

Appendix M: Glossary of Key Terms and Concepts

Sources include:

NPS Inventory and Monitoring website; (<http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Miller, M.E., D. Sharrow and L. Cudlip. 2003. *Northern Colorado Plateau Vital Signs Network and Prototype Cluster Plan for Natural Resource Monitoring*. National Park Service, Moab, UT. 111 pp.

Adaptive management – a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form – “active” adaptive management – employs management programs that are designed to experimentally compare selected policies or practices by implementing management actions explicitly designed to generate information useful for evaluating alternative hypotheses about the system being managed (<http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Attribute – any living or nonliving feature or process of the environment that can be measured or estimated and that provides insight into the state of the ecosystem. The term **Indicator** is reserved for a subset of attributes that is particularly information-rich in the sense that their values are somehow indicative of the quality, health, or integrity of the larger ecological system to which they belong (Noon 2003); (<http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Degradation – an anthropogenic reduction in the capacity of a particular ecosystem or ecosystem component to perform desired ecosystem functions (e.g., degraded capacity for conserving soil and water resources). Human actions may degrade desired ecosystem functions directly, or they may do so indirectly by damaging the capacity of ecosystem functions to resist or recover from natural disturbances and/or anthropogenic stressors (derived from concepts of Herrick et al. 1995, Whisenant 1999, Archer and Stokes 2000, Whitford 2002).

Disturbance – “...any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment” (White and Pickett 1985). In relation to monitoring, disturbances are considered to be ecological factors that are within the evolutionary history of the ecosystem (e.g., drought). These are differentiated from anthropogenic factors (*stressors*, below) that are outside the range of disturbances naturally experienced by the ecosystem (Whitford 2002).

Domains – sub-populations defined after sampling occurs that can be changed and are used during data analysis to derive estimates of the sub-populations of interest.

Driver (or ecosystem driver) – major driving forces such as climate, fire cycles, hydrologic cycles, and natural disturbance events that have large scale influences on natural ecosystems.

Dynamic soil properties – soil properties that vary in relation to management activities, climatic fluctuations, or natural disturbances (e.g. bulk density, infiltration capacity, soil-surface roughness, organic matter content, soil aggregate stability, biological soil crust cover and composition).

Ecological integrity – a concept that expresses the degree to which the physical, chemical, and biological components (including composition, structure, and process) of an ecosystem and their relationships are present, functioning, and capable of self-renewal. Ecological integrity implies the presence of appropriate species, populations and communities and the occurrence of ecological processes at appropriate rates and scales, as well as the environmental conditions that support these taxa and processes (<http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Ecological site – a kind of land with specific physical characteristics which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management (Society for Range Management Task Group on Unity in Concepts and Terminology 1995).

Ecoregion (also called ecosystem region) – a large area of similar climate where similar ecosystems occur on similar sites (those having the same landform, slope, parent material, and drainage characteristics); for example, beach ridges throughout the Subarctic ecoregion support a dense growth of black spruce or jack pine (Bailey and Ropes 2002).

Ecosystem – a spatially explicit unit of the Earth that includes all organisms, along with all components of the abiotic environment within its boundaries (Likens 1992, cited by Christensen et al. 1996).

Ecosystem functioning – the flow of energy and materials through the arrangement of biotic and abiotic components of an ecosystem. Includes many ecosystem processes such as primary production, trophic transfer from plants to animals, nutrient cycling, water dynamics and heat transfer. In a broad sense, ecosystem functioning includes two components: ecosystem resource dynamics and ecosystem stability (Díaz and Cabido 2001).

Ecosystem integrity – see *ecological integrity*.

Ecosystem management – the process of land-use decision making and land-management practice that takes into account the full suite of organisms and processes that characterize and comprise the ecosystem and is based on the best understanding currently available as to how the ecosystem works. Ecosystem management includes a primary goal of sustainability of ecosystem structure and function, recognition that ecosystems are spatially and temporally dynamic, and acceptance of the dictum that ecosystem function depends on ecosystem structure and diversity (Dale et al. 2000).

Ecosystem sustainability -- see *sustainable ecosystem*.

Endpoints – Ecosystem attributes of ecological and/or societal importance (Harwell et al. 1999). Endpoints may or may not be indicators of overall ecosystem condition (also referred to as *assessment endpoints*).

