Information for Michigan Insecticide Applicators

U.S. Fish and Wildlife Service, Michigan Ecological Services Field Office
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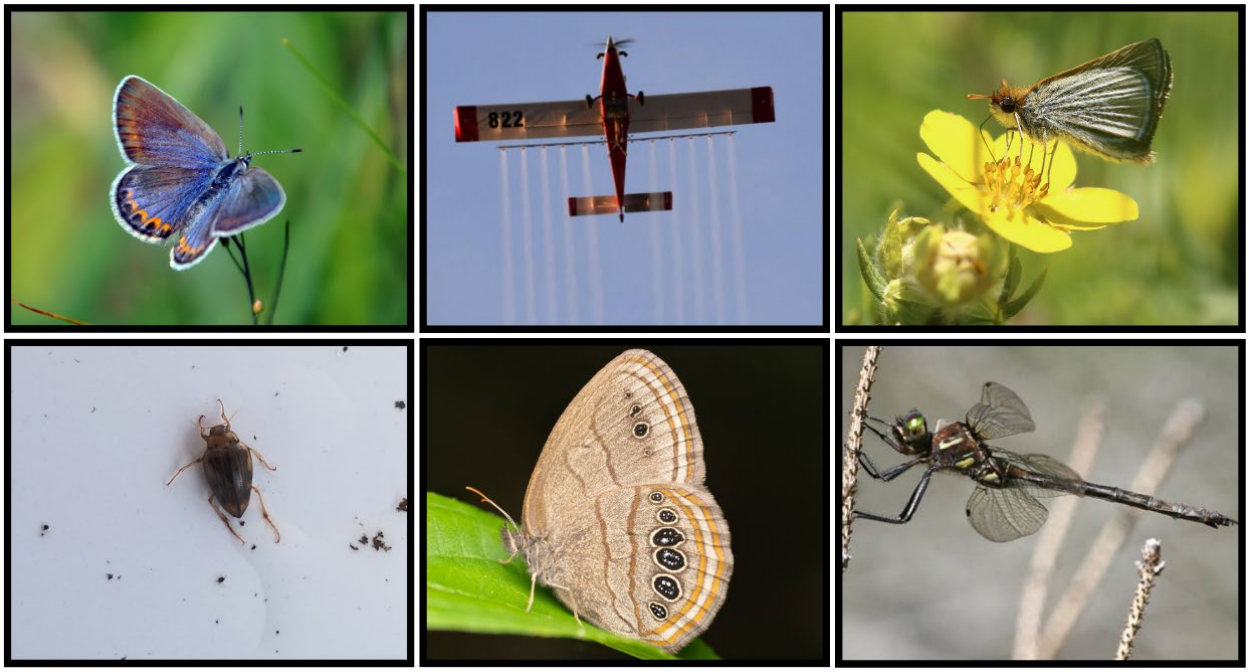

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Introduction

Insecticides are extremely valuable tools for protecting human health and safety. They can be used for many purposes, including removing pests from food crops to increase crop yields, slowing the spread of invasive insects that can damage or defoliate trees, and helping prevent diseases that can be spread by insects, such as West Nile virus and Lyme disease. Many insecticides can also negatively impact non-target native insects. Insect species are critical for a healthy ecosystem. Insects pollinate fruits, flowers, and vegetables, decompose organic waste so nutrients can be reused by plants, and are integral to nearly all food webs. Consequently, it is very important to protect our native insect species, including threatened and endangered insects.

The purpose of this document is to provide a resource about sensitive insect species for insecticide applicators in Michigan. When planning an application, applicators must comply with state and federal laws, including the Endangered Species Act and the Bald and Golden Eagle Protection Act. **This information is specific to insect species listed as threatened or endangered under the federal Endangered Species Act**. Separate from federally listed species, information and voluntary conservation measures are provided for additional insects of special conservation concern.

