IPBES Global assessment – Chapter 1 Supplementary materials

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SM 1.2 Nature's contributions to people

Table S1. Reporting categories of nature's contributions to people (NCP) used in IPBES assessments according to the generalizing perspective (from (Díaz et al., 2018)**)**

The 18 NCP reporting categories recommended for IPBES assessments, according to the generalizing perspective (see main text and Figure 2). The NCP listed here are in some cases sharply-defined contributions, and in some others represent bundles of similar contributions. Beyond IPBES, this list of NCP is meant to be indicative, not exhaustive. The explanations, examples and references are also illustrative. The order of NCP in the table does not denote importance or priority. The placing of each of the 18 reporting categories in the broad groups of material, non-material and/or regulating NCP is shown in Figure S2. The NCP are provided, depending on the case, by particular organisms, by ecosystems, or by particular mixtures of organisms, assembled naturally (e.g. the assemblage of pollinators in a landscape) or artificially (e.g. a planted grove, or a plant mixture on a green roof). Note that these contributions can be positive or negative according to the cultural and socio-economic context of the stakeholders, or even perceived as benefits or decrements by same stakeholder group according to the spatial or temporal context (Rasmussen et al., 2017; Saunders & Luck, 2016; Shapiro & Báldi, 2014; Villa et al., 2014).

	Reporting categories of nature's contributions to people	**Brief explanation and some examples**
1	Habitat creation and maintenance	The formation and continued production, by ecosystems or organisms within them, of ecological conditions necessary or favorable for living beings of direct or indirect importance to humans. E.g. growing sites for plants (N. Turner, 2014), nesting, feeding, and mating sites for animals, resting and overwintering areas for migratory mammals, birds and butterflies (Berkes, 2012; N. Turner, 2014), roosting places for agricultural pests and disease vectors (Waldner et al., 2015), nurseries for juvenile stages of fish (Liquete et al., 2016; Schönberg & Fromont, 2012; Staveley et al., 2016; Thomsen et al., 2016), habitat creation at different soil depths by invertebrates (Ransom, 2011)
2	Pollination and dispersal of seeds and other propagules	Facilitation by animals of movement of pollen among flowers (Ellis et al., 2015; Hill et al., 2016; Potts et al., 2016), and dispersal of seeds, larvae or spores of organisms beneficial or harmful to humans (Culot et al., 2017; Ellis et al., 2015; Galetti et al., 2008; Gonzáez-Varo et al., 2017; O'Farrill et al., 2013; Tol et al., 2017; Young et al., 2016)
3	Regulation of air quality	Regulation (by impediment or facilitation) by ecosystems, of CO_2/O_2 balance, O_3, sulphur oxide, nitrogen oxides (NOx), volatile organic compounds (VOC), particulates, aerosols, allergens (A. Arneth et al., 2010; Ciais et al., 2013; Lelieveld et al., 2008; McInnes et al., 2017; Nowak et al., 2006; Sospedra et al., 2015) Filtration, fixation, degradation or storage of pollutants that directly affect human health or infrastructure (Abhijith et al., 2017; Klingberg et al., 2017; Obrist et al., 2017; Ren et al., 2017)

4	Regulation of climate	Climate regulation by ecosystems (including regulation of global warming) through: . Positive or negative effects on emissions of greenhouse gases (e.g. biological carbon storage and sequestration; methane emissions from wetlands) (Ciais et al., 2013; Le Quere et al., 2016; Mosier et al., 1991; Zimov & Zimov, 2014) . Positive or negative effects on biophysical feedbacks from vegetation cover to atmosphere, such as those involving albedo, surface roughness, long-wave radiation, evapotranspiration (including moisture-recycling) and cloud formation (Chapin et al., 2008; Houspanossian et al., 2017; Nakai et al., 2003; Poeschl et al., 2010; Ringgaard et al., 2014) . Direct and indirect processes involving biogenic volatile organic compounds (BVOC), and regulation of aerosols and aerosol precursors by terrestrial plants and phytoplankton (Almut Arneth et al., 2016; Bai et al., 2016; Bryan et al., 2015; Hantson et al., 2017; Houspanossian et al., 2017; Lana et al., 2011; Quinn & Bates, 2011; Svendsen et al., 2016; Unger, 2014; Zhu et al., 2016)
5	Regulation of ocean acidification	Regulation, by photosynthetic organisms (on land or in water), of atmospheric CO_2 concentrations and so seawater pH, which affects associated calcification processes by many marine organisms important to humans (such as corals) (Cao & Caldeira, 2008; Lavery et al., 2013; McCulloch et al., 2017)
6	Regulation of freshwater quantity, location and timing {(Ref, #1857}	Regulation, by ecosystems, of the quantity, location and timing of the flow of surface and groundwater used for drinking, irrigation, transport, hydropower, and as the support of non-material contributions (NCP 15, 16, 17) (Brauman, 2015; Brauman et al., 2007; David C Le Maitre et al., 2015) Regulation of flow to water-dependent natural habitats that in turn positively or negatively affect people downstream, including via flooding (wetlands including ponds, rivers, lakes, swamps) (Collen & Gibson, 2000; Dadson et al., 2017; Palmer et al., 2014; Stürck et al., 2014; Zedler & Kercher, 2005) Modification of groundwater levels, which can ameliorate dryland salinization in unirrigated landscapes (D C Le Maitre et al., 1999; Lerner & Harris, 2009; Marchesini et al., 2017; Pannell & Ewing, 2006)
7	Regulation of freshwater and coastal water quality	Regulation – through filtration of particles, pathogens, excess nutrients, and other chemicals – by ecosystems or particular organisms, of the quality of water used directly (e.g. drinking, swimming) or indirectly (e.g. aquatic foods, irrigated food and fiber crops, freshwater and coastal habitats of heritage value) (Brauman et al., 2007; Cardinale, 2011; Dosskey et al., 2010; Keeler et al., 2012; Madsen et al., 2001; Verhoeven et al., 2006)

8	Formation, protection and decontamination of soils and sediments	Formation and long-term maintenance of soil structure and processes by plants and soil organisms. Includes: physical protection of soil and sediments from erosion (Fu et al., 2011; Guerra et al., 2016), and supply of organic matter and nutrients by vegetation; processes that underlie the continued fertility of soils important to humans (e.g. decomposition and nutrient cycling) (Falkowski et al., 2016; Ghaley et al., 2014; Wall et al., 2015); filtration, fixation, attenuation or storage of chemical and biological pollutants (pathogens, toxics, excess nutrients) in soils and sediments (Jeffries et al., 2003; O'Donnell, 2016; van der Heijden et al., 2008; Vangronsveld et al., 2009; Wall et al., 2015)
9	Regulation of hazards and extreme events	Amelioration, by ecosystems, of the impacts on humans or their infrastructure caused by e.g. floods, wind, storms, hurricanes, heat waves, tsunamis, high noise levels, fires, seawater intrusion, tidal waves (Bravo de Guenni et al., 2005; Marois & Mitsch, 2015; Ow & Ghosh, 2017; Saleh & Weinstein, 2016; Spalding et al., 2014) Reduction or increase, by ecosystems or particular organisms, of hazards like landslides, avalanches (Greenwood et al., 2007; Moos et al., 2017; Notaro & Paletto, 2012; Stokes et al., 2005)
10	Regulation of detrimental organisms and biological processes	Regulation, by organisms, of pests, pathogens, predators or competitors that affect humans (materially and non-materially), or plants or animals of importance for humans. Also the direct detrimental effect of organisms on humans or their plants, animals or infrastructure. These include e.g.: . Control by predators or parasites of the population size of animals important to humans, such as attacks by large carnivores (Becker & Farja, 2017; Nyhus, 2016; Palmeira et al., 2008; Peterson et al., 2010), or infestation by liver fluke, on game or livestock) (Carmona & Tort, 2017; Karesh et al., 2012) . Regulation (by impediment or facilitation) of the abundance or distribution of potentially harmful organisms (e.g. venomous, toxic, allergenic, predators, parasites, competitors, pathogens, agricultural weeds and pests, disease vectors and reservoirs) over the landscape or seascape (Andreo et al., 2012; Begg et al., 2017; Garni et al., 2014; Karp & Daily, 2014; Lacey et al., 2015; Naylor & Ehrlich, 1997; Pearson & Callaway, 2006) . Removal, by scavengers, of animal carcasses and human corpses (e.g. vultures in Zoroastrian and some Tibetan Buddhist traditions) (Abay et al., 2011; Ćirović et al., 2016; Moleón et al., 2014; Morales‐Reyes et al., 2017) . Biological impairment and degradation of infrastructure (e.g. damage by pigeons, bats, termites, strangling figs to buildings) (Di Giovine, 2009; Spennemann et al., 2017; Zeale et al., 2016) . Direct physical damage to crops, forest plantations, livestock, poultry and fisheries by mammals, birds and reptiles(Nyhus, 2016; Peterson et al., 2010) . Damage caused by invertebrates as pests of agriculture, horticulture, forest, and stored products, and by affecting

