Review of the Rusty Patched Bumblebee (2018-2019)

Updated Oct 2020

Endangered Species Act

The Endangered Species Act of 1973 (ESA; 16 U.S.C. § 1531 et seq.) was signed into law on December 28, 1973 by President Richard Nixon.

It is designed to protect critically imperiled species from extinction.

The Act is administered by two federal agencies, the United States Fish and Wildlife Service (FWS) and the Commerce Department's National Marine Fisheries Service (NMFS).

"It is the policy of Congress that all Federal departments and agencies shall seek to conserve endangered and threatened species and shall use their authorities in furtherance of the purposes of this Act" (Sect. 2(c)(2)).

Endangered species - a species which is in danger of becoming extinct
Threatened species - a species which is in danger of becoming endangered
Critical habitat - specific areas which have physical or biological features essential to the conservation of the species
Jeopardize - an action where you could reasonably expect to appreciably reduce the likelihood of both survival & recovery of a listed species in the wild

Section 7(a)(2) requires Federal agencies to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize a listed species, or result in destruction or adverse modification of their habitat.

The goal of Section 7 is to minimize impacts of a proposed project on a listed or proposed species. Under Section 7, a Federal agency approaches the Service and requests informal consultation. If the Federal agency determines that the proposed action is not likely to affect any listed species in the project area, and if the Service concurs, the informal consultation is complete and the proposed project moves ahead. If it appears that the agency's action may affect a listed species, that agency may then prepare a biological assessment to assist in its determination of the project's effect on a species.

Informal Consultation

In April 2018, the Metropolitan Mosquito Control District contacted the US Fish & Wildlife for advice to evaluate the potential impact of District mosquito control operations on the rusty patched bumblebee *Bombus affinis* (RPBB). An informal consultation was the logical starting point according to section 7 of the ESA. US Fish & Wildlife reviewed the District's annual Operational Review that describes District programs in detail and surmised that District operations probably posed a low risk to the RPBB but asked for more detailed information including maps depicting where adult control operations occur. US Fish & Wildlife provided a source of downloadable polygons depicting the areas with the highest probability of containing the RPBB (https://www.fws.gov/midwest/endangered/insects/rpbb/rpbbmap.html). These areas represent a geographic depiction of critical habitat.

The informal consultation involved the following three questions (Voluntary Implementation Guidance Version 2.1).

- Where is RPBB critical habitat located in the control area?
- How and where will MMCD conduct larval and adult mosquito control?
- How might the RPBB be affected by larval and adult mosquito control?

The biology of the RPBB includes seasonal development and associated environmental requirements (nesting habitat, floral resources, overwintering sites) (Conservation Management Guidelines of RPBB) (Figure 1, 2).

