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Draft Resolution on guidance on identifying peatlands as Wetlands of International Importance (Ramsar Sites) for global climate change regulation as an additional argument to existing Ramsar criteria

Submitted by the Scientific and Technical Review Panel

1. RECALLING that Article 2.1 of the Convention requires the designation of Wetlands of International Importance (Ramsar Sites);
2. RECALLING ALSO the Vision for the Ramsar List and the criteria for designation of Ramsar Sites in Annex 2 to Resolution XI.8 on *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance of the Convention on Wetlands (Ramsar, Iran, 1971) – 2012 revision*;
3. FURTHER RECALLING Resolution XII.11 on *Peatlands, climate change, and wise use: Implications for the Ramsar Convention*, which requests the Scientific and Technical Review Panel (STRP) to develop guidelines for the further application, as regards peatlands, of Criterion 1 for the selection of Wetlands of International Importance, and in particular paragraph 121 of Annex 2 to Resolution XI.8, which encourages Contracting Parties to designate at least one peatland Ramsar site as appropriate, that is suitable for communication, education, and raising of awareness of the conservation, restoration and wise use of peatlands and their role in climate change mitigation and adaptation, and summarizes the significance of peatland conservation and management in the context of climate change;
4. RECOGNIZING that, through their sequestration of atmospheric carbon, wisely managed peatlands are an international asset with a value for global climate mitigation independent of their location;
5. NOTING that peatlands provide space-effective terrestrial stores of carbon, and that peatland conservation, including as a cost-effective measure to maintain terrestrial carbon stores (emission avoidance), and restoration (emission reduction) are among the measures for long-term climate-change mitigation;
6. RECALLING that the United Nations Framework Convention on Climate Change is the primary multilateral forum for addressing climate change issues and that the Intergovernmental Panel on Climate Change (IPCC) is the international body for assessing the science related to climate change, providing policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation; and NOTING

that some countries are currently testing the methodology in the *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*;

7. AWARE that peatlands store large quantities of carbon and that protection and restoration of peatlands contributes to climate change mitigation and adaptation, whereas the drainage of peatlands causes net emissions of greenhouse gases (GHGs),
8. NOTING that designation of even small peatlands as Ramsar Sites can be valuable for education and for raising public awareness of the nature of peatlands and their role in providing ecosystem services, including long-term carbon storage, and that the larger and thicker the peatland, the greater the sequestration capacity and the carbon stock, and the more the peatland contributes to climate change mitigation;
9. ALSO RECOGNIZING that permafrost loss and overgrazing may act as significant factors of peatland degradation;
10. NOTING the Ramsar Briefing Note on *Best practice guidelines for conducting tropical peatland inventories to facilitate their designation as Ramsar Sites*; and
11. RECOMMENDING that Parties with appropriate peatland sites consider the identification of potential peatland Ramsar Sites as an essential element of national wetland inventories, with due attention being paid to different types of peatlands and their condition;
12. RECOGNIZING that most of the peatlands in semi-arid regions are dependent on sustained groundwater and/or hillslope intermediate flows and therefore their designation should consider catchments and related landscapes as part of the strategy to conserve these peatlands;

THE CONFERENCE OF THE CONTRACTING PARTIES

13. ADOPTS the *Revised guidelines for identifying and designating peatlands* related to the designation of peatlands as wetlands of international importance, found in Annex 1 to the present Resolution, which replaces and supersedes Appendix E2 of the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance of the Convention on Wetlands (Ramsar, Iran, 1971) – 2012 revision*;
14. URGES Contracting Parties to use the Revised guidelines in their consideration of potential peatland Ramsar Sites as appropriate; and
15. ENCOURAGES Contracting Parties to use all available methods, including remote sensing, to help identify sites as appropriate; and
16. NOTES the case study included in Annex 2 to the present Resolution, related to the designation of a Wetland of International Importance that has contributed to better public awareness of the role of its peatland resource in relation to climate-change avoidance and mitigation; and RECOGNIZES that there are many other examples of designated Wetlands of International Importance that make the same or similar contributions.

