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Habitats Directive in northern Italy: a series of proposals for habitat definition improvement

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Abstract

Habitats Directive (92/43/EEC) is the cornerstone of nature conservation in Europe and is at the core of the EU Biodiversity Strategy for 2030. There is room, however, for its improvement, at least for northern Italy, where ambiguities in the definition of habitat types of Annex I of the Habitats Directive are not novel and interpretation difficulties have been highlighted. Sharpening the characterization of habitat types represents an opportunity for lowering classification uncertainties and improving conservation success. With the aim to refine the definitions of habitat types and associated typical species of the Habitats Directive, a group of vegetation scientists of the Italian Society of Vegetation Science based in northern Italy made the exercise of finding viable proposals for those habitat types having a problematic interpretation in the Alpine biogeographical region of Italy. Such proposals arise from group discussions among scientists, and professionals, thus offering a shared view. We prepared 9 habitat proposals important for this geographic area. They include new habitat types at the European level, new subtypes within pre-existing habitat types, including some adjustments of the recently proposed subtypes with respect to northern Italy, and recognition of priority criteria for a pre-existing habitat type. With a vision of tailored conservation, our proposals represent a starting point in view of a future update of Annex I. Furthermore, the list of typical species could be useful for preparing expert systems for automatic classification. Irrespective of legally binding solutions in place, we caution these proposals represent relevant baseline conservation indications that local and regional administrations of the Alpine Arch should consider.

Keywords

Alpine biogeographical region, Alps, Annex I, Habitats Directive, Habitat types, Natura 2000 network, Nature conservation

Introduction

Habitats Directive (92/43/EEC) deals with the conservation of natural habitats, wild fauna and flora, and aims to promote the maintenance of biodiversity, also considering economic, social, cultural, and regional requirements. This European Union (EU) community legislative tool is widely recognized as cornerstone of nature conservation in Europe. Annex I of Habitats Directive lists today 200+ European natural habitat types, including 70+ priority ones (i.e. habitat types in danger of disappearance and whose natural range mainly falls within the territory of the EU). A scientific reference document, namely the Interpretation Manual of EU Habitats EUR28, aims to clarify any ambiguities in the interpretation of Annex I of the Habitats Directive by developing common definitions for all habitat types (European Commission, 2013). Nevertheless, inherent problems of imprecise interpretation concerning Annex I habitat types have long been highlighted (Evans, 2010). In many cases, a better, more extensive, definition of the habitat types in the Interpretation Manual of EU Habitats EUR28 would be enough to avoid misinterpretations. This would mean, for example, to mention specific syntaxa in the description. Similarly, in some cases, the removal of the keywords linked to the substrate (i.e. basiphilous/acidophilous) would make the habitat types more inclusive. In other cases, extending the geographical range of the habitat type would clarify its identity. In doubtful habitat type assignment cases, however, the adoption of a mosaic solution with multiple habitat types, typically between transitional ones, has been adopted to overcome such issues, making it difficult to apply conservation measures. In addition, similar problems arise for degraded vegetation for which a clear habitat identification is often compromised. When dealing with this decision, the recommendation has been to assign the habitat type when elements of naturalness are still present, differently to what happens with reforestations, in which the assignment of a habitat type is instead not recommended (Lasen, 2006). Other structural problems are related to the lack of experts of a given geographical area in the initial planning phase of the Habitats Directive. In spite of that, considering cascading implications entailed by the definition of habitat types, habitat types deserve to be unambiguously identified regardless of all the limitations due to the assignment procedure or other problems derived from the initial planning. Thus, sharpening their characterization represents an opportunity for lowering the classification uncertainties and improving the overall conservation success. This step is practically implemented by defining more net floristic-vegetation boundaries among different habitat types that are essential for the identification of more accurate lists of typical species (Bonari et al., 2021; Dalle Fratte et al., 2022). In recent years, a parallel new habitat classification at the pan-European level has been proposed (Chytrý et al., 2020). The new EUNIS (European Nature Information System) classification is more consistent and removes many ambiguities and overlapping in the definition of habitat types. Still, because the Habitats Directive currently remains legally binding, implementation efforts of the definitions of habitat types and associated typical species are desirable.

In view of the fifth EU reporting 2019-2024 (Art. 17 Habitats Directive; DG Environment, 2017), the Italian Society for Vegetation Science started a series of contributions to refining habitat type distribution knowledge at the national scale. To date, this initiative resulted in new grid-cell data for 30+ EU habitat types in Italy (Gigante et al., 2019a; 2019b; Gianguzzi et al., 2020; Rivieccio et al., 2020; Bazan et al., 2021; Rivieccio et al., 2021; Tavilla et al., 2022; Rivieccio et al., 2022). In parallel, the growing necessity to improve the list of Annex I habitat types, led to a series of proposals for new habitat types and subtypes for Sicily, Sardinia, southern and central Italy (Casavecchia et al., 2021; Fois et al., 2021; Guarino et al., 2021; Spampinato et al., 2023). Though the Directive is known to be more deficient in (sub)mediterranean areas for what concerns habitat type definitions, other non-mediterranean areas are also subjected to some inaccuracies, meaning having problems of poorly defined or even neglected habitat types (Lasen, 2006). When considering the Alpine biogeographical region, on one hand, there are habitat types reported by the Habitats Directive as a priority (e.g. 4070, 6230) that are de facto not threatened in northern Italy, and on the other hand, there are many other habitat types that are not classified as a priority but represent peculiar natural aspects requiring special conservation (e.g. 3130, 3140, 3150, 3160, 3230, 3260, 4080, 5110, 62A0, 6410, 7140, 7150, 7230, 8310, 9160, 9340). To counteract this gap, some recent studies have investigated hygrophilous forests, scrubs, and aquatic vegetation in northern Italy (Poldini et al., 2020; Castello et al., 2021). Furthermore, checklists of habitat types have been improved and extended (Wilhalm et al., 2022). Yet, despite these thematic contributions, many aspects linked to Annex I habitat types within the Alpine biogeographical region (*sensu* EU) have still to be elucidated. This effort is essential to identify habitat types more easily in the field and thus develop more accurate maps of habitat types and, more generally, for improved habitat type conservation and monitoring (Gigante et al., 2016; Dalle Fratte et al., 2019; Bonari et al., 2021). The last assessment of habitat types in the Alpine biogeographical region of Italy reports an evident and undeniable deterioration of habitat types compared to the previous report: 29 habitat types are currently threatened here (Angelini et al., 2021). Since many habitat types are of great natural value but neglected or with an unclear definition for northern Italy, in this contribution, we aim to clarify the poor definition of some habitat types of northern Italy by refining their typical species, improve their distribution, propose new habitat types and subtypes, and highlight priority recognition criteria.

Materials and methods

Backed by their experience, a core group of thirteen vegetation scientists of the Italian Society of Vegetation Science and skilled practitioners (hereafter all reported as experts) based in northern Italy made the exercise of finding viable, shared, proposals for those habitat types having a problematic interpretation in the Alpine biogeographical region of Italy. Specifically, the Italian regions here considered are, from East to West: Friuli-Venezia Giulia, Veneto, Trentino-South Tyrol, Lombardy, Piedmont, and Aosta Valley (Fig. 1).

The workflow took place in five steps essentially represented by the identification of the proposals, assessment of their urgency in terms of conservation, drafting of the text, and control quality check. In particular, i) In the first meeting, each expert proposed one or multiple potentially suitable habitat type case(s) suffering interpretation problems, lacking in the Habitats Directive for northern Italy, or worthy of priority recognition. Because this step aimed to produce the first list of potential "working habitats" (i.e. candidate-proposals) this process was expeditive and devoid of any discussion. This list comprehended 27 candidate-proposals; ii) In the second step, this list was shared among the experts in an online document for three months. Each expert had the possibility to comment - positively or negatively - on this list, along with comments and explanations of her/his opinion; iii) In the third step, the proposals were then re-assessed and streamlined collectively, so that only the most sound and urgent proposals were retained and continued up to the next step. Because of the different competence of the experts involved (e.g. aquatic vegetation, grassland, forest), in this step, a coordinator for each proposal was identified. The coordinator had the responsibility of finding the best collaborators among the experts to elaborate the full proposal; iv) In the fourth step, proposals were drafted by different subgroups of specialists led by the coordinators. The proposals mostly followed a standard template provided by the Italian Society for Vegetation Science, already used for other series of proposals for different geographic areas of Italy (Casavecchia et al., 2021; Fois et al., 2021; Guarino et al., 2021; Spampinato et al., 2023); v) In the fifth and last step, each proposal was commented in a choral fashion and improved with minor comments by the whole team of experts.

Proposal template

Title of the proposal

Natura 2000: Habitat type name present in the Interpretation Manual of EU Habitats EUR28 (European Commission, 2013).
Type: Three possible cases of proposals are reported: i) new habitat type proposal; ii) new subtypes in a pre-existing habitat type; iii) recognition of priority criterion for habitat types or subtypes.
Authors: List of authors who contributed to the proposal. The first name is the coordinator, followed by collaborators.

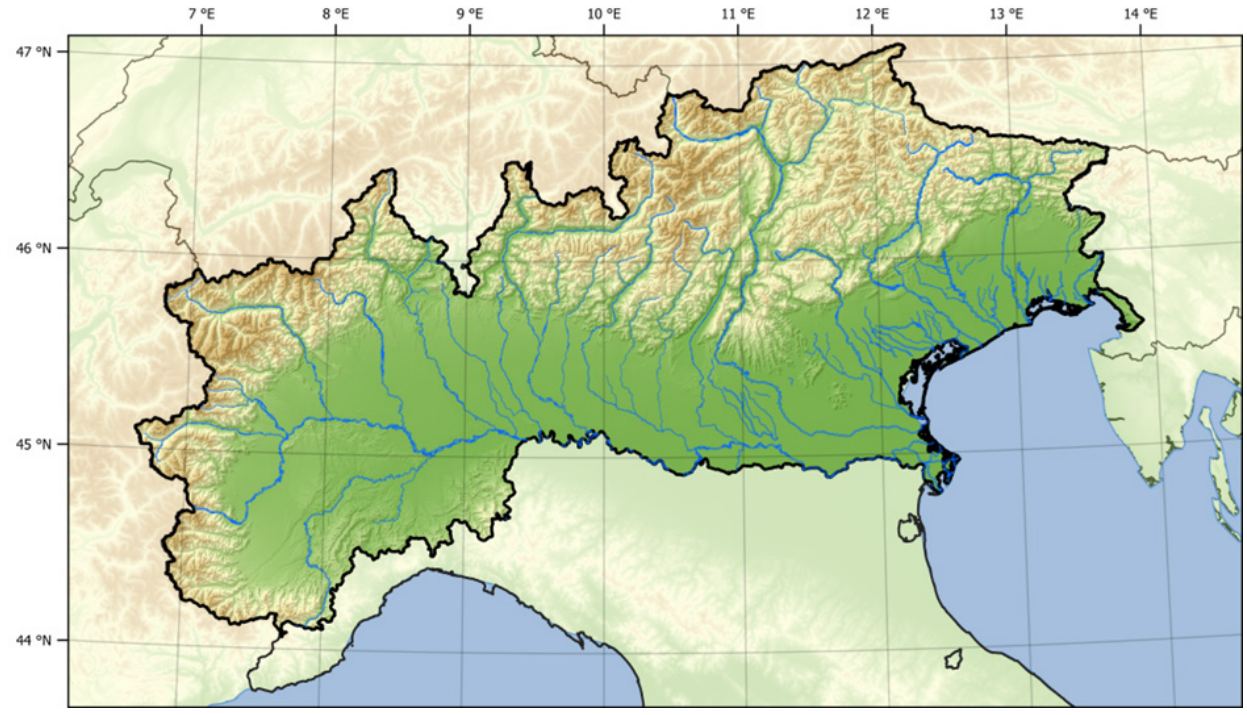

Figure 1. Map of northern Italy encompassing the regions of Friuli-Venezia Giulia, Veneto, Trentino-South Tyrol, Lombardy, Piedmont, and Aosta Valley from East to West (administrative borders not shown) for which our proposals apply.

Macrotype: Macrotype code according to European Commission (2013); when the habitat type or subtype is new, the proposed code is consistent with the structure designated in Annex I of the Habitats Directive.
EEA Biogeographical region: Biogeographical region according to EEA (2022a).
Region: Italian administrative regions (in alphabetic order).
CORINE Biotopes/PALAEARCTIC: CORINE Biotopes and PALAEARCTIC classification codes according to Devillers et al. (1991) and Devillers and Devillers-Terschuren (1996), respectively.
EUNIS 2012: EUNIS 2012 classification code (EEA, 2012), based on Davies et al. (2004) and updated in 2012.
EUNIS 2021: EUNIS 2021 classification code (EEA, 2021), based on Chytrý et al. (2020).
European Red List of Habitats: European Red List of Habitats according to Janssen et al. (2016).
Bern convention: Bern Convention Resolution 4 habitat types (Evans and Roekaerts, 2019).
Motivation: Scientific reason of the proposal.
Diagnostic sentence: Description of the new habitat type, subtype or priority criteria.
Reference list of typical species: Typical species, typically ten, in addition to and/or comprising those already listed in the Interpretation Manual of EU Habitats EUR28 (European Commission, 2013); new list of species if a new habitat type/subtype is proposed, comprising the species already reported in the Italian Interpretation Manual of habitat types (Biondi et al., 2009); typical species are meant as a combination of literature, expert evaluation, and, if present, local or regional habitat interpretation manuals.
Syntaxonomic reference: Syntaxonomic reference to the alliance level, followed by classification to high-ranking syntaxa. If not specified, syntaxonomic nomenclature of alliances, orders, and classes follows Mucina et al. (2016, v. 2, 2022-06-30). Where necessary, the syntaxonomic level of association is specified.
Dynamics and contacts: Vegetation dynamics and contacts.

