Report on the Biological Planning Process for Livestock Management at Las Cienegas NCA. Fall 2005 Upland Monitoring Results and Adaptive Management by the Bureau of Land Management, Technical Resource Team, and Rangeland Resource Team.

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Executive Summary

This report summarizes the information and processes involved in making decisions on the 2005-2006 grazing plan for Las Cienegas National Conservation Area (LCNCA). It demonstrates how the BLM, with input from its various partners and advisory teams, and the grazing permittee, is using upland monitoring data followed by pasture reconnaissance to make grazing management decisions.

Upland monitoring plots showed significant increases in perennial grass canopy cover and litter cover across the NCA. For perennial grass basal cover and bare ground cover, however, changes were less consistent, with some plots improving dramatically and others declining in these same factors. The direction of change for these factors was not affected by whether the pasture had been grazed in the past season, though this analysis did not consider intensity of use.

The permittee used this monitoring data to alter his proposed grazing plan in order to promote recovery of pastures whose monitoring plots showed notable or consistent declines in cover conditions. BLM advisory teams helped refine these adjustments.

The data gathering and decision making cycle at Las Cienegas has proven to be an unusually effective example of adaptive management in practice. Several factors contribute to the success of this process, including:

- collection of high-quality data that ties directly to objectives set out in BLM's Las Cienegas Resource Management Plan;
- a decision-making schedule that is linked to rainfall cycles and is timed to efficiently incorporate each year's monitoring data into plans for the next year's management;
- flexible management that enables managers to respond to ecosystem and market changes;
- positive working relationships between BLM, the permittee, and advisory groups; and
- active involvement of partners and community members with relevant expertise.

In addition, participants have shared a commitment to continue improving this adaptive management process. Refined monitoring protocols now more reliably document improvements in range condition, as well as catching potential problems in their early stages. A revised monitoring and decision-making schedule for 2006 should make this process even more timely. Recent development of a more detailed format for planning and tracking livestock movement will improve projection and evaluation of pasture use. With input from the advisory teams, BLM is expediting development of a plan to deal with shrub encroachment problems that are undermining the recovery of several grassland plots.

Introduction

In recognition of the extraordinary biological and cultural values in the upper Cienega Creek basin, the US Congress designated some 49,000 acres as a National Conservation Area in the year 2000. As with most public lands, the Las Cienegas National Conservation Area (LCNCA) is managed for multiple uses. Livestock grazing in particular has a long history in the area and is considered an appropriate use so long as it does not undermine protection of biological and cultural values. BLM is committed to using an adaptive management process on LCNCA to ensure that grazing use remains consistent with protection of these underlying values.

Las Cienegas NCA is managed by the Bureau of Land Management and guided by the recently completed Las Cienegas Resource Management Plan (RMP). This RMP was developed though broad public participation in an eight-year collaborative planning process with the Sonoita Valley Planning Partnership, and management actions chosen in the final version therefore represent the area's official guiding principles.[1]

The RMP sets out desired resource objectives (pages 8-12) as well as livestock grazing management actions (pages 53-70). The RMP also emphasizes the importance of upland monitoring and adaptive management to meeting grazing-related resource objectives. Upland monitoring is done every year, and this data is fed into the decision making process described below. As per the RMP's directive to improve monitoring protocols to better address resource objectives and to provide information needed for adaptive management, several changes have been made to these original monitoring protocols (see below, Review of monitoring protocol changes).

> *Adaptive management is a formal, systematic, and rigorous approach to learning from the outcomes of management actions, accommodating change and improving management. It involves synthesizing existing knowledge, exploring alternative actions and making explicit forecasts about their outcomes. Management actions and monitoring programs are carefully designed to generate reliable feedback and clarify the reasons underlying outcomes. Actions and objectives are then adjusted based on this feedback and improved understanding. In addition, decisions, actions and outcomes are carefully documented and communicated to others, so that knowledge gained through experience is passed on…*
>
> ~Las Cienegas Resource Management Plan, p.77

The RMP stipulates a planning process for livestock grazing that uses a Biological Planning team to help BLM review monitoring data and provide input into proposed actions.[2] The Biological

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[1] Approved Las Cienegas Resource Management Plan (RMP) and Record of Decision. Bureau of Land Management, July 25 2003.

[2] RMP, p. 55. Composition of this team is outlined in the Approved RMP, summarized below.

Planning Team composition consists of a balance between resource managers, resource users, and those concerned with the resource's proper management.[3] The Biological Planning team includes the Rangeland Resource Team, Technical Review Team and other interested agencies and public.

The Las Cienegas Rangeland Resource Team (RRT) is a subcommittee of the Arizona Resource Advisory Council (RAC). It mirrors the composition of the RAC and has nine public members representing commercial and recreational public land users, environmental interests, academia, elected official, historic/cultural interests and public at large. The RRT is charged with providing local level input to the RAC regarding issues relating to the administration of grazing on public lands within LCNCA. The Las Cienegas RMP also charges the Las Cienegas RRT with reviewing monitoring data and evaluating and providing recommendations to the BLM Field Manager on proposed actions on the LCNCA grazing allotments.

The Technical Review Team (TRT) members represent federal and state agencies as well as consultants and have a broad range of expertise in resource management including range management. The TRT is charged with providing input on monitoring protocols, gathering and analyzing data, reviewing upland monitoring data and making recommendations to aid the BLM's decision making process on the permittee's proposed annual grazing plan.

The Biological Planning Process generally consists of the following steps:

a. Proposed annual grazing plan developed by permittee.

b. Monitoring data collected and analyzed by TRT and permittee and modifications to initial grazing plan are proposed.

c. Monitoring data reviewed by RRT in context of other issues that may have arisen for LCNCA. RRT reviews the TRT's recommended modifications to the grazing plan or other proposed actions based on the monitoring data and makes additional recommendations, as needed.

d. All of these recommendations are then discussed by the Biological Planning Team as a whole during twice-yearly Biological Planning meetings and receive additional public input at each meeting.

e. After review of existing data and recommendations from the Biological Planning Team, the BLM Field Manager will then approve or make any necessary changes to the annual grazing plan.

[3] Participants include representatives of the following: a. Land ownership (BLM, Arizona State Land Department, U.S. Forest Service, Audubon Society, private owners, and the Natural Resources Conservation Service); b. Permitted uses (grazing permittees and recreation groups); c. Research efforts (USDA Agricultural Research Service, University of Arizona, and Arizona State University; d. Wildlife management needs and concerns (AZ Game and Fish Department, and the US Fish and Wildlife Service); and e. Environmental interests and public concerns. (Proposed Las Cienegas Resource Management Plan and Final Environmental Impact Statement, BLM, June 2002, p. 2-125.)

Summary of monitoring data

Upland monitoring protocols in use before 2003 are summarized in the Approved Las Cienegas Resource Management Plan / Record of Decision (RMP/ROD).

Substrate cover data collected since 2003 follows a modified protocol adopted by the Technical Resource Team (TRT) in 2004 and implemented again in 2005. Details of the line-point intercept protocol used here can be found in agency literature.[4] Its modifications from the original LCNCA protocols are summarized in a report produced under a cost-share agreement between the BLM and The Nature Conservancy.[5]

Precipitation:

Rainfall was spotty across Las Cienegas. Averaged across pastures, it was approximately 2 inches better than yearly totals for the previous droughty three years (see Appendix 1). Nevertheless, most pastures still fell slightly below their five-year averages; six gauges received 3-5" less (gauges serving KA4&5, 16, 19, 21, 22, and 27) and two received 2-5" more (serving KA17&18 and KA13). The record for one of these gages—West Pasture/KA17&18—extends back to 1988. This pasture's 2005 rainfall also ranked well above its longer-term average. The BLM's Remote Automated Weather Station at the Empire Ranch headquarters registered 13.65" of rain in the 2005 season (October 2004 through September 2005), which fits neatly within its 12-16" classification. In general, the northern and eastern pastures tended to receive less rainfall than other parts of the allotment.

Line-Point Intercept/Substrate Cover Objectives and Results:

Cover data addresses two key resource objectives:

- Maintain <30% exposed soil surface (bare ground) in grassland communities; and
- Maintain >10% live basal cover of perennial grasses.

The former is set forth in the RMP to guard against soil erosion and promote watershed health as a whole. The later was chosen by the TRT in 2004 as an interim objective for Las Cienegas NCA's grasslands, pending development by TRT of more site-specific objectives for particular ecological sites.

Cover values for 21 Key Areas were read using the modified point intercept protocol. Cover data are summarized below, and included as Appendix 2. Repeat photographs were taken as well. Reading these plots took approximately 170 person-hours (with 23 BLM staff hours, 8 NRCS

[4] Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Volume II: Design, supplementary methods and interpretation. By Jeffrey E. Herrick, Justin W. Van Zee, Kris M. Havstad, Laura M. Burkett and Walter G. Whitford, with contributions from Brandon T. Bestelmeyer, Alicia Melgoza C., Mike Pellant, David A. Pyke, Marta D. Remmenga, Patrick L. Shaver, Amrita G. de Soyza, Arlene J. Tugel and Robert S. Unnasch. Published by the USDA-ARS Jornada Experimental Range, 2005. Distributed by the University of Arizona Press. Details of the line-point intercept protocol used here can be found on p. 86, Alternative D.

