Oregon Indicators of Sustainable Forest Management

Developing Sustainability Metrics B.c. for Forest Ecosystem Services Contributions to Society

FINAL REPORT
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EXECUTIVE SUMMARY

Maintaining and enhancing Oregon forest's ecosystem services contributions to state and local economies and to quality-of-life are very important to Oregonians. The demand for ecosystem services (such as recreation, carbon sequestration, water quality, and other passive values like biodiversity) is often constrained by the supply of healthy environments that support these services. Monetary estimates, while difficult to measure because ecosystem services are not traded in markets with price signals, may provide an indicator of their value to society. Trends in the demand for and supply of ecosystem services are an important indicator of management, policy and environmental affects on the natural landscape's ability to provide these services. The desirable pattern of trends in the demand for, and supply of, ecosystem services would indicate that they are increasing or at least not declining over time. Trends associated with ecosystem services are contingent upon shifts in public perceptions regarding the importance of these resources.

A review of the literature on other projects developing sustainability indicators supports the process initiated by Oregon Department of Forestry in their *Forestry Program for Oregon*. A consistent and major constraint on developing sustainability indicators in nearly all attempts has been the lack and quality of data. Quite often data for ecosystem services are generally not available, and when they are available, they are not linked to resources in specific locations where environmental and social (policy and management) stressors are realized. Thus, indicators developed with existing data cannot meet their intended purpose. Data availability is a significant constraint to the development of valid and robust ecosystem services sustainability indicators for Oregon.

An Ecosystem Services Workshop was convened to determine the viability of developing sustainability indicators for recreation, carbon sequestration, water quality and passive use values (e.g., biodiversity). Consensus of workshop participants was that development of the recreation sustainability indicator was the only one that could potentially be completed with existing data. The other ecosystem services indicators would be better measured as quantity/quality of the resources themselves, which are being developed elsewhere in the sustainability indicators project. A second project meeting was held in which suggestions made by the workshop participants could be refined and implemented.

Recreation sustainability indicators were developed for total visits, total value, trends in use, and recreation resource supply. Total recreation visits to national forests, state forest campgrounds, and state parks were about 66 million in 2007. This is equivalent to approximately $514 million in recreation use value. However, there is substantive concern in converting quantity measures to a monetary metric and is not suggested due to data limitations including amount and robustness of per unit monetary values for recreation and their appropriateness in tracking changes in social values for recreation.

Trends in recreation use were measured from a source that is internally consistent, but not consistent with the 2007 baseline use measure. Recreation use in Oregon has increased by 28% from 1987 to 2002; however, total population in Oregon has increased by 30%. Therefore, we cannot claim that overall recreation use has increased on a per capita basis. Recreation use has

increased for most activity types, with hiking remaining constant and picnicking, horse riding and backpacking declining. National trends suggest increased participation in all types of outdoor recreation from 1995-2001.

Baseline measures of recreation resource supply are provided based on a 2001 inventory of recreation resources by Oregon Parks and Recreation Department as part of their Statewide Comprehensive Outdoor Recreation Plan. There are a variety of supply measures provided by their survey of recreation managers, among other sources, including miles of various trail types, ski lifts, campsites, acres of recreation land and water resources, etc, and by major suppliers (federal, state, county, municipality, private, schools and utilities). No trend information is available as this is the only comprehensive, yet incomplete, assessment of recreation resources in Oregon of which we are aware.

We offer several recommendations for the future development of ecosystem services sustainability indicators.

- Periodically (e.g., annually) measure recreation use by location and activity type for all relevant public and private recreation resources in Oregon and develop a repository for these data.
- Periodically (e.g., annually) inventory the supply (public and private) of recreation resources in Oregon by resource type and location, including quantity, quality and accessibility of each resource, and develop a repository for these data.
- Periodically (e.g., annually) track budget allocations for recreation-related resources for all natural resource agencies managing resources in Oregon.
- Ideally, the demand and supply measures would be derived for sites and resources that could then be linked to identify demand responses to changes in supply or supply responses to changes in demand while controlling for other factors influencing demand and supply, such as natural disasters, climate change, policy/management changes, changes in accessibility and social changes (e.g., economic conditions).
- Measures of quantity and quality of ecosystem services and environmental resources in Oregon should serve as sustainability indicators for them. Converting these quantity and quality measures to a monetary metric is not recommended.
- Design and implement a survey of Oregonians that directly measures their perceptions, preferences, and values of ecosystem services and environmental resources in the sustainability indicators project. If this survey was periodically implemented (e.g., every five years), then trends in social values would emerge from the consistently derived data. Preference weights also could be derived from the survey for use in aggregating across all metrics and indicators provided by the sustainability indicator project, resulting in a composite indicator for Oregon.

INTRODUCTION

For many years now there has been considerable discussion over how exactly to define sustainability and how it may be measured most effectively. The 1960s saw the beginning of research efforts focusing on meeting the needs of increasing global populations while simultaneously managing natural resources for multiple uses and future generations. Though sustainability research was already addressing the highly complex questions of modern sustainable development strategies, it would be a few more years until this area of inquiry would acquire the title by which it is known today (Robinson, 2004).

Among researchers and policy makers, there is disagreement over exactly how to define or conceive of sustainable development (USFS, 2004). Broadly speaking, strategies for sustainable development fall into two categories. One approach focuses largely on environmental and ecological factors. Those taking this more ecologically centered approach have suggested that in order to meet the needs of sustainable development, government institutions need to adjust and regulate growth strategies in order to operate within the finite limits of available resources (Brown, 1981). The other strategy involves concentrating efforts on economic and industrial development, expansion of which will promote better living conditions for the underprivileged (Bartelmus, 2007; Parris & Kates, 2003). The Brudtland Report, one of the first major policy documents concerning sustainability, adopts this economic and industrial focus by calling for a significant increase in world industrial output in order to meet the needs of the world's poor (World Commission on Environment and Development, 1987). More recently, some researchers have suggested that the idea of sustainable development itself may require further evaluation and clarification. It has been suggested that rather than conceive of the challenges (ecological or economic) in terms of development, a more appropriate approach to the problems of efficient resource use is to recast them in terms of "sustainability" rather than "sustainable development" (Robinson, 2004).

The fundamental difference between these two seemingly identical terms lies in their underlying assumptions about growth (Robinson, 2004). The idea of sustainable *development* relies on the assumption that growth potential is essentially limitless. With the benefit of new technologies, global economic and industrial growth may continue unencumbered into the foreseeable future. This will ultimately benefit everyone since economic prosperity will allow all people to shift some of their time and energy away from exclusive concern for fulfilling basic needs such as food and shelter to more "secondary concerns", which include a clean environment for future generations (Maslow, 1943). Simply put, people with full bellies and healthy children can afford to worry about the environment. The strategy of *sustainability*, on the other hand, is focused on the central premise that the environment cannot support unlimited growth. There are ecological constraints which are becoming, if they are not already, inescapable. There are finite resources in the natural environment and it is up to human beings to learn to live within these boundaries. The planet can provide only so much in the form of raw materials for production and it can absorb only so much as a pollution sink. The debate continues as to whether future development takes a primarily anthropocentric approach concerned with growth and industrial development, or whether nations embrace the biocentric doctrine of ecological limits (Robinson, 2004).

There are clearly significant challenges ahead in the efforts to forge policy on sustainable development and achieving sustainability goals. What is fairly evident though is that the work of developing sustainability indicators is a process that will have to contend with often conflicting goals, significant data challenges and frequent hurdles to interagency coordination. In order to effectively carry on the increasingly important work of indicator development:

> "….sustainability should not be conceived of as a single concept, or even a consistent set of concepts. Rather, it is more usefully thought of as an approach or process of community-based thinking that indicates we need to integrate environmental, social and economic issues in a long-term perspective, while remaining open to fundamental differences about the way that is to be accomplished and even the ultimate purposes involved" (Robinson, 2004:381).

Challenging though it may be, development of suitable indicators is vital if we are to meet the needs of sustainability and sustainable development. Because sustainability research focuses on both human and ecological conditions, indicators must encompass numerous different theme areas. Indicator treatments typically include ecological, economic and social themes or criteria in order to capture data on both the human and environmental conditions at levels ranging from the local to the national and international (Lindsay, 2003; Valentin & Spagenberg, 2000). Indicators will provide the necessary tools for accurate measurement that will in turn facilitate effective decision making and management of resources, advocacy, participation and consensus building, and research and analysis (Parris & Kates, 2003). Perhaps first and foremost, indicators will provide the metrics that permit tracking and analysis of sustainability practices. In this sense, indicators put into practice the saying, "What gets measured, gets managed." Proper selection of indicators will make it possible for managers and decision makers to get an accurate assessment of the successes or failures of achieving specific sustainability goals.

Ideally, sustainability indicators allow managers and planners to get a clear idea of what the current conditions are and the historical conditions were, so that they have a starting point from which to map out the best strategy to achieve the desired objectives. This type of baseline data is essential in making valuable assessments on the implementation of sustainability programs. Unfortunately, it is often the case that such baseline or historical data may be only partially available or altogether absent (USFS, 2004). Where baseline data are available however, they will provide planners with the required information to permit an unambiguous assessment of the progress towards, or away from, specified endpoints.

The United States Forest Service, in its 2004 Forest Sustainability Assessment includes a concise and useful definition of an ideal indicator as defined by the National Research Council:

> "Indicators are repeated observations of natural and social phenomena that represent systematic feedback. They generally provide quantitative measures of the economy, human well-being, and impacts of human activities on the natural world. The signals they produce sound alarms, define challenges, and measure progress . . . Generally, indicators are most useful when obtained over many intervals of observation so that they illustrate trends and changes. Their calculation requires concerted efforts and financial

investments by governments, firms, nongovernmental organizations, and the scientific community." (USFS, 2004: 5)

Indicator Development

Government agencies, research and development bodies and advocacy organizations have generally adopted a strategy of indicator development that begins with establishing general criteria that directly reflect sustainability concerns. Criteria are essentially goals and conceptual frameworks which qualitatively describe areas or themes in which sustainability is deemed important to achieve (Parris & Kates, 2003). These criteria often include such topics as biodiversity and social values. For example, research carried out at the Pinchot Institute (Sample, Kavanaugh, & Snieckus, 2006) has concluded that indicators should reflect criteria including:

1) Conservation of biological diversity
2) Maintenance of soil and water resources
3) Maintenance of forest contribution to global carbon cycles
4) Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies.

The United States Forest Service (USFS, 2004) has adopted the following criteria under which indicators will be organized:

1) Conservation of biological diversity
2) Maintenance of productive capacity of forest ecosystems
3) Maintenance of forest ecosystem health and vitality
4) Maintenance of soil and water ecosystems
5) Maintenance of forest contribution to global carbon cycles
6) Maintenance and enhancement of long term socioeconomic benefits to meet the needs of societies
7) Legal, institutional and economic framework; capacity to measure and monitor changes; and capacity to conduct and apply research and development for forest conservation and sustainable management.

The USFS (2004) describes in detail what information the criteria are meant to capture. For example, the biodiversity criterion acknowledges the importance of natural capital to human systems. That is, biodiversity is a form of natural capital, just like water, soil, timber or minerals. Natural capital provides valuable and often irreplaceable services for the benefit of humankind. Natural capital stocks, including biodiversity, directly impact the availability of essential inputs for the human economy not only nationally but also at the local level in communities that are dependent upon resource-based economies. Another example of themes the Forest Service captures are found in criterion #6, concerning socioeconomic benefits. Under criterion #6, indicators will provide useful information on the two basic elements of consumer items: goods (such as wood products) and services (such as tourism). Recreation indicators found in this criterion are meant to capture the trends in benefits that recreation area visitors are experiencing as well as available recreation capacity. These indicators consider such characteristics as total area available for recreation and an inventory of services and facilities. Indicators designed to assess cultural, social and spiritual values that forests provide are also found under this criterion. These indicators are meant to capture the potentially significant values of nonconsumptive uses available in U.S. national forests.

As the reader will note, there are significant similarities in the two examples of criteria described above. Many organizations and government agencies that are embracing sustainable management practices, including the Pinchot Institute, USFS, and the Oregon Department of Forestry (Rapp, 2000) employ a set of criteria and indicators derived from the strategy/policy entitled the Montreal Process.

The Montreal Process has its roots in the United Nations Conference on the Environment and Development in 1992, known commonly as the Earth Summit. The Earth Summit produced numerous documents concerning sustainable development including statements addressing biodiversity preservation, climate change, and an action plan for the 21st century called Agenda 21 (Montreal Process Working Group, 2005). In 1993, representatives from multiple nations met at a conference in Montreal, Canada with the specific intention of constructing a series of criteria and indicators of sustainable development to be adopted by participating nations. European nations were the first to act in a coordinated effort but decided to work under another collective body known as the Ministerial Conference on the Protection of Forests in Europe. Other nations, in 1994, officially began the Montreal Process with their meeting in Geneva to discuss how best to construct and implement sustainability indicators. In 1995, Montreal Process countries met in Santiago, Chile and produced what is now known as the Santiago Declaration. The Declaration contains seven criteria and 67 indicators within the various criteria that provide resource managers and legislators with guidelines to promote and support sustainable development of forests and other landscapes. The Montreal Process criteria and indicators are designed to approach sustainable development in a holistic fashion, taking into account not only economic development, but also social, cultural and ecological factors critical to the long term and sustainable management of forests. The participating Montreal Process countries are: Argentina, Australia, Canada, Chile, China, Japan, the Republic of Korea, Mexico, New Zealand, the Russian Federation, the United States and Uruguay. The seven Montreal Process criteria are:

1) Conservation of biological diversity
2) Maintenance of productive capacity of forest ecosystems
3) Maintenance of forest ecosystem health and vitality
4) Conservation and maintenance of soil and water resources
5) Maintenance of forest contribution to global carbon cycles
6) Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies
7) Legal, policy and institutional framework

Some of the examples of the indicators found in the various criteria are:

Criteria 1: Conservation of biological diversity

- Number of native forest-associated species
- Status of *in situ* and *ex situ* efforts focused on conservation of species diversity
- Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes
- Population levels of selected representative forest-associated species to describe genetic diversity.

