Integration and Synthesis Summary: Caribbean Island species (Insects)

Scientific Name:	Common Name:	Entity ID:
Atlantea tulita	Puerto Rico harlequin butterfly	10007

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)
Status: Candidate
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few)
Species Trends: Unknown
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Puerto Rican harlequin butterfly occurs within the subtropical moist forest life zone on limestone-derived soil in the northern karst region and in the subtropical wet forest on serpentine derived soil in the Maricao Commonwealth Forest (Ewel and Whitmore 1973, pp. 25 and 32). The subtropical moist forest life zone on limestone derived soil covers about 1.15 percent (10,338 ha (25,545.75 ac)) of the total area of Puerto Rico (USDA 2008, p. 21), however, the subtropical wet forest on serpentine-derived soil cover about 0.04 percent (358 ha (884.63 ac)) of the total area of Puerto Rico (USDA 2008, p. 20).

The species has been observed on forested areas in the coastal cliffs in Quebradillas and on sclerophullous forest (type of vegetation characterized by hard, leathery, evergreen foliage that is specially adapted to prevent moisture loss) in the Maricao Commonwealth Forest. The Puerto Rican harlequin butterfly has only been observed utilizing the *Oplonia spinosa* (prickly bush) as its host plant (plant used for laying the eggs and serves as a food source for the development of the larvae). *Oplonia spinosa* is a common tropical coastal shrub that is widely distributed in Puerto Rico.

The historic range of the Puerto Rican harlequin butterfly includes the northern and southern karst, and the central western volcanic, regions of Puerto Rico. Within these three regions, the species has been historically reported from five municipalities: (1) Quebradillas and Arecibo in the northern karst region; (2) Maricao and Sabana Grande in the central-western volcanic region; and (3) Peñuelas in the southern karst region, it was reported from the municipality of Peñuelas (Carrión-Cabrera 2003, p. 32). Currently, the Puerto Rican harlequin butterfly has been reported from the northern karst region, and the central-western volcanic-serpentine region (Pérez-Asso et al. 2009). On the northern karst region, the species is known to occur in an approximately 144 ha (356 ac) strip of forested habitat located on the northern coastal cliff that extends along the municipalities of Isabela, Quebradillas, and Camuy (Biaggi- Caballero 2009). Here, the species' habitat is limited on the east by quebrada Bellacas (creek), on the west by the Royal Isabela Gulf Court, on the north by the Atlantic Ocean, and on to the south by PR-2 and some deforested areas utilized for agricultural practices such as cattle grazing.

Within this area, the Puerto Rican harlequin butterfly occurs in:

• 10 scattered patches in the Terranova and San José wards in the municipality of Quebradillas, occupying an area of 1.05 ha (2.6 ac) (Monzón- Carmona 2007);

• One patch occupying an area of approximately 0.26 ha (0.65 ac) on the forested cliff on western side of the mouth of the Guajataca River mouth in Coto ward, Isabela (Monzón-Carmona 2007);

• One patch (no acreage reported) on the forested cliff along El Pastillo beach at Cotoward in the municipality of Isabela (H. Torres, University of Puerto Rico Mayagüez (UPRM), 2012, pers. comm.); and

• One small patch (no acreage reported) at Puerto Hermina in the municipality of Camuy (BiaggiCaballero, pers. comm., 2010).

Habitat modification and fragmentation have been identified as the main threat to the Puerto Rican harlequin butterfly (Carrión-Cabrera 2003; Monzón- Carmona 2007; Biaggi-Caballero 2009; Pérez-Asso et al. 2009; DNER, 2010, unpublished data). The consequences of the loss and fragmentation of natural habitat for the species is detrimental because: (a) it seems to have low dispersal capabilities, (b) has limited distribution, (c) has highly specialized ecological requirements, and (d) is considered a specialist species because of the larvae's monophagous habit of feeding only on the plant *Oplonia spinosa* (Carrión-Cabrera 2003). Currently, the Puerto Rican harlequin butterfly is threatened by large-scale residential and touristic projects, which are planned within and around its habitat in northern Puerto Rico. Based on a review of the best available information, we have determined that the Puerto Rican harlequin butterfly may also be threatened by: limited distribution; low reproductive capacity, and ecological requirements; human induced fire; use of herbicides and pesticides; vegetation management; and climate change.

The Puerto Rico harlequin butterfly *Atlantea tulita* is a candidate species for which listing is warranted but precluded. As such, this consultation includes a conference opinion for this species. This species remains vulnerable to threats due to its isolated and fragmented distribution and very low numbers of individuals.

Critical habitat has not been designated for this species.

EB/CE Source:

U.S. Fish and Wildlife Service Species (USFWS). Assessment and Listing Priority Form for the Puerto Rican harlequin butterfly *Atlantea tulita*. Prepared by USFWS Region 4. 04/16/2015.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labelled uses across the range)

Risk to individuals if exposed: Puerto Rican harlequin butterflies exposed to malathion on use sites or from spray drift are expected to die.

Risk to the species from labelled uses across the range: The table below summarizes the risk to the species from labelled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality	No effects expected
Spray drift areas – mortality	Potential for mortality depending on proximity to use sites
Volatilization	Potential for exposure via this route higher elevation population
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	N/A
Spray drift areas - Prey item mortality	N/A
Plants affected (decline in growth)	No effects expected
MOSQUITO CONTROL	
Direct (mortality)	Potential for mortality if exposed
Indirect	No effects expected

Risk modifiers: The Puerto Rico harlequin butterfly occurs in two populations: the subtropical-moist-forest life zone in the northern karst region, municipalities of Isabella, Quebradillas (estimated population size = 50 individuals) and Camuy, and the subtropical-wet-forest life zone, Maricao Commonwealth Forest, municipality of Maricao and Sabana Grande (estimated population size = 20 individuals) of Puerto Rico. Quebradillas municipality is low in elevation; while the Maricao municipality attains an elevation of 1,388 feet and is thus less likely to overlap with lowland uses of this pesticide. This species is only known to use prickly bush *Oplonia spinosa* as its host plan for laying eggs and as a food source for larvae. The Service has a cooperative agreement with a local non-governmental organization, Iniciativa Herpetologica to promote the enhancement and conservation of suitable habitat for this species on private lands in the northern karst region.

Inhabiting the northern karst and west-central volcanic-serpentine regions of Puerto Rico, the Puerto Rican harlequin butterfly is found in four different life zones or ecological settings: subtropical moist forest on limestone-derived soil; subtropical wet forest on limestone-derived soil; subtropical wet forest on serpentine-derived soil; and subtropical moist forest on serpentine-derived soil. Within these four life zones, the butterfly inhabits four forest types: mature secondary moist limestone evergreen and semi-deciduous forest; young secondary moist limestone evergreen and semi-deciduous forest; mature secondary moist and dry serpentine semi-deciduous forest; and young secondary moist serpentine semi-deciduous forest. The species has been observed on a forest associated with coastal cliffs in Quebradillas and on sclerophullous forest (type of vegetation characterized by hard, leathery, evergreen foliage that is specially adapted to prevent moisture loss) in the Maricao Commonwealth Forest. (Biaggi-Caballero 2010).

Based its preference for forested habitats, we do not expect harlequin butterflies to be exposed to malathion on use sites. Some individuals are anticipated to be exposed to spray drift if malathion use sites were adjacent to their habitat, particularly for the population in the lower-elevation Quebradillas municipality. However, we expect spray drift to be minimized by forest vegetation, limiting exposure in interior habitats.

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE
(Anticipated usage within the range based on past usage data)

Information regarding past usage of malathion in Caribbean Islands is not available, however prior survey data has indicated that 11.2% of agricultural crops were treated with insecticides. Based on information collected for CONUS species, we estimate that 5% of developed and open space developed would undergo some level of treatment with malathion. Due to the high degree of uncertainty associated with this data, discussed in the General Effects to Listed Species in Caribbean Islands section above, we consider this quantitative usage data broadly. Instead, we assess exposure from malathion usage qualitatively by considering the likelihood that species will occur in the areas where insecticide usage will take place, as described individually for each species or group of species.

At present, information indicates that malathion would not likely be not used as a mosquito control agent in Puerto Rico due to concerns about insecticide resistance; future use cannot be ruled out but is not expected to increase significantly.

Overall Usage: ☐ High ☐ Medium ☒ Low

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the Puerto Rican harlequin butterfly. As discussed below, even though the vulnerability is high for this species, we anticipate use and the likelihood of exposure to malathion is low. We do not anticipate species-level effects to occur during the duration of the Action.

The Puerto Rican harlequin butterfly has a high vulnerability ranking due to its limited distribution, extremely small population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., habitat modification and fragmentation, human induced fire, use of herbicides and pesticides, vegetation management, and climate change). We anticipate risk from pesticides as described in the General Effects section but expect the risk to this species is low from exposure to malathion given its forested habitat preference. Similarly, the species has a low usage ranking because of its habitat preference and the low likelihood of its exposure to malathion within its habitat; furthermore, we expect spray drift in adjacent areas will also be minimized due to the forest vegetation, which will greatly limit exposure in interior habitats where the species is found. Thus, we anticipate that, at most, only very small numbers of individuals would be exposed and experience mortality over the duration of the Action,, and we

do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Puerto Rico harlequin butterfly.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's Biological Opinion that the registration of malathion is not likely to jeopardize the continued existence of the Puerto Rico harlequin butterfly.

Conclusion: Is not likely to jeopardize

Integration and Synthesis Summary: Caribbean Island species (Puerto Rican Forest Birds)

Scientific Name:	Common Name:	Entity ID:
Amazona vittata	Puerto Rican parrot	80
Columba inornata wetmorei	Puerto Rican plain pigeon	101
Setophaga angelae	Elfin-woods warbler	4237

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Primary threats to forest birds in Puerto Rico are habitat loss and degradation due to agriculture, urbanization, cattle grazing, and predation. Small populations and the associated threats from inbreeding depression, as well as demographic and environmental stochastic events (hurricanes) are also problems for many species. Populations of these species are very small, and neither exists in more than three populations.

Puerto Rican parrot

Our analysis of the Puerto Rican parrot is qualitative as the species is not anticipated to be exposed to malathion or experience more than discountable effects from exposure.

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Small number of individuals in one or more populations; Unknown sensitivity to stochastic events
Number of Populations: Unknown number of populations
Species Trends: Unknown
Pesticides noted ☐

The Puerto Rican parrot is an endemic known from the El Yunque National Forest (EYNF) in the Luquillo Mountains in the northeast interior of Puerto Rico. The species is vulnerable due to its endangered status, limited distribution, small population size, potential susceptibility to stochastic events (e.g., weather extremes), and historically, anthropogenic threats to the species (e.g., degradation, fragmentation, and loss of suitable habitat from deforestation). The species is a habitat specialist requiring large diameter trees in native, mature forest stands. It presently is only known from protected/conserved lands within the EYNF. Thus, the species is not anticipated to be exposed to use sites. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Puerto Rican parrot.

Puerto Rican plain pigeon

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few); Declining population(s) – one or more populations declining
Species Trends: Declining
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Plain pigeons are habitat generalists that behave as an edge species, nesting, foraging, and roosting in trees at or near roads (Rivera-Milán et al. 2003a, p. 49). It also may be found in areas of continuous secondary growth forest (e.g., gallery forests) or flying through farmlands and urban areas when traveling to feeding or roosting sites (Ruiz-Lebrón et al. 1995, p. 6; Rivera-Milán et al. 2003a, p. 48-49). Plain pigeons also frequent dairy farms and croplands where they supplement their diet with grass seeds and grains leftover from farming activities (Pérez-Rivera and Collazo-Algarín 1976a, p. 54). For breeding and roosting, the species seems to prefer areas of secondary mature forest, usually in close proximity to creeks or rivers. In fact, sites selected for nesting are always characterized by the presence of dense vegetation and proximity to water (Pérez-Rivera 1978, p. 90). These vegetation associations are common in the lower montane regions of Puerto Rico.

The massive deforestation in Puerto Rico during the early part of the twentieth century probably caused the decline of the plain pigeon. Extensive clearing of forests began early in the nineteenth century (Capó 1925, p. 48), and by 1828 about one-third of the island was cleared for agriculture (USFWS 1982). However, second-growth forests recovered as agriculture and pastureland were abandoned (Rivera-Milán et al. 2003b, p. 471). Indeed, forest recovery exceeded development between 1977 and 1989, but the contrary occurred between 1989 and 1995 (Ramos-González 2001, p. 103). Habitat destruction in the form of road construction, recreational activities, and land clearing, associated with agricultural, residential, and tourism development, has been identified as the primary factor threatening the Puerto Rican plain pigeon (Pérez-Rivera 1990, p. 24; Rivera-Milán 1996, p. 100 and 105; Rivera-Milán et al. 2003b, p 467 and 477; Pérez-Rivera and RuizLebrón, unpubl. data).

