Natural and Cultural Resource Valuation:

A Place-Based, Resource-Driven Approach

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Abstract

Assessing non-market values of natural and cultural resources involves intrinsic values that are often overlooked or undervalued in routine environmental assessments. This paper examines a place-based resource-driven approach to characterize these values to better understand it's utility in natural resource management. Existing methods produce monetary values for market and non-market resources, but are often criticized for under-representing critical aspects of value, over-representing market related aspects of value, ignoring ecological interconnections, or simply being uni-dimensional. Factor analysis of the expressed preferences of active stakeholders for the natural resources of a national park results in a two-dimensional value-space. The role of value-space in routine operations, storm recovery, and climate change adaptation is discussed. These scenarios suggest that the place-based resource-driven approach informs the entire decision process; it is proactive and quantitative. This approach broadens the basis for decisions, while using reasonable and reliable evidence to avoid arbitrary and capricious decision-making.

Keywords: resource valuation; intrinsic values; place-based valuation; natural and cultural resources; value-space

Introduction

This paper examines a place-based resource-driven approach to characterize the values of resources to better understand it's utility in natural resource management. A number of preference-based measures exist for valuing natural and cultural resources. Ciriacy-Wantrup (Ciriacy-Wantrup 1947) conceptualized the maximum monetary value a person is willing to pay (exchange, sacrifice or otherwise barter) for a public good as one measure of value for non-market resources. These measures rely on preferences for hypothetical outcome(s). Davis designed and implemented the first survey using willingness-to-pay; he correlated the results with the travel cost method, and found the results were quite similar (Davis 1963). In spite of these early tests of reasonableness, reservations were raised about using partial values to represent resources, which encourages (or subsidizes) over-use of scarce resources (Krutilla 1967). Contingent valuation measures stemming from the willingness-to-pay concept have become widely used in valuing environmental resources and outcome(s). In spite of widespread use in the 1980's, a debate ensued between those who found these measures sufficiently valid to warrant requiring their use in environmental regulation and those who opposed such requirements because of the under-representation of non-market values (Portney 1994; Beatley 1994). This paper accepts the idea that uni-dimensional monetary measures of natural and cultural resources under-represent the value associated with these resources. It assesses the perceived intrinsic values of natural and cultural resources associated with a particular place in multiple dimensions. The result is an abstract graphic value-space that represents the unique contribution(s) of significant dimensions of value relative to and independent of one another. The

value-space method can be used independently or in conjunction with other measures to inform natural and cultural resource decisions.

Including the full range of values for natural and cultural resources in resource management decisions is one of the most vexing problems facing resource managers, planners and policy makers. Shafer and Brush (1977) developed a model of preference to quantify the value of natural landscapes through statistical analysis of spatial data and observed strong correlations with stated preferences for landscape features. Carlson (1977) challenged that quantification of aesthetic beauty may not be possible or even reasonable; he notes that landscape assessments fail to express overall quality adequately, but perform better in capturing relationships between elements within a landscape. This excludes some important drivers of aesthetic beauty such as public preferences for formalism in photographs rather than more robustly understood natural aesthetic beauty. Ribe (1982) suggests that this misconstrues the intentions and purpose of those who seek to quantify the value of natural scenic beauty as a pursuit of objectivity alone, rather than a more effective, deep and considered exploration of the elements and relationships of aesthetic beauty. Multiple approaches enhance human awareness of the function of environmental aesthetics (Ribe 1982). By recognizing that scenic beauty depends on human perception, Gobster (2008) suggests that the complexities associated with dimensions such as symbolism, culture and natural processes are inherently multi-dimensional. Humans each hold their own unique relationships with their surroundings, which are complex, and when viewed holistically blend the natural and cultural resources found therein (Antrop 2005). Each interaction with a landscape, whether as a participant in

a landscape or as a policy maker affecting that landscape, expresses an individual's values associated with that place and its resources. These physical resources create unique places that are highly valued and it is crucial that we understand how changes may alter the meanings and sense of place for residents and visitors (Stedman 2003). Measuring this perceived value, however, is limited by the ways that values are associated with resources, few of which readily incorporate multiple dimensions. As a result, these measures often arguably fail to incorporate significant portions of the individual or shared community values people associate with these resources in information that guides decision processes affecting them (Bingham et al. 1995; Loomis 2000; National Research Council 2005). This under-representation of value is most often the case when non-market resources, those not easily priced or quantified for inclusion in economic efficiency analyses, are considered (Loomis 2000; Beatley 1994).