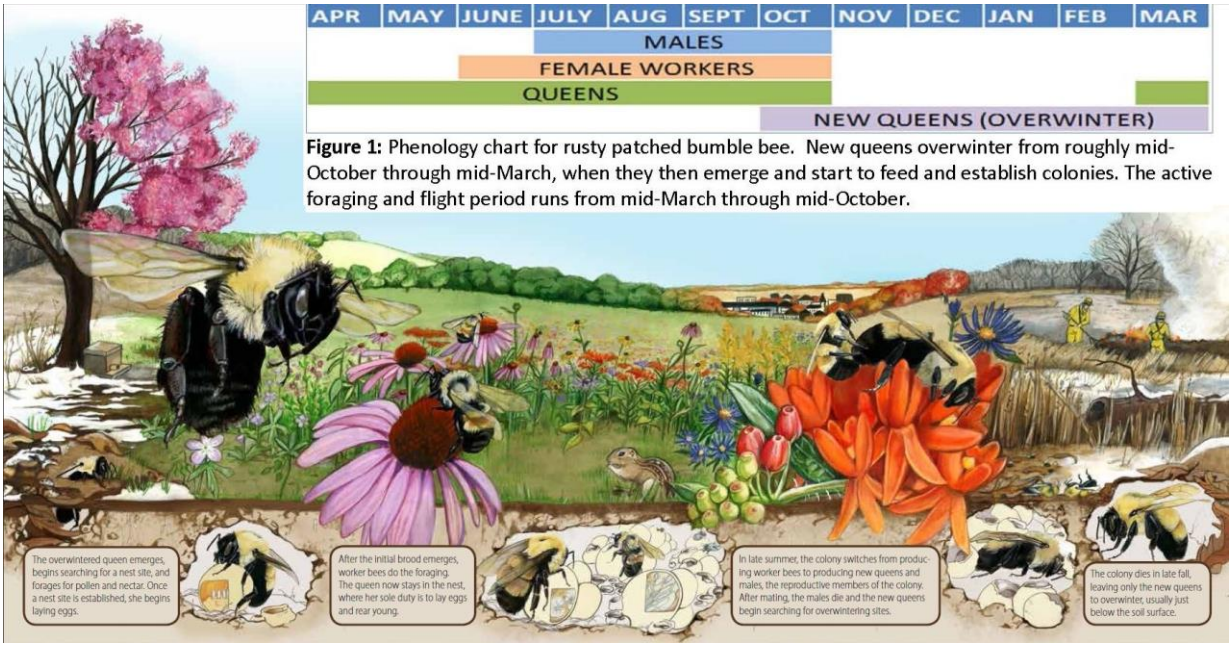

Figure 1: Phenology chart for rusty patched bumble bee. New queens overwinter from roughly mid-October through mid-March, when they then emerge and start to feed and establish colonies. The active foraging and flight period runs from mid-March through mid-October.

Figure 1. Seasonal phenology of the Rusty Patched Bumblebee (Conservation Management Guidelines of RPBB).

RPBB Environmental Requirements

During the spring, summer and early autumn the RPBB needs diverse floral resources and suitable nesting habitat. Rusty patched bumblebee nests are typically in abandoned rodent nests or other similar cavities, one to four feet below ground. Nests locations are likely be in open areas or near open areas where it is not heavily forested and not too wet (i.e., not marsh, shrub wetlands, or wetland forest). During the later autumn, winter and early spring the gynes (new queens) need suitable overwintering sites.

Life Stage	Winter	Spring	Summer	Autumn
Queen		Diverse floral resources; suitable nest habitat	Diverse floral resources; suitable nest habitat	Diverse floral resources; suitable nest habitat
Worker females		Diverse floral resources in close proximity to nest	Diverse floral resources in close proximity to nest	Diverse floral resources in close proximity to nest
Males			Diverse floral resources	Diverse floral resources; suitable dispersal habitat
Gynes (new foundress queens)	Suitable diapause sites		Diverse floral resources	Diverse floral resources; suitable dispersal habitat

Figure 2. Seasonal environmental needs of the Rusty Patched Bumblebee (Conservation Management Guidelines of RPBB).

Metropolitan Mosquito Control District Integrated Mosquito Management Program.

The District concentrates on larval mosquito control and augments this with limited adult mosquito control. Elimination of larval development sites is useful to manage some mosquito species, primarily those that develop in artificial containers that hold water such as tires, bird baths, tarps over boats, clogged storm gutters, etc., and natural structures that hold water such as tree holes. All control operations are based upon surveillance and treatment thresholds. Different mosquito species have different larval and adult treatment thresholds (2018 Operational Review & Plans for 2019).

The District uses the lowest effective treatment dosage of the least toxic effective control materials available for both larval and adult mosquito control. The District's programs are described in detail in its annual Operational Reviews reports (2018 Operational Review & Plans for 2019).

Larval Mosquito Control Material Review

Materials applied to wetlands where mosquito larvae are developing for larval mosquito control include formulations containing Bti, spinosad or methoprene.

Bti (*Bacillus thuringiensis israelensis*) is a bacterium originally isolated from dying mosquito larvae. It is very specific to mosquitoes and closely related flies. The formulation used for larval mosquito control (a Bti-coated corn cob granule) is designed to be applied to water where mosquito larvae are developing.