To facilitate this process, we developed a map with information on sensitive insect species and bald eagle nests. The file indicates two boundary categories: (1) federally listed insect or bald eagle and (2) insects of special concern. **This information does not show areas where insecticide application is restricted**; rather it shows areas where coordination before application can help reduce potential impacts to these protected species. The map can be viewed online at https://storymaps.arcgis.com/stories/8a371d4283e04a6ca3c0323b84d846eb.

We have also developed a flowchart to be used in conjunction with the map. It has examples of best management practices (BMPs) that when implemented help protect sensitive insect species during insecticide application. These BMPs can be implemented during any application to protect native insects.

Many insecticide labels also have legally binding restrictions controlling their use in areas with sensitive species or specific types of habitats. It is a violation of federal law to use any pesticide in a manner inconsistent with its labeling. Applicators should review Environmental Protection Agency's Bulletins Live! Two Website for products with active Endangered Species Protection Bulletins to determine if their application area falls within a Pesticide Use Limitation Area.

The USFWS Michigan Ecological Services Field Office plans to update this information annually. If you would like assistance in viewing the online map or need additional resources please contact Michelle Kane, USFWS, at michelle_kane@fws.gov or 517-351-3460.

Federally Endangered Michigan Insects and Insecticides

Many insecticides commonly used to control pest insects can also impact other species, including threatened and endangered insects. An insecticide commonly used to control spongy moth, Foray 48B, can cause impacts such as mortality to the caterpillars of other butterfly species. This includes federally endangered Poweshiek skipperling, Karner blue butterfly, and Mitchell's satyr. Merus 3.0, a mosquito adulticide, is known to be toxic to aquatic insects and bees and may impact aquatic or partially aquatic species such as federally endangered Hine's emerald dragonfly and Hungerford's crawling water beetle.

Poweshiek skipperling was once an abundant butterfly but has declined dramatically in the last 20 years. There are now less than 1,000 individuals remaining in Michigan and southeast Manitoba. In Michigan, these butterflies can only be found in prairie fens, one of the most imperiled ecosystems in the world. Recovery efforts include captive rearing and habitat management. Since there are so few Poweshiek skipperlings left, every individual matters to the survival of the species. Therefore, avoiding insecticide use near remaining populations and rearing facilities are especially important.

Karner blue butterfly live in oak savannas and pine barren ecosystems. Caterpillars feed on wild lupine and adults feed on nectar from several flowers. The largest threats to Karner blue butterfly include habitat loss, alteration, and fragmentation. Important conservation measures for this species include early successional habitat management and avoiding the use of insecticides in areas they occur.

Michell's satyr butterfly is found in restricted areas within Michigan, Indiana, Virginia, Mississippi, and Alabama. They live in prairie fens and rich tamarack swamps. A major threat to this rare butterfly is habitat destruction and alteration. Insecticide applications and drift also pose a risk to this species. Recovery efforts for Mitchell's satyr include captive rearing and habitat management.

Hine's emerald dragonfly was listed as endangered in 1995 and are now only found in Illinois, Michigan, Missouri, and Wisconsin. They live in calcareous spring fed marshes and sedge meadows. The principal threat to the species is habitat destruction and alteration, including changes to hydrology. Insecticides that kill aquatic invertebrates may harm the aquatic life stages of this dragonfly.

Hungerford's crawling water beetle is aquatic and found in 13 streams, 11 in the Northern Lower Peninsula of Michigan and 2 in Ontario. HCWB live in cool water streams with moderate to fast flow, good stream aeration, and alkaline water conditions. Threats to this species include any activity that degrades water quality, including insecticide application or runoff into water.

Even when these listed insect species are not present in the area of application, drift and runoff can carry dangerous amounts of insecticide into areas where these sensitive species live. It is important to consider these federally endangered species when planning an insecticide application. With collaboration and the use of best management practices, insecticides can continue to be used on the landscape while minimizing impacts on threatened and endangered insects.

Flowchart for Considering Sensitive Insects Before Insecticide Application

Compare planned application location to Michigan Sensitive Species Map online

Application falls within a boundary

Application falls completely outside a boundary

No coordination needed for sensitive insect species or bald eagles. If spraying near public land, please make sure to contact them to find out about any additional considerations.

