Guidance note on ecosystem extent accounts

Technical Note

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Contents

1. Introduction

Compilation of extent accounts is usually the first step in the compilation of ecosystem accounts. Extent accounts present policy relevant information on changes in ecosystem extent, and they are the basis for the compilation of ecosystem condition and ecosystem services accounts.

This guidance note aims to assist EU compilers with the compilation of ecosystem extent accounts to meet the (future) reporting obligation (amended Regulation (EU) 691/2011)[1] and help harmonise compilation approaches across the EU. It also provides insights relevant for more detailed voluntary reporting of EU ecosystem types. It is primarily focused on national scale compilation but may also be helpful at sub-national scales. The guidance note is specific for Europe: focussing on European ecosystem types and connecting to European ecosystem classifications and datasets. The guidance note considers that, compared to other continents, Europe has a broader range of semi-natural, often biodiversity-rich ecosystems.

The guidance note follows the SEEA Ecosystem Accounting 2021 (SEEA EA) and the SEEA Experimental Ecosystem Accounting Technical Recommendations 2017 (SEEA EEA TR). Several sections in this guidance note are excerpts from the SEEA EA or the SEEA EEA TR. Sometimes these sections are slightly modified, for instance to include European examples. Compared to the SEEA EA, further detail has been added with regard to the ecosystem types found in Europe, and to relevant European classifications and datasets.

This guidance note includes a three-level EU ecosystem typology to support the compilation of extent accounts with growing level of detail. Level 1 (L1 EU) of the classification corresponds to the level at which reporting on ecosystem extent, condition and ecosystem services to Eurostat is mandatory. Levels 2 (L2 EU) and 3 (L3 EU) can be used for voluntary reporting to Eurostat or to support the identification of classes for national ecosystem accounts. Level 1 and most terrestrial level 2 classes can, in principle, be mapped using existing remote sensing data, for instance CORINE land cover. Level 3 is a more flexible classification, partly based on the level 3 EUNIS habitat classification[2].

[1] See the Commission technical proposal at: https://eur-lex.europa.eu/resource.html?uri=cellar:ddb7c711-010b-11ed-acce-01aa75ed71a1.0010.02/DOC_2&format=PDF. The text of the Guidance note will be adjusted as the legal process advances. This note is applicable to all relevant references to the legal act and amended Regulation (EU) 691/2011 throughout the text of the guidance note.

[2] https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification-1. The EUNIS habitat classification is a comprehensive pan-European system for habitat identification. The classification is hierarchical and covers all types of habitats from natural to artificial, from terrestrial to freshwater and marine. The habitat types are identified by specific codes, names and descriptions. The EUNIS descriptions have been revised several times, including in 2012, 2019, 2021 and 2022. In 2019, a revised marine classification was published. In 2021 a revised version of terrestrial EUNIS habitat classification was published covering coastal habitats, grasslands, heathland, forest, sparsely vegetated and vegetated man-made habitats. Inland water habitats are still (June 2022) under revision whereas the

In particular for L3 EU, countries may add or reduce classes depending upon national needs for the compilation of ecosystem accounts. Any new classes for use at national scale at L3 EU should be linked to the appropriate L2 EU class, so that aggregation at the harmonised L1 and L2 EU remains possible. When adopting L3 EU classes, it may be helpful to consult the crosswalks between the EUNIS habitat classification version 2012 and other hierarchies including the Habitats Directive Annex I habitat types and CORINE Land Cover classes. The newly revised EUNIS habitat groups include crosswalks to EUNIS 2012, to Annex I and to European Red List habitats. Updates of these crosslinks and a crosswalk to the EU ecosystem typology are planned to be developed by the EEA, the custodian of the EUNIS classification.

The EU ecosystem typology set out in this guidance note may be revised before the first mandatory data collection, based on experiences in countries with the 2023 voluntary data collection for ecosystem extent accounts.

2. Overview of extent accounts

2.1 Concepts and definitions

Ecosystem extent accounts are the basis for ecosystem accounting. They are defined as accounts '*recording the areas and changes in areas for each ecosystem type within the national territory*' (proposed amendment of Regulation (EU) 691/2011). They cover '*the terrestrial (including freshwater) and marine ecosystems on the national territory'*. The proposed legal text furthermore specified that '*As a component of the ecosystem extent accounts, a conversion matrix recording conversions between ecosystem types between two points in time*' is also a reporting requirement.

Relevant key concepts used in SEEA EA are shortly described below; for more detail the reader is asked to refer to the SEEA EA and the SEEA EEA TR.

Ecosystem accounting area is the area for which the ecosystem account is compiled. Conceptually, it is possible to develop a set of ecosystem accounts for an individual ecosystem asset (see next paragraph), such as an individual forest, wetland or farming area. It is also possible to develop a set of ecosystem accounts for a specific ecosystem type (e.g. for all grasslands in a country). However, the general ambition of ecosystem accounting is to record and track changes in ecosystem related stocks and flows in larger and diverse spatial areas. Commonly, the extent account will reflect contiguous areas, such as administrative areas or river basins.

Ecosystem assets are contiguous areas of a specific ecosystem type. Ecosystem assets are considered to be bounded spatially, with each asset comprising all of the relevant biotic (i.e. living) and abiotic (i.e. non-living) components within those bounds that are

wetlands are nearly ready. The marine classification was updated in 2022 including corrections for the Atlantic regional sea.

required for the ecosystem asset to function and to supply ecosystem services. Where an individual ecosystem type crosses a national boundary, the associated ecosystem assets need to be delineated with reference to the national boundary such that the aggregate of all ecosystem assets for a country is equal to the total country area.

Ecosystem type is defined as a specific class of ecosystem assets of comparable ecology and ecosystem use. Ecosystem type classifications define ecosystem types based on various characteristics such as vegetation structure and type, species composition, ecological processes, climate, hydrology, soil characteristics and topography. For illustration, there may be different areas of (a type of) heathlands in different parts of a country. Each individual heathland is considered a separate ecosystem asset but is classified to the same ecosystem type 'Heathland and shrub' (in the case of the EU ecosystem typology).

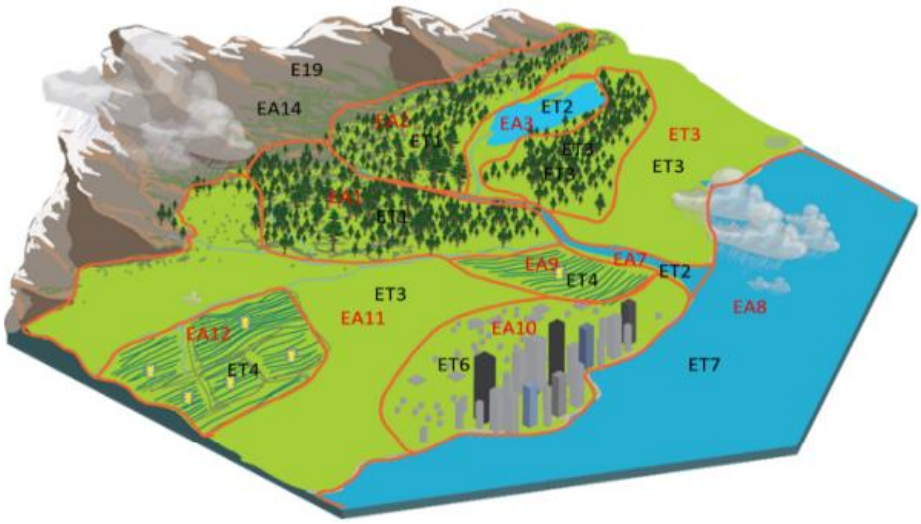

Figure 1. Visualization of the SEEA EA spatial framework. The Ecosystem Accounting Area (EAA) consists of the shown tile. Ecosystem assets (EAs) are delineated by the red lines, indicated and numbered in red letters. EAs are classified into different Ecosystem Types (ETs) shown in black letters (United Nations 2021).

Maps and spatial data. Maps are an integral part of the statistical reporting in SEEA EA. The SEEA EA specifies (SEEA EA 3.7): "*The statistical outputs from ecosystem accounting are most commonly presented either in tabular form where data on ecosystem assets are grouped according to their ecosystem type; or in the form of maps where individual ecosystem assets are reflected and the configuration and location of different ecosystem types can be displayed*". The scope of the (proposed) legal module ecosystem accounts is only limited to tabular data. However, these accounting tables can only be developed on the basis of suitable geo-spatial data. Countries are free to choose making maps available to users, noting that maps are often of particular interest to users and can greatly facilitate the use of information in ecosystem accounts.

The term spatial data (or geospatial data) is used to describe input data sets that can be used for an analysis involving spatial distribution of an environmental phenomenon (such as ecosystem types) or an analysis of trends that have a spatial dimension (such as ecosystem extent accounts). The term 'map' is used to describe the graphical output of that analysis (e.g. Ivits et al, 2020). The objectives and methodology of SEEA EA requires using geospatial data to compile ecosystem accounts. SEEA EA also includes maps, as outputs, showing the spatial variation in the tabular information in the SEEA EA. In tabular format, the extent account will show the area covered by the ecosystem types occurring in a country or in the EU, and the ecosystem extent map will show where the ecosystems are located, their size and their shape.

2.2 Principles of the EU ecosystem typology

The EU ecosystem typology was proposed as a common classification to harmonize the reporting on ecosystem accounts in the EU. Its development considered the most important existing EU-wide/international ecosystem classifications: MAES, EUNIS and IUCN Global Ecosystem Typology (GET) as starting points. The EU ecosystem typology has been developed based on the following principles:

1. The typology should support mapping and modelling of ecosystem condition and ecosystem services. Therefore, the typology builds on and enhances the MAES ecosystem typology (Maes et al., 2013) as the basis (at level 1) to ensure that there is alignment with ongoing efforts on developing methodological guidance for measuring ecosystem condition at EU level.

2. Alignment with IUCN functional ecosystem types so that international reporting is possible; but leaving out the IUCN classes that are not present in Europe (e.g. mangroves and tropical forests).

3. Excluding the IUCN GET sub-terranean ecosystem types, in line with recommendations provided in the SEEA EA and SEEA EEA TR, to avoid double counting in terms of ecosystem extent area, since these sub-terranean ecosystems will generally be part of other EAs.

4. Distinguishing important ecosystem types that are not fully natural (and therefore not explicitly included in the IUCN GET) but are nevertheless important in Europe in terms of area and ecosystem services supply.

5. Only present ecosystem types that are significant in at least one EU country. Hence, some IUCN classes have been merged in the EU ecosystem typology given their limited extent in the EU (and considering resource needs for their mapping). These include e.g. the various types of lakes and rivers distinguished by IUCN).

6. Ensuring a connection with the European habitat classification system 'EUNIS' that is widely used in Member States, and that is connected to several important EU biodiversity-related policies.

2.3 EU ecosystem typology

At **level 1 (EU L1)**, the EU ecosystem typology is an updated MAES ecosystem typology. Level 1 of the typology is the mandatory level for reporting on ecosystem extent to Eurostat. Level 1 ecosystem types can, in principle, be derived from CORINE land cover data.

At **level 2 (EU L2)**, ecosystem types are differentiated in a manner that is relevant for ecosystem service and condition modelling and reporting. **EU L2** aligns, where feasible, with the EUNIS habitat level 2 classification and can partly be derived from CORINE data (see Petersen et al., 2022, for an example of a spatial analysis based on CORINE data). The breakdown at level 2 is included in the ecosystem extent questionnaire for voluntary reporting.

Level 3 (EU L3) presents an additional, more detailed layer to support ecosystem service and condition modelling, and national reporting. EU L3 ecosystem types may be adjusted for national level analysis, for instance, specific crops may be added in the extent account. EU L3 of the typology is based upon EUNIS, with some aggregation of the EUNIS level 3 classes to simplify the typology for ecosystem accounting.

The level 1 typology is shown in Table 1. Table 2 presents the detailed typology at levels 2 and 3. Annex 3 presents a description of ecosystem types at all three levels. The ecosystem types 'Rivers and canals' 'Lakes and reservoirs', 'Marine inlets and transitional waters', and 'Marine ecosystems', are 'three dimensional', i.e., they include all ecosystems across the water column including substrate and pelagic ecosystems.

Table 1. EU ecosystem typology, level 1

Category	Name of ecosystem type
1	Settlements and other artificial areas
2	Cropland
3	Grassland (pastures, semi-natural and natural grasslands)
4	Forest and woodland
5	Heathland and shrub
6	Sparsely vegetated ecosystems
7	Inland wetlands
8	Rivers and canals
9	Lakes and reservoirs
10	Marine inlets and transitional waters
11	Coastal beaches, dunes and wetlands
12	Marine ecosystems (coastal waters, shelf and open ocean)

Table 2. EU ecosystem typology

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3
1. Settlements and other artificial areas	1.1 Continuous settlement area	1.1.1 Continuous residential area
		1.1.2 Continuous commercial and industrial area
	1.2 Discontinuous settlement area	1.2.1 Discontinuous residential area
		1.2.2 Discontinuous commercial and industrial area
	1.3 Infrastructure	1.3.1 Road and rail networks and associated land
		1.3.2 Port areas
		1.3.3 Airports
		1.3.4 Other infrastructure
		1.3.5 Mineral extraction sites (excluding peat extraction sites, see 7.3.1)
		1.3.6 Dump areas
		1.3.7 Construction sites
	1.4 Urban greenspace	1.4.1 Parks (including Zoos and botanical gardens)
		1.4.2 Sports and recreation sites
		1.4.3 Other urban green
	1.5 Other artificial areas	1.5.1 Permanent Greenhouses
		1.5.2 Cemeteries
		1.5.3 Archaeological sites
		1.5.4 Urban blue
2.2. Cropland[3]	2.1 Annual cropland	2.1.1 Cereals excluding rice (C1000) excluding maize (C1500)
		2.1.2 Maize (C1500 + G3000)
		2.1.3 Dry pulses and protein crops (P0000)
		2.1.4 Root crops, like sugar beet and potatoes (R0000)
		2.1.5 Vegetables (including melons) and strawberries (V0000_S0000)
		2.1.6 Industrial crops including annual bioenergy crops (I0000)
		2.1.7 Flowers and ornamental plants (N0000)
		2.1.8 Fallow land (Q0000)
		2.1.9 Temporary grasses (G1000)
		2.1.10 Other crops (further categories may be added by Member States, depending upon nationally important crop types).
		2.1.11 Semi-natural elements associated with agricultural land use in annual cropland

[3] The breakdown of cropland uses the terms and breakdown of crop statistics at level 3 of the EU ecosystem typology for classes 2.1 – 2.3 (i.e. for annual cropland, rice fields and permanent crops). The codes in brackets at level 3 refer to crop statistics codes. However, technically, the crops reported under these codes in crop statistics also include crops grown in 'permanent greenhouses'.

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3
	2.2 Rice fields	2.2.1 Rice fields (C2000)
	2.3 Permanent crops	2.3.1 Olives (O1000)
		2.3.2 Grapes (W1000)
		2.3.3 Pome fruits (F1100)
		2.3.4 Stone fruits (F1200)
		2.3.5 Berries excluding strawberries (F3000)
		2.3.6 Citrus fruits (T1000)
		2.3.7 Nuts (F4000)
		2.3.8 Hazelnut
		2.3.9 Chestnut
		2.3.8 Other perennial crops and orchards
		2.3.9 Semi-natural elements associated with agricultural land use in in permanent crops
	2.4 Agro-forestry areas	2.4.1 Holm and cork oak forests
		2.4.2 Other agro-forestry area
	2.5 Mixed farmland	2.5.1 Mosaic farmland (comprising cropland, grassland and (semi-)natural components)
	2.6 Other farmland	2.6.1 Nurseries
		2.6.2 Christmas tree plantations
		2.6.3 Perennial bioenergy crops
		2.6.4 Semi-natural elements associated with agricultural land use in other farmland
3. Grassland	3.1 Sown pastures and other grass (modified grassland)	3.1.1 Sown pastures used for grazing
		3.1.2 Sown grassland mown frequently for fodder or silage
		3.1.3 Semi-natural elements associated with agricultural land use in modified grassland
	3.2 Natural and semi-natural grassland	3.2.1 Mesic grassland
		3.2.2 Dry grassland
		3.2.3 Seasonally wet and wet grassland
		3.2.4 Alpine and subalpine grasslands
		3.2.5 Woodland fringes and clearings and tall forb stands
		3.2.6 Inland salt steppes
		3.2.7 Wooded pastures
		3.2.8 Semi-natural elements associated with agricultural land use in (semi-) natural grassland
4. Forest and woodlands	4.1 Broadleaved deciduous forest	4.1.1 Riparian forest and woodland
		4.1.2 Broadleaved swamp forest on non-acid and acid peat
		4.1.3 Fagus dominated forest
		4.1.4 Temperate, Submediterranean and Mediterranean thermophilous deciduous forest

EU ecosystem typology: level 1	**EU ecosystem typology: level 2**	**EU Ecosystem typology: level 3**
		4.1.5 Acidophilous [*Quercus*]-dominated forests
		4.1.6 Temperate and boreal and Southern European *Betula* and *Populus tremula* forest on mineral soils
		4.1.7 Other broadleaved deciduous forest, excluding highly modified plantations
		4.1.8 Highly modified broadleaved deciduous forests, in particular plantations including stands of non-native trees species that have long been established in European ecosystems stands
	4.2 Coniferous forests	4.2.1 Boreal and temperate fir and spruce forest
		4.2.2 Mediterranean mountain fir and spruce forest
		4.2.3 Temperate subalpine Larix, *Pinus cembra* and *Pinus uncinata* forest
		4.2.4 Pine forest (excluding mires, non-thermophilous)
		4.2.5 Mediterranean thermophilous lowland pine forest
		4.2.6 Spruce, pine and larch mire forests
		4.2.7 Taiga forests
		4.2.8 Other coniferous forests, excluding plantations
		4.2.9 Highly modified coniferous forests, in particular plantations
	4.3 Broadleaved evergreen forest	4.3.1 Mediterranean evergreen *Quercus* forest
		4.3.2 Mainland laurophyllous forest
		4.3.3 Macaronesian laurophyllous forest
		4.3.4 *Olea europaea-Ceratonia siliqua* forest
		4.3.5 Palm groves
		4.3.6 Other broadleaved evergreen forests
		4.3.7 Highly modified broadleaved evergreen forests, including stands of non-native trees species that have long been established in European forest mixes.
	4.4 Mixed forests	4.4.1 Mixed forests dominated by coniferous species
		4.4.2 Mixed forests dominated by broadleaved species
		4.4.3 Other mixed forests including stands of non-native trees species that have long been established in European forest mixes.
	4.5. Transitional forest and woodland shrub	4.5.1 Transitional woodland/forest land
	4.6 Plantations	4.6.1 Monoculture or mixed plantations
5. Heathlands and shrub	5.1 Tundra	5.1.1 Tundra
	5.2 Scrub and heathland	5.2.1 Arctic, alpine and subalpine scrub
		5.2.2 Temperate and Mediterranean montane scrub
		5.2.3 Temperate shrub heathland