Nomenclature of vascular plants follows Bartolucci et al. (2018) and subsequent updates available on Portal to the Flora of Italy v. 2022.1 (Portal to the Flora of Italy, 2022) and for bryophytes Aleffi et al. (2020).

Results

Overall, after the streamlined process, we retained 9 proposals. They include new habitats at the European level, new subtypes within pre-existing habitats, including some adjustments of recently proposed subtypes with respect to northern Italy, and a recognition of priority criteria for a pre-existing habitat type (Table 1).

i) New habitat types

FRESHWATER LARGE SEDGES
Natura 2000: Not yet included in any Annex I habitat type. The vegetation dominated by *Cladium mariscus* (7210*) is classified within the class *Phragmito-Magnocaricetea* Klika in Klika and Novak 1941 but can also develop adjacent to sedge vegetation attributable to the alliance *Caricion davallianae* Klika 1934 or with other types of helophytic vegetation (*Phragmition communis* Koch 1926) or large sedges (*Magnocaricion elatae* Koch 1926).
Type: New habitat type.
Authors: Selvaggi A., Lasen C., Mainetti A., Lonati M.
Macrotype: 3 "Freshwater habitats"; 31 "Standing water".
EEA Biogeographical region: Continental (Alpine).
Region: Aosta Valley, Friuli-Venezia Giulia, Lombardy, Piedmont, Trentino-South Tyrol, Veneto.
CORINE Biotopes/PALAEARCTIC: 53.21.
EUNIS 2012: C3.29, D5.21.
EUNIS 2021: Q53.
European Red List of Habitats: VU (C5.2).
Bern convention: D5.2, C3.2.
Motivation: Habitat very sensitive to land reclamation, water regulation, eutrophication, pollution by phytosanitary products, and deterioration due to the invasion of alien species (Casavecchia et al., 2021). Chytrý et al. (2020) highlighted that the main threats are the expansion of agricultural, industrial, and urban areas, and changes in the level of groundwater and its pollution. In many places, the habitat is totally transformed, and strong intervention is needed for recovery. Tall-sedge beds are assessed as VU (Vulnerable) in the European Red List of Habitats (Janssen et al., 2016) and included in the list of natural habitats requiring specific conservation measures under the Bern Convention (Evans and Roekaerts, 2019). Some regions, such as the Aosta Valley in Italy, have already included the habitat within regional nature conservation laws (Aosta Valley Regional Law no. 8/2007). It hosts rare or threatened species of Italian vascular flora as *Carex buekii* and *C. vulpina*, listed as Endangered, *Thelypteris palustris*, listed as VU (Rossi et al., 2020). The Red List of vascular flora of Veneto (Buffa et al., 2016) includes the typical species *Carex appropinquata*, *C. elongata*, *C. vulpina* and *Ranunculus lingua*, listed as Critically Endangered, and *C. randalpina* as VU. The habitat hosts the threatened snails *Vertigo moulinsiana* and *V. angustior*, listed in Annex II of Habitats Directive.
Diagnostic sentence: Terrestrial stands or water-fringing stands vegetation by lakes, rivers and brooks. It includes stands of *Carex* species growing on waterlogged ground, usually species-poor, from plain to montane (subalpine) level. Tall-sedge communities are often dominated by one species with dense tussocks, accompanied by few characteristic species growing among the tussocks.
Reference list of typical species: *Carex acuta*, *C. acutiformis*, *C. appropinquata*, *C. buekii*, *C. elata* subsp. *elata*, *C. elongata*, *C. lasiocarpa*, *C. paniculata*, *C. pseudocyperus*, *C. randalpina*, *C. riparia*, *C. rostrata*, *C. vesicaria*, *C.*

vulpina, *Galium palustre*, *Lycopus europaeus*, *Lythrum salicaria*, *Mentha aquatica*, *Phalaris arundinacea*, *Ranunculus lingua*, *Scutellaria galericulata*, *Stachys palustris*, *Thelypteris palustris*, *Thysselinum palustre*.
Mosses: *Calliergonella cuspidata*, *Climacium dendroides*, *Plagiomnium ellipticum*.
Syntaxonomic reference: The habitat includes the alliances *Magnocaricion elatae* Koch 1926, *Magnocaricion gracilis* Géhu 1961, *Carici-Rumicion hydrolapathi* Passarge 1964) (order *Magnocaricetalia* Pignatti 1953, class *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941). In northern Italy, reedbeds (alliance *Phragmition communis* Koch 1926, order *Phragmitetalia* Koch 1926) are not included, in contrast to the previous proposals for central and southern Italy, and Sicily (Casavecchia et al., 2021; Guarino et al., 2021; Spampinato et al., 2023).
Dynamics and contacts: The habitat often occurs at the transition from submerged to emerged areas, placing between the classes *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941 and *Molinio-Arrhenatheretea* Tx. 1937 (Biondi et al., 2014); the habitat is adjacent or in transition mainly with the alliance *Phragmition communis* Koch 1926 and *Carici-Rumicion hydrolapathi* Passarge 1964; dynamic relationships are observed with the alliance *Calthion palustris* Tx. 1937 by reduction of soil moisture, and with the class *Epilobietea angustifolii* Tx. et Preising ex von Rochow 1951 (habitat type 6430) at marsh margins on eutrophic to mesotrophic soils. Further moisture reduction or water drainage can lead to dynamic transformation towards alliance *Arrhenatherion elatioris* Koch 1926 (habitat type 6510) or *Triseto flavescentis-Polygonion bistortae* Br.-Bl. et Tx. ex Marschall 1947 (habitat type 6520). The habitat can be colonized by pre-forest willow carr (alliance *Salicion cinereae* T. Müller et Görs ex Passarge 1961) which are a prelude to the formation of marshy woods of the alliance *Alnion glutinosae* Malcuit 1929 (habitat type 91E0*). Contacts can be observed with the *Bidention tripartitae* Nordhagen ex Klika et Hadač 1944 alliance (habitat type 3270), with tall-herb humid meadows (habitat type 6410), and with fens, mires and bogs belonging to alliances *Caricion fuscae* Koch 1926 nom. conserv. propos., *Caricion davallianae* Klika 1934, *Scheuchzerion palustris* Nordhagen ex Tx. 1937, *Sphagno-Caricion canescentis* Passarge (1964) 1978 nom. conserv. propos., *Sphagno warnstorfii-Tomentypnion nitentis* Dahl 1957, *Sphagnion medii* Kästner et Flössner 1933 (habitat types 7110*, 7120, 7140, 7150, and 7230).

GREY WILLOW CARRS
Natura 2000: Not included in any Annex I habitat type.
Type: New habitat type.
Authors: Selvaggi A., Oriolo G.
Macrotype: 4 "Temperate heath and scrub".
EEA Biogeographical region: Continental, (Alpine).
Region: Aosta Valley, Friuli-Venezia Giulia, Lombardy, Piedmont, Trentino-South Tyrol, Veneto.
CORINE Biotopes/PALAEARCTIC: 44.921.
EUNIS 2012: F9.21.
EUNIS 2021: S9.21.
European Red List of Habitats: NT (F9.2).
Bern convention: -
Motivation: This habitat type plays an important role in the conservation of diversified riparial and alluvial ecocomplexes consisting mostly of mosaics of wet and swampy woods, swamps and tall sedges wetlands.

Salix fen scrub (EUNIS 2012 F9.2) are assessed as NT (Near threatened) in the "European Red List of Habitats" (Janssen et al., 2016). In alpine countries the habitat type is considered in low decline in France (Villaret et al., 2019) and in Switzerland is assessed as NT (Delarze et al., 2016). It can host rare and threatened plant species (Rossi et al., 2020) like *Thelypteris palustris* (VU) and *Osmunda regalis* (NT), or amphibians like *Hyla arborea*, *Rana latastei*, *R. dalmatina*, *Pelobates fuscus* subsp. *insubricus*. Furthermore, this habitat suits many bird species, especially for the nesting of the herons *Ardeola ralloides* and *Nycticorax nycticorax*.
Diagnostic sentence: Large or medium sized shrubby willows, generally dominated by *Salix cinerea*, alone or in association with *Alnus glutinosa* and *Frangula alnus* subsp. *alnus*. The herb layer is usually sparse due to shading by shrub species; presence of species of marshes, wet meadows or beds of large sedges.
Reference list of typical species: *Alnus glutinosa*, *A. incana*, *Carex acutiformis*, *C. elata*, *C. elongata*, *C. pseudocyperus*, *Calamagrostis canescens* subsp. *canescens*, *Frangula alnus* subsp. *alnus*, *Galium palustre* s.l., *Lycopus europaeus*, *Lysimachia vulgaris*, *Osmunda regalis*, *Phragmites australis*, *Salix cinerea*, *S. myrsinifolia*, *Scutellaria galericulata*, *Solanum dulcamara*, *Thelypteris palustris*.
Syntaxonomic reference: Alliance *Salicion cinereae* T. Müller et Görs ex Passarge 1961 (order *Salicetalia auritae* Doing 1962, class *Franguletea* Doing ex Westhoff in Westhoff et Den Held 1969) according to Mucina et al. (2016). Biondi et al. (2014) considered class *Franguletea* as syntaxonomic synonym of *Alnetea glutinosae* Br.-Bl. et Tüxen ex Westhoff, Dijk et Passchier 1946.
Dynamics and contacts: The fringes of lakes and ponds in the silting phase (e.g. meander lakes), marshy floodplains or fens where maintenance or mowing interventions are interrupted can evolve into permanently flooded sedges and common reed beds. They can be colonized by pre-forest willow carr of *Salix cinerea* which are a prelude to the formation of marshy woods with *Alnus glutinosa* (habitat type 91E0*).

ACIDIC FENS
Natura 2000: Not yet included in any Annex I habitat type.
Type: New habitat type.
Authors: Selvaggi A., Lasen C., Miserere L.
Macrotype: 7 "Raised bogs and mires and fens".
EEA Biogeographical region: Alpine, Continental.
Region: Aosta Valley, Friuli-Venezia Giulia, Lombardy, Piedmont, Trentino-South Tyrol, Veneto.
CORINE Biotopes/PALAEARCTIC: 54.41, 54.42.
EUNIS 2012: D2.21, D2.22.

Table 1. Overview of the series of habitat proposals and, if present, their associated subtypes. Legend for proposal type: New = New habitat types; Sub = New subtypes within pre-existing habitat types; Prior = New priority criteria for pre-existing habitat types. Abbreviations of the Red List of Habitats EUR28 are: EN = Endangered, LC = Least Concern, NT= Near Threatened, VU = Vulnerable. p.p. = Pro parte.

