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Research Article

Effects of Helicopter Capture and Handling on Movement Behavior of Mule Deer

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ABSTRACT Research on wildlife movement, physiology, and reproductive biology often requires capture and handling of animals. Such invasive treatment can alter behavior, which may bias results or invalidate assumptions regarding representative behaviors. To assess the impacts of handling on mule deer (*Odocoileus hemionus*), a focal species for research in North America, we investigated pre- and post-recapture movements of collared individuals, and compared them to deer that were not recaptured (controls). We compared pre- and post-recapture movement rates (m/hr) and 24-hour straight-line displacement among recaptured and control deer. In addition, we examined the time it took recaptured deer to return to their pre-recapture home range. Both daily straight-line displacement and movement rate were marginally elevated relative to monthly averages for 24 hours following recapture, with non-significant elevation continuing for up to 7 days. Comparing movements averaged over 30 days before and after recapture, we found no differences in displacement, but movement rates demonstrated seasonal effects, with faster movements post- relative to pre-recapture in March and slower movements post- relative to pre-recapture in December. Relative to control deer movements, recaptured deer movement rates in March were higher immediately after recapture and lower in the second and third weeks following recapture. The median time to return to the pre-recapture home range was 13 hours, with 71% of deer returning in the first day, and 91% returning within 4 days. These results indicate a short period of elevated movements following recaptures, likely due to the deer returning to their home ranges, followed by weaker but non-significant depression of movements for up to 3 weeks. Censoring of the first day of data post-capture from analyses is strongly supported, and removing additional days until the individual returns to its home range will control for the majority of impacts from capture. © 2014 The Wildlife Society.

KEY WORDS animal handling, animal movement, capture effects, Colorado, GPS radio collar, helicopter net gunning, live capture, mule deer, *Odocoileus hemionus*.

Technological advances such as global positioning system (GPS) radio collars (Cagnacci et al. 2010), heat sensitive vaginal implant transmitters indicating the birth of neonates (Bishop et al. 2007), and advanced physiological monitoring equipment (Laske et al. 2011) allow detailed and novel research on wildlife. The employment of such approaches necessitates the capture and handling of animals, which potentially can lead to mortality (Jacques et al. 2009), injury (Cattet et al. 2008), and altered behavior (Neumann et al. 2011) in focal individuals. As capture programs continue to become more common, assessment of the impacts of capture and handling on wildlife is needed to ensure ethical standards and the validity of analyses of movement or space-use behavior.

Advancements in statistical methods have allowed researchers to use relocation data from GPS collars to make inferences on complex processes such as habitat selection (Aarts et al. 2008) and behavioral switching (Morales et al. 2004). Such studies typically operate under the implicit assumption that individual animals exhibit normal behavior after capture, and that these behaviors can be extrapolated to the greater population. If capture and handling alter these behaviors, then this assumption is violated, leading to the potential for biased results. As such, determining the existence of such alterations and subsequently the period over which data are biased by capture and handling is broadly applicable to movement and spatial ecology research and their application for wildlife management objectives.

A number of studies have assessed capture effects on behavioral metrics in free ranging wildlife, and the potential impacts include displacement from areas around capture sites (Chi et al. 1998, Moa et al. 2001), altered space and habitat use (Morellet et al. 2009), and depressed movements (Cattet

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et al. 2008, Quinn et al. 2012). Defining what constitutes normal behavior for comparison to post-capture behavior is often a difficult task. Using visual observations of collared and uncollared animals, Arzamendia and Vila (2012) found that collared and sheared vicuna (*Vicugna vicugna*) moved significantly more post-capture than unprocessed animals, though they did not determine if the response was due to the shearing or capture. Likewise, Nussberger and Ingold (2006) compared visual observations of collared and uncollared alpine chamois (*Rupicapra rupicapra*) and found no effect of collars, but they did not assess behaviors immediately following capture. Although uncollared animals provide natural controls, they rarely are accessible for comparison because of difficulties in making direct and accurate behavioral observations. In the absence of true controls, Neumann et al. (2011) compared movements of collared moose (*Alces alces*) before and after recapture, finding increased movements for a short time period post- relative to pre-recapture. Although this framework provides useful insight into how capture might cause departures from normal behavior, it is susceptible to erroneously ascribing changes in behavior to capture effects that may be normal seasonal variation (e.g., Ager et al. 2003). Such behavioral changes could obscure or heighten perceived capture effects and to date have not been accounted for in assessments of capture and handling on animal behavior.