This leaves natural and cultural resource planners in a quandary; how to incorporate the non-market intrinsic values into decisions processes in a meaningful rational way? (1) Planning processes often support executive decision making with factual assessments, but what gets assessed, how it is characterized, the analysis and interpretation are all laden with values. This accountability becomes even more difficult when the intrinsic values associated with natural and cultural resources are involved. Creating a value-space on the basis of the place-based resource driven approach described herein empirically quantifies these values, which allows them to be more effectively incorporated into these decisions (2) Congress and the Council on Environmental Quality defined the National Environmental Policy Act (NEPA) process to comply with the constitutionally derived prohibition of

arbitrary and capricious government regulations and actions. Resource planners and managers cannot make value choices that are not substantiated by reasonable and reliable evidence. The place-based resource-driven approach allows planners to incorporate intrinsic values into the process on the basis of reasonable and reliable empirical evidence. (3) Because of the special legal and political foundations of National Parks, decisions therein may be somewhat insulated from economic valuations, tradeoffs, and market proxy evaluations. But park managers still make decisions that impact natural and cultural resources. The value-space method supports these resource management decisions by measuring the value associated with natural and cultural resources empirically, in multiple dimensions, and providing quantitative evidence that is based on the specific preferences of their constituents and stakeholders. The place-based resource-driven method incorporates and synthesizes factual assessments of perceptions of values associated with natural and cultural resources.

This expressed preference approach quantitatively assesses a range of peceived intrinsic values, those outside of monetary markets and often variably described by individuals as related to the very existence of a resource, associated with natural and cultural resources in a national park. Resources are represented relative to one another in an abstract graphic value-space of multiple dimensions to express intrinsic values. Each dimension is unique from all others and significantly contributes to the overall value-space as described later. These assessments can be used throughout the descision processes and may be employed prior to or alongside traditional monetary measures of value. This approach:

1. is an important step in valuing natural and cultural resources, with their attendant intrinsic

nature;

2. supports resource management decisions by valuing benefits;
3. complies with the constitutionally derived prohibition of arbitrary and capricious government regulations and actions as it is based on factual assessments of reasonable and reliable evidence; and
4. supports executive decision-making by allowing the intrinsic values of natural and cultural resources to be more effectively incorporated into these decisions.

Friedmann (1987) conceptualized planning as using scientific knowledge to inform action in the public domain, which involves making scientific and technical knowledge effective in informing plans, policy and public actions. Ackoff (1974 p.5) describes preactive planning as problem solving "…based more on logic, science and experimentation than common sense"; it often involves specifying goals and objectives, selecting appropriate planning tools (e.g., courses of action, programs, or policies), and determining the resources required. Interactive planning usually adds to an understanding of organizational and/or social requirements, and designing the implementation; it is (a) participatory in that it is done by the system not for it, (b) coordinated across functional boundaries, (c) integrated at all levels, and (d) continuously updated, corrected and revised to assure it adapts to its environment. Effective planning efforts, including both of the above types, also reflect the community's values in the outcome products; plans, policies and decisions, while respecting stakeholder-values (Brody et al. 2003). Hence, if resource managers are to address planning issues comprehensively, they must account for all the natural and cultural resources in the community (i.e. how could comprehensive claims have meaning without complete representation?). Second, all significant dimensions of each resource will be

represented (i.e., how could it be comprehensive if significant intrinsic values are omitted?). Third, all stakeholders need to be involved in the resource assessment (i.e., how could it be comprehensive while only representing limited perspectives?). In this light, it is essential to create methods that offer better ways to assess and include values for non-market resources in planning decision processes (Bingham et al. 1995; de Groot 2006). Hence, decision makers with greater access to information and perspectives that address the complexities of the problem will have a greater opportunity to make better-informed choices.