Ephemeral stream – A stream or reach of a stream that flows briefly only in direct response to precipitation in the immediate locality and whose channel is at all times above the water table. The term “may be arbitrarily restricted” to a stream that does “not flow continuously during periods of as much as one month” (Meinzer 1927).

Focal species / organisms – species / organisms that play significant functional roles in ecological systems by their disproportionate contribution to the transfer of matter and energy, by structuring the environment and creating opportunities for additional species / organisms, or by exercising control over competitive dominants and thereby promoting increased biological diversity (derived from Noon 2003). [Encompasses concepts of keystone species, umbrella species, and ecosystem engineers.]

Functional groups – groups of species that have similar effects on ecosystem processes (Chapin III et al. 1996) – frequently applied interchangeably with *functional types*.

Hydrologic function (upland systems) – capacity of a site to capture, store, and safely release water from rainfall, run-on, and snowmelt, to resist a reduction in this capacity, and to recover this capacity following degradation (Pellant et al. 2000).

Hydrologic function (lotic and lentic systems) – capacity of an area to:

- dissipate energies associated with (1) high stream flow (lotic); or (2) wind action, wave action, and overland flow (lentic); thereby reducing erosion and improving water quality;
- filter sediment, capture bedload, and aid floodplain development;
- improve flood-water retention and groundwater recharge;
- develop root masses that stabilize streambanks against cutting action;

- develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses;
- support greater biodiversity

(Prichard et al. 1998, Prichard et al. 1999).

Indicator (general use of term) – a term reserved for a subset of environmental attributes that is particularly information-rich in the sense that their values are somehow indicative of the quality, health, or integrity of the larger ecological system to which they belong (derived from Noon 2003)
<http://science.nature.nps.gov/im/monitor/Glossary.htm>).

Indicators of ecosystem health (specific use of term) – measurable attributes of the environment (biotic or abiotic) that provide insights regarding (1) the functional status of one or more key ecosystem processes, (2) the status of ecosystem properties that are clearly related to these ecosystem processes, and/or (3) the capacity of ecosystem processes or properties to resist or recover from natural disturbances and/or anthropogenic stressors (modified from Whitford 1998). In the context of ecosystem health, key ecosystem processes and properties are those that are most closely associated with the capacity of the ecosystem to maintain its characteristic structural and functional attributes over time (including natural variability).

Intermittent stream – A stream or reach of a stream that flows only at certain times of the year, as when it receives water from springs or from some surface source. The term “may be arbitrarily restricted” to a stream that flows “continuously during periods of at least one month: (Meinzer 1923).

Landscape – a spatially structured mosaic of different types of ecosystems interconnected by flows of materials (e.g., water, sediments), energy, and organisms.

Measures -- the specific variables used to quantify the condition or state of an Attribute or Indicator (or vital sign). These are specified in definitive sampling protocols. For example, stream acidity is the indicator, while pH units are the measure (from NPS Inventory and Monitoring website, <http://science.nature.nps.gov/im/monitor/vsm.htm#Definitions>).

Natural variability – the spatial and temporal variation in ecological conditions, which are relatively unaffected by people, within a period of time and geographical area appropriate to an expressed goal (Landres et al. 1999).

Panel – a group of sample units that are always sampled together during a sampling occasion.

Perennial stream – a stream or reach of a stream that flows continuously throughout the year and whose upper surface generally stands lower than the water table in the region adjoining the stream (Jackson 1997).

Population (Target) – total collection of sample units.

Probability sampling – where each sampling unit in the finite population has a known probability (a selection probability) of being included in a sample.

Rangeland – land on which the indigenous vegetation is predominantly grasses, grass-like plants, forbs, or shrubs and is managed as a natural ecosystem. Rangelands include natural grasslands, savannas, shrublands, many deserts, tundra, alpine communities, marshes and wet meadows (Society for Range Management 1999). For purposes of this document, we further include pinyon-juniper woodlands and oak woodlands in this definition.

Reach or Stream Reach – A continuous part of a stream between two specified points. (From USGS Water Resources website: <http://water.usgs.gov/pubs/circ/circ1208/glossary.htm>)

Reference conditions – the range of historic (or natural) variability in ecological structures and processes, reflecting recent evolutionary history and the dynamic interplay of biotic and abiotic conditions and disturbance patterns (Morgan et al. 1994, Swanson et al. 1994).

