Public Benefits of Undeveloped Lands on Urban Outskirts: Non-Market Valuation Studies and their Role in Land Use Plans

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I. Introduction

Private markets can be an efficient way to allocate many resources, but they can fail to take account of public benefits that do not flow to the participants in market transactions. Many of the public benefits of undeveloped lands, whether natural or agricultural, share this characteristic. Remote wilderness may support ecological diversity; city parks may support recreation for thousands of people. In between the two, natural undeveloped land on city outskirts, while rarely supporting rich ecological diversity, can still provide critical habitat for endangered native flora and fauna. It can help purify surface and groundwater, improve air quality, and keep the region cooler in the summertime. It can provide a place for hiking and other recreation. It can provide an aesthetic view and a sense of serenity lost in city developments.

For all of these reasons, accounting for the public benefits of undeveloped lands on city outskirts must play a crucial role in city planning. Over the past three decades, the economics profession has developed and refined a number of methods for estimating these public benefits empirically, providing an opportunity to incorporate such information into actual land-use planning. While federal regulations routinely require such estimates for major regulations, the extent to which they are used in local land use plans is not clear.

In this paper, we review the literature on public values for lands on urban outskirts, and evaluate the role these studies have played in land use plans.[1] While all types of public

[1] In this respect, this literature review differs from another recent, and much more extensive, review of values for "open space" by McConnell and Walls (2005). That review covers undeveloped lands in rural areas and within the urban center, as well as on urban outskirts, but does not address the role the papers have played in the policy process.

benefits are relevant to these issues, because recreational and other "use values" are often emphasized in this literature, we have made a particular effort to cover studies of ecological values, giving them more weight in our discussion. Consequently, because natural lands generally have higher ecological values than farmland, we similarly emphasize natural land cover in this paper. That said, the emphasis is only a matter of degree relative to the coverage in the literature; all types of benefits and lands are discussed within this review.

The paper begins by reviewing the various benefits to preserving undeveloped lands, and discusses which of these benefits households emphasize over other types, and which are likely to be provided by various types of undeveloped land. In Section 3, it then briefly reviews the methods for economically estimating such benefits before passing on, in Section 4, to a review of specific studies and they way their use in the policy process. Section 5 concludes.

II. Why do Households Value Undeveloped Lands on Urban Outskirts?

It is evident that urban and suburban households increasingly value the conservation of their nearby undeveloped lands. According to the data collected by the Land Trust Alliance and the Trust for Public Land, over the past five years, from 2000 to 2004, there were over 850 state, county, or municipality ballot measures targeting such conservation, of which some 75% were successfully adopted. The movement is widespread, encompassing over 40 states, and continues to build momentum, with 162 measures authorizing total expenditures of over $4 billion passing in 2004.

There are many good reasons for households to desire conservation of undeveloped lands. These lands can provide habitat for wildlife; they can provide beautiful scenery and help maintain local patterns in the way of life; they can reduce stormwater run-off and air pollution, thereby improving human health and/or reducing compensating municipal expenditures; and they can provide opportunities for outdoor recreation.[2] Before discussing ways of economically measuring these benefits, it will be useful to review the reasons households actually give for wanting to preserve lands.

[2] Duerksen and Snyder (2005 Ch.2) provide an overview of some of these benefits in the context of local nature protection.

Kline and Wichelns (1996) surveyed 515 Rhode Island residents, intercepted at the State's Department of Motor Vehicles. They presented to respondents a list of nine reasons one might protect "open space" from development, based on focus groups, and asked the respondents to rank those reasons.[3] The nine reasons, in order of importance, are shown below:

1. Protecting groundwater,
2. Protecting wildlife habitat,
3. Preserving natural places,
4. Providing local food,
5. Keeping farming as a way of life,
6. Preserving rural character,
7. Preserving scenic quality,
8. Slowing development, and
9. Providing public access.

The nine reasons might be clustered into four more general ones: environmental (1-3), agrarian (4-5), aesthetic (6-7), anti-growth (8), and recreational (9).[4] Of these reasons, respondents clearly prioritize the environmental ones, putting all three at the top. Surprisingly, the more self-interested reasons of aesthetics and recreation (admittedly, enlightened, rather than material, interests) are ranked at the bottom.

In a study of residents in the small town of Petoskey, MI, Krieger (2004) found a similar ordering. He asked respondents to rank these same five broad reasons for preserving undeveloped lands. Six hundred ninety four responded, ranking "environmental objectives" as the most important reasons for preserving undeveloped lands, with "growth management" second, agrarian third, aesthetic fourth, and, again, recreational last. However, Krieger doubts that people carefully think through the types of lands protected and their true ecological values. With most development in Petoskey occurring on farmland, which generally has little ecological value, the emphasis on ecological values seems ill informed.[5]

[3] Unfortunately, the authors did not define the term "open space" for respondents.
[4] Kline and Wichelns offer an alternative clustering based on the correlation of these rankings and the latent "factors" of a factor analysis: environmental (1-3), agrarian (4-5), aesthetic (6-7 and 9), and anti-growth (8).
[5] For example, an exercise conducted in focus groups in which participants were asked to match types of lands to the types of values they would support was not very successful. (Personal correspondence with the author.)

Rosenberger (1998) presented a related list to a sample of 70 residents and 402 tourists in Routt County, CO, home of Steamboat Springs and an important resort area experiencing great pressures for development. (See the discussion of the Rosenberger and Walsh 1997 study below for more details.) Rosenberger's list is somewhat different, ranking not "reasons" but "assets." That is, both natural features and man-made objects and institutions are ranked for their "contributions to the enjoyment of living in and visiting Routt County." The list consists of 43 items, encompassing protection of the environment, aesthetic amenities, recreation including sports and theater, salient features of Western American culture (speech, food, etc.), and so forth. Even with this large list, however, environmental assets rise to the top, with the seven highest ranked assets being

1. Rocky Mountains and forests,
2. Wildlife,
3. Meadows,
4. Rivers and lakes,
5. Air and water quality,
6. Trails for recreational use, and
7. Grasslands with livestock.

It is clear that a purely recreational asset like "trails" and agrarian assets like ranchlands are ranked lower than natural assets like "wildlife" or "forests," although the reasons for the higher ranking of these assets is not clear. Still, with these assets beating out "schools," "law enforcement," "western food," and so forth, these results seem broadly consistent with Kline and Wichelns (1996). One note of caution in interpreting these results is in order, however. The interpretation of the "contribution" of these assets "to the enjoyment of living in and visiting Routt County" may be that they are the most important components of enjoyment, or alternatively, that they are what is most special about Routt County—or some combination. To put it in the language of economics, the interpretation may be in terms of "total value" or "net value" relative to the opportunity cost of living/visiting some other county.[6]

[6] For example, "horse equipment" as an asset ranks above "religious services" for residents. It seems hard to believe that residents would truly prefer to forego all horse equipment to all religious services. But religious services being available most places, it may be that horse equipment is a more important reason for living in Routt County in particular.

Finally, Krieger (1999) offers a fourth and very useful qualitative assessment of reasons for protecting lands from urban sprawl. He studied the loss of farmland and open space in three counties in the Chicago metropolitan area. Like Kline and Wichelns (1996), he offered a list of nine reasons for protecting farmland and more generic "open space" from development. The table below gives these reasons and the rank ordering of the 1,509 and 1,549 respondents for each case.

Reasons	Ranking for Protection of Farmland	Ranking for Protection of "Open Space"
Ensure future food supply	1	9
Protect family farms	2	8
Slow & control development	3	2
Preserve rural quality	4	3
Preserve scenic beauty	5	5
Reduce flooding	6	4
Protect groundwater quality	7	6
Protect wildlife habitat	8	1
Public access to open spaces	9	7

In this case, Krieger finds that for farmland, using the terminology of Kline and Wichelns (1996), the so-called "agrarian" reasons score much higher than either aesthetic or environmental reasons. However, for other open space, protecting wildlife habitat scores at the top, while aesthetic amenities generally score in the middle. In both cases, "public access," the closest reason to recreation-type amenities, scores at or near the bottom. This despite the fact that some 90 percent of respondents reported visiting at least one type of open space during the prior six months.[7]

Not the least of Krieger's contributions is to the understanding of what the public means by the term "open space.[8]" This term is quite vague, yet is frequently tossed about in

[7] It may be that this is a sign that sufficient protected lands are available for recreation already.
[8] "Sprawl" is an equally nebulous term. Participants subtly associated sprawl with a wide range of quality-of-life issues including traffic congestion, crime, a more hectic pace of life, and a loss of community cohesiveness. These images thus lie behind some of the aesthetic and anti-growth factors.

policy debates, so putting definite meaning on its use is quite valuable. In focus groups, participants were first asked to name different types of open space. The types named include forest preserves and wildlife refuges, state parks, city parks, wetlands and lakes, and recreational trails, as well as private lands such as farmland, golf courses, open areas as part of developments, cemeteries, and vacant lots. This long list reinforces the idea that "open space" can mean many things. Nevertheless, focus group participants generally made two distinctions among these various types. The first distinction was between "developed open spaces" (such as open areas as part of a subdivision, city parks, and golf courses) and "undeveloped open spaces" such as natural lands and farmland. The second, related, distinction was between congested or heavily used types of open space (again, city parks, e.g.) and empty, uncongested lands. Tapping into these images and key words may help to persuade local residents, or to communicate salient information about the kinds of lands at issue in any particular context.

Triangulating on these different studies allows us to gain important insights into people's reasons for protecting lands from development. First, as shown in Krieger (1999), people correctly understand that farmland does not have the same ecological value as other types of land cover. In the case of non-agricultural lands, ecological and environmental values do rise to the top. Moreover, Rosenberger (1998) finds that people would rank such lands above agricultural lands and urban "open spaces." Finally, Kline and Wichelns (1996) and Krieger (2004) confirm the implication that ecological and environmental values are at the top of the list of reasons for protecting lands from development.

