Teton County Best Practices Analysis

Impacts on Wildlife of Low-Density Dispersed versus Clustered Development

Low-density or exurban residential development has expanded rapidly throughout the rural landscapes of the western United States. At an average density of one home per 10 to 40 acres, the area occupied by exurban development has increased five-fold since 1950 (Brown et al. 2005) and now covers nearly one-quarter of the private land area of the conterminous United States (Theobald 2001). With expanding transportation and communications infrastructure, people can more easily choose to live farther from work and locate their homes in areas with abundant natural amenities (Davis and Nelson 1994). Exurban development is expected to expand by an additional 14 percent by 2020 (Theobald 2005).

The conversion of rural private lands to residential development is a leading driver of the loss of biodiversity, wildlife habitat, and productive agricultural lands in the western United States (Sala et al. 2000, McKinney 2002). Private lands, especially those located at lower elevations at the edge of protected areas, typical have a greater degree of biological productivity and provide a disproportionate amount of high quality habitat compared to higher elevation public lands (Scott et al. 2001). Residential development introduces many human disturbances to biological communities (e.g., light, noise, traffic and domestic animals) (Hansen et al. 2005), and a growing scientific literature indicates that it leads to changes in wildlife species composition (Odell and Knight 2001), altered animal behavior (Beckmann and Berger 2003), and decreased biotic integrity (Glennon and Porter 2005). These effects are confounded by the fact that disturbances associated with lower-density development correspond to a more gradual change in the environment, and the possibility for further declines in native species over time (Tilman et al. 1994).

Scientists have used three primary approaches to investigate the effects of residential development pattern on wildlife: (1) comparing wildlife communities in areas with different housing densities (i.e., along a rural-to-urban gradient); (2) comparing wildlife communities in areas with clustered versus dispersed residential development; and (3) quantifying the distance at which houses impact wildlife in adjacent habitat.

Although the richness, abundance, and composition of sensitive, urban avoider wildlife species typically declines with increasing levels of urbanization (Chace and Walsh 2006), the effects of density and configuration of development on wildlife vary by ecoregion and taxonomic group (Pidgeon et al. 2007). For example, in exurban developments in southeast Arizona, native lizard species were scarce, likely due to their vulnerability to domestic predators (Audsley et al. 2006), whereas no effect was observed for rodent community composition or abundance (Bock et al. 2006). In our own research in northern California, we found that individual bird species and functional groups of species exhibited variable responses to exurban development. Some groups of birds (e.g., tree and shrub feeders) were impacted by exurban development (10-40 ac lots) to the same extent as they were impacted by suburban-density development (0.5-2.5 ac lots), whereas others (e.g., temperate migrants) were less sensitive to lower-density development. Full details of the study design and results are available from Merenlender et al. (2009).

Only a few empirical field studies have compared the effects of clustered versus dispersed rural residential development on wildlife species, and the results of those studies have been mixed. In theory, clustering homes should reduce the impacts of residential development on native wildlife, because the zones of influence around individual homes would overlap (Odell et al. 2003, Theobald et al. 1997). However, due to the beneficial effects on home sales prices, clusters of homes are often located near sensitive areas (e.g., lakes), with the potential to negatively impact species in those areas (Gonzalez-Abraham et al. 2007). In the northeastern U.S., clustered subdivisions were more effective at protecting threatened conservation resource than baseline dispersed development scenarios (Milder et al. 2008). In Colorado, clustered and dispersed housing developments did not differ in the composition of songbirds, mammals, or non-native plants (Lenth et al. 2006). In Missouri, clustered housing developments supported fewer forest interior bird species than dispersed developments (Nilon et al. 1995).

Perhaps the most useful approach to evaluate the relative benefits of clustering residential development is to review studies that quantify the distance at which houses negatively impact wildlife. Several studies have measured the effect-distances of residential development on a variety of wildlife species. These distances range from 164 ft (i.e., for mule deer [*Odocoileus hemonius*]) up to 6,562 ft (i.e., for the long-toed salamander [*Ambystoma macrodactylum*]). Table 1 summarizes effect-distances reported in the scientific literature for several groups of birds, mammals, and amphibians that occur in the Rocky Mountain West.

