He who can no longer pause to wonder and stand rapt in awe, is as good as dead; his eyes are closed

-- Albert Einstein

University of Alberta

Aversive Conditioning on horseback: A management alternative for grassland systems threatened by sedentary elk populations.

by

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A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Ecology

Department of Biological Sciences

Fall 2009
Edmonton, Alberta

Your file Votre référence
ISBN: 978-0-494-53961-3
Our file Notre référence
ISBN: 978-0-494-53961-3

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To Antje, Mia and Finn who always stand behind me – despite all.

ABSTRACT

Loss of migratory behaviour in ungulates has been observed worldwide and invites new tools for managing the habitat degradation that results from these sedentary populations. We assessed use of aversive conditioning on horseback as a means of reducing grazing pressure and restoring migratory behaviour in elk (*Cervus elaphus*) at the Ya Ha Tinda Ranch, which is an important wintering range. We conditioned elk by herding them daily in the direction of their historic migratory route and monitored changes in elk distribution and grassland biomass each year. After three summers of aversive conditioning treatments, summer elk presence on the targeted grassland had declined substantially and grassland biomass had increased. Although elk use shifted in the desired direction, we did not detect any longer-distance migration in targeted elk. Our research suggests that aversive conditioning on horseback can temporarily reduce grazing pressure on threatened grasslands, but is unlikely to change migratory behaviour.

ACKNOWLEDGEMENTS

I thank my Supervisor Colleen Cassady St Clair, for an astounding amount of understanding and never-ending support of whatever weird idea or situation I came across with. Cliff White provided a great combination of thoughts, lively discussions, shockingly drastic ideas and quiet background support. Thanks to both of you; you really made this project what it was.

The project would not have been possible without support from the Ya Ha Tinda Ranch staff; Rick and Jean Smith, Rob and Sue Jennings (with Jordan and Shelby), Johnny and Marie Nylund, Dick Levie and Helene Galt, Craig van Curen, Kirk Phillips, Jeff Gray, and Tom McKenzie. They not only supported a very experimental approach to range management but also had the patience to teach me horseback riding and everything that is connected to work with livestock. We also had support with the horse end of things from participants of three advanced warden horse schools and some private Volunteers, especially Adair and Susan McDonald, and Murray and Karen Hagel, who spent a great number of their weekends at the ranch moving elk with us.

To successfully conduct a long term, large scale project it was necessary to have dedicated field assistants who spent endless days moving elk, collecting pellet samples, conducting surveys and observing elk. I thank the following volunteers and research assistants for their hard work: Jenny Coleshill, Sonja Gerritzen, Lisa Gijsen, Helene Guillen, Jason Mitchell, Holly Munroe, Valentina Peronace, Hiske Pekelder, Ali Pons Andrea Ram, Tiffany Smith, Emilie Touzeau and Daan Witlox. I especially thank Maria Didkowsky for never-ending optimism and a laugh that can wake up even the most tired researcher.

I had great support form a huge number of wardens and workers from Banff National Park. I thank Ian Syme for major support of the project, Frank Burstrom for fixing anything that is made out of wood, his plumbing companion Brian Youngberg, and the best electrician of all P.J. Connolly. I would like to thank Blair Fyten, Tom Davidson and Ron Leblanc, who spent hours on horseback in the coldest weather to dart elk that refused to walk into the corral trap. I thank Ian Pengelly and Brian Low for sparing our houses while burning down the forest around them.

I thank colleagues and co-operators for scientific input, great discussions and being there for questions (of which I had many); Evie Merrill, Luigi Morgantini, Nate Webb, Barry Robinson, Marco Musiani, Phil de Witt, Scott Nielsen and Darcy Vissher. Jesse Whittington helped greatly on the statistical end of things; writing up this thesis would not have been possible without his long hours of explaining to me how 'R' really works. Special thanks go to Mark Hebblewhite who not only started off my work by hosting me as a volunteer on his own project, but whose constant support, challenging mind and strong belief in me made me appreciate him as colleague, mentor and a very good friend.

