

From Poland to around the globe: increasing surveillance for insect vectors of parasites

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Mosquito-borne parasites have ranked among the most important disease agents worldwide ever since the discovery of arthropod vector transmission in the 1800s, but were neglected for much of the late 1900s. Despite frequent warnings by parasitologists and entomologists, the global health community did not re-awaken to the importance of mosquitoes and other arthropods until the early 21st century, when Zika and other arboviruses swept the Americas and zoonotic dirofilariosis repens emerged across Europe, borne by a combination of native and exotic invasive species of mosquitoes. Within the same two decades, new emergence of Schmallenberg virus spread to domestic animals by *Culicoides* (Ceratopogonidae) midges across Europe, and emergence of leishmaniasis carried by *Lutzomyia* and other phlebotomine (Psychodidae) flies in North America and other areas showed a new reality that humanity has entered a new era of confrontation with vector-borne infectious diseases.

Inspired by research on zoonotic dirofilariosis repens emerging in Ukraine by our colleagues in Warsaw, Poland, my research group has initiated new surveillance research on mosquitoes and other insect vectors in diverse locations around the globe. Our new research since 2017, including work with international collaborators, has established surveillance for vectors in sites from the Arctic to near the equator including: 1) mosquitoes, phelobotomines, and ceratopogonids atop the Cumberland Plateau of Tennessee USA; 2) mosquitoes, phelobotomines, ceratopogonids, and tabanids in the Piedmont/Appalachian boundary region of Georgia USA; 3) mosquitoes in southern Florida, USA; 4) mosquito breeding sites in urban areas of the Central and Southern Caribbean (Puerto Rico, St. Maarten, Haiti, Aruba, Bonaire, Curaçao, St. Kitts) to near the northern coast of South America; 5) mosquitoes in multiple locations of Slovakia; and 6) mosquito breeding sites in Copenhagen, Denmark and urbanized areas along the coast of Norway, to north of the Arctic Circle. Methods include diverse trapping and hand collecting of adults, plus dipping and suction of water for larvae and pupae. Additionally, we are using Polymerase Chain Reaction (PCR) for molecular screening of selected mosquito populations in North America for *Dirofilaria immitis*, *Dirofilaria repens*, and other filarioid nematode parasites.

Our principal findings include: 1) 25 mosquito species of 7 genera atop the Cumberland Plateau high elevation of Tennessee; 2) 35 mosquito species of 8 genera in the valley lowlands of Georgia; 3) invasive *Aedes albopictus* and *Aedes japonicus* in Tennessee and Georgia; 4) *Aedes grossbecki* as a new record for the state of Georgia; 5) Cumberland Plateau as a new record for *Ae. albopictus*, *Ae. japonicus*, and the phlebotomine sand fly, *Lutzomyia shannoni*; 6) northwest Georgia as a new record for *L. shannoni*; 7) flower pots as urban breeding sites for invasive *Aedes aegypti* in Basseterre, Saint Kitts; 8) water meter chambers as urban breeding sites for invasive

Ae. aegypti in San Juan, Puerto Rico; 9) new records of large populations of diverse ceratopogonid biting midges in Tennessee and Georgia; 10) first record of *Dirofilaria* in mosquitoes from northwest Georgia. Fieldwork for sites in Europe, Florida, and the southern Caribbean are underway during summer 2019.

These new data show significant risk of parasite and other pathogen transmission across diverse areas of the Northern Hemisphere, all of which require increased ongoing surveillance with a growing concern for climate change and emerging infectious diseases.