Our objectives were to examine the effect of live capture, handling, and transportation to a central processing site on the movements of mule deer (*Odocoileus hemionus*) that we recaptured between 1 and 4 times, and to compare them to individuals that we did not recapture at the same time. This design allows for understanding capture effects on wildlife behavior and allows for understanding of these effects in the context of typical seasonal behavior.

STUDY AREA

This study took place on mule deer winter range in the Piceance Basin of Northwestern Colorado, near the town of Meeker. Winter range in this area is topographically diverse, with elevation ranging from 1,700 m to 2,300 m. The dominant vegetation type was a mix of pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), and big sagebrush (*Artemisia tridentata*). Dominant human activity in the area included natural gas extraction and hunting during the fall. Deer in this area were migratory and inhabited winter range between October and May (Lendrum et al. 2012, 2013).

METHODS

Data Collection

We captured adult (>1 yr old) female mule deer between January 2008 and March 2012 as part of ongoing research in the Piceance Basin. Prior to December 2010, we surveyed outlined capture areas with a helicopter and captured deer opportunistically. Starting in December 2010, we selected a group of deer to recapture every December or March for the following 2 years (Table 1). If deer that were scheduled for recapture died, we replaced them with a randomly captured deer. We recaptured deer by locating them via aerial telemetry from a helicopter or fixed-wing aircraft. Upon location, the helicopter capture crew obtained visual confirmation of the focal deer (all collars were fit with unique placards to aid in visual identification of individuals) and captured them using a net gun. We then blindfolded and hobbled the deer, and administered 0.5 mg/kg of Midazolam (a muscle relaxant) and 0.25 mg/kg of Azaperone (an anti-anxiety drug) intramuscularly to alleviate capture-related stress (we administered a standard dose of both drugs to each deer based on an average weight of 75 kg). We transported deer to a central processing site typically within 2 km of the capture site (extreme distances were within 5 km) where we took standard measurements and samples. During March captures, we assessed the pregnancy status of all deer and fit a subset ($n = 5$) with vaginal implant transmitters, requiring increased processing times (see Bishop et al. 2007, 2011 for further details). We fit each deer with a GPS radio collar (G2110D, Advanced Telemetry Solutions, Isanti, MN) and released them at the processing site immediately following the collection of samples and collar attachment. We recorded the time the deer arrived at the processing site as the capture time. All procedures were approved by the Colorado State University (protocol ID: 10-2350A) and Colorado Parks and Wildlife (protocol ID: 15-2008) Animal Care and Use Committees.

Deer that we opportunistically captured prior to December 2010 were fit with GPS radio collars set to attempt a relocation once every 5 hours. The group of deer we selected to be recaptured starting in December 2010 were fit with GPS collars set to attempt a relocation once every 30 minutes or once every hour. We recaptured all of these deer in

Table 1. Details of groups of captured mule deer used in analyses of capture effects in the Piceance Basin, Colorado, 2008–2012.

Group	Details	Number used in analysis
December control	Randomly captured 2008–2009; fix rate 5 hourly; not recaptured	61
March control	Captured December 2010 or 2011; fix rate hourly or half hourly; not recaptured during March 2011 or 2012	26
December recapture	Captured December 2010 or March 2011; fix rate hourly or half hourly; recaptured December 2011	41
March recapture	Captured December 2010 or 2011; fix rate hourly or half hourly; recaptured during March 2011 or 2012, and December 2011	38

December 2011, and recaptured a subset in March 2011 and/or March 2012 (see Table 1 for further details).

