*Proposal Format: Large Mammal Advisory Committee 2014*

# East Tehama Deer Abundance 2015

Proposed Start and Completion Date:

June 2015 – August 2019

Statement of Need

Robust estimates of the state's deer populations are needed to fulfill CDFW's regulatory obligations and for conservation of deer. The methods currently being used for estimating populations and assessing trends need to be improved.

Introduction

We will evaluate the ability of an integrated application of random sampling (Thompson 2012), fecal DNA transects (Lounsberry et al. 2015), and camera traps (O' Connell 2011) to estimate deer abundance across a large geographic area. To accomplish this, we will model abundance using a closed, mark-recapture model (Kéry and Schaub 2011) of the DNA data and an N-mixture model (Royle 2004) of the camera trap data.

Surveys will occur throughout portions of northern California deer zones C3, C4, and X4 between 500 - 2,500 m elevation and summing to approximately 11,500 km2 (Figure 1). This area corresponds to summer range habitat of the East Tehama deer herd.

Objectives

- Establish 2 camera trap stations/plot and 1 pellet collection transect on 50 randomly selected plots in the East Tehama Study Area (Years 1-3).
- Deploy Iridium collars on 20 male deer (Year 1).
- Use cameras to attempt abundance estimation (Years 1-3).
- Collect and analyze DNA samples to determine unique individuals and gender (Years 1-3).
- Use results of DNA analysis to run CMR model (Years 1-3).
- Use home range information to attempt to scale up local density and abundance estimates (Years 1-3).

Methods

Fifty hexagons were randomly selected from the U.S. Forest Service's Forest and Inventory Analysis sampling frame that completely intersects our study area (Bechtold and Patterson 2005). Surveys will be located with respect to the centroids of these hexagons or offset locations nearby if access is not feasible (Figure 1, Appendix 1).

Starting in July 2015 through August 2015, we will conduct a camera trap survey in the vicinity of each survey site. Two camera stations will be established at the start and end points of each fecal DNA transect and left up for 30 days. The images will be reviewed to create a detection history of the minimum number of individually distinguishable deer per station per 24-hour survey period by gender/juvenile/antler classes.

Following the protocol of Lounsberry et al. (2015), we will concurrently establish a 1.2-km long, 2-m wide belt transect in the vicinity of each random site that follows deer trails (when present). On the first sampling occasion, we will collect all fresh pellets with a mucous sheen and attempt to clear all pellets from 2 m beyond either side of the transect. We will return each week (for a total of 3 revisits) to collect newly deposited pellets from the transect. If no pellets are encountered after 2 visits, the transect will be discontinued. The pellets will be analyzed by a genetics laboratory at UC Berkely to determine the individual identities and gender of deer to create of a 4-period detection history for each individual.

The camera data will be used to estimate local abundance (deer per station) by means of an N-mixture model (Royle 2004). The pellet data will be used to estimate local abundance (deer per transect) by means of a closed, mark-recapture model (Kéry and Schaub 2011). We will also combine the data and attempt to estimate local abundance by means of an integrated population model (Kéry and Schaub 2011). We will use gender- and season-specific information on deer movement and home range size to scale-up local abundance to an estimate of density and population size for the study area. This ancillary data will be provided by existing GPS collar data on does in the study area (S. Hill, unpublished data) and 20 additional GPS collars to be placed on bucks this year. The results will be used in Monte Carlo simulations (Metropolis and Ulam 1949) and power analysis (Purcell et al. 2005) to determine the precision to baseline abundance estimates and ability to detect population trends over 20 years. These simulations will also identify the optimal mix of sample size allocation among camera traps and fecal DNA transects.

<u>Collaborators</u>

Brett Furnas will lead the project. He will also model the data with the assistance of Russ Landers. We will collaborate with Justin Brashares at UC Berekely on genetic analysis of the pellet samples. Scott Hill and Jennifer Carlson will oversee implementation of surveys by Scientific Aids. Stuart Itoga will lead the buck collaring effort with assistance from Richard Callas and Scott Hill. Four scientific aids (to be hired) working independently will conduct fecal DNA transects.

<u>Required Products</u>

Quarterly progress reports will be submitted to the species coordinator quarterly beginning November 2015.

A final report will be submitted in the last quarter of 2018.

Final results will be submitted for journal publication.

Budget Detail

| | Year 1 | Year 2 | Year 3 | |
|---|---|---|---|---|
| Sci Aids | $55,000.00 | $55,000.00 | $55,000.00 | **$165,000.00** |
| Collars | $50,000.00 | | | **$50,000.00** |
| Supplies | $20,000.00 | $20,000.00 | $20,000.00 | **$60,000.00** |
| Equipment | $20,000.00 | | | **$20,000.00** |
| **Total** | **$145,000.00** | **$75,000.00** | **$75,000.00** | **$295,000.00** |

References

Bechtold, W. A., and P. L. Patterson. 2005. The enhanced forest inventory and analysis program: national sampling design and estimation procedures. General Technical Report SRS-GTR-80. USDA Forest Service, Southern Research Station Asheville, North Carolina, USA.

