Dengue and Zika Control: Stop the Spread with Trap-N-Kill® Lethal Ovitraps

by Elizabeth Schaafsma, Alyssa Branca, Emilie Bess and Michael Banfield

The recent outbreak of dengue fever in Hawai'i and the spread of the Zika virus across Central and South America have once again highlighted the need for effective new weapons in the mosquito control arsenal against the container-inhabiting species *Aedes aegypti* and *Ae albopictus*. Since September 2015, 263 cases of dengue have been confirmed on the Big Island of Hawai'i; see Figures 1 and 2. Concerned residents are clamoring for something they can do in addition to the vector control programs put in place by the state Department of Health. This problem is not restricted to Hawai'i, as *Ae aegypti* and *Ae albopictus* are expanding their ranges with the changing climate, and traditional methods of vector control like adulticidal and larvicidal spraying are usually inadequate against these species. Therefore, new tools are needed to fight the spread of dengue, to stop container *Aedes* mosquitoes from feeding and breeding.

Enter the lethal ovitrap. While based on established mosquito monitoring technology, the use of lethal ovitraps in integrated vector control management is brand new. Developed in the 1990s by two US Army scientists, Brian C Zeichner and Michael J Perich, the lethal ovitrap mimics an ideal larval site for *Ae aegypti* and *Ae albopictus*, attracting them for oviposition and killing them with pesticide before any further feeding, thereby preventing those adults from continuing to spread diseases like dengue and chikungunya. Zeichner and Perich's original lethal ovitrap, patented in 1999, was constructed of a black plastic cup with a pesticide-treated oviposition paper. The trap attracts gravid mosquitoes with its dark color, standing water source, and added olfactory attractant, and encourages oviposition on the textured paper. Following extensive field

Figure 1: County of Hawai'i Civil Defense workers prepare to check mosquito traps in the Big Island community of Milioli'i.

Figure 2: Many beaches, parks, and even communities have been closed on the Big Island of Hawai'i in response to the 2015 dengue outbreak.

Figure 3: A Trap-N-Kill lethal ovitrap deployed in a garden, showing eggs collected on the oviposition paper.

testing of their prototypes, the US Army licensed the technology to SpringStar, Inc in 2008, for further product development and commercialization.

SpringStar continued to refine and field-test the concept, using evaluations and recommendations to develop the Trap-N-Kill® lethal ovitrap; see Figure 3. The Trap-N-Kill includes a black plastic jar with drain hole, a screw-on lid, and an oviposition strip, and uses a minute amount of slow-release dichlorvos (DDVP) pesticide, making it highly effective against container mosquitoes, but safe for humans, pets and other non-target organisms. The ovitraps complement a conventional vector control program, and should reduce the need for other types of pesticide application, such as the use of interior residual spraying in tropical regions.

By targeting gravid adult container-inhabiting *Aedes* mosquitoes, mass trapping with ovitraps specifically eliminates mosquitoes seeking oviposition sites, a stage in their adult lifespan when CO_2 baits are minimally attractive and neither ground nor aerial spraying may reach their favored cryptic resting spots. Multiple field trials of the Trap-N-Kill and other lethal ovitraps have shown success in several locations. Perich and Zeichner evaluated their technology in large scale trials in Brazil and Thailand, and showed significant reductions in the densities of *Aedes* mosquitoes following trap deployment (Perich *et al* 2003; Sithiprasasna *et al* 2003). Recent studies in Puerto Rico have shown that lethal ovitraps can reduce mosquito populations across entire communities and reduce the likelihood of annual dengue outbreaks during rainy seasons (Barrera *et al* 2014). Additionally, mass-trapping studies where attractant-baited traps were used to create a barrier around a given location have shown significant reductions in the numbers of mosquitoes within the barrier (Kline 2007). This strategy could be deployed around areas ranging from a single home to an entire golf course, and could potentially reduce the density of mosquito vectors. In combination with public education and outreach materials about trap use and mosquito oviposition site reduction, such as those we prepared for communities in Hawai'i, lethal ovitraps can be used to increase community awareness about mosquito biology and control efforts; see Figure 4. Our recent experience in Hawai'i emphasized that community-level use of lethal ovitraps led to very high engagement and a better public understanding of this aspect of mosquito control. Additionally, engaging communities in mosquito source reduction, trap setup, and monitoring efforts allowed vector management to focus on mosquito management strategies, not trap deployment.

Ovitrap programs benefit when employed concurrently with source reduction efforts, as the reduction in potential egg-laying sites will make the ovitrap even more attractive to gravid mosquitoes. When the number of alternate larval sites remains high – for example, in junkyards, cemeteries or other locations with large numbers of flowerpots, urns and vases – the number of ovitraps deployed must be increased to maintain efficacy. SpringStar recommendations for Trap-N-Kill deployment are based on reported studies, many of which took place in tropical locations with high numbers of alternate oviposition sites, as well as Australian studies on ovitrap mass-trapping programs (Ritchie 2005;