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3
	5.3 Sclerophyllous vegetation	5.3.1 Maquis, arborescent matorral and thermo-Mediterranean scrub
		5.3.2 Garrigue
		5.3.3 Spiny Mediterranean heaths (phrygana, hedgehog-heaths & coastal cliff vegetation)
		5.3.4 Thermo-Atlantic xerophytic shrub (Madeira and Canary Islands)
6. Sparsely vegetated ecosystems	6.1 Bare rocks	6.1.1 Rocky pavements, outcrops, and screes
		6.1.2 Lava flows
	6.2 Semi-desert, desert and other sparsely vegetated areas	6.2.1 Semi-desert steppes
		6.2.2 Cool deserts and semi-desert steppes
		6.2.3 Other sparsely vegetated areas
	6.3 Ice sheets, glaciers and perennial snowfields	6.3.1 Ice sheets, glaciers and perennial snowfields
7. Inland wetlands	7.1 Inland marshes and other wetlands on mineral soil	7.1.1 Inland marshes
		7.1.2 Inland salt marshes
		7.1.3 Reedbeds
		7.1.4 Springs
	7.2 Mires, bogs and fens	7.2.1 Raised bogs
		7.2.2 Blanket bogs
		7.2.3 Valley mires, poor fens and transition mires
		7.2.4 Aapa, palsa and polygon mires
		7.2.5 Base-rich fens and calcareous spring mires
		7.2.6 Peat extraction sites
8. Rivers and canals	8.1 Rivers	8.1.1 Permanent, non-tidal, fast, turbulent water courses
		8.1.2 Permanent non-tidal, smooth-flowing watercourses
	8.2 Canals, ditches and drains	8.2.1 Canals
		8.2.2 Ditches and drains
9. Lakes and reservoirs	9.1 Lakes and ponds	9.1.1 Lakes
		9.1.2 Inland saline or brackish lakes and pools
		9.1.3 Ponds and natural small standing water bodies
	9.2 Artificial reservoirs	9.2.1 Artificial reservoirs
	9.3 Geothermal pools and wetlands (Iceland)	9.3.1 Geothermal pools and wetlands (Iceland)
10. Marine inlets and transitional waters	10.1 Coastal lagoons	10.1.1 Coastal lagoons
	10.2 Estuaries and bays	10.2.1 Estuaries and bays
	10.3 Intertidal flats	10.3.1 Intertidal flats (e.g., Wadden Sea)
11. Coastal beaches, dunes and wetlands	11.1 Artificial shorelines	11.1.1 Artificial shorelines
	11.2 Coastal dunes, beaches and sandy and muddy shores	11.2.1 Coastal dunes
		11.2.2 Beaches and sandy shores

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3
		11.2.3 Muddy shores
	11.3 Rocky shores	11.3.1 Coastal shingle
		11.3.2 Rock cliffs, ledges and shores
	11.4 Coastal saltmarshes and salines	11.4.1 Coastal saltmarshes
		11.4.2 Salines
12. Marine ecosystems	12.1 Marine macrophyte habitats	12.1.1 Kelp forests
		12.1.2 Coastal macrophyte beds
		12.1.3 Seagrass meadows
	12.2 Coral reefs	12.2.1 Coral reefs
	12.3 Worm reefs	12.3.1 Worm reefs
	12.4 Shellfish beds and reefs	12.4.1 Shellfish beds and reefs
	12.5 Subtidal sand beds and mud plains	12.5.1 Subtidal sand beds and mud plains
	12.6 Subtidal rocky substrates	12.6.1 Subtidal rocky substrates
	12.7 Continental and island slopes	12.7.1 Continental and island slopes
	12.8 Deepwater benthic and pelagic ecosystems	12.8.1 Deepwater benthic and pelagic ecosystems
	12.9 Deepwater coastal inlets (fjords)	12.9.1 Deepwater coastal inlets (fjords)
	12.10 Sea ice	12.10.1 Sea ice

2.4 General setup of extent accounts

The extent account will generally have three main elements, each underpinned by one or more spatial dataset(s):

1. An accounting table (asset account)
2. A conversion matrix
3. An ecosystem extent map representing the spatial distributions of ecosystems. This output is not required under the proposed amendment of Regulation (EU) 691/2011 but essential for producing the mandatory elements and very useful for quality assurance and further analysis.

The three main elements are explained below.

Accounting table for ecosystem extent. The most common starting point for ecosystem accounting is organising information on the total extent of different ecosystem types within a country in terms of area. The structure of an ecosystem extent account is shown in Table 3. The columns reflect the basic structure of asset accounts, as described in the SEEA Central Framework, with opening stocks (area), the flows, and closing stocks (area), using the terminology from the proposed legal module. A

column on net changes is added, in line with the SEEA EA. The rows show ecosystem types at level 1 of the EU ecosystem typology. The total (i.e., national) opening area should be equal to the total closing area. The following rule also applies: the opening area of each individual ecosystem type in the following accounting period must be equal to the closing area of the preceding accounting period.

Conversion matrix. The conversion matrix can be produced by comparing ecosystem extent maps for different years. A conversion matrix shows the additions and reductions in area between individual ecosystem types, for instance how much forest was converted to croplands in a specific period. It can be constructed by comparing the ecosystem extent maps in two years, using standard GIS algorithms. It is crucial to base any analysis of temporal changes of spatial data on a common reference layer (see section 3.3. of the guidance note and chapter 3.2.1 from Ivits et al., 2020). An example of the conversion matrix is presented in Annex 1. Some common challenges in producing the conversion matrix are described in Section 4 of this Guidance note.

Ecosystem extent map. Critical elements are if a raster or vector map is produced, the minimum mapping unit (MMU, i.e. the specific size of the smallest feature that is being reliably mapped) and the resolution (the level of spatial detail; in the case of raster maps the resolution is a function of the grid size). Vector maps are better in dealing with linear landscape elements, whereas raster maps can be more easily linked to remote sensing images and can be easier to process. The compiler may choose to publish the map at a coarser resolution than at which it is produced in view of the degree of accuracy of the map. Accuracies relate to both the spatial accuracy (are objects located in the correct place?) and the classification accuracy (are areas classified in the correct ecosystem type?). These accuracies should be examined (through comparison with ground-truth/referenced data) and published. Annex 2 presents an example of an ecosystem extent map for the Netherlands.

Table 3. Reporting table for ecosystem extent accounts, for level 1 ecosystem types (note: the variable 'net changes' is voluntary, i.e., not part of the legal proposal).

		Opening area (Extent in the previous reference year)	**Additions**	**Reductions**	**Closing area (Extent in the current reference year)**	Net changes (additions less reductions ; +/-)
1	**Settlements and other artificial areas**					
2	**Cropland**					
3	**Grassland (pastures, semi-natural and natural grasslands)**					
4	**Forest and woodland**					
5	**Heathland and shrub**					
6	**Sparsely vegetated ecosystems**					
7	**Inland wetlands**					
8	**Rivers and canals**					
9	**Lakes and reservoirs**					
10	**Marine inlets and transitional waters**					
11	**Coastal beaches, dunes and wetlands**					
12	**Marine ecosystems (coastal waters, shelf and open ocean)**					

2.5 First and subsequent reporting to Eurostat

This section is an interpretation of the text in the proposed legal module ecosystem accounts and its objective is to clarify the reporting requirements for the first and subsequent mandatory reporting[4].

The draft legal text specifies for ecosystem extent accounts, including the conversion matrix, that:

- *Statistics shall be compiled and transmitted every three years. The data shall refer to a representative average for the reference year, and for the conversion matrix to the change in the three years between two reference years*

[4] The text assumes the legal act will be passed in its current version; the text in the guidance note will be updated for changes during the legal process, as needed.

- *Statistics shall be transmitted within 24 months of the end of the reference year.*
- *The first reference year is 2024. For the conversion matrix the first reference year is 2027.*
- *In the first data transmission, Member States shall include data from 2024 for extent accounts. For the conversion matrix the data shall show the changes between 2024 and 2027.*
- *In each subsequent data transmission to the Commission, Member States shall provide for extent accounts data for years n – 3 and n, where n is the reference year.*
- *Ecosystem extent accounts: For all ecosystem types referred to in section 3* [i.e. level 1 ecosystem types]*, in the first transmission, data shall be reported for the first reference year. For all subsequent data transmissions, data shall be reported as follows:*
    - *Extent in the previous reference year* [representing the opening stock/area in the accounting period]*;*
    - *Additions;*
    - *Reductions;*
    - *Extent in the current reference year* [representing the closing stock/area in the accounting period].

  The conversion matrix shall report conversions between all ecosystem types referred to in section 3 between the previous and the current reference year.

According to the draft legal text, the legal deadline for the **first data transmission** on ecosystem extent accounts, but <u>not</u> for the conversion matrix, is December 2026. Member States are required to report data for reference year 2024; this means, data on the extent of ecosystems on their national territory in 2024. For the first reporting, Members States only need to fill in data for variable '*extent in the current reference year*', i.e. only the sixth column in Table 3 above. Data for all level 1 ecosystem types listed in the table must be reported.

The proposed legal deadline for the **second data transmission** on ecosystem extent accounts is December 2029. For this deadline, Member States have to report <u>both</u> the ecosystem extent account and the conversion matrix, as detailed below:

- The extent account reported by the December 2029 deadline is a complete asset account for the reference period 2024-2027. This means that Member States are required to report data for columns '*extent in the previous reference year*', '*additions'*, '*reductions*' and '*extent in the current reference year*', in Table 3 above, for all level 1 ecosystem types. The value for '*extent in the current*

reference year' reported for the December 2029 deadline represents ecosystem extent in 2027 and the value for '*extent in the previous reference year*' represents ecosystem extent in 2024. This latter value is equal to the value for '*extent in the current reference year*' reported for the December 2026 deadline. The reporting unit is thousand ha with one decimal.

- The conversion matrix reported by the December 2029 deadline is a complete conversion matrix showing total conversions (i.e. sums) between all level 1 ecosystem types between the reference years 2024 and 2027. This means that Member States are required to fill in data in all cells of the conversion matrix shown in Annex 1 of the guidance note. The reporting unit is thousand ha with one decimal.

The logic above applies to **all subsequent data submissions** taking place every three years **and any voluntary data collections preceding the first mandatory one.**

Reporting on ecosystem extent accounts, including the conversion matrix, needs to use '**representative averages**' of the extent of ecosystem types in the given reference year. This is especially relevant for areas of crop production, coastline or glaciers where changes in the extent within a reference year might occur. Countries are not expected to measure the opening and closing area on 1 January or 31 December, but use data obtained on an appropriate date to assure that representative averages of the extents of these ecosystems for a given reference year are recorded.

For instance, annual cropland on 1 January may be bare and therefore in theory could be classified as sparsely vegetated areas. However, with the beginning of the growing season it will be covered with crops that will be harvested in autumn and the area may be bare again on 31 December. In this example the relevant area is then the one covered with crops during the growing season.

3. Stepwise approach to compiling extent accounts

3.1 Introduction

There are two main approaches to prepare ecosystem extent accounts: (i) to use and adjust existing spatial data, e.g. the CORINE land cover data (which will allow preparing an extent account at level 1 and level 2) or a nationally available data set; or (ii) to prepare a new spatial data set on the basis of a set of source geospatial data sets. The tabular data can simply be prepared by counting the areas (hectares) in each ecosystem type, in a given year. At L3 EU, there are no European data available but countries may have national data, for that was developed using the EUNIS classification

and that can be relatively easily translated or aggregated into the L3 EU ecosystem types.

CORINE land cover data can relatively easily be used to prepare a national map at L1 EU. The main additional step needed is to single out ecosystem type 'Coastal beaches, dunes and wetlands', which can be done with basic GIS operations. In particular, this involves identifying and mapping the location of coastal beaches, dunes and coastal wetlands (e.g., saltmarshes), and aggregating them into this level 1 ecosystem type. With some further adjustments and reclassifications many level 2 ecosystem types can be mapped with European datasets (see Petersen et al., 2022). CORINE land cover data is now only produced once in 6 years - but recent developments in the Copernicus program indicate that the temporal resolution of replacement data sets will become three-yearly from 2024, also with increased spatial resolution.

When a new spatial data set is to be prepared, the starting point will usually be the land cover, land use and vegetation and ecosystem data available in a country (or other area for which the accounts are to be produced) and the requirement is to determine how information in these data sets can be combined to produce an ecosystem extent account and spatial representation that reflects the composition of ecosystem types. Since all data layers will be connected to a common coordinate system, it is possible to overlay different spatial information (data layers) for accounting purposes. The use of cadastre information allows to establish the link between ecosystem assets and their owners, which may be highly relevant for policy initiatives. However, knowing who owns the land is not required for the compilation of ecosystem extent accounts, and thus is not further elaborated on in the guidance note.

To develop a spatial data infrastructure for accounting, it is first necessary to select and set-up a soft- and hardware environment integrated into a Geographical Information System (GIS). Adequate data storage and computing power are also required. Preparing an extent account includes applying an ecosystem classification system to existing land cover and potentially vegetation and land use maps to produce an ecosystem extent spatial dataset (e.g., at national scale), that is used to make an ecosystem extent accounting table, a conversion matrix and an ecosystem type map.

A key decision to be made is if the extent account will be based upon an existing dataset (for instance CORINE land cover, for level 1 and 2 of the EU ecosystem typology), an update of an existing national dataset (with established procedures for defining and mapping classes), or if the account will be produced from scratch, with a new classification of ecosystems in a country, e.g. for national purposes. While newly designing the ecosystem extent map gives more flexibility to fine-tune the account to the ecology of the country, it also brings more costs, depending upon the ambition level (in terms of resolution, targeted accuracy, number of differentiated levels and classes) and the availability of existing spatial datasets.

The main steps to compile ecosystem extent accounts are shown in Figure 2. They are described in detail in the next sections. It is strongly recommended to develop software, for example using a Python script that incorporates GIS tools, in a well-documented manner to ensure that the same classification procedure can be applied by other technical staff, or in subsequent years via an automated process (Bellingen et al., 2021).

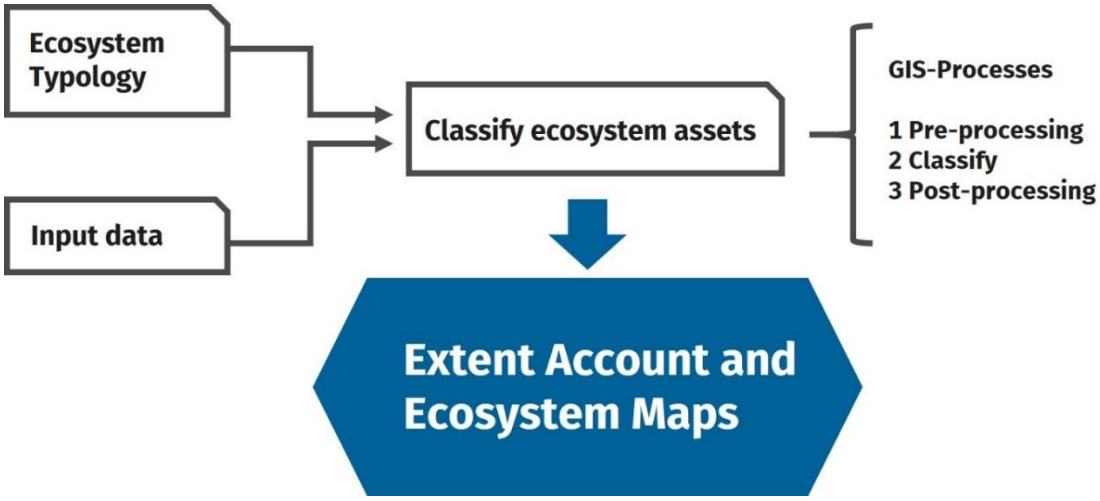

Figure 2. Principal steps to compile ecosystem extent accounts

3.2 Design of classification process

To map each ecosystem asset to an ecosystem type, compilers need to identify sets of rules and variables that enforce the completeness and mutual exclusiveness of the classification of ETs. These variables and rules can be summarised in a classification matrix or a decision tree structure. Rules and variables can depend on local context, e.g., different climatic zones or elevations. Specifying a full classification matrix of variables and rules for all types can help to automatically test the uniqueness and mutual exclusiveness, by showing that each branch of the decision tree ends at a unique ecosystem type. The relation between the level of detail in the classification matrix and the data requirements is a key trade-off in the compilation of ecosystem extent accounts. It is strongly recommended to document, in detail, the procedure used to classify ecosystem types and prepare the extent account to support classification efforts in following years.

Classification of spatial data conform to the EU ecosystem typology can be done based on different data sources and following different criteria. Level 1 and partly level 2 of the EU ecosystem typology can, in principle, be derived from CORINE land cover data, made available every 6 years by the European Environment Agency through the Copernicus program (see Petersen et al., 2022). More specifically it is recommended to

use the CLC accounting layers (see below). These accounting layers are CORINE maps that are adjusted in order to provide land cover maps that are consistent over time (using similar classes and consistent mapping procedures) – using the 2018 CORINE map as the basis. While the MMU of CORINE is relatively coarse (25 ha) it appears sufficient to support national level ecosystem accounting at least for EU L1. CORINE data have some shortcomings at level 2 of the EU ecosystem typology, specifically for those countries with heterogeneous landscapes with large variations at short distances (i.e. fields and other landscape elements typically smaller than 25 ha, occurrence of many small water bodies). In such cases, national datasets should be used, reflecting vegetation type, topography, soils, groundwater levels, etc. Furthermore, the forthcoming new product called 'CLC backbone' to replace the original CORINE data set has a MMU of 0.5 ha and hence provides much finer spatial detail (Probeck et al., 2021).

3.3 Selecting input data

To apply the classification matrix with its rules and variables, compilers need to gather the necessary data for all ecosystem assets. A land cover data set of complete coverage which can be categorised into different ecosystem types (such as CORINE) forms a reasonable starting point and can be sufficient on its own for developing ecosystem extent accounts. If countries decide to develop a higher resolution extent account, it requires national spatial data and the necessary GIS processing capacity, to complement or replace CORINE.. Such data could be spatial land use, vegetation and ecosystem data already available in a country (or other ecosystem accounting areas of interest), including maps for Natura 2000 sites and other areas with high biodiversity. As much as possible, input data should have the same reference year. Only if no alternative data sources are available, data from different years may be combined, and in this case the extent account should minimise the potential error (for instance by giving more weight to data from the 'correct' reference year) and aim to document the resulting uncertainties of the map and the account.

For marine ecosystems the data situation appears to be more challenging both at national and EU level, but EMODnet EUSeaMap[5] seems promising and is based on the EUNIS typology. A time series is available but the reference years do not match the reference years of e.g. CORINE data. Also, there are considerable improvements in methodologies between release years which means that inter-year comparisons may not always be appropriate. Until marine data sources have reached the same maturity as terrestrial data sources it may not be possible to report changes between reporting years.

Land cover data sets are not directly designed to reflect all ecological and structural characteristics of ecosystems that the compilers may want to account for. Therefore, additional data sources can be added to capture these traits. Examples include

[5] https://www.emodnet-seabedhabitats.eu/

vegetation maps, maps of ecosystem types, soil maps, elevation models or biotope mappings. Land cover models also may not cover the entire ecosystem accounting area that compilers want to map. Additional data sources, for instance on marine ecosystems beyond the coastal zone and in the exclusive economic zone, can be included. Lastly, linear landscape-fragmenting features, such as roads and rivers, and/or small areas of high nature value, such as hedgerows, may not be present in land cover models, if they fall under the MMU. If available, additional data sources can help to capture these important areas. Where these areas cannot be included in the extent account, the density of small or linear landscape elements, such as hedgerows or stonewalls can be included as ecosystem condition indicator (e.g. for cropland or grassland, given that structural diversity is an important indicator in agro-ecosystems).

In general, the data requirements for the compilation of ecosystem extent accounts will depend on the level of the typology that the compiler aims to differentiate and relate directly to the classification matrix. For example, while land cover data can be used to map level 1 ‘Inland wetlands’, a soil map can provide the necessary information on soil profiles to differentiate between bogs and fens at level 3.

All input data sources must be geo-referenced and respect the desired MMU, i.e. the largest MMU of the input datasets should be equal to or smaller than the MMU of the ecosystem extent accounts. The MMU is determined by data availability and the spatial heterogeneity of ecosystems in a country, typically on the basis of the available land cover data. The MMU should be at the maximum 10 hectare (but a smaller MMU is allowed). Applying this MMU means that only areas with a size of at least 10 hectares will be shown on the map and will be included in the extent account. In urban areas, a MMU of not more than 1 ha is recommended to be able to map out with sufficient accuracy urban green spaces, many of which are smaller than 10 ha.

