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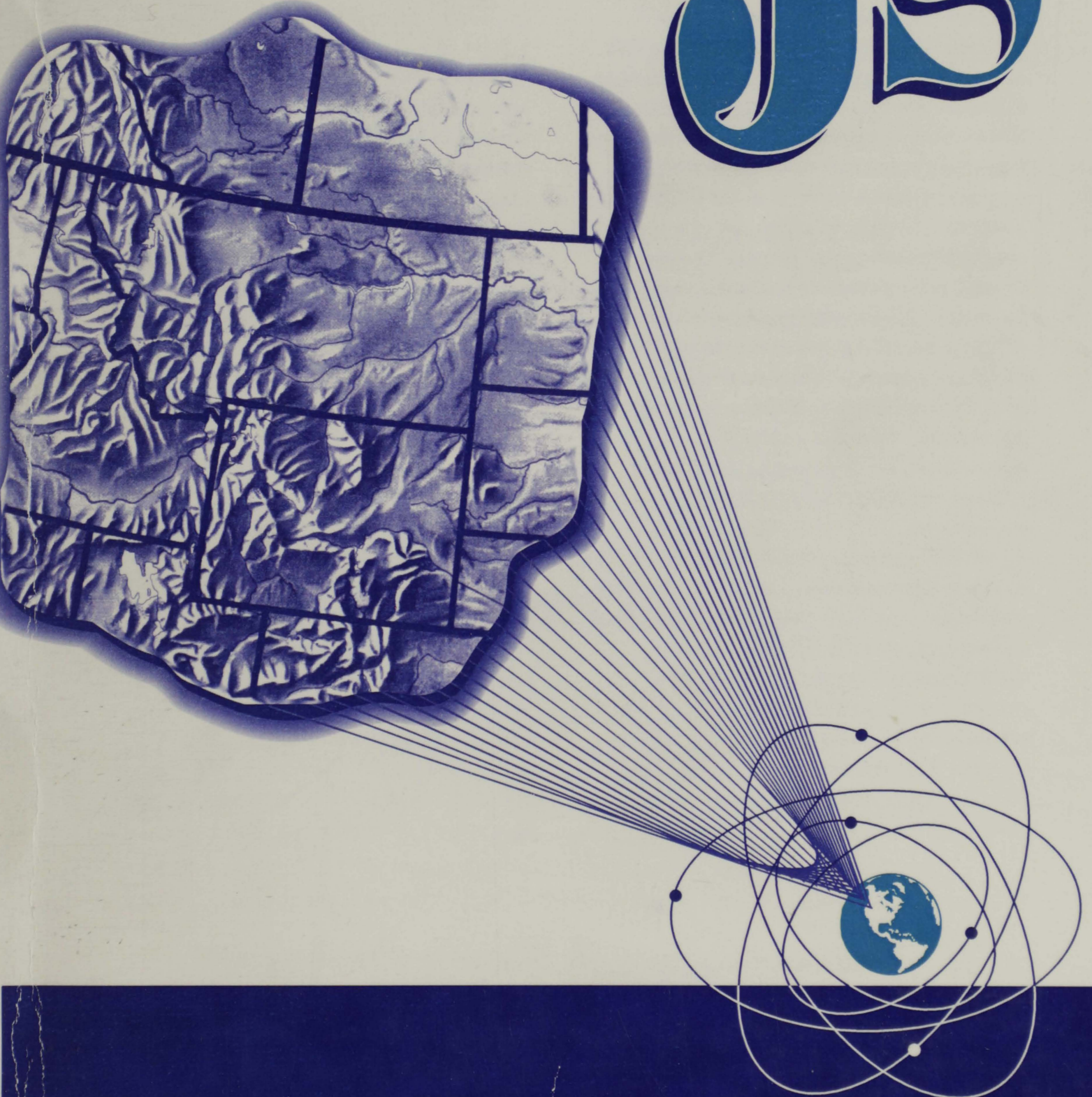
ANNEX

Intermountain Journal of Sciences

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IJS



INTERMOUNTAIN JOURNAL OF SCIENCES

The Intermountain Journal of Sciences is a regional peer-reviewed journal that encourages scientists, educators and students to submit their research, management applications or view-points concerning the sciences applicable to the intermountain region. Original manuscripts dealing with biological, environmental engineering, mathematical, molecular-cellular, pharmaceutical, physical and social sciences are welcome.

Co-sponsors/publishers include the Montana Academy of Sciences, the Montana Chapter of The Wildlife Society, and the Montana Chapter of The American Fisheries Society. This journal offers peer review and an opportunity to publish papers presented at annual meetings of the co-sponsor organizations. It is the intent of the governing bodies of the co-sponsor organizations that this journal replace printed proceedings of the respective annual meetings. Therefore, it is the policy of the editorial board that presenters at annual meetings of the co-sponsors be given priority in allocation of space and time of publication, although submission of other manuscripts for review and publication without regard to membership is encouraged.

Initial funding was provided by the co-sponsor organizations. Long-term funding will be derived from page charges assessed authors, sponsoring organizations or agencies at \$45 per printed page upon acceptance of each manuscript and from annual subscriptions: student \$6; regular member \$15; patron member \$25; library \$25; life member \$150; and, sustaining subscriber \$2,500.

The intent of the co-sponsors and editorial board is that *The Intermountain Journal of Sciences* be expanded to a quarterly journal. Achieving that objective depends upon numbers of acceptable manuscripts received and available funding. It also is the intent of the editorial board that contributing authors be assured of publication within 12 months of acceptance of their manuscript by the managing editor.

The organizational staff is voluntary and consists of an editorial board, an editor-in-chief, a managing editor, associate editors, a business manager and a panel of referees. The editorial board is responsible for establishing policy and the chair of the editorial board serves as liaison to the sponsoring organizations. The editor-in-chief is responsible for determining acceptability and level of revision of manuscripts based on referees' comments and recommendation of an associate editor. The managing editor serves as liaison for layout and printing. Associate editors include but are not limited to the section vice presidents of The Montana Academy of Sciences. Referees are selected on the basis of their field and specific area of knowledge and expertise.

Referees and associate editors judge submitted manuscripts on originality, technical accuracy, interpretation and contribution to the scientific literature. Format and style generally follow the *Guidelines for Manuscripts Submitted to the Intermountain Journal of Sciences, Dusek 1995*.^{*} Organization may vary to accommodate the content of the article, although the text is expected to elucidate application of results.

*For detailed information about IJS, please go to our website at:
www.montanatws.org/ijsindex.html

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FINANCIAL STATEMENT (01/01/02-12/31/02)

Balance 01/01/02 -\$734.41

Income

Regular Member	1,425.00
Student Member	6.00
Library Subscription	375.00
Patron Member	75.00
Subscription Total	\$1,881.00
Page Charges	6,997.50
Reprints	1,656.50
Back Issue Sales	50.00
Grants *	1,710.00
Total Income	\$12,295.00

Expenses

Design and Printing	8,006.81
Postage	588.48
Supplies	137.85
P.O. Box Rent	116.00
Fees	15.00
Reprints and Layout	1,669.30
Website Maintenance	255.00
Total Expenses	\$10,788.44

Accts Payable 12/31/02 \$1,830.00

Balance 12/31/02 \$-1,057.85

*Grantors: Idaho Chapter of the American Fisheries Society, Montana Chapter of the American Fisheries Society, Montana Chapter of the Wildlife Society, EPSCOR

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EDITORIAL REVIEW POLICY

The *Intermountain Journal of Sciences* (IJS) is a fully refereed journal.

Manuscripts are submitted to the Editor-in-Chief (EIC) for initial consideration for publication in the IJS. This review shall include, but not be limited to, appropriateness for publication in this journal, correct formatting, and inclusion of a letter of submittal by the author with information about the manuscript as stated in the "Guidelines for manuscripts submitted to the *Intermountain Journal of Sciences*" (Dusek 1995). This cover letter must also include a statement by the author that this paper has not been submitted for publication or published elsewhere. The EIC notes the date of receipt of the manuscript and assigns it a reference number, IJS-xxxx. The EIC forwards a letter of manuscript receipt and the reference number to the corresponding author. The corresponding author is the author who signed the submittal letter.

Three hard copies of the submitted manuscript, with copies of the "Guidelines and checklist for IJS referees" attached are forwarded to the appropriate Associate Editor. The Associate Editor retains one copy of the manuscript and guidelines for his/her review, and submits a similar package to each of two other reviewers. A minimum of two reviewers including the Associate Editor, is required for each manuscript. The two other reviewers are instructed to return the manuscript and their comments to the Associate Editor, who completes and returns to the EIC a blue "Cover Form" and all manuscripts and reviewer comments plus a recommendation for publication, with or without revisions, or rejection of the manuscript. This initial review process is limited to 30 days.

The EIC reviews the recommendation and all comments. The EIC then notifies the corresponding author of the results of the review and the publication decision.

ACCEPTANCE

For accepted manuscripts, each copy of the manuscript containing comments thereon and other comments are returned to the corresponding author. Revised manuscripts are to be returned to the EIC in hard copy, four copies if further review is required, or one hard copy plus the computer disk if only minor revision or formatting is necessary. The revised manuscript shall be returned to the EIC within 14 days of the notification. Review of the revised manuscript by the Associate Editor and reviewers shall be completed and returned to the EIC within 14 days. An accepted manuscript will then be forwarded to the Managing Editor (ME) for final processing.

REJECTION

Each manuscript that is rejected for publication is returned by the EIC to the corresponding author along with the reasons for rejection. The author is also advised that the manuscript may be resubmitted, provided all major criticisms and comments have been addressed in the new manuscript. The new manuscript may be returned to the initial review process if deemed appropriate by the EIC. If the manuscript is rejected a second time by either the EIC or the Associate Editor and reviewers, no further consideration will be given for publication of the manuscript in IJS. The corresponding author will be notified of this decision.

REVIEWER ANONYMITY

The identity of all reviewers shall remain anonymous to the authors called a blind review process. All criticisms or comments by authors shall be directed to the EIC; they may be referred to the ME or the Editorial Board by the EIC for resolution.

MANUSCRIPTS SUBMITTED BY EDITORS

Each manuscript submitted by an Associate Editor shall be reviewed by the EIC and a minimum of two other reviewers with expertise in the subject being addressed. Each manuscript submitted by the EIC shall be forwarded with the necessary review materials to the Chairman of the Editorial Board of IJS, who will serve as the EIC for that manuscript.

ABSTRACTS

Only abstracts from the annual meetings of the sponsoring organizations will be published in IJS. Other submissions of abstracts shall be considered on a case-by-case basis by the Editorial Board. Sponsoring organizations shall collect abstracts, review them for subject accuracy, key or scan them onto a 3.5" diskette, and submit the diskette and hard copy of each abstract to the EIC on or before November 1. Each abstract shall be reviewed by the

EIC to assure proper grammar, compliance with IJS "Guidelines for Abstracts Only" and for assignment to the appropriate discipline section. All abstracts will be published in the December issue only.

COMMENTARY

Submissions concerning management applications or viewpoints concerning current scientific or social issues of interest to the Intermountain region will be considered for publication in the "Commentary" Section. This section will feature concise, well-written manuscripts limited to 1,500 words. Commentaries will be limited to one per issue.

Submissions will be peer reviewed and page charges will be calculated at the same rate as for regular articles.

LITERATURE CITED

Dusek, Gary L. 1995. Guidelines for manuscripts submitted to the *Intermountain Journal of Sciences*. Int. J. Sci. 1(1):61-70.

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USE OF RECLAIMED MINELANDS BY PRONGHORN AND MULE DEER

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ABSTRACT

We examined use of reclaimed minelands by pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) in the Powder River Basin, Wyoming. Pronghorn selection of topography did not differ from availability and pronghorn were most commonly found on flat to gently sloped topography. We most often observed mule deer on sloped terrain; deer used base of slope more than expected during spring, summer, and fall. Alfalfa (*Medicago sativa*), sweetclover (*Melilotus officinalis*), and other forbs constituted important components of habitats used by pronghorn and mule deer. During summer, pronghorn also used areas with low overall vegetation height. Pronghorn use patterns reflected avoidance of human activity, whereas mule deer were more tolerant. Further enhancement of reclamation areas for these species might include increasing abundance of forbs, providing more cover, maintaining a mosaic of vegetation heights, and reducing fragmentation.

Key words: *Antilocapra americana*, habitat, mining, mule deer, *Odocoileus hemionus*, pronghorn, Powder River Basin, reclamation.

INTRODUCTION

Impacts of large-scale surface mining on pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) in the Powder River Basin of northeast Wyoming and southeast Montana are of concern to wildlife managers. Surface mining disturbs the original environment by removing topsoil and overburden to allow access to underlying coal. Disruption of the natural environment causes changes to which wildlife must adapt. Management concerns include elimination of habitat, interruption of migration, range partitioning, and increased human activity (Tessman 1985). To assure continued use of the land after mining, Congress enacted the Surface Mining Control and Reclamation Act (SMCRA) of 1977 to mitigate adverse impacts of coal development, protect public resources, and restore the capability of the mined land (Anderson et al. 1994). This

act includes beneficial objectives for both fish and wildlife.

Both pronghorn and mule deer utilize reclaimed lands following mining (Seegerstrom 1982, Medcraft and Clark 1986). Proper management of pronghorn and mule deer in the Powder River Basin requires an analysis of habitat needs and impacts of mining. Our objective was to determine which habitat features on reclaimed mining lands were important to pronghorn and mule deer. Goals were to compare sites used by each species seasonally to random sites and describe physical and vegetative components of habitats used by pronghorn and mule deer on reclaimed surface-mined lands.

STUDY AREA

The study area encompassed mine-land areas on seven surface coal mines on the eastern portion of the Powder River Basin in northeastern Wyoming. Mean annual precipitation is approximately 40 cm at the Gillette Weather Station 15 km south of

¹Current address: Idaho Department of Fish and Game, 868 Main Street, Jerome, ID 83338

Gillette most of which occurs during spring and early summer. Midsummer precipitation is usually light and drought is common (Thilenius et al. 1994). Summer temperature extremes may occasionally reach above 38 °C with winter extremes below -15 °C.

Once coal is extracted, mined lands consisting of open pits, are filled and re-contoured to resemble natural topography and are planted with a variety of plant species designed to produce a rangeland suitable for livestock grazing and capable of supporting wildlife (L. Vicklund, pers. comm.). Sterile wheat (*Agropyron domesticus*) or other easily established plants are initially planted for soil stabilization. Legumes such as alfalfa (*Medicago sativa*) and yellow sweetclover (*Melilotus officinalis*) are sometimes planted to augment soil nitrogen. Re-contoured areas are eventually seeded with native grass species such as wheatgrasses (*Agropyron* spp.), blue grama (*Bouteloua gracilis*), and needlegrasses (*Stipa* spp.). Grass seed mixtures are often complimented by forb species such as yellow sweetclover or alfalfa which contribute to the diversity of the planting. Final plantings also may include hand-planted shrub species such as big sagebrush (*Artemesia tridentata*), winterfat (*Ceratoides lanata*), and fourwing saltbush (*Atriplex canescens*).

METHODS

Twenty-five adult female pronghorn and 25 adult female mule deer were captured with a net-gun fired from a helicopter on or near reclaimed mine lands during November 1994 and radio-collared in accordance with guidelines approved by the American Society of Mammalogists. Radio-collared animals were located twice monthly from the ground using a handheld two-element directional antenna (Telonics Inc., Mesa, AZ) or from the air using a fixed-wing aircraft. Animal locations were recorded using Universal Transect Mercator (UTM) coordinates obtained from a portable Global Positioning System (GPS)

unit. Data were recorded only on visually confirmed radio-collared animals.

Animal groups located from the ground were observed with a spotting scope or binoculars. We defined a group as one or more animals within close proximity (<50m) to each other. Date, time of day, UTM location, topographic position, aspect, slope, distance to man-made disturbance (roads, buildings, etc.), distance to water, and sex and age composition were recorded. Data collected during flights included date, time of day, location (UTM), and total number of individuals.

We categorized position of observed animals on reclaimed mine lands as ridge/hilltop, mid slope, base of slope, flat, or drainage/riparian. Slope was estimated as degrees from horizontal. General weather conditions including temperature, wind speed and direction, precipitation, and cloud cover also were recorded for each animal location but were not used in the analysis.

We measured habitat variables at microsites used by radio-collared animals (use sites) on reclaimed lands during the growing season. Because radio-collared animals often were associated with each other at use sites, only a single radio-marked animal was chosen to represent the site. To assure statistical independence, we chose use sites by systematically selecting every third recorded animal location with no individually collared animal sampled more than once/season. This restricted our sample on reclaimed areas to nine pronghorn use sites and 11 mule deer use sites measured each season.

We measured 29 random sites on reclaimed mine lands using a grid of XY coordinates overlaid on a map of reclaimed land. Random sites were randomly selected from XY coordinates by use of a random numbers table. We located at least one random site in areas reclaimed during 1976-1995 to assure representation of available habitat and then located sites in the field. We recorded the same physical data as on use sites.

On both animal use and random sites, the following vegetation variables were

measured at the peak of the growing season: plant species frequency, average plant height, percent shrub cover, and number of different species. We estimated plant species frequency by determining presence or absence of plants in 30 (25x25 cm) frames placed at 1-m intervals on two perpendicular bisecting 15-m transects centered at each site. Transects were oriented in the four cardinal directions. We determined frame size adequacy a priori by ensuring that average frequencies of major species fell within 20 and 80 percent frequency for the sample site (Higgins et al. 1994). The line intercept technique estimated percent shrub cover on both transects. Average plant height was estimated using a Robel pole positioned at the center of the plot and observed from a distance of 4 m along each transect (Robel et al. 1970). We recorded four more readings from random placement of the pole within each quadrant created by the two transects.

