An Assessment of the Economic Benefits Provided by Conservation Lands

Five Case Studies of Conservation Opportunity Areas Identified in State Wildlife Conservation Strategies

PROJECT OVERVIEW AND SUMMARY OF FINDINGS

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This study, the five individual case studies and a companion report (Kroeger and Manalo, 2006) outlining the basic theory underlying economic valuation of natural resources and approaches used in valuation can be found online at
http://www.defenders.org/programs_and_policy/science_and_economics/conservation_economics/economic_valuation_of_natural_resources_and_ecosystem_services/conservation_economics_valuation_publications.php

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THE ISSUE: CONTINUED LOSS OF WILDLIFE HABITAT IN THE UNITED STATES

Since the beginning of human settlement, forests, grasslands and wetlands in North America have experienced some degree of conversion to other land uses. The rate of conversion of natural lands increased markedly with the industrial revolution as a result of continuing growth in human populations and a vast increase in humans' ability to modify the physical landscape for food production and resource extraction. More recently, human lifestyle preferences coupled with cheap and convenient individual transportation have added to the pressure on natural ecosystems (Burchell et al., 2002). For example, between 1970 and 2000, developed land, that is, the built-up surfaces associated with urban and exurban growth, transportation systems, and many other dispersed built-up lands, experienced a net increase of 26.5 percent in the eastern United States, equivalent to nearly 9.1 million acres (14,200 square miles) and almost equal to the loss in forest land in the region during that period (Loveland and Acevedo, 2008). The population of the region increased by 32.6 percent during that time.

Given the projected further significant population increases and their expected spatial distribution (U.S. Census Bureau, 2005; Burchell et al., 2002; Stein et al., 2007), continued agricultural expansion and the expected impacts of climate change (Drummond et al., no date), the historic trend of habitat loss or change in the U.S. inevitably will continue.

WHY HABITAT LOSS MATTERS – AN ECONOMIC PERSPECTIVE

Undeveloped lands and the ecosystems they are composed of provide a wide range of uses to people (Hassan et al., 2005; Daily et al., 1997). These uses can take a direct form, involving the immediate interaction of individuals with the ecosystem (e.g., consumptive and non-consumptive recreation activities) or the extraction of resources from the system (e.g., water withdrawal; harvest of timber and non-timber products; grazing). Humans also use ecosystems indirectly. This form of use often is referred to as ecosystem services, which are those contributions the ecosystem makes to human production activities that do not involve the purposeful extraction of resources (e.g., crop pollination, biological pest control, carbon sequestration).[1] Finally, many people derive value from the "passive use" of particular landscapes or charismatic species independent of any actual use of those resources on their part, simply because these individuals cherish the thought of the existence of particular species or intact ecosystems and their preservation for future generations (Krutilla, 1967; Loomis and White, 1996; Freeman, 2003).[2]

All of these uses of natural lands carry economic value, in the sense that they contribute to people's material and non-material well-being. From an economic perspective, these values should be taken into account when considering the conversion of natural lands to other uses.

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[1] Kroeger and Casey (2007) discuss several definitions of the term "ecosystem services" found in the literature. Although all of those definitions have their merits, some are better suited for the purpose of economic analysis than others (Boyd and Banzhaf, 2007).

[2] See Kroeger and Manalo (2006) for a more detailed discussion of the concept and literature on passive use values.

Land conversion changes ecosystem structure and functioning and thus impacts the type, quantity and quality of the goods and services the system provides for onsite and offsite uses. For example, conversion of the land cover from forest to pasture, through its impacts on both ecosystem structure and function, is expected to result in changes in the type, quantity or quality of the goods and services provided by the land. The degree to which service flows change as a consequence of land cover changes depends on a variety of factors, including the original and new cover types, the extent of the loss of the original cover and the spatial arrangement of any remaining original cover, both on the site itself and in relation to off-site land covers.

