Protected wetlands assessments and monitoring: EU policy context and methodological approach

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Restore4CS

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European Commission

The cornerstones of EU nature conservation policy

Birds Directive (1979, 2009/147/CE)

protects all wild birds occurring in the EU + regularly migrating species.

Articles 4.1 and 4.2: Member States must ensure habitat conservation measures for bird species

Habitats Directive (1992, 92/43/EEC)

Article 2.2: aims to the maintenance or restoration, at **favorable conservation status**, natural habitats and species of wild fauna and flora of Community interest in the **European territory**.

Concerns 232 Habitats types and thousand of non-birds (fauna/flora) species.

→ Both directives requires the Member States to designate protected sites (**Natura 2000**) to maintain, or where appropriate restore, at a favorable conservation status habitats and species.

Links to the Nature Restoration Regulation

Restore EU's **land and sea areas**, and define conservation measures

Article 4: Terrestrial, Coastal, and Freshwater Ecosystems

Member States are required to implement restoration measures to improve and re-establish habitats listed in **Annex I of the Habitats Directive**. The targets includes:

- Art 4.1: Restoring at **least 30% of the total area** of these habitats that are not in good condition **by 2030**, with progressive increases to **60% by 2040** and **90% by 2050**.
- Art 4.4: **Re-establish annex I habitats** in areas where it does not occur
- Art 4.7: Ensuring that there is a continuous improvement in the quality and quantity of habitats for species listed in Annexes II, IV, and V of the **Habitats Directive**, as well as for wild birds covered by the **Birds Directive**.

Article 5-13: Marine, urban, rivers, pollinators, agricultural ecosyst., forest, 13 billions trees

Other important legislations: Invasive Aliens Species regulation, Water Framework directive, Marine Strategy Framework directive, etc.

Carbon storage / Climate change mitigation

Peatlands as Carbon Stores:

- Although their annual sequestration rates are lower than forests (~1.5 tC/ha·yr vs. ~2.6 tC/ha·yr), peatlands store **twice as much carbon per hectare** (260 tC/ha vs. 130 tC/ha).
- This long-term accumulation makes them crucial for climate mitigation strategies.

Potential Carbon Sequestration under Natura 2000:

- The **137,000 km² of Annex I-listed peatlands** could sequester **~38 million tons of CO_2 per year**, but only **if in good condition**.
- This underscores the need for **restoration efforts**, as degraded peatlands can become carbon sources instead of sinks.

Coastal and Salty Habitats:

- Their theoretical contribution is estimated at **30 million tons of CO_2-equivalent per year**.
- However, current data suggest that **much of this carbon is not stored in the habitats themselves**, which raises questions about the actual sequestration potential and stability of these carbon stocks. → more research/data to clarify the potential

Implications for Natura 2000 and policy

Habitat Restoration is Key
The sequestration potential is fully realized only if habitats are in **favorable conservation status**.
This highlights the need for **effective conservation and restoration** strategies under the Habitats Directive.
See for example LIFE projects (e.g. El Hito lagoons restoration project in ES)

Monitoring and Data Gaps
The uncertainty around carbon storage in coastal habitats suggests that **improved monitoring and data collection** are needed to refine carbon accounting for these ecosystems.

Synergies Between Climate and Biodiversity Goals
Protecting and restoring peatlands and coastal habitats under Natura 2000 aligns with both **biodiversity conservation** and **climate mitigation** objectives.

Annex I habitats: definition and conservation status

Annex I of the Hab Dir – humid habitats

Coastal and salt habitats (11 types)

1130	Estuaries
1140	Mudflats and sandflats not covered by seawater at low tide
1150	Coastal lagoons
1310	Salicornia and other annuals colonizing mud and sand
1320	Spartina swards (*Spartinion maritimae*)
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
1340	Inland salt meadows
1410	Mediterranean salt meadows (*Juncetalia maritimi*)
1420	Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)
1530	Pannonic salt steppes and salt marshes
1650	Boreal Baltic narrow inlets

More wetlands and humid habitats are found under other sections of the Annex I

Annex I habitats definitions

List of Annex I habitats originally based on Corine. Correspondences with EUNIS (walkthrough)

