# The peatland map of Europe

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## SUMMARY

Based on the 'European Mires Book' of the International Mire Conservation Group (IMCG), this article provides a composite map of national datasets as the first comprehensive peatland map for the whole of Europe. We also present estimates of the extent of peatlands and mires in each European country individually and for the entire continent. A minimum peat thickness criterion has not been strictly applied, to allow for (often historically determined) country-specific definitions. Our 'peatland' concept includes all 'mires', which are peatlands where peat is being formed. The map was constructed by merging national datasets in GIS while maintaining the mapping scales of the original input data. This 'bottom-up' approach indicates that the overall area of peatland in Europe is 593,727 km². Mires were found to cover more than 320,000 km² (around 54 % of the total peatland area). If shallow-peat lands (< 30 cm peat) in European Russia are also taken into account, the total peatland area in Europe is more than 1,000,000 km², which is almost 10 % of the total surface area. Composite inventories of national peatland information, as presented here for Europe, may serve to identify gaps and priority areas for field survey, and help to cross-check and calibrate remote sensing based mapping approaches.

**KEY WORDS**: drained peatland, GIS, Histosol, mire, organic soil, peat

## INTRODUCTION

Peatlands increasingly play a role in policy relating to climate change, biodiversity and ecosystem services. Spatially explicit information on peatland distribution is needed to raise awareness of peatlands, to assess their ecosystem values, functions and losses, and to develop and implement strategies for peatland protection and wise use (FAO 2017). Surprisingly, no detailed and complete peatland map yet exists for the continent with the longest history of peatland study and exploitation - Europe.

During the last half-century or so, maps of Europe have been produced showing mire regions (*e.g.*, Kats 1971) or the general occurrence of peatlands (*e.g.*, Lappalainen 1996). Jones *et al.* (2004, 2005) presented the first map of organic carbon in topsoil (OCTOP, 1 km × 1 km raster) but this did not include many east European countries or European Russia. A map of the European Soil Database (European Soil Bureau 2004, 1:1,000,000) covered the entire continent, but left out peat soils in various peatland-rich areas (Sweden, Denmark, Lithuania) and almost all south European countries. Montanarella *et al.* (2006) produced a peatland map by combining the OCTOP dataset and the European Soil Database, again excluding a large part of Europe (*e.g.*, Belarus, Iceland, Moldova, Russian Federation, Svalbard and Ukraine). In 2009, in response to the scarcity of harmonised up-to-date organic carbon data, the LUCAS (Land Use/Cover Area frame statistical Survey) topsoil survey was implemented at European Union (EU) level and was based on 20,000 soil samples analysed centrally (Montanarella *et al.* 2011). De Brogniez *et al.* (2015) used the LUCAS topsoil carbon data to create a map of predicted topsoil organic carbon content, an approach which Yigini & Panagos (2016) extended to predict present and future soil organic carbon stocks in the EU using climate and land cover change scenarios.

Some of the earlier pioneering work towards a peatland map of Europe was severely hampered by scarcity and heterogeneity of digital data. Until recently, geographic information systems (GIS) were not widely used across Europe, and much of the national soil and vegetation inventory information was stored in formats that were almost impossible to combine and harmonise between countries, and seldom fully accessible. Harmonisation has improved considerably in the last decade, but only at EU level. Therefore, until now there has been no peatland map for the entire geographical extent of Europe.

In recent years, information on peatland distribution within the countries of Europe has been compiled by the Greifswald Mire Centre (GMC) in the process of producing the book *Mires and Peatlands of Europe* (Joosten *et al.* 2017a) for the International Mire Conservation Group (IMCG). The history of this 'European Mires Book' dates back to 1990, when IMCG decided to compile a comprehensive report on the mires of Europe. Earlier less complete attempts include the 1980 Council of Europe review covering 17 'west' European countries (Goodwillie 1980) and the 1988 review of peat resources in the European part of the Soviet Union and 26 other European countries (Olenin 1988). The changing political situation in central and eastern Europe in the late 1980s and early 1990s provided the interest and opportunity to examine the whole of Europe. Several major regional overviews were produced (*e.g.*, Minayeva *et al*. 2009; see Joosten *et al.* 2017b for an overview) and eventually, in 2017, the European Mires Book itself was finished. During compilation of this book it became clear that most countries nowadays possess either GIS data on the distribution of peatlands or proxy data that give a fair impression of national peatland distribution. Thus, it is now possible to provide a composite map of national datasets as the first comprehensive peatland map for the whole of Europe. Along with the map, this article presents best current estimates of the extent of mires and peatlands in each European country individually and for the entire continent.

