Laramie Foothills Mule Deer Project
September 2010 Update

The National Science Foundation (EF-0914489) is sponsoring research to improve our basic understanding of the dynamics of mule deer populations infected with chronic wasting disease (CWD). We intend to provide a case example of assimilating diverse sources of information with dynamics of a population infected with CWD to determine effects on population trajectory. We aim to evaluate the transmission process and provide an estimate of the reproductive rate of the disease. We also hope to reveal demographic, genetic, and environmental effects on transmission.

We established a work plan during September 2009 to initiate a 48 month field campaign involving the capture and recapture of mule deer in northern Larimer County, Colorado. We set manageable goals during the first year leaving flexibility for allocation of resources during the later years of the study informed by the initial information gathering. Herein, we summarize our efforts during 2009-10 and establish objectives thru summer 2011.

Accomplishments

Site Selection

We developed a GIS for Larimer County including layers for parcel ownership, deer wintering range, CWD prevalence, soil type, infrastructure, and land cover. We also received Colorado Division of Wildlife count, prevalence, and age and gender composition data recorded during 1985-2002. We chose four wintering areas representing a range of environmental characteristics, prevalence, and deer density, which we refer to as the Red Mountain, Big Hole, Lone Pine, and Campbell Valley. Land owners with parcels nearby or overlapping wintering areas were contacted for permission to capture and monitor deer during 2009-2013.

Telemetry Acquisition

We procured coded telemetry collar devices from Advanced Telemetry Systems that enable ganging of up to eight devices on a single frequency to reduce frequency congestion. Devices were programmed on the federal research bands of 166-167 MHz. We requested 40 devices fit for adult female deer with a mortality sensor, release mechanism, and onboard GPS programmed to collect location information once every eight hours for 30 months. We also requested 160 devices fit for adult female deer with a mortality sensor lasting 48 months and 15 devices fit for six month old deer with a mortality sensor lasting 18 months. Device refurbishment and purchase of additional GPS and mortality sensing collars were contracted thru 2013.

Animal Capture and Handling

We contracted Quicksilver Air Inc. to implement helicopter net capture of deer. Deer were captured by aerial handlers, transported to processing sites, and released from those locations. We captured 48 deer from Red Mountain on January 4-5 and February 5, 2010, 46 from Big Hole (January 5 and February 5), 21 from Campbell Valley (January 4), and 25 from Lone Pine

(January 7). All animals survived initial handling, but we suspect one fawn subsequently died of related complications. Colorado State University, Colorado Division of Wildlife, and City of Fort Collin's personnel assisted with animal handling. Deer were administered drugs to reduce capture-related stress. Hyperthermic animals were treated with supplemental oxygen, application of alcohol to the head, an intravenous injection of Banamine, and acute cases were intervened with a cold-water enema. Standard interventions were made for capture-related trauma. Handling time from receiving of netted deer to release from processing areas ranged from 8-44 minutes with most captures lasting less than 16 minutes. Deer were fit with a telemetry collar and marked with a metal ear tag. We collected blood, fecal, and rectoanal mucosa-associated lymphoid tissue (RAMALT) samples. Animals were aged according to tooth wear and body condition was assessed using ultrasonography. RAMALT samples were submitted to the Colorado State University Diagnostics Laboratory for immunohistochemical staining.

Ground and Air Monitoring

We regularly monitored the status of deer by systematically driving designated roads that intersect the study area. Field technicians spent 20-30 hours weekly listening for mortality signals, and mortalities were investigated to determine cause of death, retrieve telemetry devices, and secure a sample for CWD testing. Carcass heads and/or segments of spine were collected and submitted to the Colorado State University Veterinary Diagnostics Laboratory. Deer were also located once each during February, April, July, and September using standard aerial homing techniques. Individuals and associated groups were not identified by aerial observers during locating.

Outreach

We involved four school teachers from the Rocky Mountain High School in Fort Collins, Colorado by holding an afternoon seminar on using radio telemetry in locating wildlife using ground homing techniques. Each individual also spent at least one day working with field technicians in monitoring the survival status of study animals and/or searching for known carcasses. We gave talks to the Rocky Mountain National Park Annual Science meeting, the annual meeting of Soapstone Naturalists, the City of Fort Collins Natural Resource Staff and Master Naturalists, and the Larimer County Open Lands Board. We held two community meetings and met twice with our Citizens Advisory board.

