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ORIGINAL PAPER

Ecosystem services and biodiversity conservation: concepts and a glossary

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Abstract The RUBICODE project draws on expertise from a range of disciplines to develop and integrate frameworks for assessing the impacts of environmental change on ecosystem service provision, and for rationalising biodiversity conservation in that light. With such diverse expertise and concepts involved, interested parties will not be familiar with all the key terminology. This paper defines the terms as used within the project and, where useful, discusses some reasoning behind the definitions. Terms are grouped by concept rather than being listed alphabetically.

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Introduction

The RUBICODE project is an attempt to explore and develop the practical tools and operational approaches needed for an 'ecosystem approach' to environmental management, as adopted by the Conference of the Parties to the Convention on Biological Diversity (CBD 1998), as the primary framework for action under the Convention. There is no rigorous definition and working manual for the ecosystem approach although the principles are enshrined within the CBD and within the Millennium Ecosystem Assessment (MA 2003). As in any emerging field of endeavour, the Ecosystem Approach is presently characterised by a diversity of typologies, schemes and terminologies championed by the various protagonists. In this respect, the RUBICODE project is no different and we do not expect that our terminology (described below) will be acceptable in its entirety to all working in this area. RUBICODE has enlisted a broad range of expertise, including experimental and theoretical ecologists, mathematical modellers, social scientists, political scientists and environmental economists, each discipline bringing with it specific terminology. Whilst the project has been careful to follow existing terminology as far as possible, some definitions have required amendment and a few new terms have been introduced. We have thus adopted a terminology agreed by consensus by those leaders in the field within the RUBICODE project in order to ensure consistency and rigour within the RUBICODE project, and to be thoroughly consistent and resonant with the principles of the CBD and the workings of the MA, these being well-accepted by, and familiar to

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policy, makers. The scheme presented below may be useful for others who follow, but it is not intended to be prescriptive. Indeed, we expect it to evolve as the ecosystem approach develops. Here, it is presented so that the reader can see exactly what we mean by the various terms in an increasingly busy and rapidly changing research area.

Frameworks used by RUBICODE

The classification of ecosystems and ecosystem services within RUBICODE follows that of the Millennium Ecosystem Assessment (MA 2003). Appendix 4 therein is a glossary, and RUBICODE follows this as far as possible. Central to the RUBICODE framework is the 'Drivers, Pressures, State, Impact, Response' (DPSIR) framework, which describes interactions between society and the environment and has been adopted by the European Environment Agency (EEA) for use in environmental risk assessment (EEA 1995, 1999; Maxim et al. 2009). To capture the dynamics of interactions between humans and other organisms, RUBICODE has modified the DPSIR framework to incorporate concepts from the Social–Ecological Systems (SES) framework (Berkes and Folke 1998). The new framework, FESP (Framework for Ecosystem Service Provision), is described by Rounsevell et al. (2010). FESP considers attributes of human agents and other organisms, as well as the supporting habitat, as the 'State' component of the DPSIR, thus superimposing the SES framework on DPSIR (Dawson et al. 2010; Rounsevell et al. 2010). The Service-Providing Unit (SPU) concept (Luck et al. 2003), is unified within RUBICODE (Luck et al. 2009) with the concept of Ecosystem Service Providers (ESPs; Kremen 2005), and the concept of an SPU-ESP continuum (also referred to as the service-provider concept) is used to encourage quantification of the characteristics of organisms and habitats which are necessary to provide a service at the level required by the human beneficiaries within the SES. The loss of ESPs as a result of an environmental pressure, such that they no longer adequately provide a service, signals an adverse impact requiring a response, such as a direct intervention or a strategy or policy change (Haslett et al. 2010; Samways et al. 2010). Whether the response aims at restoring the service providers to a level suitable to meet beneficiary demands or advocates alternative solutions to service provision that do not involve biodiversity, requires a valuation framework (Skourtos et al. 2009). The SPU-ESP continuum is described within RUBICODE in both taxonomic and functional terms, and indicators of the state of ecosystem services are being considered using both systems (Feld et al. 2010; Vandewalle et al. 2010). Ultimately RUBICODE is designed to guide prioritisation of conservation effort in the light of limited resources (Harrison et al. 2010) and to assist with designing an improved landscape to deliver ecosystem services while mitigating adverse impacts (Samways et al. 2010). Conservation based on ecosystem services is seen as complementary to the present European strategy and a new conceptual framework is employed to propose ways of adding value to traditional approaches (Haslett et al. 2010). The terminology of these frameworks, as applied to RUBICODE and used in this Special Issue, is described below.

