



# **Conditioned Taste Aversion: A behavioral solution to the behavioral aspects of predator-prey conflicts.**

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# Introduction

- **The Problem from a behavioral perspective: Recently released endangered predators are being killed because they are attracted to scent and other cues of aggregated domestic livestock**
- **Conditioned Taste Aversion (CTA) is a powerful and lasting form of learning that converts preferred food cues into aversive stimuli. It is “Conditioned Disgust”, resulting in predators avoiding live target prey from a distance because target prey are no longer attractive.**
- **For a full explanation and substantiation see: [www.conditionedtasteaversion.net](http://www.conditionedtasteaversion.net) and be sure to read the PDF literature documenting how it has been successfully tested in the field.**

# Our Purpose:

**To develop a clinical protocol that safely and effectively produces aversion among predators due for release where they are likely to conflict with livestock.**

# The Experiment

The study subjects were a wolf pack consisting of 9 “generic” gray wolves maintained in a 40m x 50m enclosure at the California Wolf Center in Julian, CA. There were 6 males and 3 females, the mean body weight was 39 kg (range of 27 – 48kg).



# The Experiment

**Experimental trials were conducted in the early morning of each day. Wolves were food deprived 3 days/week and fed several hours after morning trials 4 days/week. So, deprivation before morning trials was 20 hours every other day for 4 days/week and 40 hours the 3 intervening days/week throughout the entire month of September, 2008.**

# Experimental Sequence:

## Pretest:

**For 4 consecutive mornings we gave the whole wolf pack two untreated sheep meat baits. One bait for 60 minutes and then another bait for another 60 minutes. Baits consisted of 100 g ground mutton with clean, fresh sheep hide securely sutured around the meat.**



## Treatment:

- Consisted of 10 consecutive mornings with one 60 minute trial during which the pack was given a single treated sheep meat bait.
- Bait was 250 g of ground mutton with 5.4 g of Thiabendazole (TBZ) well mixed in the meat to mask its taste and scent. This was wrapped with fresh, clean sheep hide sutured securely around the meat. Note: if one wolf fully consumed a single bait the dose of TBZ would range from 113 mg TBZ/Kg body weight to 200 mg/Kg.



**The intention is to require predators to interact with the external taste and scent of target livestock while opening the bait, followed by GI tract illness resulting from consuming a hidden dose of aversion agent in the interior meat.**



# Post-test:

- Consisted of 4 consecutive days each identical to the Pretest (no TBZ in baits).
- Throughout the experiment we remained outside the enclosure to fully record behavioral details on video and then numerically scored frequencies of behavior for each participating wolf, including interactions with other wolves.



# Results:

## Safety:

- **Of 4 wolves fully treated, two were small females receiving 200 mg TBZ/Kg their body weight**
- **Physiological effects of TBZ are subtle (lethargy) and so "illness" did not provoke attacks from other wolves.**
- **All treated animals recovered fully within 6 hours (consumed maintenance diet normally)**
- **This is consistent with a robust literature documenting safety/low toxicity of TBZ**

# Effectiveness (Problems):

**Because of conditions at the CWC, wolves had to be treated all together in their enclosure and so three problems occurred that must be avoided in future:**



- 1. Bias: Wolves least shy of observers dominated baits even though they were not high ranking.**



## **2. Contamination: The unique external taste and scent of sheep of every bait was extensively contaminated with:**

- Urine (every bait was urinated on at least once before, during or after being opened) and then subsequently interacted with by other wolves.**
- Scent gland secretions (most baits were rolled on by wolves before others interacted with them)**
- The ultra-familiar and ubiquitous dusty substrate of the enclosure quickly coated the outer surface of all baits as these were carried and dragged about and sometimes, buried.**



**The effect was that no wolf had a single, clear taste and scent cue preceding consumption of the treated interior meat and so the exterior of baits did not become a barrier to some of the wolves.**





**3. Under dosing: several wolves competing for baits resulted in treated meat being broadly spread and so scavenging resulted in 4 of the wolves being only partly treated with TBZ.**



**Consequently, none of the baits remained unopened throughout. Instead, while fully treated wolves avoided baits largely at a distance, partially treated wolves opened bait exterior with the altered taste and scent but they rejected the interior meat, ending up spreading it all over the enclosure.**

**Effectiveness: Even under these conditions, treated wolves demonstrated the most common indicators of having acquired an aversion to the baits. These are:**

	PRE-TEST				TREATMENT										POST-TEST				
	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
<b>(Note: "Y"=yes)</b>																			
<b>Fully-Treated</b>																			
Kiana	Y	Y	Y	Y	100% [No further consumption of baits.....]														
Minka			Y		100% [No further consumption of baits.....]														
Ketchikan		Y	Y		100% [No further consumption of baits.....]														
Barrow	Y				97% [No further consumption of baits.]														
<b>Partially-treated</b>																			
Taku		Y	Y	Y	20%	30% [No further consumption of baits.....]													
Inuk		Y	Y		15%	30% [No further consumption of baits.....]													
Tundra			Y		30% [no further consumption of baits.....]														
Naomi																		20%? [no further consumption.]	
Recovered Meat%	0	0	0	0	0	60	0	10	0	3	90	20	60	80	75	99	90	75%	
																		[ SPILLED.....]	