Spinosad is a biological toxin produced by the soil bacterium *Saccharopolyspora spinosa* that has been used by organic growers for more than a decade. Granular formulations of spinosad were developed to be applied to water where mosquito larvae are developing.

Methoprene is a juvenile hormone analogue formulated in granules (pellets) or briquets applied to water where mosquito larvae are developing. Methoprene is specific to mosquitoes and closely related flies; it will not control other kinds of insects.

These larval control materials and their formulations are very specific to mosquito larvae and do not impact bees including the RPBB. These larval mosquito control materials are applied to wetland areas where RPBB is not located resulting in no exposure of RPBB to larval mosquito control materials. The granular formulations of these larval mosquito control materials prevent them from moving away from application sites thereby also preventing exposure of RPBB.

Adult Mosquito Control Material Review

Adult mosquito control products used by the District contain synthetic pyrethroids (permethrin, sumithrin or etofenprox) (2018 Operational Review & Plans for 2019). Very low dosages can effectively control mosquitoes. Sumithrin and etofenprox are fragile molecules that degrade within hours after treatment. Permethrin remains effective for a few days.

Labels for adult mosquito control products containing these actives include restrictions designed to protect pollinators including the RPBB by minimizing exposure. Pollinator biology was used to design these label restrictions. Applications of these adult mosquito control products are designed to maximize mosquito exposure by exploiting mosquito resting behavior or activity behavior. Both mosquito resting behavior and activity behavior differ sufficiently from pollinator biology to enable effective adult mosquito control applications that pose a minimal exposure risk to pollinators including the RPBB.

Permethrin treatments: Permethrin is applied to vegetation around the edges of woods, bushes, and other areas (harborage) where mosquitoes rest in shade during the day. This is known as a perimeter or barrier treatment. Because these harborage areas are small, they can be treated by staff carrying a backpack sprayer. Treatments are effective for approximately three to five days. Both the treatment equipment and method are designed to minimize drift. Staff are trained to apply permethrin to dry vegetation with a wind velocity less than 15 mph to avoid drift.

Ultra Low Volume (ULV) sumithrin or etofenprox treatments: ULV treatments are applied as a fog of very small droplets produced by a ULV sprayer. These treatments usually are conducted in the evening (after sundown most often) when adult mosquitoes are flying. Very small amounts of pesticide are used. ULV sumithrin and etofenprox do not have a residual effectiveness on vegetation or other surfaces. These treatments work by immediate knockdown. Control occurs

when mosquitoes physically contact the material droplets as they are dispersed from the ULV sprayer. A hand-held ULV sprayer may be used to access areas that cannot be reached by truck. Conditions best for ULV treatments are light, predictable evening breezes (2 to 8 mph), when the greatest number of mosquitoes are flying in search of a blood meal, and when the air temperature is within label requirements.

Perimeter and Interior Applications Used in Combination: In some small harborage areas a permethrin application using a backpack sprayer is made to the perimeter vegetation. In addition, a hand-held ULV machine may be used to apply non-residual material (sumithrin or etofenprox) to the shady interior of the daytime resting area. This is an effective strategy against daytime active mosquitoes such as the vectors *Aedes triseriatus* and *Aedes japonicus*. Simultaneous elimination of artificial containers that hold water such as tires and natural structures that hold water such as tree holes prevent development of additional mosquitoes.

Exposure of pollinators including the RPBB is minimized by not applying permethrin, sumithrin or etofenprox to blooming plants or areas where pollinators are active (minimal floral resource overlap minimizes exposure). Labels for all of these products include specific restrictions prohibiting applications to blooming plants or areas where pollinators are active. No daytime treatments are applied to open areas where nests are most likely located (minimal nest overlap minimizes exposure). ULV sumithrin and etofenprox break down in a few hours (minimal control material life minimizes exposure).

Overlap of Mosquito Control Operations and the RPBB

Minimizing exposure to materials used for mosquito control will minimize potential impact to the RPBB. Potential impact can be evaluated by assessing the temporal (both seasonal and during a 24-hour period) and spatial (both larger area and local) overlap of mosquito control treatments and RPBB critical habitat (nesting sites, floral resources, overwintering sites).

