The Use of Ecosystem Health Indicators in Evaluating Ecological and Social Outcomes of Collaborative Approaches to Management: the Case Study of the Diablo Trust

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"Understanding the loss, creation, and maintenance of resilience through the process of co-discovery (by scientists, policy-makers, practitioners, stakeholders, and citizens) is at the heart of sustainability…"
Gunderson and Holling, Panarchy.

INTRODUCTION

A collaborative process provides opportunities to integrate social values and learning into ecosystem management. Thus, it allows the implementation of an "ecologically democratic" vision of sustainability. Conceptually, this definition requires the integration of the natural and human components into what can be called a complex socio-ecological system. This conceptual integration poses the challenge of how to measure the success of a collaborative process through the effects that it may have on the socio-ecological system. This consideration is important because ultimately a collaborative process seeks to be a more effective means to higher order societal goals, not just an end in itself.

Nevertheless, the majority of previous evaluation research has focused on examining case studies to identify lessons and keys to success with participant perceptions as the most common data gathering method[2]. Studies regularly cited in the literature use similar definitions of collaboration and develop 'success' criteria mostly on the basis of internal process and organizational dynamics (i.e. effective consensus process, building relationships and trust, open communication and information sharing, increased education and outreach, development of mutually agreeable management plans, creativity and proactiveness, etc.). Other than perceived outcomes as defined by the participants and non-material results, these studies don't offer systematic criteria for addressing and measuring tangible ecological and social outcomes[3].

A few studies have tried to evaluate ecological and social impacts. Yet, although these studies developed criteria for measuring actual impacts, evaluations were still limited to perceived implementation and effectiveness. Thus, even here we have a partial measurement of the effects of the process only focused on its participants[4].

Evaluation research is clearly progressing in providing answers to critical questions about the collaborative process and its effectiveness. However, the question still remains whether there is a correlation between a working collaboration and on-the-ground impacts. Innes and Booher[5] believe that the process and outcome are tied together and that "a process that involves all stakeholders, including those with little power, is likely to produce a just outcome… (and) are likely to be sustainable because both environmental and economic interests must be satisfied". Yet, as Kenney[6] contends, the ultimate measure of success is whether efforts have led to improvements in environmental conditions and social capital.

The main challenge facing this type of evaluation is the lack of adequate monitoring data linking partnership activities to changes in ecological and socio-economic conditions[7] and the many years required to monitor and test changes on the ground[8]. This paper seeks to be a contribution in the direction of providing an indicator framework that would allow the collection of such information and a better understanding of what determines the success of these processes.

To this end, since the outcome evaluation depends on the definition of a process vision, we need to make a few precisions around the notion of sustainability. Sustainability indicators are now widely employed to assess the environmental, social, economic, and institutional dimensions of sustainability and measure the progress of these aspects towards goals in a simplified manner[9]. Most efforts developing sustainability indicators provide dissimilar parameters and scales. Yet, they can be classified, as is done by the International Sustainability Indicators Network, in 1) local community (municipalities and rural counties); 2) regional (metropolitan areas, multiple local communities; 3) state/province; 4) national, and, 5) international[10]. As can be seen, scale is defined via political unit criteria rather than, with notable exceptions, by a combination with bioregional considerations (watershed. micro-watershed, etc.) and at scales that may capture the smaller contexts that may characterize collaborative processes.

So, even if sustainability indicator frameworks can serve as a starting point for conceptualizing critical elements that define the multidimensional nature of the collaborative context, they usually are too broad for the site-specific requirements of many collaborative efforts. Ecological and social aspects at the local level are highly variable, thus adopting a broad set of indicators would overlook specific parameters that determine the system under study.

In summary, the literature on evaluation research is mostly limited to evaluating the internal process of collaboration and not the impacts outside of the meeting room, while the frameworks available for integrated evaluations of outcomes are too broad to capture the site-specific parameters of many collaboration efforts. The necessary next step in evaluation research is to move to systematic assessment and measure actual site-specific, on-the-ground impacts that allow for a relationship to be established between the collaborative process and organizational achievement in producing social, economic, and environmental benefits[11].

PART I: Ecosystem Health Indicators to Evaluate Outcomes of Collaborative Processes.