All collars were set to automatically drop off deer after a time period of 12–17 months (i.e., Apr of the year following capture). Once we retrieved collars, we downloaded relocation data. Although we did not explicitly design our capture efforts to assess capture effects, we collected the March data in such a way as to allow a before-after-control-impact (BACI) analysis because of temporally overlapping before-after data from deer that were both recaptured and those that were not. For analysis, we separated these data into 4 groups (Table 1). The first included data from deer that were recaptured while wearing GPS collars in March (hereafter March recapture data; Table 1). The second group acted as a control for this group and was comprised of deer that were wearing collars during a March capture (i.e., they had been captured and collared the previous December) but were not recaptured in March (hereafter March control; Table 1). The third group consisted of deer that were recaptured while wearing a GPS collar in December (i.e., they had been captured previously; hereafter December recapture data; Table 1). The final group acted as a control for the December recapture data and was comprised of deer fit with GPS collars that were not recaptured during a December capture (hereafter December control; Table 1). The December control deer did not provide a true control as they were not temporally overlapping with the December recapture data, thus we do not make direct quantitative comparisons between December recapture and control data, we only make qualitative comparisons based on the patterns resulting from the models below. In addition, because the December controls were on a 5-hour relocation schedule, whereas December recapture data were on an hourly or 30-minute relocation schedule, we rarefied the finer scale data to match the resolution of the control data for all comparative analyses below.

Analysis focused on movements derived from relocations collected 1 month prior and 1 month following recapture. Captures generally took place during the first week of December or March, and we used the mean capture date across all years to categorize control data for pre- and post-recapture comparisons. Deer in this area are migratory (approx. median winter range leave date is 7 May, approx. median fall winter range arrival date is 22 Oct; C. R. Anderson, Colorado Parks and Wildlife, unpublished data), so we excluded any summer range or migration data falling within this period. We classified spring migration as the time when deer made a directed movement away from their winter range and did not return, and fall migration as when deer made directed movement away from summer range until they ceased directed movement on winter range. We removed any locations with a positional or horizontal dilution of precision (PDOP/HDOP) greater than 10. In addition, we removed erroneous locations identified by unrealistic movements: the largest 95% of movements that upon visual examination in ArcMap 10.1 (Environmental Systems Research Institute, Redlands, CA, USA) were the result of a single outlier location. We used the resulting data to examine the effect of recapture on movement behavior. In all subsequent analyses, the movement data consist of multiple observations from the same individual, and thus are not independent. To account for the nested nature of the data, we used hierarchical (i.e., random effects) models, fit in a Bayesian framework, to assess the effects of recapture on movements. Unless otherwise noted, we fit all models with intercepts varying by individual (i.e., a random effect on intercept). We fit all models in R with the "rjags" package (Plummer 2013; for JAGS code and specifics on models see supporting information, available online at www.onlinelibrary.wiley.com).

Movement Behavior Analyses

We fit a series of models on combined pre- and post-recapture movements to assess the influence of handling on movement behavior. In cases where analyses indicated a difference between pre- and post-recapture movements, we conducted further analyses directly comparing recapture movements with the control data.

Using the recapture data, we calculated the 24-hour daily displacement (straight-line distance between the first and last location of each day) for every deer 1 month prior to and 1 month after recapture. For post-recapture data, we started calculations at midnight on the day of capture, to standardize across deer with different capture times. We fit a model to the displacement distances for the March and December data separately, with a binary covariate for if the displacement was post-recapture (i.e., 1 indicating if the movement was post-recapture and 0 if it was pre-recapture). We allowed both the intercept and the coefficient for pre- versus post-recapture to vary across individuals.

We calculated the movement rate (m/hr) for all locations. We fit a model to movement rates from the December and March recapture datasets (2 models total) examining a single covariate: whether the movement was before or after a recapture. We allowed both the intercept and the coefficient for pre- versus post-recapture to vary across individuals. As these models showed differences between pre- and post-recapture movement rates, we next examined the control data. We fit models to movement rates from the December and March control datasets for comparison with the recapture models. Because the March control data temporally overlapped the March recapture data, allowing for direct comparisons among datasets, we next fit a model to the 1) post-recapture and control data and 2) the pre-recapture and control data for March, with a binary covariate indicating if the movement was a recapture or control movement. The combination of these models allows us to assess whether the patterns seen in the recapture data differed from those of the control data, which would indicate an effect of capture. If control and recapture data displayed similar patterns, this would indicate no effect of capture.