## METHODS

Europe as a continent is a historical and cultural construct, defined only by convention. According to the modern geographical definition the border between Europe and Asia stretches along the Ural Mountains, the Ural River and the Caspian Sea in the east, and the Greater Caucasus range and the Black Sea with its Bosporus and Dardanelles outlets in the south-east. Fifty internationally recognised states (i.e. United Nations member states and the Holy See/Vatican City) have their territories within this geographical definition of Europe and/or are members of pan-European organisations (*e.g.*, Council of Europe). Of these 50 countries, five (Kazakhstan, Malta, Monaco, San Marino and Vatican City) are omitted because no peatlands are known to exist within (in the case of Kazakhstan, the European part of) their territories. Three archipelagos (Azores, Faroe Islands and Svalbard) are reported separately because of their geographical positions and distinct biogeographical features.

To obtain peatland distribution data we approached mire scientists, geologists, botanists, pedologists and other persons involved in mire science and peatland management from the IMCG network and beyond (usually 1–2 persons *per* country) in 2014–2016. We requested data on the distribution of 'peatland' as defined for the IMCG European Mires Book: "A peatland is an area with a naturally accumulated layer of peat at the surface" (Joosten *et al.* 2017c, 2017d). Peat is defined as sedentarily accumulated material of which at least 30 % (dry mass basis) is dead organic matter. The presence or absence of vegetation is irrelevant to the definition of peatland. No strict criterion for minimum thickness of the peat layer has been adopted, in line with the 2006 (Eggleston *et al.* 2006) and 2014 (Hiraishi *et al.* 2014) IPCC definitions of 'organic soil', which follow the FAO (2006) definition of Histosol but refrain from defining a minimum thickness for the organic layer (*cf.* FAO 2006 and FAO 2015 for Histosols) to allow for variety amongst country-specific definitions, which are often historically determined. This 'peatland' concept includes all 'mires', *i.e.* peatlands where peat is being formed (Joosten *et al.* 2017c, 2017d).

For each country, the available datasets and their correspondence to the definition of peatland adopted for our mapping purposes, as well as their uncertainties, were discussed individually before single or combined datasets were selected for inclusion in the composite map. We had to use data on soil or ecosystem types that may not exactly comply with our 'peatland' concept, but in absence of better data give a fair impression of the peatland (= organic soil) distribution, for a few countries, namely: Austria ("Moor"), Denmark ("mose", "eng", and "strandeng" protected under §3 Danish Protection Act), Finland ("suo"), Hungary ("láp"), Iceland ("votlendi"), Norway ("myr"), Russian Federation (“zabolochennye melkootorfovannye zemli” and “boloto”), Sweden (“myr”), and Switzerland (“Moor”). For eight countries, information on the occurrence of peatlands was deduced from the distribution of potentially peat-forming vegetation types or peatland-associated habitat types only (Andorra, Belgium, Luxembourg, Republic of Moldova) or from vegetation/habitat information in combination with peatland data (Bulgaria, Czech Republic, Hungary, Italy). All of the national datasets used in the map are described in Appendix 1.

The map was constructed in ArcGIS 10.3 by merging national datasets (‘bottom-up approach’) while maintaining the mapping scale of the original input data. Polygon data for peatland borders (and rarely for larger areas containing several smaller peatlands) were used if available. For countries with point data, all points were transformed into polygons representing 50 ha and those for peatlands of size > 50 ha identified by name in the national dataset were enlarged to approximate the real shape and size of the peatland based on comparison with satellite imagery (Google Earth, *cf.* Connolly & Holden 2011).

The map layout was also produced in ArcGIS 10.3 (A3 format). For all countries except Russia, the data were displayed in greyscale 60 %. For Russia we distinguished areas with peat layers ≥ 30 cm thick (greyscale 50 %) from paludified shallow-peat lands (greyscale 30 %) (see Appendix 1). To improve visibility of the biogeographically important small peatlands in (mostly) southern Europe, polygons were symbolised in ArcGIS with solid (width 0.4 point) outlines for the following countries: Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, France (dataset 2 only; for dataset 1 the outline width is 0.2 point; see Appendix 1), Georgia, Greece, Italy, Liechtenstein, Republic of Macedonia, Republic of Moldova, Montenegro, Portugal, Serbia, Slovenia, Spain, Svalbard, Turkey and Ukraine (dataset 2 only, see Appendix 1). All other country data were depicted with dotted polygon outlines (dashes of width 0.01 point and length 1 point, separated by 9-point gaps). Very accurately mapped small peatlands (*e.g.*, in Andorra) could not be depicted. For the purposes of this article, the map was exported from ArcGIS into a tif raster format (300 dpi, 8-bit grey scale, LZW compression; provided in Supplementary Material).

