Tetracycline as an Ingestible Biological Marker for Feral Pigs

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ABSTRACT: Tetracycline hydrochloride (THC) is an ingestible antibiotic that produces a fluorescent mark on growing bone and may be combined with baits to aid ingestion by wildlife species. Feral pigs are an invasive species found throughout the United States. They are implicated in damages such as increased erosion, direct competition with native wildlife, destruction of habitat, disease transmission, and crop damage. Land managers are currently utilizing lethal and non-lethal control strategies to minimize damage. THC may be useful as a voluntary biological marker for feral pigs. Possible uses include mark recapture analysis, evaluation of large-scale movements, and determining the uptake of pharmaceuticals by feral pigs. We evaluated the palatability of THC for feral pigs, dosage necessary for adequate marking, and time necessary between ingestion and identification of marks. We found that feral pigs will consume THC when combined with palatable baits, that >150 mg THC is necessary for adequate marking, and that marks can be identified in teeth ≤7 days post ingestion.

KEY WORDS: biomarker, feral pigs, mark recapture, *Sus scrofa*, tetracycline

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INTRODUCTION

Tetracycline hydrochloride (THC) is an ingestible antibiotic that produces a fluorescent mark on growing bone and teeth (Milch et al. 1957). THC is inexpensive and can be acquired in capsulated, liquid, and powder form. Researchers have used THC to quantify black bear (*Ursus americana*) (Garshelis and Visser 1997) and polar bear populations (*Ursus arctos*) (Taylor and Lee 1994), measure the use of supplemental feed by white-tailed deer (*Odocoileus virginianus*) (Bartoskewitz et al. 2003), determine the feasibility of delivering pharmaceuticals to white-tailed deer (Van Brackle et al. 1994) and feral pigs (*Sus scrofa*) (Fletcher et al. 1990), and as a marker for the oral rabies vaccination program to identify the proportion of target and non-target animals consuming rabies vaccination baits (USDA 2004). However, tetracycline alone is not palatable to wildlife (Van Brackle et al. 1994; Garshelis and Visser 1997). Time between ingestion of THC and marker analysis varied within the literature from 2 days (Hanlon et al. 1989, Fletcher et al. 1990) to 180 days (Taylor and Lee 1994). Furthermore, dosages used for marking wildlife with THC range from 2-60 mg/kg (Taylor and Lee 1994). Finally, THC incorporated into manufactured baits may not be 100% effective at marking wildlife (Johnston et al. 2005).

Feral pigs are an expanding, invasive species in the United States (Mayer and Brisbin 1991) and are implicated in economic and environmental damages including consumption of crops, disease transmission, increased soil erosion, destruction of habitat, competition with native wildlife, and predation of livestock, ground nesting birds, reptiles, and amphibians (Mayer and Brisbin 1991, Gipson et al. 1998). Land managers are currently using various lethal control strategies to reduce feral pig damage. However, knowledge of population size and movements is important for effective damage management (Sweitzer et al. 2000). Furthermore, traditional population estimation techniques for native free-ranging wildlife are not validated for feral pigs (Ilse and Hellgren 1995, Reidy 2007). Therefore, we conducted a captive trial with wild-caught feral pigs. Our objectives were to determine the palatability of THC in fishmeal baits, time between ingestion and adequate marking, and the THC concentration necessary for adequate marking in feral pigs.

METHODS

Our study was conducted from 2-15 February 2006 at the Texas A&M University–Kingsville (TAMUK) Captive Wildlife Research Facility (CWRF). The CWRF was located 5 km south of Kingsville in Kleberg County, Texas (27°27'N, 97°53'W). We used a 0.17-ha pig-proof pen constructed of 2.5-m-high fence attached to a central building where pigs could be handled.

We used 9 wild-caught feral pigs ranging from 12-46 kg as study animals. We placed a plastic ear tag (Allflex, Dallas Fort Worth Airport, TX) with a unique identification number in the left ear of each animal and housed them in a pig-proof pen described above. We provided free access to water and food.

We isolated each feral pig in the handling building with free access to water and a 15-g fishmeal bait combined with 150 mg THC (Bait-Tek, Beaumont, TX) from 2-15 February 2006. THC concentrations ranged from 3-13 g/kg for feral pigs in the trials. We monitored each feral pig for 12-48 hours with a Silent Image™ (RECONYX, LaCrosse, WI) motion-sensitive continuous video camera. Immediately after a feral pig had consumed the bait, we released it back into the pig-proof pen and isolated another feral pig in the handling

building. We continued this process until all feral pigs had consumed a THC treated bait.

We euthanized 3 pigs 7 days after consumption of the THC treated bait, 3 pigs 1 month after consumption of the THC treated bait, and 3 pigs 2 months after consumption of the THC treated bait, following AVMA (2007) guidelines. We removed and boiled lower jaws for approximately 3 hours. We removed and sectioned teeth (100-150 µm thick) longitudinally, and then examined them microscopically under ultraviolet light for the presence of a THC marker following Fletcher et al. (1990). We report presence or absence of a THC marker in feral pig teeth among treatments.

RESULTS AND DISCUSSION

We found feral pigs exhibited reluctance to consume fish meal baits combined with THC, but readily consumed baits mixed with corn. Therefore, we combined fishmeal baits with 0.1 L of corn to increase palatability. Feral pigs were isolated for an average of 3 hours before ingestion of the THC baits. We found that teeth from all 9 pigs, including the 7 day treatment, exhibited the presence of THC marking. However, our samples displayed weak inflorescence, suggesting baits with >150 mg THC should be used, particularly if feral pigs >46 kg need to be marked during one feeding event.

Feral pigs are a destructive, exotic species in the United States (Seward et al. 2004) and continue to expand into new areas. Therefore, one of the greatest needs for feral pig management is a method of measuring population size and movement (Higginbotham 1993, Sweitzer et al. 2000, Sweeney et. al 2003). However, traditional population size and movement techniques are inhibited by logistical constraints, time, and manpower (Sweitzer et al. 2000). New technologies using ingestible biological markers such as THC (Garshelis and Visser 1997) may be better options for monitoring movement and population trends of feral pigs.

THC shows promise for use as a biological marker for feral pigs. THC is readily ingested by feral pigs when combined with palatable bait (Reidy 2007), and marks can be identified from feral pig teeth. THC may be useful for quantifying the effectiveness of control techniques, analyzing large scale movements, and determining uptake of oral pharmaceutical baits by feral pigs. However, THC is a permanent marker and may not be used regularly on a given area (Garshelis and Visser 1997). Furthermore, approximately 40% of THC incorporated into manufactured baits, such as the baits used for this study, may not be available for absorption when ingested by targeted animals (Johnston et al. 2005). Finally, THC is currently used as a marker for the oral rabies vaccination program (ORVP) in the United States (USDA 2004) to identify the proportions of target and non-target animals consuming rabies vaccination baits. We have demonstrated that feral pigs will consume these baits, and therefore use of THC for free-ranging feral pigs in ORVP zones may produce biased information.

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