Technical Report 2007-07

Valuing Puget Sound's Valued Ecosystem Components

Prepared in support of the Puget Sound Nearshore Partnership

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Valued Ecosystem Components Report Series

Puget Sound Nearshore Partnership

Restoring Our Ecosystem Health

The Puget Sound Nearshore Partnership (PSNP) has developed a list of valued ecosystem components (VECs). The list of VECs is meant to represent a cross-section of organisms and physical structures that occupy and interact with the physical processes found in the nearshore. The VECs will help PSNP frame the symptoms of declining Puget Sound nearshore ecosystem integrity, explain how ecosystem processes are linked to ecosystem outputs, and describe the potential benefits of proposed actions in terms that make sense to the broader community. A series of "white papers" was developed that describes each of the VECs. Following is the list of published papers in the series. All papers are available at *www.pugetsoundnearshore.org.*

Brennan, J.S. 2007. Marine Riparian Vegetation Communities of Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-02. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Buchanan, J.B. 2006. Nearshore Birds in Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-05. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Dethier, M.N. 2006. Native Shellfish in Nearshore Ecosystems of Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-04. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Eissinger, A.M. 2007. Great Blue Herons in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-06. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Fresh, K.L. 2006. Juvenile Pacific Salmon in Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-06. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Johannessen, J. and A. MacLennan. 2007. Beaches and Bluffs of Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-04. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Kriete, B. 2007. Orcas in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-01. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Leschine, T.M. and A.W. Petersen. 2007. Valuing Puget Sound's Valued Ecosystem Components. Puget Sound Nearshore Partnership Report No. 2007-07. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Mumford, T.F. 2007. Kelp and Eelgrass in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-05. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Penttila, D. 2007. Marine Forage Fishes in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-03. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

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Executive Summary

"Valued ecosystem components," or VECs, are key elements of the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) conceptual framework for nearshore restoration. In this paper, we discuss the underlying human values that motivate the choice of VECs and their use in environmental management, with a focus on the PSNERP nearshore restoration program.

VECs are now finding increasing application in environmental management; they are selected for wide-ranging purposes and represent economic, cultural, spiritual and aesthetic values as well as (or in lieu of) ecological values. The PSNERP VECs were selected primarily to communicate the value of Puget Sound nearshore restoration to managers and the public, and are intended to speak to ecological and societal values. They embody both economic value and a mix of cultural, spiritual and aesthetic values. Like most VECs, the ones discussed in this paper embody bundles of values, and the values ascribed to them extend beyond their biophysical or ecological characteristics.

Human values with respect to nature are exceedingly complex. Values sitting outside traditional ecological or economic realms should not be presumed subordinate to the ecological or economic values that experts more readily link to environmental management. VECs are flexible tools capable of embodying a wide variety of human values with respect to nature. In this paper, we review contemporary literature on the values humans hold with respect to nature and discusses how these values can be and are realized in VECs.

VECs are frequently intertwined with ecosystem services, a concept that has gained popularity since its broad introduction by Daily and Costanza and colleagues in the previous decade (Costanza et al. 1997, Daily 1997). Ecosystem services, like VECs, can be used to highlight the many ways in which humans benefit from nature, and there have been multiple attempts to classify these services (Millennium Ecosystem Assessment 2005). Though the use of VECs has arisen from the use of ecosystem services in management, the role of VECs is distinct and should not be confused with that of ecosystem services.

A variety of economic techniques can be used to value VECs. We discuss relevant valuation techniques and their limitations. However, because most VECs embody a bundle of values, the choice of a valuation approach typically focuses on one type of value to the exclusion of others. Economic valuation is most appropriate when applied to marginal changes in the levels of goods and services. Efforts to tally individual components of value that derive from the many different services provided by a particular VEC run the risk of multiple counting, as many ecological goods and services are "jointly produced" by restoration.

The use of VECs in restoration can be motivated by many different reasons. They can be selected primarily to facilitate public communication of restoration objectives or because of "anthropocentric" (extrinsic) or "ecocentric" (intrinsic) concerns. In reality, the selection of individual VECs can almost never be tied to a single motivational factor. Much like the human values that are embodied in the VECs, selection can be motivated by a combination of views. Numerous motivations for restoration of Puget Sound's nearshore systems exist, and both anthropocentric and ecocentric views can be discerned in the restoration dialogue now taking shape in the Puget Sound region. Taken as a group, the PSNERP VECs suggest a mix of these motivations. The value of considering nearshore restoration from contrasting ecocentric and anthropocentric perspectives is to recognize that elements of both are likely necessary for robust designs.

This report elucidates a relatively recent evolution in environmental management, embodied by PSNERP and many others, to use VECs to communicate management goals and benefits. It emphasizes the ways that VECs can connect human and environmental values, the nature of those values, and how an emphasis on human connectedness to the environment can advance environmental management and environmental restoration in particular. Clearly, thinking comprehensively about VECs in all their dimensions can considerably enrich the value set derived from restoration, adding "human dimensions" that have until recently often been subordinated in the pursuit of ecological goals in environmental management.

Valued Ecosystem Components

"Valued ecosystem components," or VECs, are key elements of the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) conceptual framework for nearshore restoration. The PSNERP VECs are considered among the most important potential beneficiaries of envisioned environmental restoration actions. While other choices for the VECs were certainly possible, those described in the companion reports to this white paper share at least three important characteristics. First, all are judged likely to be enhanced by nearshore restoration. Second, each can be said to have "ecosystem services" value. If they are not end products of nature in themselves, some VECs nevertheless provide essential support to other ecosystem components that have direct value to humans. Third, each component is already recognized by many people in the region as having associations with a "healthy" Puget Sound. While many people likely consider the operative notion of health to include economic, social, cultural, recreational, or aesthetic as well as ecological dimensions, the VECs, taken as a group, seem able to speak to the broader dimensions of our relationship with Puget Sound. An emphasis on VECs thus becomes a way to articulate and communicate to the general public the links among restoration, ecosystem health and the broader values that many in the region hold for Puget Sound.

In short, the PSNERP VECs can be considered to represent benefits that we hope to achieve through restoration. These benefits may take the form of targets and goals as restoration planning proceeds to greater levels of detail, or they may simply represent collateral benefits that accrue as products of restoration aimed at "repair" of currently impaired ecosystem processes and functions.

The VEC concept is closely related to, but not the same as ecosystem services. The latter have received considerable attention in environmental management and planning of late, having been popularized a decade ago through influential writings of Costanza et al. (1997), Daily (1997) and others. Ecosystem services are intimately bound up with notions of sustainability and sustainable development, a point emphasized in the United Nation's Millennium Ecosystem Assessment (MEA 2005), where the ability of planetary systems to continue to provide valued ecosystem services is highlighted as a key challenge of global sustainability. As the discussion that follows will show, VECs are generally chosen in ways that speak more simply and directly to goals or expected end-benefits of environmental management compared with ecosystem services. VECs appear to have the advantage of greater tangibility, a result of their often being chosen for their value in helping communicate benefits and goals of management to non-specialists, but they also have the disadvantage of being less well grounded conceptually than ecosystem services. Choosing VECs in a particular management arena is not necessarily the same thing as characterizing the most important ecosystem service values associated with the same environmental system.

VECs are nevertheless now finding increasing application in environmental management. The purpose of this report is to elucidate this recent evolution in environmental management, emphasizing the ways that VECs can connect human and environmental values, the nature of those values and how human connectedness to the environment can advance environmental management and environmental restoration in particular. Few people using VECs go through the step of formal definition. However, VECs seem invariably to be selected with management or policy intention. In fact, biophysical or ecological attributes of systems are often supplemented (even replaced) by socio-economic considerations that may also range widely, incorporating spiritual, cultural and aesthetic values along with economic values.

This paper is organized as follows:

- *Valued Ecosystem Components* entails an exploration of current uses of VECs in environmental management, connections between VECs and human values with regard to nature and, briefly, the relationship between VECs and the PSNERP conceptual approach to defining restoration opportunities for Puget Sound.
- *VECs and Human Values* is focused on ecosystem goods and services and their relationship to VECs.
- *Ecosystem Services* involves a brief review of the application of economic valuation techniques to "monetization" of values associated with ecosystem services or VECs, including limitations in the use of valuation techniques in support of management.
- *Applying Economic Valuation Techniques to Ecological Resources* provides illustrative examples relevant to the PSNERP VECs throughout and leads to a summary of rationales, examples and approaches for quantifying values associated with the PSNERP VECs.
- *Application to Puget Sound VECs* entails a description of how VECs can contribute to the sometimes underappreciated challenge of "valuing" restoration goals. Contrasting "ecocentric" and "anthropocentric" perspectives on the broader purposes of restoration serve to highlight the ways that VECs can speak to diverse rationales. Their flexibility makes them compatible with the "incremental cost analysis" procedures that the U.S. Army Corps of Engineers (USACE or the Corps) employs in detailed project planning.
- *VECs and the Valuation of Restoration* provides contrasting anthropocentric and ecocentric perspectives on using VECs to guide natural resource management.

- *Summary and conclusions* highlights the diversity of ways in which VECs can be and are being used in current environmental management.

The diversity of values that are de facto represented by the PSNERP VECs suggests that, as restoration planning proceeds, VECs can provide a basis for a more complete consideration of the "human dimensions" of Puget Sound as a coupled social–ecological system. Understanding and incorporating values into restoration planning that move beyond traditional ecological considerations may prove essential for a program of the scope envisioned by PSNERP to become a reality, given the diversity of ways that the region's growing population values Puget Sound.

Current Uses of VECs

The VEC "universe" is large—VECs can be chosen to represent any of at least three relatively distinct sources of value (ecological, economic, or social, cultural and aesthetic values) as well as all possible combinations of those value types (Figure 1). Illustrative examples serve to compare the PSNERP VECs with others selected against different bases or for other purposes.

Puget Sound Nearshore Ecosystem Restoration Program (PSNERP)
The nine PSNERP VECs were selected primarily to communicate the value of Puget Sound restoration to decision makers and the public. While PSNERP managers are interested in ways management actions might support restoration or enhancement of individual VECs, this interest has so far stopped short of attempting to establish direct linkages between proposed management actions and quantifiable outcomes in terms of abundance or quality of VECs. The PSNERP VECs were chosen because they are considered important ecologically and socially. In terms of the values represented, they thus can be considered to fall within the overlap between the social and ecological systems (Figure 1, filled "stars"). The dashed line running through the "social system" ellipse in Figure 1 is intended to suggest that the social value embodied in the selected VECs includes both economic values, expressed in monetary terms, and other values that defy direct, or possibly any, quantification—for example, spiritual, aesthetic and cultural values associated with wild nature.

