A Review of the
Economic Benefits of Species and Habitat Conservation

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Executive Summary

The overall purpose of this report, A Review of the Economic Benefits of Species and Habitat Conservation, is to inform state-level wildlife and biodiversity conservation agencies of the various principles and methods, along with concrete examples, that can be employed to identify the *economic benefits* of conservation efforts. We believe that this information will be useful for state agencies that move from the planning stages of developing their respective State Wildlife Action Plans, to the implementation stage in which choices about habitats to protect will be based on some form of economic analysis. Just as important, the methodological tools and extensive bibliography will illustrate that all habitat conservation efforts result in some form of public and private benefits, and that these benefits must be identified and compared with the economic costs of these efforts if public policy objectives are to be efficiently implemented.

Conservation actions in the plans to acquire, protect or restore priority wildlife habitat for species of concern will often be influenced by the economic environment. Decision makers need a more complete understanding of the economic *benefits* conservation areas provide, and the tools economists use to determine those benefits, in order to make better conservation policy.

The paper and bibliography are intended to introduce State wildlife planners and other interested staff to the topic of economic valuation of natural resources in general, and to wildlife habitat specifically. The paper is also designed to provide an overview of the available methodologies and studies. We believe an understanding of the economic benefits of conserving the Nation's wildlife and their habitat can contribute to improved management of these resources and implementation of the wildlife plans, by supplying State wildlife agencies with an additional and powerful argument for conservation vis-à-vis competing demands on these resources from other interests. In essence, this document is a tool and a guide to be used by state wildlife agency planners and economists to identify and start researching the economic benefits associated with implementing the State Wildlife Action Plans.

This paper is structured in five sections. The first provides a brief introduction to the topic and our paper. Section 2 gives an overview of the types of market and non-market economic benefits associated with the conservation of wildlife and their habitat. Section 3 discusses the methods commonly used to quantify these values in monetary terms and how these methods have been applied to identifying the economic benefits of biodiversity and habitat conservation. Section 4 lists the literature cited in sections one through three. Finally, Section 5 presents a comprehensive bibliography of valuation studies and methodological papers relating to wildlife and habitat conservation benefits. The bibliography can help state representatives to identify previous studies that will be useful in carrying out additional benefits analysis.

The bibliography is organized into five tables that identify the types of economic value measured and the valuation method(s) used, as well as additional information that may help the user in assessing the usefulness of the source for his or her purposes. The tables

are organized in the following manner: 1) studies that cover particular ecosystem types; 2) studies that cover particular species; 3) studies on open space, roadless, and wilderness areas; 4) studies on recreational activities; and 5) papers on valuation methods and theory.

This report represents Defenders' longstanding involvement in both conservation planning as well as providing sound economic analysis of wildlife conservation policy and decision making. As a follow-up to this paper, Defenders will be conducting an analysis of the economic value of selected geographic areas identified as priority conservation focal areas in the State Wildlife Action Plans and is currently in the process of selecting a representative sample of priority focal areas to be included in an economic analysis. This effort will take the form of a series of case studies that will further the interest and capacity of state agencies to conduct economic analyses of their habitat conservation efforts.

Introduction

This paper discusses the economic benefits that individuals and society as a whole receive from the conservation of wildlife and their habitat. The paper has two main purposes. The first is to equip conservation advocates, wildlife planners, and policy makers with a basic understanding of the economic importance of wildlife and their habitat. The second is to provide individuals interested in conservation with an overview of economic valuation concepts and bibliographic sources that will enable them to assess and effectively communicate the economic benefits associated with wildlife and habitat conservation.

The structure of this paper is as follows: first, we present the conceptual basis of the economic valuation of natural resources (defined broadly to include all components of nature and ecosystems); second, we introduce the most common approaches used in such valuation exercises; and finally, we present a bibliography of wildlife and habitat valuation studies.

Society obtains a wide range of benefits from its manifold uses of nature. Attempts to quantify the economic value of these benefits historically have been constrained by a lack of a comprehensive conceptual framework and a lack of available valuation methodologies. However, since the 1960s, great advances have been realized in overcoming both of these constraints.

Of particular importance in this respect has been the realization in the economics profession that nature provides real contributions to human welfare that go beyond its use as a mere supplier of immediate physical inputs for the production of goods in the human economy. This realization was spawned particularly by seminal articles by Weisbrod (1964) and Krutilla (1967) (see Smith, 2004; Hanemann, 2005), in which the authors laid the conceptual groundwork for the comprehensive analysis of the economic value of natural resources by explicitly acknowledging the existence of what have come to be known as option and passive use values. Since then, a large and rapidly growing number of environmental valuation studies have been conducted. These studies have documented the benefits individuals obtain from the protection of particular habitats or endangered species, the benefits associated with improvements in environmental quality such as clean air and water, and the benefits derived from environmental services such as the pollination of crops or the prevention of topsoil loss.

In the remainder of Section 2 we briefly discuss the relation between ecosystems and economic value, followed by a discussion of the different types of economic value provided by ecosystems and species. Section 3 gives an overview of the various approaches used in economics to quantify the economic value of natural resources. Section 4 lists the literature cited in Sections 1 through 3. Finally, in Section 5 we provide a comprehensive, though not exhaustive, list of valuation studies and methodology references.

1. Economic Valuation Framework

Ecosystems and economic value

Ecosystems, and the species and habitats that form their constituent parts, are the objects of assigned values. The value society assigns to a resource is a function of the held values of the individuals that make up society, both in their capacities as individuals and as members of society.[1] It is also a function of the relative scarcity of the resource, and of people's knowledge about the resource.

From an economic perspective, the total value provided by an ecosystem or a species (or any other resource, for that matter) can be distinguished into several components, on the basis of the particular ways in which the system is used by humans. Use values are composed of direct use value, including option value, and indirect use value. Passive use values, often also referred to as non-use values, comprise existence value, stewardship value, and bequest value (Prato, 1998). As shown in Figure 1, use and non-use values together make up the total economic value (TEV) of a resource.

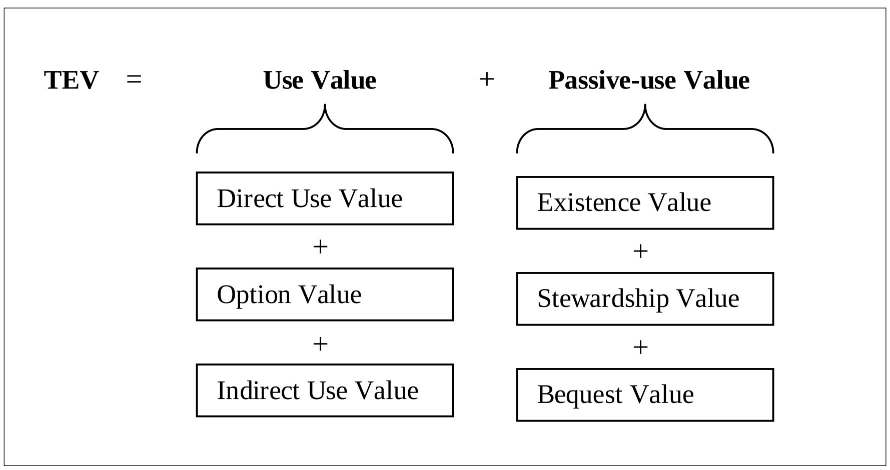

Figure 1: Components of the total economic value (TEV) of a natural resource

Both use and non-use values represent assigned economic values, that is, they are a measure of the perceived relative benefits society receives from the various uses to which it puts the resources at its disposal. Assigned economic values are informed by (among other things), but are distinct from, held values, that is, the social ordering principles society regards as desirable, such as for example fairness, freedom, or legal and political equality. Hence, the economic value derived from a given use of a resource is not

[1] These two different roles played by every individual (see for example Sagoff, 1988; Brouwer *et al.*, 1999; Kontogianni *et al.*, 2004) reconcile observed behaviors that appear contradictory when viewed from the perspective of utility maximization based on consumption.

necessarily in all cases indicative of the desirability of that use from a broader social perspective.[2]

It is also worth noting that both use and non-use values represent purely anthropocentric values. It can be argued on philosophical grounds that all living things, and perhaps even ecosystems, also have *intrinsic* values, that is, that they are valuable independently of their importance for, or usefulness or appeal to, humans (see for example Kneese and Schultze, 1985; Sagoff, 1988). It is conceptually impossible to assign an economic value to this intrinsic component, because economic values necessarily are based on human perception.[3]

The distinction of the various components of total economic value is not of purely theoretical interest. Rather, it is useful, and indeed often necessary, when seeking to quantify the economic value of a resource in monetary terms. The reason for this is that of the various approaches economics offers for the quantification of value, not all are suitable for quantifying all values. Hence the importance of determining clearly what types of values are associated with particular uses of a resource. Table 1 provides an overview of the various uses or benefits provided by ecosystems and species, and the type of value these uses represent.

Direct use values

Humans derive benefits from the direct use of ecosystems and species. The values associated with that use collectively are referred to as direct use values. Direct use can either be consumptive or non-consumptive, depending on its impact on the resource in question.[4] Consumptive uses appropriate a resource, as in the case of hunting, fishing, or the extraction of food, fiber, substances used in medical and medicinal applications, minerals, or water. Or they change the structure and functioning of the used ecosystem, as in the case of off-road trails that erode topsoil and cause death or detrimental behavioral or distributional changes in some species inhabiting the affected area.

Non-consumptive uses do not impact the natural resource base. Examples of non-consumptive uses are wildlife watching or nature viewing in general, photography, hiking, non-motorized water activities and other recreational uses, to the extent that they do not cause detrimental impacts to species or their habitat. In addition, non-consumptive use of ecosystems may occur from off-site, that is, from outside of the system. This is the case of property owners enjoying the proximity of natural areas that

[2] For example, the use of animal testing for the production of consumer goods such as cosmetics might carry a substantial economic value in cases where there are no alternatives to animal tests or where such alternatives are substantially more expensive. However, such testing may nevertheless be regarded as unethical and hence undesirable by the majority in society. In this example, economic value would be a poor indicator of larger societal values.

[3] Heal (1997) suggests that this intrinsic value could potentially be incorporated into decision making by interpreting it as placing a constraint on society's economic activities.

[4] In this context, the terms "resource degrading" and "extractive" are sometimes used instead of consumptive.

provide them with views of natural, open spaces, or of motorists enjoying scenic vistas from motorways.

Table 1 lists the major benefits derived from direct human use of species or ecosystems. Direct and indirect uses often are registered in markets, as for example in the case of outdoor recreation activities or resource extraction. Passive uses are not. However, as will be discussed in Section 3, the value of direct and indirect uses of natural resources that is reflected in market transactions as a rule does not capture the full economic value of those resources.

Table 1: Categories of values and associated benefits provided by ecosystems and species

Value category	*Benefit*
Use values	
• Direct use values [1]	Non-consumptive recreation (e.g., wildlife viewing) Consumptive recreation (e.g., hunting & fishing) Consumptive non-recreation uses: extraction of wild foods (venison and birds, mushrooms, berries, etc.), fibers (timber, livestock grazing), water, minerals, or inputs for medical and medicinal uses for sustenance and sale Social, religious, and spiritual events Education & Research Renewable energy generation (hydro, wind, etc.) Nature-inspired art, crafts, and publications (calendars, TV shows, etc.) Input for film industry *+ Economic multiplier effects associated with above activities* Real estate value premium in undeveloped/low density areas
• Indirect use values ("ecosystem service" value)	Pollination services Hydrological services Erosion prevention Carbon sequestration Biodiversity maintenance Habitat provision, etc.
• Option value	Possibility to engage in direct use of the resource in the future
Passive use values (Non-use values) [2]	
• Existence value	Appreciation of the scenic beauty of the Mojave, and of the natural systems it contains
• Stewardship value	Appreciation of the fact that this scenic beauty and the natural systems are maintained for and are...
• Bequest value	...passed on to future generations

Notes: Not all species or ecosystems provide all of the benefits listed in the table. [1] Market and non-market values. [2] Primarily non-market values.

The fact that individuals attach value to the use of species and ecosystems is evidenced by the time, effort and money people devote to engaging in a wide range of outdoor recreation activities, to living near scenic areas, or to experiencing them in zoos or vicariously through nature books, documentaries, calendars, or other media.[5] It is also attested by the fact that people expend considerable resources on obtaining ecosystem products such as timber and water.

Even if an individual does not engage in any use of a particular ecosystem or species in the present, she may nevertheless attach value to maintaining the possibility of exercising such use in the future (Prato, 1998; Freeman, 2003). This value is called option value, and constitutes a special sub case of direct use value. Although option value generally decreases with increasing distance from the locale of potential future use, and may be small on a per-capita level, it can account for a non-negligible portion of the total economic value of regionally or nationally known protected natural resources. For example, Barrick and Beazley (1990) estimated that the total option value of preventing oil and natural gas development in the Washakie Wilderness area in Wyoming's Shoshone National Forest (adjoining the southeastern portion of Yellowstone National Park) to people in the U.S. not residing in the area was $3.6 billion at 1983 prices. Walsh *et al*. (1984) found that option value accounted for over half the total value Colorado residents assigned to the state's wilderness areas in 1980.

Economy-wide impacts of direct use of species and ecosystems

The direct uses shown in Table 1 have value for the individuals who engage in the respective activities. However, these uses may generate value for others as well, to the extent that they generate market activity. The direct expenditures associated with the uses create direct economic impacts in the form of output and associated earnings and employment in the sectors in which the spending occurs. These direct impacts then ripple through the regional economy creating further, so-called indirect and induced, effects, in the process leading to additional output, earnings, and employment. For example, a State Park produces a direct economic impact in an area in the form of the spending by park visitors on goods and services such as gasoline, souvenirs, or restaurant visits. These expenditures produce sales by local businesses. The businesses directly impacted by tourism link back to other businesses from which they purchase their inputs, which in turn link back to others, and so forth. The chain of secondary effects constitutes the indirect economic impact of the State Park. Finally, the salaries received by local households that are sustained by the park result in household expenditures that in turn generate local economic activity. These are commonly referred to as induced effects of the park. The total economic impact of the park is the sum of the direct, indirect, and induced effects. All of these impacts have value for the affected individuals to the extent that the latter are better off because of the increased net income and potentially other, non-monetary benefits derived from employment.

[5] As Kramer *et al.* (2002) point out based on Smith and Desvouges (1986), such vicarious consumption can be seen as use, but in practice its value is not separable from pure existence value.

Indirect use values (ecosystem service values)

In addition to providing the direct uses discussed in the preceding section, ecosystems and individual animal or plant species contribute to the production of many goods and services in the human economy (Daily *et al.*, 1997; Balmford *et al.*, 2002). For example, some insect, bat and bird species provide pollination functions that contribute to, and in some cases are essential for, the production of a wide variety of agricultural products. Likewise, forests and wetlands moderate the intensity of surface run-off from storm events. This reduces the erosion of topsoil in surrounding areas and the leaching out of soils of macro nutrients and trace minerals essential for plant productivity. Through the functions they perform as part of the hydrological system of an area, forests and wetlands also reduce fluctuations in soil moisture in surrounding areas that in their absence would result from storm events and droughts. This moderating influence on nutrient leaching and soil moisture fluctuations improves the productivity of surrounding agricultural areas and reduces the requirement for manufactured inputs such as fertilizers.

The foregoing provides two examples of how ecosystems or individual species contribute to economic production indirectly through their functional activities that enter the human production of goods and services (Barbier, 2000). In economic and ecological terminology, these activities commonly are referred to as ecosystem services or ecosystem functions (Costanza *et al*., 1997; Daily *et al*., 1997; De Groot *et al.*, 2002).

The literature on indirect use values often uses the terms "ecosystem functions" and "ecosystem services" interchangeably. However, ecosystem functions by definition include all flows of matter and energy in an ecological system (Odum, 1962). Not all of those flows are necessarily beneficial to humans. In any case, their relation to human welfare in many cases may be unclear and difficult or impossible to determine quantitatively.

In addition, some definitions of ecosystem functions or services do not distinguish between the functions (flows of energy and matter) and the resulting services (the actual benefits to humans that the functions produce). More generally, they often do not distinguish between direct and indirect uses. For example, the Millennium Ecosystem Assessment (2003) categorizes ecosystem services into supportive (those that lead to the maintenance of the conditions for life such as nutrient cycling), provisioning (those that provide direct inputs to human economy like food and water), regulating (such as flood and disease control), and cultural ones (opportunities for recreation and spiritual or historical purposes) (see Figure 2). Note that what in Figure 2 is labeled "supporting services" would, under our definition, be considered functions, as would many regulating services. Furthermore, under the Millennium Ecosystem Assessment's definition, no distinction is made between direct uses (such as the harvest of animals and fibers from ecosystems) and indirect ones (like the pollination of agricultural produce).

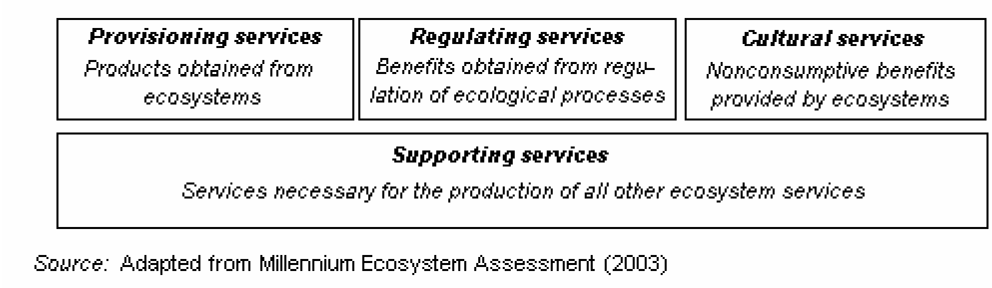

Figure 2: Typology of ecosystem services following the Millennium Ecosystem Assessment

This lack of distinction between the terms functions and services may not seem much of an issue from an ecological perspective. After all, the ecosphere is the sum total of all ecosystemic structures and functions found on earth, and, as in any complex system, some of its properties are emergent, that is, are the result of the interplay of its constituent parts (von Bertalanffy, 1968; Odum, 1994). Humans, therefore, arguably depend on the total set of biogeochemical arrangements that characterize our present global ecosystem, and likely would be negatively affected by the loss of any of them. Viewed from this perspective, the distinction between functions and services is rather pointless, because in the last regard all services that humans derive from ecosystems are the result of the functioning of those systems.

For the purposes of analyzing the economic value of the indirect use of ecosystems, however, it is helpful, and indeed necessary, to distinguish between ecosystem functions, and ecosystem services proper. Banzhaf and Boyd (2005) provide a useful distinction. They define ecosystem functions as the biogeochemical flows that connect the different constituent parts of ecosystems, and ecosystem services as those outputs of these functions that are "consumed" by humans.[6] For example, water purification by a wetland is a function, because the process of purification does not enter human use. By contrast, the clean(er) water that results from this function is the service consumed by humans.

Within our valuation framework of direct use, indirect use, and passive use of ecosystems and species, some of what is classified as ecological services under Banzhaf and Boyd's definition actually constitutes direct use. These are products that are directly appropriated by humans, such as water, food and fiber obtained from ecosystems, and recreation. Hence, for purposes of our analysis, we further narrow down the definition of ecosystem services by explicitly excluding all ecosystem goods directly consumed by humans.

By our definition then, indirect use comprises those ecosystem inputs to the human economy that do not constitute desired and consumable products in their own right. Rather, these inputs contribute to human produced output, entering the production

[6] The term "consumed" here is used in the economic sense, indicating that the service enters a firm's or a household's production function, thereby contributing to the generation of utility or profit. In this context, consumption need not imply a change in the physical structure of the resource. An example of such a non-degrading consumption is a person enjoying a scenic view.

function of households and firms and in the process reducing production costs or increasing output. Examples are the pollination of agricultural cultivars; reduced input requirements for fertilizers that result from reduced topsoil and nutrient erosion; improved productivity of cultivars as a result of the reduction of excessive soil moisture, or the prevention of the lack of sufficient soil moisture; reduced concentrations of organic waste materials due to wetlands' waste dilution and decomposition activities; or reduced coastal erosion and property damage from coastal storm events due to the buffering impact of wetlands.

Ecosystem services contribute to economic output, commonly measured as gross production (for example, on the national level, the familiar gross domestic product, or GDP). Therefore, they carry economic value in proportion to their contribution to that output (Barbier, 2000). Most economic analyses of the goods and services produced in a geographic area have tended to ignore ecosystem service values. Instead, economic analysis commonly focuses on human-produced goods and services only, without recognizing explicitly the value of the ecosystem inputs. Fortunately, this is beginning to change.[7] Neglecting the value of environmental services often generates grave misperceptions as to what makes human economies function (Hall *et al.*, 1986; Cleveland and Ruth, 1997), and has the potential to undermine the quality and efficacy of public policies (Pagiola *et al.*, 2004; Banzhaf and Boyd, 2005). A rigorous analysis of the relationships between ecosystem functions and human well-being, and an integration of ecological services into existing economic accounting systems are needed if the goal is to achieve economically sensible natural resource policies (Banzhaf and Boyd, 2005). Presently, there still exist only few quantitative, site-specific studies of the economic value of ecosystem services. Many of these are listed in the bibliographic tables in Section 5 of this paper.

Table 2 provides an overview over important functions and services that ecosystems and individual species perform for humans. A complete list can be found in De Groot *et al.* (2002) and Millennium Ecosystem Assessment (2003).

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[7] See for example The Economist (April 23rd 2005). Local, regional, national, and international markets have been developing for ecosystem services ranging from single service functions (e.g., water supply and purification, carbon sequestration) to multiple functions (e.g., wetlands banking).

Table 2: List of selected ecosystem functions, processes, and resulting goods and services to humans

Function	*Ecosystem processes*	*Goods and services (examples)*
Supporting and regulating services	*Maintenance of essential ecological processes and life support systems*	
Water regulation	Role of land cover in regulating runoff and river discharge	Drainage and natural irrigation
Water supply	Filtering, retention, and storage of fresh water (*e.g.*, in aquifers)	Provision of water for consumptive use (residential, agricultural, and industrial uses)
Waste treatment	Abatement of pollution	Reduced dust particles and noise pollution, reduced water pollution
Soil retention	Role of vegetation root matrix and soil biota in soil retention	Prevention of damage from erosion/siltation
Soil formation	Weathering of rock, accumulation of organic matter	Healthy and productive soils and ecosystems
Disturbance prevention	Ecosystem structure dampens environmental disturbances	Reduction of intensity of runoff from rainstorms, mudslides, droughts
Carbon sequestration/ Climate regulation	Land cover influence on climate	Climate conditions suitable for humans and animals
Nutrient cycling	Storage and recycling of nutrients	Maintenance of healthy soils and productive ecosystems
Pollination	Dispersal of floral gametes	Pollination of wild plant species and crops
Refugium	Suitable habitat for plants and animals	Biodiversity maintenance
Nursery	Suitable reproduction habitat	Production of harvested plant and animal species
Provisioning services	*Provision of natural resources*	
Food production, raw materials	Capture and conversion of solar energy into biomass	Plants and animals for food, fibers, genetic, medicinal, etc. resources
Cultural and amenity services		
Cultural and artistic information	Variety in natural features with cultural and artistic value	Nature as motive in books, films, paintings, folklore, national/local symbols, architecture, advertising, etc.
Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (*i.e.*, heritage value of natural ecosystems and features)
Aesthetic information	Attractive landscape features	Enjoyment of scenery
Science and education	Variety in nature with scientific and educational value	Use of natural systems for school excursions and scientific research
Recreation	Variety in landscapes with (potential) recreational uses	Recreation and tourism

Sources: De Groot *et al.* (2002), Millennium Ecosystem Assessment (2003).

Passive use values

Besides valuing resources for their direct or indirect usefulness to humans, individuals may attach value to landscapes, ecosystems, or species independently of any actual use. For example, it is well-documented that there are many people who have never visited

Yellowstone National Park of the Arctic National Wildlife Refuge and who do not plan to visit these places in the future, but who nevertheless would be willing to contribute to the preservation of these unique natural assets.

There are a variety of reasons why people may attach value to these objects, even if they never actually experience them in person. Individuals may value the fact of simply knowing that particular landscapes, habitats or species exist, that they are maintained, and that they are passed on to future generations, even though they themselves may never come into contact with the species or habitats (Krutilla, 1967; Freeman, 2003). These values are referred to as existence, stewardship, and bequest values, respectively. Because they are not tied to any use of the resource in question, they are collectively known as passive use or non-use values.

As with all objects of assigned values, the motivations for valuing the environment or its components vary widely among individuals. These motives include the following: (1) spiritual or ethical ones, such as a belief in the inherent right of other species or their habitats to exist, and the responsibility to respect that right; (2) sympathy for or empathy with other living creatures; (3) altruism towards plants and animals; (4) a recognition that species form part of the web of life and, functioning as environmental linkages, and hence maintaining the functioning of specific ecosystems; (5) the fact that an area provides habitat for a variety of endangered, threatened, and rare species; (6) an appreciation of a species' or landscape's beauty or uniqueness; and (7) bequest goals (Bishop and Heberlein, 1984; Boyle and Bishop, 1987; Madariaga and McConnell, 1987; Sagoff, 1988; Harpman ***et al***., 1994).

While non-use values and option values have long been established in economic theory as components of a resource's total economic value (Weisbrod, 1964; Krutilla, 1967; Freeman, 2003), more recently they have also been recognized as legitimate components of the economic value of natural resources by the courts (U.S. Court of Appeals, 1989) and by legislation (U.S. Department of Commerce, 1994; U.S. Department of the Interior, 1994).

Passive use values generally are not reflected in market transactions.[8] Rather, market transactions associated with environmental resources reflect only the minimum value that people place on the direct use of those resources (see Part 2). In cases where passive use value accounts for a large share of the TEV of an environmental resource, ignoring these values is likely to result in the suboptimal (***i.e.***, inefficient, or not welfare-maximizing) management of the resource.

A famous example of the importance of considering passive use values is Friedman's

[8] Although the economic value associated with passive or option use commonly is not captured in market transactions, passive uses in some instances may generate some market activity. An example of market impacts associated with such passive uses is the purchase of media that focus on the desert (literature, calendars, documentaries, photos and picture books, etc.). As Kramer ***et al.*** (2002) point out based on Smith and Desvouges (1986), such vicarious consumption could be seen as indirect use, but in practice it is not separable from pure existence value.

(1962) proposal to close down a National Park or wilderness area if the commercial value of timber and minerals exceeded the WTP for recreation use of the Park or wilderness area. If this was the case, so Friedman's argument, the opportunity costs associated with maintaining the Park or wilderness area fell short of the benefits, and considerations of economic efficiency suggested that the area be allocated to alternative uses. Weisbrod (1964) responded that the WTP of recreation users understated the true value of the Park to society as a whole because it didn't capture the WTP of non-users for maintaining the option of future use of the Park. Krutilla (1967) contended that many individuals also may be willing to pay for the knowledge of the existence of unique environmental resources, and of bequesting these to future generations. Clearly, using the WTP of recreation users as a measure of the benefits society derives from National Parks or wilderness areas would lead to serious underestimates of the total economic value of those environmental resources.

The literature suggests that the importance and magnitude of passive use value in a given case may depend on the irreversibility of the action, the irreplaceability of the resource, whether the resource is regionally, nationally, or internationally significant, whether threatened or endangered species or their habitats are involved, and whether use is rationed (Harpman ***et al***., 1994; Walsh ***et al***., 1984). Passive use value is not limited to resources of outstanding significance, but its relative importance tends to be highest in cases where unique resources are concerned (ibid.). Priority conservation areas identified in State Wildlife Action Plans may generate passive use values, to the extent that people are aware of the importance (biological, cultural, or other) of the animal or plant wildlife found in those areas.

