Attached is a report on Residual Dry Matter (RDM) monitoring at Point Reyes National Seashore. The purpose of the report is to evaluate data collected from 1987-2014 to determine if the methods and standard used remain appropriate for monitoring grazing activities managed by the Seashore. The analysis, conducted by the UC Berkeley Range Ecology Lab, finds that 1,200 lbs/acre RDM is the appropriate standard.

RDM is the plant material remaining in a field at the end of the season. Samples are collected and weighed in the fall and the RDM values are calculated. Managing for a specific RDM level is a common practice used to protect soils from erosion and nutrient loss and to maximize forage production in the following year. Several conditions, including RDM, influence which plants will grow and how much forage is produced at a particular site. The strongest influences on RDM are the amount and timing of rain and the local site conditions (such as soil type).

The past several years have been particularly challenging, with an historic drought in California. Annual mean precipitation has been below average, with 2014 being among the lowest on record. With adverse conditions such as the multi-year drought, RDM values below the standard can be expected. This report will help establish a baseline from which to work together with ranchers to achieve our shared stewardship goals.

1987-2014 Residual Dry Matter Analysis Report and Updated Rangeland Monitoring Guidelines for Livestock Grazed Grasslands within Point Reyes National Seashore and Golden Gate National Recreation Area

Point Reyes National Seashore (PORE) Project
Phase 1: CESU Task Agreement # P11AC91045

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Appendix B

Part I. 1987-2014 Residual Dry Matter Analysis Report

1. Introduction

The Rangeland Monitoring Guidelines for Point Reyes National Seashore (PORE) were last updated and revised in 1990. Following these and earlier guidelines, PORE staff have been measuring residual dry matter (RDM) and conducting condition/trend monitoring at the Seashore consistently since the early 1980s. Over the last several decades, technology and methods for RDM monitoring have improved substantially. The Range Ecology Lab (REL) and PORE's work under this Task Agreement will improve the efficiency and effectiveness of the Seashore's RDM monitoring. Improved monitoring will allow National Park Service (NPS) staff to communicate more clearly with ranchers and make better informed management decisions. This report will complete Phase 1 of the Californian Cooperative Ecosystem Studies Unit Cooperative and Joint Venture Agreement, #P11AC91045: Developing updated RDM monitoring methods for Point Reyes National Seashore (PORE) Project. This project includes 1) an analysis of historic PORE RDM monitoring data and 2) an update of PORE RDM monitoring guidelines and methods.

1.1 Background

The Range Ecology Lab (REL) conducted an analysis and interpretation of 27 years of PORE residual dry matter (RDM) monitoring data, 1987-2014. The techniques used by PORE for RDM monitoring are double-sampling, visual estimation, and RDM zone mapping. Point Reyes National Seashore (PORE) and Golden Gate National Recreation Area (GOGA) have ranch and dairy operations that occur over approximately 28,000 acres in both in the pastoral zone of PORE and in the north district of GOGA. Currently, there are 6 dairies, 18 beef ranches and one heifer grazing operation in the parks.

Point Reyes National Seashore is unique in the National Park Service because dairying and ranching operations were an integral part of the formation of the park. During the 1950s and 1960s, development pressure from real estate developers and speculators was strong, and at the same time dairies were struggling. To secure their place at Point Reyes, the dairy and cattle ranchers formed an alliance with the Sierra Club in hopes of preserving their ranches and west Marin open space. The National Park Service had actively sought to establish a literal beachhead on the California coast and at Point Reyes in particular as early as 1936. Federal legislators were approached to help solve the pressing needs of many local and national constituencies. The compromise hammered out by Congress and signed by President Kennedy in 1962 provided for

the retention of the ranches in a designated pastoral zone, with ranchers signing reservations of use and occupancy, and special use permits for cattle grazing.

Secretary of the Interior, Ken Salazar, recently directed PORE to develop 20-year lease permits for ranchers in the park, an increase from the existing 5- and 10-year lease permits. The Secretary's memorandum demonstrates the support of the NPS and the Department of the Interior for the continued presence of dairy and beef operations within these NPS lands. Rangeland monitoring is essential to ensure that National Park Service standards and standards of rangeland health are being met by ranchers in the park. RDM is a key component to monitor and is described clearly by Bartolome et al. (2006):

> Residual dry matter (RDM) is a standard used by land management agencies in California for assessing the level of grazing use on annual rangelands and associated savannas and woodlands. Residual dry matter is the old plant material left standing or on the ground at the beginning of a new growing season. It indicates the combined effects of the previous season's forage production and its consumption by grazing animals of all types. Properly managed RDM can be expected to provide a high degree of protection from soil erosion and nutrient losses. Applications of specific RDM standards based on a limited research base and experience have demonstrated the effectiveness of this approach to grazing management.

1.2 History of PORE livestock grazing monitoring

Rangeland Monitoring Guidelines were originally developed for the park in 1983 (Sugnet and Bartolome) and were revised in 1990 by Shook. Two types of monitoring for livestock grazed grasslands have been conducted at PORE since the early 1980s: residual dry matter in the fall and grassland species composition in the spring.

RDM monitoring began on livestock-grazed grassland in Point Reyes National Seashore and Golden Gate National Recreation Area as a way to assess grazing operations management and its effect on the ecology of the grasslands within the parks. Public meetings and several pilot years of RDM data collection led to the creation of the currently used monitoring protocol included in the Range Management Guidelines and Range Monitoring Handbook (Shook 1990). Two types of livestock grazing monitoring are conducted every year according to the 1990 guidelines: spring condition and trend and fall RDM. The spring condition and trend monitoring analysis of the grassland species composition dataset is not included in Phase 1 of task agreement #P11AC91045. The long-term species composition dataset will be analyzed in Phase

2 of the task agreement and is described in the Grasslands chapter of the 2015 Natural Resource Condition Assessment for PORE.

The PORE fall RDM monitoring dataset summarized in this report includes RDM double-sampling, zone mapping, and visual estimation measurements that were collected from 1987-2014.

1.3 PORE 1990-2014 Residual Dry Matter monitoring method descriptions

The RDM measurement protocols are based on a key area within each ranch unit or pasture unit selected by PORE staff. The following are explanations of range terminology and RDM monitoring methods derived from notes on PORE datasheets, conversations with PORE staff Devii Rao and Dylan Voeller, and two internal documents, the PORE Range Management Guidelines and Range Monitoring Handbook (Shook 1990).

a) Key Area

Key areas are a widely used rangeland monitoring concept to focus fall surveys for livestock grazing use of the ranch unit. The majority of key areas across PORE and GOGA were chosen during the pilot years 1987-1990 using the following basic criteria (Rangeland Monitoring Guidelines 1990):

- 2 acres in size and a single “range site” or soil and vegetation type;
- responsive to livestock grazing management practices;
- reflective of the current grazing regime;
- representative of the average grazing use of the pasture.

b) Double-sampling RDM measurement

The PORE double-sampling method measures the RDM of the key area with a combination of clipped quadrats and visually estimated quadrats of residual dry matter along a 100m transect within the designated key area. This method gives an upper and lower 95% confidence interval for the RDM value in a given year. The double-sampling allows a more precise RDM measurement, which includes a confidence interval or calculation of error. The double-sampling RDM monitoring method improves the statistical reliability of the measurement at least cost. This method is, however, more time intensive than other current methods (Shook 1990, BLM 1996).

c) RDM zone mapping

The PORE RDM zone mapping method has one surveyor use a topographic map of the park with pasture fences and key area/transect locations. Each ranch pasture is hand-colored on the map with the levels of RDM estimated. In most years where mapping occurred, the RDM mapping unit was at a smaller scale than the pasture. In other words, some pastures have multiple zones of RDM levels with a minimum mapping unit of 2-5 acres. The RDM zones on the map are coded: red 0-600 lbs/acre, orange 600-1,200 lbs/acre, yellow 1,200-1,800 lbs/acre, no color >1,800 lbs/acre. Non-grassland vegetation such as shrubs or wetland rushes is excluded from the mapping. Spot clipping for eye-calibration is also suggested for this method. RDM zone mapping is prioritized for ranch units that had problems with meeting the minimum target RDM or pending a lease renewal (Shook 1990).

d) Visual RDM estimation

The PORE visual RDM estimation values were occasionally substituted for double-sampling for key area transects throughout the early years of fall monitoring. They are based on expert opinion by PORE staff conducting the double-sampling or RDM zone mapping. Although not written into the 1990 Guidelines or Handbook, notes on the double-sampling datasheets include some key area ocular or visual assessments reported in lbs/acre.

1.4 1987-2014 RDM dataset description

The following is a summary of the long-term PORE RDM monitoring dataset over 1987-2014. PORE staff followed Rangeland Monitoring Handbook (1990) protocols to monitor, every September-October, between 40-50 key areas within the livestock grazed area of the Seashore. The first few years of RDM monitoring, 1986-1990, before the handbook was finalized, are pilot years during which PORE staff chose the key areas and tested the adequate number of quadrat clippings and estimates.

From 1987-1996, key area monitoring for each ranch or dairy was consistently conducted to determine grazing use with a combination of the double-sampling method and the pasture-based RDM zone mapping. From 1989-1990, the majority of grazed areas have RDM maps. During 1998-1999, PORE staff only created RDM zone maps for priority ranch units within the park; priority ranch units or pastures were those that were either not meeting the minimum target RDM (>1,200 lbs/acre) or were up for lease renewal (Shook 1990).

Between 1996 and 2011, there was occasional RDM sampling of priority key areas with the combination of the visual estimation alone or the double-sampling method. The last few years, 2012-2014, PORE staff measured RDM every year with the double-sampling method for all 52 existing key area transects.

Within the 52 transects measured in 2012-2014, there are key area transects in livestock-grazed pastures and in other grasslands that are not grazed by livestock. The transects that are not livestock-grazed are located in grassland areas where livestock grazing ended at some point during 1987-2014, livestock grazing was removed with the creation of the park or before 1987, or grazing over the RDM sampling period is only by PORE tule elk. These transects without livestock grazing are included in the analysis to allow for a comparison with the livestock-grazed transects and will be referred to as ungrazed transects.

For this report, ranch unit names for the key area transects are the current ranch names, and do not necessarily reflect the ranch unit names in the early years of the dataset.

2. RDM calculation methods

2.1 Dry weight correction ratio

The purpose of a dry weight correction ratio calculation is to standardize the key area RDM estimate against the variable moisture content of a clipped sample. From year to year or pasture to pasture, the amount of fog or precipitation can affect the weight of the RDM clipped estimate and skew the final value. A yearly dry weight correction factor for each estimate of residual dry matter is calculated using the ratio of dry weight to wet weight. The wet weight is the clipped biomass (approximately 10 quadrat clippings) that is weighed on site during sampling. This clipped biomass is allowed to air dry for several days and then combined to create the air-dry weight. The combined dry weight is divided by the combined wet weight to calculate the dry weight correction ratio.

If there was a missing dry weight correction ratio within the dataset (primarily in 2001-2002), or the combined dry weight for a key area transect in a given year was heavier than the combined wet weight, the closest adjacent key area transect dry weight correction ratio was used.

2.2 Double-sampling RDM calculation

Double-sampling RDM measurements for 1987-2014 were calculated for the years and transects available. The RDM quadrat visually estimated weights, clipped weights, and their combined dry weights were used to calculate the RDM values with a 95% level of confidence or interval. The upper and lower limits to the 95% confidence interval (CI) show the amount of variation in the sample of clipped and estimated weights. Double-sampling RDM calculations were made using R software (version 3.2.0).

3. Results

Results are presented below for the years of RDM monitoring that had either double-sampling, visual estimation, or RDM mapping. For more detail see Appendix A tables. Appendix A tables contain the full set of RDM values for all years and transects and a summary table that organizes which years and transects had double sampling and visual estimation surveys. Summary figures that graph RDM values for all transects from 1987-2014 are in Appendix A.

3.1 RDM Results 1987-1996

Summary key area transect double-sampling and visual estimates.

During this period, from 1987-1996, double-sampling or visual estimate RDM measurements were conducted for most existing key area transects. The years 1987-1990 were pilot years during which transects were added over time. Table 3.1 includes the average RDM for each year during this period and the number of key area transects.

Table 3.1. 1987-1996 park-wide average of RDM estimates and number of transects surveyed; averaged values include double-sampling and visual estimates.

Year	*Average RDM in lbs/acre*	*# of Transects surveyed*
1987	1238	38
1988	1160	40
1989	1786	46
1990	1904	51
1991	2641	53

Year	*Average RDM in lbs/acre*	*# of Transects surveyed*
1992	2695	50
1993	3595	49
1994	3380	51
1995	4089	52
1996	3135	29

3.1.1 Summary of RDM zone mapping

RDM zone mapping was conducted from 1986-1996 for ranch units that were considered priority areas to measure. The year 1989 RDM zone mapping has the most complete RDM zone mapping of the ranching areas with approximately 45 ranch pastures mapped. There are different ranch boundaries and names in the early years of the mapping effort.

3.2 RDM Results 1998-1999

There were no double-sampling or visual estimates recorded for this time period.

3.2.1 Summary RDM zone mapping

RDM zone mapping was conducted from 1998-1999 for ranch units that were considered priority areas to measure. Only Kehoe J Ranch was mapped in 1998. In 1999, nine ranch units were mapped.

3.3 RDM Results 2001-2002

3.3.1 Summary key area transect double-sampling and visual estimates

During this period, from 2001–2002, double-sampling RDM measurements were conducted only for priority key area transects. Table 3.3 includes the average RDM for each year during this period and the number of key area transects.

Table 3.3. 2001-2002 park-wide average of RDM estimates and number of transects surveyed; averaged values include double-sampling and visual estimates.

Year	*Average RDM in lbs/acre*	*# of Transects surveyed*
2001	1802	20
2002	1583	27

3.3.4. Summary RDM zone mapping 2001-2012

There was no RDM zone mapping from 2001-2012.

3.4 RDM Results 2008-2011

3.4.1 Summary key area transect double-sampling and visual estimates.

During this period, from 2008–2009, double-sampling RDM measurements were conducted for the majority of key area transects, while in 2011 only priority transects were assessed. Table 3.4 includes the average RDM for each year sampled during this period and the number of key area transects.

Table 3.4. 2008-2011 park-wide average of RDM estimates and number of transects surveyed; averaged values include double-sampling and visual estimates.

Year	*Average RDM in lbs/acre*	*# of Transects surveyed*
2008	1066	45
2009	1073	46
2011	1572	24

3.4.2 Summary RDM zone mapping (2008-2011)

There was no RDM zone mapping from 2008-2011.

3.5 RDM Results 2012-2014

Summary key area transect double-sampling and visual estimates.

In this period, from 2012 - 2014, double-sampling RDM measurements were conducted for almost all existing key area transects. Following the 1990 RDM guidelines, for the key area transects 38 and 39 in 2013, the RDM values were calculated using weights that excluded *Juncus* spp. (transects 38a and 39a in raw data file). Table 3.5.1 includes the average RDM for each year sampled during this period and the number of key area transects.

Table 3.5.1. 2012 – 2014 park-wide average of RDM estimates and number of transects surveyed; averaged values include double-sampling and visual estimates.

Year	*Average RDM in lbs/acre*	*# of Transects surveyed*
2012	2581	51
2013	1927	52
2014	1410	51

3.5.1 Summary RDM zone mapping (2012-2014)

There was no RDM zone mapping from 2012-2014.

4. Discussion

The long-term dataset of PORE RDM monitoring is a good representation of livestock use of PORE and GOGA rangeland over time. This monitoring dataset was essentially set up properly from the beginning and included the most rigorous and standard RDM monitoring protocol for the time. The twenty-five year length of the dataset allows for some interesting comparisons including the effects of the current drought and the removal of livestock grazing.

4.1 Drought 2013-2014

Over all the years surveyed, 2013-2014 have among the lowest RDM values across the park. The California-wide, multi-year drought is an obvious explanation for this phenomenon. The average RDM value for 2014, 1,410 lbs/acre, is the lowest over all the years (Table 4.1). For comparison purposes, Table 4.1 only includes average RDM values for years with consistent and full RDM estimate coverage (50 or more transects measured).

Table 4.1. PORE park-wide average RDM values in lbs/acre in years where at least 50 transects included RDM estimates.

Year	Average RDM (lbs/acre)
1990	1,904
1991	2,641
1992	2,695
1993	3,595
1994	3,380
1995	4,089
2012	2,581
2013	1,927
2014	1,410

4.2 *Comparison areas 1990-2014*

Ungrazed comparison areas 1--Strain Hill, 11--Beebe East, 20--Abbots Lagoon, 23--Beebe South, and 24--Limantour were added to the RDM monitoring survey in 1990. In spite of the small number of transects (n=5), these transects make an interesting qualitative comparison for what happens to a coastal grassland with different types of disturbance over twenty-five years: burning, livestock grazing removal, and introduction of elk grazing. Livestock grazing was removed from Strain Hill in 1971 and from the Beebe transect areas in approximately 1976 following purchase of the property by the federal government (Livingston 1995). Timing of cessation of livestock grazing for the other two transects is less certain; Limantour was likely grazed until 1970 (see Livingston 1994), and presumably grazing ceased at Abbotts in this same general timeframe. These ungrazed transects were surveyed occasionally throughout 1990-2014, although not in consecutive years.

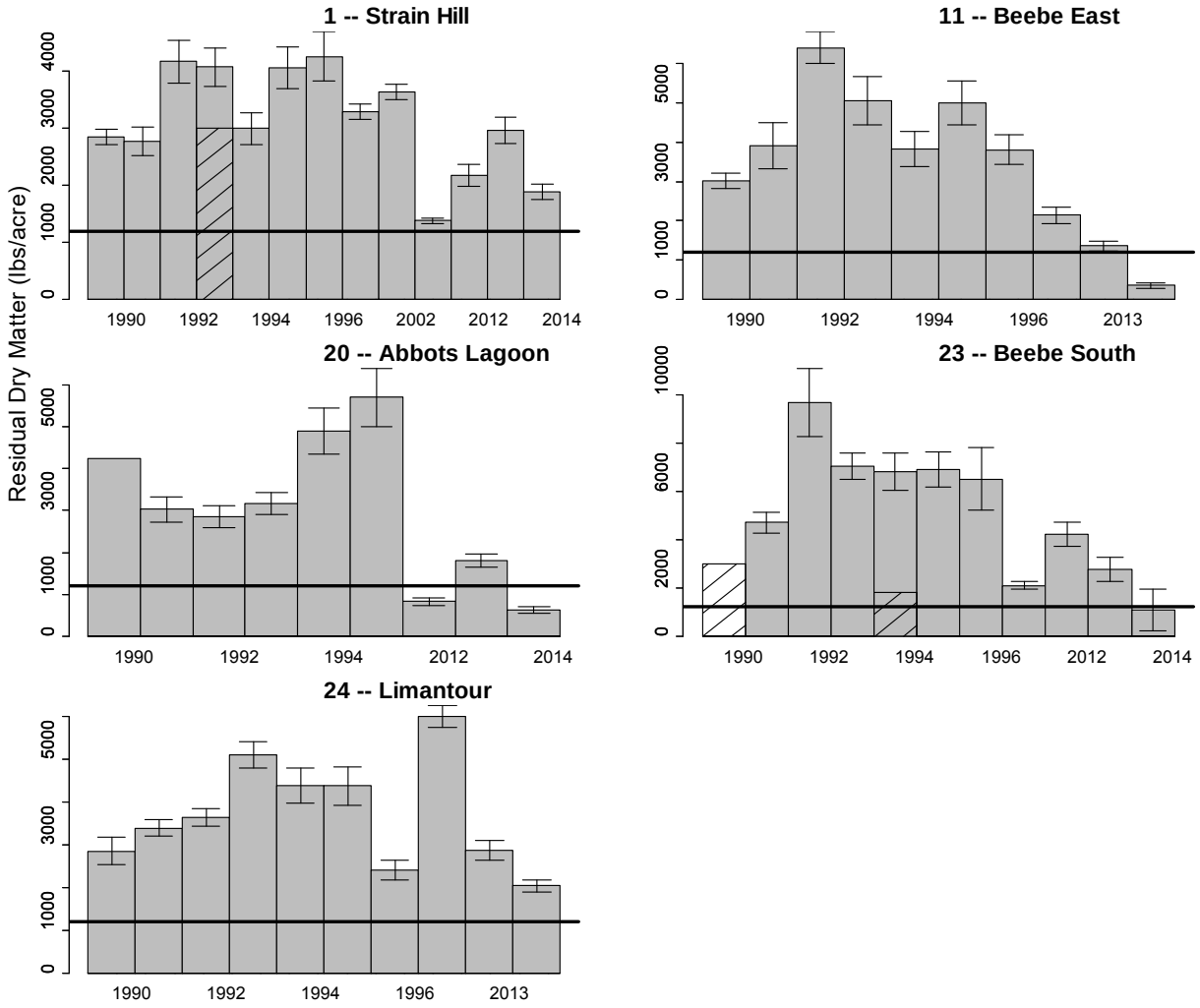
Comparison area transects with relatively little known cattle grazing disturbance from 1990-2014, (11, 20, 23), show initial years with high RDM values that in later years are closer to or below the minimum RDM target of 1,200 lbs/acre. These three transects range from 3,000-9,000 lbs/acre RDM in the period 1990-1996. In the latest years of measurement, 2012-2014, the ungrazed comparison transects range much lower, with RDM values of 500–3,500 lbs/acre. Notes from the double-sampling datasheets indicate a potential switch from grassland to shrubland with dominance of shrub plant species in 2013. There are no notations of dominance

by shrubs in the earlier years of these three transects. Woody plants like coyote brush (*Baccharis pilularis*) are not included in the RDM weight measurement and shade out grassland species which make up the bulk of a quadrat estimate. Shrubland conversion potentially could be one explanation for the lower RDM values from 2012-2014. Conversion to a coastal scrub vegetation type is a common effect of livestock grazing removal in coastal prairie. Along the coast of California, disturbance, whether by fire, grazing, or mowing, is often necessary to maintain open grassland areas (Ford and Hayes 2007).

The Strain Hill comparison area (transect 1) also had no livestock grazing disturbance during 1990-2014; however, controlled burning for fuel reduction and non-native species control was recorded for this area on eight of the twenty-five years. Strain Hill (1) RDM values show a less pronounced difference between the two time periods; the RDM values range from 2,900-4,500 lbs/acre in the period 1990-2002 (additional years surveyed for this transect) and slightly lower with a range of 1,300-3,000 lbs/acre in 2009-2014. In 2013, occasional shrubs are noted as present on the transect. Burning is an effective method for the reduction in shrub cover especially *B. pilularis* and potentially explains the less variable RDM values.

The Limantour comparison area (transect 24) has no livestock grazing disturbance from 1990-1998. The lower RDM values in 1996 may reflect the burn in 1995. In 1999, tule elk were re-located to the Limantour area and are noted as grazing on this transect. The RDM values do not reflect any pattern from the introduction of elk grazing and do not indicate the dominance of shrubs along the transect in 2013.

Figure 4.1. RDM estimates on five ungrazed comparison area transects from 1990 to 2014.



4.3 Non-compliance key area transects in 2012-2014

A standard condition of most grazing management plans and grazing leases is to allow for one year of non-compliance during which it is acceptable to be under the minimum RDM standard. If the pasture or key area is under the RDM standard the following year, this would trigger additional monitoring and alternative management actions. Key area transects considered not in compliance for 2014 would need to have been also under the minimum RDM standard for 2013. Table 4.4 below is a list of key area transects that are below the 1,200 lbs/acre standard for both 2013 and 2014 RDM estimates. Notes from the 2013 datasheets show that the majority of the non-compliant transects are representative of the field or pasture.

Table 4.2. RDM estimates for 2012-2013 that are under the 1,200 lbs/acre minimum RDM standard in both 2013 and 2014

Transect	*2012*	*2013*	*2014*
8	855	888	857
10	1080	1091	964
15	964	1077	624
16	429	505	1184
21	1007	808	943
25	730	461	342
26	1409	620	755
29	1041	960	622
32	777	521	389
34	383	204	250
37	566	465	487
42	3049	719	1071
45	1852	1168	898
47	365	401	165
50	147	392	581

4.4 2012-2014 key area transect monitoring issues

While there are definite benefits to permanent monitoring areas, at this point, there are transects or key areas in the PORE RDM monitoring dataset that require review. Table 4.5 includes key areas where problems were noted on the 2013 datasheets such as invasive shrub or noxious plants. Ranch use information is from the site information excel file.

Table 4.5 Key area transects with RDM monitoring issues; NG is not grazed

Transect	*Problem*	*Recommendation*	*Ranch Use*
11	Shrub dominance	Burn or Re-locate	Comparison area NG
12	Teasel dominance	Weed management	NG since 1998
20	Shrub dominance	Burn or Re-locate	Comparison area NG
23	Shrub dominance	Burn or Re-locate	Comparison area NG
36	Shrub dominance	Burn or Re-locate	NG since 2001
41	Not representative	Re-locate	Beef ranch
48	Fence through middle	Re-locate	Beef ranch

PART II. PORE Residual Dry Matter (RDM) monitoring update

5. Residual Dry Matter (RDM) monitoring introduction

As noted above, this report completes Phase 1 of the Californian Cooperative Ecosystem Studies Unit Cooperative and Joint Venture Agreement, #P11AC91045: Developing updated RDM monitoring methods for Point Reyes National Seashore Project. This section of the report comprises an update of PORE residual dry matter monitoring guidelines and methods.

Monitoring of livestock grazing falls into two general categories: 1) **compliance monitoring**, which determines if a management action complies with expectations or regulations; and 2) **effectiveness monitoring**, which determines if management actions are achieving the desired results (Bush 2006). The results from a well-designed monitoring program provide guidance both for compliance and effectiveness and are used to improve management practices. A good range monitoring program can address goals at the pasture, ranch, and landscape levels and efficiently produces the information required to accomplish those stated goals at minimum cost.

Compliance monitoring generally produces information about the number of livestock animals, timing of livestock grazing, distribution of grazing, and the intensity of grazing. In California, the distribution and intensity of grazing are commonly monitored through assessment of RDM. This report addresses the RDM monitoring component of compliance monitoring. We recommend, however, that PORE develop full compliance monitoring and, if desired, effectiveness monitoring, plans as part of a grazing management plan (see "Future Directions" section below).

Current PORE RDM monitoring protocols follow the PORE Range Management Guidelines and Range Monitoring Handbook developed by Shook in 1990. The goals and objectives and monitoring protocols therein have proved serviceable for PORE but need updating at this point. Some Tomales Bay watershed ranches already have "Ranch Water Quality Plans", as required by the Regional Water Quality Control Board's Waiver of Waste Discharge Requirements for Grazing Operations in the Tomales Bay Watershed (Tomales Bay, Lagunitas Creek, Walker Creek, and Olema Creek) in the San Francisco Bay Region.