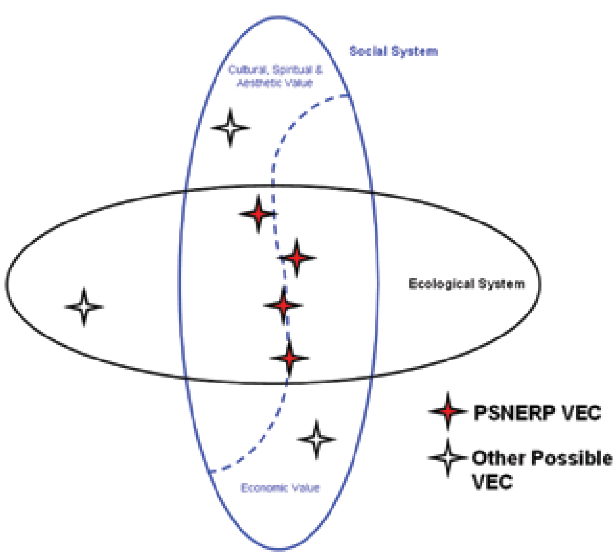

Figure 1. Valued ecosystem components (VECs) in the social–ecological system.

Although the philosophy underlying PSNERP's VEC selection is shared by many others who desire to emphasize system attributes of both ecological and social relevance, such an orientation is by no means universal. The next example illustrates an attempt to focus more directly on ecological values.

South Florida Water Management District
The South Florida Water Management District (SFWMD) emphasizes management for "biotic integrity." It focuses on the "dominant habitat-forming communities" of coastal ecosystems in selecting grass beds, oyster reefs and mangroves as VECs: "The implied link between biotic integrity and VEC is that managing for VEC will sustain the biotic integrity of the whole system" (SFWMD 2006). Were one to "price" the SFWMD VECs in line with their stated value as the backbone of biotic integrity for coastal ecosystems, approaches from ecological economics that emphasize the "natural capital" value of ecosystem components would likely be appropriate (Costanza et al. 1997; see also VECs and Human Values, this paper).

Ecosystem goods and services of direct consumptive or non-consumptive value to humans are no doubt highly valued in SFWMD's program, but they are not explicit in the rationale for selecting VECs.[1] Both biotic integrity and the three selected VECs may of course be proxies for other ecosystem components that are directly valued, even if unarticulated in the SFWMD's overarching goals. In contrast, PSNERP's VECs are more specific and generally representative of ecosystem attributes valued in and of themselves. Quantification of the associated values would likely engage numerous tools from natural resource economics to capture social values as well as natural-capital and ecological-service values.

If we use the South Florida case as the context for Figure 1, the open star to the left might represent the situation where choice is guided primarily by the contribution to the restoration and maintenance of biotic integrity.[2]

[1] The notion of "ecosystem services" is elaborated upon in the section, VECs and Human Values. To Boyd and Banzhaf (2006), ecosystem services are "components of nature, directly enjoyed, consumed, or used to yield human well being" (p. 8).

[2] This approach should not be taken to be "more scientific," however, nor as one that is free of social or human-value content. We draw upon R. Lackey for our contention that a decision to manage a system for biotic integrity (i.e., so as to show as little influence of human activity as possible) is still a choice wedded in human values (Lackey 2001).

Pacific Northwest Coastal Ecosystems Regional Study
The NOAA-funded Pacific Northwest Coastal Ecosystems Regional Study (PNCERS) project at the University of Washington adopted VECs with the intention of representing ecological and social values, an approach in line with the PSNERP philosophy. However, the intended role of the VECs differed from PSNERP's by illustrating interrelationships among disparate elements of the PNCERS' multidisciplinary research program. Pacific salmon, Dungeness crab, Pacific oyster and shorelands were chosen. The integrative value of these VECs was highlighted in a workshop report in which each VEC was placed in physical, biological and social contexts. This placement also highlighted relevant studies that were part of the research program: "VEC diagrams help display how social and natural science systems interrelate and highlight what components are valued by these distinct systems."[3] PNCERS VECs, like those selected by PSNERP, would be represented by filled stars in Figure 1.

Canadian Environmental Assessment Agency (CEAA)
The Canadian Environmental Assessment Agency (CEAA) chose VECs purely for the socio-economic values they embody (top and bottom open stars, Figure 1). Guidelines developed by the CEAA for project-level cumulative-effects assessments argue for explicit use of VECs defined very broadly:

[A VEC is] any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values **or** *scientific concern. [emphasis added] (CEAA 1999, Section 2.1).*

The potential breadth of application is illustrated by a low-level radioactive waste management project currently underway in the Port Hope area. Examples of VECs include habitat for bird species "rare" in the area, fish species important to fisheries or tourism, heritage buildings, aesthetic landscape features and "lands used by aboriginal people for traditional purposes" (Port Hope Area Initiative 2003). While the CEAA guidelines say that the intent is to emphasize biophysical effects—and perhaps did not intend that the VEC label be applied as broadly as it has been at Port Hope—the guidelines nevertheless admit "valued social components" (VSCs) as indicators: for instance, changes in employment as an indicator of regional change. "Valued ecosystem and cultural components" (VECCs) are taken to be the selected VECs and VSCs in their totality.

The Port Hope example certainly illustrates VECCs in application. Regardless of what motivates the selection of VECs, the values they represent are not easily binned as ecological, economic and cultural/spiritual. Most VECs embody bundles of values and the values ascribed to them are not simple extensions of their biophysical or ecological characteristics.

[3] Parrish, J., and D. Huppert, December 8-9, 1999, Vancouver, Washington. Meeting summary: Valued ecosystem components: the natural and social scientists' view, protecting and restoring Pacific Northwest estuaries: human activities and valued ecosystem components. Pacific Northwest Coastal Ecosystems Regional Study (PNCERS).

VECs and Human Values

In practice, a division between economic and non-economic values (Figure 1, dashed line) may prove difficult to place. The placement of the PSNERP VEC stars in Figure 1 suggests that each star likely has aspects of both types of value but may emphasize one side of the divide.

The different choices PNCERS and PSNERP made in choosing shellfish VECs illustrate these subtle but important distinctions. PNCERS chose the Pacific oyster (*Crassostrea gigas*)—an introduced and possibly invasive species that is extensively cultivated in Washington and Oregon, particularly in the coastal estuaries that were the focus of PNCERS research. PSNERP on the other hand chose the Olympia oyster (*Ostreola conchaphila*)—a native species that is currently depleted owing to the combination of pollution and overharvest, but which could have significance as a sensitive monitor of ecological recovery in Puget Sound. Pacific oysters, the introduced but extensively cultivated species, might be considered to have primarily economic value (through recreational and commercial harvest), with some ecological-service value for water filtration and as a food source for shellfish-eating predators.

Replacing the Pacific oyster with the native Olympia oyster appears to increase ecological value. As a formerly much-prized native species now severely depleted, the Olympia oyster likely also has great symbolic value (Table 1). Replacing the Pacific oyster with the Olympia oyster as the VEC thus shifts socio-cultural value away from harvest-related utilitarian values and toward iconic and ecological value. The topmost filled star in Figure 1 represents the Olympia oyster VEC, while the filled star just below it represents a VEC that embodies values similar to those associated with the Pacific oyster.

Although we have portrayed the non-native Pacific oyster as having primarily utilitarian values, this species may also have symbolic value—for example, in relation to water quality (Wilson 2005). Commercial oyster growers have endeavored to engage private property owners in cultivating oysters on privately owned tidelands as a means of increasing public awareness and support for clean water initiatives (Pacific Coast Shellfish Growers Association 2001). As will become clearer in the section on Ecosystem Services, even though a particular VEC may be considered to represent primarily cultural or spiritual values, "utilitarian" approaches to valuation that make reference to market transactions (in "substitute" markets) may still be appropriate.

Values associated with killer whales and other cetaceans include cultural and spiritual values (topmost filled star, Figure 1), with their ecological value to Puget Sound (for top-down ecological regulation) currently diminished because of their decreased numbers. In attempting to quantify their value, the resource economist might well rely on another source of value—recreational value, perhaps estimated as aggregated annual expenditures for commercial whale watching trips.

Table 1. A typology of human values associated with nature. Adapted from Kellert (1993, 1997).

Aesthetic	The physical appeal and beauty of nature
Doministic	Opportunities provided by nature for achieving mastery, prowess and physical control or dominance
Ecologistic	Opportunity for the systematic study of structure, function and relationships of living resources and their habitats in nature
Humanistic	Strong affection, emotional attachment and bonds with nature
Moralistic	Strong affinity, spiritual reverence and ethical concern for nature
Naturalistic	Satisfaction from direct experience or contact with nature
Negativistic	Nature as a source of fear, risk, aversion and awe
Symbolic	Use of nature for metaphorical expression, language and expressive thought
Utilitarian	The practical, material and commodity benefits derived from nature

Public investments in recovery efforts for whales and other marine mammals under the Endangered Species Act could be considered to be motivated by the cultural values society holds for these animals. (For a detailed discussion of the philosophy underlying resource valuation, see Applying Economic Valuation Techniques to Ecological Resources, this paper).

Human Values Associated with Natural Resources

Value is directly tied to human preferences and thus has many manifestations. When we think of value we frequently think of market prices expressed in monetary units such as dollars. The price of a good is indeed an important signal of value, but, as illustrated in Figure 1, total value goes beyond that which can be measured in an economic market. It may include aesthetic as well as spiritual and cultural components. As Marcia Eaton observes, "Human valuings are holistic; we rarely experience something purely aesthetically, or purely ethically or purely religiously or purely scientifically, etc." (Eaton 1998). Attempts to focus solely on the "economic" value of a VEC, or to quantify that value monetarily, will generally fail to adequately represent the cultural and aesthetic value of that VEC. Writing about human values associated with forestry in Britain, E.A. O'Brien similarly argues that, while economic valuation of woodlands is useful, it does not describe the contribution they make to culture and identity. "Human value systems should not be stated in a single dimension such as economic value, as they are bound up with wider issues, priorities and judgments" (O'Brien 2003).

E.O. Wilson's notion of 'biophilia'—"…the innate tendency to focus on life and lifelike processes" (Wilson 1984)—is the basis for one attempt to classify the spectrum of human values with respect to nature. Biophilia is not a single innate characteristic, but a complex set of human feelings toward nature that range from the biophilic to the biophobic. An example of an evolutionary biophobic response is the fear of snakes, which persists in many people. This fear may have developed as a safety or security response that enhanced protection of early humans. The values people attach to whales and other "charismatic megafauna" emerge as expressions of the opposite, or biophilic, response. Kellert and Wilson (1993) identify and examine "nine fundamental aspects of our species' presumably biological basis for valuing and affiliating the natural world" (Kellert 1993; Table 1).