Glossary

Where definitions or qualifications of terms include terms defined elsewhere in this paper, those terms are italicised.

The definitions have been grouped according to the frameworks described above to which they are considered most appropriate, although many definitions are appropriate to more than one framework.

Terms relating to the DPSIR framework

DPSIR

<The scoping framework for describing the interactions between society and the environment adopted by the European Environment Agency (EEA 1995). The framework assumes multiple cause-effect relationships between interacting components of social, economic, and environmental systems, which are:

D_rivers_ of environmental change (e.g. industrial production);
P_ressures_ on the environment (e.g. discharges of waste water);
S_tate_ of the environment (e.g. water quality in rivers and lakes);
I_mpact_ on *population*, economy, *ecosystems* (e.g. water unsuitable for drinking) and
R_esponse_ of the society (e.g. watershed protection)>

The *DPSIR* framework is useful in that it provides a structure in which a number of physical, biological, chemical and societal *indicators* can be analysed to set and evaluate targets and give a clear picture of progress, or lack thereof, in a number of policy areas (EEA 1999). However, this framework depicts mainly a linear and unidirectional causal chain, cannot take into account dynamics of the system it models, and ignores key non-human *drivers* of environmental change (Rapport and Friend 1979; Barker 2003; Olson et al. 2004a, b; Maxim and Spangenberg 2006). The RUBICODE approach is to extend the traditional *DPSIR* framework to describe interactions between society and the environment by linking it with the concept of *Social–Ecological Systems*, which describes the dynamics and interconnectedness of human and non-human components in the same system (see Rounsevell et al. (2010) for discussion).

Drivers

<The underlying causes of environmental change that are exogenous to the *ecosystem* in question>

They reflect either the past, present or future conditions that cause changes to *ecosystems* and are equivalent to the 'indirect drivers' and 'exogenous drivers' of the MA (2003).

Pressures

<The endogenous variables that quantify the effect of drivers within an *ecosystem*>

They are equivalent to the 'direct drivers' and 'endogenous drivers' of the MA (2003).

State

<The collection of variables that describe the whole of the *social–ecological system*, including the attributes of *ecosystem service beneficiaries* (*ESBs*) and the attributes of *ecosystem service provides* (*ESPs*)>

Changes in *state* variables represent the sensitivity of the *ecosystem* to the *pressure* variables.

Impact

<A measure of whether the changes in the state variables have a negative or positive effect on individuals, society and/or environmental resources>

Negative or positive effects are measured in terms of the relationship between the *state* and human need (through the *SPU-ESP continuum service-provider concept*). There is an *impact* if the *state* no longer equates to *service* provision.

Response

<Action through policy and management aiming to minimise negative *impacts* (or maximise positive *impacts*) by acting on the *pressure* variables or on the *ESP* and *ESB state* variables>

'Mitigation' reduces the severity of the problem by acting directly on the *pressure* variables. 'Adaptation' enhances the capacity of the *ecosystem* to cope with *pressures* by influencing the *state* variables.

Terms relating to ecosystem response to pressures

Resilience

<An *ecosystem*'s ability to recover and retain its structure and function following a transient and exogenous shock event>

If a stress or disturbance does alter the *ecosystem*, then it should be able to bounce back quickly to resume its former ability to yield a *service* or utility rather than transform into a qualitatively different state that is controlled by a different set of processes. In order for *ecosystem resilience* to be defined, the *ecosystem* must have a degree of *stability* prior to the perturbation. *Resilience* relates to return to *stability* following perturbation (Holling 1973; Dawson et al. 2010).

Stability

<An *ecosystem*'s tolerance to transient and endogenous perturbations)>

An important component of *stability* is resistance—the ability of the *ecosystem* to continue to function without change when stressed by a disturbance that is internal to the system. A system can be stable in the sense of a steady or dynamic equilibrium state, evidenced, for example, in predator–prey relationships. In this sense, the system adapts through autonomous (usually negative) feedback mechanisms or through managed policy/response interventions (Dawson et al. 2010).

