

Proposal Format: Large Mammal Advisory Committee



North Central Region (R2)

In ESTIMATION OF ABUNDANCE OF MULTIPLE DEER HERDS USING FECAL DNA NORTH CENTRAL REGION

Project Leaders:

Proposed Start and Completion Date: June 2016 to June 2022

Executive Summary

Obtaining accurate data necessary to monitor deer populations, especially in forested environments, is difficult. Aerial surveys are limited to landscapes with open terrain for better visibility and past aerial survey attempts within the North Central Region (Figure 1) have proven ineffective in observing deer through heavily forested canopies. Aerial surveys in the northeastern Deer Conservation Unit (DCU) have been intermittent and population estimates have not been adequately obtained in several years. Population estimates for deer within other DCU's (Figure 2) within the NCR have been lacking or non-existent.

We propose to utilize non-invasive DNA techniques to obtain rigorous estimates of abundance and density with moderate precision for several deer herds within the North Central Region over the next six years.

This multi-year, landscape level project follows the successful implementation of the pilot study that estimated abundance for the Pacific Deer Herd (BGMA project NC-8001-11) with acceptable precision. Additional studies within the State are taking place which illustrate the efficacy and utility of utilizing this technique to obtain accurate population estimates for deer in California (Figure 3).

Introduction

Management of deer in California requires knowledge of population parameters in order to effectively determine hunting quotas, season dates and direct activities that will ensure population viability of our deer herds.

Estimating populations of mule deer in densely vegetated environments has been problematic. Aerial surveys to ascertain population estimates of mule deer in densely vegetated coniferous forest are not practical due to poor visibility through canopies. Moreover, because aerial surveys are typically conducted in the fall and spring when deer are on their winter ranges, surveying deer from the air is limited due to the presence of houses, restricting the area that can be effectively surveyed from the air when deer are on winter range habitats. Given these limitations, helicopter survey methodology is not warranted in heavily forested regions.

Road surveys are also unreliable in forested environments since surveys are limited to accessible roads (Brinkman et al. 2011). Road surveys rarely provide unbiased estimates, nor do they provide a representative sample of habitats, and are therefore statistically less reliable (Garton et al. 2004). Road surveys also are limited by visibility issues and access is often limited due to weather related road conditions or ownership.

Population indices derived from pellet counts have been used to monitor trends in deer populations. In principle, mark-recapture approaches are the most reliable and accurate way to estimate population abundance (Lukacs and Burnham 2005). However, physically marking and re-capturing or re-sighting deer is prohibitively expensive. Consequently, non-invasive DNA-based

mark-recapture techniques are the only feasible way to conduct such surveys and are necessary to establish robust population estimates for deer within the NCR. In particular, DNA from deer fecal pellets would be used. This method has been successfully used to estimate population density of ungulates and black bears (Brinkman et al. 2011, Harris et al. 2010, and Bellemain et al. 2005) and deer (Brinkman et al. 2010, Lounsberry et al. 2015). This methodology has proven to be effective in estimating abundance for deer in the North Central Region (Brazeal et al., 2016, Report to CDFW).

Objective

1) Estimate abundance of deer herds within the North Eastern Sierra, Sierra Nevada, Central Valley and North Coast DCUs (Figure 2) using deer fecal DNA over a six year period.

Study Area

The study area consists of designated zones and herds within portions of 4 Deer Conservation Units (DCU) in Region 2 (Table 1).

Table 1. Distribution of the Deer Conservation Units represented in the NCR

DEER CONSERVATION UNIT	% WITHIN NCR
North Coast	18%
Central Valley	30%
Sierra Nevada	37%
North Eastern Sierra	76%
Klamath Mountains and Cascade Range	4%

Within the 4 DCU's, 11 hunt zones and fourteen deer herds (Figure 4) will be sampled. These herds include:

X ZONES

Northeastern DCU

- Carson River-Loyalton Truckee Deer Herds are located within Alpine, El Dorado, Sierra, Plumas, Nevada and Placer counties within Region 2 (Figures 5 & 6). The seasonal ranges and movements for thirty deer within the CRDH were recently studied (Big Game Management Project: NC-8001-09). This herd lies within the North Eastern Sierra DCU and comprises the X8 deer hunt zone.

There have been some telemetry studies for the Loyalton Truckee Deer Herd (LTDH). The most recent telemetry study started in 2006 and is still ongoing as part of a multi-agency stewardship endeavor to reduce deer-vehicular collisions on Highway 89. Previous telemetry studies (1988-1991, 1992-1994, and 2002-2005) on this herd have delineated the seasonal ranges for this herd. This herd comprises the X7a and X7b deer hunt zones.

- Doyle Deer and Sloat herds are located within Lassen and Plumas Counties in California and western Washoe County in Nevada (Figures 7 & 8). The most recent telemetry study for the Doyle herd occurred in 1996 (Doyle deer herd plan update, 2011). We propose to collar 30 deer within the summer range of these herds that occupy the X6a and X6b hunt zones.

A (NORTH UNIT) AND B3 ZONES

North Coast and Central DCUs

- Clear Lake (Clear Lake subherd), East Park-Capay, and Monticello Herds are located within Colusa, Glenn, Lake, Mendocino, Napa and Yolo Counties (Figure 9). These herds occupy portions of the A Zone (North) Hunt Zones. All herds are comprised of resident deer. Outside of yearly harvest statistics there is little information on herd population or demographics. Past attempts at determining these data using traditional survey methods have proven unsuccessful (Thornton 1983). We propose to collar 30 deer to determine home range size and seasonal movements and follow with DNA.

NCR plans to coordinate with the Bay Delta Region (BDR, R3) on fecal pellet collection for the Monticello Herd in Napa County. BDR plans to collar deer as part of a separate project and separate capture plan. By utilizing this collar data and collaborating with R3 we will be increasing sample size and reducing the workload for both Regions as we work toward better knowledge of the A Zone deer populations.

- Alder Springs and Clear Lake (Pillsbury subherd) herds are located within Lake, Colusa and Glenn counties (Figure 9). These herds occupy portions of two hunt zones, the A Zone (North) and B3 Hunt Zones. Outside of yearly harvest statistics there is little information on herd population or demographics of the Pillsbury Subherd. Portions of the Alder Springs herd were studied extensively in the Mendocino Deer Study (Wittmer 2014). We may collar a few bucks in this area to add to the home range information for males in the population. However, no pellet transects will be conducted in the Alder Springs and Pillsbury subherd given the population data that was previously completed.

ZONES D3-D5

Sierra Nevada DCU

- Railroad Flat, Salt Springs and Grizzly Flat Deer Herds study area is located within Calaveras, Alpine, Tuolumne and El Dorado Counties (Figures 10-12). All three of these herds are migratory. The most recent telemetry data for the Railroad Flat herd was collected in 1976 with only ten female deer collared. In 1984, ten females and one male were collared. Pellet group transects were initiated in 1967 and were sampled until 2007. However, these transects were not randomly placed and therefore any estimates of population trend were biased and inaccurate.

There has never been a telemetry study conducted on the Salt Springs herd. Pellet group transects were initiated on the Salt Springs herd in 1961 and run until 1976; however, these transects were not randomly placed and therefore any estimates of population trend were biased and inaccurate.

Deer were trapped on the Grizzly Flat winter range in 1977 in five locations. Forty two were trapped and ear tagged and 8 does were radio collared. Seasonal range and migration data was restricted to only 8 individuals. Population estimates have been calculated using hunter kill and pre-post buck/doe ratios obtained from inconsistent and unreliable herd composition counts.

We propose to collar a minimum of 30 deer on the summer range of these herds to better delineate seasonal ranges. Once that is established, we will initiate collection of fecal DNA within the summer range of this herd). These herds reside within the D5 hunt zone.

