Information Bulletin

Fish and Wildlife Related Impacts of Pesticides Used for the Control of Mosquitoes and Blackflies

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF FISH, WILDLIFE, AND MARINE RESOURCES

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I. PURPOSE

The purpose of this bulletin is to provide the public with information about the fish and wildlife impacts of pesticide use. Three factors should be considered if a pesticide is selected for controlling mosquitoes and blackflies. These factors are: the effectiveness of the pesticide, the potential effects on human health, and the effects on the environment. Other items to consider are when, where, and how much of the pesticide is used, and how the pesticide is applied. Pesticide users should know which non-target organisms will be exposed, and how sensitive to the pesticide they are. The basic question should also be asked, is there an actual need for pest control? If so, what are the goals of the pest control program? This information bulletin will state the recommendations of the Division of Fish, Wildlife, and Marine Resources. The recommendations will be followed by detailed background information.

II. RECOMMENDATIONS

Experience gained over the past years has shown that chemical pesticides can cause harm to fish and wildlife communities. This harm can range from outright toxicity from chemicals such as Diazinon to more subtle, long term effects. These effects include impacts such as reducing the food available to insect-eating birds and animals, or the accumulation of persistent chemicals in fish and wildlife. Alternatives to chemical pesticides should be considered first. Some communities have reported that the populations of mosquitoes and blackflies have decreased after stopping chemical treatment programs. This may be because of an increase in the abundance of bats and birds that feed on mosquitoes and blackflies. Installing bat boxes and bird houses may encourage the presence of these natural predators of biting insects. Use personal insect repellents, following the label directions carefully. Repellents should be used sparingly, covering only exposed skin or clothing, and washing skin when the repellent is no longer useful. Insect repellents are beneficial, but their use has also been associated with some adverse health effects. Wear light colored clothing. Darker colored clothing, especially red, green, and blue tend to attract these insects. Inexpensive headnets can greatly reduce bites and the aggravation associated with face swarming blackflies. Add screens to doors, windows, and porches to keep insects out of houses. Keep yards free of cans, old tires, or other receptacles that could hold water. These containers can become mosquito breeding areas. Measures such as these will not

harm the environment. The Division of Fish, Wildlife, and Marine Resources does not recommend the use of chemical pesticides for comfort-related control of blackflies and mosquitoes. If some type of control program is necessary, larvicides are preferred over adulticides. Bti, *Bacillus sphaericus* and Monomolecular Surface Film (MSF) are preferred larvicides from an environmental standpoint. Larvicide impacts are confined to water. The number of non-target organisms exposed is minimized. Bti and *Bacillus sphaericus* are quite specific in their effects and are harmless to most non-target aquatic life. MSF is not directly toxic even to the mosquito larvae. Methoprene may be comparable to Bti and *Bacillus sphaericus* with regards to environmental effects. It is not known, however, if methoprene is as selective as these for only mosquito and blackfly larvae. MSF and methoprene are not registered for use on blackflies.

If an adulticide is necessary, select a product and a method of application that will protect sensitive environments. In an area with many streams and ponds, ground application would be preferable. Aerial application might be satisfactory in an area without many water bodies. Schedule applications when other sensitive species would not be present.

Where the same or similar type of pesticide, such as an organophosphate or synthetic pyrethroid has been used repeatedly over a period of time, be alert to the possibility of pest resistance developing. If blackflies or mosquitoes become resistant to the pesticide used in past treatments, then control will be achieved with greater difficulty. Consider alternative control strategies, testing target insect populations for resistance, or alternating compounds used, for example switching from temephos to Bti or *Bacillus sphaericus*.

When using any pesticide, follow all label directions precisely. If a permit is necessary before applying a pesticide, you must carefully observe all permit conditions. This is the only way the environmental safety of pesticide use can be assured.