Clustering residential development allows for more opportunities to conserve large patches of wildlife habitats; land containing a few large patches is less fragmented than land containing smaller patches within the same area. For example, in hypothetical subdivisions of a 640 ac section into 16 parcels, Theobald et al. (1997) demonstrated that the proportion of the property that occurred within an effect-distance of 100 m (i.e., 328 ft) was the same (19%) in clustered and dispersed development scenarios. However, for greater effect-distances, the area impacted was much greater in the dispersed scenarios. At 200 m (i.e., 656 ft), housing impacted 74% of the property in the dispersed scenario compared to 31% of the property in the clustered scenario. At 400 m (i.e., 1,312 ft), housing impacted the entire property in the dispersed scenario compared to less than half (46%) of the property in the clustered scenario.

Species or Taxonomic Group	Location of Study	Effect-distance (ft)	Source
Birds			
Riparian birds	Boulder and Larimer Counties, CO	4921	Miller et al. (2003)
Resident birds	San Diego County, CA	656 - 1640	Bolger et al. (1997)
Songbirds	Adirondack Park, NY	656	Glennon and Kretser (2013)
Songbirds	Pitkin County, CO	591	Odell and Knight (2001)
Mammals			
Mule deer, white-tailed deer	Gallatin Valley, MT	1312	Vogel (1989)
Rodents	Boulder County, CO	1171	Bock et al. (2002)
Bighorn sheep	Riverside, San Diego and Imperial Counties, CA	984	Rubin et al. (2002)
Coyote, red fox	Pitkin County, CO	591	Odell and Knight (2001)
White-tailed deer	Groton, CT	283	Kilpatrick and Spohr (2000)
Mule deer	Shasta County, CA	164	Smith et al. (1989)
Amphibians			
Long-toed salamander	Latah and Benewah Counties, ID	6562	Goldberg and Waits (2009)
Pacific treefrog	Latah and Benewah Counties, ID	1640	Goldberg and Waits (2009)
Columbia spotted frog	Latah and Benewah Counties, ID	1640	Goldberg and Waits (2009)
Amphibians	Baltimore, MD	1640	Simon et al. (2009)

Table 1. Published scientific studies that quantified the distance at which housing negatively impacts wildlife.

Taking into account our limited knowledge of the distances at which housing affects individual wildlife species, our recommendations are as follows:

1) Encourage site design based first on the property's natural resource values

Residential development and associated infrastructure should first be directed away from sensitive natural resources on the site (i.e., high value habitats and movement pathways from the Natural Resources Overlay). This will ensure that clustering does not occur haphazardly (i.e., generating a broader-scale pattern of sprawl; Theobald et al. 1997) and that high-density clusters of homes are not located immediately adjacent to important natural resource areas (Gonzalez-Abraham et al. 2007). It will also ensure that land is protected in a way that benefits conservation of wildlife species and habitats in the larger landscape, by contributing to an interconnected network of biologically important open space. In addition to the published effect-distances listed above, several governments and organizations have established thresholds or buffer distances for locating residential development in relation to specific natural resources (e.g., ELI 2003, FWP 2012, SI 2013); if desired, we could assist with summarizing these data and making specific recommendations for Teton County.

2) Encourage clustering of residential development on adjacent lots

In the absence of detailed data on natural resources, or in places where natural resources data is uninformative (e.g., the entire development property has the same natural resource value), residential development and associated infrastructure should be clustered near to development on adjacent properties. This clustering will ensure that the zones of influence around individual homes overlap, thus providing opportunities to conserve larger patches of unfragmented wildlife habitat. This could be achieved by creating incentives for new residential structures and associated infrastructure to be located close to existing development, or incentives for protected land to be contiguous with protected land or undeveloped areas on adjacent properties.

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