlife Habitat Management
Conservation Practice Standard 644, Practice Specifications

SCOPE

This specification serves as a guide for selecting and implementing the **Wetland Wildlife Habitat Management** practice. This document contains a list of considerations for the applicant and the NRCS requirements and constraints of this practice. This document will be given to all producers who apply for NRCS financial and technical assistance to conduct **Wetland Wildlife Habitat Management**.

DEFINITION

Retaining, developing or managing wetland habitat for wetland wildlife.

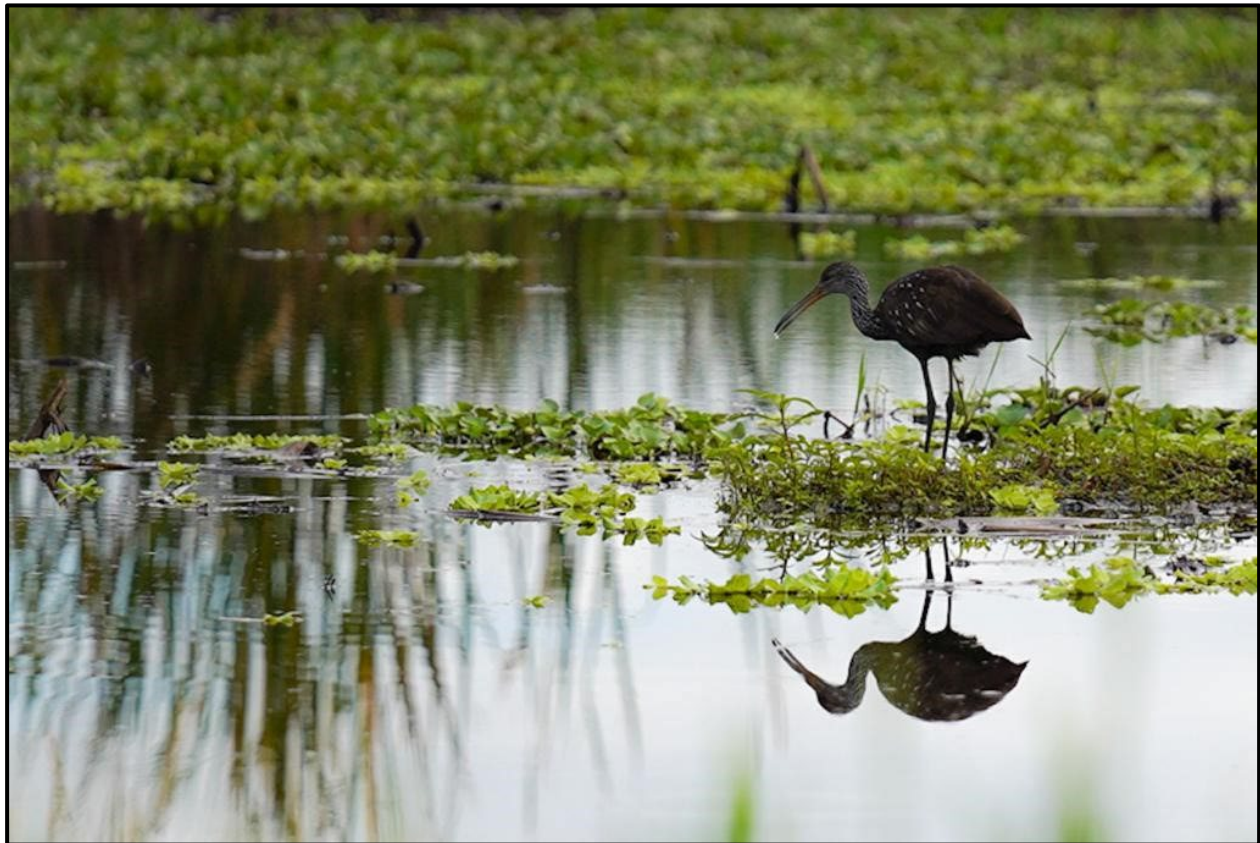


Photo by José Gilberto Martínez (USFWS). NRCS Caribbean Area Wetland Wildlife Habitat Management

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- To maintain, develop, or improve wetland habitat for waterfowl, shorebirds, or other wetland dependent or associated flora and fauna.



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CONDITIONS WHERE PRACTICE APPLIES

This conservation practice can be applied on or adjacent to wetlands, rivers, lakes and other water bodies where wetland associated wildlife habitat can be managed. This practice applies to natural wetlands and/or water bodies as well as wetlands that may have been previously restored NRCS Conservation Practice Standard (CPS) Wetland Restoration (Code 657), enhanced NRCS CPS Wetland Enhancement (Code 659), and created NRCS CPS Wetland Creation (Code 658).

BACKGROUND

Wetland wildlife habitat management consists of managing water and/or vegetation to provide the type of wetland habitat that will best meet the land user's objectives and desired wildlife needs. All wetlands provide habitat for some wildlife species. The term "wildlife" means non-domesticated birds, fish, reptiles, amphibians, invertebrates, and mammals. The term "wetland wildlife habitat" refers to the aquatic and terrestrial environments required for fish and wildlife to complete their life cycles, providing air, food, cover, water, and spatial requirements. Not all elements may apply to every habitat type but consider the following elements when assessing existing and planned wetland wildlife habitat:

- **Food:** Types of food, quantity, quality, distribution, and seasonal availability.
- **Cover:** Types of cover (for nesting, brood rearing, fawning, resting, roosting, escape from predators, summer shade, travel corridors), quantity, quality, and distribution.
- **Water:** Quantity, quality, accessibility, and seasonal availability.
- **Interspersion and Connectedness:** Distance and connections to food, cover, and water.

Cropland, pastureland, woodland and wetlands all produce and support wildlife by providing some or all of the basic habitat elements. Landowners can address some habitat shortcomings on their property by providing food plots (wildlife habitat planting), nesting boxes, brush piles, watering facilities, and other structures. However, maintaining a sustainable wildlife population often requires cooperation of multiple landowners. Simply having considerable amounts of food, cover, or water does not ensure a sustainable wildlife population. Within any area, large quantities of potential food, water, or cover may go unused because they are too far apart in relation to the customary travels of the animals in that area. An animal could travel a long distance to find food if necessary, but it would do little good if the animal was preyed upon along the way. Properly arranging the habitat components across a landscape is important to ensure that each component benefits the species of concern. Accomplishing this goal requires an understanding of the specific habitat needs of the managed species.

Habitat value depends on the quality, quantity, and interspersion of food, water, cover, and living space. To provide complete habitat, all requirements for the target species must be found within its home range.



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Wetland Wildlife Habitat Management is a resource management system, not a single practice. To accomplish the goals of the resource management system, a variety of NRCS practices can be employed to maintain and enhance wildlife habitat.

Planning assistance may apply to two levels of wildlife habitat management. The first level is for situations where wildlife production is the primary land use. The second level applies to planning units where wildlife is a secondary land use.

Steps to use this Practice Specification

1. Identify the objectives: what are the goals or results expected to achieve?
2. Identify the current conditions of the habitat, the missing components (food, cover, water, and spatial requirements) and the target species.
3. Use the Target species requirements to create, protect or enhance the habitat to guarantee their life cycles, providing air, food, cover, water, and spatial requirements. Not all elements may apply to every habitat type. The data provided in Appendices 1 to 8 include specific information regarding several requirements or characteristics for numerous Caribbean Area terrestrial and wetland wildlife species. This information can be used to develop recommendations or to conduct an on-farm inventory.

GENERAL CONSIDERATIONS

Consider the following items when managing an area for wetland wildlife:

- Project purpose, including identification of the wildlife species or groups of species to be supported and the habitat needs that can be met on the managed property.
- Surrounding landscape and its relationship to the project location. Farms located adjacent to or near State forests, secondary forests, federal forests, reserves, or waterbodies may require establishment of a buffer zone or transitional zone.
- Site conditions such as soils, available water sources, water quality and quantity, and existing vegetation; all habitats will be planned and managed according to soil capabilities.
- The feasibility of providing food, cover, and water for the desired wildlife species at the appropriate time(s) of year.
- When establishing vegetation is recommended, include documentation of the essential fish or wildlife species that will be benefited. Encourage plant diversity and native vegetation suitable for a wetlands environment.



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- The positive and negative impacts that wetland wildlife may have on the successful management of the site as well as on surrounding areas. Also consider the potential for attracting nuisance wildlife into an area.
- The effects of management on plants and plant diversity, including the potential for invasion by undesirable and invasive species.
- The effects of timing of management on wildlife.
- The effects of management on non-targeted species, especially threatened and endangered species, and other species of concern. NRCS wildlife habitat planning assistance must not adversely impact a federally listed Threatened, Endangered, or Candidate species or its habitat. This also applies to State Species of Special Concern.
- The potential use of ecological services in place of mechanical or chemical treatments to achieve management goals (e.g., services provided by grazers).
- The effects of management actions on compliance with federal and state hunting regulations (e.g., baiting).
- Other constraints such as recurring costs, availability of equipment, site access, regulatory or cost-share program requirements, social effects, and visual aspects like compatibility with the natural landscape.