[5] Gori, D., and H. Schussman. 2005. State of the Las Cienegas National Conservation Area. Part I. Condition and Trend of the Desert Grassland and Watershed. Prepared by The Nature Conservancy of Arizona.

staff hours, 53 TNC staff hours, and 88 volunteer hours, not including travel times). Each plot required an average of 8 person-hours to read, or 2 hours for a team of 4 people.

Bare ground: Some key areas showed declines in bare ground cover from 2004 to 2005 while others showed increases, with no significant overall increase or decrease (paired t-test, df=20, p=0.55). Of the 21 plots read, 16 met the bare ground cover objective. Of the five that did not, all have had problems meeting bare ground cover objectives in past years as well. Three (KA8, KA9, KA13) showed a statistically significant increase in bare ground since 2004 (χ^2 test, $p<0.1$ for each comparison). The other two (KA1, KA31) showed significant improvement (decrease in bare ground cover). One plot (KA17) that did not meet the bare ground objective in 2004 improved enough that it easily met the objective this year. It is worth noting that for all of the above plots that improved significantly in bare ground cover, this improvement would likely *not* have been detected with 100-point sampling (χ^2 test, $p>0.1$, with 100-point data simulated using the proportions from 1000-point sampling).

Perennial grass basal cover: As with bare ground cover, some key areas showed declines in perennial grass basal cover from 2004 to 2005 while others showed increases, with no significant trend (paired t-test, p=0.44). Of the 21 plots read, 11 met perennial grass objectives. Of those that did not, two (KA5, KA23) represent significant improvements from their 2004 values, and three were significantly lower than previous values (KA1, KA8, KA9). Of these later three, KA1 has had consistently low vegetation cover since 1998. KA8 and KA9, however, show marked declines from their 1999, 2000, 2001, and 2004 values. KA22 has not declined significantly from 2004, but shows a consistent and highly significant downward trend since 1995.

Of plots that *did* meet perennial grass basal cover objectives, three showed significant declines since 2004 (KA10, KA13, and KA16), and five show significant improvements (KA2, KA3, KA17, KA18, and KA19). KA10 and KA16 have met both objectives for virtually all past years, though KA16 is now on the verge of not meeting the bare ground objective. KA 13, however, has bounced between meeting and not meeting bare ground and grass cover objectives in the past.

Overall concerns: Just two plots—North Pasture's KA8 and Alamo Solo's KA9—failed to meet both objectives *and* changed in the wrong direction on both since 2004. Dramatic increase in bare ground and decrease in perennial grass of Beck pasture's KA13 (formerly part of Hilton pasture), paired with its demonstrated ability to meet grass objectives in the past, draw additional attention to this plot. Fresno pasture's KA22 calls attention to itself by virtue of marked ten-year trends away from desired conditions in both bare ground and grass cover.

Other observations:

The main changes from 2004-2005 that held across key areas were significant increases in perennial grass canopy cover (average increase of 8% canopy cover, paired t-test p=0.033) and litter cover (average increase of 5% litter cover, p=0.006). These presumably resulted from good summer rains in 2005 across much of the NCA.

There was no relationship between increases or decreases in basal grass cover or bare ground cover and whether a pasture was grazed last year, though this analysis did not account for intensity of use (t-tests, $p<0.1$). For example, average 2004-2005 increase in perennial grass was no larger in rested vs. grazed pasture. Bare ground cover improved in 6 grazed plots and 4

ungrazed plots, and declined in 4 grazed and 2 ungrazed plots. Relationships between plot condition and recent rainfall was also not clear from this cover data.

Frequency objectives and results:

On October 29 and November 12, 2005 the Bureau and members of the University of Arizona Range Club (Tierra Seca) collected pace frequency data at 9 of the permanent upland vegetation transects (1, 2, 3, 8, 9A, 9B, 11, 12, and 13. Refer to Appendix 4 for data summary.

Results vary by site, but it is apparent that there are some declines in the densities of the perennial grass plants due to the ongoing drought. However, overall the composition of the plant communities has remained fairly stable at most of the sites sampled.

Utilization:

The Bureau collected and mapped forage plant utilization on the Empire and Cienega Allotments in July of 2005. After fall shipping the cattle moved north from the Headquarters (HQ) area to the winter range in the Empire and Whetstone Mountains, then south through the sacaton pastures in spring to the Alamo Solo and Enzenburg pasture in June and July. The proposed rotation was to summer in the Johnson, Hilton and Davis pastures following the monsoon rains until fall when they would return to the HQ.

Shipping Pastures, Maternity, West, Enzenburg, and North Pastures: Use tended to be light (30%) in the level loamy and sandy loam upland sites and moderate (50%) in the loamy hills and limy slopes.

Empire and Alamo Solo Pastures: Use was moderate to heavy (50 to 70%) due to the division of the main herd for herd management reasons.

Upper/Lower 49 and Rockhouse Pastures: Little or no livestock use was made in these pastures because of the reoccurring problem of feral dogs, gates being left open, and lack of developed livestock water in the lower Empire Mountains.

Apache, Fresno, Upper and Lower Mattie Pastures: Livestock utilization was generally light on the slopes and hills ecological sites (< 30%) in the Whetstone Mountain complex, light to moderate (30 to 50%) in the canyons where cattle were trailing between waters, and moderate to heavy (50 to 70%) in Fresno Canyon and on top in the flats around the Test Hole water facility.

Mattie, Ag Fields, and Mac's Sacaton Pastures: The new Mattie sacaton pasture was lightly used by cattle, but the utilization was spotty as the sacaton was dry and not very palatable. Pasture gates were open to the adjacent uplands and Ag Field pastures so cattle trailed through the areas rather than creating a uniform use pattern. The Gardner, 500 Acre, Five Wire sacaton pastures have not been used yet this year. The Cieneguita pasture had rather uniform use of about 30%. These lower sacaton pastures will probably be used in the fall as the cattle return to the HQ for shipping.

The Upper and Lower Springwater, Hilton, and Johnson pastures: These have not been grazed since last summer's growth and will be used this summer.

Davis Pasture: Has been used by the bull herd and use is about 30%.

Beck Pasture: Has been used heavily by the horse herd and utilization is severe around the waters and heavy throughout the rest of the pasture.

Remote sensing:

A research team at the USDA-ARS Southwest Watershed Research Center in Tucson has been using LCNCA as a testing area for remote sensing techniques designed to estimate available forage, mesquite densities, and total vegetation cover across large areas of the West.[6] Ground-truthing involved comparing estimates of various vegetation and soil parameters based on satellite images with estimates from on-the-ground measurements at Las Cienegas. Researchers found close matches between satellite-based and ground-based estimates of percent live vegetation cover, site height factor (an index of vegetation height), and vegetation biomass. Analysis of satellite images worked well for measuring mesquite cover but could not distinguish other shrubs from forbs or grasses. It does not distinguish ground-cover parameters such as bare ground, gravel, or rock cover. This data was not used directly in decision making for the 2005 cycle. It may, however, prove useful for evaluating the how representative the key areas are for their respective pastures (see below, monitoring plot discussions and recommendations).

Summary of the Biological Planning Process

Adaptive management requires managers to respond in a timely manner to current information. At Las Cienegas, the seasonality of rainfall, grass growth, and livestock breeding create a narrow window for collecting and analyzing data before yearly stocking and rotation decisions have to be made. The following schedule illustrates how participants achieved their goals of collecting data at the appropriate stage of plant growth and providing timely results for managers.

- Utilization monitoring of pastures (done before summer rains): July
- Substrate cover monitoring of key area plots, line-point intercept protocol (done after summer rains): Sept.28 –Oct 12
- Substrate cover-frequency monitoring of key area transects, pace-frequency protocol (ideally done after summer rains): Oct 29-Nov 12
- TRT/RRT special workshop on upland monitoring: Nov. 4
- TRT meeting: Nov. 15
- RRT meeting: Nov. 17
- Biological Planning meeting: Nov. 17

Changes to the proposed grazing plan:

The BLM, TRT, and permittee reviewed the substrate and shrub cover results for key area plots measured in 2004 and 2005 along with available rainfall data. Special attention was paid to plots that showed a marked improvement or decline since 2004. For the latter key areas, the results were also summarized and analyzed in the context of the 10-year data set (1995-2005). The

[6] Detailed descriptions on the project can be found at http://www.globalchange.msu.edu/ranges2.html, with some details on ground truthing at http://foliage.geo.msu.edu/research/projects/nasa_usda/srmhawaii_files/frame.htm.

permittee's proposed grazing plan for 2006 was reviewed, along with actual pasture use for 2005 in light of the above monitoring results.

Discussions and observations of the following key area plots and pastures prompted the permittee and TRT to make the following changes to the proposed grazing plan for 2006. Responses and recommendations of the RRT and individuals taking part in Biological Planning to these proposed changes in the grazing plan are also summarized below.

