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 36th Task Force Meeting

The 36th meeting of the Programme Task Force was held online from 13-15 February 2023, and hosted by the UNECE, Switzerland.

1. The meeting was attended by 110 participants from 36 countries. Participation included representatives of EMEP/MSC-West, ICP Forests, the Coordination Centre for Effects (CCE) of the ICP Modelling and Mapping, in addition to the UNECE Secretariat of the LRTAP Convention. Participation included 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, noting that this online meeting gave opportunities for attendance by representatives of countries participating in outreach work of the ICP Vegetation, in addition to those participating as representatives of countries covered by the UNECE region.

3. A brief welcome address was given by Ms. Anna Kaplina, UNECE Secretariat of the LRTAP Convention.

4. A representative of the United Kingdom of Great Britain and Northern Ireland made a statement in support of Ukraine and against the ongoing military aggression by Russian Federation.

5. Ms. Felicity Hayes (UK), Chair of ICP Vegetation, gave an overview of the activities and achievements of the ICP Vegetation in 2022 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. Further details on impacts on crop yield loss and deciduous forest biomass losses for the various scenarios were given by Ms. Katrina Sharps later in the meeting.
    - Progress with additional chapters to Scientific Background Document B. Further details on new species-specific fSMI for flux-based ozone risk assessment, and on flux-based parameterisations for poplar, were presented later in the meeting.
    - Progress with development of a coupled photosynthesis-stomatal conductance model for wheat, including an ozone damage module that affects both instantaneous photosynthesis as well as canopy senescence. Modelled vs observed phenology, which is a key parameter determining exposure to ozone episodes and the length of the growing season, showed a good relationship across a range of countries.

- Outreach activities beyond the UNECE region, including results from ozone diffusion tube deployment in Brazil, Ecuador, Ghana, Kenya, Malawi and Zambia. In Malawi and Zambia 28-day mean ozone concentrations of 57 and 64 ppb respectively were reached, which could indicate potential large crop production losses.
- The current moss survey, from 2020-2022 (extended for 1 year due to Covid-19 restrictions on fieldwork in some countries), for content of selected metals, N and POPs. Further details of progress with the 2020-2022 survey were given later by Ms. Marina Frontasyeva (Russian Federation).
- The pilot study on mosses as biomonitors of microplastics as an indication of atmospheric deposition, with samples received from >29 countries.
- Update of the ICP Vegetation website (https://icpvegetation.ceh.ac.uk).

6. Ms. Marina Frontasyeva (Russian Federation) gave an overview of the moss sampling campaign from countries that had collected samples in 2020, 2021, and 2022, including a GIS map of sampling sites for total samples and maps for individual countries. The first European moss survey was conducted in 1990 and has been repeated every five years since. Despite difficult conditions due to the global pandemic, moss collection was undertaken in many European countries and in some Asian ones as well.

7. Ms. Katrina Sharps (UK), Head of PCC, presented 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. This showed that although there were improvements, significant losses were still predicted to occur even under the most stringent scenario.

8. Mr. Thomas Scheuschner (Germany) of the CCE of the ICP Modelling and Mapping gave an update of the current receptor map for the European domain, which has increased resolution of land classes compared to the previous version.

9. Ms. Anne-Katrin Prescher and Ms. Alexa Michel (Germany), representing ICP Forests, gave an update on recent ICP Forests activities including the recent survey of heavy metal content of forest soils. There is potential for collaboration work between ICP Forests and ICP Vegetation in the coming year.

10. Mr. Yasutomo Hoshika (Italy) presented progress in establishing flux-based critical levels for poplars, using newly collected experimental evidence.

11. Ms. Tania Carrasco-Molina (Spain) gave an update of work to parameterize the stomatal conductance response to soil moisture index for Mediterranean forest and semi-natural vegetation species for flux-based ozone risk assessment. The new parameterisations will be used to update Chapter 4 of Scientific Background Document-B.