III. Valuation Methods

Economists generally use willingness to pay as a measure of the benefits to households of public goods as well as private goods. Values for undeveloped lands, left in their natural or agricultural state, are no exception. Such monetary measures have the advantage of being directly comparable to costs of providing these goods. Since protecting lands does come at some cost—that is, some other use of the land must be given up, as must some other use of public funds—willingness to pay measures can motivate private and public decision-makers to consider the alternative ways that resources could be used.

Just because it is a monetary measure, however, does not mean that willingness to pay need reflect only narrowly materialistic values. People may be willing to pay to protect lands for a variety of reasons. These reasons encompass material self-interest (to raise their property values, lower their energy bills, etc.), love of the look or feel of a community, and benevolent care for others or even for nature. Economists generally divide all these into three types: use values, non-use values, and altruistic and bequest values. Use values include active recreation and even enjoying a view—anything where the land is actually employed in an activity. Non-use values include the sheer existence of wildlife or a cultural way of life—anything where one does not need to be present. Altruistic values reflect people's willingness to pay for others' enjoyment of either the use or non-use values of the lands; similarly, bequest values reflect such concerns for future generations.

Willingness-to-pay measures of benefits must be contrasted with measures of cost avoidance. Often, analysts will use replacement values or the costs of replacing the services of natural resources as the measure of the benefit of those services. For example, analysts might value the service of undeveloped lands in providing clean water by the amount it would cost to do that cleaning through other means, such as a filtration plant. But if such a filtration plant were very expensive, and if the water were sufficiently clean, the costs of the filtration plant would likely overstate the actual benefits of the filtration services of the lands. In other words, just because a service costs a given amount to provide, does not signify that households would receive that level of benefits if it were provided. The one exception to this rule is when the services must be provided because of legal or other constraints. In the famous example of the watershed services provided by the Catskill Mountains for New York City, for example, the water filtration plants would be required to be built by law (see Daily 2002). The fact that land preservation could provide the service at less expense saved real resources from being spent.

Although there are many reasons people value undeveloped lands, the various economic methods for measuring such values are not equally good at capturing all of them. In this section, we review some of the prominent methods for measuring values for public goods.

Stated Preference Methods

The stated preference method uses surveys to elicit willingness to pay from households by constructing a hypothetical scenario and "market" (see Mitchell and Carson 1989 for an introduction and Arrow et al. 1993 for best practices suggested by a blue ribbon panel). Stated preference surveys generally have four main steps. First, a broad policy context is set and people are asked to think about their priorities—that is, about all the ways they could use their money and all the programs for which public money could be used. Second, a specific policy context is set (e.g. issues related to urban sprawl and land use) and a plan is put forth to achieve some purpose (e.g. protecting *x* acres of land of some type). The plan should involve some concrete "payment vehicle" through which funds would be raised. To elicit households' true willingness to pay, this payment vehicle should be realistic and believable, and should be one through which households would bear the cost. Taxes are a common choice because they are the most believable for many programs, but are problematic because not all households actually pay taxes. Third, households are asked to indicate how much they are willing to pay for a program, cast a hypothetical vote in favor of or against a program, or make a choice among alternative programs. This step, the meat of the stated preference method, is discussed below. The fourth and final step is to ask various demographic and attitudinal questions of the respondents, and to probe on their understanding and acceptance of the information conveyed in the survey.

The third step of the stated preference method, the actual valuation question, is worth discussing in more detail. Stated preference methods can be divided into two types, contingent valuation and conjoint valuation. Contingent valuation surveys describe a single scenario and program and elicit information on the support for that program. As gauges of support, "open-ended" questions and "payment cards," in which respectively the respondents suggest their maximum willingness to pay or circle a number from a list, have generally given way to "dichotomous choice" questions, in which respondents given a yes/no "vote" on a hypothetical referendum. The latter provides weaker information, but invites less room for gaming the cost on the part of the respondent.

Conjoint valuation methods instead describe a series of programs, differing along different dimensions, or "attributes." For example, respondents might see a series of paired conservation programs, each differing with respect to the quantity of land protected, the type of land cover preserved, public access, and costs. The respondents would be asked to select their preference from the pair. Repeating this exercise over many pairs, and over many respondents, public preferences for the various attributes can be inferred. For example, does the public prioritize agricultural land or forested land for preservation? Does the type of land matter as much as public access? How much added cost is the public willing to accept to obtain improvements along these dimensions? Using this kind of information about attributes, analysts can repackage the attributes to evaluate many potential policies. In contrast, contingent valuation allows an evaluation of only on specific policy. Consequently, conjoint analysis can provide richer information than contingent valuation.

In many respects, stated preference methods in general can provide more complete information for the policy process, relative to other valuation methods. First and foremost, they provide information on people's total values—use, non-use, and altruistic—because any of these types of values would be gained if the hypothetical program were to pass. Second, because they are hypothetical in nature, they can create a scenario for which information is required, a scenario which might not be found in the real world. Third, through other survey questions, they can provide a range of qualitative information about households attitudes and support for programs beyond willingness to pay. Conjoint surveys in particular can shed light on people's attitudes about many features of land use plans.

Although a source of some of its strengths, the hypothetical nature of stated preference methods might also be a disadvantage if there is reason to believe that words are different from deeds (see e.g. Hausman 1993). As an alternative, so-called revealed preference methods have the advantage of inferring people's values from their actual behavior in linked markets and activities. We next discuss those revealed preference methods most salient to values for undeveloped lands.

Hedonic and Residential Choice Methods

The hedonic pricing method is based on the premise that market prices are related to the attributes of a property (for introductions, see Freeman 2003 Ch. 11 and Palmquist 2003). For instance, of two otherwise identical houses in otherwise identical neighborhoods, we would expect the one in the better school district to have a higher value. Similarly, we would expect the one with the more pleasant surrounding land uses to have a higher value. A difference in prices of comparable properties, but differing in access to environmental amenity, reflects the economic value of the amenity. Land-use-related attributes may include proximity to a park, golf course, forest, or farmland; unblocked views of greenery; temperature and quality of the air, etc. When all these and other housing attributes vary simultaneously, the importance of each can be inferred using a multiple regression of property values on the various attributes.

Any reason for valuing undeveloped lands that can be enjoyed by living near them can be captured by the hedonic method. For example, a beautiful view or convenient access to nature trails are fundamentally spatial: they can be obtained only by purchasing houses that have them. Because a view is valued, demand is higher for houses with a good view, which bids up the price. The price differential to other houses is identified in the hedonic regression. Unfortunately, values related to nature per se, or other existence values, cannot be measured with hedonic regressions. Because such values are obtained regardless of where one lives, they do not affect land values. For example, people may value the preservation of the spotted owl for purposes of genetic diversity, but not for bird watching. But the existence of the genetic diversity—unlike a good view—is the same wherever one lives. Thus, there is no reason to buy land near the spotted owl, and no mechanism to bid up prices.

The hedonic method also raises several statistical issues. First, the regression of prices on attributes yields a price-function. Like prices for market goods, this price function indicates only households' marginal willingness to pay for a small increase in an attribute. Unlike stated preference methods, it does not indicate their total willingness to pay for an attribute. In principle, a second stage can be used to infer these total values from data across multiple markets. However, the statistical requirements are steep (e.g. Epple 1987) and may

remain yet to be successfully implemented. In our review, we focus only on the first-stage marginal values for undeveloped lands for nearby property values. Second, recent work (e.g. Irwin 2002) has emphasized the spatial correlation between prices even after accounting for observed attributes. The most reliable studies take account of this correlation.

Two related methods are discrete choice models of residential location and equilibrium sorting models. Both of these methods rely on the same intuition that values for aesthetic amenities increase the demand for property near desirable land uses, and that that demand increases property values. However, they differ with respect to the way that they make use of this intuition statistically. Instead of estimating the values for those amenities by a hedonic price regression, discrete choice models of residential location directly consider the choices households make about where to live to infer their willingness to trade higher prices for more amenities. Not unlike conjoint analysis, discrete choice models look at the patterns of people's choices (in this case, about where they live), and the attributes (low prices, large houses, good schools, good environment, etc.) of the alternatives among which they choose. Priorities among the attributes can be identified, as well as the trade-offs among them. Unlike conjoint analysis, however, the choices are not hypothetical, but the actual ones that people face in the housing market. More recently, equilibrium sorting models have been used to similarly infer those values from households' choices of residential neighborhoods. The main differences from other discrete choice models is that they focus on the *distribution* of household types (incomes, etc.) across neighborhoods. Although different statistically, both methods capture similar values as the hedonic method and rely on a similar underlying logic.

In summary, the main strength of these property value methods is that they can be used to estimate values based on actual choices reflected in property prices and rental rates. Unfortunately, the scope of environmental benefits that can be measured is limited to things that are related to housing prices. In addition, the method will only capture people’s willingness to pay for perceived differences in environmental attributes, and their direct consequences. Thus, if people aren’t aware of the linkages between the environmental attribute and benefits to them or their property, the value will not be reflected in home prices.

The Travel Cost Method

Travel cost methods provide a way to measure values for outdoor recreation. One of the earliest forms of non-market valuation, dating to early work by Marion Clawson, the travel cost method is used extensively to estimate recreational values in a variety of settings, including park and lands management and Natural Resource Damage Assessments. The method infers values for recreational lands based on how far people are willing to travel to use them: higher-quality resources (in terms of the recreational experience) attract more people and from greater distances. The trade-off people make between travel costs and the quality of the lands and waters can provide an estimate of value (see Freeman 2003 Ch. 13).

To our knowledge, most recent applications have been to remote resources or to large sets of resources (e.g. all the fishing sites in a state), and have not been used in land use plans on urban outskirts. For this reason, we do not discuss travel cost studies in this review.