PLANNING CONSIDERATIONS:

- Planning Criteria:** A planning criterion is a quantitative or qualitative method to assess the existing condition of the natural resources on a site to determine whether additional treatment is needed to address **Terrestrial habitat for wildlife and invertebrates and Aquatic habitat for fish and other organisms** resource concerns.
- Planning Consideration:** planning consideration is a description of potential actions or activities that should be considered to help address an identified resource concern or to address unintended consequences of an action.

NRCS recommends that planers use one of the following tools for a basic assessment:

- Generalized Caribbean Wildlife Habitat Evaluation Index (WHEI) wetland
- Stream Visual Assessment Protocol_2
- Specialist (e.g., biologist) report or management plan; Example: a report developed by the NRCS Caribbean Area Biologist, a Management Plan created by a partner under the US Forest Service Stewardship Program, or a Conservation Planning Activity for Forest, Pollinator or Fish and Wildlife developed by a Technical Service Provider.



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Other considerations or questions that are important to consider:

- a) Do the conservation practice or management activities that are in place meet species or guild-specific habitat model thresholds?
- b) Are the availability of food, cover or water in the quantity and quality to support habitat requirements for the species of interest?
- c) Is the connectivity of habitat components adequate to support stable populations of the targeted species?

Planning alternatives for wildlife will be based on a habitat appraisal. NRCS recommends use of the Caribbean Area Wildlife Habitat Evaluation Index (WHEI). These guides evaluate habitat for overall wildlife species diversity. When a habitat appraisal for a particular wildlife species is desired, consult the NRCS State Biologist.

WILDLIFE OBSERVATIONS AND MONITORING (Data Recording)

To implement the wetland wildlife habitat management practice, it is crucial to maintain a record of observations and implement adaptive management activities to achieve the habitat objectives and goals. For that reason, it is necessary to keep a record of those observations and implemented management actions. Some activities to be recorded and performed can be two or four monitoring efforts that require one or two persons and no more than 8 hours per effort (for this practice). Recommended adaptive management actions (2 - 5 efforts) may include cutting limbs that impede bird access to nesting boxes, replacing damaged fence markers, and cleaning nest structures and debris around other structures. These actions require hand labor and light equipment, a two-person crew, and less than one day per effort. All observations and activities performed need to be recorded and implemented annually for the best application of this practice.

This is a management practice that needs to be implemented in conjunction with other supporting conservation practices such as Tree/Shrub Establishment (Code 612), Riparian Forest Buffer (Code 391), Riparian Herbaceous Cover (Code 390), Hedgerow Planting (Code 422), Wildlife Habitat Planting (Code 420), Early Successional Habitat Development and Management (Code 647), Aquatic Organism Passage (Code 396), Stream Habitat Improvement and Management (Code 395), Structure for Wildlife (Code 649) or Forest Farming (Multi-Story Cropping, Code 379).

WILDLIFE SPECIES INFORMATION

The NRCS planner's primary wildlife management tool is the manipulation of vegetative habitat components. Use the information in this section as guidance to identify and evaluate wildlife species requirements, habitats, and distribution and for planning to improve or establish habitat.



1. Aquatic Fish

A healthy river supports aquatic fauna such as fish, shrimps, crabs, snails, aquatic insects, and insect larvae. In the Caribbean, most fish and shrimp river species have complex life cycles requiring them to migrate between riverine, estuarine, and marine habitats, moving downstream or upstream as needed. Dams, water intakes, river channelization, and other stream crossing structures disrupts the natural streamflow, preventing free movement of these migratory species. Rivers have also been impacted either accidentally or deliberately by discharges that carry toxic substances or increase nutrients and organic load, thus decreasing available oxygen.

High elevation, steep streams are dominated by shrimp species and the Sirajo and River gobies. Coastal plain streams are dominated by large shrimp, fish, and eels.

Consider the following conservation measures for river fish:

- Maintain minimum stream flows.
- Reduce in-stream physical barriers (dams, culverts, water intakes).
- Maintain habitat variety (riffles, pools, meanders).
- Avoid using agricultural chemicals near rivers or streams.
- Restore stream banks.
- Enhance and maintain riparian forest buffers. Do not cut any trees or shrubs in the riparian area.
- Reduce bank erosion.
- Clean up trash in rivers, streams, or guts.
- Do not release non-native fish.

See Appendix 1 for Native Caribbean River Fauna Table developed by the U.S. Fish and Wildlife Service Caribbean Ecological Services Field Office (USFWS-CESFO).

Remember this conservation practice can be implemented on or adjacent to wetlands, **rivers**, lakes and other water bodies where wetland associated wildlife habitat can be managed.

2. Birds

Birds are one of the most prevalent forms of wildlife present in the Caribbean Area. Most bird species listed in the Appendices are found in both Puerto Rico and the U.S. Virgin Islands (USVI). Birds may provide ecological services for agricultural activities but may not always be beneficial; sometimes birds can impact agricultural yield. Intensive agricultural production can also threaten bird species. Appendix 2 includes the habitat, nesting and feeding descriptions for some representative terrestrial and wetland Caribbean Area birds. Appendix 3 identifies their nesting periods. When planning to attract birds to the farm, consider the following conservation practices:



- Plant native trees.
- Plant a variety of flowering trees and shrubs to provide year-round food for birds.
- Prune trees and shrubs to promote healthier plants that provide more flowers and fruits to benefit wildlife.
- Promote agroforestry conservation practices.
- Provide wildlife escape ramps in livestock watering troughs.
- Avoid using agricultural chemicals in or adjacent to bird habitat.
- Install buffers, hedgerows, and similar plant structures.

3. Reptiles

Reptiles are animals mostly adapted to live in terrestrial and wetland environments, except sea turtles that spend most of their lives in the sea and oceans. Reptiles such as lizards, snakes, turtles, caimans, and crocodiles, have their body covered by scales that protect them from physical injuries and prevent desiccation. They are known as “cold blooded” animals because they are not able to control their body temperature as well as the “warm blooded” birds and mammals. Their temperature varies with that of the environment.

Reptiles are beneficial because they can work as biological controls for several pests that can be harmful for crops. The diet of snakes, boas, and lizards consists of predation on rats, mice, iguanas, and insects. Reptiles are also an important component in the food web for their diversity and abundance. Puerto Rico has 51 native species of reptiles and the USVI has 16 native reptiles. Appendix 4 identifies endemic reptiles for PR and the USVI.

Conservation measures recommended for reptiles include:

- Build wood or rock piles in sunny spots to create shelters and structure to provide basking sites in places not to be used for agricultural practices.
- Conduct reforestation with native trees/shrubs in areas not used for agriculture.
- **Do not** introduce exotic reptile species.
- Increase reptile awareness with clients and partners and avoid harming reptiles by providing educational information about their benefits to crops.
- Maintain a diverse vegetation structure.
- Avoid using agricultural chemicals in or adjacent to reptile habitat.
- Avoid burning piles of organic material or brush to “clean” the land for agricultural purposes.
- Build brush piles to create cover, provide additional structure to existing habitat and enhance prey availability.
- Plant native trees.
- Maintain structures used for shelter or protection, such as ponds.
- Increase the area of habitat suitable for reptiles.
- Pile rocks in a sunny spot to provide basking sites.
- Consider planting shade-tolerant groundcovers under trees and leaving a thick layer of leaves to provide temperature shelter.

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- Place stumps, logs, and rock piles in a shady spot.
- Maintain a mosaic of open habitats and scrub.

4. Amphibians

Amphibians are characterized as being dependent on humidity or water bodies for reproduction and survival. Amphibians, unlike most other animals, do not drink water because they absorb water through their smoothy semi-permeable skin. With some exceptions, such as “coquís”, amphibians have an aquatic life and terrestrial life stages through their cycle of life. Amphibians, such as frogs and toads, use freshwater bodies for habitat and reproduction. They lay eggs in the water and these hatch in their aquatic larvae (known as tadpole) and eventually grow and metamorphose in their terrestrial stage (froglets or toadlets). Frogs are more dependent to aquatic environment, inhabiting areas closer to water bodies. Toads are adapted to terrestrial environment, inhabiting areas more distant from water bodies. Both frogs and toads use forested habitats around and along water streams as corridors and shelters.

Amphibians are important for agricultural activity. An example of this are the “coquís” and toads that provide biological control of insects that are harmful to crops. See Appendix 5 for information regarding several amphibians that are endemic to Puerto Rico and the USVI. Their diet consists mainly of insects, termites and small ants, spiders, and other invertebrates.

Conservation measures recommended for amphibians include:

- Protect and enhance riparian forest buffers along streams, waterbodies, ponds, and guts.
- Build piles of rocks or woods under trees or shrubs in areas distant from water bodies. Amphibians can use them as shelter during their migrations.
- Avoid using agricultural chemicals (such as pesticides, herbicides) in areas close to amphibian habitat or close to water bodies. Even those considered “safe” by industrial standards might have potential toxic effects on amphibians.
- Implement best practices to prepare the agriculture land that reduce the sediment flow and streambank erosion.
- Clean up trash in rivers, streams or guts.
- Maintain ground cover and leaf-litter.

5. Pollinators

The word pollinator usually brings to mind honeybees. However, pollinators may also include butterflies, moths, wasps, flies, beetles, ants, bats and even some birds. A wetland area can be also habitat for pollinators.