Proposal type	Proposal	Subtype	N2000	CORINE Biotopes / PALAEARCTIC	EUNIS 2012	EUNIS 2021	Red List of Habitats EUR 28	Bern convention	Syntaxon
New	[31XX] Freshwater large sedges	-	-	53.21 Large *Carex* beds	D5.21 Beds of large *Carex* spp.	Q53 Tall-sedge bed	Included as VU at different level (C5.2 Tall-sedge bed)	Included in a Resolution 4 habitat type at a higher level (D5.2)	*Magnocaricion elatae*; *Magnocaricion gracilis*
			-	53.21 Large *Carex* beds	C3.29 Water-fringing large sedge communities	Q53 Tall-sedge bed	Included as VU at different level (C5.2 Tall-sedge bed)	Included in a Resolution 4 habitat type at a higher level (C3.2)	*Carici-Rumicion hydrolapathi*
	[4XXX] Grey willow carrs	-	-	44.921 Grey willow scrub	F9.21 Grey willow carrs	S921 Grey willow carrs	Included as NT at higher level (F9.2 *Salix* fen scrub)	-	*Salicion cinereae*
	[7XXX] Acidic fens	-	-	54.42 Black-white-star sedge fens	D2.22 *Carex nigra*, *Carex canescens*, *Carex echinata* fens	Q24 Intermediate fen and soft-water spring mire	Included as VU at higher level (D2.2c Intermediate fen and soft-water spring mire)	-	*Caricion fuscae*; *Sphagno-Caricion canescentis*
			-	54.41 Alpine cotton-grass lake girdles	D2.21 *Eriophorum scheuchzeri* fens	Q22 Poor fen	Included as VU at higher level (D2.2a Poor fens)	-	*Drepanocladion exannulati*
	[9XXX] Scots pine forests	A)	-	42.53 Inner-alpine restharrow steppe forests	G3.43 Inner-Alpine Ononis steppe forests	T353 Inner-Alpine *Ononis* steppe forests	Included as NT at higher level (G3.4a Temperate and continental *Pinus sylvestris* woodland)	Included in a Resolution 4 habitat type at the same level (G3.43)	*Ononido rotundifoliae-Pinion sylvestris*
		B)	-	42.541 Alpine spring heath scots pine forests	G3.441 Alpine spring heath Scots pine forests	T3541 Alpine spring heath *Pinus sylvestris* forests	Included as NT at higher level (G3.4a Temperate and continental *Pinus sylvestris* woodland)	Included in a Resolution 4 habitat type at a higher level (G3.44)	*Erico carneae-Pinion*
				42.58 Southwestern Alpine mesophile scots pine forests	G3.48 Southwestern Alpine mesophile *Pinus sylvestris* forests	T358 Southwestern Alpine mesophile *Pinus sylvestris* forests	Included as NT at higher level (G3.4a Temperate and continental *Pinus sylvestris* woodland)	Included in a Resolution 4 habitat type at a higher level (G3.44)	*Erico carneae-Pinion*
		C)	-	42.55 Inner Alpine sandwort steppe forests	G3.45 Inner Alpine *Minuartia laricifolia* steppe forests	T355 Inner Alpine *Minuartia laricifolia* steppe forests	Included as NT at higher level (G3.4a Temperate and continental *Pinus sylvestris* woodland)	-	*Dicrano-Pinion sylvestris*
				42.525 Eastern Alpine acidophilous Scots pine woods	G3.425 Eastern Alpine acidophilous Scots pine woods	T3525 Eastern Alpine acidophilous *Pinus sylvestris* forests	Included as NT at higher level (G3.4a Temperate and continental *Pinus sylvestris* woodland)	-	*Dicrano-Pinion sylvestris*
				42.53 Inner-alpine restharrow steppe forests (p.p.)	G3.43 Inner-Alpine *Ononis* steppe forests (p.p.)	T353 Inner-Alpine *Ononis* steppe forests (p.p.)	Included as NT at higher level (G3.4a Temperate and continental *Pinus sylvestris* woodland)	Included in a Resolution 4 habitat type at the same level G3.43) (p.p.)	*Calamagrostio pseudophragmitae-Pinetum sylvestris*
		D)	-	42.5 Scots pine forests (p.p.)	G3.4C Southeastern European *Pinus sylvestris* forests (p.p.)	T361 Southeastern European *Pinus sylvestris* forests (p.p.)	Included as LC at higher level (G3.4b Temperate and submediterranean montane *Pinus sylvestris-Pinus nigra* woodland)	Included in a Resolution 4 habitat type at a different level (G3.44) (p.p.)	*Salici eleagni- Pinetum sylvestris*
				42.541 Alpine spring heath scots pine forests (p.p.)	G3.441 Alpine spring heath Scots pine forests (p.p.)	T3541 Alpine spring heath *Pinus sylvestris* forests (p.p.)	Included as NT at higher level (G3.4a Temperate and continental *Pinus sylvestris* woodland)	Included in a Resolution 4 habitat type at a different level (G3.44) (p.p.)	*Alno incanae-Pinetum sylvestris*
		E)	-	42.5 Scots pine forests (p.p.)	G3.4C Southeastern European *Pinus sylvestris* forests	T361 Southeastern European *Pinus sylvestris* forests	Included as LC at higher level (G3.4b Temperate and submediterranean montane *Pinus sylvestris-Pinus nigra* woodland)	Included in a Resolution 4 habitat type at a different level (G3.44)	*Erico-Fraxinion orni*

Table 1. Continuation.

Sub	[4060] Green alder scrub with tall herbs	-	4060	31.611 Alpine green alder scrub	F2.3111 Alpine green alder scrub	S25111 Alpine green alder scrub	Included as LC at different level (F9.2 Subalpine deciduous scrub)	-	*Alnetum viridis*
	[6130] *Calaminarian* grasslands of the *Violetalia calaminariae*	A)	6130	36.44 Alpine heavy metal communities	E1.B5 Alpine heavy-metal grassland	R1S5 Alpine heavy-metal grassland	Included as EN at higher level (E1.B Heavy-metal grassland)	Included in a Resolution 4 habitat type at higher level (E1.B)	*Caricetum fimbriatae*
		B)	6130	-	E1.B Heavy-metal grassland	R1S Heavy-metal grassland in Western and Central Europe	Included as EN at higher level (E1.B Heavy-metal grassland)	Included in a Resolution 4 habitat type at higher level (E1.B)	Community with *Cerastium utriense* and *Alyssoides utriculata*
	[6230*] Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas in Continental Europe)	A)	6230	35.11 Mat-grass swards	E1.71 *Nardus stricta* swards	R1M1 *Nardus stricta* swards	Included as VU at higher level (1.7 Lowland to submontane, dry to mesic *Nardus* grasslands)	Included in a Resolution 4 habitat type at the same level (E1.71)	*Violion caninae*
		B)	6230	35.11 Mat-Grass swards	E1.71 *Nardus stricta* swards	R1M1 *Nardus stricta* swards	Included as VU at higher level (1.7 Lowland to submontane, dry to mesic *Nardus* grasslands)	Included in a Resolution 4 habitat type at the same level (E1.71)	*Nardo-Agrostion tenuis*; *Nardo-Agrostion caninae*
		C)	6230	37.32 Heath rush meadows and humid mat-grass swards	E3.52 Heath *Juncus* meadows and humid *Nardus stricta* swards	R372 Heath *Juncus* meadows and humid *Nardus stricta* swards	Included as EN at higher level (E3.5 Temperate and boreal moist or wet oligotrophic grassland)	Included in a Resolution 4 habitat type at higher level (E3.5)	*Nardo-Juncion squarrosi*
		D)	6230	36.311 Pyreneo-Alplne mesophile mat-grasslands	E4.311 Pyreneo-Alpine mesophile mat-grass swards	R4311 Pyreneo-Alpine mesophile mat-grass swards	Included as LC at higher level (E4.3a Boreal and arctic acidophilous alpine grassland)	Included in a Resolution 4 habitat type at higher level (E4.3)	*Nardion strictae*
	[6510] Lowland hay meadows	-	6510	38.1 Mesophile pastures	E2.1 Permanent mesotrophic pastures and aftermath-grazed meadows	R21 Mesic permanent pasture of lowlands and mountains	Included as VU at the same level (E2.1 Mesic permanent pasture of lowlands and mountains)	-	*Cynosurion cristati*
Prior	[62A0] Eastern sub-mediterranean dry grasslands (*Scorzoneretalia villosae*)	-	62A0	34.75 Eastern sub-mediterranean dry grasslands	E1.5524 Triestine knapweed-*Chrysopogon* grasslands	R1K24 - Triestine knapweed-*Chrysopogon* grasslands	Included as LC at higher level (E1.5d Greek and Anatolian oromediterranean siliceous dry grassland)	Included in a Resolution 4 habitat type at higher level (E1.55)	*Chrysopogono grylli-Koelerion splendentis*
		-	62A0	34.1 Middle european pioneer swards	E1.1 Inland sand and rock with open vegetation	R19 Dry steppic sub-mediterranean pasture of the Amphi-Adriatic region	Included as VU at the same level (E1.1j Dry steppic, submediterranean pasture of Southeastern Europe)	-	*Saturejion subspicatae*; *Centaureion dichroanthae*
		-	62A0	38.6 Steppe meadows	E2.5 Meadows of the steppe zone	R1A Semi-dry perennial calcareous grassland (meadow steppe)	Included as VU at the same level (E1.2 Semi-dry perennial calcareous grassland)	-	*Scorzonerion villosae*

EUNIS 2021: Q22, Q24.
European Red List of Habitats: VU (D2.2a, D2.2c).
Bern convention: -
Motivation: Very rare habitat type in the plains and in reduction on the montane belt. It is frequent in the subalpine-alpine belt of the Alps but limited to small surfaces. It plays a very important functional role in the conservation of diversified wetland eco-complexes, mostly consisting of mosaics of habitat types. The wettest and more peaty communities are the most interesting from a biological point of view. As all mires, ranging from fens to bogs, they are threatened by multiple impacts, like intensive cattle grazing (overgrazing and trampling), draining (Spitale, 2021), and climate change (Essl et al., 2012). Acidic fens (Poor fens and intermediate fens listed with codes D2.2a and D2.2c) are considered VU in European Red List of Habitats (Janssen et al., 2016). In the Alps, the habitat is considered in decline in France (Villaret et al., 2019), and in Switzerland is assessed as VU (Delarze et al., 2016). Some Italian regions, such as the Aosta Valley, have already included the habitat within regional nature conservation laws (Aosta Valley Regional Law no. 8/2007). It is the habitat of some rare or specialised odonates like *Aeshna juncea*, *Leucorrhinia dubia*, *Somatochlora alpestris*, and *Sympetrum danae* (Delarze and Gonseth, 2008; Villaret et al., 2019).
Diagnostic sentence: Fen communities associated with acidic lithological substrates with low values of conductivity and high average values of annual precipitation, dominated by small sedges and mosses, associated with a reduced number of other vascular plants. The moss layer is made up of brown mosses, *Sphagnum* spp., or both. On the montane-alpine belt, they occupy wet gentle slopes and plateaus where snow meltwater remains or encircle lakesides with *Eriophorum scheuchzeri* or *Carex rostrata*.
Reference list of typical species: *Agrostis canina*, *Carex canescens* subsp. *canescens*, *C. demissa* subsp. *demissa*, *C. echinata* subsp. *echinata*, *C. lachenalii* subsp. l*achenalii*, *C. magellanica* subsp. *irrigua*, *C. nigra*, *Drosera rotundifolia*, *Epilobium palustre*, *Eriophorum angustifolium* subsp. *angustifolium*, *E. scheuchzeri*, *Juncus filiformis*, *Trichophorum caespitosum* subsp. *cespitosum*, *Viola palustris*.
Mosses and liverworts: *Aulacomnium palustre*, *Drepanocladus aduncus*, *Gymnocolea inflata*, *Sarmentypnum exannulatum*, *S. sarmentosum*, *Scapania paludosa*, *Sphagnum compactum*, *S. fallax*, *S. palustre*, *S. subsecundum*, *S. warnstorfii*, *Straminergon stramineum*.
Syntaxonomic reference: Alliances: *Caricion fuscae* Koch 1926 nom. conserv. propos., *Sphagno-Caricion canescentis* Passarge (1964) 1978 nom. conserv. propos., *Drepanocladion exannulati* Krajina 1933 (order *Caricetalia fuscae* Koch 1926, class *Scheuchzerio palustris-Caricetea fuscae* Tx. 1937). Mucina et al. (2016) proposed to conserve the name *Caricion fuscae* Koch 1926 "in order to use this well-established name for moderate to lowly calcium-rich slightly acidic fens dominated by calcifuge brown-mosses or nutrient-demanding peat-mosses of Europe" while Biondi et al. (2014) used the name *Caricion nigrae* Koch 1926 em. Klika 1934 nom. mut. propos.
Dynamics and contacts: Acidic fens are characterized by the presence of a regular and permanent or semi-permanent oligotrophic water table. Evolution is slow and leads to the formation of hydromorphic, peaty, acidic, and poorly oxygenated soils. In a peaty context, local topographical conditions, evolution, and current or historical use, can create mosaics of habitat type including flat areas, reliefs, and depressions (pools and hummocks). The reliefs (hummocks) can host vegetation of the alliance *Sphagnion medii* Kästner et Flössner 1933 (habitat type 7110*), while depressions (pools) can be occupied by transitional communities classified into the alliances *Caricion lasiocarpae* Vanden Berghen in Lebrun et al. 1949 (habitat type 7140) and *Rhynchosporion albae* Koch 1926 by some authors (Biondi et al., 2014), but included in *Caricion fuscae* Koch 1926 nom. conserv. propos. by others (Mucina et al., 2016; Peterka et al., 2017; Preislerová et al., 2022). If the fen is fed by spring waters, there may be contact with the spring and runoff vegetation belonging to the alliance *Cardamino-Montion* Br.-Bl. 1926 (EUNIS 2012 D2.2C1), characterized by the presence of a compact layer of specialized bryophytes.

In the driest part of the acidic fens, often raised and/or at the edge of the wetland, there is an increase in the coverage of *Trichophorum caespitosum*, which, with *Nardus stricta*, highlights the transition to pastures of *Nardion strictae* Br.-Bl. 1926. The mosaics with the pasture vegetation belonging to alliance *Nardion strictae* Br.-Bl. 1926 or *Poion alpinae* Gams ex Oberd. 1950 are also influenced by the intensity and type of grazing.