The pesticide user must understand these factors and considerations to make informed, sensible decisions. This bulletin will only address fish and wildlife impacts. For health concerns, contact Department of Health, Bureau of Toxic Substances Assessment, Flanigan Square, 547 River Street, Troy, New York 12180, (800) 458-1158. For other pesticide information, contact the New York State Department of Environmental Conservation, Bureau of Pesticides Management, 50 Wolf Road, Albany, New York 12233-7254, (518) 457-7482. Note: During the summer of 2001, the NYSDEC address will change to 625 Broadway, Albany, New York, 12233-7254.

III. **DEFINITIONS.** A list of several terms related to pesticide issues follows:

A. Accumulate, or accumulation: This is the potential for a pesticide to build up within the tissues of exposed organisms. Some pesticides will dissolve in an organism's fat or body fluids and tissues. There, they can build up to levels many times higher than concentrations in the surrounding air and water. When these organisms are eaten by others, food chain accumulation results.

B. Acute: Harmful effects that result directly from short term exposure to a pesticide, and that can appear immediately or within several days. When death occurs immediately upon exposure or shortly afterwards, it is considered as an acute, lethal effect.
C. Active Ingredient: The chemical component of a pesticide that actually causes the pesticidal effect to the target organism.

D. Broad Spectrum: A pesticide that targets a wide range of pests, such as all flying insects, or all chewing insects. It is highly toxic to many different species.

E. Chronic: Harmful effects that occur over a long time, and do not cause the outright immediate death of the exposed organism. Chronic effects include delayed growth rate, impaired reproduction, increased birth defects, or eventual death. Chronic effects can also result from continuous exposure to pesticide doses that are too low to have acute effects.

F. Concentration: The quantity of pesticide in a given media such as air or water. A concentration of 50 mg/1 would indicate 50 milligrams of pesticide were found in one liter of water. Concentrations can also be expressed as parts per thousand, parts per million, etc. Ten parts per million (ppm) would mean ten units of pesticide were contained in one million units of media. One mg/1 is the same as one part per million.

G. Non-target species/organisms: Organisms or species that are not intended to be controlled or impacted by a particular pesticide.

H. Organism: An organism is any living creature such as a plant, animal, or microbe.

I. Persistence: A measure of the length of time that a pesticide remains in the environment in its toxic state.

J. Specific pesticide: A pesticide that is toxic to only a single species, or small number of related species.

K. Surfactant: Any compound that reduces surface tension when dissolved in water or water solutions.

L. Target species/organism: The particular plant, animal, insect, or microbe that a particular pesticide is designed to kill or control.

M. Toxicity: A measure of the potential that a chemical substance has for causing harm to living organisms.

IV. THE REGISTRATION PROCESS

Pesticides are chemicals intended to kill target organisms. Pesticides include insecticides,

herbicides, fungicides, and others. Registration is the means by which the U.S. Environmental Protection Agency regulates and controls pesticide use. To obtain registration, a pesticide manufacturer presents scientific evidence that characterizes the benefits and potential risks from using the pesticide. The manufacturer must state what pest the chemical is targeted to control, and when, where, how, and how much of it is to be applied. They must also identify the potential environmental and human health impacts. If the EPA decides the risks exceed the potential benefits, the request for registration is denied and the pesticide cannot be used. Alternatively, the EPA can request more data on a pesticide, or approve the registration conditionally while data gaps are being filled. If necessary, the EPA can require changes to the pesticide label directions. The label directions control how the pesticide can be applied and how much can be used. The EPA can also register a pesticide as **Restricted Use.** This means the material can only be purchased and used by or under the direct supervision of a certified pesticide applicator.

A pesticide must have EPA registration to obtain New York registration. The Bureau of Pesticides Management is responsible for the registration of all pesticides in New York State. New York has specific registration requirements for pesticides. However most of the pesticides discussed in this paper were registered before the current extensive data requirements were in place. Registration does not mean a pesticide is free from harmful effects. It means the potential for harmful effects is tolerable if the pesticide is used **exactly** according to the label.