The Puerto Rican plain pigeon density and population size fluctuated between 0.051 individuals/hectare (ind/ha) (5,578 individuals) in 2011, and 0.039 ind/ha (4,257 individuals) in 2017. A survey conducted during April-June 2018, after Hurricane María, showed that the Puerto Rican plain pigeon density and population size declined to 0.006 ind/ha and 660 individuals, respectively. This decline represents more than 85 percent reduction of the species in the east-central region of Puerto Rico (Rivera-Milán, Service, 2018b, pers. comm.). According to Rivera-Milán (USFWS, 2018b, pers. comm.), this is the lowest abundance estimate since monitoring of the species began in 1986. The east-central region was surveyed again in August 2018, and according to this data and that of April-June 2018, little reproduction occurred after the hurricane, and, therefore, the population probably continued declining (Rivera-Milán, USFWS, 2018b, pers. comm.).

Elfin-woods warbler

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few); Declining population(s) – one or more populations declining
Species Trends: Unknown
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Maricao Commonwealth Forest: Cruz and Delannoy (1984a, p. 92) reported the highest densities in the Maricao Commonwealth Forest at Los Viveros (20.9 individuals/ha [51.6/61.7 ac]), and significantly lower densities at Rosario Alto (3.0/25 ha [7.4/61.7 ac]) and Campamento Santana (1.2/25 ha [2.9/61.7 ac]). Waide (1995, p. 9) found the highest densities of elfin woods warbler in Puerto Rico in the Maricao Commonwealth Forest (20.9 individuals/ha). Anadón-Irizarry (2006, p. 27) surveyed 102.4 ha (253 ac) of habitat in the Maricao Commonwealth Forest and recorded 778 elfin-woods warblers in 18 counts for an average of 0.42 warblers/ha/count (1 warbler/acre/count). Podocarpus forest had the highest density, and the dry slopes the lowest. Delannoy (2007, p. 13) did not estimate the overall number of individuals in the Maricao Commonwealth Forest and adjacent properties but provided an average elfin-woods warbler abundance per point-count station. Of the 127 point count stations located within the Maricao Commonwealth Forest, 106 (83.5%) yielded positive results for presence of elfin woods warbler. Of the 234 point count stations located in lands adjacent to the Maricao Commonwealth Forest, only 58 (24.8%) yielded positive results for elfin-woods warbler presence. Gonzalez (2008, p. 16-18) determined the abundance of elfin-woods warblers in habitats of the Maricao Commonwealth Forest and adjacent areas. As with previous studies, species abundance was highest in Podocarpus forest (1.41 individuals per point count station), and lowest in dry adjacent forest (0.01 individuals per point count station). Within the Maricao Forest, Gonzalez (2008, p. 18) estimated 97.67 elfin-woods warblers in a 203.2 ha/count (502 acres/count) sampling area; whereas in areas adjacent to the Maricao Commonwealth Forest, he estimated 43.02 elfin-woods warblers in a 374.4 ha/count (925 acres/count) sampling area. Based on the above studies, the Maricao Commonwealth Forest sustains the highest number of elfin woods warblers per hectare (acre). Delannoy (2007, p. 24) stated that the Maricao Commonwealth Forest population is currently thriving, and there is no indication that these populations are declining in numbers.

Within the Maricao Commonwealth Forest there are strong and continuous pressures to cut and replace Podocarpus forest for the development of infrastructure for the communications industry and for the expansion of recreational facilities and trails within the forest (Delannoy 2007, p. 21). The Maricao Commonwealth Forest has several private and government inholdings with communication towers and recreational facilities. Around 2004, about 4 ha (9.9 ac) of Podocarpus forest habitat, the equivalent of about four to five elfin-woods warbler territories, were cleared to create a picnic area; and in 2009, about 12 ha (29.6 ac) of Podocarpus forest were cleared to expand a camping ground, possibly eliminating 10 to 12 elfin-woods warbler territories (C. Delannoy, UPRM, pers comm. 2009). Waide (1995, p.17) suggested that areas of high pedestrian use have fewer birds. Therefore, the expansion of trail or road systems in either forest, or the increased use of those presently existing, pose a threat to the species. Elfin-woods warbler is also known to use lower elevation forested areas such as shade coffee plantations adjacent to the Maricao Commonwealth Forest. These areas have been identified as potential suitable habitat for the species. However, the conversion of shade coffee plantations into sun coffee has resulted in the elimination of the over story, decreasing the value of this habitat for wildlife, including the elfin-woods warbler.

Despite regulatory mechanisms to protect the warbler, habitat modification still exists within the Maricao Commonwealth Forest, and adjacent private lands adjacent to both the Maricao Commonwealth Forest and El Yunque National Forest. Furthermore, shade coffee plantation

may be converted into sun coffee without overview of natural resources agencies. Agricultural practices are exempt from compliance with DNER regulations. Therefore, we consider that inadequacy of existing regulatory mechanisms to be a threat to the elfin-woods warbler, as enforcement remains a challenge and existing regulatory mechanisms do not apply to agriculture lands.

Catastrophic events such as hurricanes affect the abundance and distribution of the elfin-woods warbler. Arroyo-Vazquez (1991, p. 55) surveyed the Toro Negro and Carite Commonwealth forests after Hurricane Hugo in 1989 and did not detect the species. Tossas (2006, p. 84) found that the elfin woods warbler in Maricao Commonwealth Forest was one of three bird species that, after Hurricane Georges in 1998, decline in capture rates to zero. Nevertheless, the species recovered within a year to pre-hurricane population levels; suggesting that the warblers abandoned defoliated sites immediately after the hurricane and shifted to protected patches with adequate foraging substrate and prey until the defoliated sites recovered. It is possible that small populations of elfin-woods warbler may experience local extinction with these catastrophic events. More surveys are necessary to assess the impact of these events on habitat-use patterns of the species. There are no studies on the effects of hurricanes on the species habitat either. However, hurricanes have affected the composition of elfin-woods warbler habitat, and thus, degrade the habitat quality, particularly for the species in at El Yunque National Forest (Arendt et al., 2013, p.9). Thus, we believe that hurricanes are a current threat to the elfin-woods warbler.

At the present time, the species is only known from two disjunctive areas of Puerto Rico. The El Yunque National Forest population represents approximately 38% of the total population and it has recently undergone a significant decline (Arendt et al., 2013, p.1); if this trend continues it could result in local extirpation, limiting the species just to the Maricao Commonwealth Forest. Thus, the effects of other natural and manmade factors could be exacerbated (as there would only be one population to sustain the effects).

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 2017. 5-Year Review: Summary and Evaluation for the Puerto Rican Parrot (*Amazona vittata*). Southeast Region, Ecological Services, Rio Grande, Puerto Rico. 75 pp.

U.S. Fish and Wildlife Service. 2009 (USFWS). Recovery Plan for the Puerto Rican Parrot (*Amazona vittata*). Atlanta, Georgia. 31 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. Puerto Rican plain pigeon or Paloma sabanera (*Patagioenas inornata wetmorei*) 5-Year Review. Atlanta, Georgia. 25 pp.

U.S. Fish and Wildlife Service (USFWS). 2019. 5-Year Review of Puerto Rican plain pigeon or Paloma sabanera (*Columba* (*Patagioenas*) *inornata wetmorei*), Addendum 1. Summary of new information obtained since the 2011 Five Year Review. USFWS, Southeast Region, Caribbean Ecological Services, Boqueron, Puerto Rico. pp. 23-36.

U.S. Fish and Wildlife Service (USFWS). 2013. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for *Dendroica angelae* (Elfin-woods Warbler); 2013; Southeast Region; 13 p.

Overall Vulnerability:	☒ **High**	☐ **Medium**	☐ **Low**	Puerto Rican parrot
Overall Vulnerability:	☒ **High**	☐ **Medium**	☐ **Low**	Puerto Rican plain pigeon
Overall Vulnerability:	☒ **High**	☐ **Medium**	☐ **Low**	Elfin-woods warbler

RISK
(Risk is based on species exposure and response from labelled uses across the range)

Risk to individuals if exposed:

Effects to Puerto Rican parrot:

The species is not anticipated to be exposed to malathion on use sites, from spray drift, or from mosquito control or experience more than discountable effects from exposure.

Effects to Elfin-woods warbler and Puerto Rican plain pigeon from use sites:

Both species are anticipated to experience some degree of mortality and/or sub-lethal effects from exposure to malathion on use sites. No effects are expected from exposure via spray drift.

- The Elfin-woods warbler, a small-bodied insectivore, is expected to experience mortality on all use sites from consumption of contaminated insects or from exposure via direct spray or contact with contaminated media.

- The plain pigeon, a larger passerine that relies on leaves and fruits, is expected to experience up to 20% mortality on use sites with higher application rates.

Effects to Elfin-woods warbler and Puerto Rican plain pigeon from mosquito control:

- Elfin-woods warblers have a low chance of mortality (<10%) from foraging on insects exposed to malathion from mosquito control

- The plain pigeon is not expected to experience effects related to malathion use for mosquito control.

Risk to the species from labelled uses across the range:

The table below summarizes the risk to the species from labelled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality and sub-lethal effects	A small proportion of plain pigeons are anticipated to experience mortality or sub-lethal effects from foraging on or near malathion use sites.

	No effects are expected to Elfin-woods warblers or Puerto Rican parrots, as they are not expected to enter use sites.
Spray drift areas – mortality	No effects expected
Volatilization	Potential for higher elevation populations
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	No effects expected to terrestrial invertebrates (Elfin-woods warbler)
Spray drift areas - Prey item mortality	Potential for terrestrial invertebrates (Elfin-wood warbler)
Plants affected (decline in growth)	Potential reduction in growth on use sites (Plain pigeon)
MOSQUITO CONTROL	
Direct (mortality and sub-lethal)	No effects expected for the plain pigeon or Puerto Rican parrot, low chance of mortality for the Elfin-woods warbler
Indirect	Potential effects to terrestrial invertebrates

Risk modifiers: These species are predominately restricted to mid- to upper-elevation forests on their respective habitats. The plain pigeon can be found associated with urban, rural and agricultural areas in the mountain regions of Puerto Rico and may also be found within valleys lower in elevation, and much closer to developed areas than the warbler. The warbler is insectivorous and the plain pigeon forages on a wide variety of seeds and fruits from canopy trees.

Plain pigeons are habitat generalists that behave as an edge species, nesting, foraging, and roosting in trees at or near roads (Rivera-Milán et al. 2003a, p. 49). It also may be found in areas of continuous secondary growth forest (e.g., gallery forests) or flying through farmlands and urban areas when traveling to feeding or roosting sites (Ruiz-Lebrón et al. 1995, p. 6; Rivera-Milán et al. 2003a, p. 48-49). Other habitat types used include lowland swamp, lowland woodland, open woodland, cultivated land in mountains, limestone karst forest, and coffee plantations. Malathion is not registered for use on coffee.

Based on its habitat preferences, we anticipate the plain pigeon will be exposed to malathion on use sites when traveling to foraging or roosting sites. However, its tendency to forage high in the canopy is anticipated to reduce its exposure directly on use sites. In addition, we expect most of its foraging to occur in forested areas or in edge habitats adjacent to use sites. In this manner, the pigeon and its prey species are anticipated to be exposed to spray drift.

The Elfin-woods warbler is found in high elevation Elfin Woodland forests (640 to 1,030 m) (2,099 to 3,378 ft) and Palo Colorado forests in El Yunque National Forest. The elfin-woods warbler was also reported from the Maricao Commonwealth Forest, located in the Cordillera Central, western Puerto Rico. This forest is comprised by a mixture of mature native trees and abandoned shade coffee and woodland plantations. In the Maricao Commonwealth Forest, the species is found in a variety of habitats, including disturbed sites, in elevations ranging from 650

to 900 m (2,132 to 2,952 ft) (Cruz and Delannoy 1984a, p. 90). Migrates to north-facing valleys during the months of heaviest rainfall.

Based its preference for forested habitats, we do not expect Elfin-woods warblers to be exposed to malathion on use sites. Some individuals or prey resources are anticipated to be exposed to spray drift if malathion use sites were adjacent to their habitat. However, we expect spray drift to be minimized by forest vegetation, limiting exposure in interior habitats.

The Puerto Rican parrot is an endemic known from the El Yunque National Forest (EYNF) in the Luquillo Mountains in the northeast interior of Puerto Rico. It presently is only known from protected/conserved lands within the EYNF. Thus, the species is not anticipated to be exposed to malathion on use sites, from spray drift, or from mosquito control.

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**	Puerto Rican parrot
Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low**	Puerto Rican plain pigeon
Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**	Elfin-woods warbler

USAGE
(Anticipated usage within the range based on past usage data)

Information regarding past usage of malathion in Puerto Rico is not available, however prior survey data has indicated that 11.2% of agricultural crops were treated with insecticides. Based on information collected for CONUS species, we estimate that 5% of developed and open space developed would undergo some level of treatment with malathion. Due to the high degree of uncertainty associated with this data, as discussed in the General Effects to Listed Species in Caribbean Islands section above, we consider this quantitative usage data broadly. We assess exposure from malathion usage qualitatively by considering the likelihood that species will occur in the areas where insecticide usage will take place, as described individually for each species or group of species.