Statistical Analysis

We tested hypotheses that observed occurrences of pronghorn and mule deer on topography types were similar to the proportional availability of topography types predicted by our random samples on reclaimed areas using a contingency table framework for studies with sampled availability of resources (Design I, Manley et al. 1993). The term expected use throughout this paper refers to the proportion of available habitat resulting from the random samples times the number of pronghorn or mule deer observations. We tested whether pronghorn or mule deer use differed from expected use of topography types during each season by applying a Bonferroni correction (to maintain experiment-wise error rates) to the probability of a 1df chi-square test that the estimated selection ratio was 1.0 ($H_0: w = 1.0$, Manley et al. 1993). Tests were considered significant at $\alpha \leq 0.10$.

We used independent sample *t*-tests to test for significant differences between microhabitat variables at use and random sites for three seasons on reclaimed areas:

winter (1 Jan-15 Apr); spring (16 Apr-30 June); and summer (1 Jul-31 Aug).

Microsite data were further analyzed with stepwise logistic regression to determine habitat variables that distinguish use sites from random sites. We estimated logistic regression parameters by the maximum likelihood method (Norusis 1994).

Covariance of habitat components can confound interpretation of analysis (Yeo and Peek 1992), so we used only one of a pair of highly correlated ($r^2 > \pm 0.8$) variables in the model; we eliminated the least biologically important variable from the data set. SPSS for Windows version 6.1 was used for all statistical analyses.

RESULTS

Flats and mid slope areas accounted for the greatest use of topography types by pronghorn on reclaimed lands during each season (Table 1). Overall pronghorn use of topography types during spring did not differ with expected use as determined by the proportional availability ($\chi^2 = 5.16$, $P = 0.271$). Pronghorn made the greatest use of flats, which was similar to the expected use ($P = 1.0$). The second most used topographic type was mid slope terrain which also did not differ from expected use ($P = 1.0$). Pronghorn exhibited a similar pattern during summer and fall. An exception to this pattern occurred during winter. Mid slope areas accounted for the highest use by pronghorn, which did not differ from expected use ($P = 0.527$), with no use observed on flats.

Mule deer use mostly occurred on flats and midslope areas (Table 2). During spring, overall mule deer use of topography types differed with expected use as determined by the proportional availability ($\chi^2 = 7.81$, $P = 0.099$). Mule deer made greater ($P = 0.011$) use of base of slope than expected during spring. Overall use of topography types during summer did not differ from expected use ($\chi^2 = 6.66$, $P = 0.155$). However, within topographic categories, mule deer used base of slope ($P = 0.076$) and drainage areas ($P = 0.076$) more than expected. Overall use of

Table 1. Pronghorn use compared with expected use of topographic categories on reclaimed minelands, 1995-1996.

Season	Availability (%)	Observed (%)	Expected (%)	Selection (%)	Bonferroni adjusted P-value (H0: w=1.00)
Topographic category					
Spring ($\chi^2 = 5.16$, $P = 0.271$)					
Ridge/hill top	3.4	6.7	5.3	1.933	1.0
Midslope	41.4	28.9	33.8	0.698	1.0
Base of slope	3.4	13.3	9.6	3.867	0.115
Flat	48.3	51.1	50.0	1.059	1.0
Drainage	3.4	0.0	1.3	0.000	1.0
Summer ($\chi^2 = 3.69$, $P = 0.449$)					
Ridge/hill top	3.4	8.5	7.3	2.468	0.958
Midslope	41.4	30.9	33.3	0.746	1.0
Base of slope	3.4	11.7	9.8	3.394	0.166
Flat	48.3	46.8	47.1	0.970	1.0
Drainage	3.4	2.1	2.5	0.617	1.0
Fall ($\chi^2 = 2.33$, $P = 0.675$)					
Ridge/hill top	3.4	12.5	6.8	3.625	0.556
Midslope	41.4	37.5	40.0	0.906	1.0
Base of slope	3.4	6.3	4.2	1.813	1.0
Flat	48.3	43.8	46.8	0.906	1.0
Drainage	3.4	0.0	2.2	0.000	1.0
Winter ($\chi^2 = 7.63$, $P = 0.106$)					
Ridge/hilltop	3.4	0.0	2.0	0.000	1.0
Midslope	41.4	80.0	48.0	1.930	0.527
Base of slope	3.4	20.0	6.0	5.800	0.305
Flat	48.3	0.0	42.0	0.000	0.23
Drainage	3.4	0.0	2.0	0.000	1.0

topography categories during fall also did not differ from the expected use ($c^2 = 3.35$, $P = 0.501$). Within topographic categories, use of base of slope was higher ($P = 0.098$) than expected. Mule deer use of topography did not differ from the expected use ($c^2 = 2.97$, $P = 0.563$) during winter and no differences were observed within categories ($P = 1.0$).

Spring Use

Microsite habitat data were analyzed by season. Frequency of graminoids on random sites was higher ($P = 0.001$) than on mule deer use sites (Table 3). Random sites had more ($P = 0.04$) green needlegrass (*Stipa viridula*) than estimated at pronghorn use sites (Table 4) but less ($P = 0.02$) than deer use sites. Both pronghorn and deer use sites had more ($P = 0.01$) yellow sweetclover than

random sites. False flax (*Camelina microcarpa*) and mustard (*Descurainia* spp.) also were more common on pronghorn ($P = 0.02$) and mule deer ($P = 0.001$) use sites than random sites. Alfalfa was more common ($P = 0.001$) on pronghorn use sites than random sites. Spring pronghorn sites had no shrubs while random sites had < 1 percent. Shrubs were more common ($P = 0.01$) on mule deer use sites than random sites primarily because of greater ($P = 0.01$) occurrence of Gardner's saltbush (*Atriplex gardneri*). The number of plant species on pronghorn use sites was greater ($P = 0.03$) than at random sites. Deer use sites had greater ($P = 0.001$) plant height and shrub cover ($P = 0.001$) than random sites during spring.

Percent frequency of alfalfa and

Table 2. Mule deer use compared with expected use of topographic categories on reclaimed minelands, 1995-1996.

Season	Availability (%)	Observed (%)	Expected (%)	Selection (%)	Bonferroni adjusted P-value (H0: w=1.00)
Topographic category					
Spring ($\chi^2 = 7.81$, $P = 0.099$)					
Ridge/hill top	3.4	5.2	4.7	1.506	1.0
Midslope	41.4	40.3	40.5	0.973	1.0
Base of slope	3.4	15.6	12.2	3.867	0.011
Flat	48.3	27.3	33.0	4.519	0.269
Drainage	3.4	11.6	9.6	3.390	0.191
Summer ($\chi^2 = 6.66$, $P = 0.155$)					
Ridge/hill top	3.4	4.4	4.3	1.279	1.0
Midslope	41.4	39.7	40.0	0.960	1.0
Base of slope	3.4	12.5	10.9	3.625	0.076
Flat	48.3	30.9	33.9	0.640	0.444
Drainage	3.4	12.5	10.9	3.625	0.076
Fall ($\chi^2 = 3.35$, $P = 0.501$)					
Ridge/hill top	3.4	5.7	5.2	1.657	1.0
Midslope	41.4	42.9	42.6	1.036	1.0
Base of slope	3.4	12.4	10.5	3.590	0.098
Flat	48.3	37.1	39.4	0.769	1.0
Drainage	3.4	1.9	2.3	0.552	1.0
Winter ($\chi^2 = 2.97$, $P = 0.563$)					
Ridge/hill top	3.4	0.0	1.7	0.000	1.0
Midslope	41.4	55.2	48.3	1.333	1.0
Base of slope	3.4	6.9	5.2	2.000	1.0
Flat	48.3	34.5	41.4	0.714	1.0
Drainage	3.4	3.4	3.4	1.000	1.0

mustard contributed significantly to predicting pronghorn use. Both species were more likely to occur at sites selected by pronghorn than random. The logistic model correctly classified 84 percent of the sites (use and random) overall. However, only 44 percent of pronghorn use sites were correctly classified. Frequencies of alfalfa, downy brome, mustard species, and common dandelion (*Taraxacum officinale*) and average distance to human disturbance contributed to a site being utilized by mule deer. All these same variables except human disturbance were positively associated with increased probability that mule deer selected sites. The logistic model correctly classified 98 percent of the sites overall, and 91 percent of mule deer use sites were correctly classified.

Summer Use

Occurrence of graminoids on random sites was higher than both pronghorn ($P = 0.004$) and mule deer ($P = 0.001$) use sites. Downy brome ($P = 0.003$) was more common on random sites than on pronghorn use sites. Crested wheatgrass ($P = 0.03$) and other wheatgrasses ($P = 0.01$) were more common on random sites than on mule deer use sites. Alfalfa was more common ($P = 0.001$) on both pronghorn and deer use sites than on random sites. Random sites had greater ($P = 0.02$) frequencies of vetch species (*Astragalus* spp.) than did pronghorn use sites. Mule deer use sites had more ($P = 0.001$) mustard than did random sites. We found no shrubs on pronghorn or deer use sites. More ($P = 0.008$) plant species occurred on random

Table 3. Percent frequency (\pm SE) of common plant species and other variable on mule deer reclaimed use and random habitat sites, 1995-1996.

Category	Percent Frequency of Occurrence (\pm SE)			
	Spring	Summer	Winter	Random
Species				
Total Graminoids	97.0 \pm 0.0	93.3 \pm 3.8	96.1 \pm 2.0	99.3 \pm 0.4
Crested wheatgrass (<i>Agropyron cristatum</i>)	16.7 \pm 8.3	3.0 \pm 1.9	52.4 \pm 14.1	14.3 \pm 5.9
Other wheatgrasses (<i>Agropyron</i> spp.)	17.8 \pm 7.9	7.0 \pm 3.8	10.6 \pm 4.9	25.3 \pm 4.8
Green needle-grass (<i>Stipa viridula</i>)	16.4 \pm 8.4	12.7 \pm 5.7	4.3 \pm 1.7	10.5 \pm 2.4
Total Forbs	68.2 \pm 10.9	57.6 \pm 8.5	43.9 \pm 7.8	44.8 \pm 6.2
Yellow sweetclover (<i>Melilotus officianalis</i>)	30.3 \pm 12.6	22.4 \pm 8.5	12.1 \pm 4.9	12.4 \pm 4.5
False flax (<i>Camelina microcarpa</i>)	10.6 \pm 7.5	6.1 \pm 3.0	1.2 \pm 0.7	6.7 \pm 2.7
Mustard spp. (<i>Descurainia</i> spp.)	11.2 \pm 6.6	10.9 \pm 5.3	5.2 \pm 2.3	1.1 \pm 0.8
Alfalfa (<i>Medicago sativa</i>)	7.3 \pm 4.7	11.8 \pm 6.6	15.8 \pm 8.6	0.6 \pm 0.4
Total Shrubs	3.3 \pm 3.0	0.0 \pm 0.0	0.6 \pm 0.6	0.5 \pm 0.3
Gardner's saltbush (<i>Atriplex gardneri</i>)	3.0 \pm 3.0	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0
Big sagebrush (<i>Artemisia tridentata</i>)	0.3 \pm 0.3	0.0 \pm 0.0	0.0 \pm 0.0	0.3 \pm 0.0
Silver sagebrush (<i>Artemisia cana</i>)	0.0 \pm 0.0	0.0 \pm 0.0	0.6 \pm 0.6	0.0 \pm 0.0
Category	Average (\pm SE)			
Other Habitat Variables	Spring	Summer	Winter	Random
Number of plant species	9.4 \pm 1.1	9.9 \pm 0.7	8.2 \pm 1.1	9.8 \pm 0.8
Percent shrub cover	1.1 \pm 1.0	0.0 \pm 0.0	0.0 \pm 0.0	0.1 \pm 0.1
Plant Height (cm)	20.4 \pm 3.2	18.1 \pm 2.0	17.4 \pm 1.1	15.7 \pm 0.8
Slope ($^{\circ}$)	16.8 \pm 4.9	11.8 \pm 4.5	10.5 \pm 4.2	12.4 \pm 2.4
Distance to man-made disturbance (m)	137.7 \pm 27.7	108.2 \pm 30.2	163.2 \pm 42.7	211.2 \pm 27.3

sites than on pronghorn use sites during summer.

Among primary vegetative characteristics, frequency of alfalfa and average plant height distinguished pronghorn use sites from random habitat sites. As frequency of occurrence of alfalfa increased, probability of the site being utilized by pronghorn increased. As average plant height decreased, probability of pronghorn use increased. The logistic model correctly classified 84 percent of the sites overall. However, as during spring, the model correctly classified only 44 percent of pronghorn use sites. Frequency of mustard species and wheatgrass species, and average distance to water were significant variables distinguishing sites used by mule deer from random sites. Increasing the frequency of mustard species

increased the probability of mule deer selecting a site. Increasing the frequency of wheatgrass species and increasing the distance to water decreased the probability of mule deer selecting a site. The model correctly classified 88 percent of the sites overall and 64 percent of mule deer use sites.

Winter Use

Graminoids more commonly occurred ($P = 0.001$) on random sites than on either pronghorn or mule deer use sites. However, green needlegrass was more common ($P = 0.04$) on pronghorn use sites than on random sites. Crested wheatgrass was more common ($P = 0.01$) on deer use sites than on random sites. Other wheatgrasses were more common on random sites than mule deer sites ($P = 0.05$). Both pronghorn ($P = 0.02$) and deer ($P = 0.001$) use sites

Table 4. Percent frequency (\pm SE) of plant species and other variables on pronghorn reclaimed use and random habitat sites, 1995-1996.

Category	Percent Frequency of Occurrence (\pm SE)			
Species	Spring	Summer	Winter	Random
Total Graminoids	99.6 \pm 0.4	97.0 \pm 3.0	93.4 \pm 3.1	99.3 \pm 0.4
Crested wheatgrass (<i>Agropyron cristata</i>)	17.4 \pm 10.9	7.0 \pm 5.6	7.0 \pm 5.6	14.3 \pm 5.9
Other wheatgrasses (<i>Agropyron</i> spp.)	17.8 \pm 7.9	7.0 \pm 3.8	10.6 \pm 4.9	25.3 \pm 4.8
Downy brome (<i>Bromus tectorum</i>)	15.6 \pm 6.5	1.1 \pm 0.8	12.2 \pm 6.2	18.3 \pm 4.8
Green needle-grass (<i>Stipa viridula</i>)	3.7 \pm 1.2	2.6 \pm 1.6	16.3 \pm 7.2	10.5 \pm 2.4
Total Forbs	70.7 \pm 10.9	42.6 \pm 9.3	32.6 \pm 11.4	44.8 \pm 6.2
Yellow sweetclover (<i>Melilotus officinalis</i>)	27.8 \pm 13.1	7.0 \pm 6.2	0.0 \pm 0.0	12.4 \pm 4.5
False flax (<i>Camelina microcarpa</i>)	24.4 \pm 11.5	1.9 \pm 1.9	1.9 \pm 1.3	6.7 \pm 2.7
Mustard spp. (<i>Descurainia</i> spp.)	7.8 \pm 3.2	1.5 \pm 1.5	10.7 \pm 6.0	1.1 \pm 0.8
Vetch spp. (<i>Astragalus</i> spp.)	7.8 \pm 3.8	0.7 \pm 0.5	0.4 \pm 0.4	8.7 \pm 2.8
Alfalfa (<i>Medicago sativa</i>)	6.7 \pm 4.4	5.6 \pm 3.9	5.9 \pm 5.9	0.6 \pm 0.4
Total Shrubs	0.0 \pm 0.0	0.0 \pm 0.0	0.7 \pm 0.5	0.5 \pm 0.3
Big sagebrush (<i>Artemisia tridentata</i>)	0.0 \pm 0.0	0.0 \pm 0.0	0.7 \pm 0.5	0.3 \pm 0.3
Category	Average (\pm SE)			
Other Habitat Variables	Spring	Summer	Winter	Random
Number of plant species	11.6 \pm 0.9	7.9 \pm 0.6	7.4 \pm 0.9	9.8 \pm 0.8
Percent shrub cover	0.0 \pm 0.0	0.0 \pm 0.0	0.0 \pm 0.0	0.1 \pm 0.1
Plant height (cm)	16.9 \pm 2.4	11.3 \pm 1.5	14.1 \pm 1.0	15.7 \pm 0.8
Slope ($^{\circ}$)	12.2 \pm 5.9	18.9 \pm 5.4	18.3 \pm 5.5	12.4 \pm 2.4
Distance to man-made disturbance (m)	192.8 \pm 50.8	132.2 \pm 31.5	165.6 \pm 36.2	211.2 \pm 27.3
Distance to water (m)	350.0 \pm 40.8	245.6 \pm 43.1	361.1 \pm 55.1	355.5 \pm 30.1

included more alfalfa than did random sites. False flax was more common ($P = 0.04$) on random sites than mule deer sites, while other mustard species were more common ($P = 0.01$) on mule deer use sites.

Percent frequency of alfalfa, total forb frequency, and total graminoid frequency contributed significantly in distinguishing pronghorn use sites from random sites. As the frequency of alfalfa increased, the probability of the site being utilized by pronghorn increased. As the frequency of total forbs and graminoids decreased, the probability of pronghorn use increased. The model correctly classified 86 percent of the sites overall and 56 percent of the pronghorn use sites. Among significant variables, frequency of alfalfa and crested wheatgrass distinguished mule deer use sites from random sites, and as the

occurrence of both species increased, probability of the site being utilized by mule deer increased. The model correctly classified 85 percent of the sites overall and 64 percent of mule deer use sites.

