WCC-40 2003 Agenda- Reno NV

Monday, October 6th

1 :00-6:00 PM

Joint meeting with WCC 55 and trial run of symposium- "Rangelands in Transition: The Changing Faces of Rangeland Users, Implications for Management and Rangeland Sustainability"

Symposium Presentations

Ken Sanders, University of Idaho. Traditional Users, Values and Beliefs Meant Good Stewardship.

Lynn Huntsinger and Adriana Sulak, Western Ranching: Loving it or Leaving It.

L. Allen Torell, Neil RRimbey, and Dan McCullom. New Faces and the Changing Value of Rangeland.

Jim Knight. The Growing Importance of Wildlife and Recreational Activities for Rangeland Users.

Tex Taylor. Rural Communities and the Changing Rangeland User.

John Tanaka and Neil R Rimbey. New Faces, What Does it Mean for Sustainable Rangeland Management?

Tuesday, October 7th

Dr. Jim Young and Dr. Bob Blank will be leading a field trip titled "A Salt Desert Shrub Experience."

Wednesday, October 8th 8:00-12:00 AM

Business meeting

Opening comments- Jim Jacobs

Old business

Review and approval of 2002 minutes

New business

State and agency reports

Updates on the following programs:

SRM Rangeland Assessment and Monitoring (RAM) Committee

Sustainable Rangeland Roundtable (SRR)

Rangeland Environmental Assessment Program (REAP)

Heinz Center

The Nature Conservancy activity- Neil West

Comments related to symposium

Scheduling 2004 WCC 40 meeting

Allen Torell reviewed the afternoon's dry run of the symposium papers and discussion and wanted to assign reviewers to each of the papers at the conclusion of the presentations.

The following are the Symposia Presentations for this afternoon:

Ken Sanders, University ofldaho, *Traditional Users, Values and Beliefs Meant Good Stewardship.* Lynn Huntsinger and Adriana Sulak, *Western Ranching: Loving it or Leaving It.* Sanchita Sengupta, Daniel Edward Osgood, *The value of remoteness: a hedonic estimation of ranchette prices.*
L. Allen Torell, Neil R. Rimbey, and Dan McCullom, *New Faces and the Changing Value of Rangeland*
Jim Knight, *The Growing Importance of Wildlife and Recreational Activities for Rangeland Users.* Tex Taylor, *Rural Communities and the Changing Rangeland User.* John Tanaka and Neil R. Rimbey, *NewFaces, What Does it Meanfor Sustainable Rangeland Management?*

John Tanaka reported on the Sustainable Rangeland Roundtable project. The project's first approximation report is now completed and available at the CSU website (http://sustainablerangelands.cnr.colostate.edul). The next meeting will be on October 2022 in Boise, Idaho and will focus on where the Sustainable Rangeland Roundtable project should go next defme existing research gaps etc.

Neil Rimbey reported on the W-192 research group. Neil reported the group is looking at western changes in rural communities from changes in public policies and has listed the following four items as the objectives.

I) Continue to refine economic models
2) Assess the social impacts of public policies
3) Look over and assess existing laws and policies
4) Continue to support the Policy Analysis Center for Western Public Lands

Under objective 3, the person from Alaska who was handling the existing policies part of the project is no longer available. Don Snyder mentioned that the dean from Alaska noted that others might be interested. Don agreed to follow up and determine who would be willing to join the group.

Since the Center no longer exists, objective 4 will be deleted.

Neil reported that he is in the final stages of updating the Owyhee County Social and Economic system project. He is working with JD Wulfhorst who is handling the social assessment part of the update.
http://www.ag.uidaho.edu/aers/publications/AEES 2003/aees2003.htm

Paper Preparation Schedule

Present papers in Reno and papers to reViewers	Monday Oct. 6 1 - 5 pm
Papers returned to authors for revision	Friday Oct. 24
Return final papers and coordinate printing	Friday Nov. 21
Paper Presentation in Salt Lake - Changing Faces Symposium- Tuesday	Tuesday January 27 8 am-nQoIl
For those interested - Social and Economics Technical Session-	Thursday January 29 starts at 1 pm

Paper Reviewers

Paper and Authors	W CC5 5/W CC40 Reviewers
Ken Sanders, University of Idaho, *Traditional Users, Values and Beliefs Meant Good Stewardship.*	
Lynn Huntsinger and Adriana Sulak, *Western Ranching: Loving it or Leaving It.*	
Sanchita Sengupta, Daniel Edward Osgood, *The value of remoteness: a hedonic estimation of ranchette prices.*	No review necessary as this paper will not be presented in Salt lake City
L. Allen Torell, Neil R. Rimbey, and Dan McCullom, *New Faces and the Changing Value of Rangeland.*	
Jim Knight, *The Growing Importance of Wildlife and Recreational Activities for Rangeland Users.*	
Tex Taylor, *Rural Communities and the Changing Rangeland User.*	
John Tanaka and Neil R. Rimbey, *New Faces, ,What Does it Mean for Sustainable Rangeland Management?*	

10-8-2003 - Reno, NV. Meeting Attendance

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State Report
The University of Arizona

WCC-55 Annual Meeting Range Resource Economics and Policy

(Reno October 6-8, 2003)

Trent Teegerstrom Department of Agricultural & Resource Economics The University of Arizona

Research Projects (2003)

1. Map Based Calf Sale Weight Calculator: http://minu.arec.arizona.edu/calfweiaht (Osgood, Teegerstrom, & Tronstad)

Based on the study above, this decision support system allows one to investigate selling decisions under different scenarios. It starts with a mapserver that allows one to view and select a region. Once a place is select on the map, the worksheet starts with suggested values based on information from our geographic database. This program is evolving into a joint project between Climate Assessment for the Southwest (CLIMAS) and our department. We currently have several graduate students working on integrating paleoclimatology data with range and economic data into decision tool models.

2. The Raingauge Webpage: http://minu.arec.arizona.edu/rainaauae (Osgood, Teegerstrom & McReynolds)

.In collaboration with Cochise and Santa Cruz County Extension and area ranchers, an interactive webpage is being developed. The webpage will allow ranchers to communicate their personal raingauge and range quality observations with one another. Once operational the webpage will have a potential tie in with the Map Based Calf Sale Weight Calculator web page. This program is continuing to expand and develop

3. RighRisk Training for Western Livestock Producers: www.riahtrisk.ora (The RightRisk Education Team)

RightRisk is an innovative risk research and education program to help you the farmer or rancher understand and explore risk management decisions and evaluate the effects of those decisions. RightRisk, explores risk management strategies, helps build decision-making skills, and teaches individuals about personal risk management styles. RightRisk uses real world farm/ranch settings and agricultural economics. It allows many kinds of risk and risk management strategies and lets the user compare one strategy against another.

4. Ranch Re-stocking Decision Tool: (Tronstad & Teegerstrom)

The restocking decision tool for cow-calf producers helps evaluate what the risks and returns are associated with user supplied restocking scenarios. Financial calculations regarding how much ranchers can afford to pay for livestock of better genetics (e.g., carcass quality traits, fertility) and the risks associated with restocking under different levels of available capital, remaining herd size, and the performance of raised versus purchased animals can be evaluated with this tool.

5. Arizona Risk Management Education for Priority Commodities: (Tronstad & Teegerstrom)

A continuation of last years risk management workshops utilizing the 20 laptop mobile computer lab. With software tailored for the producers' local conditions and commodities, we will be teaching decision tools and risk management strategies in a 6 to 8 hour "hands-on" training session at locations around the state.

6. Farming & Ranching with Families.
(Members of the Western Farm Management Extension Committee)

Developing a series of output/product for use in extension workshops, one-on-one meetings with producers, and classroom teaching. The features of the output/product are: 1) Case studies, 2) Tools to meet and overcome problems/issues, 3) Recognizelidentify current and future situation, 4) Understanding of options available, and 5) Minimize the use of lawyers (avoid legal problems). We hope to provide well-known business practices, etc. in the context of a Family Business, minimizing the costs and problems where possible

Publications & Workshops:

1. **Crop & Livestock Drought/Risk Management Workshop:** Completed 28 workshops and presentations last year.
(Teegerstrom, Tronstad & Osgood)

2. **Ranchers Guide Article Updates:**
(Various Authors from University of Arizona & California)

3. **The Role of Electronic Technologies for Reaching Underserved Audiences.** (Teegerstrom, Tronstad & Osgood)

ELSEVIER

Ecological Economics 44 (2003) 91–103

ECOLOGICAL ECONOMICS

www.elsevier.com/locate/ecolecon

ANALYSIS

The value of remoteness: a hedonic estimation of ranchette prices

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Received 6 May 2002; received in revised form 17 September 2002; accepted 6 October 2002

Abstract

Throughout the western United States, production ranches are being subdivided into recreation-oriented 'ranchettes'. This change has dramatic impacts on local environmental and economic viability. Ranchettes fall in a gap in the economic literature between production agriculture and residential uses. This paper presents the first hedonic model for ranchettes, introducing the use of remote sensing vegetative indices and the use of sale status of adjacent ranchettes as explanatory variables. Parcel level sale data in Yavapai County, Arizona is combined with satellite greenness indices. It is found that increased greenness raises sale prices. Access to roads, cities, and neighbors also increase sale prices, implying that isolation is a disamenity and that it may be beneficial for policymakers to encourage ranchette grouping.