Furthermore, requirements concerning time-consistency (i.e., methods are consistent over time), frequency (i.e., regular updates are required, at least once every three years given the reporting requirements to Eurostat), and quality should be fulfilled. Data will stem from government departments, international organizations or published scientific sources.

All input data need to be referenced to the same coordinate system, usually a national system, or alternatively the European system ETRS89 to avoid introducing errors when stacking them and creating statistical meaningless results. Based on the available input data sets it needs to be decided if a raster or a vector-based approach to producing the ecosystem extent account is used. In many cases, a vector-based approach will be preferred to better deal with linear elements in the landscape; in the case of a raster-based approach a general problem is that small linear elements such as streams or roads will get interrupted where they do not cover the majority of a grid cell. However, using a raster-based approach with small grid cells (<10-20 meters) reduces these disadvantages, and countries can select a vector or raster approach or a combined approach based on national preferences.

In general, input data should record a sufficiently long and coherent time series without breaks as a result of methodological or data source changes. The number and reference year of data sets should coincide with the requested reference years of the accounts. The CLC accounting layers[6] (Ivits et al., 2020) represent such a time series for CLC and are the result of a dedicated quality improvement process to ensure coherent tracking of real land cover (and hence ecosystem extent) changes over time based on a clear methodology and dedicated spatial data infrastructure adopting a raster approach.

The EU ecosystem extent accounting layers for the reference years 2012 and 2018 are available as open data[7].

The main difference between the CLC status layers and the CLC accounting layers is that the status layers record CLC data as recorded during the original data collection / compilation exercise. Accounting layers on the other hand build on insights from later CLC time points which are then used for updating the original CLC status layers to offer a consistent time series and to ensure comparability over time which is essential for accounting. In the CLC accounting layers, specific changes in land cover smaller than 25 ha, but larger than 5 ha are also shown, yet the MMU of the maps for which land cover is compared remained 25 ha.

Often input data for one reporting time point will have different reference years, in particular if national and EU wide data are combined. This may have an (unknown) effect on the accuracy of the estimates. Generally, input data from different years (different from the reference year of the extent account) are less problematic if they cover relatively stable characteristics, such as soil type or riparian zones, while misalignment of data reference years may be problematic for highly fluctuating characteristics such as weather data, physical soil parameters, vegetation, etc. The share of ecosystem assets that were partially or fully classified using data with different reference years than the reference year of the reporting should be documented in the metadata.

Capturing real changes in land use/ land cover, ecosystem extent etc. is important for ecosystem accounting and should be based on a reference layer (reference year). The first reference year for data on change of ecosystem extent in the EU is proposed to be 2024. Like status data sets, change data are characterised with a MMU and a Minimum Mapping Width (MMW). The MMW is the width of the narrowest feature to be drawn in a map, and a key factor for measuring changes in extent as it determines the minimum width ecosystem features must have to be detected. While the CLC MMW is

[6] Documentation on the CLC accounting layers can be found at https://www.eea.europa.eu/data-and-maps/data/corine-land-cover-accounting-layers

[7] https://gisco-services.ec.europa.eu/pub/ecosystems_accounting/EU_ecosystem_extent_accounts/accounting_layers/

100 m, linear features such as hedgerows are often much narrower so a MMW of less than 10 m is desirable to capture also these smaller features. It is expected that the higher resolution and smaller MMU of the CLC+ maps will facilitate identifying linear elements. However, national scale, higher resolution data may be needed to adequately map small, linear landscape elements.

3.4 Pre-processing

To achieve a complete extent account spatial dataset, various sources for input data will usually have to be combined (unless a pre-existing dataset is used, e.g. when the extent account is based on CORINE land cover data only). As described above, additional sources can be integrated with land cover data to improve their suitability as ecosystem maps. The three main applications of pre-processing are (from Bellingen et al., 2021):

7. Some ecosystem classes require creating completely new geometries. Often, this includes linear features such as roads, railroads, rivers and hedgerows that may be smaller than the land cover data's MMU and MMW. Being important ecosystems or a key factor for landscape fragmentation, these linear objects should be included in the extent account by buffering them with their width if this information is available or some approximation otherwise. In line with the expected pixel size of the CLC+ product, these linear features should be buffered with at least 10 m if the real width is unknown.

8. Alternatively, disregarding linear landscape features such as hedgerows in the ecosystem extent account and including them as condition indicators, in the condition accounts, is an option. Different countries will select different approaches based on the relative importance of these linear features and data availability. This is also reflected in the EU ecosystem typology, level 2 and 3.

9. Some ecosystem types belonging to level 2 or 3 of the typology are only partly represented by the existing geometries in the land cover model, e.g. a forest in a riparian zone may be part of a larger polygon/cell of broadleaf forest in the land cover model. Subdividing such areas based on additional information leads to a more precise classification while preserving the outer bounds of the area in question. Of course, it is important to respect the MMU in these subdivision steps.

10. Some ecosystem types may need to be re-coded due to their location. This mainly concerns ecosystems close to the shore that may not be correctly attributed with CORINE data alone. A coastal mask with a defined width supports the correct re-classification of these ecosystems. The width of the mask depends on local features but as a minimum a 1000 m buffer inland should be applied for beach dunes and sand habitats (100m for rocky shores and cliffs).

The addition of further data to existing, new or modified geometries in the land cover model using zonal statistics or spatial joins without changing their shape completes the pre-processing steps.

3.5 Classification

The classification needs to be mutually exclusive and exhaustive, based upon the EU ecosystem typology elaborated in this guidance note. This involves defining priority orderings. For example, once a bog forest is classified as such, the same area cannot become a montane forest later in the classification process, even if it is located at high altitude.

To accommodate such orderings, different classifiers, each handling one ecosystem type or a group of several similar ones requiring the same additional data sources, are applied one at a time in pre-specified order. This means that, starting with the land cover for the accounting area, the input data is updated constantly and passed on. In the following step, this updated input data is referred to as the working file. Note that this iterative classification algorithm (see Figure 3) describes one example of implementing a classification matrix and avoiding double counting, but other approaches may also apply. Each classifier works as follows:

i) Before including the pre-processed data in the working file, it is clipped to the current state of the working file. This guarantees that areas that have been classified before will not be dealt with again. Ecosystem types for which the classifier is responsible for are then assigned to each suitable area.

ii) The working file is updated. For this purpose, areas that have been classified in the prior classifier step are removed from the working file and stashed in the extent account geo-dataset.

Once all classifiers have been applied, data remaining in the working file is classified based on data of the land cover map because they are therefore ‘left over’ by the classifiers.

To better handle the volume of operations and data, ecosystem accounting areas may be split up and classified separately.

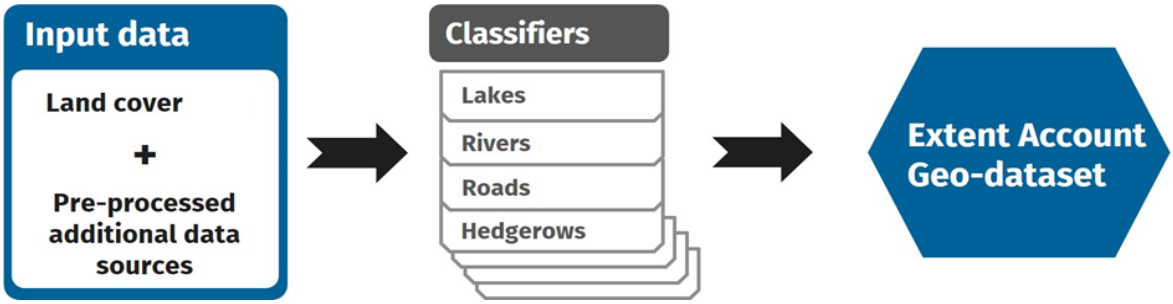

Figure 3: Iterative classification process

It may be easier to start this classification process on the coastal areas to avoid that they are classified as non-coastal ecosystem types. Based on national experiences it may also be easier to start the classification at level 2 of the ecosystem typology and then aggregate to level 1.

3.6 Post-processing

Post-processing is used to 'clean up' and aggregate the extent account database. Among others, the following steps help to refine the final product:

1. Control the completeness and exhaustiveness of the classification, repair geometries and clean up small sliver polygons.
2. Log the classification data source and the location (if coastal) of each polygon to ensure transparency and traceability of the classification.
3. Implement a quality control procedure, for instance, by drawing a random sample of extent account polygons and attempt to validate the ecosystem class using aerial photography or other representative samples and studies.
4. Aggregate at different administrative and classification levels to create the final data outputs, i.e., accounts and maps.
5. Overlay extent maps from different accounting periods to identify ecosystem conversions.
6. Aggregate conversion areas identified in the change maps to report into the conversion matrix.

3.7 Crosswalk table to the IUCN Global Ecosystem Typology

Reporting ecosystem extent in the sense of the amended Regulation (EU) 691/2011 follows the level 1 of the EU ecosystem typology. Nevertheless, for international comparison, the IUCN GET has been proposed by the SEEA EA. A provisional crosswalk between levels 1 and 2 of the EU ecosystem typology and the IUCN GET is provided in Annex 4.

3.8 Using ecosystem extent accounts for the reporting of ecosystem services accounts for the legal module

Extent and condition accounts are to be compiled and reported to Eurostat once every three years, because it is expected that in most EU countries there are insufficient changes in ecosystem extent to justify annual reporting. At the same time, services accounting involves annual reporting. Physical services supply can change as a function of: (i) changes in ecosystem extent (e.g. conversion of forest to cropland); (ii) changes in ecosystem condition (e.g. fire damage to forest) and changes in the use of ecosystem

services as a function of changes in demand (e.g., in the COVID period people intensified use of nearby ecosystems for recreation). If ecosystem extent and condition is assumed to be the same as in the previous year, physical services supply can change, from one year to the next, only due to changes in the demand and therefore the use of services.

Compilers should use the most recent extent and condition accounts to compile the ecosystem services account, and not apply interpolation between years to estimate changes in ecosystem extent for years in which the extent account is not updated. This is because the changes are likely to be small in the first place, and second because there is no credible way to interpolate: changes are unlikely to be linear, especially when zooming in on the local level. In addition, it is very time consuming to develop, apply and explain a credible interpolation approach.

4. Overcoming common challenges in the compilation of ecosystem extent accounts

4.1 Extent accounts for very heterogeneous areas, for example agricultural mosaics

A challenge arises when a large share of the landscape consists of ecosystem assets smaller than the MMU. Individual ecosystem assets in this area defined by the type of the land cover map therefore cannot be fully mapped. In this case, the whole area needs to be assigned to the L1 EU ecosystem type that covers the largest share of the area defined by the input land cover map. For instance, croplands mixed with small landscape elements such as hedgerows, small plots of woodlands, etc., can be classified as ‘Cropland’ (at level 1); and ‘2.5 Mixed farmland land’ (L2 EU). Mixed farmland includes nurseries and other agricultural land use smaller than the MMU; hence only large nurseries (with an area larger than the MMU) would be distinguished in the ecosystem extent account.

The same approach may have to be adopted in parts of the Nordic countries with many lakes that are smaller than the MMU.

4.2 Dealing with linear landscape elements smaller than the MMU

Usually, linear landscape elements are below the MMU and/or MMW of the input data. Where very high-resolution data on ecosystem types can be brought together, it may be possible to single out individual hedgerows, tree alleys, small water courses and ditches of a few meters wide and assign them to their level 2 or level 3 class (see section 3.4 on

pre-processing). Currently, this is only possible with national data sources. Linear features in the landscape typically have a length of at least 100 meter and a width of not more than 10 meters. They may be composed of rows or groups of trees, shrubs or hedges. In the latter case, the term 'hedgerows' is used to indicate the landscape feature. Clearly, the use of vector as opposed to raster maps for the compilation of ecosystem extent accounts enhances the possibilities to include linear landscape elements. Even if it is possible to rasterise linear elements this may lead to overestimating their surface depending on the pixel size. If introduced in raster maps the pixel size should be no more than 10 m but the resolution of the original data may not support these small pixels.

If linear elements cannot be mapped as separate ecosystem assets, they have to be included in larger area assets and their density or share should be recorded as a separate condition indicator.

4.3 Dealing with changes in input data between years

It will frequently occur that input data used to produce the extent account are not consistent between years, for instance in terms of resolution, accuracy or classification. In this case, the resulting extent account may also be different. For example, in the 2018 maps used as input to produce the Netherlands ecosystem extent account, the level of detail with which canals and ditches were mapped greatly increased compared to 2013. As a result, it appeared as if the area covered by waterways in the country in 2018 was much higher than in 2013. Alternatively, a finer resolution in later maps may show small forest plots not previously seen in maps. The choice then to be made is if a correction or adjustment can be made – for instance by assuming similar water bodies or forest plots existed in earlier years, or if the discrepancy is accepted and explained to the user. The CLC+ accounting layers which update previous reference years ex-post in light of better information/detection of errors may partially address this challenge.

Generally, stability of the spatial and thematic quality of a data source over the years is more important than aiming for the best possible quality at each reference year, in particular if the continuation of a high-quality data source in the future is not guaranteed. These irregular, non-frequent but high-quality data sources may still be used as auxiliary data to support certain classification decisions.

4.4 Manipulating raster and vector data to produce ecosystem extent accounts

This Guidance note builds on the SEEA EA. Additions and reductions of ecosystem extent are basic concepts in 'landcover accounting' defined in the SEEA EA, which also provides examples of extent tables and conversion matrices (SEEA EA Table 4.1, 4.2 and 4.3). Creating the tables generally involves combining raster and vector data. For

mapping linear features such as tree alleys, vector data seems to be the better choice. In order to compare vector data and raster data, for instance for developing the conversion matrix, vector data may need to be converted into raster data. However, data sources in different formats (vector and raster) and with different accuracy can be difficult to integrate into a single unified data source for pixel-by-pixel comparison over time. Hence, the converted data should have the same pixel size as the original raster data.

Rasterising linear landscape elements may lead to overestimating their area unless the pixel size can be kept small enough, but this may conflict with the coarser pixel size of other essential input data.

The technical challenge of developing geospatial data sets suitable for extent accounts may need to be further discussed in an additional technical note on dealing with and processing geo-spatial data sets for ecosystem accounting purposes. This would include aspects related to defining a stable coastline and/or a spatial mask for coastal areas.

4.5 Classification of inland and coastal wetlands (including peatlands)

'*Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life*' (definition by the Ramsar convention on wetlands). As such, wetlands can be associated with different vegetation cover and some wetland types may appear as a boundary case in the EU ecosystem typology at levels 1, 2 and 3, depending upon vegetation type. By convention, wetlands (including peatlands) with over 30% tree canopy[8] cover are classified in level 1 'Forest and woodlands', for example in '4.2.5 Picea, pine and larch mire forest', in the EU ecosystem typology. Heathlands can have peat soils and be actively accumulating peat. Where these are covered with shrub species, they are classified as 'Heathland and shrub'. Drained peatlands used for agricultural purposes are to be classified as 'Cropland' or 'Grassland', following the description of respective categories in the EU ecosystem typology. If urban centres are built on drained peat; the area is to be classified as 'Settlements and other artificial areas'.

There is a clear distinction between wetlands in ecosystem type 7. '*Inland wetlands'* and in ecosystem type 11 *'Coastal beaches, dunes and wetlands*', which includes wetlands within dune areas. The latter are different from 'Inland wetlands' in that these ecosystems are strongly influenced by salt, either because of past or present regular flooding with sea water, or because of accumulated salt due to sea spray, and that they are found along the coast: Groundwater is salty, vegetation is adapted to saline conditions, and there may be occasional flooding of the ecosystem by the sea during

[8] The threshold is 10% for boreal regions (see Annex 3 Description of the EU ecosystem typology)

storms. Location near to the sea (within the storm zone, typically several 100 m inland) differentiates these systems from 7.3.1 ‘Inland salt marshes’ (which are floristically different from coastal salt marshes).

4.6 Mapping urban green and urban blue

Urban areas may include water courses such as ponds, canals or rivers. Where these blue ecosystems exceed the MMU and MMW, they need to be mapped as 8. Rivers and canals (and respectively as 8.1 Rivers and streams; or 8.2 Canals, ditches and drains) or 9. Lakes and reservoirs (and respectively as 9.1 Lakes and ponds or 9.2 Artificial reservoirs). All other ecosystems in urban zones dominated by water that exceed the MMU and cannot be classified as rivers, streams, canals, ditches, drains, lakes, ponds or artificial reservoirs can be classified as ‘urban blue’. It is noted that 1.4 Urban Greenspace may also include small water bodies (such as small lakes or ponds), where these water bodies are smaller than the MMU or MMW.

For illustration:

1. if both urban green (park) and a lake within a park are both > MMU, urban green will be recorded as 1.4 ‘Urban greenspace’ and the lake as 9.1 ‘Lake’.
2. if both urban green (park) and urban blue (e.g., a lake within a park) are both < MMU, neither of them will be distinguished as separate ecosystem type at level 2 or 3 in the accounts but they will be recorded as continuous or discontinuous urban areas.
3. if urban green (park) > MMU but a lake within the park < MMU, urban green will be recorded as under point 1. The lake or urban blue will not be distinguished separately but will appear as part of the surrounding urban green, hence recorded as 1.4. ‘Urban greenspace’.

The extent account showing urban green can also be the basis for the thematic urban ecosystem account, which provides an analysis of ecosystem extent, condition, services and assets in urban areas.

4.7 Coastal areas

Ecosystems on both sides of the shoreline present specific challenges for the classification process.

Land cover related to cliffs, beaches, dunes and sands occurs mostly at the coast but also inland. Hence it is important to be able to recode land cover such as CLC 3.3.3 Sparsely vegetated areas or CLC 3.3.2 Bare rocks as belonging to level 1 class 11. Applying a coastal mask with a certain width inland would support a re-classification of these land cover types into the correct level 1 and level 2 ecosystem.

For rocky areas the width of this coastal mask will depend on the topography of the coastline, in particular its steepness. Salt spray influence may be a defining characteristic although difficult to estimate. A 100 m coastal buffer zone is recommended as default option in this case. Whereas for other coastal habitats such as dunes a coastal buffer of 1000m is currently recommended.

It may also help to classify ecosystems within this coastal zone first before extending the classification process further inland and to try first a classification at level 2 that then can be aggregated to level 1 instead of reclassifying level 1 pixels.

A second challenge is the definition of a coastline, for example in intertidal flats and larger river estuaries under tidal influence. Ideally the coastline should be defined using national data but as a default option the coastline used for the reporting under Marine Strategy Framework Directive[9] may be applied to define limits of lagoons, tidal flats and estuaries.

Identifying a coastal mask and a single coastline for Europe that is spatially coherent between the various EU reporting processes and analytical domains is challenging. The EEA has therefore generated such a coastal mask adopting the approach outlined in Annex 5.

4.8 Distinguishing real from artefact conversions between reference years

Not all changes between reporting periods are due to actual conversions from one ecosystem type to the other but may be due to technical artefacts as a result of data processing. This reflects that small changes in extent may also be the result of mapping errors and not necessarily reflect changes in ecosystem extent. Additionally, overlays can introduce artefact conversions due to spatial measurement errors or meteorological conditions (e.g., dry versus wet year) that may result in narrow polygons that depict inconsistencies in mapping.

Compilers may therefore need to filter relevant changes by applying size or compactness thresholds to distinguish between real changes and artefact conversions (‘noise’), using specific filters (e.g., Break detection for Additive Season and Trends) or rules (e.g., Hidden Markov Model or temporal post-regression rules) and remove these artefacts from the overlay extent maps. The thresholds need to be selected by Member States on the basis of the national ecosystem characteristics and data resolution, and preferably be a consistent value. The approach to this filtering artefacts must be documented in the metadata.