12. Mr. Markus Guepel (Germany), of the CCE of the ICP Modelling and Mapping presented a review of the current critical levels for ammonia and a draft revision of text for this section of the Modelling and Mapping Manual, Chapter 3. Following discussions and minor edits to this text during the course of the meeting, the TF approved the revised text.

13. Mr. Winfried Schröder (Germany) presented results from the 2020 moss survey in Germany and demonstrated the importance of consideration of tree canopy drip effects

during the sampling of mosses and the data evaluation. It was agreed that the protocol for the 2025 survey should be amended slightly to reflect these findings. Mr. Schröder argued that the accumulation factor due to the filtering of air through tree crowns should also be included in the modelling and mapping of atmospheric deposition by EMEP MSC East and West. EMEP modelling should be compared with LOTOS EUROS modelling based on the same meteorological and emission data with the same resolution in time and space. Mr. Schröder also showed partial discrepancies between the time trends of emission register data and moss data (contrary to the emission data no significant decrease in nitrogen accumulation 2002-2020 but significant increases of metals in mosses 2015-2020).

14. Ms. Carmen Wolf (Germany) presented data on the presence of microplastics and POPs in moss samples from the 2020 moss survey in Germany and showed that microplastics were present in all samples analysed.

15. Mr. Richard Cross (UK) presented details of new methodology to analyse larger (approximately 10 g) samples of moss for microplastic content. He showed that microplastics were found in moss samples from across the UK and that these covered a wide range of plastic type.

16. Mr. Julian Aherne (Canada) gave an update on a study to investigate microplastic content of mosses sampled in Canada, where microplastics had been found even in very remote locations. He presented data to show that when using subsamples of <1 g for analysis, then three subsamples should be used to give a better representation for areas of low microplastic content.

17. Ms. Felicity Hayes (UK) gave a progress update on behalf of the Microplastic Atmospheric Assessment using Moss in Europe team, to thank participants for sending samples for analysis. Samples have been received from >29 counties and preliminary processing of these has been completed prior to the next stages of analysis.

18. Mr. Alexander Uzhinskiy (Russian Federation) gave some insights on the possible future of air quality monitoring and showed how remote sensing of pollutants using satellite data could provide information.

19. The following four sessions considered the ozone and moss survey sub-programmes, and also included a session dedicated to nitrogen impacts on vegetation. 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, nine posters were presented during the meeting, covering similar topics as the oral presentations. The Task Force also thanked Mr. Jürgen Bender (Germany, retiring in the coming month) for his invaluable contributions to the ICP Vegetation over the years.

20. 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 changes to the text for the Critical Levels for ammonia were agreed and the CCE were invited to submit additional background information on the changes to the ICP Vegetation for inclusion in Scientific Background Document-A.

- it was agreed that the coordination of the moss survey should be moved to the UK to enable the continued participation by contributing countries. Ms. Hayes (UK) asked participating countries to consider whether they would be willing to coordinate the moss survey in future years.

21. 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 2023. The Task Force took note of the offer from Lithuania to host the 37th Task Force Meeting at the Institute of Forestry, Lithuanian Research Centre for Agriculture and Forestry in Girionys (Kaunus district), provisionally in February 2024. The Task Force took note of a provisional offer from Albania to host the meeting in 2025.

14. On behalf of the Task Force, Ms. Hayes (UK) closed the meeting by thanking Anna Kaplina and colleagues at the UNECE 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 36th meeting, 13-15 February 2023, Online. Workplan items for 2022-2023 are included in Annex II, together with proposed items for 2024-2025.

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
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)
Validation of soil moisture index used in EMEP model	Ignacio González Fernández (Spain)	Sabine Braun (Switzerland), Vicent Calatayud and Arnaud Carrara (Spain), Giacomo Gerosa and Riccardo Marzuoli (Italy), Lisa Emberson (UK), Per Erik Karlsson (Sweden), David Simpson (Sweden, EMEP/MSC-West)
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)	

- 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 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 to discuss methodologies and exchange results.