Keywords: Adjacency; Geographical information systems; Hedonic models; Hobby agriculture; Ranchette; Remote Sensing

1. Introduction

A dramatic change in land stewardship is occurring throughout the western United States. Hobby agriculture is becoming increasingly common, as farms and ranches are subdivided into small parcels for recreational purposes. This large-scale conversion of land to intensive use has substantial impacts on the ecological and economic viability of rural areas (Riebsame, 1997). In addition, these parcels confound traditional agricultural statistics and analysis because they are not operated for profit. Inputs are purchased with non-farm income instead of revenues from agricultural sales.

This 'consumptive use' of agricultural land is becoming increasingly widespread (Pope and Goodwin, 1984). Almost 70% of Arizona agricultural operators responded that the definition of a 'hobby' farm should be defined to include farms with less than 10,000 dollars in sales. If this change were to occur, more than 60% of the nationwide agricultural operations in the 1997 United States Census of Agriculture would be reclassified as hobby operations (Farm Foundation, 2001).

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0921-8009/02/$ - see front matter
PII: S0921-8009(02)00254-9

Blank (1998) argues that agriculture will become complementary to urban development. Livestock operations provide an example of this phenomenon, as recreational ranching activities displace traditional livestock production. Production oriented cattle ranches are being subdivided into smaller lots for use as second homes, recreational horse operations, summer cabins, and for retirement. Direct expenditures in the Arizona recreational horse industry were 700 million dollars in 2000. This was 80 million dollars more than all of the cattle sales in the state (Beattie et al., 2001).

Huntsinger and Hopkinson (1996) argue that there is a 'critical mass' of ranchers, below which there is rapid subdivision of land. This transformation has implications for the ecological viability of rangelands. As this change in land stewardship occurs, the incentive structure changes from the profit motives of the firm to the utility maximization problem of the household. Production ranches rely on rangeland quality to provide forage for the cattle they sell. If land is mismanaged, it cannot support livestock and the operation is not viable. A recreational ranch, or 'ranchette' is supported by outside income. The owners may not know if their rangeland is being mismanaged, not only because feed expenses are covered by other income but also due to a lack of ranching experience. Owners may graze horses on parcels that are too small to support the animals. What a ranchette owner sees as native meadow flowers may be an infestation of invasive knapweed, prickly poppy, or thistle. Ranchettes can, therefore, lead to severe resource degradation due to mismanagement, intense land use, and ecological fragmentation.

In response to concerns about erosion and weed issues, agricultural extension agents have developed new ranchette management products in Montana and Arizona (McReynolds, 2000). Active support for these efforts has come from agencies including the Arizona Soil and Water Conservation Society, the Arizona Game and Fish Department, the United States Department of Agriculture and the United States Forest Service. Given the impact of ranchettes on the rural landscape, their management has become one of the dominant issues to face rural western policymakers[1]. However, the economic literature does not directly address ranchette issues.

When a land-use choice is made, the recreational value of land is weighed against its production value. Therefore, analysis of the market value of site amenities can provide insight into the forces behind land-use change. Amenities themselves are not bought and sold in the market. Consequently, their direct value is not revealed through market prices. Instead, properties embodying packages of amenities are bought and sold. The hedonic price approach addresses this valuation problem through estimation of the contribution of each amenity to the value of the property.

A broad literature exists on hedonic values of scenery and environmental amenities in urban settings. These include studies of the value of open space, watersheds, wetlands and views (Shultz, 2001; Acharya and Lewis, 2001; Mahan et al., 2000; Benson et al., 1998; Colby and Wishart, 2002) as well as ecological diversity and fragmentation (Geoghegan et al., 1997). Although these papers address the values of natural amenities, they study urban residential housing, as opposed to rural hobby agriculture. Another body of literature investigates how recreational, amenity, and urban pressure impacts on the values of production-oriented agricultural land (Rowan and Workman, 1992; Baen, 1997; Spahr and Sunderman, 1995; Sunderman et al., 2000; Yue et al., 1997; LeGoffe, 2000). Others have studied the amenity value of production oriented agricultural land for nearby urban land (Brunstad et al., 1999). Since the ranchettes are neither urban land nor production-oriented agricultural land, their unique features have yet to be addressed.

Isolation is a characteristic that may be particularly important in ranchette value. Ranchettes are often purchased by urban dwellers who desire a rural ranch lifestyle, so the isolation of these properties could be one of the amenities purchased. While buyers may desire to escape from

[1] Because of the level of concern about range management issues, a fellowship provided by the National Aeronautics and Space Administration and United States Department of Agriculture supports the current work.

city life, they are also accustomed to urban amenities and social interaction so remoteness may actually be a disamenity.

In order to address the issues concerning to hobby ranching, this paper presents the first hedonic study of ranchette amenities. It focuses on quantifying the value of remoteness as an amenity or disamenity while addressing environmental and site specific attributes. It uses novel remote sensing and traditional data in Yavapai County, Arizona. This study begins to bridge the gap in the literature between hedonic benefits of urban households and the recreational uses of agricultural land in order to assist policy-makers in addressing the environmental and economic impacts of rapidly spreading hobby agriculture.

2. Hedonic price specification

Rosen (1974) provides the basic framework followed for the specification of the hedonic model. P is defined as the price of housing. Let x be the numeraire good, a composite commodity representing all goods other than housing. Housing characteristics are described through a slight variation of the standard hedonic specification. **E** is a vector of environmental characteristics, **S** is a vector of site-specific structural characteristics, and **R** is a vector of variables describing the remoteness of the property. Household utility is a function of these characteristics, $u(x, \mathbf{E}, \mathbf{S}, \mathbf{R})$. Agents maximize utility subject to the normalized budget constraint $U-P-x=0$. Assuming that prices are in equilibrium, and that preferences are weakly separable, the hedonic pricing function can be specified as $P=P(\mathbf{E}, \mathbf{S}, \mathbf{R})$; (Freeman and Myrick, 1997).

3. Study area

Yavapai County, Arizona has seen substantial ranchette formation in the past 10 years, with almost 9,000 ranchette sales occurring between 1991 and 2000. In this period Yavapai's population has grown from 108,000 to 130,000, representing a growth rate almost twice the national average. Long-term tourists are an important part of the regional demographics. 'Ghost subdivisions' of second homes owned by seasonal visitors have become an established feature of the landscape (Riebsame, 1997). Many ranchette buyers visit the area as tourists before they purchase ranchette properties.

As with many western regions, Yavapai County offers amenities for urbanites searching for a rural ranch experience while also providing small cities with art galleries, brew-pubs, and cafes. The largest cities in Yavapai county, Prescott (population 34,610) and Sedona (population 9,940) are small enough to be considered quaint frontier towns by those visiting from Phoenix, Los Angeles, or New York. The prospective ranchette buyer has the choice of a parcel with proximity to urban amenities or one that is in a remote corner of the county.

Seventy four percent of the county's 5.2 million acres are under public ownership, with production oriented ranches typically operating on a combination of private and leased public land. Ranchettes are formed when ranches cease cattle production and subdivide their private land. About 20% of the private land in the county has been subdivided into ranchette-sized parcels (2–40 acres), with 7%, or 94,842 acres of the ranchette-sized land having been sold. Fig. 1 shows the ranchette-sized parcels that have sold in Yavapai county between 1991 and 2000, major roads, and urban areas.

In the northern 'checkerboard' region of the county, every other square mile is private land, originally deeded to the railroads to provide incentives for migration to the west. Much of the railway land has since been sold and subdivided into ranchette-sized parcels. This distribution of public land enables a buyer to select between land surrounded by ranchette subdivisions or one adjacent to hundreds of acres of public land. Since its distribution of amenities, rapid ranchette formation, and the distribution of public and private land, Yavapai county offers an excellent study area for investigating preferences concerning isolation, scenery, and access to urban amenities.

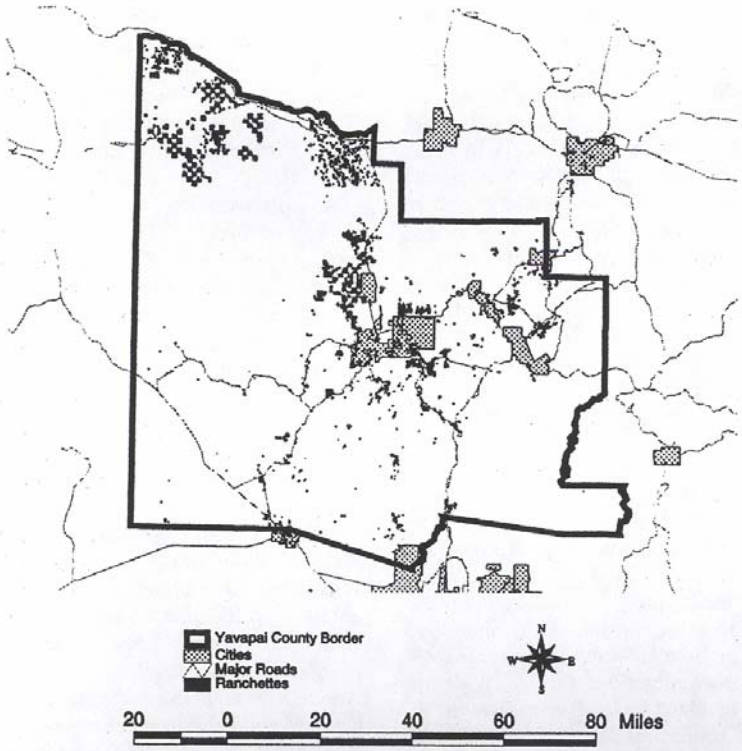

Fig. 1. Ranchettes in Yavapai County.

