Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Texella reddelli	Bee Creek Cave harvestman	464

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends **Pesticides noted** ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
According to the 1994 Recovery Plan and 2009 and 2018 5-Year Reviews, there are 11 caves known to contain *T. reddelli* in Travis and Burnet Counties, Texas. Bee Creek Cave harvestman (BCCH) is generally found in the subterranean environment, although there have been a few surface occurrences documented as well. Its habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Travis County. Karst areas commonly have few surface streams; most water moves through cavities underground. Within this habitat this species depends on high humidity, stable temperatures, and nutrients derived from the surface.

The species was listed as endangered in 1988, based on the threats of: 1) habitat loss to development; 2) cave collapse or filling; 3) alteration of drainage patterns; 4) alteration of surface plant and animal communities, including the invasion of exotic plants and predators (e.g., the red-imported fire ant, *Solenopsis invicta*), changes in competition for limited resources and resulting nutrient depletion, and the loss of native vegetative cover leading to changes in surface microclimates and erosion; 5) contamination of the habitat, including groundwater, from nearby agricultural disturbance, pesticides, and fertilizers; 6) leakages and spills of hazardous materials from vehicles, tanks, pipelines, and other urban or industrial runoff; and 7) human visitation, vandalism, and dumping; mining; quarrying (limestone); or, blasting above or in caves.

Currently, the BCCH faces the same threats as it did at the time it was listed. The total number of individuals is unknown, as are many aspects of their biology. The Bee Creek Cave harvestman requires a source of food in the form of invertebrates or other organic matter.

Of the areas in which the species are found, the 2018 5-Year Review reports that four individual cave sites are impaired. Development in the rapidly growing Austin-Round Rock metropolitan area has resulted in loss and degradation of surface and subsurface habitats and is an ongoing

stressor for the species. Open space with native vegetation has been reduced at impaired sites with tracts fragmented and isolated from one another. These sites may be unable to supportviable populations of the Bee Creek Cave harvestman over the long-term.

The 2018 5-Year Review also notes that the Balcones Canyonlands Preserve contributes significantly to the current resiliency of some of the sites: Bee Creek and Little Bee Creek Cave Cluster, Merkin Hole, RI-1, and Spider Caves. While these Bee Creek Cave harvestman sites are located in areas of Travis County that have experienced substantial urban development, the protections provided by the preserve system have maintained large amounts of open space surrounding most of these caves and the integrity of cave cricket foraging habitat.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2018. Bee Creek Cave Harvestman (*Texella reddelli*): 5-Year Review: Summary and Evaluation. Austin Ecological Services Field Office, Austin, Texas. 39 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. 5-Year Review for the Bee Creek Cave Harvestman (*Texella reddelli*). 13 pp.

U.S. Fish and Wildlife Service (USFWS). 1994. Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas. Albuquerque, New Mexico. 154 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK
(Risk to the species across the range based on labelled uses)

Risk to individuals if exposed: We anticipate the Bee Creek Cave harvestman will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the BCCH for all uses (except mosquito control) is 21% with <1% from wheat, cotton, other crops, orchards and vineyards, vegetables and ground fruit, Christmas trees, nurseries, pasture, other row crops, and rice. We anticipate up to 42% mortality from spray drift from all use sites. 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	21%
Spray drift areas – mortality	Up to 42%

Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	21% arthropods
Spray drift areas - Prey item mortality	Up to 42% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct – mortality	37%
Sublethal	NA
Indirect – mortality	37% arthropods

Risk modifiers: The BCCH habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock). The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the reproductive strategy of the BCCH.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces, rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the BCCH relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the BCCH range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey. While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individual spiders where exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects; therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in

mortality to 37% of BCCH individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	243,079	37.11	0	0
Open Space Developed	D,I	60,934	9.3	3,078	0.47
Developed	D,I	40,568	6.19	2,030	0.31
Corn	D,I	23,834	3.64	1,375	0.21
Other Grains	D,I	6,866	1.05	6,866	1.05
Wheat	D,I	4,659	0.71	4,323	0.66
Cotton	D,I	2,963	0.45	2,685	0.41
Other Crops	D,I	1,374	0.21	0	0
Orchards and Vineyards	D,I	479	0.07	479	0.07
Christmas Trees	D,I	360	0.05	360	0.05
Vegetables and Fruit	D,I	187	0.03	187	0.03
Nurseries	D,I	177	0.03	177	0.03
Pasture	D,I	58	<0.01	58	<0.01
Other Row Crops	D,I	11	<0.01	11	<0.01
Rice	D,I	1	<0.01	1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		142,471	21.73	21,630	3.31
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		142,471	21.73	21,630	3.31
TOTAL[4]:		385,550	58.84	21,630	3.31

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

itself. Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 654,992 acres
% of range in California[5] (i.e., where CalPUR data is available): 0%
Range overlap with Federal lands: 38,028 acres, 5.8%
Overall Usage: ☐ **High** ☐ **Medium** ☒ **Low**

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Bee Creek Cave harvestman is not an aquatic species, as a karst cave species, it is closely associated with the underground streams and other aquatic habitats that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Bee Creek Cave harvestman by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing any initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms will likely be 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 ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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.

[5] Indicates percent of the range where CalPUR data was used.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Bee Creek Cave harvestman. As discussed below, even though the vulnerability and risk are 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 very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

Pesticides are a noted threat to the species, and the risk to the individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s).

Where individual spiders are exposed, we anticipate mortality will occur; thus we do not anticipate exposed individuals would experience sublethal effects. Mortality for the Bee Creek Cave harvestman for all uses (except mosquito control) based on overlap with the species range is 21%, and we anticipate an additional 42% mortality across the species range from spray drift from all use sites. Similarly, we anticipate mosquito adulticide applications would result in 37% mortality of individuals across the species range based on overlap of use sites. However, we anticipate usage will be low. Most of the species' range (94.2%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands (e.g., agricultural lands) may reach the species and its prey through groundwater flow, based on the low anticipated usage (3.31%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range (5.8% overlap), but we assume only low levels of malathion usage on Federal lands as well, per the rationale related to usage in these areas as described in the Biological Opinion. While usage is not expected on all use sites at the maximum rates allowed by the label, we anticipate that usage would occur, particularly from use occurring on open space developed and developed areas, which is found within the range of this species. Substantial exposure from agricultural uses is not expected. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new

label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Bee Creek Cave harvestman. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Bee Creek Cave harvestman and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Bee Creek Cave harvestman in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst InvertebratesRecovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Texella reyesi	Bone cave harvestman	465

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

Status: Endangered
Distribution: Population size/location unknown
Number of Populations: Multiple populations (numerous, 8 caves)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Bone cave harvestman (BCH) spends its entire life underground and is endemic to karst formations (caves, sinkholes, and other subterranean voids) in Travis and Williamson counties, Texas. It was listed as endangered in 1988 based on the threats of: 1) habitat loss to development; 2) cave collapse or filling; 3) alteration of drainage patterns; 4) alteration of surface plant and animal communities, including the invasion of exotic plants and predators (i.e. the red-imported fire ant), changes in competition for limited resources and resulting nutrient depletion, and the loss of native vegetative cover leading to changes in surface microclimates and erosion; 5) contamination of the habitat, including groundwater, from nearby agricultural disturbance, pesticides, and fertilizers; 6) leakages and spills of hazardous materials from vehicles, tanks, pipelines, and other urban or industrial runoff; and 7) human visitation, vandalism, and dumping; mining; quarrying (limestone); or, blasting above or in caves.

The 2009 5-Year Review for the species reported that 168 caves were known to contain the species in Travis and Williamson Counties, Texas. Since that time, the extent of the species within the various cave and karst features has been refined to remove a few areas in which the species has not been detected, add additional sites where new detections have been documented, and to more accurately reflect the spatial extent and connectivity of these features. The 2018 5-Year Review reports the number of extant occupied sites to be 57 cave clusters and individual caves. Currently, the species faces the same threats that it did at the time it was listed. The recovery plan provides some conceptual guidelines on habitat conditions that are important to karst invertebrates, including maintaining humid conditions, air flow, and stable temperatures in the air-filled voids; maintaining adequate nutrient supply; preventing contamination from the surface and groundwater entering the karst ecosystem; controlling the invasion of exotic species; and allowing for movement of the karst fauna and nutrients through voids between karst features (USFWS 1994).

The 2018 5-Year Review reports that analyses indicate that 26 of the 67 extant Bone Cave harvestman cave clusters and individual cave sites are impaired. Several of those sites fall below

3.6 ha (9 ac) in size and, due to degraded cave cricket foraging area, potential edge effects, and isolation from other habitat patches may be unable to support Bone Cave harvestman populations over the long-term. However, 36 cave clusters and individual caves are currently of sufficient resiliency (i.e., high to moderate) to potentially support Bone Cave harvestman populations over the long-term. For the most part, these sites are located in larger tracts of open space and have relatively unaltered cave cricket foraging areas.

EB/CE Sources:

U.S. Fish and Wildlife Service (USFWS). 1994. Endangered Karst Invertebrates (Travis and Williamson Counties). Recovery Plan. Albuquerque, New Mexico. 162 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. Bone Cave Harvestman 5-Year Review. Austin, Texas. 24 pp.

U.S. Fish and Wildlife Service (USFWS). 2018. Bone Cave Harvestman 5-Year Review. Austin, Texas. 41 pp.