		health of domestic animals (FAO, 2015; Oerke, 2005; Sallam, 1999) . Direct damage caused by organisms to humans by e.g. frightening, hurting, killing, or transmitting diseases (Peterson et al., 2010) . Regulation of the human immune system by a diverse environmental microbiota (Hanski et al., 2012)
11	Energy	Production of biomass-based fuels, such as biofuel crops, animal waste, fuelwood, agricultural residue pellets, peat (Cole et al., 2016; Gasparatos et al., 2011; Kamimura et al., 2012; Lawton et al., 2017; Yamamoto, 2008)
12	Food and feed	Production of food from wild , managed, or domesticated organisms, such as fish, bushmeat and edible invertebrates, beef, poultry, game, dairy products, edible crops, wild plants, mushrooms, honey (Ayantunde et al., 2014; Boa, 2004; Chaves et al., 2017; FAO, 2016b, 2016a; Hill et al., 2016; Kittinger et al., 2017; Mueller et al., 2016; Norris et al., 2010; Payne et al., 2016; Potts et al., 2016; Rowland et al., 2017; Schulp et al., 2014; Stafford et al., 2017; Tessema et al., 2014; Van Vliet et al., 2017) Production of feed (forage and fodder) for domesticated animals (e.g. livestock, work and support animals, pets) or for aquaculture, from the same sources (FAO, 2016a, 2016b; Henry et al., 2015; Payne et al., 2016; Sanchez-Muros et al., 2014)
13	Materials, companionship and labor	Production of materials derived from organisms in cultivated or wild ecosystems, for construction, clothing, printing, ornamental purposes (e.g. wood, peat, fibers, waxes, paper, resins, dyes, pearls, shells, coral branches) (Albert et al., 2015; Auliya et al., 2016; D'Cruze & Macdonald, 2016; FAO, 2010, 2016b; ITTO, 2016; Saheb et al., 2011; Yamamoto, 2008) Live organisms being directly used for decoration (i.e. ornamental plants, birds, fish in households and public spaces), company (e.g. pets), transport, and labor (including herding, searching, guidance, guarding) (Cruz-Garcia et al., 2015; Dehnen-Schmutz et al., 2007; FAO, 2010; Hull, 2008; Larson & Fuller, 2014; Linnell & Lescureux, 2015; Militz et al., 2016; Ng et al., 2016; Phillips, 2015; Prakash et al., 2017; Rhyne et al., 2017; Silva Souto et al., 2017)
14	Medicinal, biochemical and genetic resources	Production of materials derived from organisms (plants, animals, fungi, microbes) used for medicinal, veterinary and pharmacological (e.g. poisonous, psychoactive) purposes. Production of genes and genetic information used for plant and animal breeding and biotechnology (Bari et al., 2016; Blunt et al., 2017; Demunshi & Chugh, 2010; Goeschl & Swanson, 2002; Hunt & Vincent, 2006; Ruiz Muller, 2015; Schultes et al., 2001; N. Turner, 2014)
15	Learning and inspiration	Provision, by landscapes, seascapes, habitats or organisms, of opportunities for the development of the capabilities that allow humans to prosper through education, acquisition of knowledge and development of skills for well-being, information, and inspiration for art and technological design (e.g. biomimicry) (Baino & Ferraris, 2017; Berkes & Turner, 2006; Chan et al., 2012; Fisch, 2017; Fish et al., 2016; Gould

		& Lincoln, 2017; Mocior & Kruse, 2016; Posey, 1999; Santos-Fita et al., 2015; N. J. Turner & Berkes, 2006)
16	Physical and psychological experiences	Provision, by landscapes, seascapes, habitats or organisms, of opportunities for physically and psychologically beneficial activities, healing, relaxation, recreation, leisure, tourism and aesthetic enjoyment based on the close contact with nature (e.g. hiking, recreational hunting and fishing, birdwatching, snorkeling, diving, gardening) (Balmford et al., 2015; Barua, 2011; Gobster et al., 2007; Hausmann et al., 2015; Kaplan & Kaplan, 1989; Keniger et al., 2013; Maller et al., 2006; Martín-López et al., 2008; Oteros-Rozas et al., 2017; Posey, 1999; Sandifer et al., 2015; van Zanten et al., 2016; Verschuuren, 2010)
17	Supporting identities	Landscapes, seascapes, habitats or organisms being the basis for religious, spiritual, and social-cohesion experiences: . Provisioning of opportunities by nature for people to develop a sense of place, belonging, rootedness or connectedness, associated with different entities of the living world (e. g. cultural, sacred and heritage landscapes, sounds, scents and sights associated with childhood experiences, iconic animals, trees or flowers) (Agnoletti & Santoro, 2015; Basso, 1996; Bratman et al., 2015; Garibaldi & Turner, 2004; Hausmann et al., 2015; IEEP et al., 2016; Klain et al., 2014; Maas et al., 2009; Pawu-Kurlpurlurnu et al., 2008; Plieninger et al., 2013; Rutte, 2011; Swanwick et al., 2003) . Basis for narratives, rituals and celebrations provided by landscapes, seascapes, habitats, species or organisms (Berbés-Blázquez et al., 2016; Berkes, 2012; Boa, 2004; Hill et al., 2016; Jimoh et al., 2012; Pawu-Kurlpurlurnu et al., 2008; Santos-Fita et al., 2015) . Source of satisfaction derived from knowing that a particular landscape, seascape, habitat or species exists (García-Llorente et al., 2012; Mace et al., 2012)
18	Maintenance of options {Note this is different from option/bequest value which is the value of knowing that any given NCP will be available for future enjoyment, #1858}	Capacity of ecosystems, habitats, species or genotypes to keep options open in order to support a good quality of life. Examples include: • Benefits (including those of future generations) associated with the continued existence of a wide variety of species, populations and genotypes. This includes their contributions to the resilience and resistance of ecosystem properties in the face of environmental change and variability (Anderson et al., 2015; Berbés-Blázquez et al., 2016; Bullock et al., 2017; Colloff et al., 2017; Lavorel et al., 2015; Schindler et al., 2015) • Future benefits (or threats) derived from keeping options open for yet unknown discoveries and unanticipated uses of particular organisms or ecosystems that already exist (e.g. new medicines or materials) (Faith et al., 2010) • Future benefits (or threats) that may be anticipated from on-going biological evolution (e.g. adaptation to a warmer climate, to emergent diseases, development of resistance to antibiotics and other control agents by pathogens and weeds) (Faith et al., 2010; Hendry et al., 2017)

Table S2: Two examples of nature's contributions to people (NCP) reporting categories, according to the context-specific perspective (from {Díaz, 2018 #2414}

In addressing NCP within the context of knowledge systems other than physical, natural and economic sciences, the 18 generalizing categories of Table S1 are often not applicable. This is typical, but not exclusive (e.g. (Latour, 2005)) of the knowledge systems of indigenous peoples and local communities. Instead different categories or more holistic relationships through practices are recognized. In some cases, relationships between nature and people are highly reciprocal, with NCP arising from practices of mutual care (Berkes, 2012; Comberti et al., 2015; Jackson & Palmer, 2015; Von Heland & Folke, 2014). The two examples below are illustration of the diverse ways in which NCP are framed in different cultural contexts. Note that this perspective and the generalizing perspective are not mutually exclusive; they often blend and interweave (Berger-González et al., 2016; Chilisa, 2017; Idrobo & Berkes, 2012; Sterling et al., 2017).

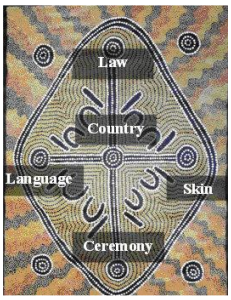
Example 1 - Categories used to recognize context-specific NCP in the IPBES Pollination Assessment (Hill et al., 2016)

In the IPBES Pollination Assessment, engagement with ILK-holders led to part of NCP being framed as "gifts" to both people and biota, through "practices" that link people and pollinators in ongoing reciprocal relationships. ILK-holders explained how pollination processes are understood, celebrated and managed holistically through fostering fertility, fecundity, spirituality and diversity; see (Hill et al., 2016) for full referencing.

How NCP is framed to suit this context	**The categories used for analysis of NCP in this context**	**Examples/description**
Practices (for and with pollinators) gifted to indigenous peoples and local communities	Practices of valuing diversity and fostering biocultural diversity	Kawaiwete people in the southern Amazon perceive that the spiritual entity who protects stingless bees will inflict "bee illness" on those who do not show respect and observe silence when collecting honey; they identify 37 stingless bee species and protect 28 forest tree species used for nesting as well as 19 other plant species used for food by these bees.
	Landscape management practices	Seven practices were identified: i. Taboos that protect pollinators and pollinator resources; ii. Kinship relationships that protect pollinators and pollination resources; iii. Mental maps and animal behaviour knowledge as management practices; iv. Fire management to enhance pollination resources; v. Manipulation of pollination resources in different seasons and landscape patches; vi. Biotemporal indicators for management actions; vii. Providing pollinator nesting resources.
	Diversified farming systems	Four types of diversified farming systems that influence agrobiodiversity, pollinators and pollination were identified: i. Shifting cultivation (e.g. Milpa systems in central America); ii. Home gardens (e.g. Mesoamerican home gardens contain some 811 cultivated species); iii. Commodity agroforestry (e.g. shade coffee systems provide habitat for bird pollinators); iv. Farming of semi-domesticated and domesticated bees.