At present, information indicates that malathion would not likely be used as a mosquito control agent in Puerto Rico due to concerns about insecticide resistance; future use cannot be ruled out but is not expected to increase significantly.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**	Puerto Rican parrot
Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**	Puerto Rican plain pigeon
Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**	Elfin-woods warbler

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap

with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations as initial residues degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

Puerto Rican parrot

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican parrot. While the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is very low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat.

Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Given the species status, distribution, and preference not only for forest, but old growth forest, we anticipate that, at most, only a small number of individuals may experience mortality, effects to growth or reproduction from direct exposure, or from small reductions in prey over the duration of the Action and we do not expect species-level effects to occur.

Therefore, after reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action it is Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the Puerto Rican parrot.

Puerto Rican plain pigeon

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican plain pigeon. As discussed below, even though the vulnerability is high for this species and the risk ranking is medium, we anticipate the likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Puerto Rican plain pigeon has a high vulnerability ranking due to its endangered status, limited distribution, small population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation, and loss of suitable habitat from agricultural uses and increasingly urbanization). The species has a medium risk ranking due to potential uses across the range, including mortality or sub-lethal effects from foraging on or near malathion use sites. The species is known to forage in agricultural fields, but effects from such are anticipated to be limited (as best we understand usage) or mitigated by the timing of their use (i.e., foraging for seeds in post-harvest agricultural fields when residual pesticide contamination would be minimized). While this species has suffered significant losses recently and population numbers are currently as low as they have been in decades of monitoring, the driver for these losses appears to be stochastic events (e.g., hurricanes) as the significant declines documented came after Hurricanes Irma and Maria impacted Puerto Rico in 2017. Prior to 2018's survey, population numbers included annual fluctuations (seemingly associated with environmental conditions and availability of suitable foraging resources) but were generally stable. Thus, it appears that the susceptibility to stochastic events are driving the species trend and not attributable to the present action. While the vulnerability is high, the risk is medium for this species, especially when traveling to foraging or roosting sites. However, its tendency to forage high in the canopy is anticipated to reduce its exposure directly on use sites, although we expect that foraging in edge habitats adjacent to use sites would expose individuals to malathion via drift. However, we anticipate the likelihood of exposure to malathion is low based on the low usage expected for this species.

Implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. For example, residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Thus, while we anticipate that small

numbers of individuals plain pigeons will experience mortality from exposure to contaminated prey on use sites, and sublethal effects to growth from exposure from foraging on or near use sites over the duration of the Action, we do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Puerto Rican plain pigeon.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action it is Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the Puerto Rican plain pigeon.

Elfin-woods warbler

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the elfin-woods warbler. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion are low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The elfin woods warbler has a high vulnerability ranking due to its endangered status, limited distribution, small population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation, and loss of suitable habitat from agricultural conversions and telecommunications infrastructure and recreational uses). The species has a low risk ranking due to potential uses across the range, including potential mortality or prey item mortality, if exposed. The species is not anticipated to be exposed to use sites however. While this species is insectivorous, the mid to upper elevation forests comprising preferred habitat generally precludes exposure at more than minimal levels. While we anticipate that small numbers of individuals will experience mortality from exposure through ingestion of contaminated prey on use sites, and from exposure ingestion of contaminated prey from mosquito adulticide use over the duration of the Action, we do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the elfin woods warbler.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action it is Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the elfin-woods warbler.

Conclusion: Is not likely to jeopardize	Puerto Rican parrot
Conclusion: Is not likely to jeopardize	Puerto Rican plain pigeon
Conclusion: Is not likely to jeopardize	Elfin-woods warbler

Integration and Synthesis Summary: Caribbean Island species (Non-forest bird species)

Scientific Name:	Common Name:	Entity ID:
Agelaius xanthomus	Yellow-shouldered blackbird	117
Caprimulgus noctitherus	Puerto Rican nightjar	111

The Caribbean Islands contain two other non-forest species of listed birds which may be impacted by pesticides, both of which are found in Puerto Rico: the yellow-shouldered blackbird (*Agelaius xanthomus*), and the Puerto Rican nightjar (*Caprimulgus noctitherus*). We believe we can analyze them together due to the small size of these island and overlapping ranges for these species, creating similar threat and exposure risks.

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

The yellow-shouldered blackbird (*Agelaius xanthomus*) and the Puerto Rican nightjar (*Caprimulgus noctitherus*) have been reduced to small populations in different habitats in Puerto Rico. In addition, pesticides and other contaminants are specifically mentioned as a threat to the blackbird (USFWS 2011). Threats to these species vary, but both are heavily threatened by reduction in range, loss of habitat through urbanization, nest parasitism with regards to the blackbird, or other factors.

Yellow-shouldered blackbird

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few); All populations at least stable, and one or more increasing populations
Species Trends: Stable
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Data gathered during a post-breeding census in August 2007 showed approximately 994 mariquitas in southwestern Puerto Rico (municipalities of Cabo Rojo and Lajas), an increase from 2004 (759 individuals). In Salinas (southeastern Puerto Rico), 113 individuals were observed during the post-breeding census of 2005, a slight increase from 2004 (97 individuals). The principal listing factor threatening the mariquita (nest parasitism by shiny cowbirds), is being managed or reduced. This information suggests that the status of the species is improving.

Mariquitas are omnivorous, but some scientists consider the species as arboreal insectivores since the majority of their diet consists of insects belonging to the orders Lepidoptera, Orthoptera, Homoptera, Coleoptera, Diptera, Dermaptera, and Hymenoptera. They also eat arachnids, unidentified mollusks, and plant matter including fruits, seeds, and nectar from various plant species. Aside from natural material, the species also consumes processed foods

such as cattle ration, human food (cooked rice and sugar), dog food, and monkey chow, among others.

The revised recovery plan identified invasion of nesting areas by Caribbean martins (*Progne dominicensis*) as one of the two most important threats to the mariquita. Caribbean martins were responsible for the loss of ten mariquita eggs in artificial nest structures, and 17 eggs of Caribbean martins were found in 18 mariquita nests (Falcón et al. 2002). The document also identified the destruction of mariquita feeding, roosting, and nesting habitat as the major threat to the species (USFWS 1996); stating that destruction of mariquita foraging and nesting habitat on the mainland for residential and tourist development, as well as agricultural activities continued in southwestern Puerto Rico. It further indicates that the use of La Parguera waters, cays, and shoreline is incompatible with the needs of the species for roosting and nesting in the area.

The revised recovery plan states that nest infestation by two species of blood-feeding mites (*Ornithonyssus bursa* and *Androlaelaps casalis*) may lead to nest abandonment by adult mariquitas and premature nest desertion by young birds (USFWS 1996). Lice (*Philopterus agelaii*, *Machaerilaemus* sp., and *Myrsidea* sp.) may also affect nesting mariquitas, particularly those in cavity (covered) nests and re-used nests from the previous breeding event (Cruz-Burgos et al. 1997).

Avian pox was identified in the revised recovery plan as a potential problem for the mariquita (USFWS 1996). Mariquitas infected with avian pox had significantly lower survival rate than uninfected birds (USFWS 1996). López-Ortiz et al. (2004) found two dead chicks in an artificial nest structure, and the preliminary necropsy report revealed avian pox as the cause of death.

Falcón et al. (1997) stated that the major causes of egg failure in artificial nest structures during 1996-1997 were disappearances (egg missing), abandonment (unpunctured eggs more than two weeks old and without parents in the vicinity), and failure to hatch. In 1999 to 2000, the major causes of egg failure were disappearance, followed by not hatched, abandoned, and punctured (Falcón et al. 2000); and similar results were observed in 2001-2002 (Falcón et al. 2002). The reasons for disappearance, abandonment, and failure to hatch are not known, but predation and presence of avian and mammalian predators around artificial nest structures was suspected; and has been suspected (Díaz and Lewis 2006) or observed on other occasions (DeLuca et al. 2010, unpub. data).

The revised recovery plan indicates that the black rat (*Rattus rattus*) is an important predator of mariquitas; being the major cause of egg and chick loss in certain breeding areas (USFWS 1996). Rats climb artificial nest structures and either prevent mariquitas from using nest structures, remove or eat the eggs and chicks, or cause adult nest abandonment (Cruz-Burgos et al. 1997). Although rat predation is controlled in artificial structures by using rat-excluding devices (metal guards on supporting poles) (USFWS 1996), natural nests continue to be threatened by rats. Cruz-Burgos et al. (1997) believe that predation is one of the most important factors affecting natural nests, and suspected that mariquitas shape their nests in part as a response to potential predation by pearly-eyed thrashers (*Margarops fuscatus*). Falcón et al. (2000) suggested that Rhesus monkeys may have been responsible for the highest percentage of egg loss found in 10 years. Monkey tracks were observed in different breeding areas where eggs were lost, where active nests were found on the ground, and where chicks disappeared. Besides the previously-

reported predators, López-Ortiz et al. (2002) indicated that other possible predators of eggs, fledgling, or adult mariquitas also seen near the artificial nest structures were smooth-billed ani (*Crotophaga ani*), mangrove cuckoo (*Coccyzus minor*), yellow-billed cuckoo (*C. americanus*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*N. violaceus*), osprey (*Pandion haliaetus*), and red-tailed hawk (*Buteo jamaicensis*).

Mariquitas may face competition for nest-sites with other bird species. Cruz-Burgos et al. (1997) mentioned that part of the reason for mariquitas to build nests covered by leaves in coconut palm forests is to avoid competition for nesting space from grackles (*Quiscalus niger*) and rock doves (*Columba livia*). Because mariquitas usually select the upper fronds of palms for nesting, Reitsma (1998) indicated that pruning of the lower fronds of coconut palm trees may remove grackles and doves that nest on the lower palm fronds.

Reitsma (1998) reported breeding failure of a mariquita nest at Villa La Mela, Cabo Rojo, due to pruning of coconut palm fronds. Mariquitas have been observed foraging in cultivated fields where insecticides are commonly applied to the crops. Therefore, some authors believe that mariquitas may be negatively affected by such insecticides (Lewis et al. 1999).

Puerto Rican nightjar

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Unknown number of populations
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

While no information exists to estimate population trends for the nightjar, information collected in Guánica and Susúa Commonwealth Forests over the years (Kepler and Kepler 1973, Wiley 1985, Vilella and Zwank 1993a, Gonzalez 2010) suggests the number of nightjars detected along survey routes has remained fairly constant. Vilella and Zwank (1993a) reported approximately 1,400–2,000 male nightjars were distributed across some 10,000 hectares in southwest Puerto Rico. Thus, assuming each singing nightjar may represent a potential breeding pair; nightjar estimates by Vilella and Zwank (1993a) represent 2,800 to 4,000 individuals across southwestern Puerto Rico. No information exists on genetic structure of the nightjar.

The recent rapid development (urbanization and industrialization) of most municipalities of southwestern Puerto Rico during the last decades is the most serious threat to the species' survival because it promotes fragmentation of remaining nightjar habitat and may result in declines and local extinctions of isolated nightjar populations (Thomas 1990).

Extensive clearing of forests in Puerto Rico began early in the nineteenth century, and by 1828 about one-third of the island had been cleared for agriculture (Wadsworth 1950). Deforestation peaked in the early 1930s when forest cover reached a low of approximately 81,000 ha, representing about 9% of the Island (Birdsey and Weaver 1987). By late 1940s, forest cover

reached a low of about 6%. However, forest recovery following cessation of intensive land-use has progressed in time and space (Lugo et al. 1996). By the 1980s, forest cover, including coffee shade, occupied about 280,000 hectares or about 31.5% of the island's land area (Birdsey and Weaver 1987), and about 32 to 42% of the island's area by 1990 (Gould et al. 2007). The economic shift away from agriculture resulted in agricultural lands reverting to forests, but urban expansion and land development have led to the loss of agricultural and forest land and their associated wildlife (Birdsey and Weaver 1987). The recent rapid development (urbanization and industrialization) of most municipalities of southwestern Puerto Rico during the last decades is the most serious threat to the species' survival, because it promotes fragmentation of remaining nightjar habitat and may result in declines and local extinctions of isolated nightjar populations (Thomas 1990).

Predation of breeding nightjars and their nests by exotic mammals has been documented (Vilella 1995). The mongoose was introduced into the West Indies during the 1870's with the intention of controlling rat populations (*Rattus* spp.) on sugar-cane plantations. Avian predators have been reported to take eggs from Puerto Rican nightjar nests (Vilella 1995). Ants can also overwhelm nightjar chicks while hatching. Two species of exotic primates established in southwestern Puerto Rico, the patas monkeys (*Erythrocebus patas*) and rhesus macaques (*Macaca mulatta*), may also represent a threat to the nightjar. These monkeys are considered omnivorous with diets consisting primarily of vegetative matter but will feed on small mammals and birds opportunistically (USDA 2008).

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 2011. Mariquita or yellow-shouldered blackbird (*Agelaius xanthomus*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office Boquerón, Puerto Rico.