4. Data

In order to estimate a hedonic pricing equation, we developed a Geographical Information Systems (GIS) database. The Yavapai County Assessor's office provided their complete dataset of 68,749 sales. The data includes reported sale price, sale date, buyer, seller, and assessed value estimates for every parcel sold from 1991 to 2000. Sale prices were adjusted for inflation using the United States Department of Labor Consumer Price Index. Sale prices were also divided by parcel size in acres. Although the data contains 10 years of sales, suggesting a time series approach, the majority of parcels sold only once, so cross sectional analysis is used. Seventy-four percent of the sales occurred once per parcel, 21% twice, 4% three times, and about 1% sold four or more times. The sales dataset did not have information on the location of each sale.

The location of each sale was determined using a second dataset. Yavapai County Management Information Systems provided a GIS coverage of the complete set of 123,501 parcel polygons representing all of the land in the county. The GIS coverage also included current county zoning by parcel. The location of each sale was determined by linking the parcel identification numbers from the sale data to the parcel identification number in the GIS dataset. Parcel centroids were used for proximity calculations.

Initially, the zoning information was used to determine which parcels should be considered ranchettes. However, because ranchettes were

found to be classified in categories ranging from residential to agricultural, a size-based classification was used. After consultation with real estate agents, extension specialists, and representatives from the Yavapai County Assessor's office, parcels ranging from 2 to 40 acres were assumed to be ranchettes, and selected from the dataset, leaving 10,453 observations.

In selecting this subset of the data, there is the potential for selection bias due to the processes driving land use change and ranch sales. The choice to sell a ranch for subdivision and sale as ranchettes is largely an endogenous decision of the rancher. Most likely, the potential value of the land as ranchettes is an important factor in this decision. This problem exists for much of the hedonic literature in which a subset of property types is regressed to investigate the amenities under that ownership type without adjusting for the endogenous processes of land use change (Shonkwiler and Reynolds, 1986). A study of the ranch retirement/land subdivision process is a complete work in its own right, requiring a separate theoretical model and data. Given the robustness of the parameter estimates in Section 5, it is not likely that the statistical impacts of the selection bias adjustments would fundamentally change the outcome of the current work. Therefore, a study of the land use change leading to ranchettes is left for future research. It should be kept in mind that much of the ranchette subdivision process is determined by county land use planners: A ranch cannot subdivide into ranchettes if it is not permitted by the government. The ability to specify where ranchette subdivision is allowed is one of the most powerful land use tools available to policy makers.

In urban hedonic analyses, real estate market areas and United States Census data can provide useful sources of data. These data sources were not applicable due to the rural setting of the current study. Since the census tracts are based on population density, they are small within cities and heavily populated areas, providing a detailed source of information. However, in rural areas, census tracts are relatively large. In Yavapai County, the ranchette sales occurred almost entirely within one census tract, so census data did not provide enough variation across ranchettes to be used in the analysis. Similarly, real estate market areas could not be used because almost all of the ranchettes fell within the same market area.

GIS coverages describing major roads, rivers, land ownership type (public or private), and cities or towns were obtained from the Arizona Regional Image Archive and the Environmental Systems Research Institute to calculate proximity measures. All coverages were converted to the Universal Transverse Mercator projection, zone 12. Using the parcel centroid, the distance to the nearest city, major road, and river was calculated. If the closest feature was in another county, the distance to that feature was used.

These raw data sources were used to develop the regression variables comprising the vector of environmental characteristic (**E**), site specific characteristic (**S**), and the remoteness proxies (**R**). It should be kept in mind that the primary purpose of the categorization is to provide structure for discussion of the results.

In other hedonic work, amenities have been categorized by the ecological typology of the amenity or by landscape patterns, such as fragmentation and diversity (Geoghegan et al., 1997). Other indices are based on the assessed quality of a view (Benson et al., 1998). These strategies allow researchers to estimate the value of the particular landscape pattern or view. However, considerable expert effort is required to develop these types of amenity datasets, and estimated values may not be generalizable to areas with different types of natural amenities.

No attempt is made to value a particular environmental quality in the current study. Instead, the goal is to find a variable that can be used to adjust for environmental amenity variation across sales. To address this need, a novel data source is tapped, a satellite measure of photosynthesis activity of vegetation. Since most of the Arizona is arid, green vegetation can provide a dramatic scenic impact. Healthy, green vegetation can also be highly correlated with other site specific amenities, such as a temperate climate or the availability of water. As with green vegetation, these amenities may have particular appeal in the

hot, dry southwestern states. Green vegetation is also correlated with elevation, which can improve a parcel's view. The remote sensing measure selected was the Normalized Difference Vegetation Index (NDVI), which is based on the interaction of chlorophyll with the electromagnetic spectrum. Large NDVI values indicate high amounts of vigorously growing green vegetation (Tucker, 1979; Jackson et al., 1983). In Arizona, work has been done to apply NDVI as a measure of forage for livestock. In this use it has faced difficulties. Developed for use in the plains states where green grasses provide the bulk of the forage, it does not measure the nutritional value of the browner dry grasses that livestock frequently utilize as a forage base in Arizona.

The index was developed by the Earth Resources Observation Systems (EROS) Data Center using Advanced Very High Resolution Radiometer multi-spectral data which has a 1 km resolution NDVI product. It was obtained from the Arizona Regional Image Archive. Although higher resolution images with more sophisticated vegetative indices exist, this EROS data was chosen because of its temporal coverage. Bi-weekly NDVI data is available beginning in 1989, covering the time span of the entire sales dataset. NDVI varies dramatically over time and space, with the vegetative response to individual storms often visible. Since the bi-weekly NDVI is highly affected by cloud cover and specific weather events, it was averaged over each year to provide a more stable index for site-specific characteristics. Parcel centroids were used to link the NDVI grid to individual sales. The annual NDVI average for the year preceeding a sale was used to provide an exogenous proxy for parcel environmental amenities. In addition to the NDVI average, the distance from each parcel centroid to the nearest river is included as a proxy for environmental amenities.

In hedonic studies, explicit housing characteristics are often used for the vector of site-specific structural characteristics. These include the number of bedrooms, bathrooms, and fireplaces. For ranchettes, appropriate data might also include corrals, wells, fences, private roads, and storage tanks. Unfortunately, this information was not available for the current study, either for a single year or for changes occurring over the 10-year time span of the sales data. As with the environmental variables, the primary concern was to adjust for structural characteristics so that the remoteness test indicators would have increased explanatory power. To serve this need, assessed value of improvements was chosen, following Faux and Perry (1999). Provided by the county assessor in the sales database, this expert estimate of the contributions of structural investments to the value of the parcel is used as a proxy for all of those features. Although the dataset does not directly include individual site-specific features, the assessor's estimate allows their combined value to be incorporated in regressions. Therefore, the value of a fireplace or corral is accounted for in the dataset although regression results do not allow estimation of the individual contribution of the particular feature. Parcel size is also included to allow for diminishing marginal utility with respect to area.

Two types of remoteness proxies were constructed, one based on adjacency and one based on distance. The distance measures were intended to represent accessibility from the parcel to transportation networks and urban amenities. Distances were calculated from the parcel centroids to the closest major road. The distance to the closest town or city was also calculated. 'Fencelines' or parcel boundaries were used to develop the other remoteness proxies. A dummy variable was constructed to indicate if any of the adjacent parcels represented previous sales. This dummy is intended to proxy the impact of having neighbors. If a ranchette buyer finds remoteness to provide positive benefits, one would expect that the buyer would pay a premium for a parcel that is not surrounded by other ranchette owners. The final remoteness measure is a dummy variable indicating if a sale is for a parcel bordering public land. Since the subdivision and private development of public land is not allowed, it represents long-term open space. Public land has additional properties such as enhanced views, dramatically larger parcel sizes, and immediate accessibility for recreational activities such as horseback riding or hunting.

Finally, in order to allow for appreciation, the number of years of the sale before 2001 was calculated, following Mooney (2001). Sales that were reported to have zero price or area were removed. Thus the final regression sample consists of 8,751 sales. The average adjusted sale price was \$15,393.13 per acre for the parcels in the final dataset.

Since the sale prices may be simultaneously impacted by each of the variables, it is necessary to perform a multivariable regression to disentangle their individual effects. We, therefore, proceed to the estimation section, which quantifies, tests and adjusts for the effect of each variable.

