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Balancing housing growth and land conservation: Conservation development preserves private lands near protected areas

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HIGHLIGHTS

- We document 343 conservation developments (CDs) in 13 Colorado counties, protecting 19,744 ha of open space.
- CDs occupied <1% of land area, but comprised 11% of private protected land.
- The majority (76%) of CDs are adjacent to protected areas.
- Targeted placement of CDs and coordinated management across CDs and protected areas will increase their conservation benefits.

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ABSTRACT

Housing development has emerged as a primary driver of land-use change around the world. In the United States, there is particular concern about low-density residential development on rural lands, which often occurs in places with abundant natural amenities. Conservation development (CD), housing development that incorporates protected open space, has emerged as a tool that can accommodate development and achieve land protection, potentially forming networks with existing protected areas. To assess how these developments contribute to housing and conservation at the landscape level, we gathered data on 343 CDs in 13 counties throughout the State of Colorado, U.S.A., including the number, location, and open space configuration of these housing developments. We found that although CDs comprise a small proportion of housing (4% on average), they account for a mean of 11% of privately owned protected lands, and they are often located in close proximity to protected areas (on average <400 m). A majority of these developments (76%) are immediately adjacent to at least one protected area, most commonly the protected open space of other CDs, and more than one-third (33%) of these developments are adjacent to two or more protected areas with different ownership. We conclude that CDs are poised to contribute to conservation at the landscape level in Colorado, given their proximity to protected lands. However, here and elsewhere, strategic placement of these housing developments and well-coordinated open space stewardship will be important if they are to serve as functional parts of protected area networks.

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1. Introduction

Globally, housing development and residential land consumption per person is rising with industrialization (Bradbury, Peterson, & Liu, 2014), with public protected areas often insufficient to conserve biodiversity and ecosystem functioning in the face of this private land conversion (Kamal, Grodzińska-Jurczakn & Brown, 2015). In the United States (U.S.), residential development in rural areas has expanded rapidly over the past 40 years, most of it in the form of low-density housing (6–10 homes/km^2) (Brown, Johnson, Loveland, & Theobald, 2005; Radeloff et al., 2005). The transformation of rural private lands is driven by multiple factors, including people's preferences for living near natural amenities and small towns, the lower cost of housing in these areas, greater willingness to commute long distances, and increasing telecommuting and

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mobility with retirement (Gosnell & Abrams, 2011). To create conventional housing developments, land is subdivided into large lots, each with a home, and no land is protected, although building is prohibited in some areas for regulatory (e.g., wetlands) or physical reasons (Pejchar, Morgan, Caldwell, Palmer, & Daily, 2007). As low-density housing has spread across the U.S., conservationists and planners have raised increasing concerns about its potential environmental impacts, particularly when housing expands in forest or wildland vegetation and/or on the periphery of publically protected lands (Hansen et al., 2005).

Residential development and associated infrastructure such as roads and fences have profound impacts on ecological systems and biodiversity, in both direct and indirect ways (Hansen et al., 2005; Kramer, 2013). Housing and infrastructure remove vegetation, which fragments remaining habitat (Hansen et al., 2005). Nutrient and biogeochemical cycles change after the removal of natural vegetation and the introduction of pollutants (Kaushal, Lewisn & McCutchan, 2006; McKinney, 2006). Homeowners manage yards, pets, and bird feeders, leading to altered hydrologic systems, exotic plants, predatory domestic pets, and resource subsidies such as food and water, nesting substrates, insulation from predators and unfavorable microclimate conditions, that favor generalist species (Boarman, Patten, Camp, & Collis, 2006; Gavier-Pizarro, Radeloff, Stewart, Huebner, & Keuler, 2010; Lepczyk, Mertig, & Liu, 2004; Longcore & Rich, 2004). Housing growth leads to an expansion of transportation infrastructure and changes travel patterns, introducing additional pollutants and disturbance (McCarty & Kaza, 2015; Wilson et al., 2013). As housing densities and impervious service increase, native species tend to decrease in abundance and richness, and human-adapted and generalist species increase (Bock, Jones, & Bock, 2008; DeStefano & DeGraaf, 2003; Gude, Hansen, & Jones, 2007; McKinney, 2006). Low-density residential development is of particular concern because it extends the environmental impacts of each house over a large area, maximizing the cumulative footprint of housing development and infrastructure (Hansen et al., 2005; Leinwand, Theobald, Mitchell, & Knight, 2010), and it often occurs in proximity to public protected lands (Radeloff et al., 2010; Wade & Theobald, 2010).