Seasonal Overlap of District Adult Mosquito Control Operations and RPBB

Adult control potentially is conducted in June through September (2018 Operational Review & Plans for 2019). This overlaps with the period when RPBB queens remain in nests while workers are foraging (Figure 1). RPBB males also potentially are outside of nests later in the summer beginning in mid-July in the Twin Cities area (Figure 1). Minimizing exposure to adult mosquito control materials primarily requires minimizing overlap with workers and males. This is accomplished by avoiding foraging (floral) sites and using localizing treatments as much as possible to avoid exposure the RPBB (e.g., male RPBB sheltering outside the nest).

Geographic Overlap of District Adult Mosquito Control Operations and RPBB

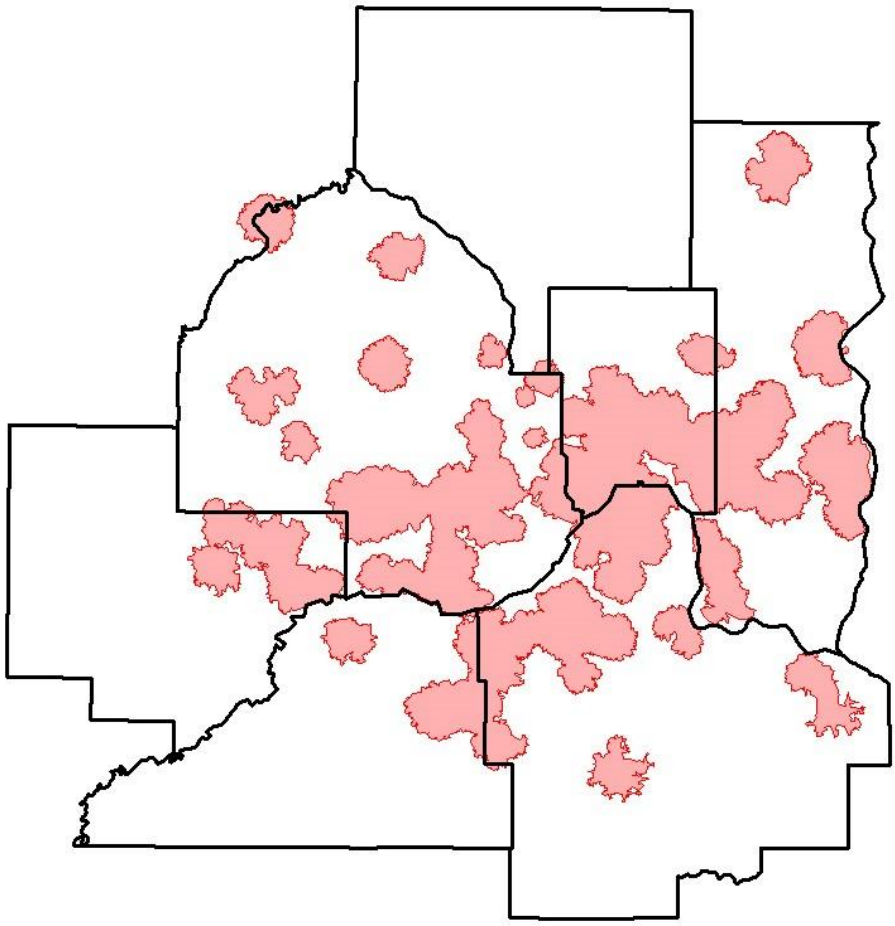

Figure 3. RPBB High Probability Zones located inside or near the seven-county District (2020).

The first step to evaluate potential geographical overlap is to create a map of RPBB High Probability Zones located inside and near the seven-county area within which the District provides integrated mosquito management services. The map indicates that most of the seven-county District area (potential adult mosquito treatment locations) is outside of RPBB High Probability Zones (Figure 3).