Modified ecosystems do not necessarily provide an inferior suite of goods and services. [3] In fact, the economic value of the particular suite of goods and services desired by a landowner generally will be higher after the conversion, judging from the owner's decision to carry out the conversion.

Nevertheless, the particular services that increasingly are of primary public concern, such as biodiversity conservation, water provision or erosion control are usually reduced or lost altogether on the converted lands.[4] Most of these services represent what economists refer to as *public good* ecosystem services. Public good services are characterized among other attributes by the fact that they benefit not just the landowner on whose property they are produced, but also others, whom the landowner is not able to prevent from enjoying these benefits and who therefore receive them for free. Prime examples of public good ecosystem services are biodiversity preservation (except perhaps in the rare cases where the species of concern occurs only on one or a few privately-held properties) or climate regulation. Because the landowner cannot exclude others from the off-site benefits they receive off her lands and charge them for these services, she has no financial incentive to take the value of those third-party benefits into account in her land use decisions. This divergence between individual and society-wide benefits from public good ecosystem services provided by a property may lead to land use decisions that are rational for the individual but suboptimal or inefficient for society as a whole (Kroeger and Casey, 2007). The total value of the services the land provides to society as a whole may be lower following the conversion, but the *private* benefits to the landowner from the conversion exceed the *private* cost for the landowner in the form of the services reduced or foregone by *her*. It is the realization of this conflict between privately and socially desirable land use choices that underlies much of public natural resource conservation policy making, including the relatively recent surge in interest in the creation of voluntary or regulation-based ecosystem service markets.

[3] Of course, all ecosystems by now are impacted by human activities (Vitousek et al., 1997a, 1997b, 1997c) and thus may be considered modified. However, here we refer to systems purposefully changed by humans through land conversion.

[4] We follow general usage and apply the term "conversion" here to describe a change from "natural" vegetation or land cover to a "developed" use such as residential/commercial or agriculture. Thus, conversion does not describe changes in the opposite direction, which also occur, for example in the case of wetland reclamation or afforestation or natural succession on abandoned farmlands.

THE ROLE OF ECONOMIC ANALYSIS IN HABITAT CONSERVATION DECISIONS

The recognition of, and the generation of quantitative information about the value of natural lands is an important, though neither a necessary nor a sufficient condition for making intelligent conservation policy decisions. Even if the value of the goods and services provided to society by a particular land or ecosystem, or some approximation thereof, is known, the protection of those values is contingent on two further factors. First, institutional mechanisms must be in place that allow the owner of the land to capture the value of the off-site services her land provides. Such mechanisms can take several possible forms, including government payment programs, ecosystem service markets based on regulation or voluntary action (e.g., carbon sequestration payments), or fiscal incentives (e.g., tax deductions) (Kroeger and Casey, 2007). In addition to the need for a value capture mechanism, the sum of the landowner's private (on-site) benefits and the compensation she receives for the off-site benefits her land provides must exceed the benefits she expects to obtain from land development in order for the conversion of the land to become financially unattractive.[5] Thus, information on the value of the benefits associated with land conservation by itself cannot guarantee the conservation of undeveloped lands. However, it is a first step towards making that outcome more likely.

Continued loss and degradation of habitat likely is unavoidable given population pressures, the effect of climate change, people's desires and society's resource needs. The challenge is to direct the land conversion that causes this loss to areas where it results in the least economic harm. This is not an easy task, but it is one that perhaps is becoming more achievable. Importantly, in their Comprehensive Wildlife Conservation Strategies, states have identified inventories of their particular biological resources they deem most in need of conservation. Notwithstanding the fact that these inventories necessarily are dynamic entities that will need to evolve in response to changing ecological realities on the ground and advances in information and scientific understanding, in many cases they could provide a good starting point for attempting to mitigate losses through directing conversion away from the most biologically valuable areas. However, this biologically-based decision input does not reduce the useful role economic analysis can play in informing land use decisions. For one thing, it is unlikely that it will be feasible to protect all of the areas identified as priority areas in the state plans. In cases where a decision is required as to which one(s) of several priority areas to protect from land conversion, economic analysis could help identify the alternative that is expected to result in the smallest economic loss. Furthermore, non-priority natural areas also provide economic benefits that should be taken into consideration in land use decision making processes. Here, just as in the case of priority conservation areas, economic analysis can help to develop estimates of the value of outputs from the undeveloped system that would be lost through conversion.