Criteria 2: Maintenance of productive capacity of forest ecosystems

- Area and percent of forest land and net area of forest land available for wood production
- Total growing stock and annual increment of both merchantable and non-merchantable tree-species in forests available for wood production
- Annual harvest of non-wood forest products.

Criteria 3: Maintenance of forest ecosystem health and vitality

- Area and percent of forest affected by biotic processes and agents (e.g., insects, disease, invasive alien species) beyond reference conditions
- Area and percent of forest affected by abiotic agents (e.g., fire, storm, land clearance) beyond reference conditions

Criteria 4: Conservation and maintenance of soil and water resources

- Area and percent of forest whose designation or land management focus is the protection of soil or water resources
- Proportion of forest management activities (e.g., site preparation, harvesting) that meet best management practices or other relevant legislation to protect soil resources
- Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions.

Criteria 5: Maintenance of forest contribution to global carbon cycles

- Total forest ecosystem carbon pools and fluxes
- Total forest product carbon pools and fluxes
- Avoided fossil fuel carbon emissions by using forest biomass for energy.

Criteria 6: Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies

- Value and volume of wood and wood products production, including primary and secondary processing
- Value of non-wood forest products produced or collected
- Revenue from forest based environmental services
- Total and per capita consumption of wood and wood products in round wood equivalents
- Recovery or recycling of forest products as a percent of total forest products consumption
- Area and percent of forests available and/or managed for public recreation and tourism
- Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available
- Value of capital investment and annual expenditure in forest management, wood and non-wood product industries, forest-based environmental services, recreation and tourism
- Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values
- Employment in the forest sector
- Distribution of revenues derived from forest management

Criteria 7: Legal, policy and institutional framework

- Provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information
- Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management
- Investment and taxation policies and a regulatory environment which recognize the long-term nature of investments and permit the flow of capital in and out of the forest sector in response to market signals, non-market economic valuations, and public policy decisions in order to meet long-term demands for forest products and services
- Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1-7
- Development of scientific understanding of forest ecosystem characteristics and functions
- Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems

In its continuing efforts to implement sustainability strategies, the U.S. Environmental Protection Agency (EPA) has recently completed its Report on the Environment (ROE), a large scale effort designed to provide detailed information on sustainability indicators on a national and regional scale, across various different elements of the natural environment (USEPA, 2008). The preparation of the report was a massive effort that took almost five years to complete, starting in June of 2003 with the release of the EPA's draft ROE made available for public comment. The final 366 page report describes data on indicators for land, water, and ecological conditions. It also looks at air quality indicators as well as human health indicators. EPA indicators in the ROE cover a range of topics including forest extent and type, forest fragmentation, wetland extent and health, biodiversity, carbon storage, and extent and condition of fresh surface water. The report is divided into sections, each looking at various indicators. For example, the section on Ecological Conditions contains indicators such as:

1) Forest extent and type. This indicator is based upon U.S. Forest Service Forest Inventory and Analysis (FIA) as well as other Forest Service reports that provide periodic data on the health, extent and type of forest land.
2) Forest Fragmentation. Critical to an understanding of the function of ecological systems, this indicator looks at the extent to which forested areas are parceled into smaller sections over a given geographic area. Non forested areas interspersed in forests have an impact on habitat integrity and the health of the indigenous animal and plant species.
3) Relative Ecological Condition of Undeveloped Land. This indicator is broadly concerned with biological diversity and the physical and biological condition of the environment. It is composed of three indices that relate to relative diversity, self sustainability, and rarity of certain biological organisms.
4) Carbon Storage in Forests. In recognition of the fact that a large amount of carbon is stored in the woody biomass of plants, this indicator seeks to measure the carbon held in pools of living and dead biomass in forests in the contiguous 48 states. It is based upon the US Forest Service FIA database. Carbon storage is estimated using existing data on field measurements of trees and land cover data which is then included in statistical models that incorporate prior research data to provide carbon pool estimates.

The section on Land Condition includes such indicators as:

1) Land Cover. This is a critically important indicator because it allows for the assessment of non point source pollution and inclusion of landscape variables in ecological condition analyses. Land cover data provide valuable information on a site's geology, climate, soil health and biota, and incorporates an important temporal element by tracking information over decades or longer units of time measurement.
2) Land Use. This indicator is distinct from the Land Cover indicator in that it specifically monitors use by humans of particular areas which may not always be as obvious as land cover type. The primary data sources for the Land Use category come from the Forest Service's FIA and the National Resources Inventory prepared by the Natural Resources Conservation Service.

The 2008 ROE Water section tracks surface fresh and marine water resources through such indicators as:

1) High and Low Streamflow. This is the only indicator in the ROE that is concerned with water quantity. The indicator is actually a composite of two indicators developed by the Heinz Center that measure flow magnitude and timing and no-flow periods. Flow magnitude and timing accounts for any major changes that have occurred in an annual average 1 day high flow or 7 day low flow periods in monitored rivers or streams in the lower 48 states. Values are compared to a baseline 20 year period for measurements from 1930 to 1950. The no-flow periods indicator follows trends in no water flow periods in shrub or grassland in the lower 48 states. Measurements are specifically targeted in semi arid or arid climates to capture water stressed conditions. The remaining indicators in the water section of the ROE track water quality.
2) Nitrogen and Phosphorous in Wadeable Streams. This indicator relies on data from the EPA's Wadeable Stream Assessment (WSA) and calculates total nitrogen and phosphorous load in streams. Unfortunately, like many of the indicators in the ROE, there is no trend data available for this indicator.
3) Nitrogen and Phosphorous Discharge from Large Rivers. Relying on data collected by the U.S. Geological Survey (USGS), this indicator tracks the discharge of nitrogen and phosphorous from four of the largest rivers in the United States. The USGS used daily stream levels and volumetric discharge data from permanent measurement sites to produce discharge levels for the Mississippi, Columbia, St. Lawrence and Susquehanna rivers.
4) Trends in the Condition of Recreational Waters and their Effect on Human Health. At this time, there are no national indicators that monitor the condition or extent of national recreation waters. However, the EPA ROE suggests that this indicator essentially encompasses two main areas: attributes that indicate whether there are health threats associated with enjoyment of recreational waters by users, and attributes that are associated with the ecosystem services such as fish and bird population health that support recreational activities. This indicator is largely associated with ecosystem stressors, principally chemical and biological contaminants that affect not only experiences of visitors to recreation sites but also are a direct or indirect indicator of ecological health of a recreational water body.

The Montreal Process (Montreal Working Group, 2005), the USFS sustainable forest strategy (USFS, 2004), the Canadian Council of Forest Minister's sustainable forest management plan (2005), and The Ministerial Conference on the Protection of Forests in Europe (2005) all focus primarily on the sustainable management of forests. Other reports have looked at different contexts and areas where sustainable development and sustainability are important targets. For example, The European Common Indicators project (ECI) final project report (Tarzia, 2003) lists ten indicators that evaluate the progress participating nations are making towards sustainable living conditions in populated areas. The indicators are:

1) Citizen's Satisfaction with Local Community, Relative to Specific Features. This indicator is meant to capture citizen's average overall satisfaction with their current living conditions in their neighborhoods and communities. This indicator measures such attributes as quality and amount of community open space and natural environments, amount and quality of cultural and recreational opportunities and opportunities for citizens to participate in local planning and decision-making processes.
2) Local Contribution to Climate Change. This indicator is intended to capture the per capita production of CO_2 emissions annually. It is measured as both a total amount of emissions and as a percent change over the base year (1990).
3) Local Mobility and Passenger Transportation. This indicator is designed to provide information concerning quality of life issues and the impact of personal mobility on the environment within a specified urban area. Units of measurement are the average number of daily trips per capita, average time and distance per capita.
4) Availability of Public Open Spaces and Services. This indicator is included with the recognition that access to open spaces is essential for the quality of life of urban inhabitants as well as contributing to sustainable cities. It is measured as the percent of the population living within 300 m of a public open space. A public open space is defined as public parks, gardens or open spaces for exclusive use by pedestrians or cyclists, public sports facilities or private areas (such as agricultural areas or private parks) accessible to the general public.
5) Air Quality. This indicator focuses on the main sources of air pollution in urban areas including vehicles, industry and energy production. This indicator is monitored as the number of times an area's air quality exceeds the limit for a specific air pollutant annually. Common air pollutants monitored are sulfur dioxide, particulate matter (PM10) and ozone for example.
6) Children's Journey to and from School. We have elected to omit description of this indicator since it is not directly relevant to this report.
7) Sustainable Management of the Local Authority and Local Enterprises. This indicator is designed to capture information on the extent to which local government bodies and private businesses are incorporating recognized sustainable management practices in their daily operations and business plans.
8) Noise Pollution. Environmental noise is recognized as having a potential harmful effect on human health and well being. This indicator is meant to capture information on the amount of excessive noise residents of urban areas face as a consequence of the presence of mobility infrastructure, industry and population. It is measured as the percent of the population exposed to night noise in excess of 55 d(B)A.

9) Sustainable Land Use. The ECI suggests that sustainable design of an urban area will incorporate strategies that allow efficient use of limited space and valuable land. Such strategies acknowledge the importance and value of undeveloped land within an urban area, the value of biodiversity and other ecosystem services and the benefits of restoring degraded land (brownfields). This indicator measures numerous characteristics including the percent of artificial surfaces in a municipal area, number of inhabitants per ha (hectare) of urbanized land and the percent of undeveloped land in a municipal area.
10) Products Promoting Sustainability. This indicator is included based upon the recognition that the use of eco-friendly products, sustainable production practices and energy efficiency all contribute to overall sustainability of an area. The indicator measures the number of private firms and public agencies or organizations which employ environmentally responsible practices in their daily operations and use eco-friendly products.

The city of Hong Kong performed a sustainability study (Government of Hong Kong SAR, n.d.) in which city planners, policy makers, legislators and researchers sought to outline strategies and practices which will promote sustainable development of their city in the 21st century. Their report describes five criteria areas designed to capture information and assist in the protection and management of such assets as biodiversity, cultural vibrancy, leisure and recreation opportunities and improvement of environmental conditions for city residents. The five criteria areas (with examples of indicators) are:

1) Economy
    - Percentage change in income less income tax for the upper quartile household minus the percentage change in income less income tax for the lower quartile
    - Expenditure on primary, tertiary and secondary education as a percentage of GDP
2) Natural Resources
    - Consumption of energy per unit of output
    - Volume of freshwater supplied per capita
    - Area of countryside
    - Indicator on landscape/scenic value to be included when data are available from a landscape study to be commissioned by the government
3) Biodiversity
    - Area of Hong Kong of high terrestrial ecological value
    - Area of Hong Kong of high marine ecological value
    - Area of managed terrestrial habitat for conservation
4) Leisure and Cultural Vibrancy
    - Number of recorded cultural and historical sites
    - Percentage of population living within districts with a shortfall of required provision of open space
5) Environmental Quality
    - Composite index for criteria air pollutants based on percentage of established air quality objectives
    - Quantity (in tons) of carbon dioxide emitted per year
    - Number of kilometers of river ranked “Excellent” or “Good” using a designated river water quality index

Data Limitations

Despite the years of effort at developing reliable indicators of sustainability, there are still significant gaps in available data. One of the most critical weaknesses at this time is a lack of a comprehensive, standardized, and limited number of indicators that have been constructed through a transparent and cooperative process by participating government bodies and research and policy organizations. Another area of sustainability policy that suffers currently is a lack of clear policy targets (Spangenberg, 2002). A lack of historical and trend data in criteria areas presents further limiting challenges for proper indicator development (USEPA, 2008; USFS, 2004). Since sustainability indicators are meant to track meaningful changes in specific metrics, the absence of trend data that establishes a baseline against which to measure current conditions represents a significant potential shortcoming for many proposed indicators.

In addition to a lack of trend data, often there is a complete absence of data for a particular indicator. For example, the USEPA Report on the Environment (USEPA, 2008) section on Water, notes data lacking for the following:

- Information on the extent of different types of fresh surface waters
- Nationally consistent information on the various stressors to fresh surface water condition
- Information on the condition of lakes
- Information on the toxic pollutant load in fresh water sediments
- Limited data on the types and extent of health problems associated with swimming in polluted recreation water

The Sustainable Water Resource Roundtable Report (SWRR, 2005) noted that the following data gaps and measurement weaknesses would prove problematic for water resource research and indicator development:

- Poor understanding of the link between land uses and water quantity, quality and overall ecological health
- In order to ensure proper quantitative assessment of water quantity and quality to facilitate proper management decisions, development of better modeling and scientific tools is needed
- Lack of historic and baseline data are hampering efforts at indicator tracking and development
- Expanded and new monitoring technologies are necessary to capture critical information on water quantity and quality. Also, updated technology to capture non traditional contaminants such as pharmaceutical waste and viruses is needed
- Improvement is needed in the valuation of water resources in order to capture the various stakeholders' values for water
- In order to capture information on a regional basis, new integration strategies among government agencies are necessary as well as improved and increased data collection capturing information on regional hydrology and water uses.

The Forest Service's Sustainable Forest Report states that a great deal of information is inconsistent across studies or regions, incomplete, or altogether absent or unavailable (USFS, 2004). The introduction to the report frankly describes that reference conditions required for an assessment of current or future conditions are lacking for most indicators. The report goes on to describe a host of data weaknesses including:

- 40 of the 67 indicators (60%) are based on nationally inconsistent or outdated data
- 11 out of 67 indicators (16%) rely on data from questionable sources, or from sources for which no strategy for remeasurement exists
- 8 of the 67 indicators (12%) are based on modeling only, not on direct measurement
- Most of the indicators are measured only at the national level with little or no subnational measurements available. The consequence being that regional trends in indicators are largely missing
- Carbon storage data has not been measured directly so any estimates are based on the best available proxy measures or on modeling alone. Models need to be improved and significant improvements in direct measurement are required to establish sound estimates of carbon storage in forests
- Ownership of forests in the U.S. is a mix of public and private actors. Consequently, significant hurdles may exist for cultivating and recording consistent data for various forest sections.

