



# Conservation Development Practices, Extent, and Land-Use Effects in the United States

JEFFREY C. MILDER\* AND STORY CLARK†

\*Department of Natural Resources, Cornell University, Ithaca, NY 14853, U.S.A., email jcm85@cornell.edu

†Conservation Consulting, 4445 Moose Wilson Road, Wilson, WY 83014, U.S.A.

**Abstract:** *Conservation development projects combine real-estate development with conservation of land and other natural resources. Thousands of such projects have been conducted in the United States and other countries through the involvement of private developers, landowners, land trusts, and government agencies. Previous research has demonstrated the potential value of conservation development for conserving species, ecological functions, and other resource values on private lands, especially when traditional sources of conservation funding are not available. Nevertheless, the aggregate extent and effects of conservation development were previously unknown. To address this gap, we estimated the extent and trends of conservation development in the United States and characterized its key attributes to understand its aggregate contribution to land-conservation and growth-management objectives. We interviewed representatives from land trusts, planning agencies, and development companies, searched the Internet for conservation development projects and programs, and compiled existing databases of conservation development projects. We collected data on 3884 projects encompassing 1.38 million ha. About 43% of the projects targeted the conservation of specific plant or animal species or ecological communities of conservation concern; 84% targeted the protection of native ecosystems representative of the project area; and 42% provided buffers to existing protected areas. The percentage of protected land in conservation development projects ranged from <40% to >99%, and the effects of these projects on natural resources differed widely. We estimate that conservation development projects have protected roughly 4 million ha of land in the United States and account for about 25% of private-land conservation activity nationwide.*

**Keywords:** biodiversity, conservation easement, conservation finance, conservation subdivision, land-use planning, limited development, urban sprawl

Práctica, Alcance y Efectos sobre el Uso de Suelo de la Conservación y Desarrollo

**Resumen:** *Los proyectos de conservación y desarrollo combinan el desarrollo de bienes raíces con la conservación de tierras y otros recursos naturales. Miles de tales proyectos se han llevado a cabo en los Estados Unidos y otros países mediante la participación de desarrolladores privados, propietarios, fideicomisos y agencias gubernamentales. Investigaciones previas han demostrado que el valor potencial de la conservación y desarrollo para la conservación de especies, funciones ecológicas y otros valores en terrenos privados, especialmente cuando no hay disponibilidad de fuentes tradicionales de financiamiento de la conservación. Sin embargo, la extensión agregada y los efectos de la conservación y desarrollo eran desconocidas. Para llenar este vacío, estimamos la extensión y las tendencias de la conservación y desarrollo en los Estados Unidos y caracterizamos sus atributos clave para comprender su contribución a los objetivos de conservación de tierras y de manejo del crecimiento. Entrevistamos a representantes de los fideicomisos, agencias de planificación y compañías de desarrollo, buscamos proyectos y programas de conservación y desarrollo en Internet y recopilamos las bases de datos de proyectos de conservación y desarrollo existentes. Recolectamos datos sobre 3884 proyectos que abarcaron 1.38 millones de ha. Cerca de 43% de los proyectos abordaron la*

*conservación de especies particulares de plantas o animales o comunidades ecológicas de preocupación para la conservación; 84% abordaron la protección de ecosistemas nativos representativos del área del proyecto; y 42% proporcionaron amortiguamiento a áreas protegidas existentes. El porcentaje de tierras protegidas en el proyectos de conservación y desarrollo varió entre <40% y >99%, y los efectos de estos proyectos sobre los recursos naturales variaron ampliamente. Estimamos que los proyectos de conservación y desarrollo han protegido alrededor de 4 millones de ha en los Estados Unidos y corresponden a cerca de 25% de las actividades de conservación en terrenos privados en todo el país.*

**Palabras Clave:** biodiversidad, contrato de conservación, crecimiento urbano desordenado, desarrollo limitado, financiamiento de la conservación, planificación de uso del suelo, subdivisión de conservación

## Introduction

Land development is one of the greatest threats to terrestrial and aquatic ecosystems in the United States (Wilcove et al. 1998; Czech et al. 2000; Allan 2004). In the past few decades, exurban and rural development has proliferated in areas that were previously too remote to be developed extensively (Brown et al. 2005; Radeloff et al. 2005). Fueled by improved transportation access, growing demand for real estate in settings rich in natural amenities, and other trends, this development is rapidly fragmenting rural regions, such as the Greater Yellowstone Ecosystem (Gude et al. 2006) and southeastern mountains and plains (Griffith et al. 2003). Although the economic recession that began in 2008 has slowed development greatly, the demographic and societal trends driving growth are likely to continue in the long term. Recent projections are that developed land in the contiguous United States will increase from 5.2% of the total land base (39.5 million ha) in 1997 to 9.2% (70.5 million ha) by 2025. This development will disproportionately affect environmentally sensitive regions, such as coastal areas (Alig et al. 2004).

In the United States 2 principal approaches are used to guide the extent and location of development: (1) land-use planning and regulation and (2) land protection, usually through fee simple or conservation-easement acquisition (Daniels & Lapping 2003). Results of both approaches have been mixed. For instance, regional land-use authority or coordination that might help establish conservation networks at a landscape or ecoregional scale is generally weak or nonexistent, whereas zoning is often an uncoordinated patchwork of local policies (Ewing et al. 2005). In addition, conservation of biological diversity appears to be a minor focus of most local planning practice (Miller et al. 2009).

Since the mid-1990s the number of land trusts, amount of private-land conservation activity, and level of voter support for public spending on open-space protection in the United States have all grown considerably (Land Trust Alliance 2006; TPL 2010). Nevertheless, inadequate funding remains a major impediment to protecting high-priority lands and waters. To establish a strategic, ecologically comprehensive network of conservation areas in the contiguous United States would require protecting an additional 95.7 million ha of private land (Shaffer et al.