[9] Shapefiles with a coastline based on national MSFD reporting can be e.g. downloaded from this link https://www.eea.europa.eu/en/datahub/datahubitem-view/d09a1d82-8e11-4448-85a5-e2613aeccf57

As a rule, the threshold per ecosystem asset below which ecosystem conversions should not be considered relevant and do not need to be included can range from 1 to 25 hectare depending on the spatial and thematic accuracy of the data and amount of change detected. In addition, a minimum change per ecosystem type should be defined, so only indicating changes of at least 100 ha per ecosystem type in the conversion matrix. However, countries may use different thresholds as appropriate, provided that this is clearly indicated in the metadata.

Additional filters may be used to decide if a change is to be recorded, e.g., compactness rules. Germany for example uses the following compactness filter before reporting a change between years. A minimum threshold of 2000 m^2 and a compactness threshold for conversions [4*π*Area/(Perimeter2)>0.1] is applied.

Again, the approach needs to be documented in the metadata.

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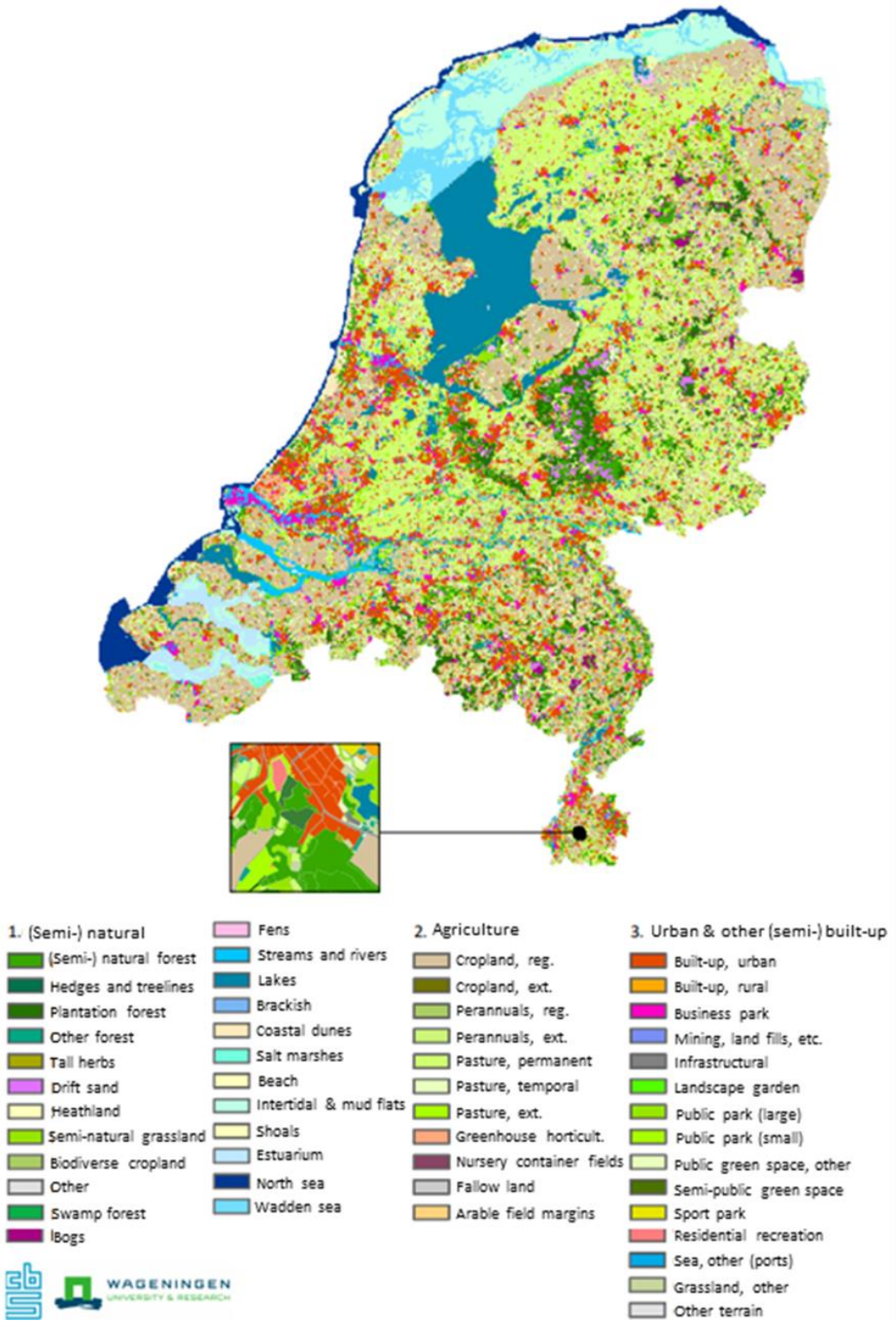
Annex 1: Conversion matrix

Unit: ha	Closing area											
Opening area	Settlements and other artificial areas	Cropland	Grassland	Forest and woodland	Heathland and shrub	Sparsely vegetated ecosystems	Inland wetlands	Rivers and canals	Lakes and reservoirs	Marine inlets and transitional waters	Coastal beaches, dunes and wetlands	Marine ecosystems
Settlements and other artificial areas												
Cropland												
Grassland												
Forest and woodland												
Heathland and shrub												
Sparsely vegetated ecosystems												
Inland wetlands												
Rivers and canals												
Lakes and reservoirs												
Marine inlets and transitional waters												
Coastal beaches, dunes and wetlands												
Marine ecosystems												

Annex 2: Example of an ecosystem extent map (The Netherlands, 2018)



Annex 3: Description classes of the EU ecosystem typology

Table A.1. Description of EU ecosystem typology, level 1

#	Ecosystem Type, level 1	Description	Source
1	Settlements and other artificial areas	This class represent human habitats, i.e. ecosystems that are strongly modified by people and that are characterised by buildings and other man-made structures. It includes dispersed and dense residential, industrial, commercial, and transport areas, urban green areas, mineral and gravel extraction sites, dumping and construction sites. The class excludes peat extraction sites (classified under 'Inland wetlands'). The class has also been labelled 'urban ecosystems'.	Based on Maes et al., 2013.
2	Cropland	Croplands are food production areas including both intensively managed cropland, extensively managed cropland, and multifunctional areas. They include areas with perennial and annual crops, and agro-ecosystems with significant coverage of natural vegetation (agricultural mosaics). Cropland also includes agroforestry areas such as cork and holm oak forests. Small semi-natural elements which are associated with agricultural land use, such as hedges, ponds, grassy margins etc., are considered part of this ecosystem type.	Based on Maes et al., 2013.
3	Grassland (pastures, semi-natural and natural grasslands)	Grassland covers areas dominated by herbaceous vegetation (including in particular grasses and forbs, but also mosses and lichens) of two kinds – modified grasslands (sown and used for grazing or hay and silage production) and (semi-)natural (extensively managed) grasslands. Grassland also includes agroforestry areas used for grazing, such as cork and holm oak forests with a canopy cover up to 10%. Small semi-natural elements which are associated with agricultural land use, such as hedges, ponds, grassy margins etc. are considered part of this ecosystem type.	Based on Maes et al., 2013.
4	Forest and woodland	Forests and woodlands include tree-dominated ecosystems with a canopy cover over 30% (in Mediterranean and temperate ecosystems) or 10% (in boreal ecosystems) or ecosystems where present trees can reach these thresholds in situ. For boreal ecosystems, a lower threshold is used due to extreme climatic conditions, which naturally limit the growth of trees and relative canopy cover.	Based on Maes et al., 2013.
5	Heathland and shrub	Heathland and shrub are areas with vegetation dominated by shrubs or dwarf shrubs, which may include dispersed trees with a canopy cover below 30%. They include natural ecosystems of predominantly harsh conditions as well as secondary ecosystems created by extensive human use. The	Based on Maes et al., 2013.

		class includes heathlands and sclerophyllous vegetation.	
6	Sparsely vegetated ecosystems	Sparsely or unvegetated ecosystems have a low density of vegetation, with typically at least 70% of barren soil. They include degraded sparsely or degraded non-vegetated areas as well as ecosystems under extreme natural conditions which may be traditionally grazed. They include bare rocks, glaciers, inland dunes and sand plains. In spite of low vegetation density, the ecosystems may contain high biodiversity of species adapted to an extreme environment.	Based on Maes et al., 2013.
7	Inland wetlands	Inland wetlands are areas that are year-round or seasonally strongly affected by water, in the form of temporary flooding or groundwater levels close to surface. This class includes natural, semi-natural or modified inland marshes as well as mires, bogs and fens, but excludes seasonally flooded grasslands and heathlands, for example. It also includes peat extraction sites.	Based on Maes et al., 2013.
8	Rivers and canals	Permanent freshwater inland surface waters of linear character. These include natural water courses, such as rivers, streams etc., as well as anthropogenic structures built for transportation, drainage or water supply purposes, i.e., canals, ditches etc.	Based on Maes et al., 2013.
9	Lakes and reservoirs	Permanent freshwater inland surface waters composed of primarily non-linear water bodies. These include natural water bodies (lakes) as well as anthropogenic water bodies developed mainly for water supply or energy generation purposes.	Based on Maes et al., 2013.
10	Marine inlets and transitional waters	Marine inlets and transitional waters are ecosystems on the land-water interface under the influence of tides and with salinity higher than 0.5 ‰. They include lagoons, estuaries and other transitional waters.	Based on Maes et al., 2013.
11	Coastal beaches, dunes and wetlands	The class coastal areas refers to land-based ecosystems close to the sea, with marine influences, such as salt spray and saline groundwater, and that may be flooded during high tide or extreme events. The class includes beaches, dunes (which may include wetland areas below the MMU in between rows of dunes) and coastal saltmarshes and salines.	Derived from IUCN GET
12	Marine ecosystems (coastal waters, shelf and open ocean)	Marine ecosystems include all marine areas in the sea extent at low tide level or below mean sea level. This ranges from near-shore ecosystems to deep water marine ecosystems. Aligned with accounting principles, the ecosystem includes the whole water column including the seabed and the pelagic zone.	Derived from IUCN GET

Table A.2. Description of EU ecosystem typology level 2 (from Maes et al., 2013, or modified from Maes et al., 2013, CORINE documentation, or EUNIS documentation, as indicated)

EU ecosystem typology: level 1	**EU ecosystem typology: level 2**	**Description**	**Correspondence**
1. Settlements and other artificial areas	1.1 Continuous settlement area	Also designated as continuous urban area or fabric. The continuous settlement area type is assigned when settlement structures and transport networks are dominating the surface area. At least 80% of the land surface in the ecosystem asset is covered by impermeable features such as buildings, roads and artificially surfaced areas.	CORINE 1.1.1. Continuous urban fabric
	1.2 Discontinuous settlement area	Also designated as discontinuous urban area or fabric. The discontinuous settlement area type is assigned when settlement structures and transport networks associated with vegetated areas and bare surfaces are present and occupy significant surfaces in a discontinuous spatial pattern. The impermeable features such as buildings, roads and artificially surfaced areas range from 30 to 80 % land coverage in the ecosystem asset.	CORINE 1.1.2. Discontinuous urban fabric
	1.3 Infrastructure and industrial areas	This includes land used for transport infrastructure such as roads, airports and ports, including associated areas (e.g. planted trees and bushes lines or spontaneous vegetation, such as grass verges), and	CORINE 1.2. Industrial, commercial and transport 1.3 Mine, dump and construction sites

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		artificial areas other than buildings that are used for commercial and industrial purposes including extraction sites, dump areas, and construction sites.	
	1.4 Urban greenspace	Areas with vegetation within or partly embraced by urban fabric. This class is assigned for urban greenery, which usually has recreational or ornamental character and is usually accessible for the public. Areas with soil sealing above 30% should be moved to class 1.1 or 1.2.	CORINE Primarily 1.4.1 Green urban areas (1.4.2 Sport and leisure facilities)
	1.5 Other artificial areas	Areas that are artificial but do not fall under the other level 2 categories of settlements and artificial areas. This includes e.g. permanent green houses, cemeteries even if predominantly green, and urban blue such as ponds in urban parks. Countries should also record here types of artificial land of specific national importance, such as archaeological sites or others, if they do not belong to any of the level 2 categories 1.1 -1.4. Countries should inform in the metadata sheet what they cover in this category.	CORINE Components of: 1.4.2 Sport and leisure facilities 1.4.1 Green urban areas 1.1.2 Discontinuous urban fabric
2. Cropland	2.1 Annual cropland	Cropland planted for annually or regularly harvested crops other than those that carry trees or shrubs. They include fields of cereals, of sunflowers	CORINE 2.1.1 Non-irrigated arable land 2.1.2 Permanently irrigated land Partially: elements of 2.4

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		and other oil seed plants, of beets, legumes, fodder, potatoes, and other forbs. Croplands comprise intensively cultivated fields, fallow land, temporary grass for silage and grazing as well as traditionally and extensively cultivated crops with little or no chemical fertilisation or pesticide application. Faunal and floral quality and diversity depend on the intensity of agricultural use and on the presence of borders of (semi-)natural vegetation and woody structures between fields. Includes non-permanent greenhouse installations such as film tunnels. Small semi-natural elements which are associated with agricultural land use, such as hedges, ponds, grassy margins etc., are considered part of this ecosystem type.	Heterogenous agricultural areas (depending on mapping rules and data sources used)
	2.2 Rice fields	See level 3 – 2.2.1	CORINE 2.1.3 Rice fields
	2.3 Permanent crops	Crops not under a rotation system which provide repeated harvests and occupy the land for a long period before they are renewed. Mainly plantations of woody crops, e.g. vineyards, fruit and berry plantations, olive groves. Excludes pastures, grazing lands and forests. Small semi-natural elements which are associated with	CORINE 2.2. Permanent crops

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		agricultural land use, such as hedges, ponds, grassy margins etc., are considered part of this ecosystem type. Includes burnt areas of this type.	
	2.4 Agro-forestry areas	Annual crops or grazing land under the wooded cover of forestry species (i.e. agroforestry), with a canopy cover of between 10% and 30%. A typical expression are the Iberian dehesas and montados. Includes burnt areas of this type.	CORINE 2.4.4 Agro-forestry areas
	2.5 Mixed farmland	Also designated as heterogeneous agricultural areas. Includes: Non-permanent crops (arable lands) associated with permanent crops on the same plot of farmland; juxtaposition or mosaics of small parcels of diverse annual crops, pasture/grassland and/or permanent crops; areas principally occupied by agriculture, interspersed with significant natural areas; and annual crops or grazing land under the wooded cover of forestry species (i.e., agroforestry). Characteristic is that none of these land cover types is dominant in the given unit. Small semi-natural elements which are associated with agricultural land use, such as hedges, ponds, grassy margins etc., are considered part of this	CORINE 2.4. Heterogeneous agricultural areas (minus CLC 2.4.4)

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		ecosystem type. Includes burnt areas of this type.	
	2.6 Other farmland	Other types of farmland not included in the other categories of cropland such as nurseries, Christmas tree plantations and bioenergy grasses and short rotation coppice. Small semi-natural elements which are associated with agricultural land use, such as hedges, ponds, grassy margins etc., are considered part of this ecosystem type.	CORINE Depending on mapping rules: elements of CLC groups 2.1, 2.2, 2.4
3. Grassland	3.1 Sown pastures and other grass (modified grasslands)	Stable grassland characterised by agricultural use or strong human disturbance. Floral composition dominated by G*raminaceae* and shaped by human activity. Regularly re-sown and fertilised and used for grazing or mechanical harvesting of grass. Small semi-natural elements which are associated with agricultural land use, such as hedges, ponds, grassy margins etc., are considered part of this ecosystem type.	CORINE 2.3.1 Pastures (modified grassland)
	3.2 Natural and semi-natural grasslands	Grasslands under no or moderate human influence. Low productivity grasslands composed of native species adapted to the local environment. Often situated in areas of rough, uneven ground, steep slopes or wetter	CORINE 3.2.1 Natural grassland

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		areas; frequently including rocky areas or patches of other (semi-)natural vegetation. Small semi-natural elements which are associated with agricultural land use, such as hedges, ponds, grassy margins etc., are considered part of this ecosystem type. Includes burnt areas of this type.	
4. Forest and woodland	4.1 Broadleaved deciduous forest	Woodlands and forests dominated by summer-green non-coniferous trees that lose their leaves in winter. Includes woodland with mixed evergreen and deciduous broadleaved trees, provided that the deciduous cover exceeds that of evergreens. The proportion of conifers should not exceed 25%. Includes burnt areas of this type.	CORINE 3.1.1 Broadleaved forest
	4.2 Coniferous forests	Vegetation formation composed principally of trees, including shrub and bush understory, where coniferous species predominate. The proportion of deciduous trees should not exceed 25%. Includes burnt areas of this type.	CORINE 3.1.2 Coniferous forest
	4.3 Broadleaved evergreen forest	Forests dominated by broadleaved sclerophyllous or lauriphyllous evergreen trees, or by palms. They are characteristic of the Mediterranean and warm-temperate humid zones.	CORINE (Part of CLC 3.1.1)

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		Includes burnt areas of this type.	
	4.4 Mixed forests	Vegetation formation composed principally of trees, including shrub and bush understorey, where neither broadleaved nor coniferous species strongly predominate (i.e. <75% deciduous and <75% coniferous trees). Includes burnt areas of this type.	CORINE 3.1.3 Mixed forest
	4.5 Transitional forest and woodland shrub	Transitional forests and woodland shrub. Includes vegetation that is always shrubland and areas of temporarily cleared forest (as part of forest management). Includes burnt areas of this type.	CORINE 3.2.4 Transitional forest and woodland scrub
	4.6 Plantations	Monoculture plantations or plantations strongly dominated by one or few species of non-European coniferous and broadleaved trees with very sparse or lacking undergrowth, e.g. eucalyptus plantations. Forest stands of single or mixed species consisting of native and/or non-native trees species that have long been established in European ecosystems and have diverse undergrowth typical for forest ecosystems should be classified as part of types 4.1 to 4.4. If not possible	CORINE Part of CLC group 3.1 and CLC 3.2.4

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		to distinguish plantations, these areas should be attributed to the classes 4.1 – 4.4. Includes burnt areas of this type.	
5. Heathland and shrub	5.1 Tundra	Vegetated land with graminoids, shrubs, mosses or macrolichens overlying permafrost. European tundras are limited to Spitzbergen and northern Russia. Vegetation with the same species also occurs on boreal mountains and in the low arctic remote from the main permafrost region, notably in Fennoscandia and Iceland; these oroboreal and low arctic habitats are listed under alpine and subalpine grassland or arctic, alpine and subalpine shrub.	CORINE Part of CLC 3.2.2 Moors and heathland
	5.2 Scrub and heathland	Vegetation with low and closed cover, dominated by bushes, shrubs, dwarf shrubs (heather, briars, broom, gorse, laburnum etc.) and herbaceous plants, including semi-natural/successional stages and mature stage of development. Includes burnt areas of this type.	CORINE 3.2.2 Moors and heathland
	5.3 Sclerophyllous vegetation	Bushy sclerophyllous vegetation including semi-natural/successional stages and mature stage of development; including maquis, matorral and garrigue. Includes burnt areas of this type.	CORINE 3.2.3 Sclerophyllous vegetation
6. Sparsely vegetated ecosystems	6.1 Bare rocks	Scree, cliffs, rock outcrops, including areas	CORINE 3.3.2 Bare rock (outside of