Pasture use:

- Alamo Solo (KA9): Permittee suggested keeping utilization at or below 15% and would consider moving herd to Hilton Pasture earlier to keep utilization low. The TRT agreed with this plan. Subsequent discussion on the effects of seasonality and intensity of livestock use on Lehmann lovegrass yielded three recommendations from the RRT and Biological Planning: 1) pasture should be used as early as Lehmann lovegrass green-up in the spring allows (by April in most years); 2) utilization should be moderate rather than light, since light and moderate utilization would have similar effects on blue grama but moderate utilization would have greater impacts on Lehmann lovegrass; and 3) if the pasture receives low winter rainfall, it should not be used and if the pasture is used in the spring, it should not be used again in the fall.
- North (KA8): TRT noted that other plots in this large pasture are meeting objectives for bare ground and perennial grass cover (KA2, KA3). However, KA4 (at the extreme north end of the pasture) also failed to meet perennial grass basal cover objectives but this is likely the result of shrub encroachment and low rainfall (i.e., there was evidence of extensive black grama mortality on the key area in both 2004, 2005); bare ground cover in KA4 was low due to high cover by rocks and gravel which protect the site from soil erosion. No changes were recommended and TRT agreed with the permittee's proposed plan to use waters to direct livestock towards the west portions of the pasture where perennial grass cover is higher.
- Fresno Pasture (KA22): Permittee suggested reducing utilization in uplands by using waters to direct herd towards west side of Fresno. This will involve watering livestock on Cienega Creek and using the sacaton pastures there (e.g., AZ Coldwater, Dominguez-Fresno, Mattie Sacaton). Keep utilization at or below 15% in eastern parts of pasture. TRT and RRT concurred with this plan.
- Hilton (Beck section, KA13): Permittee suggested not using pasture this year to promote grass re-growth and litter deposition. TRT/RRT agreed and made additional recommendations: 1) monitor utilization more carefully in future years; 2) prohibit use of the pasture for dog-training during the time livestock are there (generally less than one month) to reduce the possibility that livestock are pushed into one corner of the pasture (where KA13 is located); and 3) remove horses from the pasture this year.
- Forty-nine (KA5): Permittee suggested reducing utilization in upland portions of the pasture by using waters to direct herd towards Cienega Creek where perennial grass cover is higher. TRT and RRT concurred.
- Springwater (KA16, 31, 30): Permittee suggested not using the pasture this year to encourage litter production and to preclude livestock impacts on perennial grasses

recovering from drought and wildfire; sacaton pastures will used instead (East Mac's Sacaton, East 500 Acre, East 5-Wire). TRT and RRT concurred.

Stocking numbers and herd management:

- The permittee proposed an increase in livestock numbers from the 1,050 head run in 2004 to 1,200 this coming year. TRT/RRT agreed with this proposal.
- Permittee will consolidate animals from various breeding backgrounds into a single herd for the coming year. TRT and RRT agreed that this will streamline management and will enable more pastures to be rested each year. TRT emphasized the importance of having all livestock, including horses, included in the written rotation schedule. Permittee agreed with this documentation need.

Review of monitoring protocols:

At the request of TRT member Phil Ogden, the TRT and RRT convened a workshop meeting to address concerns among some team members that data generated from the modified substrate cover protocol might not be directly comparable to data collected using the original pace-frequency protocol (1995-2003); for a description and discussion of the two protocols see BLM (2004),[7] Gori and Schussman (2005),[5] and USDA-ARS (2005).[4] Approximately 15 members of the TRT and RRT, along with BLM and TNC staff and the permittees, Mac and John Donaldson, met at key areas 17 and 18 in West Pasture to compare details of data collection and review results.

In reviewing the 2005 data from the original (two-transect) pace-frequency protocol and the modified (ten-transect) point-intercept protocol, the group confirmed that both were essentially "telling the same story" and that both data sets accurately reflected current conditions and apparent trends in both key area plots. The group discussed the fact that the larger plots required by the modified protocol included some areas that differed in slope and aspect from the terrain covered by the original transects. However, the group concluded that data from these enlarged plots were comparable with previous years' data, and that the exclosure key area remained well-matched to the grazed key area. The advantage of the modified protocol over the original one is that the former has a greater statistical power to detect change in substrate cover, meaning that biologically significant changes in bare ground or perennial grass cover can be detected more quickly and reliably.

Comparing techniques confirmed that data was being collected consistently across years, and prompted a BLM plan to maintain this consistency by compiling all existing data forms and detailed instructions for data collection into one booklet, to be used as a reference document for Las Cienegas upland monitoring. BLM is also incorporating recommendations made by Phil Ogden on reducing monitoring bias into this booklet.

[7] Meeting notes, Las Cienegas Technical Review Team (TRT), October 8, 2004.

Monitoring plot discussions and recommendations:

In addition to the above changes in the proposed grazing plan, the TRT and permittee also made the following recommendations regarding the re-location and establishment of key area monitoring plots. Comments by the RRT and Biological planning to these proposed changes are also summarized below.

North Pasture, KA8: This plot is located < 0.5 miles from 3 water sources and therefore receives much greater than intermediate utilization as livestock move from one water source to another; it has not met bare ground objectives in any year since 1995 when monitoring began. In addition, the plot appears to be impacted by recreation and proximity to a main road. Remote sensing data also indicates that areas along this road have less vegetation cover than the rest of North pasture. Based on these considerations, the permittee and TRT recommended adding a supplemental monitoring plot that would potentially measure livestock grazing effects without the confounding impacts of recreation and would be more representative of the pasture as a whole. The new plot might eventually replace the existing KA8, but both would be measured for a transitional period. Kendall Brown (USFS) noted that the USFS would not consider this an appropriate location for a key area to evaluate grazing management because it is less than a half mile from water. Other RRT members and Biological Planning participants, however, argued for continuing to use the existing plot and simply recognizing that it may also be showing non-grazing impacts. **No decision was made although BLM will be evaluating the location of all key areas and their appropriateness for evaluating livestock grazing effects over the next year.**

Hilton (Beck section): KA13: BLM, TRT, and permittee recommended adding a supplemental monitoring plot to measure pasture condition without confounding impacts of converging fences, proximity to water, and bird-dog training (causing livestock to stay in one corner of pasture around monitoring plot) that are currently affecting KA13. Examination of the surrounding pasture during Biological Planning, however, suggested that many areas appear to have had comparable impacts and that this plot *does* represent pasture conditions fairly well. One member emphasized that when you monitor an area that is somewhat heavily used relative to the rest of the pasture, you can get "early warnings" of conditions developing elsewhere on the pasture. Others expressed concern that this plot may misrepresent the pasture, and/or may be left without solid, attainable objectives. Permittee also pointed out that an ungrazed comparison site could be added on private land adjacent to this pasture without having to do any extra fencing. **No decisions made although there was not a strong consensus among RRT and Biological Planning participants that the plot needed to be moved.**

Sacaton pastures: There is currently just one active monitoring plot in a sacaton pasture. TRT noted that additional reliance on sacaton pastures has been a default response to drought conditions and/or declining trends in other pastures, and will probably continue to serve this function. TRT recommended that another key area plot be established in a second sacaton pasture to augment information coming from KA19 (East 5-Wire).

Exclosures: TRT discussed whether the current monitoring is set up to disentangle effects of climate from effects of grazing, and whether each plot has sufficient climate information (i.e., its own rain gauge). Members responded that differentiating between effects of grazing and effects of climate was the impetus behind establishing several new exclosures and paired key areas. With paired plots, having rain gauges or soil moisture probes on each is not critical, since each

member of a pair will presumably be exposed to the same climate conditions. New exclosures have not been built yet. RRT re-emphasized the importance of getting these exclosures built.

Points of discussion: Main points of discussion center around how to apply results from key areas to management of pastures as a whole, and what to do about key areas that consistently perform poorly. Key areas were chosen to reflect trends in their respective pastures and ecological sites, but extrapolations from small plots to large areas can still be problematic. Representativeness of key areas may need to be clarified and/or better documented.

For plots that consistently fail to meet objectives, some members recommend devising plot-specific interim objectives such as demonstrable improvement of particular parameters within a set time frame. Concern here is that each plot have a solid standard against which management success can be measured. Others expressed opinions that it should be sufficient to state why a plot is not meeting objectives, and thereby re-define the purpose of a plot.

Other RRT/TRT recommendations:

Planning schedule

In 2005, monitoring data was in hand and analyzed before management decisions had to be made. This successfully enabled managers to respond directly to current conditions on the ground. Nevertheless, all parties agreed that completing this process two to three weeks earlier would fit better with the lessee's rotation schedule. Since the lessee's grazing plans typically run from September to September to match rainfall cycles, completing this process earlier would also minimize the time that livestock are being run on an un-ratified provisional plan.

Shrub encroachment

Site visits to the poorly-performing KA8 and KA9 in North and Alamo Solo pastures prompted several TRT, RRT, and Biological Planning participants to comment on the plots' high mesquite densities. These members predicted that because mesquites are such effective competitors for soil moisture, grass cover was not likely to ever meet objectives on these sites until mesquite cover was reduced.

Baseline shrub cover and mesquite density measurements in 2004 show higher-than-desired shrub cover on half of the 24 key areas surveyed (i.e., shrub cover > 20% and/or mesquite cover > 15%). These include 7 of the 9 plots that failed to meet perennial grass basal cover objectives in 2005. (Shrub cover and mesquite density change slowly enough that 2004 data is directly applicable to 2005; shrub cover and density measurements are made every 5- and 10 years respectively.)

The TRT and RRT recommend that BLM expedite the process of formulating a plan to deal with shrub encroachment problems at Las Cienegas.

Appendices

Appendix 1: Precipitation data

Appendix 2: Upland cover objectives vs. recent shrub and selected substrate cover data (point intercept protocol, 2004-2005)

Appendix 3: Longer-term substrate cover data (point intercept protocol, 1995-2005)

Appendix 4: Plant species frequency data for plots measured in 2005 (pace-frequency protocol, 1995-2005)

Appendix 5: 2005-2006 grazing plan map and rotation schedule

Appendix 1: Precipitation

2001 to 2005 precipitation by pasture, with key areas not meeting bare ground & perenial grass objectives in 2005 highlighted.