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?)		
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*	
Ozone 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 2020-22 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 to data management system (DMS), including data on moss reference material;
  - Make use of the many functionalities of the Data Management System, such as link to an App to upload metadata, conduct simple summary statistics and mapping of the data.
  - Remember that the focus of the LRTAP Convention is at rural sites, rather than at local point sources.

- 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 in the DMS.

- 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 (2022 – 2023) ICP Vegetation, and proposed items for 2024 and 2025

Workplan items in *italics* are not specifically included in the biannual workplan of the LRTAP Convention for 2022 and 2023.

2022:

- Call for data for moss survey 2020-23 on heavy metals, nitrogen and POPs
- *Comparison of spatial patterns and temporal trends of heavy metals in mosses and EMEP-modelled deposition (with EMEP/MSC-East)*

2023:

- Ozone flux-based risk assessment for vegetation for air pollution scenarios relating to: (a) Implication on vegetation of scenarios focusing on the characterisation of the contribution of methane as an ozone precursor - post-hoc analysis (b) the application of ozone modified photosynthesis-based flux-response models c) the effects of drought under present and future climatic conditions (with EMEP/MSC-West, CIAM, TFMM and TFHTAP).
- Review of ozone pollution and climate change impacts on vegetation – focus on implications for calculation and application of flux-based Critical Levels and risk assessment.
- State-of-knowledge report on 'genetics of crop resilience to ozone and potential for crop breeding'.
- *Development of ozone critical levels for forest trees based on the net annual increment (NAI)*
- *Review Critical Levels for NOx.*
- *Joint workshops with ecosystem and crop modellers, including AgMIP-Ozone.*

2024-2025 (proposed):

- 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).
- Work relating to the LOW methane scenario from EMEP-MSC-W (details to be confirmed)
- (Comparison of spatial patterns and temporal trends of heavy metals in mosses and EMEP-modelled deposition (with EMEP/MSC-East)) – may no longer be possible.

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 36th Task Force Meeting of the ICP Vegetation

Monday 13th February, 2023

Session: Plenary **Chair:** Felicity Hayes/Katrina Sharps

09:00 *Meeting link opens*

09:10 *Felicity Hayes* – Opening of meeting

09:15 *Anna Kaplina* - Welcome

Felicity Hayes – Interventions

09:20 *Felicity Hayes* - Overview of ICP Vegetation

09:50 *Marina Frontasyeva* – Moss Survey 2020-2021-2022. Sampling completed

10:10 *Katrina Sharps* – Reviewing the effectiveness of the Gothenburg Protocol: The impact of ozone on crops and deciduous forest in future policy-intervention scenarios

10:30 ***Comfort break***

Session: Plenary **Chair:** Katrina Sharps

11:00 *CCE of the ICP Modelling and Mapping* – Update of the current receptor map for the European domain

11:20 *Anne-Katrin Prescher* – Update on ICP Forests activities

11:40 *Yasutomo Hoshika* – Progress in setting flux-based critical levels for poplars

11:50 *Tania Carrasco-Molina* - Parametrization of the stomatal conductance response to soil moisture index for mediterranean forest and semi-natural vegetation species for flux-based ozone risk assessment

12:10 *Markus Guepel* – Review of ammonia critical levels and draft revision of the Mapping Manual

12:30 ***Comfort break***

Session: Plenary **Chair:** Zaida Ehrenmann

14:00 *Winfried Schröder* – German Moss Survey 2020 Part I: Accumulation of atmospheric metals and nitrogen deposition in mosses: temporal development between 1990 and 2020, comparison with emission data and tree canopy drip effects

14:20 *Carmen Wolf* – German Moss Survey 2020 Part II: Microplastics and persistent organic pollutants in moss samples