DISCUSSION

As expected, pronghorn most often used reclaimed areas with gentle slopes as evidenced by their preference for flats. We did observe pronghorn using steeper terrain, such as ridges and hill tops, although less frequently. Pronghorn have adapted to open terrain using their keen eyesight to locate and identify potential dangers (Byers 1997). The relatively gentle terrain on reclaimed land provided pronghorn with an unobstructed view of the landscape enabling them to locate predators or other

potential dangers. Pronghorn summer use sites on reclamation areas were characterized by shorter vegetation, and we often observed pronghorn bedded on areas void of vegetation. Our data showed that pronghorn selection of topographical features did not differ from availability on reclaimed lands. This was not surprising since much of the reclaimed land is contoured to resemble pre-mine conditions, which included extensive flats and gently sloped terrain (L. Vicklund, personal communication). Pronghorn selection of topography was consistent with others (Yoakum 1978, Wood 1989) suggesting that pronghorns often selected areas that allowed high visibility.

Pronghorn occurred most prevalently on mine sites with large tracts of contiguous reclaimed grassland. In contrast, fewer pronghorn used mine sites consisting of small reclaimed areas fragmented by roadways or other human-related structures (Gamo 1997). Segerstrom (1982) found that pronghorn better tolerated human activity when it was within their field of view. A combination of short plant structure, greater unobstructed viewing distance, and terrain that allows good visibility enabled pronghorn to view human activity and thus increased the likelihood that pronghorn would use reclaimed lands.

Thermoregulation is an important factor in the survival of mule deer (Parker and Gillingham 1990). Carson and Peek (1987) found that mule deer selected rugged landforms during winter. The random use of topography types exhibited by mule deer during winter suggests that re-contouring efforts on reclaimed lands provided some relief from winter winds for mule deer minimizing the effects of wind chill (Wood 1988). Sloped areas in general were most frequented by mule deer. Man-made rock placements positioned on flats and ridges and other topographic features provided cover for small mammals and birds (Rumble 1989, Parrish and Anderson 1994). These structures along with naturally eroded areas (drainages) were used by mule deer particularly during inclement weather.

These same features also offered shade during summer.

During spring, both pronghorn and mule deer selected sites with higher frequencies of forbs, particularly alfalfa. Additional moisture, which may result in more lush plant growth, may have influenced mule deer selection of base of slope areas. Our data support those of Medcraft and Clark (1986), who found that mule deer diets were dominated by forbs, including legumes, during spring on reclaimed lands in the Powder River Basin. Others (Kufeld et al. 1973, Medcraft and Clark 1986, and Yoakum et al. 1996) have shown that pronghorn and mule deer prefer forbs such as alfalfa. Alfalfa and other legumes provide a high source of protein for mule deer, pronghorn, and other ruminants. Protein is important for proper fetal development (Minson 1990, Robbins 1993), which is nearing completion during spring.

Forbs also were an important factor in classifying pronghorn and mule deer use sites during summer. The importance of a quality diet is important for lactation during the summer months for both pronghorn and mule deer (Short 1981, Robbins et al. 1987, Robbins 1993). We also observed that animals remained near water sources during summer such as ponds or diversions created by reclamation efforts. Demands of lactation increases water use by females, and in late summer, water facilitates digestion of drier plant materials (Short 1982, Minson 1990).

Winter often is a season of stress for ungulates and measuring exactly what attracts animals to particular sites is difficult. We noted a relative consistency of plant species during the two years of this study. Thus, we attempted to provide some insight by measuring vegetation at winter sites the following fall assuming that late season plant species would be **available** depending upon snow cover and **palatability** of plants. We found that during winter, pronghorn and mule deer selected sites containing residual alfalfa. Forbs are a major source of forage for pronghorn from

early spring through late fall (Medcraft and Clark 1986). Mule deer also were attracted to areas with resurgent cool season grasses such as crested wheatgrass, which often produce new growth during fall and early spring (Willms and McLean 1978, Willms et al. 1979, Austin et al. 1983). During our study, snow cover did not approach 100 percent ground cover. Therefore, forage was generally available for consumption by pronghorn and mule deer.

MANAGEMENT

RECOMMENDATIONS

Impacts of large-scale surface mining on pronghorn and mule deer concern wildlife managers. However, as evidenced by our study and others (Segerstrom 1982, Medcraft and Clark 1986), pronghorn and mule deer successfully utilized reclaimed mine lands in the Powder River Basin. Additionally, game surveys conducted on reclaimed mine lands reflected numbers and production found on native range in adjacent hunt management units (Oedekoven 1993, Gamo 1997). A unique aspect of reclaiming mined land is the opportunity to re-establish wildlife habitat if managers choose to do so. To benefit pronghorn and mule deer, we recommend increasing efforts to establish forbs, continue providing topographical relief for cover (i.e. steeper slopes, cliffs, drainages, rock outcrops), maintain a mosaic of vegetation heights, and reduce fragmentation by assimilating small tracts of reclamation into larger contiguous areas.

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EFFECTS OF SOIL DISTURBANCE ON SMALL MAMMAL CAPTURE RATES

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INTRODUCTION

Small mammal trap-sites often are prepared to enable trap placement on a level surface. This is frequently accomplished by scraping one's foot across the substrate. Soil disturbance at individual trap-sites may increase rodent capture probability (*Sensu* Thompson 1982). Whereas several studies since Price (1978) have investigated microhabitat effects, none have quantitatively examined the effect of soil disturbance caused by trap-site preparation on small mammal capture rates. Jorgensen and Demarais (1999) hypothesized that disturbance may cause a qualitatively different trap response by small mammals in open microhabitats compared to those covered by shrubs and detritus.

Due to the importance of small mammal microhabitat partitioning to theories, concepts, and models of community ecology, it is important that all of the factors that may bias observations of it be understood. Additionally, observations that do not agree with the existing paradigm, or affect its generality (e.g., Morris 1987, Thompson 1987, Bowers 1988, Jorgensen et al. 1995, Jorgensen and Demarais 1999) need to be reconciled. Notably, Douglass (1989) indicated that microhabitat selection by free-roaming deer mice (*Peromyscus maniculatus*) significantly differed from that determined by live-trapping.

We investigated the effect of minimal soil disturbance on small mammal capture

rates by comparing capture rates for traps placed on undisturbed soil to traps placed within a small area of disturbed soil. Additionally, we tested microhabitat effects by comparing capture rates for traps placed under shrubs in the presence of detritus to traps placed in open microhabitats free of detritus to detect disturbance x microhabitat interactions.

The study was conducted in mixed desert scrub habitat in south-central New Mexico. Common shrub species included mesquite (*Prosopis glandulosa*), creosotebush (*Larrea tridentata*), and mariola (*Parthenium incanum*). Common grasses included bush muhly (*Muhlenbergia porteri*) and sand dropseed (*Sporobolus cryptandrus*).

We identified and flagged 32, 30- x 200-m study plots during February 1996. Treatments were randomly assigned to study plots. The two levels of trap-site disturbance were disturbed and undisturbed. The two levels of microhabitat were under a mesquite bush with detritus and an open area lacking vegetation and detritus. Thus, eight study plots were delineated as open/undisturbed, eight as open/disturbed, eight as shrub/undisturbed, and eight as shrub/disturbed.

Two 200-m trap-lines spaced approximately 20 m apart were established within each study plot. Each trap-line typically contained 25 trap-sites. Some trap-lines contained slightly more or fewer trap-sites because of microhabitat availability although all study plots contained 50 trap-sites. We did not visit or

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disturb study plots after February 1996 until the experiment was conducted in April 1996. Study plots were sampled in a random order for two consecutive nights each using 7.7 x 7.7 x 23-cm Sherman folding, aluminum live-traps during 7-14 April 1996. We placed a consistent quantity of bait (quick oats) with measuring spoons inside (15 ml) and outside (0.6 ml at the door) of each trap. Animals were marked with permanent ink.

Soil disturbance quantifiably simulated that often caused by scraping the substrate with one's foot during trap-site preparation. We scraped the substrate with the edge of a hand trowel each evening when setting traps. A frame measuring 48x20 cm delineated the disturbed area. Disturbance depth was approximately 4 cm the first night and slightly greater the second night. We placed traps within the disturbed area and minimized trap-site disturbance on the undisturbed study plots by using 1.22-m snake tongs to set and check traps.

We compared capture rates using two-way factorial analysis of variance for each species. First capture and recapture data were analyzed separately to account for cases where responses to novel items (first capture) may differ from responses to familiar items (recaptures). We assessed normality with Shapiro-Wilk test and used square-root transformations to near normality (Johnson and Wichern 1992). Heteroscedascity was tested with Levene's test. Analyses were conducted with SPSS for windows (Norusis 1993) and Statistix (Analytical Software 1991).

We recorded 1149 captures of 831 individual small mammals during 3200 trap-nights. Species captured most frequently included Merriam's kangaroo rat (*Dipodomys merriami*; $n = 299$), desert pocket mouse (*Chaetodipus penicillatus*; $n = 153$), cactus mouse (*Peromyscus eremicus*; $n = 134$), Ord's kangaroo rat (*Dipodomys ordii*; $n = 65$), northern grasshopper mouse (*Onychomys leucogaster*; $n = 52$), deer mouse ($n = 44$), and southern plains woodrat (*Neotoma micropus*; $n = 21$).

First captures of cactus mice occurred more frequently at undisturbed sites compared to disturbed sites ($P = 0.004$). Recaptures of cactus mice failed to show this effect ($P = 0.394$), but were affected by microhabitat ($P = 0.048$) being more frequent under shrubs. Captures of other species were not affected by disturbance or microhabitat main effects ($P > 0.05$).

One species exhibited a microhabitat x disturbance interaction ($P < 0.05$). Southern plains woodrats were captured less frequently at undisturbed sites than at disturbed sites in the open ($P = 0.035$). The effect was not observed under shrubs. Thus, our treatments affected only two species ($P < 0.05$), cactus mice and southern plains woodrats.

Data from southern plains woodrats, which were captured less at undisturbed sites in the open for first capture data ($P = 0.035$), supported the hypothesis that microsite disturbance may affect capture rates unequally between microhabitats. This gives only limited support to the idea that observer-induced bias may be present in previous microhabitat studies. Notably, only two species exhibited any response to disturbance during this study, one positive and one negative.

This study supported the hypothesis of observer-induced bias from differential trap-site disturbance between microhabitats for only one species. However, we believe that additional evaluation of the hypothesis, particularly relative to kangaroo rats, needs investigation in other areas under different climatic regimes and different conditions of small mammal abundance.

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ABSTRACTS

BIOLOGICAL SCIENCES - AQUATIC

WHIRLING DISEASE IN MONTANA'S SPRING CREEKS ^{AFS}

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Spring creeks in Montana provide important wild trout habitat, as well as supporting other nearby fisheries. These thermally stable, cool, clear, nutrient-rich waters allow spawning of trout to occur earlier and over extended periods, and provide ideal conditions for trout rearing, growth, and survival. In some river systems, spring creeks may sustain the bulk of spawning adults, and hence recruitment of young fish. However, these same characteristics may also increase whirling disease infection. Higher nutrient loads may foster high densities of *Tubifex tubifex*, a vector of the disease, and the moderate, steady temperatures may prolong the release of the infectious *triacetinmyon* (TAM) stage of the disease. In non-spring streams, infection appears to follow a seasonal cycle of highs in the spring and fall during moderate temperatures, and lows in the summer and winter. Such a cycle may not occur in spring creeks and despite their importance, the role of whirling disease in Montana's spring creeks is unclear. The purpose of this study was to investigate how widespread whirling disease is in Montana spring creeks, and to determine factors that might affect its severity. We hypothesized that whirling disease severity would be of higher magnitude and longer duration in spring creeks, due to habitat and thermal characteristics. Nine spring creeks were sampled from January 2000 to September 2001 within eight watersheds in western Montana. Six 'extensive' sites (Anceny, Blaine, Clark Canyon, Kliendschmidt, Rock Creek and Mitchell-Slough) were sampled in the spring and fall to assess the extent of infection over a wider geographic area. Three 'intensive' sites (Ben Hart, Nelson and Willow Springs) were sampled monthly to assess seasonal changes in infection in relation to temperature, spawning timing, and *T. tubifex* abundance. Severity of infection was measured with sentinel fish cages using a paired sampling design, with cages deployed simultaneously in a spring creek and adjacent river. Redd counts were conducted on the three intensive sites twice monthly to determine timing and location of spawning. Thermal units from time of spawning were used to calculate time of emergence in relation to whirling disease infection levels. *T. tubifex* abundance, water quality, and habitat

Title footnote indicates organization, location and date presentation was made:

^{AFS} Montana Chapter of the American Fisheries Society Annual Meeting, Bozeman, MT,
Jan. 28 - Feb. 1, 2002

^{TWS} Montana Chapter of the Wildlife Society Annual Meeting, Fairmont Hot Springs, MT,
Feb. 26 - 28, 2002

characteristics were measured to determine their association with the occurrence or severity of infection. Infection severity varied among the nine spring creeks. Five sites had little or no infection (<1.0) (Anceny, Clark Canyon, Blaine, Mitchell-Slough and Nelson); two sites had moderate infection (1.0-2.5) (Ben Hart and Blaine); and two sites showed severe infections (>2.5) (Kliendschmidt and Willow Springs). The seasonal cycle of infection in spring creeks was much different than in non-spring streams. In these spring streams infection peaked during winter months, declined sharply in the spring, and remained at low levels until the fall when infection rates began to rise again. Since spring creek temperatures are relatively constant year-round, temperature does not appear to be a primary factor driving seasonal patterns of infection. At the three intensive sites, rainbow trout spawning occurred from February through early June. Fry emergence was protracted, occurring as early as March and continuing through August. Our cage results suggest that fry emerging during late spring or later are likely to avoid high infection, even in highly infected spring creeks. In contrast, fry of fall spawning rainbow trout may be much more susceptible to infection in these systems.

CONSERVING NATIVE YELLOWSTONE CUTTHROAT TROUT IN YELLOWSTONE LAKE (OR YELLOWSTONE GETS A VERY BIG BOAT)^{AFS}

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Yellowstone National Park (YNP) contains 90 percent of the remaining range of Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*). Until recently, Yellowstone Lake was the largest and most secure habitat for long-term perpetuation of this sub-species. Since the discovery of predatory lake trout in 1994, YNP fishery managers have been engaged in a large-scale gillnetting program in an effort to protect cutthroat trout by restricting the population growth of lake trout. As the amount of effort increased, so has the number of lake trout removed. Despite our rapidly escalating fishing effort between 1996 and 1999, it became apparent that existing YNP personnel and equipment were insufficient to effectively reduce lake trout numbers throughout the entire 90,000-acre Yellowstone Lake. Additional funds were approved for the 2000-2002, allowing us to purchase “a Very Big Boat.” This new fisheries vessel, designed specifically for gillnetting on Yellowstone Lake, was used throughout the 2001 field season, greatly improving the working conditions for employees and the efficacy of gillnet operations. The boat allowed a 3-fold increase in gill netting effort over 2000 and 6.5-fold increase over 1999. Preliminary results are very encouraging. Almost 15,500 lake trout were removed from Yellowstone Lake in 2001 using over 10,600 gillnet units (100 m of gillnet set/night). Catch per unit effort was reduced by more than half compared to 2000. An Idaho Department of Fish and Game hydroacoustic survey done in August of 2001 indicated that density estimates in the West Thumb area of the Lake, where the highest densities of lake trout exist, were reduced by 10 percent from previous surveys in 1997-1998. Mean total length of spawners also appears to be decreasing. However, we have by no means declared victory over the lake trout problem in Yellowstone Lake since the true extent of the lake trout population is not known. Given the available habitat in Yellowstone Lake it is apparent that lake trout will continue to expand if control efforts are eliminated. In 2002 we anticipate having 250 nets ready for use at ice-off. With an experienced crew and the boat in place, we anticipate an even greater effort during 2002. Newly acquired hydroacoustic equipment will allow us to determine areas of high

lake trout density, size ranges of the fish, and depths at which the fish are residing; allowing us to identify areas where effort could be increased or decreased to improve efficacy, and evaluate the effectiveness of our removal efforts by producing an index to estimate lake trout population size annually.

DISTRIBUTION AND STATUS OF FISHES IN MONTANA PRAIRIE STREAMS ^{AFS}

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We sampled fish on 87 occasions at 67 sites in 63, 2nd through 6th-order streams in the plains ecoregions of Montana during the summers of 1999 - 2001 to assess the ichthyofauna of the area. Flowing water, standing water, and dry channel were present during 66, 19 and 2 sampling occasions, respectively. Fish were present at all except two sites with water. Over 35,000 fish representing 26 native and 11 introduced species, and 9 families were captured. Native species were numerically dominant, comprising 87 percent of all individuals captured. Only two species were captured at more than 50 percent of sites: white sucker (76% of sites) and fathead minnow (75%). We assessed the conservation status of 17 native species by calculating the percentage of our sites where each species occurred, by comparing the overlap in our collections to the records in the Montana Rivers Information System (MRIS) database, and by calculating the percentage of States or Provinces where each species was considered vulnerable to extirpation. Flathead chub, lake chub, and western silvery minnow should be considered for addition to the species on the review list, and brook stickleback, northern redbelly dace, northern redbelly dace x finescale dace, and pearl dace may be more rare than currently thought. The "species on review" (SU) status of brassy minnow, creek chub, Iowa darter, and plains minnow was appropriate, as was the demonstrably secure (S5) status of fathead minnow, longnose dace, sand shiner, shorthead redhorse, stonecat, and white sucker. Sites with northern pike had fewer native species than sites where northern pike were absent (Mann-Whitney U; $P = 0.08$), and the number of native individuals was significantly and negatively related to the number of northern pike ($P = 0.03$, $r^2 = 0.29$).