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: We anticipate the Bone Cave harvestman will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is anticipated to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the BCH is approximately 22% with use sites ranging from a combined low of <1% from cotton, other crops, orchards and vineyards, Christmas trees, vegetables and ground fruit, nurseries, pasture, other row crops, and rice to a high of 38% from mosquito control. We anticipate up to 43% additional mortality from spray drift from all use sites. 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	22%
Spray drift areas – mortality	Up to 43%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	

Use areas - Prey item mortality	22% arthropods
Spray drift areas - Prey item mortality	Up to 43% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	38%
Sublethal	NA
Indirect - mortality	38% arthropods

Risk modifiers: The BCH is known from 168 caves, spanning all 7 established Karst Fauna Regions (KFRs) in Travis and Williamson Counties, Texas; distributed along a 40-kilometer (km) distance in Travis and Williamson Counties in central Texas (USFWS 1994). The habitat for the BCCH includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by a solution of bedrock). The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the reproductive strategy of the BCH.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the BCH relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the BCH range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey. While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 38% mortality to exposed BCH individuals. The malathion label does not specify a maximum number

of permissible mosquito adulticide applications per year, nor a minimum interval of application. Mosquito control usage information does not exist for this species.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	528,853	38.29	23	<0.01
Open Space Developed	D,I	132,571	9.6	6,629	0.48
Developed	D,I	88,262	6.39	4,420	0.32
Corn	D,I	51,855	3.75	3,039	0.22
Other Grains	D,I	14,938	1.08	14,938	1.08
Wheat	D,I	9,823	0.71	9,116	0.66
Cotton	D,I	6,447	0.47	5,801	0.42
Other Crops	D,I	2,989	0.22	0	0
Orchards and Vineyards	D,I	1,042	0.08	1,042	0.08
Christmas Trees	D,I	784	0.06	784	0.06
Vegetables and Fruit	D,I	407	0.03	407	0.03
Nurseries	D,I	385	0.03	385	0.03
Pasture	D,I	127	<0.01	127	<0.01
Other Row Crops	D,I	24	<0.01	24	<0.01
Rice	D,I	2	<0.01	2	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		309,656	22.45	46,714	3.41
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		309,656	22.45	46,714	3.41
TOTAL[4]:		838,509	60.74	46,737	3.42

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

itself. Developed and open space developed uses have less potential for spray drift than other uses.

 # acres in species range: 1,381,145 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 38,852 acres, 2.81%

Overall Usage: ☐High ☐Medium ☒Low

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Bone Cave harvestman is not an aquatic species, as a karst species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Bone Cave harvestman by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing initial residues to 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 ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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.

[5] Indicates percent of the range where CalPUR data was used.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Bone Cave harvestman. As discussed below, even though the vulnerability and risk are 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 very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The Bone Cave harvestman has a high vulnerability based on its status, distribution, and trends. The risk to individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Where individual spiders are exposed, we anticipate mortality will occur; thus, we do not anticipate exposed individuals would experience sublethal effects. Mortality for the Bone Cave harvestman for all uses (except mosquito control) based on overlap with the species range is 22%, and we anticipate an additional 43% mortality across the species range from spray drift from all use sites. Similarly, we anticipate mosquito adulticide applications would result in 38% mortality of individuals across the species range based on overlap of use sites.

However, we anticipate usage will be low. Most of the species' range (>97%) overlaps non-Federal lands. While applications on non-Federal lands (e.g., agricultural lands) may reach the species and its prey through groundwater flow, as described above, based on the low anticipated usage (3.42%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range (<3% overlap), but we assume only low levels of malathion usage on Federal lands, per the rationale related to usage in these areas as described in the Biological Opinion. While usage is not expected on all use sites at the maximum rates allowed by the label, we anticipate that usage would occur, particularly from use occurring on open space developed and developed areas, which is found within the range of this species. Substantial exposure from agricultural uses is not expected. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates will further reduce the likelihood of exposure of the species, its prey, and its habitat. We do not anticipate the loss of small numbers of individuals would result in species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new

label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Bone Cave harvestman. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Bone Cave harvestman and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Bone cave harvestman in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Fish and Wildlife Service (USFWS). 1994. Endangered Karst Invertebrates (Travis and Williamson Counties). Recovery Plan. Albuquerque, New Mexico. 162 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. Bone Cave Harvestman 5-Year Review. Austin, Texas. 24 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst InvertebratesRecovery Plan. USFWS Southwest Region, Albuquerque, NM. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Tartarocreagris texana	Tooth Cave pseudoscorpion	466

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations
(few)**Species Trends:** Unknown population
trends **Pesticides noted** ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The 2009 and 2018 5-Year Reviews report that *T. texana* spends its entire life underground and is endemic to karst formations (caves, sinkholes,and other subterranean voids) in Travis and Williamson counties, Texas. The Tooth Cave pseudoscorpion (TCP) was listed as endangered in 1988 based on the threats of: 1) habitat loss todevelopment; 2) cave collapse or filling; 3) alteration of drainage patterns; 4) alteration of surface plant and animal communities, including the invasion of exotic plants and predators (e.g., red-imported fire ant, *Solenopsis invicta*), changes in competition for limited resources and resulting nutrient depletion, and the loss of native vegetative cover leading to changes in surface microclimates and erosion; 5) contamination of the habitat, including groundwater, from nearby agricultural disturbance, pesticides, and fertilizers; 6) leakages and spills of hazardous materials from vehicles, tanks, pipelines, and other urban or industrial runoff; and 7) human visitation, vandalism, and dumping; and mining, quarrying (limestone), or blasting above or in caves. The 1994 Recovery Plan indicated that "most localities are imminently threatened by land development, pollution, vandalism, and/or red imported fire ants (*Solenopsis invicta*)."

Currently, this species faces the same threats that it did at the time of listing. There are only five caves known to support the species at the time of the 2018, 5-Year Review. The species depends on high humidity, stable temperatures, and nutrients derived from the surface. Examples of nutrient sources include leaf litter fallen or washed in, animal droppings, and animal carcasses. While these species spend their entire lives underground, their ecosystem is very dependent on the overlying surface habitat.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2009. Tooth Cave spider (*Neoleptoneta myopica*), Kretschmarr Cave mold beetle (*Texamaurops reddelli*), and Tooth Cave pseudoscorpion (*Tartarocreagris texana*) 5-year review. Austin, Texas. 15 pp.

U.S. Fish and Wildlife Service (USFWS). 2018. Tooth Cave Pseudoscorpion (*Tartarocreagris*

texana), 5-year review. Austin, Texas. 33 pp.

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: We anticipate the Tooth Cave pseudoscorpion will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the TCP exposed to malathion for all uses (except mosquito control) is approximately 21% with a low of <1% from nurseries, cotton, other row crops, vegetables and ground fruit, orchards and vineyards, pasture, and rice to a high of approximately 37% from mosquito control. We anticipate up to 42% additional mortality from spray drift from all use sites. 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	21%
Spray drift areas – mortality	Up to 42%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	21% arthropods
Spray drift areas - Prey item mortality	Up to 42% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	37%
Sublethal	NA
Indirect - mortality	37% arthropods

Risk modifiers: The TCP is known from 4 caves in Travis County, Texas (Tooth Cave, Amber Cave, Kretschmar Double Pit Cave, and Jester Estates Cave). The habitat for the TCP includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock). Very little is known about the life history of this and other subterranean arachnids (Cyndee Watson, USFWS, pers. comm., 2016). Like large mammals, they have few offspring and live relatively long lives (for invertebrates).

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are

derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the TCP relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the TCP range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey. While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 37% mortality to exposed TCP individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	243,103	37.11	0	0
Open Space Developed	D,I	60,940	9.3	3,079	0.47
Developed	D,I	40,572	6.19	2,031	0.31
Corn	D,I	23,837	3.64	1,376	0.21

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Other Grains	D,I	6,867	1.05	6,867	1.05
Wheat	D,I	4,659	0.71	4,323	0.66
Cotton	D,I	2,964	0.45	2,686	0.41
Other Crops	D,I	1,374	0.21	0	0
Orchards and Vineyards	D,I	479	0.07	479	0.07
Christmas Trees	D,I	360	0.05	360	0.05
Vegetables and Fruit	D,I	187	0.03	187	0.03
Nurseries	D,I	177	0.03	177	0.03
Pasture	D,I	58	<0.01	58	<0.01
Other RowCrops	D,I	11	<0.01	11	<0.01
Rice	D,I	1	<0.01	1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		142,485	21.73	21,635	3.31
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		142,485	21.73	21,635	3.31
TOTAL[4]:		385,587	58.84	21,635	3.31

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed used have less potential for spray drift than other uses.

 # acres in species range: 655,054 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 38,031 acres, 5.81%

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

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers*:* While the Tooth Cave pseudoscorpion is not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to

[4] TOTAL includes usage on all use sites with effects, including mosquito control.
[5] Indicates percent of the range where CalPUR data was used.

degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Tooth Cave pseudoscorpion by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing initial residues to 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 ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Tooth Cave pseudoscorpion. As discussed below, even though the vulnerability and risk are 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 very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

This species has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The risk to the individuals posed by the labeled uses across the range is also high, where exposure occurs. The karst habitats occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Mortality for the

Tooth Cave pseudoscorpion for all uses (except mosquito control) is 21%, and we anticipate an additional 42% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 37% mortality to exposed Tooth Cave pseudoscorpion individuals.