Durability

<An *ecosystem*'s ability to adapt to, or maintain, its function in the face of chronic (enduring) endogenous *pressure(s)*>

Durability of an *ecosystem* pertains to its ability to continue to yield a *service* or utility, for example capacity to support human or other life, over relatively long time-scales or indefinitely without any degradation or loss of the important biotic or abiotic components that make up the *ecosystem*. Evolution is an example of an endogenous *pressure* which acts on the species that make up an *ecosystem* (Dawson et al. 2010).

Robustness

<An *ecosystem*'s ability to adapt to or maintain its function under chronic exogenous *drivers* and *pressures*>

An *ecosystem* is robust when it is capable of resisting changes caused by long-term *drivers* or *pressures* that are external to the *ecosystem*, such as global warming, nutrient loading or hunting pressure (Dawson et al. 2010). Robust *ecosystems* demonstrate adaptability to external forces, for example if a keystone species goes extinct, surviving species can compensate for the loss of function over physiological, demographic, or evolutionary time scales (Lenski et al. 2006; Dawson et al. 2010).

Terms relating to the SES framework

Social–Ecological System (sometimes referred to as a 'Socio-ecological System')

<A system that includes societal (human) and ecological (biophysical) subsystems in mutual interactions (Gallopin 1991) and thus captures interactions between *ecosystems*, *biodiversity* and people>

Many recent studies have recognised that interactions exist between humans, other *biodiversity* and non-biological components of *ecosystems*. Thus changing human conditions drive, both directly and indirectly, changes in *biodiversity*, changes in *ecosystem* support structures and ultimately changes in the *services ecosystems* provide (MA 2003). However, to capture social and ecological dynamics, the human dependence on the capacity of *ecosystems* to generate essential *services* and the importance of ecological feedbacks for societal development suggest that social and ecological systems are not merely linked but are interconnected (Galaz et al. 2008) and that the relationship between social and ecological systems is based on mutual partnership and not domination of one by the other. To emphasise such a concept, Berkes and Folke (1998) use the term *Social–Ecological System (SES)*. Both social and ecological systems contain units that interact interdependently and each may also contain interactive subsystems. Social systems include economy, humans and *institutions* in mutual interaction. Ecological systems include self-regulating *communities* of organisms interacting with one another and with their environment (Folke et al. 2004).

Terms relating to the ecological component of Social–Ecological Systems

Biodiversity

<The variety of living organisms and the ecological complexes of which they are part>

Biodiversity covers genetic, structural and functional components, which are derived from different organisational levels, from single individual organisms to species, *populations*, *communities* and *ecosystems* (adapted from Secretariat of the Convention on Biological Diversity 2001, MA 2003 and extended according to Noss 1990).

Population

<A group of organisms, all of the same species, which occupies a particular area (geographic *population*), is genetically distinct (genetic *population*) or fluctuates synchronously (demographic *population*)>

Population diversity

<The number, size, density, distribution and genetic variability of *populations* of a given species (adapted from Luck et al. 2003)>

Community

<An association of interacting populations, usually defined by the nature of their interactions or by the place in which they live (Ricklefs and Miller 2000)>

Assemblage

<A group of organisms in the same taxonomic group sampled in the same focal area (e.g. butterfly assemblage, bird assemblage)>

Functional trait

<A feature of an organism, which has demonstrable links to the organism's function (Lavorel et al. 1997)>

As such, a *functional trait* determines the organism's response to *pressures* (*Response trait*), and/or its effects on *ecosystem processes* or *services* (*Effect trait*). *Functional traits* are considered as reflecting adaptations to variation in the physical and biotic environment and trade-offs (ecophysiological and/or evolutionary) among different functions within an organism. In plants, *functional traits* include morphological, ecophysiological, biochemical and regeneration *traits*, including demographic *traits* (at *population* level). In animals, these *traits* are combined with life-history and behavioural *traits* (e.g. guilds, organisms that use similar resources/*habitats*).

Functional trait attribute

<The value/state of a *functional trait*>

It may be categorical (e.g. C3 vs. C4 for plant photosynthetic pathway) or continuous (e.g. root length).