To further explore the potential for temporal effects of capture and handling on movement rates, we fit a series of additional models to all recapture and control datasets separately, in which the number of days post-recapture was a covariate (see supporting information, available online at www.onlinelibrary.wiley.com). We included the distance moved from the home range as a covariate and tested models with different functional forms for the effect of the number of days since the capture event on movement rates (i.e., linear, quadratic, or log; see supporting information, available online at www.onlinelibrary.wiley.com). We compared models using the deviance information criteria (DIC; Spiegelhalter et al. 2002, but with the effective number of parameters as formualted in Plummer 2012). For all models, the movement rate was natural log transformed to assure proper support (i.e., untransformed movement rates are strictly positive and cannot be modeled using linear regression; see supporting information, available online at www.onlinelibrary.wiley.com for specifics of models).

Home Range Return Analysis

We calculated the time it took for deer to return to their home range following recapture as the number of hours from release to the time when a deer arrived back on the 100% minimum convex polygon (MCP) home range. We calculated MCPs around the data from 1 month prior to recapture using the "adehabitat" package (Calenge 2006) in the R statistical software (R Core Team 2013), which we then imported into ArcMap 10.1 to calculate return times. To standardize return times across data derived from collars with different relocation schedules, we used linear interpolation to estimate locations every 30 minutes (i.e., the midpoint of the straight line between hourly locations). For deer whose MCP overlapped the processing site, we set the time to return at 0 hours. We then fit a model to the natural log-transformed home range return times and included covariates for if the capture event took place in March (i.e., Dec capture was the reference category) and the distance (in meters) between the processing site and the closest point of the MCP.

RESULTS

We recaptured 58 deer at some point throughout the study; we recaptured 26 deer once, 15 deer twice, 7 deer 3 times and 10 deer 4 times for a total of 117 recapture events. Because of capture myopathy (2 deer), poor GPS fix success, and some deer being too far away from the processing site and thus being recaptured and released at the capture location, we were left with 104 recapture events with which we could assess home range return times, and 99 events with which we could assess 24-hour displacements and movement rates. Of the 58 deer that we recaptured, 26 were not subsequently recaptured in March 2011 or March 2012, thus the March control data were comprised of locations from 26 deer. The December control data were comprised of locations from all 61 December control deer.

Movement Analyses

The trend in daily displacement distance suggested that displacement (straight line movement between the first and last location of each day) was shorter during the 30 days prior to recapture than the 30 days post-recapture in both March and December, though the differences were small (pre-recapture Dec: $\bar{x} = 745$ m, SD = 646; post-recapture Dec: $\bar{x} = 757$ m, SD = 893; pre-recapture Mar: $\bar{x} = 633$ m, SD = 808; post-recapture Mar: $\bar{x} = 638$ m, SD = 770), and the 95% credible intervals of the model coefficients for pre- versus post-recapture overlapped 0 (Dec: $\beta = 0.06$, 78% of posterior > 0; Mar: $\beta = 0.1$, 93% of posterior > 0). Although these values indicate little departure from pre-recapture behavior when examined in monthly aggregates, daily net displacement clearly was elevated the first day after recapture (i.e., from midnight on the day of capture, until the following midnight) and slightly elevated the remainder of the first week (Fig. 1).