Example 2 - How Warlpiri understand nature's contributions to people (Pawu-Kurlpurlurnu et al., 2008)

For the Warlpiri people, nature's contributions to people are understood in terms of *Ngurra-kurlu,* roughly translated as "from country" or "country within people". In Aboriginal English, a person's land, sea, sky, rivers, sites, seasons, plants and animals; place of heritage, belonging and spirituality; is called "country" (Australian Museum, 2018). The term *Ngurra-kurlu* reflects the fundamental Warlpiri perspective of reciprocity between people and country. In this context, people and country are one body *Palka.* The image embedded in the first column represents *Ngurra-kurlu,* Warlpiri people's understanding of how country contributes to people and vice-versa (painting by Daniel Rockman Jupurrurla, from (Pawu-Kurlpurlurnu et al., 2008), reproduced under the Creative Commons license).

How NCP are framed to suit this context	**The categories used for analysis in this context**	**Examples/description**
Ngurra-kurlu meaning "from country". "This *ngurra-kurlu* is *palka*: he got his own heart, he's got his own kidney, he's got his own liver. If you take one of them away, his whole body will drop"  	Law	The Law provides the guidelines, the knowledge, beliefs, practices, rules and regulations. "The law is a serious thing and it needs to be followed…Wawirri (red kangaroo) is a symbol of the Law. Men cooking a kangaroo is a serious thing"
	Skin	"Skin" groups connect people with each other and with nature through obligations and responsibilities; for example different skin groups have responsibility for Emu dreaming, Emu song lines, Emu ceremony and thereby the Emu.
	Ceremony	Many types of ceremony are needed for *ngurra-kurlu* to function properly – public and secret rituals of women and men separately; atonement and reconciliation ceremonies; initiation. Ceremony supports the healthy functioning of people and country.
	Language	Language encodes the unique Warlpiri worldview "language is like a tree, it makes you stand firm in country". There is skin language, land language, ceremony language, law language. People change their language to show respect, to show the messages of sacred objects and designs.
	Country	Country is in the middle of the Ngurra-kurlu template and links everything; it is home.

SM 1.3 Typology of drivers

Objects of analysis

According to the Scoping Document, the analysis refers to social and ecological systems that operate at various time and space scales. Attention is given to the global and cross-regional status of and trends in nature, nature's contributions to people and their impacts on a good quality of life, and the way in which they are affected by status of and trends in indirect and direct drivers and the major interactions among these elements, incorporating multiple world-views and different knowledge systems. Human actions often mobilise a bundle of direct (and maybe indirect) drivers which must be analysed coherently.

Direct drivers of change

Definition

Direct drivers have direct physical (mechanical, chemical, noise, light etc.) and behaviour-affecting (disturbance etc.) impacts on nature. They are also sometimes referred to as 'pressures' (e.g., MA 2005) or 'proximate sources' (e.g. Turner et al. 1990; Lambin et al. 1999; Lambin et al. 2006) in the literature in the context of other initiatives. According to the Scoping Document, direct drivers include, inter alia, climate change, pollution, different types of land use change, invasive alien species and zoonoses, exploitation, including their effects across regions. For decision makers, some drivers will be seen as within their control and others as beyond their control, be it natural or anthropogenic drivers.

Direct drivers are caused by actions motivated by values and enabled by institutions and governance mechanisms. One action can contribute to several drivers, and one driver can be caused by several actions.

Natural direct drivers

are events or processes occurring independent of human intervention, such as volcanic eruptions, which have direct influence on nature and NCP. Natural direct drivers are beyond human control, although their impacts might be ameliorated by disaster preparedness.

Anthropogenic direct drivers

comprise all those events and processes that are the immediate deliberate effect (e.g. logging) or collateral effect (e.g. pollution) of human actions , and directly affect nature and, through it, can also affect nature's contributions to people and a good quality of life on a large scale. Like climate change, they can be caused by global effects of actions, or by ubiquitous local actions such as land use change (e.g., intensification or abandonment of agriculture, set up of a protected area) or deforestation.

Natural-anthropogenic(-interaction) drivers

In some cases it may be difficult to differentiate the natural and anthropogenic origin of a given driver (e.g. extreme weather events, unusual flooding, biological invasions, pollinator loss).

Typology of Direct Drivers

Climate change

(mostly a consequence of accumulation of greenhouse gases in the atmosphere, although by definition and at considerably longer time scales it can be caused by other factors as well)
includes

- increasing global average temperatures and their local/regional modification,
- sea level rise,
- changing temperature and precipitation patterns,
- destabilisation of weather patterns and
- changes in the frequency and strength of extreme weather events.

Pollution

Contamination or undesirable modification of soil, water, the atmosphere, food or living space by a noxious or toxic substance, noise or light. Pollution includes (but is not restricted to):

- Emissions into an ecosystem such as surplus amounts of agrochemicals into gardens and agro-ecosystems, or de-icing products on roads, affecting soil or water biota.
- Spill-over of substances from the target ecosystem (where they may be harmless or useful) to sensitive ecosystems (e.g. run-off from adjacent land areas into limnic or marine ecosystems),
- Disposal or deposition of effluents, e.g. industrial pollution of soil, water or air (other than emission of greenhouse gases) or garbage disposal.
- Increased emissions of carbon dioxide to the atmosphere that,
    - cause greenhouse effects which in turn change climate (but the direct driver affecting nature is climate);
    - cause ocean acidification (carbon dioxide gets dissolved in sea water, the pH of seawater changes, which alters the calcification process of many sea organisms);
    - can directly stimulate the photosynthesis of plants (as carbon dioxide is a raw material for photosynthesis).

Land/sea use change

comprises changes in the kind of use, or the intensity of use of terrestrial, limnic and marine ecosystems (e.g. intensification or extensification of agriculture and aquaculture, fishing vs. overfishing) affecting global nature, nature's contributions to people and a good quality of life in a positive or negative direction.

Transformations

(land/sea use change) into a different kind of ecosystem, causing irreversible or at least significant and long-lasting changes to nature and NCP. Examples include but are not limited to

- turning aquatic into terrestrial surfaces or vice versa (e.g. by land reclamation from the sea, flooding by dams for energy generation),
- transforming the surface by digging, dragging or by covering it (e.g. soil sealing for settlements and infrastructure in urbanisation, or mining operations),
- transforming forests into other systems or vice versa (deforestation, afforestation / plantation, clear-cutting),
- transforming grassland and wetlands into agricultural area or vice versa,
- changing the degree of fragmentation of habitat,
- transforming aquatic systems for transport and navigation or renaturation.

Intensity changes

(land/sea use modification) implying that the kind of use remains basically the same (agriculture, forestry, leisure, etc.), but the use intensity increases or decreases as a direct result of human management decisions. Examples are

- agriculture (e.g. intensification, extensification, abandonment)
- pastoral use (grazing, overgrazing)
- start or end of conservation and restoration, land management (incl. fire use)

Direct exploitation (of components of nature)

- extraction or harvesting of wild organisms or populations (e.g. by collecting (incl. fire wood, medicinal or ritual organisms), hunting, fishing etc.)
- extraction or harvesting of other biological products from ecosystem (e.g. honey, waxes, etc.)
- extraction or abstraction of water from aquatic ecosystems (e.g. water withdrawal from streams for food and sanitation, irrigation, inter-basin water transfer)
- extraction or abstraction of soils and substrates (e.g. peat)

Invasive alien species incl. zoonoses and pest outbreaks

Invasive alien species are not native to a specific location, and have a tendency to spread to a degree believed to have impacts on nature, and through it on nature’s contributions to people, biodiversity, human economy, human health or a good quality of life. The impacts can be considered negative or positive according to the context, and the term "invasive" is itself subjective as well, a social construct which may vary over time and according to social context. Zoonoses are infectious diseases which can be transferred between humans

and animal, mostly vertebrate species representing a particular kind of invasive species usually considered to be of unambiguously negative effect.