Background

Several dominant methods are used to establish the value of natural and cultural resources. Revealed preference measures such as market prices, hedonic pricing and travel costs observe consumer behavior and impute monetary values for certain resources or their services (Heal 2000; Loomis 2000). These provide accurate market proxy measures, but have been criticized for their inability to capture multiple types of value, such as difficulties in attributing value to resources within trips with multiple destinations, or for the way multiple bundled resources are represented by single values (Bingham et al. 1995; Clough and Meister 1991; Loomis 2000). Stated preference measures, such as contingent valuation (CV) or contingent choice, use individual responses to hypothetical scenarios, to better understand preferences for future changes to landscapes. Again, these provide meaningful measures of market proxy value. Criticism of both of these methods include arguments that the nature of CV (a) violates the principles of rational choice (Arrow and United States National Oceanic and Atmospheric Administration 1993), (b) includes embedding effects and inflated hypothetical values (Diamond

and Hausman 1994), (c) is unable to allow respondents to work proactively, (d) requires respondents to value pre-selected alternatives with bundled resources in an all-or-nothing choices (Hanley et al. 1998), and (e) the idea that a single monetary value cannot take into account socially or culturally constructed values for most resources (Stephenson 2008).

Finally, there are methods available to incorporate multiple sets of normative choice information into one valuation measure in order to incorporate some of the complexities of simultaneously valuing natural and cultural resources. Techniques such as Multi-Criteria Analysis and the Analytic Hierarchy Process incorporate market and non-market use values into non-monetary relative values, but some of the same criticisms of being based on hypothetical scenarios and prescribed alternatives apply (Duke and Aull-Hyde 2002; Munda et al. 1994). Nonetheless, this recognizes resources as worth more than just the sum of independent monetary values and tend to use a "plurality" of measures to form a more holistic representation of resource value (Arrow and United States National Oceanic and Atmospheric Administration 1993; Farber et al. 2002). The need to expand measures of value to represent a broader array of dimensions that contribute to overall aesthetic experiences, ecological needs and cultural identities has been recognized and noted as a key challenge for landscape planners (Beatley 1994; Gobster 2008). Resource management based solely on a dominant characteristic, whether beauty, uniqueness, rarity or even market value undervalues resources characterized by more subtle qualities with less obvious appeal, and may bias decision processes.

Resource managers are challenged with complex decisions that are most often approached using some form of the cost-benefit analysis (CBA). Whether considering CBA in local processes for

efficiency or in NEPA processes that require it, considering multiple value types is integral to natural resource decisions. CBA is a systematic assessment of alternative actions. An outcome is considered favorably if the measurable benefits of an action are expected to exceed the measurable costs that will be incurred. Among available alternatives, the one that produces the maximum ratio of benefit to cost is the most desired action (Arrow et al. 1996; Kelman 1981). This process is typically linear and follows the basic steps of 1) articulation of the problem, 2) objectives to be considered, 3) forming multiple decision alternatives and attendant impacts, 4) valuation, assessment and ranking of alternatives, 5) selection of a preferred alternative, and 6) implementation (Seip and Wenstop 2006; Noble 2006). This linear and reactionary process relies on pre-formed problems, objectives and alternatives before value assessments are made (Figure 1). Stakeholder participation is an important element of the decision process and has the potential to include value information in the critical problem and objectives formation stages of the decision process (e.g., Noble 2006; Seip and Wenstop 2006). In fact, it informs the entire decision process including the types of values to be considered, selection of the preferred alternative and its implementation (Daniels and Walker 1996).

Figure 1. Graphic representation of a typical linear process of environmental decision making (Noble 2006; Partidário and Clark 2000; Seip and Wenstop 2006).