Mule deer movement rates were substantially greater the day of recapture than during any other time during the month before or after recapture, and were substantially greater than any control deer movements (Figs. 2 and 3). Recapture data movement rates were greater post-recapture than pre-recapture in March (pre-recapture: $\bar{x} = 82$ m/hr, SD = 145; post-recapture: $\bar{x} = 108$ m/hr, SD = 177; $\beta = 0.24$, 100% of posterior > 0). In contrast, recapture data movement rates were lower post-recapture than pre-recapture in December, though only slightly (pre-recapture: $\bar{x} = 85$ m/hr, SD = 120; post-recapture: $\bar{x} = 81$ m/hr, SD = 109; $\beta = -0.06$, 86% of posterior < 0). Control data models showed similar patterns; March control movement rates were greater after the mean March capture date (pre-mean capture date: $\bar{x} = 87$ m/hr, SD = 143; post-mean capture date: $\bar{x} = 110$ m/hr, SD = 164; $\beta = 0.26$, 99% of posterior > 0), and December control movement rates were less after the mean December capture date (pre-mean capture date: $\bar{x} = 70$ m/hr, SD = 82; post-mean capture date: $\bar{x} = 60$ m/hr, SD = 69; $\beta = -0.1$, 99% of posterior < 0). The models directly comparing March recapture and

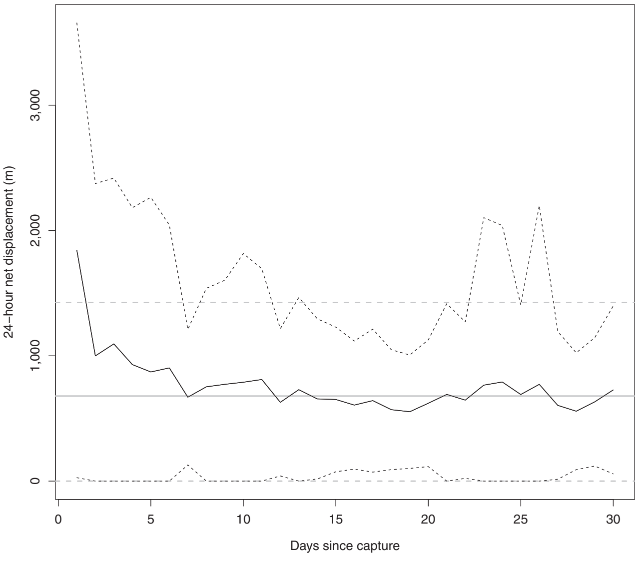

Figure 1. Daily displacement (straight line distance between first and last location within each day) as a function of the number of days since recapture for mule deer recaptured in the Piceance Basin, Colorado, 2008–2012. Black lines represent mean daily post-recapture displacement (solid line) ± standard deviation (dashed lines), and gray lines represent overall mean displacement prior to recapture (solid line) ± standard deviation (dashed lines).