2002). Such conservation would cost \$6.5 billion/year over 30 years if achieved through conservation easements and \$9.2 billion/year over the same period through fee-simple acquisition (Shaffer et al. 2002; cost figures adjusted to 2010 dollars). In contrast, funding allocated for land purchases and easements from 1998–2005 averaged about \$3 billion/year from state and local land-protection programs plus a smaller amount of private, philanthropic funding (TPL 2008, 2010). This finance gap is actually greater than it appears because most public funding is spent in a few coastal states with high land prices, and most is used to conserve land of agricultural, recreational, or aesthetic importance that many not support many native species or ecosystem functions (Lerner et al. 2007; Szabo 2007).

Many new project and funding models have been developed to address the limitations of traditional regulatory and conservation finance mechanisms (Ginn 2005; Clark 2007; Levitt 2010). Among these tools is conservation development: projects that combine real-estate development with conservation of land and other natural resources. Conservation development permanently protects a portion of the project site (typically anywhere from 40% to 99%), frequently at little or no net upfront cost to public or private conservation organizations. Thus, it effectively generates an additional source of funds that can supplement public and philanthropic funding streams on which conservation efforts have historically relied. When supported or mandated by zoning or other regulations, conservation development can also encourage developers to take an ecologically based approach to site design and real-estate development (Arendt 2004; Pejchar et al. 2007; Milder et al. 2008).

Conservation development projects may be classified into 4 categories on the basis of project goals, actors, amount of land conserved, and development patterns (Milder 2007): conservation easements with reserved homesites, limited development projects, conservation subdivisions, and conservation-oriented master-planned communities. In conservation easements with reserved homesites (i.e., reserved-homesite projects) private landowners agree to restrict future development to one or a few houses by donating or selling a conservation easement (Anella & Wright 2004; Merenlender et al. 2004; Rissman et al. 2007). The permitted homesites are

either embedded within the easement or subdivided as separate land parcels, in which case they usually abut the protected land. Development is typically of very low density ranging from as dense as one house per 6–12 ha in the East to as sparse as one house per several hundred hectares or more in the West, and homesites may not be built on for years or decades. Land trusts use reserved-homesite projects to reduce the cost of protecting a parcel of land or to engage landowners who are interested in conserving their land but wish to retain some development rights. Landowners who donate such conservation easements sometimes receive tax benefits for doing so.

Limited development projects combine conservation with low-density development, usually at about 5–25% of the maximum density allowed by land-use regulations (Milder 2005). Compared with reserved-homesite projects, limited development projects typically entail higher development density and involve activities such as land subdivision, permitting, and design of utilities and infrastructure to allow individual house lots to be sold. Limited development projects can be conducted or facilitated by land trusts, developers, investors, or landowners.

Conservation subdivisions are residential developments that designate a major portion of the site as conservation land by clustering development on smaller lots than those in conventional subdivisions (Arendt 1996). In contrast to reserved-homesite projects and limited development projects, conservation subdivisions are usually built at or near the maximum allowed density. Typically, conservation subdivisions are designed and built by developers and governed by planners and regulators through local zoning laws.

Conservation-oriented master-planned communities encompass hundreds or thousands of hectares, provide a range of housing types, and often include commercial, recreational, or public spaces. These projects often protect 50% or more of the project site (Heid 2004). Some such projects are built at the maximum allowed density, whereas others are built at a reduced density. Typically, developers design and build master-planned communities, and land trusts or government agencies may play a role in managing the conserved lands.

As this typology illustrates, conservation development includes a wide range of approaches that overlaps partially with other realms of practice, including conservation easements and protection of private land (Merenlender et al. 2004), for-profit residential and mixed-use development, and land-use planning and zoning. Although we situate this study in the context of these more widely studied fields, we focused solely on conservation development, as defined above.

Conservation development has been in use for at least 40 years. Previously, however, little was known of its overall extent and effects. To address this gap, we estimated the extent and trends of conservation develop-

ment in the United States and characterized its key attributes to understand its aggregate contribution to land-conservation and growth-management objectives. To do so, we conducted a nationwide assessment of conservation development projects and practices.

## Methods

### Survey of Conservation Development Practices

We conducted interviews, Internet searches, and a literature review and analyzed existing databases of conservation development projects. From October 2007 through April 2010, we interviewed or administered email questionnaires to representatives from 201 organizations in 42 states (126 land trusts, 33 planning agencies, 20 development companies, and 22 other organizations) engaged in conservation development. We contacted all 110 local and regional land trusts (of which we successfully interviewed 71) that, in the most recent census of U.S. land-trust activities, indicated they participated in limited development (Land Trust Alliance 2006). Through information gleaned from these interviews and our knowledge of land-trust practices, we identified and contacted other land trusts known or thought to participate in conservation development. We also surveyed the 30 local and regional land trusts that have conserved the largest amount of land. We selected interviewees from other organizations on the basis of Internet searches (described below), focusing particularly on those regions of the country where conservation development is most prevalent.

During interviews and in emails, we collected information on the extent of conservation development, change in rates of activity over time (i.e., trends), and conditions supporting or inhibiting the effective practice of conservation development (i.e., influencing factors) within the interviewee's organization or jurisdiction. We compiled responses related to trends and influencing factors to identify dominant and recurring themes. In addition, where available, we collected data on specific projects in which the interviewee's organization had been involved.

We searched the Internet to identify additional conservation development projects and regulations as well as organizations involved in conducting or promoting conservation development. From January to May 2010, we used Google to search the name of each state in conjunction with 5 phrases (*conservation development*, *conservation subdivision*, *cluster development*, *cluster subdivision*, and *limited development plus conservation*). We identified additional projects by reviewing published literature, gray literature, and case studies identified in interviews, state-level Internet searches, and Google Scholar searches conducted during the same time period with the same 5 search phrases. Finally, where available, we

obtained databases of conservation development projects in specific jurisdictions or regions compiled by groups such as regional planning agencies and land trusts.

