

## Selected Traps and Collection Methods for *Aedes aegypti* and *Aedes albopictus* Surveillance and Control March 2024

### BG-Sentinel / BG-Sentinel 2 / BG-Pro Trap

- **DESCRIPTION:** The [Biogents \(BG\)-Sentinel trap](#) is a lightweight, collapsible pop-up fabric cylinder with an opening on its top surface. A funnel is fitted into the opening and a small electric fan pulls mosquitoes into a collection bag. These traps employ attractive visual cues for host-seeking mosquitoes but can be enhanced with artificial human skin odorant lures (available from Biogents) and CO<sub>2</sub>, singly or in combination. The BG-Sentinel 2 is a revised version of the trap that features improvements including a weighted flap that closes to prevent mosquitoes escaping if the fan fails. The [BG-Pro](#) is the newest, modular version of the sentinel trap; it also can be used as a carbon dioxide-baited (EVS or CDC-style) trap<sup>1</sup>.
- **TARGET:** Sentinel-style traps primarily capture host-seeking female *Aedes aegypti* and *Aedes albopictus*; however, males are often captured as well. Trap efficacy and target species will change depending on attractants used; CO<sub>2</sub> will broaden the species diversity of the mosquito collection.
- **PROS:** Sensitive for human-seeking mosquitoes, especially *Aedes* spp.<sup>2, 3, 4</sup>; portable; captured mosquitoes do not pass through a fan and are often in better condition than CO<sub>2</sub>-baited trap collections - females are suitable for pathogen testing; removes host-seeking females from the local environment.
- **CONS:** Requires battery or connection to power outlet; may need frequent inspection and maintenance depending on power source; ants may damage or remove specimens; may need shelter to prevent rain damage; some evidence suggests that certain populations of *Aedes aegypti* may be repelled by 1-octen-3-ol bait<sup>5</sup>.



**Figure 1: Airflow through a BG-Sentinel Trap.** Mosquitoes are forced in with air intake (yellow arrows) while odorant lure is simultaneously dispersed by air outflow (red arrows).

[Image Sourced from Manufacturer \(Biogents\)](#)



**Figure 2: BG-Pro Modular Trap**, shown in EVS-style, CDC-style, and Sentinel-style configurations.

[Image Sourced from Manufacturer \(Biogenics\)](#)

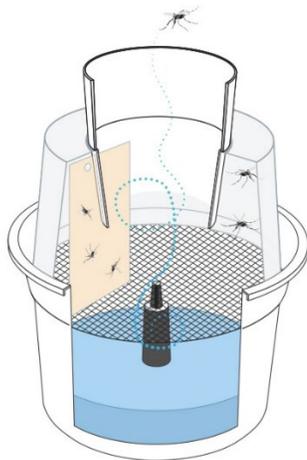
## Gravid Ovitrap

- **DESCRIPTION:** There are many different gravid ovitrap designs. In general, they are enclosed water-holding containers designed to mimic typical artificial container oviposition sites and take advantage of female *Aedes* mosquito oviposition behavior. Female mosquitoes that enter a trap encounter a killing agent and/or an adhesive. Most traps also include a barrier to prevent trapped females from dropping eggs into the water. The [CDC Autocidal Gravid Ovitrap \(CDC-AGO\)](#)<sup>6</sup> is lined with adhesive paper on its inner surface; [Biogenics-Gravid Aedes Trap \(BG-GAT\)](#) capture chamber can use a sticky card or be treated on its inner surface with insecticide<sup>7</sup> or oil; [Enoz Trap-N-Kill® A.G.O.](#) capture chamber uses a sticky board<sup>8</sup>.
- **TARGET:** Primarily gravid female *Aedes aegypti* and *Aedes albopictus*.
- **PROS:** Target-specific for container-breeding *Aedes*, but some traps may also collect other species; low maintenance: collection intervals can be extended to one week or more; inexpensive; small and relatively inconspicuous (except CDC-AGO); portable; does not require power, CO<sub>2</sub>, or chemical lures; high density trap deployment can be used for population reduction<sup>9</sup>; CDC-AGO sensitivity for *Aedes aegypti* has been shown to be comparable to that of BG-Sentinel traps in one California study<sup>10</sup>.
- **CONS:** Removes female mosquitoes from the environment only after they have fed on blood; requires removal of other competing cryptic larval sources for best performance; specimens on adhesive paper are difficult to remove without major damage and may not be suitable for pathogen testing; attractant infusion may lure non-target insects such as flies; humidity or dust can reduce lifespan of adhesive paper in some designs; traps may support larval development if not inspected regularly; larger traps (e.g., CDC-AGO) are highly visible and water infusions may smell offensive.