Our estimates of the total peatland area *per* country rely either on the national GIS data or stem from published inventories, soil maps, or detailed lists of current peatland areas which were often personally visited by the respective national authors. Estimates of the total current mire area *per* country, *i.e.* of the area of peatland where peat is currently being formed (Joosten *et al.* 2017c, 2017d), are provisional for most countries. Whereas there are indicators for peatland degradation that can easily be identified by remote sensing (*e.g.*, low water levels, ditches, specific vegetation and land uses), it is much more difficult to reliably assess current peat formation (Joosten *et al.* 2017c). Therefore, often only a range of ‘educated guesses’ could be derived from existing data. The approach to estimating mire area varied substantially between countries. In many cases expert judgement was applied to roughly estimate the peat-forming fractions of areas assigned to relevant vegetation or habitat types, perhaps for EU Natura 2000 reporting purposes - for example, 100 % for active raised bog (EU Habitat 7110) and 10 % for alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (EU Habitat 91E0). Estimates for mire areas not covered by Natura 2000 habitat types (*e.g.*, certain fens) were based on the expert knowledge of national authors. Another approach was to subtract the area of drained peatland from the total area of peatland and take the remainder as the estimate of mire area. This may have resulted in either over-estimation (if types of degradation other than drainage were present) or under-estimation (if areas reported as ‘drained peatland’ had been abandoned and undergone spontaneous or planned rewetting). For a very few countries with low peatland cover, in the absence of better data the total peatland area had to be used as the estimate of total mire area.

## RESULTS

The distribution of peatland in Europe is strongly imbalanced, with much more peatland occurring in the north than in the south (Figure 1, Table 1). The occurrence of peatland roughly reflects the influence of rainfall and temperature, with less peatland occurring where summer temperatures are higher and rainfall is lower (Moen *et al.* 2017). The effect of different definitions of peatland is visible, *e.g.*, along the Azov Sea coast, where “paludified shallow-peat lands” are shown for the Russian Federation but not for Ukraine. The diversity in mapping accuracy among countries is visible, *e.g.*, along the Finnish-Russian border (peatlands being under-represented in the Russian Federation because maps with different scale were used - the discontinuity would disappear when using regional peatland maps for Russian provinces neighbouring Finland, *e.g.*, Republic of Karelia and Leningrad Oblast) and along the Polish-Belarusian-Ukrainian borders (with peatlands being over-represented in Ukraine).

