D3.2 Aapa mire

Summary

Aapa mire develops on relatively thin saturated peat through the northern boreal region, mainly in the EU28 in more remote parts of Finland and Sweden. It comprises both topogenous and soligenous types depending on topography, hydrology, peat accumulation and ice dynamics and typically has a regular pattern of alternating hummock strings and *flarks* (wet depressions) oriented according to slope and water flow. Sphagna and other bryophytes dominate the ground carpet and they and associated sedges and other vascular plants vary with the degree of minerotrophic influence. Trees are absent or sparse on hummock strings and mire margins. Aapa mires are affected by drainage in the surrounding areas that may disrupt hydrological connections to their catchment and climate change may also affect hydrology triggering succession towards bog vegetation. Restoration of natural hydrology is needed to prevent further decline in extent and quality of the habitat.

Synthesis

The habitat type is assessed as Least Concern (LC) in view of its fairly wide distribution and because it is unlikely to be declining fast enough to qualify for a threatened category. However, there is uncertainty on the available information and once more quantitative data is available the assessment may change. Aapa mires are particularly sensitive to hydrological disturbances and it is possible that an ongoing decline in quality due to climate change and catchment disturbances is not recognized.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Least Concern	-	Least Concern	-

Sub-habitat types that may require further examination

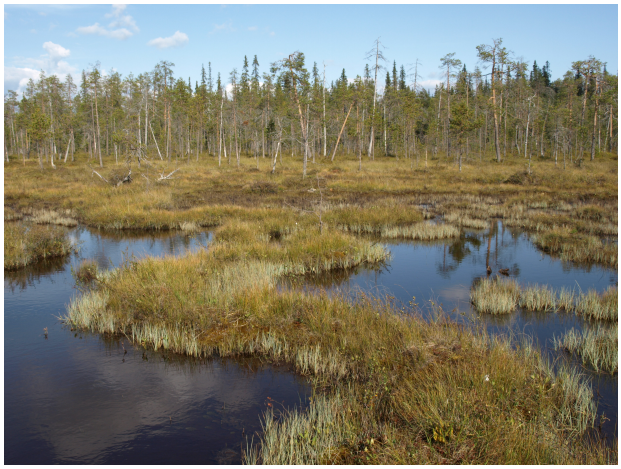
Aapa mires contain climatic-zonal subtypes whose susceptibility to hydrological changes and climate warming may differ. Northern-boreal to subarctic aapa mires most often have open water pools that are important habitats to aquatic fauna, and the drying or infilling of these by *Sphagnum* mosses may be a specific threat to the northern subt-ypes. In addition, vegetation types with different pH-levels can define different types of aapa mires.

Habitat Type

Code and name

D3.2 Aapa mire

View over a southern subtype aapa mire complex in Patvinsuo National Park, southeastern Finland. Hummock strings are low and narrow. Hollows of aapa mires are called flarks. The southern variant has usually intermediate wetness. *Sphagnum* mosses are abundant but they do not form a continuous, thick peat layer. In this area basal peat is 8000-10000 years old and peat thickness is less than one metre. The central patterned fen area is classified as the D3.2 Aapa mire -habitat type. (Photo: Teemu Tahvanainen).



A northern subtype of the aapa mire habitat. Hummock strings can be high partly due to cryoturbation. Flarks are open water pools with floating Amblystegiaceae mosses. This site is of intermediate pH level, as indicated by abundant Carex livida in string margins. If rich fen indicators are abundant, these aapa mires are included in Calcareous quaking mires. (Photo: Teemu Tahvanainen).