Gage location by pasture	Key Area	10/00-5/01	6/01-9/01	10/01-5/02	6/02-9/02	10/02-5/03	6/03-9/03	10/03-5/04	6/04-9/04	10/04-5/05	6/05-9/05	5-year summer average	5-year winter average	5-year total average
Empire Headquarters	1	10.1	10.5	2.4	6.8	3.1	8.6	6.7	6.6	4.9	8.7	**8.2**	**5.4**	**13.7**
Oak Tree	2&3	16.0	12.0	*2.4*	9.5	4.3	*7.8	*7.5*	Vand.	6.5	10.0	**10.5**	**7.3**	**17.8**
North Well	4&5	18.0	14.0	*2.4*	12.5	7.0	*7.5	*7.5*	4.5	1.0	12.0	**10.8**	**7.2**	**17.9**
Rockhouse	6&7	12.5	11.0	*2.4*	7.5			*7.5*				**9.3**	**7.5**	**16.7**
Runway (Lower North)	8	15.5	11.0	*2.4*	11.0	4.3	*6.8	*7.5*	4.0	6.0	9.0	**8.8**	**7.1**	**15.9**
Hummel House	9&10		6.6	*2.4*	6.5			*7.5*				**6.6**	**5.0**	**11.5**
Road Canyon	11&12	14.5	10.5	*2.4*	7.0	5.0	*6.8	*7.5*	5.0	6.5	8.5	**7.8**	**7.2**	**14.9**
Heart S Ranch	13			*2.4*		4.5	9.7	*7.5*	7.0	6.5	9.5	**8.7**	**5.2**	**14.0**
West Davis	14	14.5	12.0	*2.4*	9.0	5.0	*8.7	*7.5*	10.0	7.5	11.0	**10.5**	**7.4**	**17.9**
East Davis	15	13.0	8.5	*2.4*	7.5	5.0	*6.8	*7.5*	9.0	Vand.	8.0	**8.3**	**7.0**	**15.2**
South Springwater	16	14.5	11.5	*2.4*	8.0	4.5	9.3	*7.5*	4.5	5.0	8.0	**8.3**	**6.8**	**15.0**
West Pasture	17&18	16.7	10.5	2.4	6.6	5.5	7.7	8.4	4.9	11.0	12.0	**8.3**	**8.8**	**17.1**
Five Wire	19	14.0	11.0	*2.4*	6.5	4.3	*7.3	*7.5*	6.0	4.0	6.0	**7.4**	**6.4**	**13.8**
Lower Mattie	20	14.0	12.0	*2.4*	6.0	3.8	*5.5	*7.5*	7.0	5.0	8.5	**8.4**	**6.5**	**14.9**
Upper Mattie	21	15.3	12.0	*2.4*	7.5	4.8		*7.5*	6.5	5.0	5.0	**7.8**	**7.0**	**14.7**
Fresno	22	13.0	13.0	*2.4*	6.3	3.3	*6.3	*7.5*	6.0	2.5	6.0	**7.8**	**5.7**	**13.5**
Apache	27	16.0	11.0	*2.4*	10.5	5.0		*7.5*	5.5	6.0	6.0	**8.3**	**7.4**	**15.6**
North Springwater	30&31													
Fourty-Nine								7.5		8.0	8.0	**8.0**	**7.8**	**15.8**

Meets Objective
Meets some objectives
Falls Short
Cover not measured in 2005

Values in italics were represent missing data, estimated using nearby gauges.

*These summer 2003 values do not include the 1 - 2 inches received at the end of Sept. from tropical storm Marty

2005 rainfall markedly higher than 5-year average

2005 rainfall markedly lower than 5-year average

Appendix 1: Precipitation, cont.

Longer-term precipitation record for Empire-Cienega's West Pasture, 1988 to 2005

Location - ARS exclosure at Key Areas number 17 and 18

Month	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
January	0.75	0.7	0.7	0.8	1.48	7.15	0.1	1.88	0	1.25	0	0	0	2.3	0.2	0.05	1.55	2.6
February	0.6	0.15	0.2	1.65	1.62	1.1	1.2	2.2	1.35	1	4.7	0	0.25	0.75	0	2.15	0.3	2.1
March	0.15	0.5	0.18	2.15	3.15	0.5	0.8	1.07	0.35	0	2	2.05	1.3	0	0	0.6	3.25	1.8
April	0.77	0	0.12	0	0.25	0	0	0.2	0	0.2	0.2	0	0.05	2.45	0	0.15	0	0
May	0	0.15	0	0	1.05	1.9	0	0.08	0	0.4	0	0	0	0.25	0	0.25	0	
June	0.2	0.15	0.1	0	0	0	0	0	0	0.1	0.1	1.05	4.8	2.25	0	0.05	0.55	
July	7.13	1.25	4.68	0.35	2.95	2.2	1.85	1.48	3.95	0.35	8.25	5.35	0.95	3.6	3.05	3.15	3.25	
August	4.06	2.46	4.55	3.55	4.68	4.88	2.1	3.83	2.35	3.4	4.6	2.75	3.1	2.2	1.7	1.5	1.05	
September	0.15	0.35	1.05	0.5	0.15	0.8	2.13	1.5	2	2.7	2.25	1.25	1.4	0.6	1.8	3	0	
October	2.1	2.58	0.35	0.35	0.1	0.55	0.35	0.85	0.3	0.1	0.85	0.95	9.3	0.6	0.6	1.5	0.75	
November	0.15	0.22	0.55	0.85	0	0.7	3.85	0.68	0.9	0.7	1.05	0	1.65	1.2	0.4	1.3	0.3	
December	0.1	0	0.45	3.15	4.72	0.2	4.77	0.1	0	3.9	0.5	0.05	0	0.4	1.3	0.45	3.45	
Calendar year total	16.2	8.51	12.9	13.4	20.2	20	17.2	13.9	11.2	14.1	24.5	13.5	22.8	16.6	9.05	14.2	14.5	18.5
Oct. - April		3.7	4	5.95	10.9	13.6	3.55	14.3	3.33	3.65	11.6	4.45	2.6	16.5	2.4	5.25	8.35	11
May - Sept.	11.5	4.36	10.4	4.4	8.83	9.78	6.08	6.89	8.3	6.95	15.2	10.4	10.3	8.9	6.55	7.95	4.85	^^12
Rain-year total		8.1	14.4	10.4	19.7	23.4	9.6	21.2	11.6	10.6	26.8	14.9	12.9	25.4	9.0	13.2	13.2	23.0
Drought (both seasons below average)		*		*			*		*	*			*		*	*		

Average Total = 15.7 inches

Average Oct. - April = 7.35 inches

Average May - Sept. = 8.53 inches
(averaged from 1988-2005 values)
^^: *summary data provided by Mac Donaldson*

Appendix 2: 2004-2005 shrub and selected substrate cover data, compared with upland objectives for perenial grass and bare ground cover

Key Area monitoring results

Pasture, color coded by use date for 2005	Exclosure	Key Area	Bare ground basal cover		Perennial Grass basal cover		Perennial Grass canopy cover		Dominant Perennial Grass Species	Shrub canopy cover, 2004	Dominant Shrub species
			2004	2005	2004	2005	2004	2005	2004 [2005 changes]		
Davis		14	25.7	22.6	29.6	28.7	58.6	72.1	Blue grama	4.2	Unknown1
Davis		15	16.2	8.0	22.5	22.5	75.4	67.2	Sideoats grama	6.6	Burroweed
Johnson		10	20.9	20.3	26.8	10.6	64.6	42.3	Blue grama	10.9	Mesquite
5 Wire		19	23.9	24.0	19	26.7	82.9	63.1	Sacaton	4.3	Mesquite
North		2	9.9	9.6	12.7	18.0	62.8	63.0	Sideoats grama	22.0	Oak, Juniper
North		3	13.1	14.5	7.5	11.7	47.5	54.8	Sideoats grama	23.6	False mesquite
North		4	21.5	20.0	4.2	3.4	12.4	23.0	Black grama	28.8	False mesquite
North		8	51.8	58.5	7.9	4.2	16.8	37.8	Blue grama	21.6	Mesquite, Burroweed
Fresno		22	26.4	24.8	5.9	4.3	16.6	26.3	Black grama	27.8	False mesquite
Lower Mattie		20	28.1		9.4		57.7		Sacaton	10.8	Mesquite
Upper 49		5	16.5	25.5	2.8	5.1	8.7	21.1	Black grama	36.1	White-thorn acacia, False indigo bush
Springwater		16	22.3	29.3	20.4	11.7	35.7	38.2	Sprucetop grama	6.0	Shrubby Buckwheat
Springwater	outside	31	47.3	42.2	5.3	5.0	18.7	29.7	**Lehmann's**, Black grama	5.1	Range ratany
Mac's Sacaton exclosure	exclosure	30	23.2	25.6	11.3	8.0	26.4	30.6	Sprucetop grama	13.6	Mesquite, Burroweed
Alamo Solo		9	36.4	42.9	10.5	4.7	21.8	57.5	**Lehmann's**	22.7	Mesquite, Burroweed
Hilton		11	7.2	5.4	20.3	16.1	56.3	89.4	Bullgrass [Sideoats grama, Bullgrass]	16.8	Burroweed
Hilton		12	18.1	28.0	11	9.7	32.3	58.3	Curly mesquite [Sprucetop grama]	8.3	Burroweed
Hilton		13	26.9	47.7	18.9	13.7	46.8	30.3	Blue grama	0.6	Catclaw acacia
West	outside	17	32.7	23.9	12.4	19.3	31.3	58.7	Blue grama	6.6	Catclaw acacia
West	exclosure	18	19.4	16.7	17.8	24.8	49	71.7	Blue, Black, Sideoats grama	5.8	Mesquite, Burroweed
Rockhouse		6	13.5		4		20.5		Black grama	27.7	False mesquite, White thorn acacia
Rockhouse		7	19.4		3.8		13.5		Sideoats grama	27.4	False mesquite, White thorn acacia
Trap #1		1	51.4	40.8	9.5	3.6	22.8	25.3	Blue grama	10.6	Burroweed
Triangle		23	10	10.3	1.7	5.1	16.6	15.3	Tobosa	36.4	False mesquite, White thorn acacia

Meets objectives

Meets some objectives — Notable improvement from 2004

Falls Short — Notable decline from 2004

Appendix 2, cont.