[5] This assumes landowners act as profit-maximizers. In the case of a landowner who has a preference for keeping the land in an undeveloped state for non-financial motives, the payment would not necessarily need to be financially competitive with development. Rather, payment would merely need to be sufficient to make it financially possible for the landowner to avoid selling off the property to developers.

THE PURPOSE OF THIS STUDY: TO QUANTIFY AND VALUE THE ECONOMIC BENEFITS PROVIDED BY SELECTED PRIORITY CONSERVATION LANDS

In this study, we identified the human uses supported by natural lands in five conservation opportunity areas listed in states' comprehensive wildlife conservation strategies and developed quantitative estimates of the economic value of those uses for which we were able to obtain sufficient data.

METHODOLOGY

The basic steps of our analysis, outlined in Figure 1, were as follows:

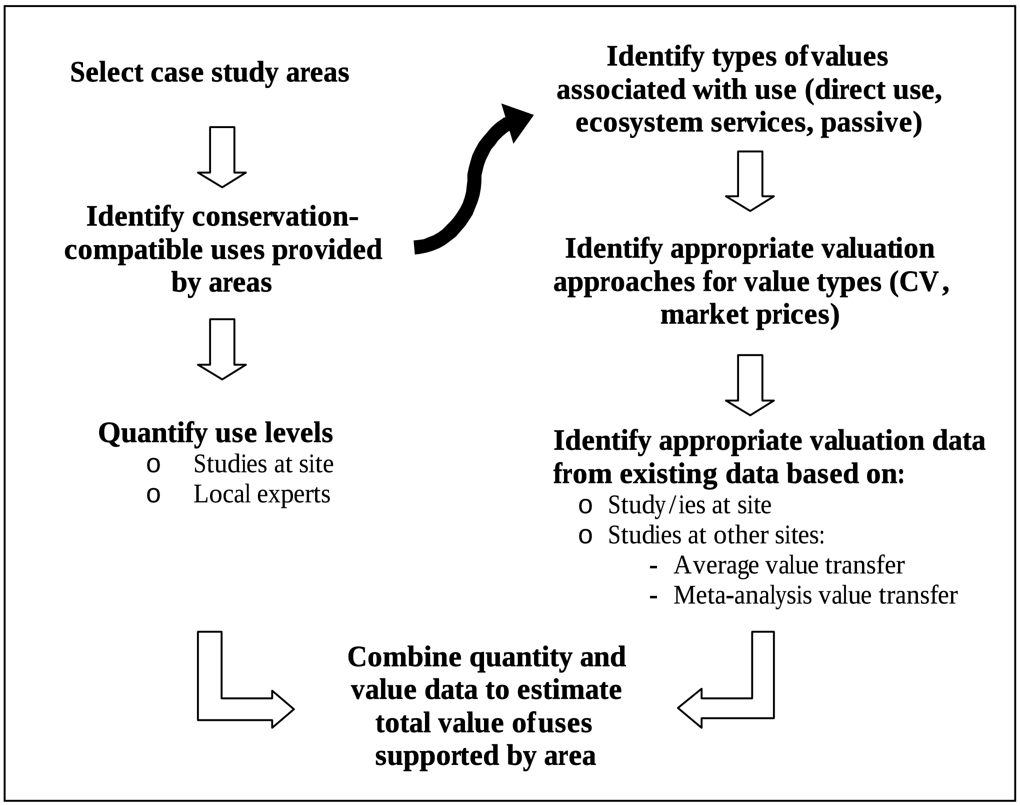

Figure 1: Flowchart of major study components

1. *Study area selection*

We chose five conservation priority areas as case study sites for our analysis. Because of the large number of priority habitat types and discrete priority areas identified in the complete set of 50 state plans and due to the lack of any centralized database that contains the complete universe of habitat types and areas, it was not possible to select representative case study areas using a random stratified sampling approach based on a systematic set of choice criteria. Given this limitation, our main objective in selecting our sample of five case study areas for this research project was to achieve a representation of diverse geographic regions, ecosystem types and land ownerships and uses within the sample. Our selection of areas was influenced by discussions with state wildlife planners in the selected states and by preliminary assessments of available data for an initial, larger sample of candidate areas. The chosen study areas include a temperate upland mixed forest and wetland complex in the Northeast (Mt. Agamenticus area, located in coastal southern Maine), a riparian corridor in the Midwest (Central Platte River, south-central Nebraska), a mixed subtropical forest and swamp area (Collier County Pine and Swamp Lands, southwestern Florida), a low to mid-altitude forest in the southwest (Lincoln National Forest and surrounding lands, southern New Mexico) and a coastal estuary (Yaquina Bay, western central Oregon) (Figure 2). In addition to the different ecosystem types, the five areas also exhibit a variety of different land use and ownership patterns.