General Theory Issues

In order to find a meeting point between the notion of sustainability and the evaluation needs of collaborative processes it seems necessary to instrumentalize sustainability through the use of a concept that can be contextually grounded in smaller complex bioregional scales. The notion of Ecosystem health may prove the necessary tool. Ecosystem health is an emerging trans-disciplinary concept useful in bridging the natural, social, and health sciences and to integrate the human values and perceptions that are part

of management. In this view, a healthy ecosystem is a socio-ecological unit that is "stable and sustainable", maintaining its organization and autonomy over time and its resilience to stress, while capable of remaining economically viable and able to sustain human communities[12]. It is an integrative notion that acknowledges societal values in defining future desired conditions while strongly relying on scientific criteria. In addition, ecosystem health is an idea, describing a complex set of ecological realities, rather than a condition that can be measured directly. As Stedman aptly states, "The concept of ecosystem health does not embody non-ambiguous rules for its measurement or valuation. These must be provided by the practitioner, preferably in the form of scientifically based decision rules and benchmarks set in a well-documented social and cultural context[13]." Such is the paradoxical nature of this concept where it is at once descriptive and prescriptive, objective and normative[14].

Lackey suggests that to use the concept of ecosystem health appropriately, public involvement must be included because such normative concepts require inherent value judgments[15]. As an integrative notion, it is not meant to rely solely on scientific proof in a hypothetico-deductive sense and it does not pretend to give predictive descriptions of causal mechanisms of the complex behavior of socio-ecological systems, but rather to provide case by case evaluation in their real-world setting[16]. To assume otherwise would validate the criticisms of the concept, particularly that of masquerading the term as an objective science.

Viewed in this light, ecosystem health is a viable paradigm, applied science, and professional practice to provide environmental management and policy professionals with a theoretical framework and methods through which to monitor and/or assess the condition and quality of ecosystems[17]. Because most people have an intuitive idea of what constitutes health, it allows for better communication among citizens, managers and scientists when developing management decisions[18].

Because ecosystem health is not directly measurable or observable, we are forced to rely on surrogate measures to index ecosystem health [19]. The practical application of ecosystem health is a process involving the identification of ecological and social endpoints of health and development of important indicators that measure progress towards these endpoints[20].

Scientific methods and information techniques from interdisciplinary fields such as ecosystem science, conservation biology, and landscape ecology can serve as the basis for making credible decisions as to decide what to manage for and to define appropriate reference points for ecosystems[21]. Social science and economic methods can also inform desirable states for healthy human communities and the appropriate methodologies for assessment. For example, emerging fields such as human ecology and environmental sociology are furthering our understanding of social systems in relation to ecological systems in terms of structure, function and process[22]. Additionally, the necessary trans-disciplinary research methods are developed. Together, the natural and social sciences can approximate the optimal ecosystem condition for socio-ecological systems.

An assessment of ecosystem health should encompass indicators that reflect properties of resilience, organization and vigor, essential functions and key attributes that sustain life systems (See Table 1 in Appendix 1)[23]. These attributes are generally derived from ecological perspectives, but they have analogous measures in other fields and may be applied to the biophysical, socioeconomic, and human health dimensions for the ecosystem[24].

Most recently, new opportunities for applying ecosystem health in practice on the scale of human communities have emerged[25].Other studies have also made the connection between the use of a participatory decision-making process and the use of an integrated methodology of ecosystem health assessment[26].

How is the notion of ecosystem health relevant to collaborative processes? Organizational theory and collaborative learning theory place the collaborative decision-making process in the context of *complex adaptive systems*. Complex adaptive systems acquire information about the environment, regularities are identified in that information and a 'schema' or model is created to help adapt to changing and uncertain world conditions[27]. Further, Innes and Booher associate the term complex adaptive systems in specific reference to explain consensus building methods that some collaborative groups employ as a way of organizing and producing agreements, experimenting, learning, and building shared meaning[28].

Daniels and Walker focus on the function of collaborative processes through collaborative learning. Because of the complexity of ecosystems at multiple spatial scales these authors argue that mutual learning is a critical element of ecosystem management[29]. Understanding complex issues is enhanced by systems thinking, which the authors explain, "is essential to active, social learning about complex and controversial situations. Drawing on work in soft systems, collaborative learning incorporates systems thinking as a significant component, in both philosophy and practice"[30].

Another aspect of the collaborative approach, as above suggested, is that it seeks to more effectively link the ecological and social aspects of ecosystem management. In this light collaborative processes are structurally socio-ecological systems. Functionally, as Machlis et al. suggest (using the concept of "human ecosystem model") they are, as also said before, complex and ever changing. Such structural and functional characteristics are the framework to understand adaptability in these systems[31].