SCOTS PINE FORESTS OF THE ITALIAN ALPS
Natura 2000: Not yet included in any Annex I habitat type. The subtype E is geographically contiguous and ecologically similar to the habitat type 91R0 "Dinaric dolomite Scots pine forests (*Genisto januensis-Pinetum*)" to which it can be associated. The *Pinus sylvestris* mire woods (CORINE Biotopes/PALAEARCTIC 44.A2) belonging to the associations *Vaccinio uliginosi-Pinetum sylvestris* Kleist 1929 and *Molinio coeruleae-Pinetum sylvestris* (Hofm.) Passarge 1978 em. Minghetti et Pedrotti 2000, recorded and described in Trentino-South Tyrol (Minghetti, 2003) are included in Annex I habitat 91D0* "Bog woodland" (Biondi et al., 2009).
Type: New habitat type with subtypes.
Authors: Caccianiga M., Armiraglio S., Bonari G., Dalle Fratte M., Lasen C., Selvaggi A.
Macrotype: 94XX "Temperate mountainous coniferous forests".
EEA Biogeographical region: Alpine, Continental, Mediterranean.
Region: Aosta Valley, Friuli-Venezia Giulia, Lombardy, Piedmont, Trentino-South Tyrol, Veneto.
CORINE Biotopes/PALAEARCTIC: A) 42.53; B) 42.54, 42.58 (SW- Alps); C) 42.55 (W-Alps, Inner alpine); 42.525

(E-Alps); D) 42.53 p.p. (W-Alps); 42.5 p.p., 42.541 p.p. (E-Alps); E) 42.5 p.p.

EUNIS2012: A) G3.43; B) G3.441, G3.48 (SW- Alps); C) G3.45 (W- Alps, Inner alpine), G3.425 (E-Alps); D) G3.43 p.p. (W-Alps); G3.4C p.p., G3.441 p.p. (E-Alps) E) G3.4C.

EUNIS2021: A) T353; B) T3541, T358 (SW- Alps); C) T355 (W-Alps, Inner alpine), T3525 (E-Alps); D*) T353 p.p. (W-Alps), T361 p.p. (E-Alps); E) T361.

European Red List of Habitats: A) NT (G3.4a); B) NT (G3.4a); C) NT (G3.4a); D) NT (G3.4a) (W-Alps), LC (G3.4b) (E-Alps); E) LC (G3.4b).

Bern convention: A) G3.43; B) G3.44; C) -; D) G3.43 p.p. (W-Alps), G3.44 p.p. (E-Alps); E) G3.44.

Motivation: *Pinus sylvestris* forests in northern Italy host floristically relevant species and represent a valuable forest type from the landscape point of view (Minghetti, 2003; Armiraglio et al., 2006; Lasen, 2006; Lasen, 2014). They occur in different environmental conditions due to the high ecological amplitude and genetic variability of *P. sylvestris* (Del Favero, 2004), also reflected in its wide geographic distribution (Euroasiatic). In the Alps, the habitat is threatened by forest decay (Vacchiano et al., 2008). Most subtypes are considered NT in the European Red List of Habitats (Janssen et al., 2016) and the subtypes (A, B, D, E) are listed in Resolution No. 4 1996 listing endangered natural habitats requiring specific conservation measures under Bern convention (Evans and Roekaerts, 2019). However, in spite of their relevance throughout the Italian Alps, no habitat type specifically includes *P. sylvestris*-dominated forests.

Diagnostic sentence: Forests of the Italian Alps dominated by *P. sylvestris*. Different subtypes can be distinguished, mainly corresponding to syntaxa identifiable on the basis of the ecological characteristics of the substrate (pH, soil, water), elevation, climate, internal or external position with respect to the Alpine Arch.

Subtypes: A*) Inner-Alpine *Ononis* steppe *P. sylvestris* forests; B) Alpine spring heath *Pinus sylvestris* forests; C) Alpine acidophilous *P. sylvestris* forests; D*) Montane *P. sylvestris* forests on gravel beds; E) *P. sylvestris* forests of dolomites and dolomite rendzinas of the eastern Alps and Pre-Alps, with a predominantly suboceanic climate.

The subtypes A and D are proposed as priority habitat types sensu Habitats Directive.

Reference list of typical species: *Pinus sylvestris* A) *Amelanchier ovalis* subsp. *ovalis*, *Astragalus austriacus*, *A. exscapus* subsp. *exscapus*, *A. monspessulanus* s.l., *A. onobrychis*, *A. hypoglottis* s.l., *Berberis vulgaris*, *Calamagrostis varia*, *Carex digitata*, *Coronilla minima* subsp. *minima*, *Daphne alpina* s.l., *Hieracium symphytaceum* subsp. *symphytaceum*, *Juniperus communis*, *J. sabina*, *Ononis natrix* subsp. *natrix*, *O. pusilla* subsp. *pusilla*, *O. rotundifolia*, *O. spinosa* subsp. *procurrens*, *Onobrychis saxatilis*, *Oxytropis xerophila*, *Prunus mahaleb* subsp. *mahaleb*, *Rosa rubiginosa*, *Silene otites* subsp. *otites*, *Thalictrum foetidum* subsp. *foetidum*, *Viburnum lantana*, *Viscum album* subsp. *austriacum*; B) *Achnatherum calamagrostis*, *Amelanchier ovalis* subsp. *ovalis*, *Arctostaphylos uva-ursi*, *Berberis vulgaris*, *Buxus sempervirens*, *Calamagrostis varia*, *Carex alba*, *C. ornithopoda*, *C. humilis*, *C. flacca* s.l., *Centaurea scabiosa* s.l., *Cytisophyllum sessilifolium*, *Cytisus nigricans* s.l., *Epipactis atrorubens*, *Erica carnea* subsp. *carnea*, *Goodyera repens*, *Juniperus communis*, *Laserpitium halleri* subsp. *halleri*, *Melampyrum pratense* s.l., *M. sylvaticum* subsp. *sylvaticum*, *Molinia caerulea*, *Monotropa hypopitys*, *Neottia nidus-avis*, *Phyteuma betonicifolium*, *Polygaloides chamaebuxus*, *Pyrola chlorantha*, *Quercus pubescens*, *Sesleria caerulea* subsp. *caerulea*, *Sorbus aria*, *Tolpis staticifolia*; C) *Avenella flexuosa* subsp. *flexuosa*, *Calamagrostis arundinacea*, *Calluna vulgaris*, *Dianthus seguieri* subsp. *seguieri*, *Festuca acuminata*, *Genista germanica*, *Lathyrus linifolius*, *Luzula nivea*, *L. pedemontana*, *Melampyrum pratense* s.l., *Minuartia laricifolia* subsp. *laricifolia*, *Molinia arundinacea*, *Rhododendron ferrugineum*, *Vaccinium myrtillus*, *V. vitis-idaea*; D) *Alnus incana*, *Calamagrostis epigejos* subsp. *epigejos*, *C. pseudophragmites* subsp. *pseudophragmites*, *Hippophae fluviatilis*, *Salix eleagnos*, *S. purpurea* subsp. *purpurea*; E) *Brachypodium rupestre*, *Carex alba*, *Cytisus purpureus*, *Erica carnea* subsp. *carnea*, *Euphorbia kerneri*, *E. variabilis*, *Fraxinus ornus*, *Ostrya carpinifolia*, *Sesleria caerulea* subsp. *caerulea*, *Thliphthisa purpurea* subsp. *purpurea*.

Syntaxonomic reference: A) alliance *Ononido rotundifoliae-Pinion sylvestris* Br.-Bl. 1950, order *Astragalo monspessulani-Pinetalia sylvestris* Oberd. in Theurillat et al. 1995, class *Pyrolo-Pinetea sylvestris* Korneck 1974; B) alliance *Erico carneae-Pinion* Br.-Bl. in Br.-Bl. et al. 1939 nom. invers. propos., order *Erico-Pinetalia* Horvat 1959 nom. conserv. propos., class *Erico-Pinetea* Horvat 1959; C) alliance *Dicrano-Pinion sylvestris* (Libbert 1933) W. Matuszkiewicz 1962 nom. conserv. propos.; order *Pinetalia sylvestris* Oberd. 1957, class *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939; D) W-Alps: association *Calamagrostio pseudophragmitae-Pinetum sylvestris* Mondino 1963 ex Poldini 1984, alliance *Ononido rotundifoliae-Pinion sylvestris* Br.-Bl. 1950, order *Astragalo monspessulani-Pinetalia sylvestris* Oberd. in Theurillat et al. 1995, class *Pyrolo-Pinetea sylvestris* Korneck 1974; Eastern Alps: association *Alno incanae-Pinetum sylvestris* Poldini 1984, alliance *Erico-Fraxinion orni* Horvat 1959 nom. invers. propos., class *Erico-Pinetea* Horvat 1959; association *Salici eleagni-Pinetum sylvestris* Oberd. 1957, alliance *Erico carneae-Pinion* Br.-Bl. in Br.-Bl. et al. 1939 nom. invers. propos., order *Erico-Pinetalia* Horvat 1959 nom. conserv. propos., class *Erico-Pinetea* Horvat 1959; E) alliance *Erico-Fraxinion orni* Horvat 1959, order *Erico-Pinetalia* Horvat 1959, class *Erico-Pinetea* Horvat 1959.

The alliance *Deschampsio-Pinion sylvestris* Br.-Bl. 1961, previously attributed to acidophilous alpine *P. sylvestris* communities, geographically vicariant of the central European alliance *Dicrano-Pinion sylvestris* (Libbert 1933) W. Matuszkiewicz 1962, is currently considered its syntaxonomic synonym.

Dynamics and contacts: Subtype D has dynamic relationships with habitat types 3220, 3230, 3240, of which they represent the final successional stage.

ii) New subtypes within pre-existing habitat types

GREEN ALDER SCRUB WITH TALL HERBS
Natura 2000: 4060 "Alpine and Boreal heaths".
Type: New habitat subtype.
Authors: Lasen C., Mainetti A.
Macrotype: 4 "Temperate heath and scrub".
EEA Biogeographical region: Alpine.
Region: Aosta Valley, Friuli-Venezia Giulia, Lombardy, Piedmont, Trentino-South Tyrol, Veneto.
CORINE Biotopes/PALAEARCTIC: 31.611.
EUNIS 2012: F2.3111.
EUNIS 2021: S25111.
European Red List of Habitats: LC (F9.2).
Bern convention: -
Motivation: The lack in the Interpretation Manual of EU Habitats EUR28 of valuable green alder scrubs deserves attention. In view of the considerable heterogeneity of the formations that can be included in the habitat type 4060, an extension is proposed here. Scrubs of the sub-alpine belt are generally zonal communities and, except for basiphilous *P. mugo* scrub (habitat type 4070*) and *Salix* spp. scrub (habitat type 4080), are grouped under the code 4060. The Interpretation Manual of EU Habitats EUR28 (European Commission, 2013) gives examples, with multiple subtypes, that allow *Rhododendron* spp. scrub to be easily referred to this code, also with *Juniperus communis*. These communities are a zonal expression of the vegetation enclosed between the upper limit of the forest and the primary grasslands or other types of scrubs such those dominated by *Ericaceae*, suffruticose dwarf-shrubs, *Genista* spp. and other thermophilous formations of the forest margins, located on average at lower elevations. However, *Alnus alnobetula* formations (*Alnetum viridis* s.l.) are not mentioned in the Interpretation Manual of EU Habitats EUR28 although they host, in the entire Alpine Arch, well characterised communities both floristically (herbaceous layer with elements of habitat 6430 with tall herbs) and ecologically (extensive slopes with long snowfall or even avalanche-prone slopes) on soils derived from both siliceous and calcareous-terrigenous substrates, capable of retaining humidity even in periods of relatively low precipitation. Moreover, *Alnus alnobetula* formations belonging to the *Alnetum viridis* characterise the alpine landscape in various sectors and are communities of naturalistic value for the species they can host, also with respect to the fauna. The alliance *Alnion viridis* includes also more trivial communities developing on abandoned pastures on subacidophilous soils. These communities are to be referred to the *Rhododendron ferruginei-Alnetum viridis* association (Boscutti et al., 2014), which are not to be considered habitats of community interest.
Diagnostic sentence: Scrubs dominated by *Alnus alnobetula*, widespread in the subalpine belt and at lower elevations on avalanche-prone slopes. Together with a few other shrub species, the herbaceous layer is characterised by extensive tall-herbs cover, favoured by the site conditions typically characterised by long snowfall and high humidity, as also indicated by the presence of high bryophyte cover.
Reference list of typical species: *Achillea macrophylla*, *Adenostyles alliariae*, *Alchemilla* spp., *Alnus alnobetula*, *Chaerophyllum hirsutum*, *Cicerbita alpina*, *Descurainia tanacetifolia*, *Doronicum austriacum*, *Dryopteris dilatata*, *Geranium sylvaticum*, *Milium effusum* subsp. *effusum*, *Poa hybrida*, *Primula matthioli*, *Rumex arifolius*, *Salix appendiculata*, *Saxifraga rotundifolia*, *Sorbus chamaemespilus*, *Stellaria nemorum* subsp. *nemorum*, *Streptopus amplexifolius*, *Tozzia alpina*, *Viola biflora*.
Syntaxonomic reference: The proposed subtype corresponds to the association *Alnetum viridis* Berger 1922 (alliance *Alnion viridis* Schnyder 1930, order *Alnetalia viridis* Rübel ex Karner et Willner in Willner et Grabherr 2007, class *Betulo carpaticae-Alnetea viridis* Rejmánek ex Bœuf, Theurillat, Willner, Mucina et Simler in Bœuf et al. 2014).
Dynamics and contacts: *Alnus alnobetula* formations are in contact with other subalpine communities, in particular with various types of willow scrubs (habitat type 4080, in which the distinction derives from the dominance relationship, but also from the herbaceous tall herb layer that is much less widespread or completely absent in willow groves). Transitional situations are often observed with *P. mugo* scrubs (also basiphile in habitat type 4070) and *Rhododendron* scrubs. Contacts of a serial nature are known with communities of *Salix appendiculata* or *Sorbus aucuparia* subsp. *aucuparia* in which the tall herb layer is diminished. Within formations dominated by *Alnus alnobetula*, small springs frequently occur and furrows are formed. Here, elements of class *Montio-Cardaminetea* occur. An elevational/serial sequence occurs in dolomitic areas with volcanic substrate, starting from pure *Alnus alnobetula* formations, which becomes enriched by *Sorbus aucuparia* subsp. *aucuparia* and then by *Acer psuedoplatanus*, revealing possible contacts with the habitat type 9140. Contacts with different types of *Fagus sylvatica* forests can be observed in correspondence of impluvia conditioned by snow discharge.