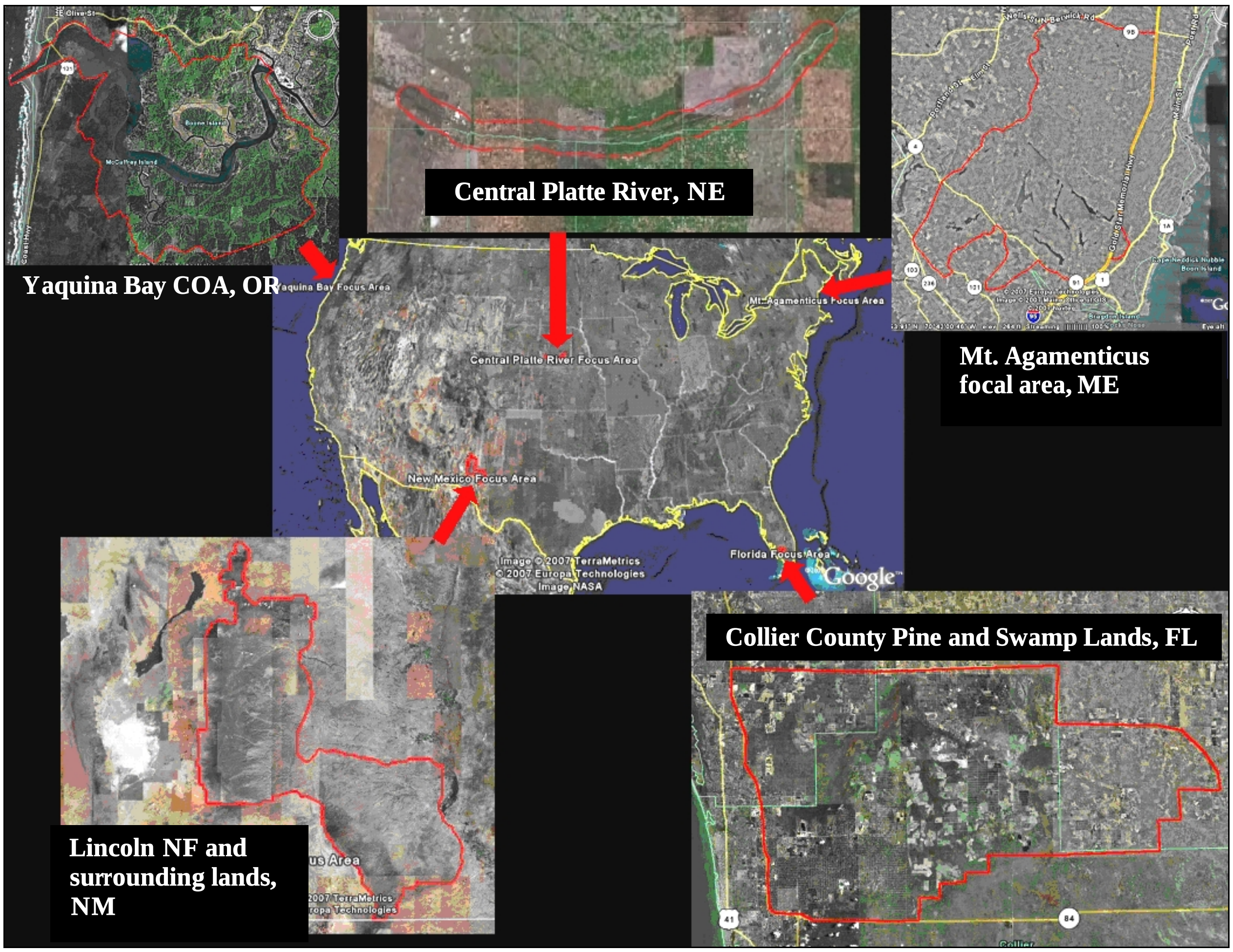

Figure 2: Location of the five study areas

2. *Identification of conservation-compatible uses supported by study areas*

In this study we focused only on the benefits from those uses that are compatible with and contingent upon the continued conservation of the area and for which we were able to obtain information. We restricted our assessment to conservation-compatible uses because the purpose of our study was to quantify the values generated by land conservation. In cases where extractive uses occurred in our study areas, the value associated with those uses was included as long as these uses were judged to be sustainable, that is, compatible with the continued conservation of the area in its current state. As a result, we did for example include the value associated with timber harvests or water withdrawals to the extent that the extracted resource volumes were sustainable. In each case, our decision regarding the sustainability of a particular use was based on the judgment of state or local public wildlife or land use managers or published reports.

The list of uses supported by the areas was identified from published reports and through consultations with state and local resource managers.

3. Quantification of use levels

Following the identification of conservation-compatible uses in our case study areas, we developed estimates of the respective use volumes. These estimates were constructed from data obtained from published reports and studies, GIS datasets, the scientific literature, and state and local resource managers.

4. Estimation of the economic value of uses

The economic theory underlying the valuation of natural resources and the general approaches used in valuation applications are reviewed in a companion report (Kroeger and Manalo, 2006). In this study, we developed quantitative estimates of the economic value of the annual flows of benefits generated by the study areas. Our