District Adult Mosquito Control Operations inside and outside of RPBB High Probability Zones

The next step is to determine how many adult mosquito control treatments occur inside RPBB High Probability Zones. Maps of the seven-county area are divided into 3,207 sections. Most sections contain one square mile. Sections near county boundaries can be smaller than one square mile because they are contained within one county. Records of adult mosquito control treatments include the location of each treatment. Tallying the number of adult mosquito control treatments in each section, both outside of and within (or partially overlapping) RPBB High Probability Zones, will indicate which adult mosquito control treatments were closest to RPBB.

In 2020, 814 adult control treatments were completed in 305 sections throughout the seven-county area (2020 Operational Review & Plans for 2021) (Figure 4). The majority of adult mosquito control treatments occurred outside of RPBB High Probability Zones. Sixty of these 305 sections were within or partially overlapped RPBB High Probability Zones (Figure 4). This pattern is very similar to 2018 except that fewer adult control treatments were completed in 2020 than in 2018.

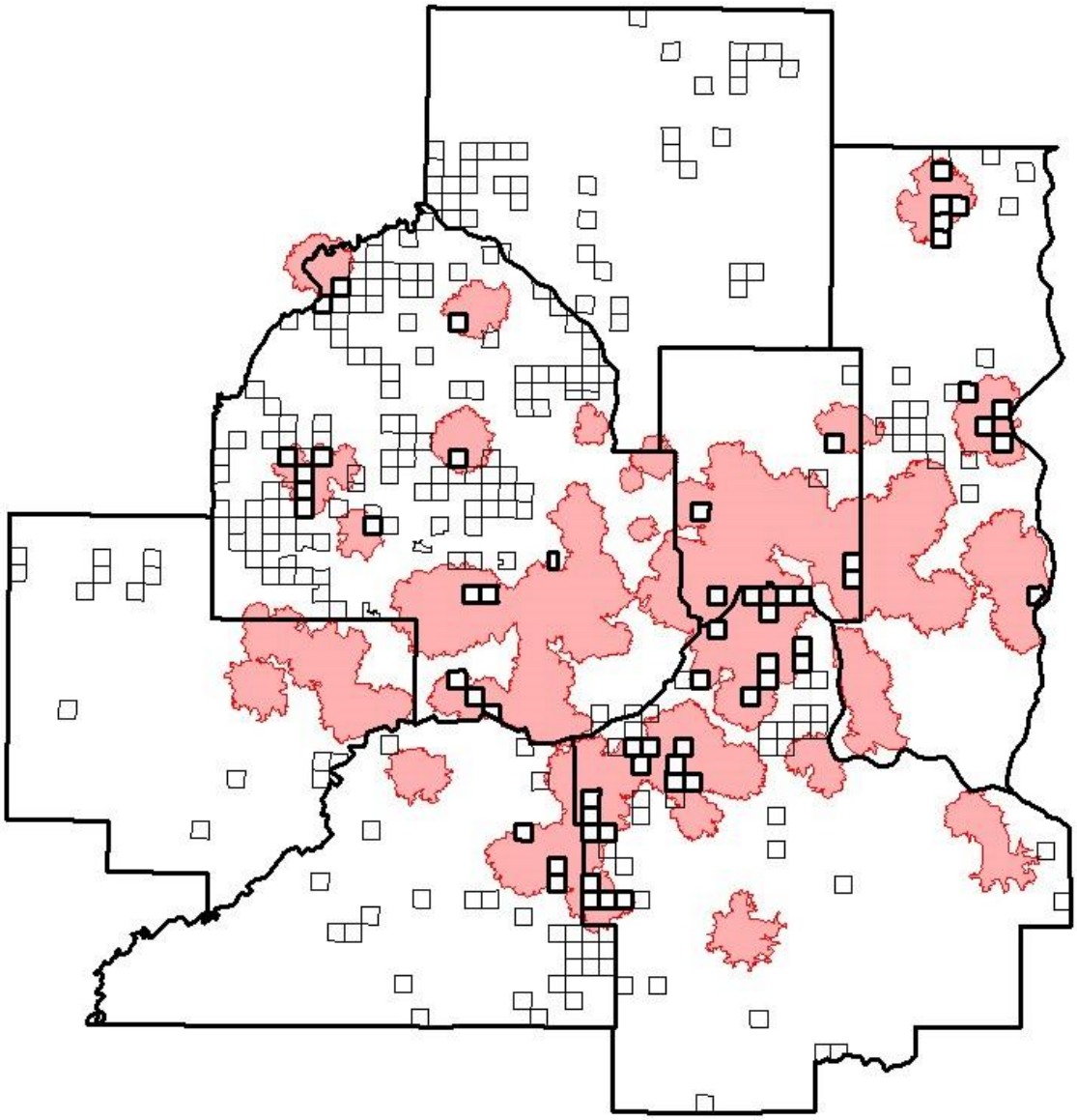

Figure 4. Sections located inside the seven-county District where adult mosquito control treatments were completed in 2020 (pink polygons: RPBB High Probability Zones).

A total of 132 adult mosquito control treatments were completed in these 60 sections. Very few adult mosquito control treatments were completed in each of these 60 sections (an average of slightly more than two treatments per section during 2020). For example, see Figure 5.

