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# **CONVENTION ON LONG-RANGE TRANSBOUNDARY**

# **AIR POLLUTION (LRTAP)**

**WORKING GROUP ON EFFECTS (WGE)**

**INTERNATIONAL COOPERATIVE PROGRAMME ON**

**EFFECTS OF AIR POLLUTION ON NATURAL VEGETATION AND CROPS**

**(ICP VEGETATION)**

## Minutes of the 37th Task Force Meeting

The 37th meeting of the Programme Task Force was held 19-22 February 2024, in Kaunas, Lithuania, and hosted by the Lithuanian Research Centre for Agriculture and Forestry.

1. The meeting was attended by 62 participants from countries within the UNECE region, representatives from countries within the EECCA region, and from outreach countries outside of the UNECE region.
2. The meeting was opened by Ms. Felicity Hayes (UK), Chair of ICP Vegetation, welcoming the opportunity to meet in-person again after several years of online meetings.
3. A welcome address was given by Mr. Gintaras Brazauskas, Director of the Lithuanian Research Centre for Agriculture and Forestry (LAMMC).
4. Mr. Marius Aleinikovas, Deputy Director for the Institute of Forestry Activities, LAMMC gave an overview of The Lithuanian Research Centre for Agriculture and Forestry, which carries out research in the fields of agronomy and forestry and the related fields of ecology and environmental sciences, biology, biophysics, botany and zoology. Mr. Aleinikovas gave details on Lithuanian forests and described how one third of Lithuania is covered by the forest. Occupying 1,148,800 ha, coniferous stands prevail in Lithuania, covering 55.7% of the forest area. They are followed by softwood deciduous forests (844,500 ha, 40.9%). Hardwood deciduous forests occupy 69,300 ha (3.4%). Around a half of all forest land in Lithuania was of State importance– 1,114,000 ha.
5. Ms. Felicity Hayes (UK), Chair of ICP Vegetation, gave an overview of the activities and achievements of the ICP Vegetation in 2023 and reported on progress with items included in the workplan of the LRTAP Convention. Important activities and deliverables included:

* Contributions to the review of the Gothenburg Protocol, which will continue to be important work for the ICP Vegetation over the coming few years. ICP Vegetation already has capacity to contribute information relating to crop yield loss and deciduous forest biomass losses for the various scenarios, and will further develop methodology relating to biodiversity impacts, including semi-natural vegetation habitats.
* Progress with additional chapters to Scientific Background Document B. A proposed chapter on new species-specific fSMI for flux-based ozone risk assessment was presented prior to the meeting and discussed later in the meeting. This documents the way in which soil water (SW) is used in the ozone deposition and flux calculations of the EMEP MSC-W chemical transport model (Simpson et al., 2007, 2012). It presents some problems associated with the availability of robust SW data, and then the solution adopted for EMEP – the soil moisture index (SMI).
* Progress with development of a nitrogen module for the DO3SE model. Ozone influences the nitrogen dynamics of wheat, in addition to the impacts on yield. The new module will allow investigation of the influence of ozone on nutrition (protein content) of wheat, which will be particularly important for developing countries where ozone concentrations are high. Further details were given by Ms. Jo Cook later in the meeting.
* Outreach activities beyond the UNECE region, which included deployment of diffusion tubes to monitor ozone concentrations; contributions to reports on global impacts of ozone; modelling of ozone impacts in Uganda. Outreach activities relating to the moss survey will begin during the current year. Opportunities to contribute to the activities of the Forum for International Cooperation on Air Pollution (FiCAP) were also presented.
* Progress with analysis of data from the current (2020-2022) moss survey, for content of selected metals, N and POPs. Data have been received from 27 participating countries, but some additional countries have been unable to analyse moss samples due to lack of access to equipment. Further details and preliminary maps of metal content of mosses across the region were presented and discussed later in the meeting.
* The pilot study on mosses as biomonitors of microplastics as an indication of atmospheric deposition, with samples received from >29 countries. Analysis of samples is currently in progress and microplastics have been found in samples from across the region.
* Update of the ICP Vegetation website (<https://icpvegetation.ceh.ac.uk>).