Kéry, M and M. Schaub. 2011. Bayesian Population Analysis using WinBUGS: A hierarchical perspective. Academic Press. Okford, UK.

Lounsberry, Z. T., T. D. Forrester, M. T. Olegario, J. L. Brazeal, H. U. Wittmer, and B, N. Sacks. 2015. Estimating sex-specific abundance in fawning areas of a high-density Columbian black-tailed deer population using fecal DNA.

Metropolis, M., and S. Ulam. 1949. The Monte Carlo method. Journal of the American Statistical Association 44:335–341.

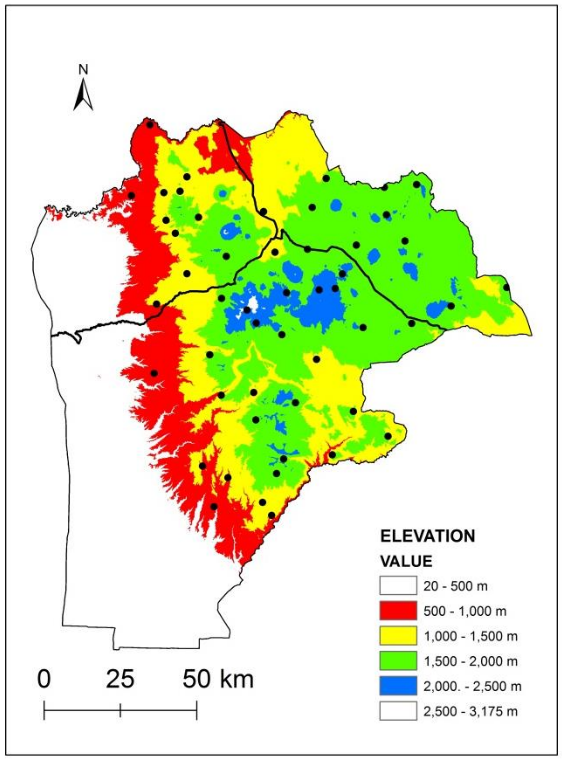
O' Connell, A. F., J. D. Nichols, and K. Ullas Karanth, editors. 2011. Camera traps in animal ecology: methods and analyses. Springer, New York, New York, USA.

Purcell, K. L., S. R. Mori, and M. K. Chase. 2005. Design considerations for examining trends in avian abundance using point counts: examples from oak woodlands. Condor 107:305–320.

Royle, J. A. 2004. N-Mixture models for estimating population size from spatially replicated counts. Biometrics 60, 108–115.

Thompson, S. K., 2012. Sampling. Third edition. John Wiley and Sons. Hoboken, New Jersey, USA

Figure 1. Survey sites for camera traps and fecal DNA transects in deer zones C3, C4, and X4.




APPENDIX 1 Survey sites

| Site | Elevation | Zone | TRS | Latitude | Longitude | Owner |
|---|---|---|---|---|---|---|
| 19927 | 653 | C3 | 36N 01W 1 | 41.00487 | -121.91776 | Roseburg Forest Products |
| 20154 | 1,579 | X4 | 35N 07E 31 | 40.85545 | -121.22964 | Lassen National Forest |
| 20168 | 1,315 | C3 | 35N 02E 29 | 40.85382 | -121.76976 | Sierra Pacific Industries |
| 20169 | 1,875 | X4 | 34N 10E 5 | 40.84083 | -120.87858 | WM Beaty & Associates |
| 20187 | 1,585 | X4 | 34N 09E 6 | 40.83158 | -121.00440 | Lassen National Forest |
| 20239 | 1,418 | C3 | 34N 02E 18 | 40.81093 | -121.79578 | Sierra Pacific Industries |
| 20249 | 1,298 | C3 | 34N 01E 16 | 40.80580 | -121.85865 | Roseburg Forest Products |
| 20270 | 671 | C3 | 34N 01W 16 | 40.79545 | -121.98439 | Sierra Pacific Industries |
| 20297 | 1,732 | X4 | 34N 06E 35 | 40.76987 | -121.28232 | Lassen National Forest |
| 20322 | 2,010 | X4 | 33N 09E 5 | 40.75076 | -120.99452 | Lassen National Forest |
| 20326 | 1,123 | X4 | 34N 04E 36 | 40.75528 | -121.47083 | Lassen National Forest |
| 20365 | 1,488 | C3 | 33N 02E 11 | 40.73532 | -121.72212 | Sierra Pacific Industries |
| 20384 | 1,430 | C3 | 33N 01E 10 | 40.72513 | -121.84773 | Roseburg Forest Products |
| 20447 | 1,204 | C3 | 33N 01E 25 | 40.68735 | -121.81091 | Sierra Pacific Industries |
| 20448 | 1,781 | X4 | 33N 09E 36 | 40.67455 | -120.92194 | Lassen National Forest |
| 20478 | 1,722 | X4 | 32N 08E 5 | 40.66059 | -121.11021 | Lassen National Forest |

