Integrating statewide research and monitoring data for mule deer in Montana

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Note: All results should be considered preliminary and subject to change; please contact the authors before citing or referencing these data.

Background and summary

Over the past century, mule deer (*Odocoileus hemionus*) have experienced periods of population growth and decline throughout their range (Mackie et al. 1998, Pierce et al. 2012, Bergman et al. 2015). Studies of mule deer population dynamics have revealed a suite of interacting factors which influence annual variation and trends in population growth (Mackie et al. 1998, Unsworth et al. 1999, Pierce et al. 2012, Monteith et al. 2014, Hurley et al. 2014, Ciuti et al. 2015). The complexity of mule deer population dynamics creates a challenge for biologists seeking to monitor local deer populations and respond with appropriate management decisions in a timely manner (White and Bartmann 1998, Bishop et al. 2005).

Mule deer population trends are of particular concern in Montana, where significant declines in hunter harvest and abundance have been documented in many areas throughout the state. Wildlife managers are tasked with the difficult mission of maintaining or recovering deer populations, dampening the magnitude of potential future declines, and stabilizing hunter opportunity. Therefore, improved quantitative understanding of mule deer dynamics is of particular relevance across Montana. The methods by which Montana Fish, Wildlife and Parks (MFWP) currently monitors and manages mule deer were established in 2001 with the adoption of the Adaptive Harvest Management (AHM) system (MFWP 2001). This system included four components: 1) population objectives, 2) monitoring program, 3) hunting regulation alternatives, and 4) population modeling. The population modeling component of AHM was initially designed to predict future deer dynamics given a suite of harvest and weather scenarios. Despite being founded upon very powerful data sets, Pac and Stewart (2007) found the AHM population models achieved mixed results and subsequently recommended they remain in an experimental phase rather than be implemented as a management tool.

MFWP currently collects multiple sources of monitoring data to guide management decisions under the AHM system, and distinct from this current process are other vital rate data collected as part of research studies. With this project, we seek to leverage existing monitoring and research data together for an integrated quantitative assessment of mule deer dynamics for guiding management. Additionally, we aim to collect novel field data in portions of northwest Montana and along the Rocky Mountain Front where biologists are faced with reduced mule deer numbers yet lack basic ecological and population information to manage with strong confidence.

Location

Field studies are focused in Lincoln, Flathead, and Lewis and Clark counties, where mule deer use 3 different and poorly studied habitat types. Population modeling involves research and monitoring mule deer from across their statewide distribution.

Study Objectives (2016-2017)

The grant for this study was instated November 2, 2016. During the remainder of the 2016-2017 fiscal year, the primary objectives were to;

1) Initiate integrated population modelling of MFWP monitoring data
2) Initiate field studies in 3 study areas of Montana
    a. Recruit 2 MS students to lead field studies
    b. Capture and begin monitoring adult female mule deer vital rates and habitat use.

Objective #1: *Integrated population modelling*

Integrated population models (IPMs) are growing in use by management agencies seeking to accommodate multiple data streams that characterize populations (Cooper et al. 2003, Schaub et al. 2007, Johnson et al. 2010, McCaffery and Lukacs 2016). One advantage to this approach is that it aligns multiple data streams into a single model of the population, while weighting the contribution of each data set according to its relative precision. A second advantage is that it formalizes the level of uncertainty surrounding any given point estimate, such that estimates of population trend or recruitment ratios come with explicit attention to precision. Third, one can incorporate links to environmental covariates into population models, which show particular potential for mule deer given links between remotely-sensed metrics of climate and vegetation and concurrent deer population dynamics (Mackie et al. 1998, Hurley et al. 2014, Ciuti et al. 2015, Stoner et al. 2016). Lastly, these models could conceivably facilitate the extrapolation of patterns from data-rich hunting districts to those without comparable monitoring data.

Much of the data compilation and model building necessary for this portion of the project has yet to gain substantial progress. However, we have done some preliminary code writing and model building to establish a basic IPM for a single mule deer hunting district (HD). We used data from HD575, which includes the Magpie census area, as a specified survey area for collection of monitoring data. We used data from 1998–2014, including post-season counts and age-sex classification data (fawn:doe and buck:doe ratios), spring counts and age classification data (fawn:adult ratios), and annual harvest data by age- and sex-class. We then built an IPM using programs R 3.1.1 (R Core Team 2014) and JAGS 3.4.0 (Plummer 2003).