These decision processes assume that the optimal decision will provide the maximum satisfaction of preferences for the entire community. This seems to be a rational way to approach the problem, however, as O'Neill and Spash (2000) point out, these approaches measure a combined strength of collective preference intensity, without addressing the strength,

weakness or conflicts among the potentially multiple underlying reasons people have for those preferences. In these cases, easily constructed values (e.g. timber harvests, increased tourism visits) have an advantage over more problematic types of value (e.g., social, cultural, psychological, ethical considerations and preferences) potentially resulting in "optimal" decisions that do not reflect the complex preferences of the community. While many authors have argued that the CBA method is far from being the recommended primary decision approach (Arrow et al. 1996; Easter et al. 1999; Hanley 1992; O'Neill and Spash 2000) this is not to say that CBA has no place in the valuation process. Rather, CBA is one input that makes important contributions to a broader set of information to be considered by decision makers.

Two problems become apparent. First, problems cannot be seen as static, wholly formed or "given" at the beginning of a decision process. Ackoff (1974) makes the point that problems are actually abstractions and can be shifted, re-focused and even re-framed, depending upon the dynamic information and sets of individuals that are utilized to conceive the problem. Thus, if problems are not static, but can be significantly affected by the dynamic sets of information that surround the problem, wouldn't it be beneficial to have more comprehensive sets of information prior to problem and alternative formation, especially information that addresses multiple dimensions of value? Second, typical linear decision processes (e.g., Figure 1) become reactive to pre-defined alternatives that may or may not reflect or adapt to the full range of values that community members hold for resources that may be impacted. Using resource values in a proactive way requires embracing multiple dimensions and perspectives throughout the entire decision process from problem formation to implementation.

Hence, CV-based measures for assessing values of environmental resources are widely used as the best available quantifiable methodology, but simultaneously condemned as not characterizing the complete picture. While putting a single monetary value on environmental resources recognizes that resources have value and should not be treated as a free gift of nature, willingness-to-pay measures are often criticized as failing to represent the full spectrum of value associated with the resource(s) under consideration. This becomes essentially a subsidy to those who benefit from the value measured but do not take on the costs of other unmeasured value dimensions.

Setting

A storm recovery planning process undertaken for the 90 km long barrier island system of Cape Lookout National Seashore in North Carolina (Figure 2) gathered the stakeholder data for this research.

Figure 2. Location Map of Cape Lookout National Seashore (National Park Service 2010).

Hazardous storms are a persistent threat to Cape Lookout and have frequently impacted park resources and operations (National Park Service 2004). The value-space discussed herein informed priorities given natural and cultural resources as part of the emergency planning process. These priorities inform decisions about the preservation and protection of park resources during routine operations and are particularly important during hazards. Even though park

personnel have specialized knowledge of park resources, they are often stretched thin during hazards, and response teams often include people less-familiar with the park resources.

A broad range of resources at Cape Lookout may be categorized into three basic categories: natural, historical and infrastructural. A diverse mix of flora and fauna comprise the natural resources. Four endangered species are present in the park, including the Piping Plover *(Charadrius melodus)*, the Sea-Beach Amaranth *(Amaranthus pumilus),* the Beaufort's Bottlenosed Dolphin *(Tursiops truncatus),* and the Leatherback Sea Turtle *(Dermochelys coriacea)*. A legislatively-protected herd of wild horses (*Shackleford Banks Horses*) also live in the park. The park has several unique habitats that support these endangered and protected flora and fauna, including salt marshes, tidal flats, ocean fisheries, maritime forests and dune and beach areas. The park's historic resources are directly tied to the history of the seafaring communities of coastal North Carolina. Two historic maritime villages of Portsmouth and Cape Lookout which includes the iconic Cape Lookout Lighthouse, two lighthouse keeper's quarters, two life saving stations, a former Coast Guard station and numerous homes, are included in the park. Infrastructural resources include human support systems such as dockage, sand and paved roads, restrooms, visitor centers, water and septic systems, communication facilities and maintained waterways.