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Pollinator habitat enhancement includes the improvement, restoration, enhancement, or expansion of flower-rich habitat that supports native and/or managed pollinators. This action provides pollen, nectar and nesting sites. It is also very important protect the pollinator from pesticides. For this reason, when recommending this conservation practice focus on the fundamentals: forage, nesting sites and protection from pesticides. Follow these three rules: (1) diversity; (2) variety of flowers (different sizes, colors and shapes); and (3) blooming the entire year. Appendix 6 includes detailed information regarding bees and their relationship with several crops. Appendix 7 includes some plants that will be recommended in order to provide habitat to support bees. A detailed plant list for pollinators is provided in the Practice Specification for Wildlife Habitat Planting (Code 420) at the eFOTG.

A. Bees – To establish bee pollinator habitat:

- a. Recommend native plants, flowering legumes, trees or forbs. On grazing lands consider long rest periods to allow for pollinator and plant recovery.
- b. Plant a variety of flowering forbs, legumes, trees and shrubs to provide year-round food for pollinators.
- c. Locate pollinator habitat where chemical drift will not be a concern.
- d. Avoid spraying herbicides or insecticides on field borders, filter strips, hedgerows and field windbreaks.
- e. Select undisturbed areas, the best site for habitat area on the least erosive portion of the field. Do not install pollinator habitat across areas of concentrated water flow.
- f. Implement no-till farming to reduce disturbance of ground-nesting insects, especially for cropland adjacent to diverse herbaceous or woody cover.
- g. Reduce or eliminate the use of insecticides. If possible, select pesticide formulations that are less toxic to pollinators (for example, liquid forms are generally less toxic than granular powders, which are less noxious than dust) or break down faster. Avoid microencapsulated formulations since they mimic pollen. Choose ground applications over aerial spraying. Time spraying operations very early or late in the day when pollinators are less active.
- h. Provide woody structures such as downed trees to make an artificial nesting site. Soil removed from drainage ditches can be piled to create potential bee ground-nesting habitat. Please see Structure for Wildlife (Code 649) documentation at eFOTG.

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Photos of nests of *Xylocopa mordax* (cigarron).

B. Bats

Bats are beneficial to agricultural activities. Bat species can provide pollination and pest management. Appendix 8 has a summary of bat species present in Puerto Rico and the USVI. Chapter 4 of the book *Biodiversidad de Puerto Rico* identifies some species that provide food for bats: Higuillos (*Piper sp.*), Maria (*Calophyllum calaba*), Moca (*Andira inermis*), Mameyuelo (*Colubrina arborescens*), Maga (*Thespesia grandiflora*), Jagüey (*Ficus sp.*), Berenjena cimarrona (*Solanum torvum*), Yagrumo (*Cecropia schreberiana*), Ausubo (*Manilkara bidentata*), and Palma de sierra (*Prestoea montana*). NRCS recommends providing artificial nesting sites for bat conservation. Refer to CPS Structure for Wildlife (Code 649) documentation at eFOTG for details.

6. Plant Species for Wildlife

Many tree and shrub species provide excellent sources of food for wildlife. Proper selection of plant material can meet both the aesthetic needs of the landowner and provide the necessary forest structure for wildlife (e.g., food and shelter needs). When recommending native plant establishment, include documentation of the essential fish or wildlife species that will be benefited.

Encourage plant diversity and native vegetation that occurs in the area. It is extremely important to recommend native species that provide shelter and food for a diversity of wildlife. Native plants provide the following benefits: adaptation to local soil, rainfall and temperature conditions; resistance to many insects and diseases; require minimal irrigation; flourish without fertilizers; promote local biological diversity (e.g., pollinators); and are unlikely to become weedy. NRCS recommends that any planting of native material is accompanied by a plan to remove weedy exotic species from the area to support the viability of the practice.



Several fruit crops such as citrus, papaya, soursop and others are suitable food for wildlife. However, establishing a monoculture crop is not considered adequate management for wildlife. It is necessary to plant a diversity of species (e.g.: 5 citrus trees, 5 soursops, 5 papayas or others) with a multi-storied plant canopy of forbs, as well as juvenile and mature shrubs and trees, to provide a variety of above-ground habitat for birds and other wildlife and below-ground habitat for burrowing animals and soil organisms.

Practice specifications for conservation practices Tree/shrubs Establishment (Code 612), Riparian Forest Buffer (Code 391), Hedgerow Planting (Code 422) and Wildlife Habitat Planting (Code 420) located in the eFOTG identify some plant species to consider for wildlife habitat. The list is not all-inclusive. The objective of the list is to provide a guide to use to inventory existing plants or select plants to establish, enhance or create habitat.

7. Conservation Practices

Application of most conservation practices is generally considered to be beneficial for wildlife. However, some practices can reduce wildlife food and cover when applied without consideration for wildlife habitat. The effect of conservation practice installation on wildlife habitat largely depends on practice selection, design and plant species used.



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Appendix 1. Caribbean native river fauna¹

SPECIES	Group	LH	Use	Preferred Habitat	Feeding Type
<i>Atya innocuous</i> (Basket shrimp)	Shrimp	A	E	mid-high river	filter/deposit
<i>Atya lanipes</i> (Spinning basket shrimp)	Shrimp	A	E	mid-high river	filter/deposit
<i>Atya scabra</i> (Gata shrimp)	Shrimp	A	E	mid-high river	filter
<i>Micratya poeyi</i> (Caribbean dwarf filter)	Shrimp	A		mid-high river	deposit/filter
<i>Micratya cooki</i> (Puerto Rican dwarf filter shrimp)	Shrimp	A		mid-high river	deposit/filter
<i>Potimirim americana</i> (American potimirim)	Shrimp	A		low-mid river	deposit/filter
<i>Potimirim mexicana</i> (Mexican potimirim)	Shrimp	A		low-mid river	deposit/filter
<i>Potimirim glabra</i> (Smooth potimirim)	Shrimp	A		low-mid river	deposit/filter
<i>Palaemon pandaliformis</i> (American grass shrimp)	Shrimp	A		low-mid river	deposit/filter
<i>Jonga serrei</i> (Estuarine tiny basket shrimp)	Shrimp	A		low river	deposit/filter
<i>Xiphocaris elongata</i> (Yellow-nosed shrimp)	Shrimp	A	B	whole river	deposit, omnivore
<i>Macrobrachium carcinus</i> (Big claw river shrimp)	Shrimp	A	E	whole river	predator
<i>Macrobrachium acanthurus</i> (Cinnamon River shrimp)	Shrimp	A	E	low river	predator
<i>Macrobrachium faustinum</i> (Caribbean long arm shrimp)	Shrimp	A	B	entire river	predator
<i>Macrobrachium crenulatum</i> (Striped River shrimp)	Shrimp	A	B	whole river	predator
<i>Macrobrachium heterochirus</i> (Cascade River prawn)	Shrimp	A	E	whole river	predator
<i>Epilobocera sinuatifrons</i> (Puerto Rican freshwater crab)	Crab	NM	E	whole river	predator
<i>Anguilla rostrata</i> (American eel)	Fish	C	E	whole river	predator
<i>Awaous banana</i> (River goby)	Fish	A	E	mid-high river	predator
<i>Sicydium</i> spp.* (Sirajo goby)	Fish	A	E	mid-high river	herbivore
<i>Eleotris perniger</i> (Smallscaled spiny cheek sleeper)	Fish	A	B	low river	predator
<i>Dormitator maculatus</i> (Fat sleeper)	Fish	A		low river	omnivore
<i>Gobiomorus dormitar</i> (Bigmouth sleeper)	Fish	A	E	whole river	predator
<i>Agonostomus monticola</i> (Mountain mullet)	Fish	A	E	whole river	omnivore

(1) Source USFWS-CESFO

LH: Life History

A: Amphidromous, adult life and reproduction in the river, eggs or larvae released to move downstream and develop in estuarine or marine waters, juveniles migrate back upstream.

C: Catadromous, adults migrate to ocean to reproduce, larvae enter into rivers and develop

NM: Nonmigratory, larval stages passed in the eggs

E: Edible, fished for sport and artisanal for human consumption

B: Used for bait, habitat preferences do not consider obstacles such as dams or high falls.




*The *Sicydium* complex population known in Puerto Rico is composed of three recognized species: *S. plumieri*, *S. buscki*, and *S. punctatum* (Engman *et al.* 2019).

