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Master Glossary

This online Master Glossary clarifies terms that describe EMAP's conceptual framework, research, and field work. To use this service, simply "click" on a letter below that corresponds to the first letter of the term you are searching for. This will bring you to the section for that letter.

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abiotic: Nonliving characteristic of the environment; the physical and chemical components that relate to the state of ecological resources. (Term added 1993. See related: **biotic**, **condition indicator**, **indicator**.)

accuracy: The degree to which a calculation, a measurement, or set of measurements agree with a true value or an accepted reference value. "Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. EPA recommends that this term not be used and that precision and bias be used to convey the information usually associated with accuracy (QAMS 1993, 1)."

acid deposition: "A complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on earth in either a wet or dry form. The wet forms, popularly called "acid rain," can fall as rain, snow, or fog. The dry forms are acidic gases or particulates." (EPA 1992, 1)

adaptive sampling strategy: A sampling strategy that allows modification of sampling design and analysis to adapt to changing objectives or to changing circumstances.

agroecosystem: A dynamic association of crops, pastures, livestock, other flora and fauna, atmosphere, soils and water. Agroecosystems are contained within larger landscapes that include uncultivated land, drainage networks, rural communities, and wildlife.

Alber's map projection: A standard map projection for representing the conterminous 48 United States. This is a conic equal area projection.

ancillary data: Data collected from studies within EMAP but not used directly in the computation of an indicator. Ancillary data can help characterize parameters and assist in the interpretation of data sets; time, stage of tide, and weather conditions are examples of ancillary data. (Term added 1993. See related: **auxiliary data**.)

annual statistical summary: A document that presents a brief and comprehensive report of EMAP data collected on a single EMAP resource for a specific year. Annual statistical summaries may include cumulative frequency

distributions, estimates of the extent of nominal or subnominal condition, comparisons among regions, or comparisons of data over time.

area frame: A sampling frame obtained by dividing a region into well-defined, identifiable subregions that in aggregate comprise the total area of the region of interest. The subregions are sampling units defined on maps or other cartographic materials. (See related: **frame**.)

area sample: The units selected for measurements from an area frame.

arid ecosystems: Terrestrial systems characterized by a climate regime where the potential evapotranspiration exceeds precipitation, annual precipitation is not less than 5 cm and not more than 60 cm, and daily and seasonal temperatures range from 40 C to 50 C. The vegetation is dominated by woody perennials, succulents, and drought resistant trees.

assessment: Interpretation and evaluation of EMAP results for the purpose of answering policy-relevant questions about ecological resources, including (1) determination of the fraction of the population that meets a socially defined value and (2) association among indicators of ecological condition and stressors.

assessment endpoint: Formal expressions of the actual environmental value that is to be protected (Suter 1990). Risk Assessment Forum defines this as an "explicit expression of the environmental value that is to be protected (RAF 1992, 37). Operationally in EMAP, an assessment endpoint is the range, proportion, or percentage of a resource that is known with statistical confidence to be in a specified condition. (See related: **condition indicator**, **nominal**, and **subnominal**.)

association rule: A rule that unambiguously links a single resource sampling unit with a grid point. Several association rules have been identified in selecting a Tier 2 sample via the EMAP grid.

attribute: Any property, quality, or characteristic of sampling unit. The indicators and other measures used to characterize a sampling site or resource unit are representations of the attributes of that unit or site. A characteristic of a map feature (point, line, or polygon) described by numbers or text; for example, attributes of a tree, represented by a point might include height and species. (See related: **continuous**.)

augmented sample: A grid-based sample whose size has been increased by using a denser grid.

auxiliary data: Data derived from a source other than EMAP, that is, from an experiment or from another monitoring or sampling program, either Federal or State. The sampling methods and quality assurance protocols of auxiliary data must be evaluated before the data are used. It is always important to establish the population represented by auxiliary data. (Preferred term 1993; replaces "non-EMAP data," and "found data," deleted in 1993; see related: **ancillary data**.)

azimuthal map projection: One of a class of map projections formed by projecting coordinates from the Earth's surface directly onto a plane that is either tangent at a point on the surface or that intersects the surface in a circle. When the plane intersects the surface, the projection is said to be the secant case.

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baseline grid: The fixed position of the EMAP grid as established by the position of the hexagon overlaying the United States. This is distinguished from the sampling grid, which is shifted a random direction and distance from the baseline grid. (See related: **grid**, **40 hex**.)

bias: In a sampling context, the difference between the conceptual weighted average value of an estimator over all possible samples and the true value of the quantity being estimated. An estimator is said to be unbiased if that difference is zero. The "systematic or persistent distortion of a measurement process which deprives the result of representativeness (i.e., the expected sample measurement is different than the sample's true value). A data quality indicator" (QAMS 1993, 3).

bioaccumulants: "Substances that increase in concentration in living organisms as they take in contaminated air, water, or food because the substances are very slowly metabolized or excreted" (EPA 1992, 4).

bioassay: A laboratory or field test in which living organisms are used to detect the presence of or test the effect of a particular substance, factor, or condition. Results are compared to a standard preparation or control to determine the relative strength of the substance, factor, or condition.

biodiversity: The variety and variability among living organisms and the ecosystems in which they occur. Biodiversity includes the numbers of different items and their relative frequencies; these items are organized at many levels, ranging from complete ecosystems to the biochemical structures that are the molecular basis of heredity. Thus, biodiversity encompasses expressions of the relative abundances of different ecosystems, species, and genes (OTA 1987).

biogeographic province: Geographic areas characterized by specific plant formations and associated fauna.

biomarker: Biochemical, physiological, or histological indicators of either exposure to or effects of xenobiotic chemicals at the suborganismal or organismal level (Huggett et al. 1992).

biomass: "All of the living material in a given area; often refers to vegetation" (EPA 1992, 4).

biome: "Entire community of living organisms in a single major ecological area" (EPA 1992, 4).

biotic: Of or pertaining to living organisms. (Term added 1993. See related: **indicator, condition indicator, abiotic, stressor indicator**. Biotic condition indicator replaces: "response indicator.")