- Blue Canyon, Nevada and Downieville deer herds are within the D3 and D4 hunt zones (Figures 13-14). In 1977 and 1978, 32 deer were trapped of which eight adult does were radio collared on winter range for the Blue Canyon deer herd. Seasonal range data for the Nevada/Downieville herds are non-existent.
- Bucks Mountain-Mooretown herds (Figure 15). The Bucks Mountain deer herd range extends from eastern Butte County to western Plumas County. Winter range is approximately 200,600 acres; migratory and summer ranges total approximately 265,600 acres. Approximately 28 percent of the critical winter range in Butte County has been lost to residential encroachment since the mid 1960's.

The Mooretown deer herd occupies a range extending from the southern boundary of the Bucks Mountain deer herd into northwestern Sierra and northeastern Yuba counties. Winter range is approximately 232,000 acres; migratory and summer ranges total approximately 217,950 acres. Approximately 50 percent of the critical winter range in Butte County has been lost to residential encroachment since the mid 1960's.

The herd study area is located within parts of Butte, Plumas, and Yuba Counties. This migratory deer herd was first studied in 1980 and 1982 when a total of 6 adult doe were captured and fitted with radio telemetry collars. A more recent telemetry study was initiated in 2010 when 27 adult does were fitted with GPS collars on the summer range over a period of several field seasons. The last 5 collars are expected to drop and be recovered in July-August of 2016.

As a result of this study, the preliminary location data provides information to delineate seasonal ranges for this herd. We will initiate collection of fecal DNA within the summer range of this herd. These herds reside within the D3 hunt zone.

Methods

The project will be implemented in phases to align with the DCU's we will be sampling (Table 3, page 8). Herds have been combined into larger blocks to facilitate more efficient sampling on a landscape level (Figure 16). Actual timing of proposed activities depends upon staffing levels, funding and acquisition of collars etc. Some items may have to be pushed to subsequent years in order to accomplish our goals. For areas where home range data is lacking, we intend to deploy a minimum of 30 collars onto bucks and does within the sampling blocks to obtain one year's worth of data. Fecal DNA transects will be established within one or two years following this effort.

Radio telemetry data provides information on home range size for deer. Having current telemetry data on home range size will help establish the affective sampling area and can be used to scale up local abundance estimates for the study area utilizing a integrated population modeling approach. Therefore, our sampling efforts will begin with deer herds that have recent home range data. For herds that do not have current data, we propose to deploy collars prior to or concurrently with pellet collection.

Transects for each sampling block will be run for two consecutive years. Pellets will be submitted to the State's contracted DNA lab where DNA will be extracted to identify individuals and gender. Once results are received, we will coordinate with the program's statisticians to run preliminary population analysis utilizing home range data to determine the transect buffer distance (Furnas, 2015).

To ensure closed population sampling, we will collect fecal DNA within the summer ranges (Figure 17) for migratory herds. Both the Carson River and Loyaltown-Truckee herds have recent telemetry

data for does. We propose to collar additional deer in the Doyle and Sloat herds that will include bucks into the analysis.

For phase 1 of our study, 245 hexagons with a central GPS point within the hexagons were placed over the summer range for three deer herds within the NES DCU (Figure 18). This area encompasses 5,979 km² of summer range within five X zones in the NES DCU of the NCR (yellow polygons in Figure 16). Thirty hexagons and their corresponding start points were randomly selected within this block (Figure 19). This method will be extended to the other DCU's in the NCR.

Starting July 2016 through September 2016, we will establish a minimum of 30, 1.2-kilometer long by 2-meter wide belt transects in the vicinity of the randomly selected sites (Lounsberry et al. 2015; Brazeal et al. 2016; Furnas 2015). Each site will be revisited after 7 days for a total of four visits to collect newly deposited fecal pellets from the transects. If no pellets are collected from a transect after two visits, the transect will be discontinued. Pellets will be analyzed by a genetics laboratory at UC Davis to identify individuals and gender to create a four period detection history for each individual (Furnas, 2015).

Cameras will be set up at the start and end points for each transect. The purpose is to augment population modeling using occupancy modeling.

Vegetation data will be collected for each transect per Furnas (2015). Data includes estimation for percent tree, shrub and ground cover and photo points to capture vegetation structure.

For phase 2, we will collar deer in the Sierra Nevada DCU to establish the home range information needed for several herds within the DCU. This will be followed by establishing pellet transects throughout the DCU as we did for the NES DCU described above.

The process will be repeated for phase 3 for the Clear Lake and Alder Springs herds within the North Coast and Central Valley DCU.

Hunt zones and Herds (Figure 4):

X6a and X6b (Doyle/Sloat); X7a and X7b (Loyalton Truckee); X8 (Carson River), C4: (Bucks Mountain (partial)); B3 (East Park/Capay (partial)); D3: (Nevada City, Downieville, Buck's Mtn (partial) and Mooretown); D4 (Blue Canyon), D5 (Railroad Flat, Salt Springs, Grizzly Flat); Zone A (Clear Lake, East Park/Capay (partial)).

Most summer ranges of migratory deer encompass public lands (Table 2). Sampling on winter ranges or for resident deer herds, may be more problematic due to the presence of private land. Effort will be made to sample these lands when possible.

Table 2. Total area for public and private ownership within summer range for deer herds in the NCR study area.

Public/Private Summer Habitat	Area (ha)
Total Public Summer	1,183,367
Total Summer Private	436,404
Total Summer	1,619,771

Public/Private Winter Habitat	Area (ha)
Total Public Winter	348,305
Total Winter Private	402,668
Total Winter	750,973

Products and completion dates (See Table 3):

1. Seasonal range maps for collared deer will be available once all collars are retrieved for deer within each study block.
2. Home range sizes will be estimated within 6 months of collar retrieval.
3. Population estimates will be completed each year with assistance from the deer program statisticians. We will evaluate the precision after the first year for each sampling effort to determine if changes need to be implemented such as increasing the number transects for the second year of sampling.

Quarterly progress reports will be submitted to the Wildlife Branch. This report will follow the LMAC reporting process.

Data will be delivered to the Wildlife and Habitat Data Analysis Branch by and contain the following:

Final report containing:

- Data including maps with sample locations, numbers of individuals based upon genotypes, habitats, etc)
- Results (population estimates and confidence intervals)

Collaborators

CDFW Project Leads: NCR Environmental Scientists (Wildlife)

NCR staff environmental scientists:

Sara Holm, Shelly Blair, Eric Kleinfelter, Joshua Bush, Henry Lomeli and Terri Weist

WMB Deer Program: Stuart Itoga, Brett Furnas

Personnel Requirements and Funding from CDFW

Regional personnel may be used to assist in data collection. Most data will be collected by CDFW scientific aids.

CDFW funding sources:

Funding for satellite collars, two scientific aids and lab work will be provided by Big Game funds.

NCR staff biologists will be project leads for their respective areas. Two scientific aids will be provided by NCR Pittman-Robertson grant monies.

Issues to be resolved

Funding from Big Game Management Account is essential to carry out this project.

A grant proposal have been submitted to the California Deer Association to help fund half of the satellite collars required for this project.

A proposal to Mule Deer Foundation to fund drop nets and box traps has been submitted to CDFW's MDF liaison.

Personnel Requirements and commitments from CDFW

Seven NCR staff biologists will be involved with this study. We are in the process of hiring two scientific aids to collect and process fecal pellets. Additional scientific aids funded by the Big Game Account will be required due to the large sampling area involved.

All deer captures will be led by the NCR staff biologists.

Budget Detail.

The proposed budget is found in Table 4. A total of 60 collars is included in this table. If CDA agrees to provide half of these collars, the amount funded by the Big Game Account would be reduced to \$67,725.