Further, one of the properties of socio-ecological systems that is gaining increasing attention in the adaptive management literature is *resilience*. The importance of managing resilience stems from the increased understanding of the uncertainty and 'surprises' in ecosystems, unexpected events that coupled with exploitation eventually lead to the inadvertent loss of ecosystem resilience[32]. Complex adaptive systems have self-reinforcing and adaptive mechanisms that prevent shifts into other states[33]. Therefore, some authors propose, as an alternative to methods based on forecasting, to manage the capacity of the system to cope with changes in the future. To this end, a

participatory-approach that includes stakeholders (i.e. collaborative process) is proposed as the appropriate mechanism to maintain and increase the system's resilience[34].

The key point here is that as we expect to see more support for collaborative processes as a mechanism for adaptive management of socio-ecological system resilience, the relevance of ecosystem health to establish desired goals and to evaluate the progress towards those goals based on the properties of resilience becomes even clearer

The Holistic Ecosystem Health Indicator (HEHI): Framework for the development and structure of indicators.

We hold in this paper that The Holistic Ecosystem Health Indicator (HEHI), an integrative indicator developed in Costa Rica in 1999, may be an adequate tool to measure the performance of collaborative processes according to the characteristics afore stated. The HEHI is an interdisciplinary methodology based on the ecosystem health notion. It quantifies ecological, social, and interactive – the interactions between humans and nature - indicators of the health of ecosystems. The HEHI, first documented by Aguilar, was used to assess and evaluate ecosystem health in managed ecosystems in Costa Rica. A key advantage to the HEHI, required by the aforementioned theoretical background, is that it incorporates specific management objectives and characteristics of the area involved, while also useful for making comparisons leading to regional policy-making[35].

The HEHI follows a hierarchical structure starting with three main branches: ecological, social and interactive (See Figure 1 in Appendix 1). Within the ecological branch, measures about the condition and trend of the ecosystem under study are organized. Socioeconomic measures concerning the community dependent on the ecosystem or affected by management decisions are organized within the social branch. The interactive branch includes measures relating to land use and management decisions that characterize the interactions between the human communities and the ecosystem. Each branch is sub-divided into categories or criteria, which further operationalize the meaning of each branch, yet it is not a direct measure in itself. Categories reflect particular attributes of the management objectives for the system under study, therefore are established based on the ecological and social characteristics of the area and management goals of the stakeholders involved.

The categories are comprised of indicators that serve as the measure for the performance of each category. For example, soil quality is a category within the ecological branch and it can be measured using indicators such as microbial biomass, water infiltration, compaction, etc. Indicators are carefully selected to test the condition and trend of the categories, and each is given a target, or benchmark, based on references available in scientific literature and specific objectives defined by management objectives or policy. For example, a water quality indicator can have a target defined by legal limits specified by the administrative authority in charge, while a target for a productivity indicator may be defined by a combination of the capacity of the system and objectives set by stakeholders.

To prioritize the importance of each category and indicator, weighted scores are assigned to each based on its relative importance to the health of the system and to stakeholder goals (see Table 2 in Appendix 1). Categories are ranked and assigned points from a total of 1000 as high, middle, and low measures of ecosystem health, also in accordance to the specific purpose and need of the management unit in question. Individual indicators are also assigned a portion of the points from the total given to the category in which it is.

The HEHI has been qualified effective at characterizing the complexity of the socio-ecological systems of Protected Zones in Costa Rica and in developing site-specific parameters for assessing and evaluating the factors that influence their ecosystem health[36]. It is therefore promising as an evaluation tool to asses and evaluate the outcomes of a collaborative process. The interactive branch is particularly relevant for the collaborative process because it encompasses the management interactions influencing the ecological and social system, thus it can capture the effectiveness of collaboration in positively influencing its context.

However, as previously discussed, identifying the appropriate variables to be measured for a different system is a challenging task. For instance, questions that need to be answered include what is the appropriate timescale by which to track management progress, and by what benchmarks does one evaluate success or failure of management? The answers to these questions are difficult to determine with certainty, which has often led managers to adopt a uniform set of indicators across broad regions (as with the examples of indicator frameworks previously discussed), even though landscapes, management authority, and community interests may vary greatly across that same region[37]. In addition, the number of indicators selected is also a crucial matter, for if too few indicators are monitored, the important elements of the system may be overlooked, and if too many are monitored, then data acquisition may be too cumbersome and expensive. A conceptual understanding using existing scientific literature of the dynamic nature of these systems and site-specific parameters to identify the essential component systems and define the relevant system structure is necessary prior to establishing benchmarks of ecosystem health[38].

