Final Evaluation Report

Your Details	
Full Name	Dr. Martin Cesar Maria Blettler
Project Title	Something is in the air: atmospheric microplastic transport and deposition in natural and unnatural environments of Argentina.
Application ID	40858-B
Date of this Report	December 19th 2024

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
1) To identify the main sources (cities, open dumps, highways) and pathways (transport, deposition) of air-plastic-pollution entering to the natural or semi-natural environment (Paraná River floodplain)			X	This objective was achieved by 90%. The only parts remaining were **i)** the measurement of MPs along roads (generated by tire wear from vehicles). For this portion of the objective, we encountered significant methodological challenges, as tire-derived MPs were not effectively captured using the methods applied to the other air-MP samples. However, we are actively working to overcome these challenges (see Section 3) and are making every effort to complete this aspect of the objective (1) in the coming months. **ii)** We were unable to obtain legal access to the Paraná city open dump (called "Volcadero"; see Section 3). Because of this, it was replaced by another one: "Leyes" open dump (Arroyo Leyes village). Sampling campaigns. It is important to emphasize that the scientific sub-discipline of "atmospheric MP" is very recent and still lacks standardized protocols for sampling and analyses. For this reason, we conducted a series of scientific tests on different materials and methods, adapting them to our working environment while carefully considering the construction and operational costs of each method. Specifically, we tested the efficiency and effectiveness of various MP collectors: 4 passive collectors and 1 active collector. We also considered different collection times (ranging from hours to days for passive methods) and varying air volumes collected for the active method (m^3 of air). Additionally, we accounted for diverse atmospheric conditions, including diverse wind intensities and directions, air temperature, as well as during liquid precipitation events. Based on our statistic results, we identified the most suitable method for our objectives (see Section 2). This valuable scientific information is detailed in our second scientific paper (currently in preparation, tentative title: "From Waste to Air: Sources of Atmospheric Microplastics"). Sample Processing. All samples were successfully processed at the Hydroecology Laboratory of the National Institute of Limnology (INALI; CONICET-UNL). Students were training for this task. Results. Definitely, the atmosphere is a vehicle for MP-transport (we demonstrated this). Our hypothesis that open-dumps and cities are a significant source of airborne MPs has been confirmed, demonstrating contamination of semi-pristine environments such as the Paraná River floodplain from those sources. When comparing MP concentrations detected in open dumps to those at reference sites located 100 and 1000 meters away, we found 3.5 times more airborne MPs at the open dumps (no windy days). Similar ratio was recorded in cities (center). Fiber was the dominant type of MP in all cases, with an average ratio of ±5:1 compared to laminar and fragments MPs. Polyethylene and textile cellulose were the dominant fiber composition (Identified in the Institute for Physical Chemistry Research INFIQC; National University of Córdoba).
2) To influence decisionmakers to bring about changes in laws, policies and practices in order to reduce airborne MP pollution.		X		Results. On one hand, we have made significant progress in bringing the issue to the public and political agenda. This is the result of meetings with government officials (from Rincón, Santa Fe, and Paraná cities), members of environmental NGOs, academics, environmental lawyers, and local residents. We even encouraged legal action against the municipality of Rincón to close the open-dump (named "Callejón Pintos") given the tremendous environmental damage caused. On the other hand, the changes we have achieved so far are not entirely satisfactory. This is the sequence of events that occurred because of the results of this project. First, we met Ombudsman Mr. Jorge Henn (Government of the Province of Santa Fe) and stakeholders, to address the issue of closing the open-air dump in Rincón City. The

				meeting concluded with a direct and formal request from Mr. Henn to the Minister of Environment and Climate Change of the Santa Fe Province, Mr. Enrique Estevez Boero https://www.defensoriasantafe.gob.ar/articulos/el-defensor-del-pueblo-le-pedira-las-autoridades-entrantes-que-le-den-prioridad-en-su Second, our actions led to the filing of a criminal complaint against the Municipality of Rincón (handled by prosecutor Dr. Ignacio Lascuarín; The Public Prosecution Office, Judiciary of Santa Fe Province) and an on-site inspection of the open dumps conducted by the Argentine Naval Prefecture, the Environmental Brigade of the PDI Police, and I (and other members of this project) https://www.ellitoral.com/area-metropolitana/tomaron-muestras-determinar-laguna-setubal-contaminantes-peligrosos-assa-aguas-santafesinas-ciudad-santa-fe_0_oPdBYz6daB.html (Rincón's open dump is located nearby the Setúbal lake, which is part of the Paraná River floodplain). Third, the case attracted widespread media attention, including the most important media groups at regional and national level. I was personally interviewed by numerous media outlets. For ex.: https://tn.com.ar/sociedad/2024/01/16/san-jose-del-rincon-la-ciudad-con-el-basural-que-ante-cada-crecida-del-rio-se-convierte-en-una-lago-contamina/ https://www.youtube.com/watch?v=Mgj8q_AqgKo https://www.ellitoral.com/area-metropolitana/contaminacion-basural-costa-rincon-arroyo-leyes-laguna-setubal_0_YNeXIaYXBi.html Fourth, the case sparked large-scale and spontaneous popular protests, which we did actively encouraged but not organize them, demanding the closure of Rincón's open dump. For ex.: https://www.airedesantafe.com.ar/santa-fe/vecinos-san-jose-rincon-piden-la-erradicacion-los-basureros-cielo-abierto-lo-sufre-nuestra-laguna-setubal-n548890 Because of our activism, even authorities from the National University of the Littoral (UNL) have echoed the issue. https://www.vecinosdelacosta.com/2024/09/03/rincon-basural-del-pinto-por-intervencion-de-la-unl-y-la-provincia-el-paisaje-rinconero-comienza-a-cambiar/ Five, as a result of the great provincial and national pressure on the Municipality of Rincón, they decided to close and "restore" the open dump, making great publicity https://www.santafe.gob.ar/noticias/noticia/280151/ Six, unfortunately, we do not agree with the measures they implemented due to their complete lack of scientific support and decision-making that directly threatens the protection of the natural environment. Basically, the Municipality of Rincón decided to bury the waste in large pits specifically dug for this purpose, without any isolation from the groundwater or the soil. In our opinion, it was just greenwashing with severe ecological consequences (we have photographically documented all this false remediation). In following media article, I formally advocate for the closure of the open-air dump and, at the very least, for encapsulating the waste that cannot be transported for proper treatment. Meanwhile, a local government official from the city of Rincón (Cecilia Álvarez, Director of Waste Management and Circular Economy) defends the absurd position that burying garbage—without any environmental isolation—is an acceptable solution https://www.pausa.com.ar/2024/05/basural-de-rincon-enterrando-ilusiones/ Regarding our connection with the Environmental Foundation CAUCE (Paraná city), we have developed a close collaboration, working side by side to share our findings with the public by organizing conferences and workshops. For this, we have utilized CAUCE's platform, including its network, connections, office space, and infrastructure (see Section 2). The dissemination of our work through TV, radio, newspaper interviews, social media, and articles has been a highly success, far exceeding our expectations. We quickly reached Argentina's most prominent and widely viewed media outlets, bringing the issue into the spotlight and onto the public agenda. Examples of this can be seen in