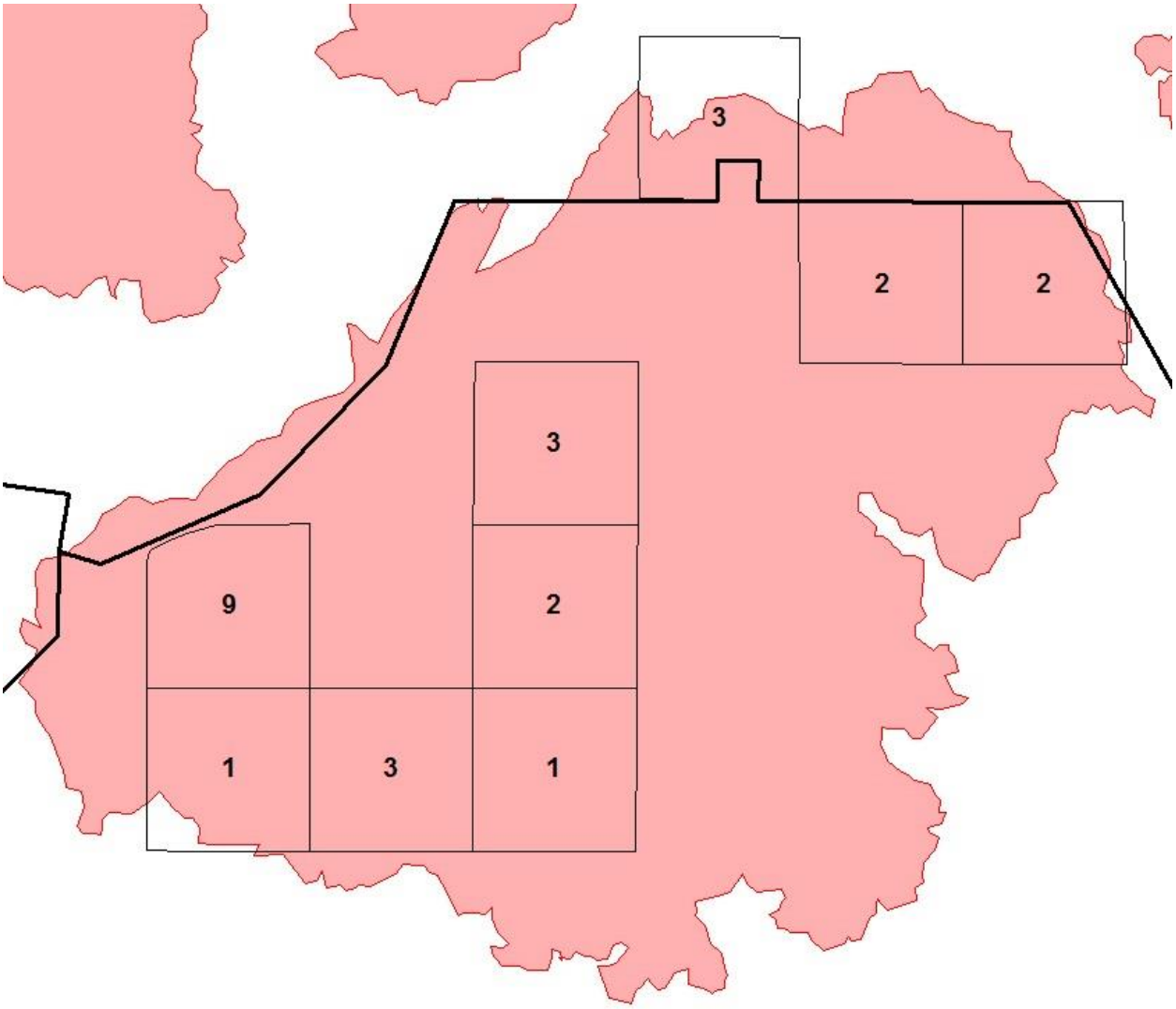

Figure 5. Number of adult mosquito control treatments completed in sections located partly or completely inside one RPBB High Probability Zone (2018).

The spatial extent (area covered by) of these adult control treatments includes only a small fraction of the area within the section (Figure 6). The control materials used persist for only hours or days, a small fraction of the season, which minimizes exposure.

Mosquito control staff are trained to examine a potential treatment area before conducting the treatment to verify that pollinators are not active in the area when the treatment would occur. The treatment is not conducted where pollinators are observed. Flowers and flowering plants are not treated which should further minimize exposure to pollinators including the RPBB. Treatments are not applied to soil or leaf litter. Open areas are not treated during the day when RPBB could be moving between nests and resources. Control materials used to treat open areas at night are applied at very small dosages and degrade before the next sunrise.