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		of active erosion, rocks and reef flats outside marine influence, inland salt planes. At least 90% of area of the ecosystem asset is covered by rocks. Rocks within a zone up to 100m from the high-water mark can be classified as coastal ecosystems.	coastal areas)
	6.2 Semi-desert, desert and other sparsely vegetated areas	Non-coastal habitats with less than 30% vegetation cover (other than in crevices of rocks, screes or cliffs) which are characterised by very low water availability. They include areas which are sparsely vegetated due to land degradation.	CORINE 3.3.3 Sparsely vegetated areas
	6.3 Ice sheets, glaciers and perennial snowfields	High mountain zones and high latitude land masses occupied by glaciers or by perennial snow. They may be inhabited by algae and invertebrates.	CORINE CLC 3.3.5 Glaciers and perpetual snow
7. Inland wetlands	7.1 Inland marshes and other wetlands on mineral soil	Low-lying land usually flooded in winter, and more or less saturated by water all year round. Vegetation is composed mainly of rushes, sedges, and some reed and shrub. Other types of this class include reedbeds and springs.	CORINE 4.1.1 Inland marshes
	7.2 Mires, bogs and fens	Wetlands, with the water table at or above ground level for at least half of the year, dominated by mosses, herbaceous or ericoid vegetation. Includes inland saltmarshes and waterlogged habitats where the groundwater is	CORINE CLC 4.1.2 Peat bogs

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		frozen. Excludes the water body and rock structure of springs and waterlogged habitats dominated by trees or large shrubs. Includes bog degradation stages dominated by heathland but excludes wet heathlands on mineral soils which support limited peat formation. Includes peat extraction sites. Includes burnt areas of this type.	
8. Rivers and canals	8.1 Rivers and streams	Natural watercourses, such as rivers, streams etc. (even though often modified by man) serving as water drainage channels.	CORINE 5.1.1 Water courses With CORINE alone only L1 EU possible
	8.2 Canals, ditches and drains	Artificial watercourses serving as water drainage or transport channels.	CORINE 5.1.1 Water courses With CORINE alone only L1 EU possible
9. Lakes and reservoirs	9.1 Lakes and ponds	Natural (but sometimes modified) water bodies with presence of standing water surface during the entire year (except in very dry years for some types).	CORINE 5.1.2 Water bodies With CORINE alone only L1 EU possible
	9.2 Artificial reservoirs	Artificial water bodies with presence of standing water surface during most of the year. Developed mainly for water supply or energy generation purposes.	CORINE 5.1.2 Water bodies With CORINE alone only L1 EU possible
	9.3 Geothermal pools and wetlands (Iceland)	See level 3 - 9.3.1	No direct CORINE correspondence
10. Marine inlets and transitional waters	10.1 Coastal lagoons	Stretches of salt or brackish water in coastal areas which are separated from the sea by a tongue of land or other similar topography. These water bodies can be connected to	CORINE 5.2.1 Coastal lagoons

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		the sea at limited points, either permanently or for parts of the year.	
	10.2 Estuaries and bays	This class includes two main types: a) estuaries, i.e., the mouth of a river under tidal influence within which the tide ebbs and flows. b) bays, i.e., a coastal body of water partly enclosed by land and that directly connects to a larger main body of water, in particular a sea or ocean. Vegetation, and fauna is adapted to saline and/or brackish conditions. It is recommended to align the border between marine waters, estuaries and river mouths in agreement with Marine Strategy Framework Directive reporting.	CORINE 5.2.2 Estuaries
	10.3 Intertidal flats	Coastal zone under tidal influence between open sea and land, which is flooded by sea water regularly twice a day in a ca. 12 hours cycle. Defined by the area between the average lowest and highest sea water level at low tide and high tide. Generally non-vegetated expanses of mud, sand or rock lying between high and low water marks.	CORINE 4.2.3 Intertidal flats
11. Coastal beaches, dunes and wetlands	11.1 Artificial shorelines	See level 3 - 11.1.1	No direct CORINE correspondence
	11.2 Coastal dunes, beaches and sandy and muddy shores	Natural non-vegetated expanses of sand or pebble/gravel, in coastal locations, like beaches, dunes, gravel pads, muddy	CORINE 3.3.1 Beaches, dunes, and sand plains (in coastal areas only)

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
		shores. Including salt-influenced wetlands between rows of dunes.	
	11.3 Rocky shores	Scree, cliffs, rock outcrops, including areas of active erosion, rocks and reef flats situated above the high-water mark up to a distance of 100 m away from the high water mark.	CORINE 3.3.2 Bare rock (in coastal areas only)
	11.4 Coastal saltmarshes and salines	This class includes two main types: a) Coastal saltmarshes, which are vegetated low-lying areas in the coastal zone, mostly above the high-tide line, but always susceptible to flooding by seawater. Often in the process of being filled in by coastal mud and sand sediments, gradually being colonized by halophilic plants. b) Salt-pans for extraction of salt from salt water by evaporation, under active use or in process of abandonment. Actively exploited salines can have a rather artificial character whereas those no longer in use often have developed substantial ecological value.	CORINE 4.2.1 Coastal salt marshes 4.2.2 Salines
12. Marine ecosystems (coastal waters, shelf and open ocean)	12.1 Marine macrophyte habitats	Kelp forests, seaweeds and seagrasses; see level 3 - 12.1.1, 12.1.2 and 12.1.3	CORINE can only provide L1 EU class 12
	12.2 Coral reefs	See level 3 - 12.2.1	CORINE can only provide L1 EU class 12
	12.3 Worm reefs	See level 3 - 12.3.1	CORINE can only provide L1 EU class 12
	12.4 Shellfish beds and reefs	See level 3 - 12.4.1	CORINE can only provide L1 EU class 12

EU ecosystem typology: level 1	EU ecosystem typology: level 2	Description	Correspondence
	12.5 Subtidal sand beds and mud plains	See level 3 - 12.5.1	CORINE can only provide L1 EU class 12
	12.6 Subtidal rocky substrates	See level 3 - 12.6.1	CORINE can only provide L1 EU class 12
	12.7 Continental and island slopes	See level 3 - 12.7.1	CORINE can only provide L1 EU class 12
	12.8 Deepwater benthic and pelagic ecosystems	See level 3 - 12.8.1	CORINE can only provide L1 EU class 12
	12.9 Deepwater coastal inlets (fjords)	See level 3 - 12.9.1	CORINE can only provide L1 EU class 12
	12.10 Sea ice	See level 3 - 12.10.1	CORINE can only provide L1 EU class 12

Table A.3. Description of EU ecosystem typology level 3 (from Maes et al., 2013, CORINE documentation or EUNIS documentation, as indicated)

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
1. Settlements and other artificial areas	1.1 Continuous settlement area	1.1.1 Continuous residential area	Urban areas where buildings, roads and other impermeable surfaces occupy at least 80% of the land, and with continuous or nearly continuous buildings, which may be houses, flats or buildings occupied for only part of the day.	EUNIS J1.1 - Residential buildings of city and town centres
		1.1.2 Continuous commercial and industrial area	Areas with current industrial or commercial use including services (e.g., public libraries, government offices). Includes office blocks, factories, industrial units, large animal-rearing batteries and large farm units.	EUNIS J1.4 - Urban and suburban industrial and commercial sites still in active use
	1.2 Discontinuous settlement area	1.2.1 Discontinuous residential area	Residential building areas in suburbs and villages where buildings and other impermeable surfaces occupy between 30% and 80% of the land area.	EUNIS J1.2 - Residential buildings of villages and urban peripheries
		1.2.2 Discontinuous commercial and industrial area	Commercial and industrial building areas in suburbs and villages where buildings and other impermeable surfaces occupy between 30% and 80% of the land area.	EUNIS J2.3 - Rural industrial and commercial sites still in active use
	1.3 Infrastructure	1.3.1 Road and rail networks and associated land	Motorways, railways, including associated installations (stations, platforms, embankments), including associated green areas (e.g. planted trees and bushes lines or spontaneous vegetation, such as grass verges), excluding dams and dykes.	CORINE 1.2.2 Road and rail networks and associated land
		1.3.2 Port areas	Infrastructure of port areas, including quays, dockyards and marinas, including associated	CORINE 1.2.3 Port areas

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			green areas.	
		1.3.3 Airports	Airport installations: runways, buildings and associated land, including associated green areas.	CORINE 1.2.4 Airports
		1.3.4 Other infrastructure	Other infrastructure (e.g. water purification plants, energy plants, transforming stations), including associated green areas.	CORINE 1.2.2 Road and rail networks and associated land
		1.3.5 Mineral extraction sites (excluding peat extraction sites, see 7.3.1)	Open-pit extraction sites of construction materials (sandpits, quarries) or minerals (open-cast mines). Includes flooded mining pits.	CORINE 1.3.1 Mineral extraction sites
		1.3.6 Dump areas	Landfill or mine dump sites, industrial or public.	CORINE 1.3.2 Dump sites
		1.3.7 Construction sites	Spaces under construction development, soil or bedrock excavations, earthworks. This class is assigned for areas where landscape is affected by human activities, changed or modified into artificial surfaces, being in a state of anthropogenic transition.	CORINE 1.3.3 Construction sites
	1.4 Urban greenspace	1.4.1 Parks (including Zoos and botanical gardens)	Varied green spaces within towns and cities. They may include small woods, mown lawns, water bodies including streams (which may be semi-natural or artificial), flowerbeds and shrubberies, and semi-natural grassland or woodland enclaves. Grasslands, usually mowed, composed of native or sometimes exotic grasses, constituting elements of urban parks. Zoological and botanical gardens are included. Urban gardens (e.g. community gardens) are included.	EUNIS X11 - Large parks E2.64 - Park lawns I2.23 - Small parks and city squares
		1.4.2 Sports and recreation sites	This class is assigned for green areas used for	CORINE

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			sports, leisure and recreation purposes, for example camping grounds, sports grounds, leisure parks, golf courses, racecourses, etc. The class applies for sites larger than the MMU within and outside of urban zones. Sport sites without green (e.g., a racing track) are excluded.	1.4.2 Sport and leisure facilities
		1.4.3 Other urban green	Other, non-specified areas within or partly embraced by urban fabric, such as tree alleys, or green areas possibly with the presence of abandoned buildings or infrastructure.	CORINE 1.4.1 Green urban areas
	1.5 Other artificial areas	1.5.1 Permanent Greenhouses	Permanent structures with hard or soft transparent surfaces dispersed within the urban, rural or natural environment established for the purpose of agricultural activities, small-scale commercial, artisanal or industrial activities, recreation, research, environmental protection. Excludes non-permanent installations such as film tunnels on cropland to protect crops from weather conditions.	EUNIS J2.4 - Agricultural constructions
		1.5.2 Cemeteries	This class includes sites designated as burial grounds, associated with church buildings or separate from them. The character of cemeteries varies substantially across Europe, for example they may have a lot of tree cover or none at all, thus more a land use than land cover/ecosystem classification. The use of this class is therefore at the discretion of countries and requires a clear meta data documentation.	A range of CORINE classes

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		1.5.3 Archaeological sites	This class includes areas formally recognised as of archaeological importance. The ecological character of such sites varies substantially across Europe and within countries, for example they may have a lot of tree cover or none at all, thus more a land use than land cover/ecosystem classification. The use of this class is therefore at the discretion of countries and requires a clear meta data documentation.	A range of CORINE classes
		1.5.4 Urban blue	Ponds and lakes in urban parks, or water bodies in settlements used for recreation.	EUNIS J5.3 Highly artificial non-saline standing waters
2.2. Cropland[10]	2.1 Annual cropland	2.1.1 Cereals excluding rice (C1000) excluding maize (C1500)	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops with little or no chemical fertilisation or pesticide application.	EUNIS I1 - Arable land and market gardens; Annual crop statistics (e.g. apro_cp_esms_an1.pdf (europa.eu)
		2.1.2 Maize (C1500 + G3000)	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops	

[10] The breakdown of cropland uses the terms and breakdown of crop statistics at level 3 of the EU ecosystem typology for classes 2.1 – 2.3 (i.e. for annual cropland, rice fields and permanent crops). The codes in brackets at level 3 refer to crop statistics codes. However, technically, the crops reported under these codes in crop statistics also include crops grown in 'permanent greenhouses'.

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			with little or no chemical fertilisation or pesticide application.	
		2.1.3 Dry pulses and protein crops (P0000)	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops with little or no chemical fertilisation or pesticide application.	
		2.1.4 Root crops, like sugar beet and potatoes (R0000)	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops with little or no chemical fertilisation or pesticide application.	
		2.1.5 Vegetables (including melons) and strawberries (V0000_S0000)	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops with little or no chemical fertilisation or pesticide application.	
		2.1.6 Industrial crops including annual bioenergy crops (I0000)	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops with little or no chemical fertilisation or pesticide	

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			application.	
		2.1.7 Flowers and ornamental plants (N0000)	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops with little or no chemical fertilisation or pesticide application.	
		2.1.8 Fallow land (Q0000)	Fallow land is all arable land either included in the crop rotation system or maintained in good agricultural and environmental condition, whether worked or not, but which will not be harvested for the duration of a crop year. The essential characteristic of fallow land is that it is left to recover, normally for the whole of a crop year. Fallow land may be bare land with no crops at all or land with spontaneous natural growth which may be used as feed or ploughed in or land sown exclusively for the production of green manure (green fallow). It includes arable land lying fallow for less than 5 years and arable land lying fallow for 5 years or more if for the purpose of fulfilling the ecological focus area	
		2.1.9 Temporary grasses (G1000)	Temporary grasses sown as intercrop, for silage and grazing.	
		2.1.10 Other crops (further categories may be added by Member States, depending upon	One component of croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. Croplands	

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		nationally important crop types).	comprise intensively cultivated fields as well as traditionally and/or extensively cultivated crops with little or no chemical fertilisation or pesticide application.	
		2.1.11 Semi-natural elements associated with agricultural land use in annual cropland	Traditional agricultural land use and landscape elements including hedges, ponds, grassy margins etc. as part of the farmed area. Such remaining semi-natural elements are considered part of cropland (and grassland) and can be mapped separately. Treelines and hedgerows are often easiest to distinguish. Member States are requested to fully document the type of landscape elements included in this class where it is reported separately.	
	2.2 Rice fields	2.2.1 Rice fields (C2000)	Inundated or inundatable fields used for the cultivation of rice (*Oryza sativa*). When not too heavily treated, they may provide substitution habitats for some wetland species, for example resident birds (e.g. ducks, rails and herons) and as feeding grounds for migratory birds.	EUNIS I1.4 - Inundated or inundatable croplands, including rice fields; Annual crop statistics (e.g. apro_cp_esms_an1.pdf (europa.eu)
	2.3 Permanent crops	2.3.1 Olives (O1000)	Cultivated areas planted with olive trees. These can be intensive plantations but also stands composed of mostly old trees interspersed with semi-natural vegetation.	CORINE 2.2.3 Olive groves; Annual crop statistics (e.g. apro_cp_esms_an1.pdf (europa.eu)
		2.3.2 Grapes (W1000)	Areas planted with vines, vineyard parcels covering >50% and determining the land use of the area. These can be intensive plantations but also vineyards managed extensively and/or on steep slopes interspersed with semi-natural	CORINE 2.2.1 Vineyards; Annual crop statistics (e.g. apro_cp_esms_an1.pdf (europa.eu)

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			vegetation.	
		2.3.3 Pome fruits (F1100)	A fruit produced by flowering plants; can be grown in intensive modern plantations but also in an extensive way, using traditional and/or organic methods.	EUNIS G1.D - Fruit and nut tree orchards; Annual crop statistics (e.g. apro_cp_esms_an1.pdf (europa.eu)
		2.3.4 Stone fruits (F1200)	See 2.3.3	
		2.3.5 Berries excluding strawberries (F3000)	See 2.3.3	
		2.3.6 Citrus fruits (T1000)	See 2.3.3	
		2.3.7 Nuts (F4000)	See 2.3.3	
		2.3.8 Hazelnut	See 2.3.3	
		2.3.9 Chestnut	See 2.3.3	
		2.3.8 Other perennial crops and orchards	See 2.3.3	
		2.3.9 Semi-natural elements associated with agricultural land use in in permanent crops	Traditional agricultural land use and landscape elements including hedges, ponds, grassy margins etc. as part of the farmed area. Such remaining semi-natural elements are considered part of cropland (and grassland) and can be mapped separately. Treelines and hedgerows are often easiest to distinguish. Member States are requested to fully document the type of landscape elements included in this class where it is reported separately.	
	2.4 Agro-forestry areas	2.4.1 Holm and cork oak forests	Annual crops or grazing land under the wooded cover of holm and cork oak, with a minimum crown cover between 10 % and 30%.	CORINE 2.4.4 Agro-forestry areas

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		2.4.2 Other agro-forestry area	Annual crops or grazing land under the wooded cover of species other than holm and cork oak; with a minimum crown cover between 10 % and 30%.	CORINE 2.4.4 Agro-forestry areas
	2.5 Mixed farmland	2.5.1 Mosaic farmland (comprising cropland, grassland and (semi-)natural components)	Mosaic of small cultivated land parcels with different cultivation types -annual crops, pasture and/or permanent crops-, eventually with scattered houses or gardens. Mosaic landscapes have no single dominant land cover that covers more than 50% of the MMU. Includes tree lines, hedgerows and other semi-natural elements in mixed farmland.	CORINE 2.4.2 Complex cultivation patterns
	2.6 Other farmland	2.6.1 Nurseries	Areas dedicated to producing young trees, shrubs, and ornamental species for planting out. Tree and shrub nurseries are the most common type.	EUNIS G5.7 - Coppice and early-stage plantations FB.1 - Shrub plantations for whole-plant harvesting
		2.6.2 Christmas tree plantations	Christmas tree plantations	EUNIS FB.1 - Shrub plantations for whole-plant harvesting
		2.6.3 Perennial bioenergy crops	This class has two expressions: a) Perennial energy grasses (e.g. Miscanthus, Reed canary grass) and other multi-annual crops used for oil or fibre production. b) Woodland treated as coppice without standards; plantations of dwarf trees or shrubs cultivated for wood or small-tree production, with a regular whole-plant harvesting regime, including short-rotation Salix beds for biomass	EUNIS G5.7 - Coppice and early-stage plantations FB.1 - Shrub plantations for whole-plant harvesting

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			production.	
		2.6.4 Semi-natural elements associated with agricultural land use in other farmland	Traditional agricultural land use and landscape elements including hedges, ponds, grassy margins etc. as part of the farmed area. Such remaining semi-natural elements are considered part of cropland (and grassland) and can be mapped separately. Treelines and hedgerows are often easiest to distinguish. Member States are requested to fully document the type of landscape elements included in this class where it is reported separately.	
3. Grassland	3.1 Sown pastures and other grass (modified grassland)	3.1.1 Sown pastures used for grazing	Stable eutrophic, grassland characterized by agricultural use or strong human disturbance. Floral composition dominated by *Graminaceae* and shaped by human activity. Regularly re-sown and fertilised and typically used for grazing.	CORINE 2.3.1 Pastures, meadows and other permanent grasslands under agricultural use; Including EUNIS E1 (dry Grasslands) and E2 (Mesic Grasslands)
		3.1.2 Sown grassland mown frequently for fodder or silage	Sown grassland which is stable and mostly under intensive use, regularly re-sown and normally strongly fertilised. Under less intensive use it can include patches of lowland and montane mesotrophic grassland and hay meadows of the boreal, nemoral, warm-temperate humid and Mediterranean zones. All types are harvested mechanically for silage or hay.	
		3.1.3 Semi-natural elements associated with agricultural land use in modified grassland	Traditional agricultural land use and landscape elements including hedges, ponds, grassy margins etc. as part of the farmed area. Such remaining semi-natural elements are considered	