U.S. Fish and Wildlife Service (USFWS). 2012. Puerto Rican Nightjar or guabairo (*Caprimulgus noctitherus*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office Boquerón, Puerto Rico.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low** Yellow-shouldered blackbird

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low** Puerto Rican nightjar

RISK
(Risk is based on species exposure and response from labelled uses across the range)

Risk to individuals if exposed:

Effects to the yellow-shouldered blackbird and the Puerto Rican nightjar from use sites:

- Individuals of both species have about a 30-90% chance of mortality and/or sub-lethal effects from foraging on insects exposed to malathion on use sites, and a smaller chance (~10%) from exposure to direct spray or contact with contaminated media.

- Effects from exposure via spray drift are not expected for either species.

Effects to other Puerto Rican birds from mosquito control:

- Neither the yellow-shouldered blackbird nor Puerto Rican nightjar are expected to experience mortality or sub-lethal effects as a result of mosquito control.

Risk to the species from labelled uses across the range:

The table below summarizes the risk to the species from labelled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality and sub-lethal effects	Based on the low potential for exposure, a low proportion of nightjars are anticipated to experience sub-lethal effects or mortality. Yellow-shouldered blackbirds are anticipated to experience moderate mortality or sub-lethal effects from foraging on use sites where malathion is used.
Spray drift areas – mortality	No effects expected
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Effects to terrestrial invertebrates
Spray drift areas - Prey item mortality	Effects to terrestrial invertebrates
Plants affected (decline in growth)	N/A
MOSQUITO CONTROL	
Direct (mortality and sub-lethal effects)	No effects expected
Indirect	Effects to terrestrial invertebrates

Risk modifiers:

Yellow-shouldered blackbird: The yellow-shouldered blackbird, although omnivorous, can be basically characterized as an arboreal insectivore. During the nesting season the yellow-shoulder's young's diet is about 90% arthropod material. At urban bird feeders and around domestic animals, this blackbird has been observed to take cattle feed, dog food, nectar, fruit, cooked rice, and granulated sugar.

Puerto Rican nightjar: The Puerto Rican nightjar inhabits coastal dry and lower cordillera forests of southwestern Puerto Rico. In a study conducted during 1985-1999, it was found in three main areas located in coastal dry and lower cordillera forests of southwestern Puerto Rico. These included; Guánica-Ensenada, Susúa-Maricao, and Guayanilla-Peñuelas. This study also reported the first nightjar records in the La Parguera Hills and Sierra Bermeja, located on the southwestern tip of Puerto Rico.

The Puerto Rican nightjar is nocturnal and insectivorous. It sleeps perched on tree branches during the day where but is unlikely to be exposed to direct pesticide spray while foraging at night. An aerial feeder, the nightjar feeds on nocturnal moths and other flying insects at night.

This behavior is anticipated to make it less susceptible insecticide exposure as it will forage from the ground on insects that have died from insecticide exposure.

Based on their preference for forested habitats, Puerto Rican nightjars are not expected to enter malathion use sites, and their nocturnal behavior limits their direct exposure to pesticides. However, some individuals of the species are anticipated to feed on insects that have been exposed on adjacent use sites or via spray drift that have not succumb to the pesticide.

Effects to the invertebrate prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications for both species. Because invertebrates exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk: ☐ **High** ☒ **Medium** ☐ **Low** Yellow-shouldered blackbird

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low** Puerto Rican nightjar

USAGE
(Anticipated usage within the range based on past usage data)

Information regarding past usage of malathion in Puerto Rico is not available, however prior survey data has indicated that 11.2% of agricultural crops were treated with insecticides. Based on information collected for CONUS species, we estimate that 5% of developed and open space developed would undergo some level of treatment with malathion. Due to the high degree of uncertainty associated with this data, discussed in the General Effects to Listed Species in Caribbean Islands section above, we consider this quantitative usage data broadly. We assess exposure from malathion usage qualitatively by considering the likelihood that species will occur in the areas where insecticide usage will take place, as described individually for each species or group of species.

At present, information indicates that malathion would not likely be used as a mosquito control agent in Puerto Rico due to concerns about insecticide resistance; future use cannot be ruled out but is not expected to increase significantly.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low** Yellow-shouldered blackbird

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low** Puerto Rican nightjar

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reduce the extent of

area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations as initial residues degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate this measure will reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

Yellow-shouldered blackbird

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the yellow-shouldered blackbird. As discussed below, even though the vulnerability is high and the risk ranking is medium for this species, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The yellow-shouldered blackbird has a high vulnerability ranking due to its endangered status, limited distribution, small population size, susceptibility to stochastic events, natural and invasive predators, brood parasitism, and anthropogenic threats to the species (e.g., continued degradation, fragmentation, and loss of suitable habitat from agricultural uses and increasingly urbanization). The species has a medium risk ranking due to potential uses across the range, including mortality or sub-lethal effects from foraging on or near malathion use sites. The species is known to forage mostly in preferred forest habitats (arboreal insectivore) but will range broadly and into urban areas for a wide variety of food items. Effects from such are anticipated to be limited (as best we understand usage), but the species is suspected of being affected by pesticide use. Thus, it appears that some effects from pesticides are reasonably certain to occur, but given the survey and distribution information we have characterizing the population as generally stable, malathion is not anticipated to represent a driving threat to the species at this time or in the period of the present action.

While the vulnerability is high and risk is medium for this species, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures

described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. While we anticipate that small numbers of individuals will experience mortality from exposure via foraging on or near use sites over the duration of the Action, we do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the yellow-shouldered blackbird.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action it is Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the yellow-shouldered blackbird.

Puerto Rican nightjar

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican nightjar. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Puerto Rican nightjar has a high vulnerability ranking due to its endangered status, limited distribution, unknown population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation, and loss of suitable habitat from agricultural uses and increasingly urbanization). The species has a low risk ranking due to potential uses across the range, including limited mortality or sub-lethal effects from feeding on affected arthropod prey. The species is known to forage primarily in preferred forest habitats, aerially, and at night, which all limit its potential exposure to effects of malathion use. Effects from such are anticipated to be limited (as best we understand usage). Thus, it appears that some effects from pesticides are reasonably certain to occur, but these effects are anticipated to be limited given the species life history, most notably its foraging habitat preferences. While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes

are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. While we anticipate that small numbers of individuals will be experience mortality via exposure from foraging on or near use sites over the duration of the Action, we do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Puerto Rican nightjar.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action it is Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the Puerto Rican nightjar (*Caprimulgu*s *noctitherus*).

Conclusion: Is not likely to jeopardize Yellow-shouldered blackbird

Conclusion: **Is not likely to jeopardize** Puerto Rican nightjar

Integration and Synthesis Summary: Caribbean Island species *(*Caribbean Island Hawks)

Scientific Name:	Common Name:	Entity ID:
Buteoplatypterus brunnescens	Puerto Rican broad-winged hawk	127
Accipiter striatus venator	Puerto Rican sharp-shinned hawk	128

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

The Caribbean Islands contain two species of raptors that are federally listed as endangered or threatened; both of which are found in Puerto Rico. This analysis examines these species for each malathion based on their occurrence and life history.

Key threats to the Puerto Rican hawks are habitat fragmentation, habitat destruction, natural disasters and nest predation (USFWS 1997). No critical habitat is designated for this species.

The population of both of these species is low and fragmented.

Puerto Rican broad-winged hawk

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few); Small number of individuals in one or more populations
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Río Abajo Commonwealth Forest supports close to 50% of the currently known population. The most recent study of the population within the Río Abajo Commonwealth Forest (Hengstenberg and Vilella 2004, p.101) indicates that this population continues to be stable since publication of the species' recovery plan in 1997. The Puerto Rican broad-winged hawk population is estimated at about 125 individuals island-wide. The USFWS does not have any information on the species abundance, population trends, demographic features or demographic trends for El Yunque and Carite forests. This species is susceptible to habitat disturbances due to limited distribution and low population numbers.

The Puerto Rican broad-winged hawk (*Buteo platypterus brunnescens*), is endemic to the island of Puerto Rico, and currently restricted to montane forests along the Cordillera Central, Sierra de Cayey, and Sierra de Luquillo. This species is currently threatened by destruction and modification of forested habitat; timber harvest and management practices in public forests; road construction; the increase in numbers of recreational facilities, and the disturbance associated with public use; mortality and habitat destruction from hurricanes.

At the present time, the Puerto Rican broad-winged hawk is an uncommon and extremely local resident. Extant populations are restricted to montane habitats of three forests: Rio Abajo

Commonwealth Forest, Carite Commonwealth Forest, and Caribbean National Forest. Breeding has not been documented in the Carite Forest (Hermindez 1980, Snyder et al. 1987). Significant adverse effects to this species or their habitat could drive them to extinction.

Puerto Rican sharp-shinned hawk

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few); Small number of individuals in one or more populations
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Overall, populations of 154 sharp-shinned hawks have been estimated. Sixty individuals of Puerto Rican sharp-shinned hawks were counted in island-wide surveys conducted in 1983, and a breeding density of.73 hawks/km2 was estimated (Cruz and Delannoy 1986). In 1985, seventy-two individuals were counted and a breeding population of.76 hawk/km2 (230-250 island-wide) was estimated in island-wide surveys (Cruz and Delannoy 1986). In 1992, a total of 285.6 km2 surveyed yielded 82 sharp-shinned hawks: 40 in Maricao, 30 in Toro Negro, 10 in Carite and 2 in the Caribbean National Forest. An overall population of 129 individuals has been estimated for these forests (Delannoy 1992) (Table 2). Although the Guilarte Forest population was not surveyed in 1992, a population of 25 individuals was estimated for the forest in 1985 (Cruz and Delannoy 1986). The Puerto Rican sharp-shinned hawk experienced a 40 percent population decline in a period of 7 years (from about 250 individuals in 1985 to 150 in 1992).

During the first half of the 20th century, forested areas were drastically reduced for intensive agricultural uses. Timber harvest without considering the vegetation structural features needed by both species and inappropriate management practices in public forests could result in negative effects on these species, reducing the number of individuals and/or diminishing habitat quality. Road construction in several forests has resulted in substantial habitat alteration and fragmentation. Road construction and/or road repair have been proposed and/or conducted in the Caribbean National Forest, Río Abajo Commonwealth Forest, and Maricao Commonwealth Forest. In the Maricao Commonwealth Forest, the reconstruction of Road 362 destroyed approximately 15.4 ha of Puerto Rican sharp- shinned habitat. Construction of recreation facilities has been proposed for the western and northern sides of the Caribbean National Forest. Such recreation facilities could potentially eliminate habitat or bring human activities too close to preferred nesting areas. In the Maricao Commonwealth Forest, the Puerto Rico Energy and Power Authority has a power substation located in the lower montane wet forest life zone, the center of Puerto Rican sharp-shinned hawk nesting habitat. Many kilometers of aerial power lines run through forest lands. The access road for the substation is located adjacent to sharp-shinned hawk habitat in the subtropical wet forest life zone (Delannoy 1992). The construction of this access road resulted in the destruction of approximately 2.6 ha of Puerto Rican sharp-shinned hawk habitat (Delannoy 1992). The construction of new or the enlargement of the

existing, communication infrastructure could potentially eliminate important sharp-shinned hawk habitat.

Extant populations are restricted only to five montane forests, respectively. Significant adverse effects to these species or their habitat could drive them to extinction.

The extensive devastation from hurricanes may be particularly detrimental to species with small population sizes and long generation times, such as the sharp-shinned hawk. Decline of this species has been attributed to possible direct and indirect effects of Hurricane Hugo in 1989 by Delannoy (1992).

The mortality of sharp-shinned hawk nestlings due to parasitism by the warble fly *Philornis* sp. has been documented. Studies conducted in Maricao Commonwealth Forest attributed 61 percent of nestling mortality to Philornis parasitism (Cruz and Delannoy 1986).

The lack of comprehensive management plans for the Commonwealth Forests could be considered a serious threat to these species. In absence of such plans, policy makers and managers lack basic information on which to base decisions related to the best use and management of forest resources.

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 1997. Puerto Rican Broad-winged Hawk and Puerto Rican Sharp-shinned Hawk Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 30 pp.

U.S. Fish and Wildlife Service (USFWS). 2010. Puerto Rican broad-winged hawk or guaraguao de bosque (*Buteo platypterus brunnescens*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region. Caribbean Ecological Services Field Office Boquerón, Puerto Rico.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low** Puerto Rican broad-winged hawk

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low** Puerto Rican sharp-shinned hawk

RISK
(Risk is based on species exposure and response from labelled uses across the range)

Risk to individuals if exposed:

Effects to Caribbean hawks from use sites:

- Sharp-shinned hawks are anticipated to experience mortality and/or effects from consuming prey exposed to malathion at maximum rates on all use site, and broad-winged hawks are anticipated to experience these effects on use sites with higher allowable application rates (i.e., orchards and vineyards, developed open space developed, vegetables and ground fruit). No effects are expected for either species from exposure via spray drift, or from direct exposure to spray or contaminated media.

- Prey mortality to birds is anticipated to occur on use sites with higher application rates

Effects to Caribbean hawks from mosquito control:

- No effects are expected for the broad-winged hawk from exposure resulting from mosquito control. Sharp-shinned hawks foraging on birds exposed from mosquito control are anticipated to experience mortality (50% chance of mortality).