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calibration: Statistical transformation of a variable to correct for scale or bias, or otherwise to impose the properties of another variable. Example: let two labs use different protocols of chemical analysis. Designate one protocol as the standard and generate a transformation function to convert the data from the second protocol into representation of the standard. Calibration will be required as a routine statistical procedure in many aspects of EMAP. New protocols will replace old ones. Surrogate attributes will be extensively measured, to be calibrated to represent the target attribute. Use of multiple laboratories invariably involves laboratory bias, which can be reduced by calibration. analytic equipment requires periodic calibration, and the data generated by such a process can also benefit from statistical calibration. Double-sample methods can utilize calibration in many ways to enhance the precision of estimates based on small subsamples.

candidate indicator (Deleted term 1993. See: **indicator development**.)

cdf: Cumulative distribution function. (See: **cumulative distribution**).

change: As used in EMAP, the difference in the distribution of measurements of condition indicators between two time periods. (See related: **status, trends**.)

characterization: Determination of the attributes of resource units, populations, or sampling units. A prominent use in EMAP is characterization of 40-hexes.

classification: The process of assigning a resource unit to one of a set of classes defined by values of specified attributes. For example, forest sites will be classified into the designated forest types, depending on the species composition of the forest. Systematic arrangement of objects into groups or categories according to established criteria.

Committee to Review EPA's Environmental Monitoring and Assessment Program (See: **National Academy of Sciences**.)

community: "All of the populations occupying a given area" (Odum 1959, 6); Odum's definition was adapted by the Risk Assessment Forum to read: "an assemblage of populations of different species within a specified location in space and time" (RAF 1992, 37). "In ecology, a group of interacting populations in time and space. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest" (EPA 1993, 6).

comparability: "The degree to which different methods, data sets and/or decisions agree or can be represented as similar; a data quality indicator " (QAMS 1993, 6).

completeness: "The amount of valid data obtained compared to the planned amount, and [it is] usually expressed as a percentage; a data quality indicator" (QAMS 1993, 6).

conceptual model: A "conceptual model describes a series of working hypotheses of how the stressor might affect ecological components. The conceptual model also describes the ecosystem potentially at risk, the relationship between measurement [endpoints] and assessment endpoints, and exposure scenarios" (RAF 1992, 37).

condition: The distribution of scores describing resource attributes without respect to any societal value or desired use, that is, a state of being. (New term 1993.)

condition indicator: A characteristic of the environment that provides quantitative estimates of the state of ecological resources and is conceptually tied to a value. (New term 1993; replaces environmental indicator. See related: **indicator, abiotic, biotic, stressor indicator**.)

confidence coefficient: "The probability statement that accompanies a confidence interval and is equal to unity minus the associated type I error rate (false positive rate). A confidence coefficient of 0.10 implies that 90% of the intervals resulting from repeated sampling of a population will include the unknown (true) population parameter (QAMS 1993, 6).

confidence interval: An interval defined by two values, called confidence limits, calculated from sample data using a procedure which ensures that the unknown true value of the quantity of interest falls between such calculated values in a specified percentage of samples. Commonly, the specified percentage is 95%; the resulting confidence interval is then called a 95% confidence interval. A one-sided confidence interval is defined by a single calculated value called an upper (or lower) confidence limit. "The numerical interval constructed around a point estimate of a population parameter, combined with a probability statement (the confidence coefficient) linking it to the population's true parameter value. If the same confidence interval construction technique and assumptions are used to calculate future intervals, they will include the unknown population parameter with the same specified probability" (QAMS 1993, 6). (See related: **confidence coefficient**.)

conformal map projection: One of a class of map projections that preserves angular relationships between the map and the surface of the earth. At any point on the map, measurement of orientation angles is correct. A

conformal map projection cannot be equal-area.

conical (or conic) map projection: One of a class of map projections formed by projecting coordinates from the earth's surface onto a cone that either intersects the surface of the earth or is tangent to a circle on the surface. When the cone intersects the sphere, the projection is said to be the secant case.

continuous: A characteristic of an attribute that is conceptualized as a surface over some region. Examples are certain attributes of a resource, such as chemical stressor indicators measured in estuaries.

core indicator (See: **indicator development**.)

cross-cutting group: In EMAP's Integration and Assessment section, one group of scientific and administrative personnel headed by a technical coordinator (TC) and charged with addressing specific cross-program, integrative issues in EMAP, such as Landscape Characterization, Design and Statistics, Indicator Development, Information Management, Assessment and Reporting, Logistics, Methods, and Quality Assurance. (See related: **resource group**.)

cumulative distribution: A means of representing the variation of some attribute by giving running totals of the resource with attribute values less than or equal to a specified series of values. For example, a cumulative areal distribution of lakes would give, for any value a of area, the total area covered by lakes with individual area less than or equal to a . A cumulative frequency distribution for lake area would give the total number of lakes with area less than or equal to a . The cumulative distribution function (cdf) of some specified attribute of a population is the function $F(x)$ that gives the proportion of the population with value of the attribute less than or equal to x , for any choice of x . For example, if the attribute was lake area in hectares, $F(a)$ would give the proportion of lakes with area less than or equal to a . (In some cases, the word "cumulative" may be omitted in discussions of the cdf, and the cdf is called the distribution function.)

cylindrical (or cylindric) map projection: One of a class of map projections formed by projecting coordinates from the earth's surface onto a cylinder that either intersects the surface in two small circles or is tangent to a great circle on the surface. When the cylinder intersects the surface, the projection is said to be the secant case.