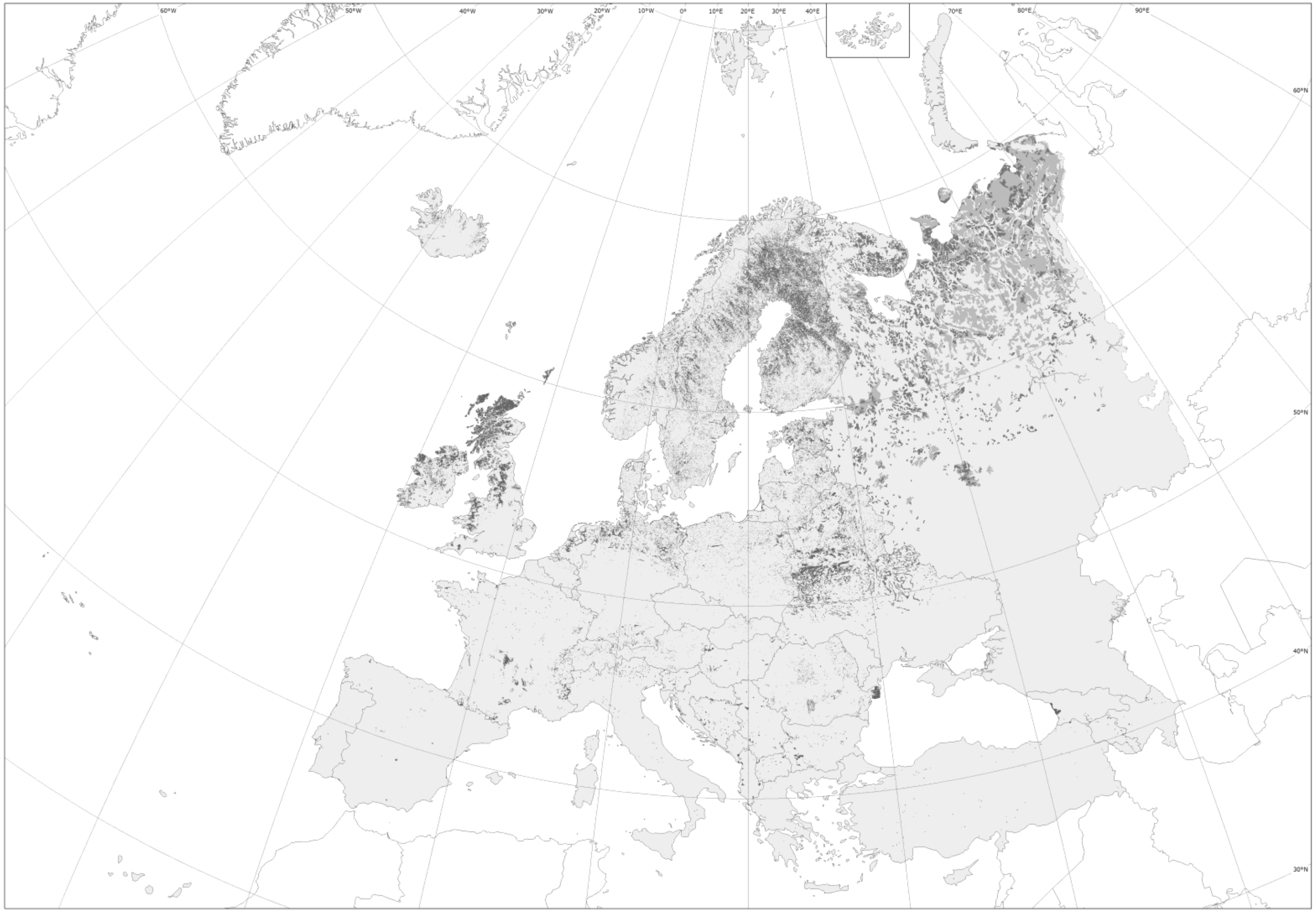

Figure 1. The composite peatland map of Europe, showing the distribution of peatland/organic soils derived from best-available national datasets. Note that small and sparsely distributed peatlands in (mostly) southern European countries are slightly enlarged for better visibility, and that the paler shading in European Russia represents peat < 30 cm thick. See text for further details.

Table 1. Estimated peatland and mire areas *per* country (in km²), as in Joosten *et al.* (2017a); also expressed as fractions (%) of, respectively, the country's surface and total peatland areas. Unless otherwise indicated, the data refer to areas with a minimum peat thickness of 30 cm. The country areas are total surface areas, including land and inland water bodies but excluding polar regions and uninhabited islands, from UNSD (2012) except for European Russia. Superscripted numbers refer to notes located below the Table.

| Country | country area (km²) | peatland area | | | | mire area | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | min (km²) | max (km²) | estimate (km²) | % of country area | min (km²) | max (km²) | estimate (km²) | % of peatland area |
| Albania | 28,748 | | | 44 | 0.15 | 3 | 4 | 3.5 | 7.95 |
| Andorra | 468 | | 5 | 5 | 1.07 | | 5 | 5 | 100 |
| Armenia | 29,743 | 42 | 52 | 47 | 0.16 | | | 37 | 78.72 |
| Austria | 83,871 | | | 1,200 | 1.43 | 150 | 200 | 175 | 14.58 |
| Azerbaijan | 86,600 | 0.5 | 2.7 | 2.7 | < 0.1 | | 2.7 | 2.7 | 100 |
| Azores | 2,333 | | | 160 | 6.86 | | | 80 | 50.00 |
| Belarus | 207,600 | | | 25,605 | 12.33 | | | 8,630 | 33.70 |
| Belgium | 30,528 | | | 247.8 | 0.81 | | | 60 | 24.21 |
| Bosnia and Herzegovina | 51,209 | 170 | 190 | 180 | 0.35 | | | 162.5 | 90.00 |
| Bulgaria | 110,900 | 66.5 | 350 | 208 | 0.19 | | | 54 | 25.96 |
| Croatia | 56,594 | 15 | 51.2 | 33.1 | 0.06 | 0.2 | 0.3 | 0.3 | 0.76 |
| Cyprus | 9,251 | | | < 0.1 | < 0.1 | | < 0.1 | < 0.1 | 100 |
| Czech Republic | 78,866 | | | 285.4 | 0.36 | | | 150 | 52.56 |
| Denmark | 43,094 | | 2,029 | 2,029 | 4.71 | | 137 | 137 | 6.75 |
| Estonia | 45,227 | | | 9,150 | 20.23 | 3,100 | 3,400 | 3,250 | 35.52 |
| Faroe Islands | 1,393 | | | 17.6 | 1.26 | | 17.6 | 17.6 | 100 |

| Country | country area (km²) | peatland area | | | | mire area | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | min (km²) | max (km²) | estimate (km²) | % of country area | min (km²) | max (km²) | estimate (km²) | % of peatland area |
| Finland | 337,010 | | | 90,000[1] | 26.71 | | | 35,000[1] | 38.89 |
| France | 551,500 | 2,750 | 3,000 | 2,875 | 0.52 | 750 | 1,000 | 875 | 30.43 |
| Georgia | 69,700 | | | 170 | 0.24 | | | 165 | 97.06 |
| Germany | 357,137 | | | 12,800 | 3.58 | | | 250 | 1.95 |
| Greece | 131,957 | | | 103 | 0.08 | | | 45 | 13.70 |
| Hungary | 93,026 | | | 300 | 0.32 | | | 75[1] | 25.00 |
| Iceland | 103,000 | | | 5,777[2] | 5.61 | | | 2,112[2] | 36.56 |
| Ireland | 69,825 | | | 14,664.7[3] | 21.00 | | | 2,692.7[3] | 18.36 |
| Italy | 301,339 | 300 | 1,200 | 750 | 0.25 | | 120 | 120 | 16.00 |
| Latvia | 64,562 | 5,991.9 | 9,036 | 7,514 | 11.64 | | | 3,165 | 42.12 |
| Liechtenstein | 160 | | | 2.6 | 1.63 | | | 1 | 38.46 |
| Lithuania | 65,300 | | | 6,460[4] | 9.89 | | | 1,781 | 27.57 |
| Luxembourg | 2,586 | 3 | 4 | 3.5 | 0.14 | | | 0.1 | 2.86 |
| Republic of Macedonia | 25,713 | | 281 | 281 | 1.09 | | | 13 | 4.63 |
| Republic of Moldova | 33,846 | | | 10 | < 0.1 | | | 1 | 10.00 |
| Montenegro | 13,812 | | | 75 | 0.54 | | | 50 | 66.67 |
| Netherlands | 37,354 | | | 2,733.4 | 7.32 | | | 150 | 5.49 |
| Norway | 323,787 | | | 44,700[1] | 13.81 | | | 37,700[1] | 84.34 |
| Poland | 311,888 | | | 14,950 | 4.79 | | | 2,390 | 15.99 |

