Desert Bighorn Sheep Suitable Habitat Modeling in Colorado

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In 2012, Colorado Parks and Wildlife developed and adopted a bighorn sheep suitable habitat model to 1) evaluate suitability of translocation sites, 2) establish population objectives in herd management plans, and 3) conduct disease transmission risk analysis (Eichhoff 2012). The original model was developed to depict summer Rocky Mountain bighorn habitat based on 10 Rocky Mountain bighorn datasets collected within the prior 15 years. The most important component of suitable bighorn sheep habitat is escape terrain which includes the presence of steep, rocky terrain and horizontal visibility. However, based on the collar location data from the 3 desert bighorn sheep populations within Colorado, desert bighorns appear to be using terrain that is less rugged than what Rocky Mountain bighorn sheep select. Habitat selection analyses have not yet been completed to determine if ruggedness selection is lower based on preference or simply availability of the habitat in desert bighorn landscapes. The Rocky Mountain bighorn summer source model described 89.7% of the desert bighorn data. Based on desert bighorn habitat selection differences and the original model being developed with Rocky Mountain bighorn data, it was determined that a separate desert bighorn habitat suitability model needed to be developed.

The presence of steep, rocky terrain and horizontal visibility are the fundamental components of suitable bighorn sheep habitat (Smith et al. 1991, Johnson and Swift 2000, Singer et al. 2000, Ziegenfuss et al. 2000, and McKinney et al. 2003). In 2008, the Colorado Division of Wildlife (now Colorado Parks and Wildlife) included a GIS-based habitat evaluation method in the Bighorn Sheep Capture and Translocation Guidelines (George et al. 2008) and later referenced in the Colorado Bighorn Sheep Management Plan: 2009-2019 (George et al. 2009). In 2012, following a presentation of the U.S. Forest Service's Full Curl summer source habitat model to the Western Association of Fish and Wildlife Agencies' Wild Sheep Working Group, a group of Colorado Parks and Wildlife's biologists used select available Colorado Rocky Mountain bighorn sheep telemetry data from 1991-2011 to develop a Colorado specific summer source model. The USFS framework for the Rocky Mountain bighorn summer source habitat is a tool that provides a flexible structure that incorporates the terrain ruggedness index by Sappington et al. (2007) and the LANDFIRE cover type and cover percent for horizontal visibility.

The development of a desert bighorn model is a continuation of the 2012 effort, with the assessment of 3 Desert bighorn datasets that cover a total 4 bighorn sheep game management units (GMUs, Appendix 1). Our goal was to map desert bighorn habitat that achieved a $\geq$ 90% correlation with all telemetry points with the smallest gain of total habitat area compared to the 2012 Colorado Rocky Mountain bighorn summer source model. The 2012 Colorado bighorn model was developed to map suitable summer habitat. The desert bighorn model will be a year round suitable habitat layer, as desert bighorns do not generally migrate to seasonal habitats that are not used year round.

Telemetry Data

For this analysis we compiled 101,803 desert bighorn telemetry locations from 3 telemetry projects that cover 4 bighorn sheep game management units in southwestern Colorado (GMUs, Appendix 1). At the time of this evaluation there were 1,665 locations from 28 individual in S-56, 9957 from 14 individuals in S-62, and 90181 from 27 individuals in S-63/S-64. The telemetry data used for this analysis was a combination of year-round field locations (ground and aerial VHF) and GPS.

Model Scenarios

To explore the effects of changes in the input variables (slope, ruggedness, and vegetation) and model methods, we processed 13 alternative model scenarios (Table 1). The first grouping of models (Alternative 1 – Alternative 10) evaluated alternatives produced during the Rocky Mountain Summer Source Model evaluation process in 2011. Alternatives 1-4 evaluate slope, ruggedness and minimum mapping unit for escape slope. Alternatives 7 – 10 increased allowable canopy cover for selected forest classes, added select low level developed land classes (LANDFIRE ID 21 & 22), and removed mesic-wet spruce fir forest. The second grouping of models (Alternative 1d – Alternative 5d) explored lower values for slope and ruggedness. In addition, Alternatives 4d and 5d evaluated changes to vegetation types and percent cover.

To summarize the modeled area, we applied a 9 mi buffer around desert bighorn Overall Range from the Colorado Species Activity Mapping program and calculated the area in square km.

Table 1. Model scenarios tested with Desert bighorn sheep radio telemetry data sets.

	Sq km	% Locations	
Rocky Mtn Summer Source	2,494	**89.69%**	**27°, 310 ruggedness, 1.6ha, 10-70% canopy, PJ <=40% and Gambels oak <=40%, developed land (21 &22), Alpine at the end**
Alt1	2,709	**87.58%**	**27°, no ruggedness, 1.6ha, 10-30% canopy**
Alt2	3,058	**87.99%**	**no slope, 310 ruggedness, 1.6ha, 10-30% canopy**
Alt2a	1,800	**82.01%**	**no slope, 310 rugged, 1.6ha, no 300-500m buffer, 10-30% canopy**
Alt4	3,518	**89.34%**	**27°, no ruggedness, no min. map, 10-30% canopy**
Alt7	3,965	**95.72%**	**27°, no ruggedness, 1.6ha, 10-70% canopy**
Alt8	2,602	**89.95%**	**no slope, 310 rugged, 1.6ha, no 300-500m buffer, 10-70% canopy**
Alt9	2,808	**88.06%**	**27°, no ruggedness, 1.6ha, 10-30% & select* 10-80% canopy, developed land (21 &22)**
Alt10	3,161	**88.47%**	**no slope, 310 ruggedness, 1.6ha, 10-30% & select* 10-80% canopy, developed land (21 &22)**
Desert Bighorn Specific			
Alt1d	2,757	**90.60%**	**24°, 310 ruggedness, 1.6ha, 10-70% canopy, PJ <=40% and Gambels oak <=40%, developed land (21 &22)**
Alt2d	3,044	**92.51%**	**27°, 110 ruggedness, 1.6ha, 10-70% canopy, PJ <=40% and Gambels oak <=40%, developed land (21 &22)**
Alt3d	3,921	**94.28%**	**27°, 110 ruggedness, No Min Map, 10-70% canopy, PJ <=40% and Gambels oak <=40%, developed land (21 &22)**
Alt4d	3,316	**95.24%**	**27°, 110 ruggedness, 1.6ha, 10-70% canopy, PJ <=40% and Gambels oak <=40%, developed land (21 &22), and Introduced Riparian Shrub**
Alt5d	2,965	**92.09%**	**27°, 110 ruggedness, 1.6ha, 10-70% canopy, PJ <=40%, Salt desert scrub (2081) <= 40%, blackbrush (2210) <= 40%, Lower montane-foothill shrubland (2086) <=60%, developed land (21 &22). Remove oakbrush classes (2215 & 2217) and Artemisia tridentata (2220) *the base model was 2d with vegetation changes**