**Figure 3: CDC Autocidal Gravid Ovitrap.**

[Image Sourced from Barrera et al. Manuscript](#)



**Figure 4: Biogents Gravid Aedes Trap (BG-GAT).**

[Image Sourced from Manufacturer \(Biogents\)](#)



**Figure 5: Enoz Trap-N-Kill A.G.O.**

[Image Sourced from Manufacturer \(Enoz\)](#)

## In2Care Mosquito Station

- **DESCRIPTION:** The [In2Care® Mosquito Station](#) takes advantage of female mosquito oviposition behavior to spread larvicides to cryptic breeding sites. The design consists of a container of water with an inner floating structure that allows females to rest and oviposit. This structure carries gauze impregnated with pyriproxyfen, a juvenile hormone analogue that prevents larval development, and spores of *Beauveria bassiana*, a fungus that kills adult mosquitoes within a few days of exposure. Females pick up both agents on their bodies when they land in the trap, then carry pyriproxyfen to other containers as they continue to oviposit, preventing larval development in these containers as well. Over a few days, the *B. bassiana* spores on contaminated female mosquitoes will germinate and kill them.
- **TARGET:** Gravid female mosquitoes; *Aedes aegypti*, *Aedes albopictus*, and *Culex spp.*
- **PROS:** Target-specific for container-breeding *Aedes*; auto-dissemination of larvicides to cryptic sources; eliminates blood-fed females that may be harboring viruses; small and relatively inconspicuous; portable; low maintenance; does not require power, CO<sub>2</sub>, or chemical lures; may help locally suppress target mosquito populations <sup>11</sup>.
- **CONS:** Allows adult females to escape, requiring additional collection methods to monitor adult mosquito populations; may support larval development if not maintained regularly.



Figure 6: Mode of Mosquito Population Reduction by In2Care Mosquito Station.

[Image Sourced from Manufacturer \(In2Care\)](#)

## Ovicup Trap

- **DESCRIPTION:** Ovicups target container-breeding *Aedes* mosquitoes. Construction materials vary and need only provide (1) a small, dark colored or opaque container of water and (2) an oviposition substrate (e.g., strip of paper or wood) along the water margin. It is best if the container material is smooth, as this may help limit oviposition to only the removable oviposition substrate. The container need only be approximately half-full of water; this provides a partially shaded and protected oviposition site. For best results, the oviposition substrate should line the entire exposed surface of the container walls and should also extend below the water margin to account for evaporation. Trial and error may be necessary to determine best materials for construction and whether stabilization is required to prevent the ovicup from tipping.
- **TARGET:** Gravid female *Aedes aegypti* and *Aedes albopictus*.
- **PROS:** Sensitive and specific for container-breeding *Aedes* spp.; inexpensive and simple to make and maintain.
- **CONS:** Low populations of mosquitoes and/or high availability of alternative oviposition sites may reduce trap sensitivity; requires frequent inspection and maintenance, especially in dry and hot areas or after rain; species identification requires either rearing eggs to larvae or adults, or using molecular methods; can become mosquito sources if not inspected and maintained regularly.



**Figure 7: Typical Ovicup Trap.**

A black plastic cup set on the ground with a strip of absorbent paper secured with a paper clip completely lining the inner surface. Tipping can be minimized with weighted cups or by using an anchor stake.

[Image Sourced from Fresno Mosquito & Vector Control District](#)

## Aspirator Collections

- **DESCRIPTION:** Backpack or handheld mechanical aspirators consist of a tube or funnel attached to a powered fan that forces adult mosquitoes into a collection bag or container. Aspirator collections can be used for area-wide surveys by sampling vegetation and other resting surfaces or can be used to target specific species from known habitats or when they are host-seeking and landing.
- **TARGET:** Resting, host-seeking, and landing adult mosquitoes.
- **PROS:** Captures both females and males, a range of physiological states, and a wide range of species; efficient collection method for blood-fed mosquitoes; specimens remain in good condition for species identification and/or pathogen testing.
- **CONS:** Prolonged aspiration collection may require a lot of time and multiple batteries; apparatus can be heavy to operate; labor intensive; may capture high numbers of non-target arthropods.