Cost Avoidance

As noted above, when, because of legal or other requirements, environmental degradation forces expenditures for cleanup, real costs are borne by society. As a consequence, environmental improvements that make such expenditures unnecessary provide the benefit of avoiding the expenditure. A prominent example of such a case is New York City's decision to protect lands in the Catskill Mountains to improve the quality of its drinking water, thereby avoiding installation of expensive water filtration plants (Daily 2002; Chichilnisky and Heal 1998). While a real value, it does not relate to the ecological or amenity benefits of the land. Here, we must make a subtle but important distinction. The water quality per se is a valuable ecological service of the preserved lands. The expenditure saved on the filtration plant is not, nor is it a measure of the value of the clean water. New York's preservation of the land no doubt helped secure a variety of ecosystem values which could in principle be estimated using any of the above techniques. Curiously, those values have never been estimated, and we have found no evidence that such factors played any role in New York's decision.

The Benefit Transfer Method

The so-called "benefit transfer method" is not actually an independent way to estimate values, but rather an organized way to use information gathered from one of the above methods in one context for policy questions in a different context (see Desvousges, Naughton, and Parsons 1992 and Desvousges, Johnson, and Banzhaf 1998). "Aggregate transfers" involve the transferring of an estimate of benefits: i.e., estimated public benefits for plat A are used to infer the benefits for a similar plat B. Disaggregate transfers involve transferring a series of scientific and economic relationships, linked together. The Urban Ecological Analyses popularized by the US Forest Service are an example of the latter. In this case, to estimate a value of a particular forest, information established from other studies about the relationship between tree cover and air pollution and tree cover and water run-off is used to estimate those relationships for the forest of interest. Information on the values of the associated reductions in pollution, again estimated in different contexts, are then linked in. The product of the two linkages is the transferred value.

Both aggregate and disaggregate transfers involve two key judgments on the part of the analysis. First, the analyst must choose which original studies, or combinations of studies, to transfer. A single study, simple average outcome of multiple studies, or meta-analysis of studies may be used. On one hand, basing a transfer on more studies makes use of more information, on the other, selected one or a few studies which best fit the new context may keep the information more relevant. Second, the analysis must decide whether to transfer the original estimate without any adjustment, to make judgmental adjustments based on qualitative differences, or to transfer functional relationships that take account of observable differences in the two contexts statistically (e.g. Loomis 1992). These analytical decisions make transfers an art and science in their own right, just like original research.

Having introduced these methods, the types of benefits they can capture, and some of the empirical issues involved with successfully implementing them, we now turn to a review of specific studies that have estimated values for undeveloped lands.

IV. Review of Studies of Public Values for Undeveloped Lands on Urban Outskirts.

Stated Preference Studies

As discussed above, stated preference studies are one of the best opportunities to infer values households place on the ecological values of lands protected on urban outskirts. Unlike aesthetic values, which may show up in land prices, most ecological values can be captured regardless of where one lives. Thus, only surveys can identify these values. This section reviews survey-based methods applied to the protection of undeveloped lands on urban outskirts.

Rosenberger and Walsh (1997) studied residents' values for preserving ranchland in the Yampa River Valley in Routt County, Colorado, which includes the town of Steamboat Springs. In a companion paper, Rosenberger and Loomis (1999) studied tourists' values for the same lands.[9] Routt County's primary industry is tourism, attracting visitors with a variety of natural and man-made assets, including national forests; ranchlands; hiking, bicycle, and horse trails; camp grounds, and so forth. The area lost approximately 20% of its valley ranchland between 1990 and 1995 (of about 50,000 acres). These lands are used primarily for grazing, but not being intensively managed provide important habitat for elk and migratory birds, and serve as a riparian buffer for the Yampa River, a target of Nature Conservancy conservation.[10] Evidence from Rosenberger (1998) suggests that ecological values were a primary factor in residents' desire to protect the land. As noted above, Rosenberger found that wildlife, meadows, and "grasslands with livestock" were near the top of the list of assets contributing to the enjoyment of living in the area.

In response to the pace of development, the County Board of Commissioners, the Governor, and other groups such as The Nature Conservancy have attempted to preserve land through zoning, regulation, and purchases. Existing tourist industries, such as the ski resorts, also were behind the conservation as a way to improve their amenities and to restrict competition.

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[9] Rosenberger is a professor in School of Forestry at Oregon State University, and was a PhD student at Colorado State University when this research was conducted. Loomis is a professor in the Department of Agricultural and Resource Economics at Colorado State University, and Walsh is retired from that department.
[10] Personal communication with Randall Rosenberger.

In the study of residents, Rosenberger and Walsh sent a contingent valuation mail survey to 320 residents of the area, with a 57% response rate. They used a payment card to elicit willingness to pay, in the form of higher taxes, for a county protection program.[11] Respondents were asked to specify their preferred level of protection (25% to 100% of the County's ranchland) and then asked their willingness to pay for that level. Willingness to pay estimates range from $36 to $72 to protect 25% of existing ranchland in specific valleys, and $107 to protect 25% of the ranchland in the whole county. The values translate to an incremental value of about $8 per thousand acres for the first increment. With only about 6,200 households in Routt County at the time of this research, this would imply a total value of about $50 per acre—not enough to justify large purchases on benefit-cost grounds.

In the study of tourists, Rosenberger and Loomis used the travel cost method to estimate how much tourists were willing to pay for trips to the area, supplemented with "contingent behavior" data for surveys on how their travel patterns would change if all the ranch open space were developed, including tourist-related development. The vast majority of tourists stated that the aesthetic contribution of the ranchlands was an important part of their trip. The published study of Rosenberger and Loomis (1999) found that, for the sub-sample of visitors who took car-trips exclusively for the purpose of visiting Steamboat, roughly offsetting numbers would decrease or increase trips if the ranchlands were replaced by tourist-related infrastructure. For a larger sample, however, it was found that trips would definitely decline if ranchland were lost.[12]

These studies were communicated into the policy process in a number of ways, including a special extension bulletin circulated among stakeholders (Routt County Extension Office [undated]), a workshop to the public, numerous meetings with land trusts and other stakeholders, participation in the county's annual economic summit, etc. Despite the fact that residents' values were generally small relative to land prices, insofar as residents were willing to pay something and insofar as tourism was likely to be negatively impacted, the work was viewed as supporting conservation. In 1995, the work was referenced in new land-use planning rules (the "Open Lands Plan"). This plan declared that farming and ranching could

[11] Unfortunately, details of this program were not made clear in the survey.
[12] Personal correspondence with Randall Rosenberger. See also (Routt County Extension Office [undated]).

not be deemed nuisances, and established Land Preservation Subdivision Regulations that encouraged clustering of new homes and preservation of remaining parcels with agricultural and/or ecological values. In 1997, citizens further approved a Purchase of Development Rights (PDR) tax that averages $20 per property per year.[13] The PDR program continues to be funded, and a follow-up study, scheduled for completion in early summer, has been commissioned to establish a basis for the continued justification of the program.

In a study undertaken not far away, in Loveland, Colorado, Loomis, Traynor, and Brown (1999) elicited household willingness to pay, through sales taxes, for a program that would protect "open space by purchase of lands from willing sellers." In the version of the survey with the most standard elicitation procedure (a yes/no dichotomous choice) question, mean willingness to pay was estimated to be $108 for recreation lands and $116 for nature lands. The study was presented to a local land commission, who eventually used it to help design a ballot initiative that was finally put on the ballot in 2003, but which was not adopted.[14]

Based in part on this experience, in more recent work in Kerri Rollins (formerly Traynor) has used more qualitative survey methods to estimate support for protecting lands at various levels, support for preference in using conservation easements (which would protect wildlife habitat) versus fee-simple purchases (which would also allow public access for recreation), and interest in wilderness and recreation. This work has been used to create a master plan for Larimer County, Colorado, that would follow a 50/50 balance between conservation easements and purchases.[15]

A third contingent valuation study in Colorado was conducted by Breffle, Morey, and Lodder (1998).[16] They elicited responses from residents of a Boulder neighborhood about their willingness to pay to preserve the Cunningham property, a 5.5 acre parcel of then-undeveloped land in Boulder, CO. Bordering other protected lands abutting the foothills of

[13] Personal communications with Randall Rosenberger and C.J. Mucklow, the county extension agent. See also Colorado State University (2002).
[14] Personal communication with Kerri Rollins.
[15] Personal communication with Kerri Rollins.
[16] Breffle is at economist at Stratus Consulting; Morey is a professor of economics at the University of Colorado; and Lodder is at the Regional Air Quality Council, Denver.

the Rocky Mountains, the property provided some wildlife habitat.[17] It also provided views of mountains and "unofficial access" to a bike path and additional open space.[18] A construction company purchased the land in 1991 for the purposes of a new subdivision. In response, a neighborhood group called the Cunningham Coalition formed to lobby against the proposed development and to raise donations to allow the City's Open Space Program to purchase and preserve the property.

Breffle, Morey, and Lodder surveyed residents within one mile of the property. The survey was conducted using in-person interviews and a double-bounded format. The payment vehicle is unspecified in the survey. The sample was small, consisting of only 71 final respondents. The sample mean household one-time willingness to pay for preservation of the land was $302, giving a neighborhood-wide value of $774,000.

The report was sent to the city council and was received by the Mayor of Boulder, and information was passed on informally to the Cunningham coalition. Because of this study and other factors, the City of Boulder decided that annexing the property was not in the best interest of the community, ending all plans for a housing development. Meanwhile, the coalition's attempt to purchase the property in cooperation with another buyer who would erect one modest home was delayed due to difficulties with the financing.[19] Ironically, the developer sold the property to another buyer who intended to build one home (in accordance with county regulations)—but a home with a pool, tennis court, artificial ponds, golf greens, expansive lawns, and a tall iron fence. While development was limited to one house, these modifications obviously were not consistent with the coalition's original vision of preservation. This story is a cautionary one: even when the information is there to persuade the public and public decision-makers, other resources have to be available to follow through with conservation.