1. Ms. Felicity Hayes gave an overview of the relevant policy framework for the ICP Vegetation. This included additional details on the upcoming revision of the Gothenburg Protocol, including some information on upcoming work within the LRTAP Convention of the UNECE to consider whether and how to address methane emissions; how to achieve additional ammonia emission reductions; overarching, collective risk-based target(s) to reduce risk to health and ecosystems, including biodiversity loss in the region and; how to achieve integrated approaches among climate, energy and air policies. Ms. Hayes also gave some perspectives on policy-relevant questions that could be addressed by the moss survey, and some ancillary work relating to the moss survey.
2. Ms. Gudynaitė-Franckevičienė (Lithuania) gave a presentation on the effects of different spectral composition LED lighting to seedlings of poplar hybrids and presented data to show that the different spectrum treatments modulate the levels of biochemical components. In particular, the dynamics of the flavonoids and phenolic acids initially indicated a stress reaction, but later showed that the plants had adapted to the changed conditions.
3. Ms. Mehriban Jafarova (Italy; Canada) presented preliminary results from the MADAME (Microplastic atmospheric deposition assessment using moss in Europe) project. Ms. Jafarova showed that for a subset of 37 sites from 17 countries, a considerable variety in the levels of microplastics in the moss was found. The microplastics identified included foams, fibres, pellets, beads and films, and with dominant polymer type being polyacrylate for foams, and polyethylene terephthalate for fibres.
4. Ms. Katrina Sharps (UK), Head of PCC, gave a recorded presentation on mapping work of the ICP Vegetation, including maps of the impacts of ozone on crops and deciduous forest in the future policy-intervention scenarios used for the review of the effectiveness of the Gothenburg Protocol. At a more regional scale an ozone flux-based risk assessment revealed that ambient ozone caused a mean 14% reduction in Indian wheat yield during 200-2012 and that the economic cost of this was primarily borne by the government and by consumers.
5. The following four sessions considered the ozone and moss survey sub-programmes. The topics of the oral presentations are provided in Annex III. For further details of the content of the oral presentations we refer to the book of abstracts and copies of the presentations available on the ICP Vegetation web site (http://icpvegetation.ceh.ac.uk). In addition, six posters were presented during the meeting, covering similar topics as the oral presentations.
6. At the end of the ozone and moss survey specific sessions, conclusions and recommendations were presented, discussed and adopted by the Task Force as described in Annex I. In particular,

* the proposed chapter on Soil Moisture Index for inclusion in Scientific Background Document-B.
* Use of colour-blind friendly colour schemes for the moss survey

1. The Task Force thanked Mr. Kent Burkey (USA) and Mr. Håkan Pleijel (Sweden), both retiring in the coming months, for their invaluable contributions to the ICP Vegetation over the years.
2. The medium-term workplan was reviewed and agreed and adopted by the Task Force (see Annex II). Ms. Hayes (UK) drew attention to various workshops and conferences in 2024. The Task Force took note of the offer from Albania to host the 38th Task Force Meeting, provisionally in February 2025.
3. On behalf of the Task Force, Ms. Hayes (UK) closed the meeting by thanking Ms. Gudynaitė-Franckevičienė, Ms. Araminienė and colleagues at the Lithuanian Research Centre for Agriculture and Forestry for hosting the meeting. Ms. Hayes thanked colleagues at the PCC. Ms. Hayes acknowledged the UK Department for Environment, Food and Rural Affairs (Defra) and the United Nations Economic Commission for Europe (UNECE) for their continuous financial support of the ICP Vegetation Coordination Centre. Ms. Hayes thanked the participants of the ICP Vegetation for their valuable contributions to the programme.

