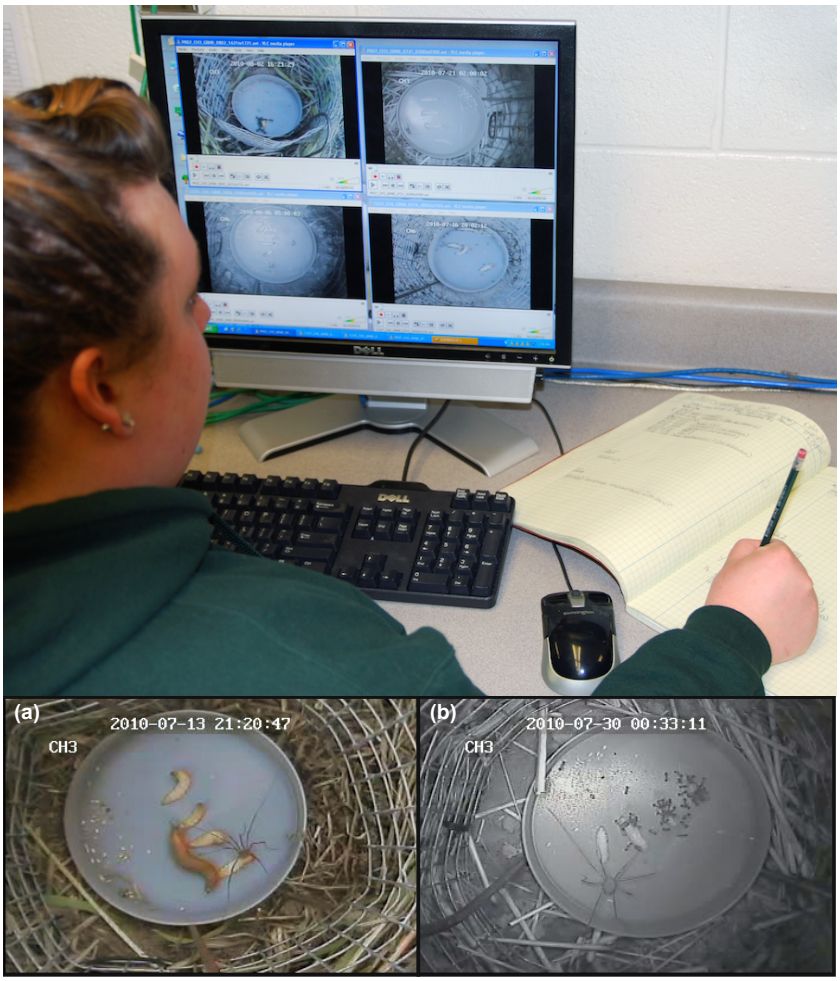
Entomology Detectives

by Joyce Parker



Top: An entomology detective watches multiple video clips of predation at high speed.

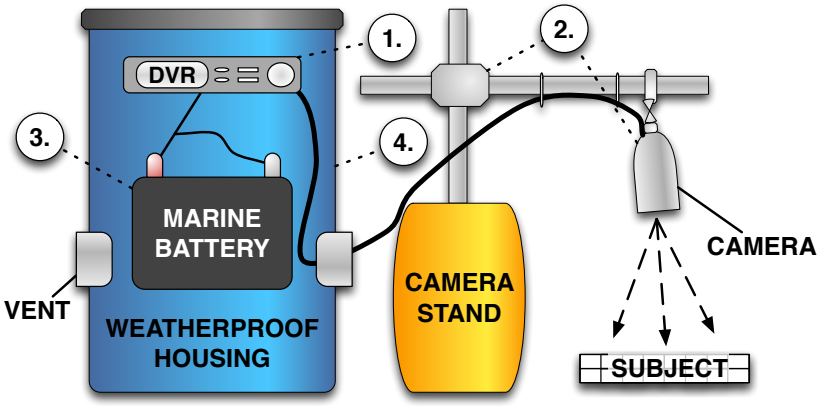
Bottom: Sample images captured with the detectives' bug video surveillance system showing (a) a slug and harvestman ("daddy longlegs") and (b) ants and a harvestman feeding on waxworm larvae during daylight and nighttime hours, respectively. The waxworm prey were placed in a Petri dish surrounded by wire mesh to keep out animals.

