A midge fly can be a source of currently used pesticides for birds, bats

April 20 2022

Non-biting midges can accumulate pesticides as larvae in polluted water and

retain them as adult flies (female shown above), exposing their predators to the pollutants. Credit: Alexis Roodt

Non-biting midges are the tiny flies that swarm together as thick masses around lakes and streams, annoying passers-by in warm weather. But early in a midge's life, it lives in the water. Now, researchers reporting in ACS' *Environmental Science & Technology* have observed that non-biting midge larvae accumulate contemporary pesticides from polluted water and retain the substances into adulthood. As a result, animals that eat the adult flies could consume small amounts of pesticides daily.

Mixtures of pesticides are applied to farms, forests, yards and gardens to keep nuisances at bay. When it rains, those compounds run off the landscape into nearby waterbodies, exposing underwater critters to a concoction of contaminants. For the non-biting midge, its larvae are bottom dwellers, slinking around sediments. However, after metamorphosis, the adults emerge and fly on shore and inland, becoming a major food source for spiders, frogs, birds and bats. Some emergent aquatic insects are known to accumulate contaminants, such as legacy pesticides, and retain the compounds as they pass from larval to pupal to adult stages—though potential differences between the sexes are rarely considered. And whether midges hold onto currently used pesticides into adulthood hasn't been addressed. So, Alexis Roodt, Ralf Schulz and colleagues wanted to track multiple pesticides throughout the life cycle of female and male non-biting midges, estimating the insects' potential to deliver these compounds to predators.

The researchers placed non-biting midge larvae into containers with sediment and water spiked with three levels of a mixture of nine pesticides. Larvae that lived in the contaminated environment for 14 days accumulated all of the fungicides and herbicides studied, and the

adult flies retained most of the compounds. The researchers found that the process of metamorphosis lowered the contaminants' levels, except for propyzamide, an herbicide which had similar levels between larvae and recently emerged flies. Adult female insects had higher concentrations of the pesticides compared to the males. But, as females mated and died, their pesticide levels generally decreased, which the researchers attribute to most of them laying eggs and transporting the compounds along to the next generation of midges. In contrast, contaminant levels remained steady for adult males from the time they emerged as flies through adulthood. Finally, the team estimated that tree swallow nestlings and two threatened bat species consume low to moderate levels of pesticides from the adult-stage flies in their diets. The researchers say that non-biting midges are a potential source of pesticides to terrestrial food webs by transferring the contaminants from water to their predators.

More information: Emerging Midges Transport Pesticides from Aquatic to Terrestrial Ecosystems: Importance of Compound- and Organism-Specific Parameters, *Environmental Science & Technology* (2022). DOI: 10.1021/acs.est.1c08079

Provided by American Chemical Society