Invasive alien species incl. zoonoses can be the consequence in particular of

- purposeful introduction of organisms (e.g. for leisure or decoration purposes)
- unintentional introduction of species and varieties (e.g. dispersion by global trade)
- climate or land-use change causing expansions of historical distribution ranges (e.g. insect outbreaks such as bark borers or mosquitoes carrying Leishmaniosis)

Indirect drivers of change

Definition:
Indirect drivers are drivers that operate diffusely by altering and influencing direct drivers. They do not impact nature directly, rather, they do it by affecting the level, direction or rate of direct drivers. They have been referred to as 'underlying causes' or 'driving forces' in the context of other initiatives (e.g. Lambin et al. 1999; Maxim et al. 2009). Indirect drivers can also affect other indirect drivers. Interactions between indirect and direct drivers create different chains of relationship, attribution, and impacts, which may vary according to type, intensity, duration, and distance. These relationships can also lead to different types of spill-over effects.
According to the Scoping Document, global indirect drivers include economic, demographic, governance, technological and cultural ones. Special attention is given, among indirect drivers, to the role of institutions (both formal and informal) and impacts of the patterns of production, supply and consumption on nature, nature's contributions to people and good quality of life.

Typology of Indirect Drivers

Institutions

Broadly defined, institutions are systems of formal and informal rules that structure human interactions. They are collectively produced by actors and in turn are shaping their behaviour, stimulating, directing or restricting action. The systems of rules can be explicit or not, formal or informal and may or may not include mechanisms for rule enforcement. Thus, they encompass all formal and informal rules that determine how decisions are taken and implemented, how power is exercised and how responsibilities are distributed. Institutions as politically relevant social rules and norms can be subdivided into institutional orientations (e.g.,~~,~~ social narratives, *leitbilder*, ,social expectations and behavioural norms), institutional mechanisms (e.g., procedures, customary laws, policies incl. taxes, subsidies, property systems and access rights to resources such as public, common-pool, private, open, or social hierarchies and ascribed status). Institutions are not equivalent to organisations, however the latter is composed of multiple institutions representing systems of rules and norms, for instance administrations, parties, advisory boards, business, the education system, etc.. Institutions also underlie, inter alia,

investment initiatives and multilateral environmental, trade agreements, as well as their effects on other components of the conceptual framework.

Economic drivers

refer to the whole economic system, comprising the economy of all processes of extraction, processing, manufacturing, distributing, transferring (money, investment, subsidies), exchanging (trade, travel, tourism), consuming and disposing goods and services, as far as it is affecting human individuals, social entities and nature, nature's contributions to people and good quality of life. The individual components of the system may act as direct drivers.

Patterns of supply

refer to the sourcing of inputs, local vs. global, and the kind of supply chains involved. They are decisive for the environmental impacts of global trade, including marine water and air pollution.

Patterns of production

comprise the kinds of products produced and the means (technologies, work organisation, resources used incl. energy) of doing so; they determine the patterns of supply and influence the patterns of consumption.

Patterns of consumption

comprise both the level of consumption and the composition of consumption; both factors influence (through direct drivers) nature, and through it nature's contributions to people and good quality of life.

- **Economic affluence** is a dominant factor influencing patterns of consumption, both level and composition, with more affluence correlated to higher impacts. Affluence is affected by the distribution of income (the flow of money or equivalents received) and wealth (the stock of money or equivalents owned).
- **Inequality** of income, wealth distribution, and access to public goods tends to enhance the consumption levels of the upper strata and thus the impacts on nature and nature's contributions to people, while the lower strata are at risk of poverty, not being able to achieve a good quality of life.
- **Poverty:** there are multiple definitions of poverty reflecting different degrees of attention to the relative and/or absolute deprivation of material (e.g., access to food, water, shelter of socially acceptable quality) and non-material conditions (e.g., social relations, choices and opportunities, and political liberties) necessary to the fulfilment of one's good quality of life. The relationship between levels of poverty, nature, nature's contribution to people, and good quality of life varies according to context (e.g., where one lives along a urban-rural gradient, level of access to natural resources) and level of analysis (e.g., individual and families, settlement, national levels).

Demographic drivers

refer to human population dynamics, including changes of population size, distribution, age and sex structure. Relevant parameters for a given population include growth rate, fertility rate, mortality rate, replacement rate, mobility and migration patterns and flows, including internal migration, displacement, and urbanization trends.

Technological drivers

are innovations, i.e. the application of inventions (discoveries and new insights or paradigms) which can have both positive and negative effects on nature, nature's contributions to people and good quality of life.

Governance drivers

represent social functions comprised of formal or informal decision-making processes centered on steering human groups toward particular goals, for instance as associated with a region or territory and/or a resource system . They may impact the status quo of societies/communities by influencing social change in preordained directions and the interaction of their members amongst each other or with the environment, affecting nature, nature's contributions to people and good quality of life.

Regional conflicts and wars

While the motivations of agents vary (e.g. resource control, political control, territorial enclosure, regime change), civil conflicts most often begin with the exclusion of social groups by majorities or power holders, denying them, amongst other rights, access to infrastructure and public services (water, energy, sewage, garbage collection) (Scheffran et al. 2012). Such conflicts can escalate into violence by suppression or by resistance, or both, resulting in human suffering and conflict-driven migration, and often in severe social environmental impacts. Positive impacts for biodiversity can exist, for instance by turning certain areas inaccessible to human use or economic development, making the protection of nature and NCP an important issue in post-war reconciliation and reconstruction processes), but that is a rare exception from the negative tendency. In different degrees, conflict situations impact nature and nature's contributions to people are at risk of severe damage, and a good quality of life amongst those affected will almost always suffer significantly.

Sociocultural and socio-psychological drivers (values, beliefs, norms)

are collective phenomena, mostly constituted by social processes and positions and conveyed by socialisation and education, shaping the attitudes and the behaviour of individuals as well as of groups and institutions. They include but are not limited to

- diverse value systems, often linked to behavioural norms,
- prevailing or changing preferences, tastes, fashions and habits,
- behavioural routines including decision making processes,
- belief systems and associated rituals

They are institutions shaping humans' attitudes towards and interaction with nature, affecting nature's contributions to people and good quality of life.

Health problems as indirect drivers

include larger-scale epidemics (pandemics) as well as wide-spread (endemic) diseases indirectly affecting nature and through it nature's contributions to people and good quality of life. For instance, epidemics may lead to population displacement (evacuation, temporary or long-term migration) and/or decline with implications for nature, affecting nature's contributions to people and good quality of life.

SM 1.4 Overarching and chapter-specific questions guiding the inclusion of 'Indigenous and Local Knowledge and Practices' [ILK] and the role of Indigenous People and Local Communities [IPLCs] in the IPBES Global Assessment (GA)

i. Question-based approach

Overarching questions:

The global assessment will consider three broad groups of questions related to ILK and IPLCs.

1. 'What have been the contributions of Indigenous and Local Knowledge and practices (ILK) and Indigenous Peoples and Local Communities (IPLC) to the sustainable use, management and conservation of nature and Nature's Contributions to People at regional and global scales?

2. 'What are the most important features, pressures and factors related to and/or enabling or constraining these contributions, as well as impacting present and future quality of life of IPLCs?'

3. 'What policy responses, measures, and processes can contribute to strengthen and improve the institutions and governance of nature and its contributions to people with regard to IPLCs?'

Chapter-specific questions:

CHAPTER 2: STATUS AND TRENDS

Questions presented in chapter 2 provide direct support for overarching questions in chapter 3

Sub-CHAPTER 2: NATURE

2.1 What are the patterns in the status and trends of terrestrial ecosystems, freshwater bodies and marine zones whose biodiversity and NCP have co-evolved with and have been managed by IPLCs? What are the most important (positive and negative) trends in biodiversity and NCP managed by IPLCs?

2.2 What major ecosystems and watersheds, and how much of biodiversity (including agro-diversity, semi/domesticated animals) lies on landscapes managed by IPLCs, within and outside protected areas, in different types of property systems and institutional arrangement?

2.3 What are the distinctive views of IPLCs regarding nature, such as the view expressed in IPBES conceptual framework, such as Mother Earth or Systems of Life?

Sub-CHAPTER 2: DRIVERS

2.4 What are the main economic, political, environmental/climate and social changes and drivers negatively and positively affecting nature and NCP in areas occupied and managed by IPLCs? How are these changes influencing local livelihoods and the ability of IPLCs to manage and conserve nature and NCP?

To be developed in collaboration with chapter 6.

2.5 How have local, national, and international level institutions and policy tools involving IPLCs contributed to the conservation of nature and sustainable provision of NCP over the last fifty years?

2.6 How the recognition and implementation of indigenous peoples' rights at the national level is affecting nature and NCP in areas managed by IPLCs.

-In order to operationalize the above three questions, the following sub-questions are provided. These questions should be approached in collaboration with chapter 6:

2.4.1 What percentage of 'protected areas' are occupied by IPLCs, particularly Indigenous peoples, during the last 50 years?
2.4.2 What percentage of 'protected areas' required the displacement of IPLCs? And, what percentage of 'protected areas' enabled the recognition of land rights for IPLCs?
2.4.3 What are the social and economic characteristics of IPLCs living within protected areas (especially regarding poverty condition, social indicators such as education and health)?
2.4.4 What have been the positive and negative impacts of 'marine protected areas' (MPAs) on IPLCs (fishing villages) whose livelihood depend on?
2.4.5 Under which conditions do local and national level institutions (e.g., conservation policies, decentralization and forestland property arrangements, resource concessions, informal and formal programs, etc.) align to promote or undermine conservation of biodiversity outside of protected areas?
2.4.6. What are the evidences for the effectiveness of management strategies involving IPLCs such as associated with biocultural approaches, co-management systems, customary right-based approaches, among others?