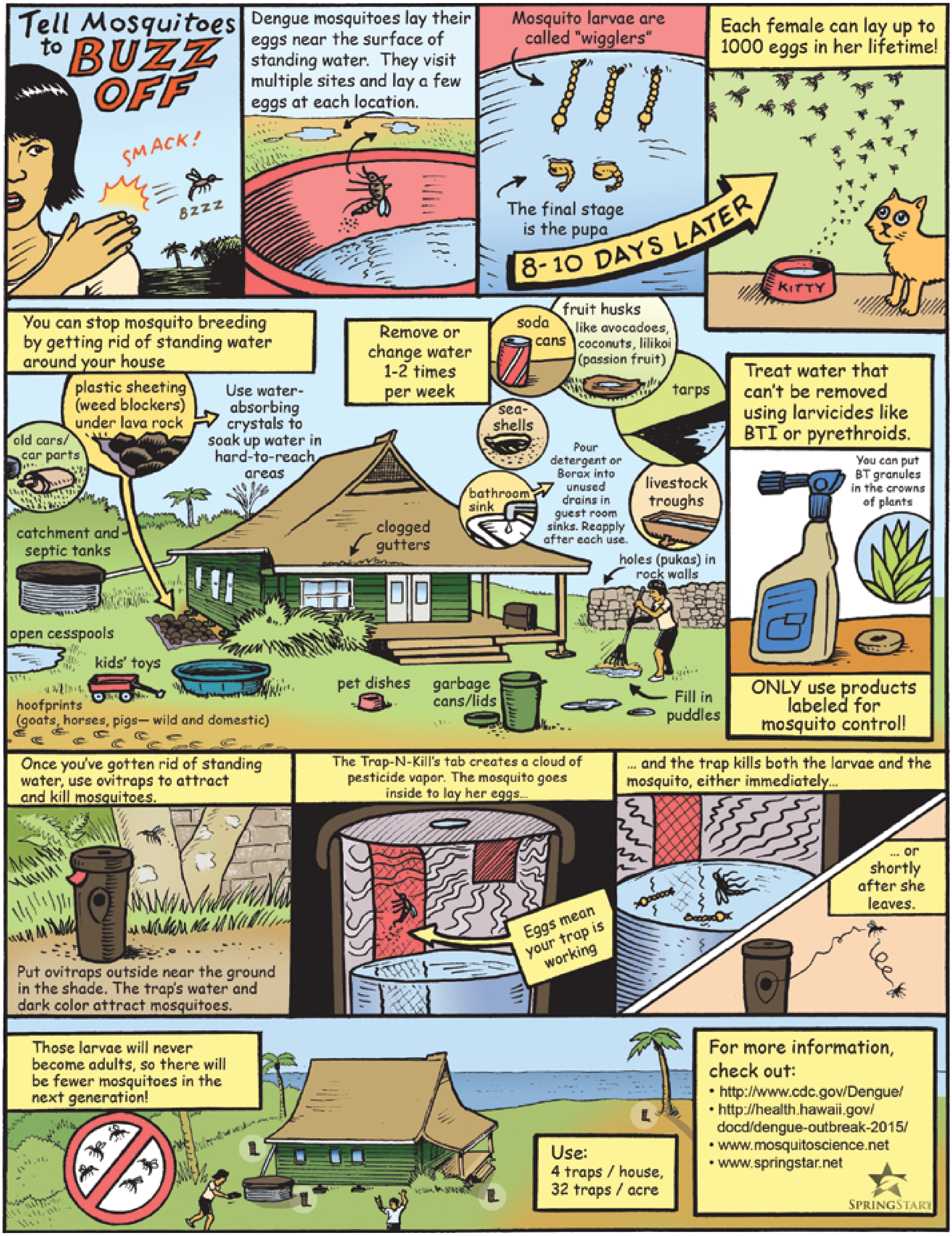

Figure 4: This public outreach comic was written by R Heinig and E Bess, with art by David Lasky, for use in Hawai'i.

Protocol: Use of Trap-N-Kill® lethal ovitrap for control of Zika, Dengue and Chikungunya

General guidelines

Trap-N-Kill traps should be deployed in a ratio of 1:10 to existing larval habitat sites. The recommended number of traps will increase with the number of alternate container sites: 4 to 10 traps for homes; 20 to 40 traps per acre for non-residential areas.

Trap-N-Kill should be deployed for a minimum of 4 weeks, or until local virus transmission has ended, but may be left out longer. Proper maintenance is essential to prevent the traps from becoming larval habitat, by replacing the pesticide and oviposition strip every 10 weeks and checking the water level and trap integrity at least every 2 weeks.

Prevention: When neighboring communities, geographic regions and/or islands have a known arbovirus outbreak, Trap-N-Kill may be deployed in high-risk areas where infectious people are likely to enter the community, such as ports of entry including airports or seaports, tourist attractions, and hotels and resorts.

Routine, widespread usage of Trap-N-Kill should be avoided when disease is not present, so that traps do not become larval habitat. If using Trap-N-Kill for an extended period of time, as with any chemical pesticide, implement a plan to counter potential resistance in the local mosquito population.

Outbreak response and control

As soon as dengue is found in your jurisdiction, Trap-N-Kill should be deployed in a 100 to 200 meter radius around locations where known infected individuals have spent significant time while viremic, such as home or work.

For widespread cases, continue the containment strategy to the extent feasible. Should resources – money, supplies, and/or personnel – be limited, then the Trap-N-Kill deployment should target higher-risk areas: a) areas frequently visited by infected individuals; b) areas with the highest mosquito population densities; and c) locations where many cases are tightly clustered.

Zeichner and Debboun 2011). Lethal ovitrap technology has been proven in the field, and offers a promising new tool for vector control. Trap-N-Kill offers a solution that can reduce pesticide use and exposure to humans and domestic animals. For the full technical dengue protocol, please contact SpringStar at info@springstar.net.

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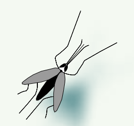

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