However, we anticipate usage will be low. Most of the species' range (>94%) overlaps non-Federal lands. While applications on non-Federal lands (e.g., agricultural lands) may reach the species and its prey through groundwater flow, based on the low anticipated usage (3.31%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range (<6% overlap), but we assume only low levels of malathion usage on Federal lands, per the rationale related to usage in these areas as described in the Biological Opinion. While usage is not expected on all use sites at the maximum rates allowed by the label, we anticipate that usage would occur, particularly from use occurring on open space developed and developed areas, which is found within the range of this species. Substantial exposure from agricultural uses is not expected. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. We do not anticipate the loss of small numbers of individuals would result in species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Tooth Cave pseudoscorpion. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Tooth Cave pseudoscorpion and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Tooth Cave pseudoscorpion in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst Invertebrates Recovery Plan. USFWS Southwest Region, Albuquerque, NM. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Leptoneta myopica	Tooth Cave spider	467

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s), Population size/location(s) unknown
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The 2018 5-Year Review documents 13 caves with records of the species in Travis County, Texas. The Tooth Cave spider (TCS) is restricted to the subterranean environment, in habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock). Karst areas commonly have few surface streams; most water moves through cavities underground. The species depends on high humidity, stable temperatures, and nutrients derived from the surface. This species was listed as endangered in 1988, based on the threats of: 1) habitat loss to development; 2) cave collapse or filling; 3) alteration of drainage patterns; 4) alteration of surface plant and animal communities, including the invasion of exotic plants and predators (e.g.,red-imported fire ant), changes in competition for limited resources and resulting nutrient depletion, and the loss of native vegetative cover leading to changes in surface microclimates and erosion; 5) contamination of the habitat, including groundwater, from nearby agricultural disturbance, pesticides, and fertilizers; 6) leakages and spills of hazardous materials from vehicles, tanks, pipelines, and other urban or industrial runoff; and 7) human visitation, vandalism, and dumping; and mining, quarrying (limestone), or blasting above or in caves.

Currently, this species faces the same threats that it did at the time it was listed.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2009. 5-year review for the Tooth Cave spider (*Neoleptoneta myopica*), Kretschmarr Cave mold beetle (*Texamaurops reddelli*), and Tooth Cave pseudoscorpion (*Tartarocreagris texana*). Austin, Texas. 15 pp.

U.S. Fish and Wildlife Service (USFWS). 2018. Tooth Cave spider (*Neoleptoneta myopica*), 5-year review. Austin, Texas. 35 pp.

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: We anticipate the Tooth Cave spider will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the TCS for all uses (except mosquito control) is 22% with a <1% from cotton, other crops, orchards and vineyards, Christmas trees, vegetables and ground fruit, nurseries, pasture, other row crops, and rice to a high of 38% from mosquito control. We anticipate up to 43% additional mortality from spray drift from all use sites. 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	22%
Spray drift areas – mortality	43%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	22% arthropods
Spray drift areas - Prey item mortality, host fish, forage for non-predators, etc.	Up to 43% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	38%
Sublethal	NA
Indirect - mortality	38% arthropods

Risk modifiers: The TCS is a known to live in six caves (Tooth Cave, Gallifer Cave, Geode Cave, Stovepipe Cave, New Comanche Trail Cave, and Moonmilk Cave) in Travis and Williamson counties, Texas, in the Edwards Plateau area (USFWS 2009). The habitat for the TCS includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock). The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the reproductive strategy of the TCS.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are

derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the TCS relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within its range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey.

While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 38% mortality to exposed TCS individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	528,853	38.29	23	<0.01
Open Space Developed	D,I	132,571	9.60	6,629	0.48
Developed	D,I	88,262	6.39	4,420	0.32
Corn	D,I	51,855	3.75	3,039	0.22

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Other Grains	D,I	14,938	1.08	14,938	1.08
Wheat	D,I	9,823	0.71	9,116	0.66
Cotton	D,I	6,447	0.47	5,801	0.42
Other Crops	D,I	2,989	0.22	0	0
Orchards and Vineyards	D,I	1,042	0.08	1,042	0.08
Christmas Trees	D,I	784	0.06	784	0.06
Vegetables and Fruit	D,I	407	0.03	407	0.03
Nurseries	D,I	385	0.03	385	0.03
Pasture	D,I	127	<0.01	127	<0.01
Other RowCrops	D,I	24	<0.01	24	<0.01
Rice	D,I	2	<0.01	2	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		309,656	22.42	46,714	3.41
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		309,656	22.42	46,714	3.41
TOTAL[4]:		838,509	60.71	46,737	3.42

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed used have less potential for spray drift than other uses.

 # acres in species range: 1,381,145 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 38,852 acres, 2.81%

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

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Tooth Cave spider is not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural

[4] TOTAL includes usage on all use sites with effects, including mosquito control.
[5] Indicates percent of the range where CalPUR data was used.

and residential uses will likely reduce the level of effects impacting the Tooth Cave spider by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing initial residues to 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 ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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

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

The Tooth Cave spider has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s).

Mortality for the Tooth Cave spider for all uses (except mosquito control) is 22%, and we anticipate an additional 43% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 38% mortality to exposed Tooth Cave

spider individuals. However, we anticipate usage will be low over most of the species' range. Most of the species' range (>97%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands (e.g., agricultural lands) may reach the species and its prey through groundwater flow, as described above, based on the low anticipated usage (3.42%), in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of malathion usage on Federal lands (2.81% overlap), per the rationale related to usage in these areas as described in the Biological Opinion. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. We do not anticipate the loss of small numbers of individuals would result in species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Tooth Cave spider. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Tooth Cave spider and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Tooth Cave spider in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst Invertebrates Recovery Plan. USFWS Southwest Region, Albuquerque, NM. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Microhexura montivaga	Spruce-fir moss spider	468

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations
(few),**Species Trends:** Unknown population
trends **Pesticides noted** ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The spruce-fir moss spider (SFMS) is historically known from four mountain peaks in the high-altitude spruce-fir forest in western North Carolina and one in eastern Tennessee. According to the 1998 Recovery Plan and 2015 5-Year Review, habitat at all four of these sites has been severely degraded. The 2021 5-Year Review reports that the spider currently exists on 22 mountain tops along six geographically isolated mountain ranges (Coyle 2009, as cited USFWS 2015). One or more distinct rock outcrop populations or subpopulations exist within each mountain range. These six montane populations occur in the Virginia Balsam Mountains (Virginia), Grandfather Mountain (North Carolina), Roan Mountain (North Carolina/Tennessee), Black Mountains (North Carolina), Plott Balsam Mountains (North Carolina), and Great Smoky Mountains (North Carolina/Tennessee). The most recent surveys conducted by Dr. Coyle (2009) were the most comprehensive to date with sampling efforts in all areas with suitable habitat in the southern Appalachian Mountains. New populations were discovered in areas not previously surveyed in the Virginia Balsams in Virginia and the Plott Balsams in North Carolina. This extends the range of the species north and south, but these populations appear to be extremely small and vulnerable.

The species' typical habitat appears to be associated with moist, well-drained moss mats growing on rocks and boulders in well-shaded situations in mature high-elevation conifer forests dominated by Fraser fir, *Abies fraseri*, often with scattered red spruce, *Picea rubens*. These forests are deteriorating rapidly, primarily because of mortality of the fir due to balsam woolly adelgid (an exotic insect pest) infestations and possibly air pollution and other factors not yet fully understood. The SFMS, and possibly itsprey base, appears to be very sensitive to desiccation and requires situations of high and constant humidity. The loss of forest canopy leading to increased light and decreased moisture on the forest floor (resulting in desiccation of the moss mats) appears to be the major threat to the SFMS' continued existence. In addition to the balsam woolly adelgid, the combined effects of several other factors are also believed to be stressing and contributing to the decline of the high-elevation spruce-fir forest stands.
While reasons for the decline of red spruce are complex and controversial, regional-scale air

pollution, in combination with other stress factors, has been implicated to have played a role in the deterioration of the health of high-elevation red spruce in the Southern Appalachians. Due to the species' history of population loss and decline and the extreme vulnerability of the surviving populations, SFMS was listed as endangered in 1995. The restricted range of each of the surviving populations of SFMS causes them to be extremely vulnerable to extirpation from a single event or activity, such as a drought, severe storm, wildfire, land-clearing or timber-harvesting operation, pesticide/herbicide application. In addition, the SFMS and the moss mats it inhabits are very fragile and easily destroyed by human trampling. One population appears to be restricted to the moss mats on a single rock outcrop and a few surrounding boulders. Trampling or other significant disturbance of the moss mats or damage to the surrounding vegetation shading the mats could result in the extirpation of this population.

The threat of climate change was not addressed at the time of listing or in the recovery plan. Climate change predictions vary but continued warming and an increase in the rate of warming is expected in the southeast (Karl et al. 2009, as cited in USFWS 2015). More frequent droughts would likely lead to drying of the moist microhabitats needed by the spider.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 1998. Recovery Plan for the spruce-fir moss spider, *Microhexura montivaga.* Atlanta, Georgia. 28 pp.

U.S. Fish and Wildlife Service (USFWS). 2014. 5-year review for the spruce-fir moss spider, *Microhexura montivaga.* Asheville, North Carolina. 20 pp.

U.S. Fish and Wildlife Service (USFWS). 2021. 5-year review for the spruce-fir moss spider, *Microhexura montivaga.* Asheville, North Carolina. 19 pp.