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			part of cropland (and grassland) and can be mapped separately. Treelines and hedgerows are often easiest to distinguish. Member States are requested to fully document the type of landscape elements included in this class where it is reported separately.	
	3.2 Natural and semi-natural grassland	3.2.1 Mesic grassland	Lowland and montane mesotrophic and eutrophic pastures and hay meadows of the boreal, nemoral, warm-temperate humid and mediterranean zones. They are generally more fertile than dry grasslands. Used to be a common grassland type but has become rare due to agricultural intensification. This vegetation type can be further sub-divided into many different species associations, influenced by soil, climate, altitude and land use management factors. Includes burnt grassland of this type.	
		3.2.2 Dry grassland	Well-drained or dry lands dominated by grass or herbs, mostly not fertilized and often of low productivity; composed of native species adapted to the local environment. Included are Artemisia steppes. Excluded are dry Mediterranean lands with shrubs of other genera where the shrub cover exceeds 10%; these are listed as garrigue. This vegetation type can be further sub-divided into many different species associations, influenced by soil, climate, altitude and land use	EUNIS E1 - Dry grasslands

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			management factors. Includes burnt grassland of this type.	
		3.2.3 Seasonally wet and wet grassland	Unimproved or lightly improved wet pastures, meadows and tall herb communities of the boreal, nemoral, warm-temperate humid, steppic and Mediterranean zones. Composed of native species adapted to the local environment. This vegetation type can be further sub-divided into many different species associations, influenced by soil, climate, altitude and land use management factors.	EUNIS E3 - Seasonally wet and wet grasslands
		3.2.4 Alpine and subalpine grasslands	Primary and secondary grass- or sedge-dominated formations of the alpine and subalpine levels of boreal, nemoral, Mediterranean, warm-temperate humid and Anatolian mountains. Composed of native species adapted to the local environment. This vegetation type can be further sub-divided into many different species associations, influenced by soil, climate, altitude and land use management factors.	EUNIS E4 - Alpine and subalpine grasslands
		3.2.5 Woodland fringes and clearings and tall forb stands	Stands of tall herbs or ferns, occurring on disused urban or agricultural land, by watercourses, at the edge of woods, or invading pastures. Stands of shorter herbs forming a distinct zone (seam) at the edge of woods.	EUNIS E5 - Woodland fringes and clearings and tall forb stands
		3.2.6 Inland salt steppes	Saline land with dominant salt-tolerant grasses and herbs. Excludes saline shrubland, listed under xero-halophile shrubs.	EUNIS E6 - Inland salt steppes

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		3.2.7 Wooded pastures	Grasslands with a wooded overstorey that normally has less than 10% cover. The tree layer is traditionally composed of single oak trees and similar deciduous trees. Associated with traditional herded pastoral systems which have largely disappeared in Europe.	EUNIS E7 - Sparsely wooded grasslands
		3.2.8 Semi-natural elements associated with agricultural land use in (semi-) natural grassland	Traditional agricultural land use and landscape elements including hedges, ponds, grassy margins etc. as part of the farmed area. Such remaining semi-natural elements are considered part of cropland (and grassland) and can be mapped separately. Treelines and hedgerows are often easiest to distinguish. Member States are requested to fully document the type of landscape elements included in this class where it is reported separately.	
4. Forest and woodlands	4.1 Broadleaved deciduous forest	4.1.1 Riparian forest and woodland	Riparian forests dominated by willows *(Salix spp.*) and poplars (*Populus spp.*) of periodically-inundated terraces and shoals; riparian alder (*Alnus glutinosa, Alnus incana*), and sometimes ash (*Fraxinus angustifolia, Fraxinus excelsior*), typically without many softwood willows in the canopy and occurring throughout Europe along streams, small to medium rivers and other water bodies; mixed broadleaved forests typical of less-frequently flooded, well-aerated mineral soils on floodplains of the middle and lower reaches of major European rivers. The canopy in high-forest stands can be very tall and multi-	EUNIS ~~T1.1 Temperate Salix and Populus riparian forest;~~ T1.2 - Alnus glutinosa-Alnus incana forest on riparian soils; T1.3 - Temperate hardwood riparian forest; and T1.4 - Mediterranean and Macaronesian riparian forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			layered and is typically dominated by various mixtures of *Alnus glutinosa, Fraxinus angustifolia, Fraxinus excelsior, Populus alba, Populus canescens, Prunus padus, Quercus robur, Ulmus glabra, Ulmus laevis and Ulmus mino*r. Deciduous broadleaved forest, most commonly dominated by poplars (*Populus*), willows (*Salix*) or oriental plane (*Platanus orientalis*), on periodically flooded alluvia or gravel terraces and streamsides in humid localities in the Mediterranean and Macaronesia. Also includes streamside forests with *Rhododendron ponticum* and *Betula pendula var. fontqueri* in Spain.	
		4.1.2 Broadleaved swamp forest on non-acid and acid peat	Deciduous broadleaved forest, commonly dominated by alder (*Alnus glutinosa, Alnus incana*), oak (*Quercus robu*r) or aspen (*Populus tremula*) on non-acid peat with groundwater at or seasonally above the surface in swamps across the lowlands of the temperate and boreal zones; Deciduous broadleaved or mixed forest on acid peat on or around active bogs and poor fens with nutrient-poor ground waters occurring through the Atlantic region and the boreal zone and locally, where ground conditions permit, also in the continental zone. It is usually dominated by birch (*Betula pubescens*).	EUNIS T1.5 Broadleaved swamp woodland on non-acid peat; and T1.6 Broadleaved swamp woodland on acid peat
		4.1.3 Fagus dominated forest	Forest dominated by beech (Fagus sylvatica and Fagus orientalis) on base-rich to acid,	EUNIS T1.7 Fagus forest on non-acid soils

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			mesotrophic to eutrophic, mineral soils. Forests dominated by beech, Fagus sylvatica, in western and central Europe, and *Fagus orientalis* and other *Fagus* species in southeastern Europe and the Pontic region.	and T1.8 Fagus forest on acid soils
		4.1.4 Temperate, Submediterranean and Mediterranean thermophilous deciduous forest	Deciduous or mixed deciduous/evergreen forest of thermophilous and drought-resistant trees, especially oaks (*Quercus spp.*), a subordinate tier of regionally varied associates, through the submediterranean zones, drier and warmer situations further north, extending into more humid higher altitudes in the mediterranean zone.; Mediterranean deciduous forests usually dominated by *Quercus pubescens* or, in the Eastern Mediterranean, by *Quercus ithaburensis* subsp. *macrolepis*. The canopy is open, either pure or with other oaks. Stands are mostly developed on shallow soil, usually at altitudes of less than 700 m. Includes burnt areas of this type.	EUNIS T1.9 – Temperate and submediterranean thermophilous deciduous forest and T.1A – Mediterranean thermophilous deciduous forest
		4.1.5 Acidophilous [*Quercus*]-dominated forests	Oak-dominated forests (mainly *Quercus robur* and Q. petraea but also other regional species) of impoverished acid soils through the atlantic and continental zones, where beech (*Fagus sylvatica*) is a potential competitor and extending northwards into the boreal zone where Scot's pine (*Pinus sylvestris*) increasingly figures in the canopy. Associated floras are generally rather poor but show some regional distinctiveness and	EUNIS T1.B – Acidophilous Quercus forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			towards the very humid western Atlantic seaboard have extraordinary richness of ferns and cryptogams. Includes burnt areas of this type.	
		4.1.6 Temperate and boreal and Southern European *Betula* and *Populus tremula* forest on mineral soils	Open, low canopy climax birch (*Betula litwinowii, Betula pubescens var. glabrata, Betula pubescens var. pumila*) and aspen (*Populus tremula*) forests with a heathy or herb-rich field layer in the boreal zone, temperate mountain ranges including the Caucasus, and temperate zone of Eastern European lowlands; Diverse climax and paraclimax forests dominated by birch (*Betula pendula* and closely related species) or aspen (*Populus tremula*) on usually acidic mineral soils in humid ravines and gorges and on unstable substrates in the montane to subalpine belts of the Pyrenees, Corsica, Apennines, Sicily and the southern Balkans. Includes burnt areas of this type.	EUNIS T1C Temperate and boreal mountain Betula and Populus tremula forest on mineral soils; T1.D Southern European mountain Betula and Populus tremula forest on mineral soils
		4.1.7 Other broadleaved deciduous forest, excluding highly modified plantations	Various other broadleaved deciduous forest such as Carpinus and Quercus mesic deciduous forest, and ravine forests. Includes burnt areas of this type.	EUNIS T1E to T1K T1-J - Deciduous self-sown forests of non site-native trees
		4.1.8 Highly modified broadleaved deciduous forests, in particular plantations including stands of non-native trees species that have long been established in European	Mixed plantations of deciduous species where at least one species is exotic or outside its natural range, or if composed of native species then managed intensively and planted in mono-age stands. Mono-cultural plantations of recently introduced species should be assigned to 4.6.1.	EUNIS G4.F - Mixed forestry plantations

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		ecosystems stands	Includes burnt areas of this type.	
	4.2 Coniferous forests	4.2.1 Boreal and temperate fir and spruce forest	Evergreen coniferous forest dominated by spruce (*Picea abies* and, in the Dinaric mountains, relict *P. omorika*), often with some fir (*Abies alba*) on usually acidic, even very oligotrophic, wet, cold or rocky soils in the montane and sub-alpine belts of nemoral mountains. Forests of European silver fir (*Abies alba*) in temperate mountains, often with European beech (Fagus sylvatica), and Norway spruce (*Picea abies*) where site conditions are harsher at higher altitudes. Includes burnt areas of this type.	EUNIS T3-1 - Temperate mountain Picea forest
		4.2.2 Mediterranean mountain fir and spruce forest	In the southern Black Sea region and the Caucasus, the dominant species is Caucasian fir (*Abies nordmanniana*), often with an admixture of Oriental beech (*Fagus orientalis*) and Oriental spruce (*Picea orientalis*); Evergreen coniferous forests of more sunless or fog-bound slopes and gullies in the lower to mid altitudinal belts of Mediterranean mountains where firs of very limited distribution dominate in highly distinctive relic stands: Spanish fir (*Abies pinsapo*), Greek fir (*Abies cephalonica*), King Boris fir (*Abies borisii-regis*), Apennine or Sicilian stands of silver fir (*Abies alba*) and Sicilian fir (*Abies nebrodensis).*	EUNIS T3.2 - Temperate mountain Abies forest and T3.3 Mediterranean mountain Abies forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			Includes burnt areas of this type.	
		4.2.3 Temperate subalpine Larix, *Pinus cembra* and *Pinus uncinata* forest	Coniferous, in part deciduous, forest of European larch (*Larix decidua*) or Arolla pine (*Pinus cembra*) in the middle subalpine belt of temperate mountains in the central Alps and Carpathians with long but shallow snow-lie and a short growing season. Dwarf mountain pine (*Pinus mugo*), spruce (*Picea abies*), silver fir (*Abies alba*), rhododendrons and other sub-shrubs are never more than subordinate, but various whitebeam (*Sorbus*) species are a characteristic associate. Includes burnt areas of this type.	EUNIS T3.4
		4.2.4 Pine forest (excluding mires, non-thermophilous)	Forests dominated by *Pinus sylvestris* and *Pinus nigra* in temperate continental, Temperate and submediterranean montane and Mediterranean montane conditions, and *Pinus heldreichii-Pinus peuce* forest in Mediterranean and Balkan subalpine conditions. Includes burnt areas of this type.	EUNIS T35 - Temperate continental *Pinus sylvestris* forest T36 - Temperate and submediterranean montane *Pinus sylvestris-Pinus nigra* forest T37 - Mediterranean montane *Pinus sylvestris-Pinus nigra* forest T39 - Mediterranean and Balkan subalpine *Pinus heldreichii-Pinus peuce* forest
		4.2.5 Mediterranean thermophilous lowland pine forest	Evergreen coniferous forest dominated by various thermophilous pines: maritime pine (*Pinus pinaster* in the western Mediterranean and winter-mild Atlantic regions), Aleppo pine (*Pinus halepensis*), stone pine *(Pinus pinea* all	EUNIS T3A - Mediterranean lowland to submontane *Pinus* forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			around the Southern European coasts, and in some places also inland), and Aegean pine (*Pinus brutia* in Greece, Cyprus and Anatolia), the first three often favouring unstable substrates or pre-climax situations. All of these forests are fire-prone. Includes burnt areas of this type.	
		4.2.6 Spruce, pine and larch mire forests	Forests (>30% canopy cover) dominated by spruce (*Picea abies* or *P. obovata*) on acid peat or around active bogs and poor fens with nutrient-poor ground waters occurring through the boreal zone and locally, where ground conditions permit, in the continental zone; Open forests (with lower canopy cover) dominated by pine (*Pinus mugo* subsp. *rotundata*, *Pinus sylvestris*) or larch (*Larix decidua, L. sibirica*) on acid peat or around active bogs and poor fens with nutrient-poor ground waters occurring through the boreal zone and locally, where ground conditions permit, in the continental zone. Includes burnt areas of this type.	EUNIS T3K - *Picea* mire forest ; T3J - Pinus and Larix mire forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		4.2.7 Taiga forests	Taiga forests: found in the boreal zone of North-Eastern Europe and western Siberia including deciduous taiga dominated by Siberian larch (*Larix sibirica*) and evergreen taiga dominated by *Pinus sylvestris*, with spruce (*Picea abies and Picea obovata*), Siberian fir (*Abies sibirica*), Siberian pine (*Pinus sibirica*), *Betula pendula* and *Betula pubescens*). Includes burnt areas of this type.	EUNIS T3F - Dark taiga T3G - *Pinus sylvestris* light taiga T3H - Larix light taiga
		4.2.8 Other coniferous forests, excluding plantations	Various other coniferous forests including juniperus forests, cedrus forests; occurring mostly south of the Alps. Includes burnt areas of this type.	EUNIS T38 - Mediterranean montane Cedrus forest T3B - *Pinus canariensis* forest T3C - Taxus baccata forest T3D - Mediterranean Cupressaceae forest T3L - Coniferous self sown forest of non site-native trees
		4.2.9 Highly modified coniferous forests, in particular plantations	Mixed plantations of coniferous species where at least one species is exotic or outside its natural range, or if composed of native species then intensively managed and planted in mono-age stands. Mono-cultural plantations of recently introduced species should be assigned to 4.6.1. Includes burnt areas of this type.	EUNIS T3M - Coniferous plantation of non site-native trees T3N - Coniferous plantation of site-native trees G4.F - Mixed forestry plantations
	4.3 Broadleaved evergreen forest	4.3.1 Mediterranean evergreen *Quercus* forest	Forest dominated by evergreen broadleaved oaks (most widely *Quercus ilex* but also with *Quercus alnifolia*, *Quercus coccifera*, *Quercus rotundifolia*, *Quercus suber*) with associated	EUNIS T2-1 - Mediterranean evergreen Quercus forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			sclerophyllous and laurophyllous trees and shrubs in the summer-drought climate of the Mediterranean lowlands and foothills. The tree canopy is often low and much modified, with widespread transitions to shrubby maquis/matorral and open dehesa/montado wood pasture. Includes burnt areas of this type.	
		4.3.2 Mainland laurophyllous forest	Patches of evergreen laurophyllous forests and thickets dominated by bay (*Laurus nobilis*), firetree (*Morella faya*) and Portugal laurel (*Prunus lusitanica subsp. lusitanica*) in oceanic and hyper-humid situations, now surviving as small relics in sheltered situations like ravines along the Atlantic coast of Portugal and Spain and in Sardinia, central and southern Italy and Sicily. Includes burnt areas of this type.	EUNIS T22 - Mainland laurophyllous forest
		4.3.3 Macaronesian laurophyllous forest	Evergreen laurophyllous forest (laurisilva) on deep soils in the hyper-humid, frost-free fog belt mainly on the northern slopes in the mountains on some Macaronesian islands. The tree and shrub canopy is very diverse and rich in endemics, with striking differences related to climatic conditions across the different island groups, local topography and long isolation of the floras. Includes burnt areas of this type.	EUNIS T23 - Macaronesian laurophyllous forest
		4.3.4 *Olea europaea-Ceratonia siliqua* forest	Olive (*Olea europaea*), carob (*Ceratonia siliqua*) and mastic (*Pistacia lentiscus*) forest or bush	EUNIS T24 - *Olea europaea-Ceratonia siliqua* forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			with a closed tree canopy in the drought-prone lowlands and foothills of the Mediterranean and Macaronesia. Includes burnt areas of this type.	
		4.3.5 Palm groves	Woods, often riparian, formed by palm trees of the Mediterranean and Macaronesian zones, *Phoenix theophrasti* of Crete and western Anatolia, and *Phoenix canariensis* of the Canary Islands. Includes burnt areas of this type.	EUNIS G2.5 - Phoenix groves
		4.3.6 Other broadleaved evergreen forests	Patches of holly (*Ilex aquifolium*) occurring in scattered localities across European forests, especially in the temperate zone and in the Mediterranean mountains. Forests with low-level tree canopy (high matorral) variously dominated by arborescent ericoids, strawberry tree (*Arbutus canariensis*) and Canarian holly (*Ilex canariensis*) in situations that range from cold and hyper-humid slopes and exposed fog-bound outcrops to sub-humid and dry foothills of Madeira and the Canary Islands. Includes burnt areas of this type.	EUNIS T27 - Ilex aquifolium forest T28 - Macaronesian heathy forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		4.3.7 Highly modified broadleaved evergreen forests, including stands of non-native trees species that have long been established in European forest mixes.	Mixed plantations of broadleaved evergreen species where at least one constituent is exotic or outside its natural range, or if composed of native species then managed intensively and planted in mono-age stands. Mono-cultural plantations of recently introduced species should be assigned to 4.6.1. Includes burnt areas of this type.	EUNIS T2-A - Broadleaved evergreen plantations of non site-native trees G4.F - Mixed forestry plantations
	4.4 Mixed forests	4.4.1 Mixed forests dominated by coniferous species	Vegetation formation composed principally of trees, including shrub and bush understorey, where coniferous species moderately predominate, in terms of canopy cover (typically between 60 % to 80 % canopy cover). The class includes forests that are a mix of native broadleaved trees and spontaneously established spruce and pine trees. Includes burnt areas of this type.	CORINE 3.1.3 Mixed forest EUNIS T3L - Coniferous self sown forest of non site-native trees
		4.4.2 Mixed forests dominated by broadleaved species	Vegetation formation composed principally of trees, including shrub and bush understorey, where broadleaved species moderately predominate, in terms of canopy cover (typically between 60 % to 80 % canopy cover). The class includes forests that are a mix of native and spontaneously established trees. Includes burnt areas of this type.	CORINE 3.1.3 Mixed forest
		4.4.3 Other mixed forests including stands of non-native trees species that have long been established in European forest	Vegetation formation composed principally of trees, including shrub and bush understorey, where neither broadleaved nor coniferous species predominate. The class includes forests that are a	CORINE 3.1.3 Mixed forest

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		mixes.	mix of native broadleaved trees and spontaneously established spruce and pine trees. Includes burnt areas of this type.	
	4.5. Transitional forest and woodland shrub	4.5.1 Transitional woodland/forest land	Forest land, including recently felled clear-cut, burnt, replanted or newly afforested. Includes burnt areas of this type.	CORINE 3.2.4 Transitional woodland/shrub
	4.6 Plantations	4.6.1 Monoculture or mixed plantations	Monoculture or mixed plantations of non-native tree species with very sparse or lacking undergrowth, e.g. Eucalyptus plantations. Forest stands of single or mixed species consisting of native and/or non-native trees species that have long been established in European ecosystems and have diverse undergrowth typical for forest ecosystems should be classified as part of types 4.1 to 4.4. Includes burnt areas of this type.	CORINE 3.1.3 Mixed forest (L2 EU) EUNIS T3L - Coniferous self sown forest of non site-native trees
5. Heathland and shrub	5.1 Tundra	5.1.1 Tundra	Vegetated land with graminoids, shrubs, mosses or macrolichens overlying permafrost. European tundras are limited to Spitzbergen and northern Russia. Vegetation with the same species also occurs on boreal mountains and in the low arctic remote from the main permafrost region, notably in Fennoscandia and Iceland; these oroboreal and low arctic habitats are listed under alpine and subalpine grassland or arctic, alpine and subalpine shrub.	EUNIS F1 - Tundra
	5.2 Scrub and heathland	5.2.1 Arctic, alpine and subalpine scrub	Shrub occurring north of or above the climatic tree limit, but outside the permafrost zone. Shrub occurring close to but below the climatic tree	EUNIS F2 - Arctic, alpine and subalpine shrub