Turning to a larger metropolitan area, Krieger (1999) studied the loss of farmland and other undeveloped lands in the Chicago area (specifically Kane, McHenry, and DeKalb

[17] For example, a study of marmots had been conducted on the property.
[18] Personal communication with Edward Morey.
[19] Personal communication with Edward Morey.

counties).[20] From 1982 to 1992, 15% and 8% of land in Kane and McHenry counties, respectively, was converted from agriculture to other uses, while 61 and 64% remained agricultural. The research included a contingent valuation mail survey of 4,000 residents of the counties, with a 45% response rate. The survey used a referendum format in which people were asked to vote for a program that would cost a given amount in taxes. As noted above, focus groups suggested that people's primary motives for voting for the hypothetical program were related to congestion and the "feel" of the community. Respondents made a distinction between agricultural and non-agricultural lands, however, ranking ecological values as a top priority for the latter, but not the former. About 76% of respondents were willing to support a program at a cost of $5 per year, for five years, to protect 20,000 acres of farmland in their county. Fifty-seven percent supported it at a cost of $100 per year, and 45 percent supported it at a cost of $170 per year.

Commissioned by American Farmland Trust's Center for Agriculture in the Environment, this work was conducted as background to the ongoing problem of sprawl in Chicago, not a particular policy decision. It was communicated via a large press conference, to media reaching millions of people. American Farmland Trust had created stakeholder committees, to which they provided some staffing, and to which they gave this report. The committees have used this report to lobby local county boards, and have just recently won the opportunity to place a PDR program on the ballot. The information about how much people were willing to pay, but also the qualitative information which showed people ranked open space as a top issue, were especially persuasive in this outcome.[21]

Like Krieger (1999), Kosobud (1998) studied households' values for land conservation in the Chicago area.[22] This study was a smaller-scale effort, but targeted ecological values more directly. In particular, respondents were told that the money would "enable the local government to fit several smaller pieces together into a viable habitat, create new areas some of which would be closer to neighborhoods that have little native vegetation, and better maintain existing natural areas" (p. 26). Unfortunately, households were not told how much

[20] Krieger is a private consultant.
[21] Conversation with Ann Sorenson, Assistant Vice President for Research, American Farmland Trust.
[22] Kosobud is in the Dept of Economics, University of Illinois at Chicago. This work was sponsored by the Chicago Wilderness Project Coalition, but efforts to contact the author and sponsor were not successful.

land would be protected with their money; they were only asked if they would support a given level of expenditure.

Using a convenience (i.e. non-random) sample of about 200 Chicago-area residents, Kosobud found that about 91% were willing to pay some amount for additional "wilderness space." The average willingness to pay was about $20 when weighted to reflect city-wide demographics. Kosobud used an estimate of the cost of creating new natural areas, including land acquisition, soil preparation, and planting of native plant species. Multiplying the $20/year figure by the Chicago area population and dividing by his estimated $10,000/acre cost, approximately 5,000 acres per year could be converted to natural areas. Again, however, participants were not specifically asked to vote for this program.

Turning to an example of work in a much smaller urban environment, Krieger (2004) explores residents' values for preserving undeveloped land around Petoskey, a city of about 14,000 people on the northern Lake Michigan shore of Michigan's lower peninsula. Although small, Petoskey's population had grown nearly 20 percent from 1990 to 2000 and its housing units by 24 percent, in part for seasonal visitors. From 1978 to 1998, urban lands increased from 4,200 to 7,200 acres, while agricultural and forest lands decreased (although some of these lands were reclaimed as wetlands). These trends suggest that forested lands of some potential ecological value, as well as farmlands, are at stake in this area. As noted above, households ranked ecologically related values at the top of a list of reasons to protect lands from development.

Beginning in 2001, the State of Michigan adapted its small PDR program, delegating authorities to local governments and providing matching grants. The City of Petoskey and two neighboring townships created a Land Conservancy Task Force, which included the mayor as well as local citizens, to write a PDR ordinance, which would qualify the area for the matching grants. The work of Krieger (2004) was in support of this process.[23]

Although Krieger conducted a contingent valuation study, the task force's interest was not in average benefits per se, that is, not in the usual information required for a benefit-cost analysis. Rather, it was interested in information on whether there was support for a property

tax millage to fund the PDR program. But when the payment vehicle of the survey is a property tax, that is precisely the information that a contingent valuation study provides. About 65% of households supported the millage if it cost their household $4 per year, with support dropping as costs increased, to a 50% level of support if it cost $105 per year. Unfortunately, these shares are similar regardless of the number of acres respondents were told would be protected. These results were presented to the task force and presented at a "reasonably well attended" public meeting. Despite the initial interest and the supporting data however, a lack of leadership seems to have stalled the program.[24]

Other recent stated preference studies of the value of undeveloped lands on urban outskirts have not been well incorporated into the policy process, to the best of our knowledge. Roe, Irwin, and Morrow-Jones (2004) estimated a conjoint model over housing characteristics, including the extent to which a neighborhood's surrounding lands were in agriculture and permanently preserved agriculture.[25] Conjoint studies like this one allow an entire preference function of values over attributes to be estimated, rather than just the support for a single scenario. As an indication of their results, a 10% increase in the amount of farmland preserved increased housing prices 3% to 6%, or $394/year for poorer families to $1,146 per year for wealthier families. A one-acre increase resulted in annual values of $1 to $3. Additional values for other scenarios are reported in the paper. This work was not introduced into the policy process.

Ready, Berger, and Blomquist (1997) studied values for preserving horse farms in rural Kentucky.[26] The values in this study were primarily aesthetic, as horse farming is an important part of Kentucky's character. For a scenario avoiding a loss of 25% of horse farms (35.6 farms), households were willing to pay about $29, or about $1 per farm. For a scenario involving a loss of only one farm, they were willing to pay about $0.49. In a small survey in Eastern Canada, Bowker and Didychuk (1994) estimated that households would each pay

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[23] Personal communication with Douglas Krieger.
[24] Personal communication with Douglas Krieger.
[25] Roe and Irwin are professors in the Dept. of Agricultural, Environmental, and Development Economic, Ohio State University. Morrow-Jones is a professor in the Dept. of City and Regional Planning, Ohio State University.
[26] Ready is professor in the Dept. of Agricultural Economics and Rural Sociology, Pennsylvania State University; Berger and Blomquist professors of economics at the University of Kentucky.

about $2 per 1000 acres of farmland for a first increment of 23,750 acres protected.[27] The study suggested to people that they were paying for open space, scenic vistas, wildlife habitat, and country life.

Finally, we note that, although we have focused most of this survey on land preservation, a number of stated preference studies have estimated values for preserving wetlands and other waters (see Brouwer et al. 1997, 1999 for a review and bibliography). Most of these studies are for waters far from urban threats, though perhaps threatened by other human activities such as mining. One exception is Kaoru (1993). Kaoru studied contingent valuation data of property owners on Martha's Vineyard, MA, for projects to improve water quality in three of the Island's ponds, such that they could support shellfishing.[28] Coastal ponds such as these are fragile because of little tidal flushing, while pollution can reach them from runoff, which in turn is a function of land uses. Kaoru found that average willingness to pay is $131 (1989$), with more than half that amount consisting of existence values for ecological health, and about one-quarter for recreational use values. These results were passed on to local managers informally, but were not otherwise introduced in the policy process.[29]

Contingent valuation is the most promising method for estimating non-use values of undeveloped lands, including their ecological values. Moreover, unlike land-price or recreation-trip surveys, it can provide a rich range of qualitative and quantitative information to stakeholders and planners. As several of these studies indicate, and as those involved in the research dissemination have confirmed, information about the numbers of people expressing support, and the tax levels at which they will maintain their support, can be more important than measures of total value in the politics of persuasion (Rosenberger and Walsh 1997; Krieger 2004). Nevertheless, it should come as no surprise that information alone cannot protect land: organizational leadership and financial resources must also be present. The experience of Breffle et al. (1998) and Krieger (2004) are testaments to this fact.

[27] Bowker is Research Scientist, Southeastern Forest Experiment Station. Didychuck is Loan Officer, Farm Loan Board, Nova Scotia Department of Agriculture and Marketing.
[28] Kaoru is now professor of economics, Nanzan University, Nagoya, Japan. At the time of the study, he was at the Woods Hole Oceanographic Institution.
[29] Personal correspondence with Yoshiaki Kaoru.

Although we have suggested several reasons why stated preference research is likely to yield the most useful information, evidence of "real" wealth and income, as incorporated into land values and tourism incomes, can be persuasive as well, as shown in the experience of Rosenberger and Loomis (1999). We thus turn to studies of such effects in the following sections.

Hedonic Pricing Studies

As noted above, the hedonic method does not capture any value from open space that does not accrue to nearby residents, but does provide a partial estimate of open space benefits based on aesthetic values (e.g. views), convenient access to recreation, and cleaner or cooler air conveyed by some types of land cover. Here, we review some of the hedonic price studies that estimate the value of open space and environmental amenities (see also the reviews by McConnell and Walls 2005 and Fausold and Lilieholm 1999). This cross section of studies estimates the value of open space, wetlands, and forested areas from several regions across the country.

A study by Irwin (2002) on the effects of open space on residential property values in Maryland uses the hedonic price method (see also Irwin and Bockstael 2001).[30] This study is perhaps the most carefully designed hedonic study of undeveloped lands, with great attention paid to the issues of spatial correlation in the statistical methods, as well as to the fact that unobservables that affect land prices also affect the probability that land remains undeveloped. The study areas include Anne Arundel and Howard counties, both of which form part of the Washington, DC – Baltimore metropolitan area, and Calvert and Charles counties, which are more ex-urban. The data consists of around 55 thousand transactions of owner occupied residential properties that occurred between January 1995 and December 1999. Classifying open space according to its preservation status, land ownership, and use, Irwin groups open space into six categories: privately owned cropland, privately owned pastureland, privately owned forested land, privately owned land that is protected from development, non-military public land, and public land owned by the military.

[30] The author is a professor in the Dept. of Agricultural Economics, Ohio State University.