Annex 1

Revised guidelines for identifying and designating peatlands

(Replacing and superseding Appendix E2 of the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance of the Convention on Wetlands (Ramsar, Iran, 1971) – 2012 revision*, as adopted by Resolution XI.8)

E2. Peatlands

Geographic distribution and extent

1. Peatlands are ecosystems with a peat soil. Peat consists of at least 30% dead, partially decomposed plant remains that have accumulated *in situ* under waterlogged and often acidic conditions. Peatlands cover over 400 million hectares worldwide and occur from the high mountains to the sea, and from high to low latitudes.
2. Commonly, many habitats with peat soil are not recognized as “peatlands” even if their peat layer is thick enough. However, some peatland examples include polygonal tundra, salt marshes and mangroves, paludified forests and cloud forests, high-mountain paramos, and dambos and vleis. Peat may be formed by various kinds of vegetation: a) bryophytes, mainly *Sphagnum* mosses and associated herbaceous and dwarf shrub species; b) herbaceous plants such as sedges and grasses; and c) trees such as in alder *Alnus* spp. forests in the temperate zone and in peat swamp forests in the tropics.

Ecological functions, ecosystem services/benefits, and societal values

3. Two main types of peatland are distinguished: bogs, which are rainwater fed and therefore acid and nutrient poor, and fens, which are additionally groundwater fed and thus generally less acid and more nutrient rich than bogs. In this guidance the term “peatland” includes both peatland with active peat accumulation (“mire”), and peatland that is no longer forming peat and may have lost peat forming vegetation and is degrading naturally or as a result of human intervention. Whereas the presence of peat is the defining characteristic of a peatland, vegetation and hydrology are key defining aspects of the peatland type.
4. Peatlands are important for the ecosystem functions and services they contribute to human well-being and to nature. The Common International Classification for Ecosystem Services (CICES)¹, accepted by most Parties as being one relevant non-exclusive source for peatland evaluation for the reporting in the Ramsar Information Sheet, distinguishes three main categories of ecosystem services.
 - a. Provisioning and supporting functions and services: for example, materials and energy, such as biodiversity, wild foods, drinking water and non-fossil and renewable biomass-based energy resources, as well as commercial development for food production.
 - b. Regulating functions and services: these relate to the maintenance of ecological conditions, such as climate regulation through carbon storage and sequestration, water regulation,

¹ See: <https://cices.eu/cices-structure>.

maintenance of water quality through removal of pollutants and nutrients, prevention of saline water intrusion, and protection from disasters.

- c. Cultural values: provision of non-material benefits, such as opportunities for recreation and education, culture and heritage, spiritual and aesthetic experiences, and information and knowledge, e.g. from biogeochemical and palaeo-environmental archives.

Peatland degradation

5. The main factors causing peatland degradation locally and globally include: a) drainage; b) vegetation removal or disturbance; c) infrastructure development; d) peat extraction; e) eutrophication and pollution; f) acid rain; g) water abstraction and/or diversion, and h) fire. These factors, which can occur in the peatlands or in their zones of influence, have various consequences, which need to be taken into consideration when defining the boundaries of peatland Ramsar Sites and determining their management:
 - a. The main drivers of peatland drainage are agriculture and forestry both on peatlands and related catchments. Peatland hydrology may be influenced by hydrological changes (e.g. drainage, erosion and groundwater abstraction) in adjacent land. Peatland drainage leads to increased greenhouse gas (GHG) emissions (carbon dioxide from peat oxidation, methane from drainage ditches, nitrous oxide from nitrification), subsidence (reduction in peat thickness by oxidation and compaction) and increased fire risk. Drainage affects water regulation capacity, and therefore water security of downstream human communities and ecosystems. Many peatlands are located close to sea or river level and subsidence may result in increased and prolonged flooding and salt water intrusion, thereby affecting the ecological character of the peatland. If the peatland is located on acidic sulphate soils, drainage may result in very acidic runoff rich in metals that contaminates the waters downstream.
 - b. Vegetation removal or disturbance (e.g. by land use change) directly reduces biodiversity (flora, fauna, their distribution patterns and population resilience). It exposes the peat to direct solar radiation and wind, water and frost erosion, resulting in changes in micro-climate and desiccation of the surface peat and flooding risk in the surrounding areas.
 - c. Construction of infrastructure (e.g. roads, pipelines, buildings) on peat causes compaction by overburden and vehicles and requires drainage (often resulting in erosion and exacerbating draining in drier climates). This results in habitat and species loss, change in drainage patterns and compaction flooding in wet periods and increased fire risk in dry ones. Construction in permafrost areas may result in ice thawing, termokarst, flooding and increased GHG emissions, especially of methane.
 - d. Peat extraction involves drainage and removal of peat (and vegetation), which reduces carbon storage and increases GHG emissions. There may also be local effects on water quality and regulation, and biodiversity, as well as aesthetic impacts potentially affecting the recreational potential.
 - e. Eutrophication (input of nutrients) is caused by direct on-site fertilization and atmospheric deposition, or (in fens) through input of nutrients in ground or surface water derived from the fertilizer added to surrounding landscape.
 - f. Acid rain deposition from industrial sources can severely affect the wildlife.