Table 3. NCR DEER POPULATION ESTIMATION USING FECAL DNA
PROPOSED SCHEDULE*

DATE	ACTIVITY	DCU	Deer Herds
7/1/2016 to 9/1/2016	Start transect establishment and pellet collection	North Eastern	LT/Doyle/Sloat/CRDH
7/1/2016 to 9/1/2016	Collar deer	North Eastern	Doyle/Sloat
6/1/2017 to 9/1/2017 6/1/2018 to 9/1/2018	Collar Deer	Sierra Nevada	Railroad Flat/Grizzly Flat/Salt Springs/Downieville/Blue Canyon/Nevada City
7/1/2017 to 9/1/2017	Re-run transects in NES	North Eastern	LT/Doyle/Sloat/CRDH
3/15/2018	Population estimates generated	North Eastern	LT/Doyle/Sloat/CRDH
7/1/2018 to 9/1/2018	Transect establishment	Sierra Nevada	Railroad Flat/Grizzly Flat/Salt Springs/Downieville/Blue Canyon/Nevada City/Buck's Mtn/Mooretown**
7/1/2019 to 9/1/2019	Re-run transects in SN DCU	Sierra Nevada	Railroad Flat/Grizzly Flat/Salt Springs/Downieville/Blue Canyon/Nevada City/Buck's Mtn/Mooretown
3/15/2020	Populations estimates generated	Sierra Nevada	Railroad Flat/Grizzly Flat/Salt Springs/Downieville/Blue Canyon/Nevada City/Buck's Mtn/Mooretown
9/25/2018 to 12/5/2019	Collar deer for Clear Lake subherd/East Park-Capay [Monticello herd#)	North Coast/Central Valley	Clear Lake subherd; EP-Capay [Monticello herd#)
2/1/2020 to 5/1/2020	Establish transects for Clear Lake subherd; EP-Capay [Monticello herd#)	North Coast/Central Valley	Clear Lake subherd; EP-Capay [Monticello herd#)
2/1/2021-5/1/2021	Re-run Transects for Clear Lake herds	North Coast/Central Valley	Clear Lake subherd; EP-Capay [Monticello herd#)
12/15/2021	Population estimates generated	North Coast/Central Valley	Clear Lake subherd; EP-Capay [Monticello herd#)
6/30/2022	Regional Report Summary		All herds

* Schedule is contingent upon receiving collars in time, refurbishment and other factors.

** Bucks Mountain herd has recent telemetry data so no need to collar deer for this area.

Region 3 may join our efforts and will collar deer within the Monticello deer herd that shares our border

Literature Cited

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- Wittmer, H.U., Forrester, T.D., Allen, M.L., Marescot, L. & Casady, D.S. (2014). Black-tailed deer population assessment in the Mendocino National Forest, California. Report to the California Department of Fish and Wildlife.



Figure 1. Study area is comprised of 16 deer herds and zones within the North Central Region. Population estimates will be obtained for up to nine herds over a five year period.



Figure 2. Statewide draft Deer Conservation Unit boundaries. The DCU's affected by the proposed NCR fecal DNA project include the North Eastern Sierra, Sierra Nevada and the North Coast DCU's.

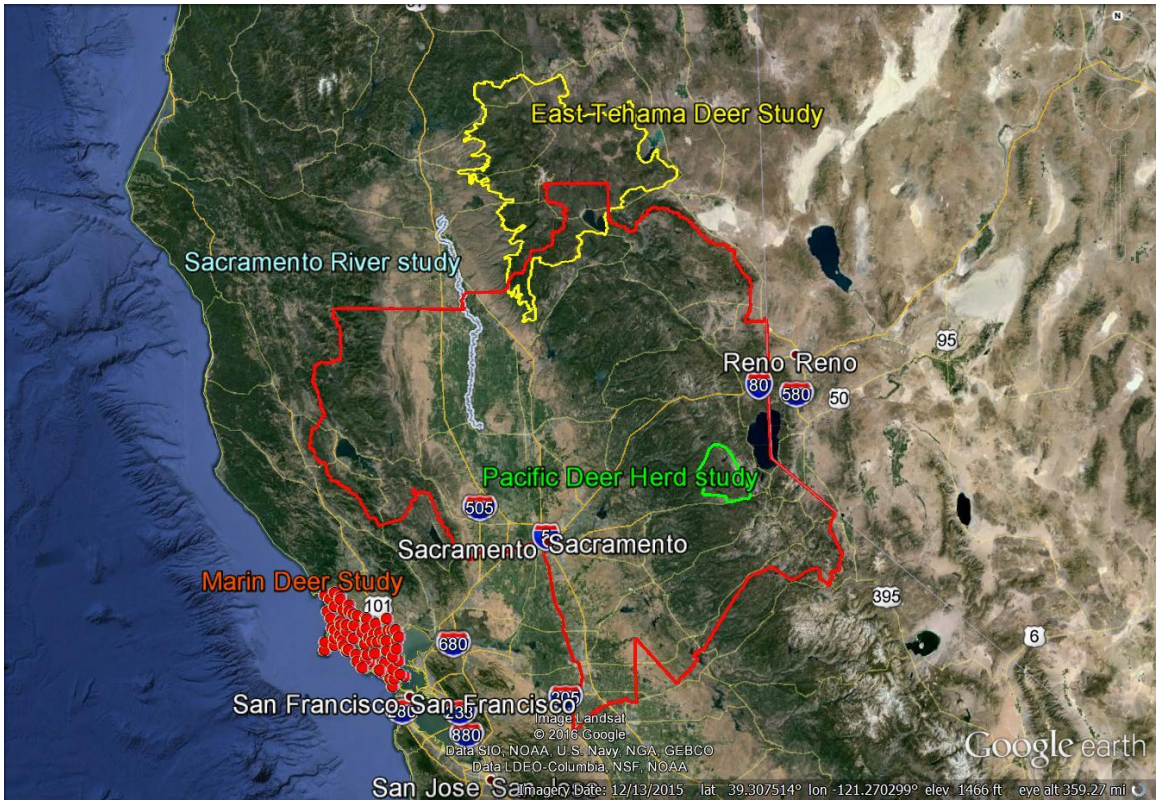


Figure 3. Recent and current fecal DNA studies occurring near or within the NCR. The report for the Pacific Deer Herd Study was completed in 2016.

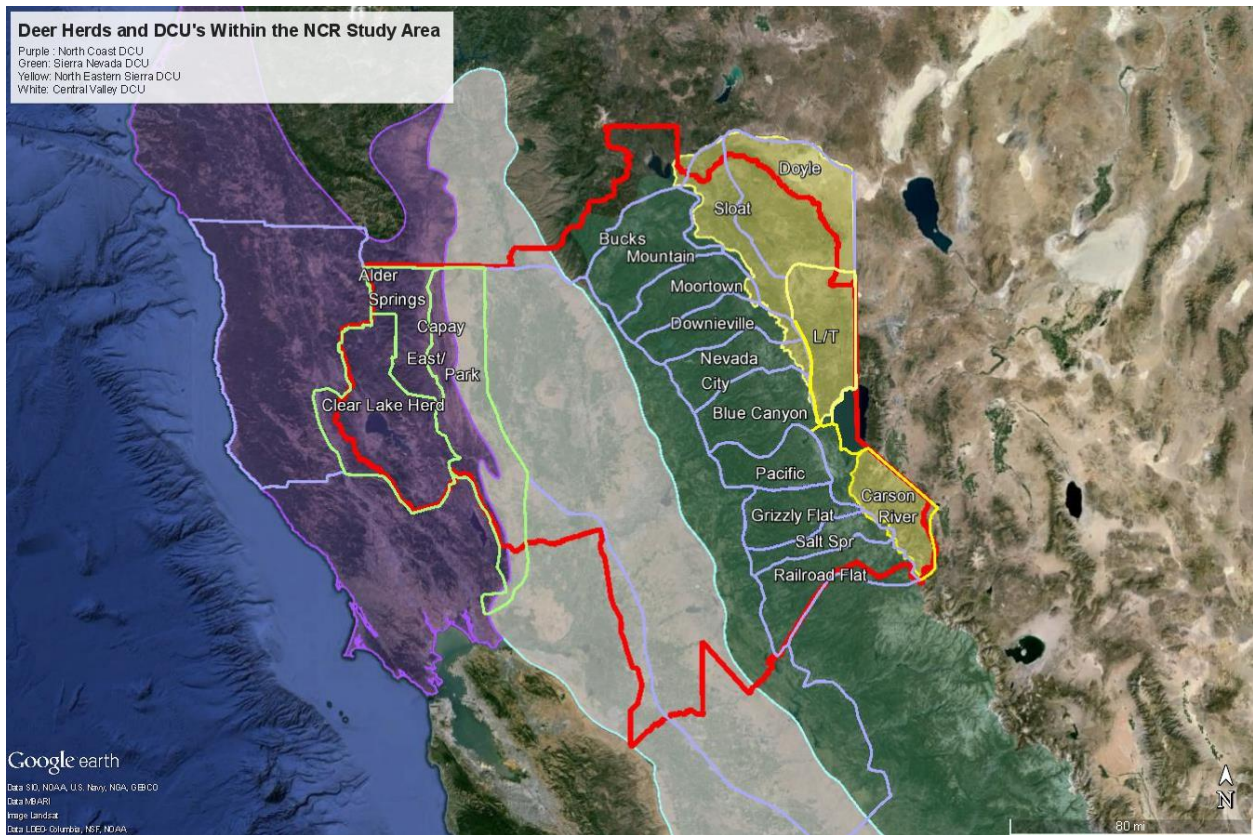


Figure 4. Deer herds represented in four DCU's within the proposed NCR deer population study area. Purple shaded area is the North Coast DCU; white shaded area is Central Valley DCU; Green shaded area is Sierra Nevada DCU and the yellow shaded area is the North Eastern DCU.