To evaluate the marginal values of these open space effects, the first stage estimates of the hedonic pricing model and the mean values of all the explanatory variables are used to calculate the change in the mean property's predicted price given a change in the neighboring landscape from one acre of pastureland to another land use. Using this method the authors find that the conversion of one acre of developable pastureland to privately owned conservation land increases the average residential value of property within a parcel's neighborhood by $3,307, or 1.87 % of the predicted residential value. Conversion of one acre to publicly owned, non-military land use increases the residential value by $ 994 or 0.57 % of the predicted value. Alternatively, a one-acre conversion from pastureland to surrounding low-density residential land use is found to decrease the value of the property by $1,530 or 0.89 % of the predicted value and a one acre conversion to commercial/industrial land use decreases the value by $4450 or 2.56% of the mean resident value. Interestingly, nearby pasture lands appears more valuable than forest land.

The results shed some light on the specific attributes of open space that are most valued and the extent to which open space may be most valued simply by virtue of not being "development." Specifically, significant additional benefits are estimated to accrue to neighboring residential properties given a marginal change in a landscape for any of the developable open spaces considered (cropland, pasture, forest) to either the private or the public non-military land uses. This suggests that households value undeveloped lands, not just for their current use, but also for the expected use of the open space over the long term. Additionally, the fact that a conversion to forestland actually reduces the mean value of a property suggests that open space may be valued for the unobstructed views it provides, rather than its ecological services. In other words, land markets may indicate that agricultural lands may have greater aesthetic value than forestland, but indicate little about true ecological values. Although very carefully conducted, this work was not communicated into the policy process.

In a study of forest lands, Thorsnes (2002) similarly concludes that merely vacant, i.e. undeveloped but unpreserved, forest lands do not have the same effect on nearby lot prices as

preserved forest land.[31] Thorsnes uses data from three subdivisions in Grand Rapids, Michigan, each bordering permanently preserved forested lands from the late 1970s to 2000, estimating separate models for each subdivision. He finds that lots bordering the preserves sell at a premium of 19% to 35% relative to more distance lots (or $5,800 to $8,400). However, these premiums appear to be very localized. As for property near vacant, but unpreserved, forests, such lots sell for a price premium in only one of the three subdivisions, though even there far less of a premium than that from the forest preserve. In addition, Thorsnes notes that a bigger lot size does not appear to increase lot values the same way it does elsewhere, suggesting that the preserves compensate for smaller lots.

Geoghegan (2002), in her study of Howard County, Maryland explicitly models the effect of "permanent open space" versus "developable" open space on surrounding residential land values.[32] Estimating a hedonic model controlling for several factors including housing characteristics, population density, distance to Baltimore and Washington, she includes variables for this conservation status (permanent and developable). Her results closely match those of Irwin (2002) and Thorsnes (2002). She finds that the coefficients for permanently conserved land are as much as three times larger than that of developable land.[33] She therefore concludes that people take into account future expected land use in addition to current land. More recent work by Geoghegan et al. (2003), in Calvert, Carroll, and Howard Counties, Maryland, has had more mixed results with respect to the value of undeveloped lands, however.

Smith, Poulos, and Kim (2002) studied the land values of nearby undeveloped lands in North Carolina's Research Triangle area, from 1980 to 1998.[34] Like Geoghegan, they categorized "open space" as "fixed" or "adjustable." In the fixed open space category are golf courses, publicly accessible open space such as parks, and a corridor for a major highway, and in the adjustable category are agricultural, forested, and vacant lands—lands which though

[31] Paul Thorsnes is an associate professor at Grand Valley State University, Grand Rapids Michigan.
[32] Jacqueline Geoghegan is at the Department of Economics, Clark University, MA.
[33] The level of significance for the developable land is slightly lower than 10 %.
[34] Smith is a professor in the Dept. of Agricultural and Resource Economics, North Carolina State University, and Poulos is a professor in the Dept of Agricultural Economics, University of Missouri.

currently undeveloped could be developed in the future.[35] Smith et al. find that being on or near a golf course is valuable, but that no other open space category provides value. In fact, being closer to public open space is detrimental to property values. These results were communicated to local transportation planners but were not aggressively used to shape policy.

Diversity of land may be just as important as quantity of a specific type. To address this issue, Acharya and Bennett (2001) construct indices of the spatial diversity and "richness" of open space.[36] One measure, the diversity index, is greater for areas with more land-use categories and for a more equitable share of land devoted to each category. Alternatively, the richness index measures the ratio of the actual number of land use categories to the potential number. Land use categories include residential of various densities, commercial, forest, and agriculture. Using 1995-1997 data from New Haven County, Connecticut, they find that an increase in the percentage of open space around a house is associated with greater property values. However, after controlling for total open space, diversity in land uses does not appear to increase property values.

Another study conducted in Connecticut by Earnhart (2001) estimates the benefit of improving the quality of coastal wetlands in Fairfield.[37] The authors combine discrete-choice analysis of housing choice and conjoint analysis to estimate the aesthetic benefits generated by the presence and quality of environmental amenities. The hedonic method captures the revealed preference and a conjoint analysis attempts to quantify the stated preference for environmental amenities in the region. The authors use random-utility theory to model individual's choice among housing location alternatives for both the revealed and stated preference models, controlling for various housing attributes. Various natural features increased housing values, with land-based amenities more important than water-based amenities. Adjacent forest increased the median property value by 13.6%, or $18,000; restoring a marsh increased it by 2.7%, or $6,684.

Riddel (2001) suggest that hedonic studies based on cross-sectional samples of housing prices may fail to find important dynamic effects in housing markets, which may

[35] However, the authors are unable to distinguish agricultural and forested lands for most of their sample, consequently most of the regressions that they run include only vacant lands in the "adjustable" category.
[36] Acharya and Bennett are affiliated with the World Bank and Bates College, respectively.

anticipate future land changes or take time to factor in previous preservation.[38] Riddel develops a model that jointly evaluates the effects of trends in environmental quality—open space purchases, in particular—on both the housing and labor markets. Using quarterly data for Boulder, Colorado, from 1981 to 1995, she finds that indeed there is a time lag before public purchases of undeveloped lands had their full effect of causing a 3.75% increasing in housing prices, or $10,125 for the median-priced home. Interestingly, she also finds that, as a result of the Boulder open space purchase program, development has "leapfrogged" to areas beyond Boulder's greenbelt. Riddel's results suggest that far from reining in development, the program has resulted in an expansion of commercial and residential development as a result of the program. These results suggest that even though the program was unsuccessful in realizing the city's growth management goals, it did generate amenity values for residents.

The Ready, Berger, and Blomquist (1997) study of preserving horse farms in Kentucky, discussed above in the stated preference section, also employed hedonic methods. The estimates were very similar to the contingent valuation work, at $0.43 per horse farm instead of $0.49, suggesting existence values were low in this application.

Like undeveloped farmlands, wetlands might also have aesthetic values. Mahan et al. (2000) estimated the effects of wetlands on house-prices in Portland, Oregon.[39] They found that increasing the size of the nearest wetland by one acre increased the average property value by $24, and decreasing the distance to the nearest wetland by 1,000 feet increased the value of property by $436. According to their findings the type of wetland does not appear to matter to nearby residents, however they influence property values differently as compared to lakes, rivers, streams, and parks. For instance, the marginal implicit price for reducing the distance to the nearest stream or lake by 1,000 feet, evaluated at the mean house value and an initial distance of one mile, indicates an increase in house value of $259 for streams and $1,644 for lakes.

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[37] The author is assistant professor, Department of Economics, University of Kansas.
[38] The author is an assistant professor at the University of Nevada, Las Vegas.
[39] The authors are, respectively, affiliated to the U.S. Army Corps of Engineers, Portland, Oregon; Department of Applied Economics, University of Minnesota, Twin Cities, and professor, Department of Agricultural and Resource Economics, Oregon State University, Corvallis.

Two other papers, Walsh (2004) and Wu and Chonn (2003), use a somewhat different, but related, empirical strategy. They employ a new kind of "sorting" model, which estimates household preferences for public goods based on the way households sort across different communities. Walsh (2004) estimates households demands for "green space," including measures of density, in Wake County, North Carolina (Raleigh). Interestingly, he finds that green space is valuable for neighboring developments when in more urban areas, but that they can have negative values in exurban areas, indicating a desire for more urban infrastructure in relatively undeveloped areas. Wu and Chonn (2003) estimated a similar model in the Portland, Oregon metro area. They included measures of public open space, rural land, and wetlands, as shares of all land, in their model. They found that households have positive values for these resources, but did not delve into the policy issues. These papers are developments of recent academic advances and have not been communicated into the policy process. The methods have the potential both to estimate values and simulate land-use responses to various public policies, but at this early point in development are not likely to give accurate forecasts.

After reviewing the hedonic studies briefly discussed above, it seems clear that in most cases land conservation has a positive effect on property prices, but that this result cannot be guaranteed. With more nuance, we can say that such an effect is more likely in areas with low levels of protection, and for lands that are permanently protected. Housing markets across the country are not homogenous, nor are land types, and both factors influence the way lands are capitalized into land and housing values. Hedonic studies generally can capture local aesthetic amenities, but remain more attractive to academic economists and have not been widely disseminated into policy debates.

Transfer Studies

In an example of the benefits transfer method, Kiker and Hodges (2005) estimate the economic benefits of natural lands in Northeast Florida, including the Jacksonville area.[40] The resident population in this four county area of Duval, Clay, St. Johns, and Putnam reached 1.12 million in year 2000, and is estimated to reach 1.38 million by 2015. The 77

[40] Kiker and Hodges are faculty members at the University of Florida, Dept. of Food and Resource Economics.

percent area of the region not developed consists of roughly equal parts ecologically sensitive wetlands, agricultural lands, and natural forest.

