1/15/2004

Utah High Plateaus Ecoregional Assessment

Summary of Conservation Scenarios

Summary

Six ecological scenarios were generated for the Utah High Plateau Ecoregion. Fifteen data sets depicting the distributions of conservation targets (species, rare communities, ecological systems) were used for the ecoregion. Numerical conservation objectives were assigned for each target, at three distinct numerical levels to describe "low risk" "medium risk" and "high risk" scenarios. "Risk" here refers to the possibility of loss for these targeted biodiversity values. "Low risk" implying a *relatively high level of representation* of that target within lands where biodiversity conservation would be a strong emphasis. "High risk" suggests an alternative where a *relatively low proportion* of the target distribution would be represented in conservation lands. We also created two "cost surface" maps based on an integration of "aquatic suitability" values and "composite suitability" values, with a series of socioeconomic factors. Hence, six scenarios resulted from the combinations of the three sets of numerical conservation objectives (low, medium, and high risk) with the two 'cost surface' layers. The scenarios were run using the Spatial Portfolio Optimization Tool (SPOT) which is designed for ecoregional conservation assessments. All target distributions and cost factors were summarized in a continuous grid of 750 hectare hexagons. SPOT uses simulated annealing to create the conservation portfolios. SPOT sifts through millions of alternative configurations of hexagons to help identify sets that optimally meet stated representation objectives while minimizing 'costs.' An additional composite data set was created using the results from the six scenarios portfolios. This composite data set depicts that number of times a single hexagon is selected in any of the scenarios.

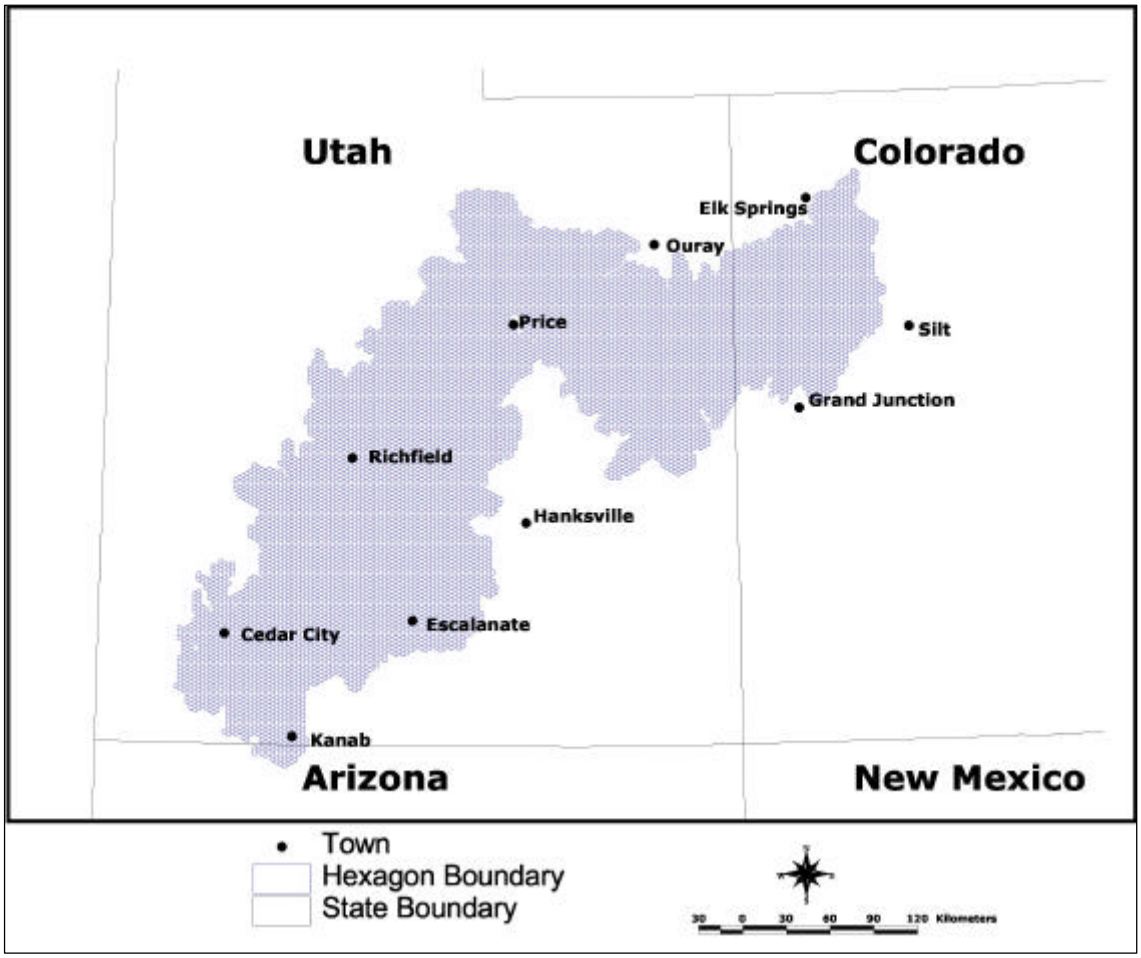
Methods

First, the boundaries of the study area for the Utah High Plateaus had to be delineated. Therefore, using The Nature Conservancy's (TNC) ecoregion boundary for the Utah High Plateaus (UTHP) coupled with freshwater occurrence boundaries (FOB) the study area for the Utah High Plateaus was defined (Figure 1.).

Figure 1

Next, hexagon boundaries were created. Each hexagon was assigned a unique identification code also each hexagon is 750 hectares in area. There are 9,973 hexagons for the entire study area making the total area 7,479,750 hectares in size (Figure2).

Figure 2



Aquatics Suitability Index (ASI) was generated using the spatial data contained in Table 1. Each hexagon was assigned a value (cost) based upon the quantity of each "Factor" and the corresponding "Score" contained with each hexagon boundary. A 'contributing area analysis' also factored in scores from hexagons in catchments from each upstream river reach to establish a final score for each hexagon.

Table 1

Factor	Data Source and Shapefile name	Score (points)	Comments
Dams and Diversions	USGS Geographic Names Information Systems ***(DAMS.shp***)	40 times # of dams or diversions	By Hexagon

Factor	Data Source and Shapefile name	Score (points)	Comments
Mines	USGS Geographic Names Information Systems (***MINES.shp***)	40 times # of mines	Includes both active and abandoned mines
Land Use/Land Cover	housing density 1990 (Theobald, pers. comm.)* (***LULC.shp)***	0 = natural/semi-natural land cover 5 = agriculture 10 = ex-urban 50 = suburban 100 = urban	Percent of area by hexagon times the Score value
Projected Urban Growth	(Theobald 2000 and 2050 block-group housing density) ***(PUG2.shp)***	500 = presence	Percent area not urbanized in 2000, but projected urban for 2050 was multiplied by the Score.
4WD Road Density	1998 TIGER files ***(ROADS_A51_B..shp)***	0 = 0 km 10 = >0-2.5 km 30 = 2.5-5 km 62 = 5-10 km 125 = 10-20 km 250 = >20 km	By Hexagon
Local Road Density	1998 TIGER files ***(ROADS_A41_B..shp)***	0 = 0 km 20 = >0-2.5 km 60 = 2.5-5 km 125 = 5-10 km 250 = 10-20 km 500 = >20 km	By Hexagon
Railroad Lines	1998 TIGER files ***(RAILS2..shp)***	0 = 0 km 20 = >0-2.5 km 60 = 2.5-5 km 125 = 5-10 km 250 = 10-20 km 500 = >20 km	By Hexagon
Highway Road Density	1998 TIGER files ***(ROADS_A31_B..shp)***	0 = 0 km 40 = >0-2.5 km 120 = 2.5-5 km 250 = 5-10 km 500 = 10-20 km 1,000 = >20 km	By Hexagon
Interstate and Frontage Road Density	1998 TIGER files ***(ROADS_A21_A11..shp)***	0 = 0 km 60 = >0-2.5 km 180 = 2.5-5 km 375 = 5-10 km 750 = 10-20 km 1,500 = >20 km	By Hexagon