estimates therefore represent the values of benefit flows in a given year, not the total present value of the natural resource stocks found in the five areas. In other words, we do not estimate the total economic net present value of the natural assets in the area (e.g., the forest and grasslands, animal and plant species), but rather the value of the benefits to humans that flow from these stocks in a given year (e.g., timber harvests, recreation, carbon sequestration, scenic views). The base year for our analysis was 2004, the most recent year for which most of the needed data were available when we began the study in 2006. All values are expressed in 2004 dollars ($2004).

Our assessment of the economic values provided by the five areas applies a welfare analysis-based perspective and attempts to quantify the total economic value of the benefits received by all individuals who directly or indirectly use the area. This welfare analysis-based assessment is able to capture market as well as non-market economic values and use as well as passive-use and ecosystem service values associated with the benefits provided by the ecosystems in the area.

In order to capture as much of the total economic value associated with a particular use of an area, we identified the type of economic value (direct, indirect, passive) associated with that use.[6] This was essential in order to identify the appropriate valuation approach(es) for particular uses. Where a particular use carries primarily utilitarian (use) value, as for example in the case of water provision, market prices generally will serve as a reasonably good indicator of the value individuals place on that use, and we used available market prices to estimate the value of these uses.[7] However, in many cases, a particular use is valued not just

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[6] For a more detailed discussion of the different types of values, see Kroeger and Manalo (2006).