| Country | country area (km$^2$) | peatland area | | | | mire area | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | min (km$^2$) | max (km$^2$) | estimate (km$^2$) | % of country area | min (km$^2$) | max (km$^2$) | estimate (km$^2$) | % of peatland area |
| Portugal | 89,879 | | | 271 | 0.29 | | | 10 | 3.69 |
| Romania | 238,391 | | | 7,690[5] | 3.23 | | | 1,427.7 | 18.57 |
| Russian Federation (European part) | ~4,000,000 | | | ~235,000/ ~680,000[8] | ~6.0/ ~17.0[8] | | >175,000[9] | >150,000[9] | 65–75[10] |
| Serbia | 88,361 | 30 | 100 | 100 | 0.11 | | | 12.5 | 12.50 |
| Slovakia | 49,036 | | | 60 | 0.12 | | | 30.6 | 11.77 |
| Slovenia | 20,273 | | | 83.9 | 0.41 | 4 | 4.5 | 4.3 | 5.07 |
| Spain | 505,992 | 300 | 400 | 350 | 0.07 | 180 | 220 | 200 | 57.14 |
| Svalbard | 62,422 | | | 3,000[1] | 4.81 | | | 3,000[1] | 100 |
| Sweden | 450,295 | 63,700 | 69,200 | 66,450 | 14.76 | | | 52,300 | 78.71 |
| Switzerland | 41,285 | | | 280[6] | 0.68 | | | 120 | 42.86 |
| Turkey | 783,562 | | | 220[1] | < 0.1 | | | 30[7] | 13.64 |
| Ukraine | 603,500 | | | 10,000[1] | 1.66 | | | 6,395[1] | 63.95 |
| United Kingdom | 242,495 | | | 26,838.3 | 11.07 | 7,500 | 10,000 | 8,750 | 32.60 |
| **Total** | | | | **~593,727** | | | | **~320,000** | **~54** |

[1] > 0 cm of peat; [2] > 0 cm of organic soil with > 12 % organic carbon content; [3] ≥ 45 cm of peat if undrained and ≥ 30 cm of peat if drained; [4] ≥ 30 cm of peat if undrained and ≥ 20 cm of peat if drained; [5] > 20 cm of organic soil with 20 % organic matter content; [6] >10 cm of organic soil with 20 % organic matter content; [7] > 20 cm of peat and >1 ha; [8] peatlands (> 30 cm peat) together with paludified shallow-peat lands (< 30 cm peat); [9] very rough estimate because statistics for agriculture and forestry do not distinguish between peatlands, shallow-peat lands and paludified mineral lands within drained lands (see Sirin & Minayeva 2001, Minayeva *et al.* 2009); [10] rather rough estimates - in some regions more than two-thirds of the peatland area may be drained, whereas in other regions almost the entire peatland area is undisturbed (Minayeva *et al.* 2009, Joosten *et al.* 2017a).

The total extent of peatland *per* country ranges from 0.015 km² (Cyprus) to around 235,000 km² (European Russia; Table 1). Proportionally (peatland as a fraction of the total area of the country), Finland is the country with most peatland (26.7 %). The extent of mire is highest in European Russia (more than 150,000 km²). The fraction of the total peatland area that is still mire is about 5 % or less in Croatia, Germany, Luxembourg, Republic of Macedonia, Netherlands, Portugal, and Slovenia (Table 1). In contrast, it is possibly close to 100 % in Andorra, Azerbaijan, Cyprus, Faroe Islands and Svalbard, which probably arises partly (*cf*. Andorra, Azerbaijan, Cyprus) because non-mire peatlands have rapidly disappeared by total oxidation of the peat layer. The overall area of peatland in Europe is estimated at 593,727 km² (5.4 % of the total surface area). Mires cover more than 320,000 km² (about 54 % of the peatland area). If shallow-peat lands (< 30 cm peat) in European Russia are also taken into account, the total peatland area in Europe is more than 1,000,000 $km^2$, which is almost 10 % of the total surface area.