RECENT EFFORTS BY MONTANA FISH WILDLIFE AND PARKS TO ELIMINATE INTRODUCED FISH SPECIES IN PRIVATE PONDS IN THE FLATHEAD RIVER DRAINAGE ^{AFS}

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Introduced fish species are one of the greatest threats to and reasons for declines in native fish populations across Montana. Such decline is evident in the Flathead River Drainage where, for over a century, government agencies and private individuals have intentionally and unintentionally introduced fish species. In recent decades as agencies have reduced introductions of new species, illegal introductions continue to occur along with a rapid proliferation of private fish ponds. Currently there are over 5300 permitted private ponds across Montana and likely thousands of others that are not permitted. Although Montana Fish, Wildlife and Parks (MFWP) restricts use of some fish species, private pond owners have illegally introduced species that may escape into state waters and threaten persistence of native or existing fisheries. A question facing fisheries managers is whether or not the expansion of introduced species can be stopped and if existing introduced populations can be eliminated. In the Flathead River Drainage, MFWP has begun projects to suppress introduced fish species in conjunction with habitat improvement and other types of native fish conservation projects. These suppression efforts include applying fish toxicant to private ponds and small lakes to remove non-native species. As example to the potential danger of illegal introductions, in 2001 MFWP treated a small private pond adjacent to the Flathead River that contained a self-sustaining population of brown trout, a species not established in the Flathead River Drainage. Current state law requiring a stocking license for a private landowner to stock fish provides limited enforcement and regulatory capacity. Presently, it is largely up to fisheries professionals to be aware of the law and risks associated with private ponds, pass this information along to pond owners, build ponds that prevent fish escapement, and inform MFWP of illegal introductions.

WESTSLOPE CUTTHROAT TROUT RESTORATION ON THE SUN RANCH ^{AFS}

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In 1996 the Montana Department of Fish, Wildlife, and Parks (MFWP) initiated an upper Madison River westslope cutthroat recovery project. Part of the project included an extensive inventory of fish distribution, genetics, and baseline fish habitat in the upper Madison River drainage. In 1999 MFWP published a Conservation Agreement for Westslope Cutthroat Trout in Montana. The agreement recommends protecting all existing pure and slightly hybridized westslope populations in each of the major drainages within the fish's historic range, including the Madison. In 2000, the privately owned Sun Ranch and MFWP began discussions on how to execute recovery efforts for westslope cutthroat trout on the Sun Ranch in the upper Madison drainage. A Cooperative Agreement was signed in

February 2001. The Sun Ranch has completed construction of a three-acre brood pond augmented with a solar powered aeration system. Additionally, since Montana implemented rules against wild fish or eggs entering any state or federal hatchery, the ranch built a small private hatchery. This entailed developing a spring, as well as drilling a backup well, to supply water for the incubation system. Even though previous genetic studies indicated that there was only a very slight chance of finding any pure westslope cutthroat trout within the upper Madison drainage, in June of 2001 representatives from the Sun Ranch and MFWP began collecting eggs from both Papoose Creek and Cabin Creek, tributaries of the Madison River. Genetic tests of the donor fish indicated that Papoose Creek was heavily hybridized, but Cabin Creek proved to be 100 percent pure. However, disease testing indicated that the Cabin Creek fish were infected with bacterial kidney disease. In September, 356 westslope cutthroat trout fry, approximately 65 mm in total length, were transferred from the Sun Ranch hatchery to the brood pond. These fish were to be raised and ultimately crossed with other pure westslope cutthroat trout to build gene pool for transplant into donor streams in the future. However, it was later discovered that we had inadvertently disposed of some of the pure Cabin Creek fish, and included hybridized fish in our pond transfer. Since this compromised the genetic purity of the fish in the pond, MFWP is working on an Environmental Assessment to reclaim the brood pond.

USFWS INAD PROGRAM: AQUACULTURE DRUG REGISTRATION AND INAD ADMINISTRATION ^{AFS}

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Very few drugs are approved for use in aquaculture, and the utility of these drugs is severely restricted by species, pathogen, and environmental conditions. Compassionate Investigational New Animal Drug (INAD) exemptions allow for the widespread, legal use of unapproved drugs and chemicals and provide an important mechanism to assist aquaculturists and fisheries managers to meet program objectives. The USDI Fish and Wildlife Service (FWS) National INAD Office (NIO) was formed in 1995 to administer and monitor the use of FWS INADs at federal aquaculture facilities. Since then, the role of the office has expanded to include (1) participation in an international effort to obtain U.S. Food and Drug Administration (FDA) approvals of drugs for use in aquaculture, (2) a pivotal study research program, and (3) the establishment of the National INAD Program (NIP) through which non-FWS aquaculture facilities (i.e., state, tribal, and private) can piggy-back on FWS INADs. Maintaining INAD drug use is extremely important because an initial approval for one drug can take years and usually requires generating and submitting six "data packages" to FDA for review. The six "data packages" include product chemistry, mammalian toxicity, tissue residue depletion, environmental fate, pivotal efficacy, and target animal safety. Since 1997, the NIO's pivotal study research program has been very involved in conducting pivotal efficacy and target animal safety studies. The focus of this effort has been to generate data to support new animal drug approvals for the use of chloramine-T and oxytetracycline in salmonids. Because work on chloramine-T and oxytetracycline is nearly

complete, current efforts are focusing on generating efficacy and target animal safety data for Aqui-S (a potential zero-withdrawal anesthetic) and florfenicol (a potent, broad spectrum antibiotic). In addition, the NIO continues to administer and monitor the federal and non-federal use of 12 INADs. Non-federal participation on FWS INADs is administered through the National INAD Program, which is more commonly referred to as the Piggy-backin' Program. In addition to allowing widespread access to needed drugs, objectives of the Piggy-backin' Program are to consolidate the INAD process, eliminate duplication of effort, reduce workloads and costs, ensure compliance with FDA guidelines, and generate supportive efficacy and target animal safety data. Supportive data can be extremely useful in obtaining an initial aquaculture drug approval or in expanding an existing aquaculture drug label. Ultimately, the work carried out by the NIO helps provide safe and efficacious drugs, chemicals, and therapeutants to aquaculturists and fisheries managers throughout the United States.

PRELIMINARY RESPONSE OF FISH HABITAT TO POST-FIRE SALVAGE LOGGING IN RIPARIAN AREAS ^{AFS}

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Fish habitat in Hand Creek, a third-order trout stream in northwestern Montana, was monitored before and after post-fire timber salvage along the stream. Approximately 89 percent of Hand Creek's watershed was burned in a 1994 wildfire but most of the riparian area was only lightly burned. In subsequent years, fire-stressed spruce have become vulnerable to a spruce beetle infestation, and begun to fall across the stream. In 1996 the Flathead National Forest used helicopter logging to remove infested riparian spruce trees. Some portions of Hand Creek did not require salvage harvesting and served as control reaches for fish habitat monitoring. Fish habitat data was collected immediately following the fire in 1994, then monitored prior to salvage activities in 1996, and then again in 2000. Both the treated and control reaches changed over time, presumably due to the wildfire effects. However, no substantial difference was noted between the treated and control reaches. All stream reaches, both treated and untreated, gradually became wider and shallower. Stream banks correspondingly became slightly less stable over time in all reaches. These channel changes are likely due to increased peak flows resulting from the wildfire. Habitat complexity, as measured by the number of pools, riffles and glides, increased in the low gradient, meandering channels but not in higher gradient reaches. Large woody debris gradually increased in all units, but no difference in treated verses control reaches was detected. Fine sediments appear to be decreasing in all units, presumably due to scouring from increased flows. These changes were quantified, but due to survey design limitations, no statistical analyses were performed. It appears that fish habitat in Hand Creek has not yet been affected by riparian salvage. Helicopter logging likely prevented any short-term adverse impacts to channel conditions; however, it may be several years or decades before the full effect of the riparian salvage treatment is manifested. Untreated stream reaches have many trees still suspended over the stream channel that have not yet fallen into the stream whereas the harvested areas have little wood available for future recruitment into the stream.

TELEMETRY STUDY OF SALMONIDS DURING DROUGHT IN THE BIG HOLE RIVER ^{AFS}

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Radio transmitters were implanted in ten arctic grayling (*Thymallus arcticus*), mountain whitefish *Prosopium williamsoni*, and brook trout (*Salvelinus fontinalis*) in the upper Big Hole River during spring 2001 prior to an impending low water year. Fish were located weekly from May through October and tracking was conducted from land, water, and air. The objectives were to determine the effects of drought conditions on movement, habitat use/overlap, and mortality of these three species. Arctic grayling habitat use information will help prioritize future habitat restoration efforts. Arctic grayling tended to move downstream, while brook trout and mountain whitefish tended to move upstream from initial tagging locations. High mortality of all species occurred in late summer during low flow conditions. Seven Arctic grayling and three each of brook trout and mountain whitefish were confirmed dead by October 10th. The upper Big Hole River experienced low flows (< 20 cfs - Wisdom gauge) and high temperatures (>70 °F) for two months. La Marche Creek was identified as important grayling habitat based on the movements of one telemetered fish and snorkeling surveys. La Marche Creek was up to 9 °F cooler than the nearby Big Hole River. Funding has been secured to continue this study in 2002.

ASSESSMENT OF CABINET GORGE FISH HATCHERY LADDER AS A BULL TROUT PASSAGE FACILITY ^{AFS}

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Cabinet Gorge Dam was built in 1952 on the Clark Fork River, approximately 10 miles upstream of Lake Pend Oreille. No fish passage facilities were included in the dam design. It is surmised that the lack of upstream fish passage at this dam has had a detrimental effect on migratory fishes living in the Clark Fork River and Lake Pend Oreille system. In February 2000, Avista was issued a new operating license for Cabinet Gorge Dam by the Federal Energy Regulatory Commission (FERC). The FERC license requires that Avista improve the long term viability of native fish populations through improved fish movements and genetic exchange among native salmonid subpopulations. The Cabinet Gorge Fish Hatchery is located on the banks of the Clark Fork River downstream of Cabinet Gorge Dam. Part of the hatchery facilities include a fish ladder that is designed to collect kokanee returning to spawn; however it was discovered that bull trout also entered the ladder. The goal of this research has been 1) to determine the suitability of the Cabinet Gorge Fish Hatchery ladder and trap as a component of the long-term trap and truck program for fish passage at Cabinet Gorge Dam, and 2) to further our knowledge of bull trout behavior and movement patterns so that long-term fish passage solutions can be developed. Some bull

trout enter the Clark Fork River from Lake Pend Oreille as early as January, although most do not move into the river until at least April. However, these fish do not enter the ladder until August, with the bulk of the run occurring in September. The presence of cold water springs along the river near the hatchery may make summer residence in the river possible in spite of apparently unsuitable water temperatures elsewhere in the river. Thus, it appears that it is the urge to spawn that prompts bull trout to enter the ladder, not a search for cold water. Although the ladder is an effective device for collecting bull trout in this system, the timing of the run may make the ladder unsuitable as a tool for providing fish transport. Bull trout entering the ladder in September and then transported past the dam may not have enough time to find their way to spawning areas in tributaries upstream. Further research needs to be done to find a method to safely collect bull trout for transport earlier in the season.

A NEW HYPOTHESIS FOR THE ORIGIN AND DISPERSAL OF THE EASTSLOPE (=WESTSLOPE) CUTTHROAT TROUT^{AFS}

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The prevailing hypothesis for the origin and dispersal of the inland cutthroat trouts involves upstream penetration of the Columbia River and headwater transfers to adjacent drainages. Data supporting this hypothesis are not conclusive, and its general acceptance is partially due to the lack of viable alternatives. Recent work with poorly dispersing aquatic invertebrates suggests another possibility. Headwater transfers of organisms in Montana are primarily from east to west, except upstream of Canyon Ferry where a massive transfer from the Snake River is suggested. Historically, the upper Snake River was not connected to the Columbia River. Before its capture by the Columbia River, the upper Snake River had highly variable connections to the southeast and across the southwest and west. These zoogeographic patterns are supported by geologic data involving the Yellowstone Hotspot and continental drift. Under the new hypothesis, the ancestor of the westslope cutthroat entered the Missouri River headwaters from the southwest before the passing Yellowstone Hotspot blocked this route by reversing the drainage. Cutthroats remaining in the upper Snake River were eliminated by the massive volcanic eruptions that occurred there. This area was subsequently recolonized by cutthroats from the nearby Great Basin. A headwater transfer, common to both hypotheses, allowed these fish into the Yellowstone River. This new hypothesis explains many, previously mysterious distributions, but it does require a more ancient origin for “eastslope” cutthroat.

FISH BYPASS CHANNEL DESIGN AND EVALUATION AT HUNTLEY DIVERSION DAM, YELLOWSTONE RIVER, MONTANA ^{AFS}

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Huntley Diversion Dam was built by the Bureau of Reclamation in 1906 to convert an arid region east of Billings, Montana into a sustainable agricultural land. This irrigation diversion dam, which diverts water from the Yellowstone River, is constructed of a concrete capped weir with a hydraulic height of eight feet. The differential water height created by the dam results in a nearly vertical plunging flow and is considered a total barrier to upstream fish migration. In 1998 the Huntley Irrigation District initiated a study to design a fish pass for the dam to coincide with some major dam reconstruction related to dam safety measures. The design for fish passage is a rip-rap roughened channel built around the north abutment of the dam. The fish passage channel was constructed under the premise that it would operate over the wide range of river stages experienced at the dam site and provide favorable attraction conditions for migratory fish species attempting to move upstream. An ongoing evaluation of the fish passage at the Huntley Diversion Dam is investigating whether and how fish are utilizing this channel and possible changes that could be employed to improve passage. Results from the first year of study indicate that fish are found throughout the channel with high densities of native flathead chub and silvery minnows present in the lower section of the channel. A variety of techniques and methods used to measure passage of fish within the channel have been utilized, including fyke nets, trap nets, side-scanning hydroacoustics, time-lapse videography and electrofishing. Evaluations in 2002 will include increased efforts to determine fish movement through the channel with a new fish counting device designed for use in flowing water.

SPATIAL AND TEMPORAL PATTERNS OF RAINBOW TROUT INTROGRESSION IN THE FLATHEAD RIVER SYSTEM, MONTANA ^{AFS}

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Although the Flathead River system is considered a regional stronghold for native westslope cutthroat trout, the dynamics of non-native rainbow trout introgression in the Flathead system are poorly understood. Genetic patterns of introgression were assessed with samples from 43 sites in the Flathead River system. Admixed populations were detected in 58 percent (25/43) of the sample sites and the percentage of rainbow trout genetic contribution decreased as the distance upstream from Flathead Lake increased. Positive spatial autocorrelation was detected in North Fork tributary sites within 19 km from sampling locations (Mantel test, $r = 0.188$, $P = 0.0013$), indicating a clustering pattern among admixed sites. Temporal comparisons against 1980s surveys showed new rainbow trout introgression (7/14 sites), continued absence of hybridization (5/14 sites), and continued presence of hybridization (2/14 sites). Twelve percent of the admixed sites (3/25) showed statistically significant patterns of linkage disequilibrium, suggesting that rainbow trout introgression is spread primarily by post-F1 hybrids or several generations have passed since the non-native invasions. These data are consistent with the hypothesis that downstream sources have promulgated upstream expansion of rainbow trout introgression.

YELLOWSTONE FISHERIES, THEN AND NOW ^{AFS}

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Yellowstone National Park was created by the Yellowstone Park Act of 1872, and for several years was the only wildland under active federal management. It was deemed appropriate and necessary for early visitors to fish and hunt for subsistence, as there were almost no visitor services. Early Park superintendents noted the vast fishless waters of the Park, and immediately asked the U.S. Fish Commission to “see that all waters are stocked so that the pleasure seeker can enjoy fine fishing within a few rods of any hotel or camp.” The

first fishes from outside the Park were planted 1889-1890. So important were fisheries during this early period of the Park that the harvest-oriented, fish management program accounted for over 310 million fish being planted in Yellowstone between 1881 and 1955. In addition, between 1903 and 1953, some 818 million eggs were collected from Yellowstone trout and shipped throughout the country. Largely due to the activities in Yellowstone and the popularity of its fisheries, recreational angling became a long-term, accepted use of national parks throughout the country. In Yellowstone National Park, fisheries management, as we understand that term today, began with the U.S. Army and was assumed by the National Park Service in 1916. Fish stocking, data gathering, and other monitoring activities began with the U.S. Fish Commission in 1889, was conducted by the USDI Fish and Wildlife Service until 1996, and has been the responsibility of the National Park Service since 1996. The indiscriminant stocking of nonnative fishes throughout Yellowstone, 40 percent of which was once fishless, has had profound ecological consequences. Most serious were the displacement of intolerant natives such as westslope cutthroat trout and grayling, hybridization of Yellowstone and westslope cutthroat trout with nonnative rainbow trout, and, most recently, competition and predation of Yellowstone cutthroat trout by nonnative lake trout. Management policies of the National Park Service since inception of the agency in 1916 have drastically changed due to insight of ecologists and the Leopold Report of 1963. As a primary goal, natural biotic associations will be maintained or, where necessary, restored to a pre-European condition. An internal conflict exists in the National Park Service mandate that states the people will “use and enjoy”, and also “protect and preserve” our pristine, natural systems. Fisheries management efforts at Yellowstone are currently focused on preservation of native species, while allowing for use of these fisheries by visiting anglers through a complete catch-and-release regulation. Along with native fish preservation, our Aquatics Section activities include native fish restoration, stream and lake inventory and monitoring, and, a new emphasis on aquatic ecosystem health including water quality and macroinvertebrate monitoring of lakes and streams to serve as an early warning for advancing aquatic, invasive exotic species.