Traditional considerations of welfare economics map most directly into utilitarian values (last row, Table 1). The relatively new field of "ecological economics" incorporates a combination of utilitarian and "ecologistic" values. More broadly, the writings of Aldo Leopold have become a touchstone for many contemporary thinkers on environmental ethics, values and aesthetics. In his much cited essay, The Land Ethic, Leopold said, "A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold 1966). The inclusion of the aesthetic, humanistic, moralistic, naturalistic, symbolic and doministic in our value set moves us toward what contemporary environmental philosopher Bryan Norton (2005) terms "normative" sustainability.

What Kellert and Wilson (1993) term "negativistic" values (Table 1) may appear to be in conflict with, or at the very least incompatible with, a desire to focus on the "positive" values of nature that justify restoration. But such values can enter the decision calculus as costs to be avoided. Suppression of the negative, even if at some cost to society, can be a positive from a utilitarian perspective. Consider for example investments in the reduction of flood risks. Methods of welfare economics are well suited to quantifiying the associated values via cost–benefit analysis (CBA) (e.g., valuing flood protection by the avoided costs of damage to built infrastructure). A study conducted by the USACE in the 1970s attached a dollar value to the protection against flooding provided by natural wetlands in the Charles River Basin of Massachusetts by comparing the costs of flood damages and engineered flood protection measures in a similar nearby river that had lost most of its wetlands to development (USACE 1971, 1976; see Applying Economic Valuation Techniques to Ecological Resources, this paper).

How the balance implied by the CBA approach is achieved in practice will determine whether conflict exists with other values. For example, we can choose to build fortifications against flooding; to preserve or rebuild wetlands, mangroves and other natural buffers against flood risks; or to undertake a combination of these two strategies. Stepping back, such motivations are *extrinsic* in character. They speak directly to manipulating the environment for human benefit, or at the very least, in ways intended to minimize human costs. This point is taken up in greater detail in Application to Puget Sound VECs (p. 15).

VECs can in principle incorporate any of the value types displayed in Table 1, and we can portray the human-social system "bubble" as a cluster of overlapping value "centers", none of which is clearly distinct from the others (Figure 2). Consider for example sharks. Humans are fearful of sharks, but at the same time are in awe of them for the way they represent power in nature. Some people value them for food or as sport-fishing trophies, while others decry their decimation in shark-fin fisheries. We may also decry their decline more generally and mourn their loss for its implications for the biotic integrity of ocean ecosystems (Jackson et al. 2001, Myers and Worm 2003,). Objects or phenomena in nature do not innately appeal to one human value and not to others; they are to us what we make of them. Sharks have the potential to embody any of the values in Table 1, and a shark VEC could in principle be selected by a management entity because it embodies a particular value or set of values to the exclusion of others, or because sharks embody all of the values listed in Table 1.

A final point is that human values are likely to change through time and in ways very difficult to anticipate today. To understand how difficult it is to anticipate how human values might change, one need only look to the past. Slavery and child labor were once widely accepted and only members of select groups had the right to vote. Whalebone and whale oil were once among the most valuable commodities

Social-Ecological System

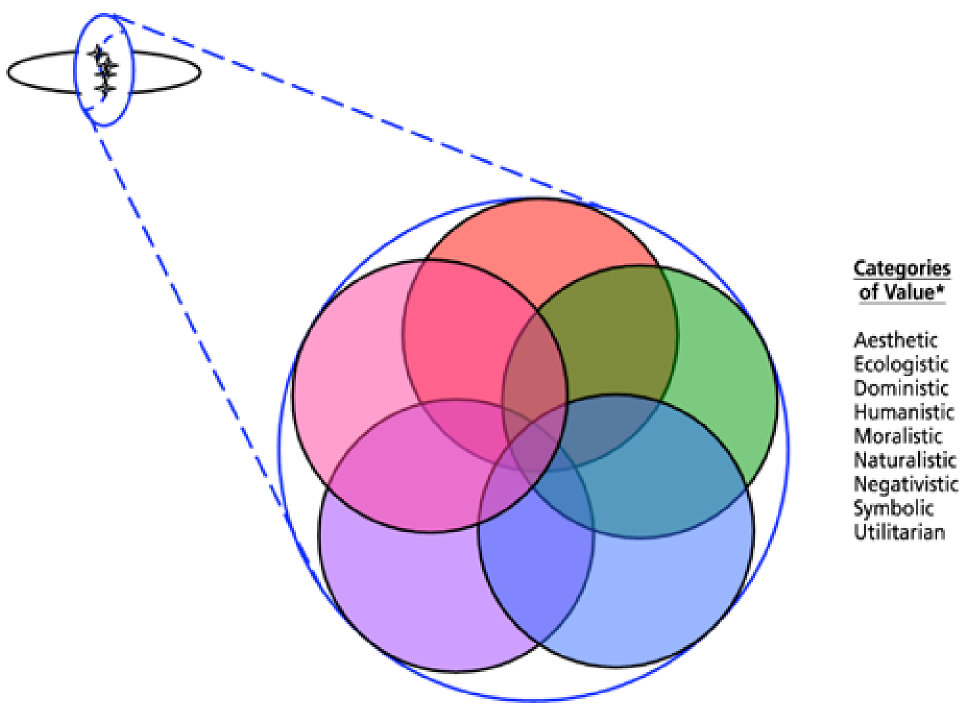

Figure 2. Human values with respect to the natural world: a "biophilia" perspective. VEC stars, if included, would cluster towards the center because they represent different values to different people. *For clarity, only five of the nine categories are shown.

in trade, yet few people today know the uses of ambergris—once the most valuable product that could be extracted from a whale. Value can change with great rapidity and can be derived from many sources, especially changes in technology. The strong winds that blow on the lower reaches of the Columbia River were mostly a nuisance until sail boarding was invented. Nineteenth Century Cape Cod farmers were easily convinced to sell the shorefront parts of their farmlands to city people newly intent on the shore-side leisure made possible by the recent expansion of the railroads, because land that couldn't be farmed was perceived to be of little value.

"Process" and "Function" VECs

It is instructive to locate the PSNERP VECs with respect to the PSNERP conceptual model of the environment as shown in an "exploded" view of the ecological system (Figure 3). As a group, the PSNERP VECs (filled stars) include ecosystem structures, habitat (i.e., ecosystem structure that meets the viability requirements of particular species) and biological resources such as native salmonids, shorebirds and the Great Blue Heron. But there is no reason in principle why VECs could not be selected to represent ecological processes or functions as well (open stars, Figure 3).

Norton (2005) characterizes "strong" sustainability as that which facilitates the maintenance of resilience. This characterization points toward "process" VECs. Akin to adaptive management, a focus on resilience emphasizes ecological processes and their role in creating and sustaining the ecological structures and functions that are the backbone of habitat and other life-support requirements of valued species (as illustrated schematically in Figure 3). A growing body of literature argues for a shift away from commodity-oriented thinking about nature and natural resources in favor of strategies that seek to maintain the resilience of ecological systems (Holling 1973, Folke et al. 2002). Kellert and Wilson's (1993) description of the "ecologistic" (Table 1) can be generalized to include the processes that support system resilience.

From such a perspective, ecological processes such as sediment transport within longshore drift cells could be included among PSNERP's VECs, under the assumption that restoring or maintaining such processes increases the resilience of the Puget Sound system as a whole. Establishing conditions supportive of habitat- or species-specific VECs may remain the goal, but the implication is that numerical targets for such VECs become secondary (and commodity-based valuation perhaps less important). Open stars in Figure 3 represent possible "process" and "function" VECs that would be coupled to the other PSNERP VECs by the cause-and-effect logic chains depicted. This is analogous to the reasoning of the SFWMD in asserting linkages between its VECs and the overall biotic integrity of South Florida coastal and estuarine systems.

Following this logic yet a step further, we could reconsider what we mean by "the system" with regard to resilience. William Adger is prominent among social scientists who seek to generalize the notion of ecological resilience to resilience in coupled human–environmental systems—termed "social-ecological resilience" (Adger 2000, Adger et al. 2005). This suggests that process-based VECs could also be chosen to reflect social processes that maintain community resilience in ways that feed back on ecological resilience, perhaps coming full circle to encompass the "valued ecosystem and cultural components" (VECCs) envisioned in the Canadian guidelines discussed previously.

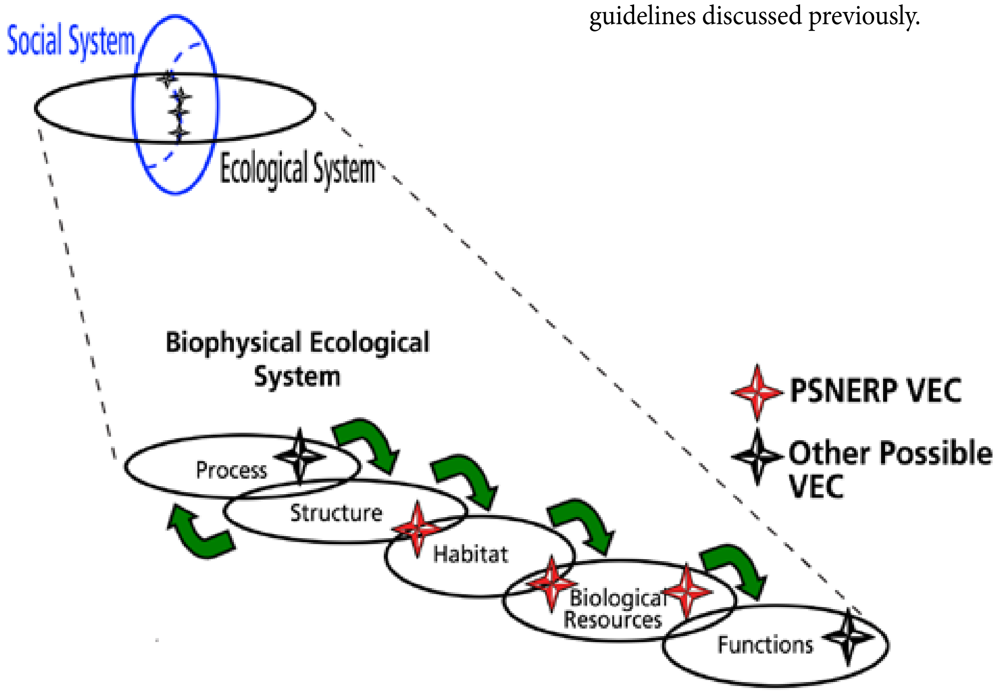

Figure 3. Ecological subsystems from which value may originate.