When considering overall performance of the models across all 3 desert bighorn data sets, Altervatives 1d,2d,4d,5d, and Alt 7 were above the minimum threshold of 90% and performed above average when comparing percentage of telemetry locations vs. model area (Figure 2). Alternative 7 had the highest percentage of telemetry locations, however it also has the highest mapped area (3965 sq km) , bringing the telemetry percentage to area ratio closer to the average than other top alternatives and thus was eliminated from further consideration. In addition to the top alternative models, Alternative 3d was also above the 90% threshold but showed below average performance in the percentage of telemetry locations per area ratio and was elimated from further consideration.

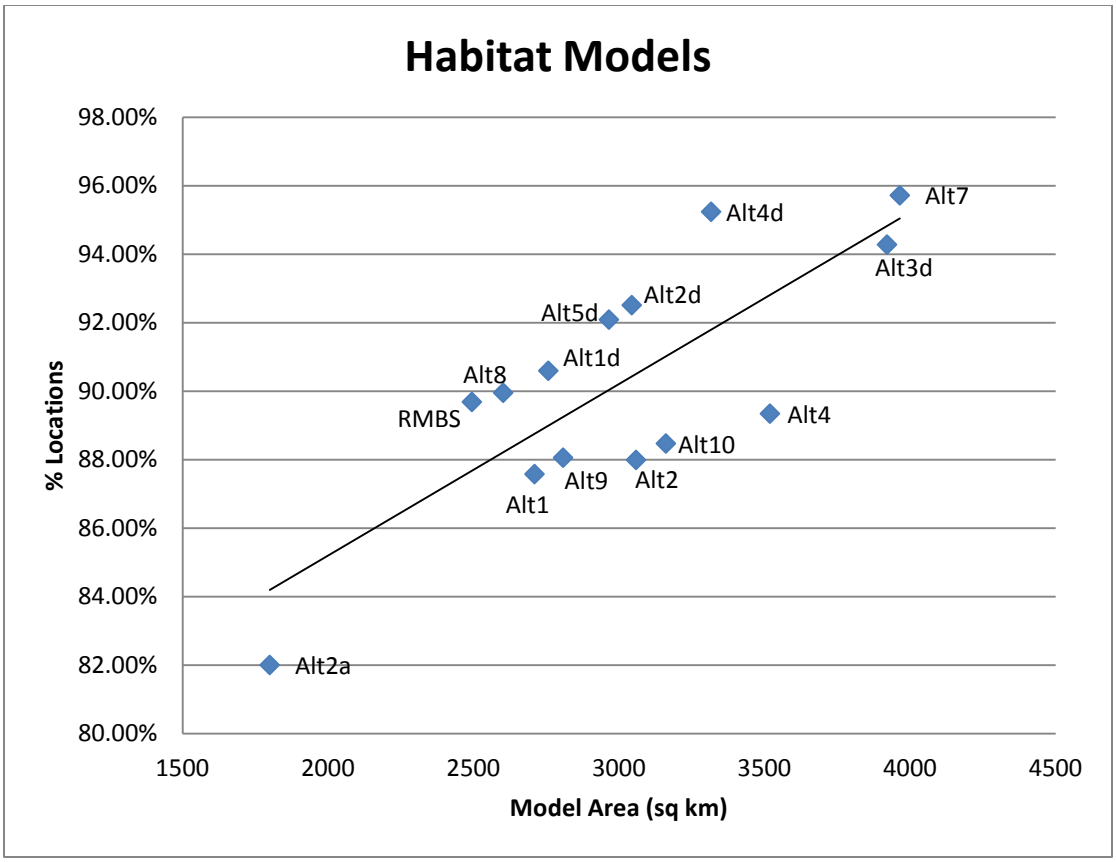

Figure 2. Habitat model alternatives by area and percent of telemetry locations.

Since the quantity of telemetry data available was very uneven between populations (1,665 locations from 28 individual in S-56, 9957 from 14 individuals in S-62, and 90181 from 27 individuals in S-63/S-64) we also considered performance by population.

Of the top models based on the combined telemetry data (1d, 2d, 4d, and 5d), alternatives 4d and 2d have the highest percentages of telemetry locations within modeled habitat for each population. Amongst the three desert bighorn populations S-63 consistently had the highest, S-56 the second highest, and S-62 the lowest percentages of telemetry locations within modeled habitat. S-62 had the highest performance in model alternatives 4 and 3d which were both based on eliminating the 1.6 ha minimum mapping unit on initial selection of escape terrain.

Below are the results, by population, for the Rocky Mountain Summer Source Model and the top alternative models (Figure 3 and Tables 2 - 7).