DEFINING AND ACHIEVING A QUALITY HATCHERY PRODUCT ^{AFS}

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Using fish hatcheries, fish managers can utilize a number of species, and strains within species, to meet objectives of fisheries management goals. Each species and its associated strains have distinct traits that can be matched to a fishery’s needs. It is these known strain-specific traits that are the basis for a water body’s stocking program. It follows then that fisheries managers must be able to rely on a hatchery product that at very least survives transport to the water, and at best predictably fulfills its intended goal. Like any intensive culture production hatchery, Montana Fish Wildlife and Parks’ Big Spring Trout Hatchery is an unnatural setting and therefore a stressful environment in which to raise fish. Because of these rearing conditions, the fish culturist must optimize every input into the fish’s environment to attain a quality product. These inputs include nutrition and feeding levels, feeding methods, tolerable densities, temperature, external stressors, egg development timing, growth rates, and size structure maintenance.

FALL CHINOOK SALMON SPAWNING ACTIVITY IN RELATION TO DAY/NIGHT AND DAM OPERATIONS ^{AFS}

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The operations of hydropower projects on the main stem Columbia River may affect the spawning or incubation success of fall chinook salmon (*Oncorhynchus tshawytscha*) that spawn in the tailraces of these projects. In addition, the timing of redd construction may be linked to environmental cues, e.g., daylight. Understanding the relationship between environmental cues and hydropower project operations and spawning activity would provide managers with information that might allow for determination of a better balance between protection for spawning salmon and their gametes/progeny, and hydropower operations flexibility. To determine the effects of daylight and hydropower operations on fall chinook salmon spawning activity, we developed a method of detecting the sounds created when female fall chinook salmon moves substrate particles while constructing a redd. Spawning activity was recorded on digital media using hydrophone systems and associated acoustical recording systems. A hydrophone system was deployed from a boat during stratified random 24-h time blocks over a 10-day period near the peak of spawning activity in 2001. The sound files are scored and the spawning activity data (digs/minute) will be compared to time of day (day and night) as well as project operations, e.g., stable, increasing, decreasing discharge. Data will be analyzed by creating multi-way contingency tables across all model factors, then assessing these factors using a log-linear model taking the cell counts from the contingency tables as the response variable.

ECOLOGY OF BULL TROUT IN THE SAINT MARY RIVER DRAINAGE, MONTANA ^{AFS}

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Populations of bull trout (*Salvelinus confluentus*), have declined throughout its historic range in the contiguous United States. This decline, mainly attributed to adverse human-caused alterations of the aquatic environment, competition and hybridization with nonnative fishes, and excessive harvest by anglers, prompted the USDI Fish and Wildlife Service to formally list the bull trout as threatened throughout its historic U.S. range in 1999. The Federal Endangered Species Act listing action included the only bull trout stocks that occur naturally east of the Continental Divide in the U.S., those in the St. Mary-Belly River drainage of the upper Saskatchewan River basin, Montana. Little information on the bull trout in the drainage was available, however. Between 1997 and 2001, we used electrofishing, fish traps, and radio telemetry to determine the distribution, movements,

status, and limiting factors for bull trout in the St. Mary River drainage. Multiple age-classes of bull trout (migratory and resident life-history forms) were found in three principal tributaries, and annual spawning runs into those tributaries numbered at least 48-121 adult fish. Twenty-seven adult, migratory bull trout caught in traps were implanted with radio tags, and 556 bull trout (>250 mm TL) caught in traps or by electrofishing were PIT tagged. Subsequent movements of radio-tagged fish between spawning and feeding-wintering areas ranged to 85 km and included movements into Alberta, Canada. Although most tagged bull trout contacted or recaptured during consecutive spawning seasons exhibited spawning-stream fidelity, several adult fish were found in different streams during consecutive years. Upstream and downstream movements of tagged bull trout past a major diversion dam on the river were also documented. Bull trout in the St. Mary drainage are negatively affected by dams, entrainment into an irrigation canals, and modified flow regimes, problems now being addressed by management agencies. This ongoing study is a cooperative effort among the Blackfoot Tribe, Glacier National Park, USDI Bureau of Reclamation, and the USDI Fish and Wildlife Service.

NATIVE LAKE TROUT DISTRIBUTION IN THE UPPER MISSOURI RIVER DRAINAGE OF MONTANA ^{AFS}

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The lake trout (*Salvelinus namaycush*) populations of Elk and Twin Lakes have long been suspected to be of native glacial origin. Recent examinations of the literature and modern genetic analysis have validated this assumption. Naturalist reports from the late 1800s described visits to both lakes and observations of lake trout prior to 1890 when the species was first introduced into the intermountain west by humans. A meristic and morphological examination of the lake trout throughout its range of distribution in 1971 concluded that the lake trout of Elk and Twin Lakes represent a unique glacial refuge population in the upper Missouri River drainage. Genetic examination of specimens from Twin and Elk Lakes in 1994 led to the conclusion that the fish were of a distinct haplotype representative of a native glacial relict with arctic roots in northern Alaska and Canada and a common refuge in Montana and southwest Alberta. More recent and detailed genetic examination of fish from both lakes in 2000 concurred with the 1994 findings and concluded that both populations represent an uncontaminated native stock of the same glacial origin. These samples also suggested that low variation in mitochondrial DNA could be associated with a genetic “bottleneck” caused and maintained by low numbers of breeding individuals within the populations. Both Elk and Twin Lakes appear to support relatively low numbers of lake trout among populations of sympatric native species such as burbot, white and longnose sucker, and mottled sculpin within systems that have been managed as sport fisheries via plants of nonnative salmonids such as Yellowstone cutthroat, rainbow, and brook trout. Trend data for lake trout populations and sympatric species are presented for both lakes.

FISH HABITAT PROTECTION IN MONTANA – A PROUD HISTORY ^{APS}

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Although Montana's fish and game agency has been in existence for over 100 years, the first fishery biologist was not hired until 1947 and regional offices that included district fisheries biologists were not established until 1955. From the onset, fisheries biologists understood that big dams, water pollution, grazing, timber harvest, highway construction, and irrigation were major threats to fishery habitat. In their minds, protecting habitat was the key to preserving the wild fisheries that Montana was known for. From the beginning, Montana's habitat program was based on the premise that fish habitat in streams consisted of three essential elements: water quantity; water quality; and physical habitat features including the bed, banks, riparian areas, and floodplain. Armed with the convictions that Montana's fishery resources were worth fighting for and the wherewithal to get things done, these early biologists helped establish many of the habitat protection tools that we rely on today.

HYDROELECTRIC DEVELOPMENT AND ASSOCIATED RISKS TO THE FISHERY RESOURCES OF THE KALI GANDAKI RIVER ^{APS}

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Several hydroelectric projects are proposed in Nepal because of growing energy demands, the extreme topography, and its vast water resources. One affected river is the Kali Gandaki, which flows through a 4000 m elevational change. It originates on the Tibetan plateau and flows south through the Himalayan Mountains before turning east through the foothill and Terai regions, and emptying into the Bay of Bengal. Construction began on the Kali Gandaki 'A' Hydroelectric Project in 1997 and is now nearly complete. The 144-megawatt project will be operated as run-of-the-river with limited peaking. Operations will have major effects on a fishery comprised of 57 species from twelve families. These fish include resident and migratory types, with each exhibiting specific life-history strategies that require accessibility to suitable habitat. As a consequence of this project, fish will endure a loss of habitat, stress and mortality from entrainment, and blocked passage. Protection strategies include a trap-and-haul transport program, intake screens, release facility, instream flows, and hatchery supplementation. However, biological information is limited, and the proposed strategies may not be completely effective for all

species and all life stages. Therefore, an adaptive management approach is integrated into a mitigation plan that will involve on-going research to continually improve management policies protecting the fishery.

PALLID STURGEON PROPAGATION AT MILES CITY STATE FISH HATCHERY ^{AFS}

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Pallid sturgeon were put on the endangered species list on September 6, 1990. In an effort to supplement and restore this species, the USDI Fish and Wildlife Service, through its Garrison Dam and Gavins Point National Fish Hatcheries, began capturing adults for egg collection and culture, with the intent of future releases back into the Missouri River below Fort Peck Reservoir. In December 1998, the Missouri River iridovirus was detected at both of the federal facilities and they had to be quarantined and the fish destroyed. In order to continue the culture of pallid sturgeon, the Miles City State Fish Hatchery was asked to participate in the recovery program. In April 2001, six adult sturgeon (2 female, 4 male) were collected from the Missouri River and transported to the Miles City hatchery. One female and two males were put into each of two 12-ft circular tanks. During June, weekly egg samples were collected and staged for development. On 25 June, it was determined that the eggs were at optimum condition, so both the males and females were injected with LHRH, with the females getting a second injection the following day. Green eggs were detected in the tank approximately 24 hours after the first injection. Milt was pre-collected the morning of 26 June and spawning began at 6:00 pm, continuing at 2-hour intervals until 6:00 am the following morning. All eggs were coated with Fuller's Earth and put into incubation jars. A total of 235,000 eggs were collected with an average eye-up rate of 95 percent. All eggs had hatched by 1 July and were transferred to 6-ft circular rearing tanks on 5 July. Due to handling stress, no initial inventory was taken that day. In mid-July a severe parasite infection occurred, causing high mortality. These fish were started on a dry diet, Biodiet #1 starter and have progressed to 1.5 mm pellets. These fish are currently 5 to 6 inches long and are free of any iridovirus. They are scheduled to be planted back into the Missouri River in August.

AN EXAMINATION OF 1995 AND 1996 CREEL CENSUS DATA FOR THE MADISON RIVER, MONTANA AND EVIDENCE OF POSSIBLE EFFECTS DUE TO WHIRLING DISEASE ^{AFS}

Leanne H. Roulson
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The parasite that causes whirling disease was first discovered in Montana in rainbow trout from the Madison River in December 1994. In response, the Montana Department of Fish, Wildlife and Parks (MFWP) initiated an intensive creel census survey in 1995 and

1996. In 1995, the creel survey covered the entire Madison River from Quake Lake to the headwaters of the Missouri River at Three Forks; and in 1996, the section from Slide Inn to Windy Point (~20 river miles) was surveyed. The results from these two surveys, when compared with historical creel censuses, provide a great deal of insight into the effects of the disease on the fishery and the angling community. The Madison River rainbow trout fishery declined significantly from pre-whirling disease levels in the late 1970s and early 1980s to the period post-1994. The decline is evident in catch rate data, population estimates, and angler use surveys. However, it appears that as whirling disease was reducing the numbers of rainbow trout, the brown trout population became proportionally more available for capture by anglers. Trout population declines as measured by the annual electrofishing surveys paralleled the catch rate declines recorded in the creel surveys. Despite these declines, the anglers who chose to fish the Madison River were generally satisfied with their fishing experience according to the 1995 angler satisfaction survey. However, MFWP's biennial mail-in surveys have shown a slight decrease in angler use of the Madison River. The economic and ecological impacts of whirling disease affect anglers and many non-angling members of the Montana community. The Madison generates a significant amount of income for the surrounding area, and for the state. By fully understanding how whirling disease has affected the Madison River fishery, FWP hopes to determine the best management strategy to facilitate recovery.

SUMMER MOVEMENTS OF SCULPIN, SALMONIDS, AND WESTERN TOADS IN A SMALL MONTANA STREAM ^{AFS}

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We studied the movements of fishes and amphibians in Chamberlain Creek, Montana from 24 July to 16 August, 2001. We operated six weirs with two-way traps, and one additional upstream trap, at various distances (from 14 to 1596 m) along the stream to quantify the timing, direction and distance of individual movements. We captured and marked 9 western toads (*Buffo boreas*) and 567 fishes of six species, including 368 westslope cutthroat trout (*Oncorhynchus clarki lewisi*), and 172 slimy sculpin (*Cottus cognatus*). We estimated that 14 percent of slimy sculpin and 48 percent of westslope cutthroat trout were mobile (passed at least 2 weirs), and most maintained detectable home ranges. We recaptured 173 westslope cutthroat trout, detecting net movements (distance between the two most distant capture locations) of up to 1581 m (median 91 m). Home ranges of 126 westslope cutthroat trout ranged from less than 18 to 1581 m (median 64 m). We detected net movements by slimy sculpin of up to 209 m and home ranges between 18 and 176 m (median 26 m). Western toad home ranges varied from 283 to 1596 m. All species moved more frequently during night/twilight ($n=296$) than during day ($n=83$). At the two-way traps, more fish were captured moving downstream ($n=419$) than upstream ($n=277$), although westslope cutthroat trout moved more frequently moving downstream at night and upstream during the day. Western toads were only captured in the morning, and although we detected upstream movements, we only captured toads in downstream traps. The results demonstrate considerable summer movement by fish and amphibians.

HISTORY OF FISH MANAGEMENT ON FOREST LANDS ^{AFS}

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The history of fish habitat management in the Forest Service is a history of environmental law in the United States. Starting with the creation of forest reserves in the late 1800s to the present day, fish habitat management programs have always had a place in the management of our National Forests. With the passing of legislation such as the National Forest Management Act, National Environmental Policy Act and the Endangered Species Act, fisheries has taken on a more complex and an ever increasing role in how are forests are managed for other resources. Fisheries biologists in the Forest Service have always been few in number and represent less than 300 in an agency of over 30,000 employees. A fisheries job in the Forest Service has never been easy and often confrontational, stressful and frustrating. In spite of these drawbacks, the agency has always been blessed with truly professional and dedicated fisheries professionals.

BIOLOGICAL SCIENCES - TERRESTRIAL

A PRIVATE SECTOR INITIATIVE TO ENHANCE CONSERVATION OF WOLVES TM

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The Turner Endangered Species Fund is a private, non-profit charity dedicated to conserving biodiversity. We concentrate our efforts on carnivores, grasslands, plant-pollinator complexes, and species that historically ranged onto properties owned by R.E. Turner. As such, one of our priorities has been to advance wolf conservation. We are

working as the only private permittee of the USDI Fish and Wildlife Service (USFWS) on wolf recovery. In cooperation with the USFWS and Wildlife Services, we tested electronic training collars on depredating packs of wolves held on the Flying D Ranch, Bozeman, Montana. These wolves were released and advanced recovery by siring pups. We assist the USFWS with trapping, monitoring and management of wolves in southwest Montana. We proposed a plan for developing a wolf experience center at the Vermejo Park Ranch that would improve the survival potential of captive-born Mexican wolves before they are released to the wild. In cooperation with the USFWS, we developed the Ladder Ranch Mexican Wolf Pre-release Captive Facility in 1997 where we have annually held 4 to 20 wolves. We have produced 5 litters of pups and released 15 individuals to the wild. As in Montana, we also have provided a biologist who routinely assists with the monitoring and management of Mexican wolves. We participated in the Southern Rockies wolf restoration population and habitat viability analysis and workshop. Private stewardship of biodiversity is new and difficult, but we intend to contribute by establishing a new measure for large carnivore conservation.

A SPATIAL AND RELATIONAL ANALYSIS OF LION CONFLICTS THROUGHOUT MONTANA, 1990-2000 TM

Keith Aune, Neil Anderson and Steve Carson
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We examined available records of lion (*Felis concolor*) conflicts reported for the fiscal years 1990-2000. Records reviewed included the USDA/APHIS/Wildlife Services animal damage reports, MFWP lion conflict reports, MFWP Enforcement Game Damage Reports, recent and archived newspaper clippings, and Mortality reports from the field. Each record was carefully reviewed and classified as non-incident or incident. Incidents must meet specified requirements and in general did not include mere observations of lions by humans. Incidents included a significant interaction between lions, humans, or livestock or required some significant management action by MFWP or Wildlife Services. In addition, we created a lion mortality data base that included all known non-hunting and hunting mortalities. In addition to these records of mortality, whole lions were extracted from the field whenever possible, and examined at the Wildlife Laboratory in Bozeman. A complete necropsy was performed on each specimen to determine sex, age, reproductive status, animal condition, and general health. We identified 752 total incidents in the record from 1990-2000. There has been a general increasing trend in the number of incidents reported during that period from 26 in 1989-90 to a high of 126 in 1998-99. Livestock-lion incidents increased at a steady rate over this period. The number of human-lion incidents varied annually with a noticeable increase in the past three years following substantially increased lion harvests. We examine various attributes in the mortality data base that includes 5220 hunting and 681 non-hunting mortalities for the 1990-2000 time period. A spatial analysis of these incidents in relation to hunting kills and non-hunting mortality is presented.