Habitat description

This habitat consists of minerotrophic main mire surfaces of the central parts of Aapa mire complexes in boreal Fennoscandia. Aapa mires include both topogenous and soligenous types with varying degrees of slope. The peat layer is usually relatively thin (< 2 m) and mainly composed of *Carex* peat and to lesser extent by remains of *Sphagnum* and other mosses. The peat is highly water saturated and water table is located very close to peat surface or above it leaving little space for aerobic rhizosphere. Peat and pore water are usually moderately to slightly acidic (with a pHof 4.5 to 5.5). Typically there is a regular pattern of alteration of variably wide wet *flarks* (wet hollows) or pools and narrow hummock strings that relate to topography, hydrology, peat formation and ice dynamics. Hummock string patterning is oriented perpendicular to slope and water flow. The strings act as dams to store water in the flarks. The string-flark pattern is dense on steep slopes, while nearly non-patterned aapa mires occur in flat terrains. Trees (*Pinus sylvestris, Betula pubescens*) are absent or sparsely found on hummock strings and are more abundant only near mire margins. *Sphagnum* and Amblysegiaceae mosses dominate the ground layer of vegetation, while hepatics growing on muddy peat and open water surfaces are common in the flarks. Aapa mires include subtypes ranging widely from nearly ombrotrophic poor fen vegetation to rich fen vegetation. However, aapa mires with true rich fen vegetation are assessed as part of D4.1c Calcareous quaking mires.

Wet flarks of aapa mires are characterized by abundance of sedges such as *Carex limosa, Carex rostrata*, *Carex chordorrhiza*, *Eriophorum angustifolium* and herbs such as *Equisetum fluviatile, Menyanthes trifoliata* and *Potentilla palustris.* Among typical carnivorous plants, *Drosera longifolia* and *Utricularia intermedia* are common in aapa mire flarks. Characteristic mosses include *Warnstorfia fluitans, Warnstorfia exannulata* and *Warnstorfia procera*, while quaking carpets of *Sphagnum majus, Sphagnum papillosum* and *Sphagnum pulchrum* are also common especially in southern range of aapa mires. The hummock strings are typically dominated by *Sphagnum* and sedges. Characteristic species are *Sphagnum angustifolium*, *Sphagnum fallax, Sphagnum flexuosum, Sphagnum magellanicum* and *Sphagnum papillosum* among mosses and *Carex lasiocarpa* and *Eriophorum vaginatum* are the commonest sedges. The degree of minerotrophic influence strongly affects species composition and diversity of vegetation. With increasing minerotrophic influence (pH 5-6) typical species of wet flarks may include *Sphagnum platyphyllum, Utricularia minor* and *Carex livida*. In hummock strings, *Sphagnum subfulvum, Sphagnum subsecundum, Sphagnum teres, Sphagnum warnstorfii, Carex dioica, Molinia caerulea, Trichophorum alpinum, Selaginella selaginoides* and *Tofieldia pusilla* are typical indicators of higher minerotrophic level. Sometimes strings have high hummocks with *Sphagnum fuscum* hummock vegetation, most typically in

marginal areas and are often characterized by abundance of *Betula nana*.

Indicators of good quality:

- Under natural conditions, the water table is very close to peat surface in wet areas (flarks) between hummock strings, often forming open water surfaces.
- There are no ditches that drain or disconnect water flow (seepage or overland flow) in the aapa mire complex.
- Water quality reflects minerotrophy with moderately acidic pH values (4.5-6.5).
- Minerotrophic sedges and bryophytes are abundant.
- Trees are found only scatteredly in hummock strings and margins.

Characteristic species:

Flora

Vascular plants: Agrostis canina, *Andromeda polifolia, Betula nana, Calamagrostis stricta, Carex aquatilis, Carex buxbaumii, Carex chordorrhiza, Carex diandra, Carex dioica, Carex heleonastes, Carex lasiocarpa, Carex limosa, Carex livida, Carex magellanica* ssp. *irrigua, Carex nigra* ssp. *nigra, Carex rostrata, Carex rotundata, Chamaedaphne calyculata, Dactylorhiza incarnata* ssp. *incarnata, Dactylorhiza maculata, Drosera rotundifolia*, *Drosera longifolia, Empetrum nigrum* ssp. *hermaphroditum, Epilobium palustre, Eriophorum angustifolium, Eriophorum gracile, Eriophorum russeolum, Eriophorum vaginatum, Equisetum fluviatile, Huperzia selago, Juncus stygius, Menyanthes trifoliata, Molinia caerulea, Parnassia palustris, Pedicularis palustris, Pinguicula villosa, Potentilla palustris, Rubus chamaemorus, Salix lapponum, Salix myrtilloides, Scheuchzeria palustris, Selaginella selaginoides, Solidago virgaurea, Stellaria palustris, Tofieldia pusilla, Trichophorum alpinum, Trichophorum cespitosum, Utricularia intermedia, Utricularia minor, Utricularia vulgaris, Vaccinium oxycoccos*