EU 27 Interpretation manual: definitions and bibliographical references: https://cdr.eionet.europa.eu/help/natura2000

Some MS developed advanced mapping manual (e.g. “Tome 2 – Habitats côtiers” in “Connaissance et gestion des habitats et espèces d’intérêts Communautaire”, MNHN, France)

1110 Sandbanks which are slightly covered by sea water all the time

PAL.CLASS.: 11.125, 11.22, 11.31, 11.333

1) Sandbanks are elevated, elongated, rounded or irregular topographic features, permanently submerged and predominantly surrounded by deeper water. They consist mainly of sandy sediments, but larger grain sizes, including boulders and cobbles, or smaller grain sizes including mud may also be present on a sandbank. Banks where sandy sediments occur in a layer over hard substrata are classed as sandbanks if the associated biota are dependent on the sand rather than on the underlying hard substrata.

"Slightly covered by sea water all the time" means that above a sandbank the water depth is seldom more than 20 m below chart datum. Sandbanks can, however, extend beneath 20 m below chart datum. It can, therefore, be appropriate to include in designations such areas where they are part of the feature and host its biological assemblages.

2) Plants:

North Atlantic including North Sea - *Zostera* sp., free living species of the *Corallinaceae* family. *On many sandbanks macrophytes do not occur.*

Central Atlantic Islands (Macaronesian Islands) - *Cymodocea nodosa* and *Zostera noltii*. On many sandbanks free living species of *Corallinaceae* are conspicuous elements of biotic assemblages, with relevant role as feeding and nursery grounds for invertebrates and fish. *On many sandbanks macrophytes do not occur.*

Baltic Sea - *Zostera* sp., *Potamogeton* spp., *Ruppia* spp., *Tolypella nidifica*, *Zannichellia* spp., carophytes. *On many sandbanks macrophytes do not occur.*

Mediterranean - The marine Angiosperm *Cymodocea nodosa*, together with photophilic species of algae living on the leaves (more than 15 species, mainly small red algae of the *Ceramiaceae* family), associated with *Posidonia* beds. *On many sandbanks macrophytes do not occur.*

Animals:

North Atlantic including North Sea - Invertebrate and demersal fish communities of sandy sublittoral (e.g. polychaete worms, crustacea, anthozoans, burrowing bivalves and echinoderms, *Ammodytes* spp., *Callionymus* spp., *Pomatoschistus* spp., *Echiichtys vipera, Pleuronectes platessa, Limanda limanda*).

Central Atlantic Islands (Macaronesian Islands) - Fish, crustacean, polychaeta, hydrozoan, burrowing bivalves, irregular echinoderms.

Baltic Sea - Invertebrate and demersal fish communities of sandy sublittoral (fine and medium grained sands, coarse sands, gravely sands), e.g. polychaetes: *Scoloplus armiger, Pygospio elegans, Nereis diversicolor, Travisia* sp., e.g. bivalves: *Macoma balthica*, *Mya arenaria, Cerastoderma* sp., e.g. crustaceans: *Crangon crangon, Saduria entomon, e.g. fish species: Platichthys flesus, Nerophis ophidion, Pomatoschistus* spp., *Ammodytes tobianus*.

Mediterranean - Invertebrate communities of sandy sublittoral (e.g. polychaetes). Banks are often highly important as feeding, resting or nursery grounds for sea birds, fish or marine mammals.

Monitoring guidelines for habitats

Guidelines for assessing and monitoring the condition of Annex I habitat types of the Directive 92/43/EC.

Describes *inter-alia*, habitats structures and functions, and lists variables to monitor.

Examples: for freshwater habitats types, Physical and chemical characteristics of water (T°, salinity, N, P, pH, organic matter), Components of the biological communities typical of these ecosystems (distribution of plankton, etc…), Biological processes(primary production biogeochemical cycles, …) are variables to monitor.

Also lists typical species of the Annex II of the Habitats directive, living in the habitat.

See also the list of species per habitat types from the Art. 17 reporting help portal.

Currently under revision by experts.

To be published after July 2025, to be presented to the Expert Group on Reporting, and published in the Office of Publication + DG ENV webpage.