V. HARMFUL FISH AND WILDLIFE EFFECTS

The pesticide label, the manufacturers' Material Safety Data Sheet, and the scientific literature provide information about the level of risk to non-target species from pesticides. Many organochlorine or organophosphate pesticides are broad-spectrum poisons which kill a wide variety of insects, fish, and wildlife. Chemical insecticides in particular are usually broad spectrum in nature. Most exposed insects are harmed, although some insects are more resistant than others. Selectivity is achieved by applying pesticides at varying concentrations, seasons, or times. Some species are targeted by the application method. A non-persistent pesticide sprayed from an airplane during the day will target daylight flying insects, and is not as likely to harm nocturnal, crawling insects. A mosquito control pesticide sprayed from a truck in the late evening will target mosquitoes that are active at dusk. It is not as likely to harm honey bees that are active during the day. However, pesticides can kill exposed nontarget organisms. Diazinon is a pesticide that was registered in New York. It was banned in New York on areas such as golf courses and turf grass farms because it killed songbirds. Pyrethroids are pesticides that are highly toxic to insects and fish, but are not very toxic to birds or mammals. The labels of most pyrethroid pesticides warn that they should not be applied directly to water. Aerial applications of pyrethroid pesticides can be harmful to fish such as koi or goldfish in backyard, ornamental pools, particularly if they have a fairly large surface area and are relatively shallow. Such ponds should be covered as much as possible when pyrethroid insecticides are being applied by air. Runoff from treated areas could also create a hazard for aquatic life.

A well-known example of a pesticide with chronic toxicity effects to wildlife is DDT. This

pesticide was highly toxic to insects, but did not appear harmful to wildlife. However, it was soon discovered that DDT caused bird eggshells to become so thin that the eggs broke under the weight of the brooding mother. Few birds were killed outright by exposure to DDT, but bird populations were reduced by reproductive failure. DDT also severely inhibited reproduction of some fish species.

Chronic effects can be caused by the accumulation of pesticides in an organism's tissue. Even though the concentration of pesticide applied may be small, pesticides in animal tissue can accumulate to very high levels. Exposed animals can become weak or sick, and easily fall victim to accidents or predation. The accumulation of pesticide can reduce the animals' ability to survive stressful life stages. As in the case with DDT, the exposed animals appear unaffected until a critical period or event occurs.

Pesticides can also have a harmful impact on the inter-relationships between groups of different organisms living together and their non-living environment. No organism in a community is completely independent of the others. For example, mosquitoes and blackflies as well as many other insect species are a food source for bats and birds. When insect populations are significantly diminished by pesticides, bats and birds that feed on insects must search a much greater area to find sufficient food. If they are not able to find enough food, the young may die and adults may leave the area to find more abundant sources of food. If allowed to forage without the removal of insects by pesticides, these aerial predators provide a significant degree of insect control by their feeding and foraging. This problem is aggravated by the fact that the effects of pesticide sprays aren't limited to mosquitoes and blackflies. The pesticides kill almost all exposed insects, thus reducing the food available to bats and birds whether they feed on mosquitoes and blackflies at all or not. Another example of harm to the natural community is the effects of pesticides on honeybees. These beneficial insects are responsible for pollinating flowering plants. The inadvertent destruction of honeybees can upset the abundance of plant life. Agricultural production may also be affected.

VI. ADULTICIDES VS. LARVICIDES

Mosquitoes and blackflies pass through four life stages. The adults lay eggs in the water. An egg hatches out into an immature, juvenile stage called a larva. The larva will live in the water while it feeds and grows. After a length of time, the larva will enter a resting stage, called the pupa. While in the pupal stage, the larva is transformed into an adult. The adult will break out of the cocoon-like pupa case, and leave the water. The adult stage is the flying, biting form of the insect with which most people are familiar.