Which boundary categories does your application fall within?

Federally Listed Insect or Bald Eagle Nest

Insect of Special Concern

Contact Michelle Kane, USFWS, at michelle_kane@fws.gov or 517-351-3460 to discuss potential BMPs

Examples of BMPs for Federally Listed Species that may be recommended include, but are not limited to:

- Time applications to avoid dates/times when listed species are active.
- Communicate with captive rearing facilities to allow animals used for captive rearing to be protected during application.
- Maintain a buffer around eagle nests during aerial applications.
- Maintain a buffer around habitat of federally listed species.

Recommended Best Management Practices (BMPs) for Broadscale Insecticide Application

- Establish untreated buffer zones around sensitive species.
- Review the information available on EPA's website about pesticide drift.
- Read the label carefully and use the lowest effective rate and lowest number of effective applications.
- Prior to application, evaluate the site and identify potential sensitive areas such as beehives, wetlands, bodies of water, and inhabited areas as well as areas that may affect spray, such as topography and windbreaks.
- Use the largest applicable droplet size near sensitive areas to reduce the potential for drift.
- Spray when wind speed is between 3 - 8 mph and wind direction is away from sensitive areas. Application should stop if wind speeds become unfavorable.
- If applying in hot, dry conditions, use a larger droplet and reduce spraying height to the lowest recommended distance.
- Avoid spraying within or above a temperature inversion.
- Consider using drift reduction technologies, such as drift retardants or drift reduction nozzles.
- Avoid spraying if heavy rain is expected within 48 hours.
- Rinse insecticide application equipment and insecticide containers on a solid surface where it won't drain to waterways.
- If spraying near public land (ex. DNR, Forest Service, FWS), make sure to contact the agency to discuss the application and potential for drift.
- If spraying for mosquitos, review the FWS guidelines for mosquito control (see attached).

Additional Recommendations for Ground Application

- Consider using a shielded boom or shroud cover.
- Use the lowest possible boom height.

Additional Recommendations for Aerial Application

- For fixed wing aircraft, boom width should not exceed 75% of wingspan.
- For rotary wing aircraft, boom width should not exceed 80% of the rotor width.
- Spray close to sensitive areas last, as a fully loaded plane displaces more air and can increase the vortex effect.
- Reduce the amount of turbulence in the area where droplets are released. This can be done by dropping the boom below the trailing edge of the wing, moving or shielding obstacles such as flow monitors and piping, and using nozzle drop tubes under the fuselage.

How to Lower the Risk of Adverse Effects to Pollinators, Federally Protected Species, and other Non-Target Wildlife from Mosquito Management

Mosquito Management in Communities

Many communities implement a broad approach to mosquito control including management for nuisance issues in addition to public health concerns. Regardless of the driver, some mosquito control management techniques can result in unintended consequences to non-target wildlife species including insects that are of conservation concern. Non-target effects to sensitive species such as pollinators can be minimized by collaboration and advance planning with mosquito control district staff and local natural resource experts. Following Best Management Practices and an Integrated Pest Management (IPM) process for mosquito control lowers risk to non-target species. This document is intended primarily to provide input when and where discretion can be exercised in relatively routine mosquito management in areas beyond lands managed by the U.S. Fish and Wildlife Service. It is not intended to direct public health officials' decisions in the event of a public health emergency, although some elements may be useful in those situations as well.

U.S. Fish and Wildlife Service Perspective for Mosquito Management on USFWS lands and Waters

Mosquitoes are a part of the natural ecosystem in habitats in which they occur. The U.S. Fish and Wildlife Service (USFWS) has determined that mosquitoes may exist unimpeded on USFWS managed lands and waters unless they pose a specific threat to public health. The USFWS uses the Handbook for Mosquito Management on National Wildlife Refuges (USFWS 2018) which emphasizes prevention and the use of larval mosquito monitoring to help inform management decisions. Public health organizations must sometimes control mosquitoes to lower risk to the public from mosquito borne diseases and when control actions occur at USFWS managed facilities, we work with mosquito control districts so that they may accomplish this for public health protection while still minimizing impacts to non-target organisms.

