ULTFARMS NID Glossary (v1)

Glossary of terms and common definitions related to Nature-inclusive Design

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Executive Summary

As Nature-inclusive Design (NID) is still an emerging concept, there has been much discussion within the ULTFARMS consortium to define and agree upon a project-wide approach to conceptualization and implementation of NID. This process has taken place through the formation of an NID working group that has met regularly online and in person, working towards the creation of an internal glossary of terms. The results of these discussions are currently being summarized in a position paper (in prep.), which will present the full theoretical rationale of NID within ULTFARMS and beyond. Below, we present the definition of NID developed by the ULTFARMS consortium, and the full glossary of terms for concepts related to NID. For some of the concepts, it is difficult to find a common definition; thus, the table below includes multiple definitions to reflect the variety of interpretations.

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1. Glossary of terms related to Nature-inclusive Design

Table 1. Definitions of nature-inclusive design and related concepts, as extracted from literature, or as developed by the ULTFARMS NID group.

Term	Definition	Reference[1]
Nature-inclusive Design	Options that can be integrated in or added to the design of an infrastructure to create optimized artificial habitat for native species (or communities) whose natural habitat has been degraded or reduced.	Hermans et al. (2020)
	Any intentional measure that creates optimized artificial habitat with the aim of enhancing selected biodiversity assets. Here, 'intentional measure' is an active and deliberate manipulation; 'creates' implies something unnatural being constructed; 'optimized' denotes adaptations or enhancements to an infrastructure without being its primary objective; 'artificial habitat' refers to the built structure or area; 'selected biodiversity assets' are selection of life forms, ecological functions and/or processes.	This group
Restorative Nature-inclusive Design	A type of nature-inclusive design aimed at promoting or regaining locally natural ecosystem assets at a certain location (such as facilitating the re-establishment of a species in a natural suitable habitat within its historical range of occurrence). The design measures are intended to have long-lasting effects, ensuring the persistence of these ecosystem assets over time.	This group
Creative Nature-inclusive Design	A type of nature-inclusive design that seeks to enhance biodiversity "beyond nature" (such as beyond the location where a habitat or species was known to occur), focusing on artificially created ecosystem assets, and which comes in two main forms.	This group

[1] If no reference is provided, the definition was compiled from multiple sources.

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	A first subtype, i.e. creative NID optimizing infrastructure, aims at ecologically optimizing the design of the necessary infrastructure, like the scour protection of an offshore wind turbine, to locally boost selected natural values. While this subtype artificially boosts selected natural values, it may be expected that it will not meaningfully harm natural values prevailing nearby. The second subtype, i.e. creative NID as add-on structures, also aims at boosting selected natural values but it does so by additional artificializing natural habitat that would not have been affected by the infrastructure needed for the activity at sea. In this case, boosting the natural values coincides with an additional direct loss of natural habitat. Examples of this subtype are concrete tubes placed in between turbines to create cod habitat.	
Nature-based solutions	Nature-based Solutions address societal challenges through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being	IUCN (2022)
	Actions to protect, conserve, restore, sustainably use, and manage natural or modified terrestrial, freshwater, coastal, and marine ecosystems, which address social, economic, and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience, and biodiversity benefits	United Nations Environment Programme (2022)
	Nature-based solutions (NBS) are inspired and supported by nature, they are cost-effective[2], simultaneously provide environmental, social and economic benefits and help build resilience; such	European Research Executive Agency (2023)

[2] Future iterations of this document might consider the implications of qualifying a solution as nature-based based on its cost-effectiveness, which may vary with changing economic conditions.

	solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. NBS must benefit biodiversity and support the delivery of a range of ecosystem services.	
Net positive or net gain solutions	An approach to development that aims to leave the environment in a measurably better state than before. This involves protecting existing habitats and ensuring that lost or degraded environmental features are nullified or, if not possible, compensated by restoration. For a solution to be considered net positive, it should incorporate the restoration of the original habitats that have been degraded.[3]	This group
Mitigation	Measures taken to reduce, minimize or nullify the negative impact of a human activity on the ecosystem. In the case of aquaculture, this can include reducing the risk of introducing diseases, invasive species, the risk of over-exploitation of the area, or mitigating anchoring effects.	
Compensation	The process of creating a specific habitat in a new location to offset environmental damage caused in another area (i.e., outside original zone of influence). It can be considered habitat creation rather than restoration, if a species is introduced in an area outside its historical area of presence.	
	Actions conducted to offset or restore natural values that were destroyed or degraded by a development project. On-site compensation is a compensatory measure carried out in the same location as the impact resulting from the development project. Off-site compensation is a compensatory measure carried out in a location away from the impact site.	Gastineau et al. (2021)

[3] In future iterations, this definition might be revised to include considerations on the broader environmental and social impacts of the solution (e.g., impact of resources, production process, logistics chain).