A large number of studies have documented the importance of passive use values. Walsh ***et al.*** (1984) found that passive use values of wilderness areas in Colorado in 1980 accounted for slightly over half the total value of those areas to residents of the state. Walsh ***et al.*** (1990) found that passive use values dominated the total economic value of Colorado forests; Haefele ***et al.*** (1991) and Kramer ***et al.*** (2002) confirmed that finding in their analysis of the passive use values of the Southern Appalachian Mountains for residents within a 500 mile radius.[9] Loomis (1987a, 1987b) and Sanders ***et al.*** (1990) obtained the same results in their studies of Mono Lake in California and of fifteen wild and scenic rivers in Colorado, respectively.

The importance of passive use values has been confirmed also for improvements in environmental quality, such as forest health, and water quality of lakes and rivers (Whitehead and Groothuis, 1992; Banzhaf ***et al***., 2004), or improvements in endangered species populations (Olsen ***et al***., 1991; Hagen ***et al***., 1992). In general, passive use values tend to account for a large share of the total economic value of environmental resources of national interest, such as National Parks or Wilderness areas (Vincent ***et al***., 1995; Walsh ***et al.,*** 1984, 1990; Kramer ***et al.,*** 2002), or charismatic megafauna such as

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[9] For a good literature review of studies analyzing passive use value of forest lands, see Vincent *et al.* (1995).

the grey wolf (Duffield, 1992; U.S. Fish and Wildlife Service, 1994; Manfredo *et al.*, 1994) or the bald eagle.

For users of an environmental resource, passive use and option values account for only a portion of the total economic value of the resource. By contrast, for non-users, passive use and option values make up the total economic value of the resource. Given that use value declines with increasing distance from the environmental resource, this explains the decrease in a person's willingness to pay with increasing distance from the site that has been observed in the case of endangered, threatened, and rare species and habitats (Loomis, 2000).

2. Quantification of the economic value of ecosystems and species

The economic value people assign to goods and services commonly traded in markets is easily identifiable by observing individuals' purchasing decisions. Goods with primarily utilitarian character are primarily valued for their use. The prices of market goods therefore generally give a fair indication of the value individuals place on them. For example, the price of an apple is a good indicator of the apple's value in a given location and at a given point in time.

By contrast, assessing the value of goods and services not commonly traded in markets is more difficult, because there are no prices that could serve as indicators of value. Many environmental goods and services fall in the latter category. This does not mean that humans do not value them: as discussed in Part 1, empirical research clearly has shown that the natural world provides benefits to individuals that are not accounted for in markets, and that people are willing to pay for enhancements in the quality of natural environments (e.g., Freeman 2003; Krutilla and Fisher, 1985). Quantifying the value of these environmental resources requires different approaches to overcome the lack of easily observable prices.

To give an example, ecosystems generally are not traded in markets. To derive an estimate of the economic value of a given ecosystem, one would need to examine all the uses (or services) the system provides to humans, and attempt to identify the value of each use. For example, one such use, recreation, generates individual enjoyment as well as tourism spending and associated multiplier effects that increase output, earnings, tax revenues, and employment in the local and regional economy. These direct use values are partially captured in markets, in the form of recreationists' expenditures on lodging, food, equipment, gasoline, etc., and the multiplier effects that these expenditures have in the local and regional economies. As pointed out in Part 1, however, the total direct use value of recreation generally is far larger than these visible market impacts indicate, because the expenditures recreationists incur seldom exhaust their willingness to pay for the recreation activities (see for example Kramer ***et al.***, 2002; Loomis, 2005).[10] In addition, the system provides many other uses besides recreation, such as clean water in the case of healthy forests, or pollination services or biodiversity maintenance. Importantly also, people who do not use that system may still value it for its existence. Depending on the type of use, several approaches are available for quantifying its economic value.

In this section, we briefly discuss the concept of willingness to pay, the measure used in economics to assess value. We then present a brief discussion of the main approaches

[10] The consumer surplus (CS) of recreationists is not captured in markets. Therefore, if revealed preference approaches are used to estimate the direct use value, the CS portion of the recreation use value will go unrecorded, with the result that the total economic value (the sum of consumer surplus and direct market impacts) will be underestimated.

used in economics to quantify the different types of values provided to humans by wildlife, their habitats, and other natural resources.

Value and willingness to pay (WTP)

The economic value an individual assigns to a particular good or service is commonly measured by the maximum amount of resources the individual would be willing to give up in order to obtain the good or service in question, or the minimum amount in compensation she would demand in order to give up that good or service.[11] For example, if someone is willing to spend up to, but no more than, five dollars to acquire a particular object, that person's willingness to pay (WTP) for that object is five dollars.[12]

In economics, WTP is the preferred measure of assigned value because it is considered to be the conceptually correct indicator of value. The reason for this is that WTP is based on the assessment of value by the actual individuals whose values are being measured (Arrow ***et al.***, 1996).[13] Economic value and hence WTP are context-specific, that is, they are dependent on a number of variables. The most important of these are income, preferences, the relative scarcity of the good or service in question, and the relative scarcity of its complements and substitutes. As a consequence, WTP for a given good or service varies among individuals with different values, interests, experiences, or in socioeconomic situations, and it often varies for the same individual over time.

From a production and consumption perspective, the total economic value (TEV) of a good or service can be broken down into the components that are captured by the producer and the consumer, respectively. Using recreation in a public park as an example, let us assume that the demand for recreation in the park is represented by the line ***D*** in Figure 3, indicating that the amount of recreation is inversely related to its price.[14] For example, at a particular price, ***p****, the amount of recreation in the park that is

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[11] The two approaches, willingness to pay (WTP) and willingness to accept (WTA) compensation, generally yield different estimates of economic value for a good or service. Studies have shown that individuals' WTP to obtain a hypothetical gain (benefit) is generally substantially smaller than their WTA a hypothetical loss (Adamowicz ***et al.***, 1993; Haneman, 1991). This difference is caused by the psychological impact of a difference in the nature of the ownership regarding the hypothetical resource change, often referred to as the endowment effect (Kahneman ***et al.***, 1990), and by the fact that income constraints bind WTP, but not WTA.

[12] WTP and economic value are commonly expressed in monetary units, although they could be expressed in any metric.

[13] It should however be noted that in cases where individuals are assigning values to future impacts, these values may not be rational and often are not compatible with society's best interests (Caplin and Leahy, 2001).

[14] All users are arranged according to their WTP for use of the park, from the one with the highest WTP (leftmost point on the ***Q*** axis) to the one with the lowest WTP (where the demand curve ***D*** meets the ***Q*** axis). The aggregate demand curve for recreation in the park ***D*** is the sum of the individual demand schedules of all users of the park.

"consumed" by the public is *Q**, where *Q** stands for a number of individuals accessing the park on a specific day.

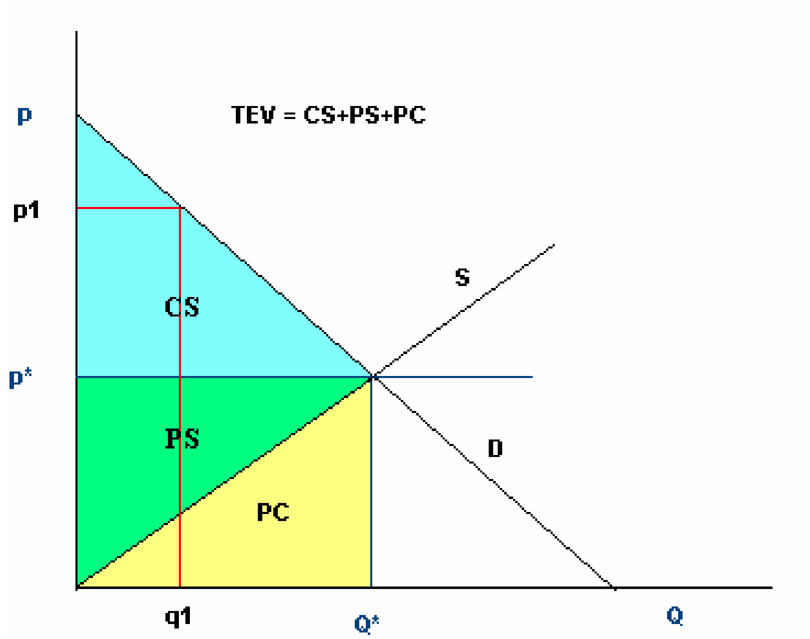

Figure 3: Consumer surplus (CS), producer surplus (PS), production cost (PC), and Total economic value (TEV)

The downward slope of the demand curve indicates that reducing the price of recreation (that is, moving to the right on the *Q* axis) would attract additional individuals to use of the park. The total economic value a particular park user receives is indicated by the point on the demand curve *D* that corresponds to that user. For example, user *q1* has a WTP of *p1,* approximately four-fifths higher than *p**. Aggregating the WTP of all park users yields the total WTP of all users for recreation in the park, indicated by the area under the demand curve *D* up to the number of visitors. For example, if the visitation level is *Q**, the total WTP of all users is equivalent to the sum of the areas PC, PS, and CS.

The supply of recreation (*S*) is "produced" by the public authority who owns and manages the park. The authority's production cost (PC) includes the salaries and benefits of park employees, installation and maintenance of park infrastructure, etc. The production cost indicates the price at which use of the park would be offered in a perfectly competitive recreation market. The supply curve (*S*) is upward sloping, which could result for example from administration costs that increase with the number of people using the park.[15] In this particular example, the demand (*D*) and supply (*S*) of

[15] Public parks are not usually operated on a competitive (*i.e.*, profit maximizing) basis – and they should not be, given the public goods character of many of the services they provide and the passive use values

recreation would result in the access price ***p**** and the number of visitors ***Q****. At this price, all visitors who are willing to spend the amount ***p**** are using the park. However, essentially all of the park users would be willing to spend more than ***p**** (in fact, all but the ones whose WTP is exactly equal to ***p****), that is, their WTP for using the park is higher than the asking price. Since WTP is a measure of the benefit an individual receives from using the park, or, in other words, of the value she assigns to using the park, in the example presented here almost all park users receive a value that is higher than the amount of resources they give up to obtain that benefit (namely, the price ***p****). That surplus in value for each individual is indicated graphically by the difference between the price ***p**** and the demand curve (***D***) at each point on the ***Q*** axis. For all park users as a whole, the surplus is equal to the area marked consumer surplus (CS). This area represents the value that the users as a group receive above and beyond what they are paying, or their net benefit (benefits minus costs). At price ***p****, the supplier of the park incurs costs totaling PC, but earns revenues equivalent to the areas PC and PS. Hence, the supplier's net benefit (or profit) is indicated by the area labeled PS, the producer surplus. The park generates ***net*** benefits to recreation users equivalent to the sum of the areas CS and PS. In addition, if the park has passive use and option value, it generates benefits to non-users as well.

The park example illustrates the limitations of using market data as a basis for estimating WTP. Actual WTP often is not known. In our example, the fact that park users are willing to pay the price ***p**** does not give us any indication of their real WTP. Rather, it only shows that their WTP is ***at least*** equal to ***p****. In order to estimate the demand curve ***D*** and hence WTP, one would need to vary the price of park use and observe the resulting changes in visitation levels, for prices from reaching from zero all the way up to where the last visitor is driven away (the latter price level is indicated by the intersection of ***D*** and the y-axis). In reality, such experiments in most cases are impossible to conduct, and all that is available to the analyst is one or at best very few price points. As a result, the shape of the demand curve is essentially unknown for many environmental goods. If we assessed the TEV of the park on the basis of the market price for park use (***p****), we would underestimate it substantially (by the amount represented by the area labeled CS).[16]

This is particularly true for goods or services that commonly are not traded in markets directly – or are not traded at all. Examples of such goods are many aspects of

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they generate – but that is of no relevance to the discussion here, the purpose of which simply is to introduce the fundamental economic concepts that will later be used in the economic analysis.

[16] Obviously, in cases where such information is available, all expenditures by the park users that can be attributed to the park use must be added when estimating WTP for park use on the basis of observed behavior, in order to minimize the underestimate of WTP. For example, the travel costs associated with the park visit (expenditures on gasoline, food and lodging, souvenirs, etc.) and associated equipment purchases must be added to the entrance fee. Still, even the most comprehensive expenditure accounting cannot overcome the fundamental shortcoming associated with estimating WTP on the basis of market transactions – namely, that a potentially substantial part of the WTP, and hence of the TEV, may be missed by this approach.

environmental quality such as air and water quality, many ecosystem services, and objects of passive use such as rare, endangered or threatened animals or protected natural areas.[17] Many of these environmental resources are not traded in markets because they show characteristics of public goods: they are non-rival in consumption and non-exclusive. Their enjoyment by one individual does not diminish enjoyment by others, and no one can be prevented from enjoying them once they exist. Goods with these characteristics cannot be offered at a socially optimal level by profit-oriented private suppliers (Samuelson, 1954). The economic value of these goods and services is not directly observable from market transactions. Using market data to impute the value people assign to these resources will therefore generally result in substantial underestimates of the total contribution of these resources to societal welfare. For example, surveys show that most outdoor recreation activities generate net benefits for participants, that is, their WTP for these activities is higher than their expenditures on them (see for example U.S. Fish and Wildlife Service, 2003a; Arizona State Parks, 2004; Loomis, 2005; McCollum *et al*., 1990).

Hence, other approaches must be used to estimate the economic benefits associated with environmental resources not traded in markets. The development and refinement of techniques for the economic valuation of environmental benefits during the past four decades has been one of the primary foci of the subdisciplines of environmental and natural resources economics. Thanks to the advances that have been achieved it is now possible to estimate the monetary value of most types of environmental benefits (Cropper, 2000).

Figure 4 shows the approaches that are available for the estimation of the economic value of environmental resources, for each type of value – direct use, indirect use, and passive use. At the most basic level, all valuation approaches rely either on individuals' revealed or stated preferences.

In many instances, an environmental resource may provide more than one use to humans. In order to estimate the full economic value of a resource with multiple uses, it is generally necessary to assess the value of the individual uses separately. For example, the horseshoe crab (*limulus polyphemus*) found along the U.S. Atlantic seaboard provides direct uses in the form of bird watching and sport fishing, both of which generate large economic net benefits in the form of consumer and producer surpluses. Horseshoe crab eggs constitute the primary food source for at least eleven migratory bird populations during their stopover in Delaware Bay, and for important sport fish such as striped bass and white and silver perch.[18] These shorebirds attract large numbers of bird watchers in

[17] Markets appear to be developing with respect to some ecosystem services. The perhaps best-known example is that of the city of New York buying conservation easements in the Catskills watershed in order to preserve the watershed's water filtration and provision services (see Chichilnisky and Heal, 1998).
[18] See Ecological Research and Development Group (ERDG), *http://www.horseshoecrab.org/nh/eco.html*.

all the mid Atlantic states,[19] who receive substantial benefits and net benefits (consumer surplus) from that activity. The same is true for bass and perch.[20]

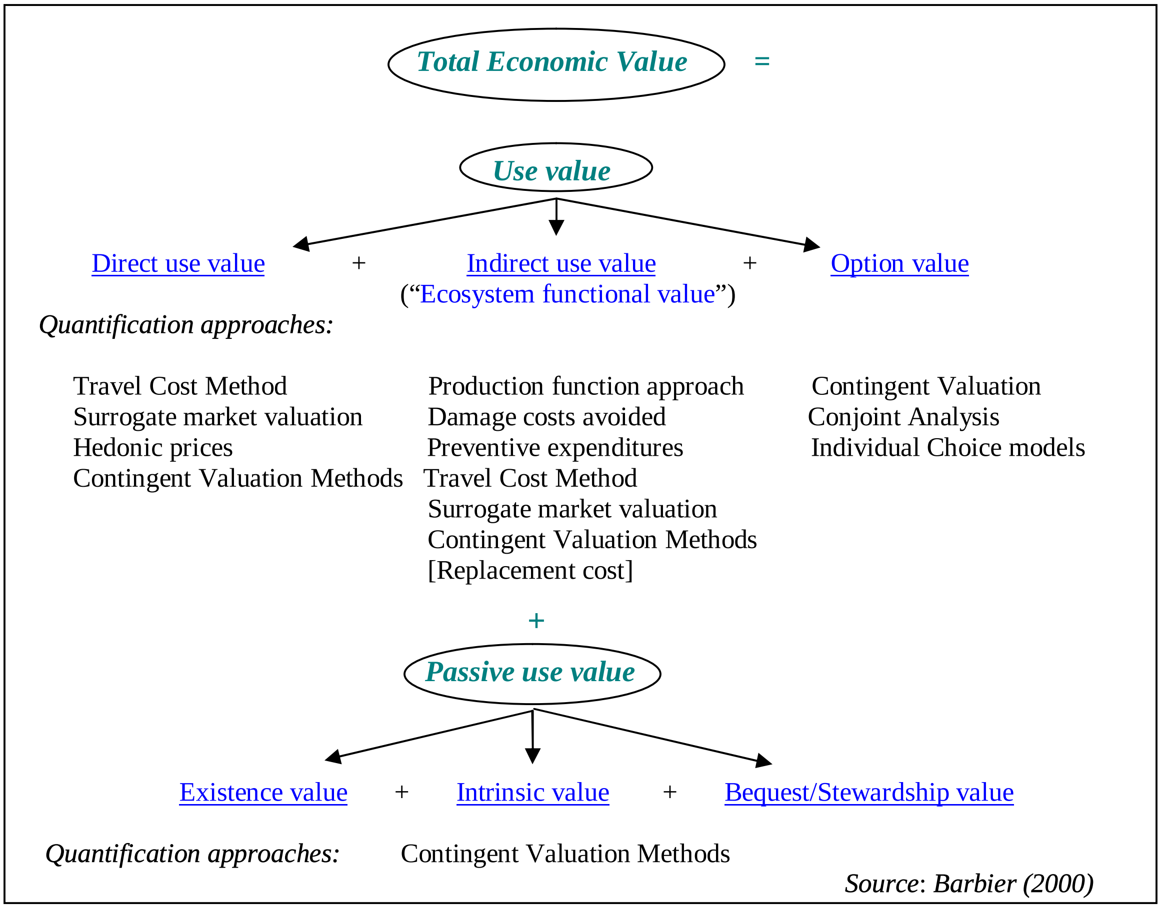

Figure 4: Categories of economic values of ecosystems and available valuation approaches

Trip and equipment expenditures associated with shorebird watching and bass fishing generate sizeable economic impacts at the local and state levels (Manion *et al.*, 2000; U.S. Fish and Wildlife Service, 2001). Horseshoe crabs also are the only currently known source of LAL (*limulus ameboecyte lysate*), a substance that is used in Food and Drug Administration mandated testing of biomedical products and vaccines to check for the presence of endotoxins. In 2000, LAL generated annual social welfare benefits estimated at over $150 million (at 1999 prices; Manion *et al*., 2000), as well as economic multiplier impacts.

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[19] See U.S. Fish and Wildlife Service and U.S. Census Bureau (2003a, 2003b).
[20] See Manion *et al.* (2000) for CS estimates associated with shorebird watching in one location in the Delaware Bay, and for estimates of the value of the biomedical uses of horseshoe crabs. See U.S. Fish and Wildlife Service (2003a) for estimates of the CS associated with bass fishing.

Horseshoe crabs also are harvested commercially, and constitute an important input to the East Coast whelk and eel fisheries (ibid.). Finally, horseshoe crabs provide ecosystem services: their eggs constitute a seasonal food source for summer and winter flounder, and all crab species; they are the main food source for sea turtles, and occupy an important role in the food web of Atlantic coast maritime ecosystems.[21] Clearly, an analysis that attempts to assess the economic value of the horseshoe crab would need to consider all of the above uses.

Revealed preference approaches

Revealed preference approaches such as the travel cost method, hedonic pricing, or preventive expenditures, are based on the premise that individuals' WTP for a good or service is reflected in their actions. Non-market goods such as environmental quality or scenic views are not traded directly in markets. Nevertheless, for any given non-market environmental good such as these two there may be market goods that serve as (partial) surrogates for the environmental good, that is, goods whose enjoyment depends on, or is enhanced by, the environmental good in question. Likewise, some market goods may serve as complements for a particular environmental good not traded in markets. Revealed preference approaches attempt to impute the value an individual assigns to a good not traded in markets by observing her resource allocation decisions with respect to activities related to that good that are reflected in markets.

For example, recreation in a National Park is not a good that is bought and sold as such in the market. Nevertheless, if an individual on a visit to a National Park spends a total of $100 on gasoline, lodging, entrance fees, time, etc., it seems reasonable to assume that the benefit she receives from visiting the park is ***at least*** equivalent to $100. This approach, known as the travel cost method, emerged in the 1950s as the earliest form of revealed preference approach (Hanemann, 2005). The traditional type travel cost analysis attempts to estimate the value people place on a particular environmental good by examining their expenditures on that good, commonly one particular recreation site. By contrast, hedonic travel cost analysis, a variant of the traditional travel cost analysis, compares people's expenditures on sites with differing levels of environmental features in order to estimate the value people place on particular site characteristics such as scenic views, clean air, etc. (e.g., see Englin and Mendelsohn, 1991).

The travel cost method is used by the National Park Service, the Forest Service, or the Fish and Wildlife Service to assess the total direct expenditures by recreationists on the use of National Parks, Forests, Wildlife Refuges, or all lands in a state or nationally (American Sportfishing Association, 2002, 2006; Caudill and Henderson, 2005; Stynes and Sun, 2003; U.S. Fish and Wildlife Service and U.S. Census Bureau, 2002).

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[21] See Ecological Research and Development Group (ERDG), ***http://www.horseshoecrab.org/nh/eco.html***.

Hedonic analysis attempts to quantify the value people assign to environmental amenities by studying their WTP for goods characterized by different levels of environmental attributes. A large share of hedonic analyses has focused on the impact of environmental amenities, such as clean water or air, proximity to protected natural areas, or scenic views on property prices. The fact that amenities such as scenic views or proximity to protected areas have economic value for residents is well documented in the economic literature. Natural amenities such as open space and scenic vistas constitute attributes of a property, just as lot size, number of rooms, or house age. All such attributes get factored into the market value of the home or property. Based on the work of Rosen (1974), economics has developed an approach for estimating the value consumers assign to particular attributes of a good. The hedonic method uses people's observed purchasing behavior for a good (say, a house) to infer the value they assign to particular attributes of the good (say, scenic views and open space). Simply put, hedonic analysis is premised on the idea that people should have the same WTP for two goods that are identical with respect to the attributes important to consumers. If two goods differ from each other only in one attribute, such as the size of open space surrounding them, but are otherwise identical, and if their prices differ, then, so the argument goes, the price difference must be caused by the difference in that one attribute. By comparing the prices of houses transacted in a particular geographical area and accounting for differences in all attributes that are expected to influence house prices, one can estimate the value of the natural amenity attribute, for example, an additional acre of open space within a 500 foot radius of a house or property.[22]

A large number of studies have documented the positive impact of open space specifically on property values.[23] In the most comprehensive recent review of this literature, McConnell and Walls (2005) examined more than 60 published articles that analyzed the economic impact of open space on house prices. The size of open space premiums in house prices reported in the literature varies substantially. This is due to a variety of factors. As Irwin (2002) points out, results of hedonic studies of property price impacts of open space are divergent because of the different kinds of open space

[22] Hedonic house price models, however, do not capture the full value of the benefits of open space (Irwin, 2002; McConnell and Walls, 2005). Especially open space benefits with public goods character (such as some non-rival and non-exclusive ecosystem services, and recreational use by others than adjacent residents) are not fully captured by house prices. Those benefits should be assessed separately, as benefits to recreationists and benefits associated with ecosystem services.

[23] Evidence of people's appreciation of these amenities also is provided by the success of open space ballot measures. For example, in 1998, voters in 26 states approved 124 open space ballot measures (84 percent of all such measures put to the voters), with many of the approved referenda authorizing tax increases as the financing mechanism. The 124 approved open space measures raised $5.3 billion in funding, not counting ballot measures for which no funding totals were specified in the referenda (Land Trust Alliance, 1999). More recently, on November 8, 2005 voters in 17 states approved total new spending of more than $650 million for land conservation, bringing the 2005 total for new state and local conservation spending authorization to $1.7 billion (Trust for Public Land, 2005).

considered, differences in the specification of the open space variable, and differences in preferences and relative scarcity of open space in different regions. The effects of proximity to natural open space also differ with the use of the open space. Positive impacts on property values are generally the greatest when the natural open space has some recreational access, limited use, few or no developed facilities, limited vehicular access, and effective maintenance and security (U.S. National Park Service, 1995).

Table 3 shows the main findings of studies that examined the property value impact of permanently protected open space.

Table 3: Impact of protected open space on house prices: selected literature findings

	Location	*Type of open space*	*Average increase in house price*
Espey and Owusu-Edusei (2001)	Greenville, SC	Medium-size attractive urban park	6% in house prices between 200 and 1500 ft of park
Frech and Lafferty (1984)	CA coast	Protected coastal land	7.6%-13.4% <.5 mile from coast; 2.6%-4.5% >.5 mile from coast
Irwin (2002)	Central MD	Permanently protected open space	1.87% for each acre of developable pasture land converted to permanently protected open space
Irwin (2002)	Central MD	Public open space	0.57% for each acre of developable pasture land converted to public open space
Lutzenhiser and Netusil (2001)	Portland, OR	Natural area urban park*	16.1% within 1500 ft. of park
Phillips (2000)	Green Mountains,VT	Wilderness area	13% of parcel price
Pincetl *et al.* (2003)	L.A.	Green spaces	1.5% for each 10% increase in green space within 500 ft
Ready and Abdalla (2003)	Berks Co., PA	Open space - public	0.3% for each additional acre within 400 m of house
Ready and Abdalla (2003)	Berks Co., PA	Open space - public	0.02% for each additional acre within 400-1600 m of house
Thorsnes (2002)	Grand Rapids, MI	Forest preserve	2.9% - 6.8% for properties bordering the preserve; (19% - 35% of lot price)

Notes: * Lutzenhiser and Netusil (2001) define a "natural area park" as a park with > 50% preserved in native or natural vegetation, with park use balanced between preservation (including exclusion of human use from certain areas) and natural resource-based recreation.

Espey and Owusu-Edusei (2001) found that in Greenville, South Carolina, medium sized attractive parks raise property values by on average six percent for properties between 200 and 1500 feet of the park. Frech and Lafferty (1984) estimated that actions taken by the California Coastal Commission to preserve open spaces increased average home values in their study area by as much as 13.4 percent for properties located within half a mile of the protected area, and by at least 2.6 percent for properties located more than half a mile from the protected area.

Irwin (2002) showed that house prices increase with the proportion of surrounding lands under easements or in public, non-military open space. These results indicate that permamently protected open space has a premium attached to it over developable agricultural and forested lands. Irwin hypothesizes that this is attributable to the fact that open space is primarily valued for its absence of development rather than for a particular bundle of amenities it provides. This hypothesis seems to be confirmed by Earnhart (2006) who found permanence of protection to be an important criterion in the value derived from open space. Geoghegan (2002) found that both developable and protected (under easements) open space increases house values, but that the latter inreases house values by more. Geoghegan *et al.* (2003) study four adjacent counties in central Maryland. Their results indicate that the value of open space is highly location specific. Also, it appears that open space value increases with development pressure, although their results in this respect are not conclusive (McConnell and Walls, 2005). Ready and Abdalla (2003) found that open space has the largest amenity value of all land uses examined by the authors within 400 meters of properties; within 400 to 1600 meters, only government-owned (local, state, federal) open space still has significant, if smaller, amenity value.[24] In his analysis of forested lands in Grand Rapids, Michigan, Thorsnes (2002) found that protected forest lands increase propery values, while merely vacant, unprotected ones do not. This result confirms the findings by both Irwin (2002) and Geoghegan (2002).

Lutzenhiser and Netusil (2001), in their analysis of open space in Portland, Oregon, found that natural area parks have the largest statistically significant effect on house prices for properties within 1500 feet of open space, increasing average house values by 16 percent. The authors define natural area parks as parks with more than 50 percent of their area preserved in native or natural vegetation, and with park use balanced between preservation (including exclusion of human use from certain areas) and natural resource-based recreation. Natural area parks also have the largest "reach" of all open space types examined by the authors: at 1200 to 1500 feet from the park, house prices are still 15 percent higher. Their results also show that, in general, house prices increase with the size of natural areas. Anderson and West (2003) also found that house values in proximity to parks increase with the size of the park. Lutzenhiser and Netusil's (2001) and Anderson and West's (2003) results suggest that parks do not just benefit houses in their immediate vicinity.

[24] See also Ready and Abdalla (2005).

Irwin's (2002), Lutzenhiser and Netusil's (2001), and Anderson and West's (2003) findings of a positive relationship between the size of house price impacts and the size of protected open space suggest that properties located in proximity to National Parks would receive even larger benefits than those found in the literature, which all were for substantially smaller open spaces.

Phillips (2000) examined the impact of wilderness areas on parcel prices in towns located in the Green Mountain Wilderness of Vermont. He found that, all other things being equal, the average parcel price in towns containing wilderness was 13 percent higher than in towns not containing wilderness. Phillips' results also showed that the price of parcels decreases by 0.8 percent per acre with each kilometer farther away from the nearest wilderness area.

A comparison of revealed environmental amenity value of homeowners based om hedonic analysis shows that the latter closely matches the stated value estimate of the property value of environmental amenities: For example, a survey conducted for the National Association of Realtors (2001) revealed that 50 percent of the respondents would be willing to pay 10 percent more for a house located near a park or protected open space. Nearly 60 percent stated that if they were in the market for a new home, they would be likely to select one neighborhood over another if it was close to parks and open space.

Revealed preference approaches can be applied in the estimation of direct use and some indirect use values. For example, the water filtration function of wetlands or forests provides clean water as a service to humans. The value of this service can be quantified on the basis of its replacement cost, or on the basis of averting behavior. If the forest or wetland were lost or its water filtration ability compromised, the clean water provided by the natural system could also be produced by a water treatment plant; alternatively, consumers of that water could switch to buying bottled water instead (e.g., Chichilnisky and Heal, 1998). It is important to note that the appropriate measure of the value of a good or service provided by a natural system is the cost of the least expensive alternative.

In addition to the economic valuation of protected open space, scenic views, and clean air and water (e.g., Boyle *et al*., 1999), revealed preference methods also have been used widely in valuing consumptive recreation (e.g., Englin *et al*., 1997).

Although revealed preference approaches are widely used in the valuation of environmental non-market goods, it is important to be aware of their limitations. Perhaps the most important one of these is that for a given environmental non-market good of interest there may not exist a complementary or surrogate market-good, or the market good(s) may not capture all of people's preferences for the environmental good.[25] In

[25] As discussed above, the consumer surplus is unknown if only a single price point is available.

addition, passive use values of non-users of environmental resources would not be captured by revealed preference approaches.

Multiplier impacts of environmental resource use

All direct and indirect uses of ecosystems create market impacts. These impacts can be distinguished into direct effects and indirect and induced effects. The direct effects, such as product sales, earnings, tax revenues, and employment, are the result of the direct spending associated with the resource use. The direct spending in turn creates multiplier impacts in the rest of the economy (indirect and induced effects) in the form of additional product sales, earnings, tax revenues, and employment. As a result, all activities involving expenditures have economic impacts that are larger than the initial market transaction.

For example, recreationists' trip expenditures on food, lodging, etc. to visit wildlife habitat, together with their equipment expenditures, represent the direct market impacts of recreation. These impacts lead to an increase in output and employment in the sectors of the economy that provide these goods to recreationists. The firms in these sectors in turn purchase inputs from other sectors (such as machinery, manufacturing, utility and financial services, etc.), both for their operation and to acquire the merchandise they sell to recreationists, who in turn draw in inputs from other sectors, and so on. These input purchases constitute the indirect effects of spending by recreationists. Both direct and indirect impacts also lead to income payments by firms to households, which in turn fuel spending by households that leads to further sales, earnings, employment, and tax payments in the economy. The latter impacts are referred to as induced effects. The aggregate economic impact on all sectors that is the result of spending by recreationists is the sum of the direct, indirect, and induced effects (U.S. Department of Commerce, 1997).

Estimates of the total market impacts of a given change in output are commonly developed with input-output models, such as the Minnesota IMPLAN Group's Impact Analysis and Planning Model, the Bureau of Economic Analysis' RIMS II (Regional Input-Output Modeling System; see U.S. Department of Commerce, 1997), or the National Park Service's Money Generation Model (MGM2).

Estimating the total market impact associated with the use of a given habitat or other resource requires information on the magnitude of the indirect and induced effects associated with the initial expenditure on that resource use. For example, consider recreationists' average expenditures during visits to Joshua Tree National Park (Table 4). According to data based on a survey of Park users by the University of Idaho's Park Studies Unit (Le *et al.*, 2004), visitor spending in and around the Park in 2003 totaled some $47.5 million. Of this, some 25 percent, or $11.9 million, were spent on lodging. Now, let us assume that what is of interest is the impact of this spending on the regional economy. Since lodging services are provided locally, all of this spending is captured locally, generating a direct effect in the regional economy of $11.9 million. According to the Bureau of Economic Analysis's (BEA) Regional Input-Output Modeling System (RIMS II) 2003 multipliers for the BEA's Bakersfield-Riverside-San Bernardino Region,[26] the total regional output multiplier that results from a $1 change in final output in the accommodation sector is 1.7483. In other words, the $11.9 million spent by Joshua Tree National Park visitors on lodging in 2003 resulted in a total (direct, indirect and induced) output in the four-county region of $20.8 million. In the same way, earnings and employment multipliers can be used to estimate total earnings and employment impacts, respectively, of Joshua Tree National Park visitor's lodging expenditures.

Table 4: Estimated total local expenditures by visitors of Joshua Tree National Park, and breakdown by spending category, 2003

	Joshua Tree National Park	
Recreation visits	1,283,346	
Re-entry factor	2.08	
Visitors	616,993	
Avg. per-capita expenditures in and around Park/Preserve (*2003$*)	$ 77	
Total expenditures in and around Park/Preserve (*million 2003$*)	$ 47.5	
Per-capita expenditure breakdown:	*%*	*$*
Hotels, motels, cabins, B&B	25	19.48
Camping fees and charges	6	4.62
Guide fees and charges	1	0.77
Restaurants and bars	17	13.32
Groceries and take-out food	14	10.78
Gas and oil	13	10.01
Other transportation expenses	7	5.39
Admissions, recreation, entertainment fees	4	3.08
All other purchases (film, gifts, etc.)	11	8.47
Donations	<1	0.77

Notes: The re-entry factor indicates the number of times the average visitor enters the Park or Preserve during the visit. Expenditures "in and around" a Park or Preserve are defined as those that occur within 50 miles of the Park or Preserve.
Source: Le *et al.*, 2004.

The size of the multiplier effect varies with the sector experiencing the increase in output and the capture rate of the regional economy (U.S. Department of Commerce, 1997; Stynes, 1999). The capture rate is the share of all sales that is produced within the region, as opposed to being imported from outside the region. The capture rate, and hence the multiplier effect, is positively related to the size and the structural diversity of the regional economy (Hughes, 2003).

[26] This region comprises Inyo, Kern, Riverside, and San Bernardino Counties.

Total impact estimates have been developed for many recreation activities, including hunting and fishing (even for individual species), wildlife watching, camping, hiking, or off-highway vehicle use, at the state, national, and local levels (see for example American Sportfishing Association, 2002, 2006; Caudill and Henderson, 2005; Stynes and Sun, 2003; U.S. Fish and Wildlife Service, 2003b). Such estimates can also be developed for discrete areas identified in the State Wildlife Action Plans. For example, the Bureau of Economic Analysis's RIMS II multipliers are available for any county or contiguous multi-county area for currently $275 per dataset. This allows impact estimation at the county level, provided information on visitation level and on per-capita expenditures and their composition is available or can be generated.

Stated preference approaches

In contrast to revealed preference approaches, which attempt to infer people's WTP for a resource by observing their behavior, stated preference approaches (contingent valuation, conjoint analysis, individual choice) directly ask individuals to state their WTP for a specific good or service.

As indicated in Figure 4, stated preference approaches can be applied to all value categories.[27] However, it is generally recognized that only stated preference methods are applicable to the quantification of passive use values (Carson *et al*., 2003). Among stated preference methods, contingent valuation often is the approach of choice (Arrow *et al.*, 1996; Krupnick and Portney, 1991), although conjoint analysis is becoming increasingly popular.

In contingent valuation surveys, individuals first are presented with a hypothetical situation, for example a predicted qualitative or quantitative change in a natural resource. They are then asked to assign a monetary value to achieving that change or to preventing it from occurring.[28] In conjoint analysis, researchers ask respondents to state their WTP for goods or bundles of goods with varying attributes. Based on their choices, the relative benefits respondents receive from the various attributes can be estimated (see for example Zinkhan *et al.*, 1994).

Designing the survey instrument in such a way as to obtain unbiased and consistent value estimates often is a significant challenge (see Diamond and Hausman, 1994; Stevens *et al.* [1991, 1993] for a discussion of the problems faced by survey researchers). However, if the survey format follows best-practice design principles (see Arrow *et al.*, 1993), valid value estimates can be generated, with respondents' replies representing reasonably accurate expressions of their willingness-to-pay (WTP) for the resource in question.

[27] However, they may yield poor estimates of the value of many ecosystem services (Vatn and Bromley, 1995).
[28] See Mitchell and Carson (1989) for a comprehensive discussion of contingent valuation.

There now exists considerable evidence in the benefits estimation literature that contingent valuation-based WTP estimates based on best practice survey procedures are generally in line with estimates based on revealed preference approaches (Hanemann, 1994). Nevertheless, high quality surveys that yield valid value estimates are very demanding in their design and implementation (for examples see Carson *et al.*, 2003; Banzhaf *et al.*, 2004).

Stated preference approaches have been applied to direct (including option), indirect, and passive use of natural resources, and to the valuation of the full range of environmental resources: air and water quality (e.g., Carson and Mitchell, 1993; Halstead *et al.*, 2004; Krupnick and Portney, 1991); the protection of individual or groups of rare or endangered species (e.g., Chambers and Whitehead, 2003; Loomis, 2000; Lash and Black, 2005), of ecosystems and whole landscapes (e.g., Johns *et al.*, 2001; Barrick and Beazley, 1990; Milton *et al.*, 1999; Richer, 1995; Banzhaf *et al.*, 2004; Power, 1991; Milon *et al.*, 1999); recreation (e.g., McCollum et al., 1990; Loomis, 2005; U.S. Fish and Wildlife Service, 2003a); and open space and scenic view amenities (e.g., Breffle *et al.*, 1998; Mathews *et al.*, 2003).

Milon *et al.* (1999) used conjoint analysis to estimate the value to Florida households for several alternative degrees of restoration of the Everglades ecosystem. They used both hydrological and wildlife species attributes to represent alternative states of the Everglades along with possible effects on municipal water supplies, farmland, and household taxes. Their results showed that respondents had a strong preference for restoration of the Everglades, tempered however by concern about the consequences of restoration on municipal water users and farmland acreage. The study suggests that the average South and Central Florida household had a willingness to pay for full restoration of the system of $60 to $70 per year over a ten-year period.

Chambers and Whitehead (2003) used contingent valuation to estimate the willingness to pay of residents in Ely and St. Cloud, Minnesota, for the introduction of a Wolf Management Plan that would maintain a minimum wolf population in Minnesota of 1600 animals. To achieve this goal, activities under the plan would include the monitoring of the population and the health of wolves, and the preservation of their habitat and that of their prey. Respondents were informed that as a result of the passing of the plan, a stable wolf population of 1600 animals would be sustained and wolves would not be returned to the threatened and endangered species list in the near future. The elicitation context presented to respondents was that the expected delisting of wolves would result in the funding for protection of wolf population levels falling to the state. Respondents were asked if they were willing to pay a one-time tax increase to fund the plan, and could choose among the answer categories “yes,” “no,” and “don’t know.” The survey employed a dichotomous choice format, with payments varying across surveys, from $5 to $25, $50, $75 and $100. The authors selected two respondent samples. The local residents sample was drawn from Ely, located in the center of wolf habitat. The nonlocal sample was taken from St. Cloud, situated outside of FWS-designated primary wolf habitat. Mean annual per capita WTP for the wolf management plan was $21.49 (2001$) in St. Cloud, significantly higher than the mean WTP in Ely of $4.77. In both cities, opponents of the plan outnumbered supporters. In St. Cloud, 33 percent of respondents stated that they would be willing to pay the requested amount to support the tax-funded management plan, and 44 percent said that they would not; the remainder (23 percent) stated that they did not know. In Ely, 67 percent of respondents stated that they would not be willing to pay the requested increase in taxes to support the plan, while 23 percent stated that they would, and 10 percent said that they didn't know. The authors also tested residents' WTP for an alternative plan, the Wolf Damage Program, which would compensate farmers and pet owners for animals lost to wolves. The tax increase presented to each respondent was either $1, $10, $15, $25, $35, $50, or $75, again with the response choices of "yes," "no," and "don't know." WTP for this plan was very similar to that for the Wolf Management Plan, with mean WTP of $20.16 in St. Cloud, and $4.43 in Ely.

Ecosystem service values

In many instances willingness to pay approaches (either stated or revealed) may be poorly suited to the quantification of ecosystem service values (Cropper, 2000). The main reasons for this are people's limited knowledge about and awareness of many ecosystem services, and their unfamiliarity with assigning economic values to these services. These problems together may make stated preference approaches particularly poorly suited to the identification of the economic value of many ecosystem services.[29]

Ecosystem service values, therefore, may in many cases better be estimated through other approaches (De Groot ***et al.***, 2002; Barbier, 2000; Pagiola ***et al.***, 2004). The most commonly used of these are the production function and replacement cost approaches. For example the value of the drinking water provision services provided to New York City by the Catskills watershed was estimated using a replacement cost approach, by costing out the construction and operation of a water filtration plant that could provide the same service (Chichilnisky and Heal, 1998).[30] In the production function approach, the biological resource or ecosystem service are treated as an input into a particular economic activity, and the value of this input then is equated with the impact of the resource or service on the productivity of the marketed output. An example of a

[29] By far more complex still are the problems underlying the economic valuation of ecosystem functions. Excellent discussions of the conceptual problems involved in applying economic valuation in general, and the use of contingent valuation in particular, to ecosystem functions and services can be found in Vatn and Bromley (1995) and Gowdy (1997).
[30] To replace the drinking water supplied by the Catskills watershed, New York City would have needed to make capital investments of between $6 **-** $8 billion for a water purification plant, and in addition it would incur annual operating costs for the plant of around $300 million (Chichilnisky and Heal, 1998).

production function approach is Barbier's (2000) analysis of the value of mangroves for fisheries. Mangroves support off-shore fisheries by serving both as a spawning ground and a nursery for fish. The size of an area of coastal mangroves may therefore have a direct influence on the catch of mangrove-dependent species. In southern Thailand, the value to fisheries of an average hectare of mangroves was an estimated $33-$110 per year (in 1997 dollars), depending on management regime and demand elasticity (Sathirathai, 1997). In Mexico's Gulf coast state of Campeche, the value of an average hectare of mangroves for shrimp production during 1980-1990 was an estimated $1400 per year (Barbier, 2000).

Like direct use values, indirect use values in many instances may be captured in market transactions, because they become embodied in the prices of goods and services produced in the human economy.[31] However, the estimation of these values is often difficult, because it requires quantitative information on the size of the particular service flows that enter the human economy. Generally, the size of the economic value of the services generated by an ecosystem depends on the type of ecosystem (for example, coastal wetland, freshwater wetland, shrubland, forest, etc.), as different ecosystems provide a different mix of services. The economic value of ecosystem services also generally is site-specific, depending, among other factors, on the proximity of the particular ecosystem to locations of human activity, the size of the affected economy (*i.e.*, the number and wealth of individuals and the size and composition of output), and the relative scarcity of particular ecosystem services (Salzman and Ruhl, 2000; Wainger *et al.*, 2001). For example, the economic value of the hydrological services provided by the Catskills watershed is so immense only because these services deliver the public drinking water supply for essentially all of New York City. If instead only 10,000 people benefited from these services (as opposed to around 10 million), then the value of these services obviously would be substantially smaller. For all of these reasons, the range of values reported for specific ecosystem services is very large (see for example Costanza *et al.*, 1997).

Due to the fact that the area of ecosystem services valuation is relatively new, the number of valuation studies that have been conducted is small compared to that available for direct and passive use values. Nevertheless, the area has been identified as a top research priority by the National Research Council (2005).

The difficulty of quantifying economic value varies highly among different ecosystem services. Among the best-studied services are many of those related to water, which have been quantified using travel cost, hedonic, and contingent approaches (see for example Brouwer *et al.*, 1997; Hanemann, 2005; U.S. Forest Service, 2000; and Wilson and

[31] The same caveat pointed out in the discussion of direct use values also applies to indirect use values: both only get captured in market values to the extent that the prices of the respective goods and services are equal to the WTP of consumers. In most instances, this may not be the case, and using market prices will lead to underestimation of economic value by ignoring the consumer surplus.

Carpenter, 1999). On the other end of the spectrum, the economic value of the services provided by biodiversity has eluded attempts at comprehensive quantification. Some known direct use benefits biodiversity provides to humans - such as the biological resources used as raw materials (e.g., Peters *et al.*, 1989; Gavin, 2004) and for wildlife-based extractive and non-extractive recreation (e.g., Geist, 1994), including the value of future drugs based on animal or plant species (e.g., Mendelsohn and Balick, 1995), and the value of the reduced risk of major agricultural losses from insects or pathogens developing resistance to pesticides[32] - and the quantifiable passive use value biodiversity provides to people who value particular ecosystems or species (Gowdy, 1997; Millennium Ecosystem Assessment, 2003; United Nations Environment Programme, 2005) have been quantified. However, the total value of the ecosystem services provided by biodiversity is largely unknown, and is perhaps unknowable, due to the limitations of scientific knowledge, the presence of fundamental uncertainties and irreversibilities, and the inability of valuation methodologies to overcome these challenges (Vatn and Bromley, 1995; Gowdy, 1997). The presence of large uncertainties and of irreversibilities of changes in ecological systems has led many economists to call for the use of the Safe Minimum Standard (SMS) in biological diversity policymaking instead of the use of cost-benefit-based analyses (see for example Bishop [1978, 1993], Bulte and Van Kooten [2000], Ciriacy-Wantrup [1952], and Pagiola *et al.* [2004]).

Benefits transfer

Ideally, individuals' willingness to pay for a given good (*e.g.*, a particular recreation activity, a scenic view, preservation of a particular species, habitat, or ecosystem) is estimated on the basis of primary research at the location for which the benefit information is desired (the "policy site"). In many cases, however, such site-specific studies do not exist, and due to time or resource constraints it may not be feasible to carry them out for a given project. In cases where no primary data are available, the only option to derive value estimates is to employ the second-best approach to estimating willingness to pay, namely, benefits transfer.

Benefits transfer is commonly defined as the adaptation of value estimates generated at a study site to another site (the "policy site") for which such estimates are desired but no primary data for their generation are available (Rosenberger and Loomis, 2001). Benefit transfer generates valid benefit estimates for the policy site if specific conditions are met: First, the policy context must be precisely defined, including the type and magnitude of the expected policy impacts, the characteristics of the population affected, the type of

[32] Agricultural pest control and the development by the pests of resistance to those controls has been a continuous process since the development of large-scale agriculture. Major components of the world's food base such as commercially dominant varieties of rice and corn at various times have benefited heavily from the incorporation of particular disease resistance genes found in their wild varieties. The value of cultivar improvements stemming from crop genetic resources is estimated in the billions of dollars per year worldwide (e.g., see Rubenstein *et al.*, 2005).

value measure (average or marginal value) used, the category of value measured (direct use, indirect use, non-use, total economic value), and the degree of certainty surrounding the transferred data. Second, the data available for the study site must be of sufficiently high quality (sample size, sound economic method, sound empirical technique, and sufficient number of similar study sites to allow credible statistical inferences) and the background information is sufficient (population characteristics). Third, the study and policy site must possess similar characteristics (similar resource, type and degree of change in resource, and source of change; similar demographic characteristics, especially income and cultural background; and, if recreation activities are valued, a similar condition and quality of the recreational experience at both sites) (Rosenberger and Loomis, 2001; Brower, 2000).

Approaches to benefits transfer

Benefits transfer can take the form of a value transfer or of a function transfer. A value transfer is the application of a single-point or average-value estimate from a study site to the policy site. For example, in an average value transfer, the average willingness to pay of hikers at site A is used to estimate the average willingness to pay of hikers at site B. In a benefit function transfer, a model is used that statistically relates benefit measures to the independent study variables, that is, the study characteristics (demographic and resource characteristics). Benefit function transfers either are based on demand or benefit functions estimated for a study site, or on meta-analysis. Meta-analysis is a regression analysis of the findings of all relevant and suitable empirical studies that systematically explores study characteristics as possible explanations for the variation of results observed across primary studies (Brouwer, 2000; U.S. Environmental Protection Agency, 2000). The coefficients of the variables indicate the change in willingness to pay produced by a marginal change in the variable. In both function transfer approaches (demand and meta-analysis), the values of key variables from the policy case are inserted into the benefit function in order to develop policy-site-specific value estimates.

Meta-analysis based benefits transfers have been used widely to value outdoor recreation activities, endangered species, and water quality. For example, Loomis and White (1996) used a meta-analysis to develop a willingness to pay function for protecting threatened and endangered species. The function contains all variables that have been employed in the willingness to pay studies for threatened and endangered species surveyed by the authors, such as type of species, size of proposed population change, whether the respondent lives in the area where the species occurs or not, and the type of payment mechanism suggested for increasing the species' population. Kroeger *et al*. (2005) and Kroeger and Casey (2006) applied Loomis and White's meta-equation to estimate the willingness to pay of households for Mexican wolf reintroduction to the southwestern U.S. and for increases in lynx populations in Maine and Montana, and Loomis (2006) used it to estimate the value of an increase in the southern California sea otter population. Rosenberger and Loomis (2001) and Loomis (2005) used meta-analyses to derive estimates of the value of a wide variety of recreation activities for different regions in the U.S. Smith *et al*. (2002) used meta-analysis to compute a function that can be used to estimate the total value of water quality improvements to households for different recreation and non-recreation uses, while Woodward and Wui (2001) used meta-analysis to derive a function for estimating the value of several wetland ecosystem services.

Although benefit transfer appears to become the approach of choice in cases where primary valuation studies are infeasible, it is not without its problems. There rarely are policy sites whose most important WTP-relevant characteristics exactly match study sites for which original data have been generated. Furthermore, studies do not always measure all aspects of the perceived resource quality of the environmental amenities of a study site for which WTP is elicited and thereby prevent the incorporation of all relevant resource quality aspects into meta-analysis functions. For these reasons, benefit transfer may provide a useful tool for estimating the order of magnitude of values, but it potentially can introduce large errors into benefit estimates (see for example Kirchhoff *et al.*, 1997). This criticism however is not a sufficient reason for rejecting the use of the benefit transfer approach, because, as Smith *et al.* (2002) point out, in most real-life situations the alternative to benefit transfer is not a site-specific study, but qualitative judgment. Smith *et al.* (2002) develop a technique that addresses the main criticism advanced again many transfers, namely, the failure to impose budget constraints.

Selecting the correct benefit measure

Estimation of the economic benefits derived from a particular use of a natural resource usually serves at least one of two purposes: to understand better the contribution to societal welfare of that particular resource use; or to compare this welfare contribution with that which could be derived from alternative (and generally conflicting) uses. For either purpose, it is important that correct benefit measures be employed.

Total (gross) vs. net benefit

The value of any use of a resource, direct, indirect, or passive, can be expressed either as gross or as net benefit. Total economic value (TEV) as measured by WTP constitutes the *gross* value an individual assigns to a particular resource (or a particular use of that resource). Most direct and indirect uses of a resource require some input on the part of the individual. These could be expenditures on trip or equipment, or time spent on that resource use. All these inputs represent opportunity costs, that is, they could have been spent on some alternative endeavor from which the individual derives benefits.

In order to measure the net benefit or welfare the individual derives from the resource use in question, one needs to subtract the opportunity costs associated with that resource use from the gross benefits derived from the use. For example, in Figure 3, users of the park derive a total gross benefit (TEV) equivalent to the sum of the areas PC, PS, and CS. However, they expend resources valued at p*Q* on using the park. Their net benefit, or consumer surplus (CS) is the benefit they receive above and beyond their opportunity costs. Likewise, the suppliers (producers) of the resource use receive total benefits equal to their revenue, p*Q*. When deriving net benefits to producers, production costs (PC) must be subtracted from revenue. Hence, net benefits to society from park use are the sum of net benefits to consumers (CS) and net benefits to producers (PS). In this example, as in most real-world cases, total net benefits (CS+PS) are substantially smaller than total gross benefits (TEV). Hence, when reporting the results of a valuation, it is important to be clear what value measure is being used – total benefits (or value) vs. net benefits (or value).[33]

The net value of the regional economic impacts associated with a resource use (e.g., tourism) is difficult to estimate. To derive it, information is needed on the profits of affected companies and the net income of the individuals from the jobs supported by the resource use. Often, neither information is readily available. However, multiplier effect-related earnings can serve as a reasonable approximation of net benefits.[34] Earnings multipliers for individual and contiguous multi-county areas in all of the U.S. are available from the Bureau of Economic Analysis.

Total value vs. marginal value

Of equal importance as the distinction between total and net value is that between total and *marginal* value. As already discussed, the total value of a resource is equal to the benefits received from a given use by all individuals engaging in that use. By contrast, the marginal value expresses the *change* in total value that results from an incremental change in resource quantity or quality or an incremental change in the number of users of a resource. Returning to Figure 3, the marginal value of the park is the value received by the "last" user visiting the park, that is, the one receiving the smallest benefits. This value is of interest for example when considering the loss in welfare associated with a restriction of park access to levels below Q* - summing over the marginal values of the excluded users gives the change in total benefits that results from the access restriction.

Alternatively, improvements in a resource, such as an increase in the population of a species valued for direct or passive use, or an improvement in water quality in a given river segment or lake, represent *changes* in the total value received by users of that resource. This is of interest, for example, when evaluating the change in value received by anglers, swimmers, boaters, etc. from a given change in river or lake water quality. Some studies measure the total value of a resource to individuals, while others measure

[33] Most recreation value studies measure net benefits (e.g., see Loomis [2005] and U.S. Fish and Wildlife Service [2003a]).

[34] Earnings comprise wages and salaries, proprietors' income, directors' fees, and employer contributions for health insurance less personal contributions for social insurance (U.S. Department of Commerce, 1997).

marginal value. Obviously, the total value of a resource is larger than its marginal value. Hence, it is crucial to be clear about what value measure is used when assessing the value of a resource or the values of competing resource uses.

Consider for example the U.S. Wilderness system. With approximately 16 million visitor days, the wilderness system in the year 2000 generated an estimated ***total*** net recreation value (consumer surplus) of $634 million annually (Loomis and Richardson, 2001). Research shows that creation of additional wilderness areas in the lower U.S. increases the number of total visitation days, that is, it attracts new visitors to the system (Loomis, 1999). The designation of an additional 10,000-acre roadless area as wilderness would constitute a marginal increase (around 0.02 percent) in the size of the total system in the lower 48 states (around 45 million acres). In the western U.S, such an increase would yield about 3,875 additional visitor-days per year, providing around recreation value to visitors each year. In the eastern U.S., an additional 10,000 acres would generate approximately 11,000 visitor-days per year with an annual recreation value to visitors of $436,000 (Loomis and Richardson, 2001). These ***marginal*** values of the Wilderness system ($153,000 in the West, $436,000 in the East, for an additional 10,000 acres) represent the value of a small change in the total quantity of the resource.

As in the case of a change in resource quantity, the distinction between total and marginal value also applies in the case of a change in resource quality. For example, an improvement in the recreation relevant attributes of a lake, say in the form of water quality improvements or increased populations of game fish, would yield an increase in the recreational value of the lake. This increase is likely to take the form of an increased recreation value for each user as well as an increase in the number of users due to the increased attractiveness of the lake to recreationists. The change in the lake's characteristics would lead to a marginal or incremental increase in the recreational value of the lake that may be relatively small or relatively large compared to the total recreational value of the lake. In all cases, however, it will be less than the total recreational value of the lake.

Spatial boundaries of valuation studies

A further crucial aspect of any valuation exercise is the choice of the geographic scope of the analysis. Selection of the spatial boundaries determines whose benefits are being included and whose are not. For example, the benefits generated by Yellowstone National Park could be estimated for the local area, say, the counties surrounding the park. Alternatively, one could estimate the park's benefits at the state level or at the national level. Each choice of boundary excludes a (decreasing) part of the total benefits generated by the park.[35] Evidently, therefore, the choice of spatial boundary impacts the size of the total value estimate.

[35] Even a benefit analysis at the national-level would ignore the benefits accruing to people outside the U.S.

3. Summary and Recommendations

In the preceding sections we have reviewed the different types of economic values that are generated by ecosystems and ecosystem components like species and their habitat. Though the relative importance of the various economic values provided by these natural resources may depend on the characteristics of a particular species or habitat, it is important to consider all of these values when analyzing the economic value of a given resource.

We also have provided a brief overview of the different economic approaches commonly used to quantify the value of natural resources, including their advantages and shortcomings when applied to the different types of values provided by those resources. The feasibility and suitability of applying a particular approach to a specific valuation problem depends on the available resources and the desired degree of accuracy and reliability of the results of the valuation exercise. In general, site-specific, original studies require a higher commitment of resources than do studies based on benefits transfers. In return, the values arrived at via the former tend to be more reliable. In many cases, however, benefits transfers, if conducted following best practice guidelines, will generate value estimates of the right order of magnitude. By using different plausible assumptions for key parameters, lower and upper bound value estimates can be established that give a good indication of the range of the likely economic benefits provided by a particular (change in a) resource.

The economic values and the methods for their quantification presented in this paper are relevant for the areas identified as priority conservation areas in the State Wildlife Action Plans. Indeed, valuation studies for species and habitats occurring in those areas in many cases may already exist. To guide wildlife planners and others in identifying such studies, in the following section we provide a list of bibliographic resources that deal with species and habitat valuation. This bibliography at a later point also will be available on the web (at ***http://www.biodiversitypartners.org/econ/reports.shtml***) and will be updated periodically. It is arranged into the categories *Ecosystem Type*, *Individual Species*, *Roadless and Open Space Areas*, *Recreation Activities*, and *Economic Methods and Theory of Valuation*. In addition, on pages 50 and 51 we provide links to several online databases and bibliographies on environmental valuation. Even in cases where context of a given study does not exactly match the context for which valuation is desired, the findings of the study may be adapted through the application of benefits transfer.

Frequently, valuation studies focus on a particular type of economic value, such as direct use values or passive use values, or, in the case of economic impact studies, on the value of market transactions associated with a particular species or habitat. As a result, most studies do not capture the total economic value of the environmental resources they analyze. The discussion of value types and valuation methods presented in this paper is intended to help the reader identify which types of value are captured in a particular study, and which ones are not. This is important in order to interpret correctly the comprehensiveness (or the shortcomings) of the value estimates.

In some cases, state or federal statutes may clearly define for what purpose particular biological or ecological resources are to be managed, thus determining what kind of benefits are to be included in a valuation study of those resources. In general, however, the decision as to the comprehensiveness of an analysis, that is, of the range of different types of economic values to be included, is a critical component of the study design and is likely to have a large impact on estimates of the total value of a resource. It is therefore important to determine at the outset clearly the purpose which the results of a particular valuation study are to serve.

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5. Bibliographic tables of species and habitat valuation studies

The purpose of the tables presented in this section is to serve as a resource for the economic valuation of wildlife and ecosystems. Such valuation may be useful for a variety of purposes, such as for gauging the economic impacts of implementing a particular natural resource management project or a program to conserve areas as wildlife habitat. Ecosystems and individual species provide a range of public and private economic benefits. This bibliography documents the environmental resources, including species and their habitat, for which valuation studies exist, and the type of benefits analyzed in the particular studies. Furthermore, it contains a number of publications that may be useful to individuals or organizations seeking to perform their own formal benefits analyses.

The following studies are published reports, articles, and books or book chapters. Each study is categorized into one of five major categories: *Ecosystem Type*; *Specific Species*; *Roadless and Open Space*; *Recreation*; and *Economic Methods and Theory of Valuation* (see Column 1 of Tables 5.1 through 5.5). Subsequent columns delineate: specific value type(s) estimated in an analysis; the valuation technique(s) used; what economic measure is valued; and other practical information pertaining to a study's execution. A thorough description of the value types and valuation techniques described here can be found in sections 1 and 2 of this report.

The studies are separated into five tables according to the study focus: *Ecosystem Type*; *Specific Species*; *Roadless and Open Space*; *Recreation*; and *Economic Methods and Theory of Valuation.* Several of these studies are multiple-topic and may be found under a combination of categories. A few studies provide a qualitative discussion on benefits valuation that is pertinent to the specific category it is under rather than report actual monetary values of benefits.

Within the category of *Ecosystem Type* (Table 5.1), the studies are further divided into sub-categories: Forests, Wetlands, Grasslands, Desert, and Corral Reefs and Mangroves. Most of the ecosystem-focused studies here value forests and wetlands, and some studies value specific locations, such as particular refuges or parks, which encompass more than one ecosystem type. There is an apparent lack of valuation research for grassland and desert ecosystems.

Within the category of *Specific Species* (Table 5.2), sub-categories comprise Invertebrates, Birds, Fish, Reptiles, and Mammals. The Mammals grouping includes the most studies within the Species category, and certain mammal studies value the protection of two or more species. A separate section for wolves is included, as a significant number of wolf valuation studies have been carried out for this species. Since animal species and the ecosystem in which their habitats are located are closely connected, many valuation studies, depending on how they are executed, focus equally on both. For example, valuation of the spotted owl may involve valuing the preservation of their old-growth forests.

Roadless and Open Space (Table 5.3) includes studies which value the premium that people put on land unaffected by human development, such as designated wilderness, and specific types of landscapes such as parks, farms, and countryside. In valuing open space and roadless areas, these studies may also focus on a specific ecosystem. The most common method of valuing amenities of roadless and open space is by using the hedonic-pricing model.

Recreation contains (Table 5.4) valuation studies and publications related to recreational uses of the environment. Most of these studies value non-consumptive uses of natural resources, such as wildlife viewing and nature-related sports. Some studies relate to the consumptive use of natural resources, such as fishing and hunting activities. The travel cost method and synthesis of actual expenditures are two common methods for deriving recreational benefits in the analyses here.

The studies under *Economic Methods and Theory of Valuation* (Table 5.5) are comprehensive discussions relating to the valuation of natural resource benefits but do not necessarily include a quantitative monetary valuation analysis. Included are surveys of techniques of resource and environmental valuation and cost-benefit analysis. Most studies include guidelines on the application of valuation methods and caution on the drawbacks of specific valuation procedures and suggest improvement on those specific methods. The analyses often involve a case study to clarify understanding, or the economic method discussed is commonly used in valuing a particular natural resource, thus, many of these studies are cross-categorized.

Tables 5.1 to 5.5 also include information on the types of values estimated in the studies, the valuation method used, and the type of economic measure used, as well as additional relevant information.

Benefits from natural resources are classified as direct use values, indirect use values, and non-use values (Columns 2, 3, and 4, respectively). A detailed discussion of these value types and how they are defined in this table is found in the first section of this report.

The various studies reviewed here use economic valuation techniques (Column 5) which are generally described as actual market pricing, revealed preference, and stated preference methods. Revealed preference methods include the hedonic-pricing model, the travel-cost method (TCM), and the use of replacement costs. Stated preference methods include the contingent valuation method (CVM), which is used in several of the studies listed here and takes place in several forms, and conjoint analysis. Revealed and stated preference methods are also used in combination. Some of the studies listed use benefits transfer (BT) for valuation, and other authors develop their own models, which are also described in the Valuation Method column.

Where the Valuation Method column is left blank, the source listed does not use a specific method to value a natural resource. Rather, it provides a general discussion pertaining to a specific context, category, or value type, or is an overview of several valuation techniques for the category under which it is listed. Many of the methodological papers are not associated with any one particular valuation method. Other methodological papers that investigate a particular valuation method do not necessarily focus on valuing a particular ecosystem or species.

Column 6 in each of the tables describes the specific benefit measure valued in the study, such as a particular group's willingness to pay (WTP) for protection of a specific natural resource. Consumer surplus (CS), willingness to accept (WTA), compensating variation, and compensating surplus are other monetary amounts measuring benefits in these studies. Other significant information regarding the methodology, the context of the study, observations from performing the study, or more detail on the type of value quantified is described here. Some studies analyze both benefits and costs attributed to a particular policy action regarding a natural resource, and a few focus primarily on economic costs. For the studies that do not perform a benefits analysis, this last column describes the content of the report that pertains to economic valuation of natural resources.

This table is not a complete reference source for studies reporting the economic benefits of natural resources. New studies and developments in valuation theory are continuously appearing. However, this table should provide the reader with a thorough review of existing studies. Additional references may be found on the following websites.

Environmental Valuation Reference Inventory (EVRI) maintained by Environment Canada is a regularly updated resource for valuation studies. This searchable database provides detailed descriptions of published valuation reports, as well as a straightforward tutorial for searching the database and a bibliography on benefits transfer. The database is accessible online at *http://www.evri.ca.*

While EVRI is considered to be the most thorough online database of environmental valuation studies available, other online searchable databases may provide studies which are not listed in EVRI.

ENVALUE
New South Wales Environmental Protection Authority
http://www.epa.nsw.gov.au/envalue

New Zealand Non-Market Valuation Database
Lincoln University, Canterbury, New Zealand
http://learn.lincoln.ac.nz/markval

Valuation Study Database for Environmental Change in Sweden (ValueBase SWE)
Beijer International Institute of Ecological Economics
Royal Swedish Academy of Sciences, Stockholm
http://www.beijer.kva.se/valuebase.htm

Review of Externality Data (RED)
Institute of Studies for the Integration of Systems, Rome, Italy
http://www.red-externalities.net/

The **2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation** reports provide statewide data on recreation, useful in estimating recreational use values. The national report is referenced here, although the state-specific reports may prove more useful. These reports are available online at *http://www.census.gov/prod/www/abs/fishing.html.*

Steven Polasky, Ph.D, University of Minnesota maintains the **Biodiversity Bibliography: Ecology, Economics and Policy**. This bibliography is a searchable database of references on biodiversity and conservation, and it includes studies under the categories, *Valuation Methods, Values, and Benefit-Cost Analysis* and *Value of Ecosystem Services*. The bibliography is available online at *http://www.apec.umn.edu/faculty/spolasky/Biobib.html.*

Ecosystem Valuation. Website created by Dennis King, Ph.D, University of Maryland, and Marisa Mazzotta, Ph.D, University of Rhode Island. The site describes in non-technical terms the concepts behind ecosystem valuation, methods, and their use. *http://www.ecosystemvaluation.org.*

Table 5.1: Economic Valuation by Ecosystem Type

Forests	Direct Use Value	Indirect Use Value	Non-Use Value	Valuation Method	Economic Measure & Additional Information
Amirnejad, H., S. Khalilian, M.H. Assareh and M. Ahmadian. 2006. Estimating the existence value of North Forests of Iran by using a contingent valuation method. *Ecological Economics* 58(4):665-675.			•	CVM – dichotomous choice	WTP for forests based on two scenarios of forest degradation; in terms of government tax
Atakelty, H., V. Adamowicz and P. Boxall. 2000. Complements, substitutes, budget constraints and Valuation. *Environmental and Resource Economics* 16:51-68.		•	•	CVM – dichotomous choice	WTP for combined programs for habitat and endangered species preservation
Banzhaf, Spencer, Dallas Burtraw, David Evans, and Alan Krupnick. 2004. Valuation of natural resource improvements in the Adirondacks. Resources for the Future. Report, September 2004.	•	•	•	CVM – referendum style	Change in total economic value to NY residents that would result from an improvement in the Adirondack Park system through further reductions in air pollution
Barrick, K.A., and R.I. Beazley. 1990. Magnitude and distribution of option value for the Washakie Wilderness, Northwest Wyoming, USA. *Environmental Management* 14(3):367-380.	•	•	•	CVM – open-ended	CS and option values; on-site, rural and urban users
Bateman, I.J. and A.P. Jones. 2003. Contrasting conventional with multi-level modelling approaches to meta-analysis: An illustration using UK woodland recreation values. *Land Economics* 79(2):235-258.	•			BT – meta-analysis; multi-level modeling (MLM)	WTP derived from 30 studies, 1970 - 1998, containing estimates for woodland recreation value; suggests that correct specification matters; suggests that MML technique may be more robust than conventional meta-analysis
Bateman, I.J. and A.A. Lovett. 2000. Estimating and Valuing the Carbon Sequestered in Softwood and Hardwood trees, timber products and forest soils in Wales. *Journal of Environmental Management* 60(4):301-323.		•		Actual expenditure/ market output price	Shadow price value of net carbon flux through afforestation
Bateman, I.J. and J. Mawby. 2004. First impressions count: Interviewer appearance and information effects in stated preference studies. *Ecological Economics* 49(1):47-55.	•	•	•	CVM – open-ended	WTP for a woodland conservation scheme paid via annual tax; suggests that changing the appearance of the interviewer and the degree of info provided significantly impacts WTP
Bishop, K. 1992. Assessing the benefits of community forests: An evaluation of the recreational use benefits of two urban fringe woodlands. *Journal of Environmental Planning and Management* 35(1):63-76.	•	•	•	CVM – open-ended	WTP to visit specific woodlands; willingness to invest in preservation of those woodlands; total annual user benefits per hectare
Bjorner, T.B. and C.S. Russell, A. Dubgaard, C. Damgaard and L.M. Anderson. 2000. Public and Private Preference for Environmental Quality in Denmark. SOM publikation nr. 39, AKF Forlaget.	•	•	•	CVM – open-ended	WTP for admission to forest; tested framing effects

Table 5.1 continued...

Forests	Direct Use Value	Indirect Use Value	Non-Use Value	Valuation Method	Economic Measure & Additional Information
Bulte, Erwin, and G. C. Van Kooten. 2000. Economic science, endangered species, and biodiversity loss. *Conservation Biology* 14(1):113-19.	•	•	•	Actual expenditure/ market output price	Marginal preservation value; harvest of rainforest and minke whale; argues conservation effort should not be based on hypothetical markets solicited by human preferences; suggests using Safe Minimum Standard approach
Buttle, J., and D. Rondeau. 2004. An incremental analysis of the value of expanding a wilderness area. *Canadian Journal of Economics* 37(1):189-198.	•	•		BT	Option value framework – amenity benefits compared against timber value; incremental benefits
Casey, J.F., T. Vukina, and L.E. Danielson. 1995. The economic value of hiking: Further considerations of opportunity cost of time in recreational demand models. *Journal of Agricultural and Applied Economics* 27(2):658-668.	•			TCM – single site	Net benefits of recreational services from Grandfather Mountain Wilderness Preserve
Caudill, James, and Erin Henderson. 2003. Banking on Nature 2002: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. September 2003. Washington, DC: USDI FWS Division of Economics. 119 pp.	•			Actual expenditure/ market output price	Non-consumptive use of wildlife; income and employment effects of recreational visitors on local economies
Cedar River Group; Mundy Associates LLC; and William B. Beyers, Ph.D. 2002. Evaluation of Blanchard Mountain: Social, Ecological, and Financial Values. Washington State Natural Resource Department.	•	•	•	CVM – dichotomous choice	Discontinuation of logging; recreational and educational opportunities, logging, ecological functions
Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, , Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton, and Marjan van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-60.	•	•	•	Extrapolation from point estimates to global totals	Price, CS; per unit area of each ecosystem service for each ecosystem type; 17 ecosystem services provided by 16 biomes; based on a literature review and information synthesis done during a week-long workshop
Dean, Cornelia. 2005. To save its canal, Panama fights for its forests. *New York Times*, May 24, 2005. http://www.nytimes.com/2005/05/24/science/earth/24pana.html or http://www.forestcouncil.org/tims_picks/view.php?id=1071		•			Ecosystem services to be received by a watershed (Gatun Lake; Chagres River; Panama Canal)
ECONorthwest. 2001. Protecting Roadless Areas and Montana's Economy: An Assessment of the Forest Service Roadless Initiative. January 2001. Eugene: ECONorthwest.	•	•		Actual expenditure/ market output price	Positive impact of Roadless Initiative in MT
Englin, J., J. Loomis and A. Gonzalez-Caban. 2001. The dynamic path of recreational values following a forest fire: A comparative analysis of states in the Intermountain West. *Canadian Journal of Forest Research* 31(10):1837-1844.	•			Combined revealed and stated preference; TCM – negative binomial count	Studies the change in demand for hiking after a forest fire (three scenarios)

Table 5.1 continued...

Forests	Direct Use Value	Indirect Use Value	Non-Use Value	Valuation Method	Economic Measure & Additional Information
Foster, Shonda G., and Molly W. Ingraham. 2005. The Indirect Use Value of Ecosystem Services Provided by the United States National Wildlife Refuge System. Graduate Program in Sustainable Development and Conservation Biology, University of Maryland, College Park. *http://www.life.umd.edu/CONS/Scholarly%20papers/Ingraham.foster.scholarlypaper.pdf*		•		BT	Ecosystem services provided by Refuge System land
Foster, V., I.J. Bateman, and D. Harley. 1997. Real and Hypothetical Willingness to Pay For Environmental Preservation: A Non-Experimental Comparison. *Journal of Agricultural Economics* 48(2):123-138.		•		Actual expenditure/ market price of output; CVM – open ended	Non-experimental comparison of real and hypothetical payments for environmental preservation; based on summary statistics describing responses to fund-raising appeals and CV surveys
Garber-Yonts, B., J. Kerkvliet, and R. Johnson. 2004. Public Values for Biodiversity Conservation Policies in the Oregon Coast Range. *Forest Science* 50(5):589-602.			•	Conjoint analysis; CVM - dichotomous choice	WTP for four biodiversity conservation programs in the Oregon Coast Range
Goldar, B., and S. Misra. 2001. Valuation of environmental goods: Correcting for bias in contingent valuation studies based on willingness-to-accept. *American Journal of Agricultural Economics* 83(1):150-156.	•	•	•	CVM - dichotomous choice	WTP and WTA for changes in tree density; shows how to correct bias in reported WTA
Guo Z., X. Xiao, Y. Gan, and Y. Zheng. 2001. Ecosystem Functions, Services and Their Values: A Case Study in Xingshan County in China. *Ecological Economics* 38:141-154.	•	•		TCM	Value from taking forest tour; used official statistics
Haefele, Michelle, Randall A. Kramer, and Thomas Holmes. 1991. Estimating the Total Value of Forest Quality in High-Elevation Spruce-Fir Forests. In *The Economic Value of Wilderness - Proceedings of the Conference*, General Technical Report SE-78, Southeastern Forest Experiment Station, U.S. Forest Service, Asheville, NC, 91-96.			•	CVM – discrete choice and payment card	WTP to protect forest quality; most forest protection benefits reflect nonuse values
Hagen, Daniel A., James W. Vincent, and Patrick G. Welle. 1992. Benefits of preserving old-growth forests and the Spotted Owl. *Contemporary Economic Policy* 10(2):13-26.			•	CVM	WTP for preservation of old-growth forests
Hanley, N. and R. Ruffel. 1993. The Contingent Valuation of Forest Characteristics: Two Experiments, Forestry and the Environment: Economic Perspectives. Adamowicz, W.L., White, W. and Phillips, W.E. (eds) CAB International Wallingford. 171-197.	•			CVM – open-ended and payment card	WTP for access to forest with certain characteristics
Hanley, N., K. Willis, N. Powe and M. Anderson. 2002. Valuing the Benefits of Biodiversity in Forests. Report to the Forestry Commission, Centre for Research in Environmental Appraisal and Management (CREAM), University of Newcastle.			•	CVM – open-ended	WTP to protect biodiversity in existing forests, WTP to create additional hectares of forest to promote biodiversity
Holmes, T.P. and R.A. Kramer. 1995. An Independent Sample Test of Yea-Saying and Staring Point Bias in Dichotomous-Choice Contingent Valuation. *Journal of Environmental Economics* 29(1):121-132.	•	•	•	CVM – dichotomous choice and payment card	WTP to protect remaining spruce-fir forest

Table 5.1 continued...

Forests	Direct Use Value	Indirect Use Value	Non-Use Value	Valuation Method	Economic Measure & Additional Information
Jenkins, D.H., J. Sullivan, and G.S. Amacher. 2002. Valuing high altitude spruce-fir forest improvements: Importance of forest condition and recreation activity. *Journal of Forest Economics* 8:77-99.	•	•	•	CVM – referendum style	WTP for improved forest protection
Kiker, Clyde F., and Alan W. Hodges. 2002. Economic Benefits of Natural Land Conservation: Case Study of Northeast Florida. Final Report submitted to Defenders of Wildlife, Institute of Food and Agricultural Sciences, Food and Resource Economics Dept. Gainesville: University of Florida.	•	•	•	Actual expenditure/ market price of output; IMPLAN input-output model	Case study of economic benefits of natural lands in Duval, Clay, St. Johns and Putnam Counties
Klocek, C. A. 2004. Estimating the Economic Value of Canaan Valley National Wildlife Refuge: A Contingent Valuation Approach. Dissertation, West Virginia University.	•	•	•	CVM – dichotomous choice	WTP to purchase land for Canaan NWR
Kramer, Randall A., Thomas P. Holmes, and Michelle Haefele. 2002. Using Contingent Valuation to Estimate the Value of Forest Ecosystem Protection. In: Sills, E.O. and K.L. Abt, (eds.) Forests in a Market Economy. Dordrecht, The Netherlands: Kluwer Academic Publishers.			•	CVM	Review of case studies using CVM for evaluating "forest quality, health and extent"; case study of Southern Appalachian Mountains
Kramer, R.A., T.P. Holmes and M. Haefele. 2003. Contingent Valuation of Forest Ecosystem Protection in Forests in a Market Economy. Edited by Erin O. Sills and Kathie Lee Abt, Netherlands: Kluwer Academic Publishers.		•	•	CVM – dichotomous choice	WTP for protection along trails or roads, WTP for protection of entire forest ecosystem
Krieger, Douglas J. 2001. Economic Value of Forest Ecosystem Services: A Review. Washington D.C.: The Wilderness Society. 31pp.	•	•	•		Reviews value of ecosystem goods and services of forests in the U.S.
Lehtonen, E., J. Kuuluvainen, E. Pouta, M. Rekola and L. Chuan-Zhong. 2003. Non-Market benefits of forest conservation in Southern Finland. *Environmental Science and Policy* 6: 195-204.		•		CVM – dichotomous choice; CE – nested logit model	WTP for forest conservation programs
Loomis, John B. 1999. Do additional designations of wilderness result in increases in recreation use? *Society and Natural Resources* 12:481-91.	•			Fixed-effects regression model	Wilderness use in NF and NP; additional designations of wilderness will provide recreation benefits
Loomis, John. 2005. Updated outdoor recreation use values on national forests and other public lands. Gen. Tech. Rep. PNW-GTR-658. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.	•			CVM; TCM	Emphasis on Pacific Northwest forests; database from 1967-2003; averages of values per day from original CVM or TCM studies
Loomis, J.B., A. González-Cabán, and R. Gregory. 1996. A Contingent Valuation Study of the Value of Reducing Fire Hazards to Old-Growth Forests in the Pacific Northwest. Forest Service Research Paper PSW-RP-229-Web, Pacific Southwest Research Station, United States Department of Agriculture. http://www.fs.fed.us/psw/publications/documents/rp-229/rp-229-cover.pdf	•	•	•	CVM – open-ended and dichotomous choice	Value to public knowing old-growth forests and critical habitat units will be protected from fire; annual WTP of Oregon residents

Table 5.1 continued...

Forests	Direct Use Value	Indirect Use Value	Non-Use Value	Valuation Method	Economic Measure & Additional Information
Macmillan, D.C., E. Duff and D.A. Elston. 2001. Modelling the Non-Market Environmental Costs and Benefits of Biodiversity Projects Using Contingent Valuation Data. *Environmental and Resource Economics* 18(4):391-410.	•	•	•	CVM – dichotomous choice	Restoration of large contiguous area of native woodland and reintroduction of beaver and wolf; estimates WTP and WTA for six different biodiversity projects
Mallawaarachchi, T., R.K. Blamey, M.D. Morrison, A.K.L. Johnson, and J.W. Bennet. 2001. Community values for environmental protection in a cane farming catchment in Northern Australia: A Choice modelling study. *Journal of Environmental Management* 62:301-316.	•	•	•	Choice modeling approach	WTP for woodland and wetland preservation; ecosystems threatened by the sugar cane industry
McCollum, D., G. Peterson, J. Arnold, D. Markstrom, and D. Hellerstein. 1990. The Net Economic Value of Recreation on the National Forests: Twelve Types of Primary Activity Trips Across Nine Forest Regions. Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S. Dept. of Agriculture, Research Paper RM-289.	•			TCM	Recreation uses in state parks
Minnesota Dept. of Natural Resources, Office of Management and Budget Services. 2002. Contributions of the Minnesota State Park System to State and Regional Economies. August 2002. MN DNR. 37pp.	•			Input-output model	Shows how Minnesota State Parks contribute to state and regional economies in the state
Mogas, J., P. Riera, and J. Bennett. 1999. A Comparison of Contingent Valuation and Choice Modelling: Estimating the Environmental Values of Catalonian Forests. Department d'Economia, Universitat Rovira i Virgili, Reus, Spain.	•	•	•	Conjoint analysis; CVM – dichotomous choice	WTP for an increase in forest coverage
North East State Foresters Association. 2001. The Economic Importance of Maine's Forests. *http://www.nefainfo.org/publications/nefame.pdf*	•			Actual expenditure/ market output price	Forest-based manufacturing, forest-related recreation
Nowak, David J., Daniel E. Crane, Jeffrey T. Walton, Daniel B. Twardus, and John F. Dwyer. 2002. Understanding and Quantifying Urban Forest Structure, Functions, and Value. 5th Canadian Urban Forest Conference, Oct. 7-9, 2002. York, Ontario. Pp. 27-1 - 27-9.		•			Overview of new evaluation methods and findings, show how these procedures could help aid in urban forest management
Olewiler, N. 2004. The Value of Natural Capital in Settled Areas of Canada. Ducks Unlimited Canada and the Nature Conservancy of Canada. *http://www.ducks.ca/aboutduc/news/archives/pdf/ncapital.pdf*	•	•	•	BT; market proxies (substitutes)	Value per hectare per year of conserving natural resources
Phillips, Spencer. 2000. Windfalls for wilderness: Land protection and land value in the Green Mountains. In S.F. McCool, D.N. Cole, W.T. Borrie, J. O'Loughlin, comps. Wilderness Science in a Time of Change Conference – Vol. 2: Wilderness in the context of larger systems; 1999 May 23-27. Missoula, MT. Proceedings RMRS-P-15-VOL-2:258-267. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.	•			Hedonic-pricing model	Average parcel price of towns with wilderness versus that of towns without wilderness
Power, Thomas M. 1991. Ecosystem preservation and the economy in the Greater Yellowstone area. *Conservation Biology* 5(3):395-404.	•			Actual expenditure/ market output price	Income and employment effects of extractive industry and recreational activities on local economy

Table 5.1 continued...

Forests	Direct Use Value	Indirect Use Value	Non-Use Value	Valuation Method	Economic Measure & Additional Information
Power, Thomas M. 2000. The Economic Impact of Preserving Washington's Roadless National Forests. June 13, 2000. Missoula: University of Montana. 72pp.	•			Actual expenditure/ market output price	Impact of reduced timber harvest
Power, Thomas M. 2001. The Economic Impact of the Proposed Maine Woods National Park and Preserve. Hallowell: The North Woods. *http://www.restore.org/Maine/publications.html*	•			Actual expenditure/ market output price	Impacts of designating Maine Woods as a National Park; employment, forest products industry, natural amenities effects on regional economy
Raunikar, R. and J. Buongiorno. 2005. Willingness to Pay for Forest Amenities: The Case of Non- industrial Owners in the South Central United States. *Ecological Economics* 56:132-143.	•		•	Timber profit maximization function	WTP or foregone revenues; non-timber benefits in industrially and naturally managed forests
Reaves, D. W., R. Kramer, and T. P. Holmes. 1999. Does Question Format Matter? Valuing an Endangered Species. *Environmental and Resource Economics* 14:365-383.			•	CVM – dichotomous choice, payment card, and open-ended	WTP for preservation of red-cockaded woodpecker and habitat restoration
Rekola, M., and E. Pouta. 2004. Public preferences for uncertain regeneration cuttings: a contingent valuation experiment involving Finnish private forests. *Forest Policy and Economics* 7(4):635-649.	•	•	•	Conjoint analysis; CVM – dichotomous choice	WTP for hypothetical land use policy regulating regeneration cuttings on private land
Rogers, M.F. and J.A. Sindin. 1994. Safe Minimum Standard for Environmental Choices: Old-growth forest in New South Wales. *Journal of Environmental Management* 41:89-103.	•		•	Conjoint analysis	Willingness to forego jobs and regional income for protection of species and their habitat
Rubin, J, M. Cheney-Steen, W. A. Ahrens. 1987. The Measurement of Non-Market Benefits: The Northern Spotted Owl and Recreational Delights. Conference Proceedings of the American Agricultural Economics Association (AAEA).	•		•	TCM – multi-site, regional/hedonic; CVM – dichotomous choice	Compensating variation, equivalent surplus, equivalent variation, WTP for preservation of spotted owl habitat
Stevens, T.H., R. Belkner, D. Dennis, D. Kittredge and C. Willis. 2000. Comparison of Contingent Valuation and Conjoint Analysis in Ecosystem Management. *Ecological Economics* 32:63-74.	•	•	•	Conjoint analysis; CVM – dichotomous choice	WTP for ecosystem management on non-industrial private land; studies substitution effects
Stynes, Daniel J., and Ya-Yen Sun. 2003. Economic Impacts of National Park Visitor Spending on Gateway Communities. Final Draft, February 2003.	•			Money Generation Model	Estimates the park's contribution to sales, income and jobs in the area, and visitors' costs
Talberth, John, and Karyn Moskowitz. 1999. The Economic Case Against National Forest Logging. Report prepared for The National Forest Protection Alliance, December 1999. (Chapter 3: Ecosystem Services of National Forests and Externalized Costs of Logging.)	•	•	•		Describes numerous costs and benefits of national forests
Thorsnes, Paul. 2002. The Value of a Suburban Forest Preserve: Estimates from Sales of Vacant Residential Building Lots. *Land Economics* 78(3):426–41.	•				Value of proximity to forest preserves (proximity premia) – capitalized into sale prices of vacant building lots

Table 5.1 continued...

Forests	Direct Use Value	Indirect Use Value	Non-Use Value	Valuation Method	Economic Measure & Additional Information
Travisi, C.M., and P. Nijkamp. 2004. Willingness to Pay for Agricultural Environmental Safety: Evidence From a Survey of Milan, Italy, Residents, Department of Management Economics and Industrial Engineering, Polytechnic of Milan, Italy.		•		Conjoint analysis and CVM – dichotomous choice	WTP to protect human health, protect bird biodiversity, reduce soil and aquifer contamination
University of Montana, Institute for Tourism and Recreation Research. 2003. 2002 Nonresident Expenditure Profiles. 15 August 2003. *http://www.itrr.umt.edu/nonres/ExpProfile02.pdf*	•				Data on expenditures by 2002 non-residents; in the state of Montana
White, P. C. L., and J. C. Lovett. 1999. Public preferences and willingness-to-pay for nature conservation in the North York Moors National Park, UK. *Journal of Environmental Management* 55:1-13.			•	CVM – dichotomous choice	WTP for conservation of 11 National Parks in the UK or for Levisham estate in North York Moors National Park.
Walsh, R.G., J.B. Loomis, and R.A. Gillman. 1984. Valuing Option, Existence, and Bequest Demands for Wilderness. *Land Economics* 60(1):14-29.	•		•	CVM	WTP to maintain wilderness in Colorado
Walsh, R.G., R.D. Bjonback, R.A. Aiken, and D.H. Rosenthal. 1990. Estimating the public benefits of protecting forest quality. *Journal of Environmental Management* 30:175-189.	•		•	CVM – iterative bidding	WTP for improved forest quality
Vincent, James W., Daniel A. Hagen, Patrick G. Welle, and Kole Swanser. 1995. Passive-Use Values of Public Forestlands: A Survey of the Literature. U.S. Forest Service.			•		Surveys economic research on nonuse value of forests
Zinkhan, F. Christian, Thomas P. Holmes, and D. Evan Mercer. 1994. Conjoint analysis: a pragmatic approach for the accounting of multiple benefits in southern forest management. Southeastern Center for Forest Economics Research. Research Triangle Park. SCFER Working Paper No. 76. 16 pp. *http://www.srs.fs.usda.gov/econ/pubs/scfer/scfer76.pdf*			•	Conjoint analysis	Non-market benefits from southern forests

Table 5.1 continued...

Wetlands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
An, M. Y. 2000. A Semiparametric Distribution for Willingness to Pay and Statistical Inference with Dichotomous Choice Contingent Valuation Data. *American Journal of Agricultural Economics* 82:487-500.	•			CVM – dichotomous choice	WTP for protecting wetland habitats and wildlife for current use in San Joaquin Valley, California; two different models and two different levels of data
Anderson, R. and M. Rockel. 1991. Economic Valuation of Wetlands. Discussion Paper #065, American Petroleum Institute, Washington, D.C., 1991.	•	•	•		Summary of findings from several studies; WTP for various wetland functions
Atkins, J.P. and D. Burdon. 2005. An Initial Economic Evaluation of Water Quality Improvements in the Randers Fjord, Denmark. *Marine Pollution Bulletin* 53(1-4):195-204.	•	•		CVM – open-ended	WTP of county residents for reduction in eutrophication; costs and benefits associated with plan to reduce nutrient inputs
Azevedo, C. D., J. A. Herriges and C. L. Kling. 2003. Combining Revealed and Stated Preference: Consistency Tests and Their Interpretations. *American Journal of Agricultural Economics* 85(3):525-537.	•		•	Combined revealed and stated preference	CS for recreational trips to Iowa wetlands; inconsistency between stated and revealed preference CS values; suggests a need for more research to combined each method's strength for a more accurate valuation method
Bateman, I.J., Cole, M., Cooper, P., Georgiou, S., Hadley, D. and G.L. Poe. 2004. On visible choice sets and scope sensitivity. *Journal of Environmental Economics and Management* 47: 71-93.	•		•	CVM – open-ended	WTP for three lake improvement schemes; tests for differences between WTP values elicited through different study designs; demonstrates a difference depending on how information is disclosed to respondents
Bauer, D.M., N.E. Cyr and S.K. Swallow. 2004. Public preferences for compensatory mitigation of salt marsh losses: A contingent choice of alternatives. *Conservation Biology* 18(2):401-411.		•		CVM – dichotomous choice	WTP for different wetland mitigation alternatives
Bell, F.W. 1997. The Economic Valuation of Saltwater Marsh Supporting Marine Recreational Fishing in the Southeastern United States. *Ecological Economics* 21:243-254.	•			BT	Benefits to estuarine-dependent recreational fisheries; annual value of marginal CS per acre of wetland
Berrens, R.P., P. Ganderton, and C. Silva. 1996. Valuing the Protection of Minimum Instream Flows in New Mexico. *Journal of Agricultural and Resource Economics* 21(2):294-309.	•		•	CVM – dichotomous choice	Compensating variation; WTP for protection of instream flows to protect silvery minnow and eleven endangered and threatened fish species
Bin, O., and S. Polasky. 2005. Evidence on the Amenity Value of Wetlands in a Rural Setting. East Carolina University. *Journal of Agricultural and Applied Economics* 37(3): 589-602.		•	•	Hedonic-pricing models	Value of wetlands based on their effect on property prices in Carteret county, North Carolina; negative association

Table 5.1 continued...

Wetlands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Birol, E., K. Karousakis, and P. Koundouri. 2005. Using a Choice Experiment to Estimate the Non-Use Values of Wetlands: The Case of Cheimaditida Wetland in Greece. Discussion Paper Series no. 08.2005, Environmental Economy and Policy Research, University of Cambridge.			•	Choice experiment	Marginal WTP for wetland management attributes
Bishop, R.C., W.S. Breffle, J.K. Lazo, R.D. Rowe and S.M. Wytinck. 2000. Restoration Scaling Based on Total Value Equivalency: Green Bay Natural Resource Damage Assessment. U.S. Fish and Wildlife Service, U.S. Department of Interior and U.S. Department of Justice Final Report.	•	•		Conjoint analysis	WTP for restoration programs
Boyer, Tracy, and Steve Polasky. 2004. Valuing urban wetlands: A review of non-market valuation studies. *Wetlands* 24(4):744-755.	•	•	•		Review of wetland valuation studies
Brander, L.M.; R.J.G.M. Florax; and J.E. Vermaat. 2004. The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature. European Association of Environmental and Resource Economics 13th Annual Conference, Budapest Hungary, June 25th to 28th 2004. *http://eaere2004.bkae.hu/download/paper/branderpaper.pdf*	•	•	•	Meta/synthesis analysis	Review of wetland valuation studies; value of wetlands per hectare per year
Broadhead, C.A. 2000. Riparian Zone Protection: The Use of the Willingness-to-Accept Format in a Contingent Valuation Study. Dissertation. Utah State University.	•	•	•	CVM – open-ended	WTA for participation in preservation program along Garonne River, France
Brouwer, Roy, Ian H. Langford, Ian J. Bateman, Tom C. Crowards, and R. Kerry Turner. 1999. A meta-analysis of wetland contingent valuation studies. *Regional Environmental Change* 1(1):47-57.	•	•	•	CVM	Values associated with ecological, geochemical, and hydrological functions
Brox, J.A., R.C. Kumar, and K.R. Stollery. 1996. Willingness to pay for water quality and supply enhancements in the Grand River watershed. *Canadian Water Resources Journal* 21(3):275-288.	•		•	CVM – dichotomous choice	WTA and WTP for water quality improvements
Cardoch, L., and J.W. Day Jr. 2001. Energy analysis of nonmarket values of the Mississippi Delta. *Environmental Management* 28(5):677-685.		•		Calculates change in gross primary productivity of the natural system	Non-market value of the Mississippi Delta under different land cover scenarios in past, present, and future
Carman, M., Lamb, G., Miller, A., Sadowske, S., and Shaffer, R. 1992. The Oconto Waterfront: Issues and Options A Survey of Oconto Residents. National Coastal Resources Research and Development Institute.	•	•	•	CVM	WTP for three waterfront preservation and development options
Colby, B., and S. Wishart. 2002. Riparian areas generate property value premiums for landowners. University of Arizona, Department of Agricultural and Resource Economics, College of Agriculture and Life Sciences. January 2002. *http://ag.arizona.edu/arec/pubs/riparianreportweb.pdf*	•				Property value premium for proximity to riparian corridor

Table 5.1 continued...

Wetlands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, , Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton, and Marjan van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-60.	•	•	•	Extrapolation from point estimates to global totals	Price, CS; per unit area of each ecosystem service for each ecosystem type; 17 ecosystem services provided by 16 biomes; based on a literature review and information synthesis done during a week-long workshop
Dalecki, G.M., J.C. Whitehead, and G.C. Blomquist. 1993. Sample Non-response Bias and Aggregate Benefits in Contingent Valuation: an Examination of Early, Late and Non-respondents. *Journal of Environmental Management* 38:133-143.			•	CVM – dichotomous choice	WTP for wetland preservation in Kentucky
Danielson, L.E. and J.A. Leitch. 1986. Private vs public economics of prairie wetland allocation. *Journal of Environmental Economics and Management* 13(1):81-92.		•		CVM – open-ended	WTA to sell land for wetlands protection or sell wetlands protection easements; value of service flows and of drained wetlands to agriculture
Ferguson, A., G. Holman, and R. Kristritz. 1989. Wetlands are not Wastelands: Application of Wetland Evaluation Methods to the Cowichan Estuary. British Columbia, Sustainable Development Branch, Canadian Wildlife Service and Wildlife Habitat Canada.	•	•	•	CVM – open-ended; Opportunity cost approach	WTP to preserve the estuary; two magnitudes of change considered
Garber-Yonts, B., J. Kerkvliet, and R. Johnson. 2004. Public values for biodiversity conservation policies in the Oregon Coast Range. *Forest Science* 50(5):589-602.			•	Conjoint analysis; CVM - dichotomous choice	WTP for four biodiversity conservation programs in the Oregon Coast Range
Gren, I, K.-H. Groth and M Sylven. 1995. Economic Values of Danube Floodplains. *Journal of Environmental Management* 45:333-345.	•	•	•	BT	Total economic value (TEV) of the Danube River as inputs to provision of market goods, recreation value, and as a nutrient sink
Hanemann, W. Michael. 2005. The value of water. Manuscript, University of California at Berkeley. *http://are.berkeley.edu/courses/EEP162/spring05/valuewater.pdf*	•	•	•		Discusses whether water should or should not be treated as an economic commodity; discusses the costs and benefits of water
Hanemann, M., J. Loomis, and B. Kanninen. 1991. Statistical efficiency of double-bounded dichotomous choice contingent valuation. *American Journal of Agricultural Economics* 73(4):1255-1263.		•		CVM – dichotomous choice	Various levels of wetlands improvement; demonstrates that the double-bounded referendum technique is statistically more efficient than the single-bounded approach; single-bounded approach resulted in WTP variance up to 10 times greater than double-bounded approach

Table 5.1 continued...

Wetlands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Horton, B., and J. Fisher. 2004. The 4th Periodic Review of the UK Water Industry: A Large-Scale Practical Application of Environmental Cost-Benefit Analysis. Paper presented at the Applied Environmental Economics Conference. The Royal Society, London, United Kingdom.	•	•	•	Large-scale BT	Benefits and costs of water quality and water resource improvement schemes
Hovde, Brett and Jay A. Leitch. 1994. Valuing Prairie Potholes: Five Case Studies. Agricultural Economics Report No. 319. Department of Agricultural Economics, Agricultural Experiment Station, North Dakota State University.	•	•	•	BT; Input-output analysis from four perspectives	Annual and annual per acre values for five wetlands by societal group and by wetland output
Kaoru, Y. 1993. Differentiating Use and Nonuse Values for Coastal Pond Water Quality Improvements. *Environmental and Resource Economics* 3:487-494.	•		•	CVM – open-ended	WTP to raise water quality of ponds so that shell-fishing could be done year-round
Kiker, Clyde, and Gary D. Lynne. 1997. Wetland Values and Valuing Wetlands. In *Ecology and Management of Tidal Marshes. A Model from the Gulf of Mexico*. Coultas and Hsieh (eds.). Delray Beach: St. Lucie Press. Pp. 259-76.	•	•	•	Multiple Alternative / Multiple Attribute Evaluation	Focuses on the decision process surrounding wetland permits
Kiker, Clyde F., and Alan W. Hodges. 2002. Economic Benefits of Natural Land Conservation: Case Study of Northeast Florida. Final Report submitted to Defenders of Wildlife, Institute of Food and Agricultural Sciences, Food and Resource Economics Dept. Gainesville: University of Florida.	•	•	•	Actual expenditure/ market price of output; IMPLAN input-output model	Case study of economic benefits of natural lands in Duval, Clay, St. Johns and Putnam Counties
Klocek, C. A. 2004. Estimating the Economic Value of Canaan Valley National Wildlife Refuge: A Contingent Valuation Approach. Dissertation, West Virginia University.	•	•	•	CVM – dichotomous choice	WTP to purchase land for Canaan NWR
Lindsey, G., and G. Knaap 1999. Willingness to Pay for Urban Greenway Projects. *Journal of the American Planning Association* 65(3):297-313.	•	•	•	CVM – payment card	WTP for small projects along Crooked Creek Greenway, Indiana
Loomis, John B. 1987. Balancing Public Trust Resources of Mono Lake and Los Angeles' Water Right: An Economic Approach. *Water Resources Research* 23(8):1449-1456.	•	•	•	CVM – dichotomous choice	WTP for different scenarios based around the water level of Mono Lake
Loomis, John B. 2000. Can environmental economic valuation techniques aid ecological economics and wildlife conservation? *Wildlife Society Bulletin* 28(1):52-60. *http://www.wildlife.org/publications/wsb2801/7sc_loomi.pdf*		•		CVM – payment card	WTP for South Platte River restoration; primarily a demonstration of non-market valuation
Loomis, H., P. Kent, L. Strange, K. Fausch, and A. Covich. 2000. Measuring the Total Economic Value of Restoring EcoSystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey. *Ecological Economics* 33:103-117.		•	•	CVM – dichotomous choice	WTP for ecosystem services that would be restored along the South Platte River if conservation easements along the river are purchased
Lynne, Gary D., Patricia Conroy, and Frederick J. Prochaska. 1981. Economic Valuation of Marsh Areas for Marine Production Processes. *Journal of Environmental Economics and Management* 8:175-186.	•			Actual expenditure/ market price of output; Change in productivity	Total present value of blue crab production in salt marsh of Florida's Gulf Coast
Mahan, B. L., P. Polasky, and R. M. Adams. 2000. Valuing Urban Wetlands: A Property Price Approach. *Land Economics* 76(1):100-113.	•			Hedonic-pricing model	Wetland amenities in Portland, Oregon

Table 5.1 continued...

Wetlands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Mallawaarachchi, T., R.K. Blamey, M.D. Morrison, A.K.L. Johnson, and J.W. Bennet. 2001. Community values for environmental protection in a cane farming catchment in Northern Australia: A choice modelling study. *Journal of Environmental Management* 62:301-316.	•	•	•	Choice modeling approach	WTP for woodland and wetland preservation; ecosystems threatened by sugar cane industry
Miliadou, D. 1997. The Economic Valuation of Wetlands. Master of Science thesis in Ecological Economics, University of Edinburgh.	•	•	•	CVM – iterative bidding	WTP to preserve the wetland ecosystem of Lake Kerkini
Milon, J. Walter, Alan W. Hodges, Arbindra Rial, Clyde F. Kiker, and Frank Casey. 1999. Public Preferences and Economic Values for Restoration of the Everglades/South Florida Ecosystem. Economics Report 99-1, August 1999. Gainesville: Food & Resource Economics Dept., University of Florida.	•	•	•	Multi-attribute utility survey	Evaluates trade-offs related to the restoration of the Everglades
Olewiler, N. 2004. The Value of Natural Capital in Settled Areas of Canada. Ducks Unlimited Canada and the Nature Conservancy of Canada.	•	•	•	BT; market proxies (substitutes)	Value per hectare per year of conserving natural resources in Canada
Pate, Jennifer and John Loomis. 1997. The effect of distance on willingness to pay values: a case study of wetlands and salmon in California. *Ecological Economics* 20:199-207.	•	•	•	CVM – dichotomous choice	Logit model used to study the effects of geographic distance on respondents' WTP for wetland habitat and wildlife, wildlife contamination control, or river and salmon improvement programs
Prato, Tony. 1998. *Natural Resource and Environmental Economics.* Ames: Iowa State University Press.	•	•	•		Explains the relationship between the economy and ecosystems; describes sustainable resource use and means of sustainable economic development
Ribaudo, Marc O., and Daniel Hellerstein. 1992. Estimating Water Quality Benefits: Theoretical and Methodological Issues. Economic Research Service. U.S. Department of Agriculture, September 1992.	•	•			Guidelines on estimating economic benefits of changes in water quality on water users and from agricultural policies affecting water quality
Roberts, L.A. and J.A. Leitch. 1997. Economic Valuation of Some Wetland Outputs of Mud Lake, Minnesota-South Dakota. Agricultural Economics Report No. 381, Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University.	•	•	•	Actual expenditure/ market price of output; Averting behavior (preventing, defensive); CVM - payment card	Values flood control, water quality, habitat, recreation, aesthetics
Sunding, David, Aaron Swoboda, and David Zilberman. 2003. The economic costs of critical habitat designation: Framework and application to the case of California Vernal Pools. Report prepared for the California Resource Management Institute. February 2003. *http://www.calresources.org/admin/files/crmichreport.pdf*					Focuses on the costs of designating critical habitat for vernal pools

Table 5.1 continued...

Wetlands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Tkac, J.M. 2002. Estimating Willingness to Pay for the Preservation of the Alfred Bog Wetland in Ontario: A Multiple Bounded Discrete Choice Approach. Department of Agricultural Economics MacDonald Campus McGill University Montreal Quebec.	•	•	•	CVM – dichotomous choice	WTP to preserve the Alfred Bog, Ontario, Canada
Udziela, M.K. and L.L. Bennett. 1997. Contingent Valuation of an Urban Salt Marsh Restoration, Yale Forestry and Environmental Studies Bulletin, v.100.		•	•	Conjoint analysis; CVM – open-ended	WTP for salt marsh restoration
Unsworth, R.E. and R.C. Bishop. 1994. Assessing natural resource damages using environmental annuities. *Ecological Economics* 11(1):35-41.	•	•	•	Replacement costs	Cost of replacement or injury of Great Swamp NWR
van Kooten, G.C., and A. Schmitz. 1992. Preserving Waterfowl Habitat on the Canadian Prairies: Economic Incentives versus Moral Suasion. *American Journal of Agricultural Economics* 74(1):79-89.	•			CVM – open-ended	WTP to pay for and WTA for not draining and farming wetlands to protect water fowl habitats
Wainger, Lisa A., Dennis King, James Salzman, and James Boyd. 2001. Wetland value indicators for scoring mitigation trades. *Stanford Environmental Law Journal* 20(2):413-478.					Presents wetland value indicator methodology
Whitehead, John C. and Glenn C. Blomquist. 1991. Measuring contingent values for wetlands: Effects of information about related environmental goods. *Water Resources Research* 27 (10):2523-2531.	•	•	•	CVM – dichotomous choice	WTP for service flows provided by Kentucky wetlands; tests for effects of explicit info about substitutes and compliments to environmental goods on contingent values
Whitehead, J.C. and P.A. Groothuis. 1992. Economic benefits of improved water quality: A case study of North Carolina's Tar-Pamlico River. *Rivers* 3(3):170-178.	•		•	CVM – open-ended	WTP to improve water quality of the Tar-Pamlico River; reduce agricultural non-point pollution
Woodward, R. T. and Y.-S. Wui. 2001. The economic value of wetland services: A meta-analysis. *Ecological Economics* 37:257-270.	•	•	•	Meta-analysis	Value per acre of single-service wetlands; evaluates the impact of wetland size and estimation bias on valuations

Table 5.1 continued...

Grasslands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Alvarez B., N. Hanley, R. Wright, and D. MacMillan. 1999. Estimating the benefits of agri-environmental policy: Econometric issues in open-ended contingent valuation studies. *Journal of Environmental Planning and Management* 42(1):23-43.	•		•	CVM – open-ended	WTP for conservation of environmentally sensitive areas
Atakelty, H., V. Adamowicz and P. Boxall. 2000. Complements, substitutes, budget constraints and valuation. *Environmental and Resource Economics* 16:51-68.		•	•	CVM – dichotomous choice	WTP for combined habitat and endangered species preservation programs
Bangsund, D.A., F.L. Leistritz, and J.A. Leitch. 1999. Assessing Economic Impacts of Biological Control of Weeds: The Case of Leafy Spurge in the Northern Great Plains of the United States. *Journal of Environmental Management* 56 35-43.	•	•		Bioeconomic model	Benefits from leafy spurge control program in rangeland and wildland of Northern Great Plains
Boxall, P.C. 1995. The Economic Value of Lottery-rationed Recreational Hunting. *Canadian Journal of Agricultural Economics* 43(4):119-131.	•			TCM	Compensating variation; (extractive use) value of a series of pronghorn antelope hunting sites; calculates welfare loss by closing the site and welfare loss associated with quality changes
Brown, Katrina. 1997. Plain tales from the grasslands: extraction, value and utilization of biomass in Royal Bardia National Park, Nepal. *Biodiversity and Conservation*. 6(1):59-74.	•			Actual expenditure/ market price of output	Annual offtake of grass inside the park by local people
Butler, Martin K. 2004. Economic Analysis Prepared for the Environmental Impact Statement on Black-Tailed Prairie Dog Conservation and Management on the Nebraska National Forest and Associated Units. South Dakota State University, Economics Staff paper 2004-2.	•			Actual expenditure/ market price of output	Change in forage ability by national grassland as a result of alternatives to black-tailed prairie dog management plans
Feather, Peter, Danial Hellerstein, and Le Roy Hansen. 1999. Economic Valuation of Environmental Benefits and the Targeting of Conservation Programs: The Case of the CRP. Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 778. *http://www.ers.usda.gov/publications/aer778/aer778.pdf*	•			Recreation demand models	Consumer surplus of water-based recreation, pheasant hunting, and wildlife viewing from implementation of the Conservation Reserve Program
Foster, V., I.J. Bateman, and D. Harley. 1997. Real and Hypothetical Willingness to Pay For Environmental Preservation: A Non-Experimental Comparison. *Journal of Agricultural Economics* 48(2):123-138.		•		Actual expenditure/ market price of output; CVM – open ended	Non-experimental comparison of real and hypothetical payments for environmental preservation; based on summary statistics describing responses to fund-raising appeals and CV surveys
Garrod, G., K. Willis, M. Raley and M. Rudden. 1998. Economic Evaluation of Access Provisions in the MAFF Agri-environment Schemes. Report to the Ministry of Agriculture, Fisheries and Food (now Department of Environment, Food and Rural Affairs - DEFRA).	•			Conjoint analysis	WTP for a mile of new or improved access to countryside recreation and proximity to grasslands

Table 5.1 continued...

Grasslands	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Lockwood, M., P. Tracey, and N. Klomp. 1996. Analysing conflict between cultural heritage and nature conservation in the Australian Alps: A CVM approach. *Journal of Environmental Planning and Management* 39(3):357-370.	•		•	CVM – dichotomous choice	WTP to continue cattle grazing (preserve cultural heritage) and WTP to stop cattle grazing (preserve natural environment) of Bogong High Plains
Patrick, R., J. Fletcher, S. Lovejoy, W. Van Beek, G. Holloway, and J. Binkley. 1991. Estimating regional benefits of reducing targeted pollutants: An application to agricultural effects on water quality and the value of recreational fishing. *Journal of Environmental Management* 33:301-310.	•	•		TCM – multi-site – regional/hedonic	Compensating variation to Indiana anglers of reduction in total suspended solids and associated pollutants
Ribaudo, M. O., D. Colacicco, A. Barbarika and C.E. Young. 1989. The Economic Efficiency of Voluntary Soil Conservation Programs. *Journal of Soil and Water Conservation*, January – February.	•			Actual expenditure/ market price of output	Benefits and costs associated with the Agricultural Conservation Program, the Conservation Technical Assistance program, and the Great Plains Conservation program; water quality benefits from treatment of soil erosion
Ribaudo, Marc O. 1989. Water Quality Benefits from the Conservation Reserve Program. Resources and Technology Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C., Agricultural Economic Report No. 606, 1989.	•			Averting behavior; replacement costs; TCM – single site	Present value of off-site benefits of the Conservation Reserve Program; benefits per acre enrolled, by region
Yabe, Mitsuyasu, Kosaku Nitta, Motoyuki Goda, and Eiichiro Nishizawa. 2000. Economic evaluation of the Aso grassland landscape by contingent valuation method: Comparative analysis of donation and tax reallocation payment vehicles. *JRSRAI, Studies in Regional Science* 30:1.			•	CVM – payment card	WTP for grassland conservation

Table 5.1 continued...

Coral Reefs and Mangroves	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Andersson, J. 2003. The Recreational Cost of Coral Bleaching - A Stated and Revealed Preference Study of International Tourists. Discussion Paper 181, Beijer International Institute of Ecological Economics - the Royal Swedish Academy of Sciences.	•			TCM – single site; CVM – open-ended	Compensating variation; WTA for degradation of reefs, WTP for access to Zanzibar and Mafia
Arin, T. and R.A. Kramer. 2002. Divers' Willingness to Pay to Visit Marine Sanctuaries: An Exploratory Study. *Oceans & Coastal Management* 45:171-183.	•			CVM – payment card	WTP of divers for entry into marine sanctuary that is free of fishing
Barbier, Edward B. 2000. Valuing the environment as input: review of applications to mangrove-fishery linkages. *Ecological Economics* 35:47-61.		•		Production function approach	Reviews the intertemporal bieconomic fishing problem; two case studies of mangrove-fishery valuation
Bhat, M.G. 2003. Application of Non-Market Valuation to the Florida Keys Marine Reserve Management. *Journal of Environmental Management* 67:315-325.	•			Combined revealed and stated preference; TCM – single-site	CS for three improved coral reef quality scenarios; nature-based tourism
Carr, L. and R. Mendelsohn. 2003. Valuing Coral Reefs: A Travel Cost Analysis of the Great Barrier Reef. *Ambio* 32(5):353-357.	•	•		TCM – single-site	Compensating surplus value of tourism brought by the Great Barrier Reef, Australia among visitors
Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, , Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton, and Marjan van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-60.	•	•	•	Extrapolation from point estimates to global totals	Price, CS; per unit area of each ecosystem service for each ecosystem type; 17 ecosystem services from 16 biomes; based on a literature review and information synthesis
De Guzman, A. B. 2004. A Fishery in Transition: Impact of a Community Marine Reserve on a Coastal Fishery in Northern Mindanao, Philippines. Economy an Environment Program for Southeast Asia (EEPSEA), International Development Research Centre.	•			Actual expenditure/ market price of output	Net values and net present value of fishing activities
Johns, G.M., V.R. Leeworthy, F.W. Bell and M.A. Bonn. 2001. Socioeconomic Study of Reefs in Southeast Florida 2000-2001: Final Report, October 19, 2001 revised April 18, 2003. Final report submitted to Broward County, Palm Beach County, Miami-Dade County, Monroe county, Florida Fish and Wildlife Conservation. *http://marineeconomics.noaa.gov/Reefs/02-01.pdf*	•			Actual expenditure/ market price of output	Direct, indirect, and induced economic impact of reef-related recreational activities
Park, T., J. M. Bowker, and V.R. Leeworthy. 2002. Valuing Snorkeling Visits to the Florida Keys with Stated and Revealed Preference Models. *Journal of Environmental Management* 65(3): 301-312.		•		Combined revealed and stated preference	CS; WTP to preserve current water quality and health of coral reefs
Seenprachwong, U. 2001. An Economic Analysis of Coral Reefs in the Andaman Sea of Thailand. Economy and Environment Program for Southeast Asia, International Development Research Centre.	•	•	•	TCM – single-site; CVM – dichotomous choice	CS associated with recreational services (domestic and foreign visitors); WTP for improvements of coral reefs

Table 5.1 continued...

Coral Reefs and Mangroves	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Seenprachawong, U. 2002. An Economic Valuation of Coastal Ecosystems in Phang Nga Bay, Thailand. Economy and Environment Program for Southeast Asia (EEPSEA) Research Report No. 2002-RR5, International Development Research Centre.	•	•	•	Conjoint analysis	Compensating variation for environmental quality improvements; marginal WTP for change in various attributes of the coastal ecosystem
Spash, C. L., J. van der Wer ten Bosch, S. Westmacott, and J. Ruitenbeek. 2000. Lexicographic Preferences and the Contingent Valuation of Coral Reef Biodiversity in Curacao and Jamaica. Washington, DC: World Bank 2000. Integrated Coastal Zone Management of Coral Reefs: Decision Support Modeling.	•	•	•	CVM – open-ended	WTP for biodiversity conservation
Subade, R.F. 2005. Valuing Biodiversity Conservation in a World Heritage Site: Citizens' Non-Use Values for Tubbataha Reefs National Marine Park, Philippines. Economy an Environment Program for Southeast Asia (EEPSEA), International Development Research Centre.	•	•	•	CVM – dichotomous choice	WTP for conservation and improvement of coral reefs
Thur, S.M. 2003.Valuing Recreational Benefits in Coral Reef Marine Protected Areas: An Application to the Bonaire National Marine Park. Dissertation, UMI No. 3112702, University of Delaware.	•			CVM – dichotomous choice and payment card; Conjoint analysis	WTP for access to the marine park; tradeoff between paying an additional fee to access a higher quality environment or to accept lesser quality for no additional charge above the vacation price
UNEP-WCMC. 2006. In the front line: shoreline protection and other ecosystem services from mangroves and coral reefs. UNEP-WCMC, Cambridge, UK 33 pp. *http://www.unep.org/pdf/infrontline_06.pdf*	•	•	•		Describes the global status of mangrove and coral reef ecosystems, the services they provide, and the consequences if they are lost
Yeo, B.H. 2002. Valuing a Marine Park in Malaysia. in *Valuing the Environment in Developing Countries: Case Studies.* edited by David Pearce, Corin Pearce and Charles Palmer, Cheltenham, UK and Northampton, MA, USA: Edward Elgar 2002.	•	•	•	CVM – open-ended	WTP by domestic and foreign tourists for marine park conservation

Table 5.1 continued...

Desert	Direct Use	Indirect Use	Non-use Values	Valuation Method	Economic Measure & Additional Information
Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, , Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton, and Marjan van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-60.	•	•	•	Extrapolation from point estimates to global totals	Price, CS; per unit area of each ecosystem service for each ecosystem type; 17 ecosystem services provided by 16 biomes; based on a literature review and information synthesis done during a week-long workshop
ECONorthwest. 2002. Economic Benefits of Protecting Natural Resources in the Sonoran Desert. August 2002. 49pp.	•	•	•		Includes info on four categories of potential economic benefits of resource-conservation initiatives
Radtke, Hans D. and Shannon W. Davis. 1998. Economic Study of Implementing the Proposed Oregon High Desert Protection Act. August 1998. *http://www.onda.org/projects/ohdpa/OHDPA_econ_study.pdf*	•			Actual expenditure/ market output price; IMPLAN input-output model	Impact of change in land use – replacing public grazing with establishment of wilderness areas, a park, refuges; decrease in personal income, increase in outdoor recreation
Richardson, Robert B. 2004. The economic benefits of California desert wildlands: 10 years since the California Desert Protection Act of 1994. Draft, October 22, 2004. *http://www.wilderness.org/Library/Documents/upload/EconBenefitsOfCaliforniaDesertWildAlerts2004.pdf*	•	•	•	Actual expenditure/ market output price; IMPLAN input-output model; Hedonic-pricing model; BT	Benefits of wilderness and natural areas of California desert
Richer, Jerrell. 1995. Willingness to pay for desert protection. *Contemporary Economic Policy* Vol. XIII (October):93-104.			•	CVM – dichotomous choice	WTP for increased protection of the Mojave Desert

Table 5.2: Economic Valuation by Individual Species

Birds	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Adamowicz, W.L., and B. Condon. 1997. Socio-Economic Aspects of Marten Management. *Martes: Taxonomy, Ecology, Techniques and Management*. pp.395-406 Gilbert Proulx, Harold Bryant and Paul Woodard (Eds). 1997 The Provincial Museum of Alberta, Edmonton, Alberta, Canada 1997.	•		•	Actual expenditure/ market price output; CVM – dichotomous choice	Benefits of **American marten** habitat preservation vs. timber production; valuation of forest ecosystem
Bowker, J.M., and J.R. Stoll. 1988. Use of Dichotomous Choice Nonmarket Methods to Value the Whooping Crane Resource. *American Agricultural Economics Association*:373-381.	•		•	CVM – dichotomous choice	WTP to preserve the **whooping crane**
Gilbert, L.A., E.F. Jansen Jr., J.M. Halstead, and R.A. Robertson. 1994. Economic and Social Impacts of the Parker River National Wildlife Refuge and its Piping Plover Management Program. New Hampshire Agricultural Experiment Station, University of New Hampshire, Durham, New Hampshire.	•			TCM	Actual expenditure of visitors to the refuge to see the **piping plover**
Hagen, Daniel A., James W. Vincent, and Patrick G. Welle. 1992. Benefits of preserving old-growth forests and the Spotted Owl. *Contemporary Economic Policy* 10(2):13-26.			•	CVM – dichotomous choice	WTP to preserve old-growth forests and the **spotted owl**
Macmillan, D.C., L. Philip, N. Hanley, and B. Alverez-Farizo. 2002. Valuing the non-market benefits of wild goose conservation: A comparison of interview and group-based approaches. *Ecological Economics* 43:49-59.			•	CVM – payment card	WTP for increase in **wild geese** population; uses Market Stall process instead of interview surveys
McKenney, Bruce. 2000. Economic Activity Following Critical Habitat Designation for the Cactus Ferruginous Pygmy-Owl (Critical Habitat Units 3 and 4): A Review of Key Economic Indicators. Prepared for The Coalition for Sonoran Desert Protection. 21 pp.	•			Actual expenditure/ market price output	Focuses on costs of designating critical habitat for the **Cactus Ferruginous Pygmy-Owl**; direct use of habitat
Reaves, D. W., R. Kramer, and T. P. Holmes. 1999. Does question format matter? Valuing an endangered species. *Environmental and Resource Economics* 14:365-383.			•	CVM – dichotomous choice, payment card, and open-ended	WTP for preservation of the **red-cockaded woodpecker** and habitat restoration
Rubin, J, M., Cheney-Steen, W. A. Ahrens. 1987. The Measurement of Non-Market Benefits: The Northern Spotted Owl and Recreational Delights. Conference Proceedings of the American Agricultural Economics Association (AAEA).	•		•	TCM – multi-site, regional/hedonic; CVM – dichotomous choice	Compensating variation, equivalent surplus, equivalent variation, WTP for preservation of the **spotted owl** and habitat

Table 5.2 continued...

Fish	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Bell, K.P., D. Huppert, and R.L. Johnson. 2003. Willingness to pay for local Coho salmon enhancement in coastal communities. *Marine Resource Economics* 18(1):15-31.	•	•		CVM – referendum style	WTP to restore and improve **Coho salmon stocks**
Bennear, L.S., R.N. Stavins, and A.F. Wagner. 2004. Using Revealed Preferences to Infer Environmental Benefits: Evidence from Recreational Fishing Licenses. John F. Kennedy School of Government, Harvard University.	•			Actual expenditure/ market price of output	Freshwater recreational fishing days; sales of residential annual state licenses
Bennet, M., B. Provencher, and R. Bishop. 2004. Experience, Expectation and Hindsight: Evidence of a Cognitive Wedge in Stated Preference Retrospectives. University of Wisconsin-Madison Department of Agricultural and Applied Economics.	•			Combined revealed and stated preference	WTP for recreational fishing trips; shows a systematic difference between valuations made before and after trip outcomes
Bergstrom, J.C., J.H. Dorfman, and J.B. Loomis. Estuary management and recreational fishing benefits. *Coastal Management* 32:417-432.	•			TCM – multi-site – regional/hedonic	CS of recreational fishing trips; benefits from estuary restoration and protection
Berrens, R.P., P. Ganderton, and C. Silva. 1996. Valuing the protection of minimum instream flows in New Mexico. *Journal of Agricultural and Resource Economics* 21(2):294-309.	•		•	CVM – dichotomous choice	Compensating variation; WTP for protection of instream flows to protect **silvery minnow** and eleven endangered and threatened fish species
Ekstrand, Earl R., and John B. Loomis. 1998. Incorporating respondent uncertainty when estimating willingness to pay for protecting critical habitat for threatened and endangered species. *Water Resources Research* 34(11):3149-55.			•	CVM – dichotomous choice	WTP for CHD for nine threatened and endangered fish species; incorporated respondent uncertainty (increases goodness of fit and decreases standard error of estimated WTP in one model)
Garber-Yonts, B., J. Kerkvliet, and R. Johnson. 2004. Public Values for biodiversity conservation policies in the Oregon Coast Range. *Forest Science* 50(5):589-602.			•	Conjoint analysis; CVM – dichotomous choice	WTP for four biodiversity conservation programs in the Oregon Coast Range; **salmon** conservation
Olsen, D., J. Richards, and R.D. Scott. 1991. Existence and sport values for doubling the size of Columbia River Basin salmon and steelhead runs. *Rivers* 2(1):44-56.	•		•	CVM – open-ended	WTP, WTA doubling of **salmon** and **steelhead** runs
Pate, Jennifer, and John Loomis. 1997. The effect of distance on willingness to pay values: a case study of wetlands and salmon in California. *Ecological Economics* 20:199-207.	•	•	•	CVM – dichotomous choice	Logit model used to study effects of geographic distance on respondents' WTP for the wetlands habitat and wildlife, wildlife contamination control, or river and **salmon** improvement programs

Table 5.2 continued...

Invertebrates (Insects and Crabs)	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Degenhardt, S., and Gronemann, S. 1998. The Willingness to Pay for Nature Conservation by Holiday Visitors to Goehren (Die Zahlungsbereitshaft von Urlaubsgästen für den Naturschutz). Peter Land GmbH, Frankfurt am Main.	•	•	•	CVM – open-ended	WTP for conservation program in Goehern and to protect the **Boloria aquilonaris butterfly**
Kremen, Claire, Neal M. Williams, and Robbin W. Thorp. 2002. Crop pollination from native bees at risk from agricultural intensification. *Proceedings of the National Academies of Science* 99(26):16812-16816.		•			Shows that the diversity of **bee** communities is needed for sufficient delivery of pollination services; does not value pollination function
MacDonald, H., D.W. McKenny, and V. Nealis. 1997. A bug is a bug is a bug: Symbolic responses to contingent valuation questions about forest pest control problems. *Canadian Journal of Forest Economics* 45:145-163.	•	•		CVM – open-ended	WTP for a biological spray or for a compensation fund to allow the infestation of **jack pine budworms** and **gypsy moths** to run its course
Manion, M.M., R.A. West, and R.E. Unsworth. 2000. Economic Assessment of the Atlantic Coast Horseshoe Crab Fishery, Report Prepared by Industrial Economics for U.S. FWS.	•	•	•	Actual expenditures/ market price of output; input-output model	Regional impacts of Atlantic Coast horseshoe crab fishery; value to wildlife viewing/birding enthusiasts, biomedical industry, commercial eel and conch pot fisheries; quantification of direct use values

Table 5.2 continued...

Reptiles	**Direct Use Values**	**Indirect Use**	**Non-Use Values**	**Valuation Method**	**Economic Measure & Additional Information**
Whitehead, J.C. 1992. Ex ante willingness to pay with supply and demand uncertainty: Implications for valuing a Sea Turtle Protection Programme. *Applied Economics* 24:981-988.	•		•	CVM – dichotomous choice	WTP to prevent **loggerhead sea turtle** extinction

Table 5.2 continued...

Mammals	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Adamowicz, W., P. Boxall, M. Williams, and J. Louviere. 1998. Stated preference approaches for measuring passive use values: Choice experiments and contingent valuation. *American Journal of Agricultural Economics* 80:64-75.			•	Choice experiment	Compensating variation and WTP for **woodland caribou** preservation program
Bandara, R., and C. Tisdell. 2005. Changing abundance of elephants and willingness to pay for their conservation. *Journal of Environmental Management* 76:47-59.			•	CVM – dichotomous choice	WTP for **elephant** conservation when changes above or below the current population occur
Bandara, R., and C. Tisdell. 2004. The net benefit of saving the Asian Elephant: A policy and contingent valuation study. *Ecological Economics* 48:93-107.			•	CVM – dichotomous choice	WTP for **elephant** conservation in two housing schemes
Bastian, C.T., L.W. VanTassell, A.C. Cotton, and M.A. Smith. 1997. Opportunity Costs of Wild Horses: An Allotment Case Study In Wyoming. Paper presented at the 1997 Annual Meeting of the Western Agricultural Economics Association. Reno/Sparks, Nevada.	•			BT; Actual expenditure/ market price of output	Impacts of **wild horse** population on recreational value of other wildlife and market value of livestock cattle; (foregone opportunity value) the number of animals and the opportunity cost for different levels of wild horses
Beeusaert, D.M. 1995. The Non-Consumptive Values of Wildlife in the Riding Mountain Area. M.N.R.M. Dissertation, Canada: The University of Manitoba.	•			CVM – payment card	WTP for non-consumptive uses of mammals in the reserve; **bison**, **black bear**, **elk**, **moose**, **white-tail deer** and others
Bulte, E.H. and G.C. Van Kooten. 1999. Marginal valuations of charismatic species: Implications for conservation. *Environmental and Resource Economics* 14:119-130.			•	BT	CS; WTP to ensure survival of **minke whale**; tests two sets of optimal population estimates
Bulte, Erwin, and G. C. Van Kooten. 2000. Economic science, endangered species, and biodiversity loss. *Conservation Biology* 14(1):113-19.	•	•	•	Actual expenditure/ market output price	Marginal preservation value; harvest of rainforest and **minke whale**; argues conservation effort should not be based on hypothetical markets solicited by human preferences; suggests using Safe Minimum Standard approach
Brookshire, D.S., L.S. Eubanks, and A. Randall. 1992. Estimating Option Prices and Existence Values for Wildlife Resources. *Environmental Economics: A Reader*. Edited by Anil Markandya and Julie Richardson, New York: St. Martin's Press, 112-128, 1992.	•		•	CVM – open-ended	Compensating variation; WTP; annual net benefits to certain hunters of **grizzly bear** & **bighorn sheep**; mean existence values from those wanting to observe

Table 5.2 continued...

Mammals	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Christenberry, Vanessa, Karyn Moskowitz, and Marty Bergoffen. 2002. Economic and Ecological Benefits of Critical Habitat Designation for the Appalachian Elktoe. Southern Appalachian Biodiversity Project. 30 pp.	•				Focuses on costs of designating critical habitat for **Appalachia elktoe**; direct use of habitat
Clayton, Creed, and Robert Mendelsohn. 1993. The value of watchable wildlife: A case study of McNeil River. *Journal of Environmental Management* 39(2):101-106.	•			CVM – dichotomous choice and open-ended	WTP to watch **grizzly bears** at the McNeil River falls, Alaska; compares different valuation questions to measure the consistency of responses
Cleveland, Cutler. J. et al. 2004. Estimation of the Economic Value of the Pest control Service Provided by the Brazilian Free-tailed Bat in the Winter Garden Region of South-Central Texas. *http://ecosystemmarketplace.net/documents/cms_documents/2004%20Cleveland%20NCEAS%20Bat%20Valuation.pdf*		•		Replacement costs	Value of cotton crop lost in absence of the **Brazilian free-tailed bat**; reduced cost of pesticide use attributable to bats' presence
Defenders of Wildlife. 2004. Economic Impact Assessment of Designating Critical Habitat for the Lynx (*Lynx Canadensis*). Report prepared for the Geraldine R. Dodge Foundation. Washington, DC: Defenders of Wildlife. 293pp.	•	•	•	Actual expenditures/ market price of output; BT – meta-analysis and point transfer	Costs and benefits from designating critical habitat for **lynx**; expect net benefits
Giraud, Kelly, Branka Turcin, John Loomis, and Joseph Cooper. 2002. Economic benefit of the protection program for the Steller sea lion. *Marine Policy* 26:451-58.			•	CVM	WTP for an expanded federal protection program for **stellar sea lion**
Hoyt, Erich. 2001. Whale Watching 2001: Worldwide tourism numbers, expenditures, and expanding socioeconomic benefits. International Fund for Animal Welfare, Yarmouth Port, MA, USA, pp. i-vi; 1-158.	•			Actual expenditures/ market price output	Direct expenditures from ticket sales; total economic value of **whale** watching for some cases
Jakobsson, Kristin M., and Andrew K. Dragun. 2001. The worth of a possum: valuing species with the contingent valuation method. *Environmental and Resource Economics* 19:211-27.			•	CVM	WTP and WTA for conservation of **Leadbeater's possum** in the State of Victoria, Australia
Kontoleon, A., and T. Swanson. 2003. The willingness to pay for property rights for the giant panda: Can a charismatic species be an instrument for nature conservation? *Land Economics* 79(4):483-499. *http://www.cserge.ucl.ac.uk/Kontoleon%20and%20Swanson%202003.pdf*			•	CVM – iterative bidding	WTP for various **giant panda** conservation scenarios (non-residents of China)
Kroeger, Timm. 2005. Economic benefits of reintroducing the River otter (*Lontra Canadensis*) into rivers in New Mexico. Report prepared for Amigos Bravos. February 2005. 32pp.	•		•	BT – meta-analysis	Benefits from reintroducing the **River otter** for different spatially defined populations of beneficiaries
Loomis, John B. 2005. Economic benefits of expanding California's Southern Sea Otter population. Report prepared for Defenders of Wildlife. December, 2005.	•	•	•	Actual expenditure/ market price output; BT – meta-analysis	WTP and meta-analysis (existence value) for the **sea otter**; indirect value to kelp forests; costs to commercial fishing

Table 5.2 continued...

Mammals	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Macmillan, D.C., E. Duff and D.A. Elston. 2001. Modelling the Non-Market Environmental Costs and Benefits of Biodiversity Projects Using Contingent Valuation Data. *Environmental and Resource Economics* 18(4):391-410.	•	•	•	CVM – dichotomous choice	Restoration of large contiguous area of native woodland and reintroduction of **beaver** and **wolf**; estimates WTP and WTA for six different biodiversity projects
Ninan, K. N., and J. Sathyapalan. 2005. The economics of biodiversity conservation: A study of a coffee region in the Western Ghats of India. *Ecological Economics* 55:61-72.	•		•	CVM – dichotomous choice	WTP for participatory **elephant** conservation
Samples, Karl C., John A. Dixon and Marcia M. Gowen. 1986. Information Disclosure and Endangered Species Valuation. *Land Economics* 62(3):306-312.	•		•	CVM – open-ended	WTP for **humpback whale** preservation
Solomon, B.D., C.M. Corey-Luse, and K.E. Halvorsen. 2004. The Florida manatee and eco-tourism: Toward a Safe Minimum Standard. *Ecological Economics* 50:101-115.	•	•	•	CVM; Safe Minimum Standard	WTP for non-market benefits of **Florida manatee** preservation; estimate market values (aquatic plant removal, ecotourism dollars, park jobs)
Swanson, T., S. Muorato, J. Swierzbinski, and A. Kontoleon. 2002. Conflicts in Conservation: The Many Values of the Black Rhinoceros. *Valuing the Environment in Developing Countries: Case Studies.* Edited by David Pearce, Corin Pearce, and Charles Palmer, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, 2002.	•	•	•	CVM – open-ended	WTP for **Namibian black rhinoceros** conservation and various management scenarios
Thomas, M.,and N. Stratis. 2002. The cost of manatee protection: A compensating variation approach to lost boating opportunity in Florida. *Marine Resource Economics* 17(1):23-35.	•			TCM – RUM	Compensating variation – value of lost boating opportunities for recreational boaters, thus protection of the **Florida manatee**
Tisdell, C., C. Wilson, and H.S. Nantha. 2005. Policies for saving a rare Australian glider: Economics and ecology. *Biological Conservation* 123:237-248,			•	CVM – open-ended	WTP for **mahogany glider** conservation
White, Piran C. L., Alison C. Bennett, and Emma J. V. Hayes. 2001. The use of willingness-to-pay approaches in mammal conservation. *Mammal Review* 31(2):151-67.			•	CVM	WTP for UK Biodiversity Action Plans for four different British mammal species: **red squirrel**, **brown hare**, **otter**, **water vole**
White, Piran C. L., Keith W. Gregory, Patrick J. Lindley, and Glenn Richards. 1997. Economic values of threatened mammals in Britain: a case study of the otter *Lutra lutra* and the water vole *Arvicola terrestris*. *Biological Conservation* 82:345-54.			•	CVM – dichotomous choice	WTP to conserve the **otter** and **water vole** and their habitat

Table 5.2 continued...