5. Estimation

In order to quantify and estimate the separate impacts of each variable on ranchette prices, a statistical model is specified and multivariable regression is performed. The sample is treated as a single cross section.

Benson et al. (1998) used Box–Cox analysis to arrive at a loglinear functional form for their hedonic regressions. This functional form is commonly applied in the hedonic literature (Shultz, 2001; Acharya and Lewis, 2001; Mahan et al., 2000). Following these works, the loglinear specification was used for the benchmark regression. An intercept term was not included. The econometric model is specified below, where, e_i is assumed to independent and normally distributed.

$$\ln(P_i) = [\mathbf{E}_i \mathbf{S}_i \mathbf{R}_i T_i]' \boldsymbol{\beta} + e_i \quad (1)$$

where **E**, represents the environmental characteristics, NDVI and distance to river. The site-specific vector **S** consists of lot size and assessed improvements (normalized by lot size). **R**, the vector of site specific remoteness variables, is composed of dummy variables for neighbors and public land as well as distances to cities and major roads. The number of years before 2001 of a sale, T_i is included in order to account for appreciation.

Ordinary least squares was used to estimate the parameters of Eq. (1). The regression results are presented in Table 1. All of the variables are significant beyond the tenth of a percent level except for the dummy for neighboring public land. The R^2 is 0.9814. Since there is no intercept in the model, the R^2 is difficult to interpret. Marginal implicit price for variable x was calculated by multiplying the parameter estimate average price[2]. Marginal implicit price is reported in Table 1.

Several diagnostics were performed to investigate possible causes of spurious results. The regression was performed on half of the data and then extrapolated to the other half of the dataset. The mean squared error for the regression predictions within sample was 1.050. This was slightly less than the out-of-sample mean squared error of 1.057. Due to the weather, vegetation, roads, and settlement patterns can all be endogenous to terrain, spatial variables are often highly correlated. Collinearity was not found to be a problem for the dataset, with the maximum condition index being 7.59.

Running OLS with NDVI as the sole variable provides an R^2 of 0.95. Although the high explanatory power of NDVI was somewhat surprising, it should be kept in mind that there is a great deal of information in the NDVI dataset. Unique NDVI measurements exist for each square kilometer for every year. The cross sectional regression was constructed to be able to incorporate a certain amount of temporal variation. The date of each sale determined which annual NDVI dataset was used. The year, assessed improvements, and neighbors variables are also impacted by conditions on or before the sale date. As a diagnostic, the regression was performed using a single 1989 NDVI index for all sale data instead of the appropriate annual average. The temporal variation in NDVI was found to be important as the single period NDVI variable was not significant in the diagnostic regression.

NDVI not only measures greenness but also serves as a proxy for other variables that may have explanatory power. Since the elevation can influ-

[2] For parameter β_k, associated explanatory variable x_k, and sale price P, under the loglinear functional form marginal implicit price is $dP/dx = \beta e^{x\beta}$. Using the definition of the price function, the formula becomes $\beta_k P$.

Table 1
Log linear ordinary least squares results, $R^2 = 0.9814$

Variable	Parameter	t-value	$Pr < \|t\|$	Mean value	MIP
Distance to road (m)	−0.00006933	−17.63	<0.0001	3383.47	−1.07
Distance to city (m)	−0.00002071	−10.00	<0.0001	14007.24	−0.32
Distance to river (m)	−0.00002565	−25.78	<0.0001	7981.81	−0.39
Neighbor is public land	−0.00995	−0.32	0.7524	0.24	−153.16
Neighboring parcel previously sold	0.18571	6.89	<0.0001	0.52	2858.63
Greenness	0.07478	251.15	<0.0001	123	1151.09
Years	0.03132	5.84	<0.0001	3.97	−482.11
Parcel size (acres)	−0.02213	−12.83	<0.0001	10.14	−340.65
Assessed improvements	0.00002098	33.85	<0.0001	6290.22	0.32

ence NDVI and may be the force describing ranchette prices, a diagnostic regression was performed. The diagnostic regression used the same variables as the benchmark regression but also included elevation as an explanatory variable. In this regression, which included NDVI and elevation, NDVI remained highly significant. However, elevation was not significant. Therefore, elevation was not included in further regressions.

It is possible that sale prices were influenced by location effects that vary systematically over space. Spatial processes that are not directly included in the regression can lead to spatially dependent error processes, such as spatial autocorrelation. These processes can yield inefficiency in ordinary least squares and bias in nonlinear regressions (Anselin, 1988). The heavy use of spatially dependent explanatory variables in the regression reflects an attempt of the authors to address spatial phenomena. The distance measures, neighbor dummies, and NDVI index may represent information on spatial processes.

Although maps of regression residuals did not reveal any obvious spatial patterns, Moran's I (Moran, 1948) t-statistic was used to test for the existence of spatial error processes. An inverse squared distance weight matrix was generated. Since the large number of observations, a cutoff of 2 km was applied to make the problem computationally feasible. The Moran's I estimate of 0.2501 was not significant, with a P value of 0.6504, indicating that spatial error processes could not be detected[3].

To test for heteroscedasticity, Breusch–Pagan and White's tests were applied, both providing positive detections beyond the 99% confidence level. To correct for heteroscedasticity, a full information maximum likelihood estimation was performed, using a generalized least squares estimator of the covariance matrix. The results are in Table 3. It can be seen that the parameter estimates, significance, and signs are almost identical to the benchmark regression. The R^2 has dropped substantially.

6. Discussion

Both environmental amenity measures were significant. As mentioned in the previous section, the NDVI greenness proxy was highly significant and explained most of the variation in the data. A higher level of average annual greenness for a parcel in the year preceeding a sale increased

[3] For the sake of comparison, we performed a Moran's I test of deviations from the mean for the NDVI associated with the sale parcels for the year preceeding each sale. The diagnostic detected spatial processes, with a Moran's I of 9.9792e−01, and a P value less than 2.2204e−16 (the level of precision of the computer), indicating that the NDVI variable in the hedonic regression does account for a significant amount of spatial information in the regression.

ranchette value. Since the time variability in the NDVI data, it may be profitable to buy after dry years and sell in wet years. A 1% improvement in NDVI lead to an increase in price per acre of $1,415.84. In the Southwest, greener pastures may appeal more to people than cattle.

The explanatory power of NDVI could either be due to the vegetation, or other correlated factors that increase ranchette value. Such factors could include access to water and cooler climates, which may be positive amenities to ranchette purchasers. However, Arizona real estate agents have said that the sale price of a ranchette is 'determined by the height of the trees' (Tronstad, 2002) and that a greenness index would be useful for them to determine sale prices (Teegerstrom, 2002). Since the Southwest is such a hot, arid region, with small pockets of greenness, it would be expected that NDVI would provide more explanatory power there than in regions such as the South or New England, where greenness is more common. The distance to the nearest river, the other proxy for environmental amenities, was also significant, providing positive benefits. As distance from a river increased, the value of the property decreased, with a marginal implicit price of 39 cents per m, or $118.87 per mile. In a residential hedonic study in Oregon (Mahan et al., 2000) it was found that a one mile decrease in distance to a stream improved property values by $258.81 per acre. The estimates are somewhat similar given that predicted marginal implicit prices are the derivative of the nonlinear marginal hedonic price function at a particular point and that the Oregon study used a slightly different functional form. The estimated values may be lower for the ranchettes due to preference differences or because the Arizona distance measure has been adjusted for vegetation greenness[4].

To investigate the applicability of the linear model specification, the regression was performed without the log transformation. None of the variables in the linear regression were significant except for assessed improvements, which had a t-value of 28.17 and a recovered parameter of 1.156. The R^2 was 0.0935 and the root mean squared error was 79,017. The loglinear functional form was maintained due to the low level of significance and poor predictive power of the linear regression.

The structural variables for parcels revealed that improvements increased ranchette value and that there was a diminishing marginal return to lot size. The marginal implicit price for 1$ of assessed improvements is 32 cents. The time coefficient also was significant corresponding to an annual appreciation rate of 3.18%.

Having accounted for site specific, appreciation, and natural amenity effects, we proceed to the remoteness proxies. We begin with the distance measures and then continue to the fenceline dummies. The coefficients for distance to major roads and cities are both significant and negative, indicating that access to transportation and urban amenities provides positive benefits. Per acre price improves by $1.07 for ranchettes 1-m closer to a road and by 32 cents for ranchettes 1-m closer to a city. As mentioned earlier, these cities are relatively small art colonies or resort towns. In addition to providing sources for food and gas, the services in these communities may cater to the recreational preferences of ranchette owners.

Remaining indicators of remoteness are the fenceline dummies. The coefficient for the dummy variable representing the existence of neighbors was positive and significant. Ranchette buyers were willing to pay a premium of $2,858.63 per acre if adjacent parcels had previously sold. This may be due to unobserved infrastructure costs associated with ranchettes, such as maintenance of private road, electrical, sewage, and water systems. It is possible that the existence of a previous sale is not the appropriate proxy for neighbors but instead is merely an indicator of more desirable land that sold sooner. It could also be that realtors market groups of parcels at the same time, focusing their advertising on adjacent blocks of parcels. Unobserved local amenities could also drive the apparent clustering.