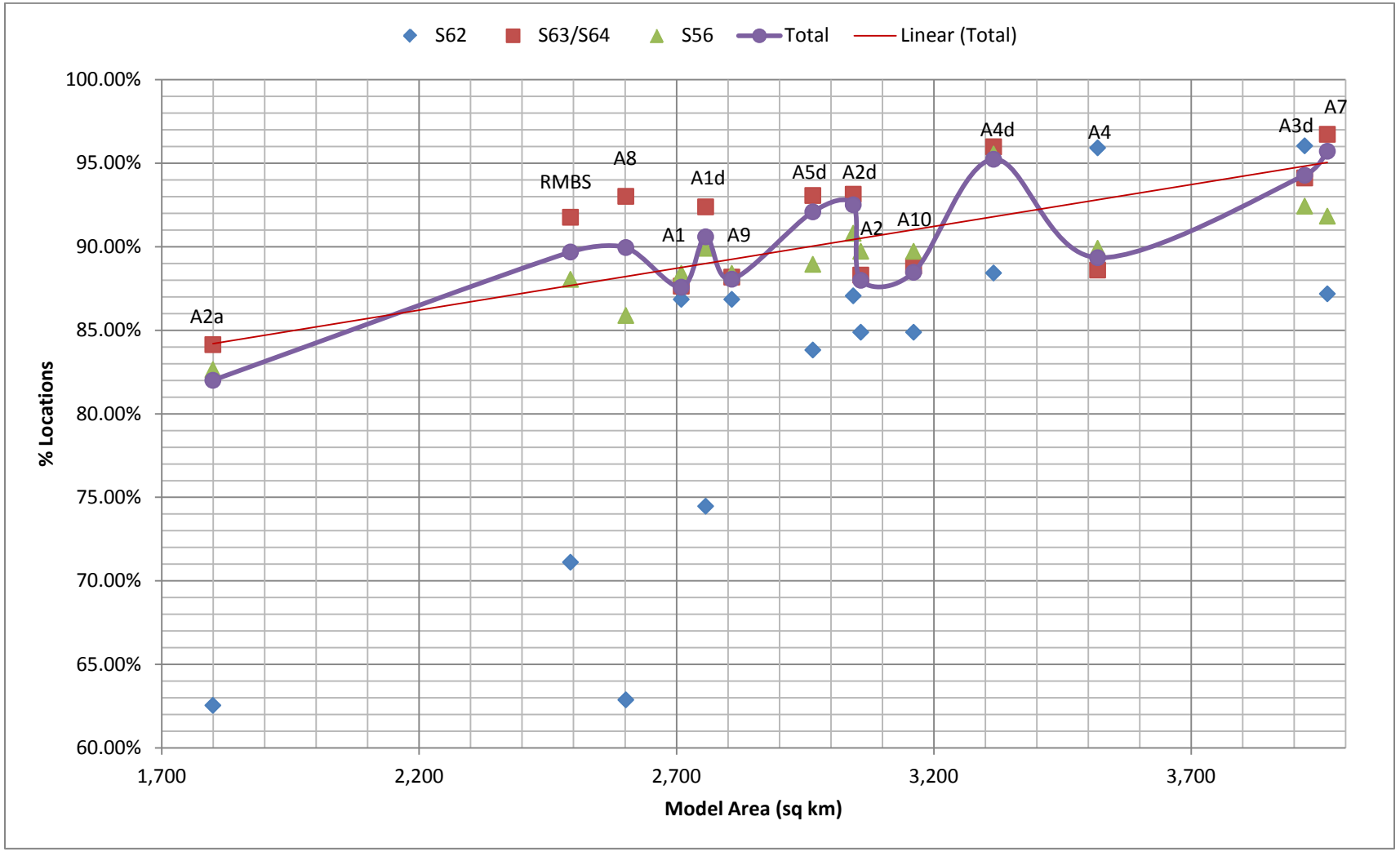

Figure 3. Habitat model alternatives by area and percent of telemetry locations within each population.

Table 2. Results by desert bighorn population for the Rocky Mountain Summer Source Habitat Model

Rocky Mountain	Not Habitat		Habitat		
Area	Count	%	Count	%	Total Count
S56	199	11.95%	1466	88.05%	1665
S62	2876	28.88%	7081	71.12%	9957
S63/S64	7425	8.23%	82756	91.77%	90181
Grand Total	10500	10.31%	91303	89.69%	101803

Table 3. Results by desert bighorn population for habitat model Alternative 7

Alt7	Not Habitat		Habitat		
Area	Count	%	Count	%	Total Count
S56	136	8.17%	1529	91.83%	1665
S62	1276	12.82%	8681	87.18%	9957
S63/S64	2947	3.27%	87234	96.73%	90181
Grand Total	4359	4.28%	97444	95.72%	101803

Table 4. Results by desert bighorn population for habitat model Alternative 1d

Alt 1d	Not Habitat		Habitat		
Area	Count	%	Count	%	Total Count
S56	168	10.09%	1497	89.91%	1665
S62	2542	25.53%	7415	74.47%	9957
S63/S64	6864	7.61%	83317	92.39%	90181
Grand Total	9574	9.40%	92229	90.60%	101803

Table 5. Results by desert bighorn population for habitat model Alternative 2d

Alt 2d	Not Habitat		Habitat		
Area	Count	%	Count	%	Total Count
S56	153	9.19%	1512	90.81%	1665
S62	1288	12.94%	8669	87.06%	9957
S63/S64	6182	6.86%	83999	93.14%	90181
Grand Total	7623	7.49%	94180	92.51%	101803

Table 6. Results by desert bighorn population for habitat model Alternative 4d

Alt 4d	Not Habitat		Habitat		
Area	Count	%	Count	%	Total Count
S56	74	4.44%	1591	95.56%	1665
S62	1152	11.57%	8805	88.43%	9957
S63/S64	3621	4.02%	86560	95.98%	90181
Grand Total	4847	4.76%	96956	95.24%	101803

