Teton County Best Practices Analysis

Impacts of House Size on Wildlife and Natural Resources

In the United States, the average size of new single-family houses has more than doubled since 1950; combined with declining household size during the same period, the amount of living area per person has tripled (Wilson and Boehland 2005). As house size increases, so does consumption of natural resources for materials and construction, at a rate disproportionate to human population growth alone (Kaye et al. 2006). For example, the total volume of wood used in the interior and exterior of new single-family houses increased from an average of 613 ft^3 in 1950 to 1,370 ft^3 in 1994 (McKeever and Phelps 1994). On the other hand, when wood building materials are used, increasing house size results in a greater amount of carbon storage in residential landscapes (Churkina et al. 2010).

In addition to increased material demand for construction, larger houses also lead to greater energy consumption. A larger house, or a house with more complex geometry, has a greater surface area. Greater surface area increases heat loss and unwanted heat gain. In addition to longer distances for transport of air and water, a larger house requires more energy for heating and cooling. Research indicates that increases in house size cannot be mitigated by simply adding energy efficiency features. For example, a recent study demonstrated that smaller houses built to only moderate energy-performance standards used substantially less energy for heating and cooling than larger houses built to very high energy-performance standards (Wilson and Boehland 2005).

Construction of larger houses also requires greater amounts of land alteration and increased impervious surface cover. Impervious surfaces include roads, sidewalks, and roof tops that are covered by materials such as asphalt, concrete, brick and stone, which impede the infiltration of water from the surface of the ground into the soil. As impervious surface cover increases, evapotranspiration and infiltration decrease, and the amount and rate of surface runoff increase. Impervious surface cover also leads to increased sedimentation and pollutant loads, degrading streams and watersheds (Brabec et al. 2002). The resulting changes in the physical and chemical environments of nearby streams are linked to declines in the diversity and abundance of fish and other aquatic organisms (Wang et al. 2001, Paul and Meyer 2008).

We are not aware of any studies that specifically relate house size to wildlife species occurrence, abundance, or movement. However, we can infer from other studies that larger structures may increase some of the negative effects of residential development. For example, collisions with buildings are believed to be the greatest source of human-caused mortality of birds, the cause of an estimated 550 million bird fatalities per year in the United States (Erickson et al. 2005). Most of these collisions are attributable to window strikes, and the mortality rate is a function of the number and size of windows on the structure (Dunn 1993) and landscaped habitat that attracts birds (Hager et al. 2008). If larger homes have more and larger windows, then they may be associated with greater rates of bird mortality. Similarly, if larger homes have more and larger windows and more exterior lighting, we might assume that they will contribute greater amounts of artificial light pollution to the surrounding landscape. Many groups of animals are attracted to or disoriented by artificial lights, and light pollution disrupts species movement, communication, reproduction, and interactions (Rich and Longcore 2006). For example, artificial night lighting impacted the reproductive behavior of several songbird species (Kempenaers et al. 2010) and disrupted the flight routes and foraging of a threatened bat species (Stone et al. 2009). Greater areas of impervious surface cover may also contribute to a localized heat island effect. The heat island effect refers to thermal radiation from buildings, pavement, and other infrastructure, which cause elevated air and soil temperatures and affect species composition and persistence (Baur and Baur 1993). Although the majority of studies on heat island effects have focused on urban areas, recent research demonstrates substantial variation in rural temperatures attributable to land cover (Hawkins et al. 2004). Lastly, larger homes will result in greater amounts of land alteration for construction and may also result in a greater loss of native vegetation cover and an increase in landscaped area of non-native plants. Landscaped areas typically have lower species richness and structural diversity and favor non-native or human-adapted generalist wildlife species (Marzluff and Ewing 2001).

