

# ANNEX I

## Glossary

### A

**Adaptive governance:** refers to flexible and learning-based collaborations and decision-making processes involving both state and nonstate actors, often at multiple levels, with the aim to adaptively negotiate and coordinate management of social–ecological systems and ecosystem services across landscapes and seascapes (Folke *et al.*, 2005).

**Adaptive management:** a philosophy that accepts that management must proceed even without complete information. It views management not only as a way to achieve objectives, but also as a process for probing to learn more about the resource or system being managed. Learning is an inherent objective of adaptive management. Adaptive management is a process where policies and activities can adapt to future conditions to improve management success (CCBA, 2008).

**Alien species:** a species whose presence in a region is attributable to human actions, intentional or unintentional, that enable them to overcome biogeographical barriers (Richardson *et al.*, 2010; Figure 1.1). This includes species, subspecies or lower taxon, and any part (gametes, seeds, eggs, or propagules) of such species that might survive and subsequently reproduce (CBD, 2002).

### B

**Biocultural community protocol:** a biocultural community protocol is a document that is developed after a community under-takes a consultative process to outline their core cultural and spiritual values and customary laws relating to their traditional knowledge and resources (LPP and LIFE Network *et al.*, 2010).

**Biocultural management (or biocultural approaches to conservation or biocultural approaches to environmental management):** actions made in the service of sustaining the biophysical and sociocultural components

of dynamic, interacting, and interdependent social–ecological systems (Gavin *et al.*, 2015; Lyver *et al.*, 2019).

**Biological control:** the use of living organisms to suppress the population density or impact of a specific invasive alien species, making it less abundant or less damaging than it would otherwise be (Eilenberg *et al.*, 2001).

**Biological invasion (or invasion process):** a process involving the transport of a native species outside of its natural range, intentionally or unintentionally, by human activities to new regions where it may become established, spread and ultimately adversely impact nature, nature's contributions to people, and good quality of life (Blackburn *et al.*, 2011; Figure 1.6).

**Biosecurity:** for the purpose of this assessment, a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) for identifying, analysing and managing risks, including invasive alien species, to human, animal and plant life and health, and associated risks to the economy and the environment (FAO, 2007).

**Biotic facilitation:** any interaction where the action of one species has a beneficial effect on another. This includes mutualistic interactions where both the facilitated and facilitator benefit (+/+), those which are commensal (+/0) when the effects of the facilitated on the facilitator are neutral as well as those which are antagonistic (+/–) when the facilitated negatively impact the facilitator. Note that this concept partially overlaps with that of mutualism, ecological engineering and niche construction (Zélé *et al.*, 2018).

**Biotic homogenization:** also referred to as the 'anthropogenic blender' (Olden, 2006), the loss of biotic uniqueness, where local community assemblages are becoming more similar to each other on average, and this biotic homogenization (Finderup Nielsen *et al.*, 2019; McKinney & Lockwood, 1999; Yang *et al.*, 2021).

**Biotic resistance to invasion:** the ability of species in a community to limit the recruitment or invasion of other species (Catford *et al.*, 2009; Levine *et al.*, 2004). It is central to our understanding of how communities at risk of invasion assemble after disturbances, but it has yet to translate into guiding principles for the restoration of invasion-resistant communities (Byun *et al.*, 2013).

**Bridging organizations** offer a means to improve environmental management outcomes by spanning the science–policy interface to allow for the effective sharing of data, information, and knowledge. Bridging organizations are institutions that use specific mechanisms such as working groups to link and facilitate interactions among individual actors in a management setting.” (Kowalski & Jenkins, 2015)

### C

**Casual species:** species that do not have self-sustaining populations and which rely on repeated introductions for their persistence i.e., not yet an established species (Blackburn *et al.*, 2011).

**Circular economy:** model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended (European Parliament, 2015).

**Citizen science:** diverse range of approaches in which scientific research is conducted, in whole or in part, by volunteers with varying levels of expertise (also known as community science, participatory monitoring, community-based environmental monitoring, crowd science, crowd-sourced science, civic science, or volunteer monitoring). Citizen science often contributes to surveillance of invasive alien species (Gardiner & Roy, 2022; Pocock *et al.*, 2018).