Factor	Data Source and Shapefile name	Score (points)	Comments
Power Transmission Lines	1998 TIGER files ***(UTILITY2.shp)***	0 = 0 km 10 = >0-2.5 km 30 = 2.5-5 km 62 = 5-10 km 125 = 10-20 km 250 = >20 km	By Hexagon
Superfund Sites	CERCLA, EPA - National Priority List ***(UTHP_CERCLA2.shp)***	40 = CERCLA values of P or F	By Hexagon
303d Imparied Water Body	EPA ***(UTHP_303d.shp)***	10 = Presence	
Industrial Discharge Facilities	EPA BASINS ***(IFD_UTM.shp)***	10 times # of facilities	By Hexagon
Oil Well (point location)	EPA BASINS ***(UTHP_OILGAS_WELLS.shp)***	5 times # of wells	By Hexagon
Toxic Release Inventory	EPA BASINS ***(TRI.shp)***	40 times # of sites	By Hexagon

The Composite Suitability Index (CSI) was calculated similarly to first stages of the ASI. The data for the CSI integrate factors relevant to the terrestrial environment, then inserts a composite score (scaled between 0 and 250) from the ASI. These data are contained in Table 2.

Table 2

Factor	Data Source	Score (points)	Comments
Mines	USGS Geographic Names Information Systems ***(MINES.shp)***	40 times# of mines	Includes both active and abandoned mines
Recent Fires for the past 20 years	USFS ***(UTHP_FIRE_HISTORY.shp)***	20 = presence	Cost was calculated by the percent of area burned in each hexagon multiplied by the Score
Land Use/Land Cover	housing density 1990 (Theobald, pers. comm.)* (***LULC.shp)***	0 = natural/semi-natural land cover 5 = agriculture 10 = ex-urban 50 = suburban 100 = urban	Cost value scaled proportional to area of hexagon

Factor	Data Source	Score (points)	Comments
Projected Urban Growth	(Theobald 2000 and 2050 block-group housing density) ***(PUG2.shp)***	50 = presence	Percent area not urbanized in 2000, but projected urban for 2050 was multiplied by the Score.
4WD Road Density	1998 TIGER files ***(ROADS_A51_B..shp)***	0 = 0 km 10 = >0-2.5 km 30 = 2.5-5 km 62 = 5-10 km 125 = 10-20 km 250 = >20 km	By Hexagon
Local Road Density	1998 TIGER files ***(ROADS_A41_B..shp)***	0 = 0 km 20 = >0-2.5 km 60 = 2.5-5 km 125 = 5-10 km 250 = 10-20 km 500 = >20 km	By Hexagon
Railroad Lines	1998 TIGER files ***(RAILS2..shp)***	0 = 0 km 20 = >0-2.5 km 60 = 2.5-5 km 125 = 5-10 km 250 = 10-20 km 500 = >20 km	By Hexagon
Highway Road Density	1998 TIGER files ***(ROADS_A31_B..shp)***	0 = 0 km 40 = >0-2.5 km 120 = 2.5-5 km 250 = 5-10 km 500 = 10-20 km 1,000 = >20 km	By Hexagon
Interstate and Frontage Road Density	1998 TIGER files ***(ROADS_A21_A11..shp)***	0 = 0 km 60 = >0-2.5 km 180 = 2.5-5 km 375 = 5-10 km 750 = 10-20 km 1,500 = >20 km	By Hexagon
Power Transmission Lines	1998 TIGER files ***(UTILITY2.shp)***	0 = 0 km 10 = >0-2.5 km 30 = 2.5-5 km 62 = 5-10 km 125 = 10-20 km 250 = >20 km	By Hexagon
Superfund Sites	CERCLA, EPA - National Priority List ***(UTHP_CERCLA2.shp)***	40 = CERCLA values of P or F	By Hexagon

Factor	Data Source	Score (points)	Comments
Oil Well	EPA BASINS ***(UTHP_OILGAS_WELLS.shp)***	40 times # of wells	By Hexagon
Aquatic Suitability Score	FWI contributing area analysis ***(AQI_SUM_SC2.shp)***	Aquatic score standardized between 0 and 250	By Hexagon

Socioeconomic Factors are contained in Table 3. Scenario 1 illustrated in Table 3 is derived from the CSI Score only (Figure 3). Scenario 2 is derived from the CSI score plus the values contained under the Scenario 2 heading (the Socioeconomic Factors) (Figure 4).

Table 3

Socioeconomic Factors		Scenario 1	Scenario 2
High Value Timber lands	Biophysical model; based on slope <35%, montane conifer and aspen forests ***(TIMBER2.shp)***	0 points	500 points Cost value scaled proportional to area of hexagon
High Value Grazing lands	Biophysical model; based on slope <35%, grassland and montane shrubland vegetation ***(RANGE3.shp)***	0 points	500 points Cost value scaled proportional to area of hexagon
High Value Mineral Development Potential	States of UT and CO ***(UTHP_OIL_GAS_POTENTIAL.shp)***	0 points	500 points Cost value scaled proportional to area of hexagon
Potential Farmland Conversion	Biophysical model; low elevation zone, valley bottoms, flats, deep soil from STATSGO, current natural vegetation, proximity to current agricultural land use ***(PFC1.shp)***	0 points	500 points Cost value scaled proportional to area of hexagon

Maximum hexagon value (cost) for Scenario 1 = 1813.089. Maximum hexagon value (cost) and Scenario 2 = 2408.73. Minimum hexagon value (cost) for both scenarios is 0.