The 1990 Handbook minimum RDM target of 1,200 lbs/acre was recommended by the Soil Conservation Service (now Natural Resources Conservation Service). Where soils are rocky or shallow, the minimum RDM target is 1,000 lbs/acre (Shook 1990). Recommendations in the 1990 Handbook for monitoring the livestock-grazed areas of the park were as follows:

- All monitoring focused on key areas within livestock-grazed pastures;
- Fall RDM monitoring (double sampling 100 meter transect, 50 quadrats estimated, 10 clipped);
- Fall RDM zone mapping (4 zones: 0-600, 600-1,200, 1,200-1,800, >1,800 lbs/acre);
- Spring Condition and Trend assessment(8 30-meter line-point transects of 50 points each, 400 points total);
- Permanent Photo points.

6. Proposed RDM Monitoring Guidelines

6.1 RDM monitoring overview

Fall RDM monitoring provides guidance related to how well grazing management is being applied to conservation goals. Published minimum RDM standards exist that are applicable to livestock grazing management and can be used for enhancing species of special concern in PORE and GOGA grasslands (Bartolome et al. 2006).

Generalized RDM guidelines, the targets or standards for minimum Fall RDM levels judged necessary for sustained livestock production, have been published for three broad precipitation zones in California's Mediterranean climate grasslands and savannas. Within each of three precipitation zones (less than 12 inches of mean annual precipitation, between 12 and 40 inches, and coastal prairie with typically more than 35 inches), standards vary by percent slope and with percent woody plant cover. The published guidelines also recommend that local standards or targets be developed as data and experience become available and as different management goals are prioritized (Bartolome et al. 2006).

RDM-based management has been successfully applied on California annual range for over 30 years. The basic relationships among RDM and rainfall, plant production, and composition were established in a long-term statewide experiment (Bartolome et al. 1980; Jackson and Bartolome 2002). A follow-up study examined the effects of RDM, slope, and aspect on forage production, forage composition, and water quality (Bartolome et al. 2006). That study also showed that the flexible RDM standards based on slope may not always work well for

grazing management. However, the exact mechanisms linking RDM to ecosystem processes remain undemonstrated. The application of RDM principles has been widely shown as useful in grazing practice (Bush 2006). It is important to note that minimum RDM standards are probably best considered targets and may differ for many reasons other than livestock grazing, including ecological site, weather, and rodent activity.

During drought years, RDM can fall below minimum standards, even in areas not grazed by livestock due to drought curtailed biomass production for that growing season). A recommended response is to plan the livestock grazing for the coming grazing season based on RDM remaining from the previous grazing season (Bartolome et al. 2006). If RDM had fallen below the minimum standard before the start of the grazing season, the stocking rate (number of animal units per area for a given period) for the following year's grazing season should be reduced. The reduced stocking rate is likely to ensure that RDM minimum standards are achieved for that grazing season. Livestock grazing to below the RDM minimum may occasionally occur but typically only within a single season, which is unlikely to result in long-term damage to the range resource. Of course, in extreme drought years when forage production fails, the grazing season may have to be curtailed.

With the advent of climate change, extreme drought years and/or multiyear droughts may become more common in California (Polley et al. 2013, Chaplin-Kramer and George 2013), which will significantly affect livestock grazing management. Specifically, planning for such events is highly recommended, and management contingencies for severe drought are a necessary component of a grazing management plan. Drought contingencies include moving cattle to more productive pastures, reducing overall herd size, early weaning, and supplemental feeding (McDougald et al. 2001).

6.2 Proposed RDM monitoring updates

6.2.1 Types of RDM monitoring

i. Key Area: characteristics of the key area concept: we recommend PORE continue using the key area concept as defined in the Rangeland Monitoring Guidelines (Shook 1990) but modify the definition to reflect the following important characteristics:
    - the key area should be representative of the pasture;
    - the key area should reflect typical, average livestock use for that pasture;
    - the key area should be responsive to changes in management;

- the key area should not be a high impact area, e.g., next to a water trough, mineral lick, or other intensively used location;
- the key area should comprise only one ecological site (previously called range site);
- the key area should be approximately 100 meters in diameter

ii. We recommend that PORE use the following monitoring methods within a key area for Fall monitoring RDM measurement:
   - permanent photo point,
   - Clip 3 representative RDM quadrats or hoops, weigh and average air-dry weight
   - Ocularly estimate and average percent bare ground in the three clipped quadrats or hoops (note: standards for bare ground have not yet been developed for coastal prairie but can easily and cheaply be developed by adding in this measure.)

iii. Some of the current key areas present problems that need to be addressed to ensure accurate RDM estimates (see RDM analysis section 4.5). These problems include:
   - invasive plants, e.g., thistle or teasel, dominate the key area;
   - key area has converted to a shrub-dominated site;
   - key area is no longer representative of the pasture.

Addressing these problems may require adding new key areas within the pasture or re-locating the key area within the pasture.

6.2.2 RDM target minimum and maximum

Although RDM estimates are typically compared to a minimum standard to minimize soil erosion and optimize forage production, a maximum standard may also be important, depending on management goals for the area. Maximum RDM standards may be necessary to meet wildlife habitat requirements, to control invasive species, or to reduce fuel loading.

For PORE, we recommend a minimum standard of 1,200 lbs/acre, based on the RDM guidelines developed by UC researchers for coastal prairie (Bartolome et al. 2006). We do not recommend the general use of flexible, slope-based standards because they do not appear to be applicable to PORE and GOGA sites. However, site-specific conditions and management goals may call for adjustment of the minimum standard for particular sites. Adjustment of RDM standards requires site-specific evaluation and planning as recommended below.

Similarly, for particular sites, a maximum RDM standard may be appropriate. Determining whether a site needs a maximum RDM standard requires site-specific evaluation and planning as recommended below. For example, grazing has proven an effective method of reducing cover of the invasive velvet grass (*Holcus lanatus*; Johnson and Cushman 2007, Hayes and Holl 2003) and slowing shrub encroachment (McBride and Heady 1968). Ensuring sufficient levels of grazing by establishing maximum RDM standards may help PORE control velvet grass and inhibit shrub encroachment. We know of no research that provides specific RDM guidelines for meeting these goals, although research from Europe and Canada suggests that higher intensity livestock grazing and trampling could reduce abundance of velvet grass while low-intensity grazing may actually encourage its spread (Pitcher and Russo 1988). Conducting a modest adaptive management experiment may provide some useful site-specific information on the RDM levels that best control velvet grass invasion and shrub encroachment without harming other resource values.

6.2.3 Management action triggers requiring additional RDM monitoring

We recommend that PORE develop management action triggers that indicate when additional or more intensive monitoring is necessary. For example, if a key area does not meet its target RDM standard (or a percent bare ground guideline if that is developed), additional monitoring at that key area may be warranted. We recommend the following intensive monitoring methods for use on such occasions:

- RDM zone mapping (2 zones: below 1,200 lbs/acre RDM and above1,200lbs/acre RDM) to assess entire pasture;
- More precise RDM clipping estimate: apply the previously used double sampling methodology within key area;
- Consider adding additional key areas or moving existing key areas;
- Additional photo points targeting problem areas, e.g., bare ground, Cal-IPC high level invasive plants, soil erosion, plants toxic to livestock.

7. Future directions

7.1 RDM monitoring as part of an integrated grazing management plan

Livestock grazing is a complex ecosystem process for which management involves site-specific control of intensity, timing, and distribution (Jackson and Bartolome 2007). This

complexity has reduced the generality of results from grazing experiments. For example, an evaluation of 30 grazing studies in California grasslands showed that effects on vegetation were primarily dependent on soil properties and weather, with variable and probably site-dependent effects of the grazing treatments (Huntsinger et al. 2007). Another issue with grazing evaluations is that spatial and temporal variation at the pasture, ranch, and landscape scales need to be linked to match variable management objectives (Huntsinger et al. 2007). Any kind of grazed site monitoring, therefore, is best developed and implemented within the context of an overall grazing management plan.

This report's recommendations for Fall RDM monitoring are potentially the first step of a collaboration between PORE and REL to develop up-to-date natural resource management goals for the livestock-grazed areas within PORE and Golden Gate National Recreation Area. PORE is currently involved in a Ranch Comprehensive Management Plan/Environmental Assessment (RCMP) planning process. The RCMP will analyze numerous proposed ranching activities on PORE and GOGA lands. There is a pending proposal for REL and PORE to collaboratively create a grazing management plan that will guide the development of specific monitoring objectives for park lands. Grazing management plans are required to implement the RCMP at the ranch level and to protect and enhance sensitive resources within PORE and GOGA livestock-grazed areas.

7.2 Ranch grazing management plans/Ranch unit plans

Ranch grazing management plans or Ranch unit plans need to be developed to finalize specific RDM targets based on site-specific needs. Site-specific needs might include:

- Tomales Bay Watershed ranches have specific RDM targets due to water quality regulations;
- dairy irrigated pasture may have different RDM targets compared to those for beef ranching pasture;
- native grasslands or wetland areas within pastures may require RDM levels different than those for areas dominated by non-native species;
- unique ecological sites or sites with sensitive species may need RDM standards tailored to their particular requirements.

Ranch grazing management plans or Ranch unit plans would include:

- ranch-specific guidelines with goals and objectives for monitoring to target;
- grazing management compliance monitoring goals and objectives;
- management effectiveness monitoring goals and objectives.

7.3 Potential additional monitoring topics for future recommendations

1) Tomales Bay Watershed pastures – Repeated intra-annual monitoring requirements for Water Quality Control Board impaired water body regulation;
2) Dairy pasture monitoring -- Additional methods or monitoring on intensive-use pastures;
3) Spring species composition monitoring or condition and trend monitoring (Phase 2 of this task agreement).

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Appendix A

Table A.1: Final RDM Summaries with Confidence Intervals 1987-2014

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
2	1987	Giacomini SUP	NA	133	1293	1250	1335
3	1987	Truttman	NA	133	883	848	918
4	1987	Lupton	NA	133	1099	1050	1149
5	1987	Lundgren	NA	133	447	434	461
6	1987	McIsaac	NA	133	941	920	961
8	1987	Giacomini	NA	133	1226	1180	1272
14	1987	Kehoe SUP	NA	133	1093	1061	1125
15	1987	Kehoe SUP	NA	133	1871	1777	1966
16	1987	Nunes SUP	NA	133	948	927	968
17	1987	Spalletta SUP	NA	133	1064	1020	1108
18	1987		NA	133	1079	1056	1101
21	1987	McDonald SUP	NA	133	1581	1496	1666
22	1987	Lunny SUP	NA	133	823	807	839
25	1987	Evans	NA	133	803	773	832
26	1987	Evans	NA	133	2024	1947	2101
27	1987	Stewart (Palomarin)	NA	133	3002	2859	3144
28	1987	Tiscornia SUP	NA	133	2382	2287	2477
29	1987	Murphy SUP	NA	133	1241	1189	1293
30	1987	Stewart (Olema)	NA	133	2254	2207	2301
31	1987	D. McIsaac ROP	NA	133	805	788	822
32	1987	Percy SUP	NA	133	524	487	560
33	1987	C. Rogers ROP	NA	133	837	817	857
34	1987	Cheda ROP	NA	133	469	458	479
35	1987	Stewart ROP	NA	133	1836	1774	1897
36	1987	Commonweal/Tacherra	NA	133	1340	1286	1394
37	1987	Zanardi ROP	NA	133	934	906	963
38	1987	Commonweal ROP	NA	133	728	715	741
39	1987	Nimon/Schell ROP	NA	133	2039	1961	2117
40	1987	Nunes (A Ranch) ROP	NA	133	565	553	576
41	1987	Nunes (E Ranch) ROP	NA	133	553	540	567

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
42	1987	Mendoza ROP	NA	133	1456	1404	1507
43	1987	Horick ROP	NA	133	1117	1084	1149
44	1987	Rich Grossi ROP	NA	133	296	290	303
45	1987	McClure ROP	NA	133	3205	3063	3346
46	1987	Al Grossi ROP	NA	133	1052	1022	1081
47	1987	Kehoe ROP	NA	133	721	679	764
48	1987	Rogers ROP	NA	133	1800	1763	1838
49	1987	Lobaugh ROP	NA	133	713	701	725
2	1988		NA	133	1415	1305	1524
3	1988		NA	133	1495	1381	1610
4	1988		NA	133	1448	1388	1509
5	1988		NA	133	946	899	993
6	1988		NA	133	514	483	546
8	1988		NA	133	895	850	940
13	1988		NA	133	639	603	675
14	1988		NA	133	1541	1479	1604
15	1988		NA	133	1845	1743	1946
16	1988		NA	133	1702	1571	1833
17	1988		NA	133	1526	1411	1641
18	1988		NA	133	1752	1688	1815
21	1988		NA	133	1744	1672	1815
22	1988		NA	133	943	895	991
25	1988		NA	133	748	716	780
26	1988		NA	133	1435	1371	1500
28	1988		NA	133	1187	1099	1275
29	1988		NA	133	809	770	847
30	1988		NA	133	1506	1464	1548
31	1988		NA	133	504	457	552
32	1988		NA	133	629	566	692
33	1988		NA	133	794	638	950
34	1988		NA	133	554	516	593
35	1988		NA	133	982	914	1050
36	1988		NA	133	719	697	741

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
37	1988		NA	133	845	788	902
38	1988		NA	133	408	382	435
39	1988		NA	133	746	714	778
40	1988		NA	133	1608	1531	1685
41	1988		NA	133	1529	1475	1583
42	1988		NA	133	1192	1145	1240
43	1988		NA	133	1210	1125	1296
44	1988		NA	133	1586	1485	1688
46	1988		NA	133	2103	2001	2206
47	1988	Kehoe ROP	NA	133	987	912	1062
48	1988		NA	133	1284	1205	1363
90	1988	So. Of Abbot's Lagoon	NA	133	605	581	628
91	1988	So. Of Abbot's Lagoon	NA	133	624	587	660
92	1988	So. Of Abbot's Lagoon	NA	133	536	517	555
93	1988	So. Of Abbot's Lagoon	NA	133	920	896	944
2	1989		2200	133	NA	NA	NA
3	1989		1800	133	NA	NA	NA
4	1989		1500	133	NA	NA	NA
5	1989		2200	133	NA	NA	NA
6	1989		1800	133	NA	NA	NA
7	1989		3500	133	NA	NA	NA
8	1989		NA	133	1322	1255	1390
9	1989		2000	133	NA	NA	NA
10	1989		2500	133	NA	NA	NA
12	1989		2000	133	NA	NA	NA
13	1989		1900	133	NA	NA	NA
14	1989		1800	133	NA	NA	NA
15	1989		1500	133	NA	NA	NA
16	1989		NA	133	2492	2286	2698
17	1989		NA	133	2591	2471	2711
18	1989		NA	133	1699	1636	1761
19	1989		1400	133	NA	NA	NA
21	1989		2000	133	NA	NA	NA

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
22	1989		NA	133	1789	1680	1897
25	1989		1300	133	NA	NA	NA
26	1989		1500	133	NA	NA	NA
27	1989		2000	133	NA	NA	NA
28	1989		2400	133	NA	NA	NA
29	1989		1900	133	NA	NA	NA
30	1989		3000	133	NA	NA	NA
31	1989		2200	133	NA	NA	NA
32	1989		1800	133	NA	NA	NA
33	1989		2200	133	NA	NA	NA
34	1989		NA	133	1229	1149	1310
35	1989		2600	133	NA	NA	NA
36	1989		1500	133	NA	NA	NA
37	1989		NA	133	1181	1121	1241
38	1989		2500	133	NA	NA	NA
39	1989		2500	133	NA	NA	NA
40	1989		2000	133	NA	NA	NA
41	1989		NA	133	2015	1950	2080
42	1989		NA	133	1989	1897	2081
43	1989		NA	133	2223	2020	2426
44	1989		3000	133	NA	NA	NA
45	1989		3000	133	NA	NA	NA
46	1989		2300	133	NA	NA	NA
47	1989		NA	133	1118	1046	1190
48	1989		3000	133	NA	NA	NA
49	1989		2500	133	NA	NA	NA
50	1989		6000	133	NA	NA	NA
51	1989		1900	133	NA	NA	NA
1	1990	Strain Hill Comparison Area	NA	133	2852	2725	2979
2	1990		NA	133	2237	2062	2412
3	1990	Truttman	NA	133	1392	1154	1629
4	1990		NA	133	730	560	900

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
5	1990	Lundgren	NA	133	2008	1675	2342
6	1990		NA	133	1476	1323	1629
7	1990	Stewart	NA	133	3580	3354	3806
8	1990	Giacomini	NA	133	1098	980	1215
9	1990		NA	133	2483	2224	2742
10	1990	Martinelli	NA	133	5178	4936	5419
11	1990		NA	133	3012	2810	3214
12	1990	Rodoni	NA	133	2421	2082	2760
13	1990		NA	133	2313	2111	2515
14	1990		NA	133	1637	1290	1985
15	1990		NA	133	1697	1526	1868
16	1990		NA	133	2226	1777	2675
17	1990	Spaletta	NA	133	861	664	1058
18	1990	Gallagher	NA	133	583	500	666
19	1990	Giacomini	NA	133	1266	1061	1471
20	1990	Abbotts Comparison	NA	133	4231	NA	NA
21	1990		NA	133	419	372	467
22	1990	Lunny	NA	133	874	797	952
23	1990		3000	133	NA	NA	NA
24	1990	Limantour	NA	133	2858	2527	3189
25	1990		NA	133	625	523	727
26	1990	K Ranch	NA	133	968	859	1076
27	1990		NA	133	748	654	842
28	1990	Tiscornea	NA	133	2428	2246	2609
29	1990	Murphy	NA	133	606	528	685
30	1990	Stewart	NA	133	2442	2296	2587
31	1990	McIsaac ROP	NA	133	2648	2513	2782
32	1990	Percy SUP	NA	133	1799	1572	2026
33	1990	C. Rogers	NA	133	4771	4456	5086
34	1990	Cheda Ranch ROP	NA	133	526	451	600
35	1990		NA	133	2877	2456	3298
36	1990		NA	133	473	425	522
37	1990	Martinelli	NA	133	941	755	1128

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
38	1990	Niman/Schell	NA	133	1240	990	1489
39	1990		NA	133	2043	1734	2352
40	1990	Nunes ROP	NA	133	1070	887	1252
41	1990	Nunes	NA	133	1068	889	1247
42	1990	Mendoza	NA	133	749	654	844
43	1990	Horick	NA	133	193	136	251
44	1990	D. Grossi	NA	133	1553	1405	1702
45	1990	McClure	NA	133	2559	2401	2716
46	1990		NA	133	2001	1626	2375
47	1990	Kehoe ROP	NA	133	590	540	641
48	1990	D. Rogers	NA	133	2216	1935	2498
49	1990		NA	133	1870	1635	2105
50	1990	Genazzi	NA	133	6246	5765	6726
51	1990		NA	133	2517	2209	2826
1	1991	Strain Hill Comparison Area	NA	133	2771	2522	3021
2	1991	Ralf Giacomini	NA	133	2219	1809	2629
3	1991	Truttman	2600	133	3208	NA	NA
4	1991	Earl Lupton	NA	133	2995	2701	3290
5	1991	Lungren	NA	133	2268	2155	2381
6	1991	Don McIsaac	NA	133	2228	2143	2312
7	1991	Boyd Stewart	NA	133	4437	4101	4773
8	1991	Ralph Giacomini	NA	133	1974	1882	2067
9	1991	Stewart	4300	133	5453	NA	NA
10	1991	Leroy Martinelli	2800	133	1406	197	2614
11	1991	Comparison Area	NA	133	3916	3330	4502
12	1991	Fred Rodoni	2500	133	NA	NA	NA
13	1991	Don McIsaac	NA	133	1959	1885	2033
14	1991	Ken Kehoe	NA	133	2555	2439	2670
15	1991	Ken Kehoe	NA	133	2322	2082	2562
16	1991	G. Nunes	NA	133	2283	2208	2358
17	1991	E. Spalletta	NA	133	3264	2972	3556
18	1991	Gallagher	NA	133	1935	1815	2055

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
19	1991	Bob Giacomini	NA	133	1723	1544	1902
20	1991	Abbots Lagoon Comparison Area	NA	133	3026	2718	3334
21	1991	McDonald	NA	133	1685	1415	1956
22	1991	Joe Lunny	NA	133	1362	1282	1442
23	1991	Comparison Area	NA	133	4719	4284	5154
24	1991	Limantour Comparison Area	NA	133	3395	3204	3587
25	1991	Dan Evans	3200	133	3657	NA	NA
26	1991	Dan Evans	NA	133	2104	1905	2302
27	1991	Bill Niman	NA	133	4112	3728	4496
28	1991	Mary T	NA	133	2653	2436	2871
29	1991	L Murphy	NA	133	2195	2094	2295
30	1991	Stewart	NA	133	2856	2297	3415
31	1991	Don McIsaac	NA	133	2656	2567	2744
32	1991	M. Percy	NA	133	1141	1010	1272
33	1991	C. Rogers	3500	133	NA	NA	NA
34	1991	Don McIsaac	NA	133	1057	1006	1108
35	1991	B. Stewart	2200	133	NA	NA	NA
36	1991	Jim Tacherra	NA	133	2618	2502	2734
37	1991	Pat Martin	NA	133	1544	1443	1644
38	1991	Bill Niman	3500	133	NA	NA	NA
39	1991	Bill Niman	NA	133	3163	2912	3415
40	1991	G. Nunes	NA	133	2002	1847	2158
41	1991	G. Nunes	NA	133	1588	1476	1699
42	1991	Joe Mendoza	NA	133	1562	1447	1676
43	1991	Horick	NA	133	3045	2935	3155
44	1991	Rich Grossi	3000	133	4323	NA	NA
45	1991	Bob McClure	2300	133	3458	NA	NA
46	1991	Dan Evans	2500	133	2926	NA	NA
47	1991	Ken Kehoe	NA	133	1499	1380	1619
48	1991	D. Rogers	NA	133	2616	2460	2771
49	1991	G. W. Lobough	NA	133	2451	2221	2681

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
50	1991	Harold Genazzi	4000	133	NA	NA	NA
51	1991	James McFadden	NA	133	3142	2624	3660
90	1991	Elk Range	NA	133	1929	1667	2192
91	1991	Elk Range	NA	133	4211	3939	4483
1	1992	Strain Hill Comparison	NA	133	4175	3792	4557
2	1992	R. Giacomini	NA	133	2906	2650	3162
4	1992	Lupton	NA	133	2030	1861	2200
5	1992	Lundgren	NA	133	2266	2030	2501
6	1992	McIsaac	NA	133	2688	2503	2873
7	1992	Stewart Olema	2300	133	NA	NA	NA
8	1992	R. Giacomini	NA	133	1498	1465	1530
9	1992	Stewart	2200	133	NA	NA	NA
10	1992	Martinelli	3000	133	NA	NA	NA
11	1992	E. Beebe Tract Comparison	NA	133	6405	6003	6806
12	1992	Rodoni	3000	133	4587	NA	NA
13	1992	McIsaac	NA	133	2850	2520	3180
14	1992	Kehoe	NA	133	2515	2223	2807
15	1992	Kehoe	NA	133	3580	2938	4222
16	1992	Nunes	NA	133	1298	1165	1431
17	1992	Spaletta	2200	133	2509	-639	5657
18	1992	Gallagher	NA	133	1389	1277	1500
19	1992	B. Giacomini	2600	133	NA	NA	NA
20	1992	Abbott's Lagoon Comparison	NA	133	2855	2587	3124
21	1992	McDonald	NA	133	1599	1446	1752
22	1992	Lunny	NA	133	1352	1172	1532
23	1992	S. Beebe Comparison Area	NA	133	9676	8262	11089
24	1992	Limantour Comparison	NA	133	3650	3441	3858
25	1992	A. Grossi "K Ranch" Dan Evans	NA	133	1630	1344	1916
26	1992	A. Grossi "K Ranch" Dan Evans	NA	133	1789	1631	1947

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
27	1992	Stewart "Bolinas"	NA	133	2214	1917	2510
28	1992	Tiscornia	NA	133	2929	2607	3252
29	1992	Murphy	NA	133	1706	1557	1854
30	1992	Stewart "Olema"	2000	133	NA	NA	NA
31	1992	McIsaac	2600	133	3768	1594	5942
32	1992	Percy	NA	133	2079	1682	2476
33	1992	C. Rogers	2300	133	NA	NA	NA
34	1992	Cheda	NA	133	1492	1347	1637
35	1992	Stewart	3200	133	5067	NA	NA
36	1992	Tacherra	NA	133	1203	1104	1301
37	1992	Zanardi	NA	133	852	720	984
38	1992	Niman/Schell	1800	133	2101	NA	NA
39	1992	Niman/Schell	2900	133	3689	-6225	13602
40	1992	Nunes	NA	133	1958	1824	2093
41	1992	Nunes	NA	133	1485	1348	1622
42	1992	Mendoza	NA	133	2200	1963	2438
43	1992	Horick	NA	133	2336	1996	2675
44	1992	D. Grossi	2300	133	NA	NA	NA
45	1992	McClure	2500	133	NA	NA	NA
46	1992	A. Grossi	NA	133	3214	2843	3585
47	1992	Kehoe	NA	133	851	745	957
48	1992	D. Rogers	NA	133	2151	1899	2403
49	1992	Lobaugh	2600	133	NA	NA	NA
50	1992	Genazzi	2100	133	3245	-5598	12088
51	1992	McFadden	3600	133	NA	NA	NA
1	1993	Strain Hill Comparison	3000	133	4080	3746	4415
2	1993	R. Giacomini	2500	133	3087	1732	4443
3	1993	Truttman	NA	133	2530	2253	2806
4	1993	Lupton	NA	133	3682	-191	7555
5	1993	Lundgren	NA	133	2256	2035	2478
6	1993	McIsaac	NA	133	2727	886	4569
7	1993	Stewart	2700	133	3691	NA	NA
8	1993	B. Giacomini	NA	133	2449	2239	2659

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
9	1993	Stewart	NA	133	4345	NA	NA
10	1993	L. Martinelli	2900	133	3977	NA	NA
11	1993	E. Beebe Tract Comparison Area	NA	133	5048	4427	5670
12	1993	Frerd Rodoni	4500	133	7541	NA	NA
13	1993	McIsaac	NA	133	4689	2135	7243
14	1993	Kehoe	NA	133	3024	2739	3310
15	1993	Kehoe	NA	133	2840	2608	3072
16	1993	Nunes	NA	133	2299	2019	2580
17	1993	E. Spalletta	NA	133	3568	3324	3812
18	1993	Gallagher	NA	133	2664	1880	3448
19	1993	B. Giacomini	3000	133	5119	1028	9209
20	1993	Abbotts Lagoon	NA	133	3172	2907	3437
21	1993	McDonald	NA	133	2235	2078	2393
22	1993	Lunny	1500	133	1809	1651	1967
23	1993	S. Beebe Tract Comparison Area	NA	133	7050	6525	7575
24	1993	Limantour Comparison	NA	133	5107	4788	5427
25	1993	Grossi "K Ranch"	NA	133	1663	1415	1910
26	1993	Grossi "K Ranch"	NA	133	2318	2150	2485
27	1993	Stewart "Bolinas"	NA	133	2505	2327	2684
28	1993	Tiscornia	NA	133	4394	975	7814
29	1993	S. Murphy	NA	133	2709	2369	3050
30	1993	Stewart	2600	133	3584	NA	NA
31	1993	McIsaac	3500	133	5292	2487	8096
32	1993	Percy	NA	133	1807	1564	2051
33	1993	C. Rogers	4000	133	5841	NA	NA
34	1993	Cheda Ranch	NA	133	1463	1390	1537
35	1993	Stewart	3500	133	5464	NA	NA
36	1993	Tacherra	NA	133	1956	1782	2131
37	1993	Zanardi	NA	133	1485	1412	1557
38	1993	Niman/Schell	NA	133	4406	NA	NA
39	1993	Niman/Schell	NA	133	3639	3289	3989