**Annex I. Decisions and recommendations by the Task Force of the ICP Vegetation at its 37th meeting, 19-22 February 2024, Kaunas, Lithuania. Workplan items for 2024-2025 are included in Annex II.**

**OZONE RELATED ACTIVITIES:**

* The TF took note of progress with the development of new chapters for Scientific Background Document B (SBD-B), associated with Chapter 3 of the Modelling and Mapping Manual of the LRTAP Convention. The table below provides an overview of the topics proposed for inclusion, who is taking the lead and who is going to contribute (subject to available funding).

|  |  |  |
| --- | --- | --- |
| **Topic** | **Lead** | **Contributions** |
| *Biomonitoring ozone impacts by using wood distillate as an ozone-protectant* | Andrea Vannini | Participants willing to test effectiveness under different climate and ozone levels using exposure facilities. Including Ignacio González-Fernández (Spain), Victoria Bermejo-Bermejo (Spain), Felicity Hayes (UK) |
| *Guidelines for assessing ozone-induced foliar damage and yield loss of horticultural crops* | Ignacio González Fernández and Victoria Bermejo (Spain) | Vicent Calatayud (Spain), Giacomo Gerosa and Riccardo Marzuoli (Italy) |
| *Impacts of ozone on pasture quality* | Felicity Hayes (Coordination Centre, UK), Ignacio González Fernández (Spain) |  |
| *Ozone flux-effect relationships and methodology for net annual increment (NAI) of trees* | Lisa Emberson (UK) | Sabine Braun (Switzerland),  Per Erik Karlsson (Sweden) |
| *Ozone removal by vegetation in urban areas* | Lina Fusaro and Fausto Manes (Italy) | Rocio Alonso (Spain), Pierre Sicard (France), Giacomo Gerosa (Italy) |
| *Ozone-induced injury guidance for educational and awareness raising purposes* | Klaudia Borowiak (Poland) | Felicity Hayes (UK), Felix Leung (Hong Kong, China), Vicent Calatayud and Victoria Bermejo (Spain), Pierre Vollenweider (Switzerland) |
| *Critical levels for ozone-sensitive clones of poplar* | Yasutomo Hoshika (Italy) | Vicent Calatayud (Spain), Riccardo Marzuoli (Italy), Pierre Sicard (France) |
| *Ozone impacts on insects* | Valda Araminiene (Lithuania) | Coordination Centre (UK) |
| *Improved phenology for ozone flux modelling in trees* | Sabine Braun (Switzerland) | Per Erik Karlsson (Sweden) |
| *Interactive impacts of ozone and nitrogen on (semi-)natural vegetation* | Felicity Hayes (Coordination Centre, UK), Ignacio González Fernández (Spain) |  |
| *Harmonization of the ozone damage indicators in the framework of the NEC Directive* | Ignacio. González-Fernández (CIEMAT, Spain), Yasutomo Hoshika (CNR, Italy) |  |

* The TF took note of the ongoing collaboration between ICP Vegetation and EMEP Task Forces and Centres and encouraged to continue such collaboration as described in further detail of the workplan of the ICP Vegetation (Annex II).
* The TF took note of a chapter update of the Scientific Background Document B, associated with Chapter 3 of the Modelling and Mapping Manual of the LRTAP Convention, on “Handling of soil moisture effect on ozone flux for large-scale modelling using the soil moisture index”. The updated chapter includes new species-specific fSMI parametrizations for flux-based ozone risk assessment in water-limited areas. This update is the result of the activity on validation of soil moisture index used in EMEP model coordinated by CIEMAT (Spain), with contributions from CEAM (Spain), Unicatt (Brescia, Italy) and EMEP MSC-West.
* The TF took note of the need to incorporate a greater number of participants and research groups also by expanding the TF topics, for example to include N effects on vegetation and interactions of ozone or nitrogen impacts with climate change and/or crop management, to encourage scientific exchange of relevant information. It was suggested that this could be encouraged by online meetings with other ICPs, side meetings involving international research forums on air pollution, and bringing together ICP-Vegetation participants for joint participation in European level research projects.
* The TF took note of the outreach activities of the ICP Vegetation and encouraged to continue such activities, especially in developing regions. The TF encouraged further collaboration with international scientific networks at the global scale.
* The TF agreed to the continued inclusion in the future meetings of a session focused on nitrogen impacts on vegetation and its interactions with other pollutants and climate change, to discuss methodologies and exchange results.
* The TF took note that the progress in the application of flux-based ozone critical levels and other ozone damage indicators in the framework of the European directive on national emission reductions, as well as other national-level initiatives, are considered as relevant policy initiatives for the ICP-Vegetation. The TF recommended that these initiatives are discussed in future Task Force meetings, with the aim to facilitate the harmonization of methodologies between CLRTAP and the EU and other regions in terms of monitoring and risk assessment of ozone impacts in vegetation.