**Classical biological control:** the intentional introduction of an alien species, usually co-evolved, as a biological control

agent for permanent establishment and long-term control (Eilenberg *et al.*, 2001).

**Closed water systems:** in the context of management of biological invasions, bodies of water that do not directly or indirectly drain with continuous and intensive flow into an ocean or river, recognizing that no natural systems may be entirely closed (e.g., some inland surface waters and water bodies/freshwater).

**Collective action:** action taken together by a group of people whose goal is to achieve a common objective. It is a term that is used in many areas of the social sciences including psychology, sociology, anthropology, political science and economics (Hardin, 2015).

**Colonization pressure:** the number of species introduced or released to a single location, some of which will go on to establish a self-sustaining population and some of which will not (Blackburn *et al.*, 2020; Lockwood *et al.*, 2009).

**Connected water systems:** in the context of management of biological invasions, bodies of water that are directly or indirectly connected to an ocean or a main river (e.g., cryosphere, shelf ecosystems and coastal areas).

**Containment:** the application of measures in and around an infested area to prevent spread of invasive alien species. Containment may also apply in the context of keeping an invasive alien species out of a defined geographic region within a broader infestation (in pest management this is also termed “area-wide management”) (FAO, 2019). Any action taken to delimit the distribution of an invasive alien species through whatever means possible.

**Control:** direct action(s) taken to reduce or suppress the distribution, abundance, spread and impacts of invasive alien species within a defined geographic area (FAO, 1995) (see management).

**Cost-benefit analysis:** an analytical tool for judging the economic advantages or disadvantages of an investment decision by assessing its costs and benefits in order to assess the welfare change attributable to it. The analytical framework of CBA refers to a list of underlying concepts which is as follows: opportunity cost, long-term perspective, calculation of economic

performance indicators expressed in monetary terms, microeconomic approach, incremental approach (European Commission, 2015).

**Cost-effectiveness analysis:** an analytical tool to identify the best activity, process, or intervention that justifies/minimizes resource use to achieve a desired result (BetterEvaluation, 2014).

**Cryptogenic species:** a species, which cannot be reliably demonstrated as being either alien or native (Carlton, 1996).

## D

**DNA barcoding:** a commonly used molecular method (e.g., for detection of species, revealing species interactions and assessment of diversity of community assemblages) that involves the amplification of a short section of DNA from a specific gene or genes. Recent advances have extended the application of this approach from the identification of individual specimens to identification of multiple specimens within mixed samples through DNA metabarcoding (Klink *et al.*, 2022).

## E

**E-commerce:** “online ordering, sale, communication and payment, in particular, business to consumer and consumer to consumer transactions but can also be applicable to business-to-business transactions” (WCO, 2018).

**Eco-evolutionary dynamics:** reciprocal interactions between ecological and evolutionary processes. Ecological and evolutionary time-scales can be so similar that evolutionary change might be rapid enough to influence ecological dynamics (Brunner *et al.*, 2019; Schoener, 2011).

**Ecosystem:** a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (IPBES glossary).

**Ecosystem-based management:** an environmental management approach that recognizes the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation (NOAA, 2020).

**Eradication:** elimination/extirpation of an invasive alien species from a defined

geographic area even in the absence of all preventive measures obviating the necessity for further control measures (Dowdle, 1998). The time period after which an invasive alien species can be considered eradicated depends on the species and location.

**Essential Biodiversity Variables:** measurement required for study, reporting, and management of biodiversity change (Pereira *et al.*, 2013).

**Established alien species:** alien species which produce self-sustaining and viable populations for a given period of time, during which climatic extremes typical for the invaded region are experienced, without direct intervention by humans or despite human intervention (Blackburn *et al.*, 2011; Pyšek *et al.*, 2004; Rojas-Sandoval & Acevedo-Rodríguez, 2015).