Sub-CHAPTER 2: NATURE'S CONTRIBUTIONS TO PEOPLE

2.5 What are the contributions of ILK to the protection of biodiversity, ecosystems and its processes, and provision of NCP to populations in rural and urban areas? And in what ways do these contributions impact the livelihoods of poor sectors of society both urban and rural?

2.6 How are changes and drivers affecting IPLCs, ILK and how are these affecting the management of biodiversity and NCP relevant to local and urban populations? What are the positive and negative impacts of these changes upon poor sectors of society?

2.7 What is the role of collective action of IPLCs in the provision of NCP?

CHAPTER 3: AICHI TARGETS AND SDGs

3.1 What have been the contributions of ILK to reach Aichi target X?

3.2 How have drivers affecting IPLCs undermined/constrained the attainment of the achievement goals of Aichi target X?

3.3 To what extent are IPLCs recognized, valued, and benefit from their contributions to the Aichi targets and the SDGs, such as conserving nature, expanding food and energy production, among others?

CHAPTER 4: PLAUSIBLE FUTURES: NATURE, NCP and QUALITY OF LIFE

4.1 What are the potential impacts of plausible scenarios of expanding resource production/extraction (agriculture, mining and oil extraction, husbandry, fisheries, etc), infrastructure networks (energy, roads, markets, etc), and urbanization on biodiversity, agro-diversity, and NCP conserved and managed by IPLCs?

> 4.2.1 How could strengthening the roles and rights of IPLCs to maintain their territories (based on plausible scenarios of where this has happened) ensure biodiversity and agrobiodiversity is conserved in the face of expanding resource production/extraction?

4.3 How will climate change interact with projected social and environmental changes in their potential impacts on IPLCs? What are the consequences of these interactions for the management of biodiversity, agro-diversity and managed species, and NCP in globally relevant regions and [IPBES] units of analysis (e.g., tropical forests, temperate grasslands, coastal zones, marine systems, etc.)?

4.5 If national and international conservation strategies are strongly relying on areas conserved and managed by IPLCs, then what are the impacts of changing social (e.g., trends in migration and livelihood changes) and environmental (e.g., resource use, pollution, climate) conditions on the sustainability of these conservation strategies?

> 4.5.1 In particular, how are projected social and demographic trends (e.g., migration, labor arrangements) likely to affect conservation areas (terrestrial, inland waters, and marine) and/or indigenous territories?
> 4.5.2 How do the management of nature and NCP by IPLCs, particularly in protected areas, may affect their quality of life in coming decades? What implications these ‘commitments’ have for improving the socioeconomic conditions of IPLCs, including poverty eradication, education, and food secutiry?
> 4.5.3 What are the implications of plausible scenarios to the definition of the role and contributions of IPLCs to a new generation of biodiversity targets for 2020-2030?

CHAPTER 5: SCENARIOS and PATHWAYS TOWARDS SUSTAINABLE FUTURES

5.1 What are potential trade-offs involved in different pathways for reconciling the rights and needs of IPLCs, and the resources they manage and depend on, and projected trends/expansion in food, energy, water, and mining production and consumption?

> 5.1.1 How to reconcile economic growth and protection of environmental functions in landscapes/seascapes managed by IPLCs (including protected areas occupied by IPLCs)?

5.2 What does it mean to achieve the SDG goals for large sectors of society (e.g., 2-zero hunger, 7-affordable and clean energy, 8-decent work and economic growth, 13-climate action) for IPLCs and their (usually sparsely populated) territories?

> 5.2.1 How to reconcile indigenous and local rights (including resource rights) with these goals?

5.3 What potential institutional arrangements involving IPLCs could contribute to the management and conservation of large-scale and trans-boundary ecosystems and resource systems?

[Follow up on question 2.3] 5.4 What are the distinctive views of IPLCs regarding nature, such as the view expressed in IPBES conceptual framework, such as Mother Earth or Systems of Life, and how these can strengthen a more sustainable relationship between nature, NCP and good quality of life?

CHAPTER 6: POLICY CHALLENGES, OPPORTUNITIES, and OPTIONS

See notes in chapter 2 regarding cross-cutting questions with chapter 6.

6.1 Based on evidences from the past 30 years, what has been the effectiveness of policy instruments and institutional arrangements aimed at enhancing the contribution of IPLCs, within and outside protected areas, to national, regional and global biodiversity conservation strategies, and how they governance systems have evolved?

6.2 What possibilities exist for improving the social-economic conditions, resource rights, and benefit sharing of IPLCs, contributing to the conservation and management of biodiversity, ecosystem restoration, and NCP, and what are the potential costs of not doing so?

> 6.2.1.What policy opportunities exist for supporting local collective action and institutional arrangements to promote conservation and management of biodiversity and NCP outside protected areas?

6.3 What are the impacts of climate change mitigation and adaptation policies (particularly carbon compensation schemes, joint mitigation and adaptation approaches, and expanding renewable energy production) and restoration programs upon IPLCs and what are the points of synergy and conflict with conservation and management of biodiversity and NCP?

6.4 What has been the effectiveness of multi-lateral agreements and ensuing national policies to protect ILK (e.g., CBD, Nagoya Protocol, Paris Agreement) and the ability of IPLCs to manage and conserve biodiversity and NCP, particularly transboundary resources?

6.5 What are the impacts of models of commodification of nature in the systems of life of IPLCs (particularly payment of environmental services – PES)? What are alternative models and policies to markets of ecosystem services, particularly based on the strengthening of rights of nature and peoples, and duties of societies with nature?

ii. Systematic and inclusive review of published evidence and geospatial data

The global assessment has sought to balance large-scale synthesis of published knowledge and data, geospatial data from different world regions and globally, and contributions from IPLC leaders and representatives and experts. Authors from each chapter integrated evidences from multiple sources. First, 1) systematic literature search in indexed journals and search engines; 2) information from other IPBES assessments and proceedings of earlier ILK Dialogue Workshops[1]; 3) information (including spatially-explicit data) from international research centers and global/regional institutions; 4) information derived from an on-line 'Call for Contribution' platform developed specifically for the GA; and, (5) a series of face-to-face presentations and consultations with IPLC networks and organizations.

The present Second-Order-Draft of chapters include examination of around 3000 bibliographic references, including articles, books, and reports, relevant to ILK and IPLC issues. Including part of the 1000 bibliographic sources submitted from 363 contributors to the Online Call for Contribution, from over 60 countries.

iii. A dedicated ILK liaison authors group

From the onset, 28 authors of the Global Assessment with different types and levels of expertise on ILK and IPLC were identified and invited to form an ILK Liaison Group with a role to contribute to and ensure cross-chapter coordination. This group was closely involved in organizing and carrying out consultation events and dialogue workshops with IPLC representatives and ILK holders. During the assessment, this group expanded with the inclusion of additional 32 Contributing Authors.

[1] B Baptiste, D Pacheco, M Carneiro da Cunha and S Diaz (eds). 2017. Knowing our Lands and Resources: Indigenous and Local Knowledge of Biodiversity and Ecosystem Services in the Americas. Knowledges of Nature 11. UNESCO: Paris. pp. 176;
M Karki, R Hill, D Xue, W Alangui, K Ichikawa and P Bridgewater (eds). 2017. Knowing our Lands and Resources: Indigenous and Local Knowledge and Practices related to Biodiversity and Ecosystem Services in Asia. Knowledges of Nature 10. UNESCO: Paris. pp. 212;
M Roué and Z Molnár (eds.) 2017. Knowing our Lands and Resources: Indigenous and Local Knowledge of Biodiversity and Ecosystem Services in Europe and Central Asia. Knowledges of Nature 9. UNESCO: Paris. 148pp;
M. Roué, N. Césard, Y. C. Adou Yao and A. Oteng-Yeboah (eds.). 2017. Knowing our Lands and Resources: Indigenous and Local Knowledge of Biodiversity and Ecosystem Services in Africa. Knowledges of Nature 8. UNESCO: Paris. 156pp.
Reports available at https://en.unesco.org/ilk-biodiversity/ipbes/workshops

iv. Online Call for Contributions

As part of the consultation strategy and to fuel the synthesis on ILK trends in the GA, an online call for contributions was launched, seeking different types of inputs an international Online Call for Contributions was carried out between August and December 2017. The survey was launched in English, Spanish, and French in an attempt to reach a wider audience who may not use English as their first language. Submissions were called for within different broad, cross-cutting topics including: i) publications, data and knowledge (including scientific literature on ILK, reports, grey literature, or datasets), ii) indigenous networks and organizations, and iii) individual experts on ILK and ILK experts and holders. A total of 363 contributors from over 60 countries participated. A publications database created from this call now consists of more than 1200 academic articles, reports, websites, and videos in about 15 languages, some of which are indigenous, and is available in a searchable repository to the GA experts to facilitate inclusion in assessment chapters. The information received on organizations and experts has been used to identify new aspects not yet covered in the assessment, as well suggesting names for contributing authors for the different chapters.

v. Multiple forms of dialogues and consultations with representatives of IPLC and the scientific community

In addition to systematic reviews and data gathering, several consultations and dialogue workshops were planned throughout the assessment process intended to bring transparency to the global assessment and to mobilize inputs and suggestions from representatives of IPLC, as well as academic experts. In addition to the *on-line Call for Contributions* mentioned above authors have carried out face to face discussions, consultations, and dialogues with IPLC representatives and ILK experts from around the world.