[7] Ideally, values should be estimated based on the demand function for a particular use since use of a single observed market price point for valuation will result in the omission of the consumer surplus from the resulting estimate. Unfortunately, demand functions generally were not available for the utilitarian uses included in our

for utilitarian purposes or is not traded in markets directly. This is true for example in the case of wildlife-associated recreation. In those cases, there are no observable market transactions associated with that use, or the observable transactions fail to capture a large share of the total economic value users derive from the particular use. For uses where this is the case, valuation approaches other than the use of market prices are necessary to capture the full value of the use. These approaches include stated preference approaches that utilize surveys to get people to state the value they place on a particular activity or use. We drew on the large body of non-market valuation studies to develop value estimates for uses whose value can not be adequately estimated alone or at all based on market transactions.

In some cases, original valuation studies were available for particular uses for a portion or all of a case study area. Where this was the case, we used the results of those studies and updated them where required. Examples of uses with available valuation studies for some of our areas included wildlife-associated recreation or timber and non-timber harvests. However, in most cases, no original studies of particular uses were available for our sites. In those cases, we applied a technique economists refer to as benefits transfer or value transfer, in which value estimates generated by an original study at a particular site are applied directly or in modified form to a site for which such estimates are desired but for which no original study has been conducted. Benefits transfer is a technique that was developed specifically to allow the generation of valid value estimates for a site without the need for conducting a costly and lengthy original valuation study (Allen and Loomis, 2008). The transfer can take one of two basic forms. The first applies a single value reported in a study, or an average of values taken from a number of studies, to the site of interest. The second variant estimates the value of a particular use for the site of interest through application of a benefit function, usually itself estimated through a meta-analysis of valuation studies for the particular use. Benefit functions contain a number of variables identified as significant in statistical analyses of several valuation studies. The user sets the values of these variables such that they reflect the characteristics of the site for which value estimates are sought, and thus “tailors” the estimates generated by the benefit transfer function to that site. The absolute and relative performance of the two transfer approaches depends on the similarity between the relevant characteristics of the site of interest on the one hand and the literature study sites on the other hand.

In addition to using appropriate benefit estimates from the literature to value particular uses in our study areas, we also conducted an original meta-analysis of open space residential property value premiums, by statistically analyzing the findings reported in the sizeable literature on the subject. This is the first such analysis for residential open space premiums. This analysis yielded an original benefit function that estimates the size of residential property value premiums that are attributable to the presence of nearby open space(s) (Kroeger, 2008a). We applied this function to generate estimates of the value of open space premiums received by residential properties located inside or in the vicinity of our five case study areas.

For four of our study areas we also conduct an economic impact analysis that quantifies the total contribution the natural lands in the study area make to the local economy, in the form

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analysis. As a result, our estimates generally represent underestimates of the actual values associated with utilitarian uses.

of the total final output (sales), labor income and employment in the area that are derived from activities supported by the natural lands in the study area. This impact analysis-based assessment only includes observed market impacts attributable to expenditures associated with the conservation-compatible uses of the study areas.

A recent comprehensive review of the existing literature on the impacts of land conservation on economic growth and earnings showed that there exists strong evidence that protected lands increase economic growth at the county level (Kroeger, 2008b). None of the studies reviewed discovered a negative association between protected lands and income, output or employment. While a few studies did not detect a significant impact of protected lands on income, output, employment or population, most reported significant positive impacts (Table 1).

Table 1: Findings of studies examining the local economic impacts of protected lands

Impact measure:	*Number of studies showing impact of conservation lands is:*		
Change in	*Positive*	*Negative*	*Not significant*
Income/Output	6	0	2
Employment	9	0	2

Source: Kroeger (2008b)

These empirical observations stand in direct contradiction to the frequently voiced statement, generally based on anecdotal evidence or simplistic misconceptions, that there is a trade-off between environmental protection and economic growth. Furthermore, the studies that support this finding focus merely on the market impacts of land protection in the form of sales and income and thus do not even consider the additional benefits for human well-being that stem from living in areas with protected lands that offer scenic views and opportunities for escaping the physical and emotional stresses of modern life (Trzyna 2003, 2005).