Functional group

<A collection of organisms with similar *functional trait attributes* (adapted from Gitay and Noble 1997)>

Some authors use 'Functional Type' in the same way.

Groups can be associated with similar responses to *pressures* and/or effects on *ecosystem processes*. A *functional group* is often referred to as a *guild*, especially when referring to animals, e.g. the feeding types of aquatic organisms having the same function within the trophic chain: the group (guild) of shredders or grazers.

Functional syndrome

<A suite of co-occurring *trait attributes*, sometimes associated with particular environmental conditions or processes>

This is related to an 'Emergent Group', which is a suite of correlated traits. It becomes a *functional syndrome* or strategy if it is associated with specific environmental conditions.

Functional diversity

<The range, actual values and relative abundance of *functional trait attributes* in a given *community* (Diaz and Cabido 2001; Diaz et al. 2007)>

This can be characterised by different metrics (see Petchey et al. 2004, for a review). The most relevant metrics are as follows.

Community Weighted Mean Trait (also called aggregated trait or community weighted average trait value)

<The mean of *trait attributes* in the *community*, weighted by the relative abundance of the species or *populations* carrying each value (Garnier et al. 2004; Violle et al. 2007)>

It is usually calculated as the mean across species of their *trait values* weighted by their relative abundances (i.e. the mean across individuals). It can also be used for instances where a *trait* expresses only one value for the whole *community* (e.g. total root density).

Functional richness

This includes two components, which authors have used selectively or jointly:

(a) <the range of *trait attributes* represented in the *community*, i.e. the amount of niche space filled by species in the *community* (Mason et al. 2005)>
(b) <the number of *functional groups* or *trait attributes* in the *community* (Petchey et al. 2004)>

Functional divergence

<The functional differentiation within the *community* i.e. the degree to which abundance distribution in niche space maximises divergence in *functional traits* within the *community* (Mason et al. 2005)>

This represents the probability that two random individuals within the *community* will have different *trait values* (Lepš et al. 2006; Pavoine et al. 2009).

Functional redundancy

<A characteristic of species within an *ecosystem* in which certain species (or other taxa) contribute in equivalent ways to *ecosystem processes* such that one species may substitute for another in this respect>

Note that species that are redundant for one *ecosystem process* may not be redundant for others (MA 2003). Also, redundancy may vary depending on interacting environmental conditions, and species that are considered redundant may become important under changed conditions. The concept is therefore at risk of misinterpretation.

Terms relating to the human component of Social–Ecological Systems

Stakeholder

<A person having a stake or interest in a biological or physical resource, *ecosystem service*, *institution* or social system, or someone who is or may be affected by a public policy (adapted from MA 2003)>

Ecosystem Service Beneficiary

<A *stakeholder* who benefits directly from a biological or physical resource, *ecosystem service*, *institution*, or social system, or someone who is or may be affected positively by a public policy>

Loser

<A *stakeholder* who loses from a biological or physical resource, *ecosystem service*, *institution*, or social system, or someone who is or may be affected negatively by a public policy>

Terms relating to interactions between components of Social–Ecological Systems

Ecosystem

<A dynamic complex of plant, animal and microorganism *communities* and their nonliving environment interacting as a functional unit (MA 2003)>

Humans, where present, are an integral part of *ecosystems*.

Dynamic ecosystem

The concept of a *dynamic ecosystem*, central to RUBICODE, acknowledges the temporal and spatial variability in *ecosystem* characteristics due to natural or anthropogenic changes affecting the organisms individually or collectively, and hence the reality that a given *ecosystem service* cannot be maintained indefinitely at a given location. However, as all *ecosystems* are dynamic, the term is tautological and just serves as a reminder that a static approach to conservation will have limited usefulness. This is entirely within the spirit of the CBD (1998) ecosystems approach report.

Ecosystem processes

<The interactions (events, reactions or operations) among biotic and abiotic elements of *ecosystems* which underlie an *ecosystem function* (adapted from Tirri et al. 1998; Wallace 2007)>

Examples of *ecosystem processes* include photosynthesis and nutrient uptake.

Ecosystem function

<An intrinsic *ecosystem* characteristic related to the set of conditions and *processes* whereby an *ecosystem* maintains its *integrity* (MA 2003)>

Examples of *ecosystem functions* include primary productivity and biogeochemical cycles.