Pasture, color coded by use date for 2005	Exclosure	Key Area	notes
Davis		14	14 meets all objectives (MAO) and cover values have been stable since 1995.
Davis		15	15 meets all objectives (MAO). Vegetation cover values have increased since 1995. Grazing seems to have been quite light on this plot so far in 2005.
Johnson		10	10 MAO but has lost a lot of grass cover from dramatic die-off of Blue Grama. Lehmann's seems to be increasing near plot.
5 Wire		19	19 MAO, improved grass cover since '04
North		2	2 MAO, grass cover up 5% from 2004.
North		3	3 MAO, grass cover up 3% from 2004 (DNMO for grass last year).
North		4	4 DNMO for grass cover, but may not be representative of area, which looks better.
North		8	8 DNMO for bare ground or grass cover; has failed to meet objectives from 1995 to present, but lost some more grass from 04-05
Fresno		22	22 DNMO for grass cover in '04 or '05; MO for bare ground with gravel, litter. Live basal veg. seems to show a downward trend since 1995.
Lower Mattie		20	
Upper 49		5	5 DNMO for grass cover, but grass up 2% from 2004. Shrub problems.
Springwater		16	16 MAO, but grass cover down 8% from '04; on verge of NMO.
Springwater	outside	31	31 DNMO for bare ground or grass cover, but stable-poor since 2000. Exclosure also lost grass (see below)
Mac's Sacaton exclosure	exclosure	30	Exclosure; lost grass cover, now barely DNMO for grass. Suggests that some problems with 31 may not be related to grazing.
Alamo Solo		9	9 has apparent drought issues: Blue Grama small, many did not flower. Some dead plants. Evidence of sheet errosion and pedestalling. BUT: patches of Lehmann's seedlings recruiting.
Hilton		11	11 MAO, cover values stable over time.
Hilton		12	12 now barely DNMO for grass (9.7%), but is close and otherwise seems OK.
Hilton		13	13 has increased bare ground since last year, now DNMO; lost grass cover but still MO.
West	outside	17	17 much improved from '04, now MAO.
West	exclosure	18	
Rockhouse		6	
Rockhouse		7	
Trap #1		1	
Triangle		23	23 is a very rocky site. Grass cover up from 2004; still DNMO for grass, but soil protected by rocks, gravel, etc.
			Meets Objective
			Meets some objectives
			Falls Short

Appendix 3: substrate cover data 1995-2005, point intercept protocols

		original protocol, 100 points						modified protocol, 1000 points		
Plot	Cover type	1995	1998	1999	2000	2001	2002	2003	2004	2005
KA1	bare ground	30	40	23	.	.	.	.	51	41
	gravel	11	10	20	.	.	.	.	10	14
	rock	0	0	0	.	.	.	.	0	0
	litter	48	45	52	.	.	.	.	28	40
	live vegetation basal	11	5	5	.	.	.	.	11	6
	perennial grass basal	.	.	.	.	.	.	.	9	4
	p. grass canopy	.	.	.	.	.	.	.	23	25
KA2	bare ground	9	40	14	4	.	.	.	10	10
	gravel	16	10	22	26	.	.	.	22	23
	rock	9	0	10	5	.	.	.	11	5
	litter	58	45	50	60	.	.	.	45	45
	live vegetation basal	9	5	4	6	.	.	.	13	18
	perennial grass basal	.	.	.	.	.	.	.	13	18
	p. grass canopy	.	.	.	.	.	.	.	63	63
KA3	bare ground	20	37	15	14	.	.	.	13	15
	gravel	32	10	35	48	.	.	.	39	32
	rock	11	8	4	4	.	.	.	11	5
	litter	23	47	33	27	.	.	.	28	35
	live vegetation basal	14	0	15	17	.	.	.	7	13
	perennial grass basal	.	.	.	.	.	.	.	7	12
	p. grass canopy	.	.	.	.	.	.	.	47	55
KA4	bare ground	23	38	8	.	.	.	25	21	20
	gravel	41	19	42	.	.	.	38	46	36
	rock	2	5	9	.	.	.	3	5	3
	litter	27	31	30	.	.	.	29	22	36
	live vegetation basal	7	10	11	.	.	.	4	4	4
	perennial grass basal	.	.	.	.	.	.	.	4	3
	p. grass canopy	.	.	.	.	.	.	.	12	23
KA5	bare ground	19	22	21	.	.	.	42	17	26
	gravel	52	34	36	.	.	.	35	61	35
	rock	4	1	0	.	.	.	2	2	2
	litter	19	38	26	.	.	.	19	16	31
	live vegetation basal	7	6	17	.	.	.	2	3	6
	perennial grass basal	.	.	.	.	.	.	.	3	5
	p. grass canopy	.	.	.	.	.	.	.	9	21
KA6	bare ground	20	14	6	.	.	.	26	14	.
	gravel	35	32	28	.	.	.	34	36	.
	rock	11	19	21	.	.	.	10	17	.
	litter	23	25	29	.	.	.	28	28	.
	live vegetation basal	10	15	16	.	.	.	3	4	.
	perennial grass basal	.	.	.	.	.	.	.	4	.
	p. grass canopy	.	.	.	.	.	.	.	20	.
KA7	bare ground	3	13	9	.	.	.	33	19	.
	gravel	27	12	11	.	.	.	28	19	.
	rock	25	35	29	.	.	.	21	31	.
	litter	35	29	45	.	.	.	16	26	.
	live vegetation basal	9	13	6	.	.	.	2	4	.
	perennial grass basal	.	.	.	.	.	.	.	4	.
	p. grass canopy	.	.	.	.	.	.	.	14	.

KA8	bare ground	40	55	50	62	38	.	.	52	59	
	gravel	0	0	3	1	1	.	.	2	1	
	rock	0	0	0	0	0	.	.	0	0	
	litter	50	37	36	21	42	.	.	38	34	
	live vegetation basal	10	9	11	16	19	.	.	8	6	
	perennial grass basal	.	.	.	.	.	.	.	8	4	
	p. grass canopy	.	.	.	.	.	.	.	17	38	
KA9a	bare ground	42	73	32	.	52	.	.	36	43	
	gravel	0	0	4	.	2	.	.	2	1	
	rock	0	0	0	.	0	.	.	0	0	
	litter	40	23	50	.	24	.	.	46	51	
	live vegetation basal	12	5	14	.	22	.	.	16	5	
	perennial grass basal	.	.	.	.	.	.	.	11	5	
	p. grass canopy	.	.	.	.	.	.	.	22	58	
KA9b	bare ground	68	52	28	.	26	.	.	.	.	
	gravel	0	0	2	.	0	.	.	.	.	
	rock	0	0	0	.	0	.	.	.	.	
	litter	22	49	68	.	54	.	.	.	.	
	live vegetation basal	10	5	2	.	20	.	.	.	.	
KA10	bare ground	32	13	8	.	6	.	.	21	20	
	gravel	0	0	0	.	0	.	.	0	0	
	rock	0	0	0	.	0	.	.	0	0	
	litter	57	79	74	.	70	.	.	50	67	
	live vegetation basal	11	10	18	.	24	.	.	28	13	
	perennial grass basal	.	.	.	.	.	.	.	27	11	
	p. grass canopy	.	.	.	.	.	.	.	65	42	
KA11	bare ground	9	12	8	.	6	.	.	7	5	
	gravel	39	14	38	.	28	.	.	23	25	
	rock	9	15	15	.	6	.	.	12	12	
	litter	32	40	28	.	41	.	.	37	40	
	live vegetation basal	12	16	11	.	19	.	.	20	16	
	perennial grass basal	.	.	.	.	.	.	.	20	16	
	p. grass canopy	.	.	.	.	.	.	.	56	89	
KA12	bare ground	22	20	18	.	20	.	.	18	28	
	gravel	32	13	24	.	32	.	.	35	24	
	rock	6	11	11	.	10	.	.	6	5	
	litter	29	39	31	.	18	.	.	29	33	
	live vegetation basal	11	19	17	.	20	.	.	12	10	
	perennial grass basal	.	.	.	.	.	.	.	11	10	
	p. grass canopy	.	.	.	.	.	.	.	32	58	
KA13	bare ground	.	42	35	.	44	.	56	27	48	
	gravel	.	20	25	.	27	.	14	28	12	
	rock	.	0	0	.	0	.	0	0	1	
	litter	.	29	23	.	16	.	25	26	25	
	live vegetation basal	.	11	17	.	11	.	6	19	14	
	perennial grass basal	.	.	.	.	.	.	.	19	14	
	p. grass canopy	.	.	.	.	.	.	.	47	30	
KA14	bare ground	.	23	26	.	20	.	28	26	23	
	gravel	.	0	0	.	1	.	2	10	2	
	rock	.	0	0	.	0	.	1	0	1	
	litter	.	54	49	.	48	.	41	33	45	
	live vegetation basal	.	23	25	.	31	.	28	30	29	
	perennial grass basal	.	.	.	.	.	.	.	30	29	
	p. grass canopy	.	.	.	.	.	.	.	59	72	