CHRONIC WASTING DISEASE IN MONTANA-SURVEILLANCE AND EPIDEMIOLOGY UPDATE ^{TWS}

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Although the first cases of Chronic Wasting Disease were diagnosed almost 40 years ago (Fort Collins, 1967) widespread concern over this disease emerged in recent years. The most significant change in the epidemiology of this disease has been the discovery of the fatal neurologic disease in captive elk raised in alternative livestock facilities. In 1996 the first cases of CWD were reported in Alternative Livestock from a facility in Saskatchewan. Subsequently since 1996 the disease has been identified in several facilities within Montana, Saskatchewan, South Dakota, Nebraska, Oklahoma, and Colorado. It has been found in wild deer in Colorado, Wyoming and recently Saskatchewan and Nebraska. A national program to control this disease in the Alternative Livestock industry was drafted in 2000 by USDA/APHIS/Veterinary Services and recently funded by Congress. In Montana CWD surveys of wildlife have been conducted since 1998 and since 1999 in the Alternative Livestock. We tested 1367 wild cervids from 1998-2001. An additional sample from approximately 250 deer (*Odocoileus* spp.) and elk (*Cervus elaphus*) harvested in the fall of 2002 was submitted and results are pending. All wild Cervids in Montana have tested negative for this disease. One alternative livestock facility was infected with CWD in Montana and was depopulated in December 1999. The Department of Livestock initiated mandatory testing for CWD in all alternative livestock facilities following this discovery. Since 1999 the Department of Livestock has tested 1705 captive cervids slaughtered for meat markets or in shooting operations. All results to date have been negative but 132 test results recently submitted are pending. Since a rigorous testing program was implemented in 1998 no wild elk or deer have been diagnosed with CWD in Montana. Following the localized outbreak of CWD in one infected alternative livestock facility in Montana further infections have not been identified. We discuss implications of this disease to wildlife and the alternative livestock industry.

GRAY WOLF RESTORATION IN THE NORTHWESTERN UNITED STATES™

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Gray wolf (*Canis lupus*) populations were eliminated from the western United States by 1930. Dispersing wolves from Canada lacked legal protection until passage of the federal Endangered Species Act (ESA) of 1973. By 1986 a pack had naturally formed in northwestern Montana. In 1995 and 1996 wolves from western Canada were reintroduced to remote public lands in Idaho and Yellowstone National Park, Wyoming. Wolves were designated as experimental populations to increase management flexibility. Wolf population growth has occurred rapidly because of the reintroduction. Over 572 wolves were present in December 2001, and the wolf population has a young age structure meaning it has the potential for continued rapid expansion. The wolf population in the northwestern U.S. should meet the recovery goal of having 30 breeding pairs distributed throughout Montana, Idaho and Wyoming for 3 successive years by December 2002. If Montana, Idaho, and Wyoming have state wolf conservation plans in place wolves could be delisted from the ESA in 2003. Wolf restoration has proceeded more quickly and with more benefits (public viewing) and fewer problems (livestock depredations), than predicted. The impact of wolf predation on big game (primarily elk) populations is a major public concern. Several cooperative research projects have yet to detect significant impacts to wolf prey but these ongoing studies will provide accurate information to address public and agency concerns. Because over 85 percent of adult wolf mortality is human-caused, the interagency recovery program focuses its efforts on addressing the concerns of people who live near wolves to increase human tolerance. Wolves restored important ecological processes to several large wild areas in Montana, Idaho, and Wyoming. The program has been widely and internationally publicized and is generally viewed as highly successful.

WILDLIFE ISSUES RELATED TO THE RECONSTRUCTION OF U.S. HIGHWAY 93 ON THE FLATHEAD INDIAN RESERVATION ^{TWS}

Dale M. Becker

Tribal Wildlife Management Program, Confederated Salish and Kootenai Tribes
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Planning for the reconstruction of U. S. Highway 93 through the Flathead Indian Reservation resulted in substantial consideration regarding wildlife and wildlife habitat issues. After years of negotiation, the Confederated Salish and Kootenai Tribes, the Montana Department of Transportation and the Federal Highways Administration reached agreement on most aspects of the project in 2000. Still to be finalized are reconstruction plans for a ten-mile portion of the highway that passes through the Ninepipe-Kicking Horse wetland complex. The Memorandum of Agreement between the three governments includes provision for the construction of 42 wildlife crossing structures and other design features to enhance wildlife habitat features and maintain habitat linkages. In addition, wetland habitat mitigation will be aimed at avoidance of wetland habitat to the extent possible and acquisition, restoration and ongoing management of wetland habitat. The logic included in planning for these design features and the details of the reconstruction plans, as they apply to wildlife and habitat concerns are presented, as are details of the anticipated designs for wildlife crossings and other mitigation plans.

TRUMPETER SWAN REINTRODUCTION OF THE FLATHEAD INDIAN RESERVATION ^{TWS}

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The Confederated Salish and Kootenai Tribes, in a cooperative project with Montana Fish, Wildlife and Parks, the U. S. Fish and Wildlife Service, and the Mission Valley Community Foundation, commenced a project to reintroduce Trumpeter Swans (*Cygnus buccinator*) on the Flathead Indian Reservation in 1995. The initial effort involved translocation of 19 Trumpeter Swans from Summer Lake, Oregon to Pablo National Wildlife Refuge. Those swans proved that suitable summer habitat existed on the Reservation, but they returned to Canada after migrating from the area. A second effort in 1998, using 10 Trumpeter Swan cygnets from Grand Prairie, Alberta, again proved the suitability of the habitat at the refuge. To date, only one swan has returned to the area. Due to problems in obtaining suitable swans suitable for reintroduction, the Tribes acquired a 22 captive trumpeter swans in 1999 and entered into an agreement with the Trumpeter Swan Fund to captively-propagate Trumpeter swans for the project. The captive propagation project resulted in production of 15 and 20 cygnets in 2000 and 2001, respectively. These birds will be released on the Flathead Reservation during the summer of 2002. Fifteen of the swans will be instrumented with satellite transmitters to monitor their migratory movements and survival. Current and future efforts involve continuing with the captive propagation and

reintroduction efforts, with the goal of re-establishment of a viable wild population on the Reservation.

LARGE-SCALE SAMPLING OF COUGAR POPULATIONS AND ONE OF THEIR PATHOGENS: WORKING WITH COUGAR HUNTERS IN MONTANA™

Roman Biek

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Mary Poss

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Cougars (*Felis concolor*) in the Rocky Mountains are commonly infected with a cougar-specific form of feline immunodeficiency virus (FIV). Contrary to its name, data available do not indicate that this virus causes any disease in infected cougars. Genetic analysis shows that most cats in a given area are infected with highly related viruses but that cougars from different regions have genetically distinct viruses. Because transmission of a virus type from one area to another requires movement of an infected cougar, evaluation of virus genetics will give important insights into how well cougar populations are connected. With the assistance of outfitters, hunters, and houndsmen, we have undertaken a study on the large-scale distribution of FIV types across all of western Montana. Small amounts of fresh blood samples are being collected from harvested animals using a sampling kit we distribute to interested hunters. In addition, we work with agencies and taxidermists to obtain samples of tissues that are likely to contain virus. Through this collaborative effort we are hoping to get a better understanding of movement and connectivity for cougar populations in Montana.

ZOOLOGY AT THE MONTANA NATURAL HERITAGE PROGRAM: PAST, PRESENT AND FUTURE™

John C. Carlson

Montana Natural Heritage Program, Helena MT 59620

The zoology program of the Montana Natural Heritage Program has been collecting data on the status and distribution of Montana's animals since 1985. I will discuss the nature of the data we collect, past projects and current projects. I will also discuss current collaborations with various agencies to bolster data submission to Heritage databases and the collaboration with Montana Fish, Wildlife and Parks to produce the unified Montana Animal Species of Concern list. In addition, I will discuss ongoing efforts to increase the availability of this data for users through the internet.

AN EVALUATION OF GENETIC DIVERSITY AND POPULATION GENETIC STRUCTURE IN ROCKY MOUNTAIN WOLVERINES™^s

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The range of wolverines (*Gulo gulo*) has contracted substantially within North America and includes small, remnant populations within the conterminous United States in Colorado, California, Idaho, Oregon, Washington, Wyoming and Montana. The population size and trend of each of these populations and the connectivity to other populations in the conterminous United States is poorly known. I examined levels of genetic diversity and population genetic structure in three states (Idaho, Wyoming, and Montana) and two Canadian provinces (Alberta and British Columbia) using both mitochondrial (mtDNA) and nuclear microsatellite DNA. A Bayesian clustering analysis suggested that there were three distinct subpopulations in Montana: Rocky Mountain Front (RMF), Crazybelts (CB), and Gallatin (GA). Restricted levels of gene flow were measured among these subpopulations for both mitochondrial and nuclear DNA. However, the Rocky Mountain Front and Wyoming subpopulations displayed minimal nuclear genetic differentiation. Nuclear DNA diversity for these two subpopulations also was comparable to levels previously reported in North America. The other subpopulations exhibited significantly lower levels of nuclear diversity. The Idaho subpopulation had the lowest levels of mitochondrial and nuclear genetic diversity, and was more isolated than the other subpopulations. Based upon these data, I suggest the designation of three separate management units: Idaho, Crazybelts, and the Rocky Mountain Front/ Gallatin/ Wyoming units. The subpopulations in the conterminous United States have lower levels of gene flow and are much more fragmented than Northern populations in Alaska and Canada. Corridors for movement should be established among the fragmented subpopulations and may be incorporated into a large carnivore conservation strategy.

SAGE GROUSE MOVEMENTS IN SOUTHWESTERN MONTANA™

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Sage grouse (*Centrocercus urophasianus*) populations have declined throughout the western United States and in southwestern Montana since the 1970s. Conservation efforts rely on knowledge of seasonal habitat distribution and sage grouse movement patterns between these habitats. Both of these factors are poorly understood and undocumented in southwestern Montana. An ongoing, cooperative study was initiated in 1999 to radio-track sage grouse in southwestern Montana. The objective is to identify resident and migratory populations, key habitat areas, and movement patterns that would be relevant to local sagebrush and sage grouse conservation. Thirty-six sage grouse have been fitted with radio-transmitters and individually tracked for up to 24 months in the Horse Prairie/Bannack area, Sweetwater Basin, and Big Sheep Creek Basin, in Beaverhead and Madison County, near Dillon, Montana. Monitoring has been conducted aerially, with some ground locations made between flights. Relocations indicate that some groups of sage grouse are basically resident within a particular habitat complex, while others are traveling significantly greater distances to utilize suitable breeding, summer, and winter habitat. Interstate movement of sage grouse between southeastern Idaho and southwestern Montana has been confirmed. Some locally important brood rearing and summer habitats have been identified through this study. Mortality of radio-tracked birds has averaged 40-60 percent over three years. This study will also serve as a basis for expanded research.

THE BOZEMAN PASS WILDLIFE LINKAGE AND HUMAN SAFETY STUDY™

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Highways and railways are sources of road mortality that threaten wildlife populations through direct mortality, habitat loss, and habitat fragmentation. High volumes of traffic along transportation corridors can block, deflect, or delay daily, seasonal, and lifetime movements. Animal-vehicle collisions also threaten human safety. The transportation corridor along I-90 over Bozeman Pass contains an interstate highway, frontage road and railroad and is likely one of the major barriers for animal movement in the region. At this point, there is strong evidence that the highway acts as a barrier to normal animal movements. The Craighead Environmental Research Institute (CERI), based in Bozeman, has completed the first year of a study to further determine the current extent of this problem and where it can best be mitigated. A total of 127 medium-to-large sized animal road-kills were recorded in 2001 along I-90 over Bozeman Pass. The greatest number of road-kills occurred between milepost 313 and 314 near the Bear Canyon exit and the MRL overpass. Two probable areas of wildlife 'connectivity habitat' were mapped on Bozeman Pass in collaboration with American Wildlands' GIS lab using habitat characteristics and least-cost-path analysis, which correspond closely with the locations of road-kills. In 2002 the study will collaborate with the Western Transportation Institute and Montana Department of Transportation in the design and possible installation of highway fences, cattle guards, and vehicle barriers to improve human safety and wildlife connectivity across the highway.

TESTING SPATIAL INDEPENDENCE OF RADIO-COLLARED BIGHORN SHEEP™

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John Firebaugh
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A common assumption in the analysis of wildlife radio-tracking data is that marked individuals move and select resources independently. This assumption can significantly affect results especially if animals are highly social or territorial. In the case of bighorn sheep, social groups are prevalent throughout the year, and this often results in single locations with multiple radio-collared individuals. Nearest-neighbor analyses have been used to test avoidance behavior by carnivores. We used this method and data from three small herds of bighorn sheep in western Montana to conduct a test of the spatial independence of individual animals. This issue can be important in a posteriori analysis and interpretation of data, as well a priori consideration of necessary sample sizes.

MANAGEMENT OF A RAPIDLY EXPANDING URBAN GOOSE POPULATION™

Kristi L. DuBois

Montana Fish, Wildlife and Parks, Great Falls, Montana 59405.

Great Falls, like many urban areas throughout North America, is home to a rapidly expanding resident Canada goose population. Concerns about goose damage and safety issues have been expressed from city and state parks, golf courses, private landowners, and the Great Falls Airport. Canada geese have become a popular attraction at city parks during the summer when goslings are present. Management strategies will be discussed in relation to two different sub-populations of Canada geese in Great Falls, including hunting, trapping and moving, and deterrents.

USING CLIMATIC DATA IN WILDLIFE STUDIES™

Phillip E. Farnes

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Twenty to 30 years of daily climatic data is now available from foothill and mountain locations at approximately 90 SNOTEL sites in Montana. Historic and near real-time data from these SNOTEL sites is now available on the web. By combining the SNOTEL data with that collected at valley Climatological stations, it is possible to develop profiles of temperature, precipitation and snow water equivalent (SWE) for most areas in the state.. Additional parameters such as growing degree-days, soil moisture deficits (using Keetch Byram Drought Index) can be generated from the original data. Relationships developed in recent years using these data will be presented. These include Winter Severity Index for elk, bison, moose, pronghorn, mule deer and white-tailed deer. Migration and distribution of elk have been related to SWE and snow models developed to relate distribution of elk over time to the forage available on winter range. Production of forage, whitebark pine cones, Western larch cones, and huckleberries have been related to these climatic variables. Phenology of plants and trees has been related to growing degree-days. Dates of spring emergence for bears, date of emergence for salmon flies, date of nesting initiation, hatching success, and clutch size of American pipits, have all been related to snowpack and climatic variables. Streamflow, reservoir levels and outflows have been predicted using winter snowpack and spring precipitation variables. Climatic and snow data has also been used to identify long-term trends and variability of mountain climate. Examples of these and other relationships will be presented.

COAL BED METHANE: BOOM FOR INDUSTRY, BANE FOR WILDLIFE™

Steve Gilbert
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Associated with coal seams in southeast Montana is natural gas referred to as coal bed methane (CBM), held there by water pressure. To get the gas, the water must first be removed. There is great interest by industry and state and federal administrations to pump and use this resource. It will take only 10-20 years of boom and bust development to drain Montana of its methane resource. This will have severe impacts to wildlife in perpetuity. CBM development will negatively affect Montana's water and lands forever, regardless of "reclamation." Aquifers, springs and seeps depended upon by farmers, ranchers and wildlife will be dried up. Water pumped from these aquifers, although drinkable by humans and wildlife, is very salty and kills vegetation. This water will be sprinkled across the land and pumped to leaking discharge pits killing vegetation and soil. Surface destruction by this industry will be massive. Thousands of miles of powerlines, pipelines, and access roads will lace sagebrush-grasslands of southeast Montana supporting pronghorn, mule deer and white-tailed deer and dwindling populations of sage grouse. Huge noisy compressors will drown the calls of many bird species including sage and sharp-tailed grouse. Well pads with access roads will dot the countryside, and trucks of every size will careen down dusty roads 24 hours a day. Fragmentation of wildlife habitat will occur from this resource development at levels never before experienced in Montana. Tens of thousands of acres of sagebrush-grassland habitats will be destroyed. It is unlikely any will be reclaimed in kind or function. There will be soil compaction, weed encroachment, and the cut-and-run philosophy will once again leave Montana citizens holding the reclamation bag, and wildlife populations the victims of lost and fragmented habitat.

SPATIAL AND TEMPORAL ANALYSIS OF GRIZZLY BEAR MOVEMENTS IN RELATION TO MOTORIZED TRAIL USE IN PORTIONS OF THE LEWIS AND CLARK NATIONAL FOREST: PRELIMINARY ANALYSIS™

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Understanding the possible impact of motorized ORV use on grizzly bear movements and habitat use would be valuable to land managers as they seek to balance human uses with wildlife needs. To assess this question, I studied grizzly bear movements and quantified recreational use in the Badger-Two Medicine area of the Lewis and Clark National Forest. Grizzly bear locations were collected using GPS collars collecting data at 1-hour intervals from early June to late October of 1999, 2000, and 2001. Detailed temporal and spatial recreation use data on backcountry trails was simultaneously collected in the same area. Preliminary analysis of these data uses motion metrics to attempt to quantify and relate bear movements to motorized recreational use in this area.

POPULATION DYNAMICS OF SNOWSHOE HARES IN THE SEELEY-SWAN REGION™

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We present mark-recapture based snowshoe hare densities from 20 sites, where we observed a decline in snowshoe hare populations since 1998. Snowshoe hares are found in multiple habitats, and can reach high densities in forest stands with a component of saplings and shrubs near ground level. Mature stands with complex structure may provide important winter habitat. We present estimates of survival from radio-telemetry, suggesting that survival is high in the summer and winter, but lower in the spring and fall. Lowest survival rates were in spring and fall in forest stands with open-canopies and few saplings in the understory. We present preliminary results from an experiment examining the short-term effects of pre-commercial thinning on snowshoe hare densities. We find roughly a four-fold decrease in winter hare densities after stands are thinned to standard industry prescription. A modified thinning treatment, with 20 percent of the stand retained in unthinned patches, shows some promise in retaining hares.