Mosquitoes and blackflies are chemically controlled by two types of pesticides in New York State. These are adulticides and larvicides. Adulticides target the adult, flying stage of the insect. They are sprayed into the air, either by aircraft or truck mounted sprayers. Mosquitoes, blackflies, and other flying insects, are killed directly or soon after contact with the pesticide mist. Adulticides can also coat the vegetation and ground. Insects that come in contact with the

pesticide are weakened and killed. The advantage of an adulticide is that an immediate, dramatic reduction in the numbers of mosquitoes and blackflies results. This reduction can be very short. Larval blackflies and mosquitoes in the water are not controlled by the spray. They can hatch in a few days, bringing the population back up to pretreatment levels. Insects from nearby, untreated areas can migrate into the treated area. Weather conditions can reduce the effectiveness of the treatment by dispersing the cloud of pesticide too rapidly. Winds can carry the pesticide into areas where it should not be, such as over water or wetlands. All organisms in the area treated may be exposed including humans, wildlife, domestic and farm animals. Larvicides target the juvenile, immature stage of mosquitoes and blackflies called the larval stage. Larvae live in water. Mosquitoes reproduce in still water such as shallow ponds, marshes, or even temporary puddles. Blackflies reproduce in cool, rapid streams. Larvicides kill the larvae in the water before they can become adults. This does not result in a dramatic reduction of adult mosquitoes or blackflies because adults are not affected. However, an effective larvicide treatment will prevent development of large populations of biting adults. Fewer mosquitoes and blackflies become adults and reproduce, so the population continues to decline below pre-treatment levels.

Larvicides are produced with the intention of being applied to and used in water. Potential impacts to nontarget aquatic organisms such as fish have usually been taken into consideration. Adulticides, on the other hand, usually contain specific instructions to avoid application to water. These instructions can range from the very general warning such as "Do not apply directly to water", to a specific statement such as "Do not apply to lakes, streams, or ponds". Before an adulticide is used, these warning statements should be checked to insure a risk to aquatic life will not result.

Pesticides that are applied by spray are often mixed with a carrier to dilute the pesticide and to produce the necessary volume. Some are mixed with relatively harmless materials such as soybean oil or mineral oil. Others are mixed with kerosene or other petroleum based products. These carriers can also have harmful effects on humans, fish, and wildlife.

VII. PESTICIDES AVAILABLE IN NEW YORK

Thirteen pesticide active ingredients are presently registered for use on mosquitoes and blackflies in New York, five larvicides and eight adulticides. The larvicides are temephos, methoprene, Bti, *Bacillus sphaericus*, and MSF. The adulticides are naled, malathion, resmethrin, chlorpyrifos, pyrethrins, permethrin, sumithrin and methoxychlor. Methoxychlor has been used both as a larvicide and adulticide, although it is no longer registered for use as a larvicide in New York State. The larvicidal uses of methoxychlor are discussed below, however, because of its historical use a a larvicide. However the formulation and application rate will vary depending on the use. Always check the label before using! Each active ingredient will be discussed below. These active ingredients are available under various tradenames and formulations. Table 1 lists the various trade names these active ingredients are registered under in New York State. The table also tells if they are registered for the control of mosquitoes, blackflies, or both.

A. Larvicides

1. Methoxychlor: Methoxychlor is an organochlorine pesticide, belonging to the same group of pesticides as DDT. Methoxychlor had been primarily used as a larvicide in New York State and had limited use as an adulticide. As a larvicide, methoxychlor was applied directly to water. Unlike DDT, methoxychlor is not persistent. Methoxychlor is a broad spectrum pesticide, killing target and non-target aquatic insects alike. Methoxychlor at application rate is toxic to some mayflies, stoneflies, and caddisflies. These non-target aquatic insects are important food for many fishes. While methoxychlor is very toxic to fish, actual field studies in streams treated with methoxychlor have not demonstrated any lethality from proper applications. Accumulation in fish flesh was not a serious problem. Methoxychlor is no longer labeled for aquatic (larvicide) use.