To address these concerns and assure that site-specific measures are identified based on the context specific conditions and success criteria of the socio-ecological system using a collaborative process, a methodology based on participatory research was developed to assist the process of developing appropriate indicators for the Holistic Ecosystem Health Indicator (HEHI) framework. The following section describes the methodological steps involved in the framework using the Diablo Trust, a rangeland collaborative management group based in Flagstaff, AZ, as the case study.

PART II: Development of the HEHI for a Collaborative Management Scenario: the DiabloTrust Case Study

General Considerations

The Diablo Trust was convened in 1993 by a group of landowners, agencies, scientists, and citizens that were concerned with the mix of private and public lands managed by two large ranches. The lands managed by this collaborative group comprise of 426,000 acres under the federal (58% - USDS Forest Service), state (22% - Arizona State Land Department), and private (20% - Flying M and Bar T Bar Ranches) ownership. While official management responsibility exists as a patchwork pattern over the extent of the land, it is greatly influenced by the stakeholders participating in the group. Based on Allan Savory's Holistic Resource Management framework, this non-profit group suggests appropriate rangeland management practices to agencies in order to meet the goals of ecological and economic sustainability. As an agroecosystem, food production is a driving goal for this landscape, especially for the private lands. Yet, because the land is tightly linked to state and federal lands that must also incorporate public values, it is necessary for management to address and combine goals for conservation and productivity. Therefore, the first three years of the group's collaboration were spent building trust among stakeholders with different land values, developing a collective vision of landscape condition that encompasses stakeholder goals, and writing a management plan that comprises a variety of tools and prescriptions in order to achieve the desired conditions for the private and public lands as a whole[39].

The Diablo Trust developed a three-part holistic goal (see Table 3 in Appendix 1) that is composed of goals for quality of life, goals for production, and goals for a future landscape and resource base, to drive land management[40]. Based on their goals, parameters that define this management unit are characterized by a combination of biophysical, cultural and socio-economic factors that integrate principles of ecological sustainability and economic viability. In general, the *goals for quality of life* and *forms of production* guide the information necessary for the social and interactive branches of the HEHI. The Diablo Trust is concerned for the quality of life of the ranches, the collaborative group, and to some extent the community in general. The quality of life goals and values define their vision for the Diablo Trust stakeholders and the rest of the community. Their goal is of a "prosperous rural community reflecting a land culture with young and old enjoying opportunity and security". The goal of production is guided by the possibility of the ranches to continue to "serve as the foundation for sustainable long-term health of the Diablo Trust lands" through food production, while achieving the ecological goals as well. Management objectives of the government agencies that also have jurisdiction of the public lands guide the information for the social and interactive branches. Many of the land uses in the Diablo Trust management unit are regulated by these management agencies, thus there their legal benchmarks must also be considered in management and monitoring. From a social perspective, the county is also involved as it provides the general vision for land use in the surrounding lands with private properties. Therefore, many of the indicators in the social and interactive branches, particularly those concerning land use, management decisions, and public attitudes, will reflect the combined goals of the Diablo Trust, management agencies, and county guidelines.

The *future landscape and resource base goals* describe the vision, or desired conditions, for the ecosystem and for the stakeholders that comprise the collaborative group; thus defining the ecological and social targets that the group wants move towards (see Table 3 in Appendix 1). The Diablo Trust landscape is characterized as a semi-arid ecosystem, with vegetation types ranging from Great Basin grasslands to pinjon-juniper woodlands and ponderosa pine forests. All are managed for multiple purposes, primarily cattle grazing, recreation, hunting and fishing, wildlife management, forest thinning, and watershed protection, although the management treatments may vary for each particular vegetation type. Nonetheless, all 426,000 acres are managed as a whole, guided by the future landscape goals and specific objectives outlined in their management plan. Therefore, along with regulatory management objectives for the public lands as defined by the administrative agencies, the ecological branch is developed to address these landscape goals. Similarly, the future human resource base goals the Diablo Trust has developed to guide how their collaborative process should function and sustain itself in the future inform the management strategy and social capital available to direct the use and sustainability of the resources. These aspects are tracked under the interactive category of the HEHI.