ULTRAMAFIC GRASSLANDS OF NORTHWESTERN ITALY
Natura 2000: 6130 "Calaminarian grasslands of the *Violetalia calaminariae*".
Type: New habitat subtypes.
Authors: Selvaggi A., Lonati M.
Macrotype: 61 "Natural grasslands".
EEA Biogeographical region: Alpine, Continental, Mediterranean.
Region: Aosta Valley, Piedmont.
CORINE Biotopes/PALAEARCTIC: 36.44.
EUNIS 2012: E1.B5.
EUNIS 2021: R1S5.
European Red List of Habitats: EN (E1.B).
Bern convention: E1.B.
Motivation: As suggested by Casavecchia et al. (2021), herbaceous and dwarf shrub-suffrutescent plant commu-

nities typical of Italian ultramafic soils have been generally referred to the habitat type 6130 based on broad ecological similarity, rather than on syntaxonomic evidence (Mucina et al., 2016), limiting the vegetation of the *Violetalia calaminariae* only to communities on screes and the "heavy-metal tolerant vegetation on mining spoil heaps of cool-temperate Europe". On the contrary, the Interpretation Manual of EU Habitats EUR28 (European Commission, 2013) explicitly highlights that this habitat type includes open natural or semi-natural grasslands on natural rock outcrops rich in heavy metals and cites the reference to the PALAEARCTIC codes 34.2 (Lowland heavy metal grasslands) and 36.44 (Alpine heavy metal communities). For these reasons we propose here, in agreement with Casavecchia et al. (2021), to adopt a more inclusive concept and diagnostic sentence for the habitat type 6130, and to include all the communities present in northern Italy on ultramafic soils. We consider necessary to better define their attribution to subtypes. These open grasslands are characterized by a highly specialized flora with the presence, mainly among the nickel hyperaccumulator taxa, of threatened endemic taxa and species, subspecies, and ecotypes adapted to heavy metals. Baker et al. (2010) highlighted the rarity and fragmentation of primary sites of metallophytes, often forming small geographically isolated 'islands' in areas characterized by background vegetation with non-elevated metal concentrations. Because of their restricted geographical distribution and very limited ecological amplitude, metallophytes are prone to extinction due to habitat destruction, genetic drift, demographic stochasticity, and inbreeding.

Diagnostic sentence: Herbaceous or herbaceous-suffrutescent formations with sparse cover, natural or semi-natural, on shallow soils often with rocky or gravelly outcrops, rich in heavy metals (e.g. nickel, zinc, chromium, copper), mostly of ultramafic nature, locally in mining districts. The flora is highly specialized, with taxa adapted to heavy metals and often Ni-hyperaccumulators. Variants are recognized based on geographical distribution, floristic composition and nature of the substrate.

We propose to better define, in Piedmont and Aosta Valley, two of the five subtypes described by Casavecchia et al. (2021), and we highlight the need for further analysis to delimit other subtypes proposed by the same authors in northwestern Italy.

Subtypes: A) Herbaceous or herbaceous-suffrutescent communities on the subalpine-alpine belt of the Italian western Alps, developed on serpentine rocks; B) Northern Apennines garrigue communities growing on ophiolitic substrates.

Communities strictly found on ultramafic cliffs and screes deposits (chasmophytic, comophytic and glareicolous) should be referred to other habitat types.

Reference list of typical species: A) *Carex fimbriata*; B) *Alyssoides utriculata* subsp. *utriculata*, *Cerastium utriense*, *Euphorbia spinosa* subsp. *spinosa*, *Centaurea aplolepa* subsp. *aplolepa*, *Cherleria laricifolia* subsp. *ophiolitica*, *Linaria supina* subsp. *supina*, *Linum campanulatum*, *Potentilla pedata*, *Sesamoides interrupta*, *Viola bertolonii*.

Syntaxonomic reference: A) association *Caricetum fimbriatae* Richard, alliance *Oxytropido-Elynion myosuroidis* Br.-Bl. 1950, order *Oxytropido-Elynetalia* Albrecht 1969, class *Carici rupestris-Kobresietea bellardii* Ohba 1974; B) Community with *Cerastium utriense* and *Alyssoides utriculata*, order *Rosmarinetalia officinalis* Br.-Bl. Ex Molinier 1934, class *Ononido-Rosmarinetea* Br.-Bl. in A. Bolòs y Vayreda 1950.

Mucina et al. (2016) considered the alliance *Alyssion bertolonii* E. Pignatti et Pignatti 1977 included in order *Erysimo-Jurineetalia bocconei* S. Brullo 1984, class *Festuco hystricis-Ononidetea striatae* Rivas-Mart. et al. 2002; according to the Italian literature (Biondi et al., 2014; Casavecchia et al., 2021), we adopted the syntaxonomic treatment within the class *Rosmarinetea officinalis*.

The association *Campanulo bertolae-Alyssoidetum utriculatae* Montacchini et al. 1982, described for Susa Valley (Piedmont) on ophiolitic rocky habitats, would be attributed to the alliance *Potentillion caulescentis* by the authors (Montacchini et al., 1982); therefore, it seems appropriate to associate it with the habitat type 8210, waiting for further analyses.

Communities consisting only of chasmophytes of serpentine rocks (alliance *Asplenion serpentinii* Br.-Bl. Et Tüxen 1943) (PALAEARCTIC 62.213, EUNIS 2012 H3.113) are included in the habitat type 8220 (Siliceous rocky slopes with chasmophytic vegetation), according with European Commission (2013).

The alliance *Galio anisophylli-Minuartion vernae* Ernst 1965, with the association *Violetum dubyanae* Ernst 1965 described on the basis of surveys carried out in the Bergamo Alps, are indicated by Ernst (1965) as typical herbaceous communities of heavy metal substrates belonging to order *Violetalia calaminariae* Br.-Bl. Et Tx. Ex Ernst 1965. As also reported by other authors (Baker et al., 2010), they should be excluded and must be traced back to the alliance *Thlaspion rotundifolii* Jenny-Lips 1930 (Punz and Mucina, 1997; Mucina et al., 2016).

Dynamics and contacts: The community of the subtype A mainly contacts the association *Caricetum fimbriatae* and is at the crossroad of three orders (Richard, 1985) characterized by acidophilous species of *Caricetalia curvulae* Br.-Bl. In Br.-Bl. et Jenny 1926, neutrophilous species of *Seslerietalia caeruleae* Br.-Bl. In Br.-Bl. et Jenny 1926, and indicator species of windy ridge vegetation (*Oxytropido-Elynetalia* Albrecht 1969). Consequently, contacts can be identified with habitat types 6150, 6170, and 6130. Cavallero et al. (2007) highlighted contacts with: 1) *Nardus stricta* and *Carex sempervirens* with *Trifolium alpinum* grasslands (habitat type 6150); 2) grasslands belonging to the alliance *Festucion variae* (habitat type 6150), in more rocky areas; 3) with *Festuca violacea* grasslands (association *Trifolio thalii-Festucetum nigricantis*, alliance *Caricion ferrugineae*, habitat type 6170), where the slope decreases and the soil improves; 4) with basiphilous formations with *Onobrychys montana* and *Helianthemum*

nummularium subsp. *grandiflorum* (alliance *Seslerion variae*, habitat type 6170).

Vegetation dynamics of the subtype B are very slow as underlined by Casavecchia et al. (2021). There are contacts with meso-xeric grasslands (habitat type 6210) with *Bromopsis erecta*, *Brachypodium genuense* and *Sesleria pichiana*, and stable stages dominated locally by *Erica cinerea* or *Erica scoparia* (habitat 4030), or *Juniperus communis* matorral (habitat 5130). The vegetation on screes (habitat 8130) and cliffs (habitat type 8210) partially shares the floristic composition and hosts also other serpentinophytes species like *Asplenium cuneifolium*, *Paragymnopteris marantae* subsp. *marantae*.

SPECIES-RICH *NARDUS* GRASSLANDS ON SILICEOUS SUBSTRATES OF THE ALPS

Natura 2000: 6230* "Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas in Continental Europe)".

Type: New habitat subtypes.

Authors: Dalle Fratte M., Barcella M., Caccianiga M., Oriolo G., Cerabolini B.E.L.

Macrotype: 62 "Semi-natural dry grasslands and scrubland facies".

EEA Biogeographical region: Alpine, Continental.

Region: Aosta Valley, Friuli-Venezia Giulia, Lombardy, Piedmont, Trentino-South Tyrol, Veneto.

CORINE Biotopes/PALAEARCTIC: A-B) 35.11, C) 37.32, D) 36.311.

EUNIS 2012: A-B) E1.71, C) E3.52, D) E4.311.

EUNIS 2021: A-B) R1M1, C) R372, D) R4311.

European Red List of Habitats: A-B) VU (1.7), C) EN (E3.5), D) LC (E4.3a).

Bern convention: A-B) E1.71, C) E3.5, D) E4.3.

Motivation: *Nardus* grasslands (6230*) represent a priority importance habitat type largely widespread in the EU (Galvánek and Janák, 2008). Italy is the country with the greatest surface of the habitat 6230* within the Natura 2000 sites (Galvánek and Janák, 2008), mostly located in the Alpine biogeographical region (EEA, 2022b).

The definition of this habitat type determines critically important features that are mandatory for its identification, specifically relating to substrate, elevation, and number of species. However, the habitat definition has been extended to cover wider ecological conditions, specifically to substrates not strictly siliceous (e.g. Biondi et al., 2009; Gennai et al., 2014; Lüth et al., 2011; Bensettiti et al., 2005), likely including communities with higher plant diversity (e.g. Pittarello et al., 2017). Furthermore, over the years there have been changes in the syntaxonomic classification of *Nardus* grasslands in northern Italy that have increased the possibility of confusion in the interpretation of this habitat type. The identification of habitat subtypes seems thus necessary to disentangle all the facets of this habitat type in northern Italy.

Diagnostic sentence: Closed, dry or mesophile, perennial *Nardus* grasslands occupying siliceous soils in Atlantic or sub-Atlantic or boreal lowland, hill and montane regions of middle and northern Europe and western Iberia. Vegetation highly varied, but the variation is characterised by continuity. Species-rich sites should be interpreted as sites which are remarkable for a high number of species. In general, habitats irreversibly degraded by overgrazing should be excluded.

The following habitat subtypes can be identified in northern Italy: A) Meso-subxerophytic oligotrophic grasslands in the lowland to submontane belt of the sub-Atlantic regions of western and central Europe, subject to grazing or regular mowing without fertilization (*Violion caninae*); B) Dry and oligotrophic pastures in the montane belt of the Alps (*Nardo-Agrostion tenuis* and *Nardo-Agrostion caninae*); C) Hygrophilous oligotrophic meadows on peaty soils in the montane belt of the subatlantic regions of western and central Europe (*Nardo-Juncion squarrosi*); D) Chionophilous grasslands in the subalpine belt of the Alps, usually subject to grazing (*Nardion strictae*).