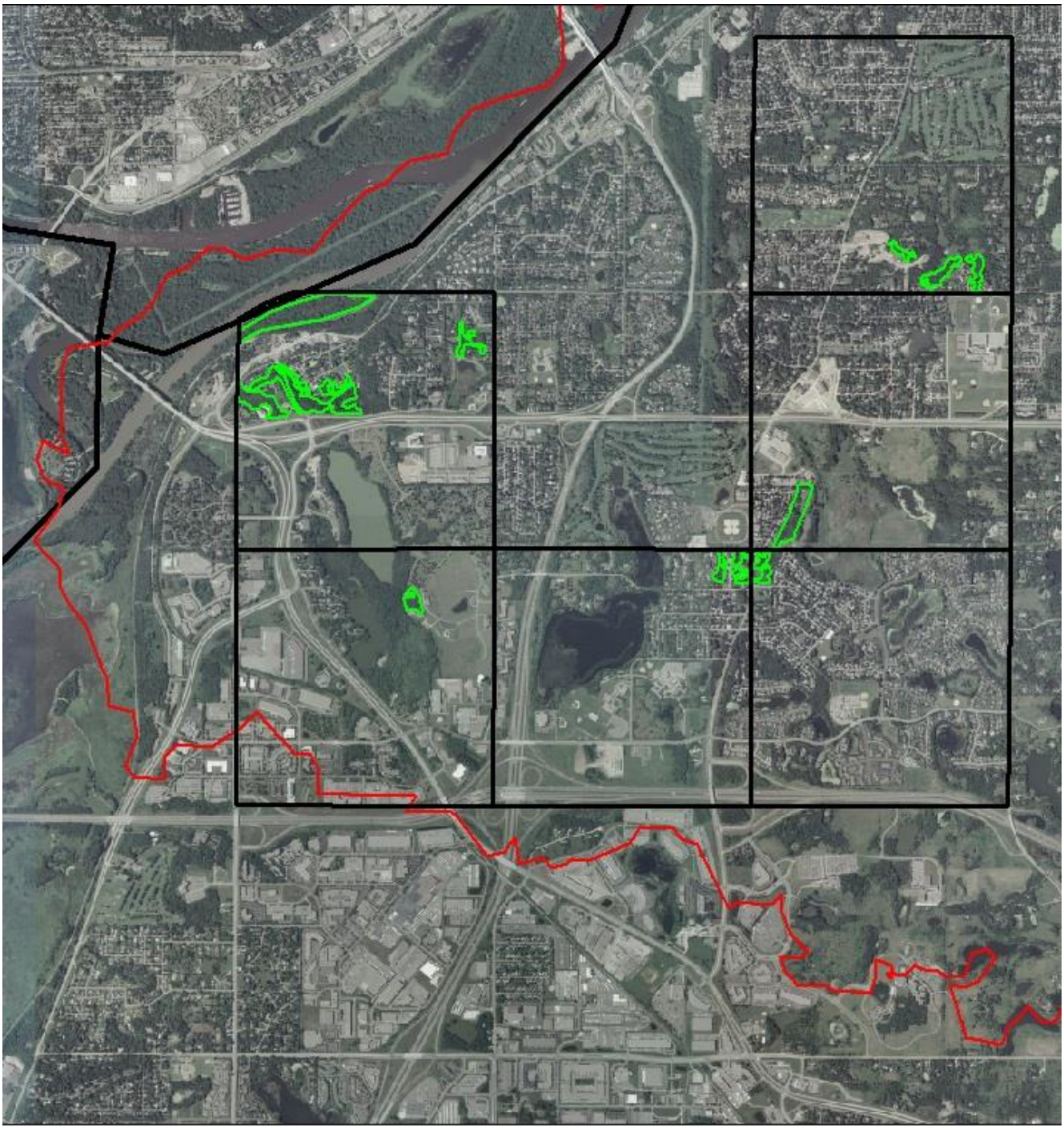

Figure 6. Spatial coverage of adult mosquito control treatments completed (green areas) in sections located partly or completely inside one 2018 RPBB High Probability Zone (red polygon) (compare with sections depicted in Figure 5).

Overall Conclusions

Exposure to larval control materials is unlikely because treatments are applied to wetlands where mosquito larvae are developing, not areas frequented by RPBB. Active ingredients have minimal toxicity to RPBB.

Exposure to individual adult control treatments is unlikely because of minimal exposure to nest areas and floral resources (including areas where RPBB might shelter overnight when outside of the nest). Exposure risk is minimized further because relatively few adult control treatments are made inside high probability areas. A very small proportion of the area within high probability areas is treated with adult control materials. Areas treated with adult control materials are treated very few times per season further minimizing exposure risk.