**MOSS SURVEY RELATED ACTIVITIES:**

* The TF recommended that important information and new developments of relevance to the moss survey should be documented into a scientific background document that can be updated with new chapters as required – similar to SBD-B of the ozone group. The table below provides an overview of the topics proposed for inclusion, who is taking the lead and who is going to contribute (subject to available funding).

|  |  |  |
| --- | --- | --- |
| **Topic** | **Lead** | **Contributions** |
| *Canopy Drip Effect on Element Concentrations in Mosses* | *Winfried Schroder* | *Sebastien Leblond* |
| *The use of mosses as bioindicators of PAH and other organic pollutants (e.g. are mosses suitable as bioindicators for all PAH, or only some?)* | *Zaida Ehrenmann* |  |
| *impact of deposition on plant/moss growth and physiology (with a focus on air deposition rather than soil contamination).* | *Sebastien Leblond* |  |
| *ecosystem links and impacts, e.g. N influencing uptake of metals?* | *Stefan Franzle* |  |
| *Nitrogen influence on metal uptake* |  |  |
| *Moss Manual Revision for 2025/26 survey* | *Winfried Schroder, Sebastien Leblond, Harald Zechmeister, Zaida, Gana Gecheva, Julian Aherne, Arlinda Cakaj, Felicity Hayes* |  |

* The TF reiterated the importance to participants of the 2025-26 moss survey to:

- Sample mosses in agreement with the monitoring manual and recommended sampling in areas with a defined humus layer (where possible);

- Conduct quality checks of data before submitting the final data, including data on moss reference material;

- Remember that the focus of the LRTAP Convention is at rural sites, rather than at local point sources, although noting that local issues may be of importance to ancillary studies using mosses.

* The TF reiterated that quality checks of submitted data are the responsibility of the data provider. Subsequently, the Moss Survey Coordination Centre is tasked to check data for outliers, discuss any country border effects with respective data providers and agree with the data providers on the final data to be included.
* The TF took note of the importance of avoiding collection of moss where there would be ‘canopy drip’ from trees and shrubs. In addition the TF took note that often managed grassland can be unsuitable for sampling mosses due to sparse occurrence of moss and that shoots may be less than three years old.
* The TF recommended the formation of a sub-group to review and update the Protocol for the Moss Survey, including consideration of the metals and pollutants of focus for the 2025/6 survey, bearing in mind potential emerging pollutants. The TF noted the following recommendations:
* Heavy metals accumulation in mosses should continue to be measured, even though they have been decreasing since 1990. The decreases are not continuous for all elements, it is important to report stagnations and renewed increase, and even low accumulation can cause critical concentrations in ecosystems to be reached or exceeded.
* Nitrogen must also continue to be measured, because in many countries, nitrogen emission and related accumulation in mosses has been monitored at unchanged high levels since 2005, exceeding critical effect thresholds.
* POP measurements started since 2010 should be continued and could be part of the standard measurement program.
* Microplastics should be measured where possible, to build the evidence base for the occurrence of airborne microplastic deposition, and to allow validation of models when such models are developed.

**Annex II. Medium-term workplan (2024 – 2025) of the ICP Vegetation**

Workplan items in*italics* are not specifically included in the biannual workplan of the LRTAP Convention for 2024 and 2025 but remain important ongoing activities.

* Call for data for the moss survey 2025-2026 on heavy metals, nitrogen, POPs and microplastics.
* Final report of the Moss Survey 2020-2022.
* Report of the survey of microplastic content of mosses and the potential for the use of mosses as bioindicators of airborne microplastics.
* State of knowledge report: Impacts of ozone on carbon sequestration in Europe (with ICP Forests).
* Review critical levels for NOx.
* Work relating to the LOW methane scenario from EMEP-MSC-W (details to be confirmed), and other work as required relating to the review / revision of the Gothenburg Protocol, including ozone impacts on biodiversity, including effects on different ecosystem components and ecosystem processes important for biodiversity conservation such as pollination.