## DISCUSSION

This article attempts to provide the most accurate representation of current peatland distribution across the whole of Europe that is possible on the basis of available national data, using a consistent definition of peatland. Where recent relevant systematic national soils data are not available, we have used proxy data and expert judgement. Although this approach weakens the consistency of the methodology, we expect it to increase the reliability and completeness of the final product.

Our estimates of national peatland/mire areas are largely derived from published sources. Combining them with other national GIS-based information, especially on land use, and using appropriate algorithms (including informed guesses) may improve the data, especially with regard to drained peatlands, whose extent may change rapidly as a result of ongoing peat oxidation (*cf*. Barthelmes *et al.* 2015 for Nordic and Baltic countries; datasets used in this publication). Eventually, however, national data must be improved by carrying out new inventories, either country-wide or in part of the country.

Too often, national soils data are still very diverse and disparate (*e.g.*, different techniques and scales of field survey, different criteria for classifying soils, different sampling methods and sampling densities), making it difficult to amalgamate the data meaningfully (Bragg & Lindsay 2003, Jandl *et al.* 2014). Combining standardised raster soil data with vegetation and climate data (‘top-down approach’, *cf.* Jones *et al.* 2004, 2005) can avoid some of these shortcomings. Montanarella *et al.* (2006) concluded that, for most European countries, the distribution of peat and peat-topped soils is more accurately portrayed by the map of organic carbon in topsoils (Jones *et al.* 2004) than by the European Soil Map (European Soil Bureau 2004). Still, the former approach yielded results that deviate substantially from the nationally-sourced information on peatland distribution presented here.

Ideally, future peatland mapping should be based on aggregated data from local and national peat surveys rather than global soil maps (Montanarella 2014). The first step towards establishing a fully operational global peatland information system would be a complete inventory of available national peatland data, as presented here for Europe. Such an inventory can serve to identify gaps and priority areas for field surveys and further data collection activities. Remote sensing based mapping approaches (*e.g.*, Gumbricht *et al.* 2017) may benefit from ‘bottom-up’ composite maps of national datasets when calibrating and cross-checking their modelling results. However, as long as elaborated ‘top-down’ maps for the whole of Europe are still absent, our map provides the most comprehensive distribution map of peatlands in Europe.

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## AUTHOR CONTRIBUTIONS

All authors except those from Greifswald Mire Centre (GMC) acquired, developed and/or modified national datasets (for their own countries) according to criteria set by, and extensive discussions with, the GMC authors. They also provided and checked the information presented in Table 1 and Appendix 1. Authors from GMC collaborated with the ‘national’ authors to develop, improve and augment the national datasets, compiled the data in GIS, and designed and created the composite peatland map of Europe. They also wrote the first draft of this article, which was then iteratively revised by all authors.

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# Appendix 1: National datasets used in the peatland map of Europe

The peatland data that make up the composite peatland map of Europe include data on soil and ecosystem types that may not exactly comply with the 'peatland' concept used in Joosten *et al.* (2017c, 2017d) and this article but, in the absence of better data, give a fair impression of the distribution of peatland. See the national chapters in Joosten *et al.* (2017a) for further details and references. PY = polygon, PT = point, R = Raster, GMC = Greifswald Mire Centre.

| **Country** | Dataset | Peatland data | Proxy data | **Dataset content** | **Year** | Data format | GIS edited by GMC | **Data creator/Holder of rights** |
|---|---|---|---|---|---|---|---|---|
| Albania | 1 | x | | "livadhore torfike" (upland peatland) | 1958 | PY | x | Soil Science Institute (IST), Tirana |
| | 2 | x | | peatlands | 2016 | PT | | S. Shumka |
| Andorra | 1 | | x | wetlands (five types) | 2013 | PY | | Department of Environment, Ministry of Tourism and Environment |
| Armenia | 1 | x | | peatlands | 2016 | PT | x | K. Jenderedjian and GMC |
| Austria | 1 | x | | "Moore" | 1992 | PY | | M.G. Steiner/Umweltbundesamt GmbH |
| | 2 | x | | soils rich in organic material based on the agricultural soil map | 2011 | R | x | Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft and Franz Essl |
| Azerbaijan | 1 | x | | studied, expected and destroyed peatlands | 2014 | PT | x | J. Etzold and A. Thiele |
| Azores | 1 | x | | peatlands (in a 2.5 km grid) | 2014 | R | | C. Mendes and E. Dias |
| Belarus | 1 | x | | "bolota" (mires) | 2016 | PY | | Scientific and Practical Centre for Bioresources |
| | 2 | x | | peatlands >10 ha | 2016 | PY | | Institute of Management of Natural Resources, National Academy of Sciences |
| Belgium | 1 | | x | peatlands, other mires/swobs, and wet forests (all related to Natura 2000 habitat types) | 2013 | PY | | Natural and Agricultural Environment Studies Department, Public Service of Wallonia; Research Institute for Nature and Forest |
| Bosnia and Herzegovina | 1 | x | | peatlands | 2013 | PY | | Đ. Milanović |