We used these methods to collect 4 types of project-level information: basic descriptive data, conservation objectives, development design, and land-management arrangements. Basic descriptive data included project name, project type, principal proponent(s), location (municipality, county, state, and U.S. Census region), type of location (urban, suburban, exurban, or rural [Hansen et al. 2005]), project area, area conserved, and area developed. Project conservation objectives included conservation of one or more of the following: specific plant or animal species or ecological communities of conservation concern, typical native ecosystems (including movement or dispersal corridors and migration routes), working agricultural land (i.e., active farms or ranches), water resources, scenic resources (i.e., visual amenities contributing to perceptions of landscape beauty as viewed from roads or other public places), historic or cultural sites, buffers to protected areas, and outdoor recreation or education amenities. Characteristics of development design included the number of single-family housing units (categorized by lot size: >2 ha, 0.2–2 ha, <0.2 ha) and multifamily housing units and the presence or absence of housing for senior citizens, affordable housing (as defined by the U.S. Department of Housing and Urban Development), golf courses, commercial development, and public facilities. Information on land-management arrangements included identification of the owner and manager of the protected land, legal means of protection, and source of management funds.

We included conservation development projects that permanently protected at least 40% of the project site. We also included projects that protected <40% of the site but were labeled by the proponent as conservation development or developed pursuant to a zoning provision that allowed or encouraged conservation development. These criteria allowed us to include a broad spectrum of conservation development projects while excluding most open-space exactions (i.e., requirements that a portion of a development site be set aside as open space). Such provisions are common, usually result in protection of <40% of the site, and typically do not place a strong emphasis on ecologically based design or conservation of natural resources.

### Estimation of the Extent of Conservation Development

We estimated the total land area developed and protected by each type of conservation development from 1968–2008 and the annual rates of activity from 2000–2008. Estimates included projects conducted by developers, local and regional land trusts, and The Nature Conservancy, but excluded projects conducted by other national land trusts, for which we were unable to

obtain data. (Government agencies implement very little conservation development, although they play other roles in some projects.) Given differences in project participants and data availability, we tailored the estimation methods for each project type, as described below.

To estimate the total area of reserved-homesite projects, we used interview data to compile information on 94 land trusts that collectively represented 70% of all local and regional land-trust conservation easements (by area). From these data, we calculated the percentage of easement holdings attributable to reserved-homesite projects and then multiplied this percentage by the total estimated easement area for all U.S. local and regional land trusts as of 2008 (Supporting Information). To this total, we added estimates for reserved-homesite activity by The Nature Conservancy.

To estimate the total extent of limited development projects, we summed actual data on land area under limited development from interviews and added this to estimates of limited development conducted by other local and regional land trusts, The Nature Conservancy, and private entities other than land trusts. Assumptions and calculations for these estimates are available in Supporting Information.

For conservation subdivisions we estimated plausible ranges for the total conservation subdivision land area in each state by combining project-level data generated from all methods with information from the Internet searches on the extent to which conservation subdivisions were built or promoted through zoning regulations and by developers or advocacy organizations in each state. The total land area of all individual projects constituted the lower-boundary area estimate for each state. The midrange and upper-boundary area estimates were based on the sources, calculations, and assumptions provided in Supporting Information.

To estimate the extent of conservation-oriented master-planned communities, we relied primarily on the project-level database, which we cross-referenced with project lists compiled by other experts that track such projects regionally or nationwide. Because conservation-oriented master-planned communities tend to be relatively large and prominent—and because our searches with different methods repeatedly turned up the same projects—we believe the project-level database included a high percentage of all such projects. Thus, we calculated estimates of the total land area within such projects by multiplying the area of all known projects by a range of plausible inflation factors (lower-boundary inflation factor of 10%, midrange 50%, and upper boundary 150%).

We used Microsoft Excel to compile project data and calculate estimates of total extent of conservation development and JMP (version 8, SAS Institute, Cary, North Carolina) to conduct Mann-Whitney *U* tests to compare attributes among project types.

**Table 1.** Descriptive statistics for the study sample of 3884 conservation development projects conducted in the United States between 1968 and 2008.

| <i>Project type</i>                              | <i>Sample size</i> | <i>Median project size (ba)*</i> | <i>Total land area (ba)</i> | <i>Median protected land (%)*</i> | <i>Total protected land (%)</i> | <i>Total protected land (ba)</i> |
|--|--------------------|----------------------------------|-----------------------------|-----------------------------------|---------------------------------|----------------------------------|
| Reserved-homesite projects                       | 3132               | 81b                              | 730,545                     | 98.2a                             | 98.4                            | 719,203                          |
| Limited development projects                     | 219                | 87b                              | 342,356                     | 85.9b                             | 93.5                            | 320,047                          |
| Conservation subdivisions                        | 477                | 32a                              | 34,602                      | 52.7c                             | 57.1                            | 19,763                           |
| Conservation-oriented master-planned communities | 56                 | 648c                             | 274,563                     | 53.7c                             | 71.3                            | 195,660                          |
| Total  | 3884               |                                  | 1,382,066                   |                                   |                                 | 1,254,673                        |

\*Different letters denote significant differences among project types (pairwise comparisons, Mann-Whitney U test,  $\alpha = 0.05$ , Bonferroni corrected).

## Results

We gathered information on 3884 conservation development projects on 1.38 million ha, including 3132 reserved-homesite projects, 219 limited development projects, 477 conservation subdivisions, and 56 conservation-oriented master-planned communities.

### Project Size and Geographic Distribution

Project size differed significantly among the project types. Conservation subdivisions generally occupied the least land per project, whereas conservation-oriented master-planned communities occupied the most (Table 1). Most of the protected land was in rural areas for all project types except conservation subdivisions (Fig. 1). About 85% of reserved-homesite projects and 50% of limited development projects were in rural areas. Conservation subdivisions and conservation-oriented master-planned communities were most numerous in suburban and exurban areas, reflecting market demand for higher-density development in and near metropolitan areas (Fig. 1).