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data quality: "The totality of features and characteristics of data that bears on their ability to satisfy a given purpose; the sum of the degrees of excellence for factors related to data" (QAMS 1993, 7).

data quality indicators: "Quantitative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are bias, precision, accuracy, comparability, completeness, and representativeness" (QAMS 1993, 7).

data quality objective (DQO): "Quantitative and qualitative statements of the overall level of uncertainty that a decision-maker is willing to accept in results or decisions derived from environmental data DQOs provide the statistical framework for planning and managing environmental data operations consistent with the data user's needs" (QAMS 1993, 8). A data quality objective may include goals for accuracy, precision, and limits of detection. It may also include goals for completeness, comparability, and representativeness. Data quality objectives are established before sampling is begun and may influence the level of effort required to select a sample.

deconvolution: The process of removing the influence of extraneous variation from an apparent cumulative distribution. Extraneous variation--such as random errors in measurement--has the effect of inflating observed variation relative to true population variation. The cumulative distribution that will be estimated when extraneous variation is present is the convolution of the population distribution (which is the cumulative distribution of interest) and the distribution of the extraneous variable. The convolution cumulative distribution will be flatter (have longer tails) than the population cumulative distribution.

demonstration field program: A collection of demonstration research projects to provide preliminary estimates of resource condition for one or more indicators applied to one or more resource classes over a standard Federal region. A demonstration field program is likely to include a group of pilot research projects to increase the cost-effectiveness of the program. The demonstration field program does not have a data quality objective, but the individual pilot and demonstration research projects do have DQOs. (New term 1993. See related: **demonstration project, implementation field program, pilot field program, pilot project**.)

demonstration project: A field research project designed to provide preliminary estimates of a resource condition for a single indicator over a standard Federal region for one or more resource classes. Separate demonstration projects are defined for each indicator of condition; in a demonstration project, quality data objectives are stated for preliminary statistical estimates. (See related: **demonstration field program, implementation field program, pilot field program, pilot project**.)

design-based: Statistical inferences using methodology based on the sampling design. Such inferences derive their properties from the design protocols.

design-unbiased: Indicates that an estimator is unbiased under the design protocol. This property does not, however, prevent bias from entering estimates from other sources. Design-unbiased estimators of variance do not always exist under EMAP designs.

developmental indicator (Deleted term 1993. See: **indicator development**.)

diagnostic indicator (Deleted term 1993. See: **stressor indicator**.)

digital line graph (DLG): Digital data produced by the U.S. Geological Survey. These data include digital information from the USGS map base categories such as transportation, hydrography, contours, and public land survey boundaries.

discrete resource: A resource consisting of a collection of distinct units, such as lakes or stream reaches. Such a resource will be described as a finite population of such units. (See related: **attribute, continuous, extensive resource, resource.**)

distribution function (See: **cumulative distribution.**)

domain: The areal extent of a resource; the region occupied by a resource.

double sample: A sample of a sample. Specifically in EMAP, resource attributes from remote sensing or cartographic materials can be measured on a larger sample than those attributes requiring field measurements. Attributes on the former sample can be used to guide selection of the latter sample.

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ecology: "The relationship of living things to one another and their environment, or the study of such relationships" (EPA 1992, 10).

ecological health: A metaphor used to invoke ideas about the integrity, complexity, and autonomy of an ecosystem (Norton 1991). A definition of ecosystem health as an actual entity with specific scale has not been resolved; the terms are useful because they facilitate "a set of rules of thumb, which can be thought of analogically, for analyzing what is going wrong when environing (sic) systems undergo rapid change" (Norton 1991, 116). (See related: **epidemiologic ecology, condition, nominal, subnominal.**)

ecological indicator (Deleted term 1993. See: **condition indicator.**)

Ecological Effects Committee (See: **Science Advisory Board.**)

ecological risk assessment: A process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors (RAF 1992, 37). (See related: **risk assessment.**)

ecoregion: A relatively homogeneous geographic area "perceived by simultaneously analyzing a combination of causal and integrative factors including land surface form, soils, land uses, and potential natural vegetation. (Omernik 1987, 123) Ecoregions "was coined by J.M. Crowley (1967) and popularized by R.G. Baily (1976) to define a mapped classification of ecosystem regions of the U.S....Ecoregions are generally considered to be the regions of relative homogeneity in ecological systems or in relationships between organisms and their environments" (123).

ecosystem: The biotic community and its abiotic environment (Krebs 1978) within a specified location in space and time (added by RAF 1992). "The interacting system of a biological community and its non-living environmental surroundings" (EPA 1992, 10).

ecosystem functions: Energy circuits, food chains, diversity patterns in time and space, nutrient cycles, development and evolution, and control within an ecosystem. (Odum 1971, 8)

ecosystem structure: Pattern of the interrelations of organisms in time and in spatial arrangements. (Odum 1971, 8-9)

ecotone: A habitat created by the juxtaposition of distinctly different habitats; an edge habitat; an ecological zone or boundary where two or more ecosystems meet.

entire: Being whole, not convoluted or divided into distinct spatial parts. In EMAP, this property affects the precision of certain sample statistics. (See related: **fragmented.**)

environment: "The sum of all external conditions affecting the life, development, and survival of an organism" (EPA 1992, 11). (See related: **habitat.**)

environmental assessment: An environmental analysis prepared pursuant to the National Environmental Policy Act to determine whether a Federal action should significantly affect the environment and thus require a more detailed environmental impact statement.