- g. Peatland fires have led to considerable damage of peatlands around the world, especially in drained and, thereby, dry peatlands affecting vegetation and emitting in some cases large amounts of GHG. Peatland fires and related haze have major economic impacts (for example, on transport, tourism, agriculture and forestry) and public health impacts.
- h. Specific quantitative and qualitative criteria for classifying peatlands as degraded are to be determined by Contracting Parties based on scientific, legislative and national policy considerations.

Peatland restoration

- 6. Rewetting of peatlands means restoring the water table or hydrological regime towards a condition where the new ground water level is close to the surface of the peatland, with the aim of partial or total reversal of the effects of drainage (Subsidence may have made original conditions impossible).
- 7. Rewetting of drained peatland restores some ecosystem functions but full recovery may be difficult and long-term. Rehabilitation of fauna and flora, for example, can take a long time, if gained at all, and depends on the peatland type and species available. Some degraded peatlands can still provide ecosystem functions, for example, fens that are used for traditional hay making and former peat extraction fields that have been rewetted and are used for paludiculture. These peatlands may be degraded but can be included in a Ramsar Site designation if they form part of a mosaic that includes pristine peatlands.
- 8. In addition to peatland rewetting, active restoration techniques that reintroduce peatland plant species are important to restore the vegetation layer.

Position within Ramsar's classification system

- 9. Since peatlands are characterized by the presence of peat, whereas the Ramsar Classification System is based on vegetation, peatlands occur in most Ramsar Wetland Type categories, especially:
 - a. Marine/coastal wetland, mainly under categories H (intertidal marshes), I (intertidal forested wetlands), J (coastal brackish/saline lagoons), and K (coastal freshwater lagoons);
 - b. Inland wetland, under categories U (non-forested peatlands) and Xp (forested peatlands); and
 - c. All other Inland wetland categories except Tp (permanent freshwater marshes/pools on inorganic soils), Ts (seasonal/intermittent freshwater marshes/pools – inorganic soils), W (shrub-dominated wetlands – inorganic soils), Xf (wooded swamps on inorganic soils) and Zk (b) (subterranean karst systems).

Applying the Ramsar Criteria

- 10. Peatlands considered for designation under Criterion 1 of Annex C include pristine, peat-forming peatlands, some human-modified and naturally degrading peatlands that are no longer forming peat, and restored or rehabilitated peatlands that meet the criteria. They may consist of a mosaic of different peatland types with various levels of human impact.

11. Ramsar designation of peatlands should pay special attention to peatland areas with at least some of the following attributes:
 - a. Intact hydrology and peat-forming vegetation;
 - b. Characteristic biodiversity;
 - c. Large carbon store and active carbon sequestration;
 - d. Well-developed and conserved historical archives of past environmental and human change;
 - e. Unique macro- and/or micro-morphological features, such as complexes of peatland habitats or diverse micro-typography (e.g. hummocks and hollows); and/or
 - f. Peatlands with high potential as “nature-based solutions” to reduce the risks of impacts related to climate change including climate change effects.
12. Special attention should be paid to the designation of vulnerable peatlands (for example, where minor impacts could lead to major degradation), to degraded peatlands with high potential for restoration and peatlands, which reduce the vulnerability of nearby human populations in the face of climate change. Criterion 2, which refers to vulnerable, endangered, or critically endangered species or threatened ecological communities, may be considered in this regard.