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
We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the SFMS exposed to malathion for all uses is approximately 0.16% with use sites all below 1% We do not anticipate any additional mortality from spray drift from all use sites. The table below summarizes the risk to the species from labelled uses across the range based on range overlapswith use sites and anticipated effects associated with the particular uses.

DIRECT (all uses except mosquito control)	

Use areas – mortality	0.16%
Spray drift areas – mortality	Up to 0.16%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Expect additional exposure; the magnitudeof increased exposure is uncertain
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	0.16%
Spray drift areas - Prey item mortality	Up to 0.16%
Plants affected (decline in growth), host fish, forage base for non-predators, etc.	NA
MOSQUITO CONTROL	
Direct - mortality	0%
Sublethal	NA
Indirect - mortality	0%

Risk modifiers: The SFMS' typical habitat appears to be associated with moist, well-drained moss mats growing on rocks and boulders in well-shaded situations in mature high-elevation conifer forests dominated by Fraser fir, often with scattered red spruce. Most recently has been found among pure red spruce (USFWS 2008). Female SFMS lay eggs in June and spiderlings emerge during September (Coyle 1981). Males mature during September and October, evidently at either 2 or 3 years of age (Coyle 1997). It has been estimated that it may take at least 2 to 3 years for spruce-fir moss spiders to reach maturity.

Allowable uses driving effects/other considerations: Overall the SFMS is not expected to use Christmas tree farms, but there is a possibility that they could enter one if it was close to their preferred habitat (Susan Cameron, USFWS, pers. comm., 2016).

The SFMS has not been observed taking prey in the wild nor is there any record of prey having been found in its webs, but the abundant springtails (*Collembola sp.*) found in moss mats with the spiders provide the most likely source of food (Susan Cameron, USFWS, pers. comm., 2016). The dietary items for this species likely include terrestrial invertebrates. Because the SFMS relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the SFMS range if food sources are in their habitat. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore it is unlikely the population would experience sublethal impacts. Populations exposed to malathion on sites of application would experience 6.4% mortality and populations exposed adjacent to the sites of application via spray drift at the maximum application rates would experience 21.8% mortality each year.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Open Space Developed	D,I	155	0.15	7.7	0.008
Developed	D,I	0.8	0.0008	0.04	0.00004
Corn	D,I	0.7	0.0007	0.7	0.0007
Other Crops	D,I	0.15	0.0001	0	0
Orchards and Vineyards	D,I	0.04	0.00004	0.04	0.00004
Vegetables and Fruit	D,I	4.6	0.005	4.6	0.005
Pasture	D,I	0.07	0.00007	0.07	0.00007
Sub-TOTAL (D): *Other uses with direct effects only*		161.36	0.15671	13.15	0.01385
Sub- TOTAL (I): *Other uses with indirect effects Only*		161.36	0.15671	13.15	0.01385
TOTAL:		161.36	0.15671	13.15	0.01385

This species consumes invertebrates, therefore, malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed use have less potential for spray drift than other uses.

 # acres in species range: 101,266 acres
% of range in California (i.e., where CalPUR data is available)[3]: 0%
Range overlap with Federal lands: 92,446 acres, 91.3%

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 proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the spruce-fir moss spider. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low, primarily based on the high level of overlap of the species' range

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Indicates percent of the range where CalPUR data was used.

with Federal lands. While we anticipate that very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The spruce-fir moss spider has a high vulnerability based on its status, distribution, and trends. The risk to the individuals posed by the labeled uses across the range is also high, particularly from spray drift, but there is a low amount of estimated usage within the range of the species. We anticipate that usage will occur on <1% of the species range annually based on standard usage data. Ninety-one percent of the species' range overlaps with Federal lands. We did not quantitatively evaluate use or usage on in these areas, per the rationale related to usage in these areas as described in the Biological Opinion. While we do anticipate that adverse effects to small numbers of individuals and their prey items will occur, we do not expect species-level effects because of the extremely low usage within the species range. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the spruce-fir moss spider in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

Coyle, F. A. 1981. The mygalomorph spider genus *Microhexura* (Araneae, Dipluridae). Bulletin of the American Museum of Natural History 170: 64-75.

Coyle, F. A. 1997. Status survey of the endangered spruce-fir moss spider, *Microhexura montivaga*. Report to the U.S. Department of the Interior, Fish and Wildlife Service, Asheville Field Office. 8 pp.

U.S. Fish and Wildlife Service (USFWS). 2008. Recovery Plan for the Spruce-fir moss spider, *Microhexura montivaga.* Atlanta, Georgia. 28 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Texella cokendolpheri	Cokendolpher Cave harvestman	469

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Population size/location(s) unknown
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The 2011 Recovery Plan reports that the Cokendolpher Cave harvestman (CCH) is only known from karst areas in Bexar County, Texas. However, suitable karst habitat extends into Medina County, so the species could possibly be found there during future search efforts. Population estimates are unavailable for thespecies due to lack of adequate techniques, their cryptic behavior, inaccessibility of mesocaverns, and difficulty accessing cave and karst habitat.

One of the main threats to the listed invertebrate is habitat loss due to increasing urbanization and human population growth. Effects of urbanization on the listed species include habitat loss from filling and collapsing caves, habitat degradation through alteration of drainage patterns, alteration of surface plant and animal communities, edge effects, contamination from pollutants, human visitation, vandalism, and activities associated with mining and quarrying. Karst landscapes are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits and little or no filtration occurs. In some areas the water that moves through the habitat of these species' percolates to the Edwards Aquifer below. The ranges of these species are becoming increasingly urbanized and thereby are becoming more susceptible to contaminants including sewage, oil, fertilizers, pesticides, herbicides, seepage from landfills, pipeline leaks, or leaks in storage structures and retaining ponds. Activities on the surface, such as disposing of toxic chemicals or motor oil, can also contaminate caves.

The 2020 5-Year Review reports that no specific studies have been conducted to determine the effects of changes in the surface and subsurface drainage basins on the hydrology of the cave. However, anecdotal observations between the 1970s and 1990 noted a decline in moisture throughout the cave (Veni and Associates 1997, p. 29, this and following references as cited in USFWS 2020). More recent observations have noted that some areas may also be receiving additional moisture (George Veni, pers. comm., April 12, 2020). Additional research is needed to determine the potential for the red-imported fire and tawny crazy ants to affect Cokendolpher cave harvestman populations. A National Oceanic and Atmospheric Administration (NOAA) report assessing the effect of climate change on Texas asserts that by the end of the 21st century

even under lower emissions scenarios (e.g., Representative Concentration Pathways (RCPs) 4.5), the coldest years will feel like the warmest years today, and the warmest years will be about 6 degrees (Fahrenheit) warmer than the hottest year from the historical record (Runkle et al. 2017, p. 1). Warming under a higher emissions scenario (RCP 8.5) would lead to higher temperatures (Runkle et al. 2017, p. 1). If surface temperature increases and longer dry periods and reduced soil moisture lead to changes in the climate of the deep cave zones, this could reduce or eliminate available habitat within occupied caves, thus affecting the Cokendolpher cave harvestman.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst Invertebrates Recovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.

U.S. Fish and Wildlife Service (USFWS). 2020. 5-year review for the Cokendolpher Cave Harvestman (*Texella cokendolpheri*). Austin, Texas. 16 pp.

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: We anticipate the Cokendolpher cave harvestman will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the CCH for all uses (except mosquito control) is approximately 43% with use sites ranging from lows of <1% from nurseries, cotton, other row crops, vegetables and ground fruit, orchards and vineyards, pasture, and rice to a high of 94% from mosquito control. We anticipate up to 55% additional mortality from spray drift from all use sites. 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	43%
Spray drift areas – mortality	Up to 55%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	43% arthropods
Spray drift areas - Prey item mortality	Up to 55% arthropods

Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	94%
Sublethal	NA
Indirect - mortality	94% arthropods

Risk modifiers: The CCH is in the order Opiliones, not closely related to other arachnids, often confused with spiders (order Araneae). The habitat for the CCH includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock). The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the reproductive strategy of the CCH.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the CCH relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the CCH range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey. While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 94% mortality to exposed TCS individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage in range[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	759,901	94.54	26	<0.01
Open Space Developed	D,I	110,153	13.70	5,546	0.69
Developed	D,I	185,236	23.04	9,244	1.15
Corn	D,I	11,418	1.42	4,099	0.51
Other Grains	D,I	20,786	2.59	20,786	2.59
Wheat	D,I	9,914	1.23	9,914	1.23
Cotton	D,I	1,891	0.24	1,849	0.23
Other Crops	D,I	3,768	0.47	0	0
Orchards and Vineyards	D,I	41	<0.01	41	<0.01
Vegetables andFruit	D,I	65	<0.01	65	<0.01
Nurseries	D,I	2,052	0.26	2,052	0.26
Pasture	D,I	1	<0.01	1	<0.01
Other Row Crops	D,I	362	0.05	362	0.05
Rice	D,I	<1	<0.01	<1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		346,687	43	53,959	6.73
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		345,687	43	53,959	6.73
TOTAL[4]:		1,105,589	137.54	53,985	6.74

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site. Developed and open space developed used have less potential for spray drift than other uses.

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.