Table 7. Results by desert bighorn population for habitat model Alternative 5d

Alt 5d	Not Habitat		Habitat		
Area	Count	%	Count	%	Total Count
S56	184	11.05%	1481	88.95%	1665
S62	1611	16.18%	8346	83.82%	9957
S63/S64	6251	6.93%	83930	93.07%	90181
Grand Total	8046	7.90%	93757	92.10%	101803

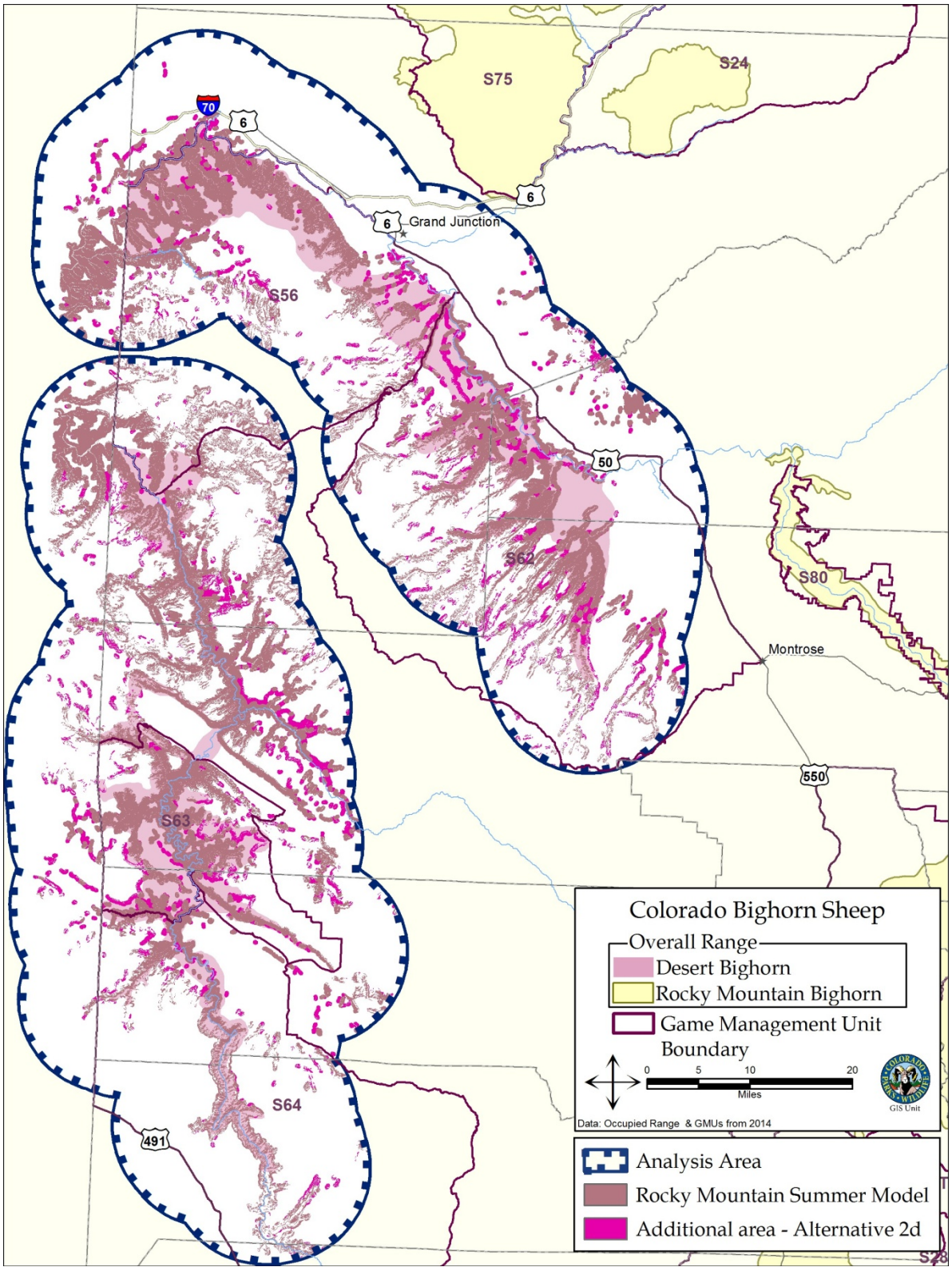

Figure 4. Rocky Mountain summer source model and Desert alternative model 2d. The bright pink color shows the areas added to the Rocky Mountain summer source model to create the 2d alternative.