Consultation through pre-existing IPLC networks during already planned relevant meetings to identify, initiate engagement, establish links with and empowering IPLC networks, given the opportunity to review and/or co-produce content for the assessment and discussion of future opportunities for participation (UN Permanent Forum on Indigenous Issues (24 April to 5 May 2017; and 19-20 April 2018); 40th Annual Conference of the Society of Ethnobiology in Montreal, Canada (May 10-13, 2017); Human Rights and Conservation dialogue organized by SwedBio, FPP and Natural Justice in Eldoret, Kenya (20-23 November 2017); a one-day event held before and two side events held during the 10th meeting of the Ad Hoc Open-ended Working Group on Article 8(j) and Related Provisions of the Convention on Biological Diversity, Montreal (13-16 December 2017); a dialogue workshop organized with the Arctic Council, Helsinki, Finland (6-8 June 2018); a dialogue workshop organized with the Community Conservation Research Network in Halifax, Canada (May 27-28, 2018), and a panel and workshop at the International Society of Ethnobiology congress Belem, Brazil (7-10 August 2017).

SM 1.5 Units of Analysis

IPBES no.	Unit (Terrestrial)	Definition-final
1	**Tropical and subtropical dry and humid forests**	Includes humid and dry broadleaf forests centered between the tropics and subtropical latitudes, and tropical and subtropical coniferous forests. Humid forests are characterized by low variability in annual temperature and high levels of rainfall (>2000 mm annually); forest composition is dominated by evergreen and semi-evergreen tree species. Dry forests occur in climates that are mostly warm year-round, with annual rainfall ranging from 200 to 1500 mm. There is a well-defined dry season which can last several months and vary with geographic location. Semi-deciduous and deciduous trees predominate in these forests. Tropical and subtropical coniferous forests are found predominantly in North and Central America. They experience low levels of precipitation and moderate variability in temperature. They are characterized by diverse species of conifers, whose needles are adapted to deal with the variable climatic conditions.
2	**Temperate and boreal forests and woodlands**	Boreal and temperate forest biomes experience a continental climate, with growing seasons of <130 days and >140 days, respectively. Both can be of coniferous (spruce, fir, larch or pine) and/or deciduous (broad-leafed, angiosperm) trees. At high latitude montane forests and in the north, these forest biomes border on the tundra. Both forest types are disturbance-driven, mostly from fires, wind, and insect infestations. In the boreal where fire return intervals vary widely (<50 years to >500 years), these result in a large-scale mosaic. Temperate deciduous forests are divided into sub-classes depending on the relative amount of annual rainfall. Temperate rain forests are characterized by mild winters, with abundant precipitation, mostly as rain. They are seldom subject to catastrophic wildfires, therefore often attain the climax stage of old-growth forests. In northern temperate rain forest, coniferous trees are dominant, whereas in the southern hemisphere deciduous species are also common or dominant.
3	**Mediterranean forests, woodlands and scrub**	Mediterranean forests, woodlands, and scrub are fire-prone ecosystems with typically dry (and generally hot) summer and rainy (and generally mild) spring and winter. They occur across 22 countries in five continents: southern Europe and northern Africa (Mediterranean Basin), South Africa (Western Cape), northwestern

		America (e.g. California chaparral), southern America (Chilean matorral), and southern Australia. Vegetation types include coniferous or (mostly evergreen) broadleaf forests and woodlands, savannahs and grasslands, scrublands and mosaic landscapes, resulting from a strong interaction between heterogeneous environmental conditions and a long-lasting influence of human activities and wildfires. Mediterranean ecosystems support an extremely high diversity of unique animal and plant species, most of them adapted to the stressful conditions of long, hot, and dry summer.
4	**Tundra and High Mountain habitats**	Tundra is an ecological community of mosses, lichens, herbs, and dwarf shrubs living under extreme conditions of cool summers and very cold winters. In the treeless plains of Arctic Europe, Asia, and North America, arctic tundra is underlain by a permanently frozen subsoil hundreds of meters deep (permafrost) which is absent under the mountain tundra found at high altitudes of the world's mountains. Mountain tundra is found at altitudes above the treeline and may include extensive grasslands. Shrubs are characteristic plants of tundra but these become smaller and are even absent at high latitudes and high altitudes. Plant production is relatively high in arctic tundra because permafrost restricts drainage and thus keeps surface layers moist. Migratory animals such as caribou/reindeer, fish, and millions of geese and other birdlife take advantage of summer plant growth and few predators to reproduce and grow in the arctic tundra. ***Similarities with Notes in relation to other units:*** this unit is distinguished from the cryosphere as being characterized by vegetation cover.
5	**Tropical and subtropical savannas and grasslands**	This unit comprises large expanses of land in tropical and subtropical latitudes characterized by a discontinuous tree canopy in a continuous grass layer, although tree cover is highly variable, ranging from few scattered trees to fairly dense woodlands. Annual rainfall ranges between 350-1500 mm, concentrated in the warm season. However, there may be great variability in soil moisture throughout the year. Herbivory by large and medium-sized mammals that have evolved to take advantage of the ample forage, as well as periodic fires are distinctive features of these habitats. ***Notes in relation to other units:*** subtropical shrublands are included in unit 7 (Deserts and Xeric shrublands). Some parts of these two units may overlap, as it is common for some areas of the subtropical savannas to be described as xerophytic shrublands.

6	**Temperate Grasslands**	Temperate grasslands occur where seasonal climates and soils favour the dominance of perennial grasses and related life forms. They are distributed mainly in the middle latitudes with differing names across continents. Steppes, prairies, pampas, and veld areas, but also including (semi-) natural (ancient or primary) grasslands and forest-steppes, wood-pastures, temperate savannas and open shrublands(?) in the regions of Temperate and Boreal broadleaved, mixed and coniferoues forests, Mediterranean regions and of mountains below the timberline. ***Notes in relation to other units:*** this unit excludes tundra and grasslands above the timberline (unit 4). Many temperate grasslands have been transformed into agricultural grasslands, which are included in unit 10 (cultivated areas).
7	**Deserts and xeric shrublands**	This unit comprises large expanses of land in tropical and subtropical latitudes characterized by sparse often discontinuous vegetation and large portions of bare soil. Deserts and xeric habitats are characterized by severe shortage of water. Two sub-units can be distinguished: deserts with annual rainfall below 200 mm and steppe or shrub lands with annual rainfall that ranges between 200 and 350 mm, concentrated in the cool season. Both steppe lands and deserts can have a dense herbaceous/grassy vegetation after the rains for a relatively short period of the year. Deserts may be hot or cold, mainly dependent on altitude. High mountain deserts can be found in the rain shadows of the Himalayas and Andes regions. Herbivory by large and medium-sized mammals that have evolved to accommodate to these dry and sparse vegetation conditions is a distinctive feature of these habitats. ***Notes in relation to other units:*** this unit excludes Antarctica (unit 12, cryosphere), though it meets some of the criteria of a cold desert.
8	**Wetlands – peatlands, mires, bogs**	Wetlands are permanent or temporary, freshwater, brackish and marine areas not deeper than 6 m (bogs, swamps, marshes, estuaries, deltas, peatlands, potholes, vernal pools, fens and other types, depending on geography, soil, and plant life). Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year. Water saturation by groundwater, precipitation, surface waters and ocean tides largely determines how frequently or continually the soil is inundated and develops and the types of plant and animal communities living in and on the soil. These are neither aquatic nor terrestrial systems, but transitional ones. Includes natural and constructed permanent