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Appendix 2. Representative Caribbean Bird Species Characteristics

Scientific (Spanish/English Name)	Photo	Identification	Habitat	Nest	Feeding
<i>Agelaius xanthomus</i> (Mariquita de Puerto Rico/ Yellow-shouldered blackbird)		Black bird with yellow "shoulder" patches and a pointed bill	Open, dry forests and mangroves of southwestern Puerto Rico.	Cup nest in mangroves, palms, and other trees or in a tree cavity or nest box.	Insects and seeds. Prey includes weevils, other beetles, caterpillars, moths, crickets, earwigs, wasps, flies, spiders, and occasional snails and seeds.
<i>Amazona vittata</i> (Cotorra de Puerto Rico/ Puerto Rican parrot)		Green with a red forehead and white eye ring	El Yunque Forest, Rio Abajo Forest (Utuado & Arecibo) and Maricao Forest in Puerto Rico/	A large tree cavity in a tree trunk, usually palo colorado tree (<i>Cyrilla racemiflora</i>).	Seeds, fruits and flowers, important food trees: sierra palm (<i>Prestoea montana</i>), Palma real (<i>Roystonea borinquena</i>), Guaraguo, Cupey (<i>Clusia</i> spp.), Camasey (<i>Miconia</i> spp).
<i>Anthracothorax viridis</i> (Zumbador verde de PR/ Green Mango)		Hummingbird with a curved bill. Both sexes are green above and below with a bluish tail. The intensity of the color depends on the sun's angle.	Coffee plantations, forest central and western mountains of Puerto Rico.	Cup-shaped nest that is coated with lichens, typically placed on a tree limb.	Insects (beetles, flies, lantern flies), spiders, and flower nectar.

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<i>Antrostomus noctitherus</i> (Guabairo/ Puerto Rican Nightjar)		Night bird that is well camouflaged with mottled brown plumage.	Dry, semideciduous forest with open understory and dense leaf litter layer on the ground for nesting. Forest areas of southwestern Puerto Rico.	Normal clutch and these are laid directly on the leaf litter on the forest floor beneath the brush.	Nocturnal flying insects.
<i>Chlorostilbon maugaeus</i> (Zumbadorcito de Puerto Rico/ Puerto Rican Emerald hummingbird)		Body is iridescent green, with a black, forked tail. The lower bill is flesh-colored or red with a black tip. The female is light below and has a white-tipped tail.	Mountain forests, it is also found irregularly on the coast (drier south).	Tiny cup made of lichens, tree ferns, and other plant material.	Insects (lantern flies, mosquitoes, and other fly species), spiders, and nectar.
<i>Coccyzus vieilloti</i> (Pájaro Bobo Mayor/ Puerto Rican Lizard-Cuckoo)		A large forest bird with a gray breast and rufous belly. It has a red eye ring, a long tail with prominent white spots underneath, and a long, relatively straight bill.	Thick forests, coffee plantations limestone hills, and even suburban neighborhoods adjacent to dense vegetation.	Twig platform in a tree or bush.	Small lizards, large spiders, and insects including cicadas, beetles, stick insects, and caterpillars.
<i>Dendroica adelaidae</i> (Reinita Mariposera/ Adelaide's Warbler)		Underparts bluish-gray, throat and breast yellow, eyebrow stripe yellow or white. Female is similar but the crown stripe edge is less pronounced and less white in tail.	Dry, lowland forests and some moist forest areas, with tangles of vines and thickets, especially in the southwest and the northern limestone hills.	Finely woven cup-shaped located in a tree or dense thicket, cup placed 3-20 feet high in a tree or shrub.	Lantern flies, grasshoppers, caterpillars, stink bugs, flies, weevils, other beetles, and spiders.

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<p><i>Setophaga angelae</i> (Reinita de Bosque Enano/ Elfin-woods Warbler)</p>		<p>Black dorsally, white ventrally. White eyebrow stripe, white patches on ears and neck, incomplete eye ring. Immature birds are grayish-green dorsally.</p>	<p>Mountain cloud forest and lower montane forest from 370-1030 meters in elevation (Sierra de Luquillo, Sierra de Cayey, Toro Negro and Maricao State Forest) in Puerto Rico.</p>	<p>Tightly woven cup in aerial leaf litter trapped in vegetation or vines.</p>	<p>Insects</p>
<p><i>Icterus portoricensis</i> (Calandria de Puerto Rico/ Puerto Rican oriole)</p>		<p>The adult is black, with a yellow wing patch, and yellow patches on the rump and on the underside at the base of the tail. Immature birds are olive green.</p>	<p>Dry and moist forests, including shade-grown coffee plantations, citrus orchards, mangroves, palm groves, urban gardens.</p>	<p>Fibrous, hanging nest and is often placed in a palm tree.</p>	<p>Eats mostly insects (earwigs, crickets, grasshoppers, roaches, cicadas, weevils, caterpillars, ants, and wasps). Also eats spiders, forest fruits and juices of overripe oranges.</p>
<p><i>Loxigilla portoricensis</i> (Come ñame de Puerto Rico/ Puerto Rican bullfinch)</p>		<p>Thick-billed, black, with large reddish patches above the eyes, on the throat, and under the base of the tail. The female is slightly smaller and duller colored than the male.</p>	<p>Moist and dry forest with thick brushy areas, and coffee plantations (not found from Fajardo to Ceiba) in Puerto Rico.</p>	<p>Open or domed with an entrance in the side.</p>	<p>Seeds, fruits, and buds.</p>

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<p><i>Megascops nudipes</i> (Múcaro Común/ Puerto Rican Screech Owl)</p>		<p>White “eyebrows”; dark brown above and white below, with dark vertical streaking on the breast.</p>	<p>Wooded areas, dense tree stands. Prefers woods with a well-developed understory, plus large hardwood trees or palms for nest cavities.</p>	<p>Tree cavity, hole in a tree.</p>	<p>Large insects (crickets, grasshoppers, roaches, beetles, moths, caterpillars).</p>
<p><i>Melanerpes portoricensis</i> (Carpintero de Puerto Rico/ Puerto Rican woodpecker)</p>		<p>Solid black upper parts, with a bright red throat and breast and a white forehead. The lower abdomen and flanks are buff colored. Its white rump patch is striking in flight. The female has less red below than the male.</p>	<p>Forests, coffee plantations, mangroves, palm groves, parks, and gardens.</p>	<p>Nest cavities are usually high in trees.</p>	<p>Insects, lizards, scorpions, frogs, and several native tree fruits.</p>
<p><i>Myiarchus antillarum</i> (Jui/ Puerto Rican flycatcher)</p>		<p>Dark brown back and light undersides. There is sometimes a slight hint of two faint, buff wing bars.</p>	<p>Shade coffee plantations and lower elevation forests, especially in coastal scrub forests.</p>	<p>Tree holes</p>	<p>Weevils, caterpillars, bees, wasps, dragonflies, and hemipteran insects, wild fruit and berries, occasionally snails, lizards and frogs.</p>

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<i>Nesospingus speculifrus</i> (Llorosa de P.R. / Puerto Rican tanager)		A noisy forest bird with an olive-brown back, darker on top of the head and white below with dusky stripes on the breast and conspicuous white spot in the wing. The adult has a small, square, white wing patch.	Mountain forests, shade coffee plantations, and gardens at higher elevations.	Cup-shaped made of roots, vines and strands of fungus, lined with strips of palm leaves.	Insects, (moths, caterpillars, beetles, grasshoppers, ants), spiders, snails, and lizards, fruit and some seeds.
<i>Spindalis portoricensis</i> (Reina Mora/ Puerto Rican Spindalis)		Male has a white stripe on a black head, yellow ventrally, reddish-orange neck and breast. Female is olive-brown dorsally, dull white with gray streaks ventrally.	Forests, suburban gardens, and plantations with fruiting plants.	Ranging from a small cup, to bulky, deeper nests.	Berries and fruits such as figs, blackberries and Cecropia fruits, but will consume some aphids and other insects.
<i>Todus mexicanus</i> (San Pedrito de Puerto Rico/ Puerto Rican Tody)		Small bright green compact body, red throat and bill, yellow flanks.	Forest types with dense thickets and vines, as long as there are earthen banks or road cuts for nesting, arid area in southern Puerto Rico.	Excavates a curved burrow with a terminal nest chamber into an earth bank.	Insects, including katydids, grasshoppers, crickets, earwigs, dragonflies, flies (Diptera), and beetles (Coleoptera), as well as spiders and occasional small lizards and fruits.

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<i>Vireo latimeri</i> (Bien-Te- Veo de Puerto Rico/ Puerto Rican vireo)		Gray head, white breast and light-yellow belly. There are white crescents above and below the eye.	Mountain forests, coffee plantations, coastal karst, and thorn forest with vine tangles.	Deep, cup-shaped, low to moderate elevation.	Insects (grasshopper, cicadas, beetles, aphids, and caterpillars).
<i>Accipiter striatus venator</i> (Falcón de sierra/ Puerto Rican Sharp-shinned hawk)		Juveniles are light brown instead of gray, and their breasts are densely striped. Adults are slate gray colored on their backs and their ventral area has reddish-blond stripes.	Subtropical montane rain forests and moist subtropical forests (cloud forests, Sierran palm, caimitillo- granadillo and tabonuco).	Builds its nest out of twigs, and usually builds them in tree canopies.	Primarily feeds on small birds such as the Puerto Rican bullfinch, bananaquits, and Puerto Rican tanagers.
<i>Buteo platypterus brunnescens</i> (Guaraguito de bosque/ Puerto Rican Broad- winged hawk)		Dark brown and has rufous- barred white ventral area. In adults, the tail is broadly banded with black and white, and the rufous (rust color) breast is characteristic. Immature birds have dark bars on the breast and lack the distinctive tail bands of the adult.	Upland montane forests as well as within mature hardwood plantations, shade coffee plantations, and mature secondary forest of Puerto Rico's north- central karst region.	The species nest on mature secondary forest and old plantations. Builds its nest in the upper reaches of large trees emerging from the canopy.	Prey types include centipedes, frogs, lizards, mice, rats, and birds.



