Adult Mosquito Control Literature Review

Abbene IJ, *et al.* 2005. Concentrations of insecticides in selected surface water bodies in Suffolk County, New York, before and after mosquito spraying, 2002-04 (No. 2005-1384). **– A study to measure contamination in surface waters by pyrethroids (resmethrin and sumithrin) before and following aerially-applied and truck-mounted ULV applications for West Nile Virus control was conducted in Suffolk County, New York. Among the samples taken following truck-mounted applications, none of the chemicals were detected.**

Boyce WM, *et al.* 2007. Nontarget effects of the mosquito adulticide pyrethrin applied aerially during a West Nile virus outbreak in an urban California environment. *Journal of the American Mosquito Control Association* 23(3): 335-339. **– Aerial application of adult mosquito control products found no effects on dragonflies, spiders, butterflies, and honeybees.**

Breidenbaugh MS and de Szalay FA. 2010. Effects of aerial applications of naled on nontarget insects at Parris Island, South Carolina. *Environmental Entomology* 39:591-599. **– A Before-After Control-Impact analysis at each location was conducted to compare changes. There were no significant changes in numbers of common taxa or total numbers in 2005. Shannon diversities (H') were not different in either year indicating that sprays had minimal impact on overall community biodiversity. In contrast, populations of pestiferous biting midges (*Culicoides* spp.) collected in CDC-style traps were reduced by 94-99% after spraying in both years; mosquito numbers declined by 88.2% in 2003 and 92.5% in 2005, after sprays.**

Carney RM, *et al.* 2008. Efficacy of aerial spraying of mosquito adulticide in reducing incidence of West Nile virus, California, 2005. *Emerging Infectious Diseases* 14(5): 747-754. **– Results from study provide direct evidence that adult mosquito control spray applications are effective in reducing human illness and potential death from West Nile Virus infection.**

Caron DM. 1979. Effects of some ULV mosquito abatement insecticides on honey bees. *Journal of Economic Entomology 72*(1): 148-151. **– Evaluated malathion, pyrethrum and naled. Caged bees exposed to malathion suffered significant mortality. Night applications of the chemicals had no observable effect on bee colonies.**

Centers for Disease Control and Prevention. 2005. Human exposure to mosquito control pesticides – Mississippi, North Carolina, and Virginia, 2002 and 2003. *Morbidity and Mortality Weekly Report* 54(21): 529-532. **– Ground based truck applications of adult mosquito control products did not produce any detectable exposure in humans.**

Chaskopoulou A, *et al.* 2014. Nontarget effects of aerial mosquito adulticiding with water-based unsynergized pyrethroids on honey bees and other beneficial insects in an agricultural ecosystem of north Greece. *Journal of Medical Entomology* 51(3): 720-724. **– Aerially applied adult mosquito control products produced no increase in mortality of beneficial nontarget organisms. Beehives exposed to the applications performed as well as others that were not exposed, increasing in weight, adult bee population, and brood population.**

Chung WM, *et al.* 2013. The 2012 West Nile encephalitis epidemic in Dallas, Texas. *Journal of the American Medical Association* 310(3): 297-307. **– An eight (8) day period of aerial spraying to stop a West Nile Virus epidemic in Dallas did not result in any detectable increase in respiratory ailments or skin rashes in emergency rooms.**

Corcos, D, *et al.* 2020. Effects of natural pyrethrum and synthetic pyrethroids on the tiger mosquito, *Aedes albopictus* (skuse) and non-target flower-visiting insects in urban green areas of Padua, Italy. *International Journal of Pest Management* 66(3): 215-221. **– Natural pyrethrums and synthetic pyrethroids did not reduce the diversity of non-target insects.**

Davis RS, *et al.* 2007. An ecological risk assessment for insecticides used in adult mosquito management. *Integrated Environmental Assessment and Management* 3(3): 373-382. **– Ground based truck applications of adult mosquito control products pose little risk to small mammals, birds, aquatic vertebrates, and aquatic invertebrates.**