Ecosystem Services

Management organizations that select VECs as reference points may equate their value with *ecosystem services* (sometimes described as both *goods* and services). For example, a review by the Texas Science Advisory Committee on Water for Environmental Flows commented on the analytic approach taken by the South Florida Water Management District (cf.): "The biogenic structure VECs [selected by the SFWMD] are without a doubt the most important ecological units in estuaries in terms of *overall ecological services* they provide" [emphasis added] (Texas Science Advisory Committee 2004, sec. 6-30). The Puget Sound ecoregion can similarly be thought of as providing a stream of benefits to society in the form of ecosystem services.

Ecosystem services are the benefits that people obtain from ecosystems. From a general perspective, they are processes in nature that contribute to human welfare (Costanza et al. 1997, MEA 2005). Ecosystem services have been described as a form of capital, albeit one that is poorly understood, scarcely monitored and subject to rapid degradation and depletion (Daily et al. 2000). Rapid degradation of unmonitored ecosystem services puts the human community at risk of not realizing the importance of these services until they are irrevocably changed or lost (op. cit.). For these reasons, ecosystem services are taking a more prominent role in the considerations of scientists, economists and policy makers. Ecosystem services have made increasingly frequent appearances in natural and social science research publications, especially after 1997 when two separate yet urgent calls for attention to the value of the world's ecosystem services were published by prominent researchers (Costanza et al. 1997, Daily 1997).

Daily et al. (1997) defines ecosystem services as "…conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life." The end products of ecosystem services may be thought of as ecosystem goods (e.g., food, fuel, natural fiber, medicines, etc.) though in practice the distinction between ecosystem goods and services is most often not made. Ecosystem goods may be thought of as more concrete than ecosystem services, more readily arising in the form of commodities that have market value. However, Boyd and Banzhaf (2006) argue that admitting conditions and processes to the class of ecological services, as Daily et al. (1997), the Millennium Ecosystem Assessment (2005) and many other authors do, leads to analytical difficulties that makes them misleading as environmental accounting measures. Utility for environmental accounting requires that ecosystem services be restricted to true "end-products" of nature, in their view. Their narrower definition requires that such services be "*directly* enjoyed, consumed, or used" [emphasis added] (Boyd and Banzhaf 2006).

In some cases, it is easy to assess ecosystem services to humans, such as the production of harvestable salmon in Puget Sound. In other instances, a service may be indirect, such as the role of eelgrass beds in the life cycle of salmon. To an uninformed person, the presence or absence of eelgrass beds in an estuary might be insignificant. However, if that person values salmon fishing, he or she has benefited from the service provided by eelgrass as a haven for both the forage fish upon which salmon prey and for juvenile salmon as they migrate towards the ocean. Deterioration in the integrity of eelgrass beds could have a cascading effect altering the mix of services provided to humans. Many authors would see this example as embodying two distinct ecosystem services, but some, such as Boyd and Banzhaf (2006), would not, instead viewing the value of the eelgrass beds as embodied in the value of the salmon. Forage fish would bear a similar relationship to salmon.[4] Recognizing that ecosystems perform valuable services and that these services are valuable in a variety of ways is an important function of describing ecosystem services. But quantifying that value in monetary terms is another matter. Valuation is not implied by designation, requiring a more systematic approach (National Research Council [NRC] 2005).

The metaphor of nature as a factory is appropriate (Banzhaf and Boyd 2005). Underlying thinking about ecosystems' roles in providing benefits in the form of goods and services is the idea that *natural capital* should be taken to be a full partner alongside manufactured, human and information capital when nature's services are "priced" (Costanza et al. 1997). The majority of ecosystem services are public goods not easily valued in monetary terms, with the result that human societies tend to undervalue such services, even though they are essential to human well being and basic survival. Because ecosystem services are not traded in markets the way ordinary goods and services are, "they do not send price signals that warn of changes in their supply or condition" (Daily et al. 1997). Absent regulation or well-defined property rights, natural capital may be all too easily depleted.

[4] Boyd and Banzhaf's (2006) full argument is that since the value of the eelgrass is already embodied in the value of the salmon, to count its value separately is to double count. More broadly, ecosystem service values should be admitted only in relation to specified human benefits. In this case, if the benefit is salmon fishing, then salmon comprise an ecological service that contributes directly to value as an end-product of nature. Such non-nature components as fishing tackle also contribute directly to value. Eelgrass beds and forage fish, on the other hand, even though essential to salmon survival, do not contribute directly to the fishing experience and should not be added to the ecosystem service value of the experience. They would have ecosystem service value in relation to activities like snorkeling, where their presence contributes directly to the quality of the experience, again as end products of nature that directly support that particular benefit. By the same token, Boyd and Banzhaf point out that coastal forests contribute direct ecological service value to recreational fishing because they enhance the aesthetic dimension of the fishing experience.

Categorization of Ecosystem Services

The Millennium Ecosystem Assessment (MEA 2005) involved a comprehensive effort to catalogue how changes in ecosystem services affect human well being, so that management decisions could better account for human and ecosystem needs. The MEA (2005) sorted ecosystem services into four categories:

1 *provisioning services* (products gained from ecosystems),

2 *regulating services* (benefits obtained from processes such as air or climate regulation),

3 *cultural services* (nonmaterial benefits derived by humans) and

4 *supporting services* (things necessary for the production of other ecosystem services) (Table 2).

Others have proposed different categorizations. For example, services are sometimes broken down into categories of "fundamental services" (those essential for ecosystem function and resilience) and "demand-derived services" (those formed by human values and demands, but not necessarily required for human survival) (Holmlund and Hammer 1999). Some add such categories as information, biogeochemical and physical structure services to the list (op. cit.). Farber et al. (2006), following the format of the MEA (2005), provide useful examples that amplify the benefits of conceiving of ecosystem services broadly. Their scope of inclusion is similar to that currently being exercised in the selection of VECs by various management entities. The primary function of VECs is to highlight goals, objectives, or constraints on management and not to serve the purpose of environmental accounting. Depending on context, VECs could in principle be chosen to highlight any of the services shown in Table 2.

Table 2. Examples of ecosystem services. Adapted from Millenium Ecosystem Assessment (2005) and Farber et al. (2006).

Examples of Ecosystem Services

Supporting	Regulating	Provisioning	Cultural
Primary Production	Gas Regulation	Food	Aesthetic
Nutrient Cycling	Climate Regulation	Fresh Water	Recreational
Soil Formation	Disturbance Regulation	Raw Materials	Spiritual
Hydrological Cycle	Biological Regulation	Genetic Resources	Historic
Habitat Formation	Water Regulation	Medicinal Resources	Scientific
Pollination	Waste Regulation	Ornamental Resources	Educational
Seed Dispersal	Nutrient Regulation		
	Soil Retention		
	Disease Regulation		
	Flood Regulation		
	Water Purification		

Choosing ecological attributes as VECs on the basis of "service" provision leaves room for considerable latitude. Salmon may be thought of as food for humans (a provisioning service), while also playing such ecological-service roles as distributing ocean-derived nutrients to inland watersheds through post-spawning mortality (nutrient cycling). The iconic value salmon have in the Pacific Northwest speaks to cultural services. Even natural beauty, an aesthetic consideration, can be thought of as a cultural service performed by ecosystems (Christensen et al. 1996). A coastal bluff may allow humans to enjoy sensations of beauty, inspiration and awe via the view afforded, or it can feed "doministic" leanings by providing an ideal hang glider launching spot, even as the same bluff provides the ecosystem service of sand supply to the nearshore ecosystem ("feeder bluffs" to coastal geomorphologists).

Shellfish are another example of an ecological component that provides multiple different ecosystem services. Residents of some areas of the Puget Sound might benefit from the improved water quality due to shellfish filtering processes, while people in other locales might benefit from purchasing shellfish for consumption. Both native and non-native shellfish perform these services, but we may still value one species over the other because what we value is not completely identified with the ecological services provided.

Many other examples are possible, as ecological services are ultimately derived from the myriad functions performed by ecosystems (Christensen et al. 1996). Complex interdependencies may exist between ecosystem functions and services, rendering simple associations of services and their associated ecological functional support impractical (Costanza et al. 1997; see also Figure 4). Ecosystem services such as those defined in Table 2 ultimately serve mostly to highlight the many ways in which humans depend upon nature.

Social Capital

The notion of social capital—frequently attributed to the sociologist Robert Putnam (2000)—is an additional "human dimensions" aspect of ecological services that is beginning to receive notice in discussions of ecological restoration. The mere existence of an ecosystem or valued ecosystem component can serve as a hub around which opportunities to build "capital" within human communities arise. *Social capital* refers to connections among individuals that generate reciprocity in their relationships (Putnam 2000); some people view this simply as a "sense of community." Social clubs, environmental organizations and ad hoc citizen groups can all play this function. The resulting social connections can be beneficial for the individual involved, for the community in which they operate and for the targets of their actions—such as the natural environment. Thus, social capital is simultaneously a "private" and a "public" good (Putnam 2000).

In opinion surveys, members of the public frequently identify the kinds of relationships and benefits that are elements of the social capital construct as important contributors to quality of life (Putnam 2000). Social capital is considered to be a force that "increases the potential for economic development in a society by creating and sustaining social relations and patterns of social organization" (Turner 2000). In essence, social capital contributes to an improved sense of welfare among people. This observation argues for the view that the goal of economic valuation should not be to "summarize ecosystem services with a single 'bottom-line' number, but to better understand the significant connections between nature and society" (Pritchard et al. 2000). Social capital considerations argue for actively engaging communities that stand to benefit as restoration projects are being conceived, designed and implemented.

Highlighting ecological service values in the selection of VECs leads to considering the ways that natural resource economists categorize values derived from nature when markets do not exist. This leads to considering use and non-use values, and within the category of use values, distinguishing consumptive from non-consumptive use. These classifications are the subject of the following discussion.

Applying Economic Valuation Techniques to Ecological Resources

The value of a product is derived from human preferences. These preferences are expressed any time an individual makes a choice between goods and services (Pearce and Turner 1990), and the value is determined by that individual's willingness to pay (WTP) for a good or service (Lipton et al. 1995). The aggregate of all individual values determines the total value of the good or service (Pearce and Turner 1990). One way to approach determining the "value" of a VEC is through economics. Economists have worked extensively to classify and measure human values in association with nature and natural resources.