Process of developing indicators using a participatory approach

Clarifying the numerous management objectives that guide the use and performance of the socio-ecological system (Diablo Trust goals and regulatory objectives in tandem) was the first step in the development of indicators for the Diablo Trust system (see Figure 2 in Appendix 1). Existing scientific literature was consulted to establish characteristics that define the health of the ecosystem and the community, which may or may not be in accordance with the desired conditions defined by the Diablo Trust and management agencies. We developed a definition of ecosystem health that would guide the prioritization of indicators, their benchmarks, and how they are weighted[41]. Step 2 in the process involved the development of a conceptual model to depict the relationships between system characteristics, what driving factors are influencing their current condition, and the management objectives and goals that are driving the future state of the socio-ecological system as a whole (see Figure 3 in Appendix 1). Although this model does not depict predictive causal relationships due to the system's complexity, we believe it considers most of the potential key variables that influence the landscape composition of the management unit *as a whole*, including the socio-economic characteristics of the community that influence or are influenced by the state of the ecosystem. This information then provides a logical basis for ecosystem health indicators to be developed and validated.

Step 3 involved collecting input from stakeholders to select an "optimal set of indicators" that informs the list of potential variables chosen previously. We used a purposive sampling approach to select respondents for in-depth interviews that pursued information directly pertaining to Diablo Trust's goals and process, thus respondents needed to be intimately familiar with these aspects of the group. This qualitative assessment used open ended questions relating to the effectiveness of the process, what factors they perceive facilitate or limit the success of collaboration, and what ecological and social

factors are most critical to achieve Diablo Trust goals, and consequently to monitor and evaluate their performance. Respondents were also given a list of ecological, socio-economic, and management or institutional factors to prioritize their importance. We do not discuss results from these interviews in this paper, but we used the information to select the preliminary list categories for the HEHI (see Table 4 in Appendix 1). To assist in a final prioritization of indicators and development of protocols and monitoring strategy, we also consulted with experts in the natural and social sciences *(*Step 4 in Figure 2 in Appendix 1).

Finally, the optimal indicators under each category are currently being selected, weighted, and organized according to the structure of the HEHI (Step 5 in Figure 2 in Appendix 1). This final list of indicators will serve as the finer level possible to capture the complexity of the system without compromising information for multiple spatial scales. To fill in the information for each indicator and test their utility, we are using available ecological and social data (i.e. vegetation data collected by the Diablo Trust and/or management agencies, census data for some of the demographic variables, spatial data for generating land cover and land use indicators, etc.), as well as primary data that we are currently gathering using field sampling methods for the ecological branch and survey questionnaires for the social and interactive branches. Context and management goals will determine the final weighting that will complete the necessary distribution of points for this application of the HEHI. Preliminary point assignments for each category are already available (see Table 4 in Appendix 1).

CONCLUSION

Sustainability and ecosystem health are related concepts; they both provide a conceptual framework and methodological approach to study the relationship between the environment and society. Yet, because of the broad nature of sustainability, this concept is often applied to individual aspects of a system (i.e. sustainable agriculture as one sector of a landscape type), while ecosystem health can measure endpoints of the system at the appropriate scale, as the concept is more biophysically and bioregionally grounded.

Therefore, although ecosystem health still shares the same ambiguity as other emerging terms- sustainability and ecological integrity - it is still invaluable in offering a guiding concept and practical applications for the holistic integration, understanding and communicability of the processes required to reach our management goals. Ecosystem health indicators tools, such as the Holistic Ecosystem Health Indicator (HEHI), are promising methods to measure the ecosystem health of the collaborative approach to ecosystem management, and consequently provide an evaluation tool to test their effectiveness. The interactive branch of the HEHI is particularly beneficial for these purposes because by measuring perceptions, awareness, and involvement of stakeholders into management, it allows for the evaluation of the *process* of collaboration, as well as the *outcomes*. Therefore, the HEHI seems to encompass all the criteria needed for a comprehensive evaluation of the collaborative process. Our current preliminary data in the application of this model to the Diablo Trust in Flagstaff, AZ. seems to confirm this.

In conclusion, because ecosystem health indicators integrate ecological and socio-economic criteria of management, provide holistic, yet quantitative measures that can be monitored over time, and can communicate complex information effectively, they serve as an ideal tool to for both researchers and groups to evaluate tangible outcomes of the collaborative effort.

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Appendix One: Tables and Figures

Table 1. General concepts for developing indicators of ecosystem health. Adapted from Rapport et al. (1998) and Aguilar (1999)
Ecosystem health can be assessed using measures of resilience, vigor and organization: **Vigor** is measured in terms of 'activity, metabolism or primary productivity'. Focuses on the existing organic base that helps accommodate disturbance. **Organization** can be assessed as the diversity and number or interactions between system components. Emphasis on structure and diversity. **Resilience** is measured in terms of a system's capacity to maintain structure and function in the presence of stress. When resilience is exceeded, the system can 'flip' to an alternate state.