Methods

A web-based survey of active stakeholders asked each respondent to identify the ten resources "most important to the park." Each resource identified was then rated on a zero-to-ten scale for the dimensions of "fundamental character," "attracting visitors," "scenic beauty," and "ability to

operate," where zero represents "not at all important" and ten represents "extremely important." The "ability to be replaced," was also rated on a zero-to-ten scale, where zero represents "not able to be replaced" and ten represents "easily replaced." These five types of value were developed through discussions with park staff concerning resources and their view of the reasons various resources were important to the park. The mean rating for each resource selected by more than one respondent represents the shared value of each resource along that dimension. Factor analysis of these shared values for all resources results in a two-dimensional space, where one dimension represents aesthetic quality of the resources, and the other represents a more functional quality (Rogers and Bardenhagen 2013).

Factor analysis is particularly well suited for this purpose in that it reveals underlying dimensions from the joint distribution of multiple measures, looks for underlying dimensions that explain the most variation while being independent of one another, and results in a standardized score for each dimension. The results of factor analysis also suggest when all the underlying dimensions have been identified. The first factor is the dimension that accounts for the most variance in the joint distribution. The second factor accounts for more remaining variance than any other dimension—resulting in a two dimensional Euclidian space. Additional factors account for more of the remaining variance than any subsequent dimension and each is orthogonal to all other factors. In this case, first factor accounts for around 80 percent of the variance, and has high factor loadings on scenic beauty (.980), fundamental character (.901) and visitation (.864). The second factor accounts for around 20 percent of the variance and has high loadings on the ability to operate (.728) and be replaced (.521). The eigenvalues (3.23 and .89 respectively) and the

limited ability of subsequent factors to explain additional variance suggests a two-factor value-space in this case. A graphic representation of the resulting value-space is depicted in Figure 3.

Figure 3. Two-Factor Value-Space for Resources Associated with Cape Lookout National Seashore.

Each resource is represented in the value-space relative to all others. The horizontal-axis of the value-space has an underlying abstract character of aesthetic quality. Resources with limited aesthetic quality including maintenance sheds, fuel storage, waste disposal areas, and administration buildings are negative, while resources having a high degree of aesthetic quality including aesthetic environmental experiences, the Shackleford Banks Horses, the Cape Lookout Lighthouse, salt marshes, and dune and beach systems are positive. The vertical-axis of the space seems to be associated with a functional quality. Dockage, vehicles, roads, cabins and cottages have positive factor scores, while Piping Plover, historic cemeteries and Beaufort's Bottlenose Dolphins are negative. Positive factor scores reflect infrastructural resources with an emphasis on logistics and function, while negative scores reflect historic, cultural and environmental resources, with endangered species being the most negatively located. Infrastructural resources dominate the upper-left quadrant of the value-space—no other resource types are located in this quadrant. Historical and natural resources dominate the lower-right quadrant. Endangered species tend toward the middle of the aesthetic quality, but are extremely low on infrastructural function as reflected in their importance to operations and ability to be replaced.

Findings

Rogers and Bardenhagen (2013) demonstrate that the resources cluster by category. Infrastructural resources are separated in the upper left quadrant of the value-space, which demonstrates the clear difference between active human ecological resources and other ecological resources. Difference of means tests confirm that infrastructural resources are significantly different ($p < .01$) from all other types of resources. Historic resources are artifacts of human ecology that have considerable aesthetic quality, while being difficult to replace if not irreplaceable—although there seems to be a recognition that the function of the lighthouse would be replaced as it is visually separated from the other historic resources. Threatened species share a similar space with historic resources in terms of both aesthetic and function quality ($p > .15$), although specifically named threatened species have less functional quality. The piping plover has the lowest functional quality score among all resources, while only historic cemeteries have functional quality less than either the Beaufort's Bottlenosed Dolphin or the Sea Beach Amaranth. While habitats are visually overlapped with threatened species, as a group habitats are attributed significantly higher scores ($p < .05$) on both functional and aesthetic quality.