environmental indicator (Deleted term 1993. See: **indicator.**)

environmental value (See: **value.**)

epidemiologic ecology: The study of the effects of human, physical, biological, and chemical stressors on conditions of ecosystems, broadly conceived. This area of ecology uses epidemiological concepts and methods to

associate ecological effects or responses with stressors through assessments, long-term monitoring data, and results of research. (Proposed new term 1993. See related: **ecological health, condition, nominal, subnominal, stressor.**)

equal-area (equivalent) projection: One of a class of map projections that preserves area relationships between the map and the surface of the Earth. On an equal-area projection, two areas that are equal on the surface of the Earth will also be equal on the map. A projection cannot be both conformal and equal-area.

estuary: "Regions of interaction between rivers and nearshore ocean waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife" (EPA 1992, 11). In EMAP, large estuaries are defined as those estuaries greater than 260 km² in surface area and with aspect ratios (i.e., length/average width) of less than 20. Large tidal rivers are defined as that portion of the river that is tidally influenced (i.e., detectable tide > 2.5 cm), greater than 260 km², and with an aspect ratio of greater than 20. Small estuaries and small tidal rivers are those systems whose surface areas fell between 2.6 km² and 260 km². (See related: **wetlands.**)

exposure indicator (Deleted term 1993. See: **stressor indicator.**)

extensive resource: A resource covering a large area that is not ecologically integrated and is not a collection of natural units, for example, large marshes or rangelands. Characterization of an extensive resource is scale-dependent.

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40-hex: The landscape description hexagon that is established on each of the grid points in the EMAP grid. Actual size of these hexagons is $634.5/16 = 39.7$ km².

forest: Land with at least 10% of its surface area stocked by trees of any size or formerly having had such trees as cover and not currently built-up or developed for agricultural use (USDAFS 1989).

found data (Deleted term 1993. See: **auxiliary data, judgment sample.**)

fragmented: Being divided or convoluted into distinct parts, rather than entire. In EMAP, the spatial fragmentation of resources and the spatial/temporal fragmentation of resource attributes affect the precision of certain population statistics, so that attention must be given to this state. (See related: **entire.**)

frame: A representation of a population, used to implement a sampling strategy as, for example, (1) a list frame that lists the identifying units in the population--for instance, a list of all the lakes in the United States between 10 and 2000 ha--or (2) an area frame that consists of explicit descriptions of a partition of the areal extent of an areal universe--like the NASS frame. (See related: **area frame, sampling unit.**)

frame, conceptual: An explicit definition of a frame that does not involve a tangible realization.

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geographic information system (GIS): A collection of computer hardware, software, and geographic data designed to capture, store, update, manipulate, analyze, and display geographically referenced data.

Great Lakes: In EMAP, the resource that encompasses the five Great Lakes--Superior, Michigan, Huron, Erie, and Ontario, including river mouths up to the maximum extent of lake influence; wetlands contiguous to the lakes; and the connecting channels, Lake St. Clair and the upper portion of the St. Lawrence Seaway.

grid: A data structure commonly used to represent map features. A cellular-based data structure composed of cells or pixels arranged in rows and columns (also called a "raster"). (See related: **40-hex.**)

grid enhancement: Increasing the grid density, a method for augmenting the sample. When the sample size is too small, as will occur for rare resources, the grid density may be increased in order to obtain a sample size adequate for population description. Grid enhancement is one method of producing an augmented sample.

grid, hierarchical: Having nested levels and structure; the density of the EMAP grid is readily increased or reduced in a regular manner into hierarchical levels of density. Adjacent levels may differ in density by a variety of factors: 3, 4, 7, or many functions of these base factors. The grid of points at one level will be contained in the grid at a higher density.

grid randomization: The process of randomly positioning the grid so that each (discrete) unit of area of fixed size is equally likely to contain a grid point. This process is the basis for the probability sample designation for EMAP monitoring.

grid, triangular (EMAP): A lattice of points in exact equilateral triangular structure on a plane. The EMAP grid points are 27.1 km apart.

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habitat: "The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living" (EPA 1992, 14).

habitat indicator (Deleted term 1992. See: **abiotic condition indicator**.)

heuristic method: In EMAP, a process for exploring and organizing information to conceptually discover and describe or postulate relationships among indicator variables and key processes of an ecosystem or resource. (New term 1993.)

hierarchial geometric decomposition: The mathematical process of breaking down a geometric structure into component parts. In the EMAP grid, the process by which the triangular grid is subdivided into higher density grids is hierarchial geometric decomposition. Related notions are enhancement and disaggregation; the opposite notion is composition of components into a larger whole.

hierarchical model: A construct in which component variables and systems of ecological entities are defined to have the smallest unit of spatial and temporal detail in the lowest level; each higher level reflects processes and interactions occurring at ever larger spatial and temporal scales. Behaviors of a particular level in the hierarchical model are determined both by constraints imposed by the levels above and filtered or averaged behaviors of components and subsystems of levels below. (New term 1993.)