Risk to the species from labelled uses across the range:

The table below summarizes the risk to the species from labelled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality and sub-lethal effects	A small proportion of hawks are anticipated to experience mortality or sub-lethal effects from foraging on prey items exposed in malathion use sites.
Spray drift areas – mortality	No effects expected
Volatilization	Potential for exposure via this route
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Potential to birds on use sites with higher allowable application rates
Spray drift areas - Prey item mortality	No effects expected
Plants affected (decline in growth)	N/A
MOSQUITO CONTROL	
Direct (mortality and sub-lethal)	No effects for broad-winged hawks, potential mortality for sharp-shinned hawks from foraging on prey if exposed
Indirect	No effects expected

Risk modifiers:

Broad-winged hawk: The Puerto Rican broad-winged hawk (*Buteo platypterus brunnescens*) is an endemic subspecies of the broad-winged hawk, occurring only in Puerto Rico. At the present time, the Puerto Rican broad-winged hawk is an uncommon and extremely local resident. Populations are found from the upper montane forest habitats within the fog belt on the island where it is anticipated to come into contact with malathion through volatilization to the lower karst region where it is anticipated to be exposed to spray drift from nearby fields, though the magnitude of that exposure is uncertain and therefore the likelihood of effects cannot be predicted.

Sharp-shinned Hawk: The Puerto Rican sharp-shinned hawk (*Accipiter striatus venator*) is an endemic subspecies of the North American Sharp-shinned Hawk, occurring only in Puerto Rico. This small forest hawk is restricted to five isolated mountain forest areas. The Puerto Rican sharp-shinned hawk feeds primarily on small birds. Its habitat is also found in upper elevation forests within the fog belt on the island where it is anticipated to come into contact with

malathion through volatilization, though the magnitude of that exposure is uncertain and therefore the likelihood of effects cannot be predicted.

While pesticides have been implicated in the loss of raptor populations worldwide, there is little scientific evidence to suggest that sharp-shinned or broad-winged hawks have been impacted in the past. In addition, the hawks' preference for forested habitat suggests that they are not likely to have a high degree of exposure to malathion by foraging on prey exposed on use sites, though this route of exposure cannot be ruled out.

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low** Puerto Rican broad-winged hawk

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low** Puerto Rican sharp-shinned hawk

USAGE
(Anticipated usage within the range based on past usage data)

Information regarding past usage of malathion in Puerto Rico is not available, however prior survey data has indicated that 11.2% of agricultural crops were treated with insecticides. Based on information collected for CONUS species, we estimate that 5% of developed and open space developed would undergo some level of treatment with malathion. Due to the high degree of uncertainty associated with this data, discussed in the General Effects to Listed Species in Caribbean Islands section above, we consider this quantitative usage data broadly. We assess exposure from malathion usage qualitatively by considering the likelihood that species will occur in the areas where insecticide usage will take place, as described individually for each species or group of species.

At present, information indicates that malathion would not likely be not used as a mosquito control agent in Puerto Rico due to concerns about insecticide resistance; future use cannot be ruled out but is not expected to increase significantly.

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low** Puerto Rican broad-winged hawk

Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low** Puerto Rican sharp-shinned hawk

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations as initial residues degrade prior to the next application. In addition, exposure to aquatic organisms

is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

Puerto Rican broad-winged hawk

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican broad-winged hawk. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Puerto Rican broad-winged hawk has a high vulnerability ranking due to its endangered status, limited distribution, unknown population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation, and loss of suitable habitat from agricultural uses and increasingly urbanization). The species has a low risk ranking due to uses across the range, including low-level potential mortality or sub-lethal effects from feeding on affected prey. The species is known to forage primarily in preferred forest habitats, which limits its potential exposure to effects of malathion use. Again, pesticides have been implicated in the loss of raptor populations worldwide, but there is little scientific evidence to suggest that broad-winged hawks have been impacted in the past. Effects from such are anticipated to be limited (as best we understand usage). Thus, it appears that some effects from pesticides are reasonably certain to occur, but these effects are anticipated to be limited given the species life history, most notably its foraging habitat preferences and lack of evidence for past impacts. While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the

number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. While we anticipate that small numbers of individuals experience mortality or sublethal effects to growth and reproduction from exposure from foraging on or near use sites over the duration of the Action, we do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Puerto Rican broad-winged hawk.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is Service's biological opinion that the registration of this pesticides, is not likely to jeopardize the continued existence of the Puerto Rican broad-winged hawk.

Puerto Rican sharp-shinned hawk

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican sharp-shinned hawk. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Puerto Rican sharp-shinned hawk has a high vulnerability ranking due to its endangered status, limited distribution, unknown population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation, and loss of suitable habitat from agricultural uses and increasingly urbanization). The species has a low risk ranking due to potential uses across the range, including limited mortality or sub-lethal effects from feeding on affected prey. The species is known to forage primarily in preferred forest habitats, which limits its potential exposure to effects of malathion use. Again, pesticides have been implicated in the loss of raptor populations worldwide, but there is little scientific evidence to suggest that sharp-shinned hawks have been impacted in the past. Effects from such are anticipated to be limited (as best we understand usage). Thus, it appears that some effects from pesticides are reasonably certain to occur, but these effects are anticipated to be limited given the species life history, most notably its foraging habitat preferences and lack of evidence for past impacts. While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the

number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. While we anticipate that small numbers of individuals will experience mortality or sub-lethal effects to growth and reproduction from exposure from foraging on or near use sites over the duration of the Action, we do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Puerto Rican sharp-shinned hawk.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is Service's biological opinion that the registration of this pesticides, is not likely to jeopardize the continued existence of the Puerto Rican sharp-shinned hawk (*Accipiter striatus venator*).

Conclusion: **Is not likely to jeopardize** Puerto Rican broad-winged hawk

Conclusion: **Is not likely to jeopardize** Puerto Rican sharp-shinned hawk

Integration and Synthesis Summary: Caribbean Island Reptiles

Scientific Name:	Common Name:	Entity ID:
Anolis roosevelti	Culebra Island giant anole	162
Ameiva polops	St. Croix ground lizard	163
Cyclura stejnegeri	Mona ground iguana	165
Epicrates inornatus	Puerto Rican boa	156
Epicrates monensis granti	Virgin Islands tree boa	174
Epicrates monensis monensis	Mona boa	164

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

Both the Mona ground iguana *Cyclura stejnegeri* and Mona boa *Epicrates monensis monensis* are endemics known only from Mona Island. We have information from the Caribbean Field Office (USFWS, pers. comm., 2020) that indicates malathion use is very unlikely on this conserved, remote, and generally uninhabited island. Human inhabitants consist primarily of researchers and rangers attending to the Mona Island Nature Reserve, which includes the entire 22 square miles of Mona Island. Thus, our analyses for the Mona ground iguana and Mona boa is a qualitative assessment and does not anticipate malathion exposure to either species or effects that rise above the discountable level.

Mona ground iguana
Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Single population
Species Trends: Stable
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Mona ground iguana is a large, heavy-headed lizard with strong legs, prominent cephalic bulges, and a vertically flattened tail reaching an average of 1.2 m (4 feet) in length and a weight of 6.8 kg (15 pounds). The population on the island of Mona appears stable, but with low adult density and a deficiency of juveniles. This adult-biased age structure may be indicative of low and unsustainable recruitment of juveniles. Threats from competing non-native mammals (e.g., pigs, goats, feral cats) are believed to be a likely contributor to the juvenile recruitment problem. A captive breeding and headstarting program is underway and has resulted in the successful release of juveniles.

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 2015. 5-Year Review Mona ground iguana (*Cyclura stejnegeri*). Boquerón, Puerto Rico. 19 pp.

Mona boa
Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Single population
Species Trends: Unknown
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Mona boa is endemic to the 5,700 hectare island of Mona. The species is secretive and hard to detect, and thus robust population estimates are difficult to obtain. However, population estimates conducted (Tolson 2000) indicate the Mona boa may be more abundant than previously thought. It is hypothesized that interactions with feral animals (e.g., cats, rats, pigs and goats) may be a hazard to the species, but there is very limited information on these potential interactions to date. Recent information points to feral cats being the most significant threat to the recovery of the species and efforts to affect their removal is underway. Similarly, the species is likely negatively affected by stochastic events, particularly hurricanes, which structurally alter the preferred vegetation components of Mona boa habitat and make them more susceptible to predation by invasive mammals. Despite these threats, sightings of boas have increased since the species was listed in 1978.

EB/CE Sources: U.S. Fish and Wildlife Service. 2011. 5-Year Review Mona boa (*Epicrates monensis monensis*). Boquerón, Puerto Rico. 21 pp.

Culebra Island giant anole
Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Unknown, species has not been observed since 1932
Species Trends: Unknown
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Culebra Island giant anole is historically known only from the island of Culebra. The species has not been located since 1932, and information about its abundance is unavailable. Population trends, demographic features and trends are not possible to define because only between eight or nine specimens in total have ever been collected. This species is presumably arboreal and restricted to *Ficus* and gumbo-limbo trees (*Bursera simaruba*). The only information available on its food and foraging behavior was from one report that indicated it fed on fig tree fruit. This is consistent with other diets of other large *Anolis* which will feed on fruits as well as insects and small lizards.

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 1982. Giant Anole Recovery Plan. Atlanta, Georgia. 26 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. 5-Year Review Culebra Island Giant Anole (*Anolis roosevelti*). Boquerón, Puerto Rico. 21 pp.

St. Croix ground lizard
Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The St. Croix ground lizard is a small species of *Ameiva* endemic to the Virgin Islands. At the present time, between 600 and 2,000 individuals of the St. Croix ground lizard are estimated to occur on Green Cay, Protestant Cay, Ruth Cay and Buck Island Reef NM. Green Cay contains the largest population known from all of the four locations where it is present. Mackay (2007) counts support the idea that the population is stable and there is no data that suggests it is declining.

In 2008, fifty-seven lizards were successfully translocated from Green Cay National Wildlife Refuge to Buck Island Reef National Monument (Buck Island Reef NM), an island protected and managed by the National Park Service. This was the second attempt to translocate lizards and the first of a series of translocations that are proposed to re-establish a self-sustainable population of lizards on this protected island. Recent population estimates from Green Cay, Protestant Cay and Ruth Cay indicate that the populations appear healthy because of the observation of numerous juveniles, hatchlings and gravid females on nearly every site visit (Treglia and Fitzgerald 2010). However, low genetic diversity was observed within lizard populations, which is consistent with a history of rapid and drastic population reductions that led to the endangered status of the St. Croix ground lizard (Hurtado et al. 2012).

The St. Croix ground lizard is currently utilizing coastal dry forest vegetation in four offshore islands in St. Croix, USVI (U.S. Virgin Islands). Green Cay NWR is a 5.17 ha (ca. 14.1 acres) islet located in Chenay Bay about 150 m offshore the northeastern coast of St. Croix (McNair and Lombard 2004). McNair and Lombard (2004) provide general descriptions of the habitat of the St. Croix ground lizard in the three most obvious topographical and vegetative features on Green Cay (North, South, and Beach). The north area is comprised primarily of a shrub-grassland association; the south area is primarily open and closed dry and mesic forest with some shrub, grassland association; and the beach area (southern tip, and some margins of the east, west and north coast) has some trees like buttonwood (*Conocarpus erectus*), manchineel (*Hippomane mancinella*), sea grape (*Coccoloba uvifera*) and sea side maho (*Thespesia populnea*). Lizards were more abundant in forested areas in the southern half of the cay, but scarcer than expected on beaches, especially treeless areas.

Protestant Cay is a 1.2 ha (ca. 3 acres) islet in Christiansted Harbor off the northeastern coast of St. Croix (McNair and Coles 2003). Habitat of Protestant Cay consists of subtropical dry forest severely disturbed by the introduction of exotic vegetation, which is part of the landscape of an existing hotel (McNair 2003). The presence of the St. Croix ground lizard is associated with a higher percentage of litter, woody debris, and shrubs with higher stem heights (McNair 2003). The species occupies 0.23 ha (ca. 0.6 acres) or 19.5% of the cay.

Ruth Cay (7.5 ha), located off the south-central coast of St. Croix, was built with dredge spoils from the construction of shipping channels for former Harvey Alumina Plant in 1965. It is composed of sand and coral rubble, with a central saltwater pond and is vegetated with mangroves and littoral vegetation (Knowles 1996). The substrate of the islet consists of sand, shell and coral rubble. Over half of the lizards counted were in smaller areas of woodland (primarily littoral habitat) as opposed to within larger areas of scrub, and lizards were not counted on barren habitat with no vegetation in the coral rubble (McNair and Mackay 2005). The rather short buttonwood-dominated littoral woodland continues to increase in height, which is generally favorable for the St. Croix ground lizard (McNair and Mackay 2005). While McNair and Mackay (2005) described finding lizards in most areas with substantial vegetation, they did not find lizards in the mangroves wetlands, the small area in the northwest dominated by grassland, and in woodland and scrub along the southern perimeter of the middle third of the island where the highest coral rubble dome begins. Succession may render areas of the island uninhabitable to the lizards (Claudia Lombard, pers. comm.).