Mosses: *Barbilophozia kuntzeana, Calliergon richardsonii, Cinclidium subrotundum, Cladopodiella fluitans, Gymnocolea inflata, Hamatocaulis vernicosus, Loeskypnum badium, Scorpidium revolvens, Sphagnum angustifolium, Sphagnum annulatum, Sphagnum compactum, Sphagnum fallax, Sphagnum flexuosum, Sphagnum jensenii, Sphagnum lindbergii, Sphagnum magellanicum, Sphagnum majus, Sphagnum papillosum, Sphagnum platyphyllum, Sphagnum pulchrum, Sphagnum riparium, Sphagnum subfulvum, Sphagnum subsecundum, Sphagnum warnstorfii, Straminergon stramineum, Warnstorfia fluitans, Warnstorfia exannulata, Warnstorfia procera, Warnstorfia sarmentosa*

Fauna

Birds: *Anser fabalis, Anthus pratensis, Asio flammeus, Circus cyaneus, Cygnus cygnus, Emberiza schoeniculus, Falco columbarius, Falco subbuteo, Gallinago gallinago, Grus grus, Lagopus lagopus, Lanius excubitor, Limicola falcinellus, Lymnocryptes minimus, Motacilla flava, Numenius arquata, Numenius phaeopus, Phalaropus lobatus, Philomachus pugnax, Pluvialis apricaria, Tringa erythropus, Tringa nebularia, Tringa glareola*

Insects: *Boloria freija, Boloria frigga*

Classification

This habitat may be equivalent to, or broader than, or narrower than the habitats or ecosystems in the following typologies.

EUNIS:

D3.2 Aapa mires

EuroVegChecklist (alliances):

Mosaic of different alliances

Annex 1:

7310 Aapa mires

Emerald:

D3.2 Aapa mires

MAES-2:

Wetlands

IUCN:

5.4. Bogs, Marshes, Swamps, Fens, Peatlands

National classifications:

Strängflarkkärr, Strängblandmyr (Sweden)

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?
Yes

Regions
Boreal

Justification
Aapa mires have their main distribution in the north-boreal zone with high climatic moisture surplus and rich snow cover. In the south-boreal zone, aapa mires are found occasionally in places where extra moisture is provided by large catchment area.