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Patagioenas inornata wetmorei (Paloma sabanera/ Puerto Rican plain pigeon)		It has a light gray-blue body with grayish brown wings. The head, neck, breast, and wings have a mauve tint. When perched, its wings show a fine, white band. The beak is gray with a black tip, and the legs are deep red. The eyes are light grayish blue. Juveniles are similar to adults, although they are browner than gray, and have dark eyes.	Behaves as a border species along the sides of roads, rivers and creeks. Also observed in secondary forests or moving across agricultural and urban developments.	Uses large, leafy trees, like the mango tree, for nesting. It also likes bamboo clusters near the water.	Seeds and fruits of a variety of plants like palm (<i>Roystonea borinquena</i>), day-blooming jasmine (<i>Cestrum diurnum</i>), camasey (<i>Miconia</i> sp.), péndula (<i>Petitia dominguensis</i>) and princess vine (<i>Cissus syciodes</i>).
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Habitat, Feeding and Nesting Information Regarding Wetlands Common Birds

Spanish Name	English Name	Scientific name	Habitat	Feeding	Nesting
Boba blanca	Red-footed Booby	<i>Sula sula</i>	Sea in deep tropical oceans.	Squid and fish.	Stick nest in a tree or brush.
Boba de cara azul	Masked Booby	<i>Sula dactylatra</i>	Feeds for long periods at sea in warm tropical waters.	Fish jacks and some squid.	Nests on the ground on rocky islands.
Chiriría	West Indian Whistling-Duck	<i>Dendrocygna arborea</i>	Fresh and saline bodies of water, wetlands, including lagoons, rice fields, and palm savannas, especially near mangroves, Pterocarpus, or other swamp-adapted trees.	Fruits, berries, seeds, grass, rice, and corn, and is particularly fond of the fruit of the royal palm (Roystonea sp.)	A cluster of palm fronds or cavity in a tree, bromeliads, Panicum grass, in tree stumps, or in clumps of palm leaves, usually near water.
Chirre	White-tailed Tropicbird	<i>Phaethon lepturus</i>	Around sea cliffs and rocky cays.	Squid and small fish.	Bare ledge or in a crevice on a rocky cliff or talus slope.
Chirre de pico colorado	Red-billed Tropicbird	<i>Phaethon aethereus</i>	Out at sea.	Fish	Rock crevices on small cays.
Gallareta común	Common Moorhen	<i>Gallinula chloropus</i>	Freshwater, brackish marshes, canals, ditches, mangroves, and ponds with dense vegetation.	Algae, plant leaves, seeds, and less common aquatic insects and worms.	Floating vegetation (eneas, grass or aquatic plants) in a shrub, or on the ground near the water.
Gallinazo Caribeño	Caribbean Coot	<i>Fulica caribaea</i>	Freshwater areas.	Algae and other plant leaves and seeds; also insects.	Floating nest.
Gallito Amarillo	Yellow-breasted Crake	<i>Porzana flaviventer</i>	Freshwater swamps with short grass borders, pond edges, flooded fields, and ditches with dense vegetation.	Insects, seeds and crustaceans plucked from water or vegetation.	Woven nest a top of floating plant.
Garza	Great Egret	<i>Casmerodius albus</i>	Marshes, ponds, shores and mudflats.	Fish, frogs and insects.	Small sticks placed near or over water.
Garza Blanca	Snowy Egret	<i>Egretta thula</i>	Freshwater swamps, but can also be found around saltwater lagoons.	Small fish, amphibians, snakes, crabs, insects, and other invertebrates.	Nest is made of sticks.



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Garza Real	Great Egret	<i>Ardea alba</i>	Fresh and salt water ponds, wetlands, canals, mangrove swamps, estuaries, lagoons, moist grassy fields, even small urban streams.	Fish, frogs, insects, crustaceans, and sometimes small birds.	Stick nest in treetop colonies over water.
Garzón Cenizo	Great Blue Heron	<i>Ardea herodias</i>	Ponds, lagoons, ocean shores, rivers, marshes, mangroves, and occasionally in grassy fields.	Fish, amphibians, snakes, crabs, other invertebrates and small mammals and birds when it can catch them.	Platform of twigs of variable height in a tree or brush.
Gaviota Pequeña, Gaviota Chica	Least Tern	<i>Sterna antillarum</i>	Shallow coastal marine waters and inland lagoons.	Small fish, shrimp and other marine invertebrates.	Nest scrape, adorned with bits of shells and pebbles.
Martinetito	Least Bittern	<i>Ixobrychus exilis</i>	Freshwater swamps with cattails and sometimes mangrove channels.	Insects and invertebrates.	Among the swamp vegetation over or near the water.
Pampero, Pimelco	Audubon's Shearwater	<i>Puffins lherminieri</i>	Open ocean; inshore waters close to its breeding colonies on rocky islands.	Fish, squid and crustaceans.	Breeding colonies on rocky islands.
Pato chorizo	Ruddy Duck	<i>Oxyura jamaicensis</i>	Ponds, lagoons, marshes and lakes with emergent vegetation. Require areas that have open water as well as cover for protection during nesting. This includes tall weeds that provide access and ability to be bent over for nest bases.	Aquatic insects, snails, mollusks, worms.	Female builds a nest over water in swamp vegetation.
Pato dominico	Masked Duck	<i>Nomonyx dominicus</i>	Shallow fresh and brackish water ponds, lagoons, swamps and flooded fields with plenty of floating vegetation.	Seeds, roots, and shoots of aquatic plants and some insects and crustaceans.	Among the swamp vegetation over or near the water.



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Pato quijada colorada	White-cheeked pintail	<i>Anas bahamensis</i>	Fresh and salt water ponds, lagoons and mangroves swamps.	Seeds and leaves of algae and other aquatic plants.	Scrape is made on dry land and concealed under a clump of vegetation, sometimes a great distance from water.
Playero Blanco	Snowy plover	<i>Charadrius alexandrinus</i>	Salt ponds and sandy beach areas.	Insect larvae and invertebrates.	Depression in a dry, sandy area.
Pollo de Mangle	Clapper Rail	<i>Rallus longirostris</i>	Mangroves	Fiddler crabs and other crab species from the surface, and will also eat some snails, worms, small fish and aquatic insects.	Platform of sticks among the mangrove roots.
Tigua	Least Grebe	<i>Tachybaptus dominicus</i>	Forages in freshwater ponds, canals and temporary pools with thick floating vegetation.	Aquatic beetles, dragonfly larvae, waterbugs, and other insects, plus crustaceans, tadpoles and small fish.	Floating mat of decaying vegetation.
Yaboa Real	Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	Freshwater swamps, it is found at times in brackish water lagoons and salt ponds.	Fish, frogs, invertebrates, and the eggs of other birds, but it is especially fond of crabs.	Stick nest in a tree.
<p>Sources:</p> <p>Puerto Rico's Birds in Photographs, Mark W. Oberle</p> <p>A Guide to the Birds of Puerto Rico and Virgin Islands, Herbert A. Raffaele</p> <p>Las Aves de Puerto Rico, Virgilio Biaggi</p>					



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Appendix 3. Terrestrial Birds' Breeding Period

	English name				Month											
Spanish name	J	F	M	A	M	J	J	A	S	O	N	D				
<i>Agelaius xanthomus</i> (Mariquita de Puerto Rico/ Yellow-shouldered blackbird)				1			1	1								
<i>Amazona vittata</i> (Cotorra de Puerto Rico/ Puerto Rican parrot)	1						1									
<i>Anthracothonax viridis</i> (Zumbador verde de P.R./ Green Mango)																
<i>Antrostomus noctitherus</i> (Guabairo/ Puerto Rican Nightjar)								1								
<i>Chlorostilbon maugaeus</i> (Zumbadorcito de Puerto Rico/ Puerto Rican Emerald hummingbird)																
<i>Coccyzus vieilloti</i> (Pájaro Bobo Mayor/ Puerto Rican Lizard-Cuckoo)																
<i>Dendroica adelaidae</i> (Reinita Mariposera/ Adelaide's Warbler)																
<i>Setophaga angelae</i> (Reinita del Bosque Enano/ Elfin-woods Warbler)					1	1	1									
<i>Icterus portoricensis</i> (Calandria de Puerto Rico/ Puerto Rican oriole)																
<i>Loxigilla portoricensis</i> (Come ñame de Puerto Rico /Puerto Rican bullfinch)																
<i>Megascops nudipes</i> (Múcaro Común/ Puerto Rican Screech-Owl)																
<i>Melanerpes portoricensis</i> (Carpintero de Puerto Rico/ Puerto Rican woodpecker)																
<i>Myiarchus antillarum</i> (Jui/ Puerto Rican flycatcher)																
<i>Nesospingus speculifrus</i> (Llorosa de P.R./ Puerto Rican tanager)																
<i>Spindalis portoricensis</i> (Reina Mora/ Puerto Rican Spindalis)																
<i>Todus mexicanus</i> (San Pedrito de Puerto Rico/ Puerto Rican Tody)																
<i>Vireo latimeri</i> (Bien-Te-Veo de Puerto Rico/ Puerto Rican vireo)																
<i>Accipiter striatus venator</i> (Falcón de sierra/ Puerto Rican Sharp-shinned hawk)	1	1	1	1	1	1	1	1								
<i>Buteo platypterus brunnescens</i> (Guaraguaito de bosque/ Puerto Rican Broad-winged hawk)	1	1	1	1	1	1	1	1								
<i>Patagioenas inornata wetmorei</i> (Paloma sabanera/ Puerto Rican plain pigeon)	1	1	1	1	1	1	1					1				



