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Drones and Mosquito Control

Rarely is there an individual that has not had an encounter or two with a mosquito. Or more likely, multiple mosquitos at the same time. These common small insects come in a variety of over 3,000 types. The adult males live on average a week and mainly rely on plant nectar to survive before transmitting their genes towards the next generation. Female mosquitos, the blood-sucking ones everyone is so fond of, live an average of seven weeks, but can be prolonged up to five months with an adequate diet. Mosquitos eggs require water, and upon hatching take a week to become flying adults. (What Is A Mosquito? |CDC).

Other than being obvious nuisances, mosquitos are one of the deadliest creatures on the planet. Looking at Figure 1, in 2015 mosquitos killed roughly 830,000 humans thoroughly outcompeting the “scarier” predators. Sharks killed only six, crocodiles around a thousand, and one of the closest animal competitors - snakes only sixty thousand. (Mosquitoes: World's Deadliest Animal).

While not having the sharp teeth or claws of other predators, mosquitos have something potentially much more terrifying, a variety of infectious diseases. Every year Anopheles mosquitos transferring malaria kill 400,000 people, the majority of which are

children, and puts another 200 million in need of rest or medical treatment. Another mosquito provided ailment, dengue fever, has 50-100 million cases per year. While not as lethal as malaria, dengue fever can easily escalate into a fatal hemorrhagic fever. Yellow fever, while only averaging 200,000 cases per year, greatly damages the internal organs and causes 30,000 deaths per year - a 15% fatality rate. These three diseases would be horrible enough without the host of other possible diseases such as Chikungunya, Eastern Equine Encephalitis, Japanese Encephalitis, La Crosse Encephalitis, St. Louis Encephalitis, West Nile, and Zika. (Mosquitoes: World's Deadliest Animal).