Application of Criterion 1 of the Application Guidelines with respect to carbon storage

13. As acknowledged in Resolutions XII.11 on *Peatlands, climate change and wise use: Implications for the Ramsar Convention* [and XIII.xx on *Restoration of degraded peatlands to mitigate and adapt to climate change and enhance biodiversity*], peatlands are important carbon stores, for carbon sequestration and – in the case of restoration of degraded peatland – in reducing GHG emissions. Peatlands provide opportunities for awareness raising, communication and education. They can be used to demonstrate best practices for wise use and restoration. Peatlands for which climate adaptation and mitigation relevance is considered in the designation process as demonstration sites with respect to Criterion 1 would feature (some of) the following attributes:
 - a. Large peat volume that can be preserved, always in proportion to the country size of the Contracting Party, which makes the request/proposal
 - b. Information on the area’s history, land use, hydrology, and peat volume, to enable assessment of the effects of restoration, as appropriate, on carbon store capacity and GHG fluxes to be used for communication and awareness raising; and
 - c. Accessibility to provide site facilities that enable awareness-raising and education activities to be carried out on site.

Boundaries and size

14. Large peatlands should generally have higher priority for designation than small areas, because their hydrology, carbon stock and historical archives are easier to protect and because they

incorporate macro-landscapes (see also Section 5.6 of the *Strategic Framework* on “Site delineation and boundary definition”).

15. Safeguarding the hydrological integrity of peatlands designated as Ramsar Sites is critical to their long-term persistence. Site boundaries must be drawn in such a way as to prevent and eliminate as far as possible the impact of off-site hydrological changes on peatland hydrology.
16. Small peatlands can also be important for biodiversity, raising public awareness and providing education on the role of peatlands (see also paragraph 78 of the *Strategic Framework*).
17. Individual peatlands and complexes incorporating several peatland types (also with various levels of human impact) may qualify for designation (see also paragraph 91 of the *Strategic Framework* concerning site clusters).

The importance of peatland inventories

18. A peatland inventory should elaborate and/or collate key information for a wide range of conservation purposes including the designation of Ramsar Sites. A comprehensive overview of the extent, location and distribution of peatlands is necessary for each peatland inventory.
19. Ramsar guidance on wetland inventory (see Ramsar Handbooks 15 *Wetland Inventory* and 13 *Inventory, assessment and monitoring*) also applies to peatlands. According to this guidance, an inventory for the designation of peatlands as Ramsar Sites should use a hierarchy of four mapping scales in GIS format (multi-scale approach):
 - a. The identification of peatland regions (at a scale from 1:500,000 to 1:1,000,000) using national and international information on bioclimatic and biogeographical ecoregions and landscape types (such as, for Europe, Moen et al. 2017);
 - b. Within the identified peatland regions, the assessment of location and rough extent of confirmed and probable peatlands (1:250,000 to 1:500,000);
 - c. The validation of these data and the collection of supplementary field and literature data to characterize hydrology and vegetation (1:100,000 to 1:250,000) to determine representativeness, rareness, or uniqueness of peatlands under Criterion 1; and
 - d. The mapping of habitats and management issues (1:10,000 to 1:50,000).
20. At all levels of analysis, the usefulness of the information must be assessed to determine if further data collection is necessary.
21. Parallel to this inventory, draft descriptions of specific peatlands in relation to Ramsar Criterion 2 should be prepared through evaluation of information on vulnerable, endangered, or critically endangered species or threatened ecological communities.

Further sources of information on peatlands

22. Much information on peatlands is available on the Internet. For successful information gathering, the use of appropriate search terms is important. Search terms should include any local term related to organic soil or peatland, combined with the country name (be aware of former country names which are no longer in use).

23. Soil data (including in manuscript form) might be available from soil institutions and other authorities. Since organic soils are subject to various kinds of land use, relevant information might be held by various national and regional authorities, including those responsible for geology, land development, environment, agriculture, forestry, resource extraction or energy. The information available from these authorities is sometimes of high resolution, often not available online, and must often be purchased.
24. Maps from digital archives (see below) are generally freely accessible and provide valuable information if geographic information system (GIS) data of appropriate resolution and accuracy are unavailable. Most maps are available as high-resolution images, which can be downloaded, geo-referenced and incorporated in GIS software. A large number of maps of the World Soil Survey Archive, the Sphaera library, and the Laboratory of Soil Science at Ghent University are not digitally available, but can be consulted at the archive sites themselves.
25. Spatially explicit soil information of various spatial resolutions is available in the open access online archives listed below at Table 1.