 # acres in species range: 803,805 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 44,495 acres, 5.54%

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

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Cokendolpher Cave harvestman is not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Cokendolpher Cave harvestman by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing initial residues to 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 (excluding use for the Boll Weevil Eradication Program, although this program has a history of implementation with conservation measures in place[6]), orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help reduce the amount of malathion

[5] Indicates percent of the range where CalPUR data was used.
[6] While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the *Description of the Action* section of the Opinion. For example, the 2018 FWS information section 7(a)(2) consultation with APHIS includes the following conservation measure for the Cokendolpher Cave harvestman: "To protect invertebrate prey base (e.g., crickets), no ground use of Program insecticides within 320 feet and no aerial use within 1,320 feet of the critical habitat of this species." As of 2020, the Texas Boll Weevil Eradication Quarantine status map, shows Bexar County, Texas as functionally eradicated (USDA 2020).

used and decrease potential exposure to the species, thus decreasing the risk of both indirect and direct effects to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Cokendolpher Cave harvestman. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion primarily due to the large degree of overlap of the species range with Federal lands, where usage is expected to be low. In addition, the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

The species has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The risk to the individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Mortality for the Cokendolpher Cave harvestman for all uses (except mosquito control) is 43%, and we anticipate an additional 55% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 94% mortality to exposed Cokendolpher Cave harvestman individuals.

However, we anticipate usage across most of the species' range will be low. Most of the species' range (93%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands (e.g., agricultural lands) may reach the species and its prey through groundwater flow, as described above, based on the medium anticipated usage (6.74%) in these areas, we anticipate effects only to very small numbers of individuals over the duration of the proposed action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range (5.54% overlap), but we assume only low levels of malathion usage in these areas, per the rationale related to usage in these areas as described in the Biological Opinion. We anticipate effects to only very small numbers of individuals over the duration of the proposed action, either through contact with malathion or through their prey. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. This level of anticipated malathion usage is not anticipated to result in species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Cokendolpher Cave harvestman. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Cokendolpher Cave harvestman and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Cokendolpher Cave harvestman in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service. 2020. 2020 Texas Boll Weevil Eradication Quarantine Status. Electronic source accessed on February 8, 2022, at: https://www.txbollweevil.org/Downloads/Quarantine%20Status%20for%20Website.pdf.

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst InvertebratesRecovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Neoleptoneta microps	Government Canyon Bat Cave spider	470

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Population size/location(s) unknown,
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The Government Canyon Bat Cave spider (GCBCS) is known from one cave in Bexar County, Texas. The 2021 5-Year Review reports the Service is working with the City of San Antonio to recognize this area as a high-quality Karst Fauna Areas (KFA) for this species. While there may be a potential for additional populations in the currently protected areas within the Government Canyon Karst Fauna Region, surveys to date have failed to identify any additional populations. Potential habitat exists in areas outside the park and adjacent preserves; however, those areas will continue to be subject to increasing development pressures. The species relies on high humidity, stable temperatures, suitable substrates and surface-derived nutrients.

The primary threat to the species is habitat destruction by (1) completely filling the cave with cement during development, (2) quarrying activities, and (3) capping or sealing cave entrances. Other habitat degradation includes altering drainage patterns, native surface plant and animal communities, reducing or increasing nutrient flow, contamination, excessive human visitation, and threats fromor competition with non-native, invasive species. Bexar County is facing continued rapid population growth and associated urbanization. Karst landscapes are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits and little or no filtration occurs. In some areas the water that moves through the habitat of these species' percolates to the Edwards Aquifer below. The Edwards Aquifer is an important source of drinking water for 1.7 million people. So, information on sources of water contamination of the Edwards Aquifer may also be indicative of sources of contamination of karst invertebrate habitat. The ranges of these species are becoming increasingly urbanized and thereby are becoming more susceptible to contaminants including sewage, oil, fertilizers, pesticides, herbicides, seepage from landfills, pipeline leaks, or leaks in storage structures and retaining ponds. Activities on the surface, such as disposing of toxic chemicals or motor oil, can also contaminate caves.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2011. Final Recovery Plan Bexar County Karst

Invertebrates. Albuquerque, New Mexico. 84 pp.

U.S. Fish and Wildlife Service (USFWS). 2021. 5-year review for the Government Canyon Bat Cave Spider (*Tayshaneta* [=*Neoleptona*] *microps*). Austin, Texas. 16 pp.

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: We anticipate the Government Canyon Bat Cave spider will experience direct mortality for most uses of malathion at maximum use rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the GCBCS for all uses (except mosquito control) is approximately 43% with use sites of <1% from nurseries, cotton, other row crops, vegetables and ground fruit, orchards and vineyards, pasture, and rice to a high of 94% from mosquito control. We anticipate up to 55% additional mortality from spray drift from all use sites. 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	43%
Spray drift areas – mortality	Up to 55%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	43% arthropods
Spray drift areas - Prey item mortality	Up to 55% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	94%
Sublethal	NA
Indirect - mortality	94% arthropods

Risk modifiers: The GCBCS is a known to live in two caves within Bexar County, Texas: Government Canyon Bat Cave and Surprise Sink. The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the

reproductive strategy of the GCBCS.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp.*) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the GCBCS relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the GCBCS range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey.

While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 94% mortality to exposed GCBCS individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
Mosquito	D,I	759,901	94.54	52	<0.01

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
control[3]					
Open Space Developed	D,I	110,153	13.7	5,546	0.69
Developed	D,I	185,236	23.04	9,244	1.15
Corn	D,I	11,418	1.42	4,099	0.51
Other Grains	D,I	20,786	2.59	20,786	2.59
Wheat	D,I	9,914	1.23	9,914	1.23
Cotton	D,I	1,891	0.24	1,849	0.23
Other Crops	D,I	3,768	0.47	0	0
Orchards and Vineyards	D,I	41	<0.01	41	<0.01
Vegetables and Fruit	D,I	65	<0.01	65	<0.01
Nurseries	D,I	2,052	0.26	2,052	0.26
Pasture	D,I	1	<0.01	1	<0.01
Other RowCrops	D,I	362	0.05	362	0.06
Rice	D,I	<1	<0.01	<1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		346,687	43	53,959	6.73
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		345,687	43	53,959	6.73
TOTAL[4]:		1,105,589	137.54	54,011	6.74

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed used have less potential for spray drift than other uses.

 # acres in species range: 803,8056 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 44,495 acres, 5.54%

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

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Government Canyon Bat Cave spider is

[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.
[5] Indicates percent of the range where CalPUR data was used.

not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Government Canyon Bat Cave spider by substantially reducing the amount of malathion that would reach the subsurface habitats of which this species resides.

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 by allowing initial residues to 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 (excluding use for the Boll Weevil Eradication Program, although this program has a history of implementation with conservation measures in place[6]), orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Government Canyon Bat Cave spider. As discussed

[6] While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the *Description of the Action* section of the Opinion. For example, the 2018 FWS information section 7(a)(2) consultation with APHIS includes the following conservation measure for the Government Canyon Bat Cave Spider: "To protect invertebrate prey base (e.g., crickets), no ground use of Program insecticides within 320 feet and no aerial use within 1,320 feet of the critical habitat of this species." As of 2020, the Texas Boll Weevil Eradication Quarantine status map, shows Bexar County, Texas as functionally eradicated (USDA 2020).

below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low, based primarily on the high level of overlap of the species' range with Federal lands, where we anticipate usage to be low. In addition, the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that very small numbers of individuals may be affected over the duration of the proposed action, we do notexpect species-level effects to occur.

This species has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The risk to the individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Mortality for the Government Canyon Bat Cave spider for all uses (except mosquito control) is 43%, and we anticipate an additional 55% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 94% mortality to exposed Government Canyon Bat Cave spider individuals.

However, we anticipate usage will be low. Most of the species' range (>94%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands may reach the species and its prey through groundwater flow, as described above, based on the moderate levels of anticipated usage (6.74%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range (5.54% overlap), but we assume only low levels of malathion usage on Federal lands, per the rationale related to usage in these areas as described in the Biological Opinion. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. Thus, we do not anticipate species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Government Canyon Bat Cave spider. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and

runoff exposure to the Government Canyon Bat Cave spider and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Government Canyon Bat Cave spider in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service. 2020. 2020 Texas Boll Weevil Eradication Quarantine Status. Electronic source accessed on February 8, 2022, at: https://www.txbollweevil.org/Downloads/Quarantine%20Status%20for%20Website.pdf.

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst InvertebratesRecovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Cicurina madla	Madla's Cave meshweaver	471

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The 2019 5-Year Review reports that Madla's Cave meshweaver (MCM) is known from 23 caves in Bexar County, Texas. It relies on high humidity, stable temperatures, suitable substrates and surface-derived nutrients.

The stressors that most influence the Madla Cave meshweaver's viability are habitat destruction, degradation, and fragmentation that results from urban development. Bexar County is facing continued rapid population growth and associated urbanization. Much of this growth is occurring in areas where endangered invertebrates are most likely to occur. Karst landscapes are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits and little or no filtration occurs. In some areas the water that moves through the habitat of these species' percolates to the Edwards Aquifer below. Based on a review of available data, three of the five karst faunal regions where the Madla Cave meshweaver occurs have three or more areas currently of sufficient resiliency with the potential to support Madla Cave meshweaver populations over the long-term. Larger tracts of open space with natural vegetation surround these caves, providing higher quality cave cricket foraging habitat and greater potential for connectivity among karst features to support cricket populations, which are prey items for this species. Persistence of Madla Cave meshweaver populations at these sites, however, are dependent upon management and perpetual protection that maintains adequate open space, sufficient buffering from edge effects, intact foraging areas for cave crickets, and sufficient quantity and quality of water from intact drainage basins. Projections indicate that the human population of Bexar County area will continue to grow from 1,986,049 people in 2018 to 3,353,060 people in 2050 (Texas Demographic Center 2018). Such significant human population growth is projected to result in increased conversion of natural surface habitat to urban land uses through 2060 (Nowak and Greenfield 2018, p. 170).