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
40	1993	Nunes	3500	133	7208	NA	NA
41	1993	Nunes (E Ranch)	NA	133	1952	1793	2110
43	1993	V. Horich	NA	133	6424	NA	NA
44	1993	D. Grossi ROP	NA	133	2940	2689	3191
45	1993	McClure	4000	133	5045	NA	NA
46	1993	Dan Evans	NA	133	3731	3281	4181
47	1993	Kehoe	NA	133	878	794	962
48	1993	D. Rogers ROP	NA	133	3547	1399	5694
49	1993	Lobaugh	2500	133	3139	-345	6623
51	1993	McFadden	2800	133	3755	NA	NA
1	1994	Strain Hill Comparison Area	NA	133	2996	2712	3281
2	1994	R. Giacomini	NA	133	2028	-1248	5305
3	1994	Truttman (Stewart)	NA	133	4498	3422	5573
4	1994	Lupton	NA	133	2336	2159	2514
5	1994	Merz	NA	133	2122	1947	2297
6	1994	McIsaac	NA	133	2723	2559	2887
7	1994	Stewart (Olema)	NA	133	5437	4339	6534
8	1994	R. Giacomini	NA	133	1782	1711	1853
9	1994	Stewart	1800	133	4371	3355	5388
10	1994	Martinelli	NA	133	2602	2306	2897
11	1994	Beebe Comparison Area	NA	133	3827	3368	4286
12	1994	Rodoni	NA	133	5833	4701	6964
13	1994	McIsaac	1800	133	3489	2704	4273
14	1994	Kehoe	NA	133	3922	3482	4361
15	1994	Kehoe	NA	133	3346	2929	3763
16	1994	Nunes (A Ranch)	NA	133	3109	2808	3409
17	1994	Spaletta	NA	133	3951	3211	4690
18	1994	Gallagher	NA	133	2250	2073	2426
19	1994	B. Giacomini	NA	133	3084	2407	3761
20	1994	Abbotts Lagoon Comparison Area	NA	133	4897	4343	5450
21	1994	McDonald	NA	133	2477	2224	2731

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
22	1994	Lunny	NA	133	2037	1862	2213
23	1994	S. Beebe Tract Comparison Area	1800	133	6810	6031	7589
24	1994	Limantour Comparison Area	NA	133	4395	3987	4803
25	1994	D. Evans (K Ranch)	NA	133	1849	1610	2088
26	1994	D. Evans (K Ranch)	NA	133	2093	1891	2295
27	1994	Niman/Schell	NA	133	2708	2505	2912
28	1994	Tiscornia	NA	133	3554	3149	3959
29	1994	Murphy	NA	133	2371	2186	2556
30	1994	Stewart (Olema)	NA	133	4360	3539	5181
31	1994	McIsaac	1800	133	4693	4079	5308
32	1994	Percy	NA	133	1893	1595	2190
33	1994	Rogers ROP	NA	133	3304	3088	3519
34	1994	Cheda	1200	133	1432	1343	1521
35	1994	Stewart	NA	133	3132	2658	3606
36	1994	Tacherra	NA	133	2213	2018	2408
37	1994	Zanardi (Martin)	NA	133	3139	3069	3209
38	1994	Niman/Schell	NA	133	3840	3676	4005
39	1994	Niman/Schell	NA	133	5035	4545	5524
40	1994	Nunes (A Ranch)	NA	133	5573	4061	7084
41	1994	Nunes "E Ranch"	NA	133	1874	1689	2059
42	1994	Mendoza	NA	133	2991	2762	3220
43	1994	Horick	NA	133	5209	4013	6406
44	1994	R. Grossi	NA	133	3877	3564	4190
45	1994	McClure	1800	133	4529	3698	5360
46	1994	D. Evans	NA	133	2724	2491	2957
47	1994	Kehoe	NA	133	1077	1015	1140
48	1994	D. Rogers	NA	133	2770	2583	2957
49	1994	Lobough	1800	133	4472	3274	5670
50	1994	Genazzi	NA	133	2627	2417	2837
51	1994	McFadden	NA	133	4745	3496	5994
1	1995	Strain Hill Comparison Area	NA	133	4063	3695	4430

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
2	1995	R. Giacomini	NA	133	3914	3183	4644
3	1995	Truttman (Stewart)	6000	133	9103	5971	12234
4	1995	Lupton	3000	133	3767	3055	4480
5	1995	Merz	NA	133	2558	2392	2724
6	1995	McIsaac	NA	133	3754	3482	4026
7	1995	Stewart	NA	133	4344	3806	4882
8	1995	R. Giacomini	NA	133	3050	2493	3608
9	1995	Stewart	NA	133	5736	4646	6827
10	1995	Martinelli	NA	133	2457	2266	2649
11	1995	Beebe Comparison Area	NA	133	4998	4450	5547
12	1995	Rodoni	4000	133	4891	3167	6616
13	1995	McIsaac	NA	133	4346	3343	5348
14	1995	Kehoe	NA	133	4854	4308	5401
15	1995	Kehoe	NA	133	4374	3894	4855
16	1995	Nunes	NA	133	5676	3822	7530
17	1995	Spaletta	3100	133	4613	3668	5558
18	1995	R. Gallagher	NA	133	2590	2294	2887
19	1995	B. Giacomini	2500	133	3742	2153	5331
20	1995	Abbotts Lagoon Comparison Area	NA	133	5701	5017	6385
21	1995	McDonald	NA	133	3699	3327	4072
22	1995	J. Lunny	NA	133	2940	2667	3214
23	1995	N. Beebe Tract Comparison Area	NA	133	6921	6182	7661
24	1995	Limantour Comparison Area	NA	133	4375	3936	4814
25	1995	K Ranch (Evans)	NA	133	1919	1611	2227
26	1995	K Ranch (Evans)	NA	133	4461	3415	5507
27	1995	Niman/Schell	2700	133	3376	3154	3599
28	1995	Tiscornia	NA	133	3191	2917	3464
29	1995	Murphy	NA	133	3692	3035	4348
31	1995	McIsaac	3000	133	4275	3134	5416
32	1995	Mike Percy	NA	133	2631	2344	2917
33	1995	C. Rogers	3700	133	4173	2793	5553

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
34	1995	Cheda Ranch	1600	133	2098	1819	2376
35	1995	Stewart	4500	133	5579	4370	6789
36	1995	Tascherra	2800	133	3768	3540	3995
37	1995	Martin	NA	133	1754	1600	1909
38	1995	Niman/Schell	5000	133	6542	5895	7189
39	1995	Niman/Schell	2100	133	2894	2703	3085
40	1995	Nunes	NA	133	6341	4307	8375
41	1995	E Ranch	NA	133	2307	2106	2509
42	1995	Mendoza	NA	133	3946	3422	4470
43	1995	Horick	3500	133	3876	3217	4535
44	1995	R. Grossi	NA	133	5152	3780	6524
45	1995	McClure	NA	133	7757	6037	9478
46	1995	D. Evans (H Ranch)	NA	133	2801	2394	3209
47	1995	Kehoe	NA	133	1044	966	1122
48	1995	D. Rogers	3100	133	4023	3398	4647
49	1995	Lobough	NA	133	4171	2869	5474
50	1995	Genazzi	1500	133	2249	1926	2572
51	1995	McFadden	3800	133	3948	2860	5036
52	1995	McDonald (Burn Site)	NA	133	6777	6136	7418
53	1995	McDonald (Burn Site)	NA	133	6257	5776	6738
1	1996	Strain Hill Comparison	NA	133	4265	3836	4694
2	1996	R. Giacomini ROP	NA	133	3568	2792	4345
4	1996	Lupton SUP	NA	133	3312	2525	4099
5	1996		NA	133	2972	2824	3120
6	1996		NA	133	2786	1959	3613
7	1996	Stewart "Olema" SUP	2800	133	4103	NA	NA
8	1996	R. Giacomini SUP	NA	133	1216	335	2097
9	1996	Stewart ROP	2900	133	4721	NA	NA
10	1996	Martinelli ROP	2000	133	2160	NA	NA
11	1996	Beebee Tract	NA	133	3808	3422	4194
13	1996		NA	133	3090	2418	3762
15	1996		NA	133	3064	NA	NA
17	1996	Spaletta SUP	NA	133	2975	2753	3197

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
18	1996	Gallagher SUP	NA	133	2424	1704	3144
21	1996		NA	133	1344	576	2113
22	1996	Lunny	NA	133	2206	NA	NA
23	1996	Beebe Tract Comparison Area	NA	133	6516	5220	7812
24	1996	Limantour Comparison Area	NA	133	2411	2174	2648
27	1996	Niman/Schell	NA	133	2802	2584	3020
28	1996	Tiscornia	NA	133	3704	3122	4286
31	1996	McIsaac SUP	NA	133	3957	3440	4475
35	1996	Stewart ROP	NA	133	2780	2073	3488
36	1996	Tiscornia	NA	133	1185	924	1446
37	1996	Martin ROP	NA	133	1227	964	1490
38	1996	Niman	NA	133	5146	4551	5742
39	1996	Niman/Schell ROP	NA	133	2753	2434	3072
45	1996		NA	133	6595	NA	NA
50	1996	Genazzi	NA	133	1676	1376	1976
51	1996	McFadden	NA	133	2149	1345	2953
1	2001	Strain Comparison	NA	133	3297	3159	3435
2	2001	Giacomini SUP	NA	133	2566	2299	2832
3	2001	Stewart (Truttman) SUP	NA	133	2391	1929	2853
7	2001	Stewart "Olema" SUP	NA	133	885	800	969
14	2001	Kehoe (J Ranch) SUP	NA	133	2006	1616	2396
16	2001	Nunes "A" Ranch SUP	NA	133	679	303	1055
22	2001	Lunny (G Ranch) SUP	NA	133	3771	3264	4277
26	2001	A. Grossi "K Ranch" SUP	NA	133	1583	1112	2054
31	2001	McIsaac ROP	NA	133	412	359	466
38	2001	Niman/Schell SUP	NA	133	5147	3924	6371
41	2001	Nunes "E Ranch" ROP	NA	133	520	492	549
42	2001	Mendoza "B Ranch" ROP	NA	133	597	489	705
44	2001	D. Grossi "H Ranch" ROP	NA	133	756	675	837
46	2001	M Ranch SUP	NA	133	618	564	673
60	2001	Lower Pierce Ranch	NA	133	2121	1883	2358

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
64	2001	White Gulch	NA	133	3344	3100	3588
74	2001		NA	133	2636	2183	3088
400	2001	Bird Rock	NA	133	415	282	547
401	2001		NA	133	759	662	856
402	2001	White Gulch	NA	133	473	NA	NA
1	2002	McCurdy Ranch - Strain Hill	NA	133	3645	3510	3781
4	2002	Lupton	NA	133	1764	1669	1859
6	2002	McIsaac SUP	NA	133	1400	1282	1518
8	2002	R. Giacomini	NA	133	417	390	443
14	2002	Kehoe SUP	NA	133	1695	1513	1878
15	2002		NA	133	838	738	938
17	2002	C Ranch	NA	133	1607	1477	1736
18	2002	Bull Point	NA	133	921	847	996
21	2002	N Ranch	NA	133	909	822	995
25	2002		NA	133	1105	1009	1202
28	2002	Milkins Ranch	NA	133	3098	2889	3307
29	2002	Home Ranch	NA	133	798	705	892
32	2002	Percy	NA	133	978	923	1034
36	2002	Tacherra	NA	133	2570	2448	2693
37	2002	Zanardi	NA	133	541	496	587
43	2002	D-Ranch	NA	133	4353	4132	4574
45	2002	McClure	NA	133	2202	1975	2430
48	2002		NA	133	417	380	454
49	2002	L Ranch	NA	133	1846	1589	2104
50	2002	Genazzi	NA	133	543	515	572
57	2002	AT&T	NA	133	1603	1137	2070
60	2002		NA	133	1422	1249	1594
64	2002	Tomales Point	NA	133	1757	1590	1923
74	2002	Tomales Point	NA	133	1767	1449	2084
400	2002	Elk Range	NA	133	1106	996	1215
401	2002		NA	133	1384	1041	1726
402	2002		NA	133	1735	1495	1974

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
2	2008	Giacomini	NA	133	667	626	708
3	2008		NA	133	1222	1122	1322
4	2008	Lupton SUP	NA	133	861	770	951
5	2008		NA	133	3109	2880	3338
6	2008		NA	133	484	445	522
7	2008	Stewart Olema	NA	133	2355	2191	2518
8	2008	Giacomini SUP	NA	133	177	161	193
9	2008		NA	133	1140	1057	1223
10	2008		NA	133	198	181	215
13	2008	McIsaac	NA	133	866	794	938
14	2008	Kehoe	NA	133	501	451	550
16	2008	A Ranch	NA	133	428	394	461
17	2008		NA	133	1345	1121	1570
18	2008		NA	133	369	334	404
19	2008	B. Giacomini (Gallagher)	NA	133	2751	2573	2929
21	2008	N Ranch	NA	133	280	242	318
22	2008	Lunny	NA	133	1569	1361	1777
23	2008		NA	133	2101	1934	2267
25	2008		NA	133	395	339	452
26	2008		NA	133	286	256	316
27	2008		NA	133	2263	2214	2311
28	2008		NA	133	2245	2031	2459
29	2008	Murphy SUP	NA	133	302	276	327
30	2008	Stewart	NA	133	1416	1292	1539
31	2008	McIsaac ROP	NA	133	556	514	598
32	2008	Percy	NA	133	218	202	235
33	2008	Rogers	NA	133	282	236	328
34	2008	Cheda	NA	133	107	107	107
35	2008		NA	133	1991	1822	2160
36	2008		NA	133	4538	4280	4795
37	2008	Zanardi	NA	133	280	259	302
38	2008	Niman	NA	133	1931	1821	2042
39	2008		NA	133	1161	1103	1218

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
40	2008	A Ranch Nunes	NA	133	1767	1611	1924
41	2008	Nunes "E" Ranch	NA	133	2420	2179	2662
42	2008		NA	133	798	672	924
43	2008	Horick (D Ranch)	NA	133	1124	1035	1214
44	2008		NA	133	1112	984	1239
45	2008	McClure	NA	133	886	831	942
46	2008	A. Grossi (Evans)	NA	133	429	403	454
47	2008	Kehoe	NA	133	136	127	146
48	2008		NA	133	298	275	321
49	2008		NA	133	371	331	411
50	2008		NA	133	100	100	100
51	2008	McFadden	NA	133	118	99	138
1	2009	Strain Hill	NA	133	1377	1329	1424
2	2009	Giacomini	NA	133	1508	1376	1640
3	2009	Stweart (Truttman)	NA	133	4180	3871	4488
4	2009	Lupton SUP	NA	133	1286	1154	1418
5	2009	Lundgren (Jewel)	NA	133	4728	4404	5052
6	2009	McIsaac	NA	133	653	555	751
7	2009	Stewart	NA	133	2458	2274	2642
8	2009	R. Giacomini SUP	NA	133	222	212	232
9	2009	Stewart ROP	NA	133	1254	1153	1355
10	2009	Martinelli	NA	133	633	610	657
13	2009	McIsaac	NA	133	849	770	928
14	2009	Kehoe	NA	133	328	293	363
15	2009	Kehoe	NA	133	144	130	157
16	2009	Nunes "A"	NA	133	186	159	213
17	2009	Spaletta "C Ranch"	NA	133	386	317	454
18	2009	Gallagher	NA	133	231	187	274
19	2009		NA	133	2906	2731	3081
21	2009	McDonald	NA	133	139	133	145
22	2009	Lunny SUP	NA	133	2473	1903	3043
25	2009	A. Grossi "K" Ranch	NA	133	323	289	357
26	2009	Grossi/Evans	NA	133	229	204	255

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
27	2009	Stewart "Bolinas"	NA	133	1321	1241	1400
28	2009		NA	133	1819	1549	2088
29	2009	Murphy	NA	133	232	182	282
30	2009	Stewart "Olema"	NA	133	1948	1891	2006
31	2009	McIsaac	NA	133	929	857	1000
32	2009	Percy	NA	133	543	485	600
33	2009	C. Rogers	NA	133	717	623	810
34	2009	Cheda	NA	133	129	129	129
35	2009	Stewart	NA	133	3053	2876	3231
36	2009	Tacherra	NA	133	3231	3031	3431
37	2009	Zanardi	NA	133	813	721	905
38	2009	Niman/Schell	NA	133	1056	869	1243
39	2009	Niman/Schell	NA	133	363	289	438
40	2009	Nunes "A"	NA	133	1158	980	1336
41	2009	Nunes "E Ranch"	NA	133	825	714	936
42	2009	Mendoza	NA	133	285	226	344
43	2009	Horick	NA	133	553	488	617
44	2009	Grossi	NA	133	675	609	742
45	2009	McClure	NA	133	1097	1043	1152
46	2009	Evans	NA	133	656	557	754
47	2009	Kehoe	NA	133	124	124	124
48	2009	D. Rogers	NA	133	337	313	361
49	2009	Lobaugh	NA	133	719	630	808
50	2009	Genazzi	NA	133	125	103	146
51	2009		NA	133	154	142	167
2	2011	Giacomini	NA	133	1948	1821	2076
3	2011	Stewart-Truttman SUP	NA	133	3671	3441	3900
4	2011	Truttman SUP	NA	133	942	877	1007
5	2011	Lundgren	NA	133	4094	3841	4347
6	2011	McIsaac SUP	NA	133	1379	1290	1469
7	2011	Stewart "Olema"	NA	133	2224	2002	2446
8	2011	Giacomini-SUP	NA	133	690	637	742
9	2011	Stewart-ROP	NA	133	2011	1803	2220

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
10	2011	Martinelli	NA	133	748	666	829
13	2011	McIsaac-SUP	NA	133	1863	1738	1988
19	2011	Gallagher	NA	133	2344	2229	2460
27	2011	Stewart Bolinas	NA	133	2192	1999	2384
30	2011	Stewart Olema	NA	133	1335	1233	1436
31	2011	McIsaac-ROP	NA	133	1404	1278	1530
32	2011	Percy	NA	133	845	762	928
33	2011	C. Rogers	NA	133	1386	1282	1489
34	2011	Cheda	NA	133	188	159	217
35	2011	Stewart ROP	NA	133	1615	1514	1717
37	2011	Zanardi	NA	133	533	477	589
38	2011	Niman/Schell	NA	133	1723	1539	1906
39	2011	Niman/Schell-ROP	NA	133	1782	1623	1940
45	2011	I Ranch	NA	133	1670	1570	1770
50	2011	Genazzi	NA	133	231	209	253
51	2011	McFadden	NA	133	900	766	1034
1	2012	Strain Hill	NA	133	2180	1984	2377
2	2012	Giacomini	NA	133	3585	3392	3778
3	2012	Stewart-Truttman SUP	NA	133	6697	6376	7018
4	2012	Lupton	NA	133	2803	2462	3144
5	2012	Lundgren	NA	133	6592	6103	7082
6	2012	McIsaac SUP	NA	133	1019	867	1171
7	2012	Stewart "Olema"	NA	133	3114	2804	3424
8	2012	Giacomini-SUP	NA	133	855	775	935
9	2012	Stewart-ROP	NA	133	2547	2418	2676
10	2012	Martinelli	NA	133	1080	993	1167
11	2012	E. Beebe Tract Comparison Area	NA	133	2141	1931	2351
12	2012	Rodoni SUP	NA	133	5378	5030	5725
13	2012	McIsaac-SUP	NA	133	2001	1851	2151
14	2012	Kehoe SUP	NA	133	1668	1546	1791
15	2012	Kehoe SUP	NA	133	964	870	1059
16	2012	A Ranch SUP	NA	133	429	384	474

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
17	2012	C Ranch	NA	133	1846	1702	1991
18	2012	Gallagher SUP	NA	133	2284	2153	2415
19	2012	Gallagher	NA	133	3466	3251	3680
20	2012	Abbotts Lagoon Comparison area	NA	133	825	727	924
21	2012	N Ranch	NA	133	1007	907	1108
22	2012	Lunny SUP	NA	133	5640	5291	5989
23	2012	S. Beebe Tract Comparison Area	NA	133	4221	3722	4720
24	2012	Limantour comparison area	NA	133	5996	5740	6253
25	2012	A. Grossi "K" Ranch	NA	133	730	634	826
26	2012	K Ranch SUP	NA	133	1409	1177	1641
27	2012	Stewart Bolinas	NA	133	3642	3403	3882
28	2012	Wilkins Ranch	NA	133	10791	10099	11482
29	2012	Home Ranch	NA	133	1041	959	1123
30	2012	Stewart Olema	NA	133	2329	2176	2483
31	2012	McIsaac-ROP	NA	133	1663	1542	1784
32	2012	Percy	NA	133	777	721	832
33	2012	C. Rogers	NA	133	1366	1195	1537
34	2012	Cheda	NA	133	383	340	426
35	2012	Stewart ROP	NA	133	3066	2777	3356
36	2012	Tacherra SUP	NA	133	4509	4156	4862
37	2012	Zanardi	NA	133	566	509	624
38	2012	Niman/Schell	NA	133	2105	1718	2491
39	2012	Niman/Schell-ROP	NA	133	2305	2168	2442
40	2012	Nunes "A" Ranch ROP	NA	133	3007	2772	3243
41	2012	Nunes "E" Ranch ROP	NA	133	5231	4922	5539
42	2012	Mendoza ROP	NA	133	3049	2864	3234
43	2012	Horick ROP	NA	133	3336	2984	3687
44	2012	D. Grossi ROP	NA	133	2604	2503	2705
45	2012	I Ranch	NA	133	1852	1745	1959
46	2012	A. Grossi ROP	NA	133	2291	2105	2476
47	2012	Kehoe ROP	NA	133	365	341	390

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
48	2012	D. Rogers	NA	133	1686	1483	1889
49	2012	Lobaugh ROP	NA	133	1711	1602	1819
50	2012	Genazzi	NA	133	147	129	165
51	2012	McFadden	NA	133	1330	1213	1447
1	2013	Strain Hill	NA	100	2966	2742	3189
2	2013	Giacomini	NA	100	1534	1438	1631
3	2013	Stewart-Truttman SUP	NA	100	2527	2411	2644
4	2013	Lupton	NA	100	2686	2366	3005
5	2013	Lundgren	NA	100	5592	5109	6074
6	2013	McIsaac SUP	NA	100	1315	1233	1397
7	2013	Stewart "Olema"	NA	100	3272	3087	3456
8	2013	Giacomini-SUP	NA	100	888	798	978
9	2013	Stewart-ROP	NA	100	1739	1632	1846
10	2013	Martinelli	NA	100	1091	1004	1177
11	2013	E. Beebe Tract Comparison Area	NA	100	1360	1232	1487
13	2013	McIsaac-SUP	NA	100	1358	1252	1463
14	2013	Kehoe SUP	NA	100	1440	1342	1539
15	2013	Kehoe SUP	NA	100	1077	1001	1153
16	2013	A Ranch SUP	NA	100	505	461	548
17	2013	C Ranch	NA	100	1340	1245	1436
18	2013	Gallagher SUP	NA	100	1700	1583	1817
19	2013	Gallagher	NA	100	3689	3196	4182
20	2013	Abbotts Lagoon Comparison area	NA	100	1804	1658	1950
21	2013	N Ranch	NA	100	808	761	856
22	2013	Lunny SUP	NA	100	5579	5129	6028
23	2013	S. Beebe Tract Comparison Area	NA	100	2781	2288	3273
24	2013	Limantour comparison area	NA	100	2868	2643	3093
25	2013	A. Grossi "K" Ranch	NA	100	461	420	503
26	2013	K Ranch SUP	NA	100	620	550	689
27	2013	Stewart Bolinas	NA	100	3363	3037	3689

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
28	2013	Wilkins Ranch	NA	100	2058	1953	2163
29	2013	Home Ranch	NA	100	960	906	1013
30	2013	Stewart Olema	NA	100	2185	2016	2354
31	2013	McIsaac-ROP	NA	100	1299	1213	1385
32	2013	Percy	NA	100	521	487	555
33	2013	C. Rogers	NA	100	1138	1057	1218
34	2013	Cheda	NA	100	204	184	223
35	2013	Stewart ROP	NA	100	3311	3101	3520
36	2013	Tacherra SUP	NA	100	5777	5340	6215
37	2013	Zanardi	NA	100	465	408	521
38	2013	Niman/Schell	NA	100	2533	2192	2874
39	2013	Niman/Schell-ROP	NA	100	2364	2127	2601
40	2013	Nunes "A" Ranch ROP	NA	100	1849	1707	1990
41	2013	Nunes "E" Ranch ROP	NA	100	3264	3074	3454
42	2013	Mendoza ROP	NA	100	719	642	795
43	2013	Horick ROP	NA	100	1167	1021	1314
44	2013	D. Grossi ROP	NA	100	2292	2089	2495
45	2013	I Ranch	NA	100	1168	1062	1275
46	2013	A. Grossi ROP	NA	100	1867	1762	1972
47	2013	Kehoe ROP	NA	100	401	368	434
48	2013	D. Rogers	NA	100	2143	1930	2357
49	2013	Lobaugh ROP	NA	100	1983	1759	2208
50	2013	Genazzi	NA	100	392	360	424
51	2013	McFadden	NA	100	2328	2170	2486
38a	2013	Niman/Schell	NA	100	2311	1973	2650
39a	2013	Niman/Schell-ROP	NA	100	2188	2015	2361
1	2014	Strain Hill	NA	100	1886	1750	2021
2	2014	Giacomini	NA	100	608	557	659
3	2014	Stewart-Truttman SUP	NA	100	2242	2108	2375
4	2014	Lupton	NA	100	1140	1046	1235
5	2014	Lundgren	NA	100	3270	3015	3524
6	2014	McIsaac SUP	NA	100	1193	1071	1316
7	2014	Stewart "Olema"	NA	100	2528	2379	2677

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
8	2014	Giacomini-SUP	NA	100	857	797	916
9	2014	Stewart-ROP	NA	100	987	931	1042
10	2014	Martinelli	NA	100	964	902	1027
11	2014	E. Beebe Tract Comparison Area	NA	100	348	279	418
13	2014	McIsaac-SUP	NA	100	1138	1057	1218
14	2014	Kehoe SUP	NA	100	770	703	837
15	2014	Kehoe SUP	NA	100	624	550	698
16	2014	A Ranch SUP	NA	100	1184	1072	1297
17	2014	C Ranch	NA	100	793	733	852
18	2014	Gallagher SUP	NA	100	1412	1305	1518
19	2014	Gallagher	NA	100	3256	3120	3393
20	2014	Abbotts Lagoon Comparison area	NA	100	626	547	705
21	2014	N Ranch	NA	100	943	904	982
22	2014	Lunny SUP	NA	100	2919	2677	3161
23	2014	S. Beebe Tract Comparison Area	NA	100	1101	239	1964
24	2014	Limantour comparison area	NA	100	2040	1905	2175
25	2014	A. Grossi "K" Ranch	NA	100	342	309	375
26	2014	K Ranch SUP	NA	100	755	650	861
27	2014	Stewart Bolinas	NA	100	3840	3467	4214
28	2014	Wilkins Ranch	NA	100	2235	2112	2359
29	2014	Home Ranch	NA	100	622	582	662
30	2014	Stewart Olema	NA	100	2249	2004	2494
31	2014	McIsaac-ROP	NA	100	1795	1705	1886
32	2014	Percy	NA	100	389	351	427
33	2014	C. Rogers	NA	100	1535	1449	1620
34	2014	Cheda	NA	100	250	229	271
35	2014	Stewart ROP	NA	100	1934	1828	2041
36	2014	Tacherra SUP	NA	100	3648	3336	3960
37	2014	Zanardi	NA	100	487	453	521
38	2014	Niman/Schell	NA	100	1204	1138	1271

T	Year	Ranch Name	RDM Visual Estimate	Conversion (lbs/acre)	RDM (lbs/acre)	Lower CI	Upper CI
39	2014	Niman/Schell-ROP	NA	100	1234	1132	1336
40	2014	Nunes "A" Ranch ROP	NA	100	3170	2930	3410
41	2014	Nunes "E" Ranch ROP	NA	100	1193	1036	1351
42	2014	Mendoza ROP	NA	100	1071	997	1145
43	2014	Horick ROP	NA	100	1451	1366	1536
44	2014	D. Grossi ROP	NA	100	1232	1174	1290
45	2014	I Ranch	NA	100	898	783	1014
46	2014	A. Grossi ROP	NA	100	2388	2201	2575
47	2014	Kehoe ROP	NA	100	165	153	176
48	2014	D. Rogers	NA	100	1185	1100	1270
49	2014	Lobaugh ROP	NA	100	837	738	935
50	2014	Genazzi	NA	100	581	549	612
51	2014	McFadden	NA	100	993	900	1087
57	2014	AT&T	NA	100	1239	1100	1378

Table A.2: Key area transect name and years surveyed; No surveys 1997-2000, 2003-2007, 2010; 1 = double sampling or visual estimate survey conducted.