**Externality:** an economic concept of uncompensated environmental effects of production and consumption that affect consumer utility and enterprise cost outside the market mechanism (OECD, 2003).

## F

**Feedback loops:** processes that either amplify (positive feedback loop) or diminish (negative feedback loop) the effects of a biological invasion. Feedback loops may make the impacts of biological invasions stronger or weaker, starting a chain reaction that repeats again and again. **Negative feedback loop:** A human-natural feedback that continually stabilizes or reduces ongoing or future biological invasions (also known as a ‘balancing’ feedback loop).

**Positive feedback loop:** A human-natural feedback that continually increases ongoing or future biological invasions (also known as ‘exacerbating’ or ‘reinforcing’ feedback loops) (Sinclair *et al.*, 2020).

## G

**Good quality of life:** within the context of the IPBES Conceptual Framework – the achievement of a fulfilled human life, a notion which varies strongly across different societies and groups within societies. It is a context-dependent state of individuals and human groups, comprising aspects such as access to food, water, energy and livelihood security, and also health, good social relationships and equity, security, cultural identity, and freedom of choice and action. “Living in harmony with nature”, “living-well

in balance and harmony with Mother Earth” and “human well-being” are examples of different perspectives on a “Good quality of life” (IPBES glossary).

**Governance:** the way the rules, norms and actions in a given organization are structured, sustained, and regulated (IPBES glossary).

## H

**Habitat:** “the area, characterized by its abiotic and biotic properties, that is habitable by a particular species” (IUCN Standards and Petitions Committee, 2013).

## I

**Impacts:** changes to nature, nature’s contributions to people, and/or the good quality of life (Ricciardi *et al.*, 2013). Impacts can be observed or unobserved. More specifically, impacts to nature (formerly ‘ecological impact’), is defined as a measurable change to the properties of an ecosystem (Ricciardi *et al.*, 2013), and implies that all introduced species can have an impact, even when not yet established or widespread, which may vary in magnitude, simply by integration into the ecosystem.

### Indigenous and local knowledge

**systems:** social and ecological knowledge practices and beliefs pertaining to the relationship of living beings, including people, with one another and with their environments. Such knowledge can provide information, methods, theory and practice for sustainable ecosystem management (IPBES glossary).

### Information and Communication

**Technology (ICT):** a broader term for Information Technology (IT), which refers to all communication technologies, including the internet, wireless networks, cell phones, computers, software, middleware, video-conferencing, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital form (FAO, 2017b).

**Information systems:** infrastructures for organising data and information. As examples, the Global Biodiversity Information Facility (GBIF) and Ocean Biogeographic Information System (OBIS) are international on-line infrastructures for organizing data of species presences in

space and time. For examples of invasive alien species information systems see Katsanevakis & Roy (2015) and Latombe *et al.* (2017).

### Integrated governance for biological

**invasions:** establishment of relationships between the roles of actors, institutions and instruments, and involving as appropriate all those elements of the socio-ecological system that characterize biological invasion and its management, for the purpose of identifying the strategic interventions needed to improve invasive alien species prevention and control outcomes (definition originated from this assessment, from the thinking on integrated environmental governance).

**Integrated pest management:** careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human and animal health and the environment. Integrated pest management emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms (FAO, 2017a). This management method seeks control using the most economical means, and with the least possible hazard to people, property, and the environment (U.S. EPA, 2015b).

### Integrated policy for biological

**invasions:** an integrated approach to planning and implementing future options to reduce the spread and limit the impact of biological invasions considers the fact that (1) multiple levels of governance are relevant, (2) diverse actors and decision-makers are involved, (3) the invasion process is multi-staged, and (4) drivers of invasion are multiple and interacting (Herrick, 2019).

**Introduction pathway:** a suite of processes that result in the introduction of a species from one geographical location to another. It means: 1) geographic routes by which a species is moved outside its natural range (past or present); 2) corridors of introduction (e.g., road, canal, tunnel); and/or 3) human activity that gives rise to an intentional or unintentional introduction. More than one vector (see definition of vector below) within a pathway may be involved in a transfer of species (Pyšek *et*

*al.*, 2011; Genovesi & Shine, 2004).