Reference list of typical species: *Nardus stricta*, A) *Agrostis capillaris* subsp. *capillaris*, *Avenella flexuosa* subsp. *flexuosa*, *Campanula rotundifolia* subsp. *rotundifolia*, *Centaurea jacea* s.l., *Danthonia decumbens* subsp. *decumbens*, *Dianthus deltoides* subsp. *deltoides*, *Euphrasia officinalis* s.l., *Galium pumilum*, *Genista sagittalis*, *G. tinctoria*, *Hypericum maculatum* subsp. *maculatum*, *Leontodon hispidus* subsp. *hispidus*, *Pimpinella saxifraga*, *Potentilla erecta*, *Thesium pyrenaicum* subsp. *pyrenaicum*, *Thymus* gr. *serpyllum*, *Viola canina* subsp. *canina*; B) *Agrostis canina* subsp. *canina*, *Asphodelus albus* subsp. *subalpinus*, *Bromopsis caprina*, *Carex pilulifera* subsp. *pilulifera*, *C. repens*, *Cerastium tomentosum*, *Festuca ovina* agg., *Filipendula vulgaris*, *Geranium austroapenninum*, *Helianthemum oelandicum* subsp. *incanum*, *Laserpitium latifolium*, *Luzula sylvatica* subsp. *sieberi*, *Polygala alpestris* subsp. *alpestris*, *Rhinanthus minor*, *Tragopogon crocifolius* subsp. *crocifolius*, *Tragopogon pratensis*, *Viola cassinensis* subsp. *pseudogracilis*; C) *Agrostis canina* subsp. *canina*, *Carex echinata* subsp. *echinata*, *C. nigra* subsp. *nigra*, *C. panicea*, *Erica tetralix*, *Festuca ovina* agg., *Gentiana pneumonanthe* subsp. *pneumonanthe*, *Juncus squarrosus*, *Lysimachia europaea*, *Molinia caerulea*, *Sphagnum* spp., *Trichophorum cespitosum* subsp. *cespitosum*; D) *Antennaria dioica*, *Arnica montana* subsp. *montana*, *Bellardiochloa variegata* subsp. *variegata*, *Carex pilulifera*, *Gentiana acaulis*, *Geum montanum*, *Patzkea* subsp. *paniculata*, *Pilosella lactucella* subsp. *lactucella*, *Pilosella officinarum*, *Polygala vulgaris* subsp. *vulgaris*, *Potentilla aurea* subsp. *aurea*, *Pseudorchis albida*, *Scorzoneroides helvetica*, *Veronica officinalis*.

Syntaxonomic reference: In northern Italy, this habitat type includes the alliances (A) *Violion caninae* Schwickerath 1944, (B) *Nardo-Agrostion tenuis* Sillinger 1933, *Nardo-Agrostion caninae* Cortini-Pedrotti et al. 1973, (C) *Nardo-Juncion squarrosi* (Oberd. 1957) Passarge 1964 belonging to the order *Nardetalia strictae* Preising 1950 (class *Nardetea strictae* Rivas Goday et Borja Carbonell in Rivas Goday et Mayor López 1966 nom. conserv. propos.), and the alliance (D) *Nardion strictae* Br.-Bl. 1926 of the

order *Festucetalia spadiceae* Barbero 1970 (class *Juncetea trifidi* Hadač in Klika et Hadač 1944). The *Nardion strictae* alliance shows a strong regional differentiation, that in the Alps and Pyrenees can be referred to the *Sieversio-Nardetum strictae* Lüdi 1948 association (European Commission, 2013) but limited to the montane-subalpine belt.
Dynamics and contacts: *Nardus* grasslands are mainly in contact with beech forests on siliceous substrates (habitat types 9110 and 9120) in the montane belt or spruce forests (habitat type 9410) at higher elevations. This habitat type is in contact with different scrubs, ranging from alpine and boreal heaths (habitat type 4060) to dry heaths (habitat type 4030) or *Juniperus communis* formations (habitat type 5130). *Nardus* grasslands are in contact also with hay meadows (habitat type 6520) mainly in the montane belt, grasslands of primary origin (habitat type 6150), and cenosis of the *Agrostion schraderianae* Grabherr 1993 in the subalpine belt. On wetter soils, they contact *Molinia* meadows (habitat type 6410), or even transitional peat bogs (habitat type 7140). Sometimes this habitat type can be in contact with subnival aspects of the alliance *Arabidion caeruleae* Br.-Bl. in Br.-Bl. et Jenny 1926. In absence of management, *Nardus* grasslands tend to be invaded by shrubs (e.g. *Calluna vulgaris*, *Juniperus* spp., *Vaccinium* spp.) or trees (e.g. *Betula pendula*, *Corylus avellana*, *Pinus sylvestris*, *Populus tremula*, and sometimes *Larix decidua*, *Picea abies*, and *Pinus cembra*). In cooler and wetter sites, they can be invaded by *Deschampsia caespitosa*.

ITALIAN LOWLAND, COLLINE AND SUB-MONTANE PERMANENT PASTURES OF *CYNOSURION CRISTATI*
Natura 2000: 6510 "Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)"
Type: New habitat subtype.
Authors: Lonati M., Selvaggi A., Mainetti A.
Macrotype: 6 "Natural and semi-natural grassland formations"; 65 "Mesophile grasslands".
EEA Biogeographical region: Alpine, Continental, Mediterranean.
Region: Aosta Valley, Friuli-Venezia Giulia, Lombardy, Piedmont, Trentino-South Tyrol, Veneto.
CORINE Biotopes/PALAEARCTIC: 38.1.
EUNIS 2012: E2.1.
EUNIS 2021: R2.1.
European Red List of Habitats: VU (E2.1).
Bern convention: -
Motivation: In Italy these semi-natural pastures have a peculiar floristic richness and host many species (Casavecchia et al., 2021). Like other semi-natural pastures, these communities in northern Italy are strongly dependent on grazing and are threatened by the intensification of agricultural practices or by undergrazing and abandonment. The floristic richness of these communities is strongly dependent by the mechanical action of grazing animals: grazing and trampling create a heterogeneous grass cover compared to mown grasslands, which favour the coexistence of different plant species (annual, thorny, sub-nitrophilous, reptant) (Buffa et al., 1988-89). Animal droppings (dung, urine) are also important, ensuring regular fertilisation of the soil (Delarze and Gonseth, 2008).
Diagnostic sentence: Mesic permanent grassland of lowlands, hills and sub-mountain areas of northern Italy.
Reference list of typical species: *Bellis perennis*, *Crepis capillaris*, *Cynosurus cristatus*, *Festuca rubra* s.l., *Hypochoeris radicata*, *Lolium perenne*, *Lolium pratense*, *Phleum pratense* subsp. *pratense*, *Poa pratensis* subsp. *pratensis*, *P. trivialis*, *Prunella vulgaris* subsp. *vulgaris*, *Scorzoneroides autumnalis*, *Taraxacum officinale* sect. *Taraxacum*, *Trifolium repens*, *Veronica serpyllifolia*.
Syntaxonomic reference: Alliance *Cynosurion cristati* Tx. 1947 (order *Arrhenatheretalia elatioris* Tx. 1931, class *Molinio-Arrhenatheretea* Tx. 1937). This proposal includes permanent communities associated with an agricultural use of grasslands. On the contrary, communities resulting from the temporary abandonment of cultivation (e.g. communities with *Lolium multiflorum*; Poldini and Oriolo, 1994) or turf relegated to archaeological sites and/or public parks (e.g. communities with *Plantago major* and *Trifolium repens*) are excluded. However, this is in contrast with Delarze and Gonseth (2008). In their view, grass carpets in parks and sport grounds constitute a very impoverished variant of *Cynosurion cristati*.
Dynamics and contacts: The maintenance of this habitat is strongly linked to regular grazing. In the lowlands, abandonment leads to rapid invasion by alien herbaceous species (*Artemisia verlotiorum*, *Solidago* spp.). The habitat is dynamically linked to scrubs of the class *Crataego-Prunetea* Tx. 1962 nom. conserv. propos. A change in agricultural practices, from grazing to mowing, favours tall grasses (*Arrhenatherum elatius*, *Trisetaria flavescens* subsp. *flavescens*) with progressive transformation of the community towards hay meadows (Habitat 6510 in lowland, Habitat 6520 in sub-montane area). Overgrazing could favour ruderal and nitrophilous species typical of heavily grazed zoo-anthropogenic nutrient-rich grasslands, belonging to the order *Potentillo-Polygonetalia avicularis* Tx 1947. Catenal contacts with semi-natural dry grasslands dominated by *Bromopsis erecta* (Habitat 6210) and acidophitic grasslands dominated by *Nardus stricta* (Habitat 6230*) occur.

iii) New priority criteria for pre-existing habitat types

XERIC AND MESO-XERIC GRASSLANDS OF THE EASTERN SUBMEDITERRANEAN ZONES OF THE SOUTHERN PRE-ALPS
Natura 2000: 62A0* "Eastern sub-mediterranean dry grasslands (*Scorzoneretalia villosae*) (* important orchid sites)".
Type: New priority criteria for a pre-existing habitat type.
Authors: Armiraglio S., Buffa G., Caccianiga M., Cerabolini B.E.L., Dalle Fratte M., Oriolo G.

Macrotype: 6 "Natural and semi-natural grassland formations".; 62 "Semi-natural dry grasslands and scrubland facies".
EEA Biogeographical region: Mainly Continental, partially Alpine.
Region: Friuli-Venezia Giulia, Lombardy, Veneto.
CORINE Biotopes/PALAEARCTIC: 34.1, 34.75, 38.6.
EUNIS 2012: E1.1, E1.5524, E2.5.
EUNIS 2021: R19, R1A, R1K24.
European Red List of Habitats: VU (E1.1j, E1.2).
Bern convention: E1.55.
Motivation: Eastern submediterranean dry grasslands (62A0) are present along the eastern coast of the Adriatic Sea, the southern Pre-Alps, and the southeastern coastal districts of the Italian Peninsula (Feoli Chiappella and Poldini, 1993; Lasen, 1995; Poldini, 1995; Sburlino et al., 2008). In Italy, the conservation status of these grasslands is Unfavourable-Bad in the alpine and continental biogeographical regions, and they show a decreasing trend (Angelini et al., 2021). Along the southern Prealps, the floristic composition of these plant communities is often rich in Orchidaceae (Meyer, 1977; Lasen, 1989; Poldini, 1995; Frisinghelli et al., 1996; Perazza and Lorenz, 2013), some of which (e.g. *Himantoglossum adriaticum*) are also protected species according to the Habitats Directive.

The habitat type 62A0 has been included in Annex I of the Habitats Directive to define the Illyrian-submediterranean localities in northeastern Italy and the Adriatic. However, the same community has been more likely attributed to the habitat type 6210(*) "Semi-natural dry grasslands and scrubland facies on calcareous substrate (*Festuco-Brometalia*) (* important orchid sites)" (Olmeda et al., 2019). Similarly to habitat type 6210(*), the xeric grasslands of 62A0 might be rich in orchids, as well as in rare and endemic species (Biondi et al., 2009). Therefore, habitat type 62A0 would deserve to be considered of priority importance when it meets the same priority criteria attributed to the grasslands of habitat type 6210(*) (Oriolo and Tomasella, 2014).
Diagnostic sentence: Xeric and meso-xeric grasslands of the submediterranean zones of the southern Pre-Alps, Istria, and Balkan peninsula, where they coexist with steppic grasslands of the *Festucetalia valesiacae* (6210), developing in areas of lesser continentality than the latter and incorporating a greater number of Mediterranean elements. They are also found in the southeastern coastal districts of the Italian Peninsula. These grasslands in northern Italy should be interpreted as priority sites on the basis of one or more of the following three criteria:

(a) the site hosts many orchid species;
(b) the site hosts an important population of at least one orchid species considered not very common on the national territory;
(c) the site hosts one or several orchid species considered to be rare, very rare, or exceptional on the national territory.