Davis RS and Peterson RK. 2008. Effects of single and multiple applications of mosquito insecticides on nontarget arthropods. *Journal of the American Mosquito Control Association* 24(2): 270-280. **– Ground based truck applications of adult mosquito control products in a National Wildlife Refuge near Great Falls, MT indicated few, if any, negative impact on nontarget aquatic and terrestrial organisms.**

Elnaiem DE, *et al.* 2008. Impact of aerial spraying of pyrethrin insecticide on *Culex pipiens* and *Culex tarsalis* (Diptera: Culicidae) abundance and West Nile virus infection rates in an urban/suburban area of Sacramento County, California. *Journal of Medical Entomology* 45(4): 751-757. **– Aerial application of adult mosquito control products were effective at reducing abundance and infection rates for West Nile Virus in mosquito populations, lowering transmission intensity and decreasing risks of human infections.**

Farajollahi A, *et al.* 2012. Effectiveness of ultra-low volume nighttime applications of an adulticide against diurnal *Aedes albopictus*, a critical vector of dengue and chikungunya viruses. *PLoS ONE* 7(11): e49181. **– Nighttime ground based truck applications of adult mosquito control products are effective at reducing populations of a difficult to control mosquito species.**

Geraghty EM, *et al.* 2013. Correlation between aerial insecticide spraying to interrupt West Nile virus transmission and emergency department visits in Sacramento County, California. *Public Health Reports* 128(3): 221-230. **– Aerially applied adult mosquito control products are not associated with any increase in respiratory, gastrointestinal, skin, eye, or neurological complaints in emergency departments.**

Ginsberg, HS, *et al.* 2017. Management of arthropod pathogen vectors in North America: minimizing adverse effects on pollinators. *Journal of Medical Entomology* 54(6): 1463-1475. **– Negative impacts of mosquito control on pollinators can be minimized by targeting specific areas and times for applications.**

Hester SG, *et al*. 2001. Efficacy of ground-applied ultra-low-volume malathion on honey bee survival and productivity in open and forest areas. *Journal of the American Mosquito Control Association* 17(1): 2-7. **– Some mortality if within 7-15 m from spray for bees outside hive. No observable effects on overall colony health and honey production.**

Jensen T, *et al.* 1999. Effects of ultra-low volume pyrethrin, malathion, and permethrin on nontarget invertebrates, sentinel mosquitoes, and mosquitofish in seasonally impounded wetlands. *Journal of the American Mosquito Control Association* 15(3): 330-338. **– Ground based truck applications of adult mosquito control products are unlikely to have any substantial effect on aquatic insects or fish, tested in a wetland environment.**

Karpati A, *et al.* 2004. Pesticide spraying for West Nile virus control and emergency department asthma visits in New York City, 2000. *Environmental Health Perspectives* 112(111): 1183-1187. **– Ground based truck applications of adult mosquito control products did not result in increased emergency room visits for asthma.**

Knepper RG, *et al.* 1996. Deposition of malathion and permethrin on sod grass after single, ultra-low volume applications in a suburban neighborhood in Michigan. *Journal of the American Mosquito Control Association* 12(1): 45-51. **– Measured deposition on grass following ULV application. Found that materials quickly break down following application. Did not assess human exposure risk but results were similar to other studies that have shown minimal risk.**

Kwan JA, *et al.* 2009. Mortality of nontarget arthropods from an aerial application of pyrethrins. *Journal of the American Mosquito Control Association* 25(2): 218-220. **– Aerially applied adult mosquito control products did not have an effect on large bodied beneficial insects.**

Lawler SP, *et al.* 2008. Does synergized pyrethrin applied over wetlands for mosquito control affect *Daphnia magna* zooplankton or *Callibaetis californicus* mayflies? *Pest Management Science* 64(8): 843-847. **– Repeated applications of permethrin were made directly over a wetland area and effects measured on *Daphnia magna* and mayfly nymphs. Though they were able to measure residue of the insecticide in water samples, no detectible deleterious effects were observed to these non-target organisms.**