A big group of people with all different kinds of support made it possible for me to focus on my work at Ya Ha Tinda. I thank: Jim Mitchell, Jim Allen and Anne Hubbs for believing in the project and trying to explain to many people on the phone why it is actually legal for us to harass wildlife. I thank Jim Chesser and Mark Cherwick for providing horses that excelled at charging at elk through icy water and steep hills instead of slowly walking down beautiful trails in Banff or Jasper. I am grateful to John Stone for coming by oh-so-often and dropping off paintings of this wonderful country, Edward Bork for providing range cages, Rich Moses for not only teaching me statistics but also showing me that being a professor does not necessarily mean you are a slow biker, Liana and Paul Dament for being a base in civilization, receiving packages and making phone calls, and finally, Bastian Ridder and Nicole Fiedler (with Luke and Zoe) for being our quiet base in Germany when visiting family at high speed got too exhausting.

Finally, I thank my family in Germany (Gaby, Ronald, Timo and Ryk Spaedtke) for long distance support and long conversations when I was visiting. Despite the fact that they never really understood what I was doing here, they believed in me and supported me every step of the way. I thank my own little family for all the love and support they give me every day, especially Antje, for reminding me to get back to work when I got distracted, and Mia and Finn for distracting me as much as they possibly could. You are the most wonderful people in the world and I can't wait to venture on to new adventures with all three of you.

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CHAPTER ONE: INTRODUCTION

OVERVIEW AND RATIONALE FOR MANAGING SEDENTARY UNGULATE POPULATIONS WITH AVERSIVE CONDITIONING.

Worldwide millions of animals migrate between habitats. Migration is a regular, periodic movement of populations away from and back to their place of origin (Baker 1978). A single round trip may take the entire lifetime of an individual, as with the Pacific salmon (*Oncorhynchus*), or an individual may make the same trip repeatedly, as with many of the migratory birds and mammals. The animals may travel in groups along well-defined routes, as with many bird and ungulate species, or individuals may travel separately, congregating for breeding and then spreading out over a wide feeding area, as for some seal species (Aidley 1981). Migration distances vary between a few hundred meters in several amphibian species (e.g., wood frogs (*Rana sylvatica*), or eastern newts (*Notophthalmus viridescens*; Regosin *et al.* 2005) and thousands of kilometers as in purple martins (*Progne subis;* Stutchbury *et al.* 2009). The record for long-distance flying is held by the Eskimo curlew (*Numenius borealis*), a shorebird that navigates from Alaska to Tierra del Fuego, a distance of 16,000 km (Jukowsky 1995). Not only costs migration an enormous amount of energy (Bohlin *et al.* 2001), a great number of animals suffer injury or death in an attempt to migrate, the most famous example for this being salmon (Cooke *et al.* 2004). For these reasons, migration must have a net positive effect. For ungulates, this benefit mostly stems from the migration triggered "grazing succession" (Vesey-Fitzgerald 1960), basically triggering a foraging facilitation effect (Sinclair and Arcese 1995). Despite the ancient history of migration in many species, migratory behaviour has changed in recent decades in a host of species (reviewed by Berger 2004). Many of the massive and historically described overland treks by herd-dwelling mammals have been lost from Asian steppes, African savannas, and North American grasslands (Berger 2004). The ecological changes connected with the loss of migratory behaviour are sometimes drastic; the changes in population distributions caused by loss of migratory behaviour influences natural predator-prey relationships, leading to hyper abundant populations (Ripple and Beschta 2006), and triggers loss of diversity in wildlife and vegetation communities (Warren 1991, Soulé *et al.* 2003). When ungulates cease to migrate to summer ranges, which are, in Canada's Rocky Mountains, typically at higher elevations (Hebblewhite *et al.* 2008), continued summer grazing on lower-elevation wintering ranges can threaten ecosystem health (Derner and Whitman 2009). When the viability of these important grasslands is compromised, the entire ecosystem that is built on it may be threatened as well (Derner and Whitman 2009). This is mainly because summer grazing has been shown to remove deep-rooted, and grazing-resistant grasses such as Parry oat grass (*Danthonia parryi*; Dormaar and Willms 1990) and rough fescue (*Festuca campestris*; McInenly 2003). On top of this, grazing may cause growth suppression and regeneration delays, as well as mortality among seedlings that are repeatedly browsed or pulled out of the ground (Crouch 1976, Tilghman 1989).