The amount of land affected by conservation development differed greatly by region. Of the total land in the sampled limited development projects, conservation subdivisions, and conservation-oriented master-planned communities, 2.3% was in the Midwest, 28% was in the Northeast, 16% was in the South, and 53% was in the West (regions were defined according to the U.S. Census Bureau's census regions). For sampled reserved-homesite projects, the Midwest had 0.8%, the Northeast 8.4%, the South 28%, and the West 63%. The number of projects, however, was proportionally higher in the Northeast (where projects often occurred on small properties) and lower in the West (where many projects occurred on very large properties).

### Conservation Objectives and Patterns

Collectively, conservation development projects sought to protect a wide range of conservation targets (Fig. 2). Protected land often functioned as a recreational, educational, or aesthetic amenity for the adjacent development. Such amenities were often explicitly developed and marketed for conservation subdivisions and master-planned communities, whereas for limited development and reserved-homesite projects they were generally private and informal. Working agricultural land was frequently a part of limited development and reserved-homesite projects. Full-density conservation subdivisions and conservation-oriented master-planned communities protected a significantly smaller portion of their respective project sites than the reduced-density projects in which land trusts often played a more central role (Table 1 & Fig. 3).

### Development Patterns

Almost all of the sampled projects contained single-family housing as a principal development component. Other development types—including multifamily housing, commercial development, and public facilities—were common only in the master-planned communities (Table 2).

In the aggregate conservation subdivisions and conservation-oriented master-planned communities both provided moderate housing densities of 0.38 and 0.27 ha/dwelling unit, respectively (Table 2)—roughly on a par with typical suburban housing densities. Limited development and reserved-homesite projects had larger house lots, on average, but because they reduced development levels by approximately 75–99% relative to the maximum allowed density, the net effect was usually to curtail the expansion of low-density housing in exurban and rural areas.

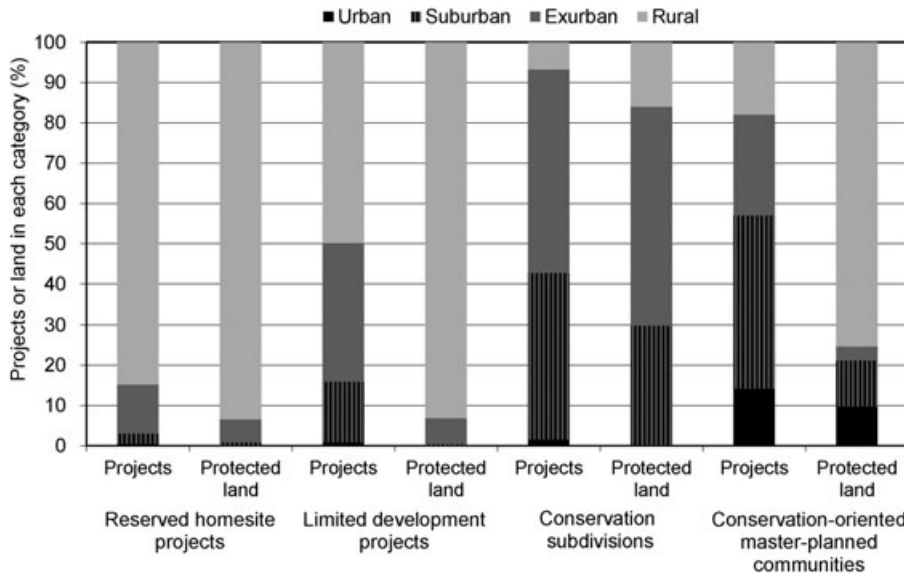


Figure 1. Level of development surrounding the sampled conservation development projects (n = 3884), analyzed by number of projects and total protected area. Development classes are defined according to Hansen et al. (2005). All sampled projects were conducted in the United States between 1968 and 2008.

**Land Management**

Three different methods were used to provide legal protection for conservation land in conservation development projects: fee-simple ownership by a public or non-profit conservation organization, conservation easements held by these same types of organizations, and restrictive covenants (deed restrictions). All of the reserved-homesite projects and 93% of the limited development projects used fee ownership or conservation easements to protect their conservation areas. By comparison, 64% of conservation subdivisions and 37% of conservation-oriented master-planned communities used restrictive covenants (Table 3).

Many projects established perpetual funding sources (such as endowments, homeowners' dues, or real-estate transfer fees) and designated professionally staffed con-

servation organizations to restore and manage conserved lands. Nevertheless, we found major differences in these arrangements among the project types. Private landowners were the principal land managers in all of the reserved-homesite projects and 61% of limited development projects (Table 3). In most instances, private landowners managed the protected land subject to the terms of a conservation easement owned, monitored, and enforced by a land trust. In contrast, protected land in 86% of conservation subdivisions and 35% of the master-planned communities was managed by homeowners' associations.

**Extent and Trends**

We estimated that conservation development has been applied to 4.29 million ha of land and accounted for 4.04