				the media-links previously mentioned, as well as those cited below (see Section 2).

2. Describe the three most important outcomes of your project.

2.1) Scientific production.

i) We successfully determined the best sampling protocol adapted to our economic and environmental conditions. For this, we tested 3 different collectors for depositing MP (Figure 1a, b, c): i. A beaker + conical glass funnel, short stem, 60° angle, 13 cm diameter. Passive sampler. ii. A beaker + conical glass funnel, short stem, 60° angle, 7.5 cm diameter. Passive sampler. iii. Glass Imhoff sedimentation cones (1000 ml capacity), 85° angle, 11 cm diameter, with a universal metal stand. Passive sampler. In addition, we tested 2 different collectors for MP in transport (Figure 1d, e): i. A Manta-type net with a 100 µm mesh size, 1.8 m in length, oriented on a pivoting aluminum tripod. Passive sampler. ii. A vacuum pump XZ-1B (flow rate: 1 l/s, maximum vacuum: -400 mm/Hg, suction Ø: 10 mm) + Büchner funnel + rubber cone + Kitasato flask. Active sampler. The tested waiting times for deposited MPs ranged from 12 to 48 hours, while for MPs in transport, they ranged from 16 minutes (filtering 1 m^3 of air) to 160 minutes (filtering 10 m^3). We determined the Imhoff cones per duplicate, 24h, under no wind condition, as the best air-MP collector and method ("R", free software for statistical computing). Under windy conditions, the pump is more effective. This is explained and discussed in the second paper under production.

Figura 1. Atmospheric MP samplers (in transport and deposition) tested and/or used in this study: (a) beaker + funnel with a 13 cm diameter; (b) beaker + funnel with a 7.5 cm diameter; (c) Imhoff cones; (d) Manta-type net (tripod is not showed); (e) vacuum pump and Kitasato flask.

The Figure 2 shows examples and locations of some samplings conducted in this study.

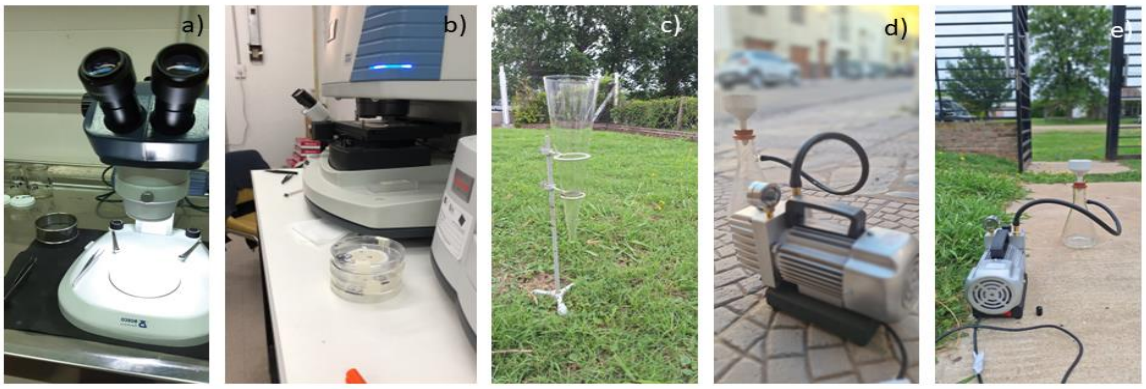

Figure 2. (a) MPs counted and classified under stereomicroscope (5, 10, 40x) in the laboratory (INALI). (b) Polymer classification using spectrophotometry with a Nicolet iN10 spectrometer and high-sensitivity detector cooled with liquid nitrogen (INFIQC). Sampling devices and examples of locations in the present study: (c) Imhoff cones in a peri-urban area, (d) and (e) vacuum pump in central (CAUCE headquarters) and peri-urban zones, respectively.

ii) The first comprehensive scientific data-base in the South American region on airborne-MPs and environmental variables (wind intensity and direction, rainfall, humidity, air temperature, etc.).

iii) We have submitted the manuscript "Microplastic ingestion in juvenile commercial fish: contrasting heavily polluted and lightly polluted lake environments" to "Archives of Environmental Contamination and Toxicology" (Figure 4). This paper is an unanticipated product since it was prompted by a question we asked ourselves working in the field: the microplastics (MPs) