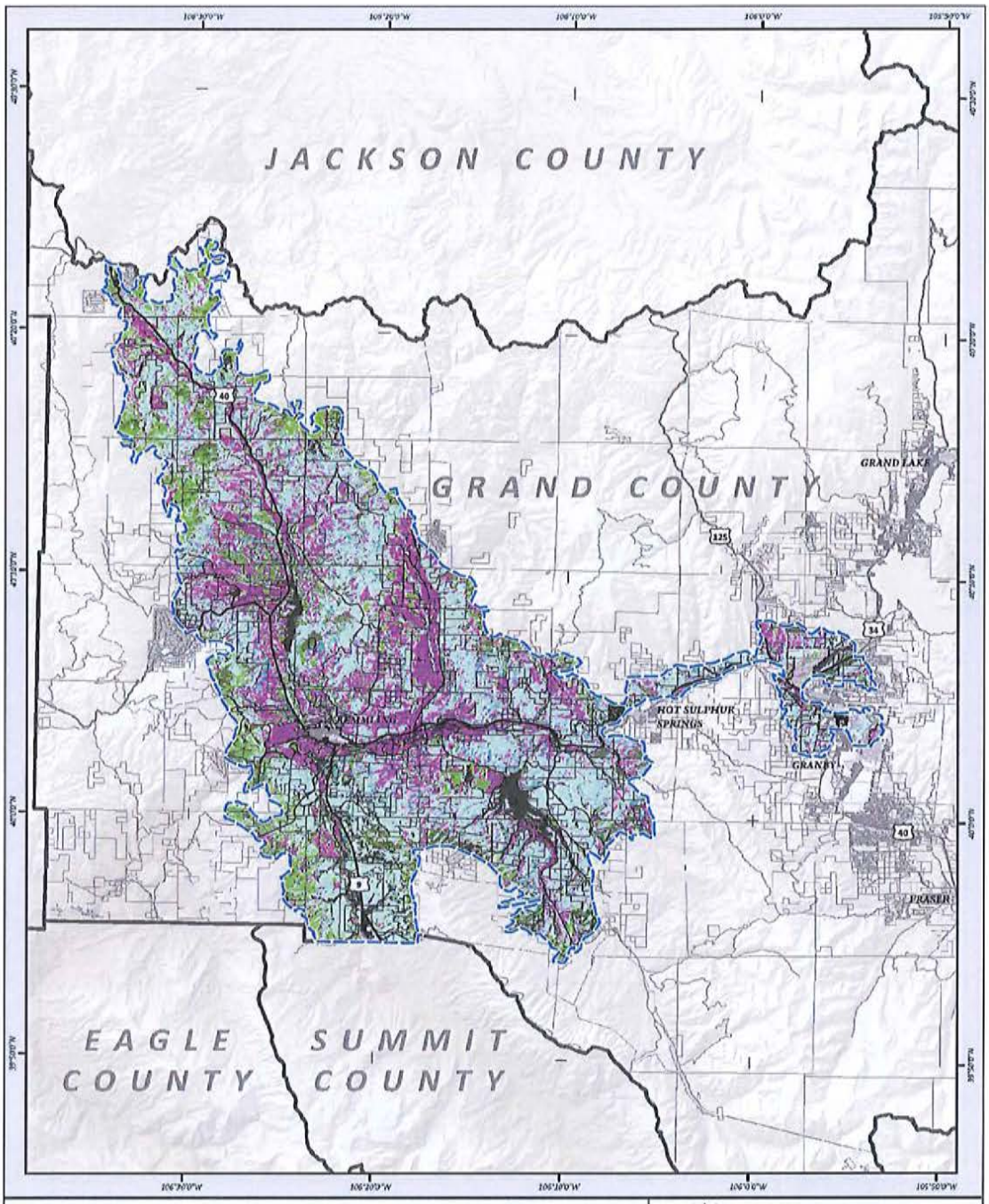
4.5, Figure 5: CVCP Vegetation Types



- Alpine Grassland
- Bare
- Forested
- Grassland
- Sage/Mixed Mountain Shrub
- Mixed Mountain Shrub
- Riparian
- Sage-dominated
- Sage-only
- Snow/Urban/Untyped

- Municipal Boundary
- County Boundary
- State Highway
- County Road

GRAND COUNTY COLORADO

Greater Sage-grouse Habitat Study

Suitable Habitat Modeling CVCP Vegetation Types

ELEV8 URS

Date: 07.26.2013
Created By: ZDP

October 22, 2013

4.6. General Model Rules

The following tables list the applicable parameters employed in each model method. The expert-based Habitat Suitability Index (HSI) lists the ranking scheme applied to each parameter and the associated weight assigned to determine the level of influence exerted by each parameter. Both fuzzy model methods (e.g., inductive and deductive methods) identify the membership types assigned to each model parameter, as well as the factors used to fit the raw data to the assigned membership type. These habitat parameters utilize published literature, as presented in section ***3.1 Table 1: Habitat Parameters from Reviewed Literature, and General habitat Parameters Employed in Modeling.***

4.6.1. Table 3: Habitat Suitability Index Model Component Ranking and Weights

Criteria	Classification	Criteria Weight	Ranking
Slope		30%	
	0 - 10%		10
	10% - 20%		9
	20% - 25%		5
	> 25%		0
Distance to Highway		10%	
	0 -1 km		2
	1 - 2 km		3
	2 - 3km		4
	3 - 4km		5
	4 - 5km		6
	5 - 6km		7
	6 - 7km		8
	7 - 8 km		9
	8 km+		10
Canopy Cover		15%	
	Shrub 10% - 20%		8
	Shrub 20% - 30%		10
	Shrub 30% - 40%		10
	Shrub 40% - 50%		8
	Shrub 50% - 60%		6
	Shrub 60% - 70%		4
	Shrub 70% - 80%		3
	Shrub 80% - 90%		2
	Shrub 90% - 100%		1
	All Other Values		0
Vegetation Types		30%	
	Forested		0

	Mixed Mtn. Shrub		0
	Mixed Mtn. Shrub (w/in 50m)		5
	Grass		0
	Grass (w/in 50m)		5
	Sage		10
	Sage/Mixed Mtn. Shrub mix		6
	Bare		0
	Urban		0
	Snow		0
	Water		0
	Riparian		0
	Riparian (w/in 50m)		5
Sage Density - 100m		10%	
	0.1 - 0.2		2
	0.2 - 0.3		3
	0.3 - 0.4		5
	0.4 - 0.5		6
	0.5 - 0.6		7
	0.6 - 0.7		8
	0.7 - 0.8		9
	0.8 - 1		10
	0 - 0.1		0
Patch Distance		10%	
	< 0 meters		10
	0 - 50 meters		9
	50 - 100 meters		7
	100 - 350 meters		3
	350 meters +		1
Proportion Forest - 350 m		5%	
	0 - 0.03		10
	0.03 - 0.06		9
	0.06 - 0.09		8
	0.09 - 0.12		7
	0.12 - 0.15		5
	0.15 - 0.2		3
	0.2 - 0.3		1
	> 0.3		0

4.6.2. Table 4: Deductive Fuzzy Model Parameter Membership Assignments

Criteria				
Slope				
		Membership Type	*Mid*	*Spread*
		Small	20	10
Distance to Highway				
		Membership Type	*Min*	*Max*
		Linear	-1023.59	8888.214714
Canopy Cover				
All canopy values first reclassified to the values listed below. Once reclassified, canopy values were 'fuzzied' by using focal stats to determine mean values within a 30-m search radius and re-scaled to an index of 0 to 1.				
	Shrub 20% - 40%			10
	Shrub 40% - 50%/10% - 20%			8
	Shrub 50% - 60%			6
	Shrub Cover 60% - 70%			4
	Shrub Cover 70% - 80%			3
	Shrub Cover 80% - 90%			2
	Shrub Cover 90% - 100%			1
	All Other			0
Vegetation Types				
All vegetation values first reclassified to the values listed below. Once reclassified, vegetation values were 'fuzzied' by using focal stats to determine mean values within a 25-m search radius and re-scaled to an index of 0 to 1.				
	Aspen			0
	Mixed Conifer			0
	Piñon-Juniper			0
	Mixed Mtn. Shrub			0
	Mixed Mtn. Shrub (w/in 50m)			5
	Grass			0
	Grass (w/in 50m)			5
	Grass/Sage Mix			7
	Grass/Mixed Mtn. Shrub mix			0
	Grass/Mixed Mtn. Shrub mix (w/in 50m)			0
	Sage			10
	Sage/Grass Mix			9
	Sage/Mixed Mtn. Shrub mix			6
	Bare			0
	Riparian			0
	Riparian (w/in 50m)			5
Sage Density				

Convert polys to binary raster; 1= sage, 0 = other. Run focal stats using 100m window; re-scaled results to index of 0 to 1.				
		Membership Type	*Min*	*Max*
		Linear	0.1	0.8
Patch Distance				
		Membership Type	*Midpoint*	*Spread*
		Small	50	2
Proportion Forest				
		Membership Type	*Midpoint*	*Spread*
		Small	0.115	7

4.6.3. Table 5: Inductive Fuzzy Model Parameter Membership Assignments

Criteria				
Slope				
		Membership Type	*Min*	*Max*
		Linear	32.112555	11.659863
Distance to Highway				
		Membership Type	*Min*	*Max*
		Linear	-1023.59	8888.214714
Canopy Cover				
Used CPW telemetry points to sample for rate of selection of specified canopy cover values. The percent selection was then re-scaled to an index of 0 to 1. Final re-scaled values were fuzzied using a neighborhood statistics function to find Mean values within a 30-meter radius.				
	Canopy Raster Value	Count	% Selected	Re-Scaled
	11	3	0.0034	0.0123
	15	1	0.0011	0.0040
	22	1	0.0011	0.0040
	24	1	0.0011	0.0040
	26	1	0.0011	0.0040
	27	1	0.0011	0.0040
	28	1	0.0011	0.0040
	38	1	0.0011	0.0040
	54	1	0.0011	0.0040
	67	1	0.0011	0.0040
	75	1	0.0011	0.0040
	79	1	0.0011	0.0040
	90	1	0.0011	0.0040
	95	1	0.0011	0.0040
	96	1	0.0011	0.0040
	101	3	0.0034	0.0123

	102	11	0.0126	0.0456
	103	10	0.0115	0.0416
	104	13	0.0149	0.0539
	105	15	0.0172	0.0622
	106	10	0.0115	0.0416
	107	11	0.0126	0.0456
	108	10	0.0115	0.0416
	109	10	0.0115	0.0416
	110	14	0.0161	0.0582
	111	10	0.0115	0.0416
	112	241	0.2764	1.0000
	113	236	0.2706	0.9790
	114	52	0.0596	0.2156
	115	66	0.0757	0.2739
	116	32	0.0367	0.1328
	117	19	0.0218	0.0789
	118	14	0.0161	0.0582
	119	2	0.0023	0.0083
	120	6	0.0069	0.0250
	121	5	0.0057	0.0206
	122	5	0.0057	0.0206
	123	4	0.0046	0.0166
	124	4	0.0046	0.0166
	125	2	0.0023	0.0083
	126	6	0.0069	0.0250
	127	2	0.0023	0.0083
	129	42	0.0482	0.1744

Vegetation Types

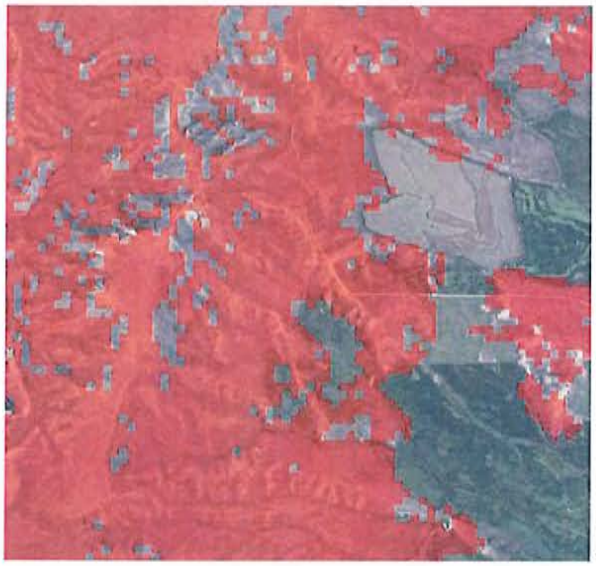
Used CPW telemetry points to sample for rate of selection of specified veg type values. The percent selection was then re-scaled to an index of 0 to 1. Final re-scaled values were fuzzied using neighborhood stats to find Mean values within a 25-meter radius.

	Raster Value	Count	% Selected	Re-Scaled
	6	55	0.0634	0.1081
	11	10	0.0115	0.0196
	13	15	0.0173	0.0295
	21	2	0.0023	0.0039
	22	509	0.5864	1.0000
	24	7	0.0081	0.0138
	32	26	0.0300	0.0512
	33	141	0.1624	0.2769

	35	31	0.0357	0.0609
	62	9	0.0104	0.0177
	67	2	0.0023	0.0039
	68	3	0.0035	0.0060
	86	3	0.0035	0.0060
	90	2	0.0023	0.0039
	91	29	0.0334	0.0570
	92	1	0.0012	0.0020
	93	8	0.0092	0.0157
	103	4	0.0046	0.0078
	104	3	0.0035	0.0060
	112	5	0.0058	0.0099
	114	3	0.0035	0.0060
Sage Density				
Convert polys to binary raster; 1= sage, 0 = other. Run focal stats using 100m window; re-scale results to index of 0 to 1.				
		Membership Type	*Midpoint*	*Spread*
		Large	0.750329	2
Patch Distance				
		Membership Type	*Min*	*Max*
		Linear	96.430047	13.435621
Proportion Forest				
		Membership Type	*Midpoint*	*Spread*
		Small	0.021784	1.75

5. Model Results

The following section discusses the results of each model method, summarized as both raw results as well as aggregated results. The raw results report and summarize the unmodified model outcomes, while the aggregated results attempt to provide a 'truer' picture of the suitable habitat areas by filling in holes in the raw results of suitable habitat and connecting adjacent, but disconnected, suitable patches to form contiguous suitable habitat patches. Raw and aggregated model results are compared and demonstrated in the images below.



Raw Model Results

Aggregated Model Results

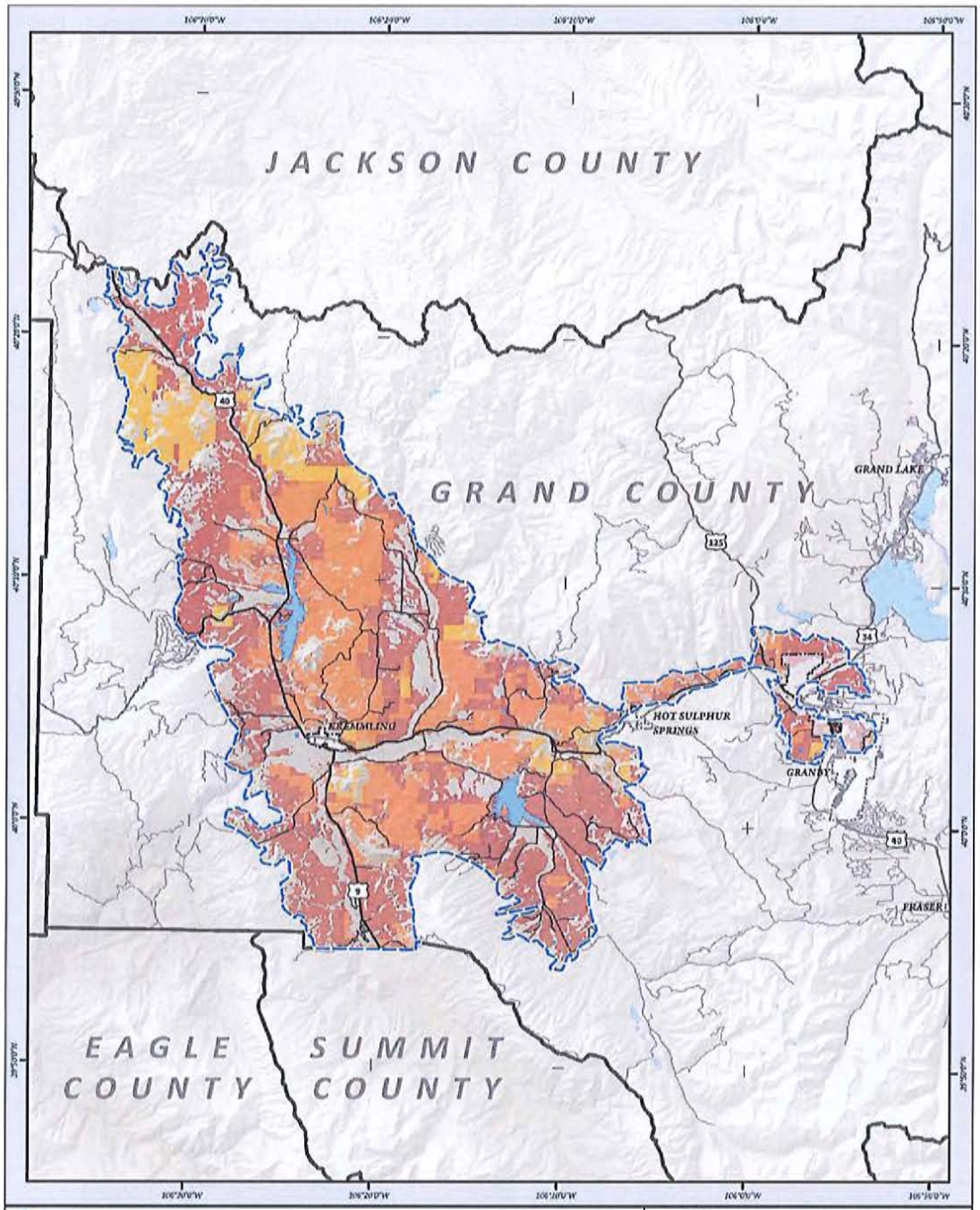
5.1. Table 6: Raw and Aggregated Model Results Summary

	Raw Results		Aggregated Results	
Model	*Acres*	*% of Study Area*	*Acres*	*% of Study Area*
HSI (Expert-based)	135,749	52%	173,913	67%
Fuzzy Deductive (Expert-based)	154,646	59%	174,754	67%
Fuzzy Inductive (Inference-based)	139,249	53%	155,370	59%

5.2. Table 7: Aggregated Model Results Summarized by Land Owner

	Private Lands		BLM Lands		State Lands		Total	
Model	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*
HSI (Expert-based)	98,727	38%	56,948	22%	18,238	7%	173,913	67%
Fuzzy Deductive (Expert-based)	98,883	38%	57,474	22%	18,397	7%	174,754	67%
Fuzzy Inductive (Inference-based)	83,961	32%	55,786	21%	15,623	6%	155,370	59%

5.2.1. Figure 6: Habitat Suitability Index (HSI) Results



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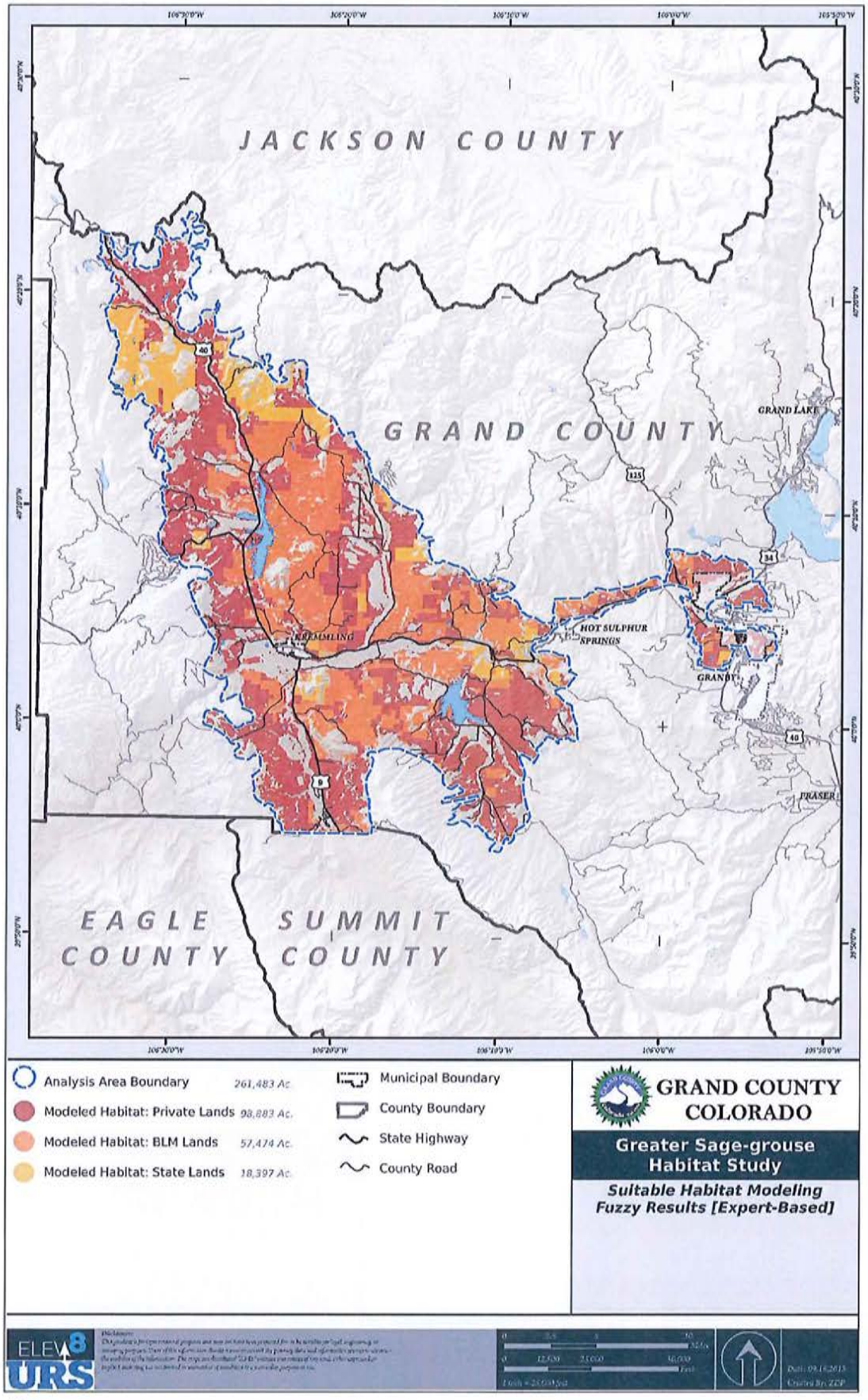
5.2.2. Figure 7: Fuzzy Deductive (Literature Based) Results



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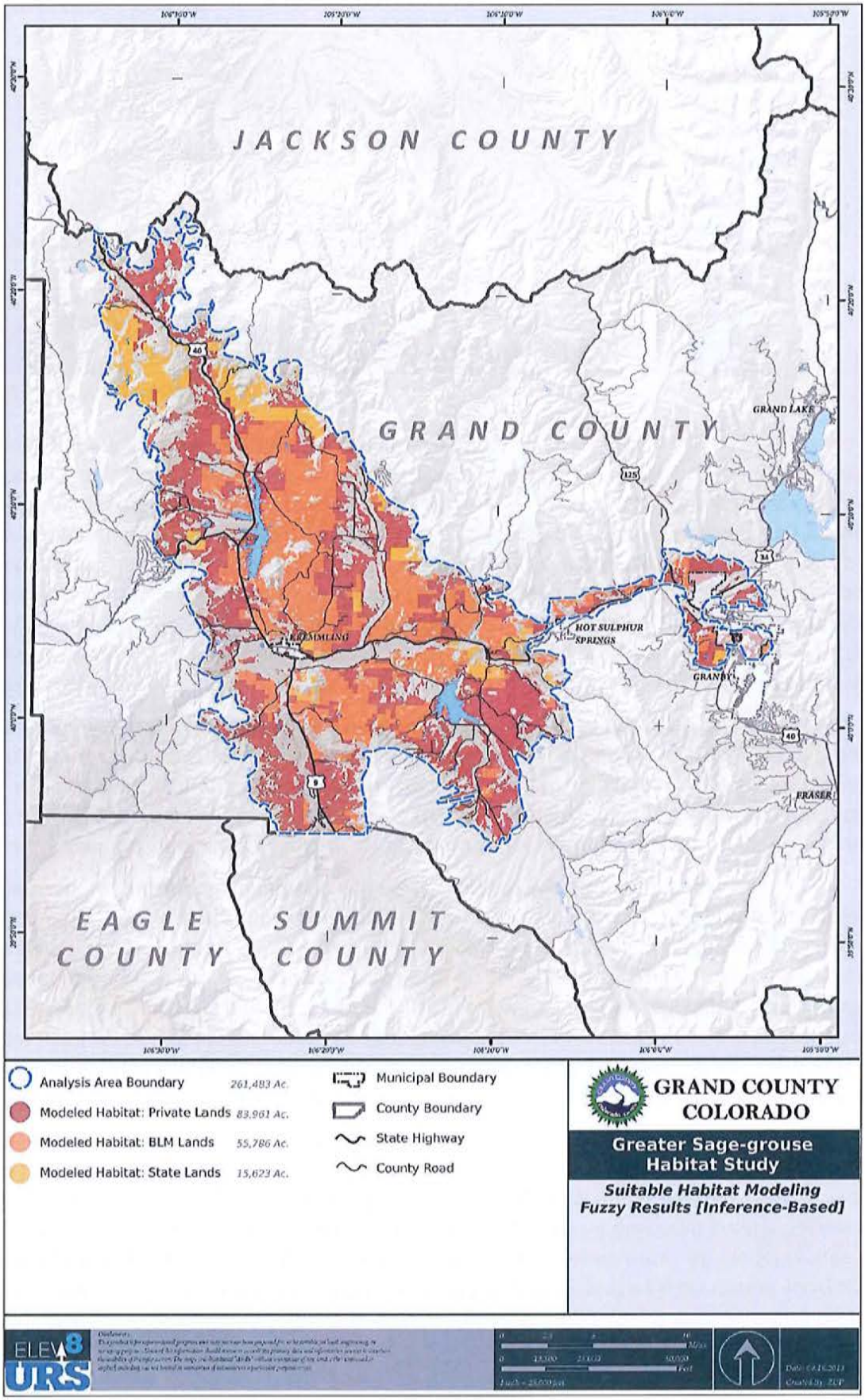
5.2.3. Figure 8: Fuzzy Inference (Inductive, Radio Telemetry Data-Driven) Results



6. Model Validation

The following section discusses the validation of each model result to assess model accuracy in identifying suitable habitats utilized within the Grand County Study Area. All model results were validated utilizing telemetry data acquired from CPW that tracked observed greater sage-grouse locations in the field during the years of 2000 to 2008. A total of 1,154 telemetry points were in the dataset; the telemetry data were further refined to remove any overlapping points, resulting in 863 unique points utilized in the validation of each model result.

CPW has stated that the horizontal precision of the telemetry data points should be within +/- 50 meters; however, numerous telemetry points were observed in locations far removed from modeled suitable habitat patches in environments that greater sage-grouse are supposed to avoid, including mature woodlands, forests and in one case there are 3 points that were located within in Williams Fork Reservoir. These three points occurred as much as 280 meters from shore. The existence of these points in areas of unsuitable habitat, far removed from known suitable habitats calls into question either the 50-meter horizontal precision of the telemetry data, or indicates that sage-grouse likely may utilize unsuitable habitats much more than the literature indicates.

As such, the model results are validated on three levels for both the raw and aggregated model results. Direct validation summarizes all telemetry points that coincide directly with the model result data. In addition, the model results were further validated to adjust for potential horizontal errors that may exist in the telemetry data by expanding the model results by increments of 50-meters and 100-meters. The results of each model validation are reported in the table below.

The primary purpose of performing the inductive modeling process was to compare the results against the deductive models (i.e., expert-based), assessing how well the expert-based opinions utilized in the deductive models reflected the habitat types selected by the Grand County greater sage-grouse population. While the inductive model results were validated utilizing randomly sampled points predicting suitable habitat and non-habitat, budgetary constraints and seasonal constraints prevented a truly robust method of validation for the model results. To perform a statistically significant method of validating the inductive model results, either additional greater sage-grouse telemetry points would be required, or a greater sample of predicted habitat and non-habitat points would need to be randomly generated and subsequently validated by field observations.

6.1. Table 8: Validation of Raw Model Results

	Direct		+ 50-meters		+100-meters	
Model	*Present*	*%*	*Present*	*%*	*Present*	*%*
HSI (Expert-based)	593	69%	782	91%	822	95%
Fuzzy Deductive (Expert-based)	679	79%	789	91%	816	95%
Fuzzy Inductive (Inference-based)	638	74%	755	87%	792	92%

6.2. Table 9: Validation of Aggregated Model Results

	Direct		+ 50-meters		+100-meters	
Model	*Present*	*%*	*Present*	*%*	*Present*	*%*
HSI (Expert-based)	714	83%	789	91%	822	95%
Fuzzy Deductive (Expert-based)	737	85%	791	92%	816	95%
Fuzzy Inductive (Inference-based)	688	80%	756	88%	792	92%

7. Interpretations and Discussion of Final Model Results

We ran approximately 20 models, varying the weighting of vegetation, slope, distances to forest, and other parameters to see which model validated the best against CPW supplied sage-grouse radio telemetry, and on-the-ground habitat conditions. Once the final model was selected, we found that there was a very high level of correlation between the HIS model, the inference based model (which used radio-telemetry data to drive habitat preferences) and the deductive (literature based) model. Further, the model validated well against the habitat conditions validated in the field.

We found that of the 20 known lek sites (as supplied by CPW), 18 leks occurred within Habitat. However, we did not model "lek habitat" for two main reasons: 1. Lek habitat is not considered to be limiting, in that patches of bare ground, salt licks, old roads, and grassy areas are not limited on the landscape; 2. If we had introduced "lek habitats", then we would have captured extremely large areas of ineffective habitats, such as rocky areas, roadways, runways, gravel pits, dryland fields, and other features which are not considered to be effective sage-grouse habitat.

When we ran the validations against the CPW radio collard bird locations, we found that around 69 to 85% of bird locations were within Habitat (see Tables 7 and 8), with the HSI model validating the worst, and the Fuzzy Expert Based (literature-driven deductive) model performing the best. However, when we simply expanded the boundaries of the model by 50 meters, we captured around 90% of bird locations. We believe this may be explained based on the horizontal accuracy of the radio collard birds- while the radio-transmitters used have an accuracy of around 50 meters, we did notice 3 bird locations over 100m into Williams Fork Reservoir, and well into non-habitat areas, which may indicate that some of the radio-transmitter locations may not be representative of actual bird locations. Further, a very small number of birds were located over ¼ mile into irrigated agricultural fields, and while sage-grouse are known to utilize the edges of fields, extensive use of broad agricultural fields is not consistent with a number of literature citations. We believed that introducing habitats (such as broad agricultural fields) would stray from peer reviewed literature and would therefore introduce unsupported bias into the modeling efforts.

Some radio-collared bird locations not in Habitat occurred in validated suitable habitats, but in these cases we found that the CVCP vegetation data layer had miss-typed these areas as "barren", likely due to the very low sagebrush cover. This emphasizes the importance of high-quality vegetation data, as well as field-validation. Another potential variable is the accuracy of the radio-telemetry.

Even though Grand County is at the extreme southern end of the rage of greater sage-grouse, the habitat utilization by birds in this area is very similar to descriptions of habitat utilization in core areas in Wyoming. We did not detect significant shifts in habitat utilization towards less suitable habitats (e.g., extensive stands of mixed mountain shrublands, pinyon-juniper, etc.), as has been observed in other Colorado populations. However, utilizing local knowledge from CPW staff in the area would help inform and elucidate local habitat use patterns.

The Fuzzy Deductive Model, which validated the best against CPW radio telemetry of bird locations, mapped approximately 67% of the study area as habitat, or approximately 33% less than what the Preliminary Priority Habitat/Preliminary General Habitat (PPH/PGH) map indicates is habitat. The Fuzzy Inference Model (based on radio-collared bird locations) mapped 59% of PPH/PGH as being

habitat, or approximately 41% less habitat than PPH/PGH habitats. Based on the modeling process, we have a high level of confidence that actual sage-grouse habitats in the area are likely around 60% to 70% of what is represented in the PPH/PGH habitat models.

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Wakkinen, W. L., K. P. Reese, and J. W. Connelly. 1992. Sage Grouse nest locations in relation to leks. Journal of Wildlife Management 56:381–383.

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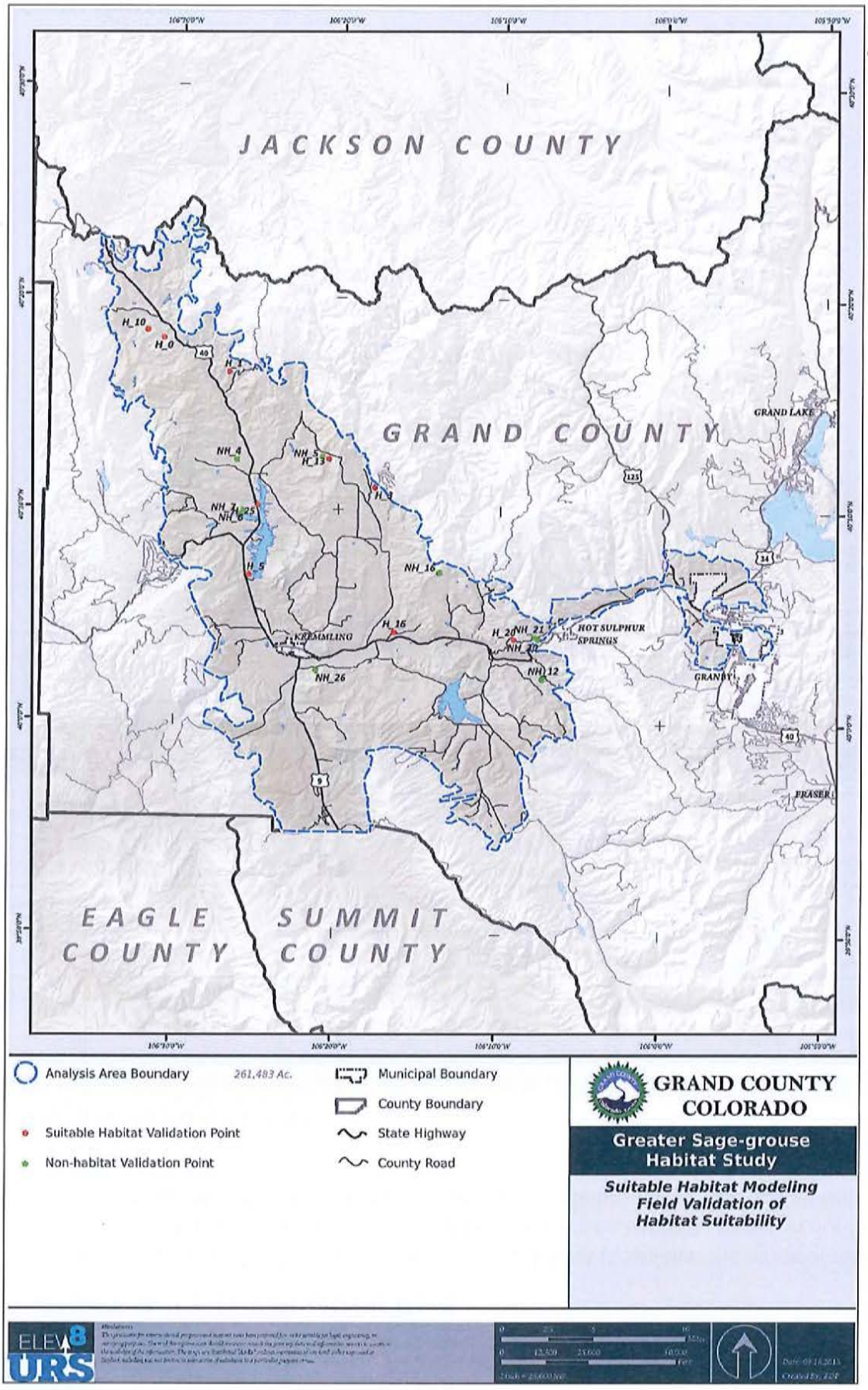
9. Appendix A: Field Validation Data

The following section presents photo point data detailing Habitat (areas that the model returned as suitable habitat) and Non Habitat (areas the model returned as non-habitat). Based on our field data points, the following table summarizes the on-the-ground conditions within Habitat and Non-Habitat areas.

9.1. Table 10: Field Validation Summary

Point ID	Fuzzy-Expert	Fuzzy-Inference	HIS-Expert	Field Check	*Notes*
Non-habitat					
NH_04	Not Present	Not Present	Not Present	Confirmed Habitat	*Area was missed in all model results due to inaccurate identification of cover type (e.g. typed as 'barren')*
NH_05	Not Present	Not Present	Not Present	Confirmed NH	
NH_06	Not Present	Not Present	Not Present	Low Potential Habitat	*Very sparse sage cover with very minimal grass/forb understory. May experience very infrequent*
NH_07	Not Present	Not Present	Not Present	Confirmed NH	
NH_12	Not Present	Not Present	Not Present	Confirmed NH	
NH_16	Not Present	Not Present	Not Present	Confirmed NH	
NH_20	Not Present	Not Present	Not Present	Confirmed NH	
NH_21	Not Present	Not Present	Not Present	Confirmed NH	
NH_26	Not Present	Not Present	Not Present	Confirmed NH	
Habitat					
H_00	Present	--	Present	Confirmed Habitat	
H_01	Present	Present	Present	Confirmed Habitat	
H_03	Present	Present	Present	Confirmed Habitat	
H_05	Present	Present	Present	Confirmed Habitat	
H_10	Present	Present	Present	Confirmed Habitat	
H_13	Present	Present	Present	Confirmed Habitat	
H_16	Present	Present	Present	Confirmed Habitat	
H_20	Present	Present	Present	Confirmed Habitat	
NH_17	Present	Present	Present	Confirmed Habitat	*Was originally part of 'non-habitat' point set as the original point occurred in reservoir. Field tech moved point to shore, putting point in modeled habitat*


JACKSON COUNTY
GRAND COUNTY
EAGLE COUNTY
SUMMIT COUNTY
GRAND LAKE
KREMMLING
HOT SULPHUR SPRINGS
GRANBY
FRASER
H_10
H_0
H_1
H_13
H_3
H_5
H_16
H_20
NH_4
NH_5
NH_7
NH_6
NH_25
NH_16
NH_21
NH_20
NH_12
NH_26
40
125
34
9
Analysis Area Boundary
261,483 Ac.
Municipal Boundary
County Boundary
State Highway
County Road
Suitable Habitat Validation Point
Non-habitat Validation Point
GRAND COUNTY COLORADO
Greater Sage-grouse Habitat Study
Suitable Habitat Modeling Field Validation of Habitat Suitability

9.3. Field Validation Photo Points

9.3.1. Non Habitat

NH_04

Photo file: NH_04n.jpg

Photo file: NH_04e.jpg

Photo file:NH_04s.jpg

Photo file: NH_04w.jpg

Plot ID: NH_04
Survey Date: September 19, 2013
Cover Type: Shrub
Sage Cover: 35%
Other Shrub Cover: *Sarcobatus vermiculatus* 55%
Total Shrub Cover: 45%
Grass Cover: 3%
Forb Cover: 1%
Aspect: southeast
Slope: 4°
Insect/Disease: none
Dominant Plant Species: *Agropyron spicatum*, *Aster* spp.,

Notes:

NH_05

Photo file: NH_05n.jpg

Photo file: NH_05e.jpg

Photo file:NH_05s.jpg

Photo file: NH_05w.jpg

Plot ID: NH_05
Survey Date: September 19, 2013
Cover Type: Conifer Forest
Sage Cover: 0%
Other Shrub Cover: *Symphorocarpos oreophylus* 12%
Tree Cover: *Juniperus scopulorum* 2%, *Acer glabrum* 1%, *Pseudotsuga menzeisii* 45%
Total Shrub Cover: 15%
Grass Cover: 6%
Forb Cover: 4%
Tree Cover: 45%
Aspect: north
Slope: 35°
Insect/Disease: few standing dead
Dominant Plant Species: *Clematis* spp., *Poa pratensis, Amelanchier alnifolia*

Notes:

NH_06

Photo file: NH_06n.jpg

Photo file: NH_06e.jpg

Photo file:NH_06s.jpg

Photo file: NH_06w.jpg

Plot ID: NH_06
Survey Date: September 19, 2013
Cover Type: Shrub
Sage Cover: 18%
Other Shrub Cover: *Sarcobatus vermiculatus* 10%, *Chrysothamnus viscidiflorus* 2%
Total Shrub Cover: 25%
Grass Cover: 8%
Forb Cover: 3%
Aspect: south
Slope: 5°
Insect/Disease: none
Dominant Plant Species: *Oryzopsis hymenoides, Viscia americana*

Notes:

NH_07

Photo file: NH_07n.jpg

Photo file: NH_07e.jpg

Photo file:NH_07s.jpg

Photo file: NH_07w.jpg

Plot ID: NH_07
Survey Date: September 19, 2013
Cover Type: Shrub
Sage Cover: 3%
Other Shrub Cover: *Sarcobatus vermiculatus* 18%, *Chrysothamnus viscidiflorus* 2%, *Artemisia fridgida* 2%
Total Shrub Cover: 20%
Grass Cover: 10%
Forb Cover: 4%
Aspect: west
Slope: 12°
Insect/Disease: none
Dominant Plant Species: *Oryzopsis hymenoides*, *Astragalus* spp.

Notes: Just above a steep drop.

NH_12

Photo file: NH_12n.jpg

Photo file: NH_12e.jpg

Photo file:NH_12s.jpg

Photo file: NH_12w.jpg

Plot ID: NH_12
Survey Date: September 18, 2013
Cover Type: Conifer forest
Sage Cover: 0%
Other Shrub Cover: *Juniperus communis* 8%, *Symphorocarpos oreophilus* 4%, *Purshia tridentata* 3%, *Amelanchier alnifolia* 3%, *Rosa* spp. 1%
Total Shrub Cover: 25%
Grass Cover: 15%
Forb Cover: 40%
Tree Cover: 45%
Aspect: southwest
Slope: 24°
Insect/Disease:
Dominant Plant Species: *Populus tremuloides, Pseudotsuga menzeisii, Arcostaphylos uva-ursi, Mahonia repens, Achilliia lanulosa, Carex geyeri*

Notes:

NH_16

Photo file: NH_16n.jpg

Photo file: NH_16e.jpg

Photo file: NH_16s.jpg

Photo file: NH_16w.jpg

Plot ID: NH-16
Survey Date: September 18, 2013
Cover Type: Aspen
Sage Cover: 0%
Other Shrub Cover: *Symphorocarpos oreophilus* 2%, *Populus tremuloides* 10%, *Rosa* spp. 4%, *Prunus virginiana* 3%, *Salix* spp 5%, *Juniperus scopulorum* 8%,
Total Shrub Cover: 25%
Grass Cover: 58%
Forb Cover: 30%
Tree Cover: 10%
Aspect: south
Slope: 27°
Insect/Disease: None
Dominant Plant Species: *Carex* spp., *Phleum pratense*, mulasp

Notes: There is a spring near this area where the cattle gather so cattle use was obvious.

NH_20

Photo file: NH_20n.jpg

Photo file: NH_20e.jpg

Photo file: NH_20s.jpg

Photo file: NH_20w.jpg

Plot ID: NH-20
Survey Date: September 18, 2013
Cover Type: Aspen
Sage Cover: 0%
Other Shrub Cover: *Juniperus communis* 20%, *Populus tremuloides* 15%, *Pseudotsuga menzeisii* 18%
Total Shrub Cover: 30%
Grass Cover: 5%
Forb Cover: 30%
Tree: 25%
Aspect: north
Slope: 12°
Insect/Disease: few dead fir
Dominant Plant Species: *Acrtostaphylos uva-ursi, Mahonia repens*, astvic, antspp, lupspp, achlan, taroff

Notes:

NH_21

Photo file: NH_21n.jpg

Photo file: NH_21e.jpg

Photo file: NH_21s.jpg

Photo file: NH_21w.jpg

Plot ID: NH-21
Survey Date: September 18, 2013
Cover Type: Aspen
Sage Cover: 0%
Other Shrub Cover: juncom 3%, poptre 20%, abelas 4%, psemen 8%
Total Shrub Cover: 3%
Grass Cover: 8%
Forb Cover: 6%
Tree: 30%
Aspect: north
Slope: 12°
Insect/Disease: none
Dominant Plant Species: *Arctostaphylos uva-ursi, Poa spp. Carex geyeri, Lupinus spp., Senicio spp., Antennaria spp.*

Notes:

NH_26

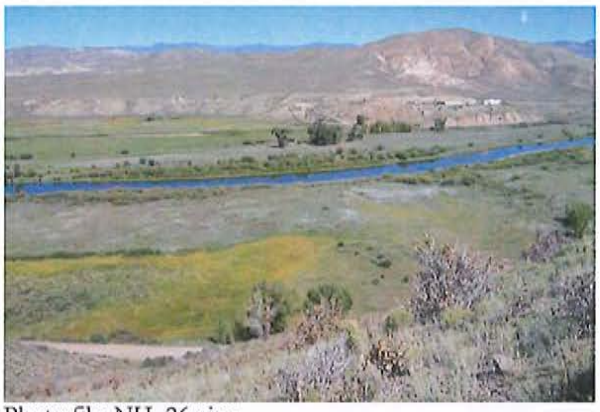


Photo file: NH_26n.jpg

Photo file: NH_26e.jpg

Photo file:NH_26s.jpg

Photo file: NH_26w.jpg

Plot ID: NH_26
Survey Date: September 20, 2013
Cover Type: Shrub
Sage Cover: 1%
Other Shrub Cover: *Amelanchier alnifolia* 5%, *Chrysothamnus viscidiflorus* 10%
Total Shrub Cover: 15%
Grass Cover: 10%
Forb Cover: 8%
Aspect: north
Slope: 27°
Insect/Disease: none
Dominant Plant Species: *Artemisia fridgida, Potentilla spp., Lupinus spp., Koelaria macrantha*, Elytra

Notes: Very steep slope

9.3.2. Habitat

H_00

Photo file: H_00n.jpg

Photo file: H_00e.jpg

Photo file: H_16s.jpg

Photo file: H_16w.jpg

Plot ID: H_00
Survey Date: September 20, 2013
Cover Type: Shrubland
Sage Cover: 18%
Other Shrub Cover: *Symphorocarpos oreophilus* 8%, *Chrysothanmus viscidiflorus* 5%
Total Shrub Cover: 28%
Grass Cover: 60%
Forb Cover: 5%
Aspect: southeast
Slope: 8°
Insect/Disease: none
Dominant Plant Species: *Achillea lanulosa, Eriogonum umbellatum, Taraxacum officinale, Luipnus* spp.

Notes: Some grazing by horses

H_01

Photo file: H_01n.jpg

Photo file: H_01e.jpg

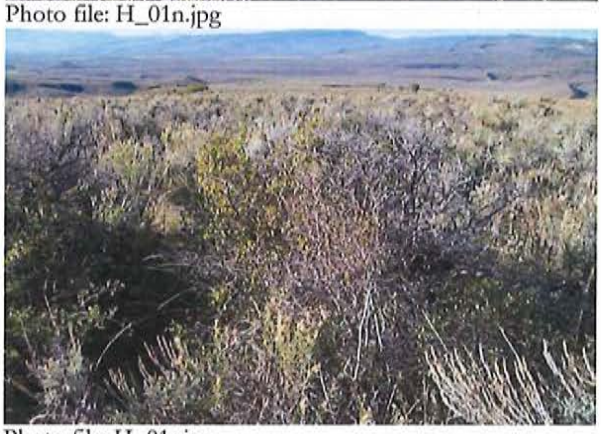


Photo file: H_01s.jpg

Photo file: H_01w.jpg

Plot ID: H-01
Survey Date: September 20, 2013
Cover Type: Shrubland
Sage Cover: 26%
Other Shrub Cover: *Symphorocarpos oreophilus* 23%, *Chrysothamnus nauseosus* 18%
Total Shrub Cover: 70%
Grass Cover: 12%
Forb Cover: 30%
Aspect: south
Slope: 3°
Insect/Disease: none
Dominant Plant Species: *Eriogonum umbelatum, Achillea lanulosa, Heterotheca villosa*, bropor

Notes: Within a cattle lease.