Table 1: Open access soil information archives

Source	Website
International Soil Reference and Information Centre (ISRIC World Soil Information)	http://www.isric.org/
European Union Joint Research Centre	https://ec.europa.eu/jrc/en
FAO Corporate Document Repository	http://www.fao.org/documents/search/en/
Institute de Recherche pour le Développement : Base de données Sphaera du service Cartographie	http://www.cartographie.ird.fr/sphaera
World Soil Survey Archive and Catalogue (WOSSAC)	http://www.wossac.com
Perry-Castañeda Library Map Collection, University of Texas at Austin	http://www.lib.utexas.edu/maps/topo/
Ghent University Laboratory of Soil Science	http://www.labsoilscience.ugent.be/Congo
Commonwealth Scientific and Industrial Research Organization: Land Research Surveys	http://www.publish.csiro.au/nid/289/aid/16088
International Peatland Society: Publications	www.peatlands.org
International Mire Conservation Group: Publications	www.imcg.net/pages/publications/papers.php
Greifswald Mire Centre	http://greifswaldmoor.de/about-us.html
Wetlands International: Peatland Treasures	https://www.wetlands.org/our-approach/peatland-treasures/
Ramsar Recommendation 7.1: A global action plan for the wise use and management of peatlands	https://www.ramsar.org/document/recommendation-71-a-global-action-plan-for-the-wise-use-and-management-of-peatlands
Directory of Soil Institutions and soil experts in Africa	http://www.apipnm.org/swlwprn/reports/y_sf/sf/tb221.htm

26. More empirical supplementary data can be obtained from a wide range of sources, including publications and grey literature on wetland, peatland and organic soil research and protection, paleo-ecological, pedological, geological, hydrological and botanical research, expedition

reports, technical reports by companies and environmental organizations, and incidental descriptions.

27. To locate data (including proxy data) on the occurrence of peatland and organic soil, relevant research institutes, ministries or agencies may be contacted. Data on organic soil are generally elaborated by and stored at various authorities, reflecting the multiple land use applied on them. Relevant national authorities may include those for agriculture, forestry, resource extraction, geology, hydrology or environment. Considering the often very local terms for peatlands and organic soils, it is important to become familiar with local terms and concepts before contacting local authorities and researchers.

Annex 2

Case Study Example: Designation of a peatland as a Ramsar Site using climate mitigation relevance as an additional argument (Lille Vildmose, Denmark)

1. Lille Vildmose is a Ramsar Site, a peatland complex with one of the largest areas of active raised bog in lowland Northwest Europe. The bog was until about 2,500 years ago part of a strait connected to the sea of Kattegat. The landscape elevated due to post-glacial uplifting and eventually the strait was blocked with a brackish lagoon that was covered by nutrient-poor reed swamp. The reed swamp and subsequent development of forest bog were followed by treeless bog of *Sphagnum* mosses. The sphagnum eventually lost contact with the ground water creating the raised bog that exists at present in Lille Vildmose.
2. The bog is currently subject to a large-scale ecological restoration project. Even though the approximately 24 square kilometres (km²) of raised bog is the largest remaining in lowland Northwestern Europe, it is only 40% of its original size. Originally, four lakes covering 400 hectares (ha) were situated in the raised bog: Tofte Sø, Birkesø, Lillesø and Møllesø. These were surrounded by peat habitat having a natural outlet to the sea at Strebæk south of Mulbjerg. Between 1760 and 1769, these lakes were drained and the lake bottoms used for agriculture.
3. At that time, handmade channels were excavated over several years, including a channel of about 7 metres deep and 2 km long leading the drainage water to the sea. Two of the lakes (Lille Sø and Tofte Sø) have been restored (one in 1927 and one in 1973) and a third (Birkesø - 130 ha) is in the process of restoration. In contrast to the acid bog, the freshwater lakes in the area have a neutral pH, as they are fed by groundwater springs connected to calcium-rich soil.
4. From 1937 to 1939, the Danish government acquired 2,300 ha in the central part of the peatland with the objective of creating farmland for small-scale farmers. Digging 200 km of ditches improved the drainage and cultivation begun along the eastern border, including for marling, a friable earthy deposit consisting of clay and calcium carbonate used especially as a fertilizer for soils deficient in lime. Lack of fuel during Second World War hampered this project and the northwestern part was sold for peat-extraction and fuel for the local cement-industry. After the war, the cultivated land was found to be rather unattractive. Of 80 planned peatland areas for smallholders, only 36 were sold. Much of the area was turned into grassland and used for summer grazing by domestic animals. The government also started to lease land for peat-extraction. Initially this was mainly for fuel, but later it developed into a highly industrialized extraction of *Sphagnum* for private and market gardening. Peat extraction stopped in 2011 and today the central part of the Ramsar Site is a mixture of farmland, extensive grassland and recently abandoned open peat-mines in the process of being restored in the sense that the water level has been raised.