**Invasion cold spot:** areas of low alien species richness relative to other regions with similar biogeographic characteristics (O’Donnell *et al.*, 2012). Biodiversity hot spots of diversification and species richness are defined as geographic regions with high diversification rates or high species richness, respectively, while conversely cold spots are geographic regions with low diversification rates or species richness (Melían *et al.*, 2015).

**Invasion curve:** depiction of the different stages of invasive alien species management from prevention to early detection and eradication, containment and adaptive management (Invasive Species Centre, 2021). The curve shows that eradication of an invasive alien species is less probable and more costly as it spreads over time. Choosing a management action relies on where a species is on the invasion curve.

**Invasion debts:** the potential increase in biological invasions at a site over a particular time frame in the absence of any interventions (Rouget *et al.*, 2016). It is composed of the number of new species that will be introduced (introduction debt), the number of species that will become invasive (species-based invasion debt), the increase in area affected by invasions (area-based invasion debt), and the increase in the negative impacts caused by introduced species (impact-based invasion debt) (Zengeya & Wilson, 2020).

**Invasion hotspot:** areas of high alien species richness relative to other regions with similar biogeographic characteristics (O’Donnell *et al.*, 2012). Biodiversity hot spots of diversification and species richness are defined as geographic regions with high diversification rates or high species richness, respectively, while conversely cold spots are geographic regions with low diversification rates or species richness (Melían *et al.*, 2015).

**Invasion stages:** stages (transport, introduction, establishment, and spread) that a species must pass through on the invasion continuum from native to (invasive) alien species, recognising the need for a species to overcome the barriers (geography, captivity or cultivation, survival, reproduction, dispersal and environmental) that obstruct transition between each stage (Blackburn *et al.*, 2011).

**Invasional meltdown:** the amplification of impacts of invasive alien species through community-level processes in which there is a cascade of effects, positive feedback loops, arising from the interactions amongst species, in this case alien species, which ultimately affect ecosystem functions (Simberloff, 2006).

**Invasive alien species:** animals, plants or other organisms introduced directly or indirectly by people into places out of their natural range of distribution, where they have become established and dispersed, and generating an impact on local ecosystems and species (IPBES, 2016); see Chapter 1 for further discussion). Invasive alien species are a subset of established alien species that have negative impacts.

## L

**Lag phase:** the time between when an alien species arrives in a new area and the onset of the phase of rapid, or exponential, increase. Multiple factors are frequently implicated in the persistence or dissolution of the lag phase in biological invasions, including an initial shortage of suitable sites, the absence or shortage of essential mutualists, inadequate genetic diversity, and reduction in competition or predation (due to other alterations in the resident biota) (Zengeya & Wilson, 2020).

**Legal personality:** any entity that has the ability to conclude and negotiate international agreements in accordance with its external commitments; become a member of international organizations; join international conventions, such as the European Convention on Human Rights, stipulated in Article 6(2) of the Treaty on European Union (EUR-Lex, 2022).

## M

**Management:** for the purpose of the assessment, any action taken to address the threats, risks, distribution, abundance and impacts of an invasive alien species within a defined geographic area (Hulme, 2006; Pyšek *et al.*, 2020). Management includes prevention, preparedness, eradication, containment, and control (Robertson *et al.*, 2020).

**Monitoring:** for the purpose of this assessment, the continued or regular observation of an ecosystem to detect invasion/reinvasion by invasive alien species and/or their impacts.

## N

**Native species:** taxa that have originated in a given area (their natural range) without human involvement, or that have arrived there without intentional or unintentional intervention of humans, from an area in which they are native (IPBES glossary). This definition excludes products of hybridization involving alien taxa since “human involvement”, in this case, includes the introduction of an alien parent (Pyšek *et al.*, 2004).