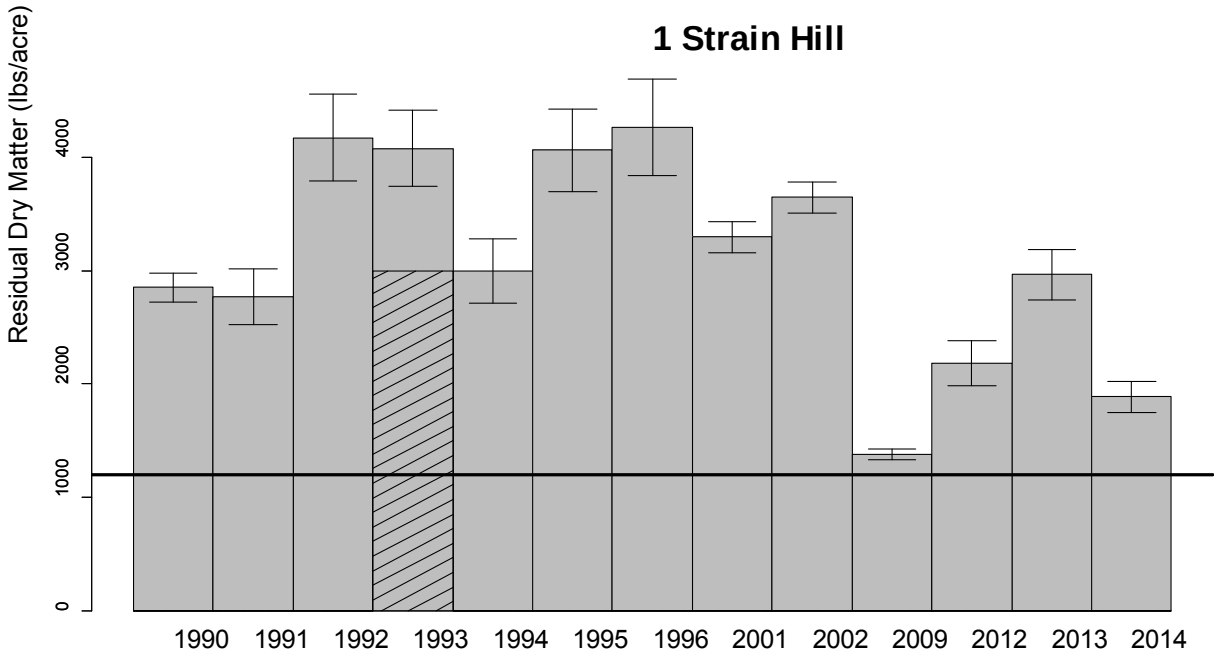
T	Current name	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	2001	2002	2008	2009	2011	2012	2013	2014	Total
1	Strain Hill				1	1	1	1	1	1	1	1	1		1		1	1	1	13
2	R Giacomini	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	17
3	Stewart Truttman	1	1	1	1	1		1	1	1		1		1	1	1	1	1	1	15
4	Stewart Lupton	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	17
5	Jewell	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	16
6	McIsaac Bolinas	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	17
7	Bear Valley			1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	15
8	R Giacomini	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	17
9	Stewart			1	1	1	1	1	1	1	1			1	1	1	1	1	1	14
10	Martinelli			1	1	1	1	1	1	1	1			1	1	1	1	1	1	14
11	Beebe East				1	1	1	1	1	1	1						1	1	1	10
12	Olema Marsh			1	1	1	1	1	1	1							1			8
13	McIsaac Bolinas		1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	15
14	J Ranch North	1	1	1	1	1	1	1	1	1		1	1	1	1		1	1	1	16
15	J Ranch East	1	1	1	1	1	1	1	1	1	1		1		1		1	1	1	15
16	A Ranch	1	1	1	1	1	1	1	1	1		1		1	1		1	1	1	15
17	C Ranch	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	16
18	F Ranch	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	16
19	E Gallagher			1	1	1	1	1	1	1				1	1	1	1	1	1	13
20	Abbots Lagoon				1	1	1	1	1	1							1	1	1	9
21	N Ranch	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	16
22	G Ranch	1	1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	16
23	Beebe South				1	1	1	1	1	1	1			1			1	1	1	11
24	Limantour				1	1	1	1	1	1	1						1	1	1	10
25	K Ranch	1	1	1	1	1	1	1	1	1			1	1	1		1	1	1	15

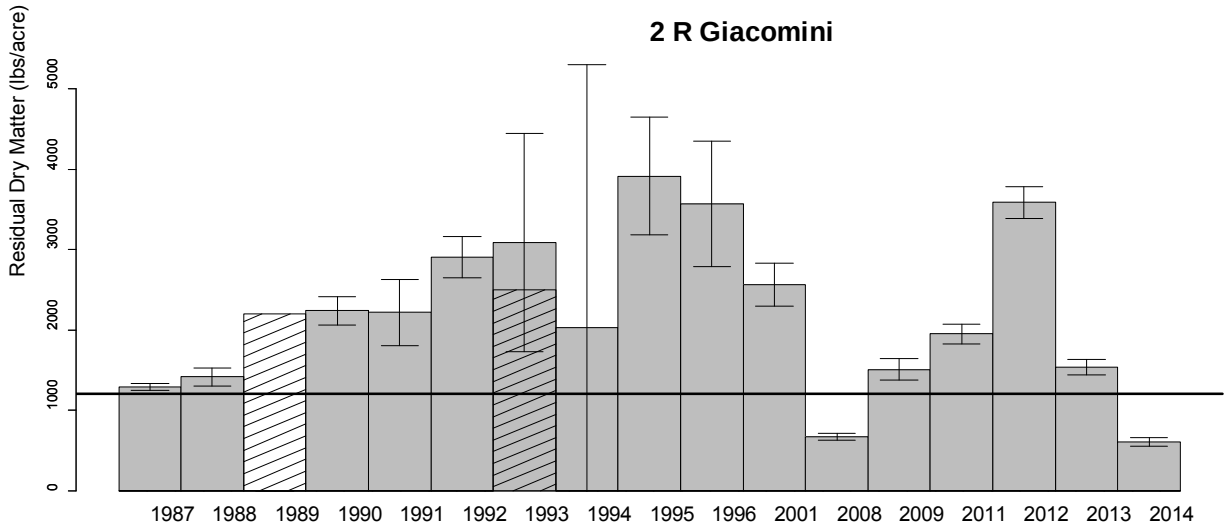
T	Current name	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	2001	2002	2008	2009	2011	2012	2013	2014	Total
	Kehoe																			
26	K Ranch Evans	1	1	1	1	1	1	1	1	1		1		1	1		1	1	1	15
27	Commonweal	1		1	1	1	1	1	1	1	1			1	1	1	1	1	1	15
28	Dogtown	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	16
29	Home Ranch	1	1	1	1	1	1	1	1	1			1	1	1		1	1	1	15
30	Bear Valley	1	1	1	1	1	1	1	1					1	1	1	1	1	1	14
31	McIsaac West	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	17
32	Percy	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	16
33	C Rogers	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	15
34	Cheda	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	15
35	Stewart	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	16
36	Tacherra	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	16
37	Zanardi	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	17
38	Commonweal	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	17
39	Niman	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	16
40	A Ranch	1	1	1	1	1	1	1	1	1				1	1		1	1	1	14
41	E Ranch	1	1	1	1	1	1	1	1	1		1		1	1		1	1	1	15
42	B Ranch	1	1	1	1	1	1		1	1		1		1	1		1	1	1	14
43	D Ranch Nunes	1	1	1	1	1	1	1	1	1			1	1	1		1	1	1	15
44	M Ranch	1	1	1	1	1	1	1	1	1		1		1	1		1	1	1	15

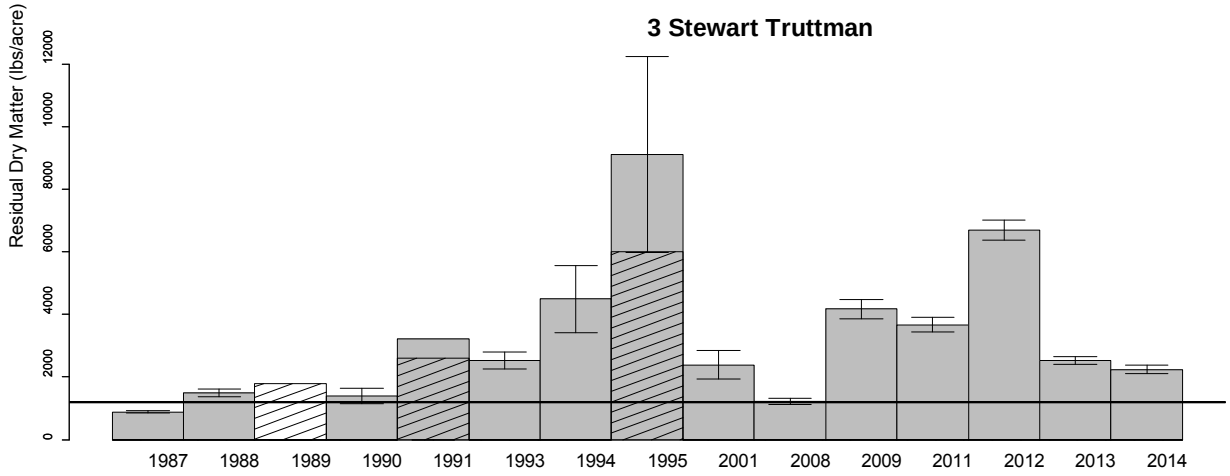
T	Current name	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	2001	2002	2008	2009	2011	2012	2013	2014	Total
45	I Ranch	1		1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	16
46	H Ranch	1	1	1	1	1	1	1	1	1		1		1	1		1	1	1	15
47	J Ranch West	1	1	1	1	1	1	1	1	1				1	1		1	1	1	14
48	D Rogers	1	1	1	1	1	1	1	1	1			1	1	1		1	1	1	15
49	L Ranch	1		1	1	1	1	1	1	1			1	1	1		1	1	1	14
50	Genazzi			1	1	1	1		1	1	1		1	1	1	1	1	1	1	14
51	McFadden			1	1	1	1	1	1	1	1			1	1	1	1	1	1	14
57	AT&T												1						1	2
60												1	1							2
64												1	1							2
74												1	1							2
90			1			1														2
91			1			1														2
92			1																	1
93			1																	1
400												1	1							2
401												1	1							2
402												1	1							2
Total transects		38	40	46	51	53	50	49	51	52	29	20	27	45	46	24	51	52	51	

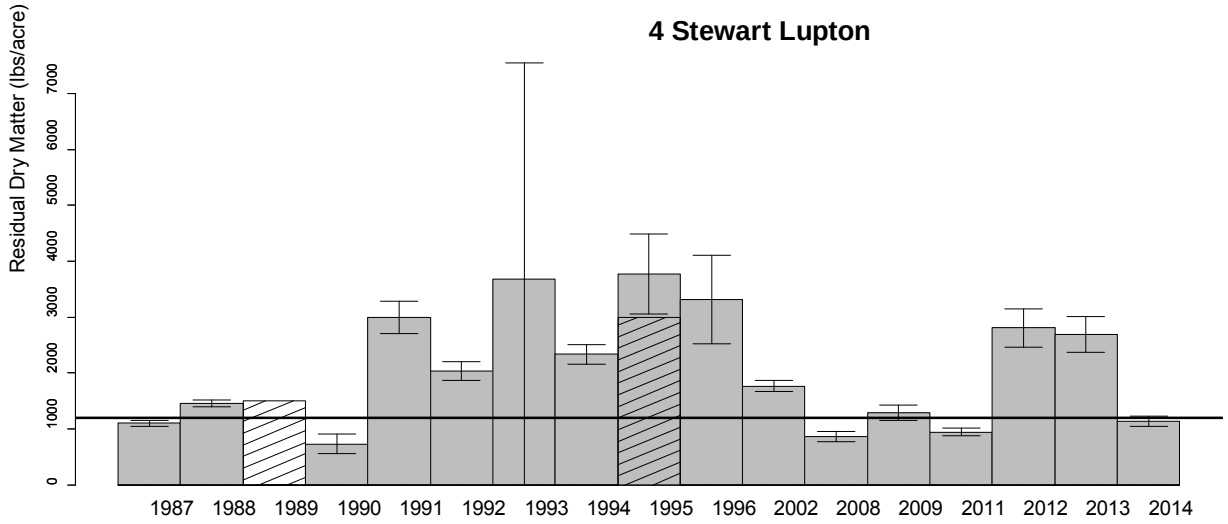
Figure A.2 1987-2014 RDM by key area transect

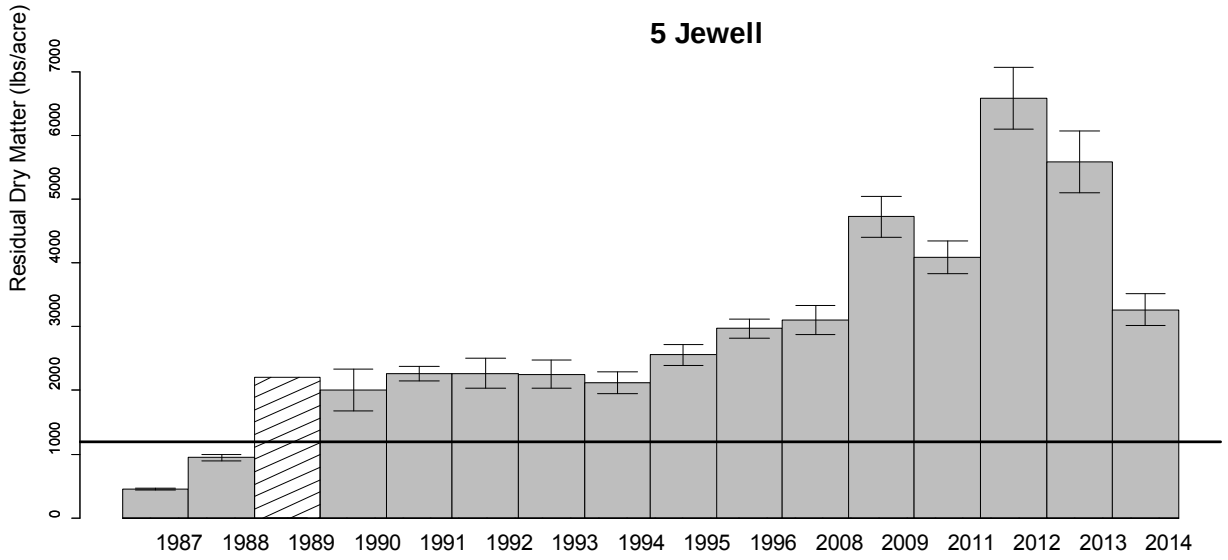
The figures for the following RDM values show annual variation in RDM for all years that are sampled with visual estimation or double-sampling monitoring. The solid grey bars with whiskers show the double-sampling RDM estimates and the corresponding 95% confidence interval. Whiskers are not shown for incomplete double-sampling estimates where a confidence interval is not calculated. The bars with only hash marks show visual estimates of RDM. Any bar that shows grey and hash marks represents a transect that in one year had some clipped estimates and visual estimation but only double-sampling if there are whiskers to represent the 95% confidence interval. The solid black line marks the 1,200 lbs/acre minimum RDM standard.

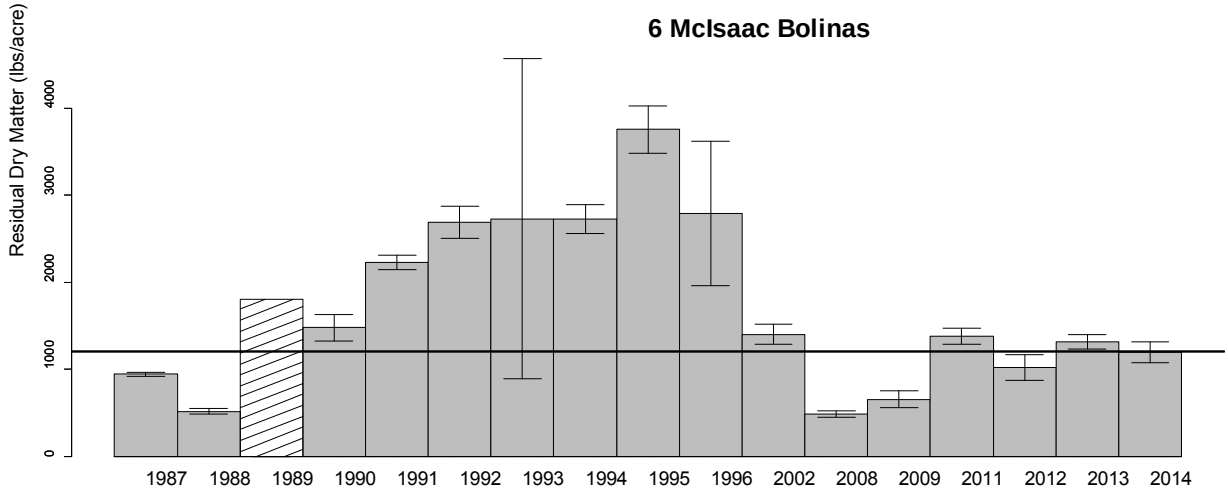

1 Strain Hill
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
1990
1991
1992
1993
1994
1995
1996
2001
2002
2009
2012
2013
2014

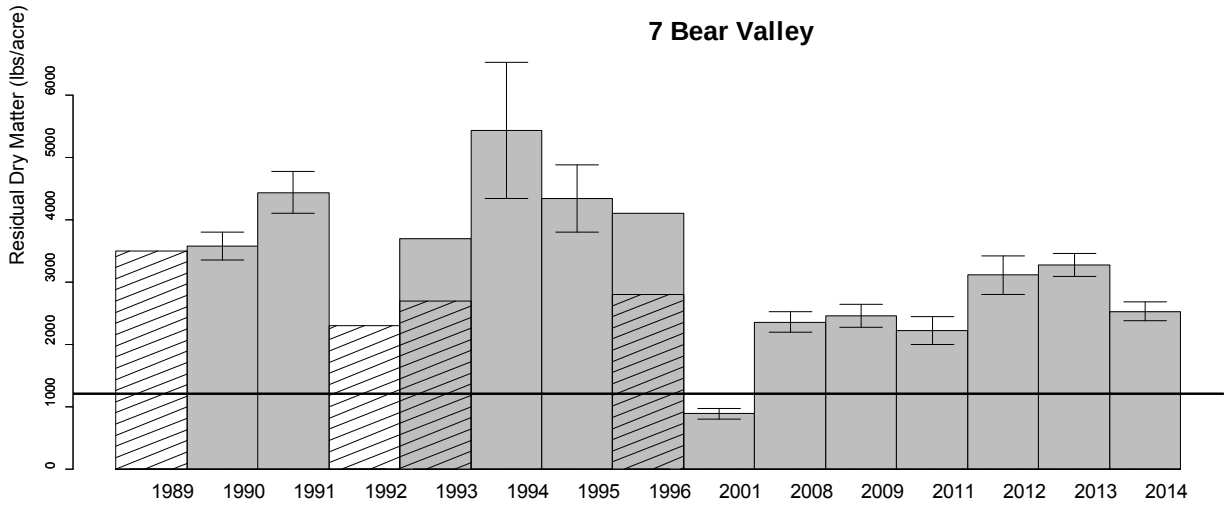

2 R Giacomini
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
2001
2008
2009
2011
2012
2013
2014

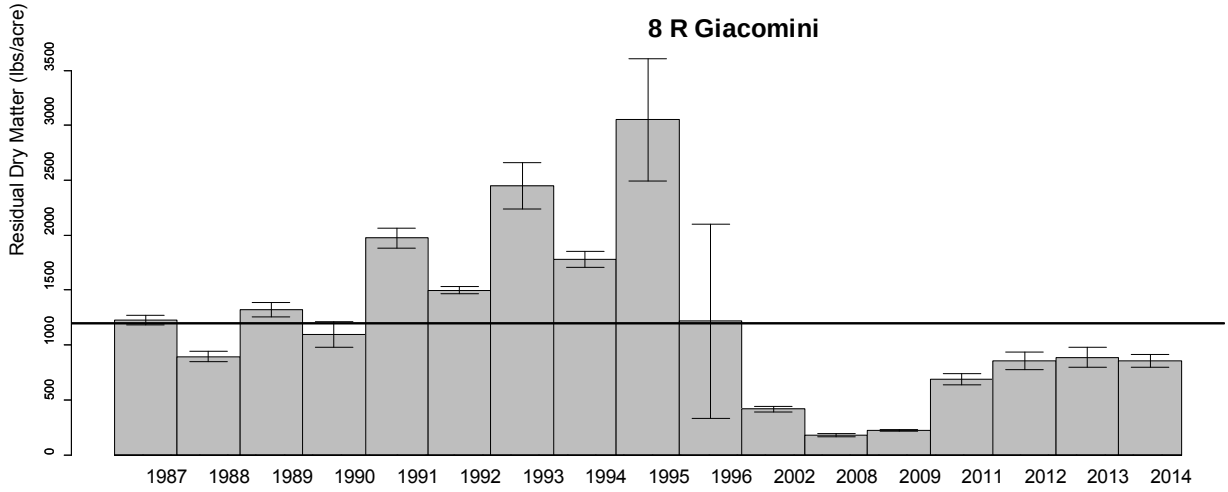

3 Stewart Truttman
Residual Dry Matter (lbs/acre)
0
2000
4000
6000
8000
10000
12000
1987
1988
1989
1990
1991
1993
1994
1995
2001
2008
2009
2011
2012
2013
2014

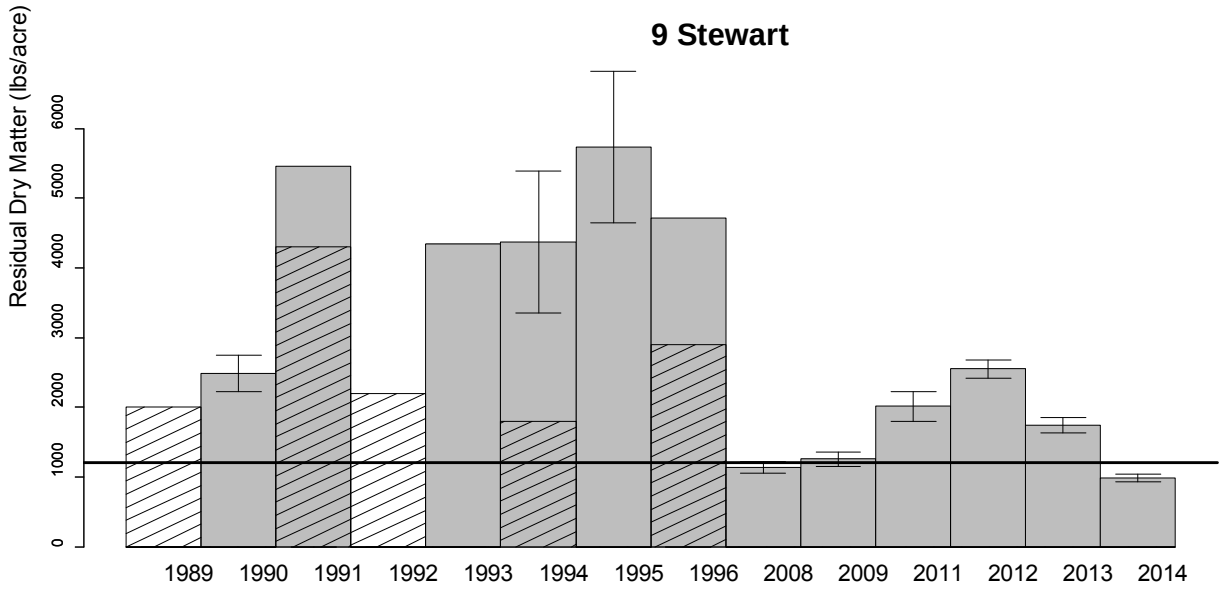

4 Stewart Lupton
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
7000
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
2002
2008
2009
2011
2012
2013
2014


5 Jewell
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
7000
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
2008
2009
2011
2012
2013
2014


6 McIsaac Bolinas
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
2002
2008
2009
2011
2012
2013
2014


7 Bear Valley
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
1989
1990
1991
1992
1993
1994
1995
1996
2001
2008
2009
2011
2012
2013
2014