Resilience – the capacity of a particular ecological attribute or process to recover to its former reference state or dynamic after exposure to a temporary disturbance and/or stressor (adapted from Grimm and Wissel 1997). Resilience is a dynamic property that varies in relation to environmental conditions (Scheffer et al. 2001).

Resistance – the capacity of a particular ecological attribute or process to remain essentially unchanged from its reference state or dynamic despite exposure to a disturbance and/or stressor (adapted from Grimm and Wissel 1997). Resistance is a dynamic property that varies in relation to environmental conditions.

Responses – measurements taken on sample units.

Sample – the collection of responses from the chosen sample units.

Sample Unit – predefined spatial entities in which measurements are taken.

Sampling Frame – the pool from which samples are selected in order to make references to the entire population (sampled and unsampled).

Soil quality – the capacity of a specific type of soil to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, to maintain or enhance water and air quality, and to support human health and habitation (Karlen et al. 1997). From an NPS perspective, soil quality is defined by a soil's capacity to perform the following ecological functions: (a) regulate hydrologic processes; (b) capture, retain, and cycle mineral nutrients; (c) support characteristic native communities of plants and animals. Soil quality can be regarded as having (1) an inherent component defined by inherent soil properties as determined by the five factors of soil formation, and (2) a dynamic component defined by the change in soil function that is influenced by human use and management of the soil (Seybold et al. 1999).

Soil / site stability – the capacity of a site to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water (Pellant et al. 2000).

State – as applied to state-and-transition models, a *state* is defined as “a recognizable, resistant and resilient complex of two components, the soil [or geomorphic] base and the vegetation structure” (Stringham et al. 2003). These two ecosystem components interactively determine the functional status of the primary ecosystem processes of energy flow, nutrient cycling, and hydrology. States are dynamic and “... are distinguished from other states by relatively large differences in plant functional groups and ecosystem processes [including disturbance and hydrologic regimes] and, consequently, in vegetation structure, biodiversity, and management requirements” (Bestelmeyer et al. 2003). (Also see *threshold* and *transition*.)

Strata – artificial constructs defined prior to sample selection that should never change, regardless of conditions on the ground (Geissler and McDonald 2003).

Stressor - any physical, chemical, or biological entity or process that can induce an adverse response (modified from EMAP Master Glossary, (<http://www.epa.gov/emap/html/pubs/docs/resdocs/mglossary.html>)). For purposes of monitoring, stressors are considered to be anthropogenic factors that are outside the range of disturbances naturally experienced by the ecosystem (Whitford 2002). Compare with *Disturbance*, above.

Sustainable ecosystem – an ecosystem “...that, over the normal cycle of disturbance events, maintains its characteristic diversity of major functional groups, productivity, and rates of biogeochemical cycling” (Chapin III et al. 1996).

Tinaja – a type of waterpocket formed by the weathering and erosion of a rock basin over time. Typically, tinajas form in incipient or established drainages that are mostly ephemeral or intermittent, and are re-charged by precipitation from storms.

Threshold – as applied to state-and-transition models, a *threshold* is a point “...in space and time at which one or more of the primary ecological processes responsible for maintaining the sustained [dynamic] equilibrium of the state degrades beyond the point of self-repair. These processes must be actively restored before the return to the previous state is possible. In the absence of active restoration, a new state... is formed” (Stringham et al. 2003). Thresholds are defined in terms of the functional status of key ecosystem processes and are crossed when capacities for resistance and resilience are exceeded. (Also see *state* and *transition*.)

Transition – as applied to state-and-transition models, a *transition* is a trajectory of change that is precipitated by natural events and/or management actions which degrade the integrity of one or more of the primary ecological processes responsible for maintaining the dynamic equilibrium of the state. Transitions are vectors of system change that will lead to a new state without abatement of the stressor(s) and/or disturbance(s) prior to exceeding the system’s capacities for resistance and resilience (adapted from Stringham et al. 2003). (Also see *state* and *threshold*.)

Vital signs – a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values. The elements and processes that are monitored are a subset of the total suite of natural resources that park managers are directed to preserve “unimpaired for future generations,” including water, air, geological resources, plants and animals, and the various ecological, biological, and physical processes that act on those resources. Vital signs may occur at any level of organization including landscape, community, population, or genetic level, and may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes) (from NPS Inventory and Monitoring website, <http://science.nature.nps.gov/im/monitor/vsm.htm#Definitions>).

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