2. Temephos: Temephos is an organophosphate pesticide, belonging to the same group as malathion and naled. Temephos is used primarily as a larvicide and is applied directly to the water. When applied at a concentration of 0.1 ppm, temephos will not harm most non-target aquatic insects, yet it is effective against mosquito and blackfly larvae. It does not pose a significant threat to fish. Temephos is not persistent. It is however a broad spectrum pesticide and at higher concentrations it will kill target as well as non-target aquatic insects. It does not accumulate, so contamination of fish flesh should not occur.

3. Methoprene: Methoprene is a chemical that mimics juvenile insect hormones. It interferes with the transformation of a mosquito larva into an adult. The larval mosquitoes remain as non-biting larvae longer than normal and their growth and survival is disrupted. Methoprene is used primarily as a mosquito larvicide and is applied directly to water. Methoprene is not persistent. It is fairly specific for mosquito larvae, but some studies have shown impacts on other non-target aquatic insects. While methoprene is listed as being somewhat toxic to fish, very little potential for toxicity to fish and wildlife exists. Methoprene may accumulate to low levels in fish. Some specific products are labeled "Do not use in waters that are known fish habitat". Check the label before use.

4. Bti: Bti is a biological control pesticide produced from bacteria, *Bacillus thuriniensis israelensis* serotype H-14. These bacteria produce spores containing crystals. When the spores or the crystals are eaten by blackfly or mosquito larvae, their digestive system is affected, killing the larvae. Used as a larvicide and applied directly to the water, Bti is not persistent. Bti is very specific, killing only the larvae of mosquitos, blackflies, and a few non-biting flies. Most other species of aquatic insects are not affected by Bti. The potential for toxicity to fish is so small as to be considered negligible. Bti does not accumulate in fish and wildlife.

5. *Bacillus_sphaericus*: *Bacillus sphaericus* is a biological control pesticide produced from bacteria, *Bacillus sphaericus* serotype H5a5b, Strain 2362. These bacteria produce spores containing crystals, similar to Bti. When the spores or the crystals are eaten by

mosquito larvae, their digestive system is affected, killing the larvae. Used as a larvicide and applied directly to the water, *Bacillus sphaericus* is not persistent. It is particularly effective in murky, high organic water bodies. *Bacillus sphaericus* is very specific, and is labeled for only killing the larvae of mosquitos. Most other species of aquatic insects are not affected by *Bacillus sphaericus*. The potential for toxicity to fish is so small as to be considered negligible. *Bacillus sphaericus* does not accumulate in fish and wildlife.

6. Monomolecular Surface Film: A monomolecular surface film (MSF) is a completely unique way to get a pesticide effect. It is not ingested by target organisms to produce a toxic effect. Instead it intereferes with the ability of mosquito larvae and pupae to breathe. Most aquatic invertebrates possess gills, or can absorb dissolved oxygen directly out of the water. Most mosquito larvae, however, must migrate to or remain at the surface and obtain oxygen through a respiratory tube, or siphon. An MSF uses an isostearyl alcohol. It modifies the surface tension by creating a monomolecular surface layer that prevents the larvae from obtaining air through the respiratory tube. The larvae can absorb some dissolved oxygen from the water, and many larvae have small gills, but deprived of atmospheric oxygen, most mosquito larvae die in 24 to 72 hours. The MSF does not interfere with organism that breathe with gills, nor does it prevent atmospheric oxygen from dissolving in the water, so most fish and other aquatic invertebrates are unaffected. An MSF is not very toxic to aquatic life, and the isostearyl alcohol does not accumulate. It is not persistent, and is degraded usually within 2 - 10 days. This type of control has been used extensively on Long Island. An MSF is not effective against blackflies, and should be only applied to standing water.

B. Adulticides

1. Naled: Naled is an organophosphate pesticide, belonging to the same group of pesticides as temephos and malathion. Until a few years ago, naled was probably the most commonly used mosquito/blackfly adulticide used in New York State. It is applied by ground spraying (truck) or by aerial spraying (airplane). Naled does not persist more than two days after application. Naled is a broad spectrum pesticide which kills target and non-target terrestrial insects. Naled will kill aquatic insects and is potentially toxic to fish and birds. Naled does not accumulate in fish and wildlife tissue. The environmental hazards section of naled product labels carry the warning "Do not apply directly to water or wetlands (swamps, bogs, marshes, or potholes)." The label instructions specify ". . . vegetation **around** stagnant pools, marshy areas, swamps, . . . may be treated." Naled applied to vegetation can be taken up by plants and metabolized. One of the breakdown products resulting from the plant's metabolism of naled is itself another organophosphate insecticide known as dichlorvos, or DDVP, which can be further metabolized or evaporated off.