To address the adverse environmental effects of dispersed housing development and the continued demand for housing in rural areas, planners and conservation managers are searching for alternative approaches to residential development that minimize impacts on biodiversity and ecosystem functioning (Hostetler, Allen, & Meurk, 2011; Miller et al., 2009). One such option is conservation development (CD), where a portion of the property is protected as open space, and housing is typically clustered together on smaller lots (Arendt, Harper, & Trust, 1996; Pejchar et al., 2007). Ideally, CDs are designed to minimize the negative disturbances of residential development by constraining the size and extent of home sites, and protecting the most ecologically important areas in communal "open space" (Pejchar et al., 2007). These subdivisions are often developed under special ordinances that provide guidelines for their design, configuration, and management (Allen, Moorman, Peterson, Hess, & Moore, 2012; Reed, Hilty, & Theobald, 2014). Most commonly, ordinances specify the proportion of the parcel that must be protected as open space, often more than 50% of the site area (Reed et al., 2014). The open space portion of these subdivisions may be designed to explicitly protect biodiversity and ecosystem services (Pejchar et al., 2007), or with goals of protecting agriculture and ranch lands, cultural resources, or aesthetic values (Milder & Clark, 2011). CD open spaces may be legally protected, either owned by or under conservation easement with a public or nonprofit conservation organization, or managed by restrictive covenants (Milder & Clark, 2011).

CDs may be financially advantageous for developers, allowing them to reduce costs by clustering homes and infrastructure (McMahon, 2010), and to command a price premium for homes because people value living in proximity to open space (Bowman, Thompson, & Colletti, 2009; Hannum, Laposa, Reed, Pejcharn & Ex, 2012). For some expensive parcels of land, integrating limited housing may be the only feasible way to purchase land for conservation (Milder & Clark, 2011). CDs may confer broader social benefits such as preserving working landscapes or agriculture (Milder & Clark, 2011), providing a low-cost way for local governments and non-profits to conserve land during development (Pejchar et al., 2007), promoting environmental stewardship by homeowners (Thompson, 2004), and conferring psychological and health benefits to residents through access to open space (Fuller et al., 2007; Jackson, 2003).

Given their potential ecological, economic, and social benefits, interest in these communities has been growing. In the U.S. they are among the most commonly used land-use planning tools for conservation (study of local governments of Des Moines, Iowa; Seattle, Washington; and Research Triangle, North Carolina) (Miller et al., 2009), and across the western U.S., 31% of all counties have enacted CD ordinances (Reed et al., 2014). CDs comprise a growing proportion of residential development (McMahon & Pawlukiewicz, 2003), and have become an active area of research in the land use and conservation communities (Allen, Moorman, Peterson, Hess, & Moore, 2013; Göçmen, 2013; Hostetler & Drake, 2009; Milder & Clark, 2011; Reed et al., 2014). Globally, CDs (termed "conservation communities" or "eco-estates") have also been used to balance residential development and conservation in Canada, Latin America, Australia, and South Africa (Arendt, 2015; Ballard & Jones, 2011; Beatley & Newman, 2008; Tecklin & Sepulveda, 2014).

Advocates envision that these developments will provide ecological benefits beyond the borders of each development, contribute to land protection and the preservation of ecosystem services at the landscape level, and extend publically protected lands (Carter, 2009; Freeman & Bell, 2011; Milder, 2007). Although public lands are extensive in the western U.S., they do not contain the most productive and biodiverse lands, which remain privately held (Hansen et al., 2005). Public land holdings are much sparser in other regions of the country (Merenlender, Huntsinger, Guthey, & Fairfax, 2004), and across the U.S., public lands are increasingly bordered by housing development (Radeloff et al., 2010; Wade & Theobald, 2010). Expanding protection of private lands and maintaining connectivity across landscapes will benefit wildlife and ecosystem processes that often require large, contiguous areas of high-quality land (Fahrig, 2003; Fischer & Lindenmayer, 2007), and land conservation needs will only increase with climate change (Dawson, Jackson, House, Prentice, & Mace, 2011; Hiley, Bradbury, Holling, & Thomas, 2013).

However, despite the assumed benefits of CDs, studies are only now emerging to evaluate the extent to which these subdivisions contribute to conservation goals. Studies have documented the size of subdivisions, amount of land conserved, configuration of lots and open space (Göçmen, 2013; Milder & Clark, 2011; Milder, Lassoie, & Bedford, 2008) and their ecological performance (Göçmen, 2013; Lenth, Knight, & Gilgert, 2006; Nilon, Long, & Zipperer, 1995), with mixed results. Beyond individual CD subdivisions, it is unclear how the benefits of CDs accumulate and contribute to landscape-level conservation. These subdivisions are developed on privately owned lands, and they are established and sold in response to local and larger economic and social forces. Depending on local regulations, creating CDs may require more work from developers, extra fees, and longer approval times than conventional development (Carter, 2009), which may hinder their widespread implementation, and accordingly, the total amount of land they can protect.

To evaluate the contribution of conservation development to housing supply and protected lands at a landscape scale, we analyzed the number, size, and distribution of CDs in Colorado.