Price, Scarcity and Value

Price can be indicative of value, but it is not the same as value (Heal 2000). Prices, stated in a common unit (usually monetary), reflect relative value comparisons among goods. In addition, price is tied to scarcity. When a good or service is abundant, then the price of a slight increase in abundance of that good or service is small. Similarly, if a good is scarce, then relatively small changes in abundance correspond to higher prices. Thus, current prices are related to the present supply of a good and do not determine what the price of that good would be if its scarcity increased (Heal 2000). It is thus a marginal change in the amount of a good that is given a price and is indicative of the good's value (Simpson 1998). This complicates the determination of ecological values. Since the price and value of a service increase as that service becomes scarcer, it is difficult to extrapolate current prices into total values for an ecosystem component or ecosystem service (Pimm 1997). They may not even be related. For example, the value of wild salmon that are scarce to the point of warranting ESA listing will likely be unrelated to retail market prices for the same species. Nor are restoration costs necessarily a relevant measure of their value.

Total Economic Value

Economic values fall into two major categories: use value and non-use value, with Total Economic Value (TEV) equal to the sum of these two types of value (NRC 2005). A summary of the components of total economic value serves to illustrate how the various components of human value discussed previously can be incorporated into an economic framework (Table 3; after Ledoux and Turner 2002). The components of total economic value most frequently encountered with respect to environmental valuation warrant further, more detailed discussion.

Commonly Referenced Components of Total Economic Value

Direct Use Value

Direct use value is the benefit an individual receives from direct use of an ecosystem good or service (Goodstein 1999). These uses can be both consumptive and non-consumptive. Consumptive uses are those related to resource extraction like catching salmon or harvesting timber from a coastal forest. Frequently, the value of such consumptive uses can be found through market pricing. Alternatively, non-consumptive uses do not usually decrease the availability of the resource. Boating in Puget Sound, swimming in Lake Washington and hiking through coastal forests are examples of non-consumptive uses that provide direct benefit to the individual user. In each case, the resource is not consumed though it (or enjoyment of it) may suffer degradation from overuse—what economists refer to as externality or congestion effects (NRC 2005).

Indirect-Use Value

Indirect-use values come from supporting ecosystem services. They are "derived from the support and protection of activities that have directly measurable values (e.g., property and land values, drinking supplies, commercial fishing)" (NRC 2005). In this way, indirect use values are much like traditional intermediate goods or factors of production. They go into the creation of final goods and services that are used and valued by humans. Much of the value of the forage fish VEC would fall into this category. As noted previously, forage fish are a critical food source for many species in Puget Sound and thus have an indirect value in helping maintain those other species that people value.

Note that *use values* can also occur in the future and these future uses can be direct or indirect, consumptive or non-

Table 3. Components of total economic value. Adapated from Ledoux and Turner (2002).

Actual Use Value		Non-Use Value
Direct	**Indirect**	
Consumptive & Non-consumptive	Non-consumptive	Non-consumptive
Aesthetic	Intermediate services	Bequest
Cultural		Existence
Spiritual		Philanthropic
		Vicarious

consumptive. If the provision of an ecosystem service in the future is uncertain, individuals may be willing to pay in order to reduce the uncertainty of that good being available in the future. The term option value is not a separate value held by people in the sense of the components of value listed in Table 3, but represents differing responses to uncertain future conditions that affect the availability of the good in question and the income of the individual, as well as his or her risk attitudes with respect to these uncertainties (Freeman 2003, NRC 2005).

Non-Use Value

Non-use value can come in various forms, none associated with actual use of an ecosystem service. As the National Research Council (NRC 2005) states: "Nonuse [sic] values require special consideration; these may be the largest component of total economic value for aquatic ecosystem services." Non-use value is often synonymous with "existence" or "passive" value (NRC 2005).

Existence value is sometimes referred to as "intrinsic value." Intrinsic value is "unrelated to any actual or potential use of the good" (Pearce and Turner 1990). Bequest value is the willingness to pay for a good in order to preserve it for future generations (Pearce and Turner 1990). The passage of the Endangered Species Act (ESA) and the strict protection afforded to rare species is one way in which such preferences are expressed (Goodstein 1999). The apparent high levels of citizen support within the region for the recent listing of the Puget Sound Southern Resident Orcas under the ESA suggests that their non-use value is high and underscores the potential significance of non-use values noted in the 2005 NRC report on ecosystem values. Intrinsic values with respect to nature are sometimes called "ecocentric," meaning to value nature for its own sake as distinct from the use that may be made of it (Swart et al. 2001).

Total economic value is derived from many factors. Observable actions, from which we can infer value, are frequently the result of the combined expression of multiple types of value, rendering attempts to separate human values into component parts impractical. Attempts to measure TEV frequently involve a combination of market and non-market valuation techniques, which are discussed as follows.

Estimating Economic Values: Techniques and Limitations

Estimates of monetary values associated with ecological services may be presented in support of enhanced environmental protection. Examples in Puget Sound include an ecosystem services valuation that is part of the WRIA 9 habitat plan (Batker et al. 2005) and a study sponsored by the King County Department of Natural Resources and Parks in response to the proposed Glacier Mine on Maury Island (King County Department of Natural Resources and Parks [KCDNRP] 2004). A brief review of the methods most typically employed in such assessments serves to illustrate the application of economic valuation techniques to environmental amenities that lack market prices. The purpose is to explain these methods and to present limitations that caution against too much reliance on monetary valuation as a guide to protection or restoration priorities.

Addressing natural resources and environmental issues is problematic because established markets do not exist for many goods and services. As mentioned previously, this does not mean that the goods and services do not have value but, rather, that the value cannot be measured directly by market transactions. Economists have developed a number of techniques for assessing such values. The majority of these techniques rely on surrogate markets to infer the value of the good or service. When neither direct markets nor surrogate markets exist by which to determine value, economists attempt to determine the individual's "willingness to pay" for the good or service. Revealed preferences (via observations of behavior in the marketplace or in laboratory experiments) or stated preferences (relying on surveys) are the principal building blocks of non-market valuation.

Market Pricing

Market pricing is the most direct way of measuring economic value. For cases where a market exists, the price of a good provides one measure for determining the value of that good (Lipton et al. 1995). The price paid for a good represents the revealed preference of the consumer. However, the market price of a good does not tell the whole story. Market prices provide a useful but often incomplete picture of value (Heal 2000) and may only indicate the minimum value to an individual consumer. As noted above, the "value" of Puget Sound's wild salmon stocks is unrelated to landed value or market prices of the same species sold for retail consumption. Nor is it accurately represented by the value of the ordinary goods and services that would be purchased for purposes of salmon restoration.

Travel-Cost Method

The travel-cost method is an indirect or surrogate market technique for determining value, by which the non-market value of ecological services is inferred from the travel and time costs that individuals incur (NRC 2005). This method is particularly useful when assessing value for recreation, as it relates the costs people incur to visit a natural area or participate in an event as a reflection of how much they value that area or event (Lipton et al. 1995). By sampling a variety of trips from many individuals, one can determine the demand for a certain recreational site and, perhaps, a dollar estimate for the target activity (for example, bird watching). "All other factors being equal, the basic premise of the travel-cost approach is that people will choose the site with the lowest travel cost. When two sites have equal travel costs, people will choose the site with higher quality" (NRC 2005). Comparing attributes between sites and the relative demands for those sites allows for extrapolation of the values people place on the associated environmental services (NRC 2005).

A virtue of this technique is that it is tied to market expenditures. However, complications arise in determining the value of an individual's time spent traveling, which is not a direct market expenditure. People who live close to a site may value it highly, but spend relatively little on travel. Moreover, economists might warn that estimating the true net value of a trip to an individual requires subtracting out the value of the "next best" option. Failure to calculate net or incremental values is a frequent flaw of economic analysis aimed at estimating aggregate values for participation in recreational activities not easily priced by markets.

Hedonic Pricing

Hedonic pricing is another indirect-market valuation technique that does not rely on stated preferences but attempts to infer willingness to pay from market transactions. The typical example comes from the real estate market. House prices vary due to a number of attributes (square feet, age, quality of construction, size of lot, distance to shoreline, etc.). By using statistical techniques, analysts can disentangle these multiple factors and determine the premium people pay for increases in a single environmental attribute. For example, two houses may be identical in all aspects and differ only in their distance from the ocean. Comparing the market price of the house located on a scenic beach bluff with the comparable house located inland in principle represents the value of the ocean view from the bluff. In reality, turning such estimates into monetary values for a specific amenity, such as the shorelines of Puget Sound, requires use of statistical sampling and sale prices for many more than two houses.

A limitation in applying this technique to estimate values for ecosystem services is that the attribute under consideration must actually be evaluated by those making decisions to buy property. If potential homeowners do not assess the quality of the beach for forage fish habitat when purchasing a home, that specific value will not be accurately reflected in prices of the homes. The considerations that drive price differences in the real estate market might in fact be unrelated—if not antithetical to—ecological values. For example, the view from the top of the bluff may be the important thing, together with the presence of extensive bluff armoring that gives an assurance of safety. A coastal bluff in public ownership, such as a scenic overlook along a public highway, can provide similar benefits to a bluff in private ownership, but without an associated market that would permit value estimation via hedonic pricing techniques.

Replacement Costs

Replacement costs is an indirect economic valuation technique where the value of ecosystem services is determined by how much it would cost to replace that natural service with a man-made equivalent. For example, the value of water filtration provided by a coastal forest could be imputed by the cost of developing a water purification plant that performs the equivalent amount of filtration (Heal 2000). Among numerous problems with this approach is that rarely does the replacement system approximate all of the services provided by an ecosystem or ecosystem component. The coastal forest performs many functions beyond water purification or water retention, and has values that do not easily map into ecosystem functions. In addition, the relative effect of scarcity on values within the region of the resources in question is unlikely to be captured. Conversely, the factors that influence costs for supplying the replacement service will likely vary from region to region in a way that is unrelated to ecological endowment. The NRC (2005) cautions that this technique should be used with great care and only as a last resort.

Damages Avoided Through Protection

A final indirect market technique, the *avoidance cost method*, measures the value of an ecosystem service by the protection it provides from damage (Farber et al. 2006). Wetlands in Puget Sound provide flood protection from stormwater run-off. The value of this protection service could be extrapolated from estimates of the damages related to flooding that are avoided because the wetlands are in place. The USACE used this technique in the 1970s to estimate the benefits of preserving wetlands in the Charles River Basin in Massachusetts. The determined annual damage value of $17 million was used to justify protection of 8,500 acres of wetlands (USACE 1971, 1976). As with the replacement cost method, the value of fully functioning wetlands for just this one service (flood protection) should not be taken as representative of the value of *all* the ecological services those wetlands provide. The value of the protection afforded by wetlands or mangrove buffers has been recently highlighted by the devastating effects of Hurricanes Katrina and Rita on New Orleans and the Gulf Coast and of the tsunami that struck South Asia in late December 2004.