Integrated Pest Management – The First Line of Defense

Integrated Pest Management (IPM) is a sustainable approach to managing pests, such as mosquitoes. It combines physical, biological, cultural and chemical tools to maximize pest control and minimize economic, health, and environmental risks. When IPM is followed we minimize effects on non-target organisms by reducing the use of broad-spectrum pesticides while still reducing the potential for pathogen transmission and controlling nuisance mosquito populations. Preventative measures following IPM principles throughout mosquito control programs are cost-effective and efficient first lines of defense. For example, mosquito adulticides can adversely impact a broad spectrum of species including pollinators, so the most effective way to minimize non-target impacts is to control mosquitoes at the larval stage. This will prevent adult mosquito populations from reaching thresholds where they require control. In addition, early season monitoring for mosquito species that can carry human pathogens can allow control measures to be efficiently targeted and timed.

Principles of Integrated Pest Management for Mosquitoes

1. **Understand the mosquito management objectives and establish short- and long-term priorities.** *(Examples: Short-term priority: reduce pathogen transmission by controlling adult mosquitoes. Long-term priority: reduce mosquito breeding habitats to minimize the need for mosquito adulticides.)*

2. **Prevent mosquitoes from becoming a pest at your site.** This is the first line of defense against any pest species. See the Centers for Disease Control and Prevention (CDC) websites: Prevent Mosquito Bites, Everyone Can Help Control Mosquitoes and Get Rid of Mosquitoes at Home)

3. **Identify and monitor the mosquito species, know the life history, and the conditions that support the mosquitoes.** To help guide management actions, it's important to know if mosquitoes in the area are nuisance biters, or if they are also active vectors of pathogens that cause disease. See the CDC website: What Mosquito Control Programs Do.

4. **Understand the physical and biological factors that affect the number and distribution of mosquitoes and their natural enemies. Conserve natural enemies** when implementing any pest management strategy. *(Examples: Encourage bats by posting bat boxes. Limit standing water, which is excellent mosquito breeding habitat.)*

5. **Establish the "Action Thresholds" at which mosquito management will be implemented.** Can you tolerate a few mosquitoes? Are you controlling mosquitoes to reduce a public health threat due to pathogens cycling in a mosquito population?

6. **Build partnerships with stakeholders, communities, decision-makers, and technical experts.** *(Example: know the local beekeepers and where they are located, communicate, if control of adult mosquitoes is necessary, provide early warning notice.)* See the CDC website: Everyone Can Help Control Mosquitoes.

7. **Review available tools and best practices for the management of the identified mosquitoes.** Tools and strategies can include: 1) taking no action and monitoring only, 2) physical controls (manual and mechanical), 3) cultural, 4) biological, and 5) chemical treatment.

8. **Implement the strategy.** Make a record of when, where, how and the strategy implemented.

9. **Monitor for change and evaluate the results of the action.** Decide if the objectives were achieved. *(Example: Did eliminating mosquito breeding habitat around the yard minimize nuisance mosquitoes)*

10. **Adapt and Modify strategies, if necessary.**

Consider if Habitat Management is Appropriate to Manage Mosquitoes in the Community

By working collaboratively with your county and state partners, areas on the landscape can be prioritized for modification to manage mosquitoes while restoring natural hydrology. For examples, flowing water disrupts the mosquito lifecycle, so restoring natural water circulation can minimize mosquito breeding habitat and reduce populations of mosquito eggs and larvae before they hatch to adults. Landscape modification can be extensive and potentially expensive, and while practicable in some locations may not always be possible or appropriate, so collaboration with partners is essential. A variety of landscape measures are used to reduce mosquito breeding areas and restore hydrologic function, including the following types of modifications:

- Removing or replacing weirs, dams, or missing or undersized culverts that inhibit natural water flow.
- Restoring high marsh ponds in coastal salt marshes to serve as reservoirs for fish (such as mummichog, Fundulus heteroclitus) and other native predators that control mosquito populations.
- Maintaining or restoring the natural hydrology in altered systems to prevent poorly drained, still or stagnant pools - the perfect mosquito breeding habitat.
- Manipulating water levels to manage wetlands, so that mosquito lifecycles are disrupted by timing flood-up and draw-down.