**Selected ongoing annual activities:**

* *Review and update Scientific Background Document B for Chapter 3 of Modelling and Mapping Manual of LRTAP Convention*
* *Outreach and networking activities in developing regions, linking with other international networks*

**Annex III. Programme of the 37th Task Force Meeting of the ICP Vegetation**

**Monday 19th February, 2024**

**18:30** – Welcome reception in Victoria Hotel Kaunas

**Tuesday 20th February, 2024**

**09:00 Late registration and putting up posters**

**Session 1: 9:00 – 10:45 Plenary Chair: Valda Gudynaitė-Franckevičienė**

09:30 Opening of meeting.

09:35 Welcome address: *Gintaras Brazauskas,* Director of Lithuanian Research Centre for Agriculture and Forestry (LAMMC).

09:45 *Marius Aleinikovas*, Deputy Director for Institute of Forestry Activities, LAMMC, Lithuanian forests and activities at the Institute of Forestry.

10:00 *Felicity Hayes* – An overview of the ICP Vegetation’s work.

**10:30 – 11:00 Coffee/tea and put up posters**

**Session 2: 11:00 – 12:30 Plenary Chair: Valda Gudynaitė-Franckevičienė**

11:00 *Felicity Hayes* – Current policy developments.

11:20 *Valda Gudynaitė-Franckevičienė -* The effects of different spectral composition LED lightning to poplar hybrids at a young age.

11:40  *Mehriban Jafarova -* Atmospheric deposition of microplastics using moss: a European pilot study (MADAME).

12:00 *Katrina Sharps* (recorded) Mapping at varying scales to capture different policy requirements.

**12:30 – 14:00 Lunch**

**Session 3: 14:00 ‒ 15:30 (Two parallel sessions: Ozone and Moss survey)**

# **Session 3a: Ozone Chair: Yasutomo Hoshika**

14:00*Ignacio**González Fernández et al.* – Phytotoxic ozone dose risk assessment for national air pollution effects monitoring network in Spain in the framework of the EU national emission ceilings Directive.

14:20 *Ane V. Vollsnes et al.* – The water economy of the peatland dwarf shrub *Betula nana* in a drier climate, and possible implications for ozone dry deposition.

14:40 *Samuel* *Prieto-Benítez* – Long term monitoring air pollution and effects in Spanish network of National Parks.

15:00 *Afef Ben-Amor et al.* – Expanding knowledge on the sensitivity of Mediterranean legume crops to ozone. Case study: Alfalfa var Gabissia.

**Session 3b: Moss survey Chair: Mehriban Jafarova**

14:00 *Caroline Meyer et al.* – Microplastics accumulation in urban area: moss interspecies comparison.

14:20 *Paweł Świsłowski* – Application of active moss biomonitoring to assess air pollution by polycyclic aromatic hydrocarbons in urban areas.

14:40 *Lisa Grifoni* – Chemical and magnetic biomonitoring for the conservation of cultural heritage: the study case of Palatino Hill, Colosseum (Rome, Italy).

15:00 *Iveta* *Varnagirytė-Kabašinskienė et al.* – The role of urban green infrastructure in reducing traffic-related microplastic particles.

**15:30 – 16:00 Coffee and view posters**

**Session 4: 16:00 – 17:00 (Moss survey)**

**Session 4: Moss survey Chair: Julian Aherne**

16:00 *Lorna Marcham -* Testing the Moss Enrichment Index to normalise moss tissue nitrogen between species in a small gradient of low N deposition.

16:20 *Zbigniew Ziembik et al.* – Evaluation of metals concentration in the elements of biota.

16:40 *Omari* *Chaligava et al.* – Assessment of the influence of agricultural and mountainous areas on the accumulation of trace elements in moss biomonitors.

**19:00 Conference dinner**

**Wednesday 21st February, 2024**

**Session 5: 09:00 – 10:30 (Two parallel sessions: Ozone and Moss survey)**

**Session 5a: Ozone Chair: Ignacio González Fernández**

09:00 *Riccardo Fedeli et al.*  – Ozone injury on basil (*Ocimum basilicum* L.), a model agricultural plant, and the protective role of wood distillate.