[4] For a diagnostic regression omitting NDVI, the distance to river was significant and marginal implicit price of decreasing the distance to a river was 56 cents per meter, or $171.45 per mile. This regression is described further in the discussion of public lands.

One final possibility for positive fenceline effects is that neighbors enter as an amenity into the utility function of ranchette owners. Neighbors could be valuable in their assistance in babysitting, or for car and health difficulties. This possibility is consistent with anecdotal observations by assessors and extension personnel. Many ranchette owners come from urban environments for recreational reasons and although they may enjoy rural amenities, they may also value a certain amount of community. Assessors have commented that clusters of ranchette owners exist, 'one area representing a group from New York and another a group from Ohio' (Teegerstrom, 2002). Enclave effects may be occurring, similar to those observed in the Mexican immigrant community (Gonzalez, 1998). In enclaves, premiums are paid in order to enjoy the common cultural characteristics of the particular community.

Bordering public lands does not significantly impact ranchette value. This result is somewhat surprising since advertisements for ranchettes commonly highlight being adjacent to public land. Although the result may be from a lack of any benefits accruing from public land, there are other possibilities. The result may be due to conflicting attributes of the land. If bordering public lands provide benefits but having neighbors also provides benefits then the two effects may cancel each other. There may also be fundamentally different types of public land, with national monuments providing a premium but other public land providing negative benefits due to cattle, logging, mining or other production activity. Although public land can be used for recreation by ranchette owners, it can also be used by others for camping and off-road activity. The inability to prevent people from utilizing adjacent public lands may create a nuisance. Future study involving a categorization of public land type may provide insight into this problem.

One final explanation for the public lands results is that there may be causal relationships between greenness and public lands. National parks and forests may have been established to preserve lush vegetative areas. Alternately, public land may have increased greenness due to improved land management. Since the regression uses NDVI to control for greenness, if public land provides increased greenness, benefits from this greenness may be attributed to the NDVI variable instead of the public land dummy. As a diagnostic, the regression was performed without NDVI. Fit quality decreased ($R^2 = 0.6200$). The neighboring public lands variable was significant beyond the 0.0001 level with a t-value of 5.81. The estimated parameter was 0.14872, so, for this regression, neighboring public lands was estimated to provide a per acre benefit of $2,289.27.

Note that the fenceless results were not robust with respect to the functional specifications. For a diagnostic regression including an intercept, the neighbours coefficient had a negative sign but was not significant. The public lands coefficient was positive and significant. The other coefficients remained significant. The natural amenities and remoteness coefficients all had similar values across specifications except for the greenness measure, which was reduced by an order of magnitude.

For the sake of comparison with non-ranchette properties, the loglinear regression was repeated for the 58,894 sales of parcels smaller than two acres. These represent mostly urban, suburban, and small town parcels. The average price per acre was $1,472,995, with each acre representing about ten parcels on average. Since the explanatory variables were not specifically selected for small town, urban, and suburban parcels, the current results should only be used for comparison with ranchettes.

The R^2 was 0.9934, the root mean squared error was 1.09336, and all variables were highly significant. Table 2 presents the results of this regression. The average values reported in the tables reflects the urban and suburban nature of these parcels. The average distances to major roads and cities were much less than for the ranchette-sized parcels and the small parcels rarely bordered public land. The small parcels were much less likely to border parcels that had sold in previous years, reflecting a different temporal sale pattern than for ranchettes. Average NDVI and age of sale were similar. Average assessed improvements were substantially higher for the smaller parcels, reflecting the higher level of

Table 2
Log linear ordinary least squares results, small parcels, $R^2 = 0.9934$

Variable	Parameter	t-value	$Pr > \|t\|$	Mean value
Distance to road (m)	−0.00017367	−41.70	<0.0001	796.07
Distance to city (m)	−0.00003836	−98.23	<0.0001	6572.40
Distance to river (m)	0.00001188	8.94	<0.0001	5899.84
Neighbor is Public land	−0.22171	−7.73	<0.0001	0.036
Neighboring parcel previously sold	−0.17156	−6.49	<0.0001	0.040
Greenness	0.10968	934.03	<0.0001	124.91
Years	−0.09093	−40.05	<0.0001	4.13
Parcel size (acres)	−0.43380	−23.33	<0.0001	0.093
Assessed improvements	0.000000373	123.56	<0.0001	33 620.67

development of urban, suburban and small town areas.

Although distance to city and greenness parameters were relatively similar to the ranchette regression, most of the parameters were orders of magnitudes different from the ranchettes. Several parameters illustrated the fundamental differences between ranchettes and the smaller, more urbanized parcels. Neighboring public land decreased small parcel value significantly, as did distance to rivers. These two results are difficult to interpret without explicitly controlling for additional urban amenities in the regression, but do serve to illustrate the differences between small parcels and ranchettes. The small parcels had a larger rate of appreciation and a much higher diminishing returns to size than ranchettes, indicating that urban land uses provided higher returns on smaller pieces of land. Small parcels that neighbored lots that had sold previously had lower values. This was opposite of the findings for the more isolated ranchette parcels, revealing a fundamentally different relationship between neighbors and property values for ranchettes than for more dense land uses.

7. Conclusion

A fundamental change in rural land use is occurring in the American West. Cattle ranches are being subdivided into recreationally oriented ranchettes. Large numbers of remote, small-sized ranchette properties fragment the landscape, blocking wildlife and livestock grazing corridors. Policy makers are faced with decisions such as which ranch subdivisions to approve, what public land to sell or exchange for private land, where to invest in rural infrastructure, and how to manage public lands.

Although this type of land use is becoming increasingly important, it has not been directly

Table 3
FIML results, $R^2 = 0.6504$

Variable names	Parameter estimate	t-value	$Pr < \|t\|$
Distance to road (m)	−0.00007	−17.63	<0.0001
Distance to city (m)	−0.00003	−25.78	<0.0001
Distance to river (m)	−0.00002	−10.00	<0.0001
Neighbor is public land	−0.00995	−0.32	0.7524
Neighboring parcel has previously sold	0.185713	6.89	<0.0001
Greenness	0.074782	251.15	<0.0001
Years	0.031324	5.84	<0.0001
Parcel size (acres)	−0.02213	−12.83	<0.0001
Assessed improvements	0.000021	33.85	<0.0001

addressed by the economic literature. Ranchettes fall in a gap between hedonic works on the valuation of agricultural land and the hedonic benefits of natural amenities for urban residential properties. To fill this gap, this paper has developed and performed a hedonic estimation to quantify the benefits that different amenities have to ranchette buyers. Remoteness was introduced as a possible amenity to supplement scenic and site-specific values traditionally used in hedonic analysis. A comprehensive georeferenced database of parcel sales data in Yavapai County, Arizona was used along with other geospatial data. A novel satellite greenness index was included as a proxy for scenic amenities. Adjacency to public land was also included in the statistical analysis in order to study its potential value as an amenity. In addition to remoteness measures such as distance to the closest city and major road, the sale status of neighboring parcels was also used.

Scenic amenities were found to have a powerful influence on ranchette values, with a one percent improvement in the satellite greenness index increasing per acre value by $1,415.84 while decreasing the distance to a river 1 m lowered values by 39 cents per acre. Adjacency to public land was not found to be significant, perhaps due to endogeneity with the greenness index or the heterogeneity of public land.

Each measure of remoteness was found to decrease ranchette values. Increasing the distance of a ranchette from a major road by 1 m decreased per acre ranchette value by 1$ and 7 cents while a 1 m increase in distance from a city lowered ranchette value by 32 cents. Parcels adjacent to ranchettes that had previously sold had an increased per acre value of 2,858.63.

For the sake of comparison, the regression was repeated for sales of small parcels in Yavapai county, which represented urban, suburban, and small town land uses. The regression results for these sales were fundamentally different from the ranchette results. Most of the variables differed by orders of magnitude between the two regressions. Small parcels adjacent to properties that had previously sold saw decreased per acre values. Therefore, neighbors may provide benefits for isolated ranchette properties, but they are undesired by those living in town.

Since the elements of ranchette parcel creation are endogenous, future research involving the ranch retirement and subdivision process would be valuable. Management that influences the greenness of public land could impact neighboring ranchettes. Therefore, future work could also investigate the externality impacts of management of public lands or the importance of public land type as an amenity. A limitation of the study is that changes in ecosystem health due to ranchette land transition are only valued through the premiums offered by buyers of ranchette properties. It does not address the critical issues of what impacts ranchettes actually impose on the environment or what policies would mitigate environmental damage. Work should be done to quantify and value the environmental impacts of the land use changes associated with ranchettes, perhaps in the form of a contingent valuation study. This task would require the talents of range-scientists, biologists, and ecologists, and is therefore, left for future work.

Given the results of the current study, preliminary policy implications can be identified. Policymakers have powers for zoning and subdivision approval to influence the location of ranchette development. Planners should be mindful that local characteristics are valued differently on ranchettes than for parcels in town, particularly concerning the ownership status of neighboring land. The study results suggest that zoning and subdivision authority might be used to encourage ranchette clusters near easily accessible urban or small town amenities. Such a strategy could address rangeland and habitat fragmentation concerns while simultaneously increasing ranchette values, yielding benefits to ranchers, environmentalists, and ranchette buyers.