MMCD employees are trained to apply all mosquito control materials in accordance to product label instructions and are trained about pollinator biology so they understand the importance of these product label guidelines to minimizing risk to pollinators.

For these reasons, the overall risk of mosquito control treatments conducted my MMCD to RPBB is low.

References

Conservation Management Guidelines for the Rusty Patched Bumble Bee (*Bombus affinis*) https://www.fws.gov/midwest/endangered/insects/rpbb/pdf/ConservationGuidanceRPBBv1_27Feb2018.pdf

Voluntary Implementation Guidance Version 2.1 April 2019 U.S. Fish & Wildlife Service, Regions 3, 4, 5 and 6, Rusty Patched Bumble Bee (*Bombus affinis*) Endangered Species Act Section 7(a)(2) https://www.fws.gov/midwest/endangered/insects/rpbb/pdf/Section_7_Guidance_RPBB_Ver2_1_16April2019.pdf

Metropolitan Mosquito Control District 2018 Operational Review & Plans for 2019 https://www.mmcd.org/docs/publications/TAB-Final-2018.pdf

Metropolitan Mosquito Control District 2020 Operational Review & Plans for 2021 https://www.mmcd.org/docs/publications/TAB%20report%202020_draft_nolabelsB.pdf

Control materials used by MMCD (labels and SDS) https://mmcd.org//product-labels-and-msds/