Geographic occurrence and trends

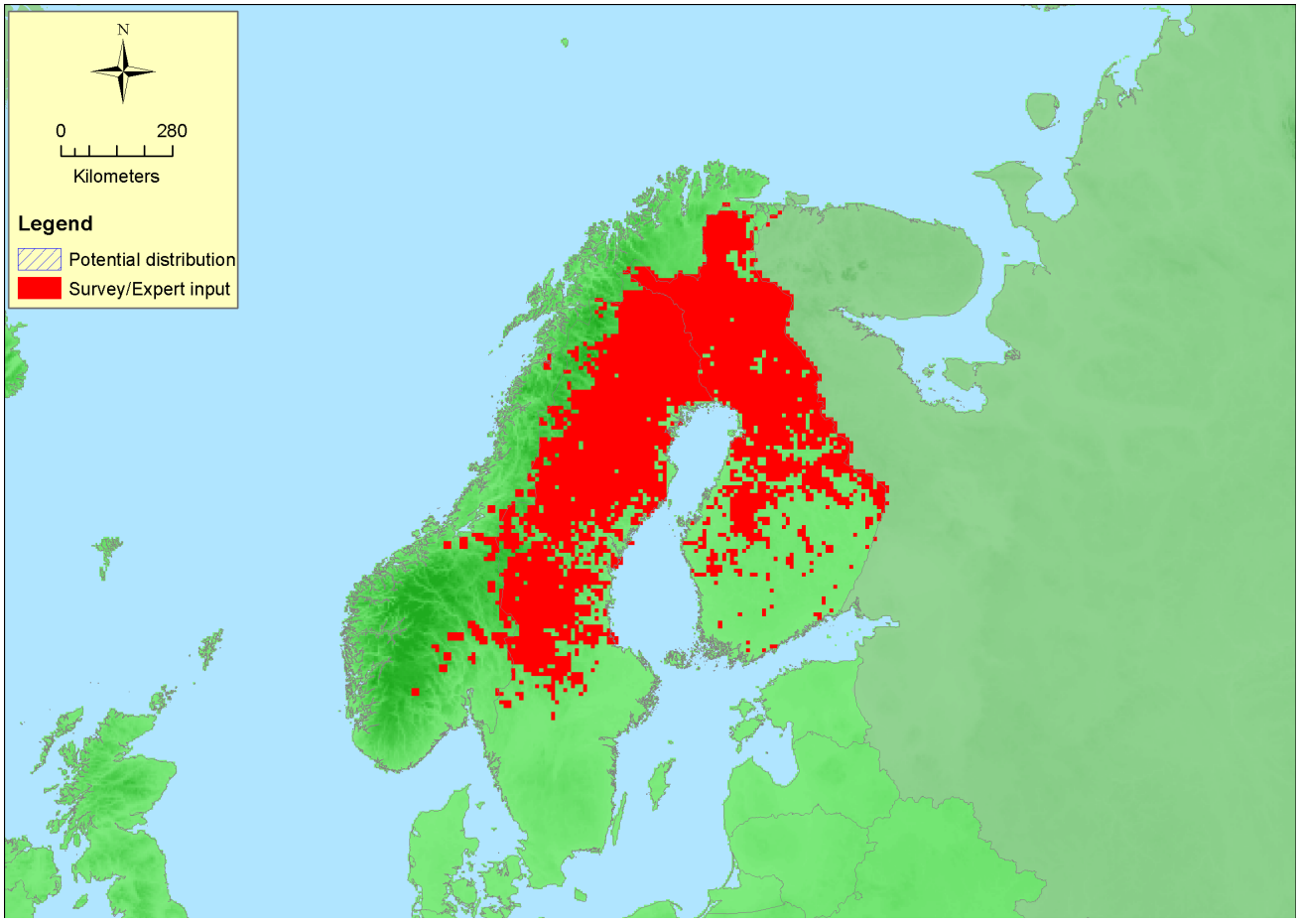
EU 28	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Finland	Finland mainland: Present	1800 Km^2	Decreasing	Decreasing
Sweden	Present	4600 Km^2	Decreasing	Decreasing
UK	United Kingdom: Uncertain	Unknown Km^2	Unknown	Unknown

EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Norway	Norway Mainland: Present	5000 Km^2	Decreasing	Decreasing

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	858400 Km^2	4211	Km^2	
EU 28+	998350 Km^2	4331	Km^2	

Distribution map



The habitat is confined to north-boreal climates and hence occurs only in northern Sweden, Norway and Finland. Some patterned fens in Scotland and in Central European mountain areas resemble the habitat description of aapa mires, but are not included here as its presence in these countries needs to be confirmed. The map is complete for the EU28plus. Data sources: Art17, BOHN.

How much of the current distribution of the habitat type lies within the EU 28?

10-15% of the global Aapa mire distribution lies within the EU 28, as this habitat habitats areis abundant in certain areas in Canada and Russia.

Trends in quantity

Aapa mire habitats have experienced only limited historical area decline as a result of their clearance for fields in their southern distribution range. Recent past trends are more remarkable, and the most significant factor that has affected the habitat type is the drainage for forestry purposes in Finland. In addition, also peat mining has lead to area loss of aapa mires. Recent area decline is estimated to be 10-20%. Some future area decline is expected if peat extraction continues in Finland.