Macedo PA, *et al.* 2010. Evaluation of efficacy and human health risk of aerial ultra-low volume applications of pyrethrins and piperonyl butoxide for adult mosquito management in response to West Nile virus activity in Sacramento County, California. *Journal of the American Mosquito Control Association* 26(1): 57-66. **– Aerial application of adult mosquito control products were below human health concern levels and were effective at reducing abundance and infection rates for West Nile Virus in mosquito populations.**

Moreno-Gómez M, *et al.* 2021. A three-pronged approach to studying sublethal insecticide doses: characterising mosquito fitness, mosquito biting, behaviour, and human/environmental health risks. *Insects* 12(6): 546. **– Prallethrin inhalation at a rate of 0.4 mg/hour for 24 hours had no risk of detrimental effects in adults or children.**

Oberhauser KS, *et al.* 2009. Impacts of ultra-low volume resmethrin applications on non-target insects. *Journal of the American Mosquito Control Association* 25(1): 83-93. **– Some mortality observed among Monarch larvae and adults within 150m of spray.**

O'Sullivan B, *et al.* 2005. The effect of pesticide spraying on the rate and severity of ED asthma. *The American Journal of Emergency Medicine* 23(4): 463-467. **– Ground based truck applications of adult mosquito control products did not increase the rate or severity of asthma presentations in emergency departments.**

Pawelek, KA, *et al.* 2014. Modeling dynamics of *Culex pipiens* complex populations and assessing abatement strategies for West Nile virus. *PLoS ONE* 9(9), e108452. **– A model of WNV prevalence based on mosquito, bird, and human infections was developed to evaluate adult control strategies. Infected mosquitoes declined in a model when adult control was implemented compared to models without adult control.**

Peterson RK, *et al.* 2006. A human-health risk assessment for West Nile virus and insecticides used in mosquito management. *Environmental Health Perspectives* 114(3): 366-372. **– Human health risks from residential exposure to adult mosquito control products are low and do not exceed levels of concern. The risk from West Nile Virus exceeds the risk from exposures to adult mosquito control products.**

Peterson RK, *et al.* 2016. Determinants of acute mortality of *Hippodamia convergens* (Coleoptera: Coccinellidae) to ultra-low volume permethrin used for mosquito management. *PeerJ* DOI 10.7717/peerj.2167. **– Results demonstrated the importance of considerations of exposure that go well beyond deposition of ULV insecticides on surfaces and the extrapolation of that deposition to risk to non-target insects.**

Phillips BM, *et al.* 2014. Monitoring the aquatic toxicity of mosquito vector control spray pesticides to freshwater receiving waters. *Integrated Environmental Assessment and Management* 10(3): 449-455. **– Some water and sediment samples toxic following ULV spray, mostly associated with naled rather than pyrethroids. PBO thought to contribute to some toxic samples due to synergy with background pyrethroids in water/sediment. Overall concluded that most ULV applications of adulticides do not pose a significant acute risk to aquatic organisms.**

Piccolomini AM, *et al.* 2018. The effects of an ultra-low-volume application of etofenprox for mosquito management on *Megachile rotundata* (Hymenoptera: Megachilidae) larvae and adults in an agricultural setting. *Journal of Economic Entomology* 111(1): 33-38. DOI: 10.1093/jee/tox343. **– There was no significant difference in the proportion of dead and live larvae when the control group was compared with the group directly treated with etofenprox. Also did not observe a significant difference in the number of emerged adults reared from the treated shelters, and the number of completed cells after exposure to the insecticide continued to increase throughout the summer, indicating that provisioning adults were not affected by the insecticide treatment. The results suggest that the amount of etofenprox reaching nest shelters was not sufficient to cause significant mortality.**

Pokhrel V, *et al.* 2018. Effects of truck-mounted, ultra low volume mosquito adulticides on honey bees (*Apis mellifera*) in a suburban field setting. *PLoS ONE*, https://doi.org/10.1371/journal.pone.0193535. **– Three synergized pyrethroids applied by truck- mounted ULV for mosquito control resulted in little to no exposure and therefore had minimal effects on domestic honeybees.**

Preftakes CJ, *et al.* 2011. Bystander exposure to ultra-low volume insecticide applications used for adult mosquito management. *International Journal of Environmental Research and Public Health* 8: 2142- 2152. **– Ground based truck applications of adult mosquito control products are below human exposure levels of regulatory concern.**