The estimated economic benefits calculated in the study include the direct use and non-use values associated with agricultural and forest products, recreational activities, and environmental amenities provided by the natural resources. The amount of value added from the market-traded products associated with the agricultural and forest industry activities taking place on the lands was approximately $440 million per year, while the total economic value of recreation-related activities on the lands was estimated at $703 million per year ($390 million in consumer expenditures and $313 in consumer surplus).[41] Furthermore, Kiker and Hodges transfer benefits from the Ready, Berger, and Blomquist (1997) study of Kentucky horse farms, discussed above, as a way to estimate aesthetic amenities provided by the lands. Conservatively using a value of only 10 percent of the original values, they nevertheless estimated these benefits at approximately $1.5 billion per year in the Florida context.[42] The total estimated value is then $2.6 billion per year.

Kroeger (2005) has produced a companion study to Kiker and Hodges, extending the research to other types of benefits.[43] In particular, they emphasize the broader range of ecosystem services of various land types. Kroeger inventories the region's ecosystems, categorizing them into 15 types, from freshwater marshes to forest to brushland and computing the acreage of each. Values for each of 11 services, including water regulation, water supply, habitat, and so forth, for each of these lands, are then transferred from Costanza et al. (1997) and the US Forest Service (2000). The estimated annual value of ecosystem services provided by major ecosystem categories in the four northeast Florida counties are as follows.

ESTIMATED ANNUAL VALUE OF ECOSYSTEM SERVICES (MILLION 2002 $/YEAR)	
Marshes, swamps, lakes, rivers, streams, estuaries	1,827

[41] As a measure of *benefits* only the consumer surplus portion is appropriate. The expenditures could be used in other economic activities which also give satisfaction.
[42] One might question the applicability of values for horse farms, which occupy relatively little land but form an important part of Kentucky's character, to all agricultural land in northeastern Florida. However, the 10 percent adjustment is certainly conservative.
[43] Kroeger is on the staff of Defenders of Wildlife.

Wetlands	1,249
Forests	118
Total	**3,194**

Thus, Kroeger estimates that the total economic value of the ecosystem services in the four-county area amounts to approximately $ 3.2 billion annually. The author emphasizes that the research does not take into account the benefits provided by several ecosystem functions like biodiversity maintenance, pollination, nursery function, and raw materials provision and hence the estimates underestimate the actual value of the ecosystem. On the other hand, the Costanza et al. (1997) study on which this work is based has been criticized by economists on the grounds that it does not sufficiently account for income constraints, with total willingness to pay exceeding worldwide incomes (see e.g. Bockstael et al. 2000).

Defenders of Wildlife repackaged the results of the Kiker and Hodges study in a shorter report called *Investing in Nature*, intended to bring the issue of the economic contribution of natural areas to the public. The report summarized the economic values derived from tourism, recreation, agriculture, ecosystem services, and existence of natural areas in the four counties of northeast Florida. The *investing in nature* report and the underlying research contributed to a provision in a major growth management act passed by the Florida legislature in 2005. The provision encourages local governments to require a full cost accounting analysis for any proposed new development outside the urban service boundary. Defenders is working to be sure full cost accounting is interpreted to include conservation values. Thus, this provision would then ensure that conservation and natural lands benefits are evaluated when rezoning and changing land uses designations. Defenders of Wildlife obtained a commitment from the bill's sponsor to make the economic value of conservation lands a subject for study as part of interim projects (i.e., matters that the legislature researches between formal sessions).[44]

Urban Ecological Analysis

Trees provide ecological services and form part of a city's "green infrastructure" (Daily 2002). These services include, among others, groundwater recharge, floodwater

[44] Personal communication with Laurie McDonald of Defenders of Wildlife.

management, and filtration of pollutants. Researchers at the USDA's Forest Service have attempted to quantify the value of some of the ecological services that trees in urban areas in a process known as Urban Ecological Analysis (UEA). They have designed the Urban Forest Effects (UFORE), using field data from randomly located plots, local hourly air pollution and meteorological data to quantify forest effects. From inputs about baseline status plantings, the model first estimates a city's species composition, diameter distribution, and tree health over time. In each future time period, the model then estimates the effect of the trees on reducing air pollution, including greenhouse gases, pollen, and energy use. Finally, cost-avoidance techniques are used to calculate the value of these effects. The basic architecture of UEA is in the form of a disaggregate benefits transfer, and would be fully consistent with best benefit-cost practices if it used willingness to pay instead of cost-avoidance as its measure of benefits. Adapting the approach in this way would provide better estimates of actual benefits.[45]

Different regions support different types of trees and hence experience different benefits from tree cover. One study (McPhearson, Fifth National Urban Forest Conference) estimated the benefits and costs of a tree-planting program in Tucson, Arizona. Specifically, the organization Trees for Tucson sought to plant 500,000 desert-adapted trees from 1989 to 1996. The USDA forest service modeled the costs of planting, pruning, watering, and removing trees over a 40-year period, which they could compare to the benefits. They found that the increased tree canopy in Tucson was projected to reduce city temperature by 3 degrees Fahrenheit. The reduced demand for air-conditioning power also reduced the amount of coal and water consumed by power plants. This amounted to an average savings of 171 Gallon/tree in annual water consumption and a reduction by 400 pound per tree of carbon dioxide. Average annual benefits from these services totals about $ 25 per tree, while average annual cost of planting, pruning, watering and removal of trees are projected at $9.61 per tree. Other studies using the same method have calculated the reduction in pollutants such as sulfur dioxide, nitrogen dioxide, and particulate matter (e.g. American Forests 2001a,b).

In Chicago, McPhearson et al (1997) studied urban tree cover in Chicago. The main findings of the study were that during 1991, the region's trees removed an estimated 5,575

[45] For example, just because the cost of removing dust (were trees not available to remove it) is estimated at such-and-such an amount, does not indicate that people actual benefit from its removal at that amount.

metric tons of air pollutants, providing air cleansing worth $9.2 million. Each year they sequester an estimated 315,800 metric tons of carbon. Increasing tree cover 10% or planting about three trees per building lot saves annual heating and cooling costs by an estimated $50 to $90 per dwelling unit because of increased shade, lower summertime air temperatures, and reduced neighborhood wind speeds once the trees mature. The net present value of the services trees provide is estimated as $402 per planted tree, and benefits were nearly three times costs.

In order to make their research more accessible to the general public, USDA researchers are developing reports for all cities. In addition, the conservation organization American Forests is building a user-friendly desktop model for planners in cities across the country. As a first step in land use planning, American Forests is attempting to create a "scorecard" of sorts for all urban areas across the country. These reports are freely available on their website (http://www.americanforests.org).

American Forests has conducted UEA in several cities across the country. The following provides brief conclusions of some of the studies:

- The Atlanta Metro area saves about 2.8 million dollars annually on residential energy during summer because of the shade provided by the tree cover. (American Forest 2001a);
- Tree cover in the Denver Metro area provides 2.6 million dollars of air pollution removal benefits. (American Forests 2001b);
- Tampa's trees reduce 8.7 million gallons (65 million cubic feet) of runoff annually, saving the City an estimated $10 million annually (Campbell and Landry, 1999).

The above studies have focused on urban trees and programs for street planting, rather than land conservation. However, the method could easily be extended to tree cover on urban outskirts. The Campbell and Landry (1999) study of Tampa comes closest to this type of application. They found that canopy cover in the city decreased by a net 4 percent between the years 1975 to 1996. Moreover, if existing agricultural and vacant land is converted to residential or mixed-use developments and tree preservation efforts are not increased, the citywide tree canopy in Tampa could decrease from 19% to 14%, possibly negating any benefits of future tree planting.

Moreover, some cities have in fact used UEAs to help manage their undeveloped lands. For example, Roanoke conducted a UEA in 1998 with the Forest Council in partnership with American Forests. As a result of the analysis, more effort is being put into protecting urban trees and green cover. American Forests has also updated its UEA analysis toolpack to allow Roanoke's forestry division to conduct similar analysis on smaller tracts of land. This would give the economic benefits of preserving the land with respect to select ecological services. This has not yet been used to place a value on leaving land undeveloped, but it is a tool that could be used for conservation purposes.[46]

In Bellevue, WA, city planners conducted a UEA in 1999 that indicated that the economic benefits of tree cover were larger than they anticipated. As a result, they rededicated their oversight of lands belonging to homeowners associations, some of which according to state law must be protected from development when in ecologically sensitive areas. Since conducting the UEA, the city has agreed to help shoulder the responsibility of managing the land in voluntary agreements with the homeowner associations. However, the area in joint management amounts to only 50 acres, about a quarter of the total protected areas under homeowners associations.[47]

One point of caution is in order before using UEA in land use planning: it must be emphasized that it captures only the direct services of tree cover to people in the form of values for air quality, water quality, and cooling. It does not estimate values for wildlife or aesthetics. Moreover, because it values only tree cover, in some cases it could lead to perverse findings if not interpreted with care. Much of the undeveloped land around urban areas is agriculture or pastureland that is not dominated by trees. As a result, development may well increase tree cover if trees are planted in backyards and along streets. Dwyer et al. (2000), for example, report that, nationally, urban tree cover is greater than previously estimated, approaching the national average tree cover over all lands of 33 percent. In this case, if other values of undeveloped, but unforested, lands were not accounted for, development would appear to increase values. This cautionary note is not meant as a

[46] Personal communication with Forestry Division, Roanoke, VA.
[47] Personal communication with City Planning Division, Bellevue, WA.

criticism of the role of UEA, but to note that, as with all analyses, its findings must be interpreted appropriately.

Other Studies

Several other studies and reports, which do not fit neatly into the above categories, have played a prominent role in the wider literature on land conservation and in the public square. One such study is the Sonoran Institute's report on "Prosperity in the 21st Century West" (Rasker et al. 2004a,b). Beginning as a study of the economic impact of public land designations on communities in the West, the report has grown into a thesis on rural development. Using data on economic variables (wages, earnings from resource extraction), demographics, land classification, housing etc., the report develops a profile of the changing nature of the West. Even though historically, the primary impetus for growth in the West was resource extraction and livestock rearing, with the growing “knowledge” economy it is increasingly becoming dominated by the service sector.