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implementation field program: The decision by EMAP to make a long-term commitment to provide scientifically defensible estimates of current status, trends, and changes in condition indicators and association of these indicators with selected stressors. The decision will include consideration of (1) the link between values and indicators proposed for implementation, (2) the scientific basis for the indicator, (3) the scientific validity of the proposed national sampling design, (4) a demonstrated ability to meet the EMAP status and trends program quality objectives, and (5) explicit plans that ensure the implementation can be conducted and produce annual statistical summaries. (New term 1993. See related: **demonstration field program, demonstration project, pilot project, pilot field program**.)

inclusion probability: The probability of including a specific sampling unit within a sample.

index: Mathematical aggregation of indicators or metrics.

index period: The period of the year when measurement of an indicator yields meaningful information.

index sample: A standardized judgment sample for which explicit rules for generating the index measure are formally prescribed. An index sample is appropriate only for ecologically integrated systems. For example, in the National Lake Survey, a lake in the probability sample of lakes was field sampled at a prescribed season of the year (index period), in a prescribed standardized location in the lake (index site), and in a prescribed manner (field protocol). (See related: **judgement sample, sample**.)

indicator: In EMAP, characteristics of the environment both abiotic and biotic, that can provide quantitative information on ecological resources. (Revised definition 1993. Preferred term for environmental indicator, deleted 1993.) "In biology, an organism, species, or community whose characteristics show the presence of specific environmental conditions, good or bad" (EPA 1992, 15). (See related: **condition indicator, stressor indicator, biotic, abiotic**.)

indicator development: The process through which an indicator is identified, tested, and implemented. A candidate indicator is identified and reviewed by peers before it is selected for further evaluation as a research indicator. Existing data are analyzed, simulation studies are performed with realistic scenarios, and limited field tests are conducted to evaluate the research indicator. In the past, this research indicator was called a "probationary core indicator" or a "development indicator" as it was evaluated in regional demonstration projects. An indicator is considered a core indicator when it is selected for long-term, ecological monitoring as a result of its acceptable performance, demonstrated ability to satisfy the data quality objectives.

integrated assessment (Deleted term 1993. See: **assessment**.)

integration: The formation, coordination, or blending of units or components into a functioning or unified whole. In EMAP, integration refers to a coordinated approach to environmental monitoring, research, and assessment, both among EMAP resource groups and with other environmental monitoring programs. Integration in EMAP also refers to the technical processes involved in normalizing and combining data for interpretation and assessment.

interpenetrating subsamples: If a sample is partitioned into subsamples, each of which closely reflects the structure of the full design, then the subsamples are said to mutually interpenetrate the frame. The EMAP design prescribes 4 interpenetrating grids, each with density one fourth of the base grid. Together, these four grids constitute the baseline grid.

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judgment sample: A form of non-probability sample in which the sample is chosen according to the judgment of the sampler.

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kriging: A weighted, moving-average estimation technique based on geostatistics that uses the spatial correlation of point measurements to estimate values at adjacent, unmeasured points (Hunsaker and Carpenter 1990, xxiii).

A sophisticated technique for filling in missing data values, kriging is named after a South African engineer, D.G. Krige, who first developed the method. The kriging routine preserves known data values, estimates missing data values, and also "estimates the variance at every missing data location. After kriging, the filled matrix contains the best possible estimate of the missing data values, in the sense that the variance has been minimized" (Fortner 1992; 215, 167-176).

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lake: In EMAP, a standing body of water greater than 1 hectare (about 2.5 acre) that has at least 1000 m² (about 0.25 acre) of open water and is at least 1 meter (about 3 feet) deep at its deepest point. (See related: **surface waters, wetlands.**)

Lambert's azimuthal map projection: The map projection used for laying out the EMAP grid. This is an equal-area projection.

landscape: The set of traits, patterns, and structure of a specific geographic area, including its biological composition, its physical environment, and its anthropogenic patterns. An area where interacting ecosystems are grouped and repeated in similar form.

landscape characterization: Documentation of the traits and patterns of the essential elements of the landscape, including attributes of the physical environment, biological composition, and anthropogenic patterns. In EMAP, landscape characterization emphasizes the process of describing land use or land cover, but also includes gathering data on attributes such as elevation, demographics, soils, physiographic regions, and others.

landscape ecology: The study of distribution patterns of communities and ecosystems, the ecological processes that affect those patterns, and changes in pattern and process over time (Forman and Godron 1986). In EMAP, a resource group.

landscape indicator (Deleted term 1993. See: **condition indicator.**)

list frame: (See: **frame.** See related: **area frame.**)

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management indicator (Deleted term 1993. See: **stressor indicator.**)

map projection: A mathematical formula or algorithm for translating the coordinates of features on the surface of the Earth to a plane for representation on a flat map.

map resolution: The accuracy with which the location and shape of map features are depicted for a given map scale.

map scale: A statement of a measure on the map and the equivalent measure on the earth, often expressed as a representative fraction of distance, such as 1:24,000.

marginal condition: The state that exists when the nominal and subnominal criteria are not contiguous.

measurement: A quantifiable attribute that is tied to an indicator.

measurement endpoint: A measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint (Suter 1990). RAF added to Suter: " Measurement endpoints are often expressed as the statistical or arithmetic summaries of the observations that comprise [sic] the measurement" (RAF 1992, 38).

meridian: One of a group of abstract lines on the surface of the Earth formed by the longitude and latitude coordinate system. Meridians represent lines of equal longitude and thus converge at the poles. All meridians are great circles. (See related: **parallel**.)

meridional zones: Areas on the surface of the earth formed by adjacent meridians.

modeling: "Development of a mathematical or physical representation of a system or theory that accounts for all or some of its known properties. Models are often used to test the effect of changes of components on the overall performance of the system" (EPA 1992, 18).

monitoring: In EMAP, the periodic collection of data that is used to determine the condition of ecological resources. "Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media [air, soil, water] or in humans, plants, and animals" (EPA 1992, 18).

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National Academy of Sciences (NAS): The National Academy of Sciences/National Research Council (NRC) performs level 2 peer review to determine if EMAP projects have overall scientific merit and integrate both internally and with other government-sponsored monitoring programs. Two commissions of the NRC--the Commission on Geosciences, Environment, and Resources (specifically, its Water Science and Technology Board) and the Commission on Life Sciences-jointly organized the Committee to Review EPA's Environmental Monitoring and Assessment Program in 1991.