		forest covered inland marshes and wet meadows (dominated by herbaceous plants), swamps (dominated by shrubs), wooded swamps (dominated by trees), seasonal freshwater wetlands (playa lakes, vernal pools, potholes, marshes), seawater and freshwater tidal swamps and marshes, estuaries, areas linked to estuaries or beyond the upper edges of tidal salt marshes where the influence of salt water ends, and unforested mires such as bogs, fens and other peatlands.
9	**Urban/Semi-urban**	Although urban and semi urban areas are a tiny fraction of the world's surface, they are the nexus of human activity with >50% of the population and 70 - 90% of economic activity. The functional urban area is defined as a city plus its commuting zone by the EU-OECD (EU-OECD FUA). This was formerly known as LUZ (larger urban zone). Urban and semi-urban areas are places dominated by the built environment, including all non-vegetative and human-constructed elements, of a given landscape unit. In general, global urban area lacks a consistent, unambiguous definition. There are approaches from different perspectives that draw on a combination of satellite imagery, census information, and other maps. In this assessment the unit is mapped from ESA CCI Land Cover dataset (value=190).
10	**Cultivated areas (incl. cropping, intensive livestock farming etc.)**	Cultivated systems can be defined as areas in which at least 30% of the landscape is in croplands, shifting cultivation, or confined livestock production in any particular year. These can include farms, orchards, rangeland, and other agricultural concerns. The defining characteristic is the level of alteration. Very heavily managed agro-ecosystems involve the planting of non-native crop species or rearing of livestock, the introduction of non-native plants often to the detriment of native species, irrigation to augment water, and boosting of production by nutrient addition through fertilizers. There are also less heavily managed agro-ecosystems, often based on local rainfall and few nutrient inputs, that do allow native wildlife species to thrive alongside those species introduced for commercial purposes, and shifting cultivation systems. Rangelands grade into natural grasslands depending on intensity of use/alteration, and may include a mix of densely populated areas with areas used for pasture. ***Notes in relation to other units:*** fishery production areas and commercial forests are not included in this Unit. Fisheries occur in the ocean units (14, 15 and 16) as well as in aquaculture areas (unit 12). Commercial forests cannot be discriminated on a global scale from natural forests (units 1 and 2), so cannot reliably be mapped separately, though by their characteristics would fit in this unit.

11	**Cryosphere**	The cryosphere consists of regions where the temperature is so low that water exists primarily in a frozen state most of the time, ie. the polar regions, glaciers and alpine regions. It also includes non-ice covered areas where temperatures are below freezing. It contains many highly unique habitats / ecosystems such as sea ice, ice shelves, the extreme cold and dry regions of Antarctica including the Antarctic dry valleys and the sub-glacial/ice sheet lakes (ex. Lake Vostok). Organisms inhabiting sea-ice overlap in terms of species occurrences considerably with Shelf ecosystems and Open ocean pelagic systems. ***Notes in relation to other units:*** Permafrost (permanently frozen subsoils) are included in the tundra and high mountain unit (4). The cyrosphere (unit 11) includes sea-ice and iceshelves, but the sea below or adjacent to them falls into unit 15 or 16 (according to the position of the compensation depth).
12	**Aquaculture areas**	Aquaculture is the farming of aquatic organisms, and involves direct intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while those exploitable as a common property resource are the harvest of fisheries. Aquaculture areas are thus any area of land, freswhater or marine water that is used in the production of cultured aquatic organisms. ***Notes in relation to other units:*** in some other schemes, freshwater aquaculture is included in cropland (unit 10), but the coverage of terrestrial, freshwater and marine for the Global Assessment makes it more consistent to group in this unit
13	**Inland surface waters and water bodies/freshwater**	Inland waters are permanent above-ground freshwater, deeper than 6 m water bodies (e.g., lakes, rivers, reservoir/ponds, reservoirs, water courses) including their littoral zones, supporting a natural community of both plants and animals. Littoral zones include those parts of banks or shores that are sufficiently frequently inundated to prevent the formation of closed terrestrial vegetation. ***Notes in relation to other units:*** inlets, estuaries and temporary seasonal, or intermittent rivers, lakes and flooded areas are NOT included in this definition of inland waters (see units 8 (wetlands/peatlands/bogs), and 14 (shelf, marine ecosystems).

14	**Shelf ecosystems (neritic and intertidal/littoral zone)**	In-shore pelagic and benthic systems extending from the coastline to the 200 m depth contour, entirely within the photic zone where Net Primary Production is positive. At the coast the unit includes the intertidal/littoral zone to the Mean High Tide Water Line including estuaries and inlets. The boundary with open ocean systems at the 200 m contour is a gradient rather than a discrete transition. In Antarctica, the 500 m depth contour is a more natural boundary for this unit. The unit contains many highly productive and biodiverse pelagic and benthic habitats intensively used by people for multiple services, including food, shelter, and transport, such as coral reefs, seagrass meadows and mangroves. ***Notes in relation to other units:*** inshore polar regions with permanent ice are placed in the cryosphere (unit 11), floating above, or beside, this unit; freshwater coastal rivers/lakes and wetlands (units 8 and 13) may form a boundary with estuaries in this unit; shelf systems intensively/multiply used by man are separated from this unit into unit 17.
15	**Open ocean pelagic systems (euphotic zone)**	This unit covers the open ocean beyond the 200 m depth contour on the seabed (500 m in Antarctica), and from the surface to 200m deep. The 200 m limit is known as the maximum for the compensation depth, where sunlight is reduced to 1% of surface levels. Above this, phytoplankton growth is sustained depending on nutrient supply and surface water stratification. In this so-called euphotic zone Net Primary Production is positive, supporting almost the entire marine foodweb. Open ocean pelagic systems include highly productive and oligotrophic (low productivity) waters, as well as sea-ice covered polar seas. ***Notes in relation to other units:*** the boundary between this unit and shelf ecosystems (unit 14) is a gradient rather than a discrete transition. Units 15 and 16 are vertically layered throughout their range, and are linked by biogeochemical pelagic-benthic coupling and vertical migration of organisms. The boundary between them is of significant ecological but low physiological relevance since species are specifically adapted to pressure (http://www.marinespecies.org/deepsea/). The cyrosphere (unit 11) includes sea-ice and ice shelves, which may extend over this unit. The sea-ice is habitat of a variety of marine organisms ranging from microorganisms to birds and mammals.
16	**Deep-Sea**	The permanently dark off-shore open ocean beyond and deeper than the 200m depth contour on the seabed (beyond 500m in Antarctica). The unit is entirely below the compensation depth, where no light-dependent Net

		Primary Production occurs. The deep-sea includes the dark pelagic zones and the upper one metre of the sea-floor sediment. It comprises a variety of different habitats such as continental slopes, vents, and sea-mounts. ***Notes in relation to other units:*** partially overlaps with shelf ecosystems (unit 14) because most boundaries between marine ecosystems are gradients rather than discrete transitions. Units 15 and 16 are vertically layered throughout their range, and are linked by biogeochemical pelagic-benthic coupling and vertical migration of organisms. The boundary between them is of significant ecological but low physiological relevance since species are specifically adapted to pressure (http://www.marinespecies.org/deepsea/).
17	**Coastal areas intensively and multiply used by human**	Coastal zones are the land-sea interface and defined as “a strip of land and sea of varying width depending on the nature of the environment, human uses and management needs". Currently, 2.5 billion people live within 100 km of the coast, placing a disproportionate stress on coastal and marine ecosystems. Intense multiple uses result in physical and biological restructuring mainly through (i) urban expansion and increased human population density, (ii) the fishing and aquaculture industry, (iii) maritime transport and associated infrastructure, and (iv) tourism and associated accommodation and facilities. These developments are associated with protection infrastructure (breakwaters, groynes, sea walls, etc.) as a reaction to the dynamic nature of the shoreline. ***Notes in relation to other units***: heavily altered and multiply used areas that are focused on biological function for aquaculture are included in unit 12, Aquaculture areas. There may be some difficulty in separating this unit from unit 9, Urban/semi-urban, as many of the structures defined here will be contiguous with it. Operationally, this unit will be mapped as a linear feature of the coastline, based on the adjacency of units 9 (urban/semi-urban areas), 10 (cultivated areas) and 12 (aquaculture), and a human coastal proximity index. It lies at the boundary between terrestrial units and unit 14, shelf ecosystems.

SM 1.6 List of core indicators

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 4	Ecological Footprint	P	DD	4	2,3,4	3	Global Footprint Network
Target 4	Water Footprint (Human appropriation of fresh water)	P	DD	4	2,3,4	3	Water Footprint Network
Target 4	Percentage of Category 1 nations in CITES	R	IGID	4,6	2,3,6		Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 5	Trends in forest extent (tree cover)	S	DD, BEF	3,4	2,3,4	4	Hansen et al., 2013
Target 5, Target 11, Target 12	Protected area coverage of Key Biodiversity Areas (including Important Bird and Biodiversity Areas, Alliance for Zero Extinction sites)	R	IGID, DD	4,6	2,3,4,6		BirdLife International, IUCN, Alliance for Zero Extinction (AZE)
Target 5, Target 7, Target 14	Total wood removals	S,I	DD, NBP	2,4,5	2,3,4,5,6	5	FAO
Target 5	Biodiversity Habitat Index	S	DD, BEF	3,4	2,3,4	4	GEO BON - CSIRO

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 5, Target 12	Species Habitat Index	P,S	DD, BEF	3,4	2,3,4	4	GEO BON - Map of Life
Target 5	Forest area as a percentage of total land area	S	DD, BEF	3,4	2,3,4	4	FAO
Target 6	Trends in fisheries certified by the Marine Stewardship Council	R	IGID	3,4	2,3,4		Marine Stewardship Council
Target 6	Estimated fisheries catch and fishing effort	P	DD, BEF	3,4	2,3,4		Sea Around Us