RESULTS

Despite the lack of data for our study areas for many of the uses supported by the areas or for the associated values, our results demonstrate that these areas provide substantial economic values. It is important to emphasize that due to the lack or incompleteness of data for many uses, our estimates provide only a partial view of the total value of the benefits provided by the five areas. Thus, our estimates are best viewed as lower bounds of the actual values delivered by the areas. Table 2 shows our estimates of the annual value of benefit flows from the five areas. Together, these areas provide an annual economic value estimated at $283-$572 million. Given a combined total undeveloped area (i.e., excluding croplands, urban and mining) of the five sites of 3.68 million acres (5,756 square miles), the mean value all lands in these five areas provide is estimated at $77-$155 per acre per year. The (unweighted) mean of the average per-acre values of the five study areas is an estimated $178-$321 per year, with mean per-acre values ranging from a low of $34 per year to a high of $781 per year across the five areas. The substantial difference between the weighted and unweighted mean values per acre results from the fact that the largest of our study area (Lincoln National Forest and surrounding lands in New Mexico) generates the lowest estimated average annual benefits per acre ($34-$66 respectively for the low and high estimate).

Table 2: Estimated annual value ofbenefits provided by five study areas

		Estimated annual value in study area; million 2004$				
	Location:	Florida	Nebraska	New Mexico	Oregon	Maine
	Benefit / *Ecosystem type:*	- wetlands/ lowlands - (825 mi²)	- riparian - (658 mi²)	- forest - (4,900 mi²)	- coastal/ estuary - (29 mi²)	- upland/ wetland - (60 mi²)
Direct uses	TIMBER EXTRACTION	✓	-	3.2	✓	0.07 *
	NON-TIMBER PRODUCTS	?	-	3.7	?	✓
	GRAZING	✓	-	2.2	0.28	?
	COMMERCIAL FISHING	-	-	-	0.9	-
	RECREATION	2.6 *	23-37	70	1.0-2.3 *	0.25 *
	- Camping	✓	✓	✓	?	?
	- Backpacking	✓	?	✓	?	?
	- Picnicking and general relaxation	✓	✓	✓	✓	✓
	- Fishing	1.2	8.1-13.1	✓	1.0-2.3	✓
	- Hunting	0.03	✓	✓	?	✓
	- Hiking	0.13	✓	✓	✓	✓
	- Wildlife watching	1.2	15.0-23.4	✓	✓	✓
	- Cross-country/downhill skiing	-	-	✓	-	✓
	- OHV use	?	-	✓	?	✓
	- Mountain biking	-	-	✓	?	✓
	RESEARCH AND EDUCATION	✓	✓	✓	✓	✓
	PROPERTY VALUE PREMIUMS	6.5	0.5	5.3	0.42	2.0 *
Indirect uses	ECOSYSTEM SERVICES	135-306	0.6-3.6	22-120	0.2-0.6	2.9-4.0
	- Water supply	130-285	?	✓	?	2.7
	- Water quality	✓	✓	✓	✓	✓
	- Species habitat provision	✓	✓	✓	✓	✓
	- Biodiversity maintenance	✓	✓	✓	✓	✓
	- Temperature modulation	✓	✓	✓	?	?
	- Crop pollination	✓	?	?	?	?
	- Carbon sequestration	5.1-21.2	0.6-3.6	22-120	0.2-0.6	0.2-1.3
	- Air quality	✓	?	✓	?	?
Passive uses	PROVISION OF HABITAT FOR THREATENED, ENDANGERED, RARE OR "CHARISMATIC" SPECIES	✓	✓	✓	✓	✓
	TOTAL ANNUAL VALUE OF QUANTIFIED USES *(million 2004$)*	**145 - 315**	**24 - 41**	**106 - 205**	**3 - 5**	**5 - 6**