Buck Island is part of the Buck Island Reef NM in the USVI. The island is approximately 2.4 km (ca. 1.5 miles) north-east of the island of St. Croix and comprises 80 ha (198 acres), rising from sea level to about 104 m (341.2 ft) in elevation. The island is covered with a dry, tropical deciduous forest (Witmer et al. 2007) and is considered optimal habitat for the lizard.

The St. Croix ground lizard actively prowls, roots, and digs for prey. They have been found to eat amphipods, hermit crabs, and small moths.

At the time of listing, habitat destruction and modification were identified as threats to the species. The final rule states that the possible expansion of development on Protestant Cay or the start of development on Green Cay could seriously reduce available habitat for the species. At present time, the St. Croix ground lizard habitat is affected by land development. Additionally, the Protestant Cay population is declining. The authors reported that less suitable habitat is presently available because of landscaping practices such as raking and removal of leaf litter, removal of undergrowth and woody vegetation, and planning of exotic vegetation by hotel management on the highly developed cay. McNair and Coles (2003) reported that the species declined in the areas most severely disturbed on the cay. Although an agreement between the Service and the managers of the hotel was signed in 2003 to eliminate deleterious landscaping practices, raking of leaf little on the hotel grounds continues (M. Rivera, USFWS, personal observation, 2008) and little has been done to benefit the lizard or its habitat. In addition, in December 2011, an adverse modification of critical habitat occurred within the lizard's habitat on the cay. The Hotel on the Cay destroyed approximately 0.17 acres of suitable and occupied lizard habitat. This represents 4% of the available habitat for the lizard within the cay (USFWS memo January 26, 2012).

Development on Green Cay is not a current threat to the species. However, some habitat degradation is occurring due to the presence of invasive vegetation (Claudia Lombard, pers. comm). Green Cay is a National Wildlife Refuge managed by the Service for conservation. Buck Island is part of the Buck Island Reef NM currently managed by the National Park Service, also for conservation.

Although Ruth Cay seems to be managed by the local government, Harvey Alumina Plant also claims ownership. The cay's unprotected status makes its future uncertain. The cay may also be used in the future for maintenance dredging, as the area continues to be an industrial port and vulnerable to anthropogenic and natural erosion.

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 1984. Recovery Plan for the St. Croix Ground Lizard (*Ameiva polops*). Atlanta, Georgia. 30 pp.

U.S. Fish and Wildlife Service (USFWS). 2019. 5-Year Review St. Croix Ground Lizard (*Ameiva polops*). Boquerón, Puerto Rico. 30 pp.

Puerto Rican boa
Status: Endangered
Distribution: Species/Populations neither constrained nor widespread
Number of Populations: The species' distribution is broader than previously thought and seems to be more abundant than what was known (USFWS, 2011).
Species Trends: Available data seems to suggest a historical decline in numbers (USFWS, 1986).
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Puerto Rican boa is an endangered reptile that is endemic to Puerto Rico, with populations found on the main island of Puerto Rico and Vieques Island. Various attempts have been carried out by researchers to determine the Puerto Rican boa's population status. However, these investigations have either been conducted on specific areas, are based on counts and do not reflect population estimates, or the results are mostly based on anecdotic reports. Reports indicate that the species is not as rare as previously thought (Moreno 1991, Bird-Pico 1994, Wunderle et al. 2004). However, some of these authors explained that the apparent abundance increment may be an artifact of increased encroachment into ever reducing habitats (Moreno 1991, Bird-Pico 1994, Puente and Vega 2005).

According to Bird-Picó (1994), boas are found throughout the karst region, on the periphery of coastal plains, and in the mountain regions. Mostly directing his research efforts towards the northern part of the Island, Bird-Picó (1994) found that the highest number of anecdotal reports and boa findings derived from areas associated to the haystack formations, which are the dominant geo ecological features of the north-northwestern part of the Island. According to the status survey of the PR boa conducted by Bird-Picó (1994), the species has a wide distribution in a variety of habitats including wooded areas, open pastures, shrubs, and cave entrances and

interiors. The presence of boas on cave entrances and interior areas is usually attributed to its feeding behavior (Rodríguez and Reagan 1984, Rodríguez-Durán 1996, Puente-Rolón 1999). The PR boa predicted habitat includes 46.3% (414,379 ha; 1,023,952.81 acres) of the Island, of which 9% occurs within protected areas. Despite conservation efforts and additional proposals to protect the northern karst region of Puerto Rico by non-government organizations, part of this area is still in private ownership. This region has been previously affected by deforestation and land movement for agricultural purposes, commercial, industrial, highway, and urban development. Habitat modification is still occurring within the region, transforming karst landscape by removing haystacks ("mogotes"), filling in sinkholes and caves, filling in wetlands, and paving over surfaces to facilitate intense uses of the land (Lugo et al. 2001).

Although the Puerto Rican boa seems to occupy a wide variety of habitats not only in the karst region but also throughout the Island, wild individuals seem to prefer specific habitat arrangements in forested areas. The species has also been reported to be very common along streams on tree branches (Schwartz and Henderson 1991). The Service has identified that riparian areas along streams are prone to direct and indirect impacts by poor development practices during and after construction.

Wiley (2003) collected data from 1973 through 1986 and reported several new localities to the Puerto Rican boa distribution, also showing that boas are widespread in Puerto Rico. Although mostly from the Sierra de Luquilllo (within the Caribbean National Forest), Puerto Rican boa individuals were also reported from Arecibo, Guanica, Ceiba, Cidra, Dorado, Maricao, Rio Abjo Forest in Utuado, and Toa Alta.

Wunderle et al. (2004) studied habitat use of the PR boa at the Luquillo Experimental Forest (LEF, currently El Yunque National Forest) in eastern Puerto Rico. His findings indicate that, although boas were located in a variety of microhabitats at LEF (i.e., vine enclosed broadleaf trees and shrubs, vine tangles, sierra palm (*Prestoea montana*), tree ferns (*Cyathea* spp.), bamboo (*Bambusa vulgaris*), dead trees, stream, building, and miscellaneous cultivated plants), the highest mean percentage of fixes for telemetrically followed boas occurred in broadleaf trees (52.8%), followed by ground or belowground sites (34.9%).

Gould et al. (2008) stated that the Puerto Rican boa predicted habitat model includes the following land cover types: moist and wet forest, woodland and shrubland mangrove, Pterocarpus, mature dry forest, and dry forest near water bodies, at or below 1,000 m of elevation.

The only published density estimate for the boa is from Ríos-López and Aide (2007). They surveyed herpetofauna within five different types of habitats (i.e., deforested valley, reforested valley, old valley, karst hilltop, karst hillside) along a 50 m transect for each habitat type in the municipality of Toa Baja (Figure 1). Ríos-López and Aide (2007) estimated a mean monthly density of 5.6 boas per hectare for the reforested valley, the old valley and the karst hilltop. They did not encounter boas in the deforested valley nor at the karst hillside habitats.

EB/CE Source:

U.S. Fish and Wildlife Service (USFWS). 2011. Puerto Rican Boa (*Epicrates inornatus*) 5-Year Review. Boquerón, Puerto Rico. 27 pp.

Virgin Islands tree boa
Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

At present there are 7 populations of Virgin Islands tree boa between Puerto Rico and the Virgin Islands. Five are wild populations (Rio Grande, Culebra Island, Cayo Diablo, St. Thomas, and Tortola) and two are the product of successful captive breeding, rat eradication, and introduction efforts. The first population was established in Cayo Ratones in 1993 and the second was established 4 in Steven Cay (USVI) in 2002. These two populations are considered by Tolson et al. (2008) as thriving populations.

At present, the populations at Cayo Diablo, Cayo Ratones and Steven Key are considered stable because of the age distribution and population composition (Tolson 2004a; Tolson et al. 2008). According to the information summarized in this review (Table 1), the population in these three cays and St. Thomas is at around 1,300 boas, an 18-fold increase from the 1985 population levels. Although the number of individuals at Río Grande (PR) and Culebra Island (PR) has not been determined, individuals have been sighted (Puentes-Rolón 2008 pers. comm.). Similarly, the species has been sighted in St. Thomas and the population estimated by Tolson (1991) is about 400 individuals.

Virgin Islands tree boa habitat occurs in subtropical dry forest and subtropical moist forest. These two types of forest are found widely distributed in Puerto Rico and the Virgin Islands. The subtropical dry forest zone is the driest life zone found in Virgin Islands, Vieques, southwestern Puerto Rico, plus all of Mona Island, Culebra Island and Desecheo (Ewel and Whitemore 1973). This life zone covers approximately 14% of Puerto Rico and USVI (Ewel and Whitemore 1973). The dry forest habitat is characterized by small (<5 m/15 ft) deciduous trees. Tolson (2003) reports the species in mangrove forests including Button wood (*Conocarpus erectus*) and red mangrove, (*Rhizophora mangle*) on Culebra Island and Cayo Ratones. Foraging boars are not restricted to trees, as they also use salt-tolerant shrub lands just above the high tide line in Cayo Diablo (Tolson 1996). Tolson (1991) mentions that although suitable habitat for the Virgin Islands boa is widely distributed throughout Puerto Rico and the Virgin Islands, the species uses less than 0.05% of this habitat. The amount of unused suitable habitat may reflect where the species has been found and that the species may have more specific requirements.

The bulk of the diet consists of *Anolis cristatellus*, mice, and nestlings from small bird species. Threats to the Puerto Rican boa include habitat loss, habitat modification, habitat fragmentation. Illegal hunting of boas for oil and meat was reported in the literature, but it is believed that these

anecdotal reports do not constitute over utilization of the species for commercial and recreational purposes.

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 1986. Virgin Islands Tree Boat Recovery Plan. Atlanta, Georgia. 27 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. 5-Year Review Virgin Islands Tree Boa (*Epicrates monensis granti*). Boquerón, Puerto Rico. 25 pp.

Overall Vulnerability Mona ground iguana:	☐ **High**	☒ **Medium**	☐ **Low**
Overall Vulnerability Mona boa:	☐ **High**	☒ **Medium**	☐ **Low**
Overall Vulnerability Culebra Island giant anole:	☒ **High**	☐ **Medium**	☐ **Low**
Overall Vulnerability St. Croix ground lizard:	☒ **High**	☐ **Medium**	☐ **Low**
Overall Vulnerability Puerto Rican boa:	☒ **High**	☐ **Medium**	☐ **Low**
Overall Vulnerability Virgin Islands tree boa:	☒ **High**	☐ **Medium**	☐ **Low**

RISK
(Risk is based on species exposure and response from labelled uses across the range)

Risk to individuals if exposed:

Effects to Caribbean reptiles from use sites:

- The Culebra Island giant anole, Puerto Rican boa, and Virgin Islands tree boa are not expected to die if exposed to malathion from maximum rates on use sites, but are anticipated to experience sub-lethal effects from consumption of birds, mammals and arthropods, particularly on use sites with higher allowable application rates. However, no effects are expected to the Virgin Islands tree boa from consumption of reptiles, its main dietary item. No effects are expected from exposure via spray drift to any of these species.

- Individual St. Croix ground lizards are anticipated to experience mortality if exposed on use sites, or from spray drift immediately adjacent to use sites (~30 m).

- Prey and forage items including terrestrial invertebrates, reptiles, and birds are anticipated to die.

Effects to Caribbean reptiles from mosquito control:

- No effects are expected to the Culebra Island giant anole, Puerto Rican boa, and Virgin

Islands tree boa.

- The St. Croix ground lizard has a low chance of mortality (~10%).
- Prey and forage items including terrestrial invertebrates and a small proportion of reptiles are anticipated to die.

Risk to the species from labelled uses across the range:

The table below summarizes the risk to the species from labelled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality and sub-lethal effects	Some potential for sub-lethal effects to the Culebra Island giant anole, Puerto Rican boa, and Virgin Islands tree boa if species forage on use sites. Low potential for mortality to the St. Croix ground lizard
Spray drift areas – mortality	No effects expected to Culebra Island giant anole, Puerto Rican boa, and Virgin Islands Low potential for mortality to the St. Croix ground lizard if exposed immediately adjacent to use sites
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	Effects to terrestrial invertebrates, reptiles on all use sites, and birds on some use sites
Spray drift areas - Prey item mortality	Potential effects to terrestrial invertebrates and reptiles if exposed.
Plants affected (decline in growth)	Effects on use sites with higher allowable application rates
MOSQUITO CONTROL	
Direct (mortality and sub-lethal)	No effects expected to Culebra Island giant anole, Puerto Rican boa, and Virgin Islands Low potential for mortality to the St. Croix ground lizard.
Indirect	Effects to terrestrial invertebrates if exposed, low chance of effects to reptiles.

Risk modifiers:

The Culebra Island giant anole has not been found since 1932 and is possibly extinct. It is thought to occur on Culebra Island and Vieques Island, Puerto Rico; St. John, U.S. Virgin

Islands; Tortola, British Virgin Islands. Little is known about its life history, but it is thought to live in tree canopies and consume fruit and small animals.