The preliminary model did achieve stable results, with annual estimates of the population growth rate, component vital rates such as adult survival (Sa) and recruitment (R; Figure 1), and relative abundance (i.e., minimum abundance within the framework of minimum counts in the census area rather than estimates of true abundance within the hunting district).

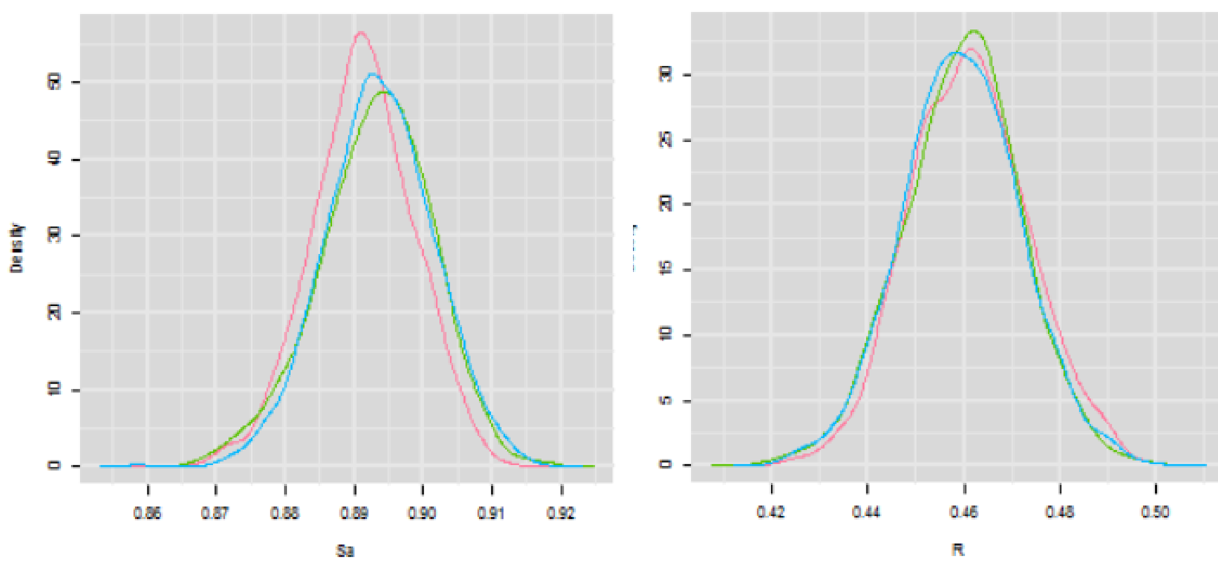

Figure 1. *Posterior distributions of values for adult survival (Sa) and recruitment (R) from 3 iterations within an integrated population model for mule deer in HD575, Montana, 1998–2014.*

Objective #2: *Field studies in 3 study areas of Montana*

2.1. Animal capture and handling

In February 2017 we worked with a contracted helicopter capture company (Quicksilver Air) and local landowners to begin capturing and radio-collaring of mule deer. Our targeted sample size is 30 adult female mule deer within each of 3 study areas (Figure 2). We also conducted some ground-darting efforts in the Whitefish Range and Rocky Mountain Front study areas. Unfortunately, helicopter net-gunning was judged to be a non-viable means of capturing deer in the majority of both Region 1 study areas, and deep snow winter conditions prevented us from instituting a thorough ground-darting or trapping effort. In total, we captured 0 deer in the Fisher River study area, 2 in the Whitefish Range, and 32 on the Rocky Mountain Front (including 2 capture-related mortalities). All deer were fit with GPS radio-collars (Lotek LifeCycle330). We are currently planning concerted ground-trapping efforts supplemented with additional helicopter captures in for the winter of 2017-18 to build sample sizes in all study areas.