Ecosystem services

<Benefits that humans recognise as obtained from *ecosystems* that support, directly or indirectly, their survival and quality of life (enlarged from MA 2003)>

These include *provisioning, regulating* and *cultural services* that directly benefit people, and the *supporting services* needed to maintain the direct *services*.

Provisioning services

<Products obtained from *ecosystems*>

Regulating services

<Benefits obtained from regulation of *ecosystem processes*>

Cultural services

<Non-material benefits obtained from *ecosystems*>

Supporting services

<*Services* necessary for the production of all other *ecosystem services*>

Ecosystem Service Provider

<The component *populations*, *communities*, *functional groups*, or *trait attributes* thereof, as well as abiotic components such as *habitat* type, that contribute to *ecosystem service* provision (adapted from Kremen 2005)>

Service-Providing Unit

<The collection of individuals from a given species and their *trait attributes* necessary to deliver an *ecosystem service* at the desired level (adapted from Luck et al. 2003)>

The *SPU* must be quantified in terms of metrics such as abundance, phenology and distribution.

SPU-ESP Continuum

<The unification of the *SPU* and *ESP* concepts, promoting the quantification of organism, *community* or *habitat* characteristics required to provide an *ecosystem service* in light of *beneficiary* demands and *ecosystem* dynamics (Luck et al. 2009)>

The concept extends the single species definition of an *SPU* to include multiple species and their supporting structures.

Ecosystem Service Antagoniser

<An organism, species, *functional group*, *population*, *community*, or *trait attributes* thereof, which disrupts the provision of *ecosystem services* and the functional relationships between them and *ESPs*>

Such disruption may be direct (e.g. through eating the provider) or indirect (e.g. through competition for resources or through direct interference with organisms that support *ESP*s).

Ecosystem integrity

<The quality of an *ecosystem* in which its constituent species and natural ecological processes are sustained (Hunter and Gibbs 2007)>

Thus *integrity* involves both *ecosystem function* and species composition. This overlaps with, but is different to, the somewhat ambiguous term ‘ecosystem health’, which emphasises function without considering the particular species involved. A key issue in the coupling of *ecosystem function* and species composition is that, with the dynamic nature of *ecosystems* spatially (historically and with anthropomorphic climate change), there will inevitably be (and has been) new combinations of species.

Indicator

<A simple, measurable and quantifiable characteristic responding in a known and communicable way to a changing environmental condition, to a changing *ecological process* or *function*, or to a changing element of *biodiversity*>

The definition basically follows the criteria defined by McGeoch (1998), but includes the categories recently defined by the EEA (2007). McGeoch (1998) principally distinguishes between environmental, ecological and *biodiversity indicators*. For the latter, the EEA has given four functions to be served by suitable *indicators*: (1) simplification, as it summarises often complex and disparate data, (2) quantification, as statistically sound and comparable measures are related to a reference or baseline value, (3) standardisation, as they are based on comparable scientific observations and (4) communication, as they provide a clear message that can be communicated.

Institutions

<Durable systems of established and embedded social rules (convention, norms and legal rules) that structure social interaction (Hodgson 2002)>

Institutions regulate relationships among people and between *social and ecological systems* (Ostrom 1990; Gatzweiler et al. 2001).

Terms relating to value and valuation of ecosystems and ecosystem services

Valuation

<The process of assigning importance and necessity to objects and actions>

Value

<The importance and necessity of objects and actions>

Several categories of value have been defined: ideal (including ethical), *real* (= *objective*) (including ecological) and *subjective* (including economic, aesthetic, and cultural).

Real (= Objective) value

<Value determined by the inherent characteristics of an object, often based on scientific criteria (e.g. rarity)>

Subjective value

<*Value* allocated to an object based on individual or collective human decisions based on preferences and, if possible, quantified on the basis of the intensity of these preferences>

Subjective values can be *intrinsic* (= *absolute*), *inherent* and *instrumental*; all economic *values* are *subjective*.