2. Malathion: Malathion is an organophosphate pesticide, similar to temephos and naled. Malathion was a commonly used adulticide in New York State. Naled had replaced malathion in most mosquito or blackfly control programs. It is applied by ground spraying (truck) or by aerial spraying (airplane). Malathion is more persistent than the other adulticides listed here for mosquito and blackfly control. While it can remain stable for three weeks, it is not as persistent as the DDT type pesticides. It is a broad spectrum pesticide which will kill target and non-target insects. Applications have been shown to kill target and non-target insects alike in a section of stream. Malathion can also be toxic to fish and birds. Information on the accumulation of malathion in fish and wildlife is lacking. The environmental hazards section of malathion product labels carry the warning "Avoid direct application to lakes, streams, ponds, tidal marshes, and estuaries."

3. Pyrethrins: Pyrethrins are a mixture of similar natural pesticides obtained from chrysanthemums (pyrethrum). They frequently have synergists added which increases their toxicity. Pyrethrins can be applied by ground spraying (truck) or by aerial spraying (airplane). Pyrethrins are not persistent and breakdown rapidly in sunlight. They are a broad spectrum pesticide which will kill target and non-target insects. Accidentally spraying a water body can harm some species of aquatic insects and other invertebrates. They are also extremely toxic to fish. Pyrethrins do not appear to accumulate or persist in the tissues of fish and wildlife. The environmental hazard section of this product (Pyrethrins) labels carry the warning "Do not apply to any body of water. "

4. Resmethrin: Resmethrin is a synthetic pyrethroid pesticide. Pyrethroids are similar to pyrethrum, a natural pesticide obtained from chrysanthemums. Scourge is the trade name of a formulation of resmethrin that has been synergized. This means that the toxicity has been increased by adding ingredients that enhance the toxic effects. Resmethrin can be applied by ground spraying (truck) or by aerial spraying (airplane). Resmethrin is not persistent. It is a broad spectrum pesticide which will kill target and non-target insects. Accidentally spraying a water body can harm some species of aquatic insects and other invertebrates. It is also extremely toxic to fish. Resmethrin does not appear to accumulate or persist in the tissues of fish and wildlife. The environmental hazard section of resmethrin product (Scourge) labels carry the warning "Do not apply to lakes, streams, or ponds. "

5. Chlorpyrifos: Chlorpyrifos is an organphosphate pesticide, belonging to the same class of pesticides as malathion and naled. It can be applied by ground spraying or aerial spraying. Unfortunately, chlorpyrifos is very persistent, unlike most organophosphate pesticides. It is also extremely toxic to fish and wildlife. It is a broad spectrum pesticide which kills target and non-target insects. Chlorpyrifos will kill aquatic invertebrates and has a strong potential to be toxic to fish and birds. Field applications, at labeled rates, have been shown to kill fish and ducklings. Some studies indicate that chlorpyrifos can bioaccumulate. Chlorpyrifos was developed for use as a larvicide, but is no longer registered for that use. The environmental hazards section of chlorpyrifos product labels

carry the warning "Do not apply directly to water." Because of possible regulatory actions by both the EPA and New York State, chlorpyrifos may soon be no longer be available in New York for use as a mosquito control pesticide.