In application, this technique most often focuses protecting the built environment as the basis for estimating value. Prominent examples that highlight the value of the coastal ecosystem service of sand supply include lighthouses threatened by beach erosion (e.g., Cape Hatteras on the North Carolina Outer Banks, where the light has had to be relocated inland, and Folly Beach, South Carolina). In the Folly Beach case, the source of the erosion is a jetty built in 1896 to protect Charleston Harbor (Neal et al. 1984). The cost of protecting or replacing the lighthouse could be taken as an estimate of the value of the sand supply that was interrupted when the jetty was built. Analogs include the aptly named Washaway Beach and other eroding coastal areas of Southwest Washington affected by jetty construction.

Contingent Valuation: Willingness-to-Pay, Willingness-to-Accept

Contingent valuation (or *contingent choice*) is one of the most commonly used valuation methods. This method entails having individuals complete a questionnaire to assess what they would be willing to pay (WTP) to preserve a particular good. WTP is the maximum amount, measured in goods, services, or dollars, that a person is willing to give up to get a particular good or service (King and Mazzotta *www.ecosystemvaluation.org/glossary.htm*). In contrast to the methods described above, which relied on direct or indirect market prices, the contingent-valuation method relies on stated preferences. It has been used in a great variety of environmental valuation situations—for example, to determine values for a range of biodiversity benefits (Nunes et al. 2001). It was famously and controversially used to estimate the total value to the United States of losses associated with the 1989 Exxon Valdez oil spill (Carson et al. 1992).

Contingent-valuation surveys are used to extrapolate value for society as a whole via statistical techniques. One difficulty is that stated preferences may not accurately reflect what consumers will actually pay. Survey responses are directly tied to an individual's knowledge as well as values; thus, additional effort may be required to account for the effects of differential knowledge on values of complex indirect ecosystem services like biodiversity.

Variations on this technique involve a focus on the willingness to accept (WTA) payment for loss of a service (Goodstein 1999), which is similar to, but frequently greater than, WTP (NRC 2005). Contingent valuation methods do not generally distinguish among the various types of values shown in Table 3, and are taken to represent the total economic value of a good or service. There are also more intricate mixed methods of valuation.

Conjoint Analysis

Conjoint Analysis is a stated preference technique that can be useful for situations that embody complicated environmental tradeoffs across multiple attributes. At the root are management options whose main differences can be expressed as differential levels of a set of attributes common to all options. For example, management measures may be estimated to affect each of several VECs differently, either because more of one (e.g., orcas) may imply less of some others (salmon upon which orcas feed), or because limited resources at the project level mean that money invested in measures to promote recovery of one VEC leaves fewer dollars available to invest in others. Use of conjoint analysis typically relies on construction of alternative scenarios with different "service" levels or suites of environmental conditions across a common set of attributes (Farber et al. 2006). These are then presented in surveys in which individuals rank or rate the scenarios with respect to overall preference, perhaps via a rating scale. Statistical techniques may then be used to construct value functions for the individual underlying attributes. If the survey was built around actual management options, the overall results may reveal which option is most preferred by the affected public; however, the greatest utility of conjoint analysis may be its ability to reveal the tradeoffs individuals may be willing to accept across VECs or other dimensions of management measures.

Benefits Transfer

Benefits transfer—a technique by which resource values determined in a study for a given location are extrapolated to another location—is commonly used, necessitated by the temporal and financial constraints on conducting economic valuation studies from scratch. Although these extrapolations can be very useful, benefits transfer is as much art as science. According to Ofiara and Seneca (2001), one study that compared directly assessed values with those inferred from benefits transfer found: "…that some transfer errors [difference in monetary value] were as high as 228 percent." Two of 24 comparisons revealed errors greater than 100 percent. Unfortunately, validation of estimates made via benefits transfer requires comparative analysis that is beyond the scope or resources of many applied studies. Some analysts attempt to deal with this problem by providing a range of value estimates (e.g., Batker et al. 2005). However, this approach may still leave unaddressed differences between locations and the consequences of those differences for the validity of the inferred estimates. Those employing benefits transfer should look to guidelines developed by practitioners to direct the choice of comparables, as benefits transfer is inherently subject to considerable inaccuracy (NRC 2005).

Other Complications and Limitations

The preceding discussion implies that many commonly applied valuation techniques achieve analytic clarity by isolating a single aspect of value. In order to understand one type of value well, we often exclude other values by simplifying assumptions. The implications for the estimates obtained are not necessarily straightforward. On the one hand, isolating on a single type of value estimated via a single valuation approach (e.g., the value of beaches for recreation via the travel-cost method) seemingly provides a lower-end estimate for the value of a resource.

On the other hand, mixing methods in the estimation of non-independent values is to invite the possibility of *multiple counting* when separately derived estimates are combined (McConnell 1990). For example, a beach may be of high value for its abundant sand and its high level of recreational use. The value of this sandy beach could be estimated either by using the travel-cost method focused on recreational value to visitors or the replacement cost method via focusing on the cost of beach nourishment to maintain the sand supply. However, if visitors chose the beach because of its abundance of sand, this does not mean that these two values are independent, and adding the results of the two techniques (for example, treating the cost of sand supply as a measure of ecological value) would likely overestimate the value of the sandy beach. Adding up the results of separate assessments may lead to a result unlikely to reflect the complex interconnections within ecosystems that act to produce multiple valued goods and services or, for that matter, the cognitive complexity of human valuations in connection with nature.

The ability of a VEC to provide a particular ecological service (e.g., a beach for shoreside recreation) may come *at the expense* of its ability to provide another (e.g., the same beach as shorebird habitat), implying that the theoretical full value of the VEC cannot be realized in practice (Figure 4a).[5] Or multiple sources of a particular ecological service may exist, implying that the value of the service may not be attributable in a simple way to any particular structure within an ecosystem. Recreation is a prime example, as the person who "goes to the beach" for a recreational visit likely draws satisfaction from other aspects of the local environment that may or may not also be VECs (Figure 4b).

Competing values may occur not only with respect to individual VECs but in conjunction with restoration as a whole. Woolley and McGinnis (2000) employed Q-methodology to identify the different restoration "discourses" that derive from different values and priorities. While restoration may enhance values associated with the VECs identified by program managers, it may do so at the expense of other values important to affected communities. These values may derive from developed relationships with the existing environment, impaired though it may be in the eyes of the restorationist. For example, in a prairie restoration project along the shores of Lake Michigan, a decision was made to leave in place the so-called "Magic Hedge" though it partially obscured the prairie view that was the goal of the restoration. This non-native honeysuckle hedge attracted native songbirds which were highly valued by local birdwatchers, a group which otherwise strongly supported the notion of native prairie restoration (Gobster and Barrow 2000).

Total valuations of ecosystem goods and services at broad regional scales (e.g., Batker et al. 2005) are, for the many reasons outlined in this paper, unlikely to produce valid estimates. The often stated presumption is that such "total valuation" studies provide information that should guide priorities in decision making. But *how* information about values should be used in policy making is not a question answered by the act of valuation itself. As we have noted elsewhere, the valuation techniques discussed are best suited to valuing *relative* changes in goods and services. As such, they are most useful for comparing policy choices within a particular region or problem context.

Pritchard et al. (2000) argue that economic valuation of ecosystem services is not inherently "for" any particular purpose; they also reject the proposition that single "bottom-line" estimates of value should guide decisions, even as they ascribe great value for decision making to valuation that reveals the character and relative strength of linkages in coupled human–nature systems. As noted previously, any actual restoration plan is likely to generate benefits to some resources (or underlying values) at the expense of benefits to others. Presumably having such tradeoffs made explicit helps decision makers, but it may be that actions that improve conditions for one species in a region (e.g., bald eagles) prove detrimental to others (e.g., Great Blue Herons, due to eagle predation—an example of a technical tradeoff across objectives). Or, subtle changes in species composition and habitat availability that result from restoration may, as a byproduct, reward one social group at the expense of another. For example, "puddle" ducks that were readily available to hunters on the freshwater marshes that formed behind dikes built to convert estuarine systems to pasture (commonly done in western Washington in the early 20th Century) may become less abundant or less available once the dikes are removed and estuarine conditions restored. Bird watchers on the other hand may reap the rewards of greater species diversity in the area, in effect shifting the beneficiaries of the values as well the values themselves.

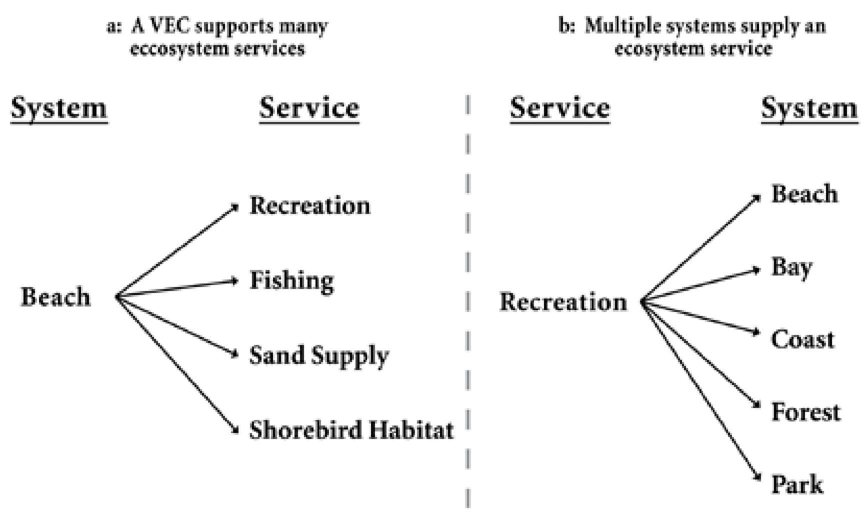

Figure 4. Relationship between ecosystem components and ecosystem services.

[5] In practice, the "negative externality" imposed on habitat value by beach recreation could be minimized by management. However, the management costs incurred similarly prevent the full theoretical value of both recreation and habitat VECs from being realized.

