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An Assessment of Imperiled Habitat in Colorado

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Abstract

Wildlife habitat is threatened by rapid conversion of agricultural to residential land use throughout the Rocky Mountain West. As a result of these changes, citizens, planners and decision makers need to identify areas of land that offer the greatest benefits for conservation of wildlife species, and that are also at greatest risk of harm from encroaching development. We combine statewide maps of historical, current, and projected development patterns with maps of habitat quality to set priorities for habitat protection. We use land cover data from the Colorado Gap Analysis project to develop modeled habitat and indices of species richness and patch value. Patch quality is estimated on the number of sensitive species that could potentially inhabit the patch, the size of the patch, and the relative contribution of the patch to all suitable habitat available to the species. Development (housing density) patterns are derived from US Census Bureau block-group and block-level data. Our analyses reveal that mid-elevation habitat types in mountain valleys as well as riparian and foothills areas on the Front Range are high priorities for conservation.

Introduction

Rapid residential development, fueled by annual population growth rates exceeding 3% per year, has resulted in extensive land use change in the Rocky Mountain West (Figure 1). This conversion from agricultural to residential land use replaces intensive, extractive-based land use changes as the foremost threat to intact, high quality wildlife habitat.

As a result of these changes, citizens, planners and decision makers need to identify areas of land that offer the greatest benefits for conservation of wildlife species, and that are also at greatest risk of harm from encroaching development. In this poster we identify these areas.

Objectives

Our overall goal is to assess the amount and distribution of imperiled wildlife habitat in Colorado.

Our specific objectives are to:

- identify imperiled habitat types;
- determine rates and trends of habitat decline;
- locate areas of concern;
- offer a method to refine analysis of stewardship/protection gaps on private land.

Methods

Land Cover Data

We used the Colorado Gap Analysis Project's statewide coverage on the land cover distribution (Figure 2). Because small features such as lakes and riparian areas are not resolved using coarse-scale mapping but provide disproportionately important wildlife habitat, we augmented the GAP vegetation data by "burning in" lakes and reservoirs and wetlands from the USGS LU/LC 1:250,000. We also modeled riparian areas using variable buffer widths by stream order using the USGS 1:100K DLG hydrography layer: 0 for 1st, 100 m for 2nd and 3rd, 200 m for 4th and 5th, and 300 m for 6th and 7th order streams.

Ranked Species Richness

We modeled potentially suitable habitat for 225 species identified as federally or state threatened or endangered, state species of special concern, Colorado Natural Heritable Program declining (imperiled), or economically-important species in Colorado. Habitat was considered to be those areas that are both within the elevational range of a species and contain vegetation for which that species has an affinity for (e.g., Figure 3 shows the suitable habitat for the Lark Bunting). We then weighted each species' modeled habitat by their COVERS (Colorado Vertebrate Ranking System) score, a biological ranking of imperilment. These weighted habitat layers were then summed to produce the overall ranked species richness map (Figure 4).

Patch Quality

The patch quality map identifies large intact patches of vegetation and weights them by relative rarity of species' habitat (Figure 5). It was created by counting the number of species that have potentially suitable habitat within each patch identified in the GAP vegetation map. We then weighted each patch by the ratio of the patch area to the total area of potential suitable habitat for each species. Small patches are given greater weight if they comprise a large proportion of a species' habitat. Larger patches have higher values relative to their size.

Development Density

Development density maps were created by using housing unit data from the 1990 Census. Housing density for 1960 and 1990 were mapped by dividing the number of units in a block-group by its area, after removing public land and areas above 10,750' and >15 degrees slope (Figures 6 and 7). Future housing density (2020) was projected by increasing population in each block group proportional to the distribution in 1990, converting population to housing units (Figure 8). The resulting projected housing densities then are conservative, in that high density areas are likely over-estimated, while adjacent lower density areas are likely underestimated.

Stewardship/Protection Level

Areas of concern, as identified by GAP analysis, are those areas that are have high species richness, but low protection level. The stewardship/protection level map (Figure 9) was derived using GAP's decision rules for converting different land ownership and management status to protection levels. High protection is provided typically in National Parks and USFS Wilderness areas, while a low level of protection is assigned to private land.

Analysis

We then intersected the development density and stewardship layers with the GAP vegetation layer, the ranked species richness map, and patch quality to ascertain imperilment and levels of protection.

Results

Overall, our analyses reveal that mid-elevation habitat types in mountain valleys as well as riparian areas and foothills along the Front Range are high priorities for conservation.

Imperiled habitat

A large portion of the overall distribution of all major land cover types occurs in private lands, except for tundra (Table 1). Only in forested and water cover types is the majority of the distribution found in public land, in moderate-low to high protection categories. The area subject to influence from development, defined here as areas of exurban or higher density, is rapidly expanding, increasing over 8% annually 1960 to 1990. Forest and water cover types have particularly been subjected to rapid rates of habitat loss due to development (Figure 10).

Species Richness

The highest species richness index values, as expected, are found in the riparian and valleys throughout the state. As a result, the average species richness index value is 40.2 on private land, 46% higher than the average on public land (27.5). The average by protection level is 38.7, 29.4, 15.4, and 26.1 for low, moderate-low, moderate, and high protection, respectively.

Areas of concern

We located areas of concern by identifying areas with native vegetation that are in the path of development (Figure 11). The species richness for these areas averaged 40.2. Areas with Urban/built-up or Agricultural land cover were assumed to have already undergone substantial land cover conversion and were excluded. Risk level corresponds to the magnitude of change between 1960 and projected (2020) levels of development.

Conclusion

As expected, priorities for habitat protection include foothills habitat along the Front Range, riparian areas statewide, and mid-elevation valleys in the mountains. Habitat on or near water and coniferous forest cover also should be included as a priority, which we did not expect.

Even in a public-lands state like Colorado, where vast acreages are "protected," there remain large areas of high quality habitat and high species richness that are at risk from conversion of native land cover and development on private lands. An interesting finding is the juxtaposition of high development densities adjacent to areas with high levels of protection (Figure 9).

Finally, we were not able to adequately address possible *fragmentation* of habitat, especially by development. The major difficulty in quantifying fragmentation is to detail, in a more realistic fashion, the biological response of individual species, rather than relying on simple metrics of patch number or average patch size.

Table 1. Land cover areas, percentages, and protection levels in Colorado.

Land Cover	Area	Percent	GAP Protection		
Type	(ha x 100)	of Total	1 (Private)	1	2
Agriculture - cropland	55718	21.3	97	2	
Barren	752	0.3	46	3	
Forest - deciduous	12063	4.6	22	3	
Forest - evergreen	750660	28.7	25	5	
Rangeland - grass	54009	20.7	80	11	
Rangeland - shrub	49793	19.0	55	8	
Tundra	9535	3.6	4	2	
Urban/Built-up	2158	0.8	95	2	
Water	552	0.2	26	5	
Wetland	2088	0.8	74	5	
TOTAL	267262	100	57	6	