6. Methoxychlor: A general description of methoxychlor is contained in the larvicide portion of this information bulletin. As an adulticide, methoxychlor is applied by either ground or aerial spraying. It is not persistent relative to DDT, but it is more persistant than the organophosphate or pyrethroid type insecticides. Methoxychlor is a broad spectrum pesticide which will kill target and non-target insects alike. Direct application to water can harm some species of aquatic insects and other invertebrates. Accumulation in fish and wildlife tissue is not a serious problem. The environmental hazards section of methoxychlor (adulticide formulation) product labels carry the warning "Do not apply directly to lakes, streams, and ponds."

7. Permethrin: Permethrin is a synthetic pyrethroid pesticide, belonging to the same group as resmethrin and sumithrin. Biomist is the trade name for a synergized formulation of permethrin. Permethrin can be applied by ground spraying (truck) or by aerial spraying (airplane). Permethrin is not persistent. It is a broad spectrum insecticide which can kill target and non-target insects, including bees. Accidentally spraying a water body can harm some species of aquatic insects and other invertebrates. Permethrin is extremely toxic to fish. Permethrin does not appear to accumulate in the tissues of fish and wildlife. The environmental hazards section of permethrin (Biomist) labels carry the warning “do not apply directly to water, or wetlands (swamps, bogs, marshes, and potholes)”. In addition, it contains a warning that it “is highly toxic to bees exposed to direct treatment on blooming crops or weeds.”

8. Sumithrin: Sumithrin (also called phenothrin) is a synthetic pyrethroid pesticide, belonging to the same group as resmethrin and permethrin. Anvil is the trade name for a synergized formulation of sumithrin. Sumithrin can be applied by ground spraying (truck) or by aerial spraying (airplane). Sumithrin is not persistent. It is a broad spectrum insecticide which can kill target and non-target insects. Accidentally spraying a water body can harm some species of aquatic insects and other invertebrates. Sumithrin is extremely toxic to fish. Sumithrin does not appear to accumulate in the tissues of fish and wildlife. The environmental hazards section of sumithrin (Anvil) labels carry the warning “do not apply directly to water, or areas where surface water is present or to intertidal areas below the mean high water mark.”

Differences in the toxicities of these pesticides can be illustrated. Figure 1 compares the relative toxicity of the larvicides to fish. Figure 2 compares the relative toxicity of the adulticides to fish, and Figure 3 compares the toxicity of the same adulticides to birds. The graphs use a value called the toxicity index to compare the pesticides. The toxicity index is the rate at which the pesticide is applied divided by the lowest recorded LC50 for fish, or LD50 for birds. The LC50 is the concentration of pesticide in water that will kill 50 % of the exposed fish. The LD50

is the lowest recorded dose of the pesticide that will kill 50% of the exposed birds. The lower the toxicity index, the less harmful the pesticide.

VIII. REGULATORY USE REQUIREMENTS

The Department of Environmental Conservation has responsibility for regulating the use of pesticides in waters and state-owned lands. The use of some of the pesticides described above may require an aquatic use or wetlands permit or an environmental impact statement. The Bureau of Pesticides Management prepared an environmental impact statement that examined blackfly control with naled and methoxychlor. The Department of Health prepared a generic Environmental Impact Statement for mosquito control programs eligible for state funding. MSF, *Bacillus sphaericus*, Bti, sumithrin, permethrin and resmethrin were not included, because those pesticides became available after the programmatic EIS was written. Since then, Bti has been extensively investigated. Under the terms of the State Environmental Quality Review Act (SEQR) a negative declaration regarding Bti was issued. The declaration states that the use of Bti as labeled will not harm the environment and an EIS is not required. A negative declaration has also been issued for *Bacillus sphaericus*, MSF, and methoprene. The use of products containing resmethrin, sumithrin, and permethrin require an environmental impact statement. Spraying adulticides over state land, or applying larvicides to state waters or wetlands requires a state permit. Check with your regional DEC office to determine if a permit or a determination of environmental significance under SEQR is necessary as early as possible when planning any treatment program. If you have any further questions about the impacts of pesticides on fish and wildlife, please contact Mr. Eric Paul, DEC Rome Field Station, (315) 337-0910, e-mail: eapaul@gw.dec.state.ny.us, or Mr. Timothy Sinnott, DEC Albany Office, (518) 457-0758, e-mail: txsinnot@gw.dec.state.ny.us.