Application to Puget Sound VECs

As has been discussed throughout this paper, valuing VECs is a substantive task. The value can come from many different arenas and valuation studies can attempt to determine that value from a variety of perspectives. Table 4 summarizes the primary types of ecological value for each VEC and provides indicative examples of how those values are expressed and measured. The table is not intended to be exhaustive but rather to provide concrete ties between the concepts presented in the previous sections and Puget Sound's VECs. Ledoux and Turner (2002) provide a good summary of the application of economic valuation techniques for valuing ocean and coastal resources, and Farber et al. (2006) provide a similar discussion in a somewhat broader context. Their work helps frame our discussion in VECs and the Value of Restoration (this paper).

The recent Maury Island study (KCDNRP 2004) serves to illustrate how the economic valuation techniques discussed in this paper may be applied within Puget Sound. The study drew from peer-reviewed studies and focused primarily on non-consumptive uses. Monetary values for 10 different types of land cover were determined by estimating the value of ecosystem services associated with each area. The study relied heavily on benefit-transfer techniques and, although it makes a case for the efficiency and cost effectiveness of this approach, the cautions stated previously apply. The study highlights the difficulty of attributing values to services that have not been previously studied (i.e., soil formation and retention for beaches near dwellings), underscoring the importance of recognizing the limitations and context-sensitivity of the benefits-transfer approach. However, the study's stated purpose was to provide the ability to value relative changes in services associated with the proposed construction of the Glacier Mine on Maury Island. The intent was to encourage decision makers to consider total economic value in decision making and the study thus aimed to facilitate comparison of total ecosystem effects across project options via the tool of monetization.[6]

[6] Farber et al. (2006) expand upon the approach taken in the Glacier Mine study and provide other examples.

VECs and the Value of Restoration

Valuing Restoration: Contrasting Anthropocentric and Ecocentric Perspectives

Focusing on VECs offers a way of holding up a mirror to the many challenges and opportunities implicit in restoration planning and implementation. We have taken a broad view of VECs, characterizing them as capable of capturing cultural, spiritual and aesthetic values as well as the economic and ecological values that dominate most current environmental management discussions (Figure 1). The motivations for environmental restoration are similarly broad and reflect the breadth of approaches that humans take to valuing nature itself (Swart et al. 2001, Higgs 2003). A *valuation approach,* as defined by environmental philosopher J.A.A. Swart and colleagues (Swart et al. 2001), is the mix of beliefs and values that influence thinking (of organizations as well as individuals) regarding restoration (Swart et al. 2001). Valuation approaches embody ethical and aesthetic considerations as well as the ecological considerations that receive the greatest attention in science-based restoration programs like that of PSNERP.

To take an ethical perspective on restoration is to ask what the "right" thing to do is in an ethical or moral sense. Swart and colleagues point to contrasting *anthropocentric* and *ecocentric* perspectives as dominant and sometimes competing contemporary conservation ethics. The anthropocentric view argues that right action is that which generates positive consequences for humans, or at a minimum, positive consequences sufficient to outweigh negative ones. Human judgments about what is desirable are at center stage from this perspective, and ecosystem goods and services are likely to be highlighted. The anthropocentric perspective is evident in the orientation of the many current environmental programs that purport to manage *for* VECs or for the ecological services they provide. The motivation is often termed "extrinsic" (or instrumental) in the sense that restoration is the instrument by which positive outcomes are achieved. Such motivations stand in contrast with the "intrinsic" motivations that define the ecocentric view.[7] To adopt an ecocentric view is in short to value nature "for its own sake" (Swart et al 2001).

[7] Social scientists frequently distinguish "intrinsic" from "extrinsic" (or instrumental) ideals or motivations for human action with respect to nature. To say that the purpose of restoration is to recover salmon is to adopt an extrinsic view. Salmon are what is valued and restoration becomes the means (i.e., instrument) by which the goal of a healthy salmon population is to be attained. The view is anthropocentric because it points directly toward something humans value (salmon or salmon recovery) as the goal. By contrast, to say that nature has an inherent right to function as it would in the absence of humans is to adopt an intrinsic or ecocentric view. Nature comes first from this perspective, while human desires and needs come first from an anthropocentric view, especially one that relies on monetary values to make its case. A thing has intrinsic value if it is valued for its own sake, as opposed to its value in relation to human well being. As with most classification, there's a middle ground, and if biotic integrity is the goal, it may be argued that elements of both views are present.

Role of VECs from an Anthropocentric Perspective

Farber et al. (2006) offer a prescription for the anthropocentric approach to restoration planning, arguing that management alternatives should be judged by the change in "service" level each provides compared with the status quo (ΔS), multiplied by the unit value (V) of the services of interest. The selection of a restoration approach is then informed by comparisons of $V \times \Delta S$ across management options. Quantification aids, though is not essential to, the comparison of options.

The connection to VECs is that service levels of interest may be associated with the production of specific VECs (or supporting habitat) with options evaluated accordingly. Any possible tradeoffs in the production of VECs at the project level likely become explicit (Farber et al. 2006). For example, one restoration approach may maximize the production of forage fish habitat while another may influence conditions in ways favorable to eelgrass production. Possibilities for joint gains across multiple VECs are also highlighted (Farber et al. 2006). For example, more extensive application of a particular management measure (e.g., creating enough marsh habitat to support avian raptors like peregrine falcons) might create conditions suitable for rare or endangered species (perhaps an animal that requires extensive foraging range) that might not benefit at all from a smaller project aimed at other VECs. In other words, a proportionate increase in restoration costs can lead to a disproportionately larger increase in restoration benefits (i.e., restored marshland and recovered falcons). In other cases, employing additional supplemental management measures might result in higher unit values for the VECs produced by a project. For example, the addition of boardwalks and overlooks to a project to increase physical and visual access might be expected to generate greater visitation, and therefore greater realized value of the VECs produced by the project (e.g., via enhanced ability to watch migratory shorebirds that use newly created shorebird habitat). The assessment procedures are finely tuned, but the analysis done is always framed in terms of extrinsic outcomes of clear value to some, if not all, humans. This approach is the embodiment of the anthropocentric perspective.

Role of VECs from an Ecocentric Perspective

VECs are flexible tools for restoration planning and implementation, and they can be defined and applied in ways that give expression to "intrinsic" motivations—the essence of the ecocentric view. Environmental philosopher J. Baird Callicott (Callicott 1997, cited in Swart et al. 2001) argues that to make restoration of ecological processes the goal of restoration—that is, to emphasize restoration of the capacity of natural systems to be self-sustaining—is to adopt an ecocentric perspective. The difficulty of articulating purely ecocentric perspectives perhaps becomes apparent in that

Table 4. VEC value summary. Appropriate valuation techniques extrapolated from Farber et al. (2006): AC = Avoided Costs, CV = Contingent Valuation, HP = Hedonic Pricing, RC = Replacement Cost, TC = Travel Cost. Note: Ledoux and Turner (2002) provide a summary of valuation studies on ocean and coastal resources.

VECs	Sources or Types of Ecological Value	Indicative Examples of Value	Possible Study Methods and Examples
Coastal Forests	Gas regulation, water purification, soil formation & retention, primary production, raw materials, habitat among others	• Expenditures on outdoor recreational activities • Legal protection in law and policies • The forests that surround Puget Sound are integral to the regions identity (Brennan 2007)	CV, HP, TC, AC, RC, Market Pricing (harvest) Kramer et a. 2003 provide a discussion and review of various economic valuation studies of forests with a focus on CV.
Beaches and Bluffs	Sand supply, disturbance regulation, habitat	• Expenditures on beach nourishment • Aesthetic value for views from bluffs and waterfront homes	AC, CV, HP, RC, TC Farber (1988) used both the TC and CV methods to find the recreational value of coastal wetlands in Louisiana. Similar approaches could be used for valuation of beaches and bluffs as well as coastal forests.
Eelgrass and Kelp	Food, primary production, gas regulation, habitat	• Expenditures on mitigation efforts • Legal protection • Cultural importance for Native Americans, source of chemicals and medicine (Mumford 2007)	AC, CV, HP, RC Johnston et al. (2002) completed four different studies using four different valuation methods (HP, TC, Wetlands Productivity and Resource Value) for an estuary in New York. This allowed for comparison between the different types of valuation methods.
Forage Fish	Intermediate good, food source for many biological resources (including salmon and Great Blue Heron)	• Legal protection • Puget Sound is referred to as a "wasp waisted ecosystem" to emphasize the importance of forage fish.	CV Blaine and Lichtkoppler (2004) used CV techniques to determine WTP and support for solid and water conservation. Since both soil and forage fish can be considered intermediate goods, similar techniques may prove effective in economic valuation of forage fish.
Great Blue Heron	Predatory role, nutrient cycling	• Iconic value • Social capital built through community groups The Heron Working Group, Herons Forever • Seattle (and Portland) City Bird • Branding (beer, wine, coffee, art, yoga and others) • Over $9 million spend in last 10 years to purchase and protect PNW Heron colonies (Eissinger 2007)	CV Bowker and Stoll (1988) used CV to determine the economic benefits of Whooping Crane preservation.

Table 4—continued.

VECs	Sources or Types of Ecological Value	Indicative Examples of Value	Possible Study Methods and Examples
Juvenile Salmon	Food, nutrient regulation linking aquatic and terrestrial environments	• Iconic value for the region • ESA listing of (some) salmon stocks • WDFW's Salmon Recovery Program • Commercial, tribal, and recreational harvest • Puget Sound Salmon Recovery page: http://www.salmoninfo.org • "In recent years, 11 federal agencies spent $1.5 billion annually to recover salmon and steelhead in the Columbia River Basin alone, according to the General Accountability Office. (Freeman 2006)	AC, CV, Market Pricing, Federal Expenditures Discussion of economic issues surrounding public support for salmon recovery in the Columbia River is provided by Huppert (2000).
Orca	Top Predator	• Iconic species of the Pacific Northwest • Cultural and spiritual value • Endangered species listing of Puget Sound Southern Resident Orca	CV, TC, Federal Expenditures Loomis and Larson (1994) used CV to determine the total economic value of increasing Gray Whale populations for both non-whale watchers and whale watchers.
Native Shellfish	Water purification, food, nutrient regulation	• Market value through shellfish harvest • Significant cultural history • Recreational shellfish harvesters collect nearly two million pounds of clams and oysters from around the Sound annually worth $100 million/year ($60 million Pacific oyster and $40 million native crab, clams and mussels). (Dethier 2006)	CV, RC, HP, Market Pricing There have been numerous studies looking at the value of improvements in water quality. Leggett and Bockstael (2000) used hedonic pricing techniques to show that water quality has an effect on residential land prices.
Marine & Shorebirds	Predator in nearshore environment	• Marine and shorebirds key in $5 million settlement for natural resource damages in the *Tenyo Maru* oil spill (NOAA on-line) • Grays Harbor Shorebird Festival http://www.shorebirdfestival.com • Dept. of Agriculture estimates that more than 85 million people engaged in recreational bird watching in 2004 (Hurt 2006)	TC Eubanks et al. 2004, explores subgroups of birder populations in the U.S. and through surveys determines an average trip cost and benefits. Marine and shorebirds considered in pollution compensation determination.