Figure 3 Two-factor Value-Space for resources associated with Cape Lookout National Seashore

The place-based resource-driven approach allows potential outcomes to be quantified to compare impacts on various resources and alternatives. These comparisons are achieved in the context of their geographic location(s) and the potential area of influence associated with that resource (e.g., through view-sheds, or access zones). Each resource is located on a geographic map, and the impact zone considered (e.g., perhaps values depicted as contours on the map), so that resources are bundled with their values in decision making and planning. Resource-driven value structures

are critically important for problem formation, and the development and selection of alternatives, as well as their implementation. They provide a proactive planning tool for shaping resource decision processes.

Routine Operations—Operations at Cape Lookout must consider iconic resources. The Cape Lookout Lighthouse and the Shackleford Banks Horses are two of the most frequently associated resources with Cape Lookout. Both are among the five resources with aesthetic quality scores greater than one. The other three resources have to do with the "aesthetic experience," " salt marshes," and "dune and beach" areas. The more management decisions limit the experience by reducing the options or limit the supporting infrastructure needed for the experience, the less the benefit of aesthetic quality will be available. So clearly maintaining the dockage areas at Cape Lookout Village, Portsmouth Village and the Shakleford Banks is important to maintaining the fundamental quality of the park. But perhaps as important, is the ferry service for the "mid-park" region that allows vehicle access to "dune and beach," "salt marshes," "tidal flats," and "maritime forests"—all among the top-seven resources in terms of aesthetic quality. So for example, in times of tight budgets forced choices between dockage and channels that support these areas of the park are ill advised. Some resources are imbued with less aesthetic quality than others, for example the "Methodist Church" with an aesthetic quality score of .723, has twice as much aesthetic quality as the "Post Office" at .293, even though both are at Portsmouth Village. Hence budgetary conditions that force choices could be resolved by preserving the optimum aesthetic quality for available budget costs. Considering value-space in conjunction with costs attributes aesthetic and functional quality as quantifiable benefits.

Storm Recovery—Cape Lookout has experienced nine hurricanes making landfall directly in the park since 1950 (Table 1). Storm recovery is an essential part of natural resource management in the park. The Cape Lookout Storm Recovery Plan (National Park Service 2011) uses the quantitative value-space to set priorities for recovery—the iconic resources of the Cape Lookout Lighthouse, dune and beach areas, Shackleford Banks Horses, as well as Cape Lookout Keeper's Quarters, and Portsmouth Village Church are among the top-five resources. These priorities provide information for the damage assessment teams and help clarify the types of expertise that needed in each impacted area during storm recovery. To a large extent storm recovery is about restoring access. The value-space helps prioritize restoration operations to optimize resources with aesthetic quality. This may mean that some important resources are isolated from access because of new inlets being established, or channels being closed, or both. Hence to restore access to some resources new infrastructure may be required, while in other cases repairing existing (now damaged) infrastructure restores limited value to the park as a whole. For example, restoring a dockage area to a place that has now been cut off from access due to new inlets probably is of limited value, while access to those resources restores greater value. This implies that choices of what infrastructure to restore/repair could be sensitive to the access provided for various resources and the benefits associated their aesthetic value.

Table 1 Storms at Cape Lookout National Seashore Since 1950

Climate Change Adaptation—Cape Lookout is comprised of a series of barrier islands, which are near to sea level. Barrier islands are among the most rapidly changing geomorphologies on earth with rapid erosion, storm inundation opening new inlets and