Reference list of typical species: *Achillea virescens*, *Anthyllis vulneraria* subsp. *polyphylla*, *Brassica glabrescens*, *Bromopsis condensata*, *Bupleurum veronense*, *Centaurea dichroantha*, *Centaurea scabiosa* subsp. *fritschii*, *C. rupestris*, *Cirsium pannonicum*, *Crepis chondrilloides*, *Cytisus pseudoprocumbens*, *Dianthus sylvestris* subsp. *tergestinus*, *Eryngium amethystinum*, *Euphorbia fragifera*, *E. kerneri*, *Gelasia villosa*, *Genista holopetala*, *G. sericea*, *G. sylvestris*, *Iris cengialti*, *Gentiana verna* subsp. *tergestina*, *Jurinea mollis* subsp. *mollis*, *Knautia ressmannii*, *K. illyrica*, *Leucanthemum platylepis*, *Linum tommasinii*, *Matthiola fruticulosa* subsp. *valesiaca*, *Muscari tenuiflorum*, *Noccaea praecox*, *Onosma echioides* subsp. *dalmatica*, *Ophrys sphegodes*, *Ornithogalum kochii*, *Pentanema ensifolium*, *Plantago argentea*, *P. holosteum*, *Polygala forojulensis* subsp. *carniolica*, *Potentilla tommasiniana*, *P. cinerea*, *P. heptaphylla* subsp. *australis*, *Pulsatilla montana* subsp. *montana*, *Rhinanthus pampaninii*, *Satureja subspicata*, *S. montana* subsp. *variegata*, *Senecio scopolii*, *Seseli kochii*, *S. tommasinii*, *Sesleria juncifolia* subsp. *juncifolia*, *Stipa veneta*, *Teucrium capitatum* subsp. *capitatum*, *Trinia glauca*, *Veronica barrelieri* subsp. *nitens*.
Syntaxonomic reference: In northern Italy, in agreement with Mucina et al. (2016), this habitat type includes the alliances, *Scorzonerion villosae* Horvatić ex Kovačević 1959 (prealpic and Illyrian meso-xerophytic submediterranean grasslands on deep and partly decalcified soils), *Saturejion subspicatae* Tomić-Stanković 1970 (Dinaric submediterranean montane calcareous rocky grasslands on shallow soils), *Centaureion dichroanthae* Pignatti 1952 (Prealpic submediterranean montane calcareous rocky grasslands on shallow soils), and *Chrysopogono grylli-Koelerion splendentis* Horvatić 1973 (Illyrian submediterranean rocky grasslands on shallow calcareous soils), while in southern Italy it includes the alliance *Hippocrepido glaucae-Stipion austroitalicae* Forte et Terzi in Forte et al. 2005 (submediterranean xeric pastures on rocky calcareous soils of Apulia (southern Italy), belonging to the order *Scorzoneretalia villosae* Kovačević 1959 (class *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947).
Dynamics and contacts: In the southeastern Pre-Alps, the habitat type 62A0 is mostly in contact with oak forests on basic substrates (91H0*, Pannonian woods with *Quercus pubescens*) sometimes with *Carpinus orientalis*, or locally in contact with *Fagus sylvatica* forests in the internal Pre-Alps, or evergreen forests dominated by *Quercus ilex* (habitat type 9340) in the northern coast of Adriatic Sea. This habitat type is in contact with different scrubs, ranging from submediterranean bushes with *Cotinus coggygria*, *Pistacia terebinthus*, *Prunus spinosa*, *Rhamnus catharticus*, and *Juniperus communis* formations (5130). In southern Italy, these grasslands are mostly in contact with *Quercus ilex* and *Quercus rotundifolia* forests (9340), with eastern white oak woods (91AA*) and *Quercus trojana* woods (9250).

In northeastern Italy, primary situations and cliff edges can be considered stable or long lasting. Here these grasslands are in contact mainly with rupicolous grasslands of the *Alysso alyssoidis-Sedion* Oberd. et T. Müller in T. Müller 1961 (6110) and submediterranean screes with

Achnatherum calamagrostis along the riverbanks. In the Mediterranean region, they are also in contact with the scrubland with *Salvia officinalis* and with arid pioneer communities of annual plants (6220), other than with grasslands of the habitat type 6210(*), as also stated in the habitat type definition.

Discussion

We report several proposals that can be considered the most urgent Annex I amendments and new habitat proposals for what concerns northern Italy. Our proposals for adjustments concern habitats with a very different ecology (i.e. wetlands, fens, scrubs, forests, grasslands) thus suggesting shortcomings for different macrohabitat types. To add more specifics to our proposals, besides the information reported for each proposal in the standard template provided by the Italian Society for Vegetation Science, we report below more insights for those habitats that deserve further discussion. We organized our proposals as: new habitat types, new subtypes within pre-existing habitat types, and new priority criteria for a pre-existing habitat type.

i) New habitat types

FRESHWATER LARGE SEDGES

Formations of the alliance *Magnocaricion elatae* Koch 1926 represent habitat types of unquestionable conservation value. They are relatively easy to identify and map. As a typical community of humid environments, it is particularly affected by pressures as periods of drought which are becoming more frequent due to climate change.

Compared to the proposal of Casavecchia et al. (2021), which also includes the vegetation dominated by *Phragmites australis*, for northern Italy it was agreed here to consider only the communities belonging to the *Magnocaricion elatae* Koch 1926, as they are generally of higher conservation value.

The conservation of this habitat type requires regular management, which in the past was implemented by mowing (and subsequent use of sedges for chair stuffing) and/or fire (Lonati and Lonati, 2005). The abandonment of such management practices saw the following emergence of tall caespitose *Poaceae* typical of fluctuating watershed (e.g. *Molinia arundinacea*, *Deschampsia caespitosa*) and then of hygrophilous woody species, with progressive deterioration of the quality of this habitat type. In perifluvial areas, *Magnocaricion elatae* Koch 1926 is highly dependent on river dynamics (flooding, bank erosion, creation of temporary ponds) and it often constitutes a short-term habitat.

GREY WILLOW CARRS

This habitat type must be distinguished from wet hedgerows and shrubby dynamical stages with *Frangula alnus* and *Salix cinerea* that are common in lowland wet areas. They present a richer floristic composition with several mesic shrub species (i.e *Cornus sanguinea* s.l., *Viburnum opulus*, *Prunus spinosa* subsp. *spinosa*, *Euonymus europaea*). In the dynamical stages, herb species like *Molinia caerulea*, *Filipendula ulmaria*, *Carex* spp. are often present. These communities are referred to the alliance *Salicion cinereae* T. Müller et Görs ex Passarge 1961 (order *Salicetalia auritae* Doing 1962, class *Crataego-Prunetea* Tx. 1962). A correspondence can be established between this habitat type and the forest type ("tipologia forestale") "Formazioni di *Salix cinerea*" by Del Favero (2004).

ACIDIC FENS

Belts of *Eriophorum scheuchzeri* (EUNIS 2012 D2.21) are included in the proposal, according to the interpretation given by Delarze and Gonseth (2008). Alkaline fens dominated by *Carex nigra* (EUNIS 2012 D4.16) must be excluded and referred to habitat 7230.

From an ecological perspective, acidic fens communities could be referred to communities identified by some dominant bryophytes. More precisely, in the western Alps, they are characterized by *Sphagnum subsecundum*, *S. compactum* and *S. girgensohnii* altogether, and *S. fallax*, *Sarmentypnum exannulatum*, *Sphagnum warnstorfii*, *Eriophorum angustifolium* and *Sarmentypnum sarmentosum* altogether (Miserere et al., 2003). Similarly, the same species have been found in the rest of Southern Alps (Bragazza and Gerdol, 1996) and more broadly together with vascular plants in Europe (Peterka et al., 2016).

Miserere et al. (2003) highlighted that many vascular plants (e.g. *Carex nigra*, *C. echinata*, *Viola palustris*, *Potentilla erecta*, *Nardus stricta* and *Eriophorum angustifolium* subsp. *angustifolium*) that are frequently found with significant cover values in fens, mires and bogs, should not be easily used to classify and characterize homogeneous communities, particularly on the Italian side of the Alps, where the limited size of the wetlands, causes an overlapping in the composition of species in the individual communities. Meanwhile, bryophytes play an important role in identifying plant communities, owing to both their high cover values and to their greater sensitivity to changes in water chemistry and to the depth of the water table. A pan-european study on fen vegetation (Peterka et al., 2017) recognizes as a major compositional gradient within fens at continental scale the base richness gradient and consider the bryophytes in the delimitation of alliances, recognising that bryophytes indicate habitat conditions and have a crucial importance for the functioning of mire habitat types. That study did not support the classification at alliance level based on dominance of selected vascular plants along with hydrological characteristics (i.e. water table depth). Accordingly, the alliances *Caricion lasiocarpae* Vanden Berghen in Lebrun et al. 1949 (Annex I: 7140) and *Rhynchosporion albae* Koch 1926 (Annex I: 7150) are not supported and mainly included in *Caricion fuscae* Koch 1926 nom. conserv. propos. *Caricion fuscae*, within this interpretation, overlaps with the interpretation giv-

en to habitat types 7140 and 7150. Peterka et al. (2017) and Preislerová et al. (2022) also recognized the presence in the Italian Alps of the alliance *Drepanocladion exannulati* Krajina 1933 and of the alliance *Sphagno-Caricion canescentis* Passarge (1964) 1978. The presence and the boundaries between *Caricion fuscae* and *Drepanocladion exannulati* or *Sphagno-Caricion canescentis* in the Italian Alps must be better investigated and defined. At the same time would be necessary re-evaluate the boundaries between the descriptions and interpretations of bogs, mires, and fens habitat types (especially 7140, 7150) in the light of the pan-european works provided by Mucina et al. (2016), Peterka et al. (2017) and Preislerová et al. (2022). In Italian Alps the vegetation of acidic fens has been studied and described mainly by the works of Gerdol and Piccoli (1980), Balátová-Tulácková and Venanzoni (1990), Würz (1992), Gerdol (1994), Lasen and Argenti (1996), Gerdol and Tomaselli (1997), Pascal and Varese (1999), Gerdol and Bragazza (2001), Miserere et al. (2003).

SCOTS PINE FORESTS OF THE ITALIAN ALPS

The diversity of *P. sylvestris* communities within the Italian Alps and northern Italy is described and testified in numerous works. The main contributions derive from the work by: Mondino (1963), Montacchini (1982), Demas et al. (1990), Poldini (1984), Varese (1996), Mondino et al. (1997), Del Favero et al. (2000), Minghetti (2003), Del Favero (2004), Armiraglio et al. (2006; 2011), Lasen (2006), Camerano et al. (2007; 2008), Caccianiga and Armiraglio (2011), Lasen (2014). The importance of *Pinus sylvestris* forests has been highlighted also beyond the Alps (Hemp et al., 2022). Remarkably, Scots pine forests of the Italian Alps have already been proposed for inclusion in Annex I of the Habitats Directive by Lasen (2014) and Lasen et al. (2016). Within the subtype B, the southwestern Alps communities (EUNIS 2021: T358) includes elements of order *Quercetalia pubescenti-petraeae* Klika 1933 and order *Brachypodietalia pinnati* Korneck 1974 nom. conserv. propos. In northern Italy, outside of the Alps, further *P. sylvestris* communities deserve to be cited: the Po terraces with *P. sylvestris* forests (EUNIS 2021: T362) and the supramediterranean *P. sylvestris* forests of the inland hills of Piedmont (EUNIS 2021: T364). Subtype A include the basophiles steppic *P. sylvestris* woods of the inner western Alps, included in the list of endangered natural habitat types requiring specific conservation measures under Bern Convention (Evans and Roekaerts, 2019). Subtype D includes the mountain *P. sylvestris* woods on gravel beds, described in the Alps with three different associations. Although classified in different alliances, these communities are conditioned by a strong determinism linked to the river dynamics and the ecology of the gravel beds, regardless of the associated species composition. For this reason, they have been included in a separate subtype, which we proposed as a priority, because of its rarity and vulnerability.

A correspondence can be established between the proposed subtypes and the forest types ("tipologie forestali") proposed by Del Favero (2004). However, a specific forest type for highly continental steppe forests has not been established. Thus, Subtype A may be partially included into different forest types linked to the inner Alpine areas ("Pineta di pino silvestre dei substrati carbonatici mesalpica e/o endalpica, Pineta a pino silvestre dei substrati silicatici montana") as well as to specific edaphic conditions such as rocky outcrops ("Pineta a pino silvestre primitive di rupe") and moraines ("Pineta di pino silvestre dei substrati silicatici mesalpica e/o endalpica su morena").

A more straightforward correspondence can be established between Subtype B and the type "Pineta di pino silvestre dei substrati carbonatici mesalpica e/o endalpica tipica" and "con abete rosso", as well as between Subtype C with "Pineta di pino silvestre dei substrati silicatici montana" and "Pineta di pino silvestre dei substrati silicatici submontana". Subtype D corresponds to "Pineta di pino silvestre primitiva di falda detritica" and Subtype E can be rather easily ascribed to the types "Pineta di pino silvestre dei substrati carbonatici esalpica tipica" and "con faggio".

ii) New subtypes within pre-existing habitat types

GREEN ALDER SCRUB WITH TALL HERBS

Notably, there is a lack of a specific code for *Alnus alnobetula* scrubs, being this plant community quite characteristic and well distributed across the Alps with peculiar vegetation characteristics. The community is a scrub where the dominant species *Alnus alnobetula* is a shrub. Therefore, the code 6430 ´Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels´ has to be rejected, notwithstanding a similar ecology and sometall herb species in common. Within 4xxx there are only two other possibilities: when *Alnus alnobetula* is admixed with *Salix* spp., the code 4080 ´Sub-Arctic *Salix* spp. scrub´ can be used, while in presence of abundant *Rhododendron ferrugineum*, the code 4060 ´Alpine and Boreal heaths´ can be alternatively used. This latter case can be adopted also for pure *Alnus alnobetula* formations, aware of not being an optimal solution. However, it has to be recalled, that including *Alnus alnobetula* formations within the code 4060 ´Alpine and Boreal heaths´ should be done carefully and only when *Alnus viridis* formations are truly admixed to other woody species and on hygro-nitrophilous soils along avalanche gullies and moderately steep slopes.