The Puerto Rican boa's diet consists of small mammals (black rats, house mice, bats), lizards (anoles), birds (ground-doves, domestic fowl chicks), and invertebrates. They are threatened by habitat loss and killing. Distribution is broader than previously thought. It can be found over most of the main island of Puerto Rico.

The Virgin Islands tree boa preys on mostly lizards (*Anolis cristatellus*), and also small mammals and birds. They are known to occur on Cayo Diablo, Cayo Ratones, Rio Grande, and Culebra Islands of Puerto Rico; Steven Key, St. Thomas; Tortola Island of the British Virgin Islands.

The St. Croix ground lizard is restricted to beaches and forests of four small offshore islands in St. Croix. Their diet consists of amphipods, moths, hermit crabs, and invertebrates. Agricultural uses on these islands are not expected. Uses near developed areas or mosquito control cannot be ruled out (one island contains a hotel/resort) but has not been identified as a threat to this species.

Effects to the prey base are anticipated from malathion exposure on or near use sites, or from mosquito control applications for all species. Because species taken as food items exhibit a range of sensitivities to malathion, exposure is expected to reduce the abundance in these areas, but not completely eliminate the prey base in these portions of the range. This reduction is anticipated to be greater on use sites, where estimated environmental concentrations are higher than would anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk Mona ground iguana:	**☐ High**	**☐ Medium**	**☒ Low**
Overall Risk Mona boa:	**☐ High**	**☐ Medium**	**☒ Low**
Overall Risk Culebra Island giant anole:	**☐ High**	**☐ Medium**	**☒ Low**
Overall Risk St. Croix ground lizard:	**☐ High**	**☐ Medium**	**☒ Low**
Overall Risk Puerto Rican boa:	**☐ High**	**☐ Medium**	**☒ Low**
Overall Risk Virgin Islands tree boa:	**☐ High**	**☐ Medium**	**☒ Low**

USAGE
(Anticipated usage within the range based on past usage data)

Information regarding past usage of malathion in Caribbean Islands is not available, however prior survey data has indicated that 11.2% of agricultural crops in Puerto Rico were treated with insecticides. Based on information collected for CONUS species, we estimate that 5% of developed and open space developed would undergo some level of treatment with malathion. Due to the high degree of uncertainty associated with this data, discussed in the General Effects

to Listed Species in Caribbean Islands section above, we consider this quantitative usage data broadly. We assess exposure from malathion usage qualitatively by considering the likelihood that species will occur in the areas where insecticide usage will take place, as described individually for each species or group of species.

At present, information indicates that malathion would not likely be not used as a mosquito control agent in Puerto Rico due to concerns about insecticide resistance; future use cannot be ruled out but is not expected to increase significantly.

Overall Usage Mona ground iguana: ☐ **High** ☐ **Medium** ☒ **Low**

Overall Usage Mona boa: ☐ **High** ☐ **Medium** ☒ **Low**

Overall Usage Culebra Island giant anole: ☐ **High** ☐ **Medium** ☒ **Low**

Overall Usage St. Croix ground lizard: ☐ **High** ☐ **Medium** ☒ **Low**

Overall Usage Puerto Rican boa: ☐ **High** ☐ **Medium** ☒ **Low**

Overall Usage Virgin Islands tree boa: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations as initial residues degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

Culebra Island giant anole

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Culebra Island giant anole. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals may be affected over the duration of the Action, we do not expect species-level effects to occur.

The Culebra Island giant anole, St. Croix ground lizard, Puerto Rican boa and Virgin Islands tree boa have high vulnerabilities based on their estimated status, distribution, and trends. The risk to the all four species (Culebra Island giant anole, St. Croix ground lizard, Puerto Rican boa, and Virgin Islands tree boa) posed by the labeled uses across the range is low. The estimated amount of usage within the range for these species is anticipated to be low given their habitat preferences. While usage is not expected on all use sites and at the maximum rates allowed by the labels where used each year, we anticipate that some use would occur based on information from a prior survey that estimated 11.2% of agricultural crops were treated with insecticides and 5% of developed and open space developed would undergo some level of treatment with malathion. Due to the high degree of uncertainty associated with this data, discussed in the General Effects to Listed Species in Caribbean Islands section above, we consider this quantitative usage data broadly. Instead, we assess exposure from malathion usage qualitatively by considering the likelihood that species will occur in the areas where insecticide usage will take place.

Although there is some potential for sub-lethal effects to the Culebra Island giant anole if it forages on use sites, we do not anticipate this occurring since the species is thought to live in tree canopies and consume fruit and small animals. No effects are anticipated to the Culebra Island giant anole from spray drift or volatilization. While the vulnerability is high for this species, risk and usage are low. Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Due to the low usage and the conservation measures that will be implemented, we expect exposure of individual Culebra Island giant anole and their invertebrate prey to occur only at

very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur; thus, we do not expect species-level effects to occur.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's Biological Opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Culebra Island giant anole.

St. Croix ground lizard

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the St. Croix ground lizard. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals may be affected over the duration of the Action, we do not expect species-level effects to occur.

The St. Croix ground lizard is expected to have low potential for mortality or sub-lethal effects through consumption of prey items on use sites and or through spray drift. While we do anticipate that adverse effects to prey items would occur, we do not expect-species-level effects as the St. Croix ground lizard is currently utilizing coastal dry forest vegetation in four offshore islands in St. Croix, USVI (U.S. Virgin Islands). Green Cay and Buck Island are managed for conservation by the National Wildlife Refuge and the National Park Service, respectively. Ruth Cay is currently managed by the Territorial government and the species is currently protected in the USVI by the Virgin Island Code, Title 12 – Chapter 2: Protection of Indigenous, Endangered and Threatened Fish, Wildlife and Plants of the Endangered and Indigenous Species Act of 1990. Agricultural uses on these islands are not expected. While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

Due to the low usage and the conservation measures that will be implemented, we expect exposure of individual St. Croix ground lizards and their invertebrate prey to occur only at very

low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur; thus, we do not expect species-level effects to occur.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's Biological Opinion that the registration of malathion, is not likely to jeopardize the continued existence of the St. Croix ground lizard.

Puerto Rican boa

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican boa. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Puerto Rican boa has high vulnerability based on their status, distribution, and trends. The risk to these species posed by the labeled uses across the range is low. The amount of estimated usage within the range of these species as a whole is low. While usage is not expected on all use sites and at the maximum rates allowed by the labels where used each year, we anticipate that some use would occur based on information from a prior survey that estimated 11.2% of agricultural crops were treated with insecticides and 5% of developed and open space developed would undergo some level of treatment with malathion.

We anticipate that the Puerto Rican boa will occur in the areas where insecticide usage will take place since their predicted habitat includes 46.3% of the island including low elevation coastal plain areas with agriculture, development, and along streams prone to direct and indirect impacts by poor development practices during and after construction. The potential for exposure to malathion in these areas is likely with direct contact with the chemical on use sites and from consuming contaminated prey items. Puerto Rican boa are not expected to die if exposed to malathion from maximum rates on use sites, individuals are anticipated to experience sub-lethal effects from consumption of birds, mammals and arthropods, particularly on use sites with higher allowable application rates. While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not

forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. While we anticipate that small numbers of individuals will experience low levels of sub-lethal effects to growth and reproduction from exposure from ingestion of contaminated prey on or near use sites over the duration of the Action, we do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce survival and recovery of the Puerto Rican boa.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's Biological Opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican boa.

Virgin Island tree boa

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Virgin Island tree boa. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Virgin Island boa preys mostly on lizards (*Anolis cristatellus*) and also small mammals and birds. Some potential for sub-lethal effects for the Virgin Islands tree boa if species forage on use sites. They are known to occur on Cayo Diablo, Cayo Ratones, Rio Grande, and Culebra Islands of Puerto Rico; Steven Key, St. Thomas; Tortola Island of the British Virgin Islands. The Virgin Island boa habitat occurs in subtropical dry forest and subtropical moist forest. In Puerto Ricco and the U.S. Virgin Island, the boa uses less than 0.05% of this suitable habitat. Cayo Ratones and Cayo Diablo are included as part of DNER La Cordillera Natural Reserve and Steven Key in USVI is managed and protected by the DPNR. It is important to note that 65% of known boas occur in small offshore islets which are managed for conservation; protection is ensured by local laws and regulations. While we do anticipate that adverse effects to prey items would occur, we do not expect species-level effects because these reptiles primarily inhabit forested habitats. Impacts to prey items would only occur along the edges of these forested habitats where they co-occur with malathion use sites. If there are areas where prey items are temporarily lost, reptiles have the ability to move to unaffected areas to forage. While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by

establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications.

While we anticipate that small numbers of individuals will experience low levels of sub-lethal effects to growth and reproduction from exposure from ingestion of contaminated prey on or near use sites over the duration of the Action, we do not expect species-level effects to occur. After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's Biological Opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Virgin Island tree boa.

At present, information indicates that malathion would not likely be used as a mosquito control agent in Puerto Rico due to concerns about insecticide resistance; future use cannot be ruled out but is not expected to increase significantly. Therefore, we do not anticipate that the Action would appreciably reduce survival and recovery of the Culebra Island giant anole, St. Croix ground lizard, the Puerto Rican boa, and the Virgin Island boa.

Conclusion for Mona ground iguana: **Is not likely to jeopardize**

Conclusion for Mona boa: **Is not likely to jeopardize**

Conclusion for Culebra Island giant anole: **Is not likely to jeopardize**

Conclusion for St. Croix ground lizard: **Is not likely to jeopardize**

Conclusion for Puerto Rican boa: **Is not likely to jeopardize**

Conclusion for Virgin Islands tree boa: **Is not likely to jeopardize**

Integration and Synthesis Summary: Caribbean Island species (Caribbean Island Amphibians)

Scientific Name:	Common Name:	Entity ID:
Eleutherodactylus jasperi	Golden coqui	193
Eleutherodactylus cooki	Guajon	196
Eleutherodactylus juanariveroi	Llanero coqui	9378
Peltophryne lemur	Puerto Rican crested toad	195

VULNERABILITY
(Summary of status, environmental baseline and cumulative effects)

There are four listed amphibians which have the potential to be affected by the use of malathion in Puerto Rico and the U.S. Virgin Islands; the golden coqui, the guajon, the Llanero coqui, and the Puerto Rican crested toad.

Golden coqui

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Unknown
Species Trends: Presumed extinct
Pesticides noted ☒

There are no known extant populations of the golden coqui as the species has not been found since the 1980s and is possibly extinct. Our analysis of this species is therefore qualitative as we anticipate that exposure to malathion is not reasonably certain to occur given the species' known distribution and likelihood of extinction. We did not assess risk and usage quantitatively for the golden coqui.

Guajon

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Multiple populations (numerous); All populations stable, with none known to be increasing or decreasing
Species Trends: Stable
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The guajon is known to occur in the Cuchilla de Panduras Mountain range in Puerto Rico, and Arroyo, Patillas, Maunabo, Yabucoa, San Lorenzo, Las Piedras, Humacao Municipalities. The population is thought to be stable. Threats to this species include loss of habitat, urban development, and recreational stream use. There is no information indicating that the species

status has either improved or declined. Known guajón populations in the Sierra de Panduras should remain stable, if negotiations during ongoing consultation result in the protection or enhancement of its habitat. Populations in Las Piedras must be closely monitored to prevent impacts from residential developments in private properties. During FY 2010, changes to species distribution, threats and habitat conditions have not been reported.

Burrowes (1997) studied the guajón at a cave system in the Cuchilla de Panduras, where a total of 130 individuals were marked at the site, resulting in a mean population size estimate of 96 individuals, and a mean of 20 new individuals entering the population every six months. Another mark-recapture study conducted by Vega-Castillo (2000) showed mean population size of 436 individuals in a rocky stream in Humacao, and 390 individuals for a rocky stream at Las Piedras.

Burrowes (2000b and 1997) assessed the genetic variation within and among populations of the guajón, in separate cave systems within the historic geographic range of the species and found a high degree of genetic variation and lack of population differentiation in the species. These studies also documented that genetic flow among populations of "guajones" is necessary to maintain the high genetic variability observed in the species. This genetic variability depends on inter-connection between caves, and the availability of clean subterranean waterways as indirect dispersal routes necessary for out-crossing (Burrowes 2000b and 1997). This study also suggested that the species is perfectly adapted to the existing environmental conditions in the caves, and that clean waterways must be maintained between the guajonales (i.e., rock formations in the species habitat consisting of caves and cavities made of plutonic, granitic or sedimentary rocks) to maintain a high degree of genetic variation among the guajón population.

Llanero coqui

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)
Number of Populations: Single population; Unknown number of individuals
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Llanero coqui is restricted to one known population. Due to the species restricted range, stochastic events such as fire are a major concern for this species. Additionally, contaminants, such as herbicide runoff and landfill leachate pollution, are also a major concern that could impact the aquatic environment in which this species depends. This species encompasses one known population occupying approximately 615 acres (248.8 ha) of wetland. The coquı´ llanero is highly restricted in its range and the threats occur throughout its range.