closing others, dynamic channels and spits—all of which are exacerbated by climate change and sea level rise. Examination of the elevation of natural and historical resources in terms of their contribution of aesthetic quality of the park helps resource managers understand the timing of critical decisions as sea level rises. Detailed topography can show which resources are challenged at various levels of sea level rise, but the value-map shows how these resources or groups of resources contribute to the underlying aesthetic quality of the park. Some resources have the potential to be protected or moved to safer locations, others may relocate naturally; still others may be restored or reconstructed as replicas of historic resources. This may mean that some geographically isolated resources will be more difficult or costly to protect, but the aesthetic value may warrant additional cost. Conversely isolated natural and historic resources receive less priority to focus efforts on groups of interrelated resources.. For example, the Portsmouth Village Post Office and General Store is among the least valued historical resources, but because it is located among other historic resources the additional costs to protect it may warrant the use of resources to protect it. Meanwhile, an individual historic house or even an historical cemetery that is isolated from other resources, is more difficult to provide resources for protection than the Portsmouth Village Methodist Church or the Cape Lookout Keeper's Quarters, because they contribute more aesthetic value to the park. This suggests protecting aesthetic quality of natural and historic resources be balanced with costs when necessary. In addition, it sets the stage for the examination of historic restoration projects that can take into consideration not only the current contribution to aesthetic quality, but also the contribution of restored or adapted historic resources to deal with the challenges presented by the need to adapt to climate change and sea level rise.

Discussion

All the resources represented in the upper-left quadrant of the value-space are infrastructural while cultural resources and natural resources dominate the lower-right quadrant. Specific endangered species are located near the bottom-middle of the value-space, with near-zero aesthetic quality and negative functional quality. This seems to reflect the intrinsic value of endangered species. The endangered species are neutral to the observable aesthetic quality as less likely to be experienced directly than other environmental resources (e.g., maritime forests, dunes and beaches, and salt marshes), which are more positively located with respect to aesthetic quality. This is consistent with the idea that endangered species have value beyond simple mortality as irreplaceable indicators of environmental health. They are valued as once-gone-forever-lost resources that have value because of their mere existence, even if they are never directly experienced.

While each resource is valued individually, they are valued in the context of the place. The value of the park is more than any single resource, or for that matter the sum of all resources. The uniqueness of the place lies in the interconnections among resources, their independence, codependence, and the subtle combination of resources that combine to create a unique whole. Like an exceptional meal at a fine restaurant is a combination of the ambiance, service, textures, flavors and more, the resources of a place combine to create a unique value-space associated with the place. As multiple dimensions of value are brought together in a complex admixture, these subtleties become more intricate and unique; and the value of the place increases. The two-

dimensional value-space presents the pattern of relationships between resources relative to one another that inform resource management, environmental planning, and policy.

The place-based resource-driven method of valuing resources represents a systematic and participatory process to quantitatively codify the nature of values associated with a place and treats identifiable resources as the objects of value in the place. In the development of various objectives and alternatives, the value-space identifies resources of similar perceived value, which help to define, shape and establish the nature of the problem. Decision and policy makers, planners and resource managers can use the value-space to associate, or disassociate outcomes and alternatives. For example, the case of Cape Lookout, resource managers are well aware of the central role of the Cape Lookout Lighthouse and the Shackleford Banks Horses, but may be less aware of the similarity of the role that salt marshes, dune and beach systems seem to have in establishing aesthetic environmental experiences. The value-space also helps resource managers and policy makers determine the boundary of the problem and potential solutions. For example, the geographic impact zone of the Cape Lookout Lighthouse is quite large—encompassing not only the visible-line-of-sight, which is large; but it has become a symbolic icon of the entire region, which is even larger. These impacts of resources often extend beyond geographic boundaries (e.g., the park boundary) well into contextual boundaries, which the value-space can help clarify. Another decision criterion might consider the extent to which the various alternatives treat resources that are grouped together in the value-space in a similar fashion. The place-based method discussed herein establishes communities-of-resources that either hold similar perceived value to the place or are grouped geographically, which highlights the potential consequences of environmental choices.