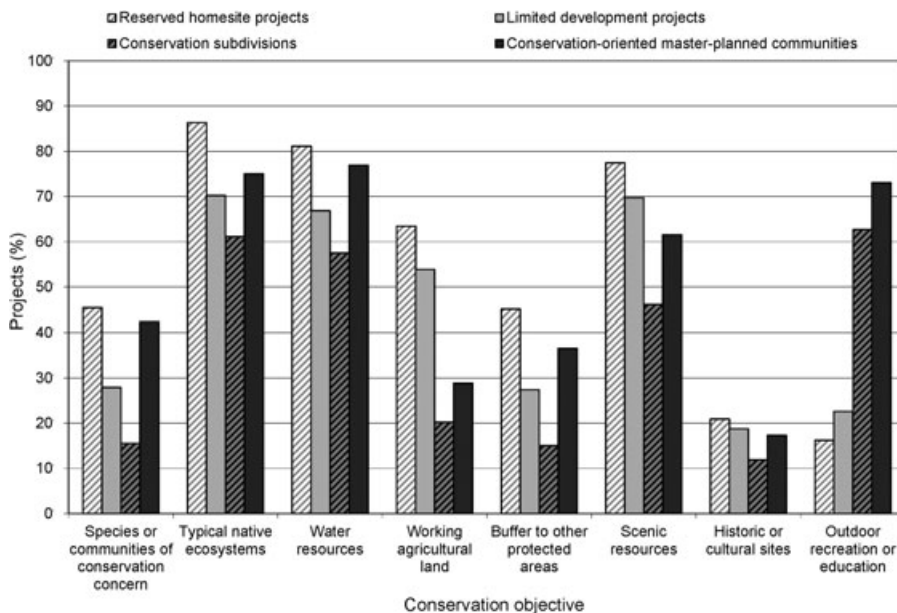


Figure 2. Conservation objectives of the 3884 sampled conservation development projects. Total percentages exceed 100% for each project type because many projects had more than one conservation objective. See the Methods section for additional explanation of the categories. All sampled projects were conducted in the United States between 1968 and 2008.

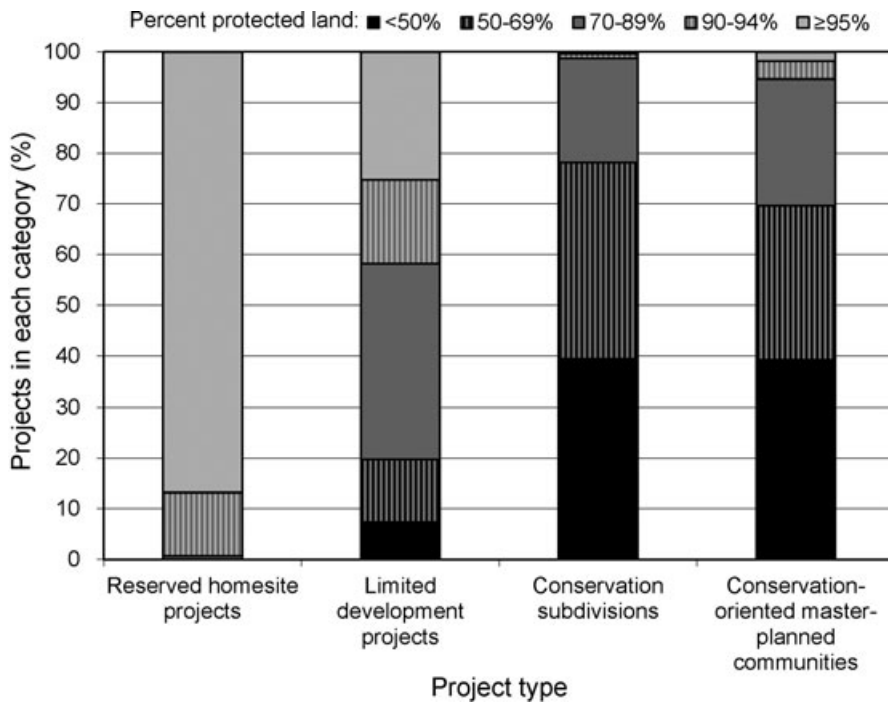


Figure 3. Land protected by 4 types of conservation development projects (n = 3884) (e.g., 87% of reserved-homesite projects protected ≥95% of the project site). Percent protected land equals the total area permanently protected from development divided by the total site area. All sampled projects were conducted in the United States between 1968 and 2008.

million ha of permanent land protection in the United States (Table 4). This area is equivalent to about 22% of the estimated total 18.1 million ha of land conserved by land trusts through 2008. The rate of land protection

through conservation development from 2000–2008 was approximately 278,000 ha/year, equivalent to about 26% of the estimated 1.05 million ha/year of land-trust conservation during this period. These estimates are probably

Table 2. Development patterns in the study sample of 3884 conservation development projects conducted in the United States between 1968 and 2008.

| Development type and attribute   | Project type*                  |                                  |                               |  |
|--|--------------------------------|----------------------------------|-------------------------------|--|
|  | reserved-homesite projects (%) | limited development projects (%) | conservation subdivisions (%) | conservation-oriented master-planned communities (%) |
| Single-family housing (all densities)                                      | 100                            | 93                               | 98                            | 88   |
| house lots >2 ha   | 77                             | 50                               | 16                            | 7  |
| house lots 0.2–2 ha  | 39                             | 47                               | 81                            | 45   |
| house lots <0.2 ha   | -                              | 6                                | 26                            | 71   |
| Multifamily housing  | -                              | 4                                | 5                             | 63   |
| Housing for the elderly  | -                              | 2                                | 1                             | 9  |
| Affordable housing   | -                              | 9                                | 3                             | 5  |
| Commercial development (e.g., retail, office space)                        | -                              | 5                                | <1                            | 59   |
| Public facilities (e.g., schools, public buildings)                        | -                              | 5                                | <1                            | 41   |
| Golf course  | -                              | 3                                | 1                             | 25   |
| Total residential units in sample  | 6565                           | 7662                             | 32,635                        | 203,591  |
| Total residential density (ha per dwelling unit)                           | 109.6                          | 28.1                             | 0.89                          | 1.08   |
| Total density averaged across unconserved land only (ha per dwelling unit) | 1.73                           | 2.44                             | 0.38                          | 0.27   |

\*Percentage of each type of project that contained each type of development. Summed percentages are >100% because many projects included more than one type of development.