Wolves	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Red Wolves (*Canis Rufus*)					
Lash, Gail Y.B., and Pamela Black. 2005. Red Wolves: Creating Economic Opportunity Through Ecotourism in Rural North Carolina. Report for Defenders of Wildlife, Washington, DC. February 2005.	•		•	Community survey	Residents' capacity to supply red wolf and wildlife tourism; demand of tourists coming to the region for the proposed activities and attractions
Rosen, William E. 1997. Red Wolf Recovery in Northeastern North Carolina and the Great Smoky Mountains National Park: Public Attitudes and Economic Impacts. Report submitted to the U.S. Fish and Wildlife Service and the Point Defiance Zoo and Aquarium.	•			Community survey	Estimates the potential annual increase in tourist revenue due to the wolves' presence
Gray Wolves (*Canis Lupus*)					
Aquino, Helen L., and Constance L. Falk. 2001. A case study in the marketing of "Wolf-Friendly" beef. *Review of Agricultural Economics* 23(2):524-537.			•	Actual expenditure/ market price output; Survey	Analysis of a market test of "wolf-friendly" beef; WTP for beef products that foster predator preservation
Chambers, Catherine M., and John C. Whitehead. 2003. A contingent valuation estimate of the benefits of wolves in Minnesota. *Environmental and Resource Economics* 26:249-267.	•		•	CVM	WTP for wolf management and wolf damage plan in Minnesota; plans have benefits estimated larger than costs
Duffield, J. W. 1992. An economic analysis of wolf recovery in Yellowstone: Park visitor attitudes and values. Pp. 2-35 to 2-85 in J.D. Varley and W. G. Brewster (eds.) *Wolves for Yellowstone?* A Report to the United States Congress, Vol. 4, Research and Analysis. NPS, Yellowstone NP.				CVM	Estimates the net annual benefits of wolf recovery to park visitors; net social benefits and regional net economic impacts
Duffield, J. W. and C. J. Neher. 1996. Economics of wolf recovery in Yellowstone National Park. Trans. 61st No. American Wildlife and Natural Resources Conference, pp. 285-292.	•		•	Replacement costs; Actual expenditures/ market price of output	Costs and benefits; effects on hunting, livestock depredation, visitor use, existence values land use restrictions
Frederick, S. and B. Fischhoff. 1997. Magnitude Insensitivity in Elicited Valuations: Examining Conventional Explanations. Department of Social and Decision Sciences, Carnegie Mellon University.			•	CVM – open-ended	Three scenarios of reintroduction; studies the sensitivity of stated WTP values to changes in magnitude of good being considered
Manfredo, M. J., A. D. Bright, J. Pate, and G. Tischbein. 1994. Colorado residents' attitudes and perceptions toward reintroduction of the gray wolf (*Canis lupus*) into Colorado. (Project Rep. No. 21). Project Rep. for the U.S. Fish and Wildlife Service. Fort Collins: Colorado State University, Human Dimensions in Natural Resources Unit. 92 pp.			•		Determines the public's attitude toward the reintroduction of the gray wolf in Colorado and what factors influence their attitudes
Ripple, W. J., E.J. Larsen, R.A. Renkin, and D.W. Smith. 2001. Trophic Cascades among Wolves, Elk, and Aspen on Yellowstone National Park's Northern Range. *Biological Conservation* 102:227-334.		•			Describes the progression of indirect effects by wolves across successively lower trophic levels

Table 5.2 continued...

Multiple Species	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
An, M. Y. 2000. A Semiparametric Distribution for Willingness to Pay and Statistical Inference with Dichotomous Choice Contingent Valuation Data. *American Journal of Agricultural Economics* 82:487-500.	•			CV – dichotomous choice	WTP for protecting wetland habitats and wildlife in San Joaquin Valley, California; two different models and two different levels of data
Atakelty, H., V. Adamowicz, and P. Boxall. 2000. Complements, substitutes, budget constraints and valuation. *Environmental and Resource Economics* 16:51-68.		•	•	CVM – dichotomous choice	WTP for combined habitat and endangered species preservation programs; **woodland caribou**, **burrowing owl**, **bull trout**
Bishop, R.C., K.J. Boyle, and M.P. Welsh. 1987. Toward total economic valuation of Great Lakes fishery resources. *Transactions of the American Fisheries Society* 116:339-345.	•		•	CVM – dichotomous choice	WTP to preserve **bald eagles** and **striped shiners** among Wisconsin residents; Wisconsin and Milwaukee River
Coursey, D. 1994. The Revealed Demand for a Public Good: Evidence from Endangered and Threatened Species. American Association for the Advancement of Science.			•	Regression model – public expenditure as function of species mean importance, size, interference with development, when endangered/threatened, type	Implied public value of endangered and threatened species; estimates implied value of one additional species member saved or one additional acre of protected habitat
Fredman, Peter, and Mattias Boman. 1996. Endangered species and optimal environmental policy. *Journal of Environmental Management* 47:381-89.			•	CVM	WTP for **wolves** and **white-backed** woodpecker; choice between Pigouvian taxes and quantitative permits depends on the endangered species considered
Giraud, K., J. B. Loomis, and R. Johnson. 1999. Internal and external scope in willingness-to-pay estimates for threatened and endangered wildlife. *Journal of Environmental Management* 56:221-229.			•	CVM – dichotomous choice	Internal and external scope tests; is not decisive as to which method is best (sensitivity to scale and scope); WTP to protect the **Mexican spotted owl** and WTP for 62 threatened and endangered species simultaneously
Halstead, J.M., A.E. Luloff and T.H. Stevens. 1992. Protest bidders in contingent valuation. *Northeast Journal of Agricultural and Resource Economics* 21(2):160-169.	•		•	CVM – dichotomous choice and open-ended	WTP for preservation of **bald eagles, coyotes**, and **wild turkeys** in New England; suggests that exclusion of protest bids may bias WTP results

Table 5.2 continued...

Multiple Species	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Kotchen, Matthew J., and Stephen D. Reiling. 2000. Environmental attitudes, motivations, and contingent valuation of nonuse values: A case study involving endangered species. *Ecological Economics* 32(1):93-107.			•	CVM – dichotomous choice	Examines interplay of environmental attitudes, nonuse CV responses, and underlying motivations; WTP to protect the **peregrine falcon** and **Shortnose sturgeon**
Loomis, John B., and Douglas S. White. 1996. Economic benefits of rare and endangered species: summary and meta-analysis. *Ecological Economics* 18:197-206.	•	•	•	Meta-analysis regression	Review of valuation studies of threatened and endangered species; identifies variables which explain variations in values
Rogers, M.F. and J.A. Sindin. 1994. Safe Minimum Standard for environmental choices: Old-growth forest in New South Wales. *Journal of Environmental Management* 41:89-103	•		•	Conjoint analysis	Willingness to forego jobs and regional income for protection of species and their habitat
Stevens, Thomas H., Jaime Echeverria, Ronald J. Glass, Tim Hager, and Thomas A More. 1991. Measuring the existence value of wildlife: What do CVM estimates really show? *Land Economics* 67(4):390-400.			•	CVM – dichotomous choice and open-ended	Value of the **Atlantic salmon** restoration program to Massachusetts residents; value of **bald eagles**, **wild turkeys,** and **coyotes** in New England
Whitehead, J.C. 1993. Total Economic Values for Coastal and Marine Wildlife: Specification, Validity, and Valuation Issues. *Marine Resource Economics* 8(2):119-132.	•		•	CVM – dichotomous choice	WTP for preservation of the **loggerhead sea turtle** and nine species of endangered marine wildlife
Kahneman, D., and I. Ritor. 1994. Determinants of stated willingness to pay for public goods: A study in the headline method. *Journal of Risk and Uncertainty* 9(1):5-38.	•	•	•	CVM – open-ended	WTP for multiple animal species, plant species, alleviation of ecological damages, public goods, public health

Table 5.3: Economic Valuation of Roadless and Open Space Areas

Roadless Areas and Open Space	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Anderson, Soren T., and Sarah E. West. 2006. Open space, residential property values, and spatial context. *Regional Science and Urban* Economics, Forthcoming. http*://www.macalester.edu/~wests/index.htm.*	•			Hedonic-pricing model	Proximity to parks; proximity to parks has a positive effect on home values in the city; insignificant in suburbs
Benson, E.D., J.L. Hansen, A.L. Schwartz, Jr., and G.T. Smersh. 1998. Pricing residential amenities: The value of a view. *Journal of Real Estate Finance and Economics* 16(1):55-73.	•			Hedonic-pricing model	Values of ocean, lake, and mountain views
Blaine, T.W., and F.R. Lichtkoppler. 2004. Willingness to pay for green space preservation: A comparison of soil and water conservation district clientele and the general public using the contingent valuation method. *Journal of Soil and Water Conservation* 59(5):203-208.	•		•	CVM – dichotomous choice	WTP for conservation easements
Brown, Thomas C., Patricia A. Champ, Richard C. Bishop, and Daniel W. McCollum. 1996. Which response format reveals the truth about donations to a public good? *Land Economics* 72(2):152-66.			•	CVM – dichotomous choice and open-ended	Value of removing roads along North Rim of Grand Canyon NP; WTP estimated under four conditions to test why the dichotomous choice format yields larger estimates of hypothetical WTP than the open-ended format
Cameron, T.A., and J. Quiggin. 1994. Estimation using contingent valuation data from a dichotomous choice with follow up questionnaire. *Journal of Environmental Economics and Management* 27:218-234.	•		•	CVM – iterative bidding	WTP to prevent mining
Carson, R.T., L. Wilks, and D. Imber. 1994. Valuing the preservation of Australia's Kakadu Conservation Zone. *Oxford Economic Papers* 46:727-749.	•		•	CVM – dichotomous choice	WTP for preservation of a zone slated for mining development; major and minor impact scenarios
Champ, P. A., R. C. Bishop, T. C. Brown, and D. W. McCollum. 1997. Using donation mechanisms to value nonuse benefits from public goods. *Journal of Environmental Economics and Management* 33(2):151-162.			•	CVM – dichotomous choice	CS; WTP of Wisconsin residents to remove roads from the Grand Canyon's northern rim
Curley, Keith, and David Petersen. 2006. Where the Wild Lands Are: Colorado: The Importance of Roadless Areas to Colorado's Fish, Wildlife, Hunting and Angling. Trout Unlimited. January 2006.	•			Actual expenditure/ market price of output	Measures statewide impact of hunting and fishing; trip-related expenditures, jobs from hunting and fishing
Espey, Molly, and Kwame Owusu-Edusei. 2001. Neighborhood parks and residential property values in Greenville, South Carolina. *Journal of Agricultural and Applied Economics* 33(3): 487-492.	•			Hedonic-pricing model	Estimates impact of proximity to different types of parks to housing prices
Earnhart, Dietrich. 2001. Combining revealed and stated preference methods to value environmental amenities at residential locations. *Land Economics* 77(1):12-29.	•			Hedonic pricing coupled w/ CV (conjoint analysis)	Examines impact of presence and quality of environmental amenities on house prices

Table 5.3 continued...

Roadless Areas and Open Space	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Earnhart, Dietrich. 2006. Using contingent-pricing analysis to value open space and its duration at residential locations. *Land Economics* 82(1):17-35.	•			Contingent-pricing analysis (CV coupled w/ conjoint analysis)	Examines importance of duration of open space on price premiums
Fausold, Charles, and Robert Lilieholm. 1996. The Economic Value of Open Space: A Review and Synthesis, 32 pp. Cambridge, MA: Lincoln Institute of Land Policy.	•	•	•		Review of market and enhancement values, production, natural systems, use and non-use values
Fleischer, A., and Y. Tsur. 2000. Measuring the recreational value of agricultural landscape. *European Review of Agricultural Economics* 27(3):385-398.	•		•	TCM – single-site; CVM	CS associated with visiting agricultural landscapes
Geoghegan, Jacqueline. 2002. The value of open spaces in residential land use. *Land Use Policy* 19(1):91-98.	•			Hedonic-pricing model	Residential land near “permanent” open space is valued higher than that near “developable” open space
Geoghegan, Jacqueline, Lori Lynch, and Shawn Bucholtz. 2003. Capitalization of open spaces into housing values and the residential property tax revenue impacts of agricultural easement programs. *Agricultural and Resource Economics Review* 32(1):33–45.	•			Hedonic-pricing model	Value of open space purchased through agricultural preservation programs in three Maryland counties to nearby residents
Irwin, Elena G. 2002. The effects of open space on residential property values. *Land Economics* 78(4):465-480.	•			Hedonic-pricing model	Tests for the marginal effects of different types of open space land uses on the value of neighboring residential properties in central Maryland
Kiker, Clyde F., and Alan W. Hodges. 2002. Economic benefits of natural land conservation: Case study of Northeast Florida. Final Report submitted to Defenders of Wildlife. Institute of Food and Agricultural Sciences, Food and Resource Economics Dept. Gainesville: University of Florida.	•	•	•	Actual expenditure/ market price of output; IMPLAN input-output model	Case study of economic benefits of natural lands in Duval, Clay, St. Johns and Putnam Counties
Loomis, John B., and Robert Richardson. 2000. Economic Values of Protecting Roadless Areas in the United States. Washington, DC: The Wilderness Society. 34pp.	•	•	•	TCM; CVM; Actual expenditure/ market output price; IMPLAN input-output model	Review of recreation, community, passive use, scientific, biodiversity, off-site, ecosystem services and educational values
Loomis, John B., and Robert Richardson. 2001. Economic values of the U.S. Wilderness System. Research evidence to date and questions for the future. *International Journal of Wilderness* 7(1):31-34.	•	•	•		Review of economic values from the protection of wilderness; eight categories
Lutzenhiser, Margot, and Noelwah Netusil. 2001. The effect of open spaces on a home’s sale price. *Contemporary Economic Policy* 19(3):291-298.	•			Hedonic-pricing model with a zonal approach	Benefits to Portland, OR homeowners from proximity to open spaces; defines three types of open space

Table 5.3 continued...

Roadless Areas and Open Space	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
McConnell, Virginia, and Margaret Walls. 2005. The value of open space: Evidence from studies of nonmarket benefits. Washington, DC: Resources for the Future. January, 2005. 78 pp.	•		•	Revealed preference and stated preference methods	Review more than 60 published articles that estimate value of different types of open space
McVittie, A., N. Hanley and D. Oglethorpe. 2001. Choice experiments, benefits transfer and the design of agri-environmental policy. Welsh Institute of Rural Studies, Ecosystem Valuation Literature.	•	•		CVM – dichotomous choice	WTP for various increases of ancient or new hedgerows, field margins, and heather moorland
National Association of Realtors. 2001. NAR Survey Shows Public Support for Open Space Depends on Use and Cost. *http://www.realtor.org/SG3.nsf/Pages/mngrtpresssurvey?OpenDocument*	•				Describes the public's support for open space when land is used for parks, play areas, and walking trails rather than golf courses; support depends on how the creation of open space is paid for
Power, Thomas M. 2000. The Economic Impact of Preserving Washington's Roadless National Forests. June 13, 2000. Missoula: University of Montana. 72pp.	•			Actual expenditure/ market output price	Impact of reduced timber harvest
Ready, Richard C., and Charles W. Abdalla. 2003. GIS analysis of land use on the rural-urban fringe: The impact of land use and potential local disamenities on residential property values and on the location of residential development in Berks County, Pennsylvania. Staff Paper 364. Final Report, June 2003. Pennsylvania State University, Department of Agricultural Econmomics and Rural Sociology.	•			GIS-based hedonic-pricing model	Benefits and costs that residents enjoy or suffer from alternate land-use patterns; GIS analysis allows for estimating the marginal impact of open space near or far from property
Ready, Richard C., and Charles W. Abdalla. 2005. The amenity and disamenity impacts of agriculture: estimates from a hedonic pricing model. *American Journal of Agricultural Economics* 87(2):314-326.	•			GIS-based hedonic pricing model	Shows that agricultural open space increases nearby residential property values; larger-scale animal operations and mushroom production decrease values
Scott, R.D. 1992. An Hedonic Model of Preservation Value Components: A Contingent Valuation Study of the Black Canyon of the Upper Snake River. Dissertation, Washington State University.	•		•	CVM – dichotomous choice	Equivalent surplus; WTP for preservation/development
Willis, K.G., and J.F. Benson. 1988. A Comparison of user benefits and costs of nature conservation at three nature reserves. *Regional Studies* 22(5):417-428.	•			TCM – multi-site – regional/hedonic	CS for one wildlife-related visit to a nature reserve; compares TCM benefits and costs of three nature reserve sites

Table 5.4: Economic Valuation of Recreational Activities

Recreation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Aiken, R., and G.P. La Rouche. 2003. Net Economic Value for Wildlife-Related Recreation in 2001: Addendum to the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation. U.S. Fish and Wildlife Service Report 2001-3.	•			CVM – open-ended	WTP for deer, elk and moose hunting; bass, trout and walleye fishing, and wildlife watching
Akuba, K., W. Adamowixcz, W. Phillips, and P. Trelawny. 1996. A Random Utility Model with Uncertain (Lotter-Rationed) Choice Data: A Utility Nonmarket Valuation of Recreational Hunting. Unpublished Draft Paper. Department of Rural Economy. University of Alberta.	•			TCM – CS	Value of moose hunting in Newfoundland; uncertain hunting choice data
Alberini, A. and Zannatta, V. 2005. Combining Actual and Contingent Behaviour to Estimate the Value of Sports Fishing in the Lagoon of Venice. Nota Di Lavoro 44.2005.	•			TCM – single-site; CVM – iterative bidding	Welfare improvement among recreational anglers related to a 50% increase in catch rate, due to reduced pollutant discharge
American Sportfishing Association. 2002. Sportfishing in America. 12 pp. *http://www.asafishing.org/asa/images/statistics/participation/sportfishing_america/fish_eco_impact.pdf*	•			Actual expenditures/ market output price	Total attendance, visitor spending, output and new sales, employment
American Sportfishing Association. 2006. State and National Economic Impacts of Fishing, Hunting, and Wildlife-Related Recreation on U.S. Forest Service-Managed Lands. Wildlife, Fish and Rare Plants, U.S. Forest Service, U.S. Department of Agriculture. January 23, 2006.	•			Actual expenditures/ market output price	Conservative estimate of expenditures within 50 miles of each USFS unit; estimate of all expenditures for wildlife-related trips within a state
Andersson, J. 2003. The Recreational Cost of Coral Bleaching - A Stated and Revealed Preference Study of International Tourists. Discussion Paper 181, Beijer International Institute of Ecological Economics - the Royal Swedish Academy of Sciences.	•			TCM – single site; CVM – open-ended	Compensating variation; WTA for degradation of reefs, WTP for access to Zanzibar and Mafia
Asafu-Adjaye, John, W. Phillips and W. Adamowicz. 1989. Towards the Measurement of Total Economic Value: The Case of Wildlife Resources in Alberta, Rural Economy Staff Paper #89-16, Department of Rural Economy, University of Alberta.	•	•	•	CVM – payment card	Mean annual aggregate use and preservation values for big game and grizzly bear hunting
Azevedo, C. D., J. A. Herriges and C. L. Kling. 2003. Combining revealed and stated preference: Consistency tests and their interpretations. *American Journal of Agricultural Economics* 85(3):525-537.	•		•	Combined revealed and stated preference	CS for recreational trips to Iowa wetlands; inconsistency between stated and revealed preference CS values; suggests a need for more research to combine each method's strength for a more accurate valuation method
Balkan, E and J.E. Khan. 1988. The value of changes in deer hunting quality: A travel cost approach. *Applied Economics* 20:533-539.	•			TCM – single-site	CS for value of deer hunting and value changes as quality changes

Table 5.4 continued...

Recreation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Bateman, I.J. and A.P. Jones. 2003. Contrasting Conventional with Multi-Level Modelling Approaches to Meta-Analysis: Expectation Consistency in UK Woodland Recreation Value. *Land Economics* 79(2):235-258.	•			BT – meta-analysis; multi-level modeling (MLM)	WTP derived from 30 studies, 1970 - 1998, containing estimates for woodland recreation value; suggests that correct specification matters; suggests that MML technique may be more robust than conventional meta-analysis
Bell, Frederick W. 1981. Recreational Benefits for the Atchafalaya River Basin. Prepared for U.S. Fish and Wildlife Service, Washington, D.C., Contract Number 14-16-009-80-009, 1981, pp. 228.	•			TCM – multi-site – regional/hedonic; CVM – open-ended	Net CS for fresh and saltwater fishing; WTP for fresh and saltwater fishing and hunting
Bell, F.W. 1997. The economic valuation of saltwater marsh supporting marine recreational fishing in the Southeastern United States. *Ecological Economics* 21:243-254.	•			BT	Benefits to estuarine-dependent recreational fisheries; annual value of marginal consumer surplus per acre of wetland
Bennear, L.S., R.N. Stavins, and A.F. Wagner. 2004. Using Revealed Preferences to Infer Environmental Benefits: Evidence from Recreational Fishing Licenses. John F. Kennedy School of Government, Harvard University.	•			Actual expenditure/ market price of output	Freshwater recreational fishing days; sales of residential annual state licenses
Bennet, M., B. Provencher, and R. Bishop. 2004. Experience, Expectation and Hindsight: Evidence of a Cognitive Wedge in Stated Preference Retrospectives. University of Wisconsin-Madison Department of Agricultural and Applied Economics.	•			Combined revealed and stated preference	WTP for recreational fishing trips; shows a systematic difference between valuations made before and after trip outcomes
Bergstrom, J.C., J.H. Dorfman, and J.B. Loomis. Estuary management and recreational fishing benefits. *Coastal Management* 32:417-432.	•			TCM – multi-site – regional/hedonic	CS of recreational fishing trips; benefits from estuary restoration and protection
Bergstrom, John C., and Paul De Civita. 1999. Status of benefits transfer in the United States and Canada: A review. *Canadian Journal of Agricultural Economics* 47(1):79-87.	•	•	•	BT	Reviews current status of BT applications by US and Canadian government agencies; overview of major BT methods, applications, and implications
Bhat, M.G. 2003. Application of non-market valuation to the Florida Keys Marine Reserve management. *Journal of Environmental Management* 67:315-325.	•			Combined revealed and stated preference; TCM – single-site	CS for three improved coral reef quality scenarios; nature-based tourism
Bin, O., C.E. Landry, C.L. Ellis, and H. Vogelsong. 2004. Some Consumer Surplus Estimates for North Carolina Beaches. Department of Economics, East Carolina University.	•			TCM – single-site	CS of beach recreation

Table 5.4 continued...

Recreation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Boxall, P.C. 1995. The economic value of lottery-rationed recreational hunting. *Canadian Journal of Agricultural Economics* 43(4):119-131.	•			TCM	Compensating variation; (extractive use) value of a series of pronghorn antelope hunting sites; calculates welfare loss by closing the site and welfare loss associated with quality changes
Boxall, Peter C., Wiktor L. Admomowicz, and Theodore Tomasi. 1996. A nonparametric test of the traditional Travel Cost Model. *Canadian Journal of Agricultural Economics* 44:183-193.	•			TCM – multi-site – regional/hedonic; Combined revealed and stated preference	Estimates cost of hunting trips (bighorn sheep); tests traditional TCM and its assumptions made about individual choices regarding the number of trips to various sites
Boyle, K.J., B. Roach, and D.G. Waddington. 1998. 1996 Net Economic Values for Bass, Trout and Walleye Fishing, Deer, Elk, and Moose Hunting and Wildlife Watching: Addendum to the 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation. U.S. Fish and Wildlife Service Report 96-2.	•			CVM – dichotomous choice	WTP for fishing, hunting, and wildlife-watching
Boyle, K. J., H. F. MacDonald, H. Cheng, and D. W. McCollum. 1998. Bid design and Yea saying in single-bounded, dichotomous-choice questions. *Land Economics* 74(1):49-64.	•			CVM – dichotomous choice	WTP for moose hunting; tests the effect of bid structures in welfare estimates using the pretest distributions and three bid structures
Brookshire, D.S., L.S. Eubanks, and A. Randall. 1992. Estimating Option Prices and Existence Values for Wildlife Resources. *Environmental Economics: A Reader*. Edited by Anil Markandya and Julie Richardson, New York: St. Martin's Press, 112-128, 1992.	•		•	CVM – open-ended	Compensating variation; WTP; annual net benefits to certain grizzly bear and bighorn sheep hunters; mean existence values from those wanting to observe
Buschena, D. E., T. L. Anderson, and J. L. Leonard. 2001. Valuing non-marketed goods: The case of elk permit lotteries. *Journal of Environmental Economics and Management* 41(1):33-43.	•			Actual expenditure/ market price of output	Marginal WTP for Colorado Elk hunting permit inferred from OC incurred to acquire the permits
California Department of Parks and Recreation, Marketing Division. 2001. Economic Impacts on Local Communities by Visitors to California State Parks from 1999-2002: An Update of the 1995 Analysis. Oct. 2001.	•			Actual expenditure/ market price of output	Visitor attendance and spending, output and new sales, employment
California Department of Parks and Recreation, Off Highway Motor Vehicle Recreation Division. 1994. Off Highway Vehicle (OHV) Recreations' $3 Billion Economic Impact in California & A Profile of OHV Users: A Family Affair. 26 pp.	•			Actual expenditure/ market price of output	Overview and impacts of OHV users in California
Carr, L., and R. Mendelsohn. 2003. Valuing coral reefs: A travel cost analysis of the Great Barrier Reef. *Ambio* 32(5):353-357.	•	•		TCM – single-site	Compensating surplus value of tourism brought by the Great Barrier Reef, Australia among visitors

Table 5.4 continued...

Recreation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Caudill, James, and Erin Henderson. 2005. Banking on Nature 2004: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. Division of Economics, U.S. Fish and Wildlife Service, September 2005.	•			Actual expenditures/ market price of output; IMPLAN input-output model	Final demand, employment, income and tax revenue effects of refuge visitors on local economies; hunting, fishing, ecotourism
Chang, Wen-Huei. 1998. Potential Bias of Using IMPLAN Type III Multipliers for Assessing Economic Impacts of Tourism Spending: A Comparison of IMPLAN and RIMS II Multipliers for the State of Michigan. (*http://www.msu.edu/user/changwe4/implan/compare.htm#t2*, accessed Dec. 2003).	•				Compares IMPLAN and RIMS II output multipliers; indirect and induced effects in other sectors that result from a change in output in a given sector
Clayton, Creed, and Robert Mendelsohn. 1993. The value of watchable wildlife: A case study of McNeil River. *Journal of Environmental Management* 39(2):101-106.	•			CVM – dichotomous choice and open-ended	WTP to watch grizzly bears at the McNeil River falls, Alaska; compares different valuation questions to measure the consistency of responses
Curley, Keith, and David Petersen. 2006. Where the Wild Lands Are: Colorado: The Importance of Roadless Areas to Colorado's Fish, Wildlife, Hunting and Angling. Trout Unlimited. January 2006.	•			Actual expenditure/ market price of output	Measures statewide impact of hunting and fishing, trip-related expenditures, jobs from hunting and fishing
Damery, D.T., and G.P. Allen. 2004. An Economic Valuation of Recreational Shellfishing On Cape Cod. University of Massachusetts Amherst Department of Resource Economics Working Paper no. 2004-10.	•			Actual expenditure/ market price of output	Value of recreational shellfishing rights; CS; surveyed WTP for the right to shellfish, WTA to give up the right
Eckton, G.D.C. 2003. Road-user charging and the Lake District National Park. *Journal of Transport Geography* 11:307-317.	•			CVM - dichotomous choice (residents, visitors); CVM - open-ended (business owners)	WTP, WTA; estimates value associated with and entrance fee (road-user charge to ease vehicle congestion)
Englin, J., and K. Moeltner. 2004. The value of snowfall to skiers and boarders. *Environmental and Resource Eco*nomics 29:123-136.	•			TCM	Compensating variation, CS value of skiing and boarding
English, Burton C., Jamey Menard, and Kim Jensen. 2002. Estimated economic impact of Off-Highway vehicle special events. Industry Brief. Department of Agricultural Economics, University of Tennessee.	•			Actual expenditures/ market price of output	Per-capita trip expenditures of participants in special motor sport events
Fadali, E., and W.D. Shaw. 1998. Can recreation values for a lake constitute a market for banked agricultural water? *Contemporary Economic Policy* 16(4):433-441.	•			TCM – count data model	WTP to avoid loss of lakes popular for fishing
Filion, F.L., A. Jacquemot, E. DuWors, R. Reid, P. Boxall, P. Bouchard, P.A. Gray, and A. Bath. 1994. The Importance of Wildlife to Canadians: The Economic Significance of Wildlife-Related Recreational Activities in 1991. Canadian Wildlife Service, Environment Canada.	•			CVM – payment card; Actual expenditure; market price of output	WTP for wildlife-related activities; estimates of annual wildlife-related expenditures and economic impacts

Table 5.4 continued...