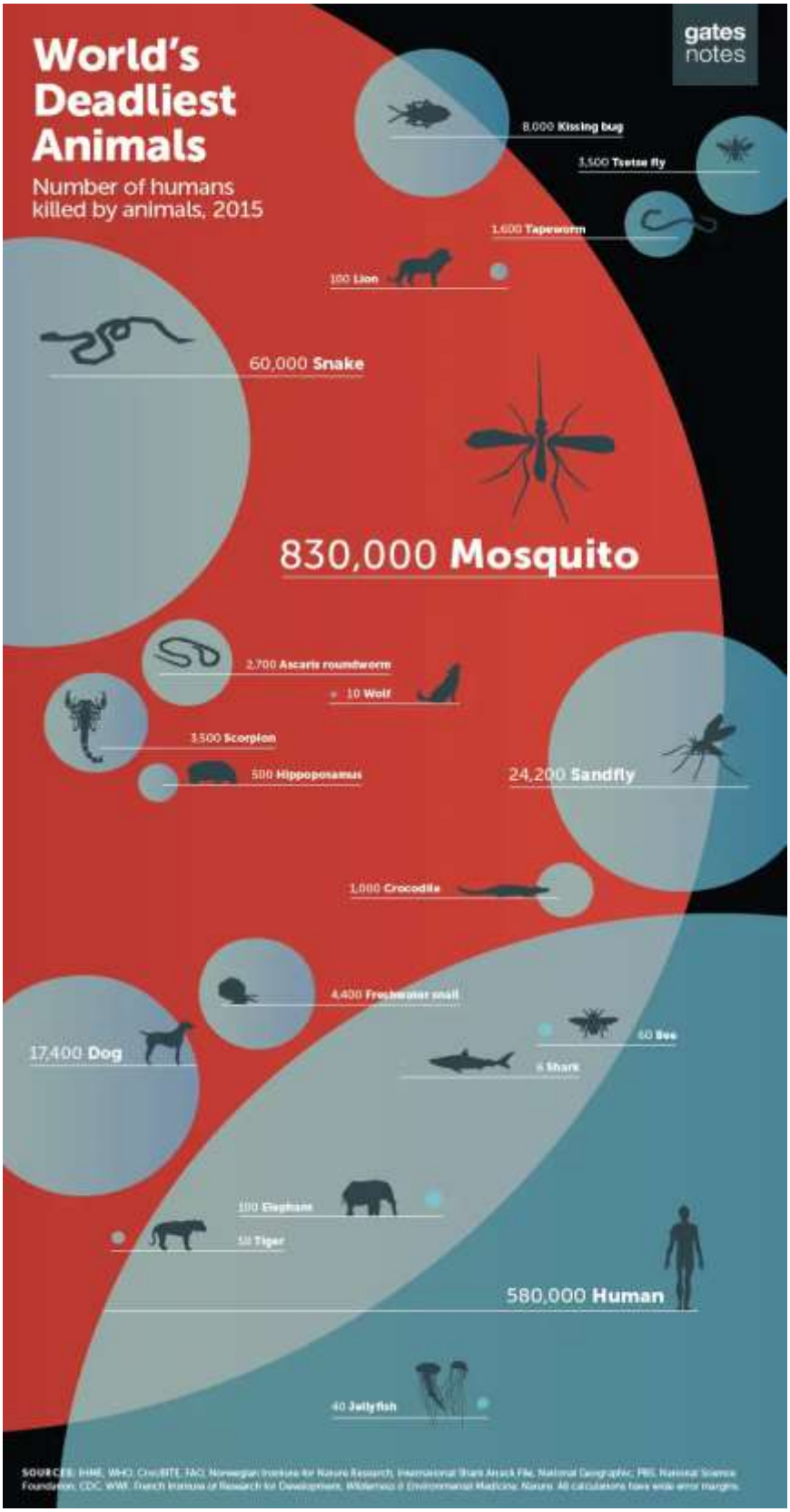

Figure 1. World's Deadliest Animals

Before continuing it is important to understand how infectious diseases originate and spread. An understanding of the process of infection is a key part of developing strategies to prevent and minimize present and future diseases.

Reservoirs are how the source of an infection maintains a stable or growing population. These can be humans, animals, and even the environment. Some of the common infections that originate from human reservoirs and require no additional factor to transmit are STDs, mumps, measles, and strep. Diseases that jump from animal reservoirs to humans are termed zoonotic diseases. “Long recognized zoonotic diseases include brucellosis (cows and pigs), anthrax (sheep), plague (rodents), trichinellosis/trichinosis (swine), tularemia (rabbits), and rabies (bats, raccoons, dogs, and other mammals). Zoonoses newly emergent in North America include West Nile encephalitis (birds), and monkeypox (prairie dogs). Many newly recognized infectious diseases in humans, including HIV/AIDS, Ebola infection and SARS, are thought to have emerged from animal hosts, although those hosts have not yet been identified.” (CDC-Principles of Epidemiology | Lesson 1 - Section 10). Environmental reservoirs are those that occur outside of the bodies of people or animals such as the soil, plants, or in the water. Two well-known diseases that can occur from this reservoir are Legionnaires Disease and Cholera.

The process of leaving the reservoir and entering a host is termed transmission. Transmission can be either direct or indirect. Direct contact can occur from skin-to-skin contact or touching contaminated material. Surprisingly, droplet spread also falls under the category of direct contact. Droplet spread can occur via sneezing, coughing, and even talking.

Indirect spread has three factors. Airborne transmission overlaps somewhat with droplet spread, however, in this instance the particle is light enough to remain in the air for some time. The same lightness that allows the particle to be suspended in the air also allows air currents to easily move the particles to new areas. Vehicle transmission is often passive and indirect. Examples would be contaminated food or water, blood, and even bedding. Vector transmission is often directly from another organism. Examples would be diseases carried by fleas, ticks, and mosquitos. A simplified image of these processes is depicted in Figure 2. (CDC-Principles of Epidemiology | Lesson 1 - Section 10).