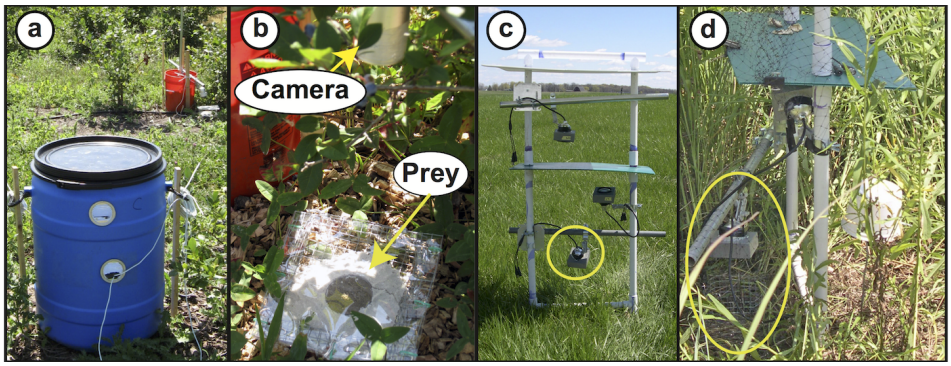
Someone or something has been attacking the waxworm larvae in local corn and grass fields. Michigan State University entomology detectives want to find who or what is responsible—not so that they can arrest them, but to thank them for their "service" to the agriculture community. The detectives are Drs. Doug Landis and Ben Werling, and they are looking for natural predators of insect agriculture pests. These predators provide an important service to local farmers and their crops—reducing the number of insect pests and therefore the amount of pesticide needed. Dr. Landis and Werling are members of the Great Lakes Bioenergy Center (GLBRC) Biodiversity Responses Team. One of the Center's goals is the sustainable production of bioenergy crops.

Do entomology detectives use spy technology? The MSU team uses surveillance cameras like those used in stores to watch for shoplifters. The cameras are outfitted with special lenses so that they can focus close up. They run off a marine battery and are connected to a hard drive that records what they see. The entomologists place the surveillance cameras in fields for approximately 24 hours to take video of anyone or anything who comes to look at the insect larvae that have been placed as bait in the cameras' field of view.

The multiple surveillance cameras are placed and generate a lot of video. Just like the hard working cops, the entomology detectives have to sort through the data. They watch four different cameras' footage at one time and run it at 4 times the normal speed, stopping it to note who is visible when and for how long.

So who *is* attacking the insect bait? It turns out there are a host of culprits/service providers: ants, slugs, crickets, beetles, spiders, and more. The busy ants are at work day and night, while the others prefer the cover of darkness. Slugs are herbivores, but apparently can't pass up a protein-rich meal. Ants and spiders are the primary killers, while others are more likely to scavenge prey that have already been attacked.





Top: Digital video system illustration. (1) digital video recorder, (2) camera frame and camera, (3) 12V batter/power supply, (4) weatherproof housing.

Bottom: Camera systems set up in the field. (a) A plastic barrel provides weather proofing for DVR and power source, which were connected to (b) cameras focused on the waxworm prey in blueberry bushes. (c) Predation in bioenergy crops was captured by attaching cameras to adjustable arms attached to a plastic frame. This frame allowed the detectives to capture video in three positions, but only the bottom camera (circled) was used for the experiment. (d) A camera (circled) set up in a prairie habitat.

All of this information adds to scientists' understanding of the diversity of invertebrates living in agriculture fields. These data complement what was already known from other types of observations such as pitfall traps, direct human observation, and analysis of the molecules found in the guts of different predators. Pitfall traps are the easiest and simplest observation technique, but only reveal who visited the trap, not when or why they were there. Direct human observation does allow researchers to know the whens and whys, but it requires a tremendous number of surveillance hours and is difficult at night. A new technique involves looking for DNA or antibodies from pests in the guts of predators. This allows scientists to sample a large number of insect predators to see what they've eaten, but like the traps, this technique does not yield information on when and how the predators act.

And what do entomology detectives do with all of this information on the private lives of invertebrates? The answer goes back to providing services. One of the goals of GLBRC research is to figure out how to maximize the biodiversity of the crops used as fuel sources. The more species that live on or around a crop, the more ecosystem services they provide. These services include increased nutrient cycling, crop yield, recreational uses, and in this case, pest control. Dr. Landis' group is finding that perennial grass crops like switchgrass or mixed prairie may be a better biofuel crop than corn, because these grasslands fields support a wider variety of useful insect predators meaning that less pesticide needs to be used to keep yields high. This, in turn, means smaller amounts of chemicals in the environment, more pollinating insects such as bees, and more songbirds—all signs of a healthy ecosystem.