The USFS report offers numerous suggestions for possible approaches to improving data availability and consistency. The suggestions below are listed according to USFS criteria but are relevant to ODF interests:

Criteria 1: Conservation of Biological Diversity

- Establish common protocols for data collection, management, and analysis, including common geographic aggregation units to facilitate data sharing and combined analyses
- Define historic baselines and thresholds of change that can serve as sustainability targets to facilitate discussions of the current level of sustainability and the risk of future changes
- Explore the feasibility of monitoring vital rates (birth, death, immigration, emigration) to supplement estimates of population levels
- Implement monitoring programs to survey important ecosystem types (their amounts and arrangement) and taxa (their distribution and abundance) that are not currently monitored. Standard monitoring programs should be expanded to include specialized habitats and rare species, which are often missed
- Establish direct measurements of genetic diversity and explore the feasibility of using them to supplement surrogate indicators such as the number of species that occupy a small portion of their former range
- Incorporate information about roads, ownership, forest type, and age-class in fragmentation metrics.

Criteria 4: Maintenance of Soil and Water Resources

- Define for forest soils the tolerable rates of erosion that allow for protection of water quality and maintenance of forest site productivity
- Address stream sediment data, which is often not collected because of cost, remoteness of some locations, and lack of regulations requiring them

- Evaluate the problems associated with determining the historic level of variation on stream gauges since most records have not been kept long enough to be able to provide good estimates of historic variation beyond about a 20-year return period
- Improve water quality databases to indicate whether data was collected from forested or other areas. Establish a national database so individual national forest units can collect biological stream data using a standard national protocol.

Criteria 5: Maintenance of Forest Contribution to Global Carbon Cycles

- Address inadequate geographic coverage (e.g., the Western United States and Alaska). Possibly expand survey crews in those regions and use cost-effective sampling methods, such as remotely sensed data
- Measure all relevant carbon pools (soils and coarse woody debris, in particular)
- Compile knowledge of land use history and the current state of land use
- Employ techniques such as remote sensing to enable wider geographic coverage within a relatively short timeframe for some of the variables of this criterion, within an acceptable level of uncertainty. Further develop flux-tower technology to estimate or validate forest carbon change estimates
- Collect data on the life expectancy of wood products in use, decay rates of wood products in landfills, and wood waste from the construction and manufacturing of wood products. Alternatively, or in addition to, design and implement a statistically designed survey of carbon in harvested wood.

Criteria 6: Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies

- Establish an ongoing inventory system to provide data on the number and type of recreation lands and facilities available for general recreation and tourism
- Establish closer collaboration among federal and state agencies to measure recreation visitation
- Establish interagency and intergovernmental collaboration to define and maintain a database that specifically inventories and tracks trends in protected lands
- Critically analyze indirect valuation through benefit transfer approaches, which are controversial, to make sure that value estimates are defensible. Empirical estimates of non-use value using the contingent value or other valuation methods are still not widely accepted unless specifically designed to apply to a specific site, situation, or feature.

Finally, the Heinz Center has provided a detailed report on important data that is currently missing or only minimally available with respect to ecosystem conditions and human health (Heinz Center, 2006). This report describes ten areas where information needs are greatest for proper development of sustainability indicators for ecological conditions in the U.S. These information gaps are preventing the most efficient and effective policy decisions. The ten areas are:

1) Measurement of crucial habitat types such as wetlands or coral reefs. Although these areas represent a small portion of geographic area, they are key habitats for ecological health.
2) Analysis of land cover data. Urban sprawl and forest fragmentation have a significant impact on ecosystem health.

3) Measurement of levels of chemical content in the environment. In particular, the effect of specific contaminants found in consumption fauna and their impact on human health.
4) Nitrogen flows in rivers.
5) Carbon storage in ecosystems.
6) Data on species and communities that are at significant risk for extinction.
7) Extent and impact of non native (invasive) species.
8) Measures of the levels of degradation of ecosystems.
9) Assessing condition of streams and riparian habitat.
10) Extent and condition of groundwater levels. Vital to human survival, as well as ecosystem health, currently there is little data on the quantity or quality of groundwater and the extent to which groundwater stocks are being depleted.

Guidelines for Constructing Indicators

There are different possible approaches to designing and constructing indicators for sustainable development. As mentioned above, one of the current weaknesses in sustainability indicators is the lack of coordination or agreement among different agencies and researchers on preparation of reliable and suitable indicators. Nonetheless, numerous studies and reports share a host of common principles concerning strategies for the proper construction of indicators. For instance, indicators are typically organized by particular areas of concern or criteria that appear consistently across studies and include such categories as economics, social values, and ecological/environmental criteria (Bartelmus, 2007; Deitz & Neumeyer, 2007; Lindsay, 2003, Spangenburg, 2002; USFS, 2004). Certain characteristics appear consistently as well across numerous different analyses and research efforts. Traits that make indicators particularly useful and compatible across studies include:

1) Flexibility. Indicators should allow for alterations and adjustments as data and conditions change
2) Clear and understandable. Useful indicators are reasonably understandable to non-experts. They should allow for information exchange beyond experts to include non specialist policy makers and citizen stakeholders
3) Representative or valid. Indicators should be accurately measuring phenomena that are of interest. In developing indicators, researchers need to ensure that they can answer the question "Are we measuring what we think we're measuring or what we want to measure?"
4) Time horizon. Related to flexibility, indicators should be responsive to changing needs but also provide useful parameters to accurately evaluate the changes in particular conditions over time. This requires not only some designated baseline conditions or time frame but also consistent measurement over particular durations of time (Vos et al., 2005; Parkins, Stedman & Varghese, 2001; Government of Hong Kong SAR, n.d.).

Valentin & Spangenberg (2000) offer useful guidelines for sustainability indicator development. Although the following suggestions focus on the community level, the principles may be applied to indicators generally at any level, although not every point may apply for every situation:

1) Preparing the process
    - Define deadlines
    - Create a binding agreement

- Involve elected officials and community leaders.

2) Form a Working Group
    - Create a steering committee reflective of community diversity. Representatives from different professions, cultural and ethnic backgrounds should be included
    - Encourage and promote diversity in perspectives.
3) Define what is Desirable and Possible for Outcomes
    - Discuss collective values and visions of sustainability and come up with policy goals
    - Use scientific and technical expertise to develop measurable goals and units to assess outcomes.
4) Choose Indicators and Data
    - Use existing models as examples for indicator development. Tailor indicators to specific local needs, circumstances. Use existing/available data
    - Make sustainability goals and indicators info public for ample participation, ensuring that data and info are presented in a clear, non technical form for ease of understanding by non experts.
5) Targets and Measures Discussion
    - Generate concrete targets and measures. Should be realistic, measurable, and achievable within a reasonable time limit
    - "They should represent an unambiguous, quantifiable, and comprehensive commitment by major groups and local government to really take action" (pg. 388).
6) Follow Up
    - If above steps are taken, an organizational apparatus will be established for regular review and updating of sustainability plans. Continual stakeholder meeting and update is necessary as situations change. Flexibility should exist in the plan to allow for changing conditions.

In general, we find the ODF sustainability indicator process to be consistent with other efforts at developing sustainability indicators. The constraint of limited data, which plagues most indicator development in other efforts, is mirrored in the development of our indicators, as detailed below.

ODF SUSTAINABILITY INDICATOR B.c. FOREST ECOSYSTEM SERVICES CONTRIBUTIONS TO SOCIETY

The *2003 Forestry Program for Oregon* defines 'sustainable forest management' as "forest resources across the landscape are used, developed, and protected at a rate and in a manner that enables people to meet their current environmental, economic, and social needs, and also provides that future generations can meet their own needs" (Oregon Department of Forestry, 2006: 23). To help guide and achieve the goals of sustainable forest management for Oregon, the Oregon Board of Forestry has endorsed the *Oregon Indicators of Sustainable Forest Management* plan (Oregon Department of Forestry, 2007). A framework of seven strategies organizes indicators to aid in achieving sustainable forest management in Oregon.

The basic objective of this project was to develop sustainability metrics for forest ecosystem services contributions to society under *Forestry Program for Oregon* Strategy B: Ensure That Oregon's Forests Provide Diverse Social and Economic Outputs and Benefits Valued By the

Public in a Fair, Balanced, and Efficient Manner; Indicator B.c.: Forest Ecosystem Services Contributions to Society (Oregon Department of Forestry, 2007). Four sustainability metrics, in monetary units, were to be developed, including (i) recreation use value; (ii) carbon sequestration value; (iii) passive use value; and (iv) water quality value. These metrics would focus on public and private forests in Oregon and be compatible with state forest management goals. Periodic remeasurement would illustrate trends over time.

A basic framework was proposed in which quantity measures representing the products of ecosystem processes (e.g., water quality, sequestered carbon, biodiversity) would be converted to monetary units using a procedure known as benefit transfer. Benefit transfer uses existing, published monetary estimates of ecosystem products. This framework requires measures of both quantity and monetary value. Notwithstanding the paucity of quantity measures in general, the monetary estimates were sparse and not applicable.

OUTCOMES

Ecosystem Services Workshop

A workshop was convened at ODF Headquarters in Salem on December 13, 2007. Appendix A provides the notes from this workshop and participants list. It was clear from this workshop that there are significant challenges in developing the proposed indicators. Of most significance was consensus of the group that there are serious data limitations. Some conceptual issues arose as well.

A primary concern was whether the indicators as proposed could rigorously measure and provide adequate signals for what they are intended to signal. The indicators are strongly tied to quantity measures for each ecosystem service, and when the quantity measures for these services are eventually developed, they will tell us about the conditions in Oregon. Therefore, indicators developed elsewhere (with the exception of recreation) will contain this information (e.g., carbon sequestration in Strategy G; biodiversity/habitat in Strategy F; and water quality in Strategy D). Multiplying these quantity measures by a price or price proxy in order to capture social values will not work. Prices are primarily affected by factors external to Oregon, such as national and global carbon markets, whose price is a function of national and global supply and demand (more information is provided for this indicator below). For the other indicators, including recreation, price proxies would be derived from the literature on the economic value of these types of resources. However, this literature may not signal important changes in social values without resource specific new estimates of value relevant to Oregon’s ecosystem services. For example, there is a large database of recreation activity values in the U.S., providing strong baseline levels of price proxies for recreation. Unfortunately, updating of these values is constrained by new research that may or may not be conducted and published, and will likely not be applicable to recreation resources in Oregon. Therefore, while the social value of recreation may change over time, information about these changes in values may not be available.

Consensus of the group suggested the project might most strongly contribute to the development of a recreation indicator (discussed below) based on supply (quantity) similar to the other ecosystem indicators. A recreation supply indicator would possibly capture the primary issues of access, quality of site/location, availability of recreation resources, and funding levels.

Consensus of the group also indicated that if social, temporally relevant values of ecosystem services to Oregonians were desired, then we should consider periodically collecting primary data from Oregonians through an appropriately designed public survey. This survey could be structured as a multi-attribute choice experiment that measures the relative values of alternative ecological future conditions juxtaposed with current social concerns/issues. Potential survey outcomes would be periodic rank-orderings of social values; marginal values (a price proxy) for resource quantity shifts; and social preference weights for resources associated with the other resources (e.g., water quality, forest production, recreation, biodiversity, carbon sequestration, etc.). The preference weights could be used in an aggregate quantity measure along with the other ODF sustainability indicators, providing a general index of sustainability conditions in Oregon.

Follow-up Ecosystem Services Meeting

A project meeting was held on April 25, 2008 as a follow-up to the Ecosystem Services Workshop. Appendix B provides notes from this meeting and participants list. Several conclusions were reached in this meeting. (1) The recreation indicator is the only one that can be effectively constructed; however with significant challenges. (2) There is a general lack of data and theoretically supported procedures for developing indicators for the carbon sequestration, water quality and passive use values. (3) Some form of public survey, conducted periodically, would better gauge the level of, and trends in, Oregonian's values for ecosystem services. A choice experiment design was proposed as a potential candidate for measuring values in a public survey.

Choice experiments can be used to estimate economic values for almost any ecosystem or environmental service, including estimating use and passive-use values. Values are inferred from the hypothetical choices or tradeoffs that people make in the survey. Typically, people state a preference between scenarios comprised of different environmental attributes, groups and levels of ecosystem services, or some other combination (Holmes & Adamowicz, 2003; Brown & Peterson, 2003). When one of the attributes is a price or cost to the individual, then the relative worth, in monetary terms, can be inferred. Regardless of monetary estimation, choice experiments allow estimation of the relative ranks and strengths of preference for varying quality and quantity levels within services, but also relative measures among services. Since choice experiments focus on tradeoffs among scenarios with different characteristics, it is especially suited to policy decisions where a set of possible actions might result in different impacts on natural resources or environmental services.

Recreation Sustainability Indicator

The development of a recreation sustainability indicator was the most plausible outcome from this project as suggested by participants in the Ecosystem Services Workshop and the follow-up indicator development meetings as discussed above. While we have developed several recreation metrics (Appendix C), we also discovered a general lack of data and limited information on trends.

Five measures for recreation were developed. Total recreation visits for forested landscapes were aggregated based on reported recreation visits in 2007 for national forests, state parks, and state forest campgrounds. Appendix D provides a detailed description of these data. Among the various agencies we contacted, only the U.S. Forest Service, Oregon Parks and Recreation Department, and Oregon Department of Forestry had data on recreation visitation, with substantial variation in the coverage and detail of these data. The USFS, based on the recently completed rounds of recreation visitation estimation (National Visitor Use Monitoring project), provided day use and overnight use by activity type for all national forests in Oregon. These data are valid at the national forest level, thus recreation visitation levels for sub-forest locations are not valid in this database. However, it is at the sub-forest level that recreation visitation and visit quality may directly be affected by resource stressors or management outcomes. Recreation visitation for state parks by day use and overnight use is provided for most parks in the Oregon system. However, day use visits are not broken out by activity type, limiting our ability to link changes in recreation activity to resource stressors and management outcomes. State forest recreation visitation data are very limited; we only have data on campground revenue and total camping visits by campground.