| **Country** | Dataset | Peatland data | Proxy data | **Dataset content** | **Year** | Data format | GIS edited by GMC | **Data creator/Holder of rights** |
|---|---|---|---|---|---|---|---|---|
| Bulgaria | 1 | | x | Natura 2000 habitat types 7140, 7210 and 7230 | 2013 | PY | | National Nature Protection Service |
| | 2 | x | | peatlands of international importance | 2014 | PT | | Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences |
| | 3 | x | | drained peatlands | 1995 | PT | x | T. Michev and GMC |
| Croatia | 1 | x | | peatlands | 2014 | PT | x | A. Alegro |
| Cyprus | 1 | x | | peatlands | 2014 | PY | | P. Delipetrou |
| Czech Republic | 1 | | x | mires based on NCA CR habitat mapping layer Version 2006, Chytrý *et al*. (2010), and Corine Land Cover 2006 | 2014 | PY | | J.Navrátilová and Nature Conservation Agency of the Czech Republic (NCA CR) |
| | 2 | x | | peatlands based on the ČGS geological map | 2014 | PY | | Czech Geological Service |
| Denmark | 1 | x | | “mose” (area with a natural peat layer), “eng” (meadow) and “strandeng” (saline meadow) protected under §3 Danish Nature Protection Act | 2009 | PY | | Danish Nature Agency |
| Estonia | 1 | x | | peatlands | 2011 | PY | | Estonian Land Board |
| Faroe Islands | 1 | x | | peatlands | 2006 | PT | x | A.M. Fosaa |
| Finland | 1 | x | | “suo” | 2011 | R | | National Land Survey of Finland and Finnish Environment Institute |
| France | 1 | x | | peatlands according to SOeS (2013) | 2013 | PY | | Service de l’Observation et des Statistiques |
| | 2 | x | | peatlands according to other sources compiled by Pôle-relais tourbières | 2014 | PT | | French Mire Resource Centre, Fédération des Conservatoires d'Espaces Naturels |
| Georgia | 1 | x | | peatlands | 2016 | PY | x | T. Bakuradze, M. Krebs and R. Kaiser |
| Germany | 1 | x | | peatlands based on geological map 1:200,000 (“Niedermoor” (fen)/ “Hochmoor” (bog)) | 2007/ 2011 | PY | | Federal Institute for Geosciences and Natural Resources |

| **Country** | Dataset | Peatland data | Proxy data | **Dataset content** | **Year** | Data format | GIS edited by GMC | **Data creator/Holder of rights** |
|---|---|---|---|---|---|---|---|---|
| Greece | 1 | x | | peatlands | 2016 | PT | x | K. Christanis |
| Hungary | 1 | x | | “tőzeg” (peat soil), “kotu” (degraded peat soil) | 1980 | PY | x | Várallyay *et al*. (1980) |
| | 2 | | x | mire-related ÁNÉR habitat types | 2011 | R | | MÉTA Program (Vegetation Heritage of Hungary) (2002–2008) |
| | 3 | x | | “láp” (peat forming vegetation and peat) under legal protection | 2003 | PT | | Ministry of Agriculture of Hungary |
| Iceland | 1 | x | | “votlendi” (wetland) | 2014 | R | | Agricultural University of Iceland (Icelandic Geographical Land Use Database (IGLUD)) |
| Ireland | 1 | x | | peatlands (raised bog, blanket bog, fen), blanket peat | 1981 | PY | | R.F. Hammond and J. Connolly |
| Italy | 1 | | x | areas >1 ha of Natura 2000 habitat types 7110, 7140, 7150, 7230 and 91D0 | 2015 | PT | | Italian National Institute for Environmental Protection and Research (ISPRA) |
| | 2 | x | | peaty / organic soils | 1966 | PT | x | F. Mancini/Comitato per la Carta dei Suoli |
| | 3 | x | | (former) peat extraction sites | 2013 | PT | x | Martinelli *et al*. (2005) |
| Latvia | 1 | x | | peatlands (raised bog, transition mire, fen) | 2013 | PY | | Latvijas Kūdras fonds, A. Lācis and O. Aleksāns |
| | 2 | x | | peat extraction sites | 2013 | PY | | A. Priede |
| Liechtenstein | 1 | x | | peatlands | 2016 | PT | x | GMC based on Broggi (2009)/GMC |
| Lithuania | 1 | x | | peatlands (raised bog, transition mire, fen) | 2004 | PY | | Lithuanian Geological Survey |
| Luxembourg | 1 | | x | Natura 2000 habitat types containing areas of open peatland | 2014 | PY | | Ministère du Développement durable et des Infrastructures |
| Republic of Macedonia | 1 | x | | “tresetishte, blato” (peatland), degraded peatland | 2016 | PT | | L. Melovski |
| Republic of Moldova | 1 | | x | wetlands, most likely with peat occurence | 2016 | PT | x | GMC based on chapter in Joosten *et al*. (2017a)/GMC |

