

ES CODING PROTOCOL

Supporting services (A)

ID	ECOSYSTEM SERVICE	DESCRIPTOR (MILLENIUM ASSESSMENT)	DESCRIPTOR (OTHER)	CODING FORMULATIONS
1	<i>Water cycling</i> (MA 2005)	'Water cycling. Water cycles through ecosystems and is essential for living organisms.' (MA 2005, p. 40)		The hydrological cycle, precipitation patterns, protection of precipitation area
2	<i>Soil Formation</i> (MA 2005)	'Soil Formation. Because many provisioning services depend on soil fertility, the rate of soil formation influences human well-being in many ways.' (MA 2005, p. 40)		Soil formation, soil quality, high quality agricultural land (underlying quality of soil context)
3A	<i>Nutrient cycling – carbon cycle</i> (Daily 1997)	'Nutrient cycling. Approximately 20 nutrients essential for life, including nitrogen and phosphorus, cycle through ecosystems and are maintained at different concentrations in different parts of ecosystems.' (MA 2005, p. 40) Due to contextual difference, the carbon cycle (3A), the nitrogen cycle (3B), the sulfur cycle (3C) and the phosphorus cycle (3D) are separated from each other.	A) Carbon is the key element of all life. It is stored in the atmosphere, is used in the photosynthesis by plants, which are consumed by animals that use the carbon from the plants in their metabolism, and dead organic material is deformed to CO ₂ or redeposited as sediment. (Daily 1997)	The carbon cycle, , emissions of greenhouse gases, emissions (general context), emissions of CO ₂ , greenhouse gas strategies, international climate obligations
3B	<i>Nutrient cycling – nitrogen cycle</i> (Daily 1997)		B) Nitrogen, in its different forms, is involved in several biological and abiotic processes, e.g. as a compound in the atmosphere and in nitrogen fixation, which is the primary source of nitrogen for living organisms. (Daily 1997)	The nitrogen cycle, eutrophication, emissions (eutrophication context), nutrient cycle (agricultural or eutrophication context)
3C	<i>Nutrient cycling – sulfur cycle</i> (Daily 1997)		C) Required by living organisms. Sulfur is an important compound of plant tissue and is also consumed by animals and eventually returned to the soil. In its acid form, sulfur has a significant role in different processes, such as natural weathering of rocks acid rain. (Daily 1997)	The sulfur cycle
3D	<i>Nutrient cycling – phosphorus cycle</i> (Daily 1997)		D) As nitrogen and sulfur, phosphorus is an essential nutrient to plants and animals. (Daily 1997)	The phosphorus cycle, eutrophication, emissions (eutrophication context), nutrient cycle (agricultural or eutrophication context)
4	<i>Primary production (of the biosphere)</i> (MA 2005)		'Primary production. The assimilation or accumulation of energy and nutrients by organisms.' (MA 2005, p. 40)	
5	<i>Photosynthesis</i> (MA 2005)	'Photosynthesis. Photosynthesis produces oxygen necessary for most living organisms.' (MA 2005, p. 40)		Photosynthesis, oxygenation of the air by green areas
6	<i>Biodiversity</i> (Daily 1997, Forest et al. 2011)		Increases ecosystem productivity and stability, essential for all other categories of ESS. Interacts with the atmosphere, geosphere and hydrosphere to make services available (Daily 1997; Forest et al. 2011). Connectivity between different green areas make it possible for animal species to move from one area to another, which is positive for biological diversity (Daily 1997).	Biodiversity, conservation of species, ecologically vulnerable area, ecological linkage, linkage (ecosystem context), natural values, unique species/natural types, nature care (ecosystem context), valuable green area, habitat connectivity, seed dispersal, pollination, linked green areas, barrier (ecosystem context), corridors, ecology (conservation context), systems of green areas, allotment gardening, cultural landscapes (ecosystem context)

Provisioning services (B)