INITIAL SITE EVALUATION FOR WIND RESOURCE DEVELOPMENT IN MONTANA: AN INDEX RELATIVE TO POTENTIAL IMPACTS ON VERTEBRATE WILDLIFE™

Al Harmata

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Sam Milodragovich

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Windpower technology has advanced significantly in recent years, and demand for development has stimulated concern over the impact of hastily developed wind farms on vertebrate wildlife. Furthermore, legal responsibilities of developers pertinent to risk posed by wind farms are elucidated in the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Endangered Species Act. We present a process to determine geographic appropriateness of wind farm siting relative to potential impact on vertebrate wildlife by developing initial site evaluation criteria, and evaluating the potential impacts on aerial wildlife resources (birds and bats) from a collision risk perspective. A Physical

Attribute checklist considers topographic, meteorological, and site characteristics that may influence bird/bat occurrence and movements. A Species Occurrence and Status checklist includes all endangered, threatened and candidate species that occur in Montana, but only bird and bat species of Special Concern listed by the Montana Natural Heritage Program. An Ecological Attractiveness checklist evaluates the presence and influence of ecological magnets and other conditions that would draw birds and bats to the site or vicinity. The Site Suitability Index is derived from checklist totals of each site evaluated. Cumulative totals are adjusted for disproportionate numbers of criteria in each checklist. Adjusted checklist totals are added to produce the Site Suitability Index. A less suitable site evaluation does not preclude development, nor does a more suitable site evaluation eliminate the need to verify the appropriateness of the development with regard to impact on vertebrate wildlife. Rather, this method ranks sites among one another, and identifies focal areas for further investigations or mitigating measures as development proceeds

CONSERVATION OF PIPING PLOVERS IN THE U.S. ALKALI LAKES CORE AREA ^{TWS}

Jacob S. Ivan

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The northern Great Plains population of piping plovers has been listed as Threatened in the U. S. and Endangered in Canada since 1985. The current population decline and poor prognosis is thought to be due to inadequate reproductive success stemming from significant alteration of the prairie landscape and predator community during the last century. Planted trees, increased woody cover, rockpiles, junkpiles, and abandoned buildings now offer denning, nesting, and roosting habitat for a variety of egg and chick predators that were once uncommon on northern prairies, e.g. great-horned owl, striped skunk, raccoon, American crow. Also, in many areas, once extensive native grasslands are now reduced to small remnants that may be more efficiently searched by predators. About two-thirds of the U.S. Great Plains population breeds annually on our eight county study area, which extends from northwest North Dakota through northeast Montana. Over the past decade, we have documented size, distribution, habitat selection, and vital rates for this population. We have also identified and implemented a rigorous predator exclusion program that has boosted piping plover reproductive rates into the range necessary to stabilize the population decline. Currently we are evaluating landscape influences on plover productivity to determine whether habitat preservation and restoration, e.g. removal of unnatural landscape features that may house predators or facilitate predation, can contribute measurably to piping plover recovery

A NEW CAPTURE PEN FOR CARIBBEAN FERAL DOG PACKS™

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The Turks and Caicos Islands, in the British West Indies, have a history of feral dog problems as do many other Caribbean island nations. These problems include attacks on tourists, presence on airport runways, and threats to residents. Previous efforts to resolve these problems included trapping, shooting, and a government proposal to introduce canine distemper. As an alternative, Global Wildlife Resources received a contract to capture feral dogs as part of a long-term multi-faceted program integrating animal capture, spay/neutering of community dogs, euthanasia of feral dogs, public education, training of local personnel, development of an animal shelter, and legislative changes. To address this unique challenge, GWR developed a unique portable capture pen for entire feral dog packs. Boxtraps also captured individual dogs near capture pens. The capture pens consisted of 2.4 m (8 ft) by 2.4 m (8 ft) chainlink panels assembled into a 4.8 m (16 ft) wide box. One panel contained a guillotine gate (www.kenneldoor.com) and a second panel contained a guillotine gate and human gate. Capture pens were pre-baited for 1-4 days. Gate controls were modified toy airplane rotor controls. The remote control consisted of a receiver, rotor, batteries with an on-off switch and a remote hand-held transmitter. When the rotor was activated, a pin pulled out of the guiding track dropping the gate. In three weeks, 370 dogs were captured: 117 by capture pen, 173 by boxtraps, and 80 by hand. Seventy community dogs were neutered and 300 feral dogs were anesthetized and then euthanized. The capture pen can be applied directly, or modified, to capture a variety of wildlife species, especially urban canids.

PHOTO ROUTES -MONITORING ORV USE ON PUBLIC LANDS: IMPLICATIONS FOR WILDLIFE HABITAT™

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Recreational motorized travel on public lands influences the ability of wildlife to effectively use habitat, to move along historic pathways, to maximize seasonal use areas, and to facilitate movement of genetic material along biological corridors. Impacts of motorized recreation upon the landscape can be minimized by implementing clearly defined allowable activities for motorized travel, or be exacerbated through a casual approach. The effectiveness of National Forest travel plans cannot be quantified without on-site monitoring information. Quantitative information about the efficacy of the existing travel management plans did not exist on the Helena National Forest, so it was determined that objective and compelling information could be gathered by photographing conditions along predetermined routes. Eight photo routes were conducted by MFWP personnel and a volunteer citizens group. Routes ranged from approximately 2 miles to 10 miles in length and followed existing off-highway motorized routes, designated hiking trails (no vehicle use), undesignated routes, and proposed motorized routes. Conditions along each route were

quantified using digital photographs. A GPS location and an azimuth reading for each photo point was noted, along with ground conditions such as wetland incursions, depth of trail erosion, trail width; any off-route use of motor vehicles and its effects, such as crushed vegetation, hill climbs, dead animals; and whether signs of wildlife use were present in the immediate vicinity of such activities (droppings, tracks, rolled rocks, trees marked by bears or ungulates, mountain lion scrapes, etc.). The information gathered was assembled in digital and hard copy format. This effort demonstrates that citizen volunteers can be a valuable resource in meeting forest plan travel management objectives through positive feedback loops that can result from a systematic monitoring approach.

COMMON LOON: PAST, PRESENT AND FUTURE™

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National concern for common loons (*Gavia immer*) began in the 1970's following increased awareness about the effect of DDT on water birds. Early loon research helped define nesting and nursery habitat requirements, clutch and brood sizes, pair bond establishment, and general dates of spring arrival, nest initiation, and hatch. Between 1980-1986, Montana researchers and volunteers defined the breeding range and breeding lake characteristics of loons. In 1986, the Montana Loon Society established the first systematic breeding survey or "Loon Day". Results showed that Montana supported a total of 180-220 common loons, including 35-40 chicks each summer. Between 1986 and 1992, researchers determined that human disturbances during the nesting season had a detrimental effect on breeding success of loons. MLS soon implemented a management program that relied on nest area closures using floating signs and public education at high use areas. Later, banding efforts determined that loons nesting in Montana wintered on the Pacific Coast and that blood-mercury levels in captured birds were minimal. The increase of human recreational and development activities on loon breeding lakes soon outpaced voluntary public education efforts. In response, recent management efforts include establishing a second loon survey in May, creating a statewide, standardized database, and funding Loon Ranger positions. In 2001, Montana produced the highest number of loon chicks since 1981. Future statewide priorities will focus on completing the statewide database, procuring secure funding for the Loon Ranger program, and establishing a common loon population and contaminant/mortality research program.

SWIFT FOX REINTRODUCTION ON THE BLACKFEET INDIAN RESERVATION™

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The swift fox (*Vulpes velox*) was declared extirpated from Montana in 1969 after 16 years of Montana fur harvest data with no record of a swift fox. A 1991 review of historical swift fox observations and specimens found that the best documentation of the swift fox in Montana prior to extirpation came from the Blackfeet Indian Reservation. From 1901 to 1906, 43 swift fox specimens were collected between Cutbank and Browning, and in 1918, the swift fox was still considered common on the Reservation east of Glacier National Park. An aerial survey of Montana grasslands in 1993, identified the Blackfeet Indian Reservation as containing large grassland blocks suitable for swift fox reintroduction. In February 1998, the concept of swift fox reintroduction on the Reservation was discussed and later formally proposed. Defenders of Wildlife would provide funding for the reintroduction effort and the Cochrane Ecological Institute (CEI) would provide 20-30 captive-raised juvenile foxes for reintroduction each year for 5 years. In July 1998, a pre-release survey identified Richardson's ground squirrel (*Spermophilus richardsoni*) colonies on a Tribal ranch located 30 km east of Browning as suitable swift fox habitat. Twenty-eight foxes were released in this area in August 1998 using a modified soft release technique developed by the CEI. Four swift fox dens were found the following spring indicating at least some survival and reproduction. Releases have been made each year in late August, and from 1998-2001, a total of 101 foxes have been released. In 2001, 9 swift fox dens were documented on the Reservation with denning foxes being located up to 45 km from the release site.

THE ROCKY MOUNTAIN POPULATION OF TRUMPETER SWAN UPDATE AND CURRENT ISSUES™^{WS}

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The Rocky Mountain Population (RMP) of Trumpeter Swans (*Cygnus buccinator*) is comprised of two breeding "groups". One breeds throughout western Canada, and the other in the "Tristate" region (southwestern Montana, western Wyoming, and eastern Idaho).

These swans overwinter primarily in the Tristate area. Canadian birds, and some local breeding swans, migrate along the East Front or through the Flathead valley in Montana. Total numbers and annual production are estimated during biannual surveys in the Tristate region. A September survey estimates the size and age ratio of the Tristate segment, and a February survey allows managers to estimate Canadian flock size and annual production. Over the past three decades Canadian flocks have increased. One hundred and eighty-six Canadian Trumpeter Swans were present in February 1975, and 3494 were counted in February 2001. Although considerable variation occurred between years, the Tristate segment increased from 70 birds in 1932 to 641 in 1958. It has since declined to 481 Trumpeter Swans in 2001. Management issues have remained basically the same since the 1980s. There is some question as to how genetically distinct the two population segments are and if any interbreeding occurs. Extensive banding from the 1960s-1980s did not document any interchange of breeders, but this *may* have changed with increased flock size. Concentration of about 40 percent of the RMP on 1-2 primary wintering sites has led to habitat degradation and high risk of mortality due to disease or extreme weather events. Since 1990 considerable effort has been made to haze or translocate swans away from these major sites with limited success. Current management efforts are centered on a diverse group of stakeholders developing a Trumpeter Swan Implementation Plan (TSIP). The TSIP will concentrate on defining tasks designed to improve water management on Henry's Fork of the Snake River, manage winter distribution, improve U.S. nesting habitat and recruitment, and refine population monitoring. Conflicts with Tundra Swan hunting in Utah remains a major impediment to solving current RMP Trumpeter Swan management problems, and has implications for Trumpeter Swan restoration elsewhere.

UNDERSTANDING RELATIONSHIPS BETWEEN GREATER SAGE-GROUSE HABITAT AND POPULATION DYNAMICS IN EASTERN MONTANA TM

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The long-term decline of greater sage grouse (*Centrocercus urophasianus*) over much of their historic range is of concern to managers of sagebrush (*Artemisia* spp.) habitats. A petition has been submitted to list the Washington population of sage grouse under the Endangered Species Act (ESA) and a range-wide listing petition is expected in the near future. That habitat quality is related to demographics of populations is a fundamental assumption of the practice of managing species via managing habitat. However, few studies explicitly acknowledge this relationship, and still fewer explicitly attempt to define this relationship on a species-specific basis. There currently is no way to reliably determine the

nature of the interaction between sage grouse population status (as indicated by estimated vital rates) and habitat condition. This research will use a combination of well-established population demography tools and state-of-the-art analysis methods to elucidate relationships between Sage-Grouse populations and habitat at 6 sites in eastern Montana. Mark-resight and radio telemetry methods will be employed to estimate vital rates of sage grouse populations. Sensitivity analysis will identify which rate(s) has the greatest influence on population growth rate (λ) under different habitat conditions. Habitat condition at each site will be assessed by several critical habitat characteristics. A regression approach will quantify the relationship between individual vital rates and each of the measured habitat characteristics. The research will provide crucial information to federal and state wildlife professionals charged with managing for sage grouse and will be of particular use in the event of a petition to list sage grouse under the ESA.

WILDLIFE RESURRECTION™

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The use of the wildlife resource for the settlement of Montana produced a catastrophe by the end of the 19th century. But by the end of the 20th century wildlife were more abundant than at any time during the previous 130 years. The passage of protective laws during the late 19th and early 20th century coupled with the gradually increasing efforts to enforce them accounts for a portion of this resource rebirth. The remainder of the story is largely untold and is the subject of this presentation. Game bird resources were heavily affected by the “cow and the plow”. The new agricultural lands provided new habitats unsuited for native species. Pheasant introduction began before 1895, by private individuals, and became a state game farm program in 1929. Over 1 million were planted by the time the state program was discontinued in the late 1960s. In 1910, elk were considered to occur in numbers only in the Sun River-South Fork of the Flathead and Yellowstone National Park areas. Rod and Gun clubs held fund raising events and paid \$5 per elk to have the Northern Pacific Railroad deliver rail car loads of 40 elk to their towns from Gardiner. The plants began in 1910 near Butte, Hamilton and in the Glacier Park area. Elk continued to be transplanted until 1972 when the last of the 7458 animals were released. Similar programs for other species were developed after the Pitman-Robertson act was accepted in 1939 and the Wildlife Restoration Division of the State Fish and Game Department was established. Harvest of the biological surplus and habitat preservation programs became prominent in the last third of the century. This resurrection of Montana’s wildlife resource was an epic effort extending through 5 generations of citizens, 2 World Wars, 3 other major wars, an economic collapse and a 3-fold increase in human population. The effort encompassed many classic human and wildlife adventures.

GRIZZLY BEAR DENNING AND POTENTIAL CONFLICT AREAS IN THE GREATER YELLOWSTONE ECOSYSTEM ^{TWS}

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Increasing winter use of steep, high elevation terrain by backcountry recreationists has elevated concern about disturbance of denning grizzly bears (*Ursus arctos*) in the Greater Yellowstone Ecosystem (GYE). To help identify areas where such conflicts might occur, we developed a spatially explicit model to predict potential denning areas in the GYE. Using a scan area of 630 m around each location, we assigned site characteristics, or attributes, to 344 den locations of telemetered grizzly bears from 1975-99. Attributes identified as predictors for the analysis included elevation, slope, an index of solar radiation, and forest cover. We used the Mahalanobis distance statistic to model the similarity between sites used by denning bears and each cell in the data layers. We used the final Mahalanobis distance model to produce maps of the study area. Suitable denning habitat, based upon the model, is abundant within the GYE. Our results can be used by land management agencies to identify potential conflict sites and minimize effects of regulated activities on denning grizzly bears. We illustrate how the Gallatin National Forest (GNF) used the model to examine the extent of overlap between potential snowmobile use areas and suitable denning habitat as part of a Biological Assessment submitted to the USDI Fish and Wildlife Service.

THE PRESENCE AND DISTRIBUTION OF LYNX IN YELLOWSTONE NATIONAL PARK™

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During 2000, the U.S. Fish and Wildlife Service listed the lynx (*Lynx canadensis*) as a threatened species. Despite evidence that lynx were historically and are still found in Yellowstone National Park (YNP), no rigorous effort has been made to document their presence. This 3-year survey is providing important baseline information necessary to assess the status of the lynx and to manage human influences that are potentially adverse. We used a GIS-based analysis of YNP topography to identify prime lynx habitats and are conducting intensive surveys in prime habitats using ground-based and aircraft-based snow tracking during winter, hair snares to obtain DNA samples during the summer. During winter 2000-2001, we found 1 possible and 1 probable lynx track in YNP. During summer 2001, we installed a 32-transect hair snare grid in east central YNP and obtained 155 hair samples (results pending lab analysis). Basic information on lynx numbers and distribution is required by park policy and by the Lynx Conservation and Assessment Strategy, a guiding document for federal land management agencies. In addition, knowledge of lynx presence and distribution in YNP may further assist neighboring federal and state land management agencies in insuring that land management is conducive to lynx recovery efforts.

A COMPARISON OF GPS PROGRAMS DNRGARMIN AND WAYPOINT+/ AVGARMIN AND CONVERSION OF GPS DATA TO ARCVIEW SHAPES™

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Interface between Global Positioning System (GPS) and Geographical Information Systems (GIS) has historically required expensive equipment and extensive training. The need for quick and reliable interface between these technologies has led to the development of many GPS/GIS interface (shareware and commercial) programs. I evaluated two shareware programs that simplify the transfer of data from Garmin GPS units to ArcView. Waypoint+ and DNRGarmin may be used as standalone programs, however, DNRGarmin may be launched directly from ArcView. Waypoint+ requires the intermediary ArcView extension AVGarmin to convert GPS data into ArcView shapefiles. Both programs incorporate multiple projections and datums. Both programs will convert waypoints to point shapefiles and track logs to line and polygon shapefiles from track log data. GPS attributes vary by program and by shape. Only DNRGarmin will allow the conversion of both waypoint and track log data to ArcView graphics. Waypoint+ generates new waypoints from entered text. DNRGarmin originates new waypoints and track logs from graphics created in an ArcView View or from ArcView shapefiles. Waypoint+ stores GPS data as comma

delimited text files with a descriptive header, thereby allowing the storing of coordinate information in several projections and datums. DNRGarmin also stores GPS data as comma delimited text files however, coordinate information is recorded only as geographical decimal degrees. Coordinates of waypoints did not vary between the two programs.