Consider Community Practices to Reduce Mosquitoes in Developed Areas

For homes and facilities, consider these practices to reduce mosquito breeding sites:

- Minimize standing water to the maximum extent possible
- Remove or otherwise manage tires, road ruts, tanks, or similar debris/containers
- Clean rain gutters to allow rainwater to flow freely.
- Turn over containers that can hold water when stored un-used outside.
- Check for trapped water in tarps used to cover boats/ equipment and arrange covers to drain water. Pump out boat bilges.
- Replace water in birdbaths and water troughs twice a week.
- Fix dripping outside water faucets
- Reference CDC website for additional practices: Mosquito Control Practices Outside Your Home and Get Rid of Mosquitoes at Home

When the Use of Pesticides for Mosquito Management is Necessary

Mosquito control pesticides can affect many types of non-target species that are sensitive to the effects of insecticides and any species that depends on them for food. Some of these non-target species may be federally listed as threatened or endangered under the Endangered Species Act (ESA) or be species of conservation concern to states. As part of contributing to an overall IPM plan, it is important to become familiar with the non-target species in your areas that may be affected by mosquito control pesticides before mosquito control is needed.

Best Management Practices when Pesticides Are Used

Best Practices are intended to help minimize risk to non-target resources whenever possible.

The Federal Insecticide, Fungicide and Rodenticide Act, implemented by the U.S. Environmental Protection Agency (USEPA), requires that a pesticide label be read and followed. Product labels contain legally mandatory instructions and recommendations for use. Product labels can be found on the USEPA Pesticide Product and Label System website. Although best management practices are often provided on product labels, not all labels are specific to sensitive species and may not be fully protective of all species in all locations. USFWS staff may provide conservation measures and technical assistance that is specific to the pesticide and the use pattern, species, timing, and location.

To reduce risk to wildlife, including sensitive species like many pollinators, use the lowest risk pesticide that allows you to accomplish your mosquito management goal (see Table).

How to Conserve Protected Species:

Do this before the mosquito management season begins:

- Refer to IPaC https://ipac.ecosphere.fws.gov/ to find out which federally listed endangered or threatened species might be present in the area that your mosquito management may impact. Here, you can draw a polygon around your mosquito management area to get a list of federally listed species in the areas.
- If your IPaC search indicates that one or more federally listed species may occur in the area of mosquito management, follow any species-specific guidance provided in IPaC and contact the USFWS Ecological Services Field Office that serves your area or state ((https://www.fws.gov/offices/). The USFWS can assist in determining whether the listed species may be adversely impacted by the mosquito management activities.
- If your IPAC search indicates that a National Wildlife Refuge or a Waterfowl Production Area is present in the area for your mosquito management, contact the refuge staff. In accordance with the Handbook for Mosquito Management on NWRs, the refuge may have restrictions for all mosquito spraying activities and/or other specific guidance. https://ecos.fws.gov/ServCat/DownloadFile/155620
- If there may be impacts, request that the local USFWS office provide:
    - A map of listed species occurrence or otherwise indicate sensitive or critically important habitats.
    - Information on listed species life history.
    - Information to minimize impacts, including preferred timing of management actions.
- Federal agencies, please note: if you are funding, authorizing or carrying out mosquito management activities, and determine those activities may affect ESA-listed species or critical habitat, you must consult with the USFWS pursuant to section 7 of the ESA.
- Use the U.S. Environmental Protection Agency Bulletins Live which is a tool that provides pesticide use limitation areas for pesticide active ingredients and products.

Larvicides and Pupacides

These products are applied to aquatic sites where mosquito larvae and pupae are found.