| | | | | | | |
|---|---|---|---|---|---|---|
| 20507 | 1,645 | C4 | 32N 06E 10 | 40.64630 | -121.29842 | Lassen National Forest |
| 20527 | 1,410 | C4 | 32N 05E 16 | 40.63660 | -121.42388 | Lassen National Forest |
| 20556 | 1,778 | C3 | 32N 03E 14 | 40.62179 | -121.61202 | Lassen National Forest |
| 20627 | 2,013 | C4 | 31N 07E 2 | 40.57506 | -121.16296 | Lassen National Forest |
| 20650 | 1,267 | C3 | 31N 02E 4 | 40.56886 | -121.76342 | WM Beaty & Associates |
| 20667 | 1,751 | X4 | 31N 13E 16 | 40.53972 | -120.52688 | Bureau of Land Management |
| 20701 | 2,067 | C4 | 31N 07E 22 | 40.53229 | -121.18931 | Lassen National Forest |
| 20711 | 2,154 | C4 | 31N 06E 24 | 40.52752 | -121.25193 | Lassen National Park |
| 20730 | 2,115 | C4 | 31N 05E 25 | 40.51789 | -121.37717 | Lassen National Park |
| 20770 | 1,642 | C4 | 31N 03E 34 | 40.49821 | -121.62758 | Lassen National Forest |
| 20772 | 1,833 | X4 | 30N 11E 4 | 40.48377 | -120.74139 | Sierra Pacific Industries |
| 20809 | 1,040 | C3 | 30N 01E 4 | 40.47797 | -121.87790 | WM Beaty & Associates |
| 20825 | 2,448 | C4 | 30N 04E 15 | 40.46529 | -121.52851 | Lassen National Park |
| 20867 | 1,672 | C4 | 30N 10E 30 | 40.43201 | -120.89306 | Lassen National Forest |
| 20892 | 2,229 | C4 | 30N 04E 25 | 40.42737 | -121.49208 | Lassen National Park |
| 20898 | 1,811 | C4 | 30N 08E 33 | 40.41813 | -121.08065 | Lassen National Forest |
| 20947 | 1,819 | C4 | 29N 05E 11 | 40.39431 | -121.39320 | Lassen National Forest |
| 21063 | 1,651 | C4 | 29N 03E 32 | 40.33176 | -121.66917 | Sierra Pacific Industries |
| 21069 | 1,407 | C4 | 29N 06E 36 | 40.32315 | -121.25824 | Sierra Pacific Industries |
| 21168 | 681 | C4 | 28N 01E 17 | 40.27369 | -121.88233 | Tehama Wildlife Area |
| 21249 | 1,460 | C4 | 27N 04E 2 | 40.22302 | -121.49774 | Collins Pine |
| 21268 | 1,204 | C4 | 27N 03E 10 | 40.21316 | -121.62241 | Lassen National Forest |
| 21293 | 1,773 | C4 | 27N 06E 17 | 40.19477 | -121.33689 | Lassen National Forest |
| 21328 | 1,620 | C4 | 27N 08E 29 | 40.17097 | -121.11391 | Plumas National Forest |
| 21387 | 1,702 | C4 | 26N 04E 2 | 40.14226 | -121.48761 | Lassen National Forest |
| 21445 | 1,597 | C4 | 26N 09E 21 | 40.09941 | -120.97981 | Sierra Pacific Industries |
| 21546 | 1,621 | C4 | 25N 07E 10 | 40.04268 | -121.19275 | Plumas National Forest |
| 21574 | 1,831 | C4 | 25N 05E 14 | 40.02837 | -121.37927 | Lassen National Forest |
| 21620 | 981 | C4 | 25N 03E 30 | 40.00383 | -121.69004 | Lassen National Forest |
| 21644 | 1,729 | C4 | 25N 05E 34 | 39.98556 | -121.40539 | Lassen National Forest |
| 21672 | 837 | C4 | 24N 03E 1 | 39.97091 | -121.59175 | Sierra Pacific Industries |
| 21782 | 1,390 | C4 | 24N 05E 31 | 39.89993 | -121.45755 | Sierra Pacific Industries |
| 21809 | 808 | C4 | 23N 03E 4 | 39.88520 | -121.64368 | Bureau of Land Management |
| 21841 | 1,177 | C4 | 23N 05E 9 | 39.86196 | -121.42159 | Plumas National Forest |