Total recreation visits

Total recreation visits in 2007 at national forests (18 million visits), state parks (48 million visits) and state forest campgrounds (30,000 visits) were about 66 million (Appendix C, Figure 1). We have segregated these visits by Oregon residents (57 million visits) and non-residents (9 million visits). National forest visitation is tracked by resident and non-resident origins, whereas for state park and state forest campground visitation user origin was unknown. Therefore, we used the proportion of resident/non-resident for national forests as a proxy for segregating state park and state forest campground visitation. We do not have comparable visitation estimates for other years, thus these estimates of visitation in 2007, limited as they are, can serve as a baseline for future recreation visitation monitoring and estimation.

Total recreation value

Total recreation value was estimated at $514 million, with $392 million for Oregonians and $121 million for non-residents (Appendix C, Figure 2). Total recreation value was estimated using the benefit transfer method where average values by recreation activity were derived from the recreation use values database (Rosenberger & Loomis, 2003; Rosenberger & Stanley, 2007). This database includes recreation value estimates for over 27 recreation activity types from 329 published documents providing 2,705 recreation use value estimates. We restricted our analysis to studies that provided use value estimates for the western U.S. Total value was estimated by multiplying activity specific use estimates by their corresponding value estimates, and then summing across activity type and agency. As stated previously, value estimates for recreation using benefit transfer is restricted to the information at hand. If no new studies are published between this assessment and the next one, the activity value estimates will not change other than adjusting for inflation. Therefore, quantity measures better reflect changes in recreation visitation whereas adding a price proxy does little beyond converting use into a monetary metric.

Recreation use trends
While total recreation visits and total recreation value can serve as a baseline for future assessments, trends in recreation use were derived elsewhere. The Oregon Parks and Recreation Department, in conjunction with their Statewide Comprehensive Outdoor Recreation Plan (1987 and 2002), surveyed Oregonians and asked them about their recreation use in Oregon. Given that these data are comparable, a trend can be derived from them. However, since they are not comparable to the recreation visitation provided above derived by location (national forest, state park, state forest), they cannot be compared. Between 1987 and 2002 total recreation visitation increased by 28%; however, total population also increased by 30% during this period. Therefore, we cannot say that total recreation visitation increased during this period on a per capita basis. We can see that recreation use patterns are different for different activities. All recreation activities increased in use except for hiking, which remained constant, and picnicking, horse riding, and backpacking which decreased (Appendix C, Figure 3).

National trends in recreation exhibit a similar pattern. The *National Survey of Recreation and the Environment* shows recreation participation has increased for all activity types between 1995 and 2001. However, there are some substantial limitations to these data. Participation in an activity is based on at least one occurrence in the prior twelve months, but does not capture frequency, duration, or location of these occurrences. Data are relevant at the state level, but changes in participation at a specific location are not known.

Recreation supply
Oregon Parks and Recreation Department, in conjunction with their 2002 Statewide Comprehensive Outdoor Recreation Plan, compiled supply estimates of recreation resources in Oregon (Oregon Parks and Recreation Department, 2001) (Appendix C, Table 1). While these data are not complete (in part they were based on voluntary responses to an inventory survey of recreation resource managers in Oregon, among other data sources), they can serve as a baseline for future assessments of recreation supply. Another limitation of these supply data is that they are not necessarily attached to a specific place where resource stressors and management can affect their availability, accessibility, and quality. We did not attempt to consolidate the various recreation resources (e.g., linear miles of trails) because their measurement is not necessarily mutually exclusive (i.e., we were concerned about double-counting leading to exaggerated supply measures). We have no knowledge of another project to measure recreation resource supply, thus there is no trend associated with these data.

Carbon Sequestration Sustainability Indicator

One of the participants at the Ecosystem Services Workshop argued that tracking a market price for carbon sequestration, such as the Chicago Climate Exchange, has merit for this indicator. While we agree that this is the only source of domestic market values for carbon available to us, it has substantial limitations. Therefore, we did not develop a carbon sequestration indicator.

Carbon sequestration valuation shares a characteristic with passive use or “non-market” values. In passive use evaluations, researchers and policy makers are confronted with the challenge of monetizing or quantifying units that are not traded in markets and consequently have no obvious price attached. Methods for valuation of some non-market goods have successfully been developed. For example, resource economists have been able to successfully evaluate monetary values for nature areas based on recreation use through the travel cost method (Loomis & Walsh, 1997). However, the more intangible non-market goods continue to present significant challenges. How does one calculate the value of existence or potential future use of a recreation site for individuals? How can policy makers include the value of scenic nature in a cost benefit analysis when such a feature has no explicit market value?

An important contributor to the hurdles facing successful valuation of intangible qualities of natural resources is the difference between revealed and stated preferences. The travel cost method mentioned above is useful because it relies on actual behavior of individuals. Other methods such as hedonic pricing rely on actual expenditures as well. Expressed preference methods are more problematic since they rely on the self reporting of individuals which may or may not accurately and truthfully reflect the value of a feature for the respondent (Loomis & Walsh, 1997). A revealed preference method that holds promise for providing an estimation of more valid estimate for the social value of forests is the use of a proxy value of sequestered carbon in total forest valuation calculations.

There are several problems however, that have yet to be solved before such a valuation procedure can accurately capture the value of sequestered carbon. In order to define a price for sequestered carbon, some form of trading regime is required to facilitate a pricing system (Huston & Marland, 2003). Montagnini and Nair (2004), for example, report that currently there is no broad market for CO_2 or carbon credits in the U.S. A precedent does exist in the SO_2 market that was created to help curb air pollution from coal fired power plants. The SO_2 credits market has experienced significant success in the ten-plus years it has been active (Montagnini & Nair, 2004). In the time since its creation, the market for SO_2 permits has grown into a $3 billion industry, led to reductions in sulfur dioxide that have exceeded EPA requirements, and at a fraction of the cost that the energy industry initially complained they would face to meet standards. Unfortunately, according to Montagnini and Nair, currently there is no mandated CO_2 cap and trade system like that for SO_2 created under amendments to the Clean Air Act. At the present, the only system for CO_2 emissions trading in the U.S. is under the voluntary system of the Chicago Climate Exchange (CCX). Because the U.S. elected not to ratify the Kyoto Protocol, no mandatory caps for CO_2 emissions are currently in force. As a consequence, the CCX remains small and relatively undeveloped, although approximately half of the states in the U.S. have elected to adhere to voluntary emissions reductions (Birdsey, 2006; Cubbage, Harou, & Sills, 2007; Montagnini & Nair, 2004).

A second issue complicating use of carbon market prices to inform Oregon sustainability indicators is that market price fluctuations will impact the value of forests for carbon storage. So for example, if sustainability indicators for Oregon forests are pegged to permit market prices, the values will be almost entirely related to events or perturbations well beyond the borders of the state. By way of example, we may consider the current severe economic downturn which commenced in the U.S. but has spread worldwide. At the time of this writing the authors were unable to locate current research findings on the impact that the economic crisis is having on carbon trading. News reporting from international sources however, suggests that the economic crisis occurring in the U.S. and other industrialized nations is dampening productivity, with a currently unclear, but likely negative impact on the use of carbon credits purchased as offsets against emissions under the UN's Clean Development Mechanism (Fogarty, 2008; Vidal, 2008). It appears then that national and international events will very likely have a notable impact on the valuation of state forests if values are pegged to carbon markets. Furthermore, with the decrease in production in response to a recession, CO_2 emissions will fall. This will result in a decline in U.S. carbon market prices, assuming a market for carbon emerges in the U.S. in the future. The potential effect of national and international perturbations on local markets leads to a conceptual challenge on the value of standing forest carbon sequestration. With a recession, carbon storage credits value decreases, but does this translate directly to less valuable forests, from the perspective of sustainability? Such market fluctuations have their roots in transactions and markets completely detached and removed from Oregon forests, so it becomes extremely problematic to pin valuation of Oregon forests on a national or global market whose fluctuating prices may significantly impact sustainability decisions locally.

A third major concern and challenge for developing a reliable carbon storage indicator is the ability to accurately measure existing carbon pools (Watson et al., 2000; Hoover, Birdsey, Heath & Stout, 2000; Murray, Prisely, Birdsey & Sampson, 2000). Currently, fairly reliable data on above ground carbon sequestration in standing timber exists, with an approximate total value of 200 Tg of carbon captured by forests in the U.S. annually at around 53.5 tons of carbon per hectare (Birdsey, Pregitzer, & Lucier, 2006; Nowak & Crane, 2002). As reported by Birdsey, Pregitzer and Lucier (2006), this 200 Tg per year figure is equivalent to approximately 10% of total CO_2 emissions produced annually in the U.S. These authors have found as well that approximately 60 Tg of carbon (of the 200 Tg total) is captured annually in the form of sequestered waste material in landfills and in wood products. Procedures for measuring above-ground carbon accumulation in biomass are fairly well established using forest inventory techniques and models developed by the timber industry and federal and state resource management agencies (Cathcart, 2000). The U.S. Forest Service's Forest Inventory & Analysis system does provide a reasonable foundation from which to begin a full accounting of above ground carbon storage but does have weaknesses including failure to account for private land holdings and poor tracking of land use change (Murray, Prisely, Birdsey & Sampson, 2000). Additional problems stem from that fact that much of the data that is input into modeling equations for projections relies on data collected in the period from the late 60s to the 80s and it is not clear whether trees have changed their allometries given the climate changes occurring in response to global warming (Brown, 2002).

The biggest blind spot currently for forest carbon sequestration occurs in measuring below ground biomass and soil sequestration (Brown, 2002). There are significant deficits of information concerning below ground biomass in roots and soil because such measurements are very difficult, are time consuming, and there is no standardized measurement approach followed among researchers (Brown, 2002). And even those sub-surface measurements that are carried out are seldom terribly accurate due to sampling and measurement problems (Watson et al., 2000; Montagnini & Nair, 2004; Hoover, Birdsey, Heath, & Stout, 2000). Furthermore, it is not yet clear what effect management strategies have on soil carbon amounts since sub-surface measurements are rarely carried out for reasons mentioned above. Some examples of management strategies that may affect carbon stocks both below and above ground include forest fertilization, pest management, forest fuel and fire management, harvest quantity and timing, low-impact harvesting, reductions in forest degradation, and forest regeneration (including human induced natural regeneration, enrichment planting, less grazing of savanna woodlands, and change of tree provenances or species for short-rotation forestry) (Murray, Prisely, Birdsey & Sampson, 2000). According to the Watson et al. (2000:16), “currently, there are no guidelines as to the level of precision to which [carbon] pools should be measured and monitored. Precision and cost of measuring and monitoring are related. Preliminary limited data on measured and monitored relevant aboveground and below-ground carbon pools to precision levels of about 10% of the mean at a cost of about US$ 1–5 per hectare and US$ 0.10–0.50 per ton of carbon have been reported.”

The challenges outlined above present significant, but not insurmountable challenges to incorporating carbon storage as part of Oregon sustainable forest indicators. Oregon forests have changed from net carbon emitters to carbon sinks following the considerable decline of the timber industry in the state (Murray, Prisely, Birdsey & Sampson, 2000; Turner et al., 2007). For some perspective on the relationship between carbon sequestration and Oregon’s forests, it is helpful to note that just after 1900, nationwide timber harvesting was contributing an estimated 800 Tg of carbon emissions annually. From 1953 until about 1986, the U.S. was actually increasing its rate of carbon sequestration with significant regrowth of previously harvested forests. This increase declined again after 1986 to the current rate of approximately 200 Tg sequestered annually (Birdsey, Pregitzer, & Lucier, 2006). Current models suggest that Oregon will be a net carbon sink for decades to come, largely due to a favorable climate and considerable regrowth in previously harvested areas (Turner et al., 2007). The most effective strategy that policy makers should employ to include this information as an indicator of sustainability, at least in terms of social values, has yet to be devised. Complete, reliable, and relevant data is simply currently not available that will allow a satisfactory accounting of the social values of carbon storage in Oregon forests.

Water Quality and Passive Use Value Sustainability Indicators

In part based on the outcomes of the Ecosystem Services Workshop and the follow-up project meeting, we did not develop sustainability indicators for water quality and passive use values (a proxy for natural resources such as biodiversity). We did search Environment Canada’s *Environmental Values Reference Inventory*, a comprehensive database of non-market valuation studies, finding a number of studies conducted on resources in Oregon with generally limited applicability to converting a quantity measure into a monetary metric. Trends in these indicators would be solely driven by changes in quantity measures of natural resources developed by other indicators as noted previously.

RECOMMENDATIONS

Data availability, applicability and quality are the most constraining factors in developing sustainability indicators that are valid and meet their intended purposes. These limitations have afflicted nearly all attempts at developing sustainability indicators, as we noted previously. For an indicator to meet its intended purpose, it must be sensitive to environmental and social stressors and consistently measured over time. With this in mind, we offer the following recommendations for developing sustainability indicators for ecosystem services.

Recreation Sustainability Indicators

- Recreation sustainability indicators should be based on demand (quantity of visits), supply (quantity and quality of recreation resources), and investments (operating budgets), with all measures ideally linked at the location of the resources. Therefore, we need:

    - *Recreation Demand Metric*—periodic measures of recreation use at the site or location of the recreation resources being used, including both public and private forests. A statewide recreation demand data repository with appropriate incentives to public and private recreation managers/landowners for recording recreation use of their resources should be developed. At a minimum, recreation managers should annually record recreation use information covering total recreation visits, activity type, and location. Additional information that could be recorded from routinely implementing a short survey of visitors at the various recreation sites includes frequency of use, duration of use, and visitor satisfaction. An example of a recreation survey for measuring use and gathering other information is the US Forest Service's National Visitor Use Monitoring system (http://www.fs.fed.us/recreation/programs/nvum/). A stakeholder panel along with experts on recreation modeling and monitoring should be convened to develop the repository, recording protocol, sampling protocol and/or survey design. The *Recreation Demand Metric* would allow measurement and tracking of changes in recreation use by activity type, location and resource.