- Average current trend in quantity (extent)
  EU 28: Stable
  EU 28+: Stable
- Does the habitat type have a small natural range following regression?
  No
  Justification
  The area decline in aapa mires has not been very dramatic.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification

This habitat type is widespread in the north-boreal zone.

Trends in quality

The historic trend for aapa mire quality is stable. A recent decreasing quality trend is the result of hydrological changes (ditching, water extraction) of mire catchment areas that reduce groundwater availability for aapa mires. In the future, climate warming and declining water surplus are expected to further degrade the habitat quality of aapa mires. Hydrological changes typically trigger vegetation changes, including increased tree encroachment and increase of bog vegetation.

- Average current trend in quality
  EU 28: Decreasing
  EU 28+: Decreasing

Pressures and threats

Drainage for forestry purposes, peat extraction, building water reservoirs and in the past also clearing of agricultural land have destroyed parts of the habitat distribution. habitat occurrences. The Sstructure and function of this habitat have deteriorated mainly because of hydorological changes caused by ditching and other land use in the surroundings of the site and in the catchment area. Pressures of lower importance include also vvarious construction activities, e.g.such as the building of roads, water engineering, water abstractions from ground water and mining activities. In addition, climate warming is also expected to amplify hydrological changes through droughts and less precipitations and water changes, which could lead to . Following hydrological changes, natural acidification and succession from fen to bog vegetation can be expected in the future.

List of pressures and threats

Agriculture

Agriculture activities not referred to above

Sylviculture, forestry

Forestry activities not referred to above

Mining, extraction of materials and energy production

Mining and quarrying
- Peat extraction
- Mechanical removal of peat

Natural System modifications

Human induced changes in hydraulic conditions
- Modification of hydrographic functioning, general
- Reservoirs
- Water abstractions from groundwater
- Groundwater abstractions for public water supply
- Other human induced changes in hydraulic conditions

Natural biotic and abiotic processes (without catastrophes)

Biocenotic evolution, succession
- Species composition change (succession)
- Acidification (natural)

Climate change

Changes in abiotic conditions
Droughts and less precipitations
pH-changes

Conservation and management

Aapa mires are well represented in protectedconservation areas in northern Finland and Sweden. Restoration of drained aapa mires has been conducted in many Finnish conservation areas. Destructive use mainly for peat extraction leading to destruction of the habitat is being increasingly restricted to directed to disturbed sites only. However, many valuable sites are still not protected and would require conservation investments, for conservation especially in their southern distribution range of aapa mires. Restoration of the hydrological conditionsnections of aapa mire habitats to their groundwater supplying catchment areas would be neededare required in many cases to prevent further decline of the quality of the habitat.

List of conservation and management needs

Measures related to forests and wooded habitats

Restoring/Improving forest habitats

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality
Restoring/Improving the hydrological regime
Managing water abstraction

Measures related to spatial planning

Establish protected areas/sites
Manage landscape features

Measures related to special resouce use

Regulating/Management exploitation of natural resources on land

Conservation status

D 3.2 Aapa mires are included in Annex 7310 Aapa mires and have a favorable conservation status (FV) in their northern range, while both Finland and Sweden report inadequate (U1) status in the boreal zone. Sweden and Finland report a total of 32400 km^2 for Annex 7310 Aapa mires. This is considerably more (5x) than the 6400 km^2 total area assessed here for EU28. Main reason for this difference is that Annex 7310 Aapa mires have been assessed as a more broadly defined type, not defined by patterned fen habitat area, but including whole complexes (Finland) and therefore several other D-types (D2.2a, D2.2c, D2.3a) and boreal bog conifer woodlands (G-types) of margins of aapa mire complexes.

When severely damaged, does the habitat retain the capacity to recover its typical character and functionality?