Figure 3, Cost for Scenario 1

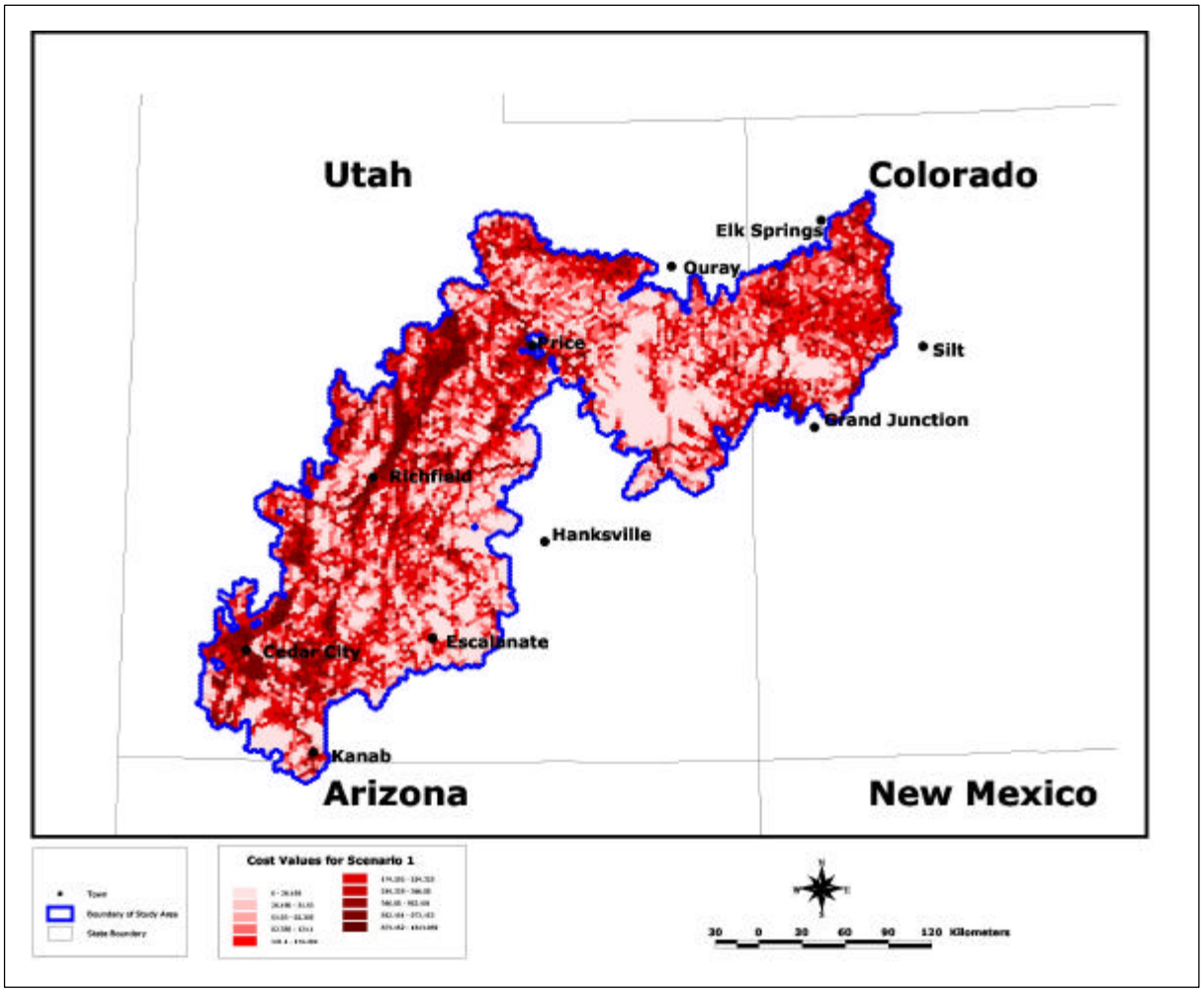
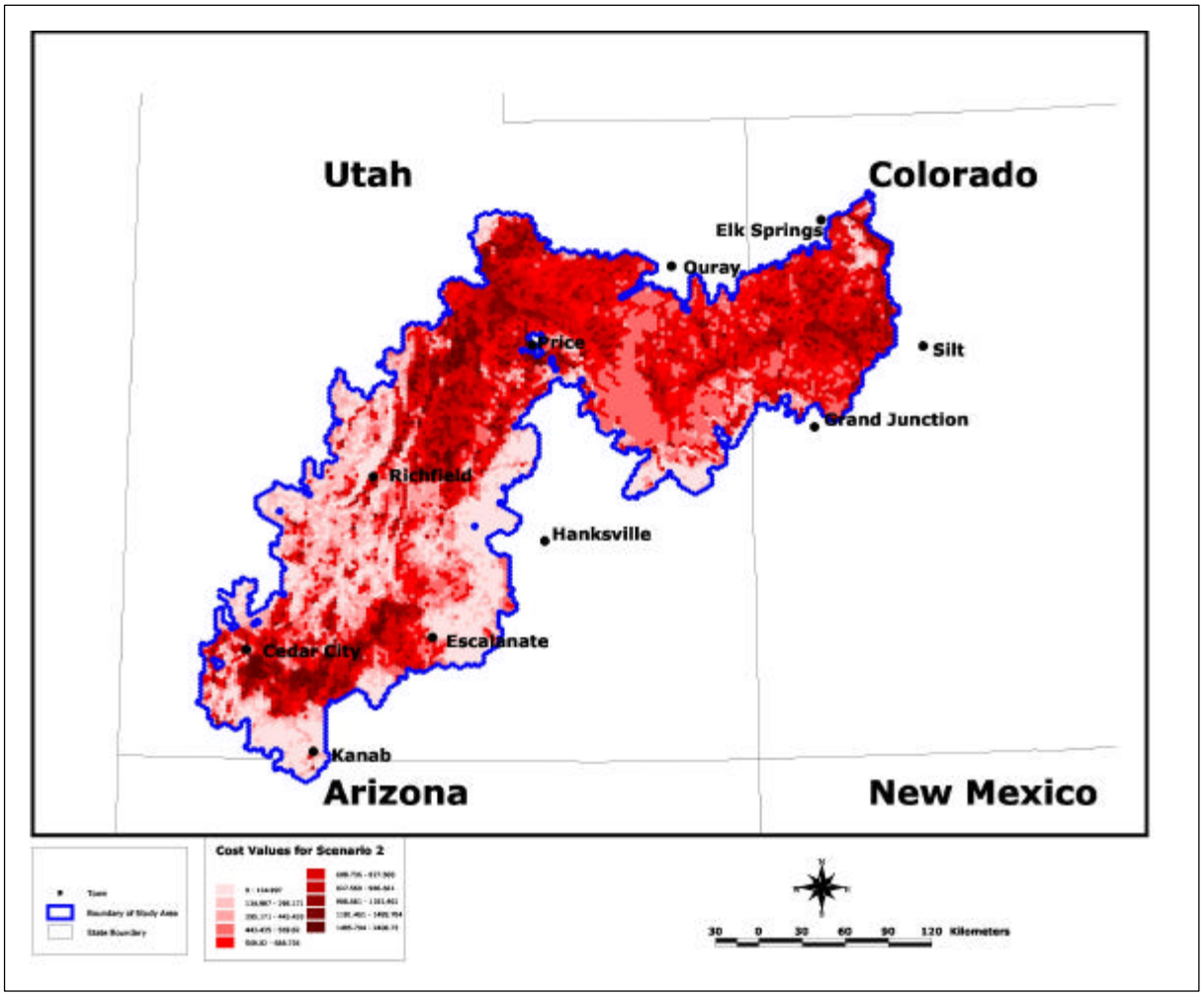


Figure 4, Cost for Scenario 2



Target Data Set

There are a total of 15 data sets that make up the target data set. These datasets are listed in Appendix I. For detailed information with respect to species name, goals/objectives, and exact species numbers, see accompanying spreadsheets.

First, the Ecological Systems data set was stratified into 'Eastern' and 'Western' types, using ECOMAP Section delineations from the Forest Service. This was simply to force a degree of stratified representation of major ecosystems across the ecoregion. Goal/objective statements for major terrestrial ecological systems are ideally stated in terms of a proportion of historical extent. Total current area estimates of each type were evaluated and adjusted to approximate historic extent *circa* 1850 using available literature (e.g. existing FS regional assessment documents) and subsequent GIS analysis. This GIS analysis quantified land use categories (i.e. High Intensity Residential or Herbaceous Planted/Cultivated) and neighboring Ecological Systems types to further corroborate documented literature. These adjusted area values are reflected in Appendix II,

and formed the basis for stating % area objectives for several terrestrial ecological system types. In these cases, he "Goal" for each Ecological System Type was calculated by multiplying 0.2 (High Risk), 0.3 (Medium Risk), and 0.4 (Low Risk) by the total area of each Ecological System Type contained in the entire study area. In addition to numerical goals for each ecological system, the systems map was overlain with the coverage of ecological land units (ELUs), which depict unique combinations of landform and substrates, nested with in elevation zones. A representation goal of 10% for each of these types was imposed to further ensure that terrestrial environmental variability and physical gradients would be represented in the solution. Numerical goals for all rare community and species targets were established within high, medium, and low risk categories (see accompanying summary tables). Many rare species had very few occurrences to select from, so their numerical goals stayed constant across all scenarios.

Results

The following graphics are the results from running 6 scenarios. Figure 5 is Socioeconmic Scenario 1 at **High Risk**. Figure 6 is Scenario 1 at **Medium Risk.** Figure 7 is Scenario 1 at **Low Risk**. Figure 8 is Socioeconomic Scenario 2 at **High Risk**. Figure 9 is Scenario 2 at **Medium Risk.** Figure 10 is Scenario 2 at **Low Risk**. Figure 11 is a bar graph of the composite scenarios. That is, this is a frequency of hexagons selected by any scenario. Figure 12 is the composite hexagon data set. That is, this graphic depicts the frequency of hexagons that are selected in any of the 6 scenarios. The range would be from 0 to 6 reflecting the number of scenarios. However, the values displayed here are from 3 to 6. Values from 3 – 6 make up 30 percent of the total population of hexagons in the study area.