Callicott's restorationist may view process restoration as a proxy for a variety of utilitarian values, including the restoration of valued ecosystem services or particular VECs. The process-based approach to restoration embodied in the PSNERP conceptual model (Figure 3) serves to capture elements of the ecocentric perspective. Figure 3 highlights the feasibility of choosing process-based or purely "functional" VECs. Taken as a group, the PSNERP VECs suggest a mix of intrinsic and extrinsic motivations.

Highlighting intrinsic "nature for nature's sake" motivations for restoration likely complicates the task of choosing VECs. The relevant measures—units of "broken" ecological processes that are to be "fixed" (in the vernacular of the PSNERP Nearshore Science Team)—are neither easily defined nor easily communicated to decision makers and the public. For example, the necessary measures must convey that nearshore drift cells whose functioning is impaired by the presence of beach armoring can be restored to functionality by proposed management measures. By contrast, the measures that go along with extrinsically motivated restoration are more readily described—acres of habitat restored or fish populations restored to numbers that constitute viability.

Using VECs to highlight benefits and goals is nevertheless as applicable and relevant to ecocentrically motivated restoration as it is to that driven from an anthropocentric perspective. But what is counted and how successful outcomes are measured likely changes. Both motivations can be problematic from an accounting perspective. Tangible outcome measures like salmon recovery, which are easily understood and embraced by the public, will rest on shaky scientific foundations if the underlying cause-and-effect relationships between restoration action and expected outcomes are weak. Process-based measures may be more scientifically defensible but may need to be convincingly explained to the public and decision makers if they are to resonate with those lacking the familiarity experts have with the complex, broad-scale biophysical and ecological processes that govern the health of nearshore systems. The value of considering nearshore restoration from contrasting ecocentric and anthropocentric perspectives is to recognize that elements of both are likely necessary for robust designs.

VECs and the Corps Approach to Measuring Restoration Benefits

The Corps, which has long relied on cost–benefit analysis to justify water projects, uses a version of cost-effectiveness analysis called incremental cost analysis (ICA) to plan environmental restoration projects. The shift to the ICA approach is in part acknowledgement of the difficulty of measuring restoration benefits in dollars (USACE 2002). Under the ICA approach, estimated financial costs of project segments are compared with the non-monetized benefits associated with each segment. The outputs are typically expressed in such units as acres or linear feet of a particular habitat type produced by the project. Segments are added to a project incrementally until some stopping point is reached, defined by total budget or in terms of a cut-off based on diminishing efficiency of return per dollar invested. With the aid of computer modeling, multiple outcome measures, reportedly up to 10, may be used in the calculations.

The Corps ICA approach provides a strong focus on project outputs (extrinsic measures) while of necessity requiring that the analytic outputs selected be fairly directly tied to the "pick and shovel" work that is central to most projects. When VECs are more directly tied to what is being "produced" by restoration enabled through an ICA accounting framework, rather than to species abundance, they likely will speak to ecological structure, habitat and possibly units of functional ecological process restored. The motivations remain predominantly extrinsic, even though they speak to outputs that are intermediate to the "final" outputs that are emphasized by the PSNERP VECs.

Role of VECs that Represent Cultural, Spiritual and Aesthetic Values

We argued earlier in this paper that VECs could be (and in practice, are) selected to highlight cultural, spiritual and aesthetic values as well as economic and ecological values (Figure 1). The aesthetic dimension constitutes the third leg of the triad that defines a fully formed "valuation approach" in the view of Swart et al. (2001). These authors argue that aesthetic and other human-centered dimensions of restoration are, in practice, accommodated in the details of project implementation as secondary rather than primary goals. Moreover, they are more likely to be included when social conflict exists. Of course conflict need not occur if affected interests are brought into project conceptualization in the early stages and if project proponents are open to accommodating interests that go beyond the purely ecological (T. Mitchell, University of Washington, Seattle, unpubl. ms.).

Swart et al. (2001) conclude that, "[N]ature development in densely populated areas seems only realizable if it coincides with other interests." Some restoration projects in the Puget Sound region possibly illustrate this point. The proposed Deschutes Estuary restoration project in the City of Olympia involves the conversion of Capitol Lake, a park-like feature with strong aesthetic appeal, back to the estuary out of which it was originally constructed via diking and filling. That project could perhaps be conceived as one aimed at replacing one aesthetic, that of the reflecting pool and promenade, with another, that of restored nature in an urban context. Such an orientation would likely lead to emphasis on measures to maximize the aesthetic and educational dimensions of the proposed restoration. The completed Seahurst Park restoration in Burien, Washington, along the Puget Sound shore, was careful to preserve existing public paths and walkways as seawalls were removed and to avoid creating situations that could be interpreted as increasing the vulnerability of parkland and infrastructure to wave attack. Perched beach features were added such that they might also be interpreted as sandboxes in which children were meant to play.

Another example is that of a proposal to restore a large area of tidal marsh in an area of southern Hood Canal that was historically used by the Skokomish Indian Tribe. The participation of tribal representatives in project planning has led to incorporating features into the restoration plans like boardwalks that would enable tribal members to regain access to islands where grasses of cultural importance to the tribe grow. Because these grasses have long histories of use in basketry and the making of ceremonial clothing, today they have cultural and economic value to the tribe.

Summary and Conclusions

VECs are employed widely in environmental management to orient intended management action toward goals and benefits presumed to be important to affected interests and the general public. VECs are typically chosen from among the more tangible attributes of ecosystems, with the idea that they will help in communicating goals and expected benefits in a relatively straightforward and understandable way. Naming VECs also invites the opportunity to define, at least conceptually, the cause-and-effect linkages between intended management action and expected outcomes in terms of VEC "production." To employ VECs in ways that make both points will likely maximize chances that the argument for action can be effectively communicated to decision makers and the public.

A review of current practice shows that VECs are used to highlight a wide variety of goals and desired outcomes of environmental management, many at the intersection of ecological, economic, and socio-cultural values. By conjuring up notions that they can be used to judge and account for the "worth" of management actions, VECs also send a signal that managers expect to be held accountable for the effectiveness of the investments they make in environmental improvement. The scope of current usage also suggests that "ecosystem" is increasingly seen as inclusive of, rather than distinct from, the human environment.

While closely related to ecosystem goods and services, VECs are more tangible and less oriented at environmental accounting. The correspondences between the two notions are nevertheless strong. Systematic consideration of the values represented by VECs, as undertaken in early sections of this paper, leads to considering the many and diverse ways that humans value nature. By contrast, environmental accounting is often the rationale for framing environmental conditions in terms of associated bundles of ecosystem services. The motivations and approaches that guide selection of VECs in practice appear often to result in measures that are applauded by managers or activists but bemoaned by economists and ecologists seeking unambiguous measures by which to evaluate the "worth" of environmental interventions (Boyd and Banzhaf 2006).

VECs are generally chosen for communicative value rather than from "first principles" considerations that would leave them better grounded conceptually. If accounting is the goal, then conceptual grounding is important both with respect to the theories of valuation employed by environmental economists and philosophers and with respect to the ecosystem theory that underlies restoration science. Quantifying value—the "V" in VEC—nevertheless remains appealing in an era where the competition for public funds is fierce. The "extrinsic" motivations that guide much contemporary environmental management lead inevitably to desires to quantify expected management outputs, but both goals and approaches to dollar valuations need to be carefully considered.

By focusing on VECs, we add a human dimension that otherwise might be overlooked if we focus on the ecological dimensions of restoration to the exclusion of other values. Clearly, thinking comprehensively about VECs in all their dimensions can considerably enrich the value set derived from restoration, and in that sense VECs are a useful tool for more fully engaging the public whose support is necessary for regional-scale restoration in Puget Sound to succeed.

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PSNERP and the Nearshore Partnership

The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) was formally initiated as a General Investigation (GI) Feasibility Study in September 2001 through a cost-share agreement between the U.S. Army Corps of Engineers and the State of Washington, represented by the Washington Department of Fish and Wildlife. This agreement describes our joint interests and responsibilities to complete a feasibility study to

"…*evaluate significant ecosystem degradation in the Puget Sound Basin; to formulate, evaluate, and screen potential solutions to these problems; and to recommend a series of actions and projects that have a federal interest and are supported by a local entity willing to provide the necessary items of local cooperation.*"

The current Work Plan describing our approach to completing this study can be found at:

http://pugetsoundnearshore.org/documents/StrategicWorkPlanfinal.pdf

Since that time, PSNERP has attracted considerable attention and support from a diverse group of individuals and organizations interested and involved in improving the health of Puget Sound nearshore ecosystems and the biological, cultural, and economic resources they support. The **Puget Sound Nearshore Partnership** is the name we have chosen to describe this growing and diverse group, and the work we will collectively undertake that ultimately supports the goals of PSNERP, but is beyond the scope of the GI Study. Collaborating with the Puget Sound Action Team, the Nearshore Partnership seeks to implement portions of their Work Plan pertaining to nearshore habitat restoration issues. We understand that the mission of PSNERP remains at the core of our partnership. However, restoration projects, information transfer, scientific studies, and other activities can and should occur to advance our understanding and, ultimately, the health of the Puget Sound nearshore beyond the original focus and scope of the ongoing GI Study.

As of the date of publication for this Technical Report, our partnership includes participation by the following entities:

- King Conservation District
- King County
- National Wildlife Federation
- NOAA Fisheries
- NOAA Restoration Center
- Northwest Indian Fisheries Commission
- Northwest Straits Commission
- People for Puget Sound
- Pierce County
- Puget Sound Partnership
- Recreation and Conservation Office
- Salmon Recovery Funding Board
- Taylor Shellfish Company
- The Nature Conservancy
- U.S. Army Corps of Engineers
- U.S. Department of Energy
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- U.S. Fish and Wildlife Service
- U.S. Navy
- University of Washington
- Washington Department of Ecology
- Washington Department of Fish and Wildlife
- Washington Department of Natural Resources
- Washington Public Ports Association
- Washington Sea Grant
- WRIA 9

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Puget Sound Nearshore Partnership

RESTORING OUR ECOSYSTEM HEALTH

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Puget Sound Nearshore Ecosystem Restoration Project

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