Natura 2000

+27 000 Natura 2000 sites

Protects 18% of the land

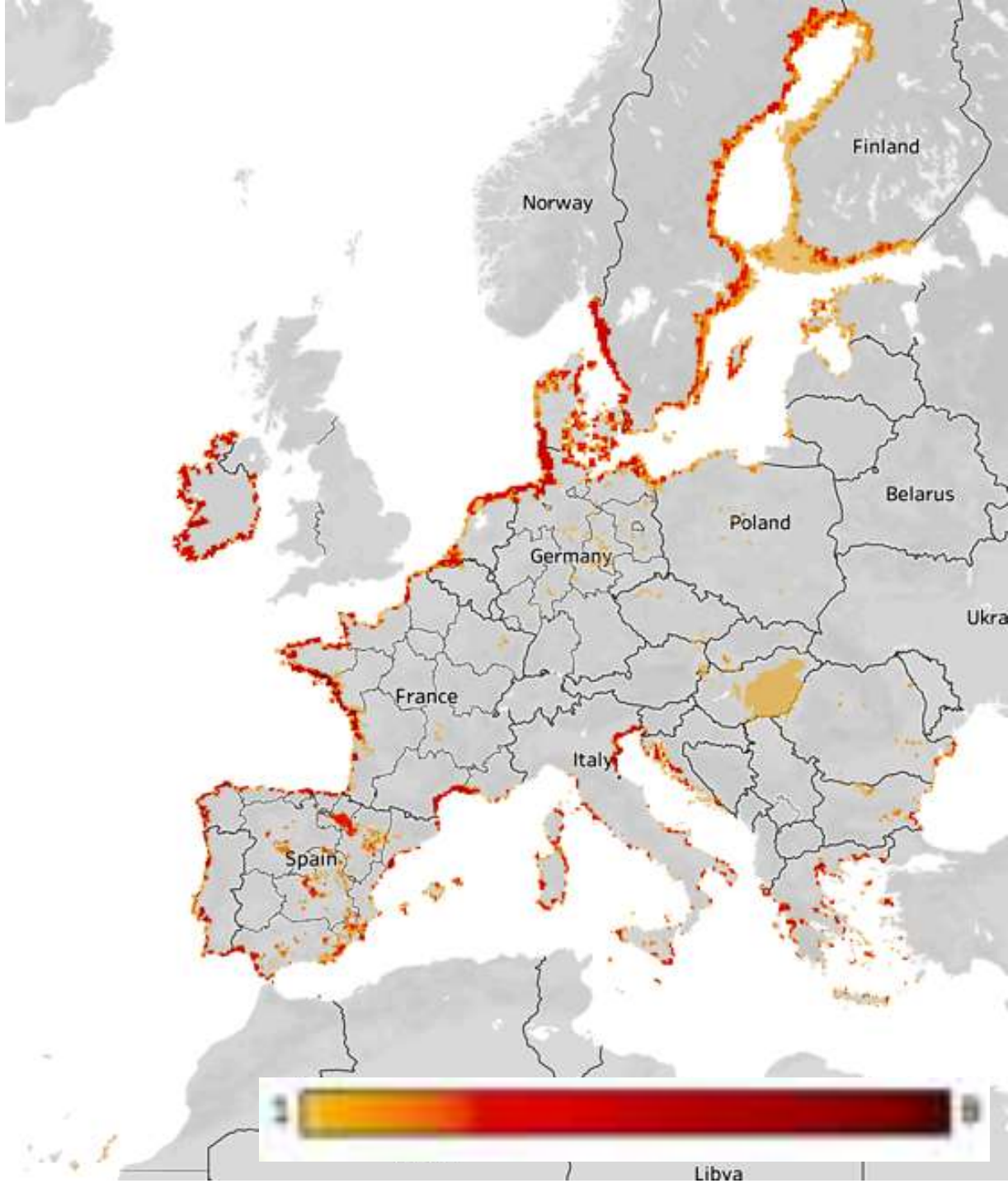
232 Habitats types

+1840 species (fauna and flora)

https://natura2000.eea.europa.eu/

Distribution of Annex I coastal and salt habitats (1130, 1140, 1150, 1310, 1320, 1330, 1340, 1410, 1420, 1530, 1650)

Distribution maps (10 km x 10 km) delivered by Member States under Article 17 reporting (period 2013-2018)



Reporting under article 17 of the Habitats directive

MS report every 6 years, **conservation status** (and their trends) of habitats/species occurring in their territory, per biogeographical regions.