Figure 5, Scenario 1 at High Risk

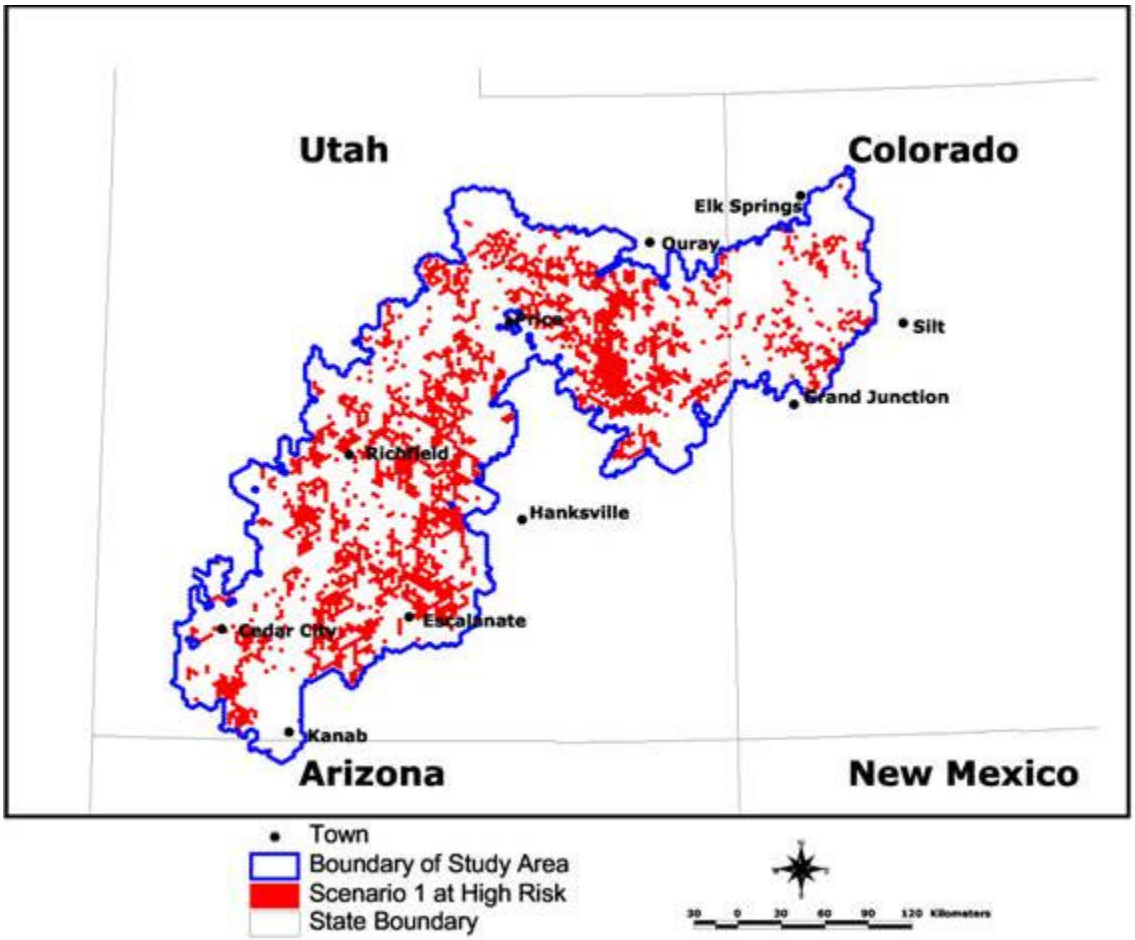


Figure 6, Scenario 1 at Medium Risk

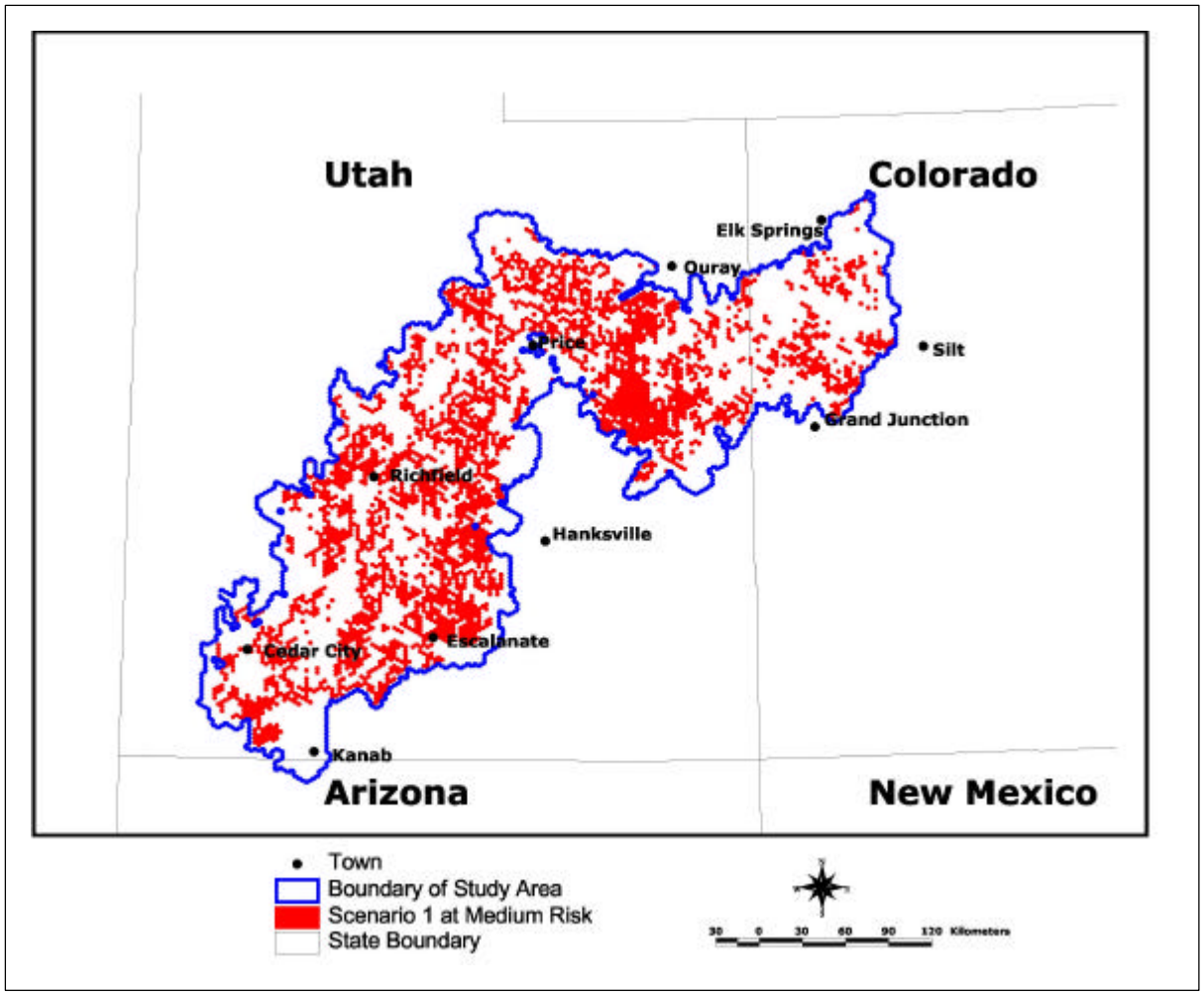


Figure 7, Scenario 1 at Low Risk

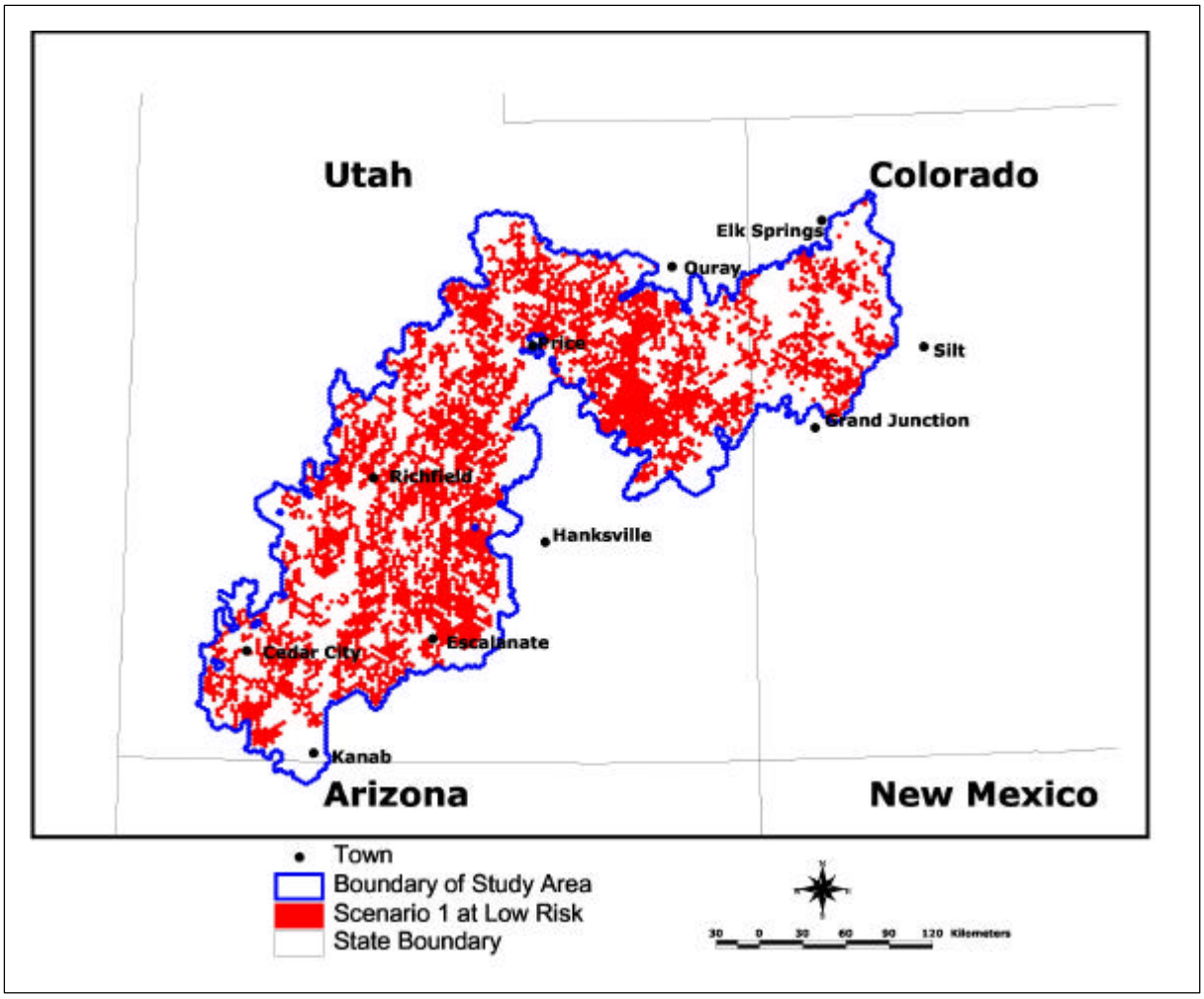


Figure 8, Scenario 2 at High Risk

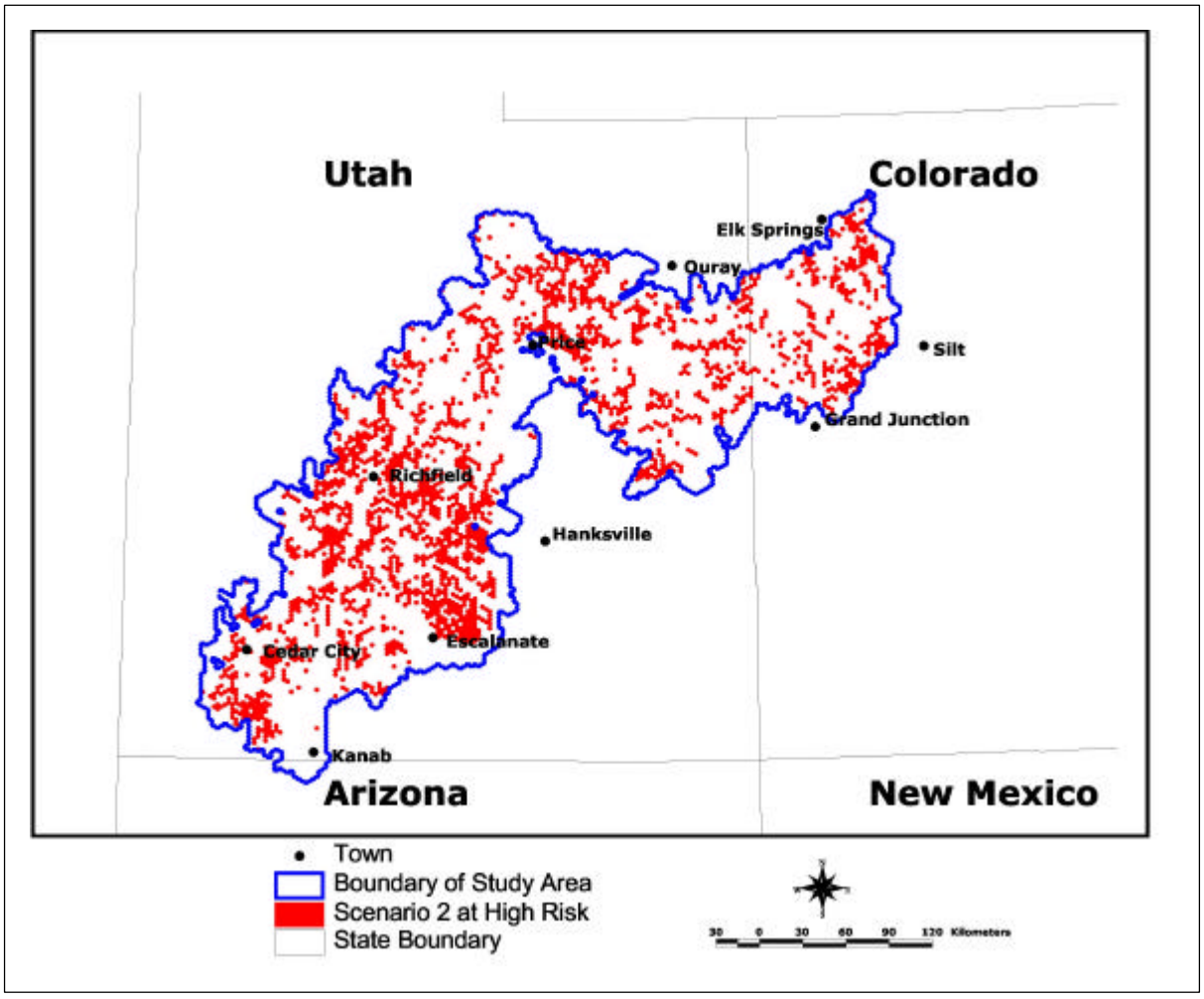


Figure 9, Scenario 2 at Medium Risk

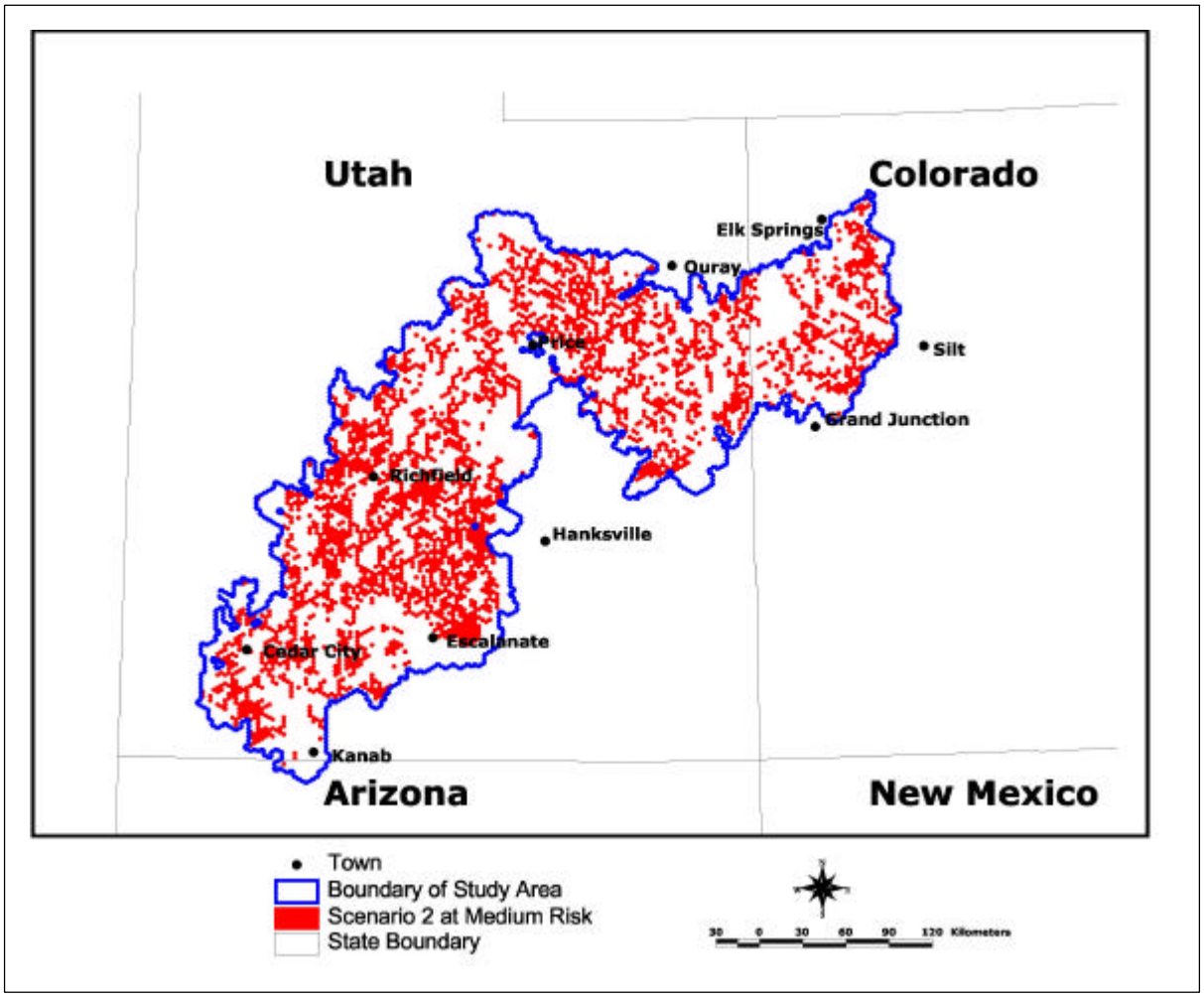


Figure 10, Scenario 2 at Low Risk

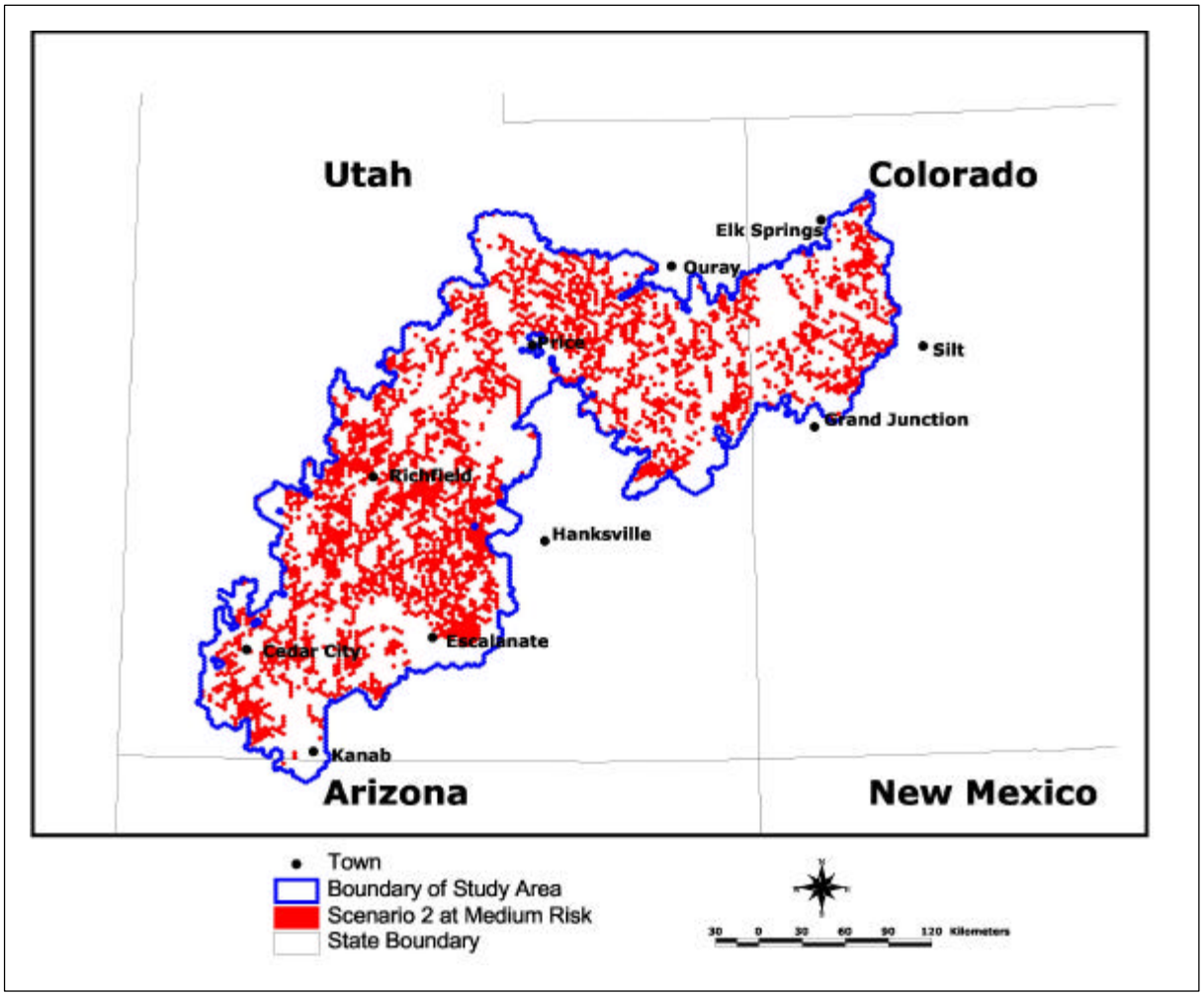


Figure 11, Composite Hexagon Graph

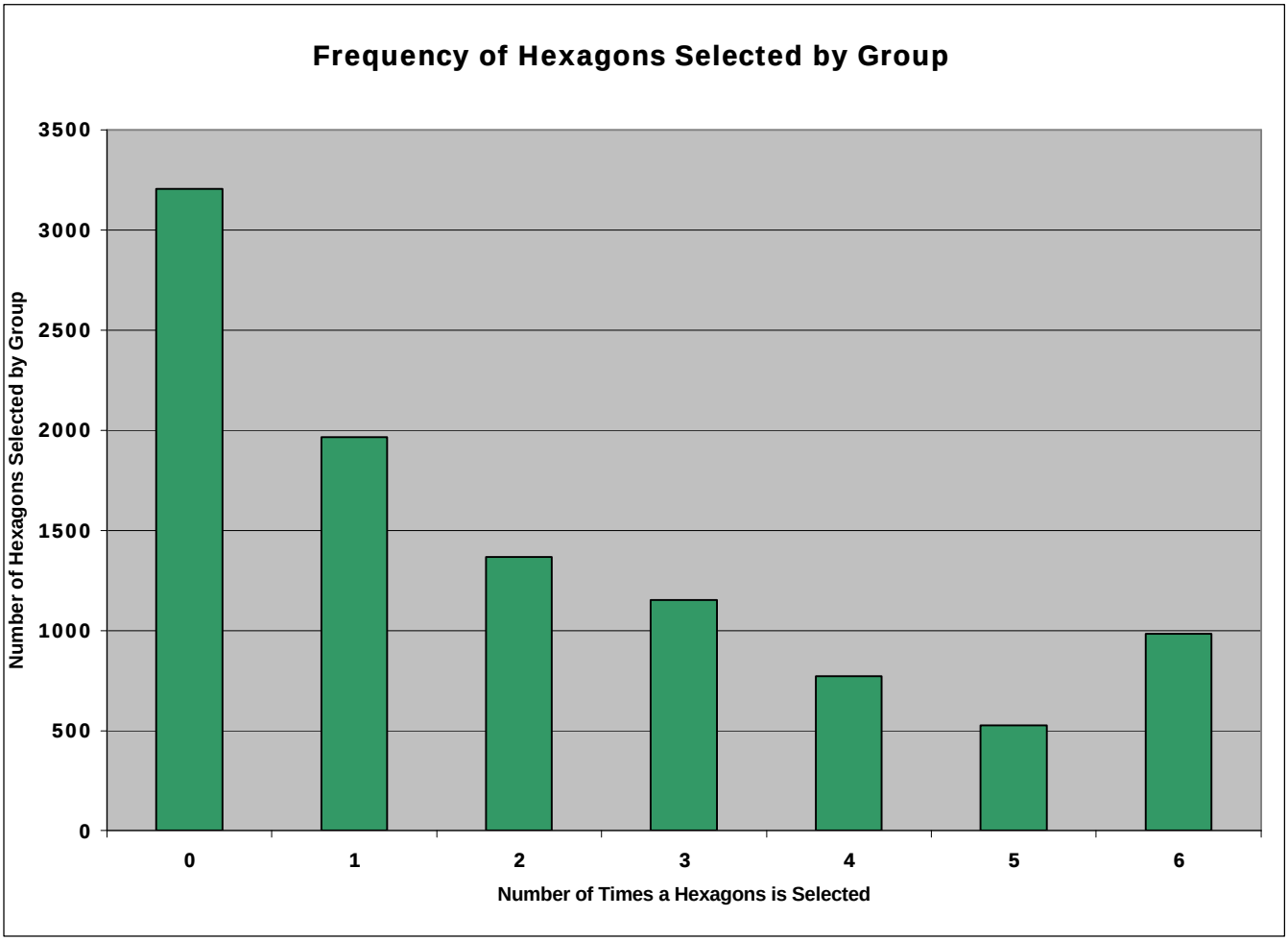
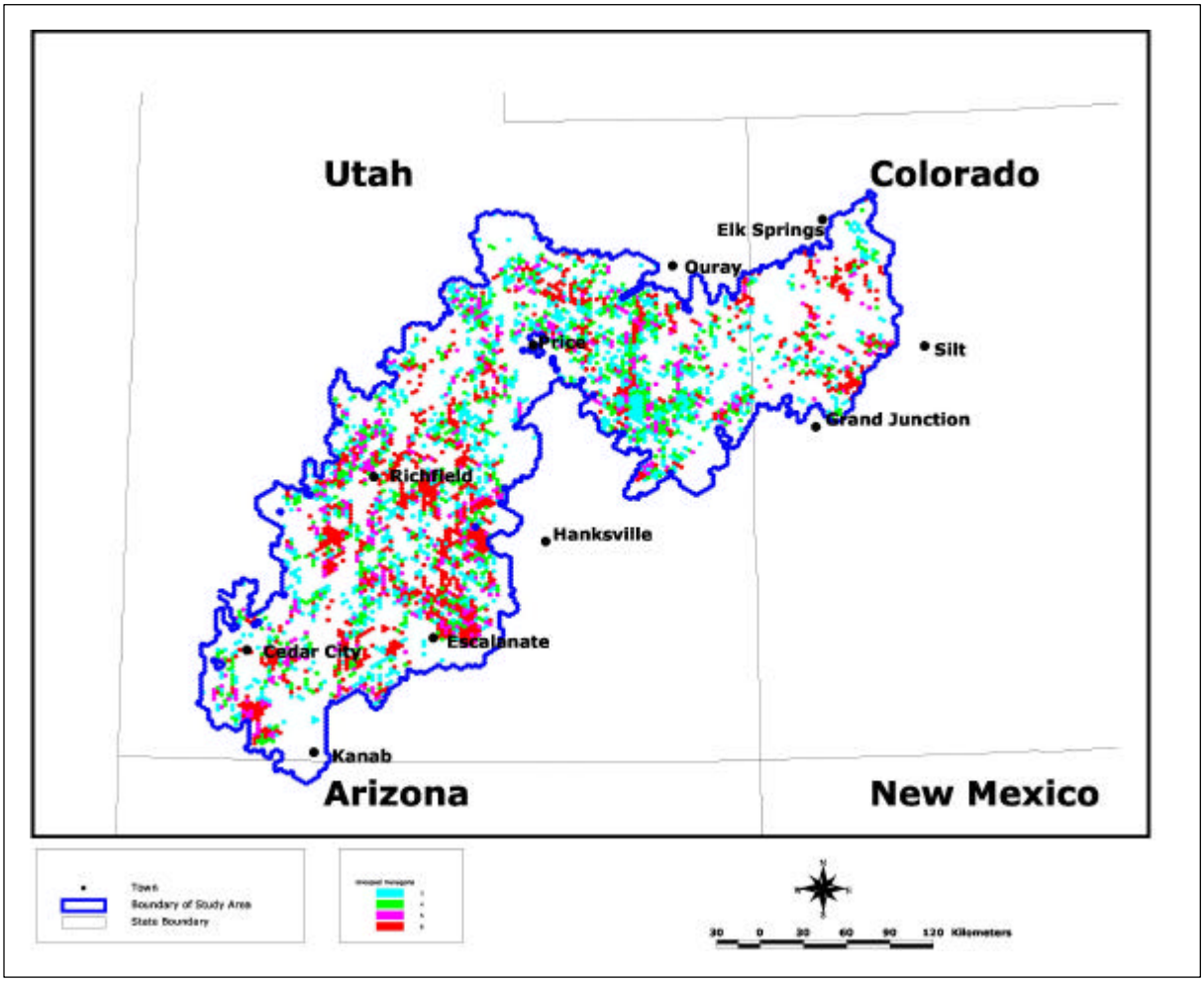


Figure 12, Composite Hexagons



Appendix I

1) Ecological Systems Types partitioned East/West (76 total types) (Units are in Hectares)