Severe damage to aapa mires due to peat extraction can be irreversible. When the hydrology of Severely damaged aapa mires has been strongly altered, in terms of strongly altered hydrology the habitat can be restoredated and it has have the capacity to redevelop characteristic features within few decades. Active intervention by implementing hydrological restoration measures of hydrological restoration (such as blocking of ditches and, damming) is needed. Ditches can also be filled with moss biomass and detritus naturally, but in such cases the recovery of characteristic features is slow, because this habitat type is dependent on very high water level and threshold of runoff.

Effort required

10 years	20 years	50+ years	200+ years
Through intervention	Through intervention	Through intervention	Naturally and through intervention

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	-15 %	Unknown %	Unknown %	Unknown %
EU 28+	-17 %	Unknown %	Unknown %	Unknown %

A decline of 15% of the habitat type in EU28 and of 17% in EU28+ has occurred over the past 50 years, and thus the habitat is assessed as Least Concern under Criterion A. In Finland, there has been an area decline of between 10-20%, as calculated by the Finnish National forest inventory (Valtakunnan metsien inventointi, VMI) from decline of "Flark fens", which also includes D2.3a Quaking mires. The types "Strängflarkkärr" and "Strängblandmyr"in Swedish wetlands inventory (Våtmarks inventering, VMI) are interpreted as D3.2 Aapa mires and the fact that their recent trends of quality decline (påverkansgrad) are clearly smaller than most other mire types indicates also a relatively small area effect. There is no information available on the future and historic trends of this habitat type.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	>50000 Km^2	Yes	Yes	Unknown	>50	Yes	Yes	Unknown	Unknown
EU 28+	>50000 Km^2	Yes	Yes	Unknown	>50	Yes	Yes	Unknown	Unknown

The EOO and AOO values exceed the thresholds for a threatened category as this habitat is very widespread and thus the habitat type is assessed as Least Concern under Criterion B. However, a continuing decline is caused by peat extraction and there are ongoing threatening processes to his haibtat type as a result of hydrological changes due to climate change and catchment drainage.

Criterion C and D: Reduction in abiotic and/or biotic quality

Criteria C/D	C/D1		C/D2		C/D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	33 %	30 %	Unknown %	Unknown %	Unknown %	Unknown %
EU 28+	33 %	30 %	Unknown %	Unknown %	Unknown %	Unknown %

Criterion C	C1		C2		C3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %
EU 28+	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %

Criterion D	D1		D2		D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	Unknown %	Unknown%	Unknown %	Unknown%	Unknown %	Unknown%
EU 28+	Unknown %	Unknown%	Unknown %	Unknown%	Unknown %	Unknown%

Finland reported slight severity decline affecting 10-20% area, although this may be an underestimate since hydrological change impacts and climate change effects can be difficult to detect. In Sweden, *ca.* 40% of "Strängflarkkärr" and "Strängblandmyr" are reported to have mainly weak local effects (in Våtmarksinventering). A combination of these data results into an extent of 33% with relative severity of 30% of the area of this habitat type. The main factor of degradation affecting the habitat type is the disturbance to hydrology, which is linked to vegetation changes. Thus, the habitat type is assessed as Least Concern under Criterion C/D1, as both abiotic and biotic factors are considered. As no quality data was available for Norway, but there is no reason to expect more critical trends than in other countries, the EU28+ is the same assessment as the EU28 one. There is no information on the historic and future decline in quality of this habitat type.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

Criterion E	Probability of collapse
EU 28	Unknown
EU 28+	Unknown

Individual case studies indicate rapid changes in aapa mires (Tahvanainen 2011, Tahvanainen *et al.* 2016) but there is not sufficient data to apply Criterion E.

Overall assessment "Balance sheet" for EU 28 and EU 28+

	A1	A2a	A2b	A3	B1	B2	B3	C/D1	C/D2	C/D3	C1	C2	C3	D1	D2	D3	E
EU28	LC	DD	DD	DD	LC	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	LC	DD	DD	DD	LC	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Least Concern	-	Least Concern	-

Confidence in the assessment

Medium (evenly split between quantitative data/literature and uncertain data sources and assured expert knowledge)

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