A robust larval mosquito monitoring program is critical to effective use of larvicides. See the Center for Disease Control and Prevent Integrated Mosquito Management website (accessed 3/24/2021). Larvicides should be the first choice, when possible and appropriate if mosquito control using pesticides is necessary. When used correctly, larvicides:

- Prevent and minimize the emergence of adult mosquitoes and midges.
- Can provide up to a month of control.
- Are less toxic to non-target species than mosquito adulticides.
- Are often applied to smaller and targeted spatial areas, thus exposing fewer non-target resources to the pesticide.

Lower risk larvicides: *Bacillus* or *Lysinibacillus* based larvicide products present a lower risk to non-target species than other currently available larvicides.

- *Bacillus thuringiensis israelensis* and *Lysinibacillius sphaericus* are generally active for approximately 14 days although some products can remain active for a month.
- *Bacillus/Lysinibacillus* based products are specific to mosquitoes, midges, and black flies due to their mode of action.
- These products are ingested by the insect and activated at a high pH that occurs almost solely in the gut of mosquitoes, midges, and black flies. See more information at https://www.epa.gov/mosquitocontrol/bti-mosquito-control.

Higher risk larvicides S-methoprene (an insect growth regulator) can impact a broad spectrum of macroinvertebrates that have aquatic larval stages.

Pupacides, such as surface oils, can impact a broad spectrum of aquatic macroinvertebrates, as well as aquatic-dependent species that can be adversely impacted by oiling. As such, pupacides generally have a greater risk of non-target impacts than larvicides and are less preferred.

Adulticides

Mosquito adulticide active ingredients are acutely toxic to a broad spectrum of insects and may harm other species in a short period of time. Insects are a vital component of foodwebs and pollinators are everywhere! To protect pollinators and other sensitive species, the use of mosquito adulticides should only occur when acutely necessary to avert the threat to public health due to mosquito vectored pathogens after other methods have failed to reduce risks sufficiently. If the IPM principles and BMPs have been followed and use of mosquito adulticides are still necessary to address human health concerns, the following Best Management Practices may help to reduce non-target impacts.

Mosquito adulticide applications use fine droplets that suspend in air to target flying mosquitoes. These droplets can drift beyond the application site and extend the area of non-target impact beyond the intended site boundaries. When the parameters of spray altitude, speed, and nozzle type are fixed, then wind speed dominates the droplet downwind travel distance.

When selecting adulticides mosquito control districts often rotate among a suite of active ingredients in order to balance effectiveness, risk to non-targets, and mosquito resistance to the active ingredients.

These Best Management Practices may help reduce risk to non-target species when using larvicides, pupacides, or adulticides.

Timing of application

- Apply when winds are low (3 to 7 mph) to minimize drift.

Location of Application

- Know which sensitive species, if any, occur in your mosquito control application area.
- Understand if they can be adversely impacted by the product, and, if so,
- Identify sensitive locations and avoid treating these locations.

Method of Application (Use Patterns)

- Use pre-programmed GPS referenced locations to avoid the sensitive resources.
- Use application equipment that will target and ensure accuracy of the treatment.
- Hand broadcast and backpack spraying applications offer greater control and lower exposure for non-target species and habitats.
- Use the lowest effective pesticide application rate for the targeted area. These rates are on the product label.

The following Best Practices are important to reduce risk to non-target species from the use of adulticides in addition to the BMPs above.

Timing of Application

- Apply mosquito adulticides late in the day or overnight when fewer pollinators are present.
- Monitor wind speed at the altitude and timing of application

Location of Application

- Implement a buffer around specific habitats to protect sensitive species including pollinators; the size of the buffer will depend on timing of application, application method, active ingredient, and the species present.
- Identify and implement a “No Spray Zone” to protect pollinator foraging, reproduction, nesting and overwintering area when necessary

Method of Application (Use Patterns)

- Review the USEPA website on pesticide drift reduction
- Target the application to the pest and turn off sprayers when moving between application sites by using pre-programmed GPS -referenced application sites
- Use the lowest effective labelled pesticide application rate.