KA15	bare ground	.	16	14	.	7	.	12	16	8
	gravel	.	28	39	.	52	.	34	22	19
	rock	.	12	7	.	17	.	11	5	4
	litter	.	34	30	.	30	.	35	33	46
	live vegetation basal	.	11	10	.	10	.	8	23	23
	perennial grass basal	.	.	.	.	.	.	.	23	23
	p. grass canopy	.	.	.	.	.	.	.	75	67
KA16	bare ground	.	32	28	22	.	.	26	22	29
	gravel	.	14	33	33	.	.	26	28	22
	rock	.	11	4	6	.	.	7	8	9
	litter	.	32	24	32	.	.	32	21	27
	live vegetation basal	.	12	11	7	.	.	9	20	12
	perennial grass basal	.	.	.	.	.	.	.	20	12
	p. grass canopy	.	.	.	.	.	.	.	36	38
KA17	bare ground	13	13	23	15	.	15	.	33	24
	gravel	4	5	1	5	.	8	.	2	1
	rock	3	5	2	5	.	0	.	0	6
	litter	68	55	54	52	.	71	.	53	48
	live vegetation basal	12	23	20	23	.	4	.	13	20
	perennial grass basal	.	.	.	.	.	.	.	12	19
	p. grass canopy	.	.	.	.	.	.	.	31	59
KA18	bare ground	24	21	22	19	.	15	.	19	17
	gravel	12	11	22	9	.	4	.	8	6
	rock	1	0	2	58	.	1	.	0	0
	litter	52	54	33	14	.	63	.	54	51
	live vegetation basal	11	12	20	7	.	17	.	18	25
	perennial grass basal	.	.	.	.	.	.	.	18	25
	p. grass canopy	.	.	.	.	.	.	.	49	72
KA19	bare ground	24	2	0	.	.	.	12	24	24
	gravel	0	0	0	.	.	.	0	0	0
	rock	0	1	0	.	.	.	0	0	0
	litter	48	75	86	.	.	.	69	56	48
	live vegetation basal	28	22	14	.	.	.	18	20	27
	perennial grass basal	.	.	.	.	.	.	.	19	27
	p. grass canopy	.	.	.	.	.	.	.	83	63
KA20	bare ground	20	.	17	17	.	.	.	28	.
	gravel	9	.	5	5	.	.	.	1	.
	rock	12	.	4	4	.	.	.	0	.
	litter	27	.	68	66	.	.	.	61	.
	live vegetation basal	4	.	6	8	.	.	.	10	.
	perennial grass basal	.	.	.	.	.	.	.	9	.
	p. grass canopy	.	.	.	.	.	.	.	58	.
KA21	bare ground	11	.	.	.	.	.	.	.	.
	gravel	23	.	.	.	.	.	.	.	.
	rock	18	.	.	.	.	.	.	.	.
	litter	37	.	.	.	.	.	.	.	.
	live vegetation basal	11	.	.	.	.	.	.	.	.
	perennial grass basal	.	.	.	.	.	.	.	.	.
	p. grass canopy	.	.	.	.	.	.	.	.	.
KA22	bare ground	6	.	13	12	.	.	.	26	25
	gravel	32	.	29	39	.	.	.	43	36
	rock	5	.	4	6	.	.	.	2	3
	litter	40	.	39	30	.	.	.	22	29
	live vegetation basal	17	.	15	13	.	.	.	6	5
	perennial grass basal	.	.	.	.	.	.	.	6	4
	p. grass canopy	.	.	.	.	.	.	.	17	26

KA23	bare ground	5	5	.	.	10	10
	gravel	32	18	.	.	18	26
	rock	25	36	.	.	42	35
	litter	40	26	.	.	27	19
	live vegetation basal	11	15	.	.	2	5
	perennial grass basal	.	.	.	.	2	5
	p. grass canopy	.	.	.	.	17	15
KA24	bare ground	2	6	.	.	.	.
	gravel	0	0	.	.	.	.
	rock	0	0	.	.	.	.
	litter	92	90	.	.	.	.
	live vegetation basal	6	4	.	.	.	.
	perennial grass basal	.	.	.	.	.	.
	p. grass canopy	.	.	.	.	.	.
KA25	bare ground	36	30	.	.	.	.
	gravel	2	1	.	.	.	.
	rock	0	0	.	.	.	.
	litter	57	69	.	.	.	.
	live vegetation basal	5	0	.	.	.	.
	perennial grass basal	.	.	.	.	.	.
	p. grass canopy	.	.	.	.	.	.
KA26	bare ground	10	1	.	.	.	.
	gravel	14	29	.	.	.	.
	rock	37	22	.	.	.	.
	litter	34	25	.	.	.	.
	live vegetation basal	3	12	.	.	.	.
	perennial grass basal	.	.	.	.	.	.
	p. grass canopy	.	.	.	.	.	.
KA27	bare ground	7	7	.	.	.	.
	gravel	18	18	.	.	.	.
	rock	24	42	.	.	.	.
	litter	47	27	.	.	.	.
	live vegetation basal	5	6	.	.	.	.
	perennial grass basal	.	.	.	.	.	.
	p. grass canopy	.	.	.	.	.	.
KA28	bare ground	.	.	.	.	.	.
	gravel	.	.	.	.	.	.
	rock	.	.	.	.	.	.
	litter	.	.	.	.	.	.
	live vegetation basal	.	.	.	.	.	.
	perennial grass basal	.	.	.	.	.	.
	p. grass canopy	.	.	.	.	.	.
KA30	bare ground	.	30	17	16	23	26
	gravel	.	13	37	42	39	31
	rock	.	17	13	8	8	6
	litter	.	28	27	22	19	28
	live vegetation basal	.	12	6	10	12	9
	perennial grass basal	.	.	.	.	11	8
	p. grass canopy	.	.	.	.	26	31
KA31	bare ground	.	.	42	50	47	42
	gravel	.	.	15	22	28	17
	rock	.	.	0	0	2	2
	litter	.	.	39	21	17	31
	live vegetation basal	.	.	4	7	6	7
	perennial grass basal	.	.	.	.	5	5
	p. grass canopy	.	.	.	.	19	30

APPENDIX 4: EMPIRE RANCH plant species frequency data for plots measured in 2005 (pace frequency protocol, 1995-2005)

KA1 Loamy Upland 41-3 Trap #1 Elev. at KA is 4640 ft.
NE 1/4 SE 1/4 Sec. 18 T19S R17E.

	1995	1998	1999	2005
Ground Cover	**%Freq**	**%Freq**	**%Freq**	**%Freq**
Bare ground	30	40	23	27
Gravel	11	10	20	11
Rock	0	0		0
Litter	48	45	52	53
Live Veg (Basal)	11	5	5	10
Plant Species				
Blue grama	59	30	26	35
Sideoats grama	33	23	36	26
Black grama	45	15	24	16
Sprucetop grama	16	8		
Wolftail	9	1		3
Hairy grama	11	4	4	
Cane beardgrass	9	5	5	5
Plains bristlegrass	1			1
Green sprangletop	1	2	2	5
Aristida spp				30
Mesa threeawn	10	6	3	
Poverty threeawn	2	3	2	
Curley mesquite	34	5	12	2
Lehman lovegrass		2	6	6
vine mesquite				4
Ann. threeawn		57	90	
Plains lovegrass	1			1
Fluffgrass	3	2	3	1
Ragweed	11	2		
Silverleaf nightshade	2		1	
Hog potato	14	9	4	
Sida	2	1	11	
Guajilla	1		1	
Burroweed	71	52	44	25
Mesquite	4	1	2	4
Evolvulous	7	2	1	
Ann. aster	52	11		
Ann. buckwheat	1		1	
Sixweek fescue	31			
Indian wheat	43	1		
Red threeawn	3			
Sand dropseed	3		2	
Tobosa	1			
Sacaton	1			
Wait-a-bit		1	1	
Croton		2	4	
AAGG		34	35	31
AAFF		72	2	79

Steady decrease in burroweed

KA2 Loamy Hills 41-1 North Pasture Elev. at KA is 4950 ft
NE 1/4 NW 1/4 Sec. 11 T19S R16E