Important efforts/costs, difficulties to reach areas to surveys, etc.

Data quality: questionable, missing data

Methodologies could be improved: higher quality, decrease of costs and burden

Role of Earth Observation and modelling: continuous monitoring of land cover, pressures and drivers evolution. Contribution to the assessments, planification of surveys (where did a change occurs compared to the former reporting, …).

Conservation status, article 17 HD, non-bird species

4 Parameters

Range

- The geographic extent where the species is present, including breeding, feeding, and migration areas.
- Criteria: range is stable or increasing.

Population

- The size and density of populations within their natural range.
- Criteria: populations are stable or increasing, and long-term viability is ensured.

Habitat for the species

- The availability and quality of habitats necessary for the species' life cycle.
- Criteria: sufficient habitat in both quantity and quality.

Future prospects

- Trends in populations, habitats, and threats, as well as the effects of conservation measures.
- Criteria: integrated evaluation to assess the species' long-term sustainability.

Article 12 of the Birds directive: only reporting on Range and population

Conservation status for Habitats

4 parameters

Range

- Refers to the geographic extent where the habitat occurs.
- Criteria: range is stable or increasing.

Total area covered by the habitat

- The overall surface area occupied by the habitat within its natural range.
- Criteria: area is stable or increasing.

Specific structure and functions of the habitat

- Assesses the qualitative state of the habitat: vegetation composition, ecological conditions (hydrology, substrate), and overall functionality.
- Includes the availability of elements necessary for long-term survival.
- Criteria: ecological functions are maintained, with no major pressures.

Future prospects

- Considers trends for the above parameters, as well as threats and conservation measures.
- Criteria: integrated evaluation of factors influencing conservation in the medium or long term.

2013-2018 | Coastal habitats | 1150 Coastal lagoons | All bioregions | Filter

View data sheet info | Audit trail | Map

Art 17 – 2013-2018

Conservation status and trends of habitats and species

Quite degraded in general

Note: Rows in italic shows data not taken into account when performing the assessments (marginal presence, occasional, extinct prior HD, information, etc)

Legend: FV Favourable | XX Unknown | U1 Unfavourable-Inadequate | U2 Unfavourable-Bad

Current selection: 2013-2018, Coastal habitats, 1150 Coastal lagoons, All bioregions. Show all Coastal habitats