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Wetland Birds' Breeding Period

Spanish Name	English Name	Scientific Name	Breeding Season*											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Boba blanca	Red-footed Booby	<i>Sula sula</i>												
Boba de cara azul	Masked Booby	<i>Sula dactylatra</i>												
Chiriría	West Indian Whistling-Duck	<i>Dendrocygna arborea</i>	Nesting season is variable											
Chirre	White-tailed Tropicbird	<i>Phaethon lepturus</i>												
Chirre de pico colorado	Red-billed Tropicbird	<i>Phaethon aethereus</i>												
Gallareta comun	Common Moorhen	<i>Gallinula chloropus</i>												
Gallinazo Caribeño	Caribbean Coot	<i>Fulica caribaea</i>												
Gallito Amarillo	Yellow-breasted Crake	<i>Porzana flaviventer</i>												
Garza	Great Egret	<i>Casmerodius albus</i>												
Garza Blanca	Snowy Egret	<i>Egretta thula</i>												
Garza Real	Great Egret	<i>Ardea alba</i>												
Garzón Cenizo	Great Blue Heron	<i>Ardea herodias</i>												
Gaviota Pequeña, Gaviota Chica	Least Tern	<i>Sterna antillarum</i>												
Martinetito	Least Bittern	<i>Ixobrychus exilis</i>												
Pampero, Pimelco	Audubon's Shearwater	<i>Puffins lherminieri</i>												
Pato chorizo	Ruddy Duck	<i>Oxyura jamaicensis</i>												
Pato dominico	Masked Duck	<i>Nomonyx dominicus</i>												
Pato quijada colorada	White-cheeked pintail	<i>Anas bahamensis</i>												
Playero Blanco	Snowy plover	<i>Charadrius alexandrinus</i>												
Pollo de Mangle	Clapper Rail	<i>Rallus longirostris</i>												
Tigua	Least Grebe	<i>Tachybaptus dominicus</i>												
Yaboa Real	Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>												
* Breeding season occurs year around with the peak in this month.														
Sources: Puerto Rico's Birds in Photographs, Mark W. Oberle A Guide to the Birds of Puerto Rico and Virgin Islands, Herbert A. Raffaele Las Aves de Puerto Rico, Virgilio Biaggi														



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Appendix 4. Characteristics of Caribbean Area Reptiles

Scientific (Spanish/English) Name	Habitat-Range
<i>Trachemys s. stejnegeri</i> (Hicotea, Jicotea)	Lives in ponds, lakes, reservoirs, rivers and streams in Puerto Rico: Laguna Tortuguero (Vega Baja), Humacao Wildlife Refuge, Caño Tiburones, Guanica irrigation canals, man-made ponds in Isabela and Piñones. Feeds in water but sunbaths are taken on exposed rocks or tree trunks lying near water's edge. Feeds on both animals and vegetables (snails, shrimp, pieces of fish, lettuce or some other tender leaves.)
<i>Sphaerodactylus gaigeae</i> (Salamanquita de Pandura/ Gaige's Dwarf Gecko)	Under leaf litter, rocks and logs in coffee plantations. Sierra de Panduras between Maunabo and Yabucoa, Cayo Santiago, Vieques, Isla Piñeros, PR.
<i>Sphaerodactylus klauberi</i> (Salamanquita Negra/ Klauber's Dwarf Gecko)	Inhabits interior, upland moist habitats occurring mostly in leaf-litter, and is present in tabonuco forest type. Carite, Toro Negro and Río Abajo state forests in Puerto Rico.
<i>Sphaerodactylus macrolepis</i> (Salamanquita Común/ Common Dwarf Gecko)	Moist forests but also semi-xeric coastal coconut groves in northeastern Puerto Rico, Vieques, Culebra and their cays, and the US Virgin Islands. PR Central Mountain Range at 2,800 ft., also identified in Boquerón, Susúa, and Playa de Ponce.
<i>Sphaerodactylus nicholsi</i> (Salamanquita Pigmea/ Puerto Rican Crescent Sphaero)	This species has been found in a range of habitats including both xeric and coastal forests, open areas and beaches, plantations, semi-evergreen ravines, and grass and brush scrubland. Individuals of this species are known to occur in anthropogenic environments, such as gardens. This species is found along the southern, western and north-central coasts of Puerto Rico.
<i>Sphaerodactylus roosevelti</i> (Salamanquita de Roosevelt/ Roosevelt's Dwarf Gecko)	A xerophilic species inhabiting dry forests. This species is found in southwestern Puerto Rico, Caja de Muertos and Vieques islands.
<i>Sphaerodactylus townsendi</i> (Salamanquita del sureste/ Townsend's Dwarf Gecko)	Xerophilic to semi-mesophilic, inhabits leaf litter, decomposing logs, and palm trash. Found in Cabezas de San Juan in northeastern Puerto Rico, south-central coast west to Playa de Ponce, Caja de Muertos Island, Piñeros Island, Platillo or Morillito Island, and Vieques Island.
<i>Pholidoscelis polops</i> (Lagartija de Santa Cruz/ St. Croix ground lizard)	Forested, woodland, and shrub land areas. Most commonly found in sandy areas and patches of direct sunlight, on the ground, or in low canopy cover and leaf litter (fallen leaves). Endangered. Native populations occur on the offshore cays of Protestant Cay and Green Cay National Wildlife Refuge in St. Croix, USVI.
<i>Ameiva exsul</i> (Siguana Común/ Puerto Rican Ground Lizard)	Lawns, sugar cane fields, vacant lots, roadsides, city parks and plazas, around human habitations, and along mangrove border. Found on Puerto Rico mainland, offshore islands Vieques and Culebra and many cays. Has been observed in the USVI.
<i>Ameiva wetmorei</i> (Siguana de Rabo Azul/ Blue-Tailed Ground Lizard)	Classified as xerophilic. Found in southwestern Puerto Rico including Magueyes, Caja de Muertos, and Morillito islands.
<i>Diploglossus pleei</i> (Culebra de Cuatro Patas/ Puerto Rican Galliwasp)	Deep forest, widely distributed in Puerto Rico at the Cambalache State Forest, coffee plantations, and other mesic wooded areas such as borders of pastures and sugarcane fields, limestone ridges and semi-dry haystack hills.
<i>Anolis cooki</i> (Lagartijo del Seco/ Cook's Anole)	Dry forest and coastal scrub in portions of the subtropical dry forest life zone. Also associated with dry evergreen seasonal woodlands found in the lowlands of southwestern Puerto Rico (Cabo Rojo to Guayanilla, and Caja de Muertos Island).