This NAS/NRC committee holds about 12 meetings and produces two or three reports every two years; its primary purpose is to consider the scientific and technical aspects of EMAP as designed as well as considering ways to increase EMAP's usefulness in monitoring conditions and trends in six representative types of ecosystems. The Committee also reviews the overall design objectives of the program, the indicator strategies, data collection methods, data analysis interpretation, and communication plans. Preparation for NAS/NRC reviews is coordinated by the Director of OMMSQA, EPA-ORD, who is also responsible for funding. (Term added 1993.)

nominal: Referring to the state of having desirable or acceptable ecological condition. The quantified standard established for a condition indicator to represent the desirable or acceptable condition is called a nominal assessment endpoint. (See related: **marginal, subnominal, assessment endpoint**.)

NRC (See: **National Research Council**)

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-O-

off-frame data (See preferred term: **auxiliary data**.)

Office of Modeling, Monitoring Systems, and Quality Assurance (OMMSQA): The office within EPA's Office of Research and Development responsible for EMAP management within the Agency.

on-frame data: Data acquired by a sampling approach that provides a probability sample. (See preferred term: **attribute**.)

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-P-

parallel: One of a group of abstract lines on the surface of the earth formed by the latitude and longitude coordinate system: parallels represent lines of equal latitude. Only the parallel at the equator is a great circle; other parallels are small circles. (See related: **meridian**.)

parameter: "Any quantity such as a mean or a standard deviation characterizing a population. Commonly misused for 'variable,' 'characteristic,' or 'property' (QAMS 1993, 15).

pattern: In EMAP, the location, distribution, and composition of structural landscape components within a particular geographic area or in a spatial context.

peer review: In EMAP, peer review means written, critical response provided by scientists and other technically qualified participants in the process. EMAP documents are subject to formal peer review procedures at laboratory and program levels. In EMAP, Level 1 peer reviews are performed by EPA's Science Advisory Board, level 2 by the NAS National Research Council, level 3 by specialist panel peer reviews, and level 4 by internal EPA respondents. (Added term 1993. See related: **National Academy of Sciences, Science Advisory Board**.)

pilot field program: A collection of pilot projects whose objectives are to provide the scientific information required prior to a decision to implement a monitoring design for a resource. Preliminary estimates of resource condition are not planned and will not be made from a pilot field program, which does not have a data quality objective; the individual pilot projects and demonstration projects do have DQOs. (New term 1993. See related: demonstration field program, **demonstration project**, **implementation field program**, **pilot project**.)

pilot project: A research project that requires field work to meet a stated research project quality objective, and the objective is not to provide preliminary estimates of resource condition. Each research activity on an indicator should be described as an individual pilot project usually during a single index period. Pilot projects are used to evaluate indicators, sampling strategy, methods, and logistics. (See related: **demonstration field program**, **demonstration project**, **implementation field program**, **pilot field program**.)

population: "A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area" (EPA 1992, 22 after Odum [1953] 1959, 6). In statistics and sampling design, the total universe addressed in a sampling effort; an assemblage of units of a particular resource, or any subset of extensive resources, about which inferences are desired or made. RAF defines population to be "an aggregate of individuals of a species within a specified location in space and time" (RAF 1992, 38).

population estimation: Classic survey estimation of population parameters. Such estimates will not reflect spatial configuration except through identification of the population, or of subpopulations, which may be defined by spatial attributes.

population units: The entities that make up a target population. The units can be defined in many ways, depending on the survey objectives and the type of measurement to be made. Typically, definitions of environmental units include (1) an explicit statement of the characteristics each population unit must possess in order to be considered a member of the target population and a (2) specification of location in space and time.

precision: The degree to which replicate measurements of the same attribute agree or are exact. "The degree to which a set of observations or measurements of the same property, usually obtained under similar conditions, conform to themselves; a data quality indicator" (QAMS 1993, 16). (See related: **accuracy**, **bias**.)

probability sample: A sample chosen in such a manner that the probabilities of including the selected units in the sample are known, and all population units have a positive probability of selection. This implies that the target population is represented by the sample and that the target population is explicitly defined.

probationary core indicator (Deleted term 1992. See: **indicator development**.)

projection: A mathematical model that transforms the locations of features on the Earth's surface to locations on a two-dimensional surface. (Term added 1993.)

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-Q-

quality assessment: "The evaluation of environmental data to determine if they meet the quality criteria required for a specific application" (QAMS 1993, 17).

quality assurance (QA): "An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence" (QAMS 1993, 7).

In EMAP, quality assurance consists of multiple steps taken to ensure that all data quality objectives are achieved. (See related: **quality assessment**, **data quality objectives**, **quality control**.)

quality control (QC): "The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. The aim is to provide quality that is satisfactory, adequate, dependable, and economical" (QAMS 1993, 17).

In EMAP, quality control consists of specific steps taken during the data collection process to ensure that equipment and procedures are operating as intended and that they will allow data quality objectives to be achieved. (See related: **data quality objectives**, **quality assessment**, **quality assurance**, **QA/QC**.)

QA/QC: Quality Assurance/Quality Control. "A system of procedures, checks, audits, and corrective actions to ensure that all EPA research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality" (EPA 1992, 23).

quantile: The value of an attribute indexing a specified proportion of a population distribution or distribution function. Quartiles (25th, 50th, and 75th percentiles), the median (50th percentile), and other percentiles are special cases of quantiles.