The Prosperity in the 21st Century West report regresses growth in personal income between 1970 to 2000 on demographics, education, housing, recreation opportunities, income distribution, geography, accessibility, and land classification. The report finds that some of the most dynamic parts of the west are benefiting from their public lands, but that not all communities benefit equally. Some areas do not flourish despite being surrounded by spectacular scenery. Those areas that combine the amenities with access to them in the form of transportation hubs (e.g., an airport) and those with more educated workforces benefit the most. The report concludes that communities dependent upon resource extraction industries, like mining, oil and gas development and the wood products industry, have the slowest long-term growth rates.

This report is not a true measure of economic *benefits*, but rather economic impacts on income. The distinction is important because some of the revenues measured in such impact studies do not represent new wealth, but rather transfers of wealth from other locations. Nevertheless, such impacts may better reflect the interests of local governments. Moreover, they ultimately reflect the presence of true amenity values of the resources: incomes increase in areas with natural lands and transportation hubs because people want to enjoy the amenities

and have the access to do so. Similarly, educated workforces may enjoy living in cities near such areas.

According to Dr Rasker, the primary author of the study, the report caught the attention of policy makers, public land managers and advocacy groups involved in wilderness campaigns, or generally interested in the changing economic role of public lands. Some of the success in communication of the report can be attributed to the effort the Institute took in outreach and dissemination to interested parties. They condensed the original 200-page report to a 30 page popular version to disseminate to conservation groups, media, and policy makers (Rasker et al. 2004b). They so far have mailed approximately 3000 copies of the report, including 280 individuals in the media, 70 conservation groups, especially wilderness advocacy groups, 120 public land managers, and 450 from a variety of lists that includes community partners, mayors and county commissioners, academia, etc.

The Sonoran Institute has also developed the Economic Profile System (EPS) an automated system to create custom socio-economic profiles for communities in the West. The EPS is free to download from the Institute's website. The Institute conducts training workshops to allow communities to conduct their own economic analysis and the Prosperity report forms part of the instruction package. The Institute has also incorporated the *Prosperity* report in all of the field-level trainings conducted for the Bureau of Land Management.

Thus rather than the report forming the basis for a conservation strategy among local communities, communities are using the methods developed (the EPS system) in the analysis for their regions and making that a part of their conservation strategy. So far they have conducted daylong workshops in Lewistown, Montana; Great Falls, Montana; and Denver.

Two other prominent reports in the conservation literature do not reflect research into the benefits for a particular context, but rather inventory the literature, offer reasons why undeveloped lands have values and reference a range of values found at other locations. While not representing new evidence of values per se, such reports can play an important persuasive role in the policy process and can be a useful tool for arming stakeholders.

One such report is the ECONorthwest report on "Economic Benefits of Protecting Natural Resources in the Sonoran Desert" (2002). The document was commissioned and funded by the Coalition for Sonoran Desert Preservation, an umbrella organization of neighborhood, civic, and environmental interest groups in Pima County, AZ, who are generally opposed to rapid development of housing and commercial tracts in the fast-growing Tucson area. The report essentially lists the various direct and indirect uses of natural resources and provides an illustrative economic value for each based on previously conducted primary studies. It reviews stated preference studies for intrinsic values in the Southwest (including instream flows necessary for fish survival, habitat for endangered species, and native desert ecosystems), recreational values. In the review, studies of recreational tourism revenues proxy for recreational values, while hedonic property price studies capture the aesthetic values of open space; neither is necessarily focused on Southwestern resources. The report has the flavor of a benefit transfer exercise, but as the authors acknowledge stops short of tailoring these values to the Sonoran Desert, as would be required by a Transfer. The authors conclude that conservation of the Sonoran Desert would yield substantial economic benefits, which should receive full consideration in policy-making, but that continued research is warranted.

This report has been fairly influential in a public campaign begun in 1998 to conserve natural habitat in the Tucson area. While ECONorthwest did not publicize their research, the Coalition released the paper in an outreach campaign designed to positively sway editorial and political opinion and public will on the Sonoran Desert Conservation Plan. Approval of the plan has depended in part on countering the development and construction interests in the region.[48]

In the fall of 2002, the Coalition presented the paper's findings to the Pima County Board of Supervisors. The staff had taken the key points of the study and listed them in a short and attractively presented summary, which was shown in a PowerPoint presentation and is carried on the Coalition website, along with the complete text of the report (www.sonorandesert.org). These documents have been downloaded numerous times over the

[48] Personal communications with Kristin Lee, research analyst at ECONorthwest, and Susan Shobe, assistant director of the Coalition for Sonoran Desert Protection, to Stan Wellborn (RFF).

past two years, and a link to it also is posted on the Pima County website on the conservation project (http://www.pima.gov/sdcp/). This launch was followed by a presentation of the paper to the 75-member public steering committee for the Conservation Plan, as well as a large open community forum for residents and other interested parties.

Susan Shobe, assistant director of the Coalition, said that a press release was written about the report, and Coalition staff and board members met with the editorial board of local papers, wrote guest editorials, and appeared on local television and radio interview programs. "We felt it was important to explain that people had heard a lot about the costs of protecting undeveloped areas around Tucson, but not enough about the benefits," says Shobe. "The paper was credible and helpful because it came from an independent research organization that had supported its findings with solid data." It also made clear that preserving land would enhance tourism values and other benefits.

Pima County held a referendum for a land conservation program in May 2004. The referendum was successful, passing with approximately 67 percent of the vote. The referendum designated $112 million specifically for a "Habitat Protection Priorities" program, for purchase of lands identified as ecologically sensitive by the Sonoran Desert Conservation Project, plus $63 million for "community open space." The county has already spent over $31 million to acquire about 20,000 acres of land, and has obtained the grazing leases for another 75,000 acres of State Trust Lands. The ECONorthwest paper clearly was a prime factor in the overall process, not only in passing the referendum but in steering protection efforts toward ecologically sensitive lands.

A second, similar report has been issued by the Lincoln Institute of Land Policy (Fausold and Lilieholm 1996).[49] The study was conducted at the request of the Boston Foundation's Fund for the Preservation of Wildlife and Natural Areas, which was the primary sponsor. According to Lilieholm, one of the report's authors, the Foundation's experience was that people generally support conservation, but often voted in favor of development when presented with economic data and statistics by developers. The Foundation was frustrated at

[49] The report was also published as a journal article (Fausold and Lilieholm 1999). Fausold is on the staff of Cornell Cooperative Extension; Lilieholm is professor in the Dept. of Environment and Society at Utah State University.

not having numbers of their own to counter those of developers, and commissioned a literature review to present communities with conservation values.

The study was purposely designed to be broad and not location specific so it could be used more broadly. The authors tried to review all literature available on the subject and to break the discussion into different kinds of economic values. Ecological benefits were a central component of the study, based on the needs of the Foundation, but specific dollar values were not assigned.

Lilieholm believes this work remains the biggest-selling working paper from the Lincoln Institute, and it was their number one request for some time after its publication. He said that the audience has largely been city officials and planners as well as academics, *not* people "on the ground," contrary to what their expectation. He says the Lincoln Institute has created publications since then and continues to take steps toward making the information more accessible to the general public. Lilieholm and Fausold have also turned the paper into extension notes for the state of Utah.[50]

Lilieholm is unaware of any specific outcomes as a result of the paper, but says it has been used in lots of places. He and his coauthor continue to receive inquiries about the paper, largely from NGOs working with local land trust groups, looking for permission to cite the paper, for clarifications, or for suggestions of additional sources. He mentioned that local chapters and field offices of The Wilderness Society and the Nature Conservancy are among those who have contacted him about it.[51]

V. Conclusions

There are many reasons for protecting undeveloped lands on urban outskirts, including the ecological, aesthetic, and recreational. Information about these values can play a vital role for stakeholders in persuading decision makers to protect the lands. It can also play a vital role in

[50] Personal communication with Janet Hodur.
[51] Many local conservation groups also make use of the paper. For examples, see The Shrewsbury (PA) Township Conservation Fund (http://www.shrewsburytownship.org/Conservancy/shrewsbury_township_conservation.htm), The California Open Space Project (http://www.californiaopenspace.com/index.htm), and The Duluth (MN) Public Policy Alliance (http://www.duluthppa.org/cs/cs200012.html).

setting priorities for lands to target and in shaping strategies to protect them. Contingent valuation studies have repeatedly found that households do value preserved agricultural and natural lands, and are willing to pay for it, often (but not always) at levels that would support preservation programs. Hedonic studies have found that nearby undeveloped lands can also increase property values. Generally, this effect is greatest where "open spaces" are rare, as in inner cities, declines at urban outskirts, and can become negative in rural areas. Another pattern is that the effect on property values is greatest for protected lands, relative to lands that are unprotected but still undeveloped. This may be because housing markets anticipate future development of the latter lands, and/or because such lands are undeveloped because of something else about the neighborhood which is undesirable, and which also depresses nearby housing values.

Research has repeatedly found that households place ecological motives at the top of the list of reasons to preserve lands. Protecting habitat and water quality are particularly important, while preserving farmland and a rural character generally comes second. Recreational values generally rank low in the list.

There is some tension between this ranking, which prioritizes ecological conservation, and the typical emphasis of land trusts to conserve lands in an agricultural state. Under the right circumstances, preservation of agricultural lands can yield ecological values related to water quality and air quality, but usually not for ecological values related to habitat (grazing lands may be an exception). Even with respect to water quality, agriculture can be a source of soil erosion and organic pollution. This tension could be resolved in one of two ways. First, one may doubt the real substance lying behind the public's stated priorities, stressing the actions of land trusts and other community organizations. However, research by Krieger (1999), which found that people gave different reasons for protecting farmland and other open spaces, in ways that make intuitive sense, bolsters the credibility of the stated priorities. Accordingly, one instead may suggest that land trusts consider revising their practices in response to such input. For example, research by ECONorthwest (2002), which emphasized ecological values of the Sonoran Desert near Tucson, has helped shape conservation initiatives in the direction of preserving ecological values.