The place-based resource-driven valuation provides decision processes with a methodology that codifies, quantifies and visualizes the relationship between resources and underlying values. This process:

- establishes an inventory of resources (e.g., natural, cultural and infrastructural) that are of value to the place;
- establishes a range of potential types of value associated with significant resources;
- quantitatively assesses the significant resources of the place for each type of value and any potential interactions among value-types;
- provides insights that shape boundary conditions, and impact zones for each resource and the place as a whole;
- visually illustrates similarities and differences among resources in terms of the underlying value-space; and
- establishes communities-of-resources within value-structures to illustrate interdependencies among resources.

Natural resource managers, environmental planners, and cultural resource guardians are often faced with decisions that require assessment of non-market values. While these intrinsic values are recognized as important, efforts to account for them often rely on qualitative interpretation of the significance and value of these resources. The place-based resource-driven method presented herein, supplements these methods by quantifying the value associated with these resources along multiple dimensions. This stakeholder value-space allows decision makers to preview impacts to the overall resource-base as various resources are lost or threatened (e.g., by ongoing

decline, sea level rise, hurricane damage, or tidal surges). These can be used throughout the decision process from problem formation, to establishing alternatives, to alternative selection, and implementation. It allows them to become meaningful contributors to the decision making process along with expressed-preference based methods (e.g., contingent valuation). Moreover this approach affords the direct examination of the relationship between these value assessments.

Conclusion

This article examines the basic utility of a multidimensional value-space to more efficiently codify, quantify and illustrate the intrinsic values associated with natural and cultural resources. The benefits of analyzing a single national park such as Cape Lookout National Seashore include, a definitive boundary within which to operate, a pre-existing inventory of resources, and a highly knowledgeable park staff to inform the process. While the research process allowed spontaneous addition to the list of resources considered, few resources were added and none were found significant. Through iterative discussions with park staff a set of five value-types were considered. Natural and cultural resources selected among the top-ten by stakeholders were rated through a web-based survey. Factor analysis of these data confirms the existence of multiple dimensions of value. Factor analysis is particularly well-suited for this endeavor as it, (a) focuses on significant dimensions by selecting the factor that accounts for the most variance in the joint distribution of resources, iteratively followed by the additional factor(s) that account for the most remaining variance, (b) selects dimensions that are orthogonal to each other and thereby independent of each other, and (c) converts all values to a standardized abstract metric to

facilitate comparison. The value-space observed has two dimensions that are connected, at least partially, with aesthetic quality on the horizontal-axis and functional quality on the vertical-axis.

The research explores the potential to measure values associated with natural and cultural resources in multiple dimensions. While it has shown that multiple dimensions of value can be measured quantitatively, it represents only one national park where a concentration of resources exists located primarily on barrier islands with no bridges. It is not possible to know from these results the extent to which these values generalize to similar parks, parks with similar resources and greater access, parks that encompass communities, other kinds of parks, or communities in general. This effort took advantage of extensive discussions with long-term park staff members in developing the types of values that were likely to be associated with park resources, but this could mean that other kinds of values may have been inadvertently omitted (e.g., peace and tranquility, repository of biodiversity or cultural heritage, or economic stimulus). While it is clear that any finite set of value-types will always exclude potential alternative value-types, a systematic approach involving all stakeholders would help assure that the range of value-types considered represent a full-range of potentially important values. This research draws on a sample of active stakeholders, but results in a relatively shared value structure that includes an adequate number of resources to support the analysis. Without the park to focus and sharpen public attention on specific natural and cultural resources, more diffuse value structures may prove difficult to characterize in terms of vague or loosely associated resources (e.g., the people, our children, leadership or friendliness).

Future research will extend the present effort by examining various parks and their resources. This will begin to clarify the extent to which the pattern of resources and valuations is stable or variable, unique or shared, global or local and to what extent generalizable. The extent to which parks with similar resources under various conditions share common elements of the value-space, and the extent to which the value-spaces are unique is an important guide for resource managers consideration. The extent of temporal stability of the value-space is an important determinant of the ongoing need for public participation. Similarities and differences among groups' value-spaces can inform resource managers about appropriate actions. For example, comparing the value-space for two or more groups of various interests may be used to inform conflict resolution efforts.

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