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 6	Proportion of fish stocks within biologically sustainable levels	S	BEF	3	2,3		FAO
Target 6, Target 14	Inland fishery production	S, I	BEF, NBP	2,4	2,3,4		FAO
Target 6	Marine Trophic Index	S	DD, BEF	3,4	2,3,4		Sea Around Us
Target 5, Target 7, Target 14	Total wood removals	S,I	DD, NBP	2,4,5	2,3,4,5,6	5	FAO

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 7	Proportion of area of forest production under FSC and PEFC certification	R	IGID, DD	4,6	2,3,4,6	6	Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC)
Target 7	Nitrogen Use Efficiency	P	DD	4	2,3,4	3	Lassaletta et al., (2014) from Environmental Performance Index (EPI)
Target 7	Nitrogen + Phosphate Fertilizers (N+P205 total nutrients)	P	DD	4	2,3,4	3	FAO

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 8	Trends in pesticide use	P	DD	4	2,3,4		FAO
Target 8	Trends in nitrogen deposition	P	DD	4	2,3,4		International Nitrogen Initiative
Target 5, Target 11, Target 12	Protected area coverage of Key Biodiversity Areas (including Important Bird and Biodiversity Areas, Alliance for Zero Extinction sites)	R	IGID, DD	4,6	2,3,4,6		BirdLife International, IUCN, Alliance for Zero Extinction (AZE)
Target 11	Species Protection Index	P,R	IGID, DD	4,6	2,3,4,6		GEO BON - Map of Life

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 11	Protected area management effectiveness	R	IGID, DD, BEF	4,6	2,3,6		UNEP-WCMC
Target 11	Protected Area Connectedness Index	R	DD, IGID	4,6	2,3,4,6		GEO BON - CSIRO
Target 11	Percentage of areas covered by protected areas - marine, coastal, terrestrial, inland water	R	IGID	4,6	2,3,6		UNEP-WCMC, IUCN
Target 5, Target 11, Target 12	Protected area coverage of Key Biodiversity Areas (including Important Bird and Biodiversity	R	IGID, DD	4,6	2,3,4,6		BirdLife International, IUCN, Alliance for Zero Extinction (AZE)

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
	Areas, Alliance for Zero Extinction sites)						
Target 12, Target 14	Biodiversity Intactness Index	P,S	DD, BEF	4,5	2,3,4,5	4	GEO BON - PREDICTS
Target 12	Red List Index	S	BEF	3	2,3		IUCN, BirdLife International and other Red List Partners
Target 5, Target 12	Species Habitat Index	P,S	DD, BEF	3,4	2,3,4	4	GEO BON - Map of Life
Target 13	Proportion of local breeds, classified as being at risk, not-at-	S	BEF, NBP	2,3	2,3,4		FAO

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
	risk or unknown level of risk of extinction						
Target 5, Target 7, Target 14	Total wood removals	S,I	DD, NBP	2,4,5	2,3,4,5,6	5	FAO
Target 12, Target 14	Biodiversity Intactness Index	P,S	DD, BEF	4,5	2,3,4,5	4	GEO BON - PREDICTS
Target 6, Target 14	Inland fishery production	S, I	BEF, NBP	2,4	2,3,4		FAO

AICHI TARGET OR SDG	SPECIFIC INDICATOR	DPSIR*	CONCEPTUAL FRAMEWORK	RA CHAPTER	GA CHAPTER	LDRA CHAPTER	SOURCE
Target 14	Percentage of undernourished people	I	GQL	2	2,3,4	5	FAO
Target 17	Number of countries with developed or revised NBSAPs	R	IGID	4,6	2,3,6		Secretariat of the Convention on Biological Diversity (CBD)
Target 19	Proportion of known species assessed through the IUCN Red List	R	IGID	4,6	2,3,6		IUCN
Target 19	Species Status Information Index	R	IGID, BEF	4,6	2,3,6		GEO BON - Map of Life

SM 1.7 List of highlighted indicators

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
	Living Planet Index		S	BEF	2,3	WWF/ZSL
Target 2	Number of countries implementing natural resource accounts, excluding energy, within the System of Environmental-Economic Accounting (SEEA)		R	IGID	2,3,6	UNSTATS, World Bank
Target 3	Number of countries with national instruments on biodiversity-relevant taxes, charges and fees	R	IGID	OECD		
Target 3	Number of countries with national instruments on REDD plus schemes	R	IGID	UNFCCC		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 3	Trends in potentially harmful elements of government support to agriculture (produced support estimates)	R	IGID	OECD		
Target 3	Trends in potentially harmful elements of government support to fisheries	R	IGID	OECD		
Target 3	Number of countries with national instruments on biodiversity relevant tradable permit schemes	R	IGID	OECD		
Target 4	Human appropriation of net primary productivity	P	DD	Krausmann et al., 2013		
Target 4	Trend in Carbon Intensity	R	IGID	WRI, WB, IEA from Environmental		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
				Performance Index (EPI)		
Target 5, Target 12	Global climate risk Index	D,I	DD,NBP	germanwatch.org		
Target 5, Target 14	Wetland Extent Trend Index	S	BEF,NBP	UNEP-WCMC		
Target 6	Global effort in bottom trawling	P	DD	Around the Sea		
Target 6	Number and coverage of stocks with adaptive management systems / plans	R	IGID	FAO		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 6	Presence of regulations requiring recovery of depleted species	R	IGID	FAO		
Target 6	Policies to secure that mortalities and significant indirect adverse impacts on non-target species are accounted for are in place	R	IGID	FAO		
Target 6	Policies make adequate provisions to minimize impacts of fisheries on threatened species.	R	IGID	FAO		
Target 6	Coverage of fisheries with management measures to reduce bycatch and discards	R	IGID	FAO		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 6	Proportion of predatory fish	S	BEF	Shin et al., 2010		
Target 6	Mean length of fish	S	BEF	Shin et al., 2010		
Target 6	BioTime-Local Species Richness, Temporal Species Turnover, Overall Abundance	S	BEF	Dornelas et al., 2014		
Target 6	Non declining exploited species	S	BES	Kleisner et al., 2015		
Target 7	Number of world natural heritage sites per country per year	P	NBP,IGID,GQL	UNESCO		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 7	Nitrogen Use Balance	P	DD	Zhang et al. 2015		
Target 7	Areas of agricultural land under conservation agriculture	P,R	IGID,DD	FAO		
Target 7	Proportion of agricultural area under productive and sustainable agriculture (indicator for SDG target 2.4)	P,R	IGID,DD	FAO		
Target 9	Trends in the numbers of invasive alien species introduction events	P	DD	IUCN ISSG		
Target 9	Trends in invasive alien species vertebrate eradications	R	IGID	IUCN ISSG, Island Conservation		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 11	Protected area coverage of terrestrial, marine and freshwater ecoregions	R	IGID,BEF	UNEP-WCMC		
Target 11	Protected Area Representativeness Index	P,R	IGID,DD	GEO BON-CSIRO		
Target 11	The Wildlife Picture Index (disaggregated by protected area)	S,I,R	IGID,DD,BEF	Tropical Ecology Assessment and Monitoring (TEAM) Network		
Target 5, Target 12	Global climate risk Index	D,I	DD,NBP	germanwatch.org		
Target 12	Mean Species Abundance (GLOBIO3)	S	BEF	Alkemade et al., 2009		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 12	Number of species extinctions	S	BEF	IUCN, BirdLife International and others		
Target 12	RAMSAR areas	S	BEF,IGID	RAMSAR		
Target 14	Better Life Index	I	GQL	OECD		
Target 14	Percentage of population using safely managed drinking water services (indicator for SDG target 6.1)	I	GQL	WHO, UNICEF		
Target 5, Target 14	Wetland Extent Trend Index	S	BEF,NBP	UNEP-WCMC		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 14, Target 15	Land under cereal production (ha)	I	NBP,DD	World Bank (WB)		
Target 15	Global Ecosystem Restoration Index	S	IGID,BEF	GEO BON, iDiv		
Target 14, Target 15	Land under cereal production (ha)	I	NBP,DD	World Bank (WB)		
Target 16	Number of countries that have adopted legislative, administrative and policy frameworks to ensure fair and equitable sharing of benefits	R	IGID	Secretariat of the CBD		

AICHI TARGET OR SDG	SPECIFIC INDICATOR		DPSIR*	CONCEPTUAL FRAMEWORK	GA CHAPTER	SOURCE
Target 18	Global Index of Linguistic Diversity and language threat level.	S	BES,NBP	Teralingua		
Target 19	Growth in species occurrence records accessible through GBIF	R	IGID	GBIF		
Target 19	Species represented in the barcode of life data system	S,R	IGID	Barcode of Life Data Systems		
Target 20	Information provided through the financial reporting framework, adopted by decision XII/3	R	IGID	Secretariat of the CBD		

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