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2019. 5-year review for the Madla Cave meshweaver. Austin, Texas. 42 pp.

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: We anticipate the Madla's Cave meshweaver will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the MCM for all uses (except mosquito control) is approximately 43% with a low of <1% from nurseries, cotton, other row crops, vegetables and ground fruit, orchards and vineyards, pasture, and rice to a high of approximately of 94% from mosquito control. We anticipate up to 55% additional mortality from spray drift from all use sites. 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	43%
Spray drift areas – mortality	Up to 55%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	43% arthropods
Spray drift areas - Prey item mortality	Up to 55% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	94%
Sublethal	NA
Indirect - mortality	Up to 94%

Risk modifiers: MCM is found in 22 Caves in Bexar County, TX: Christmas Cave, Madla's Cave, Madla's Drop Cave, Helotes Blowhole, Helotes Hilltop Cave, Headquarters Cave, Breathless Cave, Feature No. 50, Hills and Dales Pit, John Wagner Ranch Cave No. 3, La Cantera Cave No. 1, Robber's Cave, Unnamed Cave Holotes Area, Fat man's Nightmare Cave, Lithic Ridge Cave, Lost Pothole, Pig Cave, San Antonio Ranch Pit, Scenic Overlook Cave, Surprise Sink, plus two others. Very little is known about the life history of this and other subterranean arachnids (Cyndee Watson, USFWS, pers. comm., 2016). The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known

about the reproductive strategy of the MCM.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the MCM relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the MCM range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey.

While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 94% mortality to exposed MCM individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	759,901	94.54	26	<0.01
Open Space Developed	D,I	110,153	13.70	5,546	0.69
Developed	D,I	185,236	23.04	9,244	1.15
Corn	D,I	11,418	1.42	4,099	0.51
Other Grains	D,I	20,786	2.59	20,786	2.59
Wheat	D,I	9,914	1.23	9,914	1.23
Cotton	D,I	1,891	0.24	1,849	0.23
Other Crops	D,I	3,768	0.47	0	0
Orchards and Vineyards	D,I	41	<0.01	41	<0.01
Vegetables and Fruit	D,I	65	<0.01	65	<0.01
Nurseries	D,I	2,052	0.26	2,052	0.26
Pasture	D,I	1	<0.01	1	<0.01
Other Row Crops	D,I	362	0.05	362	0.05
Rice	D,I	<1	<0.01	<1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		346,687	43	53,959	6.73
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		345,687	43	53,959	6.73
TOTAL[4]:		1,105,589	137.54	53,985	6.74

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed used have less potential for spray drift than other uses.

 # acres in species range: 803,854 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 44,498 acres, 5.54%

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

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.
[5] Indicates percent of the range where CalPUR data was used.

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Madla's Cave meshweaver is not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Madla's Cave meshweaver by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing initial residues to 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 (excluding use for the Boll Weevil Eradication Program, although this program has a history of implementation with conservation measures in place[6]), cotton, orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the

[6] While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the *Description of the Action* section of the Opinion. For example, the 2018 FWS information section 7(a)(2) consultation with APHIS includes the following conservation measure for the Madla's Cave meshweaver: "To protect invertebrate prey base (e.g., crickets), no ground use of Program insecticides within 320 feet and no aerial use within 1,320 feet of the critical habitat of this species." As of 2020, the Texas Boll Weevil Eradication Quarantine status map, shows Bexar County, Texas as functionally eradicated (USDA 2020).

Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Madla's Cave meshweaver. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low, primarily due to the high overlap of the species' range with Federal lands. In addition, the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

This species has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The risk to the individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Mortality for the MCM for all uses (except mosquito control) is 43%, and we anticipate an additional 55% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 94% mortality to exposed MCM.

However, we anticipate usage will be low. Most of the species' range (>94%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands may reach the species and its prey through groundwater flow, as described above, based on the moderate levels of anticipated usage (6.74%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of malathion usage on Federal lands (5.54% overlap), per the rationale related to usage in these areas as described in the Biological Opinion. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. Thus, we do not anticipate species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Madla's Cave meshweaver. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and

runoff exposure to the Madla's Cave meshweaver and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Madla's Cave meshweaver in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service. 2020. 2020 Texas Boll Weevil Eradication Quarantine Status. Electronic source accessed on February 8, 2022, at: https://www.txbollweevil.org/Downloads/Quarantine%20Status%20for%20Website.pdf.

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst Invertebrates Recovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Cicurina baronia	Robber Baron Cave meshweaver	472

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Population size/location(s) unknown
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The 2011 Recovery Plan and the 2020 5-Year Review report that the Robber Baron Cave meshweaver (RBCM) is known from one karst limestone cave in Bexar County, Texas. It relies on high humidity, stable temperatures, suitable substrates and surface- derived nutrients. The primary threat is habitat destruction by (1) completely filling the cave withcement during development, (2) quarrying activities, and (3) capping or sealing cave entrances.

Other habitat degradation includes altering drainage patterns, native surface plant and animal communities, reducing or increasing nutrient flow, contamination, excessive human visitation, and threats from or competition with non-native, invasive species. Bexar County is also facing continued rapid population growth and associated urbanization. Karst landscapes are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits and little or no filtration occurs. In some areas the water that moves through the habitat of these species' percolates to the Edwards Aquifer below. The Edwards Aquifer is an important source of drinking water for 1.7 million people. So, information on sources of water contamination of the Edwards Aquifer may also be indicative of sources of contamination of karst invertebrate habitat. The ranges of these species are becoming increasingly urbanized and thereby are becoming more susceptible to contaminants including sewage, oil, fertilizers, pesticides, herbicides, seepage from landfills, pipeline leaks, or leaks in storage structures and retaining ponds. Activities on the surface, such as disposing of toxic chemicals or motor oil, can also contaminate caves.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2011. Final Recovery Plan Bexar County Karst Invertebrates. Albuquerque, New Mexico. 84 pp.

U.S. Fish and Wildlife Service (USFWS). 2020. Robber Baron Cave Meshweaver (*Cicurina baronia*) 5-Year Review Summary and Evaluation. Austin, Texas. 28 pp.
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: We anticipate the Robber Baron Cave meshweaver will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the RBCM for all uses (except mosquito control) is 43% with a <1% from nurseries, cotton, other row crops, vegetables and ground fruit, orchards and vineyards, pasture, and rice to a high of 94% from mosquito control. We anticipate up to 55% additional mortality from spray drift from all use sites. 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	43%
Spray drift areas – mortality	Up to 55%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	43% arthropods
Spray drift areas - Prey item mortality	Up to 55% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	94%
Sublethal	NA
Indirect - mortality	94% arthropods

Risk modifiers: The RBCM is a known to live in two caves within Bexar County, Texas. The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the reproductive strategy of the RBCM.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing

dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the RBCM relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the RBCM range if food sources are washed in or wander into caves. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 94% mortality to exposed RBCM individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	759,901	94.54	26	<0.01
Open Space Developed	D,I	110,153	13.70	5,546	0.69
Developed	D,I	185,236	23.04	9,244	1.15
Corn	D,I	11,418	1.42	4,099	0.51
Other Grains	D,I	20,786	2.59	20,786	2.59
Wheat	D,I	9,914	1.23	9,914	1.23
Cotton	D,I	1,891	0.24	1,849	0.23
Other Crops	D,I	3,768	0.47	0	0
Orchards and Vineyards	D,I	41	<0.01	41	<0.01
Vegetables and Fruit	D,I	65	<0.01	65	<0.01
Nurseries	D,I	2,052	0.26	2,052	0.26

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
Pasture	D,I	1	<0.01	1	<0.01
Other RowCrops	D,I	362	0.05	362	0.05
Rice	D,I	<1	<0.01	<1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		346,687	43	53,959	6.73
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		345,687	43	53,959	6.73
TOTAL[4]:		1,105,589	137.54	53,985	6.74

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed used have less potential for spray drift than other uses.

 # acres in species range: 803,854 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 44,498 acres, 5.54%

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

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Robber Baron Cave meshweaver is not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Robber Baron Cave meshweaver by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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%

[4] TOTAL includes usage on all use sites with effects, including mosquito control.
[5] Indicates percent of the range where CalPUR data was used.

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 by allowing initial residues to 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 (excluding use for the Boll Weevil Eradication Program, although this program has a history of implementation with conservation measures in place[6]), cotton, orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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

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

Although there is a low amount of estimated usage within the range of the species based on standard usage data, the RBCM has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The risk to the individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals

[6] While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the *Description of the Action* section of the Opinion. For example, the 2018 FWS information section 7(a)(2) consultation with APHIS includes the following conservation measure for the Robber Baron Cave meshweaver: "To protect invertebrate prey base (e.g., crickets), no ground use of Program insecticides within 320 feet and no aerial use within 1,320 feet of the critical habitat of this species." As of 2020, the Texas Boll Weevil Eradication Quarantine status map, shows Bexar County, Texas as functionally eradicated (USDA 2020).

are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Mortality for the RBCM for all uses (except mosquito control) is 44%, and we anticipate an additional 55% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 94% mortality to exposed RBCM individuals.

