A Detector Dog for Screwworms (Diptera: Calliphoridae)

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ABSTRACT A male German wirehaired pointer, Canis familiaris L., was trained to search for and locate screwworm, Cochliomyia hominivorax (Coquerel); pupae; and animals infested with screwworms. The command, “find it” led to the detection of a screwworm-infested animal and the command “search” led to the detection of screwworm pupae. After 5 mo of training, the dog could detect screwworm-infested animals. After 3 mo more of training, the dog could detect screwworm pupae. Through 7 August 1989, the dog had a success rate of 100% (265 tests) with training dummies and 94.7% (18 successes for 19 tests) with screwworm-infested animals, for an overall success rate of 99.7% (285 successes for 286 tests). Use of detector dogs at quarantine stations could result in increased efficiency, economic savings, and decreased possibility of reintroduction of screwworms into eradicated areas.

KEY WORDS Insecta, screwworm, detector dog, quarantine

SREWWORM, Cochliomyia hominivorax (Coquerel), an obligate parasite of warm-blooded animals, can cause great economic damage and death to man and animals. The insect has been eradicated from continental North America to the northern borders of Guatemala and Belize. Currently, visual examination of warm-blooded animals for screwworm infestation is done by USDA personnel at international airports and by workers of the Mexican—American Commission for the Eradication of Screwworms at quarantine stations in the barrier zone to prevent reintroduction of screwworms into eradicated areas. A major cost in maintaining the present screwworm barrier system involves unloading animals from vehicles for inspection (R. L. Mangan, USDA—ARS, personal communication). Small or hidden infested wounds that are not detected and treated may result in a reintroduction, which could cause major problems for eradication personnel, livestock producers, and wildlife populations. The past three cases of screwworm reintroduction into the United States were caused by undetected infestations of screwworms in pets being brought from non-eradicated areas. These reintroductions resulted in great cost to the government and taxpayers to eradicate.

Domestic dogs, Canis familiaris L., have an excellent ability to discriminate specific odors and are capable of smelling some odors at concentrations of as little as one part per trillion (Johnson 1977). Dogs have been trained to respond to a variety of objects including humans; leaks in natural gas pipelines (Johnson 1977); black powder, dynamite, plastic, and other explosives; marijuana, heroin, hashish, opium, and other drugs (Pearsall & Verbruggen 1982). The first recorded use of dogs to detect an insect was by Wallner & Ellis (1976) when they used dogs to locate egg masses of the gypsy moth, Lymantria dispar (L.).

Although breed and sex of the dog to be trained are not important factors in achieving success, the United States Customs Service (USCS) reportedly prefers hunting dogs (e.g., beagles, retrievers, and pointers [USCS 1979]). The preferred ages of these dogs range from 1 to 3 yr. Most of the dogs that the USCS trains are acquired from local animal shelters (USCS 1979).

According to the USCS, one of the most important factors leading to successful results is the selection of a fully qualified animal (USCS 1979). Records kept by the USCS indicate that 1 of 86 dogs considered proves worthy of certification. Besides health and stamina, three requisite qualities are sound temperament, high self-esteem, and a strong, nearly frantic desire to retrieve (USCS 1979).

My study investigated the feasibility of training a dog to detect screwworm pupae and wounds infested with screwworms. Dogs specially trained to detect infested wounds could greatly increase the efficiency of human inspectors. This use would result in substantial savings in money, time, and effort.
specially trained dogs could decrease the possibility of reintroducing screwworms into un-infested areas. A dog trained to detect screwworm pupae could inspect animal conveyances (e.g., livestock trucks, boats, and airplanes) and corrals to locate pupae that might have been left behind by infested animals. Here I describe the training of a dog to alert the handler to the presence of a screwworm-infested wound. My secondary objective was to train the dog to locate pupae that formed after the screwworm larvae had left the wound.

Materials and Methods

A male German wirehaired pointer (u 36 kg), “Caz,” registered by the American Kennel Club, was obtained on 31 May 1988 for use in this project. When the study began, the dog was 3 yr old (born 26 July 1985). The training techniques I used during this investigation were adapted from procedures used by the USCS to train dogs to detect narcotics (USCS 1979). Additional information that was useful in working with and understanding the dog’s behavior, obedience training, and training dogs to track was provided by Syrotuck (1972), Johnson (1977), Pearsall & Verbruggen (1982), Davis (1987), and Koehler (1987).

Initially, I refreshed the dog’s memory in basic obedience. The dog had previous training and responded well to the commands “heel,” “sit,” “stay,” “come,” “down,” and “kennel.” During this time, I established a relationship with the dog so that we learned to interpret each other’s body language and moods. This type of relationship is important because the dog strives to complete each task successfully to please the trainer or handler. The reinforcement reward for each success was bountiful praise.

Next, retrieving was introduced into the training regime. As in the case of USCS detector-dog training, retrieving was used to develop a desired response in the dog’s behavior and to establish scent association with the target entity. Retrieving continued to be used as a form of exercise to maintain the dog’s condition for fieldwork. A tennis ball was used for retrieving exercises. Sessions of u5 mm of hard exercise were conducted three times a day for the first 5 mo and twice a day thereafter.