**Table 3. Legal means of land protection and land management entities in the study sample of 3884 conservation development projects conducted in the United States between 1968 and 2008.**

| Attribute  | Project type <sup>a</sup>      |                                  |                               |  |
|--|--------------------------------|----------------------------------|-------------------------------|--|
|  | reserved-homesite projects (%) | limited development projects (%) | conservation subdivisions (%) | conservation-oriented master-planned communities (%) |
| Legal means of land protection   |                                |                                  |                               |  |
| fee-simple ownership by a public conservation agency                     | 0                              | 5                                | 5                             | 16   |
| fee-simple ownership by a land trust                                     | 0                              | 17                               | 3                             | 2  |
| conservation easement held by a land trust or public conservation agency | 100                            | 71                               | 28                            | 45   |
| restrictive covenant   | 0                              | 7                                | 64                            | 37   |
| Principal land manager   |                                |                                  |                               |  |
| public conservation or parks agency                                      | 0                              | 5                                | 5                             | 16   |
| land trust   | 0                              | 17                               | 3                             | 2  |
| community-stewardship organization <sup>b</sup>                          | 0                              | 5                                | 1                             | 17   |
| homeowners' association with assistance from a conservation organization | 0                              | 7                                | 9                             | 23   |
| homeowners' association alone  | 0                              | 5                                | 77                            | 12   |
| private landowner(s)   | 100                            | 61                               | 5                             | 30   |

<sup>a</sup>Percentages of each type of project that used each of the indicated legal means of land protection and had as a principal land manager each of the indicated types of entities.

<sup>b</sup>A nonprofit organization dedicated to the management of conservation land within a specific conservation development project. Such organizations typically have paid staff and conduct activities such as ecological restoration, environmental education, enforcement of building and landscape design codes, and other environmental programs and services for local residents.

conservative because they omit activities of national land trusts other than The Nature Conservancy.

Reserved-homesite projects accounted for the largest percentage (81%) of land conserved by conservation development (Table 4). Limited development projects were the second-most widespread type of conservation development by land area, accounting for an estimated 10% of the total conserved area. Although conservation subdivisions were the second-most abundant type in terms of number of projects, they conserved the least amount of land (about 1.8% of the total) because they usually occurred on land parcels of <150 ha. Conservation-oriented master-planned communities accounted for about 7% of total conserved area (Table 4).

The rate of activity in all categories of conservation development increased from the pre-2000 period to the 2000–2008 period. Nevertheless, in some areas contravening factors—such as the availability of alternative conservation funding sources or the lack of incentives for developers—led to decreased activity (Table 4).

## Discussion

Because conservation development encompasses a wide range of practices implemented by many types of actors scattered across thousands of jurisdictions across the country, assembling nationwide data proved chal-

lenging. Our samples of developer-led projects likely overrepresent the relative proportion of conservation development projects in some areas of the country and underrepresent the proportion in other areas. Notwithstanding these caveats, our results provide the first broad portrait of the characteristics, extent, trends, and land-use effects of conservation development in the United States.

Conservation development is far more widespread than previously assumed if the definition is broadened beyond conservation subdivisions (which have been most synonymous with the term *conservation development*) to include the entire range of projects. Although reserved-homesite projects and some limited development projects may be perceived as variants of conservation easements, in fact such projects present the same opportunities (e.g., low-cost land protection, economic incentives to engage private landowners in conservation) and risks (e.g., incompatible development, fragmentation of native ecosystems, negative public perception) as other types of conservation development (Milder 2010). Accordingly, we believe it is appropriate to analyze the practice of conservation development broadly, as a spectrum of project types that offers varying permutations of conservation, land development, and revenue generation (or cost savings) outcomes.

Conservation development has contributed substantially to private-land conservation and appears poised



**Table 4.** Summary of the extent, trends, and major driving factors for each type of conservation development in the United States.

| <i>Project type</i>                              | <i>Estimated area to date (1000s of ha)<sup>a</sup></i> | <i>Estimated area conserved (1000s of ha /year)<sup>b</sup></i> | <i>Trends and major driving factors<sup>c</sup></i>  |
|--|---|---|--|
| Reserved-homesite projects                       | 3329 total<br>3277 conserved<br>range 2818–3560         | 233   | increasing overall due to rising land prices, shortfalls in conservation finance, and a decrease in the number of large landowners willing to donate all development rights to their land  |
| Limited development projects                     | 424 total<br>396 conserved<br>range 320–538             | 19  | increasing overall due to expanding markets for amenity-based real estate in natural settings, rising land prices, and shortfalls in conservation finance<br>decreasing in some regions due to the availability of less-complex land-conservation options such as protection with public funding sources |
| Conservation subdivisions                        | 127 total<br>72 conserved<br>range 40–148               | 5.3   | increasing overall due to new land-use regulations and promotion efforts<br>static in some regions due to a lack of economic incentives for developers   |
| Conservation-oriented master-planned communities | 412 total<br>294 conserved<br>range 215–489             | 21  | increasing overall due to new land-use regulations and permitting requirements in some jurisdictions and to a trend toward negotiated outcomes for large, resource-rich properties contested by developers, government agencies, and conservationists  |
| Totals   | 4292 total<br>4039 conserved<br>range 3393–4735         | 278   |  |

<sup>a</sup>Total land area involved in conservation development projects and the total land area protected by these projects through 2008. Ranges indicate the lower and upper estimates of conserved area for each project type.

<sup>b</sup>Pace of conservation development activity from 2000–2008; not a prediction of the future activity rate.

<sup>c</sup>Situation prior to the recession that began in 2008.

to continue to do so. We estimate that it has protected roughly 4 million ha of land in the United States, representing approximately 22% of all private-land conservation to date and about 4.2% of the 95.7 million ha of private land that Shaffer et al. (2002) estimated would be needed to complement public lands to create a comprehensive system of conservation reserves. Excluding reserved-homesite projects, conservation development has protected about 762,000 ha, which represents about 4.2% of private-land conservation. If trends established before the start of the recession in 2008 resume by 2015 and continue through 2045, conservation development (including reserved-homesite projects) can be expected to protect an additional 8 million ha. Together with the pre-2008 tally, this would represent 13% of the private lands needed for a comprehensive nationwide reserve network. Of course, not all land protected by conservation development would be considered a priority for an ecological reserve network, just as not all lands acquired with public funding are priority conservation areas.