**Nature:** in the context of IPBES, refers to the natural world with an emphasis on its living components. Within the context of western science, it includes categories such as biodiversity, ecosystems (both structure and functioning), evolution, the biosphere, humankind’s shared evolutionary heritage, and biocultural diversity. Within the context of other knowledge systems, it includes categories such as Mother Earth and systems of life, and it is often viewed as inextricably linked to humans, not as a separate entity (see “Mother Earth”) (IPBES glossary).

**Nature’s contributions to people:** all the contributions, both positive and negative, of living nature (i.e., diversity of organisms, ecosystems, and their associated ecological and evolutionary processes) to the quality of life for people. Beneficial contributions from nature include such things as food provision, water purification, flood control, and artistic inspiration, whereas detrimental contributions include disease transmission and predation that damages people or their assets. Many nature’s contributions to people may be perceived as benefits or detriments depending on the cultural, temporal or spatial context (IPBES glossary).

**Nexus:** interlinkages among biodiversity, climate change, adaptation and mitigation including relevant aspects of the energy system, water, food, and health (IPBES, 2021).

## O

**One Biosecurity:** interdisciplinary approach to biosecurity policy and research that builds on the interconnections between human, animal, plant, and environmental health to effectively prevent and mitigate the impacts of invasive alien species. It provides an integrated perspective to address the many biosecurity risks that transcend the

traditional boundaries of health, agriculture, and the environment. Individual invasive alien plant and animal species often have multiple impacts across sectors: as hosts of zoonotic parasites, vectors of pathogens, pests of agriculture or forestry, as well as threats to biodiversity and ecosystem function (Hulme, 2020, 2021).

**One Health:** an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent (One Health High-Level Expert Panel (OHHLEP) *et al.*, 2022).

## P

**Pathway management:** any action taken (single or via systems approach) towards a particular anthropogenic invasive alien species arrival pathway (e.g., trade) to prevent or address the threats and risks of an invasive alien species arriving and establishing via that pathway either between or within jurisdictions (Robertson *et al.*, 2020).

**Policy:** a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions (IPBES, 2019). See also Governance.

**Policy cycle:** a framework describing the policy process in terms of four linked phases: agenda setting, policy design, policy implementation, and policy review (IPBES glossary).

**Policy regime:** constructs that depict the mix of institutional mechanisms that make up the governing arrangements addressing a particular problem (Herrick, 2019), noting that for the purpose of this assessment the term “regime” is used for a governance system, affecting more than one country, for a specific issue area, such as invasive alien species (Andonova & Mitchell, 2010).

**Polycentric governance:** an organizational structure where multiple independent actors mutually order their relationships with one another under a general system of rules (Ostrom, 2010).

**Polymerase chain reaction (PCR):** sometimes called “molecular photocopying,” the polymerase chain

reaction (PCR) is a fast and inexpensive technique used to “amplify” - copy - small segments of DNA. Because significant amounts of a sample of DNA are necessary for molecular and genetic analyses, studies of isolated pieces of DNA are nearly impossible without PCR amplification (National Human Genome Research Institute, 2020).

**Precautionary approach:** where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environment degradation (Principle 15 of the 1992 Rio Declaration, (CBD, 1992).

**Preparedness (in the context of invasive alien species management):**

any policy and/or action undertaken to prepare for the probable arrival of a potential invasive alien species including any preventative or adaptive response activity (Australian Government - Department of Agriculture, Fisheries and Forestry, 2019).

**Prevention:** for the purpose of this assessment, any policy and/or action/response undertaken to prevent the arrival and/or introduction of alien and invasive alien species, between and within countries and regions. Prevention is generally far more cost-effective and environmentally beneficial than measures taken following introduction and establishment of an invasive alien species (CBD, 2002).

**Propagule pressure** (also termed ‘introduction effort’): a measure of introduction intensity, including release from captivity or cultivation, comprising both the number of individuals of a species introduced per introduction (propagule size) and the frequency of introductions (Lockwood *et al.*, 2005).