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			limit, where trees are suppressed either by late-lying snow or by wind or repeated browsing.	
		5.2.2 Temperate and Mediterranean montane scrub	These scrub communities include deciduous and evergreen shrubs of the nemoral zone, and deciduous shrubs of the sub-mediterranean and supra-mediterranean zones that are adapted to a cooler climate. Excluded are heathlands with dominant Ericaceae, and the typically mediterranean maquis, garrigue and phrygana. Includes burnt areas of this type.	EUNIS F3 - Temperate and mediterranean-montane shrub
		5.2.3 Temperate shrub heathland	Shrub communities adapted to a cooler climate in which Ericaceae are dominant or at least prominent. Such heaths are best developed on acid soils in the Atlantic zone and also in sub-Atlantic Europe. This includes semi-natural (in the sense of substitutional /secondary) heathlands and scrub types. Includes burnt areas of this type.	CORINE 3.2.4 Transitional woodland shrub EUNIS F4 - Temperate shrub heathland
	5.3 Sclerophyllous vegetation	5.3.1 Maquis, arborescent matorral and thermo-Mediterranean scrub	Evergreen sclerophyllous or lauriphyllous shrub vegetation, with a closed or nearly closed canopy structure, having nearly 100% cover of shrubs, with few annuals and some vernal geophytes; trees are nearly always present, some of which may be in shrub form. Shrubs, sometimes tall, of *Juniperus*, *Arbutus*, *Cistus*, *Cytisus*, *Erica*, *Genista*, *Lavandula*, *Myrtus*, *Phillyrea*, *Pistacia*, *Quercus* and *Spartium* are typical. Included is pseudomaquis, in which the dominants are mixed deciduous and evergreen shrubs.	EUNIS F5 - Maquis, arborescent matorral and thermo-Mediterranean brushes

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			Includes burnt areas of this type.	
		5.3.2 Garrigue	Evergreen sclerophyllous or lauriphyllous shrub vegetation, with an open canopy structure and some bare ground, usually with many winter annuals and vernal geophytes. Low shrubs of *Cistus*, *Lavandula*, *Rosmarinus* and *Stoechas* are usually present, and there may be some larger shrubs and scattered trees. Garrigue is found mostly in the Mediterranean, Macaronesian and Pontic regions, where it typically derives from degradation or regrowth of broadleaved evergreen forests, but it extends into deciduous forest areas in the supra-Mediterranean zone and sub-Mediterranean zones and into steppe areas in Anatolia. Includes shrubby land with mainly herbaceous vegetation and a large component of unpalatable non-vernal monocots (*Asphodelus*, *Urginea*) and thistles, provided that shrub cover exceeds 10%. Includes burnt areas of this type.	EUNIS F6 - Garrigue; including semi-natural (in the sense of substitutional /secondary) heathlands and shrub types and bushy sclerophyllous vegetation (both in CORINE class 3.2.4)
		5.3.3 Spiny Mediterranean heaths (phrygana, hedgehog-heaths & coastal cliff vegetation)	Shrubland with dominant low spiny shrubs, widespread in Mediterranean and Anatolian regions with a summer-dry climate, occurring from sea level to high altitudes on dry mountains. Includes burnt areas of this type.	EUNIS F7 - Spiny Mediterranean heaths (phrygana, hedgehog-heaths and related coastal cliff vegetation)
		5.3.4 Thermo-Atlantic xerophytic shrub (Madeira and Canary Islands)	Xerophytic shrub formations of the lower slopes of the Canary Islands and Madeira, rich in succulents, in particular cactiform or dendroid	EUNIS F8 - Thermo-Atlantic xerophytic shrub

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			spurges *Euphorbia* spp., rosette-forming Aeonium spp. and composites. Includes burnt areas of this type.	
6. Sparsely vegetated ecosystems	6.1 Bare rocks	6.1.1 Rocky pavements, outcrops, and screes	Accumulations of boulders, stones, rock fragments, pebbles, gravels or finer material, of non-aeolian depositional origin, unvegetated, occupied by lichens or mosses, or colonized by sparse herbs or shrubs. Included are screes and scree slopes produced by slope processes, moraines and drumlins originating from glacial deposition, sandar, eskers and kames resulting from fluvio-glacial deposition, block slopes, block streams and block fields constructed by periglacial depositional processes of downslope mass movement, ancient beach deposits constituted by former coastal constructional processes. Also including unvegetated, sparsely vegetated, and bryophyte- or lichen-vegetated cliffs, rock faces and rock pavements, not presently adjacent to the sea, and not resulting from recent volcanic activity.	EUNIS H2 - Screes H3 - Inland cliffs, rock pavements and outcrops
		6.1.2 Lava flows	Hard rock surfaces, rock jumbles, loose material deposits, soils, water bodies resulting from recent or present volcanic activity, unvegetated, occupied by lichens or mosses, or colonized by specialised, relatively sparse herb- or shrub-dominated communities.	EUNIS H6 - Recent volcanic features
	6.2 Semi-desert, desert and other	6.2.1 Semi-desert steppes	These mixed semi-deserts are dominated by suffrutescent (i.e. with a woody base) or sub-	IUCN GET T5.1 – Semi-desert steppes

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
	sparsely vegetated areas		succulent (semi-fleshy) perennial shrubs and tussock grasses. Productivity and biomass are limited by low to very low average precipitation, extreme temperatures and, to a lesser extent, soil nutrients, but vary temporally in response to water availability. Vegetation takes a range of structural forms, including open shrublands, mixed shrublands with a tussock grass matrix, prairie-like tall forb grasslands, and very low dwarf shrubs interspersed with forbs or grasses. Total cover varies from 10% to 30% and the balance between shrubs and grasses is mediated by rainfall, herbivory and soil fertility. Includes burnt areas of this type.	
		6.2.2 Cool deserts and semi-desert steppes	Arid systems where productivity is limited by both low precipitation and cold temperatures but varies spatially in response to soil texture, salinity, and water table depth. Vegetation cover varies with soil conditions from near zero (on extensive areas of heavily salinized soils or mobile dunes) to >50% in upland grasslands and shrublands but is generally low in stature (<1 m tall). The dominant plants are perennial C3 grasses and xeromorphic suffrutescent or non-sclerophyllous perennial shrubs. Dwarf shrubs, tending to prostrate or cushion forms occur in areas exposed to strong, cold winds. Plant growth occurs mainly during warming spring temperatures after winter soil moisture	IUCN GET T5.4 – Cool deserts and semi-deserts

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			recharges. Includes burnt areas of this type.	
		6.2.3 Other sparsely vegetated areas	Miscellaneous bare habitats, including glacial moraines, freeze-thaw features, inland sand dunes and trampled areas. Vegetation, if present, is dominated by algae, lichens or bryophytes, with vascular plants absent or very sparse. Includes burnt areas of this type.	EUNIS H5 - Miscellaneous inland habitats with very sparse or no vegetation
	6.3 Ice sheets, glaciers and perennial snowfields	6.3.1 Ice sheets, glaciers and perennial snowfields	High mountain zones and high latitude land masses occupied by glaciers or by perennial snow. They may be inhabited by algae and invertebrates.	EUNIS H4 - Snow or ice-dominated habitats
7. Inland wetlands	7.1 Inland marshes and other wetlands on mineral soil	7.1.1 Inland marshes	Low-lying land usually flooded in winter, and more or less saturated by water all year round. Vegetation is composed mainly of rushes, sedges, and some reed and shrub.	EUNIS C3.1 - Species-rich helophyte beds C3.2 - Water-fringing reedbeds and tall helophytes other than canes EUNIS D5.1 - Reedbeds normally without free-standing water D5.2 - Beds of large sedges normally without free-standing water C3.3 - Water-fringing beds of tall canes
		7.1.2 Inland salt marshes	Salt meadows and swards of *Salicornia* and other *Chenopodiaceae* of inland salt basins of the nemoral zone. Inland saltmarshes of middle Europe are remarkable, extremely threatened communities occurring in a few isolated	EUNIS D6.1 - inland saltmarshes

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			locations.	
		7.1.3 Reedbeds	Water-fringing stands of tall vegetation by lakes (including brackish lakes), rivers and brooks, usually species-poor and often dominated by one species. Mainly composed of Common reed, horsetail and tall sedges. Including Mediterranean beds of tall canes lining permanent or temporary water courses and water bodies.	
		7.1.4 Springs	Springs are formed where groundwater flows onto the surface and have various ecological expressions, depending on terrain and water characteristics. They are an important and threatened aquatic habitat.	
	7.2 Mires, bogs and fens	7.2.1 Raised bogs	The mire surface and underlying peat of highly oligotrophic, strongly acidic peatlands with a raised centre from which water drains towards the edges. The peat is composed mainly of sphagnum remains. Raised bogs form on nearly flat ground and derive moisture and nutrients only from rainfall (ombrotrophic). Raised bog complexes (X04) include larger bog pools and a marginal lagg, as well as the main mire surface, which in actively-growing raised bogs typically comprises a complex of low hummocks, small pools and their associated vegetation. Raised bogs form only in cool climates with high rainfall. Most of the species that bogs harbour	EUNIS D1.1 - Raised bogs

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			are rare and their populations fragmented into isolated relictual elements; several are threatened. The remaining intact or nearly intact communities are exceptional.	
		7.2.2 Blanket bogs	Mire surface and underlying peat of ombrotrophic peatlands, formed on flat or gently sloping ground with poor surface drainage, in oceanic climates with high rainfall. The mire surface may on flatter ground be very similar to that of a raised bog, with a complex of small pools and terrestrial hummocks. In the strictest sense, blanket bogs are a habitat endemic to northwestern Europe, characteristic of the western and northern British Isles, the Faeroe Islands and the western seaboard of Scandinavia. They often cover extensive areas with local topographic features supporting distinct communities. Sphagna (*Sphagnum spp*) play an important role in all of them, accompanied by *Narthecium ossifragum*, *Molinia caerulea*, *Scirpus cespitosus*, *Schoenus nigricans*, *Eriophorum angustifolium*, *Eriophorum vaginatum* and *Calluna vulgaris*. Includes burnt areas of this type.	EUNET D1.2 - Blanket bogs
		7.2.3 Valley mires, poor fens and transition mires	Weakly to strongly acid peatlands, flushes and vegetated rafts formed in situations where they receive water from the surrounding landscape or are intermediate between land and water. Included are quaking bogs and vegetated non-	EUNIS D2 - Valley mires, poor fens and transition mires

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			calcareous springs. Excluded are calcareous fens, and reedbeds. Includes burnt areas of this type.	
		7.2.4 Aapa, palsa and polygon mires	Patterned mire complexes of the arctic, subarctic and northern boreal zones. Includes burnt areas of this type.	EUNIS D3 - Aapa, palsa and polygon mires
		7.2.5 Base-rich fens and calcareous spring mires	Peatlands, flushes and vegetated springs with calcareous or eutrophic ground water, within river valleys, alluvial plains, or on hillsides. As in poor fens, the water level is at or near the surface of the substratum and peat formation depends on a permanently high-water table. Excluded are reedbeds.	EUNIS D4 - Base-rich fens and calcareous spring mires
		7.2.6 Peat extraction sites	Peatland areas where peat is being mined or have been mined and natural conditions and vegetation have not (been) restored yet. Includes burnt areas of this type.	CORINE 4.1.2 Peatbogs
8. Rivers and canals	8.1 Rivers	8.1.1 Permanent, non-tidal, fast, turbulent water courses	Permanent water courses with fast-flowing turbulent water and their associated animal and microscopic algal pelagic and benthic communities. Rivers, streams, brooks, rivulets, rills, torrents, waterfalls, cascades and rapids are included. The bed is typically composed of rocks, stones or gravel with only occasional sandy and silty patches. Includes high, mid and low-altitude, usually small to medium-sized streams as defined by the Water Framework	EUNIS C2.2 - Permanent non-tidal, fast, turbulent water courses

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			Directive. Various ecological sub-types exist, depending on the surrounding geology, climate, altitude etc.	
		8.1.2 Permanent non-tidal, smooth-flowing watercourses	Permanent water courses with non-turbulent water and their associated animal and microscopic algal pelagic and benthic communities. Slow-flowing rivers, streams, brooks, rivulets and rills; also fast-flowing rivers with laminar flow. The bed is typically composed of sand or mud. Includes mid and low-altitude streams as defined by the Water Framework Directive. Various ecological sub-types exist, depending on the surrounding geology, climate, land use etc.	EUNIS C2.3 - Permanent non-tidal, smooth-flowing watercourses
	8.2 Canals, ditches and drains	8.2.1 Canals	Canals are substantial human-made linear water bodies that were created for the purpose of enabling transport by ship in most cases. They are heavily modified water bodies but may have a range of ecological features, in particular if they are no longer in active shipping use and hence subject to maintenance works.	
		8.2.2 Ditches and drains	Ditches and drains are small human-made linear water bodies that were created for drainage purposes in most cases. Some ditches have been developed from pre-existing brooks or small streams. Both types are heavily modified water bodies but may have a range of ecological features.	

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
9. Lakes and reservoirs	9.1 Lakes and ponds	9.1.1 Lakes	Lakes of natural origin containing fresh water. Manmade freshwater bodies (e.g. by damming a river) can be included, provided that they contain seminatural aquatic communities of lake character. Many ecological sub-types exist which can be distinguished on the basis of underlying geology, altitude, climate and/or their aquatic communities.	EUNIS C1 - Surface standing waters
		9.1.2 Inland saline or brackish lakes and pools	Lakes and pools of natural origin containing brackish or salt water. Often found in summer-dry climates with low precipitation; many types are prone to drying out temporarily. Characteristic feature is their saline or brackish water which determines the composition of vegetation and other aquatic communities.	
		9.1.3 Ponds and natural small standing water bodies	Ponds and other small standing water bodies containing fresh water. These can hold water all year round or may be temporarily without water during dry periods. Includes various types, ranging from natural pools, small lakes to man-made ponds with natural features. Many ecological sub-types exist which can be distinguished on the basis of underlying geology, altitude, climate and/or their aquatic communities.	
	9.2 Artificial reservoirs	9.2.1 Artificial reservoirs	Artificial water bodies that have been created by human action, e.g. by damming a river valley or by lining a natural depression with concrete or a	

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			similar surface to prevent water leakage. Developed mainly for water supply or energy generation purposes. Can be very large water bodies but also includes smaller bodies (e.g. at farm level for irrigation) if they are of artificial character.	
	9.3 Geothermal pools and wetlands (Iceland)	9.3.1 Geothermal pools and wetlands (Iceland)	Hot springs, geysers, mud pots and associated wetlands result from interactions of deeply circulating groundwater with magma and hot rocks that produce chemically precipitated substrates. They support a specialised but low-diversity biota structured by extreme thermal and geochemical gradients	IUCN GET F2.9 – Geothermal pools and wetlands
10. Marine inlets and transitional waters	10.1 Coastal lagoons	10.1.1 Coastal lagoons	Coastal brackish, saline or hypersaline lakes, ponds or pools and their pelagic vertebrates and plankton.	EUNIS C1.5 - Permanent inland saline and brackish lakes, ponds and pools
	10.2 Estuaries and bays	10.2.1 Estuaries and bays	This class includes two types: a) Estuaries, i.e. the mouth of a river under tidal influence within which the tide ebbs and flows; b) Bays, i.e. coastal body of water partly enclosed by land and that directly connects to a larger main body of water, in particular a sea or ocean. In both cases the vegetation and fauna is adapted to saline and/or brackish conditions.	CORINE 5.2.2 Estuaries
	10.3 Intertidal flats	10.3.1 Intertidal flats (e.g., Wadden Sea)	Coastal zone under tidal influence between open sea and land, which is flooded by sea water regularly twice a day in a ca. 12 hours cycle. Found in the area between the average lowest	CORINE 4.2.3 Intertidal flats

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			and highest sea water level at low tide and high tide. Generally non-vegetated expanses of mud, sand or rock lying between high and low water marks though free-floating macrophytes may occur (e.g. Ulva, Enteromorpha etc.).	
11. Coastal beaches, dunes and wetlands	11.1 Artificial shorelines	11.1.1 Artificial shorelines	Man-made dykes and dams, including wave breakers extending into the sea, constructed primarily to protect land from seawater, but sometimes also used for roads. Deposited or dumped artificial structures in the coast may attract marine biota that would not otherwise occupy such locations. Excludes transport infrastructure on the shore such as ports and seaside promenades that should be recorded in settlements and other artificial areas.	Derived from IUCN GET MT3.1 – Artificial shorelines
	11.2 Coastal dunes, beaches and sandy and muddy shores	11.2.1 Coastal dunes	Dunes occur in sand-covered shorelines of the oceans, their connected seas and associated coastal lagoons, fashioned by the action of wind or waves. Dunes are formed by aeolian deposits, though sometimes re-fashioned by waves. Dunes may be covered by grasses or forests, though generally there are important areas of bare soil. Vegetation is dominated by salt- and drought-tolerant species.	EUNIS B1 - Coastal dunes and sandy shores
		11.2.2 Beaches and sandy shores	Sandy shorelines include beaches, sand bars and spits, located just above the main waterline. These systems are affected by wave action and typically lack macrophytes, with their low productivity largely underpinned by detrital	EUNIS B1 - Coastal dunes and sandy shores IUCN GET Sandy Shores

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			subsidies dominated by wrack (i.e. drift seaweed accumulating at the high-water mark) and phytoplankton, particularly in the surf zone of dissipative beaches. Beaches include gently sloping beaches and beach-ridges, formed by sands brought by waves, longshore drift and storm waves.	
		11.2.3 Muddy shores	Highly productive environments at and above the main waterline defined by their fine particle size (dominated by silts). Benthic diatoms are the key primary producer. Macrophytes are generally absent in the intertidal zone. Fauna are dominated by deposit-feeding taxa (consuming organic matter that accumulates in the fine-grained sediments) and detritivores feeding on wrack (i.e. drift algae deposited at the high-water mark) and other sources of macro-detritus. Bioturbating and tube-dwelling taxa are key ecosystem engineers.	EUNIS B1 - Coastal dunes and sandy shores; IUCN GET MT1.2 - Muddy Shore
	11.3 Rocky shores	11.3.1 Coastal shingle	Beaches of the oceans, of their connected seas and of their associated coastal lagoons, covered by pebbles, or sometimes boulders, usually formed by wave action.	EUNIS B2 - Coastal shingle