Member States reports

MS	Region	Range (km²)				Area (km²)								Structure and functions (km²)					Future prospects				Overall assessment						Distribution area(km²)		
		Surface	Status (% MS)	Trend	FRR	Min	Max	Best value	Type est.	Method	Status (% MS)	Trend	FRA	Good	Not good	Not known	Status	Trend	Range prosp.	Area prosp.	S & f prosp.	Status	Curr. CS	Curr. CS trend	Prev. CS	Prev. CS trend	Status Nat. of ch.	CS trend Nat. of ch.	Distrib.	Method	% MS
DE	ATL	4270	12.94	=	4270	0.86	0.86	0.86	estimate	a	0.02	=	≈	0.79 - 0.82	0.04 - 0.07	N/A - N/A	FV	=	good	unk	good	FV	FV	=	U1	x	knowledge	knowledge	3000	b	6.34
DK	ATL	7980	24.18	=	≈	N/A	N/A	3715	minimum	c	91.19	+	≈	11.85 - 11.85	336.06 - 336.06	23.60 - 23.60	U2	+	good	good	bad	U2	U2	+	U2	+	genuine	genuine	5800	c	12.2
ES	ATL	2200	6.67	=	≈	N/A	N/A	8.68	minimum	a	0.21	=	x	0.64 - 0.64	N/A - N/A	8.04 - 8.04	XX	x	good	poor	unk	U1	U1	=	U1	-	noChange	knowledge	2200	b	4.65
FR	ATL	11800	35.76	=	≈	N/A	N/A	272.90	minimum	b	6.70	u	>	104.20 - 104.20	53.10 - 53.10	115.60 - 115.60	U1	u	good	poor	poor	U1	U1	x	U1	=	N/A	knowledge	12000	b	25.3
IE	ATL	6700	20.30	=	6700	N/A	N/A	24.20	estimate	a	0.59	=	24.20	3.66 - 3.66	20.58 - 20.58	N/A - N/A	U2	-	good	good	bad	U2	U2	-	U2	=	noChange	genuine	6400	a	13.5
UK	ATL	52	0.16	=	52	N/A	N/A	52.43	estimate	b	1.29	=	52	39.70 - 39.70	4.66 - 4.66	8.06 - 8.06	U1	=	good	unk	unk	XX	U1	=	U1	=	noChange	noChange	17900	b	37.8
BG	BLS	1600	64	=	1600	N/A	N/A	25.77	minimum	b	13.16	=	25.77	N/A - N/A	N/A - N/A	25.77 - 25.77	XX	x	poor	poor	poor	U1	U1	x	U1	=	method	method	1000	b	52.6
RO	BLS	900	36	=	≈	150	190	N/A	interval	a	86.84	=	≈	N/A - N/A	N/A - N/A	N/A - 900	XX	x	good	good	poor	U1	U1	=	U1	-	noChange	noChange	900	a	47.3
EE	BOR	12000	10.40	x	≈	30	60	N/A	estimate	b	3.84	x	≈	N/A - N/A	N/A - N/A	30 - 60	XX	=	good	good	unk	FV	FV	x	FV	N/A	noChange	noChange	6700	b	7.44
FI	BOR	49500	42.91	=	≈	698	698	698	estimate	a	59.49	=	≈	65 - 432	266 - 634	N/A - N/A	U2	-	good	good	poor	U1	U2	=	U1	-	knowledge	knowledge	44100	a	48.9
LT	BOR	319.60	0.28	=	319.60	N/A	N/A	319.60	estimate	a	27.24	=	319.60	319.60 - 319.60	N/A - N/A	N/A - N/A	XX	u	good	good	unk	FV	FV	=	XX	N/A	knowledge	knowledge	800	a	0.85
LV	BOR	250	0.22	u	≈	N/A	N/A	0.69	estimate	a	0.06	-	>	10 - 15	30 - 35	N/A - N/A	U2	u	good	poor	bad	U2	U2	x	U1	=	genuine	noChange	600	a	0.67
SE	BOR	53300	46.20	=	53300	N/A	N/A	110	estimate	b	9.38	=	>	N/A - N/A	N/A - N/A	110 - 110	U2	=	good	good	poor	U1	U2	=	U2	-	noChange	knowledge	37900	b	42.0
DE	CON	9035	19.01	=	9035	290.19	297.78	293.99	estimate	b	9.82	=	293.99	0.35 - 39.71	57.30 - 97.01	156.91 - 236.33	U2	=	good	good	bad	U2	U2	=	U2	=	noChange	noChange	6700	b	17.4
DK	CON	14551	30.62	=	≈	N/A	N/A	1308	minimum	b	43.69	=	≈	6.94 - 6.94	103.44 - 103.44	20.40 - 20.40	U2	+	good	good	bad	U2	U2	+	U2	=	genuine	genuine	15400	c	40.2
IT	CON	4800	10.10	x	≈	N/A	N/A	472.36	estimate	b	15.78	+	≈	357.41 - 357.41	114.24 - 114.24	0.19 - 0.19	FV	=	good	good	good	FV	FV	=	N/A	N/A	N/A	N/A	4400	b	11.4
PL	CON	6800	14.31	=	≈	N/A	N/A	909	estimate	a	30.36	=	≈	N/A - N/A	909 - 909	N/A - N/A	U1	=	good	good	poor	U1	U1	=	U1	=	noChange	noChange	5000	a	13.0
SE	CON	12100	25.46	=	12100	N/A	N/A	10	estimate	b	0.33	=	>	N/A - N/A	N/A - N/A	10 - 10	U2	=	good	good	poor	U1	U2	=	U2	-	noChange	knowledge	6500	b	16.9
SI	CON	238	0.50	=	238	N/A	N/A	0.70	estimate	a	0.02	=	0.70	0.70 - 0.70	N/A - N/A	N/A - N/A	FV	=	good	good	good	FV	FV	=	FV	N/A	noChange	noChange	300	b	0.78
ES	MAC	11	1.55	=	≈	N/A	N/A	0.27	estimate	a	6.31	-	0.27	0.17 - 0.17	0.09 - 0.09	N/A - N/A	U2	-	poor	poor	unk	U1	U2	-	U2	x	noChange	genuine	500	b	50
PT	MAC	700	98.45	+	>	1	8	4	interval	a	93.69	+	>	N/A - N/A	1 - 8	N/A - N/A	U1	=	poor	bad	good	U2	U2	=	U2	-	knowledge	noChange	500	c	50
CY	*MED*	*25*	*0*	=	≈	*N/A*	*N/A*	*6.10*	*estimate*	*a*	*0*	=	>	*6.10 - 6.10*	*N/A - N/A*	*N/A - N/A*	*FV*	=	*good*	*good*	*good*	*FV*	*FV*	=	*N/A*	*N/A*	*knowledge*	*knowledge*	*N/A*	*b*	*0*
ES	MED	11600	22.59	=	≈	N/A	N/A	306.77	estimate	b	16.73	=	x	1.20 - 1.20	284.87 - 284.87	20.70 - 20.70	U2	-	good	good	poor	U1	U2	-	U1	x	genuine	knowledge	11500	b	22.5
FR	MED	6700	13.05	=	≈	N/A	N/A	793	estimate	b	43.25	=	>	N/A - N/A	N/A - N/A	793 - 793	U1	+	unk	poor	unk	U1	U1	+	U2	=	genuine	genuine	6900	b	13.5
GR	MED	4247.15	8.27	=	≈	N/A	N/A	385.54	minimum	b	21.03	-	>	N/A - N/A	77.11 - 77.11	308.43 - 308.43	U1	x	good	poor	poor	U2	U2	-	U2	-	noChange	noChange	9900	b	19.4
HR	MED	6200	12.07	=	x	N/A	N/A	5.48	estimate	c	0.30	x	x	N/A - N/A	N/A - N/A	5.48 - 5.48	XX	x	unk	unk	unk	XX	XX		N/A	N/A		N/A	2400	c	4.71