14:40 *Richard Cross* – Distribution of microplastics >25 µm in size across the United Kingdom as detected using µ-FTIR

15:00 *Julian Aherne* – Microplastics in Canada

15:05 *MADAME Team (Felicity Hayes)* – Microplastic Atmospheric Deposition Assessment using Moss in Europe (MADAME), Progress update including map of sites and timelines for next steps

15:10 *Alexander Uzhinskiy* – The future of air quality monitoring

15:25 *Felicity Hayes* – General Discussion and check of workplan

16:00 ***End of Day 1***

Tuesday 14th February, 2023

Session: **Moss 1** **Chair:** **Caroline Meyer**

09:00 *Meeting link opens*

09:10 *Inga Zinicovscaia* – A new approach for the determination of the origin of chemical elements emitted in the atmosphere based on the moss biomonitoring results

09:30 *Stefan Fränzel* - Chitin-based M ion monitoring put to the detail: empirical determination of partition factors between water, sediment and chitin and biomonitoring, ecological conclusions derived therefrom

09:50 *Zaida Ehrenmann* - Moss Monitoring in Switzerland - Results of the 2020 Moss Survey

10:10 *Guntis Tabors* – Moss biomonitoring of atmospheric pollution in Latvia: longterm of heavy metal concentration in *Pleurozium schreberi* moss

10:20 *Pawel Świsłowski* – Poster: Bioaccumulation of trace elements from aqueous solutions by selected terrestrial moss species

10:25 *Ya Bogdanova* – Poster: Monitoring of heavy metal atmospheric deposition in the Steppe zone of the European part of Russia

10:30 ***Comfort break***

Session: **Moss 2** **Chair:** **Mike Perring**

11:00 *Katerina Bačeva Andonovska* – Poster: Mosses as biomonitors to identify atmospheric deposition with minor and trace elements in North Macedonia

11:05 *Dinesh Saxena* – Atmospheric metals from Jammu, India: Pre-pandemic and post-pandemic measurements by the moss *Hypnum cupressiforme*

11:20 *Krmar Miodrag* – Seasonal changes in spatial distribution of 7Be atmospheric deposition measured using terrestrial moss

11:40 *Arlinda Cakaj* – Investigating the use of common weed species as bioindicators for heavy metal pollution: a study of *Trifolium pratense, Alcea rosea,* and *Lolium multiflorum*

12:00 *Kayla Wilkins* – Bryomonitoring Canada Project: Progress to date

12:10 *Konstantin Vergel* – Results of the moss survey-2020/2021 in central Russia

12:30 ***Comfort break***

Session: **Ozone 1** **Chair:** **Ignacio Gonzalez-Fernandez**

13:30 *Sabine Braun* – Epidemiological estimate of growth reduction by ozone in *Picea abies*: can we improve the fit with experimental data?

13:50 *Zhaozhong Feng* – Interactive effects of elevated ozone and nitrogen addition on physiology and growth in poplar

14:10 *Alexander Cheesman* – Developing ozone dose-response functions for tropical systems

14:30 *Flossie Brown* – Ozone and sugarcane

14:50 *Felicity Hayes* Ozone and floral VOCs

14:55 *Samuel Prieto-Benitez* – Poster: Tropospheric ozone hinders the adaptation of floral phenology to climate warming in Mediterranean alpine plants

15:00 *Bourbatache Mansour* – Biomonitoring ozone impacts in Algeria

15:05 ***Comfort break***

Session: **Ozone (and Nitrogen) 2** **Chair:** **Sabine Braun**

15:30 *Valda Araminiene* – Ground-level ozone and nitrogen dioxide pollution removal capacity by urban vegetation in Lithuania

15:50 *Granit Kastrati* – Study of nitrogen concentrations in bee pollen samples in Kosovo by Kjeldahl method

16:10 *Mike Perring* – NOx critical levels update

16:30 *Felicity Hayes and Mike Perring* – NOx discussion (if required)