Figure 1. Structure of the Holistic Ecosystem Health Indicator (HEHI) (Aguilar 1999).

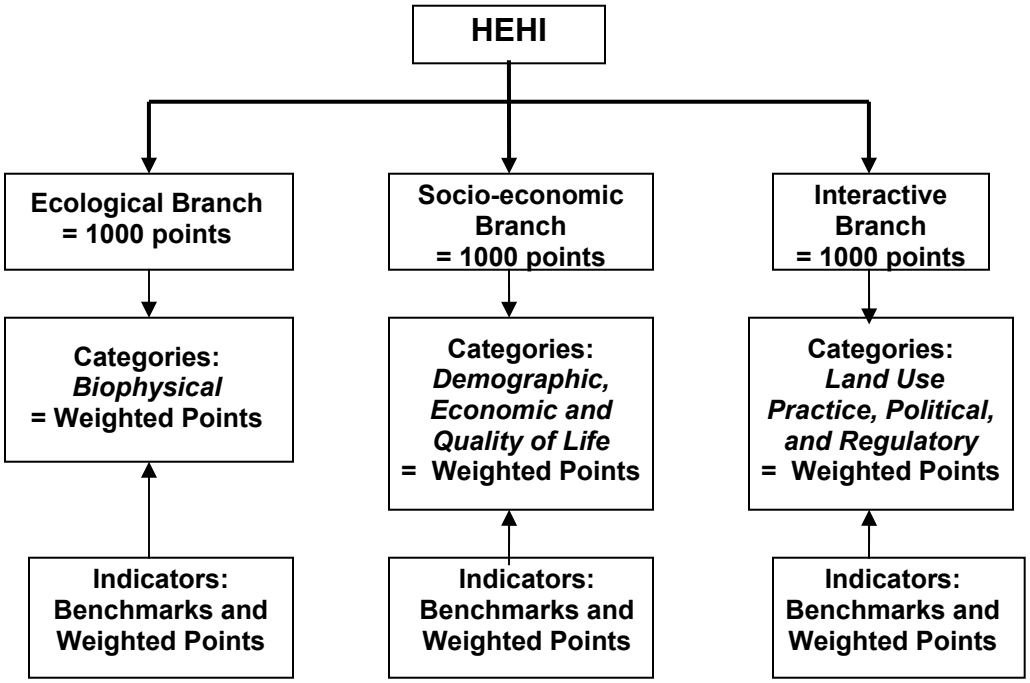

Table 2. Rationale for HEHI Weighted Score System (Aguilar 1999)
High Category measures key resources and interactions (structure/function) in the socio-ecological system and reflect management objectives of the area. Indicators that reflect a greater correlation between the test and the health of the system will receive higher score. **Middle** Category measures critical factors in the function and persistence of the system, but they are not central goals of the management strategy of the zone. **Low** Interactions between indicators and ecosystem health are still unclear or the methods not well developed. As the individual tests improved and information on their relevance to ecosystem health becomes clearer, these could be allocated more points.

Table 3. DIABLO TRUST: 3 – PART HOLISTIC GOAL (Diablo Trust Area Range Management Plan and Proposed Action 1999)		
Quality of Life Goals and Values	**Forms of Production**	**Future Landscape and Resource Base Goals**
• To have understanding, support, and acceptance that the rancher is the foundation for sustainable long-term of the Diablo Trust lands and open spaces. • To lead well-balanced lives with individual freedom to practice our personal beliefs, religions, and lifestyles. • To enjoy, both immediate and extended family, harmony and pride. • To achieve life-long personal satisfaction, self-worth and sense of well-being. • To be constructive and respected members of our communities. • To contribute economically, educationally, politically, socially, and spiritually to community well-being. • To live in safe, aesthetic, and ecologically sound settings. • To foster rural/small-town lifestyles and community cohesion. • To hand on optimum options to our children and future generations.	• Earning a reasonable return to management and equity from livestock, wildlife, wood products, recreation, education, and other sources not in conflict with our values. • To produce high quality food product from our management of land and water. • To implement land/resource projects initiated by non-ranchers in cooperation with the Diablo Trust and the community.	Future human resource base: • People who are open, accessible, and willing to listen and learn from others as well as share what they are doing and learning. • Are friendly and committed to the work they are doing. • Are honest, trustworthy, and consistent; • Strive to communicate well, to be realistic in their commitments to each other, and don't promise what they cannot deliver. Future land resource base: • Viable and diverse faunal and floral communities throughout all zones of the area. • Some areas within each of the vegetative zones will appear not to be human-dominated. • Forested areas with a mosaic of canopy closures and forest structures. • Water cycles, mineral cycles, energy cycles, and biological succession that are fully functional.