However, we anticipate usage will be low. Most of the species' range (>94%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands may reach the species and its prey through groundwater flow, as described above, based on the moderate levels of anticipated usage (6.74%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of malathion usage on Federal lands (5.54% overlap), per the rationale related to usage in these areas as described in the Biological Opinion. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. Thus, we do not anticipate species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Robber Baron Cave meshweaver. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Robber Baron Cave meshweaver and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Robber Baron Cave meshweaver in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service. 2020. 2020 Texas Boll Weevil Eradication Quarantine Status.

Electronic source accessed on February 8, 2022, at:

https://www.txbollweevil.org/Downloads/Quarantine%20Status%20for%20Website.pdf.

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst InvertebratesRecovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Cicurina vespera	Government Canyon Bat Cave meshweaver	473

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Small number of populations
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The 2011 5-Year review reported the Government Canyon Bat Cave meshweaver (GCBCM) was known from just one cave in Bexar County, Texas. The 2019 5-Year Review included updated information, including confirmation of the species in at least 17 caves. These animals depend on high humidity, stable temperatures, suitable substrates (for example, spaces between and underneath rocks), and surface-derived nutrients. Primary threat is habitat destruction by (1) completely filling the cave with cement during development, (2) quarrying activities, and (3) capping or sealing cave entrances. Other habitat degradation includes altering drainage patterns, native surface plant and animal communities, reducing or increasing nutrient flow, contamination, excessive human visitation, and threats from or competition with non-native, invasive species. Bexar County is facing continued rapid population growth and associated urbanization. Much of this growth is occurring in areas where endangered invertebrates are most likely to occur. Karst landscapes are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits and little or no filtration occurs. In some areas the water that moves through the habitat of these species' percolates to the Edwards Aquifer below. The Edwards Aquifer is an important source of drinking water for 1.7 million people. So, information on sources of water contamination of the Edwards Aquifer may also be indicative of sources of contamination of karst invertebrate habitat. The ranges of these species are becoming increasingly urbanized and thereby are becoming more susceptible to contaminants including sewage, oil, fertilizers, pesticides, herbicides, seepage from landfills, pipeline leaks, or leaks in storage structures and retaining ponds. Activities on the surface, such as disposing of toxic chemicals or motor oil, can also contaminate caves.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2011. Final Recovery Plan Bexar County Karst Invertebrates. Albuquerque, New Mexico. 84 pp.

U.S. Fish and Wildlife Service (USFWS). 2019. Government Canyon Bat Cave Meshweaver (*Cicurina vespera*). 5-Year Review: Summary and Evaluation. Austin, Texas. 40 pp.

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: We anticipate the Government Canyon Bat Cave meshweaver will experience direct mortality for most uses of malathion at maximum rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the GCBCM for all uses (except mosquito control) is approximately 43% with use sites of <1% from nurseries, cotton, other row crops, vegetables and ground fruit, orchards and vineyards, pasture, and rice to a high of 94% from mosquito control. We anticipate up to 55% additional mortality from spray drift from all use sites. 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	43%
Spray drift areas – mortality	Up to 55%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	43% arthropods
Spray drift areas - Prey item mortality	Up to 55% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	94%
Sublethal	NA
Indirect - mortality	94% arthropods

Risk modifiers: The GCBCM is a known to live in one cave within Bexar County, Texas. The reproductive strategy for most cave invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the reproductive strategy of the GCBCM.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some

cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the GCBCM relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the GCBCM range if food sources are within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey. While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 94% mortality to exposed GCBCM individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	759,901	94.54	26	<0.01
Open Space Developed	D,I	110,153	13.70	5,546	0.69
Developed	D,I	185,236	23.04	9,244	1.15
Corn	D,I	11,418	1.42	4,099	0.51
Other Grains	D,I	20,786	2.59	20,786	2.59

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
Wheat	D,I	9,914	1.23	9,914	1.23
Cotton	D,I	1,891	0.24	1,849	0.23
Other Crops	D,I	3,768	0.47	0	0
Orchards and Vineyards	D,I	41	<0.01	41	<0.01
Vegetables and Fruit	D,I	65	<0.01	65	<0.01
Nurseries	D,I	2,052	0.26	2,052	0.26
Pasture	D,I	1	<0.01	1	<0.01
Other RowCrops	D,I	362	0.05	362	0.05
Rice	D,I	<1	<0.01	<1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		346,687	43	53,959	6.73
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		345,687	43	53,959	6.73
TOTAL[4]:		1,105,589	137.54	53,985	6.74

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed used have less potential for spray drift than other uses.

 # acres in species range: 803,805 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 44,495 acres, 5.54%

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

CONSERVATION MEASURES

Rain restriction and aquatic habitat buffers: While the Government Canyon Bat Cave meshweaver is not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is not saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects

[4] TOTAL includes usage on all use sites with effects, including mosquito control.
[5] Indicates percent of the range where CalPUR data was used.

impacting the Government Canyon Bat Cave meshweaver by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing initial residues to 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 (excluding use for the Boll Weevil Eradication Program, although this program has a history of implementation with conservation measures in place[6]), orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Government Canyon Bat Cave meshweaver. As discussed below, even though the vulnerability and risk are high for this species, we anticipate the likelihood of exposure to malathion is low, primarily based on the high level of overlap of the species' range with Federal lands. In addition, the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. While we anticipate that very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

[6] While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the *Description of the Action* section of the Opinion. For example, the 2018 FWS informal section 7(a)(2) consultation with APHIS includes the following conservation measure for the Government Canyon Bat Cave meshweaver: "To protect invertebrate prey base (e.g., crickets), no ground use of Program insecticides within 320 feet and no aerial use within 1,320 feet of the critical habitat of this species." As of 2020, the Texas Boll Weevil Eradication Quarantine status map, shows Bexar County, Texas as functionally eradicated (USDA 2020).

This species has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The risk to the individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Mortality for the Government Canyon Bat Cave meshweaver for all uses (except mosquito control) is 44%, and we anticipate an additional 55% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 94% mortality to exposed Government Canyon Bat Cave meshweaver individuals.

However, we anticipate usage will be low. Most of the species' range (>94%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands may reach the species and its prey through groundwater flow, as described above, based on the moderate levels of anticipated usage (6.74%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of malathion usage on Federal lands (5.54% overlap), per the rationale related to usage in these areas as described in the Biological Opinion. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. Thus, we do not anticipate species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Government Canyon Bat Cave meshweaver. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Government Canyon Bat Cave meshweaver and its karst habitat. Together, these measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Government Canyon Bat Cave meshweaver in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service. 2020. 2020 Texas Boll Weevil Eradication Quarantine Status. Electronic source accessed on February 8, 2022, at: https://www.txbollweevil.org/Downloads/Quarantine%20Status%20for%20Website.pdf.

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst InvertebratesRecovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.

Integration and Synthesis Summary: Arachnids

Scientific Name:	Common Name:	Entity ID:
Cicurina venii	Braken Bat Cave meshweaver	474

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

Status: Endangered
Distribution: Small, endemic, constrained, and/or isolated population(s)
Number of Populations: Multiple populations (few)
Species Trends: Unknown population trends
Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:
The 2011 Recovery Plan reports that the Braken Bat Cave meshweaver (BBCM) is known from one karst limestone cave in Bexar County, Texas. It relies on high humidity, stable temperatures, suitable substrates and surface-derived nutrients.

The primary threat is habitat destruction by (1) completely filling the cave with cement during development, (2) quarrying activities, and (3) capping or sealing cave entrances. Other habitat degradation includes altering drainage patterns, native surface plant and animal communities, reducing or increasing nutrient flow, contamination, excessive human visitation, and threats from or competition with non-native, invasive species. Bexar County is facing continued rapid population growth and associated urbanization. Karst landscapes are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits and little or no filtration occurs. In some areas the water that moves through the habitat of these species' percolates to the Edwards Aquifer below. The Edwards Aquifer is an important source of drinking water for 1.7 million people. So, information on sources of water contamination of the Edwards Aquifer may also be indicative of sources of contamination of karst invertebrate habitat. The ranges of these species are becoming increasingly urbanized and thereby are becoming more susceptible to contaminants including sewage, oil, fertilizers, pesticides, herbicides, seepage from landfills, pipeline leaks, or leaks in storage structures and retaining ponds. Activities on the surface, such as disposing of toxic chemicals or motor oil, can also contaminate caves.

The 2011 5-Year Review reports that climate change was not identified as a threat to these species in the original listing document. However, the dependence of this species on stable temperature and humidity opens the possibility that climate change is impacting the species. Therefore, while it appears reasonable to assume that the species may be affected, we lack sufficient certainty to know how climate change will affect it.

EB/CE Source:
U.S. Fish and Wildlife Service (USFWS). 2011. Final Recovery Plan Bexar County Karst

Invertebrates. Albuquerque, New Mexico. 84 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. *Rhadine exilis* (no common name), *Rhadine infernalis* (no common name), Madla Cave meshweaver (*Cicurina madla*), Braken Bat Cave meshweaver (*C. venii*), Government Canyon Bat Cave meshweaver (*C. vespera*), Robber Baron Cave meshweaver (*C. baronia*), Cokendolpher cave harvestman (*Texella cokendolpheri*), Government Canyon Bat Cave spider (*Neoleptoneta microps*), and Helotes mold beetle (*Batrisodes venyivi*) 5-Year Review Summary and Evaluation. Austin, Texas. 22 pp.