**Figure 8: Modified CDC Backpack Aspirator.**

[Image Sourced from Manufacturer \(John W. Hock Company\)](#)

## Carbon Dioxide (CO<sub>2</sub>)-Baited Traps

- **DESCRIPTION:** There are many different proprietary and non-proprietary trap designs that utilize carbon dioxide (CO<sub>2</sub>) as a lure for host-seeking female mosquitoes<sup>10</sup>. If data is being compared among trap sites, it is optimal to use the same type of trap design and attractant(s) at each trap location. The CDC and encephalitis vector surveillance (EVS) style traps are proven designs typically used by government agencies for collection of female mosquitoes for arbovirus surveillance. The BG-Pro is a modern, proprietary version that can be configured in either style. These traps are typically suspended from a tree or other vertical structure with CO<sub>2</sub> generated by dry ice above or in the general proximity to the trap; they can be used with or without a light as an additional attractant. A small electric fan forces mosquitoes into a collection net or container. Other designs such as the [BG-Mosquitaire](#) and [Mosquito Magnet®](#) are targeted for homeowners and advertised to remove host-seeking females from the immediate area to reduce biting. Some designs can be used with an artificial human skin odorant lure (available from Biogents) to increase attraction to *Aedes aegypti* and *Aedes albopictus*.
- **TARGET:** Host-seeking adult female mosquitoes.
- **PROS:** Large number of designs for different applications; most designs are easily portable; broad range of target species; trap placement (e.g., height) can be adjusted for different species; lures can be added to enhance attraction for *Aedes aegypti* and *Aedes albopictus*; captured females are generally suitable for pathogen testing; removes host-seeking females from the local environment.
- **CONS:** May exhibit collection bias related to host-seeking differences in local vector ecology; may require frequent battery and CO<sub>2</sub> replacement; specimens may be damaged as they pass through the fan; may capture large numbers of non-target insects especially if using lights.



**Figure 7: CDC Trap as Set by Fairfax County Health Department, VA.**

A protective sleeve has been added to prevent rain damage to specimens in netting and collection cup.

[Image Sourced from Fairfax County Health Department](#)

## General Resources

See Appendix A of "[California Mosquito-borne Virus Surveillance & Response Plan](https://westnile.ca.gov/pdfs/CAMosquitoSurveillanceResponsePlan.pdf)" (https://westnile.ca.gov/pdfs/CAMosquitoSurveillanceResponsePlan.pdf)

[CDC guidelines for Aedes surveillance and Insecticide Resistance Testing](https://www.cdc.gov/zika/pdfs/guidelines-for-aedes-surveillance-and-insecticide-resistance-testing.pdf) (https://www.cdc.gov/zika/pdfs/guidelines-for-aedes-surveillance-and-insecticide-resistance-testing.pdf)

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<sup>2</sup> Faraji, A., and I. Unlu. (2016). "The eye of the tiger, the thrill of the fight: effective larval and adult control measures against the Asian tiger mosquito, *Aedes albopictus* (Diptera: Culicidae), in North America." *J. Med. Entomol.* 53(5): 1029-1047.

<sup>3</sup> Farajollahi, A., et al. (2009). "Field efficacy of BG-Sentinel and industry-standard traps for *Aedes albopictus* (Diptera: Culicidae) and West Nile virus surveillance." *J. Med. Entomol.* 46(4): 919-925.

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<sup>5</sup> Barrera, R., Mackay, A. J., and M. Amador. (2013). "An improved trap to capture adult container-inhabiting mosquitoes." *J. Am. Mosq. Control Assoc.* 29(4): 358-368.

<sup>6</sup> Barrera, R., et al. (2014). "Use of the CDC Autocidal Gravid Ovitrap to Control and Prevent Outbreaks of *Aedes aegypti* (Diptera: Culicidae)." *J. Med. Entomol.* 51(1): 145-154.

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<sup>7</sup> Johnson, B. J., et al. (2016). "Field comparisons of the Gravid Aedes Trap (GAT) and BG-Sentinel trap for monitoring *Aedes albopictus* (Diptera: Culicidae) populations and notes on indoor GAT collections in Vietnam." *J. Med. Entomol.* 54(2): 340-348.

<sup>8</sup> Riles, M. T., et al. (2023). "An assessment of a lethal oviposition trap's ability to produce immatures of *Aedes albopictus* in Panama City Beach, Florida." *J. Florida Mosq. Control Assoc.* 70: 54-57.

<sup>9</sup> Barrera, R., et al. (2014). "Sustained, area-wide control of *Aedes aegypti* using CDC autocidal gravid ovitraps." *Am. J. Trop. Med. Hyg.* 91(6): 1269-1276.

<sup>10</sup> Cornel, A. J., et al. (2016). "Surveillance, insecticide resistance and control of an invasive *Aedes aegypti* (Diptera: Culicidae) population in California." *F1000Research* 5.

<sup>11</sup> Buckner, E. A., et al. (2021). "A field efficacy evaluation of In2Care mosquito traps in comparison with routine integrated vector management at reducing *Aedes aegypti*." *J. Am. Mosq. Control Assoc.* 37(4): 242-249.