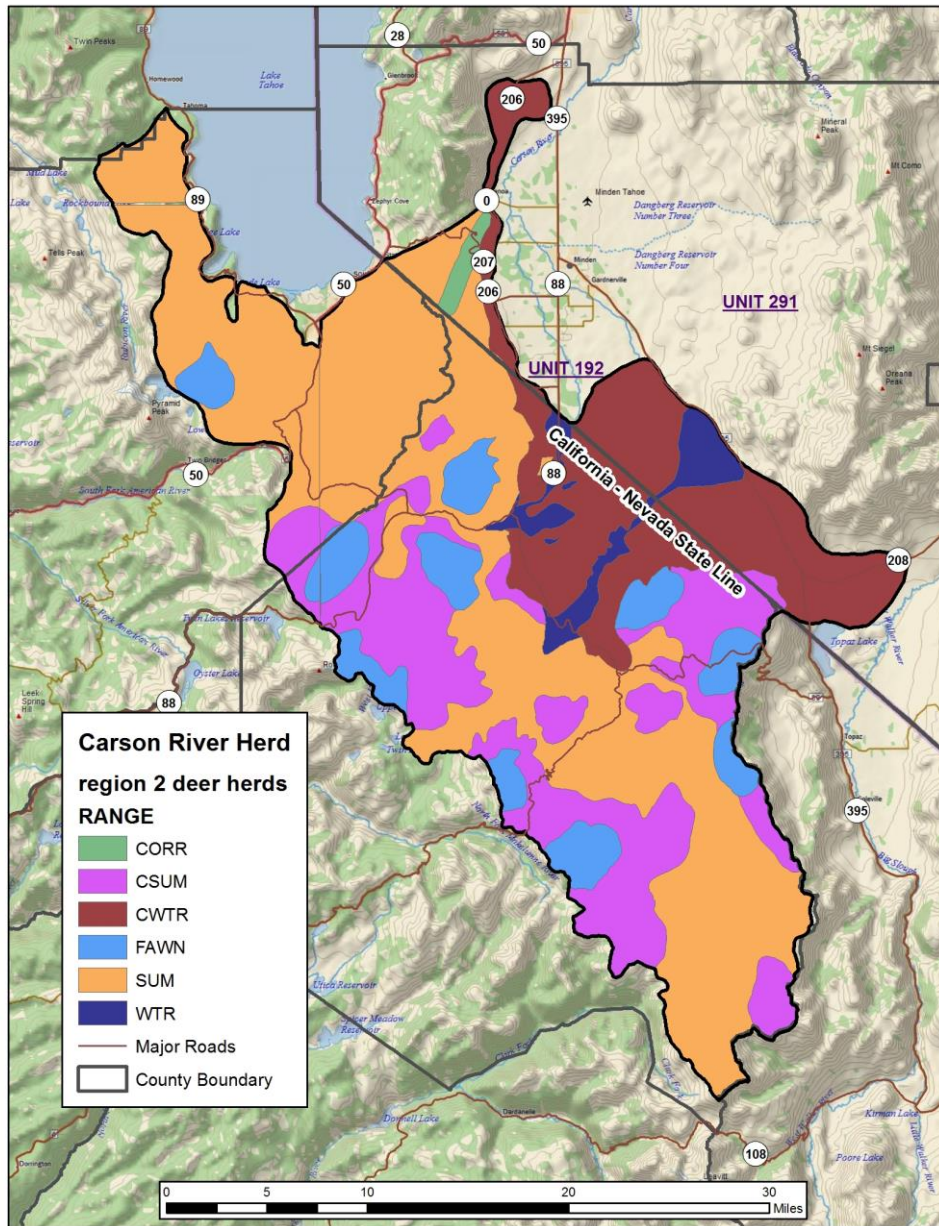


Figure 5. Seasonal range delineation for the Carson River herd (CRDH) that will be sampled during phase 1 of the NCR DNA study.