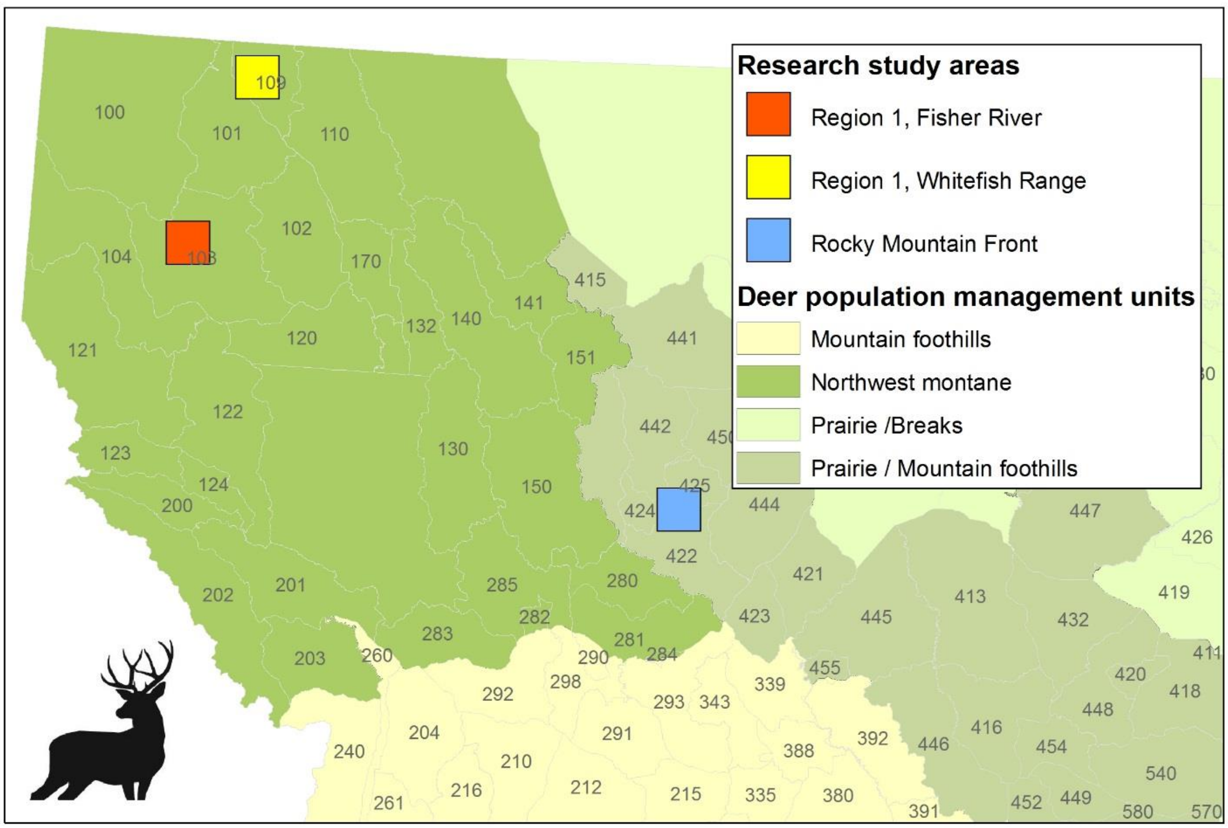

Figure 2. *Mule deer field research study areas, along with population management units and hunting districts within Montana, 2017.*

2.2 Pregnancy and health sampling

For each captured deer, we used ultrasonography and body condition scoring to assess nutritional condition, measured girth, and collected blood and fecal samples for laboratory analyses. Fecal samples were used to assess diet and parasite loads, and blood samples were used to assess pregnancy status, disease exposure via serological analyses, and trace mineral levels. Pregnancy results (PSPB levels) showed that 100% of captured deer were pregnant. Additional results from nutritional condition measurements and laboratory tests will be available in forthcoming reports.

2.3. Telemetry monitoring and summer migrations

Deployed GPS collars attempt 2 locations per day for each deer, and transmit locations remotely via Globalstar satellites. The location and extent of summer ranges were not known for these deer populations, and collar data during the first year of monitoring show a variety of seasonal migration patterns in both the Rocky Mountain Front and Whitefish Range study areas. Both populations appear to show partial migration, such that some deer remain resident within a single annual range, while others migrate various distances to distinct summer ranges. More detailed migration analyses will be forthcoming as part of this project, but thus far we have simply measured straight-line distances between winter capture locations and a summer location on 30 June, 2017 (Figures 3, 4, 5). For the 28 deer still alive on June 30th, the average migration distance was 19.5 km (SD = 18.3 km; range = 0.5–58.5 km; Figure 3). For those deer that did make some level of migration, the majority did so during the month of May (range of early April to late June).