Preliminary Findings

Survival

Adult female survival of uninfected individuals during January-August, 2010 was 0.90 (0.84-0.95, e.g. 95% credible interval) and adult female survival of CWD infected deer was 0.69 (0.28-0.95). Our initial results suggest there was a 92% probability that the survival rate of uninfected deer was greater than CWD infected animals. We attributed nine deaths to predation, one to a motor vehicle accident, one to CWD, and were unable to determine cause from eight carcass remains. Age of death varied from 3.5-10.5 years. Juvenile survival, representing survival from approximately 6-15 months of age was 0.67 (0.45-0.88). Four juvenile carcasses were investigated and we suspected one each resulted from predation and winterkill. We retrieved

retropharyngeal lymph node, tonsil, obex, and/or spinal cord samples from ten carcasses of previously uninfected adult deer. The carcass of the CWD mortality was intact and we collected the entire animal for necropsy by the diagnostics laboratory. CWD diagnosis at time of death did not differ from testing during the preceding winter in all animals. Three telemetry device malfunctions occurred where collars inadvertently released from deer. We also suspect that a fawn died of capture related complications within two weeks of handling.

Prevalence

We estimated CWD prevalence in female deer between 1.5-9.5 years old. RAMALT samples included $\geq$1 lymphoid follicle(s) in 124 deer. We considered tests with $\geq$1 follicle(s) and estimated prevalence using a random effect to accommodate for heterogeneity in prevalence between wintering areas. Infected deer were 3.5, 4.5 or 6.5 years old. Our preliminary estimate of prevalence during January-February, 2010 was 0.04 (0.01-0.18). Some suggest that at least six follicles are necessary for diagnosis. We revisited this analysis considering 103 deer with $\geq$6 follicles and estimated similar prevalence of 0.04 (0.01-0.19). The sensitivity of RAMALT conditional on adequate numbers of follicles is likely near 90% in mule deer. False negatives are proposed to occur during early stages of infection when the proteinase resistant prion localizes in the cranial nodes and has not yet circulated to the retroanal region. This delay may be exacerbated in deer that are heterozygous on the PrP gene at codon 225. Thus, we may be underestimating prevalence.

Distribution

We compared locations collected by aerial observers to provide some insight to the seasonal distributions of deer. Distribution during January-February illustrated spatial clustering into four groups which well matched the Red Mountain, Big Hole, Lone Pine, and Campbell Valley study areas. The average Euclidean distance between observations of individuals on winter ranges was 3.01 km (sd=2.85 km) suggesting concentrated use during the winter. Deer were partially migratory with resident and migratory individuals within each winter grouping. Some migrants were observed moving generally along a south-to-north direction into southern Wyoming during the April aerial survey. The average Euclidean distance between winter and summer locations was 20.6 km (14.4 km) for all deer. Twenty-three deer were non-migratory meaning Euclidean distances between summer and winter locations were less than 4 km. Deer were observed over larger use areas during the summer with average Euclidean distances between May and July sightings of 18.4 km (15.5 km). However, our larger estimates may reflect several deer using more than one non-winter range (e.g. parturition and summer). Summer distributions suggested spatial clustering into at least six groups. Deer from the Red Mountain winter group were observed in at least three summer areas and animals from the Big Hole group were observed in two summer areas. Campbell Valley and Lone Pine winter groups were generally observed in a single summer group each. Several individuals were cross-classified with respect to seasonal group and we found substantial mixing between Campbell Valley and Red Mountain, and Big Hole and Red Mountain individuals. At coarse scales summer distribution may play an important role in understanding disease dynamics. And, we intend to obtain finer resolution information from individuals fit with GPS telemetry devices during the next several months.

Objectives for 2011

Study Design

We will use our information to determine whether we have sufficient numbers of marked deer to estimate exposure and infected animal mortality rates. We intend to complete these analyses by November 2010 and provide requests to the Colorado Division of Wildlife, Larimer County, and City of Fort Collins addressing location-specific targeted numbers of captures and deployments for winter 2011.

We are developing a conceptual model of the transmission process and will provide a plan for capture and handling of males and/or fawns for 2012. Currently, we are testing an expandable GPS device for male deer.

Disease Detection

We requested the Colorado State University Veterinary Diagnostics Laboratory create and diagnosis a second biopsy slide from 2010 RAMALT samples. We intend to combine these results with existing information on test sensitivity to quantitatively assess CWD infection status in deer conditional on the number of follicles detected and individual age. We aim to develop a tool capable of forecasting the probability that a deer is infected which will be important to our efforts and useful to a variety of wildlife biologists concerned with the management of CWD.

Given these findings we intend to decide the appropriateness and feasibility of collecting alternative samples for CWD diagnosis in study animals over the course of this work.

Land Owner Permissions

We intend to contact several large land owners in southern Wyoming, within the Campbell Valley, and nearby the southern extent of the Cherokee Park State Wildlife Management Area and ask permission for aerial capture of deer.

Measurement of Study Metrics

Field technicians will continue monitoring survival status of deer by driving established routes across areas where telemetered deer are known to inhabit. Mortalities will be investigated to obtain a post-mortem diagnosis for CWD.

We will provide an initial estimate of CWD incidence rate using RAMALT samples collected during 2011 handling.

We will use aerial homing techniques during October, December, February, May, and July to locate deer on seasonal ranges. GPS devices will be downloaded during winter handling. We intend to combine the seasonal distribution surveys with fine scale GPS information to provide an initial assessment of animal home range and migration routes.