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
		11.3.2 Rock cliffs, ledges and shores	Rock exposures adjacent to the oceans, their connected seas and associated coastal lagoons, or separated from them by a narrow shoreline. The faces, ledges and caves of sea-cliffs and the expanses of rocky shore are important as reproduction, resting and feeding sites for seabirds, sea-mammals and a few groups of terrestrial birds. Sea-cliffs may also harbour highly distinctive, specialised salt-tolerant vegetation with associated terrestrial fauna.	EUNIS B3 - Rock cliffs, ledges and shores, including the supralittoral
	11.4 Coastal saltmarshes and salines	11.4.1 Coastal saltmarshes	Vegetated area in the coastal zone, dominated by Angiosperms, mostly above the high-tide line but always susceptible to flooding by seawater. Often in the process of being filled in by coastal mud and sand sediments. The vegetation develops on a variety of sandy and muddy sediment types and may have admixtures of coarser material. The character of the saltmarsh communities is affected by height up the shore, resulting in a zonation pattern related to the degree or frequency of immersion in seawater.	EUNIS A2.5 - Coastal saltmarshes and saline reedbeds
		11.4.2 Salines	Salt-pans for extraction of salt from salt water by evaporation, active or in process of abandonment.	EUNIS A2.5 - Coastal saltmarshes and saline reedbeds
12. Marine ecosystems	12.1 Marine macrophyte habitats	12.1.1 Kelp forests	The shallow sublittoral seabed supports important seaweed communities where	EUNIS A5.52 - Kelp and seaweed

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			conditions are suitable in terms of substrate, water flow and turbidity. Kelp forest is found on rocky substrate of some size, e.g. boulders or bedrock. Kelp forests are important marine habitats that provide shelter to a wide range of fish and other aquatic animals. In exposed conditions the kelp is *Laminaria hyperborea* whilst in more sheltered habitats it is usually *Laminaria saccharina*; other kelp species may dominate under certain conditions.	communities on sublittoral sediment
		12.1.2 Coastal macrophyte beds	Areas of mixed ground which lack stable rock as anker for kelp support seaweed communities. While such sublittoral sediments may include some kelp (Laminaria saccharina), they are characterised by bootlace weed *Chorda filum* and various red and brown seaweeds, particularly filamentous types. The generally sheltered nature of these habitats enables the seaweeds to grow on shells and small stones which lie on the sediment surface; some communities develop as loose-lying mats on the sediment surface.	
		12.1.3 Seagrass meadows	Beds of submerged marine angiosperms in the genera *Cymodocea*, *Halophila*, *Posidonia*, *Ruppia*, *Thalassia*, *Zostera*.	EUNIS A5.53 - Sublittoral seagrass beds
	12.2 Coral reefs	12.2.1 Coral reefs	These communities develop in a range of habitats from exposed open coasts to estuaries, marine inlets and deeper offshore habitats and may be found in a variety of sediment types and salinity regimes. A major habitat type is formed	EUNIS A5.63 - Circalittoral coral reefs A6.61 - Communities of deep-sea corals

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			by coral reefs of *Lophelia pertusa;* a cold water, reef-forming coral, which has a wide geographic distribution ranging from 55°S to 70°N, where water temperatures typically remain between 4-8°C. These reefs are generally subject to moderate current velocities (0.5 knots). The majority of records occur in the north-east Atlantic. The extent of *L. pertusa* reefs varies, with examples off Norway several km long and more than 20 m high. The Mediterranean Sea also harbours important coral reef communities.	
	12.3 Worm reefs	12.3.1 Worm reefs	Sublittoral reefs of polychaete worms in mixed sediments found in a variety of hydrographic conditions. Such habitats may range from extensive structures of considerable size to lose agglomerations of tubes. Such communities often play an important role in the structural composition or stability of the seabed and provide a wide range of niches for other species to inhabit. Consequently, polychaete worm reefs often support a diverse flora and fauna, for example Sabellaria spinosa which has gone from being widespread to red list species.	EUNIS A4.22 *Sabellaria* reefs on circalittoral rock EUNIS A5.61 Sublittoral polychaete worm reefs on sediment EUNIS A4.232 *Polydora* sp. Tubes on moderately exposed sublittoral soft rock
	12.4 Shellfish beds and reefs	12.4.1 Shellfish beds and reefs	Sublittoral mussel beds comprised of either the horse mussel *Modiolus modiolus* or the common mussel *Mytilus edulis*. These communities may be sublittoral extensions of littoral reefs or exist	EUNIS A5.62 - Sublittoral mussel beds on sediment

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			independently. Found in a variety of habitats ranging from sheltered estuaries and marine inlets to open coasts and offshore areas they may occupy a range of substrata, although due to the stabilising effect such communities have on the substratum muddy mixed sediments are typical. A diverse range of epibiota and infauna often exists in these communities.	
	12.5 Subtidal sand beds and mud plains	12.5.1 Subtidal sand beds and mud plains	Clean medium to fine sands or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets. Such habitats are often subject to a degree of wave action or tidal currents which restrict the silt and clay content to less than 15%. This habitat is characterised by a range of taxa including polychaetes, bivalve molluscs and amphipod crustacea. Sublittoral mud and cohesive sandy mud extending from the extreme lower shore to offshore, circalittoral habitats. This biotope is predominantly found in sheltered harbours, sealochs, bays, marine inlets and estuaries and stable deeper/offshore areas where the reduced influence of wave action and/or tidal streams allow fine sediments to settle. Estuarine muds tend to be characterised by polychaetes and oligochaetes.	EUNIS A5.2 - Sublittoral sand A5.3 - Sublittoral mud
	12.6 Subtidal rocky substrates	12.6.1 Subtidal rocky substrates	Infralittoral rock includes habitats of bedrock, boulders and cobbles which occur in the shallow subtidal zone and typically support seaweed communities. The upper limit is marked by the	EUNIS A3 - Infralittoral rock and other hard substrata

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			top of the kelp zone whilst the lower limit is marked by the lower limit of kelp growth or the lower limit of dense seaweed growth. Infralittoral rock typically has an upper zone of dense kelp (forest) and a lower zone of sparse kelp (park), both with an understorey of erect seaweeds. In exposed conditions the kelp is *Laminaria hyperborea* whilst in more sheltered habitats it is usually *Laminaria saccharina*; other kelp species may dominate under certain conditions. Areas of mixed ground, lacking stable rock, may lack kelps but support seaweed communities. In estuaries and other turbid-water areas the shallow subtidal may be dominated by animal communities, with only poorly developed seaweed communities.	
	12.7 Continental and island slopes	12.7.1 Continental and island slopes	Habitats on the deep-sea bed with significant elevation (typically <200m deep) in relation to their surroundings. Includes permanently submerged flanks of oceanic islands, seamounts, knolls and banks, oceanic ridges, abyssal hills and carbonate mounds.	EUNIS A6.7 - Raised features of the deep-sea bed
	12.8 Deepwater benthic and pelagic ecosystems	12.8.1 Deepwater benthic and pelagic ecosystems	The area of the sea beyond the continental shelf break, including the seabed and the pelagic water column. The shelf break occurs at variable depth, but is generally over 200 m. The upper limit of the deep-sea zone is marked by the edge of the shelf. Includes areas of the Mediterranean Sea which are deeper than 200 m but not of the	EUNIS A6 - Deep-sea bed A7 - Pelagic water column

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
			Baltic Sea which is a shelf sea. Excludes caves in the deep sea irrespective of depth. Three main components can be distinguished: the seabed and the water column divided into the photic zone (influenced by sunlight) and the water column below down to the seabed. The seabed in particular harbours specialised deep water benthic habitats, for example reefs formed by 'Black and White smokers' found at the Atlantic ridge and listed in the EU Habitats Directive.	
	12.9 Deepwater coastal inlets (fjords)	12.9.1 Deepwater coastal inlets (fjords)	Deepwater coastal inlets (e.g. fjords, sea lochs) are semi-confined aquatic systems with many features of open oceans. Strong influences from adjacent freshwater and terrestrial systems produce striking environmental and biotic gradients. Autochthonous energy sources are dominant, but allochthonous sources (e.g. glacial ice discharge, freshwater streams and seasonal permafrost meltwater) may contribute 10% or more of particulate organic matter. Phytoplankton, notably diatoms, contribute most of the primary production, along with biofilms and macroalgae in the epibenthic layer. Seasonal variation in inflow, temperatures, ice cover and insolation drives pulses of in situ and imported productivity that generate blooms in diatoms, consumed in turn by jellyfish, micronekton, a hierarchy of fish predators and marine mammals.	

EU ecosystem typology: level 1	EU ecosystem typology: level 2	EU Ecosystem typology: level 3	Description	Source
	12.10 Sea ice	12.10.1 Sea ice	Ice formations floating on sea water, usually constituting an incomplete cover, variable in form and structure, unstable and dynamic under the influence of surface air and water currents.	EUNIS A8.1 - Sea ice

Annex 4: Crosswalk between levels 1 and 2 of the EU ecosystem typology and the IUCN Global Ecosystem Typology

EU ecosystem typology: level 1	EU ecosystem typology: level 2	IUCN GET Ecosystem Functional Group
1. Settlements and other artificial areas	1.1 Continuous settlement area	T7.4 Urban and industrial ecosystems
	1.2 Discontinuous settlement area	T7.4 Urban and industrial ecosystems
	1.3 Infrastructure and industrial areas	T7.4 Urban and industrial ecosystems
	1.4 Urban greenspace	T7.4 Urban and industrial ecosystems
	1.5 Other artificial areas	T7.4 Urban and industrial ecosystems
2. Cropland	2.1 Annual cropland	T7.1 Annual croplands
	2.2 Rice fields	F3.3 Rice paddies
	2.3 Permanent crops	T7.3 Plantations
	2.4 Agro-forestry areas	T7.3 Plantations
	2.5 Mixed farmland	T7.1 Annual croplands
	2.6 Other farmland	T7.3 Plantations
	2.7 Hedgerows and tree rows in cropland	TBD
3. Grassland (pastures, semi-natural and natural grasslands)	3.1 Sown pastures and fields (modified grassland)	T7.2 Sown pastures and fields
	3.2 Natural and semi-natural grassland	T7.5 Derived semi-natural pastures and Oldfields; OR T4.5 Temperate subhumid grassland
4. Forest and woodland	4.1 Broadleaved deciduous forest	T2.1 Boreal and temperate high montane forests and woodlands; OR T2.2 Deciduous temperate forests
	4.2 Coniferous forests	T2.1 Boreal and temperate high montane forests and woodlands
	4.3 Broadleaved evergreen forest	T2.4 Warm temperate laurophyll forests; OR T2.6 Temperate pyric sclerophyll forests and woodlands
	4.4 Mixed forests	T2.2 Deciduous temperate forests
	4.5 Transitional forest and woodland shrub	T2.1 Boreal and temperate high montane forests and woodlands OR T2.2 Deciduous temperate forests
	4.6 Plantations	T7.3 Plantations
5. Heathland and shrub	5.1 Tundra	T6.3 Polar tundra and deserts
	5.2 Scrub and heathland	T3.3 Cool temperate heathlands

EU ecosystem typology: level 1	EU ecosystem typology: level 2	IUCN GET Ecosystem Functional Group
	5.3 Sclerophyllous vegetation	T3.2 Seasonally dry temperate heaths and shrublands
6. Sparsely vegetated ecosystems	6.1 Bare rocks	T3.4 Rocky pavements, screes and lava flows
	6.2 Semi-desert, desert and other sparsely vegetated areas	T5.1 Semi-desert steppes
	6.3 Ice sheets, glaciers and perennial snowfields	T6.1 Ice sheets, glaciers and perennial snowfields
7. Inland wetlands	7.1 Inland marshes and other wetlands on mineral soil	TF1.3 Permanent marshes; OR TF1.4 Seasonal floodplain marshes
	7.2 Mires, bogs and fens	TF1.6 Boreal, temperate and montane peat bog; OR TF1.7 Boreal and temperate fens
8. Rivers and canals	8.1 Rivers and streams	F1 Rivers and streams (Note that F1 is a 'Biome' in IUCN GET; the current EU typology does not permit subdividing this into the ecosystem functional groups.
	8.2 Canals, ditches and drains	F3 Artificial fresh waters (as cell above)
9. Lakes and reservoirs	9.1 Lakes and ponds	F2 Lakes (as cell above)
	9.2 Artificial reservoirs	F3 Artificial fresh waters (as above)
	9.3 Geothermal pools and wetlands (Iceland)	F2.9 Geothermal pools and wetlands
10. Marine inlets and transitional waters	10.1 Coastal lagoons	FM1.3 Intermittently closed and open lakes and lagoons
	10.2 Estuaries and bays	FM1.2 Permanently open riverine estuaries and Bays
	10.3 Intertidal flats	MT1.2 Muddy shores; OR MT1.3 Sandy shores
11. Coastal beaches, dunes and wetlands	11.1 Artificial shorelines	MT3.1 Artificial shores
	11.2 Coastal dunes, beaches and sandy and muddy shores	MT2.1 Coastal shrublands and grasslands
	11.3 Rocky shores	MT1.1 Rocky shores
	11.4 Coastal saltmarshes and salines	MFT1.3 Coastal saltmarshes and reedbeds
12. Marine ecosystems	12.1 Marine macrophyte habitats	M1.2 Kelp forests
		M1.1 Seagrass meadows
	12.2 Coral reefs	M1.3 Photic coral reef
	12.3 Worm reefs	To be decided
	12.4 Shellfish beds and reefs	M1.4 Shellfish beds and reefs
	12.5 Subtidal sand beds and mud plains	M1.7 Subtidal sand beds; OR M1.8 Subtidal mud plains
	12.6 Subtidal rocky substrates	M1.6 Subtidal rocky reefs
	12.7 Continental and island slopes	M3.1 Continental and island slopes
	12.8 Deepwater benthic and pelagic ecosystems	M2 Pelagic ocean waters; OR M3 Deep sea floors

EU ecosystem typology: level 1	EU ecosystem typology: level 2	IUCN GET Ecosystem Functional Group
	12.9 Deepwater coastal inlets (fjords)	FM1.1 Deepwater coastal inlets
	12.10 Sea ice	M2.5 Sea ice

Annex 5: Proposal for defining a coastal zone mask

This annex proposes a coastal mask for the re-classification of specific CLC classes into the correct level 1 and level 2 ecosystem types, as outlined in section 4.7 of this guidance note.

5. A. Proposed solution for the coastal mask for ecosystem type Coastal beaches, dunes and wetlands

The correct assignment of pixels of CLC classes that are considered to belong to ecosystem type 'Coastal beaches, dunes and wetlands' but found across the entire land area (ie. CLC classes 332 and 333) requires the definition of a coastal zone mask, as discussed in section 4.7 of this guidance note. This will help avoiding incorrect assignment of certain CLC classes within the coastal environment to inland ecosystem types.

EEA proposes to build a spatial coastal mask as a 1 km buffer landwards of those CLC classes that belong to level 1 ecosystem types 'Marine inlets and transitional waters' and 'Marine ecosystems'.

The creation of the coastal mask comprises of two steps:

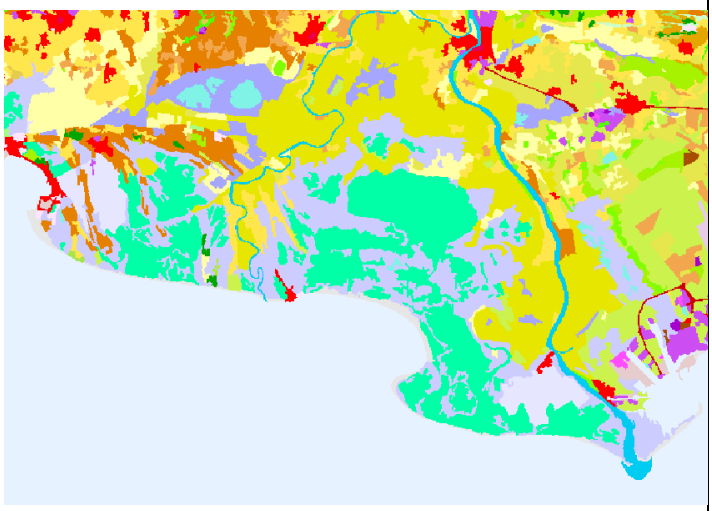
Step 1: The pixels of all CLC classes belonging to ecosystem type 'Marine inlets and transitional waters' are selected and re-classified as marine mask in a separate raster. This relates to CLC classes 521 Coastal lagoon, 522 Estuaries, 423 Intertidal flats and selected pixels from 421 Salt marshes and 422 Salines. For spatial coherence the class 523 of type 12 'Sea and ocean' is added. Figure 1 below shows how this approach works. Please note that it has been built from three CLC groupings of different types of water bodies or water-influenced land cover which all intersect in the geographic coastal environment.

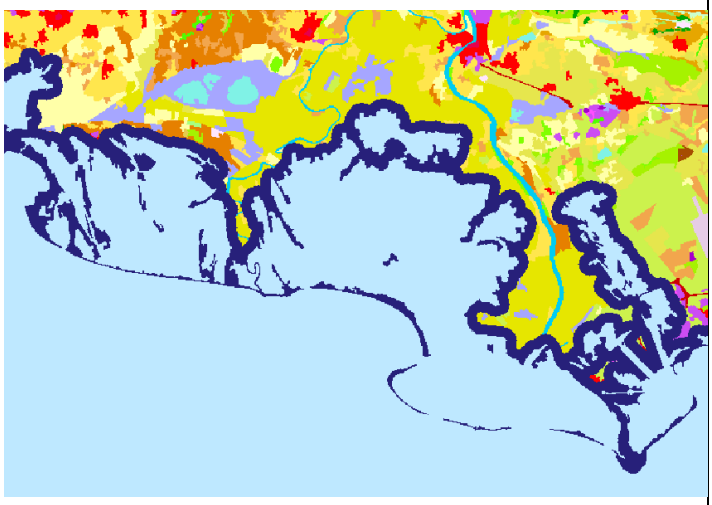
Step 2: The pixels of all CLC classes located within 1 km distance from the landward boundary of the marine mask defined in Step 1, are selected, and re-classified as coastal mask in a separate raster.

The produced coastal mask is used as follows: Any pixels classified as CLC Class 331 (Beaches, dunes and sand plains) within 1 km distance from seaward boundary of the marine mask (i.e., located within the coastal mask) are assigned to ecosystem type

'Coastal beaches, dunes and wetlands'. Further inland this CLC class is assigned to ecosystem type 'Sparsely vegetated ecosystems'.

Figure 5.1 Ecosystem types in coastal environment

<table>
<tr><th colspan="3">Ecosystem types (Corine Land Cover classes in coastal environment)</th></tr>
<tr><th>Inland waters</th><th>Marine waters</th><th>Coastal wetlands</th></tr>
<tr><td>5.1 Inland waters
5.1.1. Water courses
5.1.2. Water bodies</td><td>5.2 Marine waters
5.2.1. Coastal lagoons
5.2.2. Estuaries
5.2.3. Sea and ocean</td><td>4.2 Coastal wetlands
4.2.1. Salt marshes
4.2.2. Salines
4.2.3. Intertidal flats</td></tr>
<tr><td colspan="2">  </td><td>Example of the complex coastal mosaic of different Corine Land Cover classes on the southern French coast (Camargue area).

Note: the CLC classes shown also comprise some terrestrial classes identified by brownish or beige colours.</td></tr>
<tr><td colspan="2">  </td><td>The same mosaic of CLC classes where CLC classes belong to ecosystem types 'Marine inlets and transitional waters' and 'Marine ecosystems' are grouped together as "marine ecosystems" (in light blue). The proposed 1 km buffer inland from the marine mask is shown as a dark blue zone. Within this coastal mask certain CLC would be selected to identify ecosystem type 'Coastal beaches, dunes and wetlands'.

Marine mask (CLC 52x and 42x)
0-1 km coastal buffer</td></tr>
</table>

5. B. Proposed approach for the development of coastal mask for rocky shores

Section 4.7 of this guidance note also proposes a 100 m zone as spatial mask for assigning the CLC class 3.3.2 (Bare rocks) to ecosystem type ‘Coastal beaches, dunes and wetlands’ in areas where coastal splash influences the vegetation of rocky shores. This 100m zone cannot reliably be developed from CLC data. Hence EEA proposes that this geo-spatial data layer is developed by the countries themselves on the basis of their more fine-grained data.