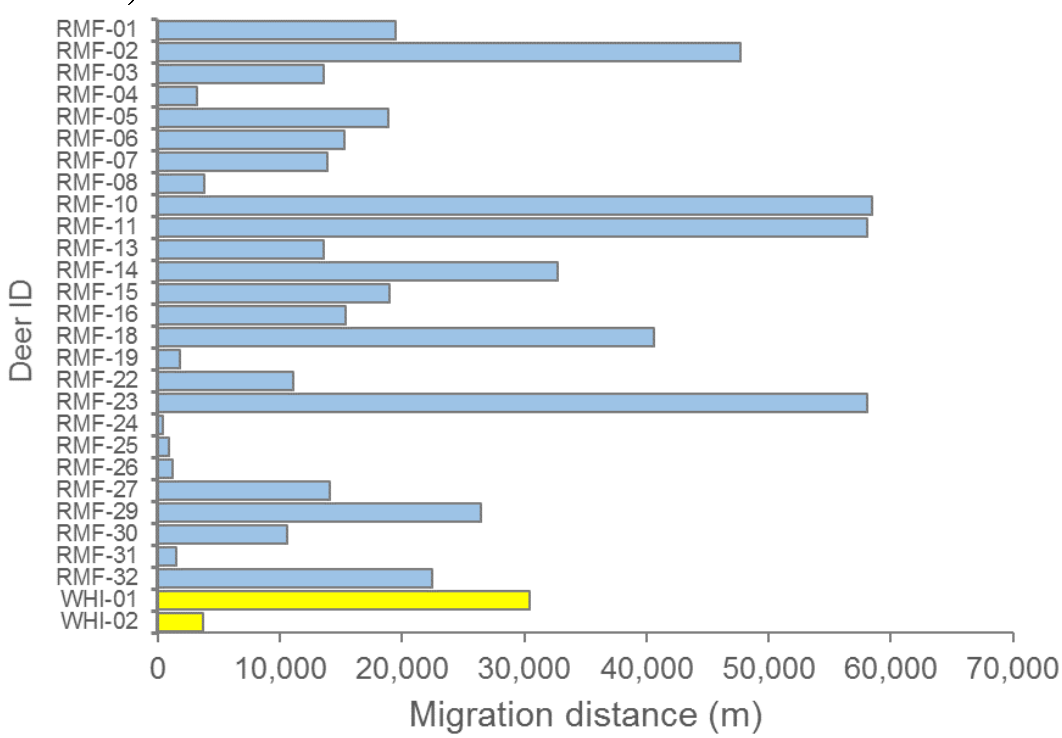

Figure 3. *Straight-line migration distance between winter capture locations and a single summer GPS location nearest to 30 June 2017, for adult female mule deer in Montana.*