CONSERVATION UNDER THE ENDANGERED SPECIES ACT: EXPENDITURES VERSUS RECOVERY PRIORITIES ^{TMS}

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Budget constraints require the USDI Fish and Wildlife Service to prioritize species for recovery spending. Each listed species is ranked according to the degree of threat it faces, recovery potential, and taxonomic distinctness. We analyzed the most recent state and federal government expenditures for recovery of threatened and endangered terrestrial vertebrates ($n = 179$ species) to determine if the priority system was being followed. Although recovery spending correlated with priority rank, priority rank explained <4 percent of the variation in spending. Species with high recovery potential, recovery programs that conflict with economic development, and wide distributions received the most funding and relatively more funding than their priority ranks dictated. Degree of threat and taxonomic distinctness did not affect the allocation of recovery spending. Island species received significantly less funding than expected based on priority rank compared to wide ranging mainland species. To improve the relationship between recovery spending on threatened and endangered species and priority rank, we believe significant changes are necessary within the private sector (less litigation, special interest lobbying), U.S. Congress (reduced earmarking, increased budget), and the USDI Fish and Wildlife Service (restructuring of regional offices, increased accountability).

ON ECOLOGICAL ASSESSMENTS AND CONSERVATION PLANNING ^{TMS}

Fred B. Samson

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Strategies that influence environmental use are often broad in scale and are rarely spatially explicit or focused on individual species because of the unfeasibility and cost of implementation. In reality, broad-scale information in concert with the conservation of individual species must be used in a way to develop conservation priorities, a more integrated ecosystem protection strategy, and to satisfy legal and policy requirements. Moreover, failure in conservation action whether in ecological assessments or conservation planning may be attributed to this lack of ecological understanding, organizational dysfunction, or to appreciate the human sense of place. In this session, needs for (1) an

ecological assessment are reviewed, (2) major agency and organizational approaches to ecological assessments and conservation planning are compared, and (3) their place in biodiversity conservation is outlined. Practical solutions to improve ecological assessments and conservation planning regardless of location are offered.

MODELLING GOLDEN EAGLE POWER POLE ELECTROCUTIONS [™]

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We identified power poles owned and operated by Montana Power Company having electrocuted golden eagles (*Aquila chrysaetos*) to provide information on reducing the number of golden eagle electrocutions. Montana Power Company has begun implementing resolutions for minimizing golden eagle electrocutions by retrofitting power poles to be raptor safe. A model identifying power poles requiring retrofitting based on pole design and pole location would improve the economic feasibility and effectiveness of remediation. We developed a habitat map from Landsat 7 spectral data for determining habitat characteristics surrounding individual power poles at 3 spatial scales. A total of 178 power poles causing 198 golden electrocutions were found during 2 field seasons in the Roundup study area of eastern Montana. The estimated probability of a power pole in the study area electrocuting a golden eagle

MANAGING MONTANA'S RECOVERED GREY WOLF POPULATION: WHO, WHAT, WHEN, WHERE, WHY, AND HOW [™]

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The Montana Wolf Management Advisory Council was appointed in April 2000 by former Gov. Marc Racicot to advise Montana Fish Wildlife & Parks (FWP) as it prepares a management plan for the gray wolf (*Canis lupus*) upon federal delisting. The Council was a diverse group, representing the interests of conservationists, hunters, landowners, livestock producers, outfitters, educators, and others. The Council completed their deliberations and presented their *Report to the Governor* to newly-elected Gov. Judy Martz early in 2001. Gov. Martz directed FWP to draft a planning document based on the Council's recommendations. The *Montana Wolf Conservation and Management Planning Document*, now available to the public, follows the Council's goal to develop a management approach and framework that is biologically possible, socially acceptable, and economically feasible. Major issues identified in the planning document address wolf conservation and management, human safety, livestock predation, compensation for livestock losses, funding,

and maintaining Montana's deer, elk and moose populations. The overall approach recognizes the gray wolf as a native species in Montana and as a valuable part of our wildlife heritage. It further seeks to integrate and sustain wolves in suitable habitats within a complex management setting and to responsively address conflicts where and when they develop. The Council's *Report to the Governor and the Montana Wolf Conservation and Management Planning Document* may be downloaded from FWP's website (www.fwp.state.mt.us). In March 2002, FWP begins a nine-month process to formally prepare an environmental impact statement for a final Montana wolf management plan. Comments may be submitted by mail, on-line, or in person at one of the upcoming public open houses. The deadline for comment during the scoping phase of the EIS process is April 30th 2002.

MITIGATING THE EFFECTS OF KERR DAM ON WILDLIFE WITHIN THE FLATHEAD INDIAN RESERVATION TM

Art Soukkala, Dale Becker, Brett Gullet, and Janene Lichtenberg
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Kerr dam was initially licensed in the 1930s and began controlling the outflow of Flathead Lake in 1938. A new license was applied for and granted in 1985 contingent on mitigation measures to be determined. Impact studies, damage assessments and an initial mitigation plan were completed in 1990. The Federal Energy Regulation Commission approved a partial settlement in 1998 and a final settlement in January 2001. Documented losses include 1792 acres of wetland and riparian habitats along the shores of Flathead Lake and 985 acres of shoreline habitat along the lower Flathead River lost because of altered lake and river hydrographs, and 624 acres of riparian habitat along the lower Flathead River lost because of flood control. Half of the lost riparian acres (312) were attributable to operations at Hungry Horse Dam on the South Fork of the Flathead River and will not be mitigated under the Kerr settlement. A Fish and Wildlife Implementation Strategy was developed that covers program goals, specific mitigation activities, threatened and endangered species, monitoring methods, and an adaptive management strategy. A Habitat Acquisition and Restoration Plan was developed that outlines acquisition priority areas on the Flathead Reservation, criteria to prioritize individual parcels, an accounting system to measure habitat crediting and a structure for restoration and management activities. This paper will give an overview of the Confederated Salish and Kootenai Tribe's acquisition plans, management goals, restoration efforts and other activities planned as part of this mitigation effort.

LYNX ECOLOGY IN NORTHWESTERN MONTANA: AN ONGOING FIELD STUDY AT SEELEY LAKE™

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Since 1998, we collared over 61 lynx (*Lynx canadensis*) near Seeley Lake, MT. To date, we documented 18 (11 males, 7 females) mortalities. Primary mortality factors include starvation (38%), predation by cougars (31%), and trapping/shooting (25%). We have located 13 dens from 7 females and we are quantifying den-site selection at multiple-spatial scales. Abundant woody debris was present at all 13 dens, usually in the form of large diameter logs, but smaller logs are used when in “jackstraw” stacks. We study demography to the extent possible given our sample. Preliminary data suggest litters are small and about 50 percent of kittens survive to independence. We spent considerable effort documenting habitat selection during winter and summer within forest stands and we are just beginning initial analysis of these data. As we complete small-scale studies, we will refocus research to address the following issues: habitat use within non-managed landscapes, habitat selection of den sites, and demography. We are also especially interested in understanding lynx movements relative to landscape and habitat features, including putative corridors and linkage zones.

RELATIONSHIPS BETWEEN LANDSCAPE CHARACTERISTICS AND DUCK NESTING SUCCESS: THE FUSION OF SCIENCE AND MANAGEMENT IN THE PRAIRIES™

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Natural resource managers are increasingly faced with the need to effectively manage populations with limited resources amid great uncertainty. In this challenging situation, strategic targeting of management coupled with integrated biological monitoring and evaluation is critical to achieving success. Here I present how Ducks Unlimited is using this approach to manage for duck production in the prairies of North and South Dakota. The foundation of this approach is a basic understanding of the population dynamics of the

species or group of interest. For prairie breeding ducks, critical habitat and landscape components consist of high densities of wetland amid large tracts of grassland. Basic relationships between the number of breeding pairs and the density of wetland have been established based on long-term survey information. Hypothesized relationships between nesting success and the amount of grassland present have been developed based on previous research. These relationships are then translated into GIS maps using remotely sensed information on landscape and habitat characteristics. By coupling these maps with a simple decision matrix of possible management prescriptions, spatially explicit management guidelines result which serve to strategically focus the appropriate management in the appropriate location. However, once these prescriptions are established and management action enacted, the process is far from complete. Because of large amounts of spatial and temporal variation in biological responses to habitat and landscape characteristics exist, a great deal of uncertainty exists with respect to the effectiveness and success of management actions. Therefore, monitoring of the biological responses is critical to ensure the continual refinement of the management actions. Additionally, the management prescriptions are only as good as the assumptions on which they are based. Therefore, testing and refinement of critical assumptions is paramount. Preliminary results from monitoring efforts will be presented and based upon those results, potential changes to management efforts will be discussed.

NORTH CENTRAL MONTANA SWIFT FOX SURVEY 2000/2001 ^{TWS}

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Swift fox (*Vulpes velox*) historically ranged throughout eastern Montana. However, their numbers were substantially reduced in the early part of the twentieth century. The swift fox was declared extinct in Montana in 1969. As part of a Canadian recovery effort, over 900 captive-raised and translocated wild-born foxes were released annually in the Alberta and Saskatchewan prairies adjacent to Montana from 1983 through 1997. A Montana graduate study in 1996 and 1997 documented wild-born swift fox breeding in Blaine County south of one of the release sites. During the winter of 1996/1997 Canadian researchers surveyed the swift fox populations on their reintroduction sites. A repeat survey was planned for 2000/2001 and FWP was asked to expand the effort into Montana. The Montana study area included 80 townships north of the Milk River extending from Havre to Opheim. Trapping began in November 2000 and ended on February 15, 2001 with 66 of the 80 townships sampled. A total of 1188 trapnights resulted in the capture of 38 different swift fox (3.2 foxes/100 trapnights). In addition, four foxes were seen in townships in which none were caught. Swift foxes were trapped or observed in 25 (38 percent) of the 66 surveyed townships. One fox had been previously tattooed and the rest were wild-born (one escaped prior to handling). The sex and age ratios of the handled foxes were, 18 adult/19 juvenile and 16 male/21 female. The total population occupying the Montana study area was estimated at 221 swift foxes based on an analysis of the capture results. The 2000/2001 survey confirmed that swift foxes had drifted south from Canada and were expanding throughout the native grasslands north of the Milk River in north central Montana.

DISTRIBUTION OF FOREST CARNIVORES IN THE PIONEER, FLINT, AND ANACONDA-PINTLER MOUNTAINS, MONTANA™

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This project was initiated in the winter of 2000-2001 by the Rocky Mountain Research Station in cooperation with the Western Federal Lands Highway Division (WFLHD) of the Federal Highway Administration. The primary goal of this 3-year study is to assess the direct and indirect impacts of the proposed Pioneer Scenic Byway improvement on lynx, wolverine, and other forest carnivores in the Pioneer and adjacent mountain ranges. We began an intensive survey effort directed at meeting 2 primary objectives; 1.) Determine the distribution of lynx, wolverine, and other forest carnivores in the Pioneer, Flint and Anaconda-Pintler Mountain Ranges, and 2.) Determine the location and relative frequency that lynx, wolverine, and other wildlife (forest carnivores, elk, deer, mountain lions, coyotes, and bobcats) cross the Byway. Last winter (2000-01), we surveyed 1,313 km of intensive survey routes and >5000 km of less data intensive reconnaissance routes. We documented one lynx track in the Anaconda-Pintler range on 12 February 2001. We frequently encountered tracks of coyote ($n=1075$), marten ($n=205$), and wolverine ($n=36$) throughout the survey area. Bobcat ($n=10$), mountain lion ($n=5$), and wolf ($n=3$) were uncommon and were rarely encountered. During the current field season (in progress), we have completed 350 km of intensive surveys and 825 kilometers of recon surveys. Distribution trends continue to be similar, with frequent wolverine tracks ($n=15$) and no lynx tracks to date. We have surveyed the closed portion of the Byway 10 times over the course of two field seasons. Martens and coyotes are the most common carnivores using the road. Wolverine crossings have been documented 8 times, with crossings in 2002 more widely distributed than in 2001. Trapping for wolverine began on 10 February 2002 in the Pioneers with two individuals captured and implanted to date.

UNDERSTANDING VARIATION IN SINGING BEHAVIOR: A MISSING LINK IN THE ANALYSIS OF COUNT DATA FOR SHRUB-STEPPE SONGBIRDS™

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Count data, e.g., line transects, point counts, are widely used in avian research and monitoring programs. Although counts rely heavily on detections of singing males, our understanding of variation in the major factors influencing singing behavior is incomplete for many songbirds. I investigated factors influencing the detectability of Brewer's Sparrows in a population of color-banded males of known pairing status and nest stage in Washington state in 1998-1999. In Brewer's Sparrows (and other shrub-steppe songbirds), a

major source of variation in male singing rates, and therefore, in detectability, is male reproductive stage, i.e., pairing status and nest stage. The detectability of paired males (0.12-0.39) is dramatically lower than that of unpaired males (0.87-0.90) for counts 3-20 minutes long. Male parental care, including male incubation and brooding, is common and further reduces the detectability of paired males. Moreover, even when count protocols are fully standardized, substantial annual variation in female arrival date, via its effects on male pairing status, may bias count data by as much as 50 percent. Variation in female arrival date may explain previous reports of high temporal and geographic variation in abundance in this and other shrub-steppe species. Understanding the main sources of variation in singing, including the effects of pairing status, female arrival date, and male parental behavior, is prerequisite for proper interpretation of point count data based on vocal detections. I outline a method for using tape-recorded count data to monitor pairing success in shrub-steppe breeding birds.

THE EFFECTS OF CATTLE GRAZING ON DUCK AND SHOREBIRD PRODUCTION IN THE ASPEN PARKLAND ECOREGION ^{TWS}

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The beef industry is growing rapidly throughout the Aspen Parkland of Canada. Increasing cattle numbers will affect the amount of pasture and potentially its value as duck and shorebird nesting and brood-rearing habitat. Increasing cattle herds will likely lead to higher stocking rates on pastures and use of previously idled areas. Conversely, conversion of cropland to pastureland may benefit upland nesting ducks and shorebirds by increasing the amount of perennial cover. We undertook the current study to evaluate the relationships of nest-site selection, nesting success, and brood abundance of upland nesting ducks and shorebirds to grazing intensity in tame and native/naturalized pastures of the Aspen Parkland. Nest searches occurred on 54 study sites in the western Aspen Parkland of Alberta. Vegetation physiognomy was quantified at each nest using Robel and Weins pole measurements. Within field vegetation physiognomy was similarly quantified at random points within pastures. Duck breeding pair and brood surveys were conducted in each pasture. Despite extensive drought, nest searches located 176 duck and 35 shorebird nests. Over half of the duck nests found were blue-winged teal; similarly, killdeer dominated the shorebird nests found. Density of duck nests on moderately grazed pastures was approximately half that of lightly grazed or idled pastures. Duck nest daily survival rates (dsr) show a trend toward greater success in native vs. tame pastures and in moderate vs. heavy or low grazing intensity sites. However, estimates have poor precision due to small sample size, and therefore are not statistically different. Shorebird nest selection favored heavily grazed treatments - 17 of 35 were found in this treatment. Shorebird nest dsr were higher in native pastures than in tame, but not significantly different. This was the first year of a multi-year study.

STATUS OF ELK PROJECT – M.A.P. HABITAT™ PROGRAM™

Polly Winebrenner
RMEF GIS Staff

The Rocky Mountain Elk Foundation (RMEF) has been dedicated to improvement of the status of elk populations and elk habitat protection and enhancement since 1984. An important step in achieving this mission has been the thorough understanding of elk distribution, population trends and habitat distribution and condition. In 1997, the RMEF initiated the Status of Elk Project with the specific goal of gathering the most accurate population status and trend information on elk for the period of 1975-1995, from United States and Canadian elk experts. In addition, in 1997 the RMEF started the collection of occupied elk habitat information. This project is referred to and copyright under the name M.A.P. (Measure and Prioritize) Habitat™ and was sponsored by the Foundation and the USDA Forest Service. Habitat distribution information was mapped in meetings held with state, tribal, Federal, corporate and independent biologists or elk experts. Currently occupied winter range, crucial winter range, summer range, crucial summer range, parturition and movement areas were all mapped using consistent conventions, and was based on expert opinion rather than a rule based model. In addition to mapping occupied habitats, experts assigned “limiting factors” which were used to qualify the effectiveness of each habitat polygon. The RMEF generously makes the M.A.P. Habitat™ available for conservation purposes.

REMOTE CAMERA SURVEYS FOR FOREST CARNIVORES™

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TrailMaster brand infrared camera stations have been used to detect and document the presence of forest carnivore species on the Bozeman Ranger District of the Gallatin National Forest since 1997. Target species for the project include Canada lynx (*Lynx canadensis*), wolverine (*Gulo gulo*), fisher (*Martes pennanti*) and American marten (*Martes americana*). The project is undertaken during the winter months to facilitate snow tracking of animals, avoid conflicts with bears, and take advantage of the winter food scarcity period to lure target species to the stations. Camera stations are baited with pieces of deer and/or beaver carcass and scented with a long distance commercial trapping lure. Chicken wings are suspended from a wire to provide a visual stimulus for attracting cats. The meat baits are hung from a wire so as to minimize the potential for providing a food reward to animals that visit the site. When an animal enters the site to inspect the lure and bait, an infrared beam is broken which triggers the camera to take a picture. Through this project, we have detected the presence of wolverine, marten, and possibly lynx, along with non-target species such as mountain lion, bobcat, coyote, red fox, red squirrel, snowshoe hare, moose and numerous bird species. A workshop will present the setup, maintenance and use of the camera stations.



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