There are several widely used management tools to limit the changes in animal distributions caused by loss of migration. Nonlethal methods such as repellents and animal-activated frightening devices are often employed to reduce damage to areas of interest (VerCauteren *et al.* 2005, 2006). The Kenya Wildlife Service, for example, has been recognized as a world leader in wildlife power fencing by being among the first in the world to use modern high powered electric fencing for the exclusion of problem wildlife (Kassilly, 2002). Largely because of the high rate of habitat destruction, relocation has become an increasingly prominent conservation tool over the last couple of decades (e.g. Conant 1988, Fisher and Lindenmayer 2000, Kleinmann 1989). Destruction of problem wildlife is often called for as a management tool in ranching communities; e.g. farmers called for destruction of problem wildlife more so than non farmers in location (McIvor and Conover 1994). Especially in urban settings destruction of wildlife threatening humans is accepted (Hansen and Beringer 1997).

Each of the management tools mentioned above has limitations. Repellents and frightening devices are largely ineffective for elk and other cervids due to rapid habituation (VerCauteren et al. 2005). Moreover, fencing and frightening devices usually cannot distinguish between target and non target animals and thus can have undesired effects on ecosystems. More invasive methods such as relocation can cause mortality rates as high as of 50% (Wright 1977; Rosatte and Macinnes 1989). Although live capture and relocation is accepted by the general public, this impression assumes that the animals will live "happily ever after" in their new location (Craven *et al.* 1998). This reaction seems to stem from the appreciation people have for urban wildlife, and the empathy they have for individuals as opposed to populations (Runde and Milsap 1994). For the same reason, the public is generally strongly opposed to lethal management of problem animals (Braband and Clark 1992).

Aversive Conditioning (AC) is widely used for predator control (reviewed by Smith *et al.* 2000) but it has rarely been used to change animal distributions (but see Kloppers *et al.* 2005). The advantages of AC are that it is inexpensive (relative to many alternatives) and its effects are, given that the contact to the target species is maintained directly, usually limited to the species of concern (Jelinski *et al.* 1983). AC can generate short-term changes in both distribution and wariness of elk (Kloppers 2005), but AC can produce rapid habituation in both deer (*Odocoileus*; Craven and Hygnstrom 1994, Curtis 1995) and black bears (*Ursus Americanus*; Leigh and Chamberlain 2008). AC seems to be most effective if it is implemented either before or at the initial stages of a conflict situation as behavioural patterns are difficult to modify once they have been established (DeNicola *et al.* 2000).

The underlying theory for AC is based on the assumption that the target species is responsive to negative associative learning. Learning can be defined as a relatively permanent change in behaviour that results from experience (Klein 2008). However, learning reflects a change in the potential for a behaviour, it does not automatically lead to a change in behaviour, also, the changes in behaviour are not always permanent (Klein 2008). Avoidance learning is an AC procedure in which a response terminates a primary aversive event. Through negative reinforcement, a target species will learn to avoid conditions that are painful or unpleasant. Through avoidance learning, the necessary coping responses can be acquired without undue physical suffering. Avoidance training involves using a signal or cue to alert the animal or person to impending danger (Klein 2008). With punishment, in contrast to avoidance learning, the animal is presented with an aversive stimulus in response for a given behaviour of its own. This does not simply suppress ongoing behaviour, it also strengthens behaviour directly associated with its termination (Lindsay 2000). Additionally as a result of implementing punishment, cues occurring prior to the onset of punishment become emotionally conditioned with fear (Lindsay 2000). As a direct contrast of terms, avoidance is sometime termed active avoidance and punishment is termed passive avoidance. In this thesis, I test the efficacy of AC on horseback as a means of changing the distribution and habitat use of elk conducted a research project at the Ya Ha Tinda Ranch, just east of Banff National Park, in Alberta, Canada, during the summers of 2005 – 2007. This elk population has partially lost its migratory behaviour which appears to be threatening the grassland ecosystem that provides its winter range (Hebblewhite *et al.* 2005). The main objectives of this research project were to (1) determine whether it is possible to use horseback riders to aversively condition elk to change their distribution (Chapter 2) and (2) determine whether it is possible to detect changes in elk use in the response of a rough fescue grassland at the Ya Ha Tinda Ranch (Chapter 3). If it is possible to manipulate elk distribution in this way with concomitant changes to grassland health, the work has implications for a variety of grasslands threatened by altered migratory patterns and overgrazing elsewhere.