	1995	1998	1999	2003	2005
Ground Cover	**%Freq**	**%Freq**	**%Freq**	**%Freq**	**%Freq**
Bare ground	9	37	14	4	11
Gravel	16	10	22	26	17
Rock	9	8	10	5	5
Litter	58	47	50	60	62
Live Veg (Basal)	9	0	4	6	6
Plant Species					
Sideoats grama	72	54	66	69	73
Beggar tick threewn	16	4	13		4
Purple threeawn					9
Purple grama	9	3			8
Plains lovegrass	14	16	9	13	17
Halls panic	2	5	19		7
Vine mesquite	3	2		3	1
Hairy grama	1	3	3	1	
Blue grama	1	6	5	2	13
Sprucetop grama	1	2		11	
Bullgrass					5
Green sprangletop					2
Goldeneye	89	62	32		56
Herbaceous sage/Silver sage	24	11	4	10	11
Shrubby buckwheat	34	13	19	10	13
Yerbe-de-pasmo	3	2	3	1	1
Guajilla/False mesquite	10	0	6		11
Velvetpod mimosa	16	4	9	7	1
Wait a minute mimosa					9
Hog potato	3	0	5	11	1
Slender grama	1	0	3	5	
Shrub dalea	2	1	2	2	
Oneseed juniper	2	8	2	4	
Arizona white oak	9	0	1	5	3
Mexican blue oak	3	17	16	2	
Mesquite	3	7	2	1	1
Cane beardgrass	3	2	1	2	5
Spreading ratany	1	4	2	2	
Curley mesquite	1	14	7	3	1
false mesquite		12		10	
AAGG		30	45	45	2
AAFF		36	16	8	29
Perennial 3-awn			12	10	15
Bidens				9	

Increase in blue and sprucetop grama

KA3 Loamy Hills 41-3 North Pasture
Elev. at KA is 4950 ft.
NE 1/4 NW 1/4 Sec. 11 T19S R16E

Ground Cover	1995 % Freq	1998 % Freq	1999 % Freq	2000 % Freq	2005 % Freq
Bare ground	20	19	15	14	19
Gravel	32	23	35	48	31
Rock	11	7	4	4	10
Litter	23	31	33	27	29
Live Veg (Basal)	14	17	15	17	11
Plant Species					
Sideoats grama	42	37	44	36	24
Purple grama	1	0		29	
Curley mesquite	17	5	29	2	17
Shortleaf tridens	9	16	10	6	7
Black grama	10	35	24	34	41
Blue grama					4
Tanglehead	8	4	11	5	
Sprucetop grama	63	50	44	29	29
Hall's panic grass					11
Fluffgrass					13
Threeawn spp					4
Muhly spp					1
False mesquite	76	52	74	66	44
Mesquite					1
Prickly pear					3
Rainbow cactus					1
Indian wheat	97	0			
Croton	11	0	2	6	5
Goldeneye	3	2	6		6
Ann. forb	1	51	1	12	30
AAGG		6	1	21	
Annual aster					4
Sida			2	6	
Evolvulus				8	
Janusia				31	

Stable; possible drop in false mesquite.

KA8 Sandy Loam Upland 41-3 North Pasture
Elev. at KA is 4500 ft.
NW 1/4 SW 1/4 Sec 9 T19S R17E

Ground Cover	1995 % Freq	1998 % Freq	1999 % Freq	2000 % Freq	2001 % Freq	2005 % Freq
Bare ground	40	55	50	62	38	45
Gravel	0	0	3	1	1	0
Rock	0	0			0	0
Litter	50	37	36	21	42	47
Live Veg (Basal)	10	9	11	16	19	5
Plant Species						
Blue grama	55	75	73	68	67	74
Plains lovegrass	34	1	7	12	14	2
Mesa threeawn	60	56	53	36		
Wolftail	56	8	4	14	12	3
Hairy grama	50	18	14	40	7	2
Black grama	24	12	18	34	17	8
Lehman lovegrass	2	6	3	10	13	12
Sprucetop grama	14	10		20	2	9
Cane Beardgrass					6	
Arizona cottontop						6
Green sprangletop						1
Vine mesquite						4
Burroweed	18	23	29	24	32	20
burroweed seedlings		22		8		
Mesquite	9	12	6	3	17	10
Evolvulous	55	35	17	46	23	
Portulaca		5		8	0	
hog potatoe		49	16	12	0	
Aristida spp.					50	32
AAGG		57	14	53	0	47
AAFF		73	41	27	57	85
PPFF					29	
Zinnia						3
Silver nightshade						1
carpetweed			4	7	0	
Spidergrass				26	0	
Blue 3-Awn				8		
Chloris virgata				28	0	
Indian Wheat					11	
Sida					6	
Daisy					41	
Annual Aster					7	
Cudweed					21	

Loss of black grama, increase in lehmann lovegrass, blue grama stable

KA9b (Burned) Sandy Loam Upland 41-3
Alamo Solo Pasture Elev. at KA is 4610 ft
NW 1/4, SE 1/4 Sec. 20 T19S R17E

Ground Cover	1995 % Freq	1998 % Freq	1999 % Freq	2001 % Freq	2005 % Freq
Bare ground	68	52	28	26	52
Gravel	0		2	0	0
Rock	0			0	1
Litter	22	49	68	54	24
Live Veg (Basal)	10	5	2	20	3
Plant Species					
Lehman Lovegrass	88	57	74	94	85
Blue grama	64	14	8	16	17
Black grama	12	5	10	22	20
Mesa threeawn	10	2	10	Lumped 3 awns	Lumped 3 awns
Arisida spp.				10	11
Wolftail					3
Arizona cottontop					1
Vine mesquite					1
Spidergrass					2
Annual 3-awn			28		
Feather fingergrass			24	0	
Burroweed	4	3	4	12	5
Mesquite		9	14	16	13
Cholla					1
Evolvulous	6	0	28	6	
Annual aster	10	6		28	
Indian wheat	42	0		30	
Wild daisy	30	0		28	
hog potato		12	20	0	
poorjoe (*Diodia teres*)			30	0	
Dalea				12	
Cudweed				6	
AAGG		66	22	0	49
AAFF		81	2	38	74
PPFF		40	18	16	

Lehmann lovegrass stable (high), Burroweed stable (low), increase in Black grama

KA9a (Unburned) Sandy Loam Upland 41-3
Alamo Solo Pasture Elev. at KA is 4610 ft
NW 1/4, SE 1/4 Sec. 20 T19S R17E

Ground Cover	1995 % Freq	1998 % Freq	1999 % Freq	2001 % Freq	2005 % Freq
Bare ground	42	73	32	52	52
Gravel	6		4	2	6
Rock	0			0	1
Litter	40	23	50	24	37
Live Veg (Basal)	12	5	14	22	4
Plant Species					
Lehman Lovegrass	88	59	90	92	92
Plains lovegrass					2
Blue grama	74	22	40	28	20
Black grama	22	19	16	22	6
Hairy grama	20	1		4	1
Mesa threeawn	18	0	8	10	2
Wolftail					1
Curly mesquite					2
Annual 3-awn			12	0	
Burroweed	56	35	52	50	15
Mesquite	22	11	14	6	12
Yerba del pasmo					7
Catclaw accacia					1
Wait a minute mimosa					1
Ann. aster		1		24	
Indian wheat	48	0		86	
Hog potato					4
AAGG		8	24	0	29
AAFF		28		40	43
PPFF		4		0	

Lehmann lovegrass stable (high), loss of burroweed down to burned level due to winter drought?

KA11 Loamy Hills 41-1 Hilton Pasture Elev. at KA is 4730 ft.
NE 1/4 SE 1/4 Sec 36 T19S R17E

Ground Cover	1995 % Freq	1998 % Freq	1999 % Freq	2001 % Freq	2005 % Freq
Bare ground	9	12	8	6	11
Gravel	39	14	38	28	10
Rock	9	15	15	6	21
Litter	32	40	28	41	49
Live Veg (Basal)	12	16	11	19	10
Plant Species					
Sideoats grama	43	52	59	48	50
Plains lovegrass	13	25	28	30	34
Bullgrass	52	32	30	43	32
Hairy grama	3	9	13	16	11
Texas bluestem	30	17	17	13	14
Curley mesquite	4	18	10	15	11
Black grama					1
Sprucetop grama		8	1	5	6
Purple grama					1
Cane beardgrass					15
Spidergrass					3
Tobosa					2
3-Awn spp. (Aristida spp)				7	10
Wooly bunchgrass					1
Goldeneye	55	60		69	16
Evolvulous	6	10		10	
Herbaceous sage	33	18	13	11	9
Croton					3
Wormwood				14	
Indian wheat	3	7		24	
Burroweed	7	9	8	10	4
Yerbe-de-pasmo	8	12	9	2	4
False mesquite					6
Shrubby buckwheat	19	8	21	2	2
Wait-a-bit mimosa (MIBI)	5	11	10	4	
sida		1		7	
AAGG					1
AAFF			5	80	14

Plains lovegrass, hairy grama increasing; Curly mesquite and half-shrubs (burroweed, shrubby buckwheat) decreasing.