Table 1. Trade names for mosquito and blackfly control pesticides registered for and most commonly used in New York State.

Active Ingredient	Trade Names	Registered for use on: Mosquitoes	Blackflies
Resmethrin	Scourge	yes	yes
	SBP-1382	yes	yes
	Purge	yes	
	Synthrin	yes	
	Vectrin	yes	
Permethrin	Aqua-reslin	yes	yes
	Mosquito Beater	yes	yes
	Biomist	yes	yes
	Permethrin	yes	yes
Sumithrin	Anvil	yes	yes
Pyrethrins	ULD BP-100	yes	yes
	ULD BP-300	yes	yes
	Pyrethrins	yes	yes
Naled	Dibrom	yes	yes
	MU-17	yes	yes
	Trumpet	yes	yes
Malathion	Cythion	yes	
	Fyfanon	yes	
	Atrapa	yes	yes
Chlorpyrifos	Dursban	yes	
Methoxychlor	Marlate	yes	
	Methoxychlor	yes	
Methoprene	Altosid	yes	
Temephos	Abate	yes	
Bti	Vectobac	yes	yes
	Teknar	yes	yes
	Acrobe	yes	yes
	Skeetal	yes	yes
	Bactimos	yes	
Bacillus sphaericus	Vectolex	yes	
Monomolecular Surface Film	Arosurf MSF	yes	
	Agnique MMF	yes	

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Figure 1. Relative toxicity of larvicides to fish.
The smaller the index, the less likely the risk of toxicity.

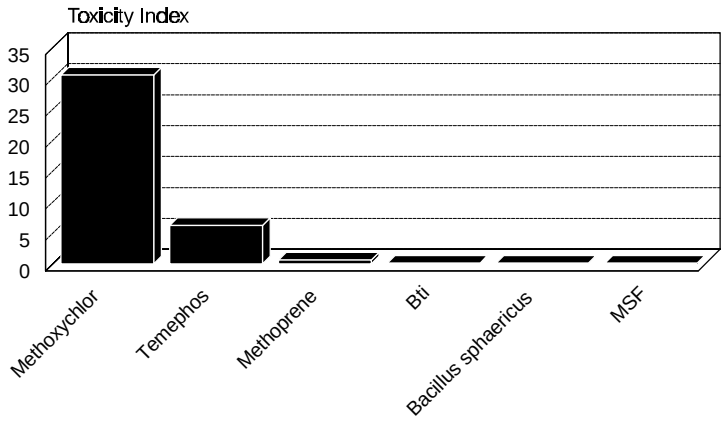

Figure 2. Relative toxicity of adulticides to fish.
The smaller the index, the less likely the risk of toxicity.

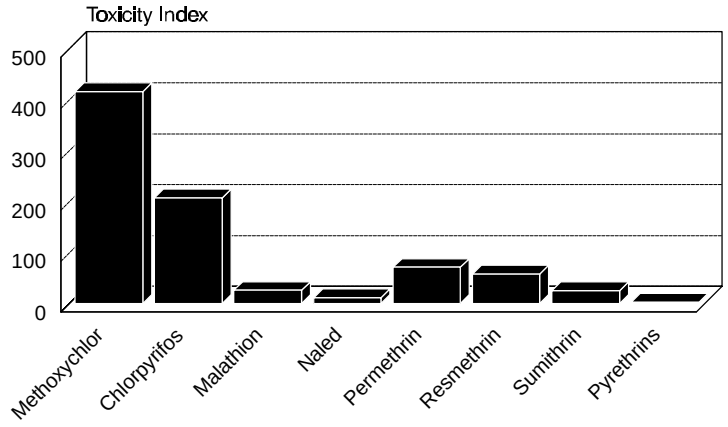

Figure 3. Relative toxicity of adulticides to birds.
The smaller the index, the less likely the risk of toxicity