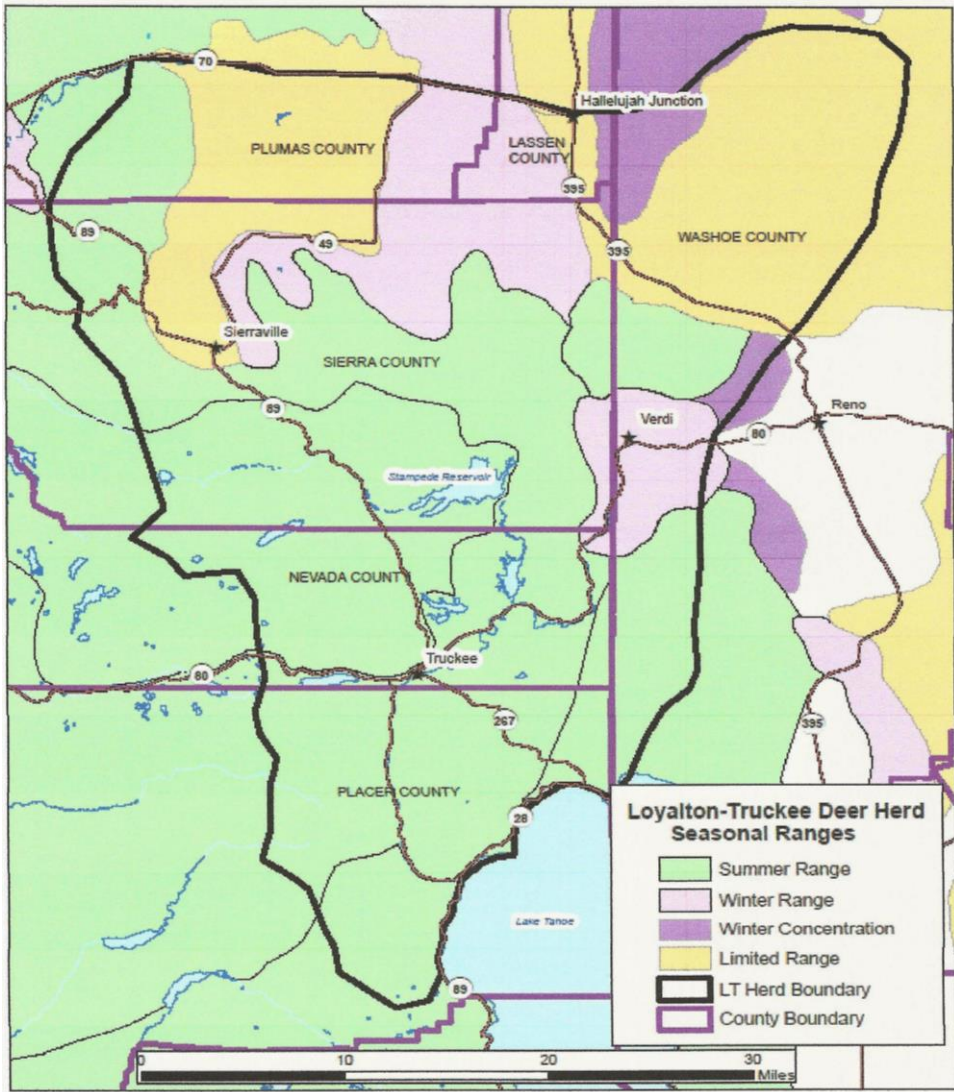
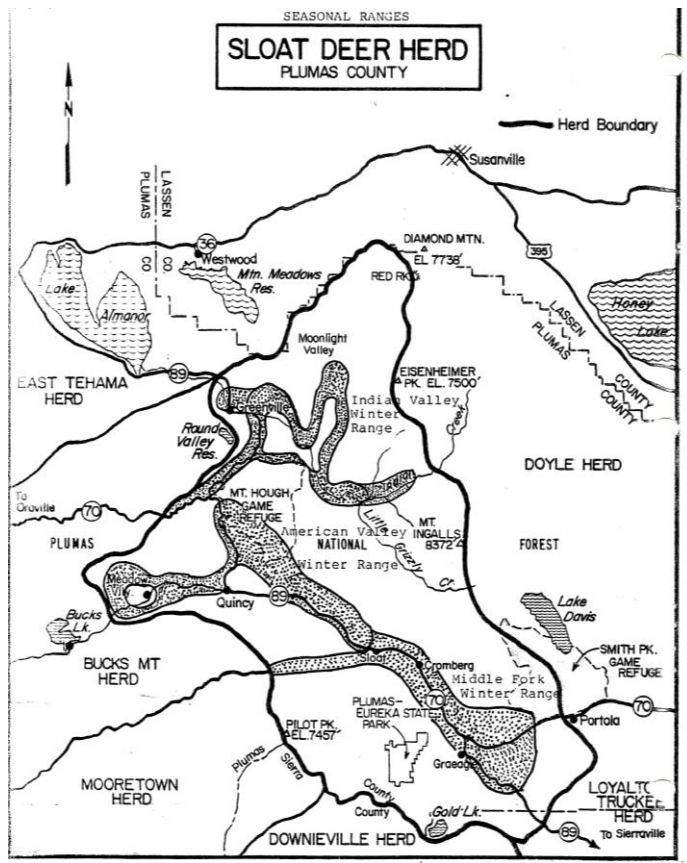
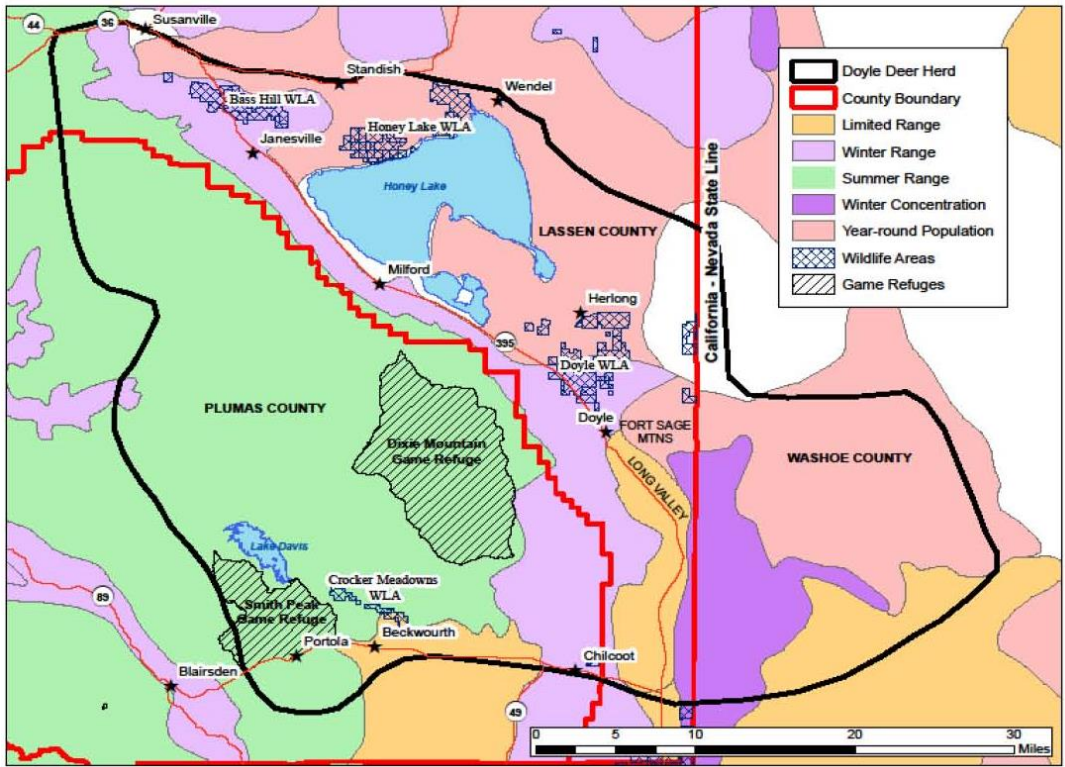


Figure 6. Seasonal ranges for the Loyalton-Truckee Deer Herd. Fecal DNA will be collected during phase 1 of the study.



Figures 7 & 8. Seasonal ranges for the Doyle and Sloat deer herds. Deer will be fitted with radio transmitters during the summer of 2016 or 2017 (depending upon when collars are received).

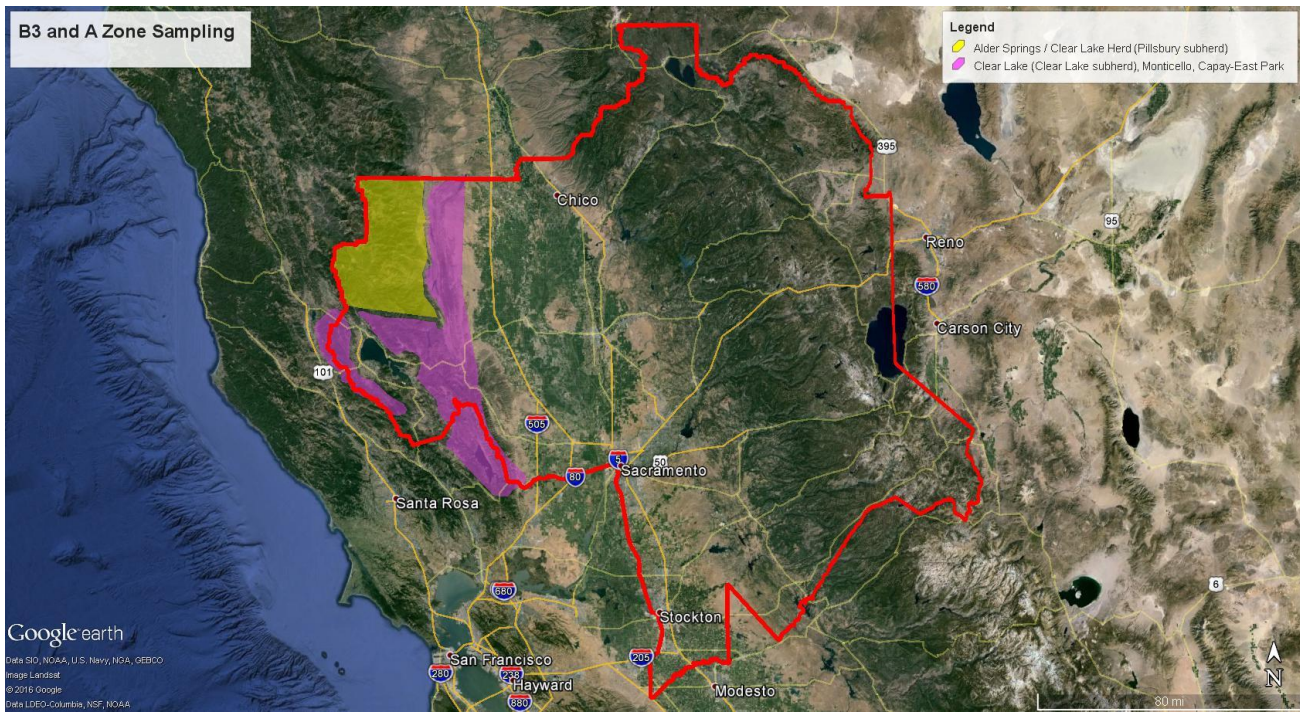


Figure 9. B3 and A Zone (North Unit) Colusa study area. The East Park-Capay, Monticello, Clear Lake (Clear Lake subherd) herds (pink polygon) are largely resident. Sampling will occur within the NCR's portion of the herd boundaries. If Region 3 participates, the entire herd boundary for the Colusa/Yolo herd will also be sampled. Population estimates from fecal DNA were already devised for the Alder Springs/Clear Lake Pillsbury subherd (yellow polygon) (Lounsberry et al., 2015).