Puerto Rican crested toad

Status: Threatened
Distribution: Small, endemic, constrained, and/or isolated population(s); Sensitive to stochastic events (natural and/or anthropogenic)

Number of Populations: Multiple populations (few); All populations stable, with none known to be increasing or decreasing
Species Trends: Stable
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

At the time the recovery plan was approved (USFWS 1992) there were two known, isolated populations. The Guanica population, although small, is relatively stable and consists of approximately 2,000 individuals (Miguel Canals, Puerto Rico Department of Natural Resources, pers. comm., 1991). The Quebradillas population consisted of approximately 25 to 50 individuals. However, no standardized quantitative population estimates have been obtained. Genetic research indicated that the two populations were distinct and should be managed separately. The latter population is currently believed to have been extirpated. Since 1992 active re-introduction efforts have resulted in more than 310,000 eggs and toadlets being released into six re-introduction sites (Manglillo Grande, El Tallonal. Gabia Farm, Rio Encantado, Cueva el Convento, and La Esperanza).

The Puerto Rican crested toad populations are vulnerable to demographic and environmental catastrophe. These isolated populations may be reduced to levels beyond which they could not recover if a natural disaster (hurricane, fire, flood, tidal wave) or a prolonged drought were to occur, especially since reproduction in this species appears to rely on climatic events. When compounded with the reduced availability of breeding sites, these factors increase the likelihood of whole populations being eliminated.

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 2011. Guajón or Puerto Rican Demon (*Eleutherodactylus cooki*) 5-Year Review: Summary and Evaluation. U.S Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office Boquerón, Puerto Rico.

U.S. Fish and Wildlife Service (USFWS). 2004. Recovery Plan for the Guajón or Puerto Rican Demon (*Eleutherodactylus cooki*). U. S. Fish and Wildlife Service, Atlanta, Georgia. 31 pp.

U.S. Fish and Wildlife Service (USFWS). 2012. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for Coquı´ Llanero Throughout Its Range and Designation of Critical Habitat. 77 Federal Register 193. October 4, 2012. Pages 60777 - 60802.

U.S. Fish and Wildlife Service (USFWS). 1992. Recovery Plan for the Puerto Rican crested toad (*Peltophryne lemur*). Atlanta, Georgia. 19 pp.

U.S. Fish and Wildlife Service (USFWS). 2016. 5-Year Review: Summary and Evaluation, Puerto Rican Crested Toad (*Peltophryne lemur*). U.S. Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office Boquerón, Puerto Rico. 52 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low** Guajon

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low** Llanero coqui

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low** Puerto Rican crested toad

RISK
(Risk is based on species exposure and response from labelled uses across the range)

Risk to individuals if exposed:

Effects to Caribbean amphibians use sites:

Terrestrial effects only:

- The golden coqui and Llanero coqui are expected to experience 50-100% mortality, depending on the use sites, if exposed to malathion from consuming contaminated insects.
- The guajon and Puerto Rican crested toad are not expected to experience mortality or sub-lethal effects.
- Effects from exposure via spray drift are not expected.
- Mortality of terrestrial invertebrates used as dietary items is anticipated to occur on all use sites.

Effects to Caribbean amphibians from mosquito control:

- Mortality or sub-lethal effects are not expected for any of these amphibians.
- Mortality of terrestrial invertebrates used as dietary items is anticipated to occur.

Risk to the species from labelled uses across the range:

The table below summarizes the risk to the species from labelled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	
Use areas – mortality and sub-lethal	No effects expected as these amphibians are not expected on use sites
Spray drift and runoff areas – mortality	No effects expected
Volatilization	
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	No effects expected as these amphibians are not expected on use sites
Spray drift and runoff areas - Prey item mortality	
Plants affected (decline in growth)	N/A
MOSQUITO CONTROL	
Direct (mortality and sub-lethal)	No effects expected
Indirect	Effects to terrestrial invertebrates if exposed, no chance of effects to amphibians.

Risk modifiers:

The Puerto Rican crested toad is endemic to Puerto Rico and Virgin Gorda, both on the Puerto Rican Shelf. Its range in Puerto Rico is limited to one known natural population: the Guanica population. In Puerto Rico, the crested toad occurs at low elevations (not exceeding 200 meters) where it appears to prefer arid or semiarid, rocky areas with an abundance of limestone fissures and cavities in well-drained soil (Rivero et al. 1980, Moreno 1985, Paine 1985). It requires aquatic vegetation, freshwater terrestrial ponds, and heavy rains (7 - 13 inches) for breeding. Currently, the toad occurs in two forest associations, including re-introduction sites: subtropical dry forest in the southern karst region, and subtropical moist forest in the northern karst region. The species was also reported in a grassy field in Arecibo.

The habitat of the guajon is terrestrial freshwater, subtropical moist forest, subtropical wet forest, cave, and streams. The guajón can be found at elevations ranging from about 83 ft (26 m) up to 1,381 ft (421 m) above sea level and extending further west into the municipality of Patillas.

The Llanero coqui is an herbaceous wetland specialist found only on a palustrine herbaceous wetland at Sabana Seca Ward. The Service has estimated the palustrine herbaceous wetland area where the coqui´ llanero is now found to be about 615 ac (249 ha). The species appears to be an obligate marsh dweller and has been found only in freshwater, herbaceous wetland habitat at an elevation of 55.8 ft (17 m).

All of these species prey on invertebrates.

Based on habitat descriptions, these amphibians appear unlikely to utilize malathion use sites, but are anticipated to be exposed from runoff from agricultural areas.

Allowable uses driving effects/other considerations: We anticipate effects to the invertebrate prey base from malathion exposure on or near developed and open space developed use sites, from spray drift, and from mosquito control applications. Because terrestrial invertebrates exhibit a range of sensitivities to malathion, we expect exposure would reduce the abundance of invertebrates in these areas, but not completely eliminate the prey base. We anticipate this reduction will be greater on use sites where estimated environmental concentrations are higher than would be anticipated from spray drift or following mosquito control. These reductions are likely temporary (based on application frequency) with community recovery over a short period of time.

Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**	Guajon
Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**	Llanero coqui
Overall Risk: ☐ **High** ☐ **Medium** ☒ **Low**	Puerto Rican crested toad

USAGE
(Anticipated usage within the range based on past usage data)

Information regarding past usage of malathion in Caribbean Islands is not available, however prior survey data has indicated that 11.2% of agricultural crops in Puerto Rico were treated with insecticides. Based on information collected for CONUS species, we estimate that 5% of developed and open space developed would undergo some level of treatment with malathion. Due to the high degree of uncertainty associated with this data, discussed in the General Effects to Listed Species in Caribbean Islands section above, we consider this quantitative usage data broadly. We assess exposure from malathion usage qualitatively by considering the likelihood that species will occur in the areas where insecticide usage will take place, as described individually for each species or group of species.

At present, information indicates that malathion would not likely be not used as a mosquito control agent in Puerto Rico due to concerns about insecticide resistance; future use cannot be ruled out but is not expected to increase significantly.

Overall Usage:	☐ **High**	☐ **Medium**	☒ **Low**	Guajon
Overall Usage:	☐ **High**	☐ **Medium**	☒ **Low**	Llanero coqui
Overall Usage:	☐ **High**	☐ **Medium**	☒ **Low**	Puerto Rican crested toad

CONSERVATION MEASURES

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (i.e., 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. We anticipate that, in many cases, these buffers will significantly reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of

area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations as initial residues degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). We anticipate that this measure will reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

Golden coqui

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, it is Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the golden coqui. As noted above, there are no known extant populations of the golden coqui as the species has not been found since the 1980s and is possibly extinct. We did not assess risk and usage quantitatively for the golden coqui; however, we anticipate that exposure to malathion is unlikely to occur given the species' known distribution and likelihood of extinction.

Guajon

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Guajon. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals may be affected over the duration of the Action, we do not expect species-level effects to occur.

The Guajon has a high vulnerability ranking due to its limited distribution, small population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation and loss of suitable aquatic and upland habitats from urbanization, invasive species, and agricultural impacts to habitat). The species has a low risk ranking due to labelled potential uses, including potential effects from consuming contaminated prey. The species ranks as at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be

subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). While we have estimated usage broadly for the Caribbean species, the Guajon resides in terrestrial freshwater, subtropical moist forest, subtropical wet forest, cave, and streams and exposure, if any, is anticipated to be limited (e.g., possible ingestion of contaminated prey). While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including rain restrictions, aquatic habitat buffers, residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Guajon when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Due to the low usage and the conservation measures that will be implemented, we expect exposure of individual Guajon and their invertebrate prey to occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur and we do not expect species-level effects to occur. Therefore, we anticipate that the proposed action would not appreciably reduce the survival and recovery of the Guajon.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's Biological Opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Guajon.

Llanero coqui

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Llanero coqui. As discussed below, even though the vulnerability and risk is high for this species, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that small numbers of individuals may be affected over the duration of the Action, we do not expect species-level effects to occur.

The Llanero coqui has a high vulnerability ranking due to its endangered status, limited distribution, small population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., loss of suitable natural habitats). The species has a high (modified) risk ranking due to potential mortality from ingestion of invertebrate prey items from use sites and mosquito adulticide use. Where exposure occurs, we also anticipate mortality and sublethal effects to growth and reproduction from loss of prey due to runoff from agricultural sites. The presence of the species on protected lands generally makes the use of pesticides unlikely, but the species' extremely limited distribution (a single site) and proximity to coastal and developed areas (e.g., residential development and a landfill) makes it unusually susceptible to stochastic and anthropogenic events, including exposure to pesticides, which are noted as a threat to the species.

However, exposure of the Llanero coqui to malathion does not appear to have been an issue to date and malathion use for mosquito control appears to be limited, given the reduction of malathion as a mosquito control agent due to resistance concerns. From the estimates of agricultural use and usage, we anticipate very limited exposure to malathion, which we anticipate will be further limited through the implementation of the conservation measures above. While the vulnerability and risk are high for this species, usage is expected to be low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures, including rain restrictions, aquatic habitat buffers, residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Llanero coqui when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Due to the low usage and the conservation measures that will be implemented, we expect exposure of individual coqui and their invertebrate prey to occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur. We do not expect species-level effects to occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Llanero coqui.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's Biological Opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Llanero coqui.

Puerto Rican crested toad

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, is not likely to jeopardize the continued existence of the Puerto Rican crested toad. As discussed below, even though the vulnerability is high for this species, we anticipate the risk and likelihood of exposure to malathion is low. While we anticipate that small numbers of individuals will be affected over the duration of the Action, we do not expect species-level effects to occur.

The Puerto Rican crested toad has a high vulnerability ranking due to its limited distribution, small population size, susceptibility to stochastic events, and anthropogenic threats to the species (e.g., continued degradation, fragmentation and loss of suitable aquatic and upland habitats from urbanization, invasive species, and agricultural impacts to habitat). The species has a low risk ranking due to labelled potential uses, including potential effects from consuming contaminated prey. The species ranks as at risk generally as amphibians, given their aquatic life histories and susceptibility to environmental contaminants (e.g., pesticides, degraded water quality), can be subject to exposure through multiple pathways (e.g., dermal exposure, ingestion of contaminated arthropod prey) and at various life stages (egg, larval, juvenile and adult). While we have estimated usage broadly for the Caribbean species, the Puerto Rican crested toad resides in forest associations of arid or semiarid, rocky areas with an abundance of limestone fissures and cavities in well-drained soil and exposure, if any, is anticipated to be limited (e.g., possible ingestion of contaminated prey). While the vulnerability is high for this species, risk and usage are low.

Thus, we anticipate the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above, including rain restrictions, aquatic habitat buffers, residential use label changes and reduced numbers of applications and application rates, is expected to further reduce the likelihood of exposure of the species, their prey, and their habitat. As with most amphibians, the rain restriction is anticipated to reduce the likelihood of exposure (directly or in runoff) to the Puerto Rican crested toad when the animals are most active (e.g., following a precipitation event). Similarly, the aquatic buffers are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Residential use label changes are expected to reduce environmental concentrations as initial residues degrade prior to the next application, reduce the likelihood of and the environmental concentration of exposure by establishing buffers from waterways (specified on the label a distance from water bodies where pesticides are not to be applied), and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated. Similarly, the reduction in the number of applications and reduction in applications rates are anticipated to reduce the likelihood of exposure by reducing or eliminating the pesticide from aquatic habitats proximate to agricultural applications. Due to the low usage and the conservation measures that will be implemented, we expect exposure of individual toads and their invertebrate prey will occur only at very low levels over the duration of the Action and would likely not result in mortality, sublethal effects, or measurable impacts to prey base that are reasonably certain to occur. We do not expect species-level effects will occur. Therefore, we anticipate that the Action would not appreciably reduce the survival and recovery of the Puerto Rican crested toad.

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the Action, it is Service's biological opinion that the registration of malathion is not likely to jeopardize the continued existence of the Puerto Rican crested toad.

Conclusion: Is not likely to jeopardize	**Golden coqui**
Conclusion: Is not likely to jeopardize	**Guajon**
Conclusion: Is not likely to jeopardize	**Llanero coqui**
Conclusion: Is not likely to jeopardize	**Puerto Rican crested toad**