The importance of the public's ecological motives for preserving land is also inconsistent with the research strategies of economists and other analysts, much of which employs property value methods than cannot recover ecological values. This emphasis on hedonic studies may follow from the fact that the effect of preserved lands on housing prices—an observed market outcome—is more persuasive than the hypothetical surveys associated with stated preference. Moreover, to any city planners or civic leaders interested in maximizing the tax base, these effects may also be more relevant.

Yet even stated preference studies, which in principle can recover such values, have tended to target more agricultural lands where objective ecological values are likely to be small. This suggests a future agenda for stated preference research to target more ecologically valuable lands. A potentially useful approach would be for interdisciplinary teams of economists and ecologists to compare people's stated reasons for wanting to protect undeveloped land, their assessment of the ecological values of those lands, and objective measures of ecologists.

A second way that the economic literature is somewhat disconnected from the needs of stakeholders and policy-makers is in the emphasis on benefit-cost analysis type measures. While benefit-cost decision rules are central in economic theory, and in many cases in federal regulations, they are not as important in the mind of local officials monitoring political support. Accordingly, studies that document political support at various levels of expense may be particularly important. Certainly, some of the studies which have played the greatest role in shaping land use plans, including Rosenberger and Walsh (1997) and Krieger (1999, 2004), have provided that kind of information.

For all these reasons, economic studies of the values of preserving lands on the urban fringe have had a mixed impact on the formation of the policies studied. Not surprisingly, academic studies focused on using the latest economic and statistical methods have generally not been communicated into the policy process. Research by academics at land grant universities, on the other hand, is more likely to be communicated to local stakeholders, often with the assistance of extension agents. Naturally, so are studies directly commissioned by land trusts. Fortunately, a sort of "secondary market" for valuation studies of preserved lands

has developed. ECONorthwest (2002) and Fausold and Lilieholm (1996) are some of the most cited and most influential reports on the value of preserving lands, but were not original research. Rather, they summarized the literature and packaged it for a more popular audience.

Nevertheless, only the style, not the fundamental content, can be repackaged. Future work using conjoint analysis would provide a richer source of information, with an opportunity to see how support varies not only with expense, but also for different lands being protected and different access to those lands. In this way, research could both help politicians gauge levels of support while also helping planners design optimal policies.

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Appendix. Summary of Valuation Studies and Policy Outcomes

Study	Region	Method	Value	Communication/Outreach and Outcomes
Acharya and Bennett (2001)	New Haven County, CT	Hedonic regression	Nearby undeveloped lands increase property values, especially in more urban settings. Diversity in nearby land uses does not appear to augment property values.	N/A
Breffle, Morey, Lodder (1998)	Boulder, Colorado	Contingent valuation	Sample mean household one-time WTP for preservation of 5.5 acre parcel of land is $302, giving a neighborhood-wide value of about $774,000.	The report was sent to the council and received by the Mayor of Boulder and passed informally to the Cunningham council. Developer finally sold the land to a buyer intending to build a single home, but one which sprawled over the land and restricted views.
Earnhart (2001)	Fairfield, Connecticut	Property value (discrete choice) analysis and conjoint analysis	Various natural features increased housing values, with land-based amenities more important than water-based amenities. Adjacent forest increased the median property value by 13.6%, or $18,000; restoring a marsh increased it by 2.7%, or $6,684.	N/A
Geoghegan (2002), (2003)	Calvert, Howard, and Caroll Counties, Maryland	Hedonic regression	The 2002 study finds positives values for undeveloped lands, with protected lands 3x more valuable than unprotected but undeveloped lands. The 2003 study finds more mixed results.	N/A
Irwin (2002)	Anne Arundel and Howard Counties, Maryland	Hedonic regression	Increase in property value as a result of conversion of 1 acre of developable pasture land to: privately owned conservation land, $3,307; publicly owned non-military land, $994; low density residential use, -$1,530; commercial/industrial use -$4,450; and forested land, -$1,424	None
Kaoru (1993)	Martha's Vineyard, Massachusetts	Contingent valuation	Average WTP of $131 for protection of island tidal ponds, with most of the value motivated by ecological benefits.	Informally passed to local managers.

Kiker and Hodges (2005)	Duval, Clay, Putnam, and St. Johns Counties	Benefit transfer plus agricultural and tourist income	Total estimated value of natural resources of $2.6 billion/year	Commissioned by Defenders of Wildlife and repackaged in popular report. Has helped shape a state growth management bill to require benefit analyses of current land uses when changing zoning outside urban service boundaries.
Kosobud (1998)	Chicago, Illinois	Contingent valuation	Residents of the Chicago Metropolitan Area are willing to pay between $39 and $59 million per year for additional wilderness of an unspecified amount.	N/A
Krieger (2004)	Petoskey, Michigan	Contingent valuation	About 65 % of the households supported a property tax millage to fund a PDR program at a cost of $4 per year, and about 50% at a cost of $105 per year. Results were not sensitive to the scope of land protected.	Commissioned by area Land Conservancy Task Force. The results were presented at a public meeting, however, despite initial interest the program has stalled.
Krieger (1999)	Kane, McHenry, DeKalb Counties, Illinois	Contingent valuation	In order to protect 20,272 acres of farmland, the mean WTP per household in the study area is $484 annually for 5 years. Median WTP is $100 to $170.	Commissioned by the American Farmland Trust's Center for Agriculture in the Environment as part of the ongoing research on sprawl in Chicago, it was communicated in a large press conference. The trust has used the study to lobby local county boards, and has just won the opportunity to place a PDR program on the ballot.
Kroeger (2005)	Duval, Clay, Putnam, and St. Johns Counties	Benefit transfer	Transfers ecosystem values estimated by Costanza et al. (1997), for a total value of $3.2 billion/year.	Commissioned by Defenders of Wildlife and part of broader effort described under Kiker and Hodges (2005).
Loomis, Traynor, and Brown (1999)	Loveland, Colorado	Contingent valuation	Using a yes/no dichotomous response format, mean WTP was estimated at $108 for recreation lands, and $116 for nature lands. The WTP values using a trichotomous response format were much lower at $ 32 and $ 40 for recreation and nature lands respectively.	The study was presented to a local land commission, which used it to design a ballot initiative executed in 2003. The initiative was not adopted.
Mahan et. Al. (2000)	Portland, Oregon	Hedonic regression	Proximity to wetlands has a positive effect on prices, with a 1000 ft decrease in distance to wetlands increasing values by $436. Respective values for a a stream or lake increased values are $259 and $1,644.	N/A

Ready, Berger, and Blomquist (1997)	Kentucky	Hedonic regression and contingent valuation	Using a hedonic pricing model, the authors find that a household in Kentucky would be willing to pay $0.43 annually to prevent the loss of a single horse farm. For the CV study, the value of the first farm lost is $0.49 per household. The corresponding figures after a loss of 10, 25, and 50 percent are $0.63, $1.02, and $3.36 respectively.	N/A
McPhearson (1997)	Chicago, Illinois	Benefit transfer (Urban Ecological Analysis)	Increasing tree cover by 10% saves annual heating and cooling costs by $50 to $90 per dwelling. NPV of a single tree estimated at $402.	The method has been taken up by American forests, which has created profiles of ecological benefits of tree cover and greenery for several cities, and is disseminated through their website. It has not been explicitly used to encourage land conservation policies, it has however been used to encourage tree plantation drives and reforestation programs in several cities.
McPhearson (1992)	Tucson, Arizona	Benefit transfer (Urban Ecological Analysis)	The increase in tree cover as a result of planting 500,000 trees between 1990 and 1996 would provide average annual benefits of $ 25.09 per tree for cooling savings, dust and runoff reduction, compared to average annual costs of $9.61 per tree.	
Riddel (2001)	Boulder, Colorado	Hedonic regression	As a result of 15,000 acres of open-space purchased between 1981 and 1995, housing prices increased by an average of about 3.75%, or $10,125 for the median-priced home.	None.
Roe, Irwin, and Morrow-Jones (2004)		Conjoint analysis	10% increase in amount of farmland preserved increased housing prices by 3% to 6%, or $394/year for poorer families to $1,146/year for richer families. A one-acre increase resulted in annual values of $1 - $3.	None.
Rosenberger and Loomis (1999)	Steamboat Springs, Routt County, Colorado	Travel cost supplemented by contingent behavior	No net value among summer visitors of preserving the existing ranchland, as converting the open space to tourist infrastructure would attract about as many visits as would be lost by the lower rural amenities. Another version of the study found that trips would decline if ranchland were lost.	The latter result was communicated to various stakeholders via the county extension office. See Rosenberger and Walsh (1997) for outcomes.

Rosenberger and Walsh (1997)	Yampa River Valley, Routt County, Colorado	Contingent valuation	The average annual household WTP to protect 25% of specific valleys is $36 to $72, and $107 for 25% of the entire county, or about $8 per thousand acres. .	Special extension bulletin circulated among stakeholders, Workshop to the public, meetings with land trusts, participation in county's annual economic summit. Referenced in new land use planning rules (open lands plan). 1997 citizens approved of a PDR tax of 20 $/person/year.
Smith, Poulos, and Kim (2002)	Research Triangle Area, NC	Hedonic regression	Mixed to negative effects of undeveloped lands on nearby housing prices, including publicly protected lands.	Their results were communicated to local transportation planners but were not aggressively used to shape policy.
Thorsnes (2002)	Grand Rapids, Michigan	Hedonic regression	Lots bordering the preserved forests sell for a premium of 19 to 35 % ($5,800 to $8,400). The results the Thorsnes observes are very localized. Lots adjacent to unpreserved forests do not sell for as much of a premium.	N/A
Walsh (2004)	Wake County, North Carolina	Property value (equilibrium sorting model)	Green space is valuable in urban areas, but is a disamenity in ex-urban areas.	None
Wu and Cho (2003)	Portland, Oregon	Property value (equilibrium sorting model)	Rural lands and wetlands all have positive values in the model.	None

Table Abbreviations

CV Contingent Valuation
NPV Net Present Value
WTP Willingness to Pay