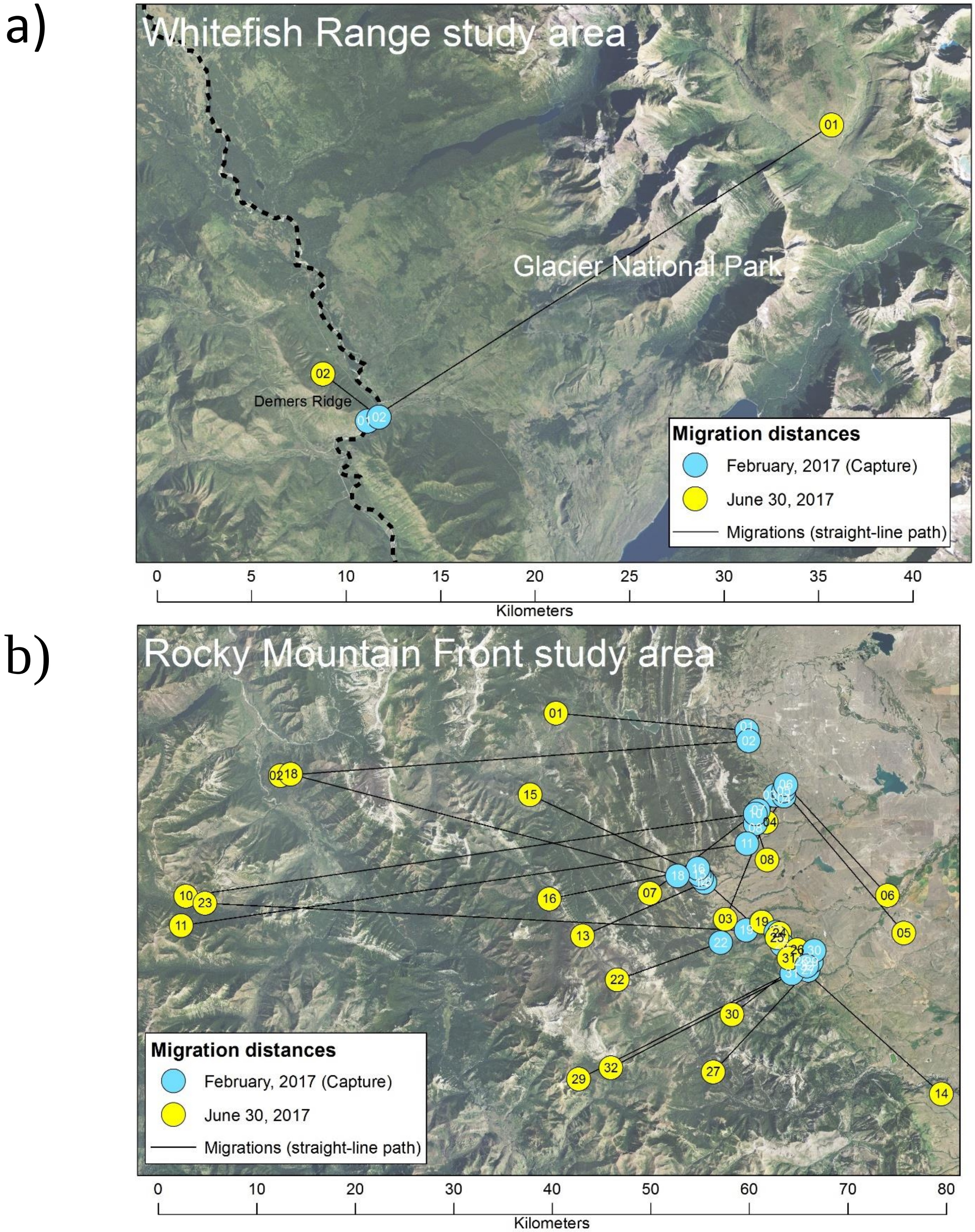

Figure 4. *Winter capture locations, summer GPS locations nearest to 30 June, 2017, and straight-line migration paths for adult female mule deer in the a) Whitefish Range and b) Rocky Mountain Front study areas of Montana.*

2.4. MS students and summer vegetation studies

During FY17 we worked with the University of Montana Wildlife Biology Program to recruit 2 new MS students that will work on studies related to this mule deer project and be co-advised by Drs. Chad Bishop and Mike Mitchell. Those students, Teagan Hayes and Collin Peterson, began conducting pilot field work in May 2017 towards assessing summer diet composition and nutrition within the Rocky Mountain Front Study area (Figure 5). Collin and Teagan will develop their MS proposals during the 2017–18 academic year, with more details concerning their projects and preliminary results in forthcoming reports.

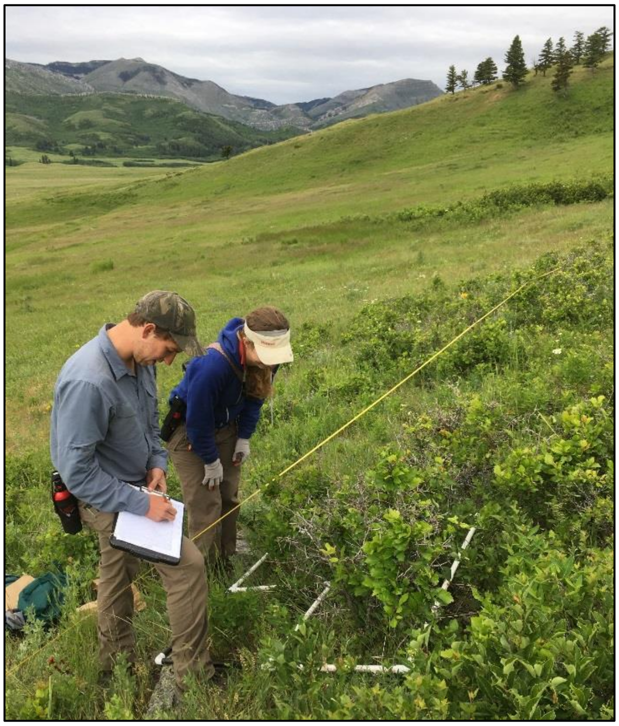

Figure 5. *University of Montana MS students Teagan Hayes and Collin Peterson collecting vegetation data at a site used by collared mule deer in the Rocky Mountain Front study area, 15 June 2017.*

Acknowledgements

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