## R

**Range:** “the current limits of distribution of a species, accounting for all known, inferred or projected sites of occurrence” (IUCN, 2016).

**Resilience:** for the purpose of this assessment, the ability of an ecosystem to adapt, withstand and respond to alien species invasions, recover rapidly from their impacts and continue to develop (U.S. EPA, 2015a).

**Restoration:** any intentional activity that initiates or accelerates the recovery of an ecosystem from a degraded state (IPBES glossary). More specifically, in the context of invasive alien species management, it refers to the process of assisting the recovery of a degraded, damaged, or destroyed ecosystem, as a consequence of biological invasions, to reflect values regarded as inherent in the ecosystem and to provide goods and services that people value (adapted from Martin, 2017).

**Risk:** probability of the occurrence of a particular adverse event at a specific time and the magnitude of the consequent damage caused, depending on various factors such as exposure to the hazard, the frequency of exposure and the severity of any consequent damage done (FAO, 2011b). The term risk is regarded as a product of three factors: Exposure x Likelihood x Consequence (Kinney & Wiruth, 1976). Exposure results from the introductions, establishment and spread of an alien species, whereas Likelihood is the probability of an alien species affecting nature, nature’s contributions to people, good quality of life and/or the economy, and Consequence is the magnitude of impacts if an introduction event occurs (D’hondt *et al.*, 2015).

## S

**Safe trade:** export of products that are free from invasive alien species (Burgiel *et al.*, 2006).

**Sentinel sites or locations:** selected locations with heightened levels of detection and effective reporting through concentration of activities on subpopulations to enhance detection and improve cost-effectiveness of invasive alien species surveillance efforts (Keeling *et al.*, 2017).

**Site-based management:** programmes that aim to manage the impacts of invasive alien species within a site/area through both implementation of control measures and where necessary restoration (sometimes referred to as asset protection) e.g., within high value protected sites/areas.

**Species-led management:** invasive alien species management (in all contexts) focused on reducing the threats and impacts of specific or multiple invasive alien species.

**Surveillance:** actions, including extended programme of surveys and general surveillance (capturing unstructured and untargeted surveillance data and information from a wide range of sources), undertaken in order to directly or indirectly detect the presence of one or many invasive alien species over time (CEPM, 1996; Clift, 2008; CPM, 2015).

## T

**Tragedy of the commons:** a situation in which individuals with access to a public resource (also called a common) act in their own interest and, in doing so, ultimately deplete the resource (Spiliakos, 2019).

**Transformative change:** a fundamental, system-wide reorganization across technological, economic, and social factors making sustainability the norm (Díaz *et al.*, 2019).

**Transformative governance:** the set of formal and informal (public and private) rules, rulemaking systems and actor networks at all levels of human society that enable transformative change (Visseren-Hamakers *et al.*, 2021).

**Trend:** temporal trends are directional long-term changes (i.e., decades to centuries) in numbers of species, populations or individuals introduced, or the spatial extent of colonization (Buckland *et al.*, 2017). In this assessment report, trends are presented as indicators of species numbers (species richness) and rates of accumulation of species (e.g., first records of a species in a given location) over time.

## V

**Value chains** (that link production systems, markets and consumers): a contact network, which provides opportunities for the transmission of contagious diseases within and between sectors. It follows that these chains (networks) can be understood and taken into account in planning risk management strategies for disease prevention and control” especially in relation with “risky parts of the value chain” (FAO, 2011a).

**Vector:** Any living or non-living carrier that transports living organisms intentionally or unintentionally (ICES, 2005).

## W

**Widespread species:** species that are able to maintain viable populations across a range of environments leading to a large range size. Widespread species are likely

to experience a large range of ecological and climatic conditions within their range. A large niche width – based on the current distribution of a species – seems to be a general pattern in widespread species (Gaston, 2003; Vincent *et al.*, 2020).

**Willingness to pay:** the stated price that an individual would accept to pay for avoiding the loss or the diminution of an environmental service (United Nations, 2003).

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