Intrinsic (= Absolute) value

<*Value* something has in its own right, irrespective of it serving any user-specified goals, objectives or conditions>

Such *absolute values* are not open to compromise; they suggest inalienable rights to existence and therefore demand the highest degree of protection without regard to (social) opportunity costs. Consequently, Justus et al. (2009) have argued that *intrinsic value* cannot guide the decision making that conservation requires, and they suggest that an adequate ethical basis for conservation must do this. We use *inherent* and *instrumental value* for this, the former representing a higher *value* category and thus requiring stronger conservation measures than the latter. The *existence value* allocated to certain objects can be an absolute one, depending on the ethical and cultural norms applied.

Inherent value

<*Value* directly provided by a unique object>

Objects which cannot be replaced, for which there is no fully equivalent substitute (like a species) are allocated an *inherent value*, ranking higher than the *value* of exchangeable objects (individuals of that species).

Instrumental value

<*Value* that something has as a means to something else>

For instance, when watching a rare species with binoculars, the latter has an *instrumental value*, but the species itself an *inherent value*. *Instrumental values* are *relative values*.

Relative value

<The contribution of an action or object to user-specified goals, objectives or conditions (Costanza 2000)>

Relative values suggest a permissible degree of substitution among different kinds of assets and therefore suggest an optimum (as opposed to the highest) degree of protection, defined as a situation where social and economic costs of conservation are in a balance with the value created by conservation. *Relative value* allows the construction of choice orderings (or rankings) and accordingly the operation of trade-offs. Economic and aesthetic values are typically *relative values*.

In *instrumentally valuing* a resource such as an *ecosystem*, the total economic *value* can be usefully broken down into a number of categories. One way of doing so is as follows.

Use value

<*Value* derived from some interaction with the resource, either directly or indirectly>

Indirect use value

<*Value* derived from indirect interaction with an *ecosystem service*>

This might, for example, include the removal of nutrients, providing cleaner water to those downstream, or the prevention of downstream flooding.

Direct use value

<*Value* derived from direct interaction with an *ecosystem service*>

This may be consumptive use such as the harvesting of reeds or fish (*provisioning services*), or it may be non-consumptive such as with some recreational and educational activities (*cultural services*).

Use values have been quantified by polling *ecosystem service beneficiaries* and other stakeholders regarding their *willingness to pay* for a hypothetical service or their *willingness to accept* compensation for its loss. However, in the measurement process, the potential users may include *non-use values* in their *subjective valuation*.

'*Willingness to Pay*' *value*

<The maximum amount (usually of money) an individual is willing to pay in order to enjoy a certain level of provision of *ecosystem services*, or to avoid a certain level of disservice>

'Willingness to Accept' value

<The minimum amount an individual is willing to accept as compensation in order to tolerate a certain level of loss, or forego a certain level of increase, in the provision of *ecosystem services*>

Exchange value

<The *value* a tradable good or *service* generates by exchanging it for some other good, usually measured in monetary terms>

Exchange values are objectively measured as market prices; their existence depends on external conditions (e.g. if there is a market for the goods, whether there is a well-defined private, public or collective ownership, etc.). For instance, where logging is banned, no (legal) exchange value for trees may exist, while there is an exchange value for non-timber forest products and other services.

Non-use value

<*Value* associated with benefits derived simply from the knowledge that a resource, such as an individual species or an entire *ecosystem*, is maintained>

It is by definition not associated with any use of the resource or tangible benefit derived from it, although users of a resource might also attribute *non-use value* to it. *Non-use value* can be both *objective* and *subjective*; its *subjective* component is closely linked to altruistic preferences, although for some analysts it stems ultimately from self-interest. It can be split into three basic components, although these may overlap depending upon exact definitions.

Existence value

<*Value* derived simply from the satisfaction of knowing that some feature of the environment continues to exist, whether or not this might also benefit others>

The *existence value* is gaining in importance as an argument for ecosystem protection.

Bequest value

<*Value* associated with the knowledge that a resource will be passed onto descendants to maintain the opportunity for them to enjoy it in the future>

Philanthropic value

<*Value* associated with the satisfaction from ensuring resources are available to contemporaries (the current generation)>

Categories not associated with the distinction between *use values* and *non-use values* include the following.

Option value

<*Value* derived from ensuring that a resource will be available for use in the future>

In this sense it is a form of *use value*, although it can be regarded as a form of insurance to provide for possible future but not current use.