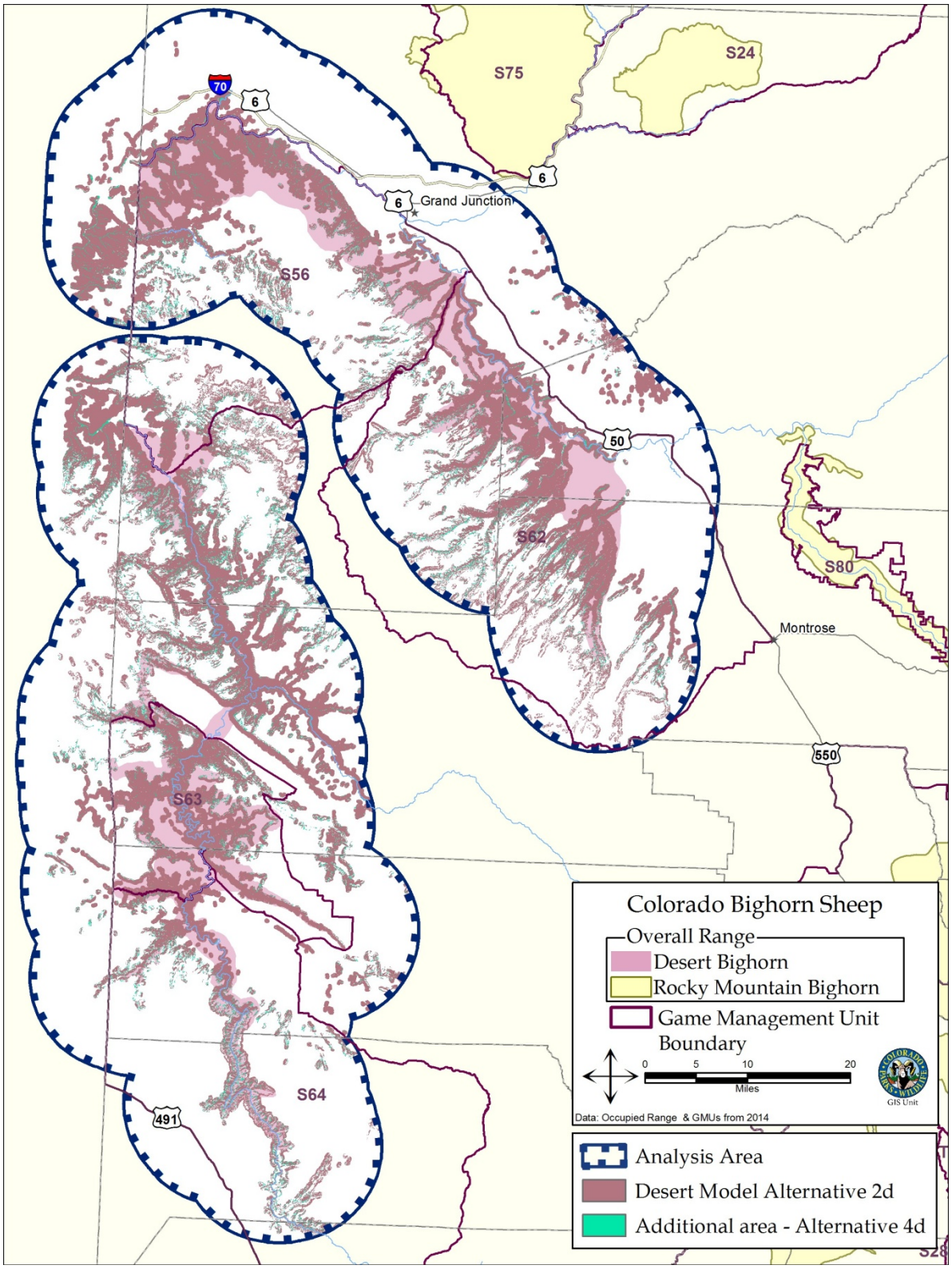

Figure 5. Desert model alternatives 2d and 4d. The green areas show the additional area, from the addition of Introduced Riparian, in model alternative 4d.

Conclusions and Recommendations:

1. Of the 5 models with ≥ 90% coverage and above average ratio area/% locations, Alternative 2d achieved 92.51% coverage of telemetry points from the pooled datasets (vs. 89.69% in Rocky Mountain Summer Source model) with the smallest gain in overall habitat area (3,044 sq km vs. 2,494 sq km in Mountain Summer Source model). Alternative 4d model achieved better coverage (95.24%) of the telemetry points by adding Introduced Riparian (Table 1).

2. Our results support use of the Alternative 4d model as the Colorado Desert bighorn sheep source habitat model for identifying suitable habitat. The Colorado Desert bighorn sheep habitat model should be incorporated into future updates of the Colorado Parks and Wildlife's Bighorn Sheep Capture and Translocation Guidelines (George et al. 2008). Descriptions and comparisons of the previous Rocky Mountain Summer Source habitat model and the new desert bighorn source habitat model (Alternative 4d) can be found in Appendix 2.

3. We recommend allowing flexibility to update model processes as more telemetry data is collected in S62 and other areas. In addition to current studies, other opportunities should be sought to opportunistically collect spatial data for further model refinement in the course of new and ongoing bighorn studies throughout Colorado.

4. It follows that lambing range models for desert bighorn can also be designed, evaluated, and incorporated as appropriate into future revisions of Colorado Parks and Wildlife's Bighorn Sheep Capture and Translocation Guidelines (George et al. 2008).

Literature Cited

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Appendix 1: Radio telemetry Data Sets Used in Analysis

Radio Telemetry Data Sets

Colorado bighorn sheep radio telemetry data sets selected for this analysis met the following criteria:

- desert subspecies
- Within the last 15 years
- ≥ 10 radio marked individuals

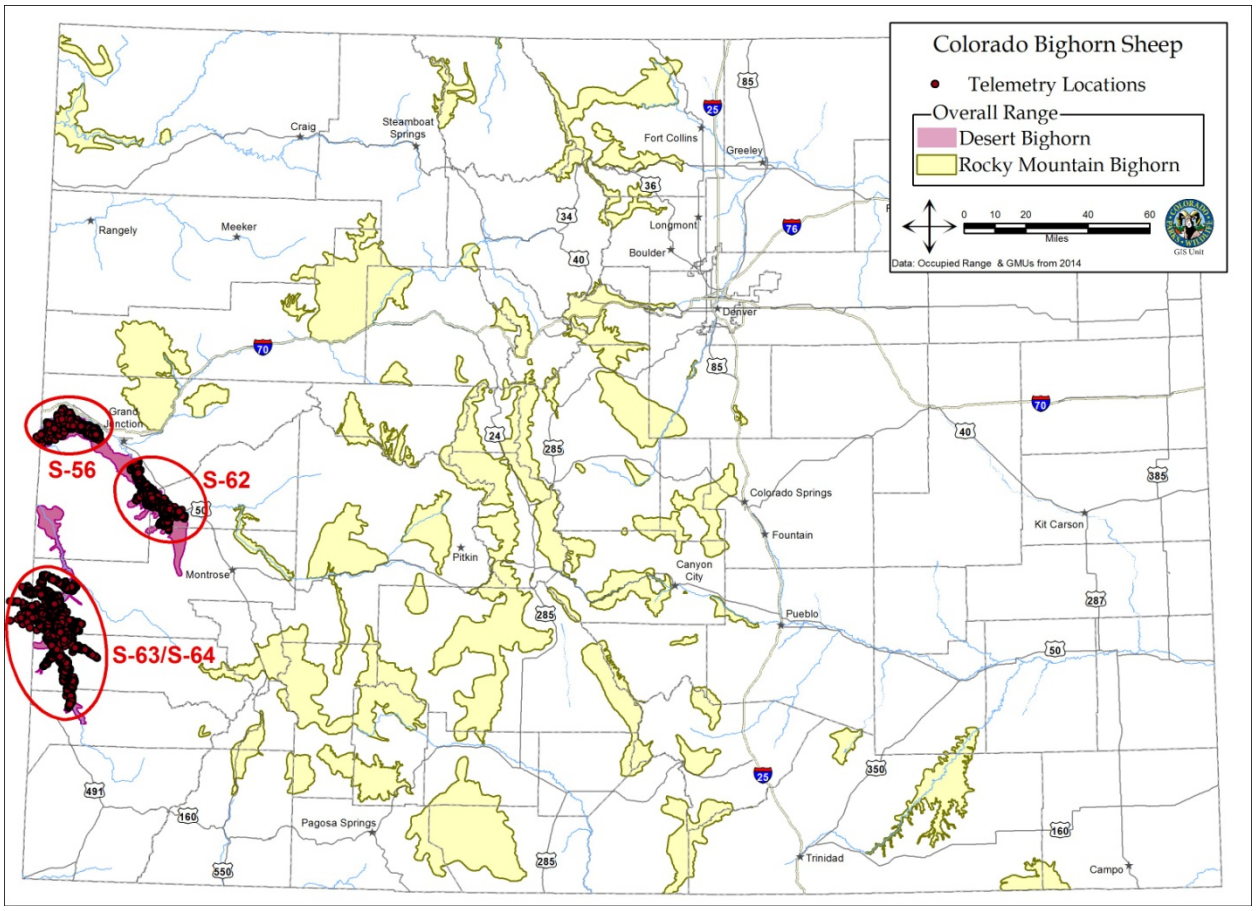


Figure A1-1 Distribution of telemetry locations used to evaluate the desert bighorn source model.

Area	Source File	Years	Number of Animals	Ewes	Rams	# Locations
S-56	BRWCA Ewes	1/4/2008 - 8/2/2012	28	28	0	1,665
S-62	S62Tele140523	12/21/2013 - 5/23/2014	14	5	9	9,957
S-63/S-64	S63Tele20140127	12/17/2010 - 1/27/2014	27	22	5	90,181
Grand Total						**101,803**

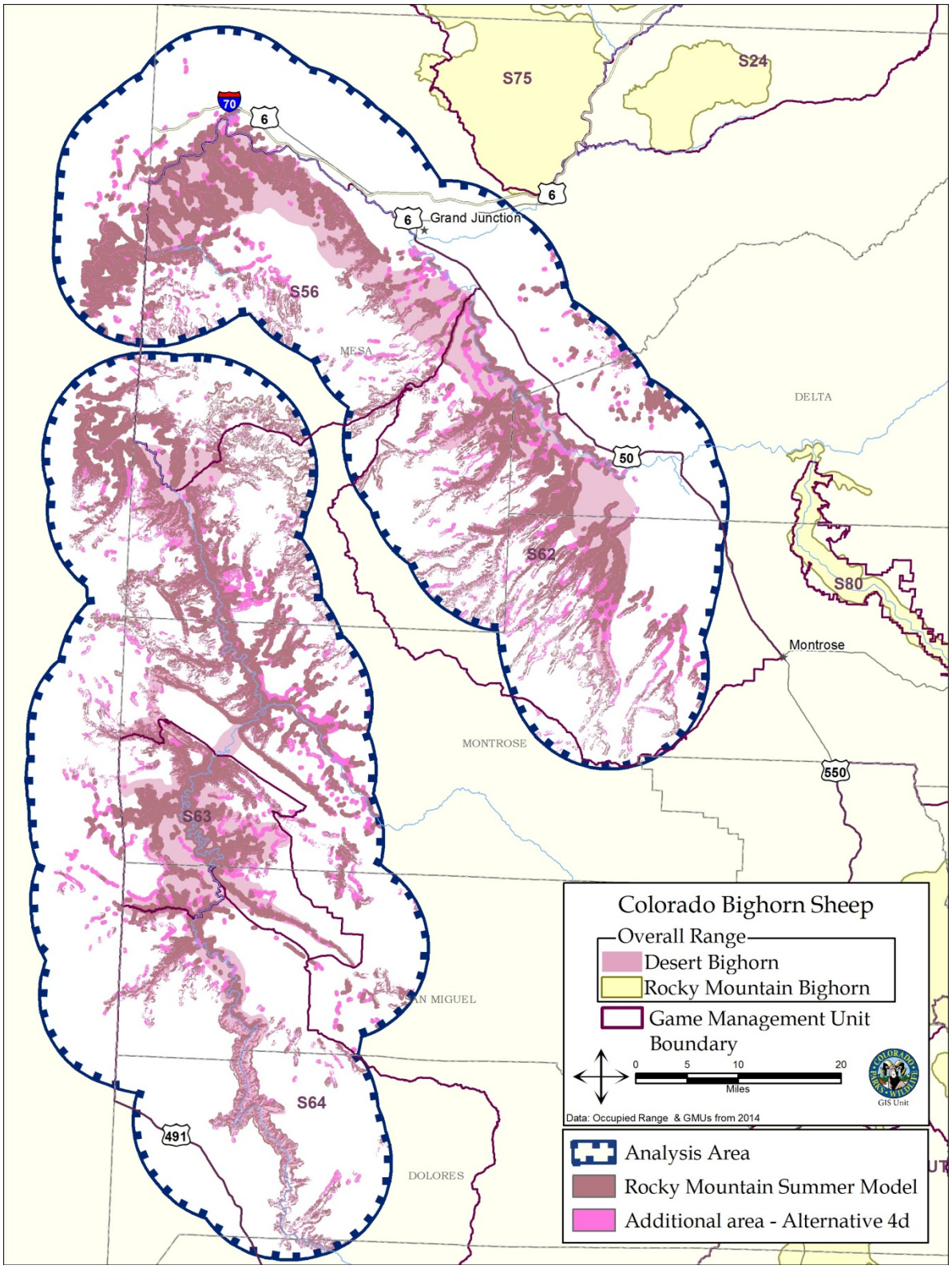
Table A1-1 Desert bighorn sheep radio telemetry data sets used in habitat suitability model evaluation.