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-R-

recovery: The partial or full return of a population or community to a condition that existed before the introduction of the stressor (RAF 1992, 38).

randomization: The process of imposing an element of chance on the selection of a sample. Randomization is a step in the design protocol and may take many forms; it is the basis for determining the design-based properties of the resulting probability sample.

reference condition: The set of attributes of ecological resources that assist in identifying the location of a portion of the resource population along a condition continuum from the worst possible condition to the best possible condition given the prevailing topography, soil, geology, potential vegetation, and general land use of the region. Reference condition typically refers to the best resource condition, but it is used more broadly in EMAP. (Term added 1993.)

reference site: One of a population of bench mark or control sampling locations that, taken collectively, represent an ecoregion or other large biogeographic area; the sites, as a whole, represent the best ecological conditions that can be reasonably attained, given the prevailing topography, soil, geology, potential vegetation, and general land use of the region or clearly subnominal condition.

region: Any explicitly defined geographic area. In the EMAP objectives, region refers to the ten standard Federal regions (OMB 1974).

relation: The concept of function, correlation, or association between or among attributes, which may be qualitative as well as quantitative.

representativeness: "The degree to which data accurately and precisely represent the frequency distribution of a specific variable in the population; a data quality indicator" (QAMS 1993, 20).

research indicator (Deleted term 1993. See: **indicator development**)

research project: A single, focussed activity with a single primary research objective. The project includes the entire research process of initial planning, conduct of research (including field work if necessary), and evaluation (analysis and reporting). A research project involving field work may require several years to complete. Many EMAP research projects will not require field work: such projects include development of conceptual models for an indicator, development of a proposed national sampling design strategy, analysis of existing data for indicator development, and others.

resource: In EMAP, an ecological entity that is identified as a target of sampling and is a group of general, broad ecosystem types or ecological entities sharing certain basic characteristics. Seven such categories currently are identified within EMAP: estuaries, Great Lakes, inland surface waters, wetlands, forests, arid ecosystems, and agroecosystems. These categories define the organizational structure of monitoring groups in EMAP and are the resources addressed by EMAP assessments. A resource can be characterized as belonging to one of two types, discrete and extensive, that pose different problems of sampling and representation.

resource assessment (See: **assessment**.)

resource class: A subdivision of a resource; examples include small lakes, oak-hickory forests, emergent estuarine wetlands, field cropland, small estuaries, and sagebrush dominated desert scrub.

resource domain: The areal extent of a resource; the region occupied by a resource.

resource group: In EMAP's Resource Monitoring and Research section, a group of scientific and administrative personnel, headed by a technical director (TD), responsible for research, monitoring, and assessments for a given EMAP resource. There are seven such groups in EMAP: Estuaries, Great Lakes, Inland Surface Waters, Wetlands, Forests, Arid Ecosystems, and Agroecosystems. Landscape ecology is also considered a resource group in EMAP. (See related: **cross-cutting group**.)

resource unit: A unit of a discrete resource, for example, a lake. A population of such a resource will be an explicit set of resource units.

response indicator (Deleted term 1993. See: **biotic condition indicator**.)

risk: "A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard" (EPA 1992, 25). In statistics, "the expected loss due to the use of a given decision procedure" (QAMS 1993, 20).

risk assessment: "Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants" (EPA 1992, 25).

risk characterization: Determination of the nature of a given risk and quantifying of the potential for adverse change to the environment from that risk. "A phase of ecological risk assessment that integrates the results of the exposure and ecological effects analyses to evaluate the likelihood of adverse ecological effects associated with exposure to a stressor. The ecological significance of the adverse effects is discussed, including consideration of the types and magnitudes of the effects, their spatial and temporal patterns, and the likelihood of recovery" (RAF 1992, 38).

risk communication: "The exchange of information about environmental risks among risk assessors, risk managers, the general public, news media, special interest groups, and others" (EPA 1992, 25).

risk management: "The process of evaluating and selecting alternative regulatory and non-regulatory responses to risk. The selection process necessarily requires the consideration of scientific, legal, economic, and behavioral

factors" (EPA 1992, 25).

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-S-

sample: A subset of the units from a frame. A sample may also be a subset of resource units from a population or a set of sampling units. (See related: **judgment sample, probability sample.**)

sampling strategy: A sampling design, together with a plan of analysis and estimation. The design consists of a frame, either explicit or implicit, together with a protocol for selection of sampling units.

sampling unit: An entity that is subject to selection and characterization under a sampling design. A sample consists of a set of sampling units or sites that will be characterized. Sampling units are defined by the frame; they may correspond to resource units, or they may be artificial units constructed for the sole purpose of the sampling design.

Science Advisory Board (SAB): A peer review panel internal to EPA. The Ecological Effects Committee of the SAB conducts reviews of EMAP's overall program and the conceptual framework for integrating EMAP with ORD's Ecological Risk Assessment program. Preparation for SAB reviews is coordinated by the Director of the Office of Modeling, Monitoring systems, and Quality Assurance (OMMSQA); the Assistant Administrator for ORD is responsible for funding. SAB review is considered level 1 peer review.

spatial model: A set of rules and procedures for conducting spatial analysis to derive new information that can be analyzed to aid in problem solving and planning. (New term 1993.)

spatial statistics: Statistical methodology and theory that accounts for spatial aspects of a spatially distributed data set. Conventional population estimation does not normally account for spatial attributes, except perhaps for spatial identity of subpopulations.

status: The distribution of scores for condition indicators with relation to the reference condition associated with specific social values or desired uses for a specific time period. (Term added 1993. See related: **change, condition, trends.**)

stratum (strata): A sampling structure that restricts sample randomization/selection to a subset of the frame. Inclusion probabilities may or may not differ among strata.

stressor: "Any physical, chemical, or biological entity that can induce an adverse response" (RAF 1992, 38).