Restoration (active)	Nature restoration is the re-establishment of lost habitats where they had known occurrence, or of lost species in their natural historical distribution area and densities. It is thus defined as an action that re-establishes/restores natural habitats, hydrological processes, biological mechanisms and/or sustainable occurrences of species.	Petersen et al. (2023)
Restoration (passive)	A strategy where natural recovery or succession processes are allowed to occur after removing a pressure, without any direct human intervention. Based on the principle that ecosystems are resilient and can recover from a disturbance once pressures are removed.	
Habitat creation	The development or establishment of a habitat in areas where it was not historically present	
Biodiversity	The variety of all life forms and their functions within an ecosystem. Biodiversity is usually considered at three levels: genetic, species and ecosystem diversity.	
Structural biodiversity	Variation in the composition and distribution of life forms within an ecosystem, such as the number of species present, their relative abundance and their spatial configuration. Structural diversity is measured at different levels of organization (from genetic to species, populations and communities).	
Functional biodiversity	The different types of activities, processes and functions that organisms and communities perform within the ecosystem. Examples are habitat creation, carbon burial, nutrient cycling, etc.	
Ecosystem asset	The stock of living and non-living components of ecosystems (plants, animals, surface freshwater, soils, etc.), representing the capacity of an ecosystem to deliver ecosystem services over time. (Assets refer to the components of the environment that have potential to provide	

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	benefits, while ecosystem services are the actual benefits that can be derived from them)	
Structural ecosystem asset	Structural component of an ecosystem that provides an ecosystem service. An example is the presence/abundance of species people like to see or value for recreational activities (e.g., whales in whale watching).	
Functional ecosystem asset	An asset that provides a certain ecosystem function. Examples are the creation of biogenic habitats (i.e., originating from living organisms), the provision of spawning grounds for reproduction, foraging grounds, and nursery grounds to ensure growth and development of organisms.	
Balanced (stable, robust) ecosystem	An ecosystem that can maintain its structure (such as species diversity, variability in species densities) and function (nutrient and water cycling, biomass production, energy flows, etc.) over a long period of time despite disturbances	Elton, 1958; Paine, 1966; MacArthur, 1955
	A balanced ecosystem refers to a natural ecosystem that maintains its structure and functions using processes and elements characteristic of its ecoregion. The idea behind this term emphasizes the preference for natural ecosystems. Alternative ecosystem states may demonstrate stability and robustness, but they might not reflect the natural conditions. While achieving a balanced ecosystem state is complex and the meaning behind this term can be extensively discussed, it entails the capacity to sustain its structure, including species diversity and variability, as well as functions such as nutrient and water cycling, biomass production, and energy flows, over extended periods despite disturbances.	This group

Suitable habitat	An area with a specific set of physical factors within which species can find food, shelter, or conditions for reproduction.	Hermans et al. (2020)
	An area with a specific set of abiotic factors within which species and/or life stages thereof can live.	This group
Restorative aquaculture	Commercial or subsistence cultivation of organisms in aquaculture settings for production purposes that may contribute to the restoration of populations and/or provision of ecosystem services	Mizuta et al. (2023)
	Restorative aquaculture occurs when commercial or subsistence aquaculture provides direct ecological benefits to the environment, with the potential to generate net positive environmental outcomes.	Nature Conservancy, 2021
Regenerative aquaculture	Commercial or subsistence aquaculture focused on maintaining a healthy environment through the nature of the farming activities and outcomes (e.g., carbon and nitrogen fixation, benefits in terms of reduced eutrophication).	Mizuta et al. (2023)
Ecological carrying capacity for aquaculture	Level of aquaculture production that does not undesirably impact the surrounding ecosystem(s). In the context of extractive aquaculture, the amount of production that can be maintained without leading to significant negative effects on the ecological processes, species, populations, or communities in an undisturbed environment.	Filgueira et al., 2015; Smaal & van Duren, 2019
Production carrying capacity for aquaculture	The maximum aquaculture production that can be supported in any given area or location, taken into consideration the availability of space and nutrients	Smaal & van Duren, 2019
Social carrying capacity for aquaculture	Amount of aquaculture that can be developed without perceived adverse social impacts (e.g., visual impacts, traditional fishing rights, needs for other resource users)	Smaal & van Duren, 2019

Ecological enhancement	Habitat creation targeting a boost of selected ecosystem assets. More specifically, ecological enhancement modifies a site to either increase or improve habitats for animals and plants, while protecting human health and the environment, thereby restoring or increasing the ecological value of an area.	
Ecological engineering	Ecological engineering is a technique that combines ecological processes and organisms with technological solutions to predict, design, construct or restore and manage ecosystems, with the aim of integrating human society with its natural environment to the benefit for both	Jørgensen & Mitsch, 1989

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