17:00 ***End of Day 2***

Wednesday 15th February, 2023

Session: **Moss 3** **Chair:** **Arlinda Cakaj**

09:00 *Meeting link opens*

09:10 *Omari Chaligava* – Evaluation of air quality in Georgia based on moss survey 2019-2022

09:30 *Yu Aleksiayenak* - Fourth moss survey in the Republic of Belarus: Brest region case study

09:50 *Sébastien Leblond* – Influence of the environment on the concentration in mosses: comparison between cemeteries and forests

10:10 *Flora Qarri* – Poster: Trace metal atmospheric deposition in Albania and the impact from wind-blown dust

10:15 *Claudia Stihi* – Poster: Romanian moss surveys - heavy metals atmospheric deposition temporal trends

10:20 *Evgeniya Gatina* – Poster: Moss-biomonitoring method in the study of air pollution on the eastern part of the Russian Plain (Perm region, Russia)

10:30 ***Comfort break***

Session: **Moss 4** **Chair:** **Winfried Schröder**

11:00 *Gana Gecheva* – Moss walls; construction, prospects for detection of heavy metals, nanoparticles and PMs, biomarkers – a new project in Bulgaria

11:20 *Jana Borovská* – Biomonitoring of atmospheric deposition of heavy metals in Slovakia in 2020-2022

11:40 *Agnes Bálint* – Determining the concentration of heavy metals deposited from the air using a moss bioindicator on Szentenrei Island (Central Hungary)

12:00 *Felicity Hayes* – Future of the moss programme and general moss discussion

12:30 ***Comfort break***

Session: **Ozone (and Nitrogen) 3** **Chair:** **Melissa Chang**

14:00 *Kent Burkey* – Testing drought-tolerant soybean cultivars and breeding lines for ozone response

14:20 *Jo Cook* – Modelling wheat nutrition in India to understand climate and O3 impacts

14:40 *Yansen Xu* – Elevated ozone decreased leaf photosynthesis of winter wheat by accelerating leaf senescence in a warming world

15:00 ***Comfort break***

Session: **Ozone (and Nitrogen) 4** **Chair:** **Felicity Hayes**

15:20 *Divya Pandey* – who pays the price? The economic implications of wheat production losses in India due to ozone

15:40 *Clare Brewster* – Effect of ozone on the nitrogen dynamics of wheat

16:00 *Nivedita Chaudhary* – Poster: Assessment of O3-induced yield and economic losses for crops in several areas of Rajasthan from 2018 to 2021, India

16:05 *Felicity Hayes* – Workplan discussion and AOB

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

LIST OF POSTERS

OZONE

Author(s)	Title
Nivedita Chaudhary	Assessment of O3-induced yield and economic losses for crops in several areas of Rajasthan from 2018 to 2021, India
Samuel Prieto-Benítez	Tropospheric ozone hinders the adaptation of floral phenology to climate warming in Mediterranean alpine plants

MOSS SURVEY

Author(s)	Title
Pawel Świsłowski	Bioaccumulation of trace elements from aqueous solutions by selected terrestrial moss species
Ya Bogdanova	Monitoring of heavy metal atmospheric deposition in the Steppe zone of the European part of Russia
Flora Qarri, Pranvera Lazo*	Trace metal atmospheric deposition in Albania and the impact from wind-blown dust
Claudia Stihi., Ene A.,	Romanian moss surveys - heavy metals atmospheric deposition temporal trends
E. Gatina	Moss-biomonitoring method in the study of air pollution on the eastern part of the Russian Plain (Perm region, Russia)
Katerina Bačeva Andonovska	Mosses as biomonitors to identify atmospheric deposition with minro and trace elements in North Macedonia
Anastasia Zhuravleva	Analysis of data on the accumulation of trace elements in the biomass of mosses of the Udmurt Republic, Russia