Acknowledgements

Supported by the Space Grant/Land Grant Geospatial Extension Program Graduate Fellowship.

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WCC-40
ANNUAL REPORT

2002-2003

Animal and Range Sciences
Montana State University
Bozeman, Montana

S .Dennis Cash

B. Publications - Those Appearing in Print During the Calendar Year Refereed Publications

a. Journal Articles

Cash, S.D., R.L. Ditterline; D.M. Wichman and M.E. Majerus. 2002. Registration of 'Montana' meadow bromegrass. Crop Sci. 42:2211-2212,

c. Contributing Book Chapters

Cash, S.D. 2002. Re-establishing pasture and hay meadows after wildfire. In: J£. Knight (Ed.) After wildfire - information for landowners coping with the aftermath of wildfire. Mont. St. Univ. Ext. Serv.

1 . Reviewed Materials

a. MAES, ES Publications, (e.g., MontGuides)

Cash, S.D., R. Funston, M. King and D. Wichman. 2002. Nitrate toxicity of Montana forages. MSU Extension Service MontGuide 200205.

Cash, S.D., R. Ditterline, D. Johnson, L. Strang, D. Wichman, K. Neill, K. Kephart, P. Lamb, and J. Eckhoff. 2002. Montana alfalfa performance summaries for 2001. (http://animalrangeextension.montana.edu/ forage/ forage).

Software, Video, *WWW,* radio, TV and Other Technology Transfer

Cosh, S.D., J. Hager and L. Keddington. 2002. Nitrate QuikTest training materials and certification examination on intranet site: http:/ /www.animairangeextension.montana.edu/ExtnAgents/ Articles/Forage/Nitro te/index.htm

Keddington, L. and S.D. Cash. 2002. Montana Forage Page. Six news articles posted and ongoing revision and publication of forage information at: http://animalrangeextension.montana.edu/F orage/ forage.htm.

2. Reviewed and Non-Reviewed Abstracts/Confere_ Proceedings of Papers Presented at Regional, National and

varieties. Monsanto. 3 years. $4,800.

Cash, S.D. and E. Davis. Fees for efficiency evaluation of 10 herbicides on alfalfa. Monsanto. 1 year. $5,000.

James E. Knight

b. Publications - Those Appearing in Print During the Calendar Year

4. Refereed Publications

b. Journal Artictes

Tortenson, W.L, M.W. Tess and J.E. Knight. 2002. Effects of elk management strategies on the profitability of beef cattle enterprises. Journal of Range Management. Vol. 55 No.2.

C . Books

Knight, James E., Editor. 2002. After WildfireInformation for landowners coping with the aftermath of wildfire. M.S.U. Extension Service 54 pp.

c. Contributing Book Chapters

Knight. J.E. 2002. Electric fencing to exclude deer and elk from recovering burned areas. In J.E. Knight, Ed. After Wildfire-Information for landowners coping with the aftermath of wildfire. M.S.U. Extension Service.

5. Reviewed Materials

b. Software, Video, *WWW,* radio, TV and Other Technology Transfer

Knight, J.E. 18 radio programs

International Meetings

Cash, S.D. and C.D. MacDonald. 2002. Cultivar and nitrogen effects on alfalfa pasture bloat. Proc. *38th* N. Amer. Alfalfa Improv. Conf. 27-31 July, Sacramento; CA.

3. Technical Reports - State, Regional and National

Cash, S.D. 2002. Production of alfalfa seed in Xinjiang. United Nations Food and Agriculture Organization Training Manual.

5. List faculty name with numbers of newsreleases. newsletters, articles and features in popular press

Cash, S.D. in 2002 published 6 newspaper articles appearing in 23 newspapers, 4 popular press articles, 2 features appearing in newsletters, 1 radio interview Oft KMON, and 1 televised interview on Montana Ag Live.

C. Grants and Contracts

1. New Grants Secured During the Year

Cash, S.D. Effect of coalbed methane discharge water on forage yield and quality. Montana Research and Commercialization Board. 2 years. $60,000. (Note: these funds revoked in 8/2002)

Cash, S.D. Risk assessment of weed seeds in commercial feeds. Montana Department of Agriculture. 1 year. $10,000.

Carlstrom, R. and S.D. Cash. Fertilizer effects on established dryland grasses. MSU Extension Service SARE-IPM mini-grant. 1 year. $980.

Cash, S.D., R.L. Ditterline, J. Eckhoff, D. Johnson, K., Kephart and D. Wichman. Fees for 2002 Montana intrastate alfalfa variety trials. Fees from seven seed companies. 2002. 3 years. $15,000.

Cash, S.D. and R.L. Ditterline. Fees for evaluation of 32 transgenic alfalfa

5. List faculty name with numbers of newsreleases, newsletters, articles and features in popular press

Knight, J.E. 6 news releases, 4 articles.

c. Grants and Contracts

1. New Grants Secured During the Year

Knight, J.E. Technical and economic guidelines for repelling deer and elk from crops. U.S.D.A .- IPM Grants Program. 2002-2005. $69,552.

Clayton Marlow

B. Publications - Those Appearing in Print During the Calendar Year

6. Refereed Publications

d. Journal Articles - Manoukian, M. and C.B. Marlow. 2002. Historical Trends in Willow Cover Along Streams in a southwestern Montana Cattle Allotment. Northwest Sci. 76(3):213-220.

7. Reviewed and Non-Reviewed Abstracts/Conference Proceedings of Papers Presented at Regional, National and International Meetings - Using a Greenline Approach for Monitoring Livestock grazing in Riparian Zones. A Critique of the Method. 55th Annual Meeting of the Society of Range Management, Kansas City, MO

8. Patents Awarded During the Year

C. Grants and Contracts

1 . New Grants Secured During the Year

Principal Investigator(s), Title of Grant, Funding Agency, Duration of Award,

Marlow, C.B., J. Knight, J. Rotella, B. Sauer, M. Maycock and J. Walker. Armells Creek Prescribed Fire Demonstration

11. Technical Reports - State, Regional and National

Mosley, J.C., J.L.S. Ferguson, and S.C. Bunting. 2002. Prescribed burning and hand-thinning to restore shrub-grass openings in Douglas-fir/steppe ecotones. Final Report for Toll Mountain Research Project, Bureau of Land Management, Headwaters Resource Area.

12. List faculty name with numbers of newsreleases, newsletters, articles and features in popular press (maximum of one sentence).

Mosley, J.C.; 2 features in national agricultural magazines, 8 newsletter articles, 7 popular press features, 5 news releases

C. Grants and Contracts

1. New Grants Secured During the Year

Mosley, J.C., and J. Peterson. Undaunted Stewardship Program. USDI Bureau of Land Management, 3 years, $900,000.

Mosley, J.C. Interpretive kiosks on private agricultural lands along the Lewis and Clark Trail in Montana. USDI National Park Service, 2 years, $20,000.

Bret Olson

B. Publications - Those Appearing in Print During the Calendar Year

13. Refereed Pub1ications
f.. Journal Articles

Olson BE, Wallander RT (2002) Does ruminal retention time affect leafy spurge seed of varying maturity? J. Range Manage. 55:65-69

Olson BE, Wallander RT (2002) Influence of winter weather and shelter on activity patterns of beef cows. Can. J. Anim. Sci. - in press (December 2002 issue)

Web site for Undaunted Stewardship@: www.undauntedstewardship.montana.edu

e. Completed Theses

Brewer, T.K. 2002. Effects of spring clipping on bluebunch wheatgrass in summer. MS Thesis, Montana State Univ., Bozeman.

Crane, K.K. 2002. Influence of cattle grazing on feeding site selection by Rocky Mountain elk. PhD Dissertation, Univ. of Wyoming, Laramie.

Reviewed and Non-Reviewed Abstracts/Conference Proceedings of Papers Presented at Regional, National and International Meetings

Brewer, T.K., J.C. Mosley, Dol. Lucas, and L.R. Schmidt. 2002. Effects of elk grazing in spring on summer cattle forage. Abstract. Society for Range Management Annual Meeting, Kansas City, Missouri.

Brewer, T.K., J.C. Mosley, D.L. Lucas, and L.R. Schmidt. 2002. (Invited Paper). Influence of elk grazing in spring on summer cattle forage. Proceedings 51st (Montana Livestock Nutrition Conference, Montana State Univ., Bozeman.

Mosley, J. 2002. (Invited Paper). Grazing management during and after extended drought in Montana. Proceedings 51st Montana Livestock Nutrition Conference, Montana State Univ., Bozeman.

Mosley, J. 2002. (Invited Paper). Livestock: The 21st century tool to enhance wildlife habitat. Profitability in Livestock and Natural Resource Management Conference, Casper, Wyoming.

Mosley, J. 2002. (Invited Paper). Prescribed livestock grazing to enhance wildlife habitat. Livestock Grazing for Vegetation Management Conference, Reno, Nevada.

Mosley, J. 2002. (Invited Paper). Prescribed livestock grazing to suppress cheatgrass. Livestock Grazing for Vegetation Management Conference, Reno, Nevada.