Appendix 2: Colorado Desert Bighorn Sheep Suitable Habitat Model

Table A2-1 Differences between the Colorado Rocky Mountain summer suitable habitat model and the Desert bighorn habitat model

Attribute	Rocky Mountain bighorn Summer Habitat	Desert bighorn Source Habitat (4d)
Escape Terrain	areas >= 27° Slope limited to rugged areas = 310	areas >= 27° Slope limited to rugged areas = 110
Low visibility vegetation	LANDFIRE Vegetation and % cover Tree canopy cover 10% - 70%, PJ cover <=40%, Gambel's oak canopy <40%, Developed-open space and Developed-low intensity Alpine vegetation at end of process regardless of slope and ruggedness	LANDFIRE Vegetation and % cover Tree canopy cover 10% - 70%, PJ cover <=40%, Gambel's oak canopy <40%, Developed-open space and Developed-low intensity Add Introduced Riparian
Total area (km^2)	2,494	3,316

Figure A2-1 Rocky Mountain bighorn summer source model and the desert bighorn source model.



Detailed information on each input and function for bighorn sheep summer habitat in Colorado is found in Table A2-2. Table A2-3 describes the LANDFIRE cover types found within the modeled area.

Table A2-2 Colorado Desert bighorn Summer Habitat Model Input

Name	Explanation
CON selection of nonforest cover types	This command creates the nonforested input for the horizontal visibility portion of the Bighorn Sheep Summer Source Habitat model. The input data is Existing Vegetation Type downloaded from LANDFIRE on May 2, 2007. The map algebra command is: con ((Covertype in {12, 31, 2001, 2006, 2007, 2064, 2066, 2070, 2072, 2080, 2081, 2086, 2093, 2094, 2095, 2103, 2104, 2106, 2107, 2111, 2121, 2125, 2126, 2127, 2132, 2133, 2135, 2139, 2140, 2141, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2153, 2160, 2180, 2181, 2182, 2183, 2210, 2211, 2213, 2214, 2215, 2220, 2495, 2503, 2504}), 1)
CON selection of forest cover types and canopy covers	This command creates the forested input for the horizontal visibility portion of the Bighorn Sheep Summer Source Habitat model. The input data are Existing Vegetation Type and Existing Vegetation Cover downloaded from LANDFIRE on May 2, 2007. The canopy covers from LANDFIRE are as follows: 101, Tree Cover ≥10 and <20%; 102, Tree Cover ≥20 and <30%, 103, Tree Cover ≥30 and <40; 104, Tree Cover ≥40 and <50%; 105, Tree Cover ≥50 and <60%; 106, Tree Cover ≥60 and <70%. The map algebra command is: con ((Covertype in {2011, 2012, 2024, 2025, 2046, 2049, 2050, 2051, 2052, 2054, 2055, 2056, 2057, 2059, 2061, 2062, 2115, 2117, 2119, 2154, 2155, 2159, 2162, 2166, 2167, 2208} and Canopy Cover in {101, 102, 103, 104, 105, 106}), 1)
CON selection of oak brush cover and canopy	This command selects the oak brush input for the horizontal visibility portion of the Bighorn Sheep Summer Source Habitat model. The input data are Existing Vegetation Type and Existing Vegetation Cover downloaded from LANDFIRE on May 2, 2007. The canopy covers from LANDFIRE are as follows: 111, Shrub Cover ≥10 and <20%; 112, Shrub Cover ≥20 and <30%, 113, Shrub Cover ≥30 and <40. The map algebra command is: con ((Covertype == 2217 and Canopy Cover in {111, 112, 113}), 1)
CON selection of Pinyon/juniper classes and cover	This command selects the pinyon/juniper input for the horizontal visibility portion of the Bighorn Sheep Summer Source Habitat model. The input data are Existing Vegetation Type and Existing Vegetation Cover downloaded from LANDFIRE on May 2, 2007. The canopy covers from LANDFIRE are as follows: 101, Tree Cover ≥10 and <20%; 102, Tree Cover ≥20 and <30%, 103, Tree Cover ≥30 and <40. The map algebra command is: con ((Covertype == 2016 and Canopy Cover in {101, 102, 103, 104}), 1)
CON selection of developed classes	This command selects the low density developed input for the horizontal visibility portion of the Bighorn Sheep Summer Source Habitat model. The input data are Existing Vegetation Type and Existing Vegetation Cover downloaded from LANDFIRE on May 2, 2007. The map algebra command is: con ((Covertype in {21, 22}), 1)
MERGE of forested and nonforest selections	This command merges the forested and nonforest components of the horizontal visibility component of the Bighorn Sheep Summer Source Habitat model. The map algebra for this command is: merge (nonforest4d, forest11, oak11, forest4dj, developed)
Region Group for minimum mapping size	This Region Group command is the first step in filtering for a minimum mapping unit. This command takes the input and groups the cells based on if they touch and then gives all the touching cells the total count for that group.
CON selection of minimum mapping size of 5 acres	This command selects from the grouped input groups of cell 5 acres or larger. The map algebra for this command is: con (D:\Projects\Terrestrial\Bighorn\USFS_Full_Curl_Model\ProcessStepData\hor_vis_rg4d.count ge 23,1)
"Slope ≥27 and ≤85 degrees" CON	This CON function selects slopes from the slope grid derived from the National Elevation Dataset elevation grid. The slopes selected are equal to or greater than 27° and less than or equal to 85° and roughness index of ≤110. This selection is as follows: con (deg_slp >= 27 AND deg_slp <= 85 AND ruf_10000 >= 110, 1)
Region Group	This command takes the input and groups the cells based on if they touch and then gives all the touching cells the total count for that group.
CON & ZONALAREA (Single Output Map Algebra)	This command selects from the grouped input groups of cell 16000 or larger. The map algebra for this command is "con (zonalarea (slpgp) ≥16000, 1)".