Management

5. In contrast, the southern part of the Ramsar Site is in a near natural condition as it was fenced, from 1906 to 1907, and set aside as traditional hunting ground for a major estate. A 25-km fence encircled 20 km² of active raised bog and the adjacent forest of Tofte Skov. Drainage of farmland including dredging of the local stream Haslevgaarde River outside the Ramsar Site has disturbed the fringe of this active bog giving it a drier surface. This in turn has allowed some colonization of birch *Betula sp.* and conifers adding further to increased evaporation and the

creation of shade not otherwise found on the active bog. In addition, this process of scrub development has been stimulated by airborne deposit of nutrients (N) to the oligotrophic bog.

6. In the northern part of the Ramsar Site there are two other important areas of raised bogs – both partly degraded. Together with a neighbouring forest (Høstemark Skov), one of these has been another private hunting ground, which was fenced (13 km) from 1933 to 1934. Both forests in the area are predominately lying on moist low-lying land and have significant sectors of fairly old, broadleaf forest.
7. After a vision-based planning process, a number of restoration activities have been initiated focusing on the re-establishment of a more natural hydrology, where possible, and facilitation of natural connectivity between the various habitats – forests, lakes, bogs and other open habitats. The restoration activities are funded by both public and private funds. An EU LIFE+ Nature project (2011 to 2018) is partly funding on-going activities.
8. Key elements of restoration on the bogs include recreation of the natural water system by ditch blocking and elimination of Birch and other trees over an area of 200 ha. In former peat extraction areas, work to restore the possibility of new bog-formation has involved damming in the drainage-system in order to retain water and/or reduce outflow. Significant areas have been flooded (770 ha). In the forests, the establishment of a natural hydrology has occurred with elimination of conifer plantations (common spruce *Picea abies*, dwarf pine *Pinus mugo*, and Sitka spruce *Picea sitchensis*).
9. Parallel to the physical restoration activities, is a large scale on-going grazing project. A third fence around the central area allows trials with free ranging red deer *Cervus elaphus* and moose *Alces alces* – the latter a re-introduction to Lille Vildmose and Denmark in 2016. The vision is to combine all three fences allowing free movement of all large herbivores, for example allowing the populations within the southern fence (red deer and wild boar *Sus scrofa*) and the northern fence (red deer) to merge. The purpose is to use these herbivores as a measure to establish a more natural grazing pressure in the area and thereby keep the area open by limiting the overgrowth of bog vegetation with trees and scrub.
10. The Ramsar Site is covered by the largest nature conservation order in Denmark to date to protect its natural, cultural and landscape characteristics and includes 7,513 ha. Furthermore, the area is protected as an EU Natura 2000 site and a management plan has been developed for the entire area with the main aim to restore the raised bog habitat including habitats for endangered and vulnerable species and threatened ecological species communities.

Climate mitigation

11. As well as 2,022 ha of active raised bog, the area contains 252 ha of degraded raised bogs still capable of natural regeneration, 1,246 ha of degraded peatland under restoration, 400 ha of bog woodland and 1,000 ha of old natural forest of high biodiversity value on mineral soil. Peat extraction up to 2011 has reduced the area of active raised bog from an original extent of 5,500 ha to its current extent of 2,022 ha.
12. Calculations, using the IPCC (2014) default values, arrived at net GHG emissions of 17,780 CO₂-eq. yr⁻¹ before the major restoration activities started in 2011 and expect 7,294 CO₂-eq. yr⁻¹ after finalizing restoration activities including rewetting of the central and drained parts of Lille Vildmose in 2018.