8 R Giacomini
Residual Dry Matter (lbs/acre)
0
500
1000
1500
2000
2500
3000
3500
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
2002
2008
2009
2011
2012
2013
2014


9 Stewart
Residual Dry Matter (lbs/acre)
0
1000
2000
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4000
5000
6000
1989
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1993
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1995
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2013
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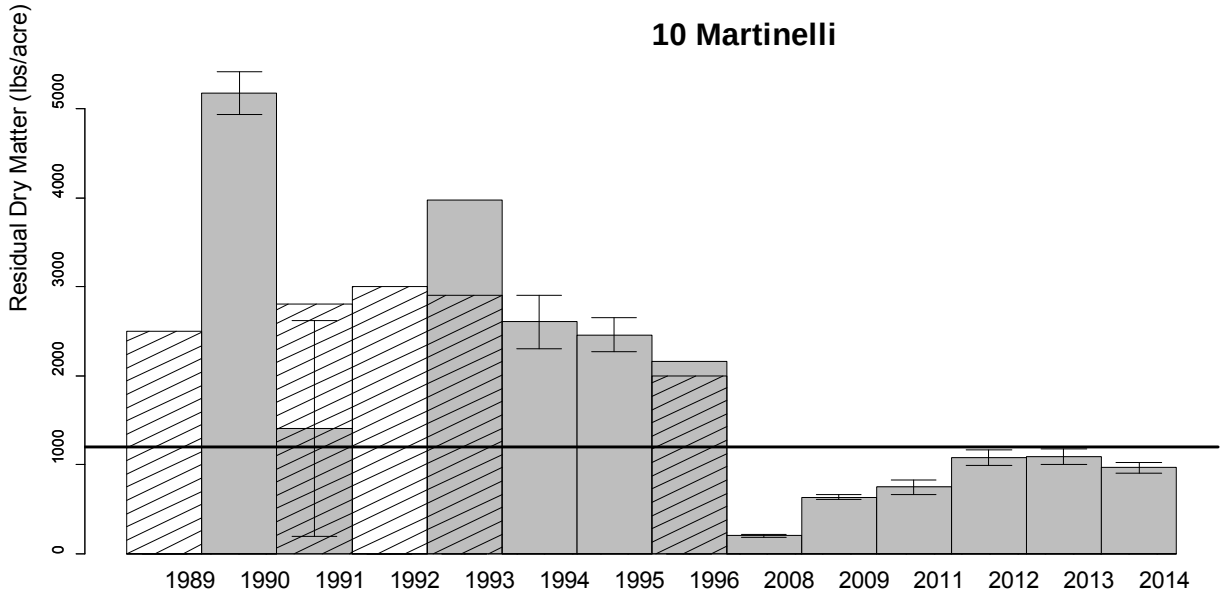
10 Martinelli
Residual Dry Matter (lbs/acre)
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2000
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4000
5000
1989
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1995
1996
2008
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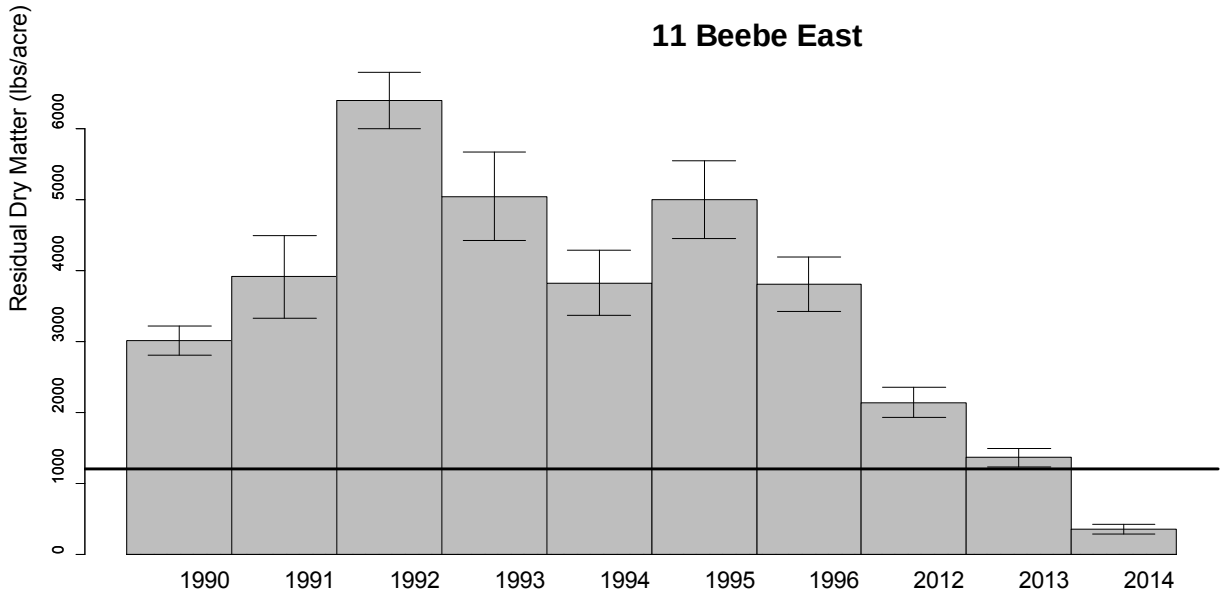
2011
2012
2013
2014


11 Beebe East
Residual Dry Matter (lbs/acre)
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1000
2000
3000
4000
5000
6000
1990
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1992
1993
1994
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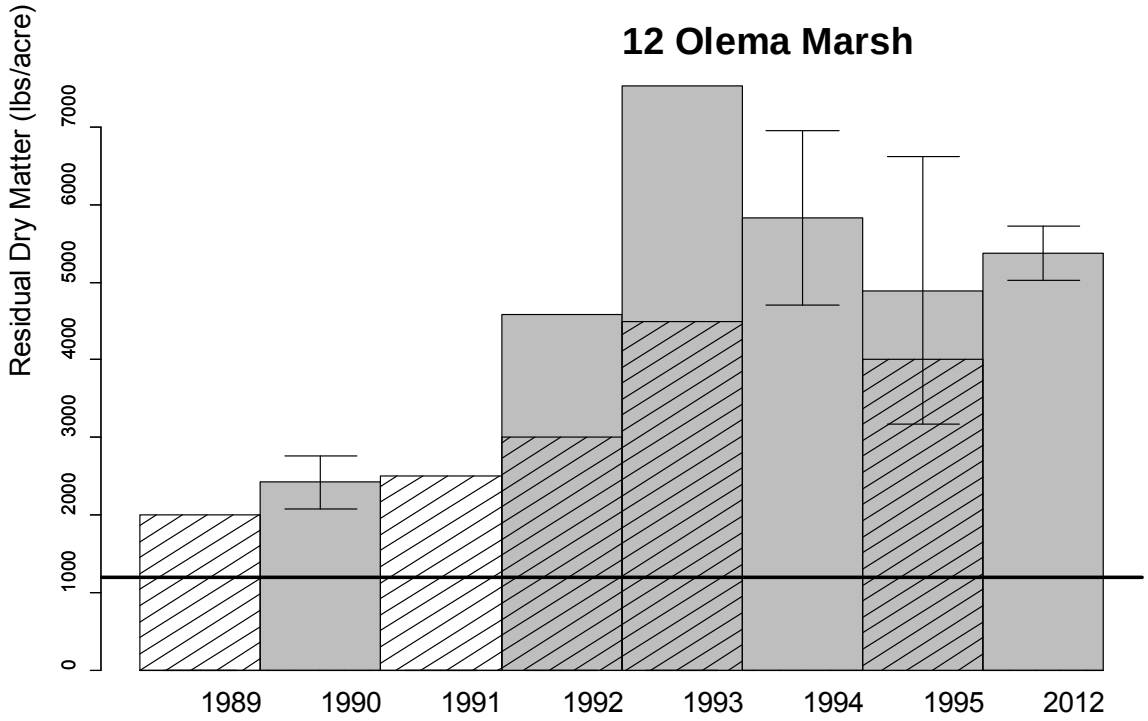
1996
2012
2013
2014


12 Olema Marsh
Residual Dry Matter (lbs/acre)
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1000
2000
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4000
5000
6000
7000
1989
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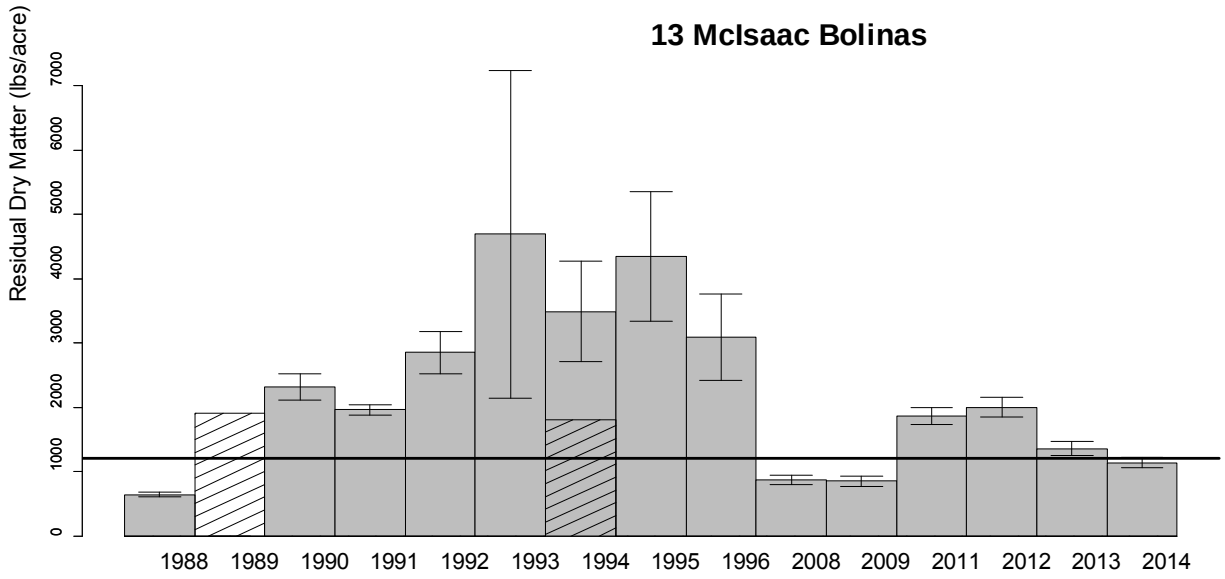
1995
2012


13 McIsaac Bolinas
Residual Dry Matter (lbs/acre)
0
1000
2000
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7000
1988
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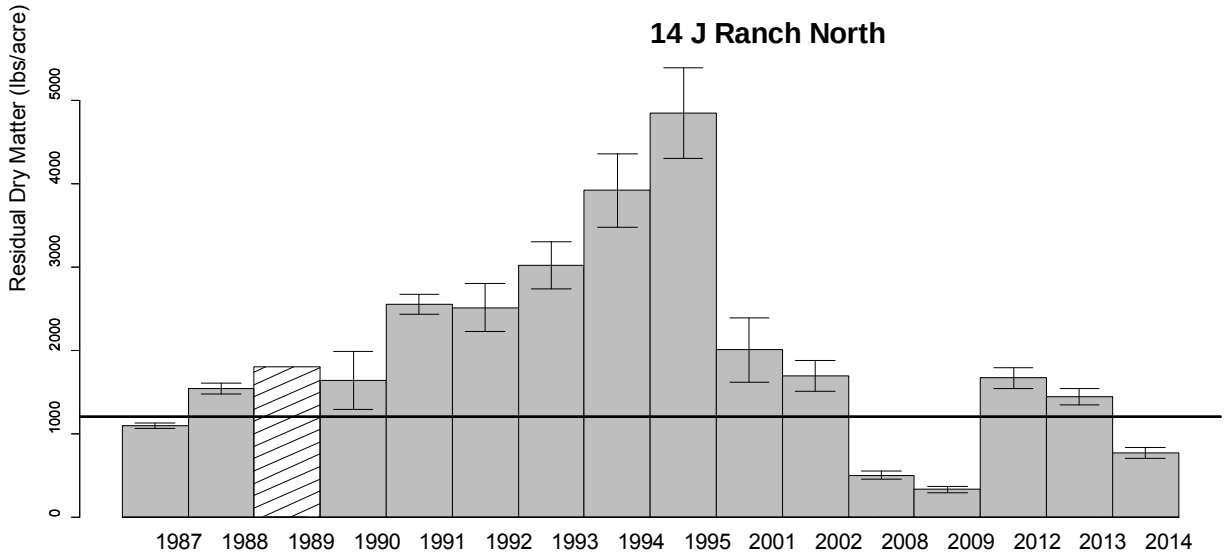
14 J Ranch North
Residual Dry Matter (lbs/acre)
0
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1987
1988
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2013
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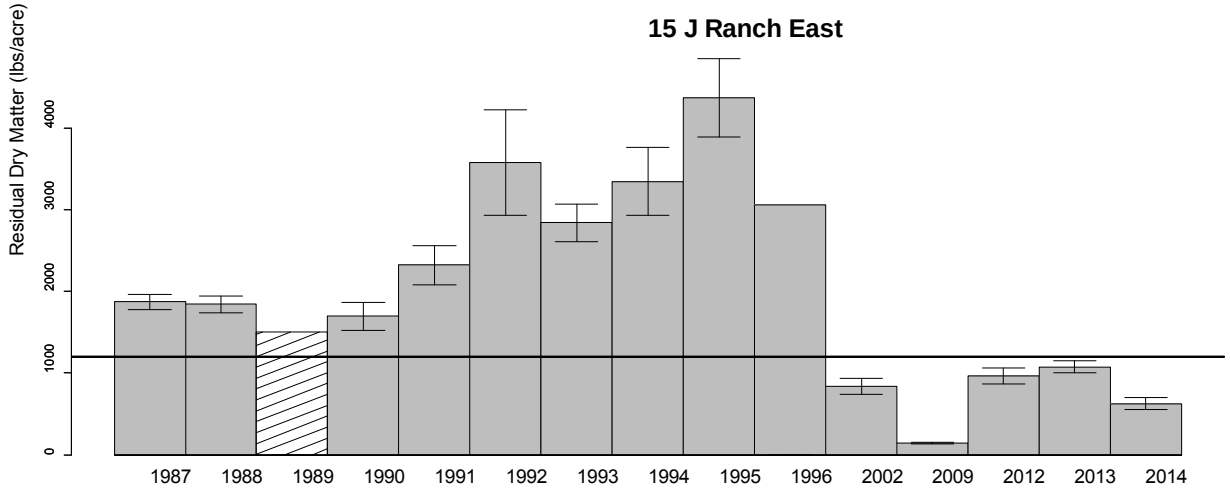
15 J Ranch East
Residual Dry Matter (lbs/acre)
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4000
1987
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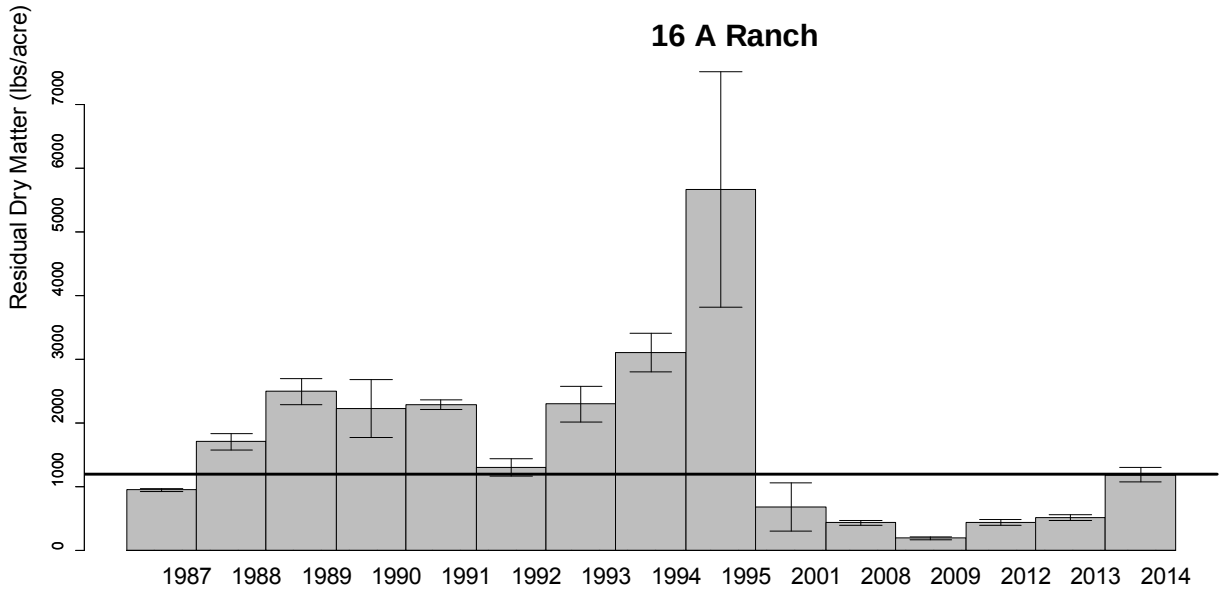
16 A Ranch
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
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5000
6000
7000
1987
1988
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1994
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2013
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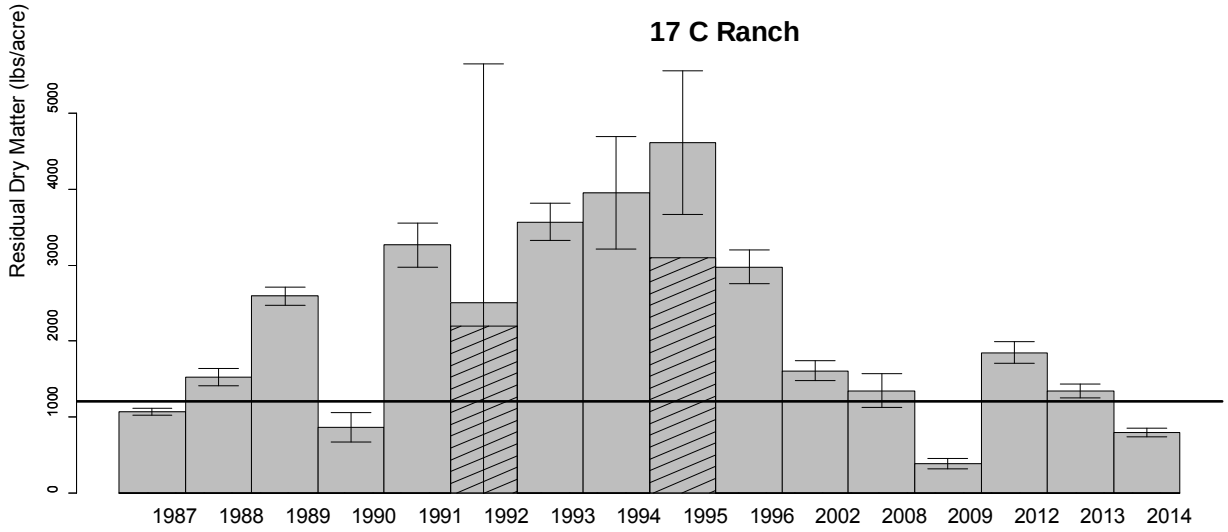
17 C Ranch
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
1987
1988
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1995
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2013
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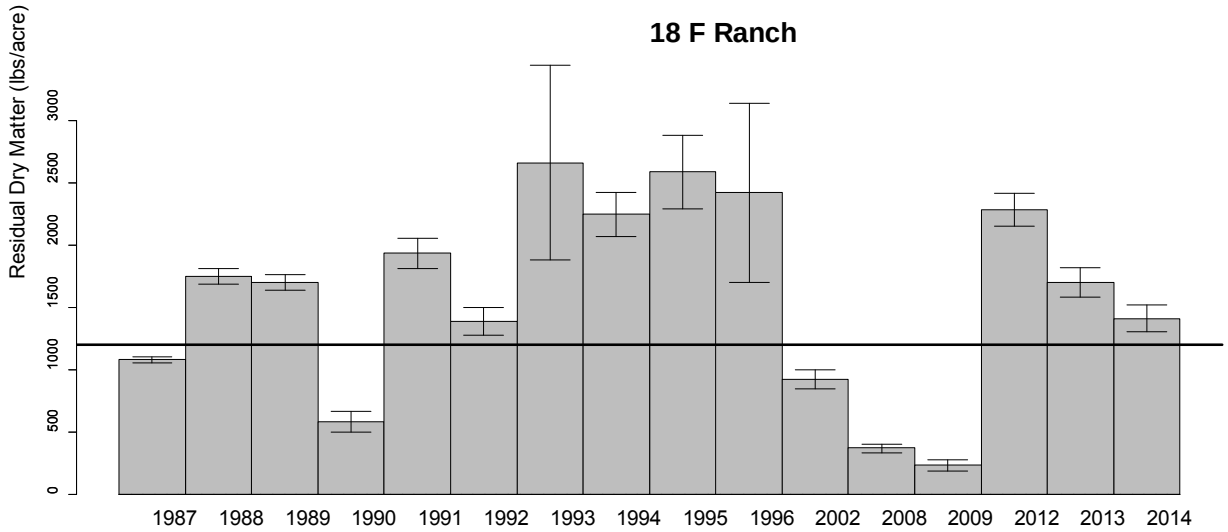
18 F Ranch
Residual Dry Matter (lbs/acre)
0
500
1000
1500
2000
2500
3000
1987
1988
1989
1990
1991
1992
1993
1994
1995
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2008
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2013
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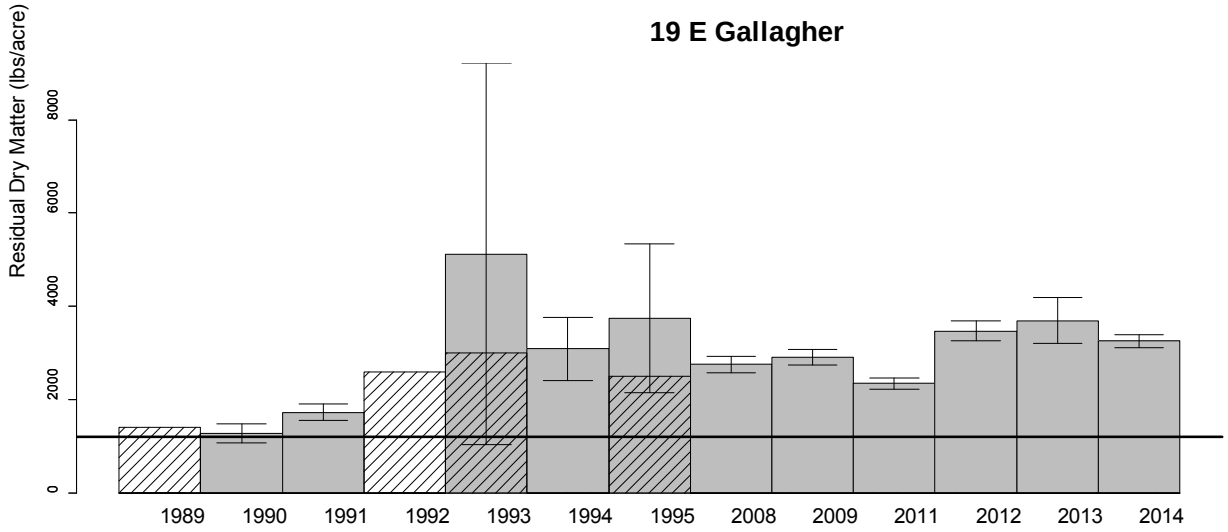
19 E Gallagher
Residual Dry Matter (lbs/acre)
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4000
6000
8000
1989
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1991
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1994
1995
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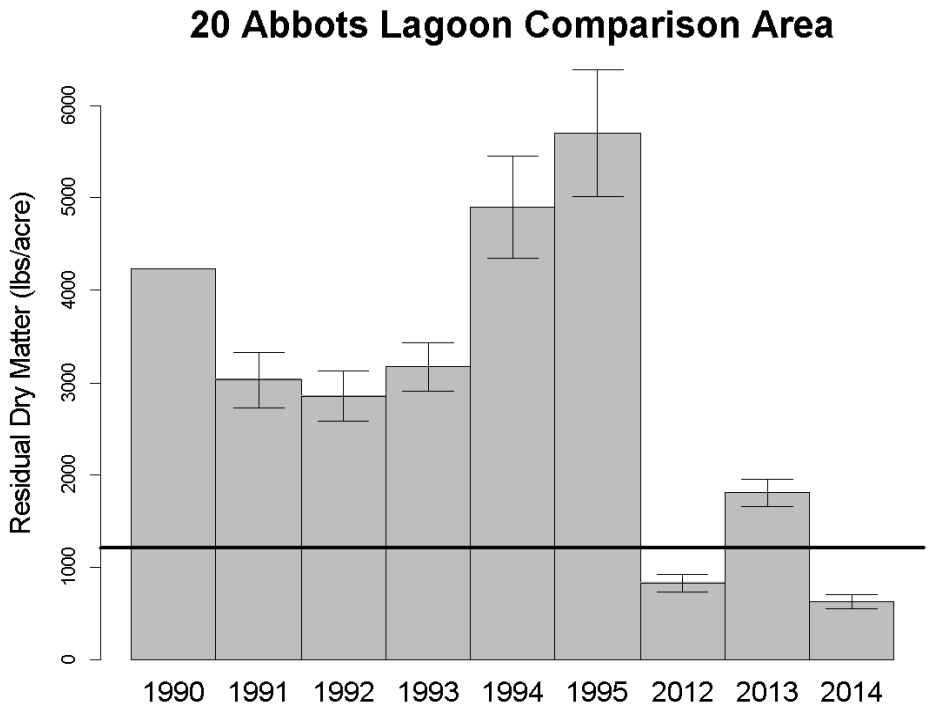
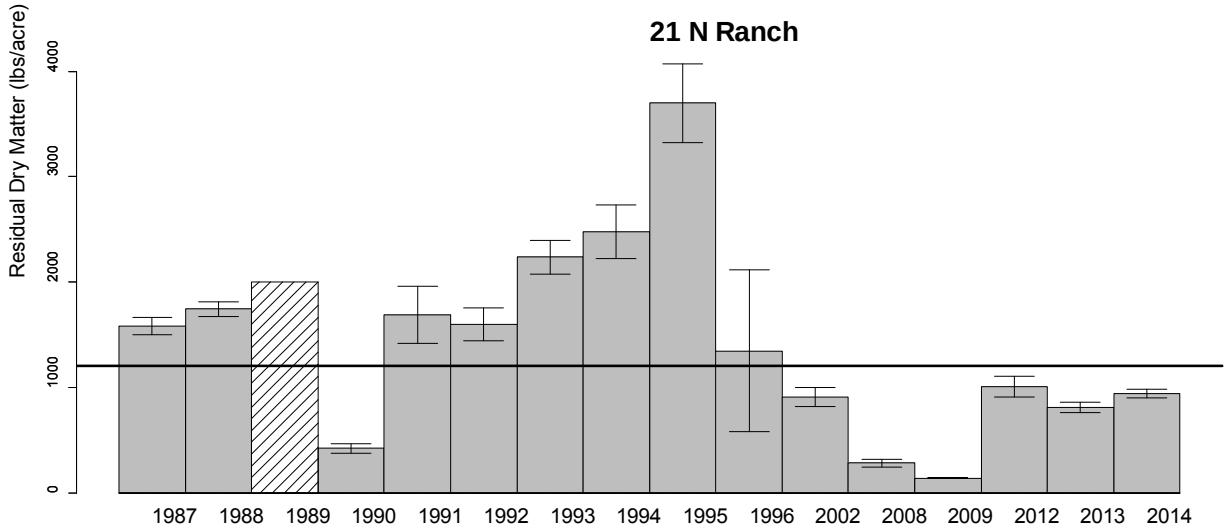
2011
2012
2013
2014