Figure 2. Methodological steps for developing the Holistic Ecosystem Health Indicator for the Diablo Trust Case study (Muñoz-Erickson et al. 2003).

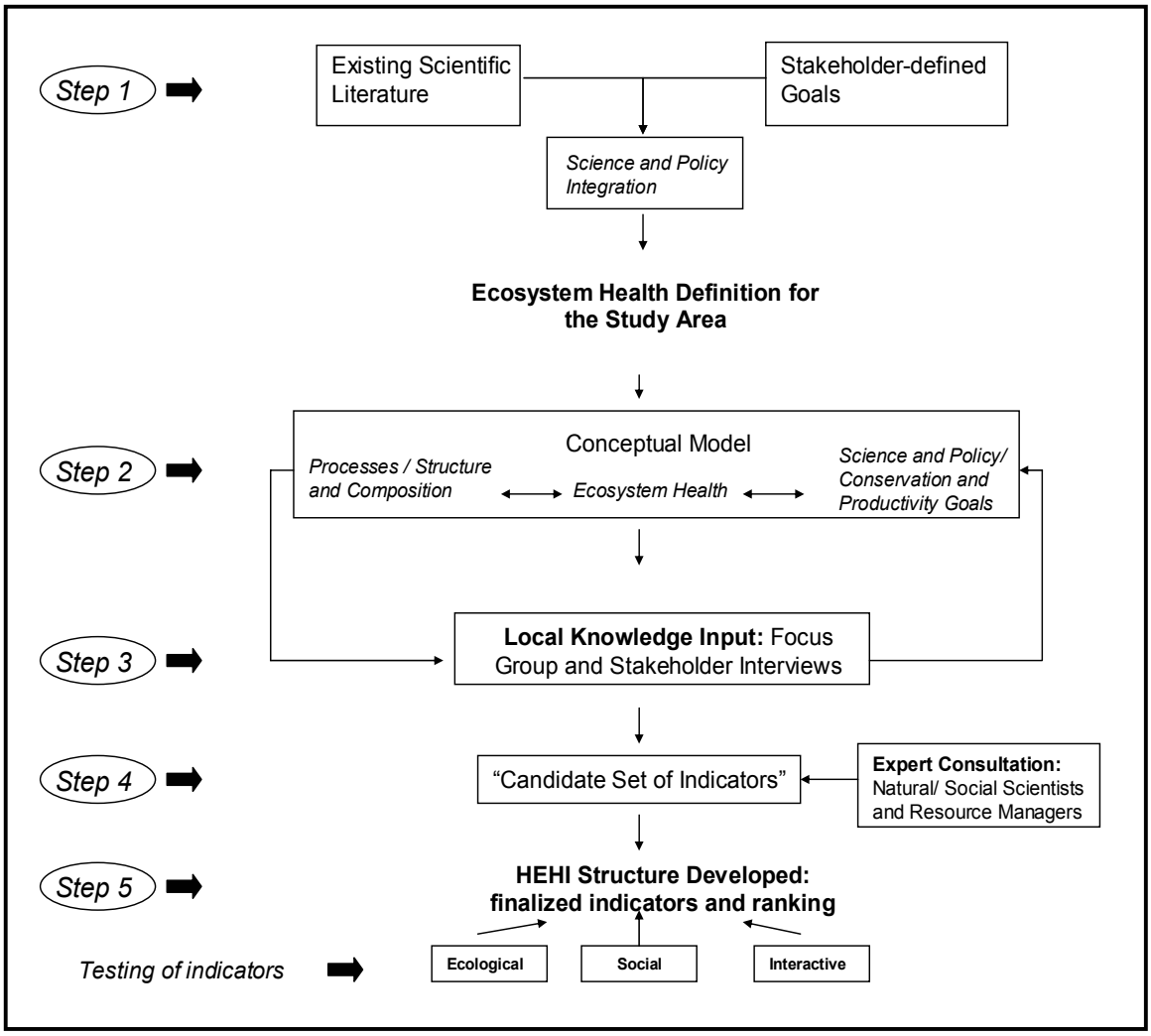

Figure 3. Conceptual model of the natural and human-induced driving processes, socio-ecological system structure and composition, and goals of the Diablo Trust management unit (Muñoz-Erickson et al. 2003).