* incomplete estimate; ? not documented; - not applicable

The lack of data is particularly pronounced in the case of ecosystem services: the only services for which we were able to develop quantitative value estimates are carbon sequestration and, in some cases, water provision.[8] Similarly, we could not include passive use values associated with biodiversity conservation, especially those that people attach to charismatic species (Loomis and White, 1996; Loomis, 2000; Loomis and Richardson, 2008). The principal reason for this was a lack of information on the quantitative contribution the individual study areas make to the conservation of specific threatened, endangered or rare species. Finally, all five areas are used for scientific research and education at the K-12 to university levels, but estimating the economic value associated with these activities is a task that lay beyond the scope of this study.

Importantly, the degree of data availability, for both use levels and values, differed among our five study areas. Consequently, the five case studies vary with respect to their comprehensiveness, that is, the number of uses included in the analyses. This prevents valid comparisons across all five areas as to the values they provide per acre.

Of particular concern is the lack of information on the value of almost all ecosystem services provided by the study areas. Although we were able to develop value estimates for carbon sequestration services for all five study areas, we were only able to quantify the value of one additional service, provision of water, for two of the areas. In those cases, the value of water provision dominated the value of all other uses provided by the areas. This, together with the high value of carbon sequestration services provided by the areas, resulted in the number of ecosystem services included in the analysis being the principal determinant of the size of our total value estimates for the individual areas. Lack of estimates of the value of water provision services provided by three of the study areas is expected to lead to substantial downward biases in our total value estimates for those areas. Furthermore, omission from all analyses of the value of a multitude of services other than carbon sequestration or water provision is expected to exacerbate these downward biases in our total value estimates for all our study areas.

CONCLUSION

Habitat conservation on a comprehensive scale requires substantial investments. For example, protecting all priority areas identified in states' comprehensive wildlife conservation strategies or wildlife action plans could cost an estimated $219 billion to $1.75 trillion over the next 30 years (Casey et al., 2008). The current investments in land protection, although substantial, are unable to meet that goal, falling short by about an order of magnitude (Lerner et al., 2007). Clearly, a scaling up of resources devoted to land protection is needed if the conservation goals laid out in the state plans are to be realized.

However, as demonstrated in this group of case studies, conserved lands also generate substantial economic benefits, both in the form of market impacts - sales, earnings and employment - and in the form of increases in human well-being not directly captured by market-based indicators. Furthermore, continuing loss of natural lands through conversion to other uses is expected to make many of the goods and services these lands provide relatively scarcer and therefore increase their value relative to that of human-produced goods

[8] The list of ecosystem services shown in Table 2 is far from exhaustive. For a more complete listing see for example Boyd and Banzhaf (2007), Brown et al. (2007) or DeGroot et al. (2002).

and services. Thus, land conservation is important from an overall economic efficiency perspective.

Currently, missing, suboptimally structured or, in some cases, perverse incentive regimes in combination with the public-good nature of many of the services provided by natural lands and our limited ability to easily measure the value of these services, make it unlikely that conservation outcomes will be achieved that are economically desirable for society at large (Kroeger and Casey, 2007).

Conserving economically valuable natural lands on anything approaching the scale envisioned in the state plans will require a two-pronged approach. The first prong consists of improved financial incentives, both market-based and fiscal, for private and public landowners and managers that encourage them to take into account the full value of the goods and services these lands provide to society as a whole. Progress along this track can be made by re-examining and modifying existing conservation programs and financial incentive structures at both the state and federal levels, and will benefit from continuing improvements in our ability to measure and value the benefits provided by land conservation. The second prong of a large-scale land conservation program consists of an increase in the investment of public resources in the direct protection of priority lands through long-term easements, rentals, land management payments or fee-simple acquisition, in cases where the deployment of effective financial incentive approaches is not yet feasible or would take too long to implement. Economic valuation of the benefits of land conservation has a crucial role to play in the design and implementation of both prongs, even if we explicitly acknowledge that economic efficiency is not the only, or even the primary, rationale underlying habitat conservation.

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