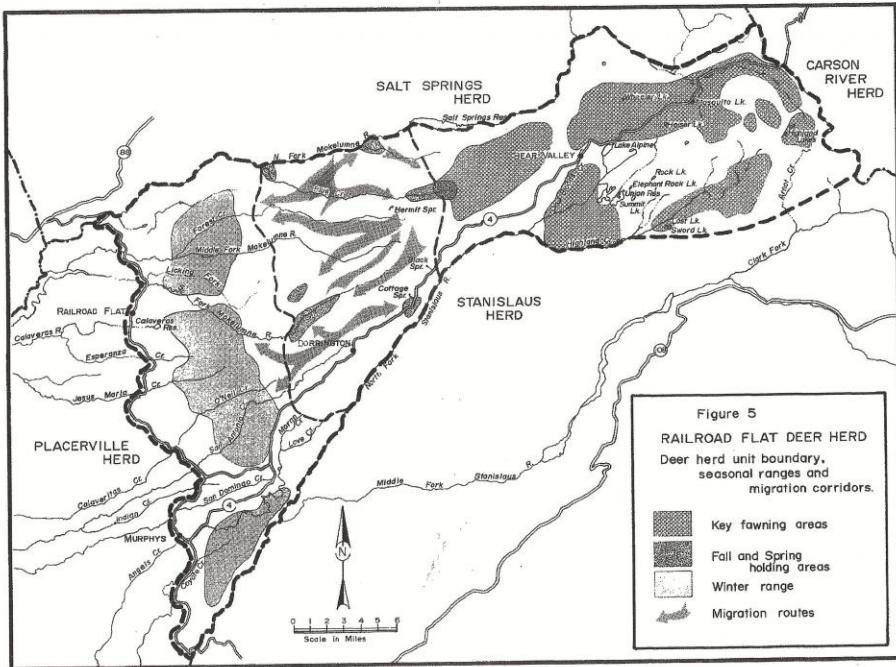


Figure 10. Railroad Flat Deer herd seasonal ranges.

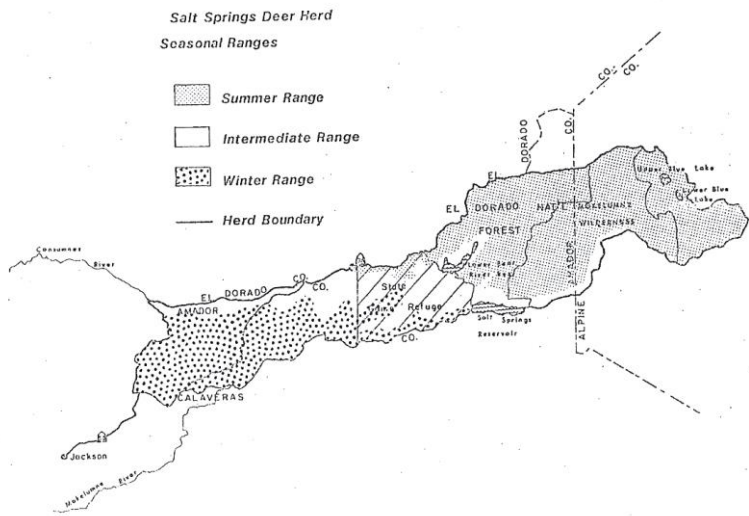


Figure 11. Salt Springs Deer herd seasonal ranges.

FIGURE 2. GRIZZLY FLAT DEER HERD BOUNDARY AND MIGRATION ROUTES

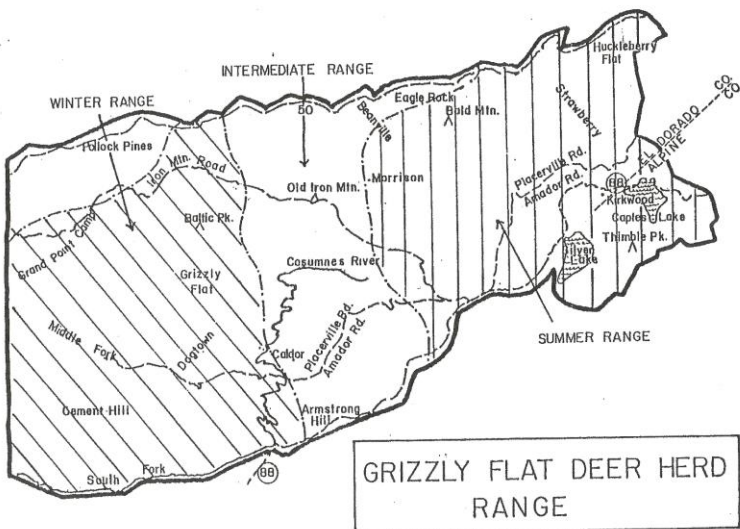


Figure 12 . Grizzly Flat deer herd seasonal ranges.

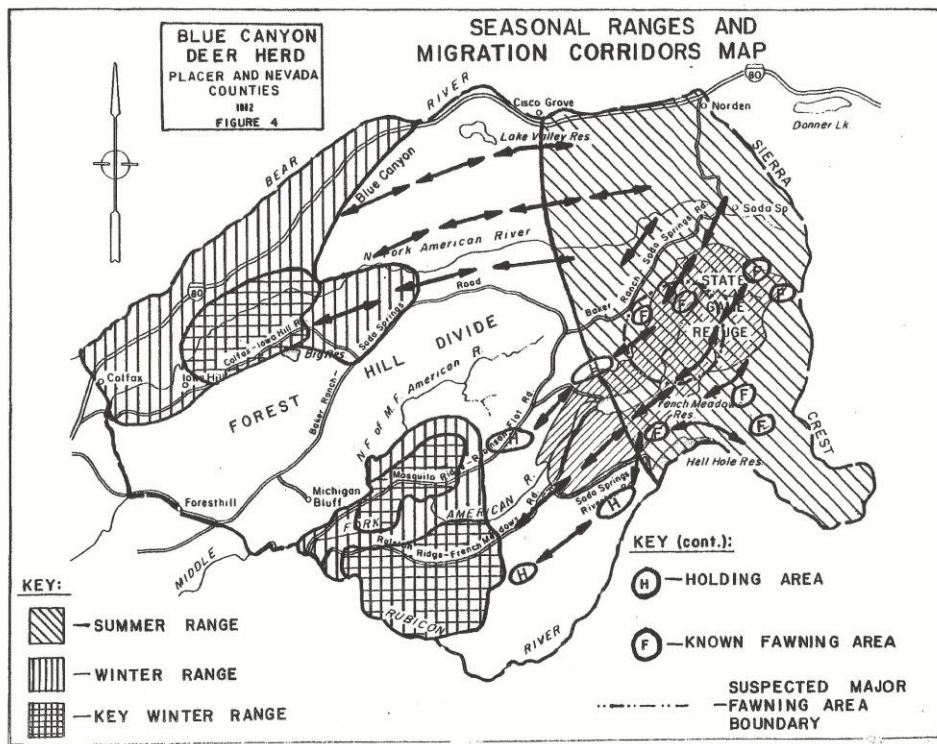


Figure 13. Seasonal ranges for the Blue Canyon Deer Herd.