Relyea RA, *et al*. 2005. Pesticides and amphibians: the importance of community context. *Ecological Applications* 15(4): 1125-1134. **– Pond mesocosm field studies showed in the presence of other predators, malathion had a positive impact on tadpole survival and biomass.**

Rinkevich FD, *et al.* 2017. Limited impacts of truck-based ultra-low-volume applications of mosquito adulticides on mortality in honey bees (*Apis mellifera*). *Bulletin of Entomological Research* 107(6): 724-733. **– A semi-field study involving pyrethroids and an organophosphate adulticide assessing the impact of truck-based ULV mosquito adulticide applications on honey bees found minimal bee mortality compared to mosquito mortality.**

Schleier III JJ, *et al.* 2008. Environmental concentrations, fate, and risk assessment of pyrethrins and piperonyl butoxide after aerial ultralow-volume applications for adult mosquito management. *Environmental Toxicology and Chemistry* 27: 1063-1068. **– Measured deposition of pyrethrins following aerial ULV applications. No pyrethrins were detectable in water samples. Where pyrethrins were detected, the risk quotients for aquatic surrogate species did not reach the U.S. EPA level of concern for endangered aquatic organisms and returned to baseline levels within 36 hours.**

Schleier III JJ, *et al.* 2008. Equine risk assessment for insecticides used in adult mosquito management. *Human and Ecological Risk Assessment* 14: 392-407. **– Assessed risk of horse exposure to three pyrethroids and two organophosphates applied by ULV. Concluded that risk well below levels of concern based on risk quotients.**

Schleier III JJ, *et al.* 2009. A two-dimensional probabilistic acute human-health risk assessment of insecticide exposure after adult mosquito management. *Stochastic Environmental Research & Risk Assessment* 23: 555-563. **– Risks to human health from adult mosquito control ULV spraying is negligible, using a sufficiently conservation measurement method.**

Schleier III JJ and Peterson RK. 2010. Deposition and air concentrations of permethrin and naled used for adult mosquito management. *Archives of Environmental Contamination and Toxicology* 58: 105-111. **– Study confirmed that risk assessment models used to estimate environmental deposition of ULV insecticides sufficiently overestimate concentrations (i.e. are sufficiently conservative).**

Schleier III JJ and Peterson RK. 2010. Toxicity and risk of permethrin and naled to non-target insects after adult mosquito management. *Ecotoxicology* 19: 1140-1146. **– Ultra-low volume (ULV) applications of adult mosquito control products do not impact populations of medium or large bodied beneficial insects.**

Schleier III JJ and Peterson RK. 2013. A refined aquatic ecological risk assessment for a pyrethroid insecticide used for adult mosquito management. *Environmental Toxicology and Chemistry* 32: 948-953. **– Developed an aquatic risk assessment for pyrethroid insecticides and estimated that the projected concentrations from ULV application would amount to less than 0.0001% of aquatic organisms potentially affected with a lethal concentration.**

Solomon KR, *et al.* 2001. Probabilistic risk assessment of cotton pyrethroids: I. Distributional analyses of laboratory aquatic toxicity data. *Environmental Toxicology and Chemistry* 20(3): 652-659. **– Regarding the relative risk to aquatic organisms, permethrin was measured among the lowest in aquatic toxicity of the various pyrethroids.**

Stevenson HR. 1980. A review on the effects of ultra low volume insecticide treatments to honey bees, *Apis mellifera* (L.). *Proceedings of the Florida Anti-Mosquito Association* 51: 11-14. **– Except for chlorpyrifos, ULV insecticides, under ideal conditions, will not subject honey bees to lethal doses.**

Weston DP, *et al.* 2005. Aquatic toxicity due to residential use of pyrethroid insecticides. *Environmental Science & Technology* 39(24): 9778-9784. **– Investigated the source of toxic levels of pyrethroids in water and sediment in Roseville, California. The evidence pointed to residential lawn applications and against mosquito control as the specific pyrethroid used by mosquito control (resmithrin) was not detected in any of the samples.**