Mosquito Control Active Ingredients (AIs) and Relative Risk for Non-Target Species.

Lower Risk AIs	Moderate Risk AIs	Higher Risk AIs
Larvicides	**Larvicides/Pupacides[2]**	**Adulticides[3]**
Lysinibacillus[1]	*S*-methoprene	Malathion
Bacillus thuringiensis israelensis[2]	Spinosad (spinosyn A and D)	Naled
	Oils	Prallethrin
	Films	Etofeuprox
	Diflubenzuron	Pyrethrins
		Permethrin
		Resmethrin
		Sumithrin

[1] These active ingredients specifically target mosquito and other dipteran larvae, and are preferred for larval mosquito control due to fewer anticipated non-target insect impacts.

[2] Methoprene and spinosads have modes of action that are common across insect species and may adversely impact a broad spectrum of non-target exposed insects. Oils and films create a barrier to the air-water interface that can suffocate a diversity of aquatic insects. These active ingredients are applied to water and pose risk to non-target aquatic insects. They may impact terrestrial insects indirectly.

[3] Mosquito adulticides may have adverse impacts to a diversity of taxa. Malathion and naled are organophosphates that impact a broad spectrum of insects over a relatively short period of time, and may impact other aquatic and terrestrial species. Prallethrin, etofenprox, pyrethrins, permethrin, resmethrin, and sumithrin are pyrethroids that are highly toxic to fish and aquatic invertebrates in addition to terrestrial invertebrates. Temephos: USEPA registrations for the mosquito control larvicide temephos, an organophosphate insecticide which affects the nervous system of insects, have been cancelled. According to the USEPA any purchased product stock in the hands of users prior to December 31, 2016 may still be used. Accessed 3/24/2021 https://www.epa.gov/mosquitocontrol/controlling-mosquitoes-larval-stage

References

- U.S. Environmental Protection Agency. Strategies for managing pesticide spray drift for aerial application, ground application, and when applying around the home: https://www.epa.gov/reducing-pesticide-drift/introduction-pesticide-drift#actions
- Centers for Disease Control and Prevention. Integrated Mosquito Management: https://www.cdc.gov/mosquitoes/mosquito-control/community/what-mosquito-control-programs-do.html

Checklist for USFWS Staff Reviewing Mosquito Control Plans for Non-USFWS Land and Waters

Prevention measures are included:

- Habitat management actions to reduce mosquitoes and benefit mosquito predators have been considered will be implemented where practicable over time
- Community measures – outreach, education, inspections are planned to reduce mosquito habitats around human use areas and minimize mosquito bites.

Mosquito control planning area is clearly defined.

Sensitive species of conservation concern that may be in the planning area are identified:

- Are relevant habitat types delineated?
- Are specific locations delineated, if known?
- Are there National Wildlife Refuges or other conservation areas in, near, or adjacent to the planning area?

Mosquito monitoring program provides sufficient information:

- To implement lowest risk mosquito control practices at the appropriate times.
- To evaluate results of the mosquito control and plan for future decisions.

Mosquito management objectives are Specific, Measurable, Achievable, Realistic, and Time-bound and based on results of monitoring.

- Are action thresholds established for different management actions (e.g. use of low-risk larvicides, use of higher risk larvicides and/or pupacides, use of adulticides).
- Does the monitoring plan include monitoring for adult female mosquitoes actively vectoring pathogens.

Review the site-specific application plans for use of BMPs, e.g. selection of low risk AI, do they address wind speed, nozzle size, time of day.

Stakeholders are engaged.

- Notification procedures before use of insecticides are adequate and include affected communities, beekeepers, organic farmers, and natural area managers in the application area as well as areas potentially impacted by drift in air or flow in water.
- If federally listed species may be present, USFWS is to be notified in advance of the application.
- Advance notice should be sufficient to allow for residents and land managers to take additional protective measures.

Developed by Region 3 Ecological Services, HQ Ecological Services, and the National Coordinator for Integrated Pest Management, NWRS.

U.S. Fish & Wildlife Service
http://www.fws.gov

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