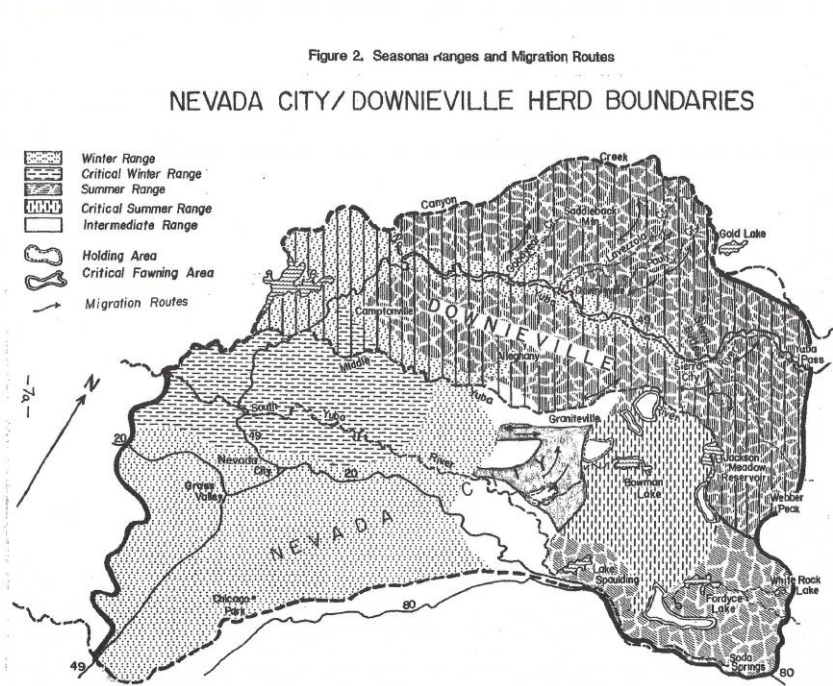


Figure 14. Seasonal ranges for the Nevada City and Downieville deer herds.

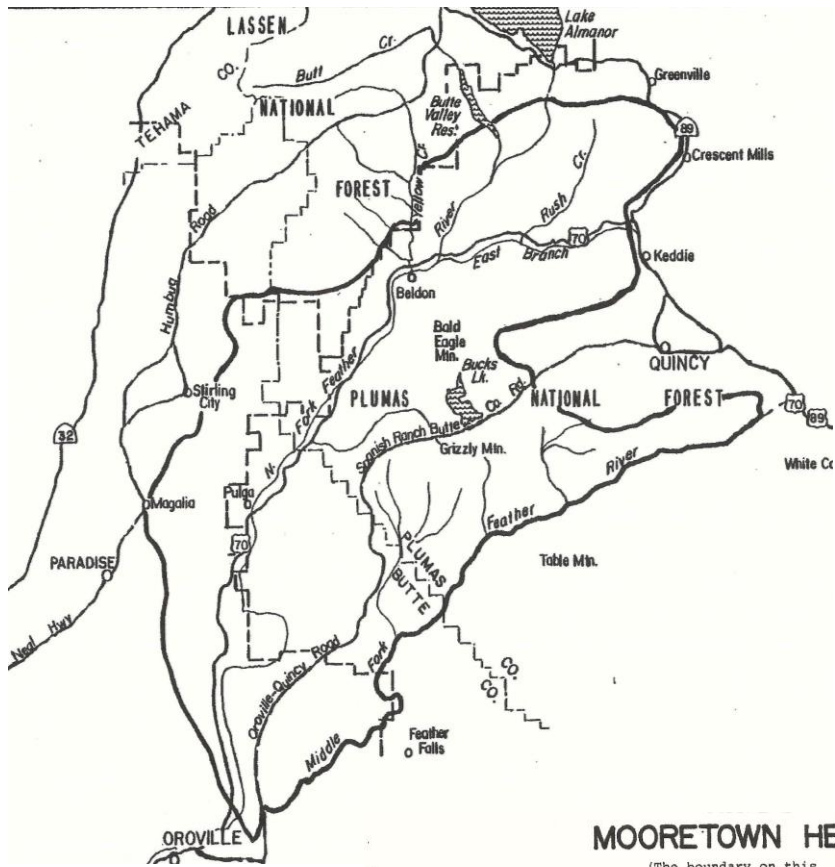


Figure 15. Bucks Mountain herd (left) and Moortown Herd below. There is recent telemetry data available for these herds.

MOORETOWN HERD

(The boundary on this map is generalized)



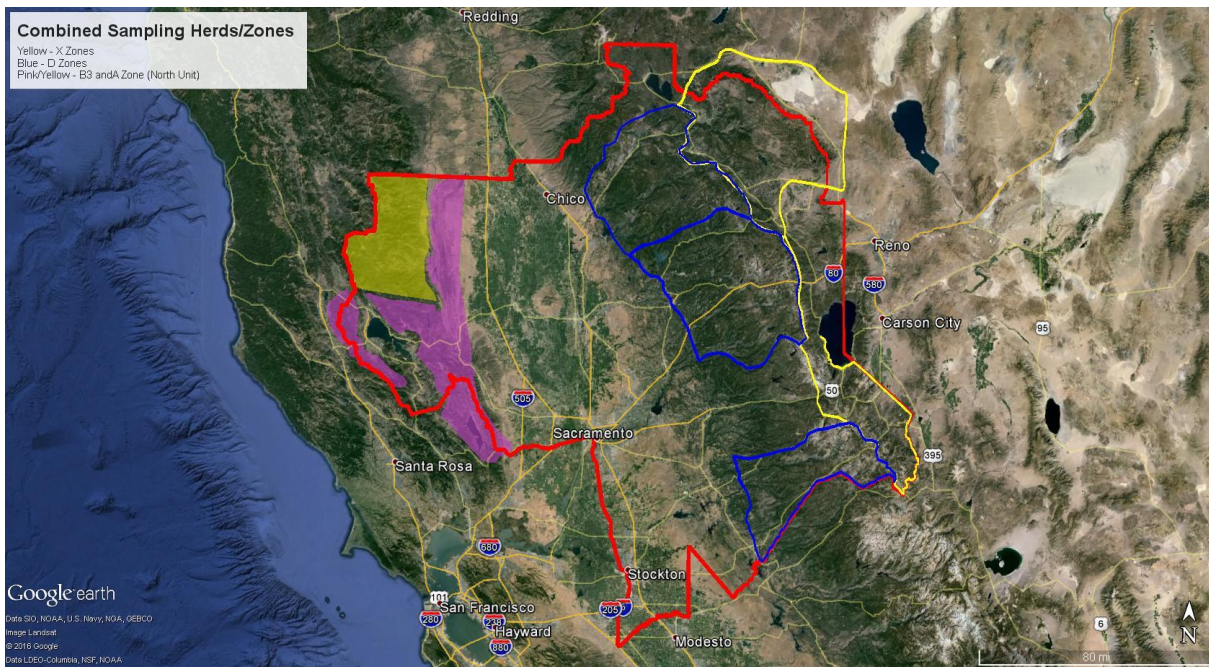
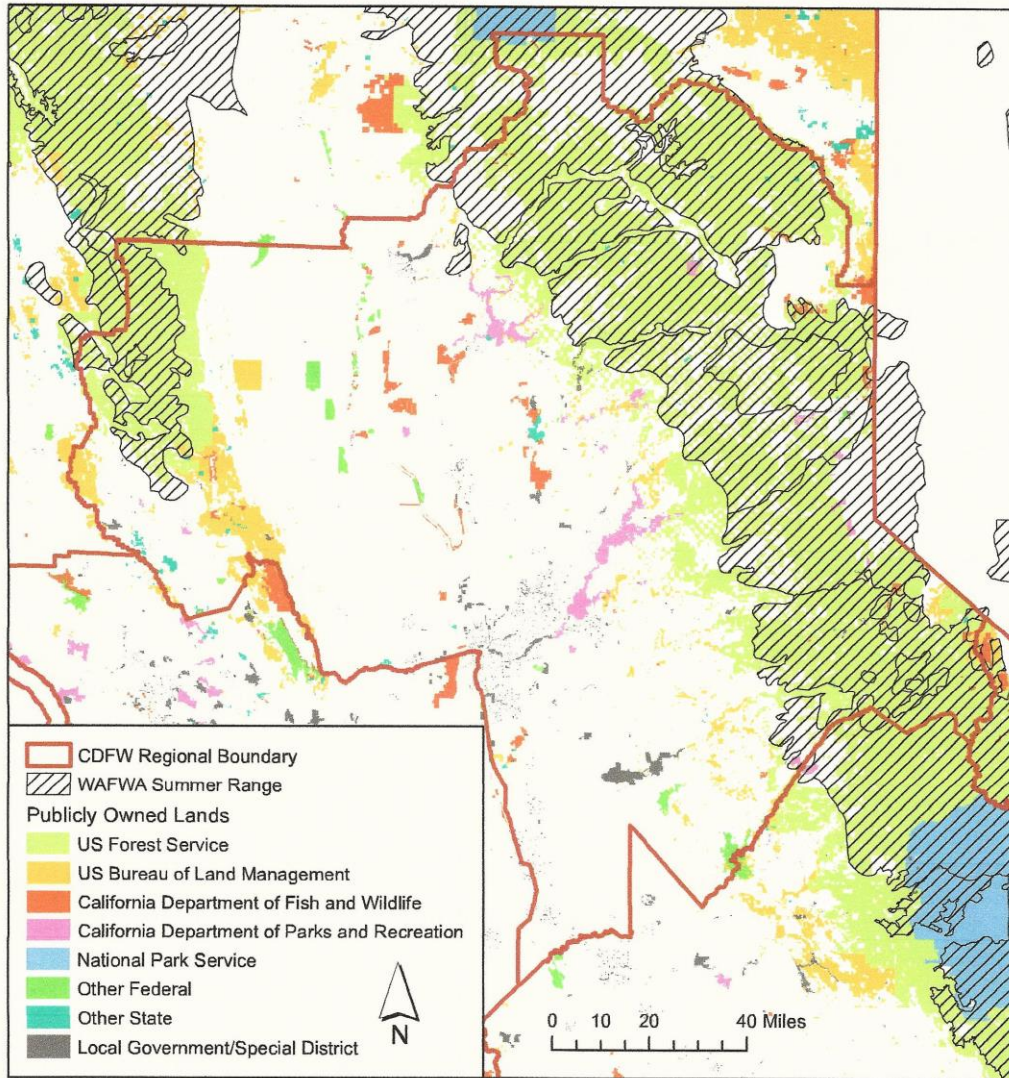