Improving Habitats monitoring with EO solutions and geographic information systems

Habitats directive and geospatial information Potential support from EO technologies

Article 4: MS must identify Habitats to protect, and protect a sufficient proportion in Natura 2000 sites

Article 17: MS must report on their protected habitats and species conservation status, occurring in their whole territory (including outside Natura 2000).

Resource intensive, sometimes not complete

Article 6.2: Compliance - Degradations inside Natura 2000 should be avoided. The Commission is interested in detecting signs of degradation (compliance / compliance promotion).

Article 6 enables conservation enforcement within Natura 2000 sites.

Monitoring habitats degradations

EU Grassland Watch: monitoring protected grassland in Natura 2000 sites (from 1994 to now, yearly updates, using Landsat, Sentinel 1&2), land cover/land cover change, indicators of intensification and abandonment.

EU Wetland Watch

Project with the Joint Research Centre (JRC) Knowledge Centre on Earth Observation (KCEO)

Develop tools, for experts reporting under article 17, utilising satellite imagery

Current stage: new methodology – analysis of the habitats structure and functions, main pressures leading to degradation. Define proxies to the corresponding pressures and degradations.

In situ data: 2 Horizon projects

Biodiversity Meets Data (BMD), KO 4/03/2025

Answer the question: can we create an EU-wide IT platform, for biologists collecting in-situ data, offering data hosting, data processing (imagery, sound, eDNA, etc), and data sharing?

→ Support biodiversity experts, but also EU projects (LIFE, Horizon), national projects, etc.

→ Encourage normalisation (data cube, normalised taxonomy), and good practices

→ Simplify data exchange (and access for Cal/Val), and encourage cross-domain research

BioDiMoBot: KO 5/02/2025 – Robotic solution, long time drifting solution (days/weeks/months), collecting water biodiversity + water properties (physical and chemical) – on-board pre-processing, data transfer to BMD

→ in-situ data intensification

Thank you