SD	ECOSYSTEM SERVICE	DESCRIPTOR (MILLENIUM ASSESSMENT)	ADDITIONAL INFORMATION	CODING FORMULATIONS
1	<i>Food - agriculture</i> (MA 2005)	'Food. This includes the vast range of food products derived from plants, animals, and microbes.' (MA 2005, p. 40)		Agriculture (ecosystem context), agricultural landscape (ecosystem context), food production, food security
2	<i>Food – capture fisheries</i> (MA 2005)	'Food. This includes the vast range of food products derived from plants, animals, and microbes.' (MA 2005, p. 40)		Fishery, fishing (commercial context)
3	<i>Food - wild</i> (Daily 1997)	'Food. This includes the vast range of food products derived from plants, animals, and microbes.' (MA 2005, p. 40)	Harvesting of wild plants, recreational fishing and hunting of wild animals for meat. (Daily 1997)	Berries, mushrooms, fishing (recreation context), hunting
4a	<i>Fresh water</i> (MA 2005)	'Fresh water. People obtain fresh water from ecosystems and thus the supply of fresh water can be considered a provisioning service.' (MA 2005, p. 40)		Access to water, drinking water, fresh water resources
4b	<i>Water - energy</i>		Hydroelectric generation (Postel and Carpenter 1997, p.196, in Daily 1997)	Hydro-electric power
4c	<i>Water - transportation</i>		'In many parts of the world, inland waterways offer convenient and relatively inexpensive pathways for the transport of goods from one place to another.' (Postel and Carpenter 1997, p.201, in Daily 1997)	Use of water body (sea, river or lake) for transportation purposes
5	<i>Biochemicals and genetic resource</i> (MA 2005)	'Genetic resources. This includes the genes and genetic information used for animal and plant breeding and biotechnology. Biochemicals, natural medicines, and pharmaceuticals. Many medicines, biocides, food additives such as alginates, and biological materials are derived from ecosystems.' (MA 2005, p. 40)		Biotechnology, genetic diversity
6	<i>Fiber</i> (MA 2005)	'Fiber. Materials included here are wood, jute, cotton, hemp, silk, and wool.' (MA 2005, p. 40)		Forestry, timber, wood, cotton
7	<i>Fuel</i> (MA 2005)	'Fuel. Wood, dung, and other biological materials serve as sources of energy.' (MA 2005, p. 40)		Bio-fuel supply, bio gas, methane (bio gas and energy context), energy crop

Regulating services (C)

SD	ECOSYSTEM SERVICE	DESCRIPTOR (MILLENIUM ASSESSMENT)	ADDITIONAL INFORMATION	CODING FORMULATIONS
1A	<i>Climate regulation – local</i> (MA 2005)	'Climate change. Ecosystems influence climate [...] At a local scale, for example, changes in land cover can affect both temperature and precipitation. Climate regulation.' (MA 2005, p. 40)		Evapotranspiration, green area (local climate context), climate regulation (local context), temperature regulation, albedo (local context), shade
1B	<i>Climate regulation – global</i> (MA 2005)	'Climate change. Ecosystems influence climate [...] At the global scale, ecosystems play an important role in climate by either sequestering or emitting greenhouse gases.' (MA 2005, p. 40)		Greenhouse gas sink, green area (global climate context), climate regulation (global context), albedo (global context)
2	<i>Air quality regulation</i> (MA 2005)	'Air quality regulation. Ecosystems both contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality.' (MA 2005, p. 40)		Green areas (in a cleaning context), air cleaning, air pollution (general), air quality (general), "natural sewage plant" (air quality context)
3	<i>Water purification and Waste Treatment</i> (MA 2005)	'Water purification and waste treatment. Ecosystems can be a source of impurities (for instance, in fresh water) but also can		Water cleaning, sewage treatment, water quality, water pollution (general), "natural