Figure 16. Image shows the deer herd blocks or phases that will be involved in the NCR Fecal DNA population study. Individual herds have been combined mostly within hunt zones in the North Central Region. The only DCU not involved is the majority of the Central Valley (Motherlode herds).



California Department of Fish and Wildlife. Habitat Conservation Planning Branch. D.Mastalir. 20160504.
 Data Sources: California Department of Fish and Wildlife. Western Association of Fish and Wildlife Agencies
 California Protected Areas Database (CPAD)

Figure 17. NCR land ownerships and WAFWA summer ranges. Resident deer herds will be sampled once telemetry data define population boundaries.

Figure 18. Hexagon grid placed over summer range habitats in the Northeastern DCU.

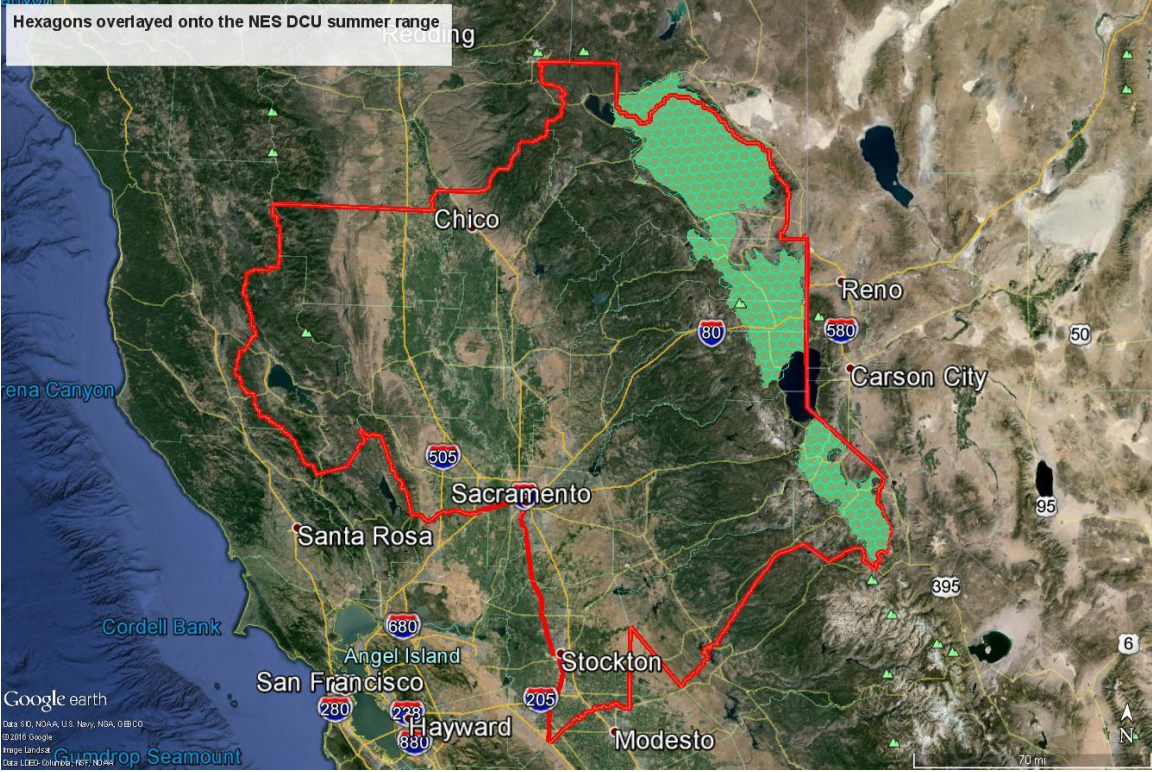


Figure 19. Blue dots depict randomly selected hexagons. Thirty of these will be used to establish transects to sample fecal DNA within the summer range habitats of the NES DCU.

NCR DEER POPULATION ESTIMATION USING FECAL DNA AT A REGIONAL SCALE							
TABLE 4. BUDGET DETAIL FOR FIVE YEAR PERIOD (2 scientific aids)							
Personnel Costs	FY16/17	FY 17/18	FY 18/19	FY 19/20	FY 20/21	FY 21/22	TOTAL
2 scientific aids for 9 months. (1500 hrs X 2=3168 hrs X \$15/hr=45,000 + benefits = about \$50,000/year (assuming they work for all 9 months)	\$ 50,000.00	\$50,000.00	\$50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 300,000.00
Operating Expenses							
GPS units (2)	\$ 950.00						\$ 950.00
60 Iridium satellite collars @ \$2,500 each [40 non-exp & 20 expandable]. Includes data plan. A proposal to CDA to purchase half of these collars has been submitted.	\$ 135,450						\$135,450.00*
Collar refurbishment		\$3,000	\$3,000	\$3,000	\$3,000	\$ 3,000.00	\$ 15,000
Miscellaneous field Supplies (flagging, batteries etc)	NCR O&E						
Capture equipment	NCR O&E						
Travel/per diem							
travel @\$46/day (meals/incidentals)	\$ 13,248.00	\$13,248.00	\$13,248.00	\$ 13,248.00	\$ 13,248.00	\$ 13,248.00	\$ 79,488.00
Mileage	\$ 4,000.00	\$ 4,000.00	\$ 4,000.00	\$ 4,000.00	\$ 4,000.00	4,000.00	\$ 24,000.00
TOTAL	\$203,648.00	\$70,248.00	\$70,248.00	\$70,248.00	\$70,248.00	\$70,248.00	\$ 554,888.00

*If CDA funds the purchase of 30 collars, the Big Game Account would fund \$67,725 and grand total would be \$477.163