    - *Recreation Supply Metric*—periodic measures of the supply of recreation resources on public and private forests, including not only measures of total quantity, but also quality and accessibility. A statewide recreation supply data repository should be developed with appropriate incentives to public and private recreation resource managers. Supply data should be gathered that is compatible with activity type (see Oregon Parks and Recreation Department's inventory for a listing of resource type and an example inventory survey: http://www.oregon.gov/OPRD/PLANS/docs/scorp/scorp_22_inventory.pdf). Additional information that could be gathered via an annual recreation supply inventory survey would include measures of site quality (e.g., capacity vs. use levels, congestion or crowding) and accessibility measures. A stakeholder panel along with experts on recreation modeling and monitoring should be convened to develop the repository, recording protocol, sampling protocol and/or survey design. The *Recreation Supply Metric* would allow measurement and tracking of changes in recreation supply by activity type, location and resource.

- *Recreation Investment Metric*—periodic tracking of recreation management budgets for natural resource agencies in Oregon should be conducted. The quality of and access to recreation resources are often constrained by recreation management budgets affecting resource maintenance, improvement, and expansion. Information on annual operating budgets could be provided by recreation managers/landowners in conjunction with the supply inventory survey noted above. The *Recreation Investment Metric* would allow measurement and tracking of changes in budget allocations, which may be important determinants of recreation resource quality and accessibility.

- *Linking Recreation Demand, Supply, and Investment Metrics*—these metrics could be linked at the location of the resources reflecting changes in demand, supply and/or investment by activity type for each location and resource, or at some appropriate level of aggregation (e.g., forest-level, county-level). As an example metric, see Cordell et al.'s (1990) analysis of the national gaps between demand and supply for a variety of recreation activities (http://www.fs.fed.us/rm/pubs_rm/rm_gtr189.pdf). Furthermore, by linking the metrics of recreation demand and supply, the effect of environmental and social stressors could be identified along with changes in the quantity, quality and accessibility of these resources, thus providing an overall sustainability indicator for recreation resources in Oregon. Furthermore, this linking would make these metrics responsive to changes in environmental, social, and political contexts.

Ecosystem Services Sustainability Indicators

- Ecosystem services sustainability indicators, such as carbon sequestration, water quality, and biodiversity, are best measured in terms of their quantity and quality. These measures should be derived in the other indicators being developed in the *Forestry Program for Oregon*. Converting these quantity/quality measures of natural resources and ecosystem services to a monetary metric is not appropriate.

Measuring Changes in Social Preferences for Ecosystem Services

- If the public's perception and preferences for different ecosystem services and natural resources, including changes in these perceptions and preferences over time, is important, then we recommend a periodic (e.g., every five years) statewide survey of Oregonians be conducted. We have offered the choice experiment as one candidate survey design for these purposes. A choice experiment can measure the relative worth (including in monetary terms) of resources that are better linked with resource variability and policy applications. However, other components could be integrated in a survey that would measure the public's satisfaction and attitudes toward natural resource management within the state.

  Choice experiments (aka conjoint analysis, stated choice, attribute-based methods) estimate the marginal utilities for a divisible set of attributes of an environmental good

(Holmes & Adamowicz, 2003; Louviere, Hensher & Swait, 2000). The ‘environmental good’ could be defined as the state of the environment for Oregon where the ‘attributes’ are the various ecosystem services and environmental resources. By varying levels of these attributes (i.e., conditions of ecosystem services), detailed information about public preferences for multiple states of the environment can be derived. If the attribute levels are technically tied to sustainability metrics derived from the sustainability indicators project, then the marginal utility (or strength of preference) of changes in the sustainability metrics can be measured. The ratios of these attribute-specific marginal utilities are rates of marginal substitution, directly indicating the public’s tradeoffs among the attributes. Furthermore, if one of the attributes is money (e.g., cost of the program), then monetary estimates of changes in environmental attributes can be derived.

A second advantage of choice experiments in this context, beyond estimating monetary worth of attributes, is the use of estimated marginal utilities as a means to aggregate sustainability indicators across the various categories (e.g., water, soil, biodiversity, and carbon services) to derive an overall sustainability indicator for Oregon. Marginal utility estimates provide a measure of strength of public preferences for each attribute; ordering these marginal utilities from highest to lowest provides a rank-ordering of the attributes. The marginal utility estimates could be standardized on a 1-100 scale, thus providing preference weights for each of the attributes by which the attributes may be combined into a single sustainability indicator (see Strager & Rosenberger (2006) and Brown & Peterson (2003) for a variant of this approach using an abbreviated paired comparison method). The overall sustainability indicator would be sensitive to changes in ecosystem services and changes in public preferences over time.

The implementation of a choice experiment is not a simple task. There are guidelines on how to implement a choice experiment (Holmes & Adamowicz, 2003); specific details about choice experiments are beyond the purpose of this report. However, the seven steps to implementing a choice experiment are (Holmes & Adamowicz, 2003:176)

1. Characterize the decision problem;
2. Identify and describe the attributes;
3. Develop an experimental design;
4. Develop the questionnaire;
5. Collect data;
6. Estimate model;
7. Interpret results for policy analysis or decision support.

There are numerous examples of choice experiment applications ranging from recreation settings to watersheds. As examples, see Rolfe & Bennett (2006), Oh & Ditton (2006), Nielsen, Olsen & Lundhede (2007), Haider & Rasid (2002), Kneeshaw et al. (2004), and Boxall & Macnab,(2000).

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APPENDIX A – ECOSYSTEM SERVICES WORKSHOP NOTES

The following is a summary of discussions at the Ecosystem Services Workshop held December 13, 2007, 0900-1130, Santiam Room, ODF, in Salem. These notes are not comprehensive, but reflect the general trends and most salient points from the meeting. If any participant feels we missed an important message, they are encouraged to add it as a supplement to our notes.
-New comments from readers/reviewers in blue (a/o 12/21/07)

OVERVIEW

It's clear from the discussion today that there are significant challenges ahead. It will be necessary to critically evaluate strategies and metrics. We are facing serious data limitations for indicators intended to cover a lot of conceptual ground. We may encounter difficulties concerning lack of clarity in metrics, value measurements the final output. Converting ecosystem services indicators into monetary metrics is rife with problems, most notably lack of price information for ecosystem services, prices are affected primarily by factors outside of Oregon's control, and total quantity measures are not appropriate scale for measuring changes in ecological quality.

A primary concern, as illustrated in each indicator's discussion notes below, is whether the indicators as proposed rigorously measure and provide adequate signals for what these indicators are intended to signal. These indicators are strongly tied to quantity measures for each ecosystem service, and when these measures of quantity are derived they will tell us whether conditions in Oregon are improving or declining. As such, indicators developed elsewhere (except for recreation) will contain this information (e.g., carbon sequestration in Strategy G; biodiversity/habitat in Strategy E; water quality in Strategy D). Multiplying these quantity indicators by price or a price proxy to capture social values will likely not work. Prices are primarily affected by factors external to Oregon, such as national and global carbon markets, whose price is a function of national and global supply and demand. For the other indicators, including recreation, price proxies would be derived from the literature on the economic value for these types of resources. However, this literature may not signal important changes in social values without resource specific new estimates of values that are relevant to Oregon's ecosystem services.

It was suggested that if we want to measure social values for ecosystem services to Oregonians that are temporally relevant (reflecting current social conditions and trends), then we should consider periodically collecting primary data from Oregonians through an appropriately designed public survey. This survey could be structured as a multi-attribute choice experiment that measures the relative values of alternative ecological future conditions juxtaposed with current social concerns/issues. Potential survey outcomes would be periodic rank-orderings of social values; marginal values (a price proxy) for resource quantity shifts; and social preference weights for resources associated with the other resources (e.g., water quality, forest production, recreation, biodiversity, carbon sequestration, etc.).

Consensus suggests that this project might most strongly contribute to the development of a recreation indicator based on supply (quantity) similar to the other ecosystem services indicators.

A recreation supply indicator would possibly capture the primary issues of access, quality of site/location, availability of recreation resources, and funding levels.

We will organize a meeting with ODF staff to discuss modifications to the project proposal and expected products and outcomes.

SUMMARY OF ISSUES DISCUSSED

Introduction (G. Lettman)

- Good data exists on timber and recreation use but -
- Currently, there is insufficient data available on water and ecosystem services.
- These indicators selected by the OR Board of Forestry (Lettman) are subject to change.
- These indicators will be built in an environment of rapidly changing supply and demand relationships. Prices and perceived values may shift dramatically based on perceptions of scarcity and about faces in government policies. For example, hydrologist Gordon Grant is now saying that very shortly water will be the number one value being produced by National Forests, overwhelming timber values. I'm not sure about how this fits, but it would certainly affect how a survey is designed and how metrics are crafted. (GaryLettman)

Recreation Indicators

- The ODF has detailed data on different types of forest cover
- This data may prove helpful with a "Quality of Forest Type" metric (refer to the Metric Valuation Template on pg. 6 of the Final Research Agreement)
- It was suggested that we could possibly tie recreation values to ROS.
- Questions were brought up about what constitutes forest? How shall it be defined? For example: is recreation in forests on the coast considered coast land rec or forest rec?
- Issues of scale may prove troublesome. This concerns levels: city, county, state, fed level? Questions of public v. private forest land. Will important information be lost moving up or down scale?
- Question: Is attaching a dollar value to rec opportunities really the best approach to measuring quality or sustainability?
- Could resources invested (e.g., federal budgets) into rec opportunities be used as a reliable metric for this indicator?
- How we choose to define areas will also impact measurement of sustainability.
- Possible metrics?
    - Access/quantity of access points? Supply measures using location attributes
    - Quality of visitor experience at sites
    - Use permits (hunting for ex)
    - Money spent on investing in recreation capital (see comment above re: fed budgets)

Carbon Sequestration

- Clearly this will be a problematic indicator to construct in ODF Strategy B.c.
- Could we simply employ a simple equation such as:
- Prevailing price for carbon * quantity sequestered = metric? Is this sufficient? (No)

- Andrew Yost at ODF has been working on biomass quantities – fitting these into equations for rough estimates of carbon – very rough equations
- The ODF inventory of biomass is broken out by species, not area or forest type – aggregation possible?
- Best figures we'll get at this point are ballpark. Increased funding and research required for more detailed information on carbon pools; for aggregating carbon to area-wide estimates.
- Carbon trails: what constitutes neutral, positive or negative emissions? How will we measure sequestration for example, in a tree farm? Time horizon then becomes an issue.
- There are models available to provide estimates of sequestration.
- We still need to define the baseline. What gets counted and how? How we define and quantify sequestration will drive policy.
- Also, how might fire events impact sequestration figures?
- Carbon indicators need to measure rates of change as direct indicators of how things are progressing
- If included in B.c, carbon sequestration may be best described in conceptual terms; using a more qualitative treatment than quant. It may turn out that sequestration is best left to Strategy G alone because B.c. is working with social values rather than strict quantities only.
- I suggest the carbon sequestration minutes are light on the point that a tree converted to a log and milled to building materials remains sequestered between gypsum wall board or painted house exterior. Unless the house burns, wood remains sequestered. Bearing this fact in mind, maximum sequestration would be clearcutting stands when their maximum sequestrating life stage ends, converting them to houses where their carbon remains sequestered, and planting a new forest to grow into carbon sinks, then repeating the process. (John Griffith)
- The discussion on carbon seems to be over complicated.
  My suggestion for carbon would be to simply track the volume and value of forest carbon offsets actually traded. Right now, the only domestic market for this information is the Chicago Climate Exchange. But, as other cap 'n trade schemes come into play, perhaps as composite of the various exchanges could be used. An add-on might be the percent of forestry offsets to total volume traded, etc.
  I understand that the above does not reflect what is going on in Oregon. But, it is the best indicator of carbon markets at the moment and would be good data for understanding market trends. The presumption being, as the volume and value of forest carbon offsets increase or their percent of total volume traded - either through the Chicago Climate Exchange - or through a growth in market exchanges - this creates better market opportunity for carbon offsets sourced in Oregon.
  Further, we need to keep an eye on the Western Climate Initiate (the regional cap 'n trade initiative that Oregon has signed up with). This could create a new market exchange - where volume and value of forest carbon offsets could be tracked and more relevant to this region.
  The overall point here is - markets for carbon offsets exist (though, nascent). In the spirit of ODF Strategy B indicators, the carbon indicator should be based on market trends as they are developing (and observable); rather than on speculative analysis and reporting on what we think is tradeable. (Jim Cathcart)

Passive Use (biodiversity/habitat)

- The goal here is to find what people are willing to pay for different levels or quality of sites, habitat. Requires survey data – have to *ask* people how much they value habitat, biodiversity etc.

- Is there a reliable quantity measure of biodiversity?
- There is some useful data in E.c.
- Relevant, reliable and robust information on social values pertaining to biodiversity is scarce and possibly not transferable to Oregon.
- Consideration of development influencing habitat change is necessary but not sufficient. We can't simply focus on areas of conflict between development and pristine habitat. Information on total habitat is necessary.
- This indicator should reflect whether we are seeing increases or decreases in biodiversity and how these changes are impacting people.
- It appears that we may be able to work successfully with Andrew Yost on obtaining required information to make meaningful calculations on biodiversity.
- The topic of scarce, endangered species was discussed. What is their value? How do we arrive at these values? We'd like to know how many individuals we may be losing from a scarce species but also need to know how many we have.
- Climate change will also impact our results. Ecosystems will change with changes in climate and this will impact benchmark metrics (refer to E.a.)
- The question of using indexes arose. There is considerable concern about use of indexes. They may be received with some negative feedback; has occurred in a previous attempt at use of indexes. But they remain a distinct possibility.

Surface Water Quality

- There was notably less discussion on this indicator. The most salient comments for the previous indicators hold here, too, including scale, what are we measuring, and lack of appropriate price proxies.
- Water quality measures exist but there appears to be a dearth of data on water quantities in forests.
- It's important to consider how management schemes will impact quality. In order to understand how changes will affect conditions, we need to get a clear picture of what current management is accomplishing and attempting to accomplish.
- The topic of choice experiments was brought up as a possible way to get at relative value of different attributes (of water, forests) but unlikely to be used in this work.

Concluding Remarks

- The questions of scale, diversity and complexity are important. What level(s) are we talking about? Different outcomes will be realized by focusing on different levels.