2) Unique combinations of Ecological Systems and ELU then selected down to 100-hectare polygons (741 total unique combinants) (Units area in Hectares).
3) Expert derived Community Polygons (14 Unique Communities with 31 total communities) (Units are in Hectares)
4) Expert derived Element Occurrences point locations (153 Unique species and 1351 point Occurrences) (Units are frequency of points)
5) Unique Combinants of the Freshwater Ecological Systems (30 unique combinants) (Units are in Hectares).
6) Goshawk Territories that were polygons were converted to centroids (points) this resulted in 188-point Occurrences. (Units are frequency of points).
7) Fish Occurrence line data there are represented by eight unique fish species. This fish data are in line format (units are meters of streams).
8) Prairie Dog Occurrences. These data were originally polygons that were converted to centroids (points). This resulted in 17 point Occurrences (Units are frequency of Points).
9) Sage Grouse Wintering areas are polygons (units are hectares).
10) Sage Grouse Brooding areas are polygons (units are hectares).
11) Wolf data was created using the Resource Selection Function (RSF). These data came in ARC/INFO GRID format with cell size of 1000 meters and floating point. These data were multiplied by 10,000 to remove the floating-point data (Units are RSF value).
12) Goshawk data was created using the Resource Selection Function (RSF). These data came in ARC/INFO GRID format with cell size of 500-meter floating-point data. These data were multiplied by 10,000 to remove the floating-point data (Units are RSF value).
13) Expert derived terrestrial points are 4 Unique Communities and 14 total communities (Units are frequency of Points).
14) Additional Fish Occurrences data came in point representing 4 unique fish species and 45 in total number (Units are number of points).
15) Black Bear Data came in ARC/INFO GRID format with 500-meter cell size and floating-point data. These data were multiplied by 10,000 to remove the floating-point data (Units are cell values).