| **Country** | Dataset | Peatland data | Proxy data | **Dataset content** | **Year** | Data format | GIS edited by GMC | **Data creator/Holder of rights** |
|---|---|---|---|---|---|---|---|---|
| Montenegro | 1 | x | | peatlands | 2014 | PY | x | D. Saveljić/Centre for Protection and Research of Birds of Montenegro and GMC |
| Netherlands | 1 | x | | peatlands (> 40 cm peat layer) | 2014 | PY | | Wageningen Environmental Research (Alterra) |
| Norway | 1 | x | | "myr" | 2015 | PY | | Staatens Kartverk www.statkart.no, NIBIO www.skogoglandskap.no |
| Poland | 1 | x | | peatlands (>10 ha, basin and raised bogs, transition and fen peatlands) | 2014 | PY | | Department of Nature Protection and Rural Landscape of the Institute of Technology and Life Sciences/Ministry of the Environment Poland |
| Portugal | 1 | x | | internationally important peatlands | 2016 | PT | x | J. Mateus and P. Queiroz |
| Romania | 1 | x | | peatlands (>20 cm peat layer) based on the Soil Geographical Information System of Romania (SIGSTAR-200) | 1999 | PY | | ICPA Bucuresti, authors: R. Vintila, I. Munteanu, C. Radnea, D. Turnea, G. Curelariu, I. Nilca, M. Jalba, I. Piciu, I. Rasnoveanu, C. Siletchi, M. Trandafir, G. Untaru, R. Vespremeanu and C. Cojocaru |
| Russian Federation (European part) | 1 | x | | "bolota" (peatlands, peat layer ≥ 30 cm thick) and "zabolochennye melkootorfovannye zemli" (paludified shallow-peat lands, peat layer < 30 cm thick)[1] | 2016 | PY | | Centre for Peatland Protection and Restoration, Institute of Forest Science, Russian Academy of Sciences |
| Serbia | 1 | x | | peatlands (five types; mires better covered than other peatlands) | 2014 | PY | | P. Lazarevic and Institute for Nature Conservation of Serbia |
| Slovakia | 1 | x | | mires | 2012 | PT | | DAPHNE - Institute of Applied Ecology |
| Slovenia | 1 | x | | peatlands (bog and fen) | 2002 | PT | | A. Martinčič and P. Skoberne |
| Spain | 1 | x | | internationally important peatlands | 2015 | PT | x | P. Heras, M. Infante, X. Pontevedra and J.C. Nóvoa |
| Svalbard | 1 | x | | internationally important peatlands | 2015 | PT | x | GMC based on chapter in Joosten *et al*. (2017a)/GMC |

| **Country** | Dataset | Peatland data | Proxy data | **Dataset content** | **Year** | Data format | GIS edited by GMC | **Data creator/Holder of rights** |
|---|---|---|---|---|---|---|---|---|
| Sweden | 1 | x | | peatlands | 2015 | PY | x | Geological Survey of Sweden (SGU) and Metria AB/Swedish EPA; further developed by GMC (see Barthelmes *et al*. 2015, pp. 167–171) |
| Switzerland | 1 | x | | “Hochmoore” (bogs) and “Flachmoore” (fens) | 2010 | PY | | Bundesamt für Umwelt (BAFU) |
| | 2 | x | | organic soils recommended for the greenhouse gas (GHG) inventory | 2015 | PY | x | C. Wüst-Galley *et al*./Agroscope |
| Turkey | 1 | x | | main peatlands, small active peatlands, peat-like formations (< 20 cm peat, < 1 ha), degraded or buried peatland | 2014 | PT | | S. Kirca |
| Ukraine | 1 | x | | organic soil (containing “bolotni”, “torfuvato-bolotni”, “torfovo-bolotni” soils, “torfovyshcha”) | 2014 | PY | x | Ukrainian Scientific Research Institute of Soil Science and Institute for Community Development |
| | 2 | x | | small mires in the Carpathians (based on Felbaba-Klyshina 2010) | 2014 | PT | x | Felbaba-Klyshina (2010) and GMC |
| United Kingdom | 1 | x | | peat and peaty soils | 2011 | PY | x | Macaulay Land Use Research Institute (MLURI; now James Hutton Institute) and University of Cranfield/Joint Nature Conservation Committee |

[1]Data for the European part of the Russian Federation (*ca*. 40 % of the land area of Europe) are based on the ‘Peatlands of Russia’ Geographic Information System (GIS) of the Institute of Forest Science at the Russian Academy of Sciences, which was initiated in the 1990s (Vompersky *et al.* 1996, 2011). More accurate regional maps (*e.g.*, Sirin *et al.* 2014) exist. Small peatlands typical for the southern (*e.g.*, Sirin *et al*. 2016) and mountain regions are mostly not represented. Data for Kaliningrad Oblast were added at higher resolution to match the mapping accuracy of neighbouring countries.

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