09:20 *Mike Perring* – Experimental work on ozone and trees.

09:40 *Andrea Vannini et al.* – Wood distillate protects plant photosynthetic system from ozone phytotoxicity: evidence from ozone-sensitive tobacco (*Nicotiana tabacum* L.) BelW3.

10:00 **Discussion** - Biomonitoring and evidence gathering within ICP Vegetation

**Session 5b: Moss survey Chair: Guntis Tabors**

09:00 *Sébastien Leblond* – Metabolomic monitoring of mosses, a complementary tool.

09:20 *Stefano Loppi –* What can be learnt from the moss monitoring survey in Tuscany?

09:40 *Marina Frontasyeva*  – (recorded) Extension of ICP Vegetation to Asia and Pacific Region.

10:00 **Discussion** moss survey priorities

**10:30 – 11:00 Coffee/tea and poster viewing**

# **Session 6: 11:00 – 12:30 (Two parallel sessions: Ozone and Moss survey)**

**Session 6a: Ozone Chair: Mike Perring**

11:00 *Kent O. Burkey* – Breeding ozone tolerant crops.

11:20 *Bermejo-Bermejo V. et al.* – Nitrogen fertilization may confuse ozone risk analysis in wheat: opening the debate.

11.40 *Jo Cook* - New modifications to the DO3SE model show accelerated senescence onset is the key factor affecting grain N under O3 exposure.

12.00 **Discussion** – Ozone, nitrogen and potential impacts on crops.

**Session 6b: Moss survey Chair: Claudia Stihi**

11:00 *Zaida Ehrenmann* – A closer look at the Swiss moss data 2020.

11:20 *Felicity Hayes et al.* – UK moss survey.

11:40 *Mehriban Jafarova* – Moss monitoring of airborne microplastic deposition in Tuscany, Central Italy.

12:00 *Felicity Hayes* – Draft maps and discussion of report.

**12:30 – 14.00 Lunch**

# **Session 7: 14:00 – 15:30 (Two parallel sessions: Ozone and Moss survey)**

**Session 7a: Ozone Chair: Jo Cook**

14:00 *Mike Perring* – N recovery indicators.

14:20 *Jo Cook (on behalf of Lisa Emberson)* – Update on the DO3SE-Crop model and other 'ozone related' activities.

14.40 **Discussion** – Ozone strategy and workplan for the next few years.

**Session 7b: Moss survey Chair: Stefano Loppi**

14:00 *Guntis Tabors* – Results of biomonitoring in Latvia from 1995 to 2020 using *Pleurozium schreberi* moss.

14:20 *Marta Segura Roux* – Rare Earth Element Concentrations in moss in Sweden.

14:40 *Jana Borovská* – Biomonitoring of atmospheric deposition of heavy metals in Slovakia in 2020-2023.

15:00 **Discussion** – Preparing for 2025 survey.

**15:30 – 16:00 Coffee and take down posters**

**Session 8: 16:00 ‒ 17:00 Final plenary session Chair: Felicity Hayes**

16:00 *Kent Burkey -* Report back of main ozone decisions / discussions.

16:10 *Caroline Meyer* - Report back of main moss decisions/discussions.

16:20 Final discussions: workplan, decisions, AOB.

17:00 ***Close of Meeting***

**LIST OF POSTERS**

**OZONE**

|  |  |
| --- | --- |
| **Author(s)** | **Title** |
| Hoshika, Y. | Stomatal flux-based critical levels for ozone effects on poplars. |
| Mishra, A.K. et al. | CO2 induced stomatal ozone flux modification on selected wheat cultivars. |
|  | |

**MOSS SURVEY**

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| --- | --- |
| **Author(s)** | **Title** |
| Černiauskas, V. et al. | Trends in Chemical Transformations of Precipitation in Conifer Stands |
| Neirynck, J. et al. | Temporal trends of heavy metals and nitrogen collected in mosses in Flanders (Belgium) 2000-2020. |
| Radulescu, C. et al. | Impact of past mining activity on the quality of surface and groundwater resources. |
| Stihi, C. et al. | A review of the moss monitoring surveys in Romania. |