Quasi-option value

<*Value* derived from the potential benefits of awaiting improved information before giving up the option to preserve a resource for future use>

It suggests a *value* in particular of avoiding irreversible damage that might prove to have been unwarranted in the light of further information. An example of a *quasi-option value* is in bio-prospecting, where *biodiversity* may be maintained on the off-chance that it might in the future be the source of important new medicinal drugs.

Insurance value is conceptually linked to the above notions of *option values*: ‘Identifying how close a system might be to collapse of some or all *functions* is itself extremely difficult, yet one would expect *willingness to pay* to avoid that collapse to be related in some way to the chances that the collapse will occur. If the chances are known, the *value* sought is then the premium that would be paid to conserve *resilience*’ (OECD 2002 p. 31).

Value metric

<A means of creating a ranking and accordingly quantifying value>

Inherent values use a nominal or Boolean metric consisting of only two possible values (1,0) in order to create orderings. That is, among a set of alternative objects and/or actions, we choose those with an *absolute value* by assigning 1 to them. All others are assigned 0. All 1s are superior to 0s; no trade-off is possible between 1s and 0s. *Instrumental values* use a variety of ordinal or cardinal metrics based on, e.g., energy, money or commodities.

Demand-driven value dynamics

<The phenomenon of *value* changes due to factors affecting the demand side of *ecosystem services*>

Supply-driven value dynamics

<The phenomenon of *value* changes due to changes in the supply conditions of *ecosystem services*>

Terms relating to conservation strategies

Habitat

<The *habitat* of a species, or population of a species, is the sum of the abiotic and biotic factors of the environment, whether natural or modified, which are essential to the life and reproduction of the species within its natural geographic range (adapted from Council of Europe 1989)>

This definition is broadly similar to, but more specific than, that given in the MA (2003) which is:

<the environmental attributes required by a particular species (its ecological niche)>

It also conforms to the general definition given by the Convention on Biodiversity (1992) which is:

<The place or type of site where an organism or population naturally occurs (Secretariat of the Convention on Biological Diversity (2001)>.

A species' *habitat* may change during different stages of life, for example in many freshwater insects which have an aquatic growth stage followed by a terrestrial reproductive stage.

Landscape

<A heterogeneous mosaic of *habitat* patches, physical conditions or other spatially variable elements viewed at scales relevant to the organisms or *processes* under consideration (adapted from Wiens 1995)>

Corridor

<A linear *landscape* structure that links similar *landscape* elements and facilitates movement of, and genetic exchange among, organisms between these elements (adapted from Wiens 1995)>

Buffer (buffer zone)

<A transitional zone around a *core area* or ecological restoration site managed to provide a protective function to mitigate or filter external disturbances arising from the wider *landscape* (adapted from Bonnin et al. 2007 and Farina 2000)>

Core area

<An area of *habitat* mosaic and/or *ecosystem* mosaic that is of high ecological quality within the wider *landscape*. The area is ecologically integrated, with functional relations between the constituent parts (adapted from Bonnin et al. 2007)>

Core areas are often (but by no means always) designated as, or form part of, a protected area (e.g. the most strongly protected portion of a National Park) and may be surrounded by a *buffer zone*.

Core Area may also be used to refer to an area occupied by a single species or a population of a species in which the habitat mosaic is most suitable for survival and reproduction (adapted from Farina 2000).

Ecological network

<A framework of ecological components, e.g. *core areas*, *corridors* and *buffer zones*, which provides the biological and physical conditions necessary for *populations* and *ecosystems* to survive in a human-dominated landscape>

The goal of *ecological networks* is 2-fold: to maintain biological and *landscape* diversity, and to serve as a network assisting policy sectors in the conservation of natural systems (adapted from Jongman and Pungetti 2004).

Concluding remarks

Glossaries can be very contentious and there will be few words herein for which the definition given is accepted universally. Even among RUBICODE participants there has been much discussion throughout the project over the precise meaning of certain terms that have been central to it. Such discussion, and as good a consensus as possible, are essential when trying to link concepts and unite their proponents who come from a range of disciplines. Thus, whilst the primary purpose of this paper is to explain usage of terminology in the papers that follow, it is hoped that it might be useful beyond the RUBICODE project.

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