Most conservation development in the United States occurs on exurban and rural lands. Therefore, it is generally not a competing alternative to other so-called

smart-growth strategies such as urban infill, “new urbanism,” and transit-oriented development, but rather a complementary approach. Growth-management policies and zoning regulations in exurban and rural U.S. communities are often much more rudimentary than those in urban and suburban communities (Edwards & Haines 2007). Our results suggest that lower-density conservation development projects can support conservation in exurban and rural contexts by engaging landowners, land trusts, and developers in land transactions that do not depend on regulatory frameworks, but are motivated voluntarily by conservation, revenue generation, or estate-planning objectives (Wright & Anella 2007). That said, local and regional planning frameworks can increase the positive effect of conservation development through siting and design guidelines that create synergies with other conservation and growth-management strategies, such as acquisition of public land (Wallace et al. 2008).

The conservation goals and likely outcomes of conservation development projects varied widely. A substantial majority of limited development and reserved-homesite projects exhibited land-protection patterns, development patterns, and land-management arrangements

that, in prior research, was shown to be relatively conducive to protecting native species and ecological functions. These characteristics include a high percentage of protected land, very low development density, and land management subject to a conservation easement held by a land trust or public conservation agency. Many such projects, particularly in the West, conserved large parcels of land that contain only a few house lots, which changed land-use patterns very little. Many of these projects also included development restrictions or conservation easements to reduce the potential effects (e.g., increased fragmentation, edge area, and potential for occurrence of invasive non-native species) of low-density housing on native species and ecosystems.

Conservation-oriented master-planned communities and especially conservation subdivisions were less consistently successful at creating land-protection patterns, development patterns, and land-management arrangements that prior research found to be conducive to sustaining native species and ecological functions. Such projects tended to protect a smaller portion of the project site than the other 2 types of conservation development, and results of prior research suggest that this characteristic, combined with development proximity and the introduction of non-native plants, can substantially limit the value of conservation-oriented master-planned communities and conservation subdivisions for many native species (Lenth et al. 2006). These 2 types of projects were also more likely than other types to use homeowners' associations for land management. Homeowners' associations that do not receive significant professional assistance may not provide effective long-term conservation management because their members lack the knowledge, capacity, or desire to do so (Austin & Kaplan 2003). In addition, conservation-oriented master-planned communities and conservation subdivisions often used restrictive covenants as the legal land-protection mechanism. Such covenants may be difficult to enforce in perpetuity (Arendt 1999) and generally do not provide conservation stakeholders with an enforceable legal interest in the land's conservation values.

Despite these limitations, even modestly sized protected areas (e.g., 5–50 ha) within conservation subdivisions and conservation-oriented master-planned communities can offer conservation benefits, including watershed protection, habitat for species with small home ranges, migratory stopover sites, and opportunities for positive human interaction with nature (Perlman & Milder 2005). These benefits can be particularly significant given that many such projects are located in suburbs, where ecosystems are already quite fragmented and where high land values prevent the creation of large-scale conservation networks. In addition, many for-profit conservation development projects are relatively successful at providing other public benefits such as recreational opportunities, scenic beauty, local food

production, and maintenance of “green infrastructure” networks.

The considerable extent and potential of conservation development is not yet matched by a commensurate support infrastructure of public awareness, education and training, and practitioner networks. Although a relatively small cadre of practitioners, researchers, and advocates continues to advance the concept and practice of conservation development, there are, as yet, no major nationwide initiatives (and few regional initiatives) to support effective conservation development practices among land-use planners, developers, land trusts, landowners, and their advisors. In addition, although there has been discussion and some application of guidelines and standards to ensure consistently high conservation outcomes, the governance of conservation development through regulations, incentives, voluntary criteria, or formal certification programs remains underdeveloped.

## Acknowledgments

We thank the more than 300 conservation, development, and land-use professionals who shared information and insight on conservation development. We also thank E. Bycer, B. Glaser, G. Hsu, J. Munger, M. Ramirez, and especially E. Iliff for research assistance; B. Gentry and L. Pejchar for research coordination; K. Briechele and E. McMahan for valuable perspectives on conservation development; and E. Fleishman, L. Huntsinger, and 2 anonymous reviewers for comments on earlier versions of the manuscript. Partial funding for this study was provided by Forrest and Marcie Berkley and by an Environmental Protection Agency STAR fellowship and a National Science Foundation Graduate Research Fellowship to J.C.M.

## Supporting Information

A spreadsheet detailing the calculations and assumptions underlying the estimates of the extent of conservation development (Appendix S1) is available online. The authors are solely responsible for the content and functionality of this material. Queries should be directed to the corresponding author.

## Literature Cited

- Alig, R. J., J. D. Kline, and M. Lichtenstein. 2004. Urbanization on the US landscape: looking ahead in the 21st century. *Landscape and Urban Planning* 69:219–234.
- Allan, J. D. 2004. Landscapes and riverscapes: the influence of land use on stream ecosystems. *Annual Review of Ecology, Evolution, and Systematics* 35:257–284.
- Anella, A., and J. B. Wright. 2004. *Saving the ranch: conservation easement design in the American West*. Island Press, Washington, D.C.