20 Abbots Lagoon Comparison Area
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
1990
1991
1992
1993
1994
1995
2012
2013
2014


21 N Ranch
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
1987
1988
1989
1990
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1992
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1995
1996
2002
2008
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2013
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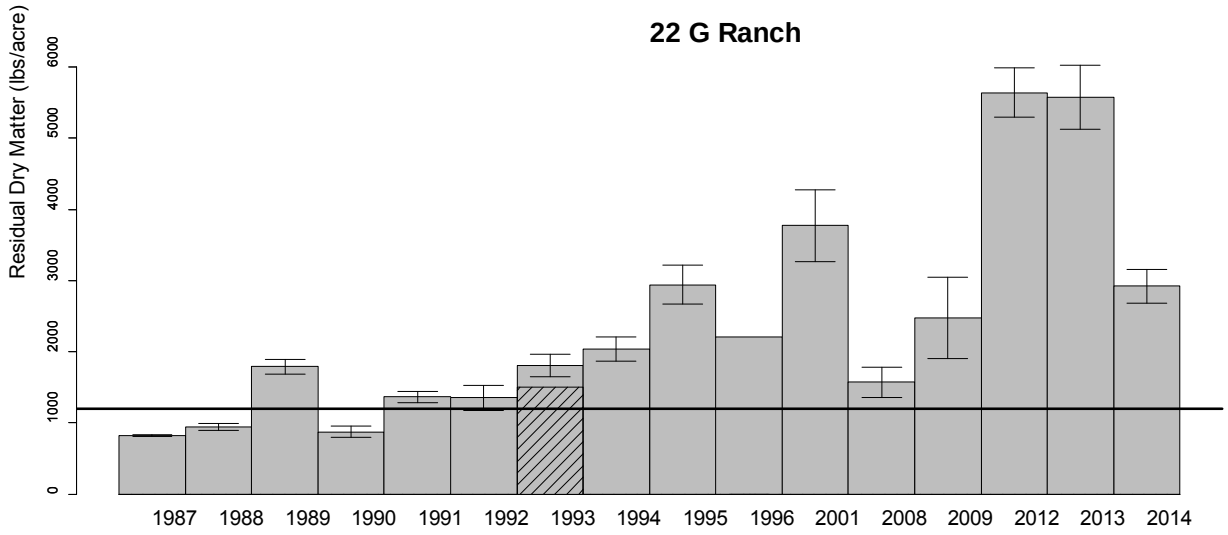
22 G Ranch
Residual Dry Matter (lbs/acre)
0
1000
2000
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4000
5000
6000
1987
1988
1989
1990
1991
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1993
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1995
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2008
2009
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2013
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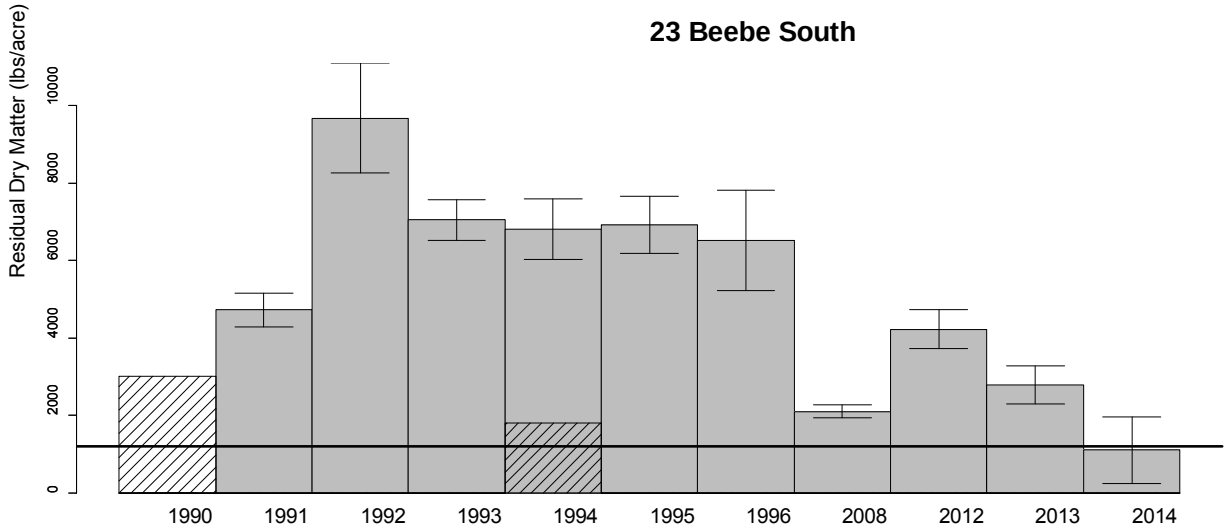
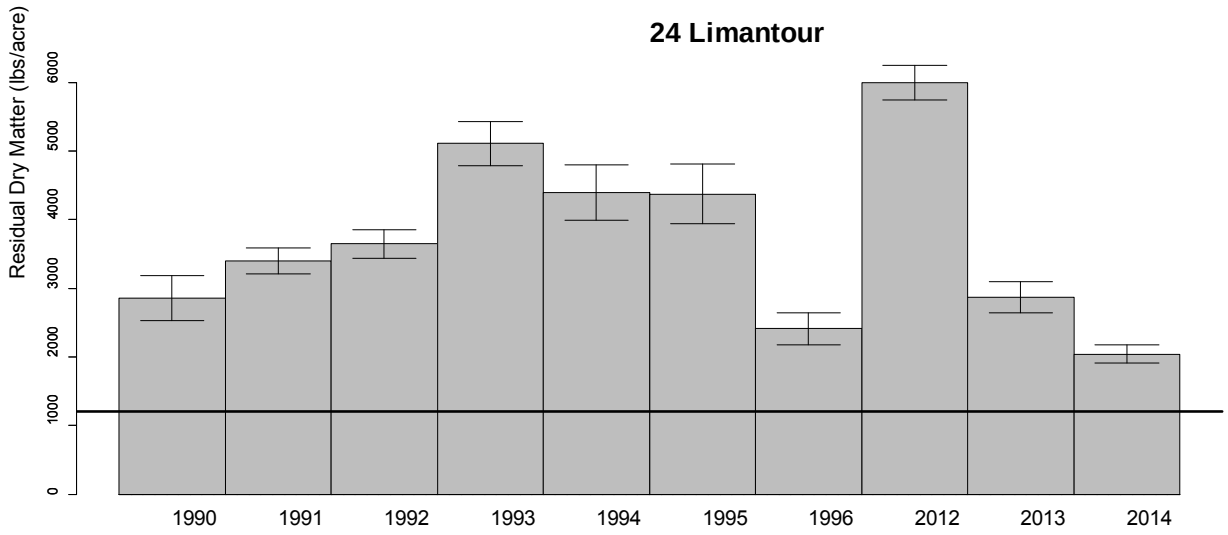

23 Beebe South
Residual Dry Matter (lbs/acre)
0
2000
4000
6000
8000
10000
1990
1991
1992
1993
1994
1995
1996
2008
2012
2013
2014


24 Limantour
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
1990
1991
1992
1993
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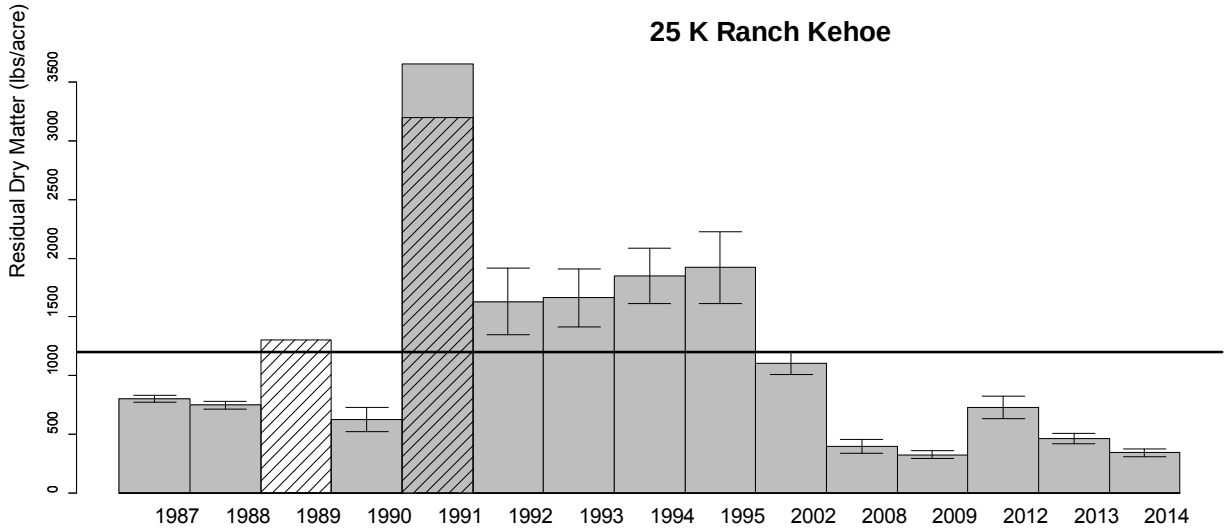
1996
2012
2013
2014


25 K Ranch Kehoe
Residual Dry Matter (lbs/acre)
0
500
1000
1500
2000
2500
3000
3500
1987
1988
1989
1990
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1992
1993
1994
1995
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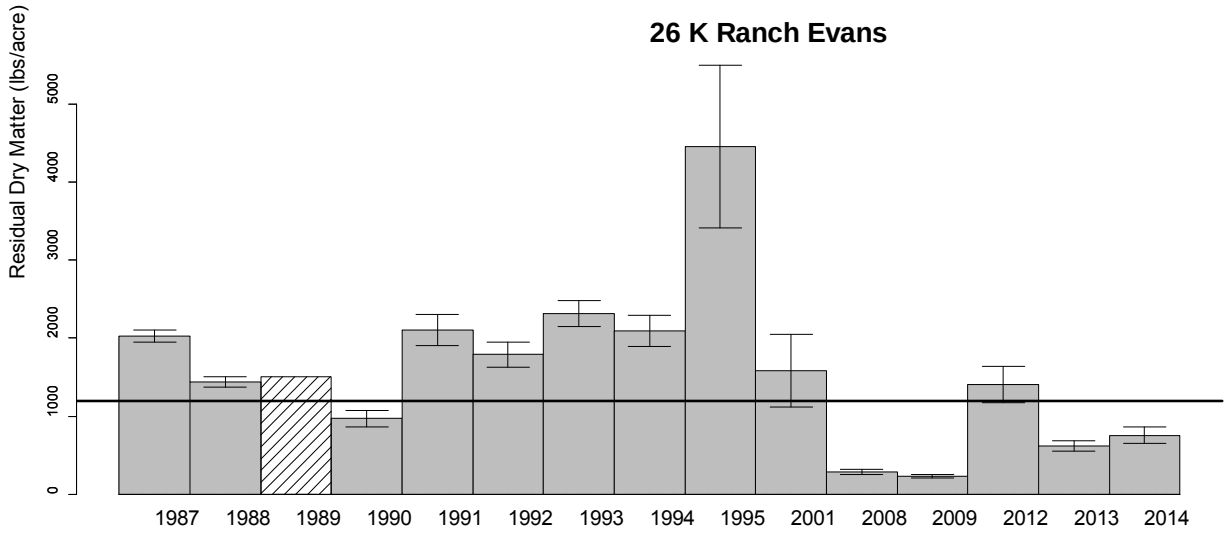
2008
2009
2012
2013
2014


26 K Ranch Evans
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
1987
1988
1989
1990
1991
1992
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1994
1995
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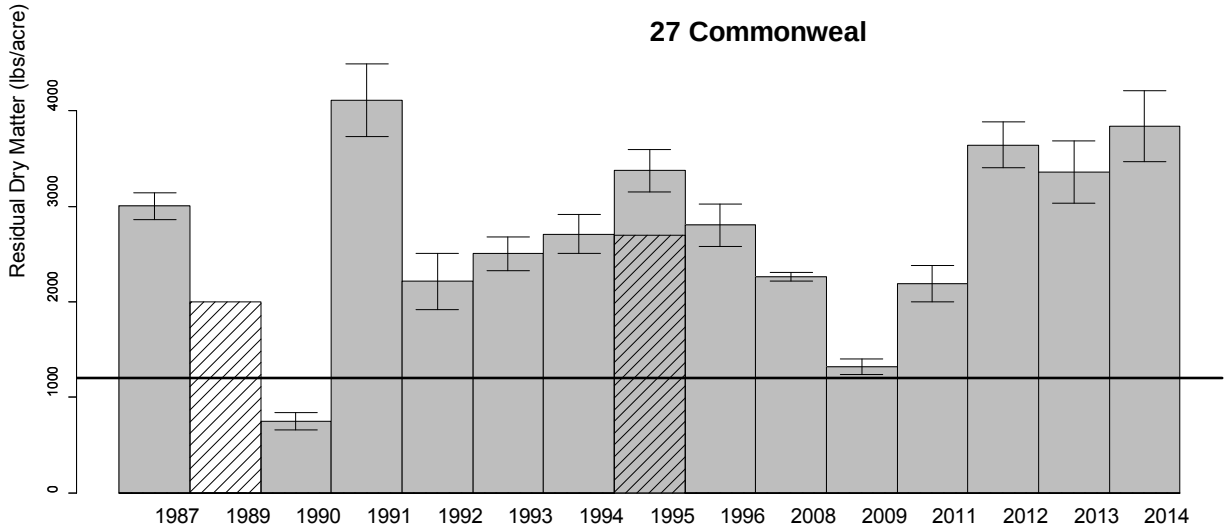
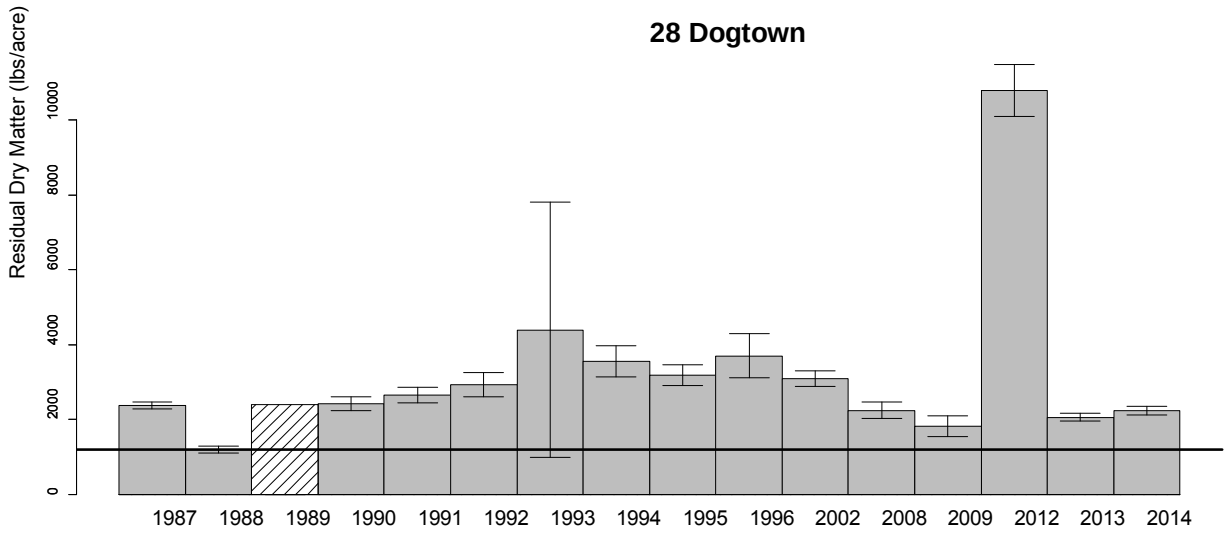
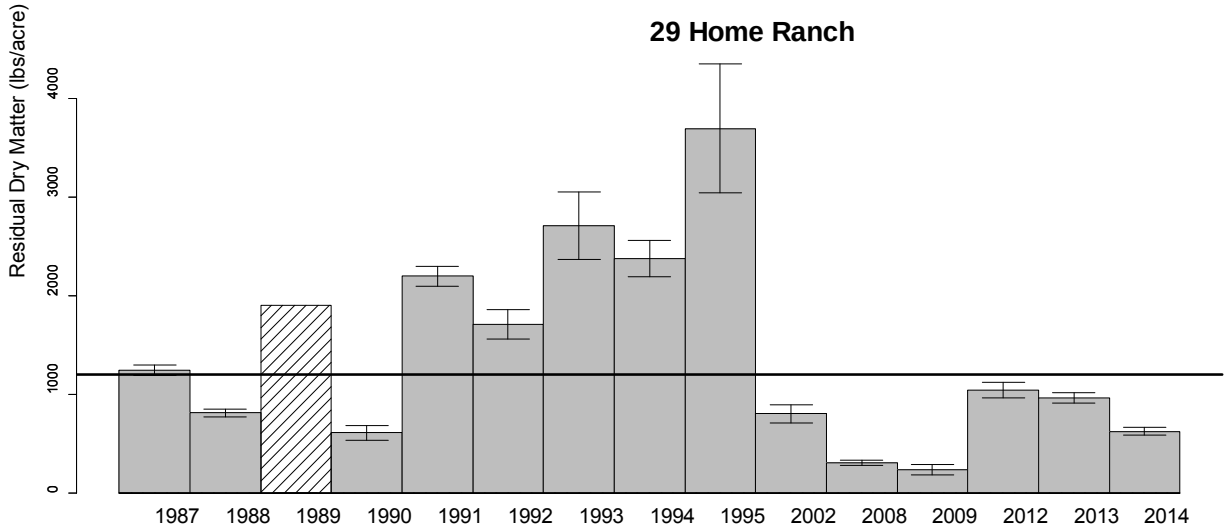
2008
2009
2012
2013
2014


27 Commonweal
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
1987
1989
1990
1991
1992
1993
1994
1995
1996
2008
2009
2011
2012
2013
2014


28 Dogtown
Residual Dry Matter (lbs/acre)
0
2000
4000
6000
8000
10000
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
2002
2008
2009
2012
2013
2014


29 Home Ranch
Residual Dry Matter (lbs/acre)
0
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4000
1987
1988
1989
1990
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2008
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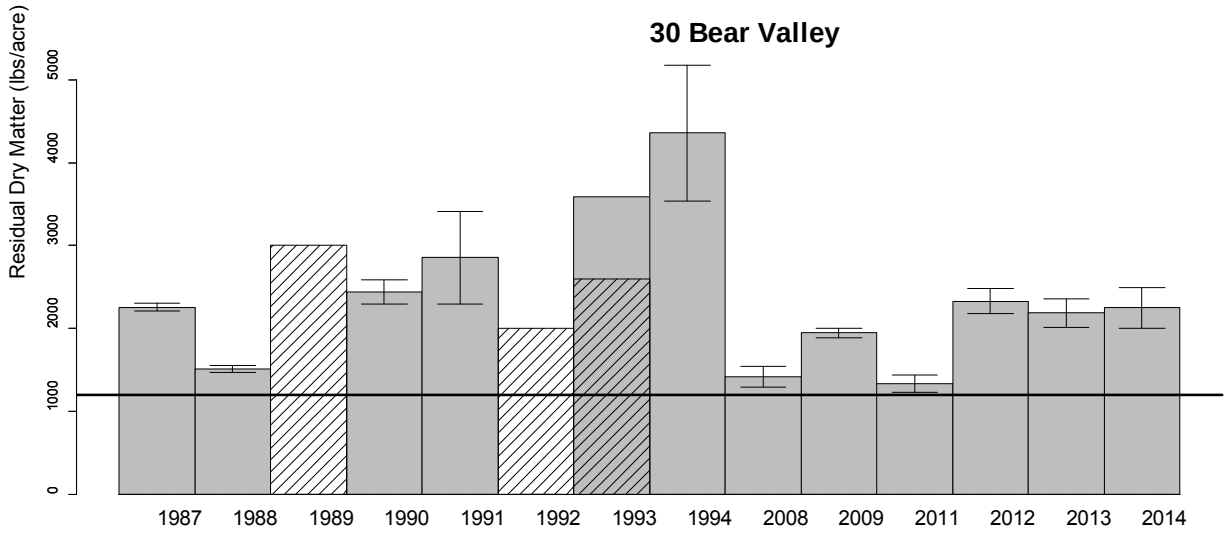
2014