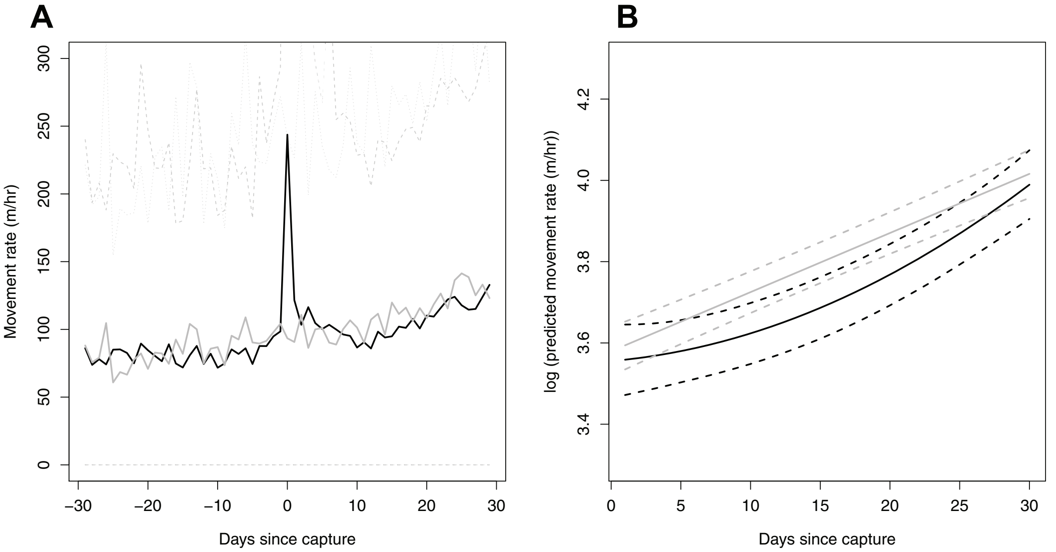

Figure 2. A: Mean movement rates of mule deer in March in the Piceance Basin, Colorado, 2008–2012. Black solid lines represent mean values for recaptured deer and gray for control deer. Dashed lines represent means ± 1 standard deviation for recaptured deer and dotted lines represent means ± 1 standard deviation for control deer. B: Predicted log movement rates (m/hr) of mule deer in March. Black solid lines represent mean predicted movement rates for recaptured deer and gray for control deer. Dashed lines represent the bounds of 95% credible intervals. For control deer, the number of days since recapture represents the number of days since the mean recapture date.