KA12 Loamy Hills 41-3 Hilton Pasture Elev. at KA is 4740 ft.
SE 1/4 NE 1/4 Sec 36 T19S R17E

Ground Cover	1995 % Freq	1998 % Freq	1999 % Freq	2001 % Freq	2005 % Freq
Bare ground	22	20	18	20	26
Gravel	32	13	24	32	10
Rock	6	11	11	10	21
Litter	29	39	31	18	37
Live Veg (Basal)	11	19	17	20	7
Plant Species					
Sideoats grama	27	28	44	19	31
Sprucetop grama	43	47	38	35	54
Hairy grama	29	8	11	14	
Curley mesquite	66	43	48	74	32
Tanglehead	21	15	20	9	2
Cane beardgrass	11	11	2	14	10
Wolftail					1
Plains lovegrass					2
Black grama	19	22	27	12	18
Blue threeawn					1
Purple threeawn					2
Spidergrass					1
Hall's panicgrass					7
Ann. goldeneye	54	2		57	
Ann. aster	30	18		77	3
Indian wheat	31	5		12	
Sida	6	6	10	12	
Evolvulous	2	6	9	10	
Croton	16	8	9	4	3
Allonia				5	
False mesquite	6	7	4	8	5
Palmer agave					4
Mesquite					1
Burroweed	24	22	19	30	11
Staghorn cholla					2
Prickley pear	3	6	6	5	5
AAGG					14
AAFF		25	3	80	48
PPFF			2	0	

Stable

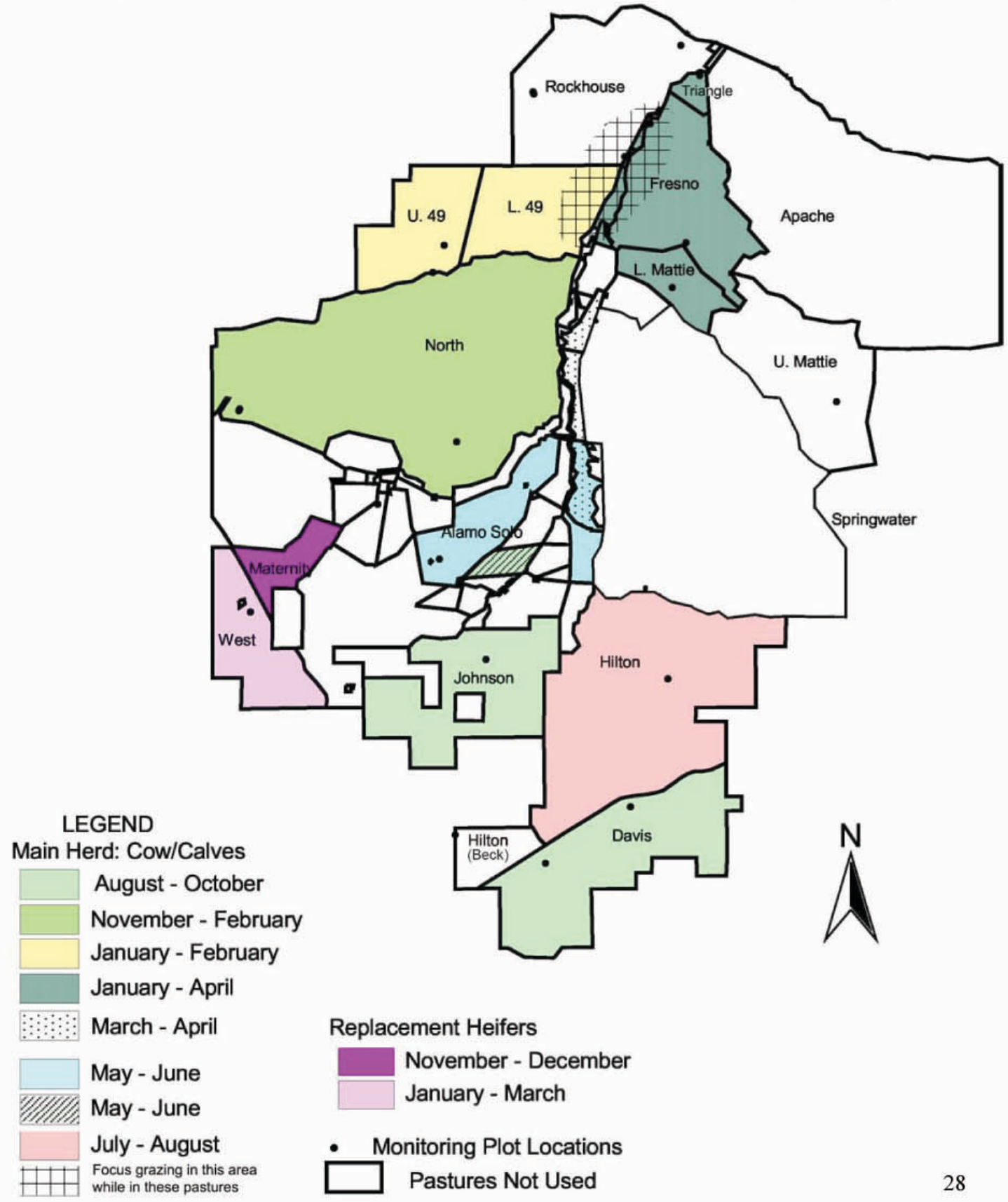
KA13 Loamy Upland 41-3 Hilton Pasture
Elev. at KA is 4760 ft.
NW 1/4 NW 1/4 Sec 16 T20S R17E

	1995	1998	1999	2001	2003	2005
Ground Cover	**% Freq**	**% Freq**	**% Freq**	**% Freq**	**% Freq**	**% Freq**
Bare ground	21	42	35	44	56	70
Gravel	13	20	25	27	14	3
Rock	0	0		0	0	1
Litter	48	29	23	16	25	21
Live Veg (Basal)	18	11	17	11	6	5
Plant Species						
Sideoats grama	68	67	77	70	58	35
Hairy grama	31	18	17	9	6	
Black grama	25	51	49	56	44	34
Curley mesquite	46	47	42	9	23	10
Cane Beardgrass	14	1				
Wolftail	5	10	11	9	6	5
Blue grama	19	27	35	51	50	43
Blue threeawn	17	35	27		6	1
Spidergrass	11				1	1
Poverty threeawn						2
Sprucetop grama	1	2	3		8	4
3-awn spp.			1	5		
Wait A Minute Mimosa	2					
Shrubby buckwheat	4					1
Yerba del pasmo	1					1
Rainbow cactus	2					1
False mesquite	54					2
Rosary bean	12	12		16	7	
Croton	16	22	26	25	17	22
Ann. goldeneye	54	23		67		30
Spiny haplopappus	32	28	7	3	13	
Ann. aster	16	4		10		2
Indian wheat	1	0		12		
Spiny aster	16			42		
Sida	6			22	11	
Evolvulus	2				11	
Hog potato	54				4	
Spike daisy	6					2
Morning glory	16				2	
PPFF			5	1	6	
AAFF		14	1	60	9	62

Very heavy yearlong use by horses in 2004 and 2005 – high bare ground, loss of perennial grasses (Bocu, Bogr, Boer, Hibe)

Appendix 5

Grazing Plan for Fall 2005 to Summer 2006



Proposed Cattle Rotation
2006

Pasture Name	Acres	No.	January				February				March				April				May				June				July				August				September				October				Nov 2005				Dec 2005			
Winter Range (Oct-Apr)																																																		
15 Upper Mattie	3147																																																	
14 Lower Mattie	891		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																															
16 Horse	257																																																	
13 Apache	9770																																																	
12 Fresno	2782		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																															
11 Triangle	186		x	x	x	x	x	x	x																																								
10 Rock House	3815		x	x	x	x	x	x	x	x																																							
8 Upper 49	1846		x	x	x	x	x	x	x	x																																							
9 Lower 49	2048		x	x	x	x	x	x	x	x																																							
7 N. Pasture	9743		x	x	x	x	x	x	x	x																																				x	x	x	x	x	x	x	x
Total	34485																																																	
Sacaton Pasture (May-Jun)																																																		
35F Cieneguita	321																																																	
40K Gardiner	395																		x	x	x	x	x	x	x	x																							
41L Cottonwood	110																																																	
38I Bills Tank	303																																																
30A Ag Fields	266																																																	
43N Ricks E	138																																																	
44O Ricks W	119																																																	
42M Hummel	250																																																	
45P Jerrys	61																																																	
39J Hilton	294																		x	x	x	x	x	x	x	x																							
46Q Cold Water	50																																																	
32C Macs E	175										x	x	x	x	x	x	x	x																															
31B Macs W	62																																																	
33D E. 500 Ac.	202										x	x	x	x	x	x	x	x																															
34E W. 500 Ac.	92																																																	
37H E. 5 Wire	331										x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																					
36G W. 5 Wire	202																																																	
Mattie Sacaton	138																																																	
Total	3509																																																	
Summer Range (Jul-Oct)																																																		
19 W. Davis	1855																																																	
E. Davis	1855		m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m																															
18 Hilton - Rd Cyn Area			b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b																			b	b	b	b	b	b	b	b
Beck	3447.5																										x	x	x	x	x	x	x	x												m	m	m	m	m	m	m	m
Blue	3447.5																										x	x	x	x	x	x	x	x																			
20 Johnson	3076																																																	
21 Bellota	2500																																																	
22 West	1633		rh	rh	rh	rh	rh	rh	rh	rh	rh	rh	rh	rh																																				
23 Maternity	707																																															rh	rh	rh	rh	rh	rh	rh	rh
6 Empire	2195																																																	
24 Alamo Solo	1423																		x	x	x	x	x	x	x	x																							
25 Oil Well	551		hs	hs	hs	hs	hs	hs	hs	hs	hs	hs	hs	hs	hs	hs	hs	hs																												hs	hs	hs	hs	hs	hs	hs	hs
17 Spring Water	10175										x	x	x	x	x	x	x	x																																
HQ			hm	hm	hm	hm	hm	hm	hm	hm	hm	hm	hm	hm	hm	hm	hm	hm																												hm	hm	hm	hm	hm	hm	hm	hm
Total	32865																																																	

Cow/Calf Herd - x
Replacement Heffers - rh
Bulls - b

Horses - 15 Mares - m
Horses - Work (4) - hm Macs
Horses - Work (8) - hs Sams