Olson BE, Wallander RT (2002) Effects of invasive forb litter on seed germination, and seedling growth and survival. Basic and Applied Ecology 3:309-317

**Blicker PS, Olson BE, Engel R (2002) Traits of the invasive *Centaurea macu/osa* and two native grasses: effect of N supply. Plant and Soil 247:261-269

** M.S. Graduate student

14. Reviewed Materials
f. MAES, ES Publications, (e.g., MontGuides)
g. Software, Video, WWW, radio, TV and Other Technology Transfer
h. Completed Theses

15. Reviewed and Non-Reviewed Abstracts/Conference Proceedings of Papers Presented at Regional, National and International Meetings

Olson, BE 2002 Sheep grazing noxious weeds in Montana. American Society of Animal Science, Annual meeting. Quebec City, Quebec. Invited

Olson, BE 2002 Orientation of beef cattle grazing foothill winter range in Montana. American Society of Animal Science, Annual meeting. Quebec City, Quebec

5. List faculty name with numbers of newsreleases, newsletters, articles and features in popular press

Olson - 1 news release (print), ITV interview

16. Patents Awarded During the Year

C.Grants and Contracts

1. New Grants Secured During the Year None

D. Other Scientific Presentations
Olson, BE 2002 Beef cattle grazing foothill winter range in Montana, International Mountain Section, Society for Range Management. Summer meeting. Kinsella, Alberta

Bok Sowell

II. RESEARCH AND SCHOLARLY /CREA TIVE ACTIVITY

B. Publications - Those Appearing in Print During the Calendar Year

17. Refereed Publications
g.. Journal Articles

Eneboe, E., B.f. Sowell, R. Heitschmidt, M. Haferkamp, and S. Karl. 2002. Drought and Grazing VI. Effects on blue grama and western wheatgrass tiller dynamics; Journal of Range Management 55:73-79.

Taylor, N., P.G. Hatfield, B.F. Sowell, J.G.P. Bowman, J.S. Drouillard, and D.V. Dhuyvetter. 2002. Pellet and block supplements for grazing ewes. Animal Feed Science and Technology. 96:193-201.

Taylor, N., P.G. Hatfield, B.F. Sowell and G.S. Lewis. 2002. Research Note: Influence of supplement form on ewe performance and reproduction. Sheep and Goat Res. J. 17:52-54.

c. Contributing Book Chapters

Bowman, J.G.P. and B.F. Sowell. 2002. Feeding the beef cow herd. Chapter 17 In: Richard o. Kellems and D.C. Church (Ed.) Livestock Feeds & Feeding. Prentice Hall, Upper Saddle River, New Jersey. Pp.341-360.

18. Reviewed Materials.
i. Completed Theses

Carolyn Johnson. Effects of prairie dog colonies on mixed-grass vegetation in Montana. M.S. Thesis completed June 2002. Bok Sowell Advisor.

19. Reviewed and Non-Reviewed Abstracts/Conference Proceedings of Papers Presented at Regional, National and International Meetings

J.G.P. Bowman and B.F. Sowell. 2002. Self-fed supplements for beef cattle on grasslands. Global Conference on Organic Beef Production. Sept-Oct 2002. Sao Paulo, Brazil. www.cpap.embrapa.br

J.G.P. Bowman and B.F. Sowell. 2002. Technology to complement forage-based beef production systems in the West. Symposium on Beef Production at the Western Section of the Society of Animal Scientists. Fort Collins, Colo., June 2002. (Presented by Jan Bowman)

B.F. Sowell. Forage factors and supplementation on rangelands. Nutralix Annual Meeting. Red Lodge, MT., February 2002.

C. Johnson and B.F. Sowell. Prairie Dog Research. Stillwater Range Association. January 2002.

B.F. Sowell. Range Curriculum in Montana's High Schools. Montana Association of Agricultural Educators Annual Meeting, Missoula, MT. 2002.

C. Grants and Contracts

1. New Grants Secured During the Year

B.F. Sowell, The Nature of Yellowstone, A new Core course for non-science majors, Montana State University New Core Executive Committee, June 2002-December 31, 2003, $2,500.

J. Hafer (Principal Investigator), B.F. Sowell, C. Marlow (Cooperators). Range Science: Contextually and Culturally Relevant Agriscience for Montana. USDASPEC, 2002-2004. $37,404.

Gene Surber

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II. RESEARCH AND SCHOLARLY/CREATIVE ACTIVITY

B. Publications - Those Appearing in Print During the Calendar Year

20. Refereed Publications

h. Journal Articles

i. Books

Fisher, T.J., T. Fisher & G. Surber (2002). Pastures, Prairies and Amazing Grazers: The Ecology of Habitat, Botany, and Agriculture, Dec, 2002 (Lesson Plans for Montana Schools)

c. **Contributing Book Chapters**

Surber, G. 2002. Water Quality Concerns after Wildfires. In J.E. Knight After Wildfire- Information for landowners coping with the aftermath of wildfire. M.S.U. Extension Service. pp 9-13.

21. Reviewed Materials

j. MAES, ES Publications, (e.g., MontGuides)

Horse Keeping For Clean Water. 2002, Surber, G. & S. Gagnon

Surber, G. 2002. Drinking Water Quality for Beef Cattle. Beef Questions and Answers, Vol. 7, No.5. pp 1 and 4.

22. Reviewed and Non-Reviewed Abstracts/Conference Proceedings of Papers Presented at Regional, National and International Meetings

M T GLCI Accomplishments- FY 2002

M T Grazing Lands Conservation Initiative - History and Accomplishments, 1992 through 2002

5. List faculty name with numbers of newsreleases, newsletters, articles and features in popular press

Surber, G. 4 newsreleases, 6 articles

C. Grants and Contracts

1. New Grants Secured During the Year

Surber, G., Grazing Lands Conservation Initiative, NRCS, 2002 03, $43,700.00

Surber, G., Grazing Lands Conservation Initiative, NRCS, 2002 03, $5,000.00

Surber, G., Environmental Resources CRT, University of Wisconsin-Madison, 2002-03, $4,999.00

Surber, G. & MT GLCI Steering Committee, NRCS, 2002-03, $40,700.00

Carl Wambolt

B Publications - Those Appearing in Print During the Calendar Year

24. Refereed Publications

j. Journal Articles

Wambolt, C.L. and M.R. Frisina. 2002. Montana sagebrush: A taxonomic key and habitat descriptions. Intermountain J. Sciences. 8:46-59.

k. Books

Wambolt, C.L., A.J. Harp, B.L. Welch, N. Shaw, J.W. Connelly, K.P. Reese, C.L. Braun, D.A. Klebenow, ED. McArthur, J.G.

The Clean Water Act: Will AFO/CAFO Rulings Affect Rangelands? Taralyn Fisher and Gene Surber, Animal & Range Extension, Montana State University, Bozeman, M T 59717

Can Beef Cattle Drinking Water Quality Enhance Performance and Environment?

Surber, G., K Williams, & M. Manoukian, 2002. International Society of Range Management, Kansas City, Missouri..

Can Beef Cattle Drinking Water Quality Enhance Performance and Environment? .

Surber, G., K Williams, & M. Manoukian, 2002. Wyoming Section, Society of Range Management, Riverton, Wyoming.

Stream and Riparian Area Management: A Home Study Course for Managers. Surber G. & B. Ehrhart, 2002. International Society of Range Management, Kansas City, . Missouri.

Stream and Riparian Area Management: A Home Study Course for Managers. Surber G. & B. Ehrhart, 2002. Wyoming Section, Society of Range Management, Riverton, Wyoming.

Drought & Water Quality, Surber, G. 2002. 51st Montana Nutrition Conference, Bozeman, M T

Private landowner Water Quality Empowerment. Surber, G. & B. Ehrhart, 2002, International Society of Range Management, Kansas City, Misouri.

23. Technical Reports - State, Regional and National

MT GICI projects funded and monies allocated 1996 through 2002
M T GLCI Publications

Thompson, L.A. Torell, and J.A. Tanaka. 2002. Conservation of the greater sage-grouse on public lands in the western U.S.: implications of recovery and management policies. Policy Analysis Center for Western Public Lands. Assoc. of Western Land Grant Universities. Univ. of Idaho Publication.

Wambolt, C.L. and M.R. Frisina. 2002. A guide to Montana sagebrush. Mont. Fish, Wildlife & Parks. Misc. Pub. Helena.

c. Contributing Book Chapters

Wambolt, Carl L. 2001 Montana sagebrush. Chapter I, p. 3-15 In: Montana sagebrush bibliography. Montana Fish, Wildlife & Parks.

25. Reviewed Materials
k. MAES, ES Publications, (e.g. Mont Guides)

PRESS RELEASE - Sage Grouse Policy report through University of Idaho Extension Service Released throughout the Western States.