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APPENDIX B – PROJECT MEETING NOTES

ODF Sustainable Forests Indicators Meeting #2
Friday April 25, 2008

The following is a summary of the follow-up meeting to the Ecosystem Services Workshop. These notes are not intended as an exhaustive record of the meeting but reflect the main points, general trends and points discussed by meeting attendants. Additional comments or notes are encouraged if any important points are inadvertently omitted.

OVERVIEW

Recreation Indicators

- This indicator is probably the only one out of the four (recreation, passive use/ecosystem service, water quality and carbon) which can be effectively constructed – still with significant challenges.
- Data is available, but sparse. The information we do have is fairly complete, but there is a lot of missing data.
- For instance, NVUM data is pretty comprehensive but OR State recreation data is limited to only camping receipts and campground and day use data.
- OPRD's 2001/2002 SCORP contains an inventory of supply side of recreation and information on use. The use data is based on voluntary reporting so there are significant holes. It's also a one time inventory, which limits usefulness.
- Using budget allotments as a recreation indicator will likely result in misleading signals. Too many complications, as with landscape changes for instance. Might be usable in connecting supply and demand – compare budget allocations to demand metrics.
- Recreation values info exists but from many different studies, all with different methods and results – too much discontinuity.
- Benefit Transfer approach likely a poor option as well – misleading or lack of price signals
- Some form of survey instrument would be helpful here. It allows collection of systematic temporal data. NSRE has trends but at the state level – wouldn't be able to narrow data down to local level and has no use frequencies or location information (urban v. rural users)

Passive Use/Ecosystem Service, Water Quality, Carbon Sequestration Indicators

- It is very unlikely, given the lack of data and theoretically supported procedures, that indicators of social values for any of these areas can be developed at this time.
- Although several groups have identified an interest in monetary-based indicators for amenities, we are not aware of any examples where these indicators were actually generated. There are no markets (except for a nascent carbon market) for these other proposed indicators so there is no reliable way to tell what price signals could tell us.
- Water Quality – there is a poor linkage or lack of data at the moment between quantity and quality measures. Reliable quantity measures are the first step before any statements can be made concerning total value

- Passive Use/Ecosystem Services – We have no data on biodiversity. There is no data on ecosystem services in OR either. Passive use values could provide a ballpark figure but any earlier studies on environmental values would be useless since it's not clear what services these studies were addressing.
- What can be provided regarding these proposed indicators is a conceptual model that is most likely to develop the desired indicators. Suggestions and instructions for necessary next steps in indicator construction since at this time, we simply do not have required data to successfully create these indicators.

Choice Experiment/Survey

- A statewide choice experiment type survey is one plausible way to accurately evaluate social values for Oregonians. Consumer surplus might provide improper signals and so should be avoided for budgeting decisions. An advantage of choice-based experiments is they allow relative ranks and strengths of preferences for varying quantity and quality levels.
- A choice experiment would reveal relative preferences of population. Need to determine how population values natural resources/services relative to other services. A total value figure will not reveal information on resource quality or public preference, but a choice experiment can. Provides a method to track values over time and is a good indicator of public preference.
- In its simplest form, the choice experiment survey would ask respondent to rank and compare resources relative to each other. Gives good demand side data where supply-side processes and trends are integrated as sources for setting the levels of the attributes for ecosystem services. Thus, a direct link between demand and supply may be derived.
- Possibly use the alternative futures model that permits choices and comparisons between indicators (e.g., water vs. biodiversity). With proper model design, parameters are constructed such that comparisons between regions and resources could be accommodated. Quantity and quality measures can be included to gauge desired tradeoffs. Attribute coefficients can be incorporated that will tie indicators to dollar amounts or to quantities of resources, or coefficients could be used without attachment to dollar amounts. Concern exists over dollar values, market prices or relative values skewing policy decisions because some values would be overwhelmed by others. Difficulties may yet exist even with omission of dollar values.
- Indicators could be modeled to move relative to other indicators – anchor indicators to one another or design such that in some cases indicators would move relative and in other cases, anchored to other indicators. However, we need to be cautious about correlation of indicators – can lead to either/or scenarios
- A stratified sampling approach would prevent imbalanced representation of populations (over sampling of urban Portland residents and poor sampling of rural residents).
- Marginal changes, which are significant to track, would be revealed in a choice experiment.
- Multiple simultaneous values and services in forests may be a significant problem. Forests can provide multiple services (carbon sequestration, forest products and water quality) at once, so need to be cautious in choice experiments – not to compartmentalize services too much. These values are not mutually exclusive.

- Aggregate services can be accounted for in choice experiment through inclusion of main effects and secondary effects, but needs to be done carefully. Proper weights, statistical relations and interaction effects must be carefully accounted for. This would be a model design issue. As mentioned above, could design factors to move in sync, and at different rates depending upon hypothetical management scenarios.

  **The OFRI surveys may provide a useful template for a choice experiment. Although largely used for internal purposes, the OFRI survey might be adjustable for this proposed choice experiment survey instrument. All parties need to review OFRI surveys to determine how best to modify them for a possible choice experiment.

Periodic Reporting

The following is a tentative schedule of deliverables (subject to change):

- Recreation indicators report will be delivered as originally discussed.
- Likely next report will be on general indicator development.
- Next report: Remaining indicators that, as discussed, simply cannot be produced at this time due to data and theoretical limitations.
- Final report expected to be conceptual treatment on future indicator development.

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Forestry Program for Oregon Strategy B: Ensure that Oregon's forests provide diverse social and economic outputs and benefits valued by the public in a fair, balanced, and efficient manner.

Indicator B.c. Forest ecosystem services contributions to society

Why is this indicator important?

Maintaining and enhancing public and private forests' non-commodity contributions to state and local economies, to communities, and to quality-of-life is very important to Oregonians and recognized as important nationally. These values, such as clean water, habitat for fisheries, and scenery are often taken for granted because they are not generally traded in markets. As such, they have no "price" and are therefore seemingly provided for free. However, the goods and services that ecosystems provide are very familiar to us and would cost billions of dollars. The demand for ecosystem services (specifically recreation, carbon sequestration, passive use values such as biodiversity, and water quality) is often constrained by the availability of healthy forest environments that support or provide these services. Trends in the demand for and availability of ecosystem services is an important indicator of management and policy effects on the forested landscape's ability to provide these services.

Desired trend

Oregon forest ecosystem services produced are stable or increasing and are sustainable.

What does this indicator tell us about sustainable forest management?

Condition

mixed or fair

Recreation: Total recreation visits in 2007 for national forests, state parks, and state forests in Oregon were 66 million, mostly by Oregonians. Converting this visits estimate to economic values results in a total recreation value of $514 million accruing to Oregonians and non-residents that visited national forests, state parks, and state forests in Oregon. This is a lower bound estimate given incomplete or missing visitation data for many recreation resources. Oregon contains an estimated 25,500 linear miles of trails, 54,600 campsites, 33 million acres of recreational land and 818,300 acres of recreational freshwater. Federal management encompasses the vast majority of trail miles and land; private campgrounds, in particular for RVs/trailers, managed the majority of campsites; and federal (46 percent) and state (30 percent) governments manage the majority of recreational freshwater resources. For recreation, the condition can be classified as “good” but with reservations (See “Trend” below). Location specific information, along with comprehensive use and resource data, would better link local resource demand and supply, potentially enabling measurement of accessibility and crowding concerns.

Passive Use, Carbon Sequestration, and Water Quality: Data on supply and demand conditions are currently insufficient for indicator reporting.

Trend

uncertain

Recreation: Total recreation demand and use has increased by 28% between 1987 and 2002; however, total population also increased by 30% during this period. In Oregon, motorized recreation (OHV, snowmobiling, boating), non-motorized recreation, hunting and fishing, and camping have increased since 1987, with hiking showing no increase, and decreases in picnicking, backpacking and horseback riding. Comparable national data do not exist to draw any comparison; however, other indicators suggest increased participation in all activity types over time for the Nation. Recreation use values per person, based on the literature, are increasing at a rate of about $1 per person per activity day faster than inflation, signaling outdoor recreation is increasing in value for people. Trends in the supply, quality and accessibility of places to recreate are unknown given the lack of temporal data. It also is uncertain how well the supply of recreation is meeting demand in Oregon, although supply is expected to remain largely constant while total population and recreation demand and values are increasing. Recent Wilderness designations in Oregon, particularly near urban population centers will alter future forest recreation uses and potentially address perceived key shortages of certain recreation opportunities.

Passive Use, Carbon Sequestration, and Water Quality: Data on supply and demand trends are currently insufficient for indicator reporting.

Information

inadequate

Recreation: Statewide data for this indicator are inadequate. While use estimates are reliable and accurate for national forests and state parks by location, estimates for other public and private lands/water are sparse or not known. Supply estimates are reliable and accurate, but based on voluntary reporting for 2001 only with no expectations of new data collection. Value estimates are derived from the literature for Oregon and Washington, and thus may not be accurate for Oregonians’ recreational use of lands/water in Oregon for any given year.

Passive Use, Carbon Sequestration, and Water Quality: Statewide data are inadequate.

Metrics and Data Sources

Metric	Data Source
Recreation use estimate on national forests, National Visitor Use Monitoring Data (2000-2004)	Dr. Eric White, USDA Forest Service
Recreation use estimate on state parks, 2007	Tom Hughes, Oregon Parks and Recreation Dept.
Recreation use estimates on state forests, 2007 (camping only)	John Barnes, Oregon Dept. of Forestry
Oregon supply of outdoor recreation resources and facilities by major suppliers, 2001	Oregon Parks and Recreation Dept.
Oregon recreation user occasions and trends, 1987-2002	Oregon Parks and Recreation Dept.
National recreation participation trends, 1994/95 – 2000/01 (National Survey of Recreation and the Environment)	USDA Forest Service
Monetary estimates, Recreation Use Values Database	Dr. Randall Rosenberger, Oregon State University

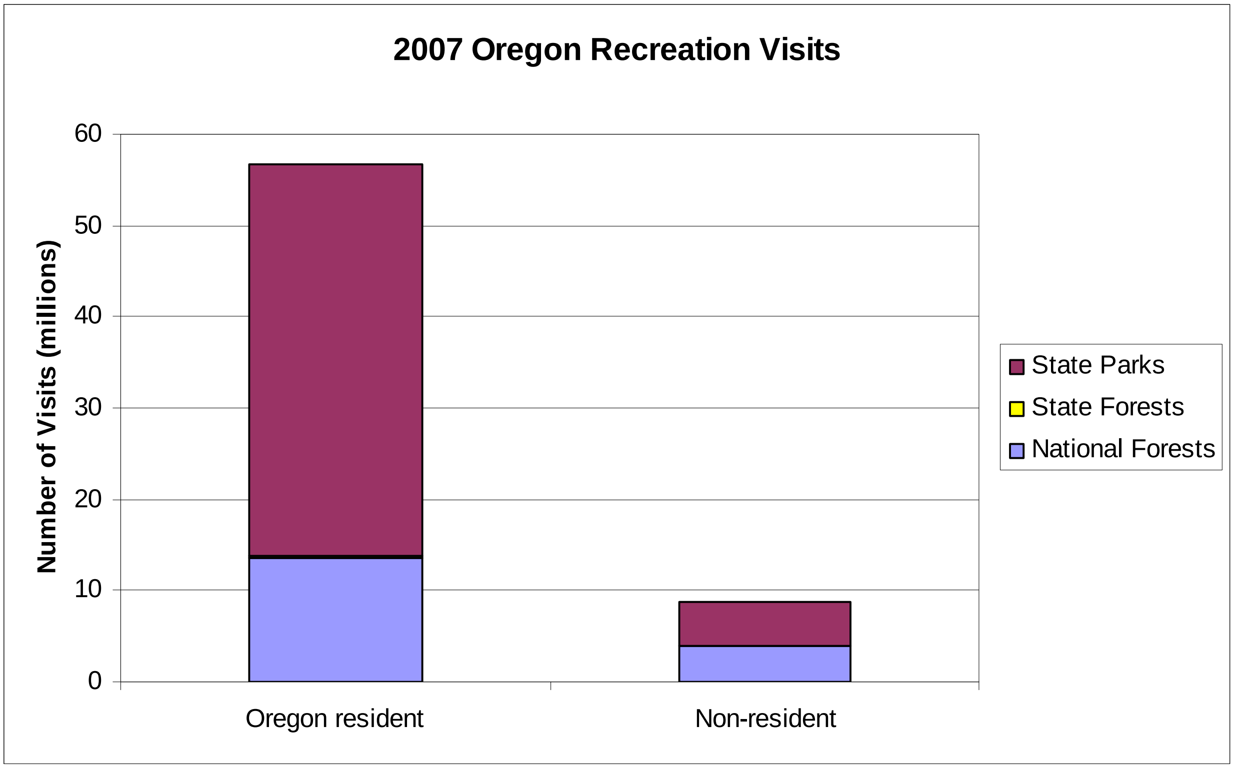

Figure 1. Total recreation visits by resident and non-resident at national forests, state parks and state forest campgrounds in Oregon, 2007.