H_03

Photo file: H_03n.jpg

Photo file: H_03e.jpg

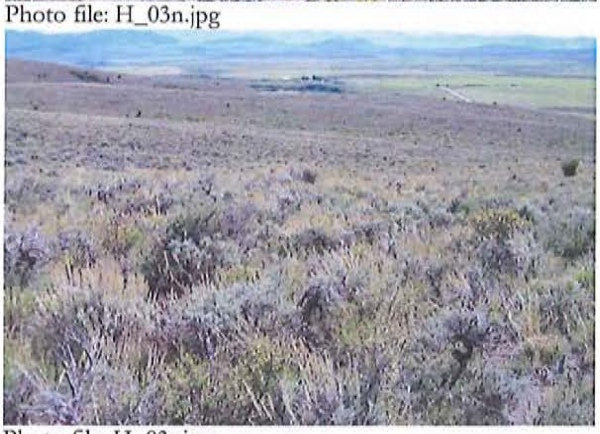


Photo file: H_03s.jpg

Photo file: H_03w.jpg

Plot ID: H-03
Survey Date: September 19, 2013
Cover Type: Shrub
Sage Cover: 28%
Other Shrub Cover: *Chrysothamnus nauseosus* 12%, *Purshia tridentata* 16%, *Symphorocarpos oreophilus* 1%
Total Shrub Cover: 40%
Grass Cover: 18%
Forb Cover: 15%
Aspect: southwest
Slope: 11°
Insect/Disease: none
Dominant Plant Species: *Koelaria macarantha, Antennaria parviflora, Pseudoroegneria spicata*

Notes:

H_05

Photo file: H_05n.jpg

Photo file: H_05e.jpg

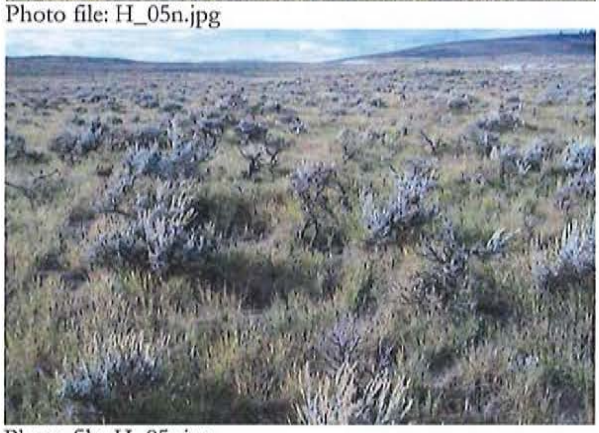


Photo file: H_05s.jpg

Photo file: H_05w.jpg

Plot ID: H-05
Survey Date: September 20, 2013
Cover Type: Shrub
Sage Cover: 20%
Other Shrub Cover: no other noted
Total Shrub Cover: 20%
Grass Cover: 60%
Forb Cover: 1%
Aspect: east
Slope: 4°
Insect/Disease: None
Dominant Plant Species: *Agropyron cristatum*, *Penstemon procerus*

Notes: Near a reclaimed road area.

H_10

Photo file: H_10n.jpg

Photo file: H_10e.jpg

Photo file: H_10s.jpg

Photo file: H_10w.jpg

Plot ID: H_10
Survey Date: September 19, 2013
Cover Type: Shrubland
Sage Cover: 10%
Other Shrub Cover: *Potentilla fruiticosa* 27%
Total Shrub Cover: 32%
Grass Cover: 60%
Forb Cover: 25%
Aspect: west
Slope: 6°
Insect/Disease: none
Dominant Plant Species: *Taraxacum officinale, Pascopyron smithii, Achillea lanlulosa, Bromus spp.*

Notes:

H_13

Photo file: H_13n.jpg

Photo file: H_13e.jpg

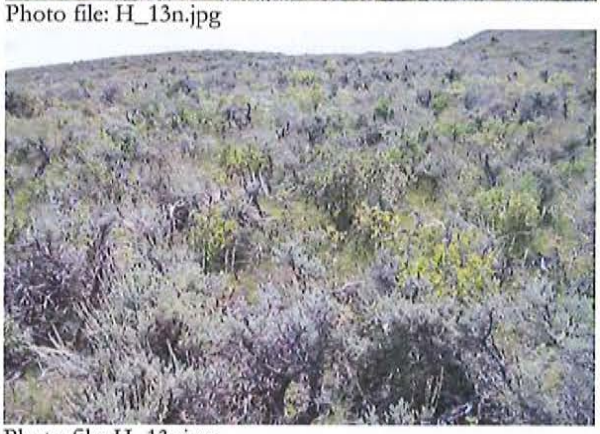


Photo file: H_13s.jpg

Photo file: H_13w.jpg

Plot ID: H-13
Survey Date: September 19, 2013
Cover Type: Shrub
Sage Cover: 25%
Other Shrub Cover: *Symphorocarpos oreophilus* 3%, *Purshia tridentata* 10%, *Chrysothamnus viscidiflorus* 5%, *Amelanchier alnifolia* 1%
Total Shrub Cover: 40%
Grass Cover: 28%
Forb Cover: 30%
Aspect: north
Slope: 5°
Insect/Disease: none
Dominant Plant Species: *Lupinus spp., Eriogonum umbelatum, Carex geyeri, Arctostaphylos uva-ursi, Antennaria parvifolora*

Notes:

H_16

Photo file: H_16n.jpg

Photo file: H_16e.jpg

Photo file: H_16s.jpg

Photo file: H_16w.jpg

Plot ID: H_16
Survey Date: September 18, 2013
Cover Type: Shrub
Sage Cover: 25%
Other Shrub Cover: *Chrysothamnus viscidiflorus* 10%
Total Shrub Cover: 28%
Grass Cover: 6%
Forb Cover: 3%
Aspect: south
Slope: 1°
Insect/Disease: none
Dominant Plant Species: *Artemisia frigida, Poa spp., Pseudoroegneria spicata, Eriogonum umbellatum*

Notes:

H_20

Photo file: H_20n.jpg

Photo file: H_20e.jpg

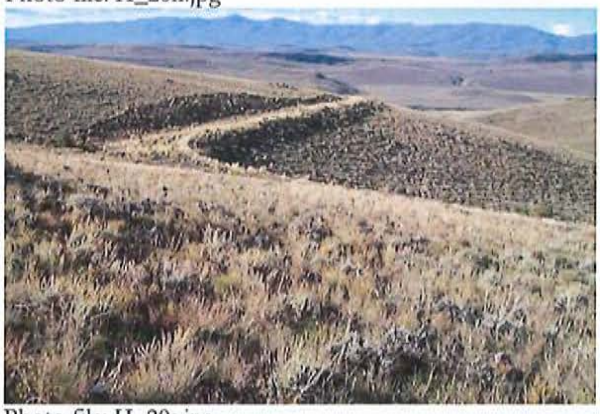


Photo file: H_20s.jpg

No Photo Available

Photo file: H_20w.jpg

Plot ID: H_20
Survey Date: September 18, 2013
Cover Type: Shrub
Sage Cover: 23%
Other Shrub Cover: *Purshia tridentata* 8%, *Potentilla fruiticosa* 5%, *Chrysothamnus viscidiflorus* 10%
Total Shrub Cover: 35%
Grass Cover: 18%
Forb Cover: 15%
Aspect: southwest
Slope: 13°
Insect/Disease:
Dominant Plant Species: *Eriogonum umbellaturm, Elymus elymoides, Koelaria macarantha, Aster spp., Carex geyeri*

Notes:

NH_17- this point was originally in open waters of Wolford Reservoir, but was moved to the uplands.

Photo file: NH_17n.jpg

Photo file: NH_17e.jpg

Photo file:NH_17s.jpg

Photo file: NH_17w.jpg

Plot ID: NH_17
Cover Type: Shrub
Other Shrub Cover: *Chrysothamnus viscidiflorus* 1%
Total Shrub Cover: 42%
Forb Cover: 1%
Slope: 1°
Dominant Plant Species: *Agropyron cristatum*

Survey Date: September 19, 2013
Sage Cover: 42%

Grass Cover: 45%
Aspect: northeast
Insect/Disease: none

Notes: Pronghorn antelope seen in area