Name	Explanation
CON & EUCDISTANCE LE 300 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells ≤300 m. The map algebra for this command is "con (eucdistance (escslp27110) ≤300, 1)".
CON & EUCDISTANCE GT 500 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells greater than 500 m. The map algebra for this command is "con (eucdistance (escslp27110) > 500, 1)".
CON & EUCDISTANCE GE 500 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells ≥500 m. The map algebra for this command is: con (eucdistance (gt500_27110) >= 500, 1)
CON & ISNULL (Single Output Map Algebra)	This CON function erases the "buff300" from "wi500" to create the final output for the escape terrain component. The map algebra for this function is: con (isnull (buff300_27110), con (wi500_27110 == 1, 1), 1)
CON combines the two model components	This CON command combines the two model components (horizontal visibility and terrain) so that on the cell and overlap from the two inputs appear in the final output.

Table A2-3 LANDFIRE cover types

ID	Description
12	Snow-Ice
21	Developed-Open Space
22	Developed-Low Intensity
31	Barren
2001	Inter-Mountain Basins Sparsely Vegetated Systems
2006	Rocky Mountain Alpine/Montane Sparsely Vegetated Systems
2007	Western Great Plains Sparsely Vegetated Systems
2011	Rocky Mountain Aspen Forest and Woodland
2012	Rocky Mountain Bigtooth Maple Ravine Woodland
2016	Colorado Plateau Pinyon-Juniper Woodland
2046	Northern Rocky Mountain Subalpine Woodland and Parkland
2049	Rocky Mountain Foothill Limber Pine-Juniper Woodland
2050	Rocky Mountain Lodgepole Pine Forest
2051	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland
2052	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland
2054	Southern Rocky Mountain Ponderosa Pine Woodland
2055	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
2056	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland
2057	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
2059	Southern Rocky Mountain Pinyon-Juniper Woodland
2061	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland
2062	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland
2064	Colorado Plateau Mixed Low Sagebrush Shrubland
2066	Inter-Mountain Basins Mat Saltbush Shrubland
2070	Rocky Mountain Alpine Dwarf-Shrubland
2072	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe
2080	Inter-Mountain Basins Big Sagebrush Shrubland
2081	Inter-Mountain Basins Mixed Salt Desert Scrub
2086	Rocky Mountain Lower Montane-Foothill Shrubland
2093	Southern Colorado Plateau Sand Shrubland
2094	Western Great Plains Sandhill Steppe
2095	Apacherian-Chihuahuan Mesquite Upland Scrub
2103	Great Basin Semi-Desert Chaparral
2104	Mogollon Chaparral
2106	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
2107	Rocky Mountain Gambel Oak-Mixed Montane Shrubland
2115	Inter-Mountain Basins Juniper Savanna
2117	Southern Rocky Mountain Ponderosa Pine Savanna
2119	Southern Rocky Mountain Juniper Woodland and Savanna
2121	Apacherian-Chihuahuan Semi-Desert Grassland and Steppe
2125	Inter-Mountain Basins Big Sagebrush Steppe
2126	Inter-Mountain Basins Montane Sagebrush Steppe
2127	Inter-Mountain Basins Semi-Desert Shrub-Steppe
2132	Central Mixedgrass Prairie

ID	Description
2135	Inter-Mountain Basins Semi-Desert Grassland
2139	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland
2140	Northern Rocky Mountain Subalpine-Upper Montane Grassland
2141	Northwestern Great Plains Mixedgrass Prairie
2143	Rocky Mountain Alpine Fell-Field
2144	Rocky Mountain Alpine Turf
2145	Rocky Mountain Subalpine-Montane Mesic Meadow
2146	Southern Rocky Mountain Montane-Subalpine Grassland
2147	Western Great Plains Foothill and Piedmont Grassland
2149	Western Great Plains Shortgrass Prairie
2153	Inter-Mountain Basins Greasewood Flat
2154	Inter-Mountain Basins Montane Riparian Systems
2155	North American Warm Desert Riparian Systems
2159	Rocky Mountain Montane Riparian Systems
2160	Rocky Mountain Subalpine/Upper Montane Riparian Systems
2162	Western Great Plains Floodplain Systems
2166	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland
2181	Introduced Upland Vegetation-Annual Grassland
2182	Introduced Upland Vegetation-Perennial Grassland and Forbland
2183	Introduced Upland Vegetation-Annual and Biennial Forbland
2208	Abies concolor Forest Alliance
2210	Coleogyne ramosissima Shrubland Alliance
2211	Grayia spinosa Shrubland Alliance
2213	Quercus havardii Shrubland Alliance
2214	Arctostaphylos patula Shrubland Alliance
2215	Quercus turbinella Shrubland Alliance
2217	Quercus gambelii Shrubland Alliance
2220	Artemisia tridentata ssp. vaseyana Shrubland Alliance
2495	Western Great Plains Depressional Wetland Systems
2503	(blank)
2504	Chihuahuan-Sonoran Desert Bottomland and Swale Grassland