Taking into account these demonstrated effects of larger houses on natural resources, and potential effects of larger houses on wildlife, our recommendations are as follows:

1) For wildlife, house size is less important than site design

A site design based on the property's natural resource values is likely to have greater benefits for conservation of wildlife species and habitats in Teton County than reducing the maximum house size. Residential development and associated infrastructure should be directed away from sensitive natural resources (i.e., high value wildlife habitats and movement pathways) on the development property. Homes should be clustered near to existing development on adjacent properties, and land protection should be encouraged to be contiguous with protected land or undeveloped areas on adjacent properties and contribute to an interconnected network of biologically important open space. These activities could be encouraged through appropriate incentives linked to maximum house size or floor area ratio.

2) For wildlife, house size is less important than land stewardship activities

Active stewardship (e.g., ecological restoration) and clear management guidelines (e.g., regarding domestic animals) for protected open space are likely to have greater benefits for conservation of wildlife species and habitats in Teton County than reducing the maximum house size. In addition, some of the potential disturbances to wildlife of larger houses could be mitigated through land stewardship activities. For example, changing landscaping that attracts birds to residential structures (e.g., bird feeders, fruiting trees, water features, and nesting sites) could help to reduce avian mortality due to window strikes (Hager et al. 2008). These activities could be encouraged through appropriate incentives linked to maximum house size or floor area ratio.

Literature Cited

Arnold, C.L. and C.J. Gibbons. 1996. Impervious surface coverage: the emergence of a key environmental indicator. Journal of the American Planning Association 62: 243-258.

Baur, B. and A. Baur. 1993. Climatic warming due to thermal radiation from an urban area as possible cause for the local extinction of a land snail. Journal of Applied Ecology 30: 333-340.

Brabec, E., S. Schulte and P.L. Richards. 2002. Impervious surfaces and water quality: a review of current literature and its implications for watershed planning. Journal of Planning Literature 16: 499-514.

Churkina, G., D.G. Brown and G. Keoleian. 2010. Carbon stored in human settlements: the conterminous United States. Global Change Biology 16: 135-143.

Dunn, E.H. 1993. Bird mortality from striking residential windows in winter. Journal of Field Ornithology 64: 302-309.

Erickson, W.P., G.D. Johnson and D.P. Young. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191.

Hager, S.B., H. Trudell, K.J. McKay, S.M. Crandall and L. Mayer. 2008. Bird density and mortality at windows. The Wilson Journal of Ornithology 120: 550-564.

Kaye, J.P, P.M. Groffman, N.B. Grimm, L.A. Baker and R.V. Pouyat. 2006. A distinct urban biogeochemistry? Trends in Ecology and Evolution 21: 192-199.

Kempenaers, B., P. Borgstrom, P. Loes, E. Schlicht and M. Valcu. 2010. Artificial night lighting affects dawn song, extra-pair siring success, and lay date in songbirds. Current Biology 20: 1735-1739.

Marzluff, J.M. and K. Ewing. 2001. Restoration of fragmented landscapes for the conservation of birds: A general framework and specific recommendations for urbanizing landscapes. Restoration Ecology 9: 280-292.

McKeever, D. and R. Phelps. 1994. Wood products used in new single-family house construction: 1950 to 1992. Forest Products Journal 44: 66-74.

Paul, M.J. and J.L. Meyer. 2008. Streams in the urban landscape. Urban Ecology 3: 207-231.

Rich, C. and T. Longcore. 2006. Ecological consequences of artificial night lighting. Island Press, Washington, D.C.

Stone, E.L., G. Jones and S. Harris. 2009. Street lighting disturbs commuting bats. Current Biology 19: 1123-1127.

Wang, L., J. Lyons and P. Kanehl. 2001. Impacts of urbanization on stream habitat and fish across multiple spatial scales. Environmental Management 28: 255-266.

Wilson, A. and J. Boehland. 2005. Small is beautiful: U.S. house size, resource use, and the environment. Journal of Industrial Ecology 9: 277-287.

Yuan, F. and M.E. Bauer. 2007. Comparsion of impervious surface area and normalized difference vegetation index as indicators of surface urban heat island effects in Landsat imagery. Remote Sensing of Environemnt 106: 375-386.