		help filter out and decompose organic wastes introduced into inland waters and coastal and marine ecosystems and can assimilate and detoxify compounds through soil and subsoil processes.' (MA 2005, p. 40)		sewage plant" (water quality context)
4	Water regulation (MA 2005)	'Water regulation. The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas.' (MA 2005, p. 40)	Forests preserve watersheds, which are necessary to regulate water flows in quality and quantity. (Daily 1997)	Regulation of water flows, water flows, storm water run off (reliability context)
5	<i>Disease regulation</i> (MA 2005)	'Disease regulation. Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes.' (MA 2005, p. 40)		
6	<i>Pest regulation</i> (MA 2005)	'Pest regulation. Ecosystem changes affect the prevalence of crop and livestock pests and diseases.' (MA 2005, p. 40)		Noxious weed infestation, exotic marine pests, introduction of invasive pathogens (resistance context)
7	<i>Natural hazard regulation</i> (MA 2005)	'Natural hazard regulation. Wetlands and barrier beaches have a flood storage capacity. Urban ecosystems are especially sensitive due to constrained water flows, which can increase the risk of floods in urban areas. Natural forests are effective protectors of crops and humans from high winds. Some ecosystems have the ability to prevent major fire disasters, which can be futile for plants, animals and the human society'. The presence of coastal ecosystems such as mangroves and coral reefs can reduce the damage caused by hurricanes or large waves.' (MA 2005, p. 40)		Water flows (extreme events context), bush fire, shade (context), flooding (flood plains, flood mitigation, flood control)
8	<i>Erosion regulation – soil retention</i> (MA 2005)	'Vegetable cover plays an important role in soil retention and the prevention of landslides.' (MA 2005, p. 40)		Landslides (context), erosion regulation (e.g. river bank protection, coastal protection, soil erosion)
9	<i>Pollination</i> (MA 2005)	'Pollination. Ecosystem changes affect the distribution, abundance, and effectiveness of pollinators' (MA 2005, p. 40)	Pollination of flowers by insects, wind, birds and water is necessary for sexual reproduction in flowering plant species. Functional composition of pollinator assemblage and connectivity of landscapes are necessary for maintenance of plant genetic pool and quality as well as quantity of fruits (Nabhan and Buchmann 1997, pp.133-150, in Daily 1997).	Pollination, ecological linkage, linked green areas (ecosystem context), barrier (ecosystem context), corridors, linkage (ecosystem context), allotment gardening
10	<i>Seed dispersal</i> (Daily 1997)		Seeds are dispersed by wind, water or by animals in various ways (Daily 1997).	Seed dispersal, ecological linkage, linked green areas (ecosystem context), barrier (ecosystem context), green corridors, linkage (ecosystem context), allotment gardening
11	<i>Noise regulation</i> (Bolund and Hunhammar 1999)		A soft lawn reduces noise from e.g. traffic better than concrete ground and vegetation, i.e. shrubbery and dense plantation, also reduces noise at some level. (Bolund and Hunhammar 1999)	Green areas (in a noise context)

Cultural services (D)

SD	ECOSYSTEM SERVICE	DESCRIPTOR (MILLENNIUM ASSESSMENT)	ADDITIONAL INFORMATION	CODING FORMULATIONS
1	<i>Social relations</i> (MA 2005)	'Social relations. Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies' (MA 2005, p. 40)		
2	<i>Cultural heritage values</i> (MA 2005)	Cultural heritage values. Many societies place high value on the maintenance of either historically important landscapes ("cultural landscapes") or culturally significant species.' (MA 2005, p. 40)		Cultural values, of cultural history interest, of cultural interest, cultural landscapes, heritage values, ancient remains (conservation context)
3	<i>Sense of place</i> (MA 2005)	'Sense of place. Many people value the "sense of place" that is associated with recognized features of their environment, including aspects of the ecosystem.' (MA 2005, p. 40)	Emotional impact tied to place identity rather than cultural or aesthetic value. Note that this often overlaps with D2 or D4.	
4	<i>Aesthetic</i> (MA 2005)	'Aesthetic values. Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations.' (MA 2005, p. 40)		Scenic views, beautiful nature.
5	<i>Inspirational</i> (MA 2005)	'Inspiration. Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising.' (MA 2005, p. 40)		
6	<i>Recreation and ecotourism</i> (MA 2005)	'Recreation and ecotourism. People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.' (MA 2005, p. 40)		Recreation, tourism (nature context), closeness to/access to nature/recreation, strolling area (nature context), walking area (nature context), active outdoor life, golf course, nature silence, park, fishing (recreation context), silence (nature context), good living environment (nature context), tourism (nature context)
7	<i>Educational and knowledge</i> (MA 2005)	'Knowledge systems (traditional and formal). Ecosystems influence the types of knowledge systems developed by different cultures. Educational values. Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.' (MA 2005, p. 40)		Botanical garden, informational plaque (ecosystem context), learning about nature, experiencing nature
8	<i>Health</i> (Maas et al. 2006)		Closeness to green areas generates positive health effects to humans. (Mass et al. 2006)	Health related (outdoor recreation and appreciation context including green areas and beaches)
9	<i>Spiritual and religious values</i> (MA 2005)	'Spiritual and religious values. Many religions attach spiritual and religious values to ecosystems or their components.' (MA 2005, p. 40)		Ancient remains (nature context),, spiritual/religious connection to the land, religious heritage