I. Software, Video, *WWW,* radio, TV and Other Technology Transfer

m. Completed Theses

Thompson, Scott. 2002. Browse condition and trend on Montana ungulate ranges. M.S. Thesis, Montana State University, Bozeman, MT

26. Reviewed and Non-Reviewed Abstracts/Conference Proceedings of Papers Presented at Regional, National and International Meetings

Thompson, S.K. and C.L. Wambolt. 2002. Browse condition and trend on Montana ungulate ranges. Proc. Soc. Range Mgt. 55th Ann. Meeting. Kansas City, KS.

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INVITED PAPER. Wambolt, C.L 2002. The role of sagebrush in a natural ecosystem. Symposium: Sagebrush. Idaho State Univ. Pocatello, ID.

Wambolt, C.L and T.L Hoffman. 2002. Browsing effects on Wyoming big sagebrush plants and communities. Symposium on Seed Dynamics in Shrubland Ecosystems. Laramie, WY.

27. Technical Reports - State, Regional and National

Lead author and organizer for Policy analysis Center *for* Western Public Lands paper on: Policy Issues Related to the Greater Sage Grouse on Public Lands.

C. Grants and Contracts

1. New Grants Secured During the Year Listed in the Following Order:

Wambolt, C.L Browse condition and trend on Montana ungulate ranges. Montana Department of Fish, Wildlife, and Parks. $35,000.

Wambolt, C.L Sage grouse policy analysis. Policy Analysis Center for Western Public Lands. Funded by Western Land Grant Universities. $6,250.

2004-2006 Catalog

Montana State University COLLEGE OF AGRICULTURE

B.S. in Wildland Resources Ecology & Management

Name: 10#: Date:

Dept#	Course Title	Credits	Class	Sem	Year	Sub/Transfer
ARNR 100	Intra Animal Science	3	FR	S		
ARNR 101	***Natural Resource Conservation***	3	FR	F		
ARNR 235	***Rangeland Monitoring***	2	SO	F		
ARNR 240	***Natural Resource Ecology***	3	SO	F		
ARNR 345	Riparian Ecology & Management	3	JR	S		
ARNR 350	***Vegetation of Western Wildlands***	3	JR	S		
ARNR 351	***Biomes of Western Wildlands***	2	JR	S		
ARNR 353	Grazing Ecology & Management	3	JR	S		
ARNR 354	Fire Ecology & Management	3	JR	F		
ARNR 438	***Wildlife Habitat Ecology***	3	SR	S		
ARNR 453	***Habitat Inventory & Analysis***	3	SR	F		
ARNR 456	***Collaborative Planning in Natrl Res Mgmt***	2	SR	F		
BCHM 122N	Organic & Biochem Prin	4	FR	FSSu (S)		
BIOL 101N	Biology of Organisms	4	FR	FS (F)		
BIOL 230	Identification of Seed Plants	4	SO	S		
BIOL 303	Principles of Ecology	3	SR	S		
BIOL 434	Agrostology (Alt Yrs 2001)	3	JR	F		
OR						
BIOL 436	Plant Systematics (Alt Yrs 2000)	3	JR	F		
BUS 201	Managerial Communication	3	SO	FSSu (F)		
OR						
ENGL 221	College Writing II	3	SO	FS (F)		
OR						
ENGL 223	Technical Writing	3	SO	FSSu (F)		
CHEM 121 N	Intra General Chemistry	4	FR	FSSu (F)		
ECON 101 S	Economic Way of Thinking	3	FR	FSSu (S)		
ENGL 121W	College Writing I	3	FR	FSSu (F)		
F&WL 301	Principles of F&WL Mgt	3	JR	S		
GEOG 305	Intro to Geographic Information Syst	3	JR	F		
OR						
LRES 357	GPS Fundamentals & Appl in Mapping	3	JR	F		
LRES 201 N	Soil Resource	3	SO	F		
LRES 454	Pedology	3	SR	F		

MATH 160M OR MATH 170M	Pre-Calculus Survey of Calculus	4 4	FR FR	FSSu (S) FSSu (S)		
PS 318 OR STAT 216M	Biometry Elementary Statistics	3 3	SO SO	F S		

CHOOSE ONE OPTION BELOW TO COMPLETE ***(All courses listed under an option must be completed)***

GRAZING LANDS ECOLOGY AND MANAGEMENT OPTION — **CREDITS REQUIRED: 19-20**

AGEC 341 OR AGEC 337	Farm & Ranch Management Agricultural Law	3 3	JR JR	S F		
ARNR 230	Range Livestock Production	3	SO	F		
ARNR 320	Animal Nutrition	4	JR	F		
ARNR 432 or ARNR 434	Sheep Management Beef Cattle Management	3 4	SR SR	S F		
PS 342	Forages	3	JR	F		
BIOL 430	Plant Physiology	3	JR-SR	S		

RIPARIAN ECOLOGY AND MANAGEMENT OPTION — **CREDITS REQUIRED: 17**

BIOL 439	Stream Ecology	3	SR	F		
ESCI 112	Physical Geography	4	FR	F,S		
ESCI 432	Surface-Water Resources	3	SR	F		
LRES 444	Watershed Hydrology	3	SR	F		
PHYS 205N	College Physics I	4	SO	F, S, Su		

WILDLIFE HABITAT ECOLOGY AND MANAGEMENT OPTION — **CREDITS REQUIRED:15-16**

ARNR 320	Animal Nutrition	4	JR	F		
BIOL 405	Advanced Animal Ecology	3	SR	S		
BIOL 430	Plant Physiology	3	SR	S		
AND CHOOSE TWO OF THE FOLLOWING FOR THIS WILDLIFE HABITAT OPTION						
ARNR 480Z	Yellowstone Range Ecology	2	JR/SR	Su		
BIOL 418	Mammalogy	3	JR/SR	F		
BIOL 419	Ornithology	3	JR/SR	S		
BIOL 421	Yellowstone Wildlife Ecology	3	JR/SR	Su		

UNIVERSITY CORE REQUIREMENTS					
Dept/#	**Course Title**	**Credits**	**Semester**	**Year**	**Sub/Transfer**
COMMUNICATIONS	**(Grade C- or better)**				**CREDITS REQUIRED: 6**
ENGL 121W	College Writing I	3	FSSu (F)		
V					
MATH	**(Grade C- or better)**				**CREDITS REQUIRED: 3**
M					
FINE ARTS					**CREDITS REQUIRED: 3**
F					
HUMANITIES					**CREDITS REQUIRED: 6**
H					
H					
NATURAL SCIENCES					**CREDITS REQUIRED: 8**
N					
N					
N					
SOCIAL SCIENCES					**CREDITS REQUIRED: 6**
ECON 101 S	Economic Way of Thinking	3	FSSu (S)		
S					
MULTICULTURAL/GLOBAL					**CREDITS REQUIRED: 6**
G					
G					

TOTAL CREDITS: _____

UPPER DIVISION: _____

_____

Student Date

_____

Advisor Date

_____

Dept. Certifying Officer Date

Subject: WCC-O40 state reports
Date: Tue, 7 Oct 2003 14:08:44 -0600
From: "Kathleen S. Bertoncelj" <KathBert@uwyo.edu>
To: "Barbara Allen-Diaz (E-mail)" <ballen@nature.berkeley.edu>,
"Bruce Jones (E-mail)" <jones.bruce@epa.gov>,
"Clayton Marlow (E-mail)" <cmarlow@montana.edu>,
"David Pyke (E-mail)" <david_a-pyke@usgs.gov>,
"Dennis Child (E-mail)" <dennisc@picea.cnr.colostate.edu>,
"K. Bruce Jones (E-mail)" <Jones.bruce@epamail.epa.gov>,
"Kirk McDaniel (E-mail)" <kmcdanie@nmsu.edu>,
"Lance Vermeire (E-mail)" <lance@larrl.ars.usda.gov>,
"Larry Bryant" <lbryantO1@fs.fed.us>, "Linda Hardesty (E-mail)" <lhardest@mail.wsu.edu>,
"Maria Ferdandez-Gimenez (E-mail)" <gimenez@ag.arizona.edu>,
"Mike Smith (E-mail)" <pearl@uwyo.edu>, "Neil West (E-mail)" <new369@cc.usu.edu>, "Patricia Johnson (E-mail)" <Patj@ces.sdstate.edu>, "Paul Tueller (E-mail)" <ptt@unr.edu>, "Rod Heitschmidt (E-mail)" <rod@larrl.ars.usda.gov>,
"Stephen Bunting (E-mail)" <sbunting@uidaho.edu>,
"William Barker (E-mail)" <William.Barker@ndsu.nodak.edu>,
"William Krueger" <william.c.krueger@orstedu>

You've already discussed state reports at the meeting in Reno. However, if you want to modify your report before submitting it electronically to Jim Jacobs for inclusion in his annual report for WCC-040, the attached state report for WCC-202 is a good example.

< <WCC- 202 -M issouri Report2002. doc> >
Accomplishments and impacts should focus on intended outcomes and potential impacts. This information should be built around the activity's milestones, as they were identified in the original proposal. The report should also reflect on the items that stakeholders want to know, or want to see. Also, describe plans for the coming year in no more than one or two short paragraphs. List publications for the current year only (with the authors, title, journal serires, etc.).

Thanks!

-Kathleen Bertoncelj Agricultural Experiment Station University of Wyoming College of Agriculture
Box 3354
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