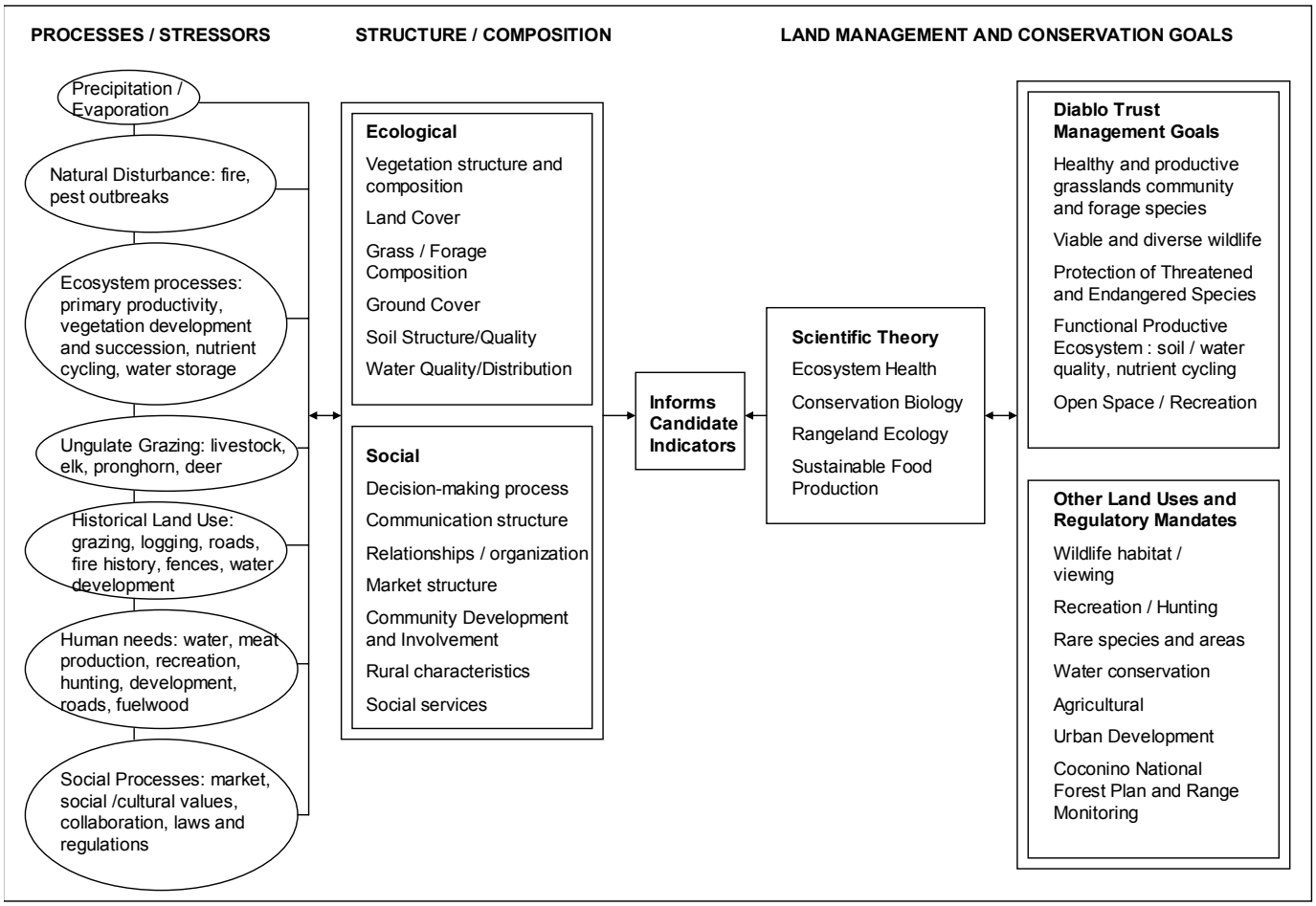

Table 4. Categories for the Holistic Ecosystem Health Indicator as developed for the Diablo Trust cast study					
I. Ecological Categories		**II. Social Categories**		**III. Interactive Categories**	
Soil Quality	200	Economic stability	420	Land use	230
Vegetation	200	Demographics	210	Social capital	230
Watershed Health	180	Community strength	190	Implementation of regulation	200
Primary productivity	140	Access to services	180	Public awareness and perceptions	180
Wildlife	140			Land distribution	160
Erosion	140				
Total points	*1000*	*Total points*	*1000*	*Total points*	*1000*