stressor indicator: A characteristic of the environment that is suspected to elicit a change in the state of an ecological resource, and they include both natural and human-induced stressors. Selected stressor indicators will be monitored in EMAP only when a relationship between specific condition and stressor indicators are known or if a testable hypothesis can be formulated. (See related: **indicator, condition indicator.**)

subnominal: Having undesirable or unacceptable ecological condition. The quantified standard established for a condition indicator to represent unacceptable or undesirable ecological condition is called the subnominal assessment endpoint. (See related: **assessment endpoint, marginal, nominal.**)

subpopulation: Any subset of a population, usually having a specific attribute that distinguishes its members from the rest of the population, for example, lakes from a specified population that are above 1000 m in elevation. Subpopulations are important entities in the EMAP plan. Any defined subpopulation is subject to characterization via estimation of subpopulation attributes and comparison to other subpopulations. It is this focus that imposes the greatest restrictions on the EMAP design and establishes the primary directions of the EMAP analyses.

surface fitting: A statistical procedure of estimating the parameters of a surface model or of approximating an implied surface by distribution free methods from a spatially distributed sample. A two-dimensional generalization of regression.

surface waters: The inland surface waters consisting of all the Nation's lakes (other than the Great Lakes), rivers, and streams. Lakes are distinguished from wetlands by depth and by size. Streams (and rivers) will be identified from stream traces on maps and confirmed in field visits. Streams are operationally defined as any first or higher order stream that is represented as a blue line on a USGS 1:100,000 topographic map.

"All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water" (EPA 1992, 28). (See related: **lake, wetlands.**)

systematic sample: A sampling design that utilizes regular spacing between the sample points, in one sense or another. The EMAP design selects samples via the triangular grid. Spatial arrangement of the selected resource units is not always strictly systematic, but the systematic grid is an important aspect of the design.

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-T-

target population: A specific resource set that is the object or target of investigation.

technical coordinator (TC): The individual responsible for directing the activities of an individual cross-cutting group.

technical director (TD): The individual responsible for directing the activities of an individual resource group.

tessellation: A pavement or tiling of a space by a mosaic pattern. The EMAP design prescribes a regular tessellation on the United States, consisting of hexagons of 634.5 km².

Tier 1 resource: A specific designation given an EMAP resource class that will be treated as a stratum at Tier 2.

Tier 1/Tier 2: The EMAP design is a multi-stage, or multiphase, design. These two terms describe the multi-stage structure of EMAP's monitoring activities. Tier 1 refers to studies that reflect the structure of the sampling grid, and these studies characterize the extent of the resource and its geographical distribution. Tier 2 refers to a double sample from a Tier 1 sample; these studies quantify the ecological condition on a national or regional basis. (See related: **Tier 3/Tier 4.**)

Tier 3/Tier 4: The general investigation of status and nature of environmental issues involves other levels of investigation below those of monitoring: in EMAP, these activities are designated as Tier 3 or Tier 4. Tier 3 studies are specialized, intensive studies of a finite duration to help diagnose or determine the extent of a degraded condition. Tier 4 studies are basic research studies that support EMAP, and they complement Tier 1, Tier 2, and Tier 3 studies.

total quality management (TQM): A system that is implemented in every aspect of an organization with the focus of providing quality; that is, highly valued products. The system provides a framework for planning, documentation, communication, etc. and strongly emphasizes a client-oriented perspective. "The process whereby an entire organization, led by senior management, commits to focusing on quality as a first priority in every activity. TQM implementation creates a culture in which everyone in the organization shares the responsibility for continuously improving the quality of products and services in order to satisfy the customer" (QAMS 1993, 26).

trends: The changes in the distribution of scores for condition indicators over multiple time periods. (See related: **status, change.**)

trophic levels: "A functional classification of taxa within a community that is based on feeding relationships (e.g., aquatic and terrestrial green plants comprise (sic) the first trophic level and herbivores comprise (sic) the second.) (RAF 1992, 38).

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-U-

universal transverse Mercator (UTM) projection: The map projection used in many standard map series. This projection uses the Mercator projection formula on meridional zones; it is a cylindrical conformal projection.

universe: The total entity of interest in a sampling program, often together with some structural features. The EMAP universe is the entire United States, together with adjoining waters. (See related: **population.**)

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-V-

value: A characteristic of the environment that is desired. In the past, the term "environmental value" was defined to mean characteristic of the environment that contributes to the quality of life provided to an area's inhabitants; for example, the ability of an area to provide desired functions such as food, clean water and air, aesthetic experience, recreation, and desired animal and plant species. Biodiversity, sustainability, and aesthetics are examples of environmental values (Suter 1990). A quantity's magnitude.

variance: A measure of the variability or precision of a set of observations.

vector: A coordinate-based data structure commonly used to represent map features. (Term added 1993.)

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-W-

watershed: "The terrestrial area of the landscape contributing to flow at a given stream location. The land area that drains into a stream" (EPA 1992, 31).

weights: In a probability sample, the sample weights are the inverses of the inclusion probabilities; these are always known for a probability sample.

wetlands: Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or where shallow water covers the land and where at least one of the following attributes holds: (1) at least periodically, the land supports aquatic plants predominantly; (2) undrained hydric soils are the predominant substrate; and (3) at some time during the growing season, the substrate is saturated with water or covered by shallow water (Cowardin et al. 1979). "An area that is saturated by surface or ground water with vegetation adapted for life under those soil conditions, as swamps, bogs, fens, marshes, and estuaries (EPA 1993, 30).

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-X-

xenobiotic: "A chemical or other stressor that does not occur naturally in the environment. Xenobiotics occur as a result of anthropogenic activities such as the application of pesticides and the discharge of industrial chemicals to air, land, or water" (RAF 1992, 38).

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