Appendix II

Ecological System Name	High Risk	Medium Risk	Low Risk	Total current extent (ha)	assumptions re: % change in extent since 1850
Eastern Colorado Plateau Blackbrush - Mormon Tea Shrubland	4067	6100	8134	20334	<10% change
Eastern Colorado Plateau Mixed Bedrock and Tableland	4372	6558	8744	21860	<10% change
Eastern Colorado Plateau Pinyon-Juniper Shrubland	21506	32259	43013	107531	<10% change
Eastern Colorado Plateau Pinyon-Juniper Woodland	180350	270525	360700	901749	<10% change
Eastern Great Basin Pinyon-Juniper Woodland	0	0	0	0	<10% change

Eastern Inter-Mountain Basins Aspen - Mixed Conifer Forest and Woodland	1792	2688	3584	8959	<10% change
Eastern Inter-Mountain Basins Big Sagebrush Shrubland	69390	104084	138779	346948	<10% change
Eastern Inter-Mountain Basins Cliff and Canyon	2887	4331	5775	14437	<10% change
Eastern Inter-Mountain Basins Greasewood Flat	5320	7980	10640	26600	<10% change
Eastern Inter-Mountain Basins Juniper Savanna	30000	45000	60000	239013	increase 60% estimated extent 1850: 150,000
Eastern Inter-Mountain Basins Mixed Salt Desert Scrub	160650	240975	321301	803251	<10% change

Eastern Inter-Mountain Basins Montane Sagebrush Steppe	65474	98211	130947	327369	<10% change
Eastern Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	303	454	606	1515	<10% change
Eastern Inter-Mountain Basins Semi-Desert Grassland	31000	46500	62000	65366	decrease 60% estimated extent 1850: 155,000
Eastern Inter-Mountain Basins Shale Badland	5239	7859	10478	26195	<10% change
Eastern Inter-Mountain Basins Volcanic Rockland	0	0	0	0	<10% change
Eastern North American Arid West Emergent Marsh	136	204	272	680	<10% change
Eastern Rocky Mountain Alpine / Montane Wet Meadow	349	523	698	1744	<10% change

Eastern Rocky Mountain Aspen Forest and Woodland	21327	31991	42655	106637	<10% change
Eastern Rocky Mountain Bigtooth Maple Ravine Woodland	0	0	0	0	<10% change
Eastern Rocky Mountain Foothill Grassland	3797	5696	7594	18986	<10% change
Eastern Rocky Mountain Gambel Oak - Mixed Montane Shrubland	70992	106488	141984	354959	<10% change
Eastern Rocky Mountain Lower Montane - Foothill Shrubland	3922	5882	7843	19608	<10% change
Eastern Rocky Mountain Lower Montane / Foothill Riparian Woodland and Shrubland	12492	18738	24984	62460	decrease (<10%)

Eastern Rocky Mountain Montane Dry - Mesic Mixed Conifer Forest and Woodland	17801	26701	35602	89005	<10% change
Eastern Rocky Mountain Ponderosa Pine Woodland	20700	31050	41400	103500	<10% change
Eastern Rocky Mountain Subalpine - Montane Riparian Woodland	1107	1661	2215	5537	<10% change
Eastern Rocky Mountain Subalpine Dry - Mesic Spruce-Fir Forest and Woodland	6355	9533	12711	31776	<10% change
Eastern Rocky Mountain Subalpine Meadow	728	1092	1457	3641	<10% change
Eastern Rocky Mountain Subalpine Mesic - Spruce-Fir Forest and Woodland	230	344	459	1148	<10% change

Eastern Rocky Mountain Subalpine-Montane Riparian Shrubland	204	305	407	1018	<10% change
Eastern Southern Rocky Mountain Montane Grassland	8111	12167	16222	40556	<10% change
Western Colorado Plateau Blackbrush - Mormon Tea Shrubland	3992	5989	7985	19962	<10% change
Western Colorado Plateau Mixed Bedrock and Tableland	9967	14950	19933	49832	<10% change
Western Colorado Plateau Mixed Low Sagebrush Shrubland	0	0	0	0	<10% change
Western Colorado Plateau Pinyon-Juniper Shrubland	6243	9365	12486	31216	<10% change
Western Colorado Plateau Pinyon-Juniper Woodland	132901	199351	265801	664503	<10% change

Western Great Basin Pinyon-Juniper Woodland	42721	64082	85442	213605	<10% change
Western Great Basin Xeric Mixed Sagebrush Shrubland	25215	37823	50431	126077	<10% change
Western Inter-Mountain Basins Aspen - Mixed Conifer Forest and Woodland	12000	18000	24000	106616	increase >80% estimated extent 1850: 60,000
Western Inter-Mountain Basins Big Sagebrush Shrubland	75000	112000	150000	322081	decrease 15% estimated extent 1850: 375,000
Western Inter-Mountain Basins Cliff and Canyon	4841	7262	9683	24207	<10% change
Western Inter-Mountain Basins Greasewood Flat	998	1498	1997	4992	<10% change
Western Inter-Mountain Basins Juniper Savanna	35000	52500	70000	279439	increase 60% estimated extent 1850: 175,000

Western Inter-Mountain Basins Mat Saltbush Shrubland	1334	2001	2668	6671	<10% change
Western Inter-Mountain Basins Mixed Salt Desert Scrub	47000	70000	94000	192088	decrease 20% estimated extent 1850: 235,000
Western Inter-Mountain Basins Montane Sagebrush Steppe	70677	106015	141353	353383	<10% change
Western Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	13184	19776	26369	65921	<10% change
Western Inter-Mountain Basins Semi-Desert Grassland	52000	78000	104000	232794	decrease 12% estimated extent 1850: 260,000
Western Inter-Mountain Basins Semi-Desert Shrub Steppe	9632	14448	19264	48159	<10% change

Western Inter-Mountain Basins Shale Badland	10842	16264	21685	54212	<10% change
Western Inter-Mountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland	1963	2944	3925	9813	<10% change
Western Inter-Mountain Basins Volcanic Rockland	1455	2182	2910	7275	<10% change
Western Mojave Mid-Elevation Mixed Desert Scrub	0	0	0	0	<10% change
Western North American Arid West Emergent Marsh	186	279	372	930	<10% change
Western Rocky Mountain Alpine / Montane Wet Meadow	819	1229	1638	4095	<10% change
Western Rocky Mountain Aspen Forest and Woodland	60000	90000	120000	183772	decrease 70% estimated extent 1850: 300,000

Western Rocky Mountain Bigtooth Maple Ravine Woodland	110	165	220	549	<10% change
Western Rocky Mountain Gambel Oak - Mixed Montane Shrubland	78213	117319	156425	391063	<10% change
Western Rocky Mountain Lower Montane / Foothill Riparian Woodland and Shrubland	18000	27000	36000	72265	decrease 25% estimated extent 1850: 90,000
Western Rocky Mountain Montane Dry - Mesic Mixed Conifer Forest and Woodland	35974	53961	71948	179870	<10% change
Western Rocky Mountain Ponderosa Pine Woodland	28411	42617	56822	142055	<10% change
Western Rocky Mountain Subalpine - Montane Riparian Woodland	3403	5105	6807	17016	<10% change

Western Rocky Mountain Subalpine Dry - Mesic Spruce-Fir Forest and Woodland	22721	34081	45442	113604	<10% change
Western Rocky Mountain Subalpine Meadow	15200	22800	30400	38054	decrease 50%: estimated extent 1850: 80,000
Western Rocky Mountain Subalpine Mesic - Spruce-Fir Forest and Woodland	855	1283	1710	4275	<10% change
Western Rocky Mountain Subalpine-Montane Riparian Shrubland	1014	1521	2028	5071	<10% change
Western Southern Rocky Mountain Montane Grassland	22959	34439	45919	114797	<10% change