13. The calculated emissions from Lille Vildmose represent c. 1% of the total emissions from peatlands in Denmark and c. 0.02% of the total net human emissions of Denmark (in 2012). It has been estimated that the estimated carbon content in the total peat area of Lille Vildmose is “estimated to be approximately 10% of the total peat carbon volume of 73.6 Mton” in the country (Joosten 2009). Based on these estimates, Lille Vildmose is and will continue to be a net GHG emitting ecosystem, although with smaller fluxes due to rewetting, despite the carbon sequestration taking place (as shown in Table 1).

Table 1. Indicative GHG in Lille Vildmose before and after project implementation (emission factors according to IPCC 2014 including the sum of CO₂, CH₄ and N₂O). After Barthelmes et al. 2015.

Land type	Extent (ha)	Emission Factor (ton CO ₂ -eq ha ⁻¹ yr ⁻¹) <u>before</u> project start	Total emissions (ton CO ₂ -eq yr ⁻¹) <u>before</u> project start	Emission Factor (ton CO ₂ -eq ha ⁻¹ yr ⁻¹) <u>after</u> project	Total emissions (ton CO ₂ -eq yr ⁻¹) <u>after</u> project
Active raised bog	2,022	0	0	0	0
Degraded raised bog capable of regeneration	252	10	2,520	3	756
Degraded peatland under restoration	1,246	10	12,460	3	3,738
Bog woodland	400	7	2,800	7	2,800
			Total 17,780		Total 7,294

14. Climate change mitigation potential is greatest in heavily degraded sites, such as peatlands that have been profoundly drained and used as cropland. In those cases, rewetting can achieve the largest GHG emissions reductions. These areas may not be as appealing from a biodiversity perspective, as a result, which could hamper their designation as Ramsar Sites. However, it is suggested that when using climate change mitigation as an additional argument to Ramsar Criterion 1, the following considerations are taken into account, which were followed in the case of Lille Vildmose, to designate complexes where:

- major parts qualify for designation for non-climate related reasons;
- there are significant areas where restoration will support and strengthen the conservation of adjacent good parts or lead to a substantial emission reductions; and/or
- where national significant peat carbon stocks are present.

Communication and awareness

15. “Lille Vildmose is one of the most advanced Danish nature areas in terms of nature communication and visitor facilities.” A large tourist and visitor centre is centrally situated in the area where wildlife exhibition, films and information activities are showcased. There are guided tours to the peatlands and special education programs for schools during the summer.
16. Several boardwalks have been placed at Portlandmosen and Tofte Mose, as well as a number of information boards and watch towers for bird and animal watching. Information boards were placed in eight areas of special interest to the restoration project between 2012 and 2015.

17. In 2013, the site was designated as a Ramsar Site using the additional argument for climate regulation for the first time in Ramsar history. The designation was based on two Ramsar Criteria: 1) that the peatland sequesters and stores carbon, and 2) that the bog contains large areas of threatened plant communities that have severely declined in distribution and extent in the relevant biogeographic region, because of large-scale extraction of peat and agricultural land use. Moreover, habitats for vulnerable animal species are present including the golden eagle *Aquila chrysaetos*, white-tailed sea-eagle *Haliaeetus albicilla*, common crane *Grus grus* and Eurasian otter *Lutra lutra*. Communication and awareness materials have been developed to raise awareness about these assets.
18. The area is greatly visited, including by foreign tourists, especially in the summer. A total of 50,000 local visitors, as well as national and international tourists visited the centre in 2014. Since then, and up to 2016, the number increased to 75,000 visitors. It is estimated that twice as many tourists visit the Lille Vildmose Ramsar and Natura 2000 Site annually.
19. Although the contribution of Lille Vildmose to global climate regulation may appear small, it plays simultaneously a valuable and active role as an information centre to thousands of people, in Europe and beyond.

References

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Figure 1. Map of Lille Vildmose with the Ramsar site boundary in yellow (designated in 2013). Restoration areas are demarcated in red primarily by reestablishing a natural high water table. Most areas in brown are raised bog vegetation including some restored areas.