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: We anticipate the Braken Bat Cave meshweaver will experience direct mortality for most uses of malathion at maximum use rates. The risk of mortality for individuals exposed to malathion is expected to be high. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labelled uses across the range: Mortality for the BBCM for all uses (except mosquito control) is approximately 43% with <1% from nurseries, cotton, other row crops, vegetables and ground fruit, orchards and vineyards, pasture, and rice to a high of 94% from mosquito control. We anticipate up to 55% additional mortality from spray drift from all use sites. 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	43%
Spray drift areas – mortality	Up to 55%
Sublethal – growth (G), reproduction (R) and behavior (B)	NA
Direct spray or contact with contaminated media	NA
Volatilization	Not an appreciable source of exposure
INDIRECT (all uses except mosquito control)	
Use areas - Prey item mortality	43% arthropods
Spray drift areas - Prey item mortality	Up to 55% arthropods
Plants affected (decline in growth)	NA
MOSQUITO CONTROL	
Direct - mortality	94%
Sublethal	NA
Indirect - mortality	94% arthropods

Risk modifiers: The BBCM range consists of one county in one state. It is found in two caves (Cyndee Watson, USFWS, pers. comm., 2016). The reproductive strategy for most cave

invertebrates is more similar to that of large mammals. Like large mammals, they have few offspring and live relatively long lives (for invertebrates). Very little else is known about the reproductive strategy of the BBCM.

Allowable uses driving effects/other considerations: Nutrients in most karst ecosystems are derived from the surface either directly (organic material washed in or brought in by animals) or indirectly, by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglophiles and troglobites that grow on the leaves or feces rather than the original material itself. Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features. For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave. The cave cricket (*Ceuthophilus spp*.) is a particularly important nutrient component and is found in most caves in Texas (USFWS 2011). Troglobites typically have very slow metabolisms, an adaptation to the sparse amounts of food found in their environment.

The dietary items for this species include terrestrial invertebrates. Because the BBCM relies on other invertebrate species for their food supply, their food supply is likely to be impacted by pesticide use within the BBCM range if food sources within the cave are exposed to malathion through transport of malathion through the karst or through food items of the spider's prey. While we anticipate mortality of all exposed invertebrate prey, exposed prey may not immediately die upon exposure to malathion; moribund or erratically moving invertebrates may be preyed up on by the spider. A high likelihood of mortality is expected among individuals exposed. If there are any exposed individuals, it would be unlikely they would survive to experience any sublethal effects, therefore, it is unlikely the population would experience sublethal impacts. Each mosquito adulticide spray of malathion is likely to result in 94% mortality to exposed BBCM individuals. The malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

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

Use type	Risk to species[1]	Use overlap with range		Estimated usage inrange[2]	
		Acres	%	acres	%
Mosquito control[3]	D,I	759,901	94.54	26	<0.01
Open Space Developed	D,I	110,153	13.70	5,546	0.69
Developed	D,I	185,236	23.04	9,244	1.15
Corn	D,I	11,418	1.42	4,099	0.51
Other Grains	D,I	20,786	2.59	20,786	2.59
Wheat	D,I	9,914	1.23	9,914	1.23
Cotton	D,I	1,891	0.24	1,849	0.23
Other Crops	D,I	3,768	0.47	0	0
Orchards and Vineyards	D,I	41	<0.01	41	<0.01
Vegetables and Fruit	D,I	65	<0.01	65	<0.01
Nurseries	D,I	2,052	0.26	2,052	0.26
Pasture	D,I	1	<0.01	1	<0.01
Other RowCrops	D,I	362	0.05	362	0.05
Rice	D,I	<1	<0.01	<1	<0.01
Sub-TOTAL (D): *Other uses with direct effects only*[3]		346,687	43	53,959	6.73
Sub- TOTAL (I): *Other uses with indirect effects only*[3]		345,687	43	53,959	6.73
TOTAL[4]:		1,105,589	137.54	53,985	6.74

This species consumes invertebrates, therefore malathion usage on any use site has the potential to result in mortality to prey species from spray drift, whether or not the species utilizes the site itself. Developed and open space developed used have less potential for spray drift than other uses.

 # acres in species range: 803,805 acres
% of range in California (i.e., where CalPUR data is available)[5]: 0%
Range overlap with Federal lands: 44,495 acres, 5.54%

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

CONSERVATION MEASURES

[1] Direct effects (D), Indirect effects (I), Spray Drift – Direct and/or Indirect effects (SD-D/I), None expected (N).
[2] Estimated usage in the range is based on information about annual past usage.
[3] Mosquito adulticide has the potential to overlap with other use types. It is not included in the Sub-TOTALs.
[4] TOTAL includes usage on all use sites with effects, including mosquito control.
[5] Indicates percent of the range where CalPUR data was used.

Rain restriction and aquatic habitat buffers: While the Braken Bat Cave meshweaver is not an aquatic species, as a karst cave species, it is closely associated with the underground streams that create the cave systems it lives in. Label language includes restricting malathion application to periods where rain is not forecasted for at least 48 hours for agriculture and 24 hours for residential use or when the soil is saturated. Rain restrictions (which allow for malathion to degrade before runoff events can occur as malathion has a relatively short half-life and rapid degradation that occurs via hydrolysis and other processes) and aquatic habitat buffers (which specify on the label a distance from water bodies where pesticides are not to be applied) required of all agricultural and residential uses will likely reduce the level of effects impacting the Braken Bat Cave meshweaver by substantially reducing the amount of malathion that would reach the subsurface habitats in which this species resides.

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 by allowing initial residues to 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 (excluding use for the Boll Weevil Eradication Program, although this program has a history of implementation with conservation measures in place[6]), orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (depending on the specific crop, previous allowable number of applications ranged from 3 to 13 applications per year). We anticipate that this measure will help 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

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to

[6] While the proposed label restriction does not apply to applications conducted by APHIS as part of the Boll Weevil Eradication Program, APHIS implements measures that are protective of listed species, as described in the *Description of the Action* section of the Opinion. For example, the 2018 FWS informal section 7(a)(2) consultation with APHIS includes the following conservation measure for the Braken Bat Cave meshweaver: "To protect invertebrate prey base (e.g., crickets), no ground use of Program insecticides within 320 feet and no aerial use within 1,320 feet of the critical habitat." As of 2020, the Texas Boll Weevil Eradication Quarantine status map, shows Bexar County, Texas as functionally eradicated (USDA 2020).

jeopardize the continued existence of the BBCM. As discussed below, even though the vulnerability and risk are 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 very small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur.

This species has a high vulnerability based on its status, distribution, and trends. Pesticides are a noted threat to the species. The risk to the individuals posed by the labeled uses across the range is also high, should exposure occur. The karst habits occupied by these species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. If a large proportion of the individuals are impacted, recolonization may not occur due to the isolated and fragmented nature of the population(s). Mortality for the BBCM for all uses (except mosquito control) is 43%, and we anticipate an additional 55% mortality from spray drift from all use sites. Each mosquito adulticide spray of malathion is also likely to result in 94% mortality to exposed BBCM individuals, and the malathion label does not specify a maximum number of permissible mosquito adulticide applications per year, nor a minimum interval of application.

However, we anticipate usage will be low. Most of the species' range (>94%) overlaps non-Federal lands. While we anticipate that applications on non-Federal lands may reach the species and its prey through groundwater flow, as described above, based on the moderate levels of anticipated usage (6.74%) in these areas per the standard usage data, we anticipate effects only to very small numbers of individuals over the duration of the action, either through contact with malathion or through their prey. We did not quantitatively evaluate use or usage on Federal lands that overlap with the species range, but we assume only low levels of malathion usage on Federal lands (5.54% overlap), per the rationale related to usage in these areas as described in the Biological Opinion. Furthermore, we anticipate the additional conservation measures above, including rain restrictions and aquatic habitat buffers, residential use label changes, and reduced numbers of applications and application rates would further reduce the likelihood of exposure of the species, its prey, and its habitat. Thus, we do not anticipate species-level effects.

Exposure from malathion use on open space and developed areas and agricultural uses will be greatly minimized through general conservation measures listed above. We anticipate the new label restrictions for residential use (applications are restricted to spot treatment) make offsite drift unlikely. They also reduce the amount of malathion used and the extent of the area treated by as much as 75% or more (based on modeled values) and decrease the likelihood of potential exposure to the Braken Bat Cave meshweaver. As with most cave-dwelling invertebrates, we anticipate the rain restrictions that apply to both residential and agricultural use reduce the likelihood of exposure to this species (directly or in runoff) following a precipitation event. Similarly, we anticipate the aquatic habitat buffers and the reduced number of applications and application rates (above in the Conservation Measures) reduce spray drift and are expected to reduce the amount of malathion used. They would also limit the likelihood of spray drift and runoff exposure to the Braken Bat Cave meshweaver and its karst habitat. Together, these

measures are anticipated to substantially reduce the likelihood of exposure to this species and its habitat. Moreover, we do not anticipate the loss of small numbers of individuals would result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Braken Bat Cave meshweaver in the wild.

Conclusion: Not likely to jeopardize

ADDITIONAL REFERENCES

U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service. 2020. 2020 Texas Boll Weevil Eradication Quarantine Status. Electronic source accessed on February 8, 2022, at: https://www.txbollweevil.org/Downloads/Quarantine%20Status%20for%20Website.pdf.

U.S. Fish and Wildlife Service (USFWS). 2011. Bexar County Karst InvertebratesRecovery Plan. USFWS Southwest Region, Albuquerque, New Mexico. 84 pp.