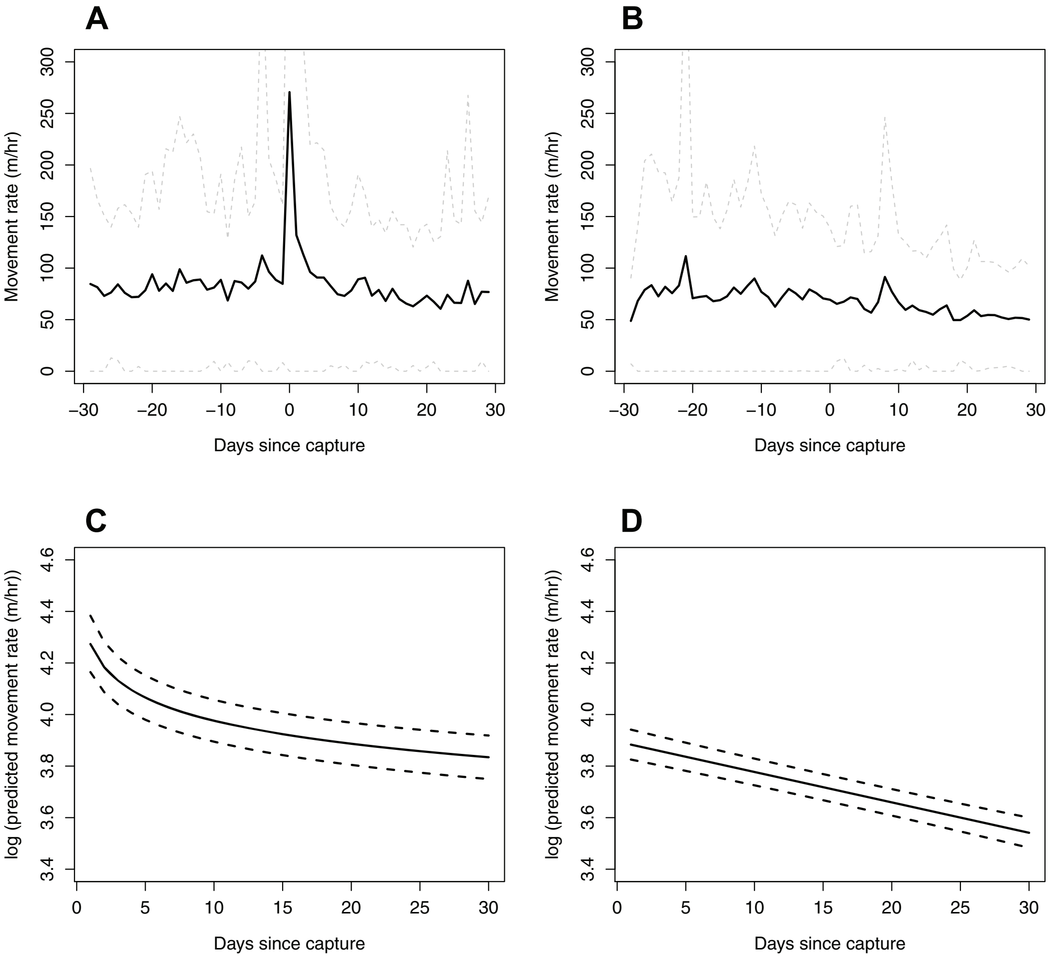

Figure 3. December mean movement rates for (A) recaptured mule deer and (B) control mule deer (i.e., deer that were not recaptured) and predicted log movement rates for (C) recaptured mule deer and (D) control mule deer in the Piceance Basin, Colorado, 2008–2012. Solid lines represent mean values and dashed lines represent means ± 1 standard deviation (A and B) or the bounds of 95% credible intervals (C and D). For control deer, the number of days since recapture represents the number of days since the mean recapture date.

control data indicated that both pre- and post-recapture movements were significantly less than pre- and post-mean capture date control movements (post-recapture $\beta = -0.14$, 100% of posterior < 0; pre-recapture $\beta = -0.09$, 100% of posterior < 0).

The model examining movements as a function of the number of days since recapture clarified these patterns, with model predictions showing a slight quadratic relationship with time since recapture, though the 95% credible intervals of the predicted movement rates overlapped at all times (Figs. 2 and 3). Predicted December recapture movements declined similarly to the December control data, but 95% credible intervals never overlapped. We caution that the December recapture and control data came from different years and thus these results must be interpreted with caution (Figs. 2 and 3; see supporting information, available online at www.onlinelibrary.wiley.com for detailed model results).

Home Range Return Analysis

The time to return to the MCP was highly variable among deer, ranging from 0 (0.5 when excluding deer whose MCP overlapped the processing site) to greater than 1,800 hours. Mean time for deer to return to their MCP after recapture was 37 hours (SD = 84), with a median of 14 hours. The model of return time also indicated that deer took longer, on average, to return in March than December (Dec median = 14 hours, $\bar{x} = 30$ hours, SD = 83; Mar median = 13 hours, $\bar{x} = 43$ hours, SD = 85; $\beta = 0.29$, 94% of posterior > 0; see supporting information, available online at www.onlinelibrary.wiley.com for detailed model results). When data from deer whose MCP overlapped the processing site were excluded, these values increased slightly (overall median = 15 hours, $\bar{x} = 40$ hours, SD = 86; Dec median = 15 hours, $\bar{x} = 33$ hours, SD = 86; Mar median = 14 hours, $\bar{x} = 46$ hours, SD = 87). Although the mean times indicate an average of greater than 1 day to return to their MCP, 71% of deer returned within 1 day, 81% within 2 days, 85% within 3 days, and 92% within 4 days. The remaining deer took substantially longer to return, though we note that in several cases, these deer used areas immediately adjacent to the MCP for long periods of time. In effect, these deer likely had returned to their home range areas, but the 30 days of data we used likely underestimated winter home ranges (post-hoc review of the data confirmed that these deer indeed used these areas during other years or other times during the same winter). The distance we moved a deer from their home range was a strong predictor of the time to return ($\beta = 0.67$, 100% of posterior > 0), with a mean predicted increase in return time of approximately 4 hours for every additional kilometer moved from the home range.

DISCUSSION

We examined movements of GPS collared mule deer following live recapture and transportation to a central processing facility and compared these movements to pre-recapture movements and to movements of control animals that were not recaptured. Deer exhibited substantially elevated movements immediately following recapture, but these movements either returned to pre-recapture levels within a few days post-recapture, or showed differences from pre-recapture movements that were similar to control deer.

The control animals allowed us to tease apart the effects of recapture on mule deer movement rates from natural seasonal behavior. Deer in March elevated their movements post-recapture. March represents a time when much of the winter snow in our study area has melted, and spring green-up is in its early stages, when deer likely have used their fat reserves. This interaction between physiology and changing ecological factors likely drove these increased movements. These changes were seen in both the recapture and temporally overlapping control data highlighting that the changes were ecologically driven. Deer in December slightly decreased their movements after recapture. December is the onset of winter, when forage availability is declining, snow accumulates, and deer decrease their activity to maintain energy stores (Anderson 1981). Thus, the documented decline in movements in December also likely represents natural seasonal patterns. Although the December control and recapture data were not temporally overlapping prohibiting a quantitative comparison, their trends were similar, supporting this assessment. The presence of control deer enabled us to make these connections; we might otherwise have attributed these changes in movement to capture effects.