- Arendt, R. 1996. Conservation design for subdivisions: a practical guide for creating open space networks. Island Press, Washington, D.C.
- Arendt, R. 1999. Growing greener: putting conservation into local plans and ordinances. Island Press, Washington, D.C.
- Arendt, R. 2004. Linked landscapes: creating greenway corridors through conservation subdivision design strategies in the north-eastern and central United States. *Landscape and Urban Planning* **68**:241–269.
- Austin, M. E., and R. Kaplan. 2003. Resident involvement in natural resource management: open space conservation design in practice. *Local Environment* **8**:141–153.
- Brown, D. G., K. M. Johnson, T. R. Loveland, and D. M. Theobald. 2005. Rural land-use trends in the conterminous United States, 1950–2000. *Ecological Applications* **15**:1851–1863.
- Clark, S. 2007. A field guide to conservation finance. Island Press, Washington, D.C.
- Czech, B., P. R. Krausman, and P. K. Devers. 2000. Economic associations among causes of species endangerment in the United States. *BioScience* **50**:593–601.
- Daniels, T., and M. Lapping. 2003. Land preservation: an essential ingredient in smart growth. *Journal of Planning Literature* **19**:316–329.
- Edwards, M. M., and A. Haines. 2007. Evaluating smart growth: implications for small communities. *Journal of Planning Education and Research* **27**:49–64.
- Ewing, R., J. Kostyack, D. Chen, B. Stein, and M. Ernst. 2005. Endangered by sprawl: how runaway development threatens America's wildlife. National Wildlife Federation, Smart Growth America, and Nature Serve, Washington, D.C.
- Ginn, W. 2005. Investing in nature: case studies of land conservation in collaboration with business. Island Press, Washington, D.C.
- Griffith, J. A., S. V. Stehman, and T. R. Loveland. 2003. Landscape trends in mid-Atlantic and southeastern United States ecoregions. *Environmental Management* **32**:572–588.
- Gude, P. H., A. J. Hansen, R. Rasker, and B. Maxwell. 2006. Rates and drivers of rural residential development in the Greater Yellowstone. *Landscape and Urban Planning* **77**:131–151.
- Hansen, A. J., R. L. Knight, J. M. Marzluff, S. Powell, K. Brown, P. H. Gude, and K. Jones. 2005. Effects of exurban development on biodiversity: patterns, mechanisms, and research needs. *Ecological Applications* **15**:1893–1905.
- Heid, J. 2004. Greenfield development without sprawl: the role of planned communities. Urban Land Institute, Washington, D.C.
- Land Trust Alliance. 2006. 2005 national land trust census report. Land Trust Alliance, Washington, D.C.
- Lenth, B. A., R. L. Knight, and W. C. Gilgert. 2006. Conservation value of clustered housing developments. *Conservation Biology* **20**:1445–1456.
- Lerner, J., J. Mackey, and F. Casey. 2007. What's in Noah's wallet? Land conservation spending in the United States. *BioScience* **57**:419–423.
- Levitt, J.N., editor. 2010. Conservation capital in the Americas. Lincoln Institute of Land Policy, Cambridge, Massachusetts.
- Merenlender, A. M., L. Huntsinger, G. Guthey, and S. K. Fairfax. 2004. Land trusts and conservation easements: who is conserving what for whom? *Conservation Biology* **18**:65–75.
- Milder, J. C. 2005. An ecologically-based evaluation of conservation and limited development projects. MS thesis. Department of Natural Resources, Cornell University, Ithaca, New York.
- Milder, J. C. 2007. A framework for understanding conservation development and its ecological implications. *BioScience* **57**:757–768.
- Milder, J. C., J. P. Lassoie, and B. L. Bedford. 2008. Conserving biodiversity and ecosystem function through limited development: an empirical evaluation. *Conservation Biology* **22**:70–79.
- Milder, J. C. 2010. Using limited development to finance conservation. Pages 65–79 in J. N. Levitt, editor. *Conservation capital in the Americas*. Lincoln Institute of Land Policy, Cambridge, Massachusetts.
- Miller, J. R., M. J. Groom, G. R. Hess, D. L. Stokes, T. A. Steelman, J. R. Thompson, L. Fricke, B. King, and R. Marquardt. 2009. Where is biodiversity conservation in local planning. *Conservation Biology* **23**:53–63.
- Pejchar, L., P. M. Morgan, M. R. Caldwell, C. Palmer, and G. C. Daily. 2007. Evaluating the potential for conservation development: biophysical, economic, and institutional perspectives. *Conservation Biology* **21**:69–78.
- Pelrman, D. L., and J. C. Milder. 2005. *Practical ecology for planners, developers, and citizens*. Island Press, Washington, D.C.
- Radeloff, V. C., R. B. Hammer, S. I. Stewart, J. S. Fried, S. S. Holcomb, and J. F. McKeefry. 2005. The wildland-urban interface in the United States. *Ecological Applications* **15**:799–805.
- Rissman, A. R., L. Lozier, T. Comendant, P. Kareiva, J. M. Kiesecker, M. R. Shaw, and A. M. Merenlender. 2007. Conservation easements: biodiversity protection and private use. *Conservation Biology* **21**:709–718.
- Shaffer, M. L., J. M. Scott, and F. Casey. 2002. Noah's options: initial cost estimates of a national system of habitat conservation areas in the United States. *BioScience* **52**:439–443.
- Szabo, P. 2007. Noah at the ballot box: status and challenges. *BioScience* **57**:424–427.
- TPL (Trust for Public Land). 2008. *Conservation almanac*. TPL, San Francisco, California. Available from <http://www.ConservationAlmanac.org> (accessed March 2010).
- TPL (Trust for Public Land). 2010. *Land Vote database*. TPL, San Francisco, California. Available from <http://www.tpl.org> (accessed March 2010).
- Wallace, G. N., D. M. Theobald, T. Ernst, and K. King. 2008. Assessing the ecological and social benefits of private land conservation in Colorado. *Conservation Biology* **22**:284–296.
- Wilcove, D. S., D. Rothstein, J. Dubrow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *BioScience* **48**:607–615.
- Wright, J. B., and A. Anella. 2007. Saving the ranch: fresh eyes on taxes, development, and conservation easements. *Rangelands* **29**:13–20.