Approximately 10 ml of exudate from a wound infested with screwworms (3 d old) was placed on the ball to establish the scent association. After the dog became accustomed to the scented tennis ball, it was thrown out of his field of view and he was commanded, “find it.” Next, I used a rolled, knotted towel that had 10 ml of exudate added to it. The towel was hidden; when the dog found it, he was highly praised and treated to an enthusiastic tug-of-war with the towel.

Finally, the transition was made from the training dummy (scented tennis ball or towel) to a screwworm-infested animal. Training and testing the dog with the animals was done by presenting him with a choice of which vehicle or corral contained an infested animal. Typically, three uninfested sheep would be placed in a truck, and two uninfested and one infested sheep (small 3-d-old wound u2 cm in diameter, infested with 20 larvae) would be placed in another truck. The dog would be given the command “find it,” and I would walk him around the vehicles or allow him to inspect the vehicles alone, off the leash. The dog was trained not to bark so he would not scare the animals.

I trained the dog to find screwworm pupae in a similar fashion (i.e., I used a scented tennis ball as a training dummy during retrieval sessions). Screwworm larvae were reared in the laboratory and larvae that had stopped feeding were collected as they crawled off the larval diet. The larvae (100) were placed inside the canister in which the tennis balls were packaged. The larvae were allowed to pupate inside the canister with the balls so the balls would pick up the scent.

The command “search” was given when the ball was thrown out of sight during the retrieval sessions. Later the scented ball was hidden (e.g., in tall grass, behind objects, and inside vehicles) and the dog was brought outside and commanded, “search.” After mastering these tasks, he made the transition to
finding hidden, sealed Petri dishes containing 20 screwworm pupae. Pupae were placed in sealed Petri dishes to prevent adults from escaping if, for some reason, the dishes were lost.

Results and Discussion

Caz was successfully trained to complete both the primary and secondary objectives of this study, which were to investigate the feasibility of training a dog to detect screwworm pupae and wounds infested with screwworm. Through 7 August 1989, the dog had a success rate of 100% (265 tests) with the training dummies and 94.7% (18 successes for 19 tests) with screwworm-infested animals, for an overall success rate of 99.7% (285 successes for 286 tests). This compared favorably with the report of Wallner & Ellis (1976), whose dog had a maximum efficiency of 96% detection of a training dummy treated with disparlure and 95% detection of gypsy moth egg masses. During my study, Caz made only one mistake in a test, on 6 January 1989. The next day the dog was obviously sick; when taken to a veterinarian, he was diagnosed as having bronchitis and a gastrointestinal infection. This substantiates the importance of maintaining the detector dog in excellent health as emphasized by the USCS (1979) and Pearsall & Verbruggen (1982).

In both my study and that of Wallner & Ellis (1976), dogs were successfully trained to locate insects. Results from my study substantiate those of Waliner & Ellis (1976), who showed that a dog already trained for a task in scent discrimination can make a rapid transition to detecting another scent. That is, the dog was able to learn to detect screwworm pupae after having been trained to detect screwworm-infested animals. A major difference between our studies is that Waliner & Ellis (1976) used food to reward their dogs, whereas I used praise. Food should not be used as the reward for successful performance: If the dog is not hungry or the handler runs out of the food, the dog will have no incentive to perform the task (Pearsall & Verbruggen 1982). The trainer must instill the willingness to work and the desire to please in the dog (Davis 1987).

A period of 150 d (1 June—28 October 1988) passed from the time work began with the dog until an animal with a screwworm-infested wound was introduced. Although the dog was initially confused by the presence of the animal, his body language showed a positive reaction to the odor of a screwworm infestation from the start. Within a couple of weeks, he was exhibiting strong positive reactions to the presence of animals infested with screwworms. Twenty-one days (28 October—18 November 1988) after he was introduced to an infested animal, Caz could detect the presence of an animal infested with screwworms. Seventy-eight days (27 March—12 June 1989) after training began with the tennis balls scented with pupae, Caz could locate the presence of pupae.

After I gave the command “find it” or “search” (depending on whether we were trying to locate an infested animal or screwworm pupae, respectively), Caz’s behavior would change to a working mode. Typically his concentrated searching behavior would include moving rather rapidly to cover ground until he detected the scent. During the search phase, his nose generally would be down or close to the ground, but it would be raised on occasion. His mouth was open; his tail was raised and wagging slightly. If no scent emanated from the vehicle, corral, or animal, he ignored the object and the searching behavior continued.

I originally noticed a positive response by reading his body language. Later, the dog stopped by the vehicle containing the infested animal, stood on his hind legs, and leaned against the vehicle with his front legs. When a positive response was indicated, Caz’s attention was focused on the vehicle or corral, his body did not move or moved very little, his ears were cocked, his muscles were tensed, his tail was raised (but with little or no movement), and he quivered. Caz started standing against the vehicles containing infested animals without being trained to do so. I reinforced this behavior because it is a visible, positive response that can be seen easily by an untrained observer.
Caz and I practice almost daily, Monday through Friday, to ensure his proficiency. “Find it” leads to the detection of a screwworm-infested animal and plenty of praise, and “search” leads to the detection of screwworm pupae and plenty of praise.

This study has shown that a dog can be trained to detect screwworm-infested animals and pupae. Use of detector dogs at quarantine and inspection stations could result in increased efficiency, economic savings, and decreased possibility of reintroduction of screwworms into eradicated areas of the world.

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