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<i>Anolis cristatellus</i> (Lagartijo Común/ Puerto Rican crested anole)	Open areas such as open forests, fields, and mostly deforested areas. It is commonly found in roadsides, poles, and fences. It has been observed in both shaded and sunny coffee plantations. Distributed in mainland Puerto Rico and many of its offshore islands, including Vieques, Culebra and Culebrita.
<i>Anolis cuvieri</i> (Lagarto Verde/ Puerto Rican Giant Anole)	Evergreen formations. Prefers shady, cool coffee plantations at intermediate elevations, areas close to the coast up to the upper Central and Luquillo Mountain Ranges of Puerto Rico.
<i>Anolis evermanni</i> (Lagartijo Verde/ Emerald Anole)	Prefers mesic and deep wet forest habitats. Occurs on shrubs and low trees in coffee plantations and where palms occur. May also be found in thick stems of bamboo. It has been consistently observed in forests dominated by tabonuco (<i>Dacryodes excelsa</i>), and sierra palm (<i>Prestonia montana</i>). Found in Maricao, Mayagüez, Dorado, and at Tortuguero Lagoon, Sierra de Panduras, Central Mountain Range, Sierra de Luquillo.
<i>Anolis gundlachi</i> (Lagartijo Barba amarilla/ Yellow-Bearded Anole)	Distributed throughout Puerto Rico but is restricted to the densely forested coffee belt and higher forested areas, although it reaches the coastal plain in some places. A trunk-crown species, it also perches on shrubs.
<i>Anolis krugi</i> (Lagartijo Jardinero de Montaña/ Upland Grass Anole)	Mountains where it prefers areas that are open but also shady, low bushes, vines and ferns alongside roads or trails. It can be found in the mountain ranges of Cayey, and Pandura along the south coast of Puerto Rico near Guayama.
<i>Anolis occultus</i> (Lagartijo Pigmeo/ Puerto Rican Pygmy Anole)	Mainland Puerto Rico, semi-dry type of vegetation. It may be found in the forest canopy, but it may also occupy peripheral vegetation, including bushes, ferns, upper surface of broad leaves, on the ground, and on the outer leaves of bromeliads on the forest floor. Found in Maricao State Forest, El Yunque, El Verde, the Cayey Mountain Range, and the haystack area west of Manatí.
<i>Anolis poncensis</i> (Lagartijo Jardinero de Ponce/ Dryland Grass Anole)	Found in subtropical dry forest, pastures, exposed grassy areas, and shrub areas. Found in southwestern Puerto Rico from the towns of Cabo Rojo to Salinas, or perhaps Guayama, and also found in the Coamo hills. It is also present in Caja de Muertos Island
<i>Anolis pulchellus</i> (Lagartijo Jardinero/ Common Grass Anole)	Prefers grasses, also occur in bushes and plants but seldom on trees. It has been observed in coffee plantations and on <i>Coccoloba</i> shrubs of coastal regions. It is considered a xerophilic to semi-mesophilic lizard. Found in Puerto Rico and its adjacent islands of Vieques and Culebra, abundant on St. Thomas.
<i>Anolis roosevelti</i> (Lagartijo Gigante de Culebra/ Culebra Island Giant)	Forests of tall gumbo limbo (<i>Bursera</i>) and Ficus trees, where it forages for fruits on the branches (USFWS 1982). Culebra Island, has probably become extinct.
<i>Anolis stratulus</i> (Lagartijo Manchado/ Barred Anole)	Associated with xeric to mesic environments. It is considered trunk-crown lizard that is most frequently observed on tree trunks, although it may also be seen on grasses. Puerto Rico, Vieques and Culebra islands. It is also present in some of the U.S. Virgin Islands.
<i>Amphisbaena bakeri</i> (Culebrita ciega de Baker/ Baker's Legless Lizard)	Found on rotten logs along edge of clearings with short weedy vegetation. It also inhabits grassy pastures, coffee plantations, western portion of Puerto Rico.
<i>Amphisbaena caeca</i> (Culebrita ciega común/ Puerto Rican Worm Lizard)	It occurs throughout Puerto Rico (except perhaps the arid southwest), and up to elevations of at least 2200 ft., in shaded habitats including upland coffee plantations, coastal Terminalia woods, mesic woods adjacent to pastures, exposed ravines, shady ravine woods. Individuals of this species have also been seen in Cocoa plantations 100 yards away from shore.
<i>Amphisbaena schmidtii</i> (Culebrita ciega de Schmidt/ Schmidt's Worm lizard)	Acacia scrub, at exposed edges of coffee plantations. Found in Puerto Rico, mostly concentrated in the northwestern limestone region. It has been collected in the limestone section from the towns of Aguadilla to Dorado and south to Utuado.



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<i>Amphisbaena xera</i> (Culebrita ciega del seco/ North American Worm Lizard)	Observed in xeric woods with leaf litter cover, mesic woods with spiny palm <i>Acronomia sp.</i> and transitional areas between xeric lowlands and mesic highlands (Puerto Rico southwest and Caja de Muertos Island).
<i>Typhlops granti</i> (Víbora de Grant/ Grant's Blind Snake)	Subtropical dry forest where it usually occurs under rocks and trunks. Has been observed in southwestern Puerto Rico, (La Parguera east to vicinity of Guánica and Caja de Muertos Island). It has also been collected at Campamento Santiago.
<i>Typhlops hypomethes</i> (Víbora universitaria/ Blind Snake)	Usually moves through yielding soil through paths of least resistance but does not create tunnels.
<i>Typhlops platycephalus</i> (Víbora decabeza aplastada/ Flat-Headed Blindsnake)	Occurs in open and semi-open habitat, such as areas containing pasture bordered by forested limestone hills with numerous limestone rocks. They occur under rocks in pasture-edge habitats. The most widely distributed blind snake in Puerto Rico.
<i>Typhlops rostellatus</i> (Víbora de pico/ Puerto Rican Wetland Blind Snake)	Found in coffee plantations, rocky hillsides, open pastures, forested and upland habitats, and can be found under fallen logs and rocks, widely distributed in the northern part of the island.
<i>Chilabothrus inornatus</i> (Culebrón/ Puerto Rican Boa)	Occupies a wide range of habitats in Puerto Rico, from wet montane forest to dry forest environments, including offshore cays and pastureland with patches of exotic trees.
<i>Chilabothrus granti</i> (Boa de Islas Vírgenes/ VI Tree Boa)	Forest or xerophytic (dry) scrubland, characterized by sharp inclines and rocky, poorly fertile soil. It usually hides under rocks and fallen tree trunks during the day. Occurs in Puerto Rico, St. Thomas (USVI), and Tortola (BVI).
<i>Arrhyton exiguum</i> (Culebra de jardín/ Ground Snake)	Prefers the forest floor under rocks, leaf litter or dead logs and branches in lower to middle sections of montane wet and dry forests. It also may often occur in urban and rural garden settings. <i>Arrhyton exiguum</i> was reclassified taxonomically to <i>Magliophis exiguum</i> by Hedges et al., (2009). Widely distributed across Puerto Rico, it is also present on St. Thomas and St. John, but it is absent from St. Croix (Platenberg et al. 2005).
<i>Borikenophis portoricensis</i> (Culebra corredora/ Puerto Rican Racer)	A diurnal (active during the daytime) and terrestrial (ground dwelling) snake, although can be found in trees. Occurs throughout the main island of Puerto Rico from the coastal plain to forested middle elevations. Also occurs in the USVI.
<i>Spondylurus nitidus</i> (Puerto Rican skink)	Favors dense clumps of <i>Opuntia</i> cacti as shelter sites and exhibits an association with arid and semi-arid areas (Hedges and Conn 2012; Hedges 2013a). Most specimens have been taken from rock fissures, beneath rocks or cacti, or at the base of coconut palms (Rivero 1998; Hedges 2013a). By contrast, Sanchez (2013) recorded the species from humid limestone forest, where it was typically active in the morning and basking on exposed rocks, leaf litter or fallen logs (Hedges 2013a). It occurs in the main island of Puerto Rico, Desecheo, Icacos, Vieques, Culebra, Cayo Luis Peña and Cayo Norte (Hedges and Conn 2012).
<i>Spondylurus culebrae</i> (Culebra skink)	The species has been reported among <i>Opuntia</i> cacti in rocky areas at and close to sea level (Hedges 2013b). It occurs in Culebra & Culebrita islands (Hedges and Conn 2012).
<i>Spondylurus spilonotus</i> (Greater Virgin Islands skink)	No ecological information is available for this species. Presumably it was viviparous, in common with other <i>Spondylurus</i> species, but no data on reproduction are available (Hedges 2013c). It occurs in St. Thomas and St. John, USVI (Hedges and Conn 2012).
<i>Spondylurus semitaeniatus</i> (Lesser Virgin Islands skink)	On the two islets where it is known to survive in the US Virgin Islands, the natural vegetation consists mainly of coastal scrub with shrubby vegetation, cacti and grass, interspersed with rocky areas and "occasional beaches" (Hedges and Conn 2012; Hedges 2013d). It occurs in USVI and BVI (Hedges and Conn 2012).



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<i>Spondylurus sloanii</i> (Virgin Islands bronze skink)	This species has been recorded from coastal scrub, characterized by shrubby vegetation or grass interspersed with rocky areas and occasional beaches, on Little Saba (Hedges and Conn 2012; Hedges 2013e). On Peter and Water Islands specimens have been found beneath cover objects (rocks, leaves and driftwood) in coastal or near-coastal situations; the Water Island specimen was on a cobble beach beneath driftwood (Hedges and Conn 2012; Hedges 2013e). It occurs in USVI & BVI (Hedges and Conn 2012).
<i>Spondylurus magnacruzae</i> (Greater St. Croix skink)	The only available ecological information is of a specimen collected in 1987, which was taken in woodland dominated by <i>Cordia rickseckeri</i> , with 5-35% shrubby ground cover, loose soil, and no grass (Hedges and Meier 2013). Morphological comparisons with better-known mabuyine skinks from the region suggests that it is likely to have been essentially terrestrial (Hedges and Conn 2012; Hedges 2013f). It may have lived among and beneath cacti, rocks and logs, but lacks adaptations to a scansorial or burrowing lifestyle (Hedges and Conn 2012; Hedges 2013f). It occurs in St. Croix and Green Cay, USVI (Hedges and Conn 2012).
<i>Capitellum parvicruzae</i> (Lesser St. Croix skink)	No ecological information is available for this species, and as no <i>Capitellum</i> species has been recorded for over a century little can be inferred from comparisons with its closest relatives (Hedges and Conn 2012; Hedges 2013g). Morphological analysis suggests a terrestrial or subterranean lifestyle (Hedges and Conn 2012; Hedges 2013g). It occurs in St. Croix, USVI (Hedges and Conn 2012).