At the phytosociological level, the alliance *Alnion viridis* Schnyder 1930 is not sufficient to characterise the subtype proposed under habitat code 4060 because it comprises several associations including the *Rhododendron ferruginei-Alnetum viridis* association (Boscutti et al., 2014) which develops on species-poor abandoned pastures on subacidophilous soils where tall herbs are not present. The subtype proposed must be referred to the *Alnetum viridis* association which is well defined from a vegetation and ecological perspective and is also easy to

recognise physiognomically directly in the field (Boscutti et al., 2014). Also relevant is the ecological homogeneity that finds its highest expression (as dominance and continuity) in the inner alpine sectors with siliceous substrate. Biodiversity is highest in the outer sectors and carbonate (albeit terrigenous) substrates. The weak ecological value of the *Rhododendron ferruginei-Alnetum viridis* association is also outlined by Bühlmann et al. (2014) which considered these formations too homogeneous, of little naturalistic and landscape value, and fundamentally linked to the abandonment of pasture use (see also Anthelme et al., 2001; David, 2010; Svensk et al., 2021; 2022). In the Dolomites area, these formations are among the most favoured by the black grouse (*Tetrao tetrix*).

Formations of *Alnus alnobetula* can be considered long-lived, although they are not climax vegetation. They occur in the subalpine belt in which the *Rhododendron ferrugineum* scrub can be considered the head of the series. In the alpine area they occupy cool sites conditioned by prolonged snowfall and in avalanche furrows even at elevations below the potential forest limit. The persistence of such conditions considerably slows down the evolution towards tree formations (in this case mainly *Larix decidua* or *Larix decidua-Pinus cembra* woodlands, habitat 9420, more rarely *Picea abies* woodlands, habitat 9410). Generally, these communities are highly natural formations that should not be seen as disruptive. Transition stages and mosaics can still be observed in which *Alnus alnobetula* does not yet form compact, well-structured communities. The nitrogen-fixing action of *Alnus alnobetula* leads to an increase in nitrogen that favours nitrophilous aspects and the development of an interesting species composition. Green alder scrub can be classified to the forest type ("tipologia forestale") "Alneto di ontano verde" by Del Favero (2004).

ULTRAMAFIC GRASSLANDS OF NORTHWESTERN ITALY

In the subalpine-alpine belt of the western and southern Alps (Cottian, Graian, Pennine, Lepontine, and Rhetian), in Italy, France, and Switzerland, on slopes of intermediate exposure and the cracks of rocks rich in fine soil, a remarkable association, specific to serpentine outcrops and dominated by *Carex fimbriata*, develops. The association *Caricetum fimbriatae* was first described by Guyot (1925) in the South of the Aosta valley, then found and specified by Verger (1983; 1987) in the North of Aosta Valley, close to Monte Rosa, and formerly described by Richard (1985), who also detailed the phytosociological and ecological characteristics. Further studies were conducted in Piedmont, Aosta Valley, and Queyras (Verger, 1993a; Verger, 1993b; Verger et al., 1993; 1998; D'Amico et al., 2009; D'Amico and Previtali, 2012) outlining and identifying limits between the *Caricetum fimbriatae* and other communities that develop on ultrabasic and serpentine substrates in different environments (rocks, debris, woods, scrubs and heaths, windy ridges, grasslands), combining vegetation, pedological and ecological analysis.

Communities of *Caricetum fibriatae* are dynamically relatively stable, limited not only by elevation and slope but also by the presence of high levels of phytotoxic heavy metals; the suffruticose species (e.g. *Vaccinium uliginosum* subsp. *microphyllum*) can however develop. When the slope is reduced and the dynamics more accelerated the extensive grazing of beef cattle favors maintenance (the animals seek above all the few palatable species present, e.g. *Trifolium alpinum*, *Carex sempervirens*).

The presence of the subtype B (alliance *Alyssion bertolonii*) is underlined by Vagge (2001), Barberis et al. (2004), Marsili and Barberis (2012) in Piedmont in the northern Appennines at SAC/SPA IT1180026 – Capanne di Marcarolo.

In the western Alps, we consider that other subtypes, such as those suggested by Casavecchia et al. (2021), can be better described and clearly separated from 6210 and 6240 habitats only by further analysis. In particular, we consider necessary to better investigate the: 1) serpentine sub-steppes of Piedmont and Aosta Valley, dominated by perennial grasses; 2) herbaceous-suffrutescent communities on the montane belt in the western Alps on serpentine and ophiolitic bedrocks.

We highlight that CORINE Biotopes and PALAEARCTIC habitats classifications (Devillers et al., 1991; Devillers and Devillers-Terschuren, 1996) consider as heavy metal alpine communities only the alliance *Galio anisophylli-Minuartion vernae* Ernst 1965, with the association *Violetum dubyanae* Ernst 1965. As previously argued these syntaxa must be included in alliance *Thlaspietea rotundifolii* and excluded from the interpretation of the habitat 6130; therefore, more appropriately the PALAEARCTIC code 36.44, EUNIS 2012 code E1.B5 and EUNIS 2021 code R1S5 must be traced back to alpine serpentine communities here described. New codes and descriptions of the EUNIS classification will have to be designed to include the northern Apennine and Mediterranean serpentine and ophiolitic communities.

SPECIES-RICH *NARDUS* GRASSLANDS ON SILICEOUS SUBSTRATES OF THE ALPS

The phytosociological classification of *Nardus* grasslands has long been somewhat problematic (Gennai et al., 2014; Lüth et al., 2011). Difficulties arise because *Nardus* grasslands are anthropogenic communities that originate in different ways inside their geographical and elevational range while preserving floristic traces of their original natural composition.

Traditionally, *Nardus* grasslands were all included in the unique order *Nardetalia* within the class *Nardo-Callunetea* (Oberdorfer, 1959; Peppler-Lisbach and Petersen, 2001; Lüth et al., 2011). Other authors partitioned the *Nardus* grasslands into two different classes (*Calluno-Ulicetea* and *Caricetea curvulae*) (Ellmauer, 1993; Foucault, 1994; Grabherr, 1993; Poldini and Oriolo, 1997), considering their syngenetic evolution and thus their chorological pattern (Krahulec, 1985). More recently, other authors recognized the class *Nardetea strictae*, which includes all

Nardus grasslands while excluding scrubs (Molina Abril, 1993; Biondi et al., 1999; Rivas-Martínez, 2002). This class also includes alliances *Nardo-juncion squarrosi* (Oberd. 1957) Passarge 1964, typical of humid and peaty soils, indicated in Italy only for the western Alps (Lonati, 2009), and *Cirsio vallis-demoni-Nardion* Giacomini et Gentile ex Di Pietro et Theurillat in Di Pietro et al. 2015, which is referred to supramediterranean grasslands of southern Italy (Di Pietro et al., 2015).

Depending on the elevation, continentality of the climate, and soil humidity, we identified three subtypes within the class *Nardetea strictae* Rivas Goday et Borja Carbonell in Rivas Goday et Mayor López 1966 nom. conserv. propos. (subtypes A, B, C). However, this scheme hardly classifies the subalpine *Nardus* grasslands of the alliance *Nardion strictae* Br.-Bl. 1926. They cannot be easily incorporated into the class *Nardetea strictae* Rivas Goday et Borja Carbonell in Rivas Goday et Mayor López 1966 nom. conserv. propos. owing to their strict similarities in floristic and environmental relationships with the primary grasslands of *Juncetea trifidi* Hadač in Klika et Hadač 1944. In the suggested classification, we included these grasslands into the subtype D, which comprises subalpine grasslands belonging to the *Nardion strictae* Br.-Bl. 1926.

Nardus grasslands are typical semi-natural grasslands on acidic soils in large part of temperate Europe (Damgaard et al., 2011; Dupré et al., 2010). However, in some countries (e.g. France, Slovakia) the habitat is also found on calcareous substrates where the calcium content is highly decreased in the upper layers of the soil because of high precipitation (Bensettiti et al., 2005; Galvánek and Janák 2008; Stanová and Valachovič, 2002). The same interpretation could be used also in northern Italy, provided that calcareous soils are leached and that only subalpine situations are considered.

One of the contacts that can cause major problems of interpretation is between subalpine *Nardus* grasslands (subtype D) and higher elevation grasslands of primary origin of the lower alpine level. In these grasslands, *Nardus stricta* can often determine the physiognomy of the vegetation, often following grazing (e.g. Dakskobler et al., 2022). Here we suggest that such grasslands of primary origin above the timber line should be referred to as natural grasslands (group 61, habitat type 6150 or 6170, respectively on siliceous or calcareous substrates).

In general, it is extremely important to avoid the inclusion of *Nardus* grasslands at its ecological extremes (e.g. on carbonatic substrates, in the alpine belt, or overgrazed pastures) since they would require different thresholds of conservation values, lowering the conservation value assessment.

ITALIAN LOWLAND, COLLINE AND SUB-MONTANE PERMANENT PASTURES OF *CYNOSURION CRISTATI*

In northern Italy, these communities are extensively grazed by means of rotational grazing systems. The adaptation of the species to frequent trampling and grazing results in a physiognomy dominated by small species with stolons (epigeal or hypogean) and/or rosettes with leaves appressed to the soil surface (Delarze and Gonseth, 2008). They differ from the typical mowing grasslands (habitat types 6510 and 6520) not only in their floristic composition but also in their heterogeneous appearance, due to the presence of heads not consumed by livestock. In lowland environments, the main threat is the transformation from permanent pasture to arable land and improved temporary grasslands; in hilly and low-mountain environments this habitat type is threatened by the abandonment of traditional grazing practices.

iii) New priority criteria for pre-existing habitat types

XERIC AND MESO-XERIC GRASSLANDS OF THE EASTERN SUBMEDITERRANEAN ZONES OF THE SOUTHERN PRE-ALPS

Dry and semi-dry grasslands are among the species-rich plant communities of Europe but their conservation status in Europe and even more in Italy is of conservation concern. In both the EU28 and EU28+, the 3 Critically Endangered habitat types are two types of dry grasslands, while four types are endangered, and more types are vulnerable. The greatest threat is the abandonment of traditional management which led to different forms of degradation and a reversion to scrub and woodland (Jansen et al., 2016). Fringe species, shrubs and trees tend to invade dry grasslands of habitat type 62A0. These dynamical processes are very common in several areas where successional stages can be more spread than the grasslands themselves.

Although some of the communities belonging to this habitat type are of primary origin, and can therefore be considered stable or long-lasting, most of these communities are secondary grasslands of anthropogenic origin, mainly related to pastoral and mowing activity. These grasslands in southeastern Europe are indeed the result of a long time of human influence, but they have been progressively abandoned after the Second World War, starting from the less productive ones. Nowadays, a mosaic with various stages of scrub encroachment can be found (Tryfon, 2016).

Due to the imprecise definitions in the Interpretation Manual of EU Habitats EUR28, some very similar types of grasslands in certain countries have been included in other priority habitat types despite they belong to E1.2a (Semi-dry perennial calcareous grassland), as a subtype of 6210(*) from a floristic-ecological point of view (Olmeda et al., 2019). In particular, this refers to the mesoxeric and base-rich facies of habitat type 6270 (northern countries), the mesoxeric facies of habitat type 6240* (eastern central Europe) and mesoxeric facies of habitat type 62A0 (Illyrian region). Therefore, Olmeda et al. (2019) suggested to include in the habitat type 6210(*) all the mesoxeric basi-

philous grasslands of Europe to avoid misunderstandings between the countries.

In northern Italy, the boundary between the communities of habitats 6210 and 62A0 is often very difficult to establish. As a rule of thumb, the limit between these two complex vegetation communities falls on the hydrographic right of lake Iseo, a region in which the calcareous and dolomitic substrates of the central-eastern Pre-Alps are replaced by marly arenaceous rocks. Furthermore, in correspondence with this limit, the average annual rainfall increases progressively towards west (Armiraglio et al., 2010).

Finally, it is relevant to note that in southeastern Italy, the communities belonging to the habitat type 62A0 are well differentiated from a floristic-ecological perspective and indeed refer to an endemic alliance (*Hippocrepido glaucae-Stipion austroitalicae* Forte et Terzi in Forte et al. 2005). This alliance includes xeric grasslands of the class *Festuco-Brometea* with accentuated Mediterranean characteristics which, although presenting affinities with those trans-Adriatic or North Adriatic, differ from these grasslands for their own endemic species pool and for the presence of species that seem to find their synecological optimum here. Due to this peculiarity, it would be appropriate for southeastern Italy to identify this habitat as always of priority importance (*).

Conclusion

With a vision of tailored conservation, we offered an overview of the most urgent issues to implement, refine, or solve in terms of Annex I Habitats Directive habitat type definitions in northern Italy. The wide community of experts who participated in this contribution represents a well-established network that allowed insights and open-minded discussions that improved the overall output. We are aware our proposals will not easily or soon become part of the Habitats Directive or within other legal frameworks. Further, we acknowledge the list of typical species should be corroborated by numerical analysis. Still, they represent a starting point in view of a future update of Annex I Habitats Directive or the Italian Interpretation Manual of habitat types and they could be useful to prepare expert systems for automatic classification. Irrespective of legally binding solutions in place, biodiversity conservation should also act locally to preserve relevant natural aspects in need of conservation. We thus caution these proposals represent applicable baseline conservation indications that local administrations should consider.

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Authors contributions

GBo conceived the idea, coordinated the activities of the group, and wrote the first draft of the paper, with major contributions from MDF, AS, CL, ML, and MC. SA, MC, MDF, CL, ML, and AS coordinated the writing of one or more proposals. All the authors read and approved the final version of the manuscript.

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