- 1. The most aggressive feeders were treated first, leaving subsequent baits to others.**
- 2. Wolves fully treated early, continued avoidance across up to 13 post-tests with substantial food deprivation.**
- 3. This avoidance persisted while in the presence of other wolves continuing to consume the food (no observational learning).**
- 4. Since all wolves rejected the interior meat during post-testing when TBZ was absent, they did not detect the TBZ in the treated baits and so associated the illness with the taste of the meat itself.**

**Greatly increased frequency of bait avoidance behavior at a distance (ignoring the bait, smell-rejection). (Table 2)**

**Table 2. Frequency of avoidance of bait at a distance (ignoring the bait, smell-reject of bait).**

	Before	After
<b>Fully-Treated</b>		
Kiana	0	46
-----		
Minka	0	4
-----		
Ketchikan	0	35
-----		
Barrow	0	21
-----		
<b>Total</b>	<b>0</b>	<b>106</b>
<b>Partially-Treated</b>		
Taku	0	42
-----		
Inuk	8	34
-----		
Tundra	0	21
-----		
Naomi	3	2
-----		
<b>Total</b>	<b>11</b>	<b>99</b>

(Inuk, Naomi shy so walked past baits in our presence)

The number of treated wolves that showed an increased avoidance of baits at a distance after treatment compared to before treatment = 7/8, Sign Test, the hypothetical probability of each event was 0.50 and so probability of 7/8 wolves showing avoidance was  $<.01$

**It is necessary to post-test animals before they are released into the wild. These behaviors are reliable indicators that aversion to anticipated livestock has been established before release.**



**Greatly increased frequency of taste-reject behavior: wolves may chew or lick baits but not consume, often accompanied with head shaking and gagging. (Table 3).**

**Table 3. Frequency of proximal avoidance of baits (Taste-reject).**

	<b>Before</b>	<b>After</b>
<b>Fully-Treated</b>		
<b>Kiana</b>	<b>0</b>	<b>23</b>
<hr/>		
<b>Minka</b>	<b>0</b>	<b>1</b>
<hr/>		
<b>Ketchikan</b>	<b>0</b>	<b>1</b>
<hr/>		
<b>Barrow</b>	<b>0</b>	<b>8</b>
<hr/>		
<b>Total</b>	<b>0</b>	<b>33</b>
<hr/>		
<b>Partially-Treated</b>		
<b>Taku</b>	<b>0</b>	<b>31</b>
<hr/>		
<b>Inuk</b>	<b>0</b>	<b>5</b>
<hr/>		
<b>Tundra</b>	<b>0</b>	<b>8</b>
<hr/>		
<b>Naomi</b>	<b>0</b>	<b>0</b>
<hr/>		
<b>Total</b>	<b>0</b>	<b>44</b>

**The number of treated wolves that showed an increased avoidance of baits on the basis of taste after treatment compared with before treatment = 7/8 (one tie), Sign Test, The hypothetical probability of each event was 0.50 and so probability of 7/8 wolves showing avoidance was <0.01**

**Note: Though dramatic to see, Taste-Reject only happens when aversion on the basis of scent of prey is insufficient to produce avoidance at a distance and so may indicate a weak aversion due to inadequate aversion agent and/or confused food cues, both of which occurred with four of the wolves in this study.**

## **Recommendations:**

**Treat with clean, dry hides of target livestock prey securely sutured around ground meat of target prey sufficient to mask taste and scent of TBZ (that is, TBZ should be no more than 2-3% weight of the meat thoroughly mixed with meat).**

**Meat should be only a fraction of meal size so that a single predator consumes all quickly. 250 g was only 8% of the 3 Kg meal size for wolves.**

**So, to treat a 200 Kg African Lion with 150 mg TBZ/Kg body weight to produce an effective aversion to beef livestock would require a beef-bait that delivers 30 g of TBZ. This must be hidden in a volume of ground beef capable of masking its flavor and so 30g is 3% of 1000 g. This 1 Kg TBZ bait must then be wrapped in fresh, clean beef hide and securely sutured so that lions must spend considerable time being exposed to the taste and scent of the outer surface before eating the TBZ-treated meat inside.**

- Treat each predator separately and prevent contamination of taste and scent of bait exterior so that taste and scent of live prey precede illness induced by TBZ.**
- Post-test only once with untreated bait to document treatment before release of the predator.**
- Track movements/activities of treated predators to measure strength and duration of aversion effects.**

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