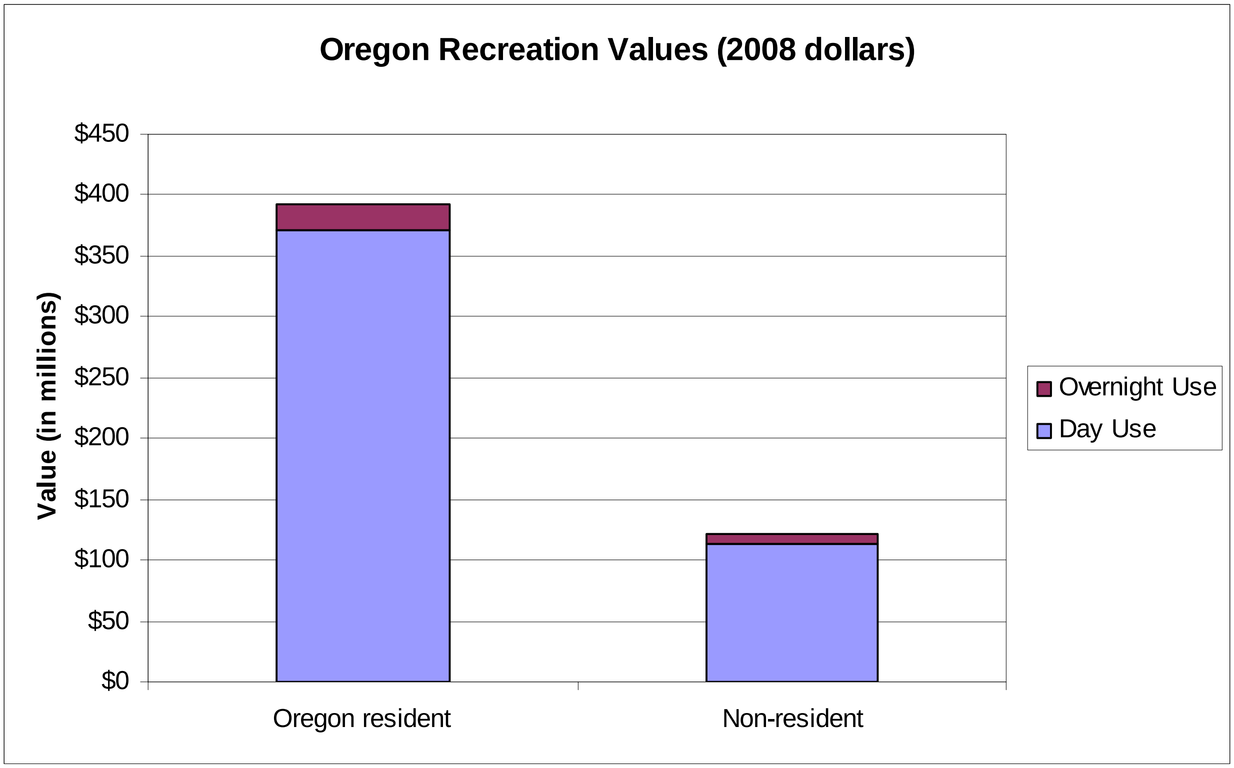

Figure 2. Total recreation value by resident and non-resident for national forests, state parks, and state forest campgrounds in Oregon, 2007.

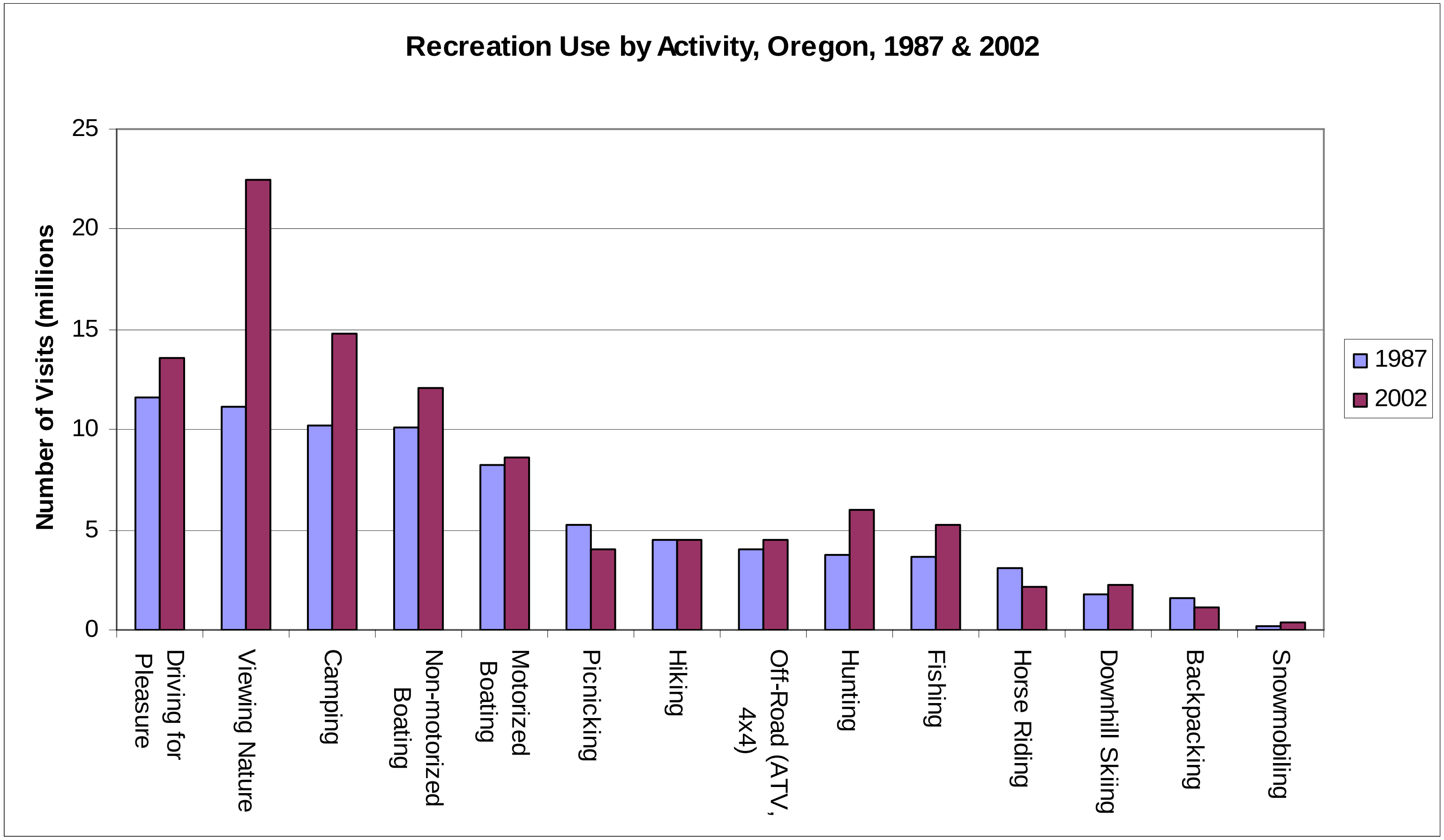

Figure 3. Changes in recreation use by activity type in Oregon, 1987-2002.

Table 1. 2001 Statewide Supply of Outdoor Recreation Resources and Facilities By Major Suppliers (OPRD)

ITEM	UNITS	STATEWIDE TOTAL	FEDERAL	STATE	COUNTY	MUNICIPAL	OTHER PUBLIC	PRIVATE	SCHOOLS	UTILITIES
Hiking Trails	Linear Miles	9,703	8,705	558	96	284	59	0	0	2
Bicycle Trails	Linear Miles	1,947	1,198	343	46	240	82	0	36	3
Designated 4x4 Trails	Linear Miles	305	253	52	0	0	0	0	0	0
Designated ATV Trails	Linear Miles	2,707	2,473	223	0	11	0	0	0	0
Designated Bridle Trails	Linear Miles	5,768	5,461	272	22	14	0	0	0	0
Nature/Interpretive Trails	Linear Miles	621	151	218	42	81	43	1	75	10
Designated Cross-Country Ski Trails	Linear Miles	1,154	925	110	0	0	3	117	0	0
Designated Snowmobile Trails	Linear Miles	3,369	3,354	4	0	0	12	0	0	0
Downhill Skiing Areas	Acres	10,730	0	0	0	0	0	10,730	0	0
Downhill Skiing Lifts	Lift Capacity	76,005	0	0	0	0	0	76,005	0	0
Day Use Picnic Tables	Tables	26,175	9,224	4,581	3,998	5,875	2,188	4	0	305
RV/Trailer Campsites	Sites	43,901	8,673	3,936	2,566	621	1,085	26,878	0	142
Tent Campsites	Sites	10,707	4,772	2,288	1,498	241	188	1,658	0	62
Freshwater Beach Area Total	Square Feet	25,763,750	1,740,271	8,001,361	2,313,600	11,861,716	1,786,802	50,000	0	10,000
Freshwater Beach Areas	Areas	118,514	88	85	87,772	4,228	26,333	1	0	7
Freshwater Beach Length	Miles	700	4	112	31	526	26	0	0	1
Boat Ramps	Lanes	783	240	99	216	98	76	41	0	13
Non-Motorized Boat Launches	Sites	322	91	57	69	66	29	1	0	9
Windsurfing Access Sites	Sites	92	25	13	13	19	16	0	0	6
Fishing Piers	Linear Miles	80,165	12,919	2,558	51,963	7,997	4,508	0	0	220
Designated Hunting Areas	Acres	17,749,202	16,159,729	1,568,012	3,001	400	18,060	0	0	0
Outdoor Recreational Land	Acres	33,007,111	30,993,055	1,673,352	34,514	267,368	28,396	262	9,775	391
Outdoor Recreational Water	Acres	818,299	377,656	241,827	96,456	91,789	6,049	0	0	4,522

APPENDIX D – RECREATION VISITATION DATA

OREGON DEPARTMENT OF FORESTRY RECREATION USE DATA SEARCH

We have:

- **National Forest day use and overnight camper use estimates by recreation activity**
- **State Parks day use and overnight camper use estimates, some by camping type (tent, primitive, etc.)**
- **State Forests overnight camper use estimates**

ERIC WHITE DATA

1.) NVUM_R6_casebyactivity.xls (11.26.07)

a). Sheet 1: Visits

Forests: Deschutes, Fremont, Gifford-Pinchot, Malheur, Mt. Baker-Snoqualmie, Mt. Hood, Ochoco, Okanogan, Olymipic, Rogue River, Siskiyou, Siuslaw, Umatilla, Umpqua, Walowa-Whitman, Wenatchee, Willamette, Winema, Colville, Columbia Gorge NSR

Activities: camping, prim camp, backpack, resort, picnic, view wildlife, view nat, history, nat center, nature study, general, fish, hunt, ohv use, driving, snowmobile, h20motor, other motorized, hike, horse, bike, h20 nonmotor, downhill ski, xc ski, other non-motor, gather, (total) camping, 27, 98, 99

2.) OR_forest_visits_111907_EW.xls (11.19.07/ 11.26.07)

a). Sheet 1: Visits by residence

Forests: Deschutes, Fremont, Malheur, Mt. Hood, Ochoco, Rogue River, Siskiyou, Siuslaw, Umatilla, Umpqua, Walowa-Whitman, Willamette, Winema, Columbia Gorge NSR, OR forests combined

Activities: All visits, camping, prim camp, backpack, resort, picnic, view wildlife, view nat, history, nat center, nature study, general, fish, hunt, ohv use, driving, snowmobile, h20motor, other motorized, hike, horse, bike, h20 nonmotor, downhill ski, xc ski, other non-motor, gather, No primary activity, Multiple primary activities

-- Number of cases by forest and activity (FYI)

-- Percent of visits by primary activity

-- Visits (resident and non-resident)

-- Percent visits by OR residents by activity (OR forest combined pct used if less than 30 cases in the forest-activity combination)

-- Oregon resident visits by forest and activity (note this is adjusted so forest row sum = number of OR resident visits by forest reported above)

3.) OR_activities_120307.xls (12.3.07)

a.) Sheet 1: Visits

-- OR resident visits

Forests: Deschutes, Fremont, Malheur, Mt. Hood, Ochoco, Rogue River, Siskiyou, Siuslaw, Umatilla, Umpqua, Walowa-Whitman, Willamette, Winema, Columbia Gorge NSR, OR forests combined

Activities: All visits, camping , prim camp, backpack, resort, picnic, view wildlife, view nat, history, nat center, nature study, general, fish, hunt, ohv use, driving, snowmobile, h20motor, other motorized, hike, horse, bike, h20 nonmotor, downhill ski, xc ski, other non-motor, gather, No primary activity, Multiple primary activities

--Number of cases

-- Percent of visits

--Visits

Forests: Deschutes, Fremont, Gifford-Pinchot, Malheur, Mt. Baker-Snoqualmie, Mt. Hood, Ochoco, Okanogan, Olymipic, Rogue River, Siskiyou, Siuslaw, Umatilla, Umpqua, Walowa-Whitman, Wenatchee, Willamette, Winema, Colville, Columbia Gorge NSR

Activities: camping, prim camp, backpack, resort, picnic, view wildlife, view nat, history, nat center, nature study, general, fish, hunt, ohv use, driving, snowmobile, h20motor, other motorized, hike, horse, bike, h20 nonmotor, downhill ski, xc ski, other non-motor, gather, (total) camping, 98, 99

b.) Sheet 2: Days

Forests: Deschutes, Fremont, Malheur, Mt. Hood, Ochoco, Rogue River, Siskiyou, Siuslaw, Umatilla, Umpqua, Walowa-Whitman, Willamette, Winema, Columbia Gorge NSR, OR forests combined

Activities: All visits, camping, prim camp, backpack, resort, picnic, view wildlife, view nat, history, nat center, nature study, general, fish, hunt, ohv use, driving, snowmobile, h20motor, other motorized, hike, horse, bike, h20 nonmotor, downhill ski, xc ski, other non-motor, gather, No primary activity, Multiple primary activities

-- Valid NF visit length cases

-- Average number of hours on the forest (forest-level values shown when >= 25 cases sampled)

-- Avg. number of hours on the forest converted to 24 hour periods (time less than 24 hours = one 24 hour period)

c.) Sheet3

Forests: Deschutes, Fremont, Gifford-Pinchot, Malheur, Mt. Baker-Snoqualmie, Mt. Hood, Ochoco, Okanogan, Olymipic, Rogue River, Siskiyou, Siuslaw, Umatilla, Umpqua, Walowa-Whitman, Wenatchee, Willamette, Winema, Colville, Columbia Gorge NSR

Activities: camping, prim camp, backpack, resort, picnic, view wildlife, view nat, history, nat center, nature study, general, fish, hunt, ohv use, driving, snowmobile, h20motor, other motorized, hike, horse, bike, h20 nonmotor, downhill ski, xc ski, other non-motor, gather, (total) camping, 98, 99

-- nfvdur_Corr

-- nfv_days2

TOM HUGHES DATA

1.) Day Use Data for Caitlin (4-8-2008).xls

a). Sheet 1: Preliminary Day Use Visitation Data for Oregon State Parks; CY 2007 and January and February 2008 (Park, year, month, visitation – Note: Missing months, or months with "0" normally indicate seasonal closure)

State Parks:

AGATE BEACH STATE RECREATION SITE
ALDERWOOD STATE WAYSIDE
ALFRED A LOEB STATE PARK
ALSEA BAY HISTORIC INTERPRETIVE CENTER
ARCADIA BEACH STATE RECREATION SITE
BALD PEAK STATE SCENIC VIEWPOINT
BANDON STATE NATURAL AREA
BANKS-VERNONIA STATE TRAIL
BATTLE MOUNTAIN FOREST ST SCENIC CORRIDR
BEACHSIDE STATE RECREATION SITE
BENSON STATE RECREATION AREA
BEVERLY BEACH STATE PARK
BOB STRAUB STATE PARK
BOILER BAY STATE SCENIC VIEWPOINT
BOOTH STATE SCENIC CORRIDOR
BRADLEY STATE SCENIC VIEWPOINT
BRIDAL VEIL FALLS STATE SCENIC VIEWPOINT
BULLARDS BEACH STATE PARK
CAPE ARAGO STATE PARK
CAPE BLANCO STATE PARK
CAPE LOOKOUT STATE PARK
CAPE MEARES STATE SCENIC VIEWPOINT
CAPE SEBASTIAN STATE SCENIC CORRIDOR
CARL G WASHBURNE/PONSLER VIEWPOINT
CASCADIA STATE PARK
CASEY STATE RECREATION SITE
CATHERINE CREEK STATE PARK
CHAMPOEG STATE HERITAGE AREA/VISITOR CENTER
CHANDLER STATE WAYSIDE
CLINE FALLS STATE SCENIC VIEWPOINT
CLYDE HOLLIDAY STATE RECREATION SITE0507
COLLIER MEMORIAL STATE PARK
COLLIER MUSEUM
CROWN POINT STATE SCENIC CORRIDOR
D RIVER STATE RECREATION SITE
DABNEY STATE RECREATION AREA
DALTON POINT STATE RECREATION SITE

DEL REY BEACH STATE RECREATION SITE
DEPOE BAY
DESCHUTES RIVER STATE RECREATION AREA
DETROIT LAKE STATE RECREATION AREA
DEVIL`S PUNCH BOWL STATE NATURAL AREA
DEXTER STATE RECREATION SITE
DRIFTWOOD BEACH STATE RECREATION SITE
EAST DEVIL`S LAKE
EAST MAYER STATE PARK
ECOLA STATE PARK
ELIJAH BRISTOW STATE PARK
ELLMAKER STATE WAYSIDE
EMIGRANT SPRINGS STATE HERITAGE AREA
FACE ROCK STATE SCENIC VIEWPOINT
FALL CREEK STATE REC AREA (WINBERRY)
FAREWELL BEND STATE RECREATION AREA
FOGARTY CREEK STATE RECREATION AREA
FORT ROCK STATE NATURAL AREA
FORT STEVEN HISTORIC AREA
GEISEL MONUMENT STATE HERITAGE SITE
GLENEDEN BEACH STATE RECREATION SITE
GOLDEN & SILVER FALLS STATE NATURAL AREA
GOOSE LAKE STATE RECREATION AREA
GOV PATTERSON MEMORIAL STATE REC SITE
GUY W TALBOT STATE PARK
H B VAN DUZER FOREST STATE SCENIC CORR
HARRIS BEACH STATE RECREATION AREA
HAT ROCK STATE PARK
HECETA HEAD LIGHTHOUSE SCENIC VIEWPOINT
HILGARD JUNCTION STATE RECREATION AREA
HISTORIC COLUMBIA RIVER HWY STATE TRL
HOLMAN STATE WAYSIDE
HUG POINT STATE RECREATION SITE
HUMBUG MOUNTAIN STATE PARK
ILLINOIS RIVER FORKS STATE PARK
INDIAN CREEK
JACKSON F KIMBALL STATE RECREATION SITE
JASPER POINT STATE PARK
JASPER STATE RECREATION SITE
JESSIE M HONEYMAN MEMORIAL STATE PARK
JOSEPH H STEWART STATE RECREATION AREA
KOBERG BEACH STATE RECREATION SITE
LAKE OWYHEE STATE PARK
LAPINE STATE PARK
LATOURELLE STATE PARK
LEWIS AND CLARK STATE RECREATION SITE

LL STUB STEWART STATE PARK
LOST CREEK STATE RECREATION SITE
LOWELL STATE RECREATION SITE
MANHATTAN BEACH STATE RECREATION SITE
MAPLES REST AREA
MAUD WILLIAMSON STATE RECREATION SITE
MAYER STATE PARK
MCVAY ROCK STATE RECREATION SITE
MILO MCIVER STATE PARK
MINAM STATE RECREATION AREA
MOLALLA RIVER STATE PARK
NEHALEM BAY STATE PARK
NEPTUNE STATE SCENIC VIEWPOINT
NESKOWIN BEACH STATE RECREATION SITE
NORTH SANTIAM STATE RECREATION AREA
OC&E WOODS LINE STATE TRAIL
OCEANSIDE BEACH STATE RECREATION SITE
OCHOCO STATE SCENIC VIEWPOINT
ONA BEACH STATE PARK
ONTARIO STATE RECREATION SITE
OPHIR REST AREA
OPHIR STATE RECREATION SITE
OSWALD WEST STATE PARK
OTTER CREST STATE SCENIC VIEWPOINT
OTTER POINT STATE RECREATION SITE
PARADISE POINT STATE RECREATION SITE
PETER SKENE OGDEN STATE SCENIC VIEWPOINT
PILOT BUTTE STATE SCENIC VIEWPOINT
PISTOL RIVER STATE SCENIC VIEWPOINT
PORT ORFORD HEADS STATE PARK
PORTLAND WOMEN`S FORUM STATE SCENIC VIEW
PRINEVILLE RESERVOIR STATE PARK
RED BRIDGE STATE WAYSIDE
ROADS END STATE RECREATION SITE
ROCKY CREEK STATE SCENIC VIEWPOINT
ROOSTER ROCK STATE PARK
SADDLE MOUNTAIN STATE NATURAL AREA
SAMUEL H BOARDMAN STATE SCENIC CORRIDOR
SARAH HELMICK STATE RECREATION SITE
SEAL ROCK STATE RECREATION SITE
SEVEN DEVILS STATE RECREATION SITE
SHORE ACRES STATE PARK
SILVER FALLS NORTH FALLS
SILVER FALLS STATE PARK
SILVER FALLS-NORTH FALLS
SIUSLAW NORTH JETTY

SMELT SANDS STATE RECREATION SITE
SMITH ROCK STATE PARK
SOUTH BEACH STATE PARK
SOUTH JETTY
SOUTH JETTY-SOUTH BEACH
STARVATION CREEK STATE PARK
STONEFIELD BEACH STATE RECREATION SITE
SUMPTER VALLEY DREDGE STATE HERITAGE
SUNSET BAY STATE PARK
SUNSET BEACH
THE COVE PALISADES STATE PARK
TOLOVANA BEACH STATE RECREATION SITE
TOUVELLE STATE RECREATION SITE
TRYON CREEK STATE NATURAL AREA
TSERIADUN STATE RECREATION SITE
TUB SPRINGS STATE WAYSIDE
TUMALO STATE PARK
UKIAH-DALE FOREST STATE SCENIC CORRIDOR
UMPQUA LIGHTHOUSE STATE PARK
UMPQUA STATE SCENIC CORRIDOR
UNITY LAKE STATE RECREATION SITE
VALLEY OF THE ROGUE STATE RECREATN AREA
VIENTO STATE PARK
WALLOWA LAKE HIGHWAY FOREST STATE SCENIC
WALLOWA LAKE STATE RECREATION AREA
WARM SPRINGS STATE RECREATION SITE
WASHBURNE STATE WAYSIDE
WB NELSON STATE RECREATION SITE
WHITE RIVER FALLS STATE PARK
WILLAMETTE GREENWAY-CLACKAMAS CO-TRYON
WILLAMETTE GREENWAY-LANE CO-SO WIL
WILLAMETTE GREENWAY-LINN CO-SO WILL
WILLAMETTE GREENWAY-POLK COUNTY-WILL MIS
WILLAMETTE GREENWAY-POLK CO-WILL MISS
WILLAMETTE GREENWAY-YAMHILL CO-CHAMPOEG
WILLAMETTE MISSION STATE PARK
WILLIAM M TUGMAN STATE PARK
WINCHUCK STATE RECREATION SITE
YACHATS OCEAN ROAD STATE NATURAL SITE
YACHATS STATE RECREATION AREA
YACHATS STATE RECREATION SITE
YAQUINA BAY STATE RECREATION SITE

b). Sheet 2: Codes, counter description associated by park

2.) CY 2007 Campernights for Caitlin (4-8-2008).xls

a). Sheet 1: “Overnight (campernights)”; Preliminary Data: Campernights at Oregon State Parks Calendar Year 2007 – 2008 (Park, year, month, visitation – Note: Missing months, or months with "0" normally indicate seasonal closure)

State Parks:

AINSWORTH STATE PARK
ALFRED A LOEB STATE PARK
BEACHSIDE STATE RECREATION SITE
BEVERLY BEACH STATE PARK
BULLARDS BEACH STATE PARK
CAPE BLANCO STATE PARK
CAPE LOOKOUT STATE PARK
CARL G WASHBURNE/PONSLER VIEWPOINT
CASCADIA STATE PARK
CATHERINE CREEK STATE PARK
CHAMPOEG STATE HERITAGE AREA/VISITOR CENTER
CLYDE HOLLIDAY STATE RECREATION SITE
CLYDE HOLLIDAY STATE RECREATION SITE0
COLLIER MEMORIAL STATE PARK
DESCHUTES RIVER STATE RECREATION AREA
DETROIT LAKE STATE RECREATION AREA
DEVIL`S LAKE STATE RECREATION AREA
EMIGRANT SPRINGS STATE HERITAGE AREA
FALL CREEK STATE REC AREA (WINBERRY)
FAREWELL BEND STATE RECREATION AREA
FORT STEVENS STATE PARK
GOOSE LAKE STATE RECREATION AREA
HARRIS BEACH STATE RECREATION AREA
HUMBUG MOUNTAIN STATE PARK
INDIAN CREEK
JACKSON F KIMBALL STATE RECREATION SITE
JASPER POINT STATE PARK
JESSIE M HONEYMAN MEMORIAL STATE PARK
JOSEPH H STEWART STATE RECREATION AREA
LAKE OWYHEE STATE PARK
LAPINE STATE PARK
LL STUB STEWART STATE PARK
MEMALOOSE STATE PARK
MILO MCIVER STATE PARK
MINAM STATE RECREATION AREA
NEHALEM BAY STATE PARK
OSWALD WEST STATE PARK
PRINEVILLE RESERVOIR STATE PARK
RED BRIDGE STATE WAYSIDE
SADDLE MOUNTAIN STATE NATURAL AREA
SILVER FALLS STATE PARK
SMITH ROCK STATE PARK

SOUTH BEACH STATE PARK
SUNSET BAY STATE PARK
THE COVE PALISADES STATE PARK
TUMALO STATE PARK
UKIAH-DALE FOREST STATE SCENIC CORRIDOR
UMPQUA LIGHTHOUSE STATE PARK
UNITY LAKE STATE RECREATION SITE
VALLEY OF THE ROGUE STATE RECREATN AREA
VIENTO STATE PARK
WALLOWA LAKE STATE RECREATION AREA
WILLAMETTE MISSION STATE PARK
WILLIAM M TUGMAN STATE PARK

3.) January and February 2008 Campernights.xls

a). Sheet 1: "Overnight_Bill_Query" (Attendance(campernights), description of camping style (primitive, overflow, tent, etc.), month, year, file code, park)

State Parks:

AINSWORTH STATE PARK
ALFRED A LOEB STATE PARK
BEVERLY BEACH STATE PARK
BULLARDS BEACH STATE PARK
CAPE BLANCO STATE PARK
CAPE LOOKOUT STATE PARK
CARL G WASHBURNE/PONSLER VIEWPOINT
CASCADIA STATE PARK
CATHERINE CREEK STATE PARK
CHAMPOEG STATE HERITAGE AREA/VISITOR CNT
DESCHUTES RIVER STATE RECREATION AREA
DETROIT LAKE STATE RECREATION AREA
DEVIL`S LAKE STATE RECREATION AREA
EMIGRANT SPRINGS STATE HERITAGE AREA
FAREWELL BEND STATE RECREATION AREA
FORT STEVENS STATE PARK
GOOSE LAKE STATE RECREATION AREA
HARRIS BEACH STATE RECREATION AREA
HILGARD JUNCTION STATE RECREATION AREA
HUMBUG MOUNTAIN STATE PARK
INDIAN CREEK
JASPER POINT STATE PARK
JESSIE M HONEYMAN MEMORIAL STATE PARK
JOSEPH H STEWART STATE RECREATION AREA
LAKE OWYHEE STATE PARK
LAPINE STATE PARK
LL STUB STEWART STATE PARK
MEMALOOSE STATE PARK
MINAM STATE RECREATION AREA

NEHALEM BAY STATE PARK
OSWALD WEST STATE PARK
PRINEVILLE RESERVOIR STATE PARK
RED BRIDGE STATE WAYSIDE
SADDLE MOUNTAIN STATE NATURAL AREA
SILVER FALLS STATE PARK
SMITH ROCK STATE PARK
SOUTH BEACH STATE PARK
SUNSET BAY STATE PARK
THE COVE PALISADES STATE PARK
TUMALO STATE PARK
UKIAH-DALE FOREST STATE SCENIC CORRIDOR
UMPQUA LIGHTHOUSE STATE PARK
VALLEY OF THE ROGUE STATE RECREATN AREA
VIENTO STATE PARK
WALLOWA LAKE STATE RECREATION AREA
WILLIAM M TUGMAN STATE PARK

JOHN BARNES DATA

Campernights and revenue at campgrounds in state forests during FY 2007 (11.13.07)

State Campgrounds:

Brown's Camp
Butte Creek Falls
Elk Creek
Gales Creek
Gnat Creek
Jones Creek
Jordan Creek
Nehalem Falls
Northrup Creek (new)
Reehers Camp (new)
Rock Creek (new)
Santiam Horse Camp (new)
Spruce Run
Stage Coach Horse Camp