Recreation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Hoyt, Erich. 2001. Whale Watching 2001: Worldwide tourism numbers, expenditures, and expanding socioeconomic benefits. International Fund for Animal Welfare, Yarmouth Port, MA, USA, pp. i-vi; 1-158.	•			Actual expenditures/ market price output	Direct expenditures from ticket sales; total economic value of whale watching for some cases
Johns, G.M., V.R. Leeworthy, F.W. Bell and M.A. Bonn. 2001. Socioeconomic Study of Reefs in Southeast Florida 2000-2001: Final Report, October 19, 2001 as revised April 18, 2003. Final report submitted to Broward County, Palm Beach County, Miami-Dade County, Monroe county, Florida Fish and wildlife Conservation *http://marineeconomics.noaa.gov/Reefs/02-01.pdf*	•			Actual expenditure/ market price of output	Direct, indirect, and induced economic impact of reef-related recreational activities
Loomis, John B. 1995. Four models for determining environmental quality effects on recreational demand and regional economics. *Ecological Economics* 12:55-65.	•			BT	Presents statistical techniques for modeling each of four recreation choice decisions
Loomis, John. 2005. Updated outdoor recreation use values on national forests and other public lands. Gen. Tech. Rep. PNW-GTR-658. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.	•			CVM; TCM	Emphasis on Pacific Northwest forests; database from 1967-2003; averages of values per day from original CVM or TCM studies
Loomis, John, and Richard Walsh. 1997. *Recreation Economic Decisions: Comparing benefits and costs.* 2nd Ed. Venture Publishing, Inc. State College, PA.	•				Introduction to cost-benefit analysis of public recreation projects and programs
Lutz, J., J. Englin, and J.S. Shonkwiler. 2000. On the aggregate value of recreational activities: A nested price index approach using Poisson demand systems. *Environmental and Resource Economics* 15:217-226.	•			TCM – multi-site, regional/hedonic	Individual and aggregate value of overnight backcountry recreational hiking in wilderness areas of the Sierra Nevada mountain region
National Parks Conservation Organization. 2003. Economic impact of visitor spending in California's National Parks. Oakland, CA: NPCA. November, 2003.	•			Actual expenditure/ market output price	Visitor expenditures
Piper, Steven. 1997. Regional Impacts and Benefits of Water-Based Activities: An Application in the Black Hills Region of South Dakota and Wyoming. Impact Assessment, Vol. 15, pp. 335-359.	•			TCM; BT; Actual expenditure/ market price of output	Estimates of regional impacts of irrigated agriculture, water-based recreation, and municipal water supplies to households; potential marginal effects from changes in water supplies presented
Rockel, Mark L., and Mary Jo Kealy. 1991. The value of nonconsumptive wildlife recreation in the United States. *Land Economics* 67(4):422-34.	•			TCM – multi-site, regional/ hedonic	CS; WTP for access to nonconsumptive wildlife recreation

Table 5.4 continued...

Recreation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Rosenberger, R. and J. Loomis. 2001. Benefit Transfer of Outdoor Recreation Use Values: A Technical Document Supporting the Forest Service Strategic Plan (2000 Revision). RMRS-GTR-72. Rocky Mountain Research Station, USDA Forest Service, Fort Collins, CO. *http://marineeconomics.noaa.gov/bibsbt/Benefits_Transfer_Guide.pdf*	•				Bibliography of outdoor recreational use valuation studies
Rudzitis, G., and R. Johnson. 2000. The impact of wilderness and other wildlands on local economies and regional development trends. In S. F. McCool, D. N. Cole, W. T. Borrie, J. O'Loughlin, compilers. Wilderness science in a time of change conference—Volume 2: Wilderness in the context of larger systems; 1999 May 23-27; Missoula, MT. Proceedings RMRS-P-15-VOL-2:14-26. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT.	•			Actual expenditure/ market price of output	Reports recreation expenditures on selected Western wilderness lands
Seenprachwong, U. 2001. An Economic Analysis of Coral Reefs in the Andaman Sea of Thailand. Economy and Environment Program for Southeast Asia, International Development Research Centre.	•	•	•	TCM – single-site; CVM – dichotomous choice	CS associated with recreational services of coral reefs (domestic and foreign visitors)
Shrestha, Ram K., and John B. Loomis. 2003. Meta-analytic benefit transfer of outdoor recreation economic values: testing out-of-sample convergent validity. *Environmental and Resource Economics* 25:70-100.	•		•	BT	Constructs generic meta-regression model from existing CV and TC values; shows that the national BT function is more appropriate in recreation valuation than the regional BT function
Silberman, Jonathan. 2003. The Economic Importance of Off-Highway Vehicle Recreation. Economic data on off-highway vehicle recreation for the State of Arizona and for each Arizona County. Arizona State University West. 91 pp.	•			Actual expenditures/ market price of output	Average per-capita off-highway vehicle (OHV) recreation trip expenditures
Thur, S.M. 2003.Valuing Recreational Benefits in Coral Reef Marine Protected Areas: An Application to the Bonaire National Marine Park. Dissertation, UMI No. 3112702, University of Delaware.	•			CVM – dichotomous choice and payment card; Conjoint analysis	WTP for access to the marine park; tradeoff between paying an additional fee to access a higher quality environment or to accept lesser quality for no additional charge above the vacation price
U.S. Department of Commerce. 1997. Regional Multipliers. A User Handbook for the Regional Input-Output Modeling System (RIMS II). 3rd ed., March 1997. 62 pp. (*http://www.bea.doc.gov/bea/ARTICLES/REGIONAL/PERSINC/Meth/rims2.pdf* , accessed Feb. 2004).	•			Actual expenditures/ market price of output	Uses multipliers to estimate the total impact of a project or program on regional output, earnings, or employment

Table 5.4 continued...

Recreation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
USDI FWS. 2001. 2001 National and State Economic Impacts of Wildlife Watching. Addendum to the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Report 2001-2. Arlington: FWS, Division of Economics. 16pp.	•			Actual expenditure/ market output price	National participation in wildlife watching, expenditures associated with that participation, income and employment effects, and associated tax revenue
USDI FWS. 2001. Birding in the United States: A Demographic and Economic Analysis. Addendum to the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Report 2001-1. Arlington: FWS, Division of Economics. 20pp.	•			Actual expenditure/ market output price; CVM	Birders' expenditures on bird-watching; impact of expenditures (value to society)
University of Vermont (U. VT), Department of Community Development and Applied Economics, U. VT School of Natural Resources, U. VT School of Business Administration, and U. VT Tourism Data Center. 1999. The Impact of the Tourism Sector on the Vermont Economy: The Input-Output Model. March 1999. 74 pp. (***http://www.uvm.edu/~snrvtdc/publications/tourism_impact.pdf***, accessed December 2003).	•			Constructs Input-Output model	Impact of the Vermont tourism industry; focuses on domestic tourists
Walsh, Richard G., Donn M. Johnson, and John R. McKean. 1992. Benefit transfer of outdoor recreation demand studies, 1968-88. *Water Resources Research* 28(3):707-13.	•			BT	Shows how estimates from previous studies can be adjusted to develop tentative estimates of non-market values
WWF. 2000. Tourism and Carnivores: The Challenge Ahead. Godalming, UK: The WWF-United Kingdom Campaign for Europe's Carnivores. May 2000. 24pp.	•			Actual expenditure/ market output price	Description of benefits and costs of carnivore tourism, in case studies; tourism revenue for some countries
Yeo, B.H. 2002. Valuing a Marine Park in Malaysia. in *Valuing the Environment in Developing Countries: Case Studies.* edited by David Pearce, Corin Pearce and Charles Palmer, Cheltenham, UK and Northampton, MA, USA: Edward Elgar 2002.	•	•	•	CVM – open-ended	WTP by domestic and foreign tourists for marine park conservation
Zawacki, W. T., A. Marsinko, and J. M. Bowker. 2005. A Travel Cost Analysis of Nonconsumptive Wildlife-Associated Recreation in the United States. *Forest Science* 46, no. 4, 496 -506.	•			TCM – single-site	Annual CS value for a non-consumptive wildlife recreation trip

Table 5.5: Economic Methods and Theory of Valuation

Economic Methods and Theory of Valuation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Adamowicz, W. L., J. Asafu-Adjaye, P. C. Boxall, and W. E. Phillips. 1991. Components of the economic value of wildlife: An Alberta case study. *Canadian Field-Naturalist* 105(3):423-29.			•	CVM	WTP for wildlife preservation per household in Alberta, Canada
Adamowicz, Wiktor L., Vinay Bhardwaj, and Bruce Macnab. 1993. Experiments on the difference between willingness to pay and willingness to accept. *Land Economics* 69(4): 416-27.	•	•	•	CVM	Shows how existence of a substitute reduces the difference between WTP and WTA
Arrow, Kenneth J., Maureen L. Cropper, George C. Eads, Robert W. Hahn, Lester B. Lave, Roger G. Noll, Paul R. Portney, Milton Russell, Richard Schmalensee, Kerry V. Smith, and Robert N. Stavins. 1996. Is there a role for benefit-cost analysis in environmental, health, and safety regulation? *Science* 272:221-222.					Discusses usefulness of benefit-cost analysis
Arrow, Kenneth, Robert Solow, Paul R. Portney, Edward E. Leamer, Roy Radner, and Howard Schuman. 1993. Report of the NOAA Panel on Contingent Valuation. *Federal Register* 58(10):4602-14.	•	•	•	CVM	Reviews drawbacks to CVM; design of CV surveys; guidelines for CV studies; research agenda
Azevedo, C. D., J. A. Herriges and C. L. Kling. 2003. Combining revealed and stated preference: consistency tests and their interpretations. *American Journal of Agricultural Economics* 85(3):525 – 537.	•		•	Combined revealed and stated preference	CS for recreational trips to Iowa wetlands; inconsistency between stated and revealed preference CS values; suggests a need for more research to combined each method's strength for a more accurate valuation method
Bateman, I.J. and A.P. Jones. 2003. Contrasting conventional with multi-level modelling approaches to meta-analysis: Expectation consistency in UK woodland recreation value. *Land Economics* 79(2):235-258.	•			BT – meta-analysis; multi-level modeling (MLM)	WTP derived from 30 studies, 1970 - 1998, containing estimates for woodland recreation value; suggests that correct specification matters; suggests that MML technique may be more robust than conventional meta-analysis
Bateman, I.J. and J. Mawby. 2003. First impressions count: A study of the interaction of interviewer appearance and information effects in stated preference studies. *Ecological Economics* 49(1):47-55.	•	•	•	CVM – open-ended	WTP for woodland conservation scheme paid via annual tax; changing the appearance of the interviewer and the degree of info provided significantly impacts stated WTP
Bateman, I.J., Cole, M., Cooper, P., Georgiou, S., Hadley, D. and G.L. Poe. 2004. On visible choice sets and scope sensitivity. *Journal of Environmental Economics and Management* 47: 71-93.	•		•	CVM – open-ended	WTP for three lake improvement schemes; tests for differences between WTP values elicited through different study designs; demonstrates a difference depending on how information is disclosed to respondents

Table 5.5 continued...

Economic Methods and Theory of Valuation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Boxall, Peter C., Wiktor L. Admomowicz, and Theodore Tomasi. 1996. A nonparametric test of the traditional Travel Cost Model. *Canadian Journal of Agricultural Economics* 44:183-193.	•			TCM – multi-site – regional/hedonic; Combined revealed and stated preference	Tests traditional TCM and its assumptions made about individual choices regarding the number of trips to various sites; estimates the cost of hunting trips (bighorn sheep)
Boyle, K. J., H. F. MacDonald, H. Cheng, and D. W. McCollum. 1998. Bid design and Yea saying in single-bounded, dichotomous-choice questions. *Land Economics* 74(1):49-64.	•			CVM – dichotomous choice	Tests the effect of bid structures in welfare estimates using the pretest distributions and three bid structures; WTP for moose hunting
Brown, Thomas C., Patricia A. Champ, Richard C. Bishop, and Daniel W. McCollum. 1996. Which response format reveals the truth about donations to a public good? *Land Economics* 72(2):152-66.			•	CVM – dichotomous choice and open-ended	WTP estimated under four conditions in order to test why the dichotomous choice format yields larger estimates of hypothetical WTP than the open-ended format; WTP for removing roads along the North Rim of Grand Canyon NP
Brouwer, Roy. 2000. Environmental value transfer: state of the art and future prospects. *Ecological Economics* 32:137-52.	•	•	•	BT	Overview of environmental value transfer; guidelines for use and application
Caplin, Andrew, and John Leahy. 2001. The social discount rate. Institute for Empirical Macroeconomics, Federal Reserve Bank of Minneapolis. Discussion Paper 137. January 2001.	•				Shows how individuals assign values to future impacts that may be irrational an incompatible with society's welfare
Carson, R.T., R.C. Mitchell, M. Hanemann, R.J. Kopp, S. Presser, and P.A. Ruud. 2003. Contingent valuation and lost passive use: Damages from the Exxon Valdez oil spill. *Environmental and Resource Economics* 25(3):257-286.			•	CVM – dichotomous choice	Demonstrates the stated preference methods are generally accepted as the only way to quantify non-use values; WTP to prevent another Exxon Valdez type oil spill
Carson, R.T., N.E. Flores, K.M. Martin, and J.L. Wright. 1996. Contingent valuation and revealed preference methodologies: Comparing the estimates for quasi-public goods. *Land Economics* 72(1):80-99.	•			Meta/synthesis analysis of 83 CVM studies for the same quasi-public good	CS; WTP; constructed CV/RP (revealed preference) ratios; questions whether there is a need to adjust CV estimates
Chichilnisky, Graciela, and Geoffrey Heal. 1998. Economic returns from the biosphere. *Nature* 391:629-30		•		Replacement costs	Water provision services to New York City by the Catskills watershed; example of using replacement cost approach to estimate value of ecosystem services

Table 5.5 continued...

Economic Methods and Theory of Valuation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Cropper, Maureen L. 2000. Has economic research answered the needs of environmental policy? *Journal of Environmental Economics and Management* 39:328-350.					Reviews the progress made in developing valuation methods of environmental benefits; describes where more research is needed
Diamond, Peter A. and Jerry A. Hausman. 1994. Contingent valuation: Is some number better than no number? *The Journal of Economic Perspectives* 8(4):45-64.			•	CVM	Tests the credibility of CVM; suggests that WTP responses are no consistent with economic theory
Foster, V., I.J. Bateman, and D. Harley. 1997. Real and hypothetical willingness to pay for environmental preservation: A non-experimental comparison. *Journal of Agricultural Economics* 48(2):123-138. *http://www.uea.ac.uk/env/cserge/pub/wp/gec/gec_1996_10.pdf*		•		Actual expenditure/ market price of output; CVM – open ended	Non-experimental comparison of real and hypothetical payments for environmental preservation; based on summary statistics describing responses to fund-raising appeals and CV surveys
Freeman, A. Myrick III. 2003. The Measurement of Environmental and Resource Values. Theory and Methods. Second Ed. Washington, DC: Resource for the Future Press.	•	•	•		Introduction of methods and techniques of resource and environmental valuation
French, Dustin D., and Fred J. Hitzhusen. 2001. Status of benefits transfer in the United States and Canada: Comment. *Canadian Journal of Agricultural Economics* 49(2):259-61.	•			BT	Shows that the BT scheme falls in one of two categories; suggests a more practical methodology of BT testing
Goldar, B., and S. Misra. 2001. Valuation of environmental goods: Correcting for bias in contingent valuation studies based on willingness-to-accept. *American Journal of Agricultural Economics* 83(1):150-156.	•	•	•	CVM – dichotomous choice	WTP and WTA for changes in tree density; shows how to correct bias in reported WTA
Gowdy, John M. 1997. The value of biodiversity: Markets, society, and ecosystems. *Land Economics* 73(1):24-41.	•	•	•		Argues market or exchange values of environmental services or goods constitute only a small portion of total biodiversity value
Green, D., K. E. Jacowitz, D. Kahneman, and D. McFadden. 1998. Referendum Contingent Valuation, Anchoring, and Willingness to Pay for Public Goods. *Resource and Energy Economics* 20(2):85-116.	•		•	CVM – dichotomous choice and open-ended	WTP for the protection of offshore Pacific Coast seabirds and to reduce traffic accidents by 20%; strong anchoring effects lead to higher estimated responses from Yes/No referendum responses than from open-ended responses
Hanemann, W. Michael. 1991. Willingness to pay and willingness to accept: How much can they differ? *The American Economic Review* 81(3):635-647.	•	•	•		Shows how a smaller substitution effect leads to a bigger disparity between WTP and WTA estimates

Table 5.5 continued...

Economic Methods and Theory of Valuation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Hanemann, W. Michael. 1994. Valuing the environment through contingent valuation. *The Journal of Economic Perspectives* 8(4):19-43.	•	•	•	CVM	Analysis of conducting reliable surveys, objections to surveys, CVM and economic theory
Hanemann, M., J. Loomis, and B. Kanninen. 1991. Statistical efficiency of double-bounded dichotomous choice contingent valuation. *American Journal of Agricultural Economics* 73 (4):1255-1263.		•		CVM – dichotomous choice	Demonstrates that the double-bounded referendum technique is statistically more efficient than the single-bounded approach; single-bounded approach resulted in WTP variance sometimes 10 times greater than the double-bounded approach; various levels of wetlands improvement
Hayden, F. Gregory. 1993. Ecosystem valuation: Combining economics, philosophy, and ecology. *Journal of Economic Issues* 27(2):409-420.	•	•	•		Emphasizes a need for broader and richer modeling of ecological crises; questions which anthropocentric values, etc. will guide policymaking; policy must be context specific
Heal, Geoffrey. 1997. Valuing our future: Cost-benefit analysis and sustainability. Columbia Business School Working Paper Series, WP-97-08, August 1997. *http://www2.gsb.columbia.edu/faculty/gheal/General%20Interest%20Papers/pw-97-08.pdf*	•	•	•		Reviews foundations of cost-benefit analysis, emphasizing discounted utilitarian roots; proposes putting more weight on the future and incorporating more centrally the services from stocks of environmental assets; concept of "sustainable net benefit"
Hughes, David W. 2003. Policy uses of economic multiplier and impact analysis. *Choices* (Second Quarter):25-29.	•				Outlines issues to be considered in conducting and interpreting impact and multiplier analysis
Kahneman, Daniel, Jack L. Knetsch, and Richard H. Thaler. 1990. Experimental test of the Endowment Effect and the Coase Theorem. *Journal of Political Economy* 98(6) (December 1990):1325-48.	•	•	•		Describes experiments demonstrating the "endowment effect"; demonstrates how WTA estimates are much larger than WTP measures
Kirchhoff, Stefanie, Bonnie G. Colby, and Jeffrey T. LaFrance. 1997. Evaluating the performance of benefit transfer: An empirical inquiry. *Journal of Environmental Economics and Management* 33:75-93. *http://are.berkeley.edu/~lafrance/reprints/KCL-JEEM-1997.pdf*	•			BT	Method to evaluate direct BT and benefit function transfer (BFT), applied to two pairs of similar non-market amenities; BFT is more robust

Table 5.5 continued...

Economic Methods and Theory of Valuation	**Direct Use Values**	**Indirect Use**	**Non-Use Values**	**Valuation Method**	**Economic Measure & Additional Information**
Krupnick, Alan J., and Paul R. Portney. 1991. Controlling urban air pollution: a benefit-cost assessment. *Science* 252:522-528.	•	•	•	CVM	Argues for CVM as preferred stated preference method of valuation; estimates benefits and costs of improving air quality
Larson, Douglas M. 1993. On measuring existence value. *Land Economics* 69(4):377-88.			•	CVM	Questions whether CVM is the only method of measuring existence value
Loomis, John B. 2000. Vertically Summing Public Good Demand Curves: An empirical comparison of economic and political jurisdictions. *Land Economics* 76(2):312-321.			•		Measures relative public good benefit gradient; discusses how broadly individuals' marginal benefit schedules should be summed; includes case studies
Loomis, John B. 1987. Expanding contingent value sample estimates to aggregate benefit estimates: current practices and proposed solutions. *Land Economics* 63(4):396-402.	•	•	•		Shows improved statistical approaches for generalizing unrepresentative samples to the general population
Loomis, John B., and Bryon P. Allen. 2006. Deriving values for the ecological support function of wildlife: An indirect valuation approach. *Ecological Economics* 56:49-57.		•		BT	Develops quasi-BT method of deriving WTP estimates for indirect values; combines WTP estimates for higher level species with info on ecosystem relationships to derive estimates of partial WTP for lower level species
Millennium Ecosystem Assessment. 2003. Ecosystems and Human Well-being: A Framework for Assessment. Washington: Island Press. 245 pp	•	•	•		Describes the current state of Earth's ecosystems at various scales, links between ecosystems and human well-being, potential for ecosystems to contribute to enhancing well-being, scenarios of our future, policy and management options for sustaining ecosystem services
Mitchell, Robert Cameron, and Richard T. Carson. 1989. Using Surveys to Value Public Goods: The Contingent Valuation Method. Washington: Resources for the Future.	•	•	•	CVM	Description and guidelines on CV surveys; contends that CVM is currently the preferred method of determining people's WTP for public goods
Morton, Pete. 1999. The economic benefits of wilderness: Theory and practice. *Denver Law Review* 76(2):465-518.	•	•	•		Includes an overview of wilderness economic research and its practice

Table 5.5 continued...

Economic Methods and Theory of Valuation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Pagiola, Stefano, Konrad von Ritter, and Joshua Bishop. 2004. Assessing the Economic Value of Ecosystem Conservation. World Bank Environment Department Discussion Paper No. 101. October 2004.	•	•	•		Summary of valuation techniques and how to use them in investment and policymaking decisions; includes several case studies
Pate, Jennifer, and John Loomis. 1997. The effect of distance on willingness to pay values: A case study of wetlands and salmon in California. *Ecological Economics* 20:199-207.	•	•	•	CVM – dichotomous choice	Uses Logit model to study effects of geographic distance on respondents' WTP for wetlands habitat and wildlife, wildlife contamination control, or river and salmon improvement programs
Piper, Steven, and Wade E. Martin. 2001. Evaluating the accuracy of the benefit transfer method: A rural water supply application in the USA. *Journal of Environmental Management* 63:223-35.	•	•	•	BT	Analyzes BT method and guidelines for using it
Portney, Paul R. 1994. The contingent valuation debate: Why economists should care. *The Journal of Economic Perspectives* 8(4):3-17.	•	•	•	CVM	Overview of CVM and the debate around CVM
Rosen, Sherwin. 1974. Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy* 82:34-55.	•			Hedonic-pricing model	Develops theory of hedonic prices; studies buyer and seller choices and market equilibrium; explains empirical implications for hedonic price regressions and index number construction
Salzman, James, and J.B. Ruhl. 2000. Currencies and the commodification of environmental law. *Stanford Law Review* 53:607-694.					Purports that the economic value of ecosystem services are site-specific and dependent on the ecosystem service's relative scarcity
Shogren, Jason, Seung Y. Shin, Dermot Hayes, and James B. Kliebenstein. 1994. Resolving differences in willingness to pay and willingness to accept. *American Economic Review* 84(1):255-70.	•	•	•	CVM	Shows that the convergence of WTP and WTA measures of value for identical goods is driven by a degree of substitution; divergence with non-market goods with imperfect substitutes
Smith, V. Kerry, George Van Houtven, and Subhrendu K. Pattanayak. 2002. Benefit transfer via preference calibration: "Prudential algebra" for policy. *Land Economics* 78(1):132-152. *http://www4.ncsu.edu/~spattan/papers/smith-etal_land_bt.pdf*	•	•	•	BT	Explores BT method that takes into account baseline conditions and scope effects; when BT is associated with a large-scale policy change
Smith, V. Kerry. 2004. Krutilla's legacy: Twenty-first-century challenges for environmental economics. *American Journal of Agricultural Economics* 86(5):1167-1178.					Establishes conceptual basis for natural resource valuation; acknowledges existence of non-use values

Table 5.5 continued...

Economic Methods and Theory of Valuation	Direct Use Values	Indirect Use	Non-Use Values	Valuation Method	Economic Measure & Additional Information
Stevens, Thomas H., Jaime Echeverria, Ronald J. Glass, Tim Hager, and Thomas A More. 1991. Measuring the existence value of wildlife: What do CVM estimates really show? *Land Economics* 67(4):390-400.			•	CVM – dichotomous choice and open-ended	Validity of CVM for estimating existence value; suggests existence value is large relative to use values; yet many respondents behaved irrationally; argues that CBA shouldn't be used to make decisions about wildlife existence; may need another method of measuring existence value
Stevens, Thomas H., Thomas A. More, and Ronald J. Glass. 1993. Measuring the existence value of wildlife: Reply. *Land Economics* 69(3):309-12.			•	CVM – iterative bidding	Purports that WTP responses reflect judgments about payment of fair share, not the economic value of a resource
U.S. Environmental Protection Agency (EPA). 2000. Guidelines for Preparing Economic Analyses. Report, September 2000. EPA 240-R-00-003. Washington, DC: EPA.	•	•	•		Presents economic concepts and applications to environmental and natural resource policies
U.S. National Park Service. 1995. Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors. A resource book (4th Ed.). U.S. Department of the Interior. United States National Park Service.	•	•	•		Shows how greenways and parks have benefited local and regional economies and how to determine their potential economic impacts
United Nations Environment Programme (UNEP). 2005. Incentive Measures: An Exploration of Tools and Methodologies for Valuation of Biodiversity and Biodiversity Resources and Functions. UNEP, Convention on Biological Diversity, Subsidiary Body on Scientific, Technical, and Technological Advice. 14 October 2005. 30 pp. *http://www.biodiv.org/doc/meetings/sbstta/sbstta-11/information/sbstta-11-inf-08-en.pdf*	•	•	•		Overview of valuation tools and their methodological status, including their applicability to different contexts of biodiversity resource valuation
Vatn, Arild, and Daniel W. Bromley. 1995. Choices without prices without apologies. In *The Handbook of Environmental Economics*, edited by D. W. Bromley. Cambridge, MA: Blackwell Publishers.		•			Challenges the presumption that explicit pricing of environmental options are inferior to hypothetical valuation analyses
Zhao, Jinhua, and Catherine Louise Kling. 2004. Willingness to pay, compensating variation, and the cost of commitment. *Economic Inquiry* 42(3):503-17.			•		Shows how observed WTP values may not be suitable for welfare analyses; uses a dynamic model