To return to their home range after capture, deer typically made long movements, causing elevated movement rates and daily displacements in the first days after recapture. The time after recapture that the deer movement rates began to decline was congruous with the time it took for deer to return to their home ranges. Thus, the major impact of our capture methods on deer, at least in terms of movement behavior, seems to have resulted from being removed from areas with which they were familiar. These findings indicate that mule deer behavior is largely unaffected by our capture methods beyond the first few days after capture, and any subsequent behavioral analyses are unlikely to be influenced by capture.

The capture procedure that we employed (helicopter net gunning followed by transport to a central processing site) is only 1 method used to capture ungulates. However, our results are similar to studies of capture effects on other ungulate species captured using different methods. Neumann et al. (2011) examined behavior of moose that were darted from a helicopter and found that individuals increased movement for a short time period following recapture, though animals in their study were fully chemically immobilized. Neumann et al. (2011) also suggested that movements declined from an elevated level shortly after recapture. Arzamendia and Vila (2012) captured vicunas by herding and also found short-term increases in movements following capture, though they attributed this to pelage loss from shearing increasing thermal stress on captured animals. Neither of the above studies documented any subsequent depression in movements, but Morellet et al. (2009), working with roe deer (*Capreolus capreolus*) captured by driving deer into nets, and Quinn et al. (2012), working with white-tailed deer (*Odocoileus virginianus*) captured via a variety of ground methods, found decreased activity and decreased movement, respectively, following capture, which they interpreted as acclimation to collars and recovery from capture. Their capture protocols did not involve transport from the capture site, so deer in our study may prioritize returning to familiar areas. Despite the differences in capture protocols, the fact that any capture related effects were short lived in our study indicates that helicopter capture via net gunning does not have long-term effects on mule deer behavior beyond the first few days. Because deer behavior was affected for at least the first day by movement to the processing site, we cannot assess the impact of helicopter capture alone. To our knowledge, no literature has assessed the behavioral impacts of helicopter net gunning and release on site, thus we are unable to compare our findings to attempt to isolate the effect of transport to the processing site. However, movement to a processing site as opposed to release on site is likely to affect deer more heavily, and thus the finding of no substantial impact on deer behavior beyond the first few days indicates that capture and release of deer on site probably has minimal behavioral impacts.

Free ranging wildlife clearly are affected by capture and handling, but the nature of these effects depend on the mode of capture and whether animals are processed on-site or transported elsewhere. In capture efforts such as ours, where a large number of individuals are captured (>40 per day on some days), and technical procedures requiring substantial expertise are required, on-site processing might not be an option. However, the most apparent capture effects were short lived, with deer returning to indistinguishable behavior within as little as a day for some individuals. We did not assess the impact of multiple captures on mule deer because, although we recaptured some individuals multiple times, the sample size of deer recaptured greater than 2 times was not sufficient to test the effects of multiple captures. Such impacts on behavior might exist, but were not obvious in our sample.

MANAGEMENT IMPLICATIONS

Capture and handling is a necessary component of any research or monitoring project requiring the instrumentation of animals. These efforts affect animal behavior and thus must be continually assessed and re-evaluated to ensure the best techniques available are being used, and that capture is not affecting animal welfare or the data being collected. For mule deer being captured with helicopter net gunning and transported to a processing site, removal of the first day of data is strongly suggested, and removing the first 4 days of data will likely control for any impacts due to removal from the home range. If deer are recaptured while wearing a GPS collar, eliminating data up until the deer has returned to its pre-capture home range appears to be sufficient for minimizing any such effects. Alternatively, daily movements could be examined to determine when elevated movements have ceased. Where concerns exist over the potential influence of capture on results, analyses could be performed both excluding and including various amounts of data and results could be contrasted.

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