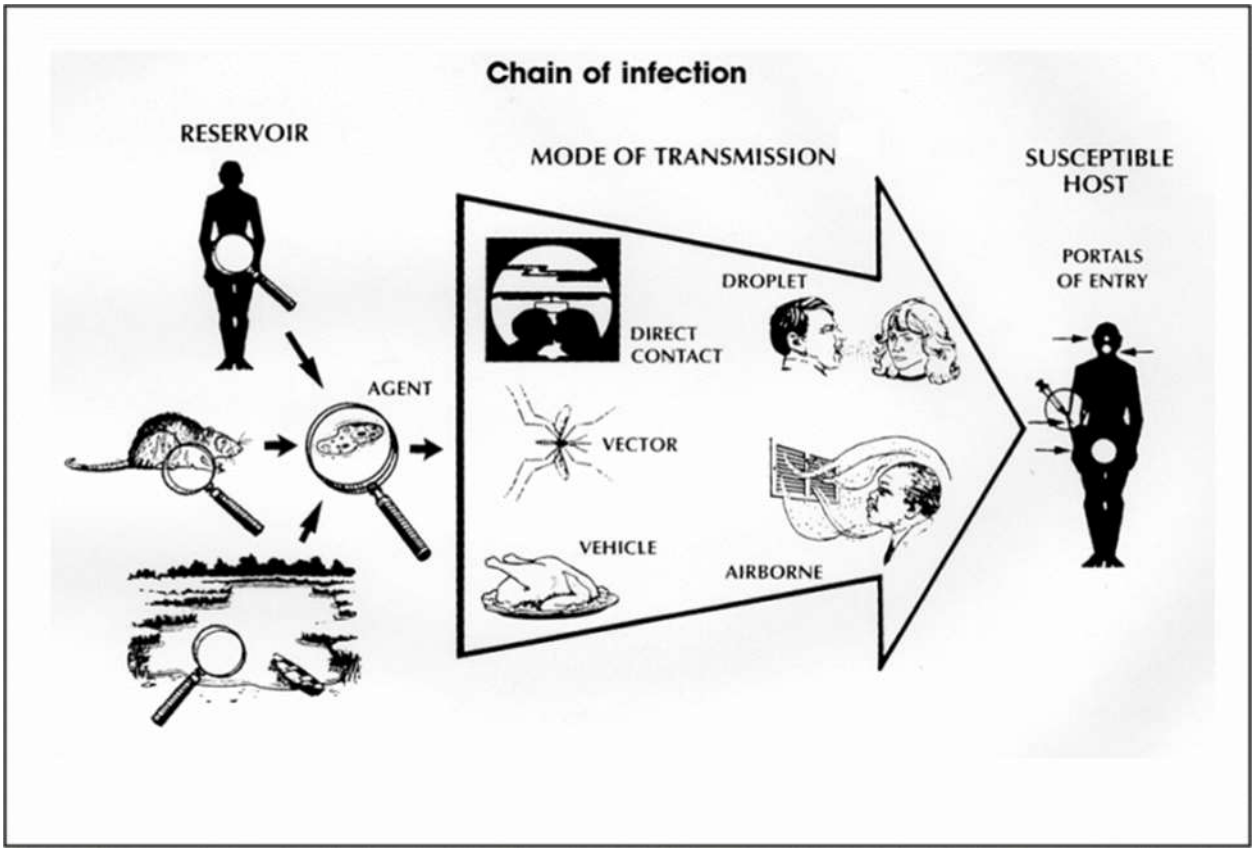

Figure 2. Chain of Infection

Krijn Paaijmans, an entomologist from Barcelona Institute of Global Health, is part of a team working on lowering transmission rates of malaria in southern Mozambique. He said, “Mosquitoes are a difficult creature to deal with. They are constantly avoiding anything we try to do against them.” “If we are to eliminate malaria, we need better entomological surveillance and data to develop more cost-effective interventions.” (Mosquitoes: World's Deadliest Animal).

Arguably, the best tool to fill this niche would be drones. Drones are fully capable of both vector control and reducing disease reservoirs. A drone can be used to collect imagery to identify breeding sites such as slow-moving bodies of water or unused debris capable of holding stagnant amounts of water. Dry streambeds can be identified as potential future sites to be monitored. These images can be accumulated into maps that can be provided to public health officials and the community.

Drones also have advantages when it comes to the delivery of pesticides to nesting sites. Drones can fit into tighter quarters and apply pesticides in a much more precise fashion than other aircraft, and at a much lower cost. While human application might be cheaper it also defeats one of the purposes of the whole process, reducing human infection rates. Without proper personal protective equipment (PPE), a person on foot applying pesticides in a concentrated mosquito breeding ground is at a high risk of being bitten and potentially infected.

A real-life example of these tools at work happened in Tanzania with DJI Enterprise Product Manager Eduardo Rodríguez in February 2020. One system used was (LSM), larval

source management, which focuses on targeting mosquitos in the larval stage of development. Rodríguez described it like this, “First, the mosquitos are concentrated; second, the mosquitos are immobile at this stage of development- they can’t fly away. And lastly, these areas are usually accessible.” (McNabb 2020).

The second way was equipping local communities with DJI’s anti-malaria drone the Agras MG-1S, an octocopter that can carry a 10 kg payload and 10 liters of insecticide. An image of which can be seen in Figure 3. “Drones are a highly efficient method, even compared to spraying with helicopters… with drones we can easily and quickly map the terrain, calculate the appropriate amount of pesticide, and deliver it. By using spraying drones to deliver the solution, we can improve productivity by more than 100%, covering 50 – 60 hectares a day.” (McNabb 2020).

In conclusion, drones are an ideal tool to disrupt the chain of infection. Their vector control and ability to disrupt disease reservoirs are likely a key tool in the fight to disrupt some of the world’s most deadly diseases. They are uniquely suited to fill the niche in eradicating mosquito populations.

Figure 3. DJI Agras MG-1S

Works Cited

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