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Appendix 5. Characteristic of Amphibians

Scientific (Spanish/English) Name	Habitat- Range
<i>Eleutherodactylus antillensis</i> (Coquí churi/ Antillean Frog)	Mainland Puerto Rico, and the islands of Vieques, Culebra pastures and other open lowland terrains. It is also found in low vegetation in urban areas, and at the edge of forests.
<i>Eleutherodactylus brittoni</i> (Coquí de las yerbas/ Grass Coqui)	Puerto Rico-wide distribution found in exposed grasslands, tall grass prairies, in pastures along roads, particularly in areas exposed to the sun, forest edges at lower elevations, and young sugar cane fields.
<i>Eleutherodactylus cochranae</i> (Coquí pitito/ Whistling Frog)	Throughout Puerto Rico and appears to have a peripheral distribution. It is also present in Vieques, Culebra, and U.S. Virgin Islands. Found in banana plants, in low plants and bushes, on cacti, on grass, but also in the upper reaches of trees.
<i>Eleutherodactylus cooki</i> (Coquí guajón/ Rock Coqui)	Strictly associated with caves formed by large boulders of granite rock known as “guajonales” but it also occurs in streams containing rocks and surrounded by secondary forest.
<i>Eleutherodactylus juanariveroi</i> (Coquí llanero/ Plains Coqui)	Ferns, plants in the <i>Cyperus</i> genus, bull tongue arrowheads, creeper vines and graminous (grassy) plants are usually in abundance in the wetlands in which the plains coquí are found. Its distribution is limited and the only known population is adapted to survive in only one herbaceous freshwater wetland located in the former Sabana Seca Navy grounds, and in Toa Baja lands managed by the Puerto Rico Land Authority.
<i>Eleutherodactylus coqui</i> (Coquí común/ Common Coqui)	Widespread throughout Puerto Rico. Introduced into Vieques and Culebra islands, and also in St. Thomas, St. John, and St. Croix, U.S. Virgin Islands. The ground up to the canopy. It is, however, uncommon in southwest PR.
<i>Eleutherodactylus gryllus</i> (Coquí grillo/ Cricket Coqui)	Most common in forests such as Luquillo, Cayey, and Maricao. It is also found in banana plantations. It makes use of bromeliads and mosses on rocks.
<i>Eleutherodactylus hedricki</i> (Coquí de Hedrick/ Tree-Hole Frog)	Found in the interior uplands of Puerto Rico, Reserva Forestal de Toro Negro and vicinity, El Verde, the west flank of El Yunque, and the Bosque Experimental de Luquillo. Mostly associated with mesic broadleaf forest. Its habitat is limited to heavy forest, and it is not found on the forest edges. It is typically associated with trunk holes to which it retreats during the daytime.
<i>Eleutherodactylus locustus</i> (Coquí martillito/ Warty Coqui)	Observed in Puerto Rico’s southeastern mountains east of Cayey, east of Carite State Forest, El Yunque region and the western part of Panduras Mountain Range. It is found in upland mesic broadleaf forest, but also in dwarf forest above 700 m. It seems to prefer dense forest openings and forest borders such as the ones along roads and trails. It occurs in low bushes, grasses or ferns and mossy trunks.
<i>Eleutherodactylus portoricensis</i> (Coquí de la montaña/ Puerto Rican Coqui)	Inhabits Puerto Rican mountain forests (Maricao, El Yunque, Carite, Toro Negro), such as mesic upland broadleaf forests, and it can be found in shrubs, palms, herbaceous plants, bromeliads, tree holes, and under rocks, trunks, roots, and leafage.



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<i>Eleutherodactylus richmondi</i> (Coquí Caoba/ Ground Coqui)	This frog inhabits wet forest in interior Puerto Rico, and mesic wooded situations in general (Jaicoa Mountain Range, Guarionex Mountains and south to Quebrada de los Cedros creek, Maricao, Toro Negro, Cayey, and Sierra Pandura). Under rocks, logs, dried mud and trash where it retreats during the day.
<i>Eleutherodactylus wightmanae</i> / Coquí melodioso	Inhabits Puerto Rico's subtropical/tropical moist lowland forests and subtropical/tropical moist montane forests. It is prevalent in El Yunque National Forest and Los Tres Picachos Forest.
<i>Leptodactylus albilabris</i> (Ranita de labio blanco/ White-Lipped Frog)	This species is native to Puerto Rico and the USVI (IUCN et al. 2004). It is considered a terrestrial and semiaquatic species that is seldom observed far from streams, ditches.
<i>Peltophryne lemur</i> (Sapo concho/ Puerto Rican Crested Toad)	Is endemic presently in a single large population in the southwest coast of Puerto Rico and a few small populations on the north coast. Threats to this species include filling and drainage of its breeding sites and direct loss of adults and their habitat during land development.
Introduced amphibian species	
<i>Rana catesbeiana</i> (Rana mujidora, sapo toro, Cane toad)	
<i>Rana grylio</i> (Rana cerdo o rana grillo)	
<i>Osteopilus septentrionalis</i> (Rana platanera)	
<i>Hyla cinerea</i> (Hila verde)	
<i>Scinax rubra</i> (Hila inquieta)	
<i>Bufo marinus</i> (Sapo común/ Giant Toad)	The Giant Toad can be found in mainland Puerto Rico, Vieques and the USVI. It was introduced to control sugar cane pests in the 1920's



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Appendix 6: Bees that pollinate crops in the Caribbean Area.

Crop	Pollinator Bee Species				
	<i>Ceratina guarnacciana</i>	<i>Exomalopsis spp.</i>	<i>Megachile lanata</i>	<i>Melissodes trifasciata</i>	<i>Xylocopa mordax</i>
Avocado <i>Aguacate</i>					x
Eggplant <i>Berenjena</i>		x			x
Pumpkin <i>Calabaza</i>			x	x	x
Pigeon pea <i>Gandul</i>			x		x
Lemon <i>Limon</i>					x
Watermelon <i>Melon</i>		x			x
Pepper <i>Pimiento</i>	x	x		x	
Tomato <i>Tomate</i>					x



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Appendix 7: Vegetation for wildflowers.

Plant Name	Pollinator Bee Species			
	<i>Exomalopsis spp</i>	<i>Megachile</i>	<i>Melissodes trifasciata</i>	<i>Xylocopa mordax</i>
<i>Amaranthus dubius</i>	x			
<i>Asystasia gangetica</i>	x			
<i>Centrosema virginianum</i>				x
<i>Chamaesyce prostrata</i>	x			
<i>Cleome gynandra</i>	x			
<i>Cleome viscosa</i>	x			
<i>Euphorbia heterophylla</i>	x			
Girasol (<i>Helianthus annuus</i>)				x
Jantar (<i>Sesbania aegyptica</i>)		x		
<i>Kallstroemia maxima</i>	x			
<i>Lantana</i> spp.				x
<i>Ludwigia octovalvis</i>	x			
<i>Macroptilium lathyroides</i>			x	x
<i>Malvastrum coromandelianum</i>	x			
<i>Melochia pyramidata</i>	x		x	
<i>Merremia quinquefolia</i>	x			
Otras plantas en la familia de gandules (<i>leguminosas</i>)		x		
<i>Prosopis</i>		x		



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Appendix 8. Characteristics of Bats

Scientific (Spanish/English) Name	Feed	Specie roost
<i>Noctilio leporinus</i> (Murciélago Pescador/ Fisherman or Bulldog bat)	Fish- fresh/salt waterbodies.	Caves and trees like <i>Ceiba petandra</i> (Ceiba), <i>Rhizophora mangle</i> (Mangle Rojo) and <i>Manilkara bidentata</i> (asubo).
<i>Pteronotus parnellii</i> (Murciélago Bigotudo Mayor/ Parnell's mustached bat)	Insects	Caves (high temperature and humidity).
<i>Pteronotus quadridens</i> (Murciélago Bigotudo Menor/ Sooty mustached bat)	Insects,	Caves
<i>Mormoops blainvillii</i> (Murciélago Barbicacho/ Blainville's leaf-chinned bat)	Insects	Caves
<i>Monophyllus redmani</i> / (Murciélago Lengüilargo/ Greater Antillean Long- tongued bat)	Nectar, insects, fruit	Caves
<i>Erophylla sezekorni</i> (Murciélago de las Flores/ Brown flower bat)	Fruit	Caves
<i>Artibeus jamaicensis</i> (Murciélago Frutero Común/ Fruit bat)	Fruit	During the day it occurs primarily in cool caves but can be found frequently in the foliage or hollow trunks.
<i>Stenoderma rufum</i> (Murciélago Hocico de Cerdo/ Cave bat),	Fruit	It shelters in trees during the day, it is the only endemic bat of Puerto Rico
<i>Brachyphylla cavernarum</i> (Murciélago Hocico de Cerdo/ Cave bat)	Fruits	It's found in dense foliage or in caves.
<i>Eptesicus fuscus</i> (Murciélago Ali-oscuro/ Big Brown bat)	Insects	Caves and buildings
<i>Lasirus borealis</i> (Murciélago Rabi-Peludo/ Red bat)	Insects	Foliage of trees
<i>Tadarida brasiliensis</i> (Murciélago Viejo/ Mexican free-tailed bat)	Insects	Well ventilated caves
<i>Molossus molossus</i> (Murciélago de Techos/ Velvety free-tailed bat)	Insects	Ceilings of wooden houses

Source: <http://facultad.bayamon.inter.edu/arodriguez/murcielagos/murcielagos.htm>



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