30 Bear Valley
Residual Dry Matter (lbs/acre)
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1000
2000
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4000
5000
1987
1988
1989
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1991
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1993
1994
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2012
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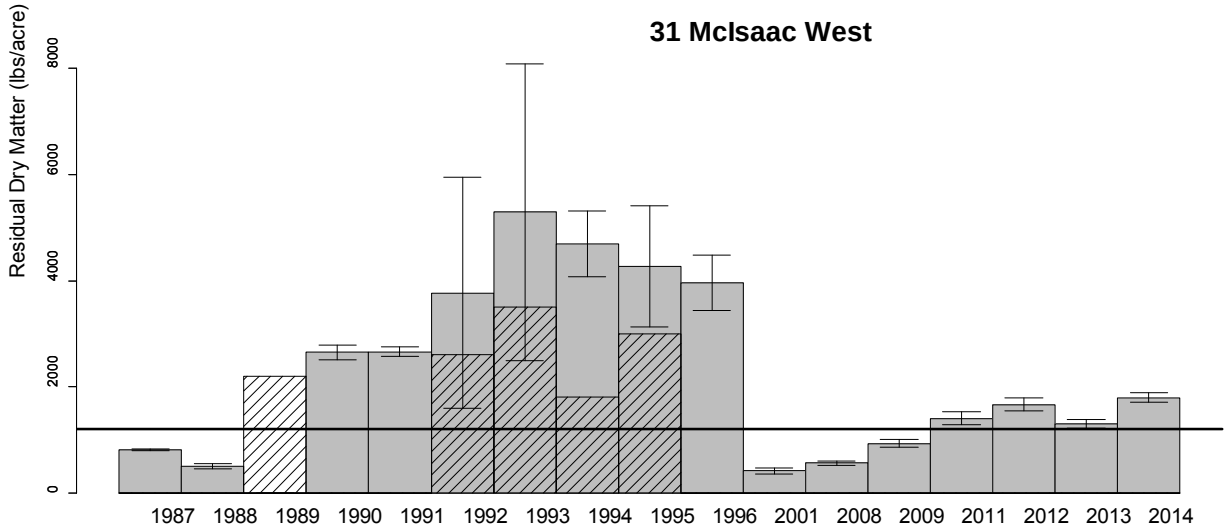
31 McIsaac West
Residual Dry Matter (lbs/acre)
0
2000
4000
6000
8000
1987
1988
1989
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1991
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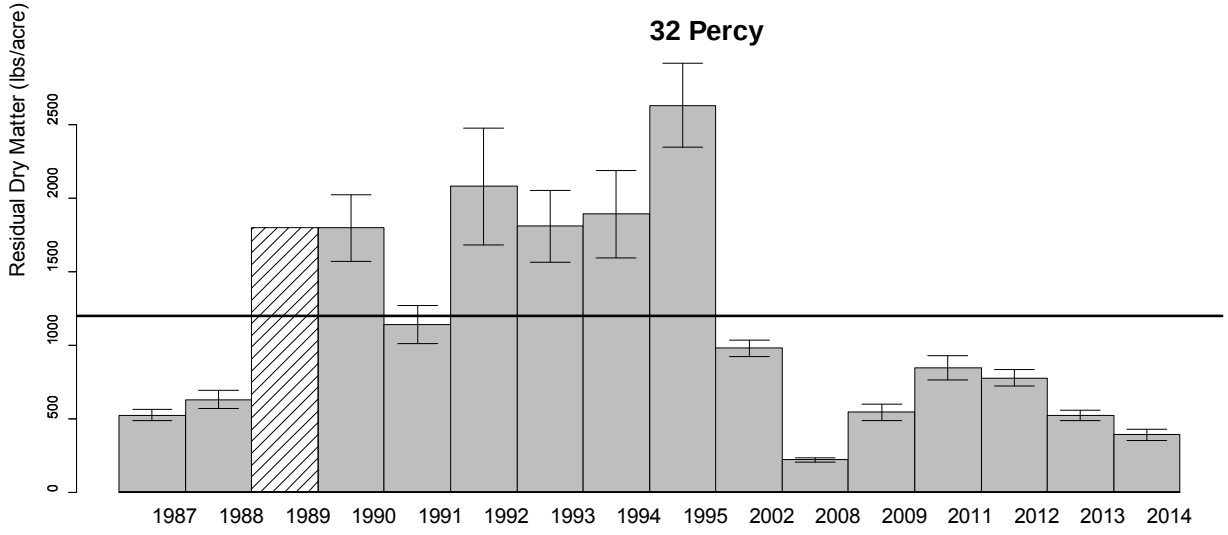
32 Percy
Residual Dry Matter (lbs/acre)
0
500
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1500
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2500
1987
1988
1989
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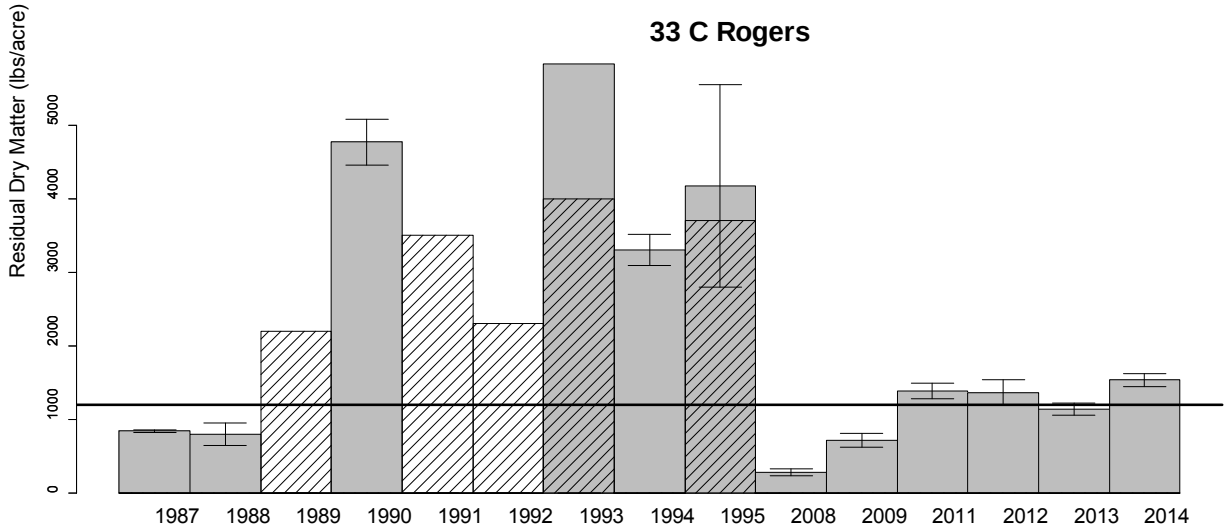
33 C Rogers
Residual Dry Matter (lbs/acre)
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1987
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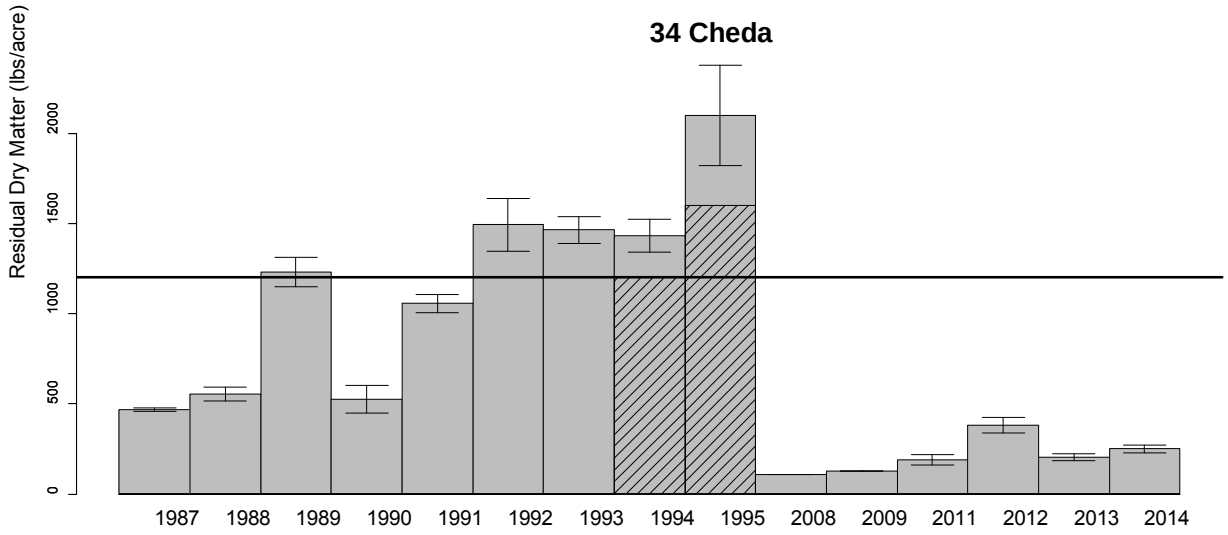
34 Cheda
Residual Dry Matter (lbs/acre)
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2000
1987
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1990
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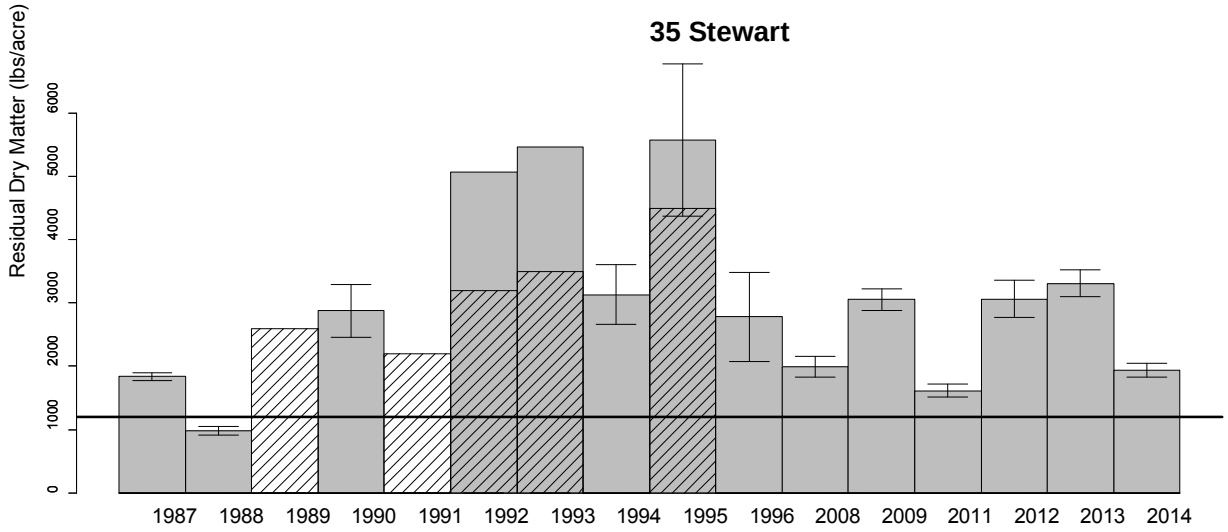
35 Stewart
Residual Dry Matter (lbs/acre)
0
1000
2000
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6000
1987
1988
1989
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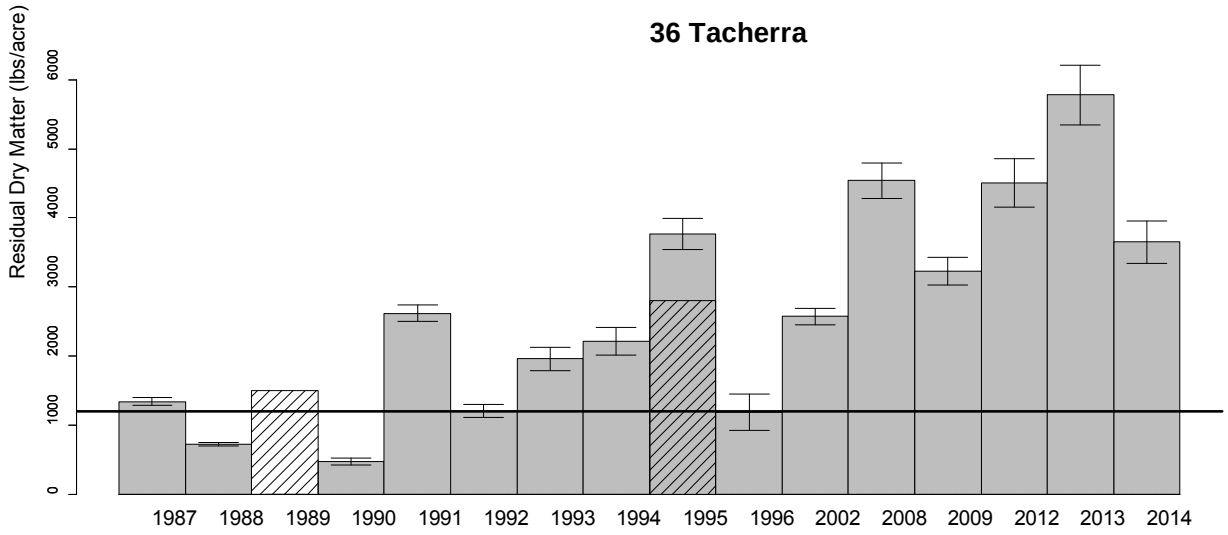
36 Tacherra
Residual Dry Matter (lbs/acre)
0
1000
2000
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1987
1988
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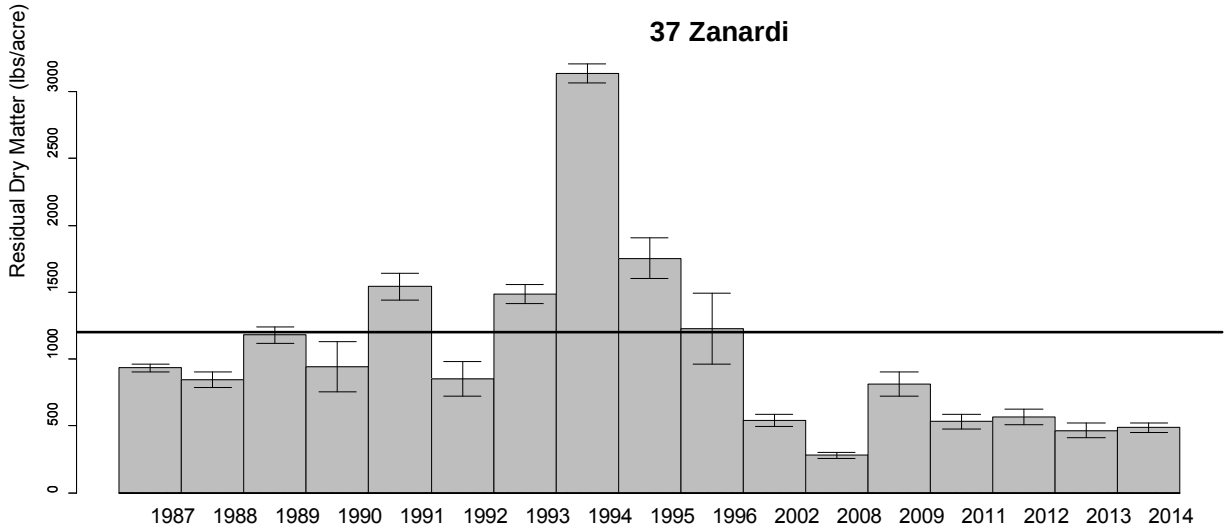
37 Zanardi
Residual Dry Matter (lbs/acre)
0
500
1000
1500
2000
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3000
1987
1988
1989
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2013
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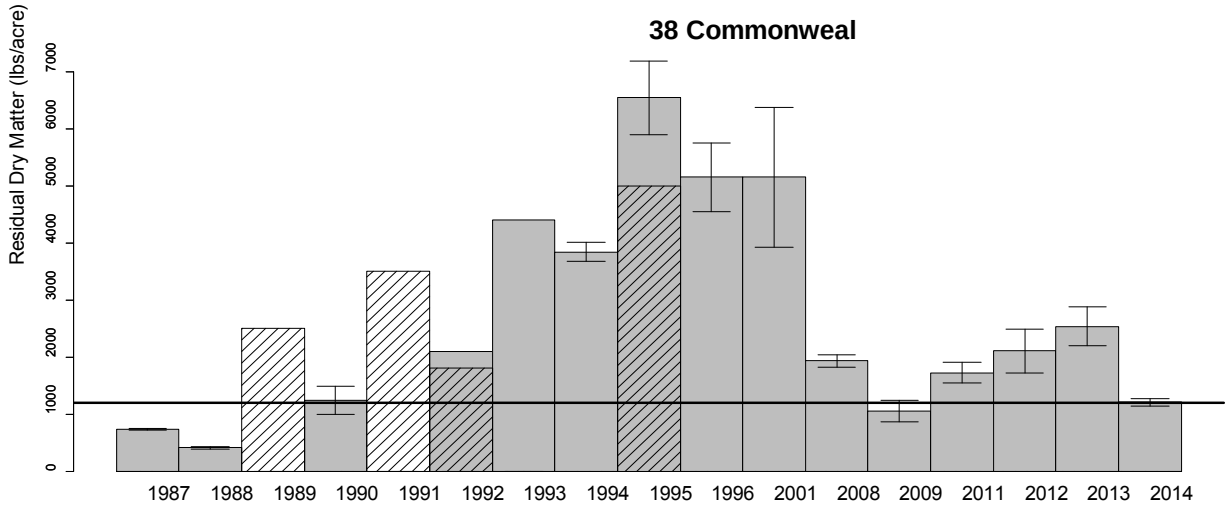
38 Commonweal
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
7000
1987
1988
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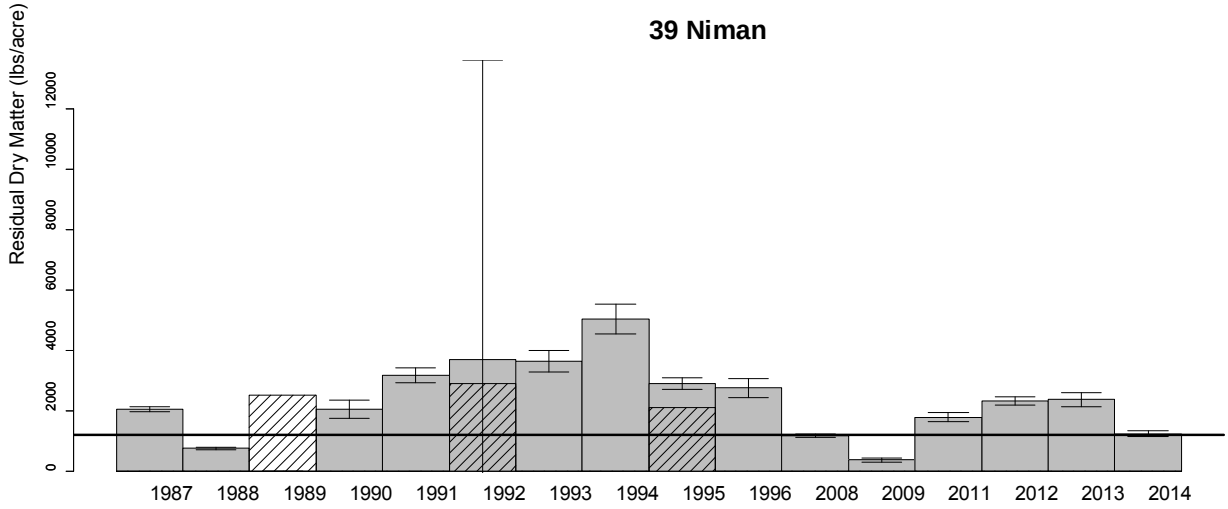
39 Niman
Residual Dry Matter (lbs/acre)
0
2000
4000
6000
8000
10000
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1987
1988
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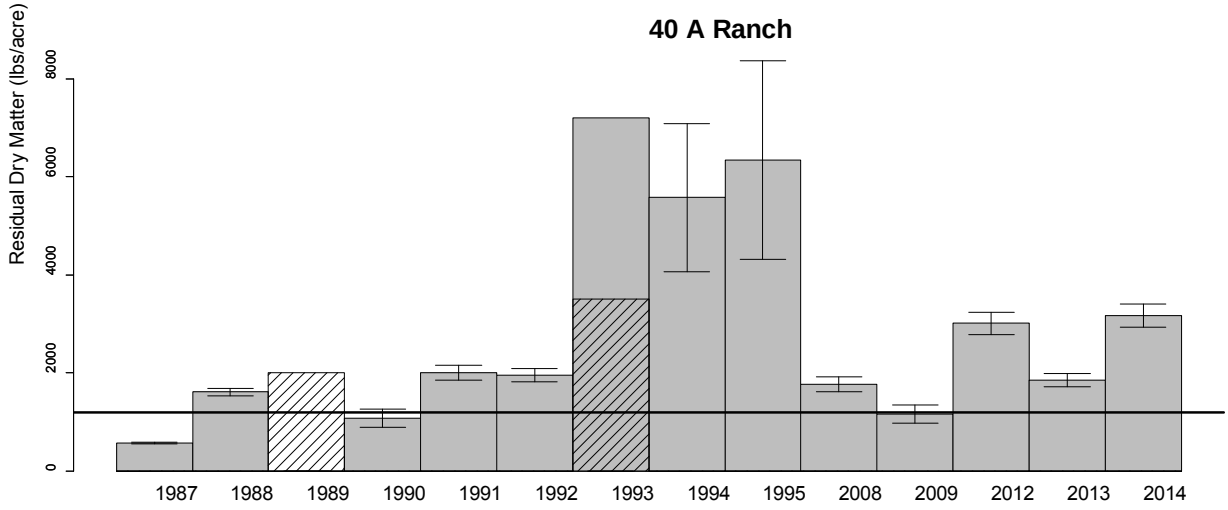
40 A Ranch
Residual Dry Matter (lbs/acre)
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2000
4000
6000
8000
1987
1988
1989
1990
1991
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1993
1994
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2008
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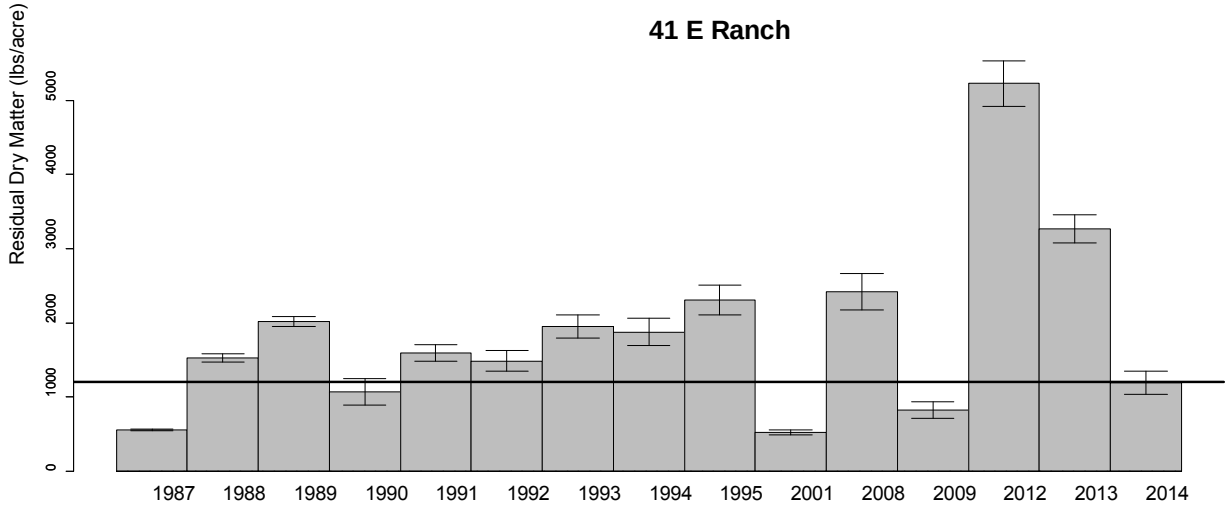
41 E Ranch
Residual Dry Matter (lbs/acre)
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3000
4000
5000
1987
1988
1989
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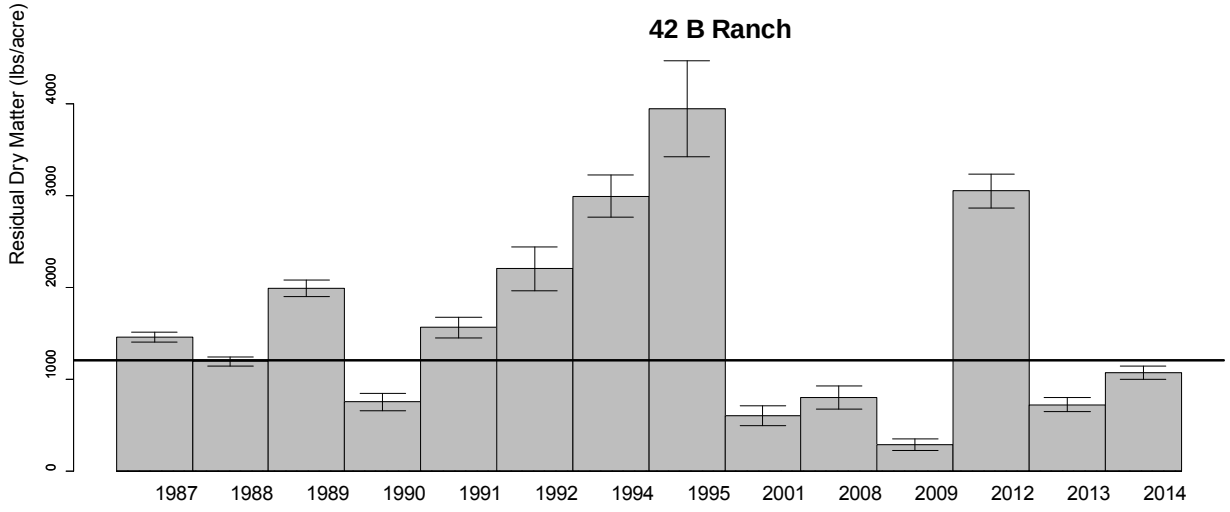
42 B Ranch
Residual Dry Matter (lbs/acre)
0
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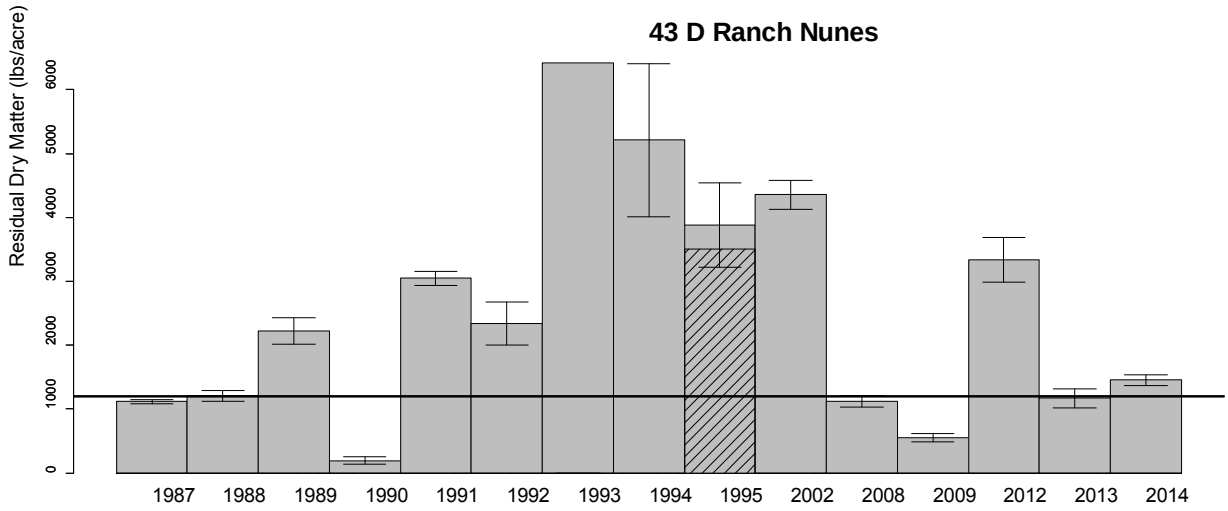
2000
3000
4000
1987
1988
1989
1990
1991
1992
1994
1995
2001
2008
2009
2012
2013
2014


43 D Ranch Nunes
Residual Dry Matter (lbs/acre)
0
1000
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4000
5000
6000
1987
1988
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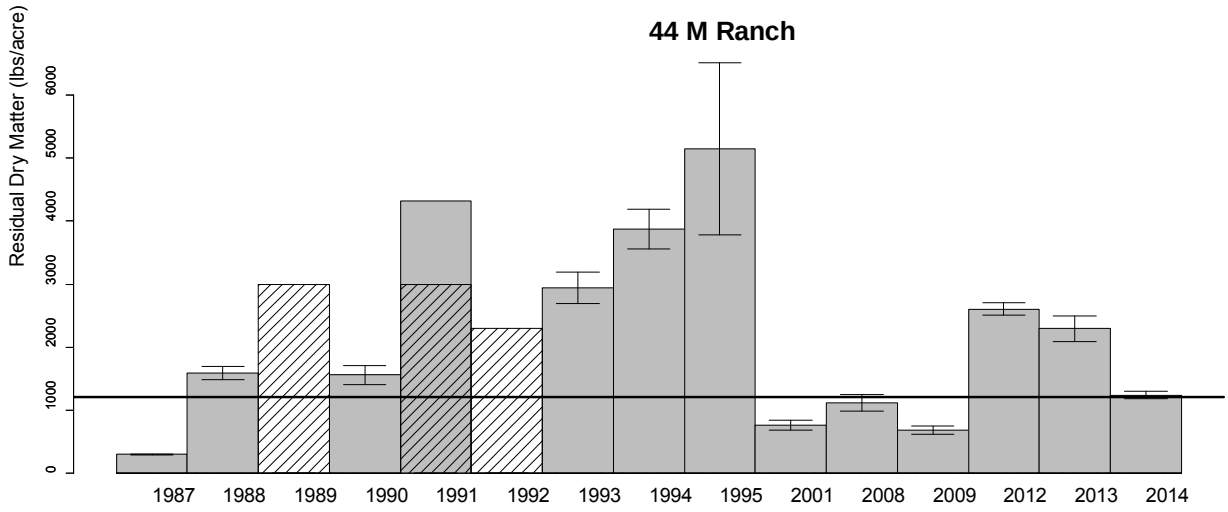
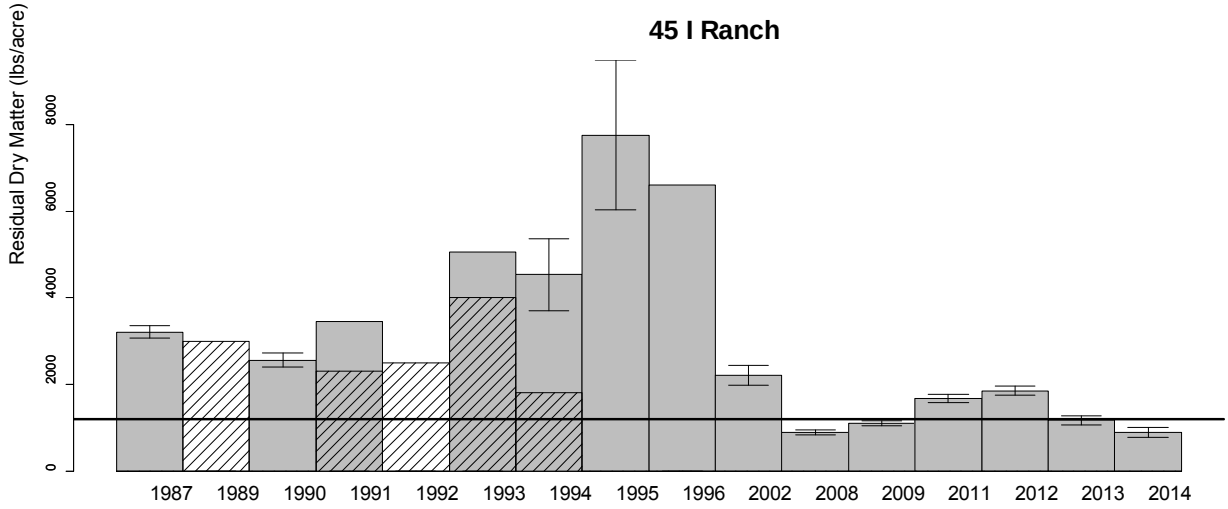
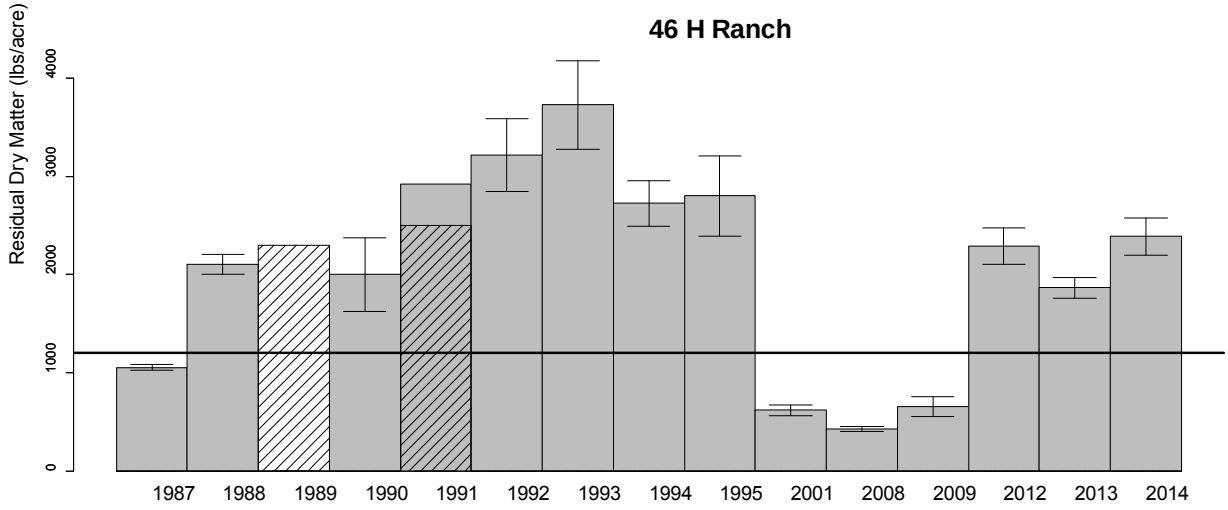
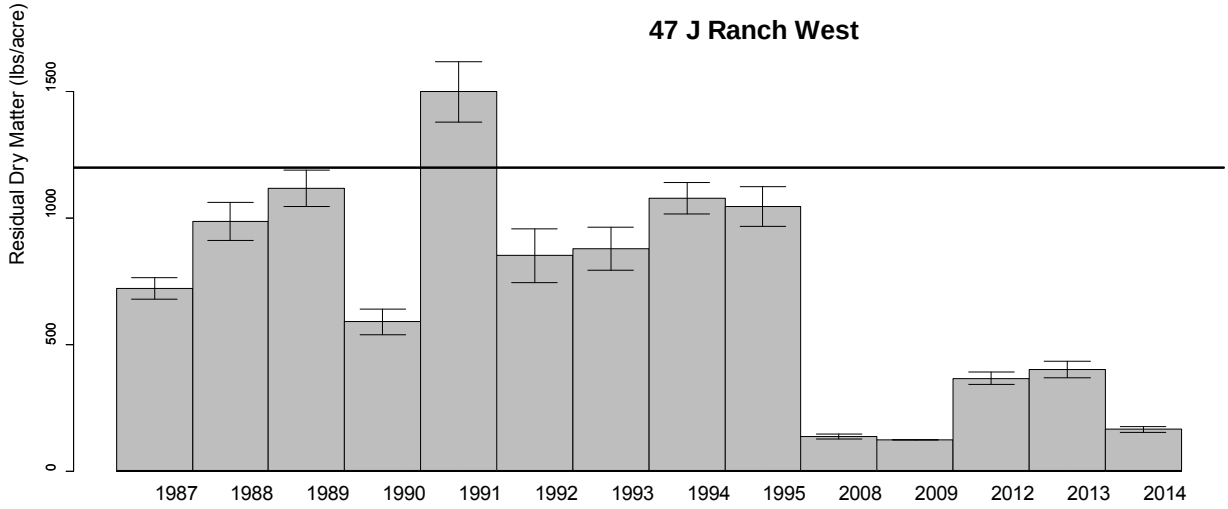
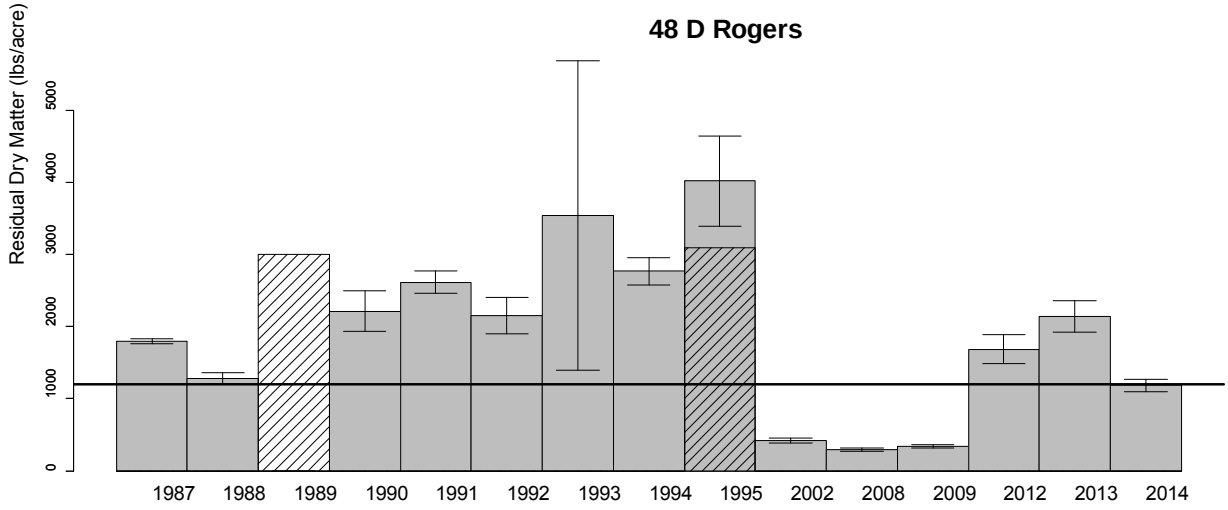
2008
2009
2012
2013
2014

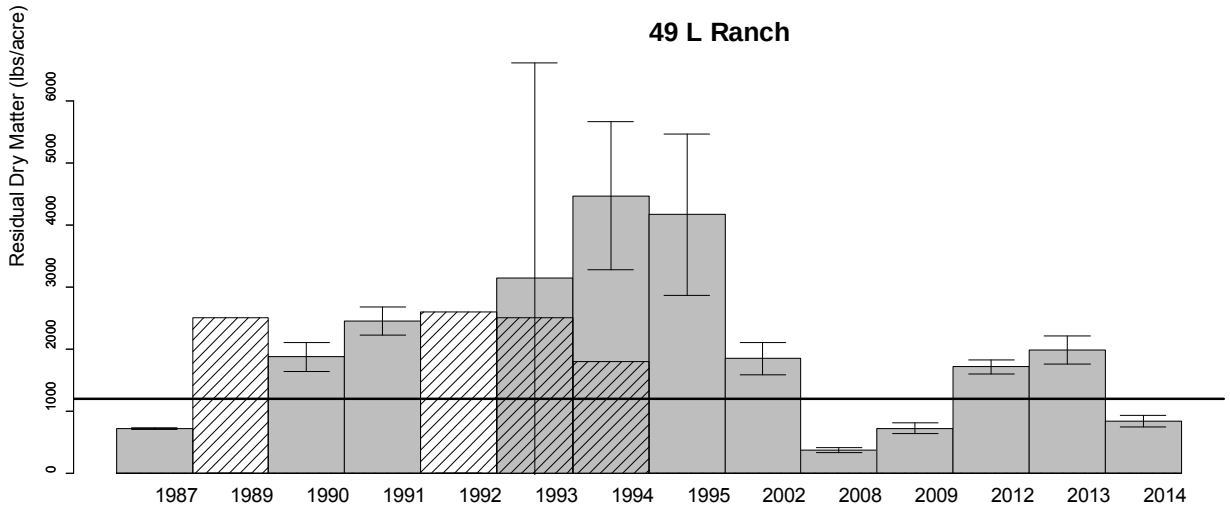

44 M Ranch
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
1987
1988
1989
1990
1991
1992
1993
1994
1995
2001
2008
2009
2012
2013
2014

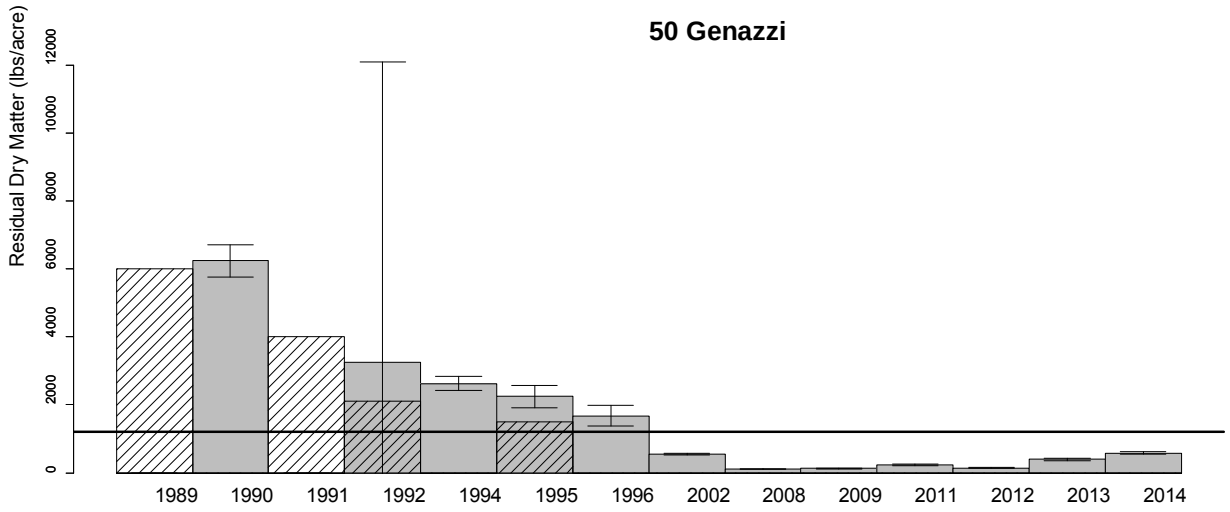

45 I Ranch
Residual Dry Matter (lbs/acre)
0
2000
4000
6000
8000
1987
1989
1990
1991
1992
1993
1994
1995
1996
2002
2008
2009
2011
2012
2013
2014

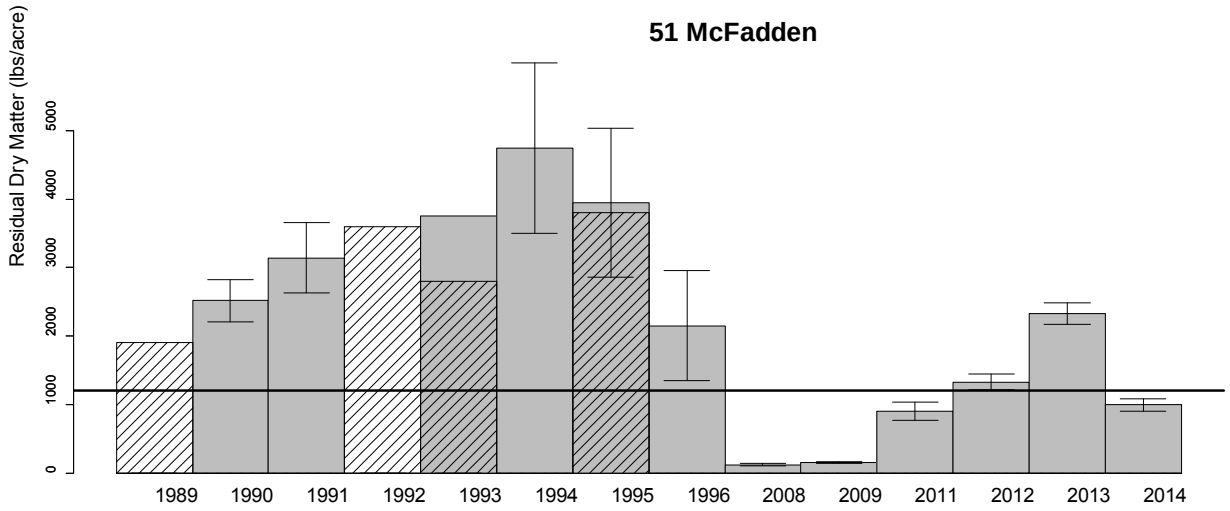

46 H Ranch
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
1987
1988
1989
1990
1991
1992
1993
1994
1995
2001
2008
2009
2012
2013
2014


47 J Ranch West
Residual Dry Matter (lbs/acre)
0
500
1000
1500
1987
1988
1989
1990
1991
1992
1993
1994
1995
2008
2009
2012
2013
2014


48 D Rogers
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
1987
1988
1989
1990
1991
1992
1993
1994
1995
2002
2008
2009
2012
2013
2014


49 L Ranch
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
6000
1987
1989
1990
1991
1992
1993
1994
1995
2002
2008
2009
2012
2013
2014


50 Genazzi
Residual Dry Matter (lbs/acre)
0
2000
4000
6000
8000
10000
12000
1989
1990
1991
1992
1994
1995
1996
2002
2008
2009
2011
2012
2013
2014


51 McFadden
Residual Dry Matter (lbs/acre)
0
1000
2000
3000
4000
5000
1989
1990
1991
1992
1993
1994
1995
1996
2008
2009
2011
2012
2013
2014

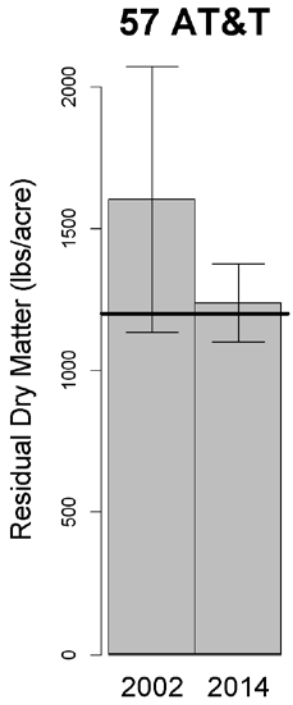
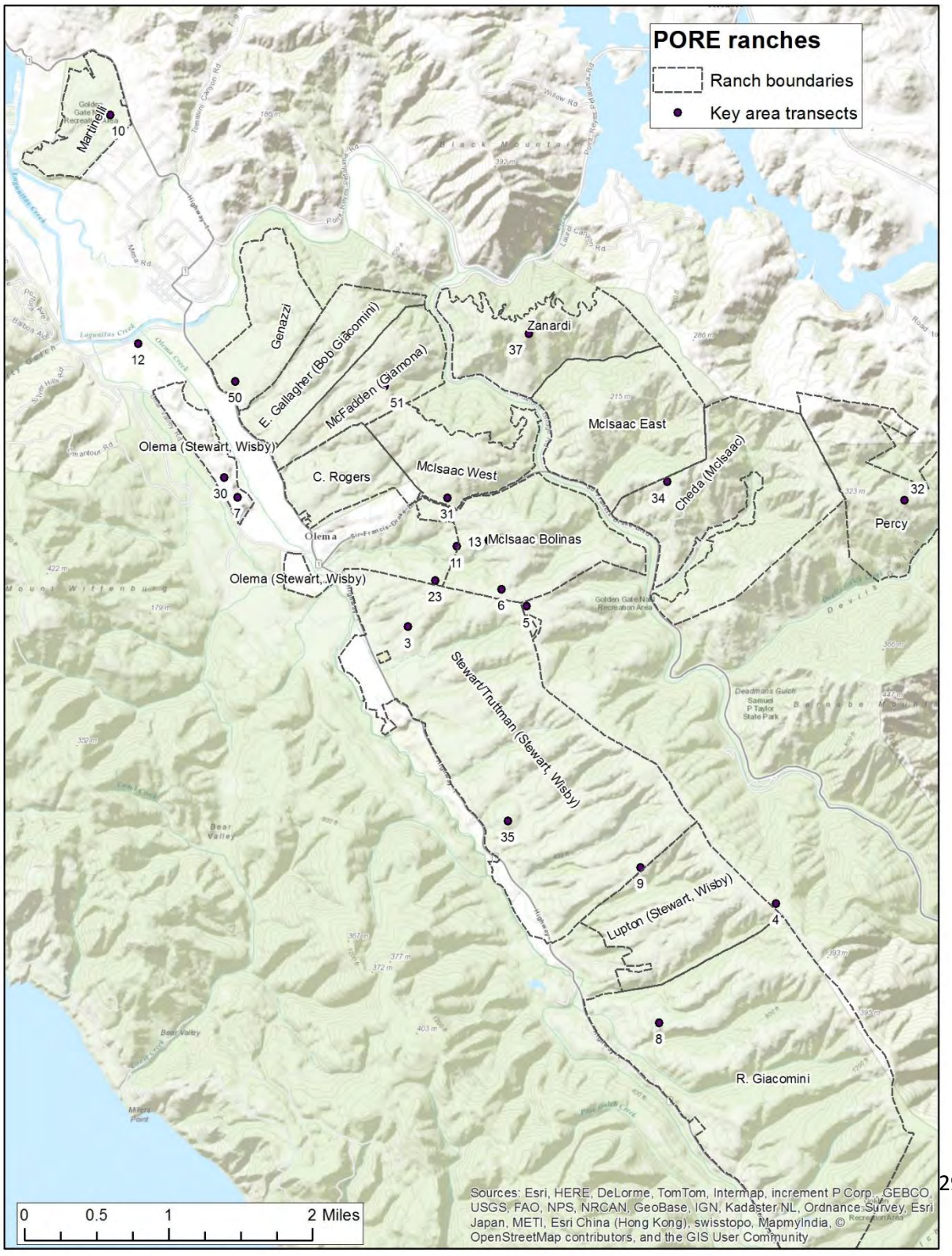
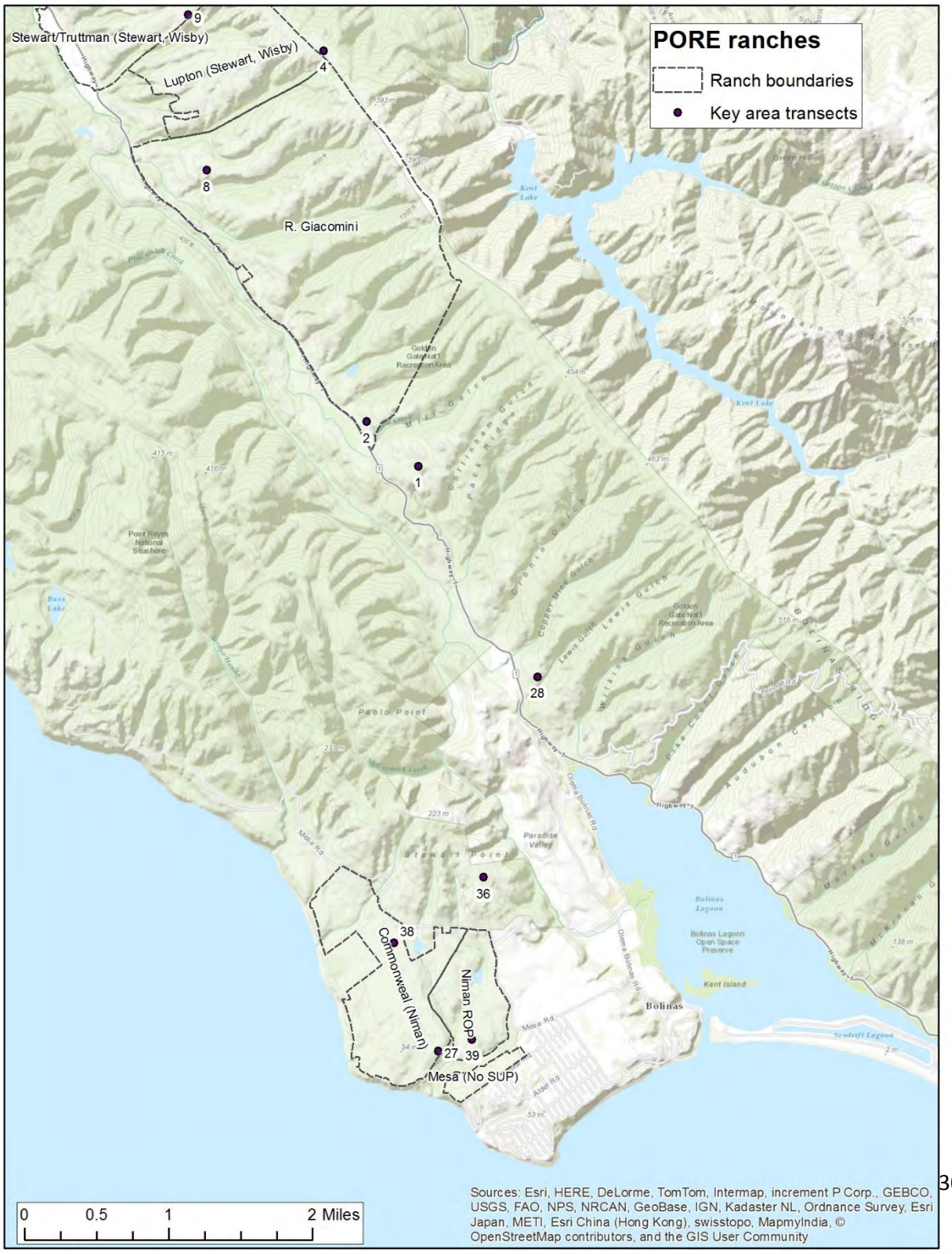

57 AT&T
Residual Dry Matter (lbs/acre)
0
500
1000
1500
2000
2002
2014

Figure A.3 PORE maps with ranch boundaries and transect locations


PORE ranches
Ranch boundaries
Key area transects
Martinelli
10
12
50
Genazzi
E. Gallagher (Bob Giacomini)
McFadden (Giamona)
51
Zanardi
37
McIsaac East
Olema (Stewart, Wisby)
C. Rogers
McIsaac West
30
7
31
34
Cheda (McIsaac)
32
Percy
13
McIsaac Bolinas
11
Olema (Stewart, Wisby)
23
6
5
3
Stewart/Truttman (Stewart, Wisby)
35
9
Lupton (Stewart, Wisby)
4
8
R. Giacomini
0
0.5
1
2 Miles
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


PORE ranches
Ranch boundaries
Key area transects
Stewart/Truttman (Stewart, Wisby)
Lupton (Stewart, Wisby)
R. Giacomini
Commonweal (Niman)
Niman ROP
Mesa (No SUP)
9
4
8
2
1
28
36
38
27
39
Point Reyes National Seashore
Golden Gate Nat'l Recreation Area
Pablo Point
Stewart Point
Paradise Valley
Bolinas Lagoon
Bolinas Lagoon Open Space Preserve
Kent Island
Bolinas
Kent Lake
Olema Bolinas Rd
Mesa Rd
Highway 1
0
0.5
1
2 Miles
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Appendix B. Checklists for RDM clipping and mapping

B1. Checklist of supplies to bring for RDM monitoring

- topo maps and any other information necessary for locating base stakes, photo points, etc.
- RDM sampling hoop
- RDM calculation: clipped sample weight (grams) X 100 = RDM lbs/acre
- vegetation clippers/shears
- one 100g scale; one 300 g scale
- bucket (to weigh samples in the wind)
- paper (not plastic!) bags for clipped biomass
- compass
- clipboards
- RDM data sheets
- field notebook
- field pens and pencils
- Sharpie marker for bag labels
- first aid kit
- camera with spare batteries
- info sheet with azimuth and field of view for each permanent photo point
- GPS device loaded with any necessary coordinates and with spare batteries
- binoculars

B.2 RDM clipping instructions

These clipping instructions are adapted from the UC RDM guidelines' instructions for clipping RDM samples (Bartolome et al. 2006):

1. Place the hoop on the ground surface. Hoop circular diameter is 13.25 feet. Calculation formula: clipped weight (grams) X 100 = RDM lbs/acre

2. Remove from the area within the hoop all tree leaves and summer annuals such as tarweed, yellow starthistle, and turkey mullein. The PORE Range Monitoring Handbook (Shook 1990) also excludes any material from shrubs, vines, ferns, rushes, sticks, manure, hay, and unpalatable plants such as iris, blackberry, thistles, poison hemlock, cocklebur, *Eryngium*. To maintain consistency with previous RDM clipping results at PORE, we recommend that these plants continue to be excluded from the collected plant material.

3. Clip the remaining plant material within the hoop as close to the ground as you can without disturbing the soil surface.

4. Collect as much of the clipped plant material as is practical without inadvertently including bits of soil.

5. Air-dry the plant material for 24 hours.

6. Weigh the plant material with scale in grams.

B.3 RDM mapping instructions

Within the last decade, the RDM mapping technique has been developed and implemented in California, an innovation that allows for a clearer picture of the spatial distribution of RDM (Wildland Solutions 2008; Harris et al. 2002). RDM mapping is easy to learn and often requires less time to complete than the traditional permanent plot-based method, while still producing robust information. Sites with too little or too much RDM can be quickly identified, and solutions based on manipulating animal distribution may also be more easily developed. Time-series of annual RDM maps can be assessed for areas requiring management attention.

RDM mapping requires developing RDM classes (e.g., 0-1,200 lbs/acre, 1,200-2,000 lbs/acre, >2,000 lbs/acre) based on the manager's goals, and then mapping RDM classes based

on visual estimation of fairly large areas (up to several hectares), with either a paper map or Global Positioning System (GPS) device in-hand. Visual estimations are calibrated during the mapping process by clipping and weighing RDM from small, representative plots (e.g., RDM 13.25 foot diameter hoop or 25cm x 25cm quadrat). Photographs are taken of large areas of representative RDM classes and of the plots prior to clipping.

B.4 Photo point instructions

Permanent photo points retaken every year can be an inexpensive but broadly effective method of monitoring for large changes in vegetation, such as increases in invasive plant cover or coyote brush encroachment into coastal prairie. They can also serve as useful indexes of annual herbaceous production and of residual dry matter (RDM).

A permanent photo point should be established with location recorded by a GPS device and, if desired, a witness post. An azimuth should be selected and thereafter fixed for that photo point. The field of view should also be defined for the photo point and always used thereafter for that photo point.

B.5 References

Bartolome, J.W., W.E. Frost, N.K. McDougald, and J.M. Connor. 2006. California guidelines for Residual Dry Matter (RDM) management on coastal and foothill annual rangelands. University of California Division of Agricultural Natural Resources Rangeland Management Series Publication 8092 (Revised). 8p. Available online at: http://anrcatalog.ucdavis.edu/Details.aspx?itemNo=8092

Harris, N.R., W.E. Frost, N.K. McDougald, M.R. George, and D.L. Nielsen. 2002. Long-term residual dry matter mapping for monitoring California hardwood rangelands. Pages 87-96 in: Standiford, Richard B., et al., tech. editor. Proceedings of the fifth symposium on oak woodlands: oaks in California's challenging landscape. Gen. Tech. Rep. PSW-GTR-184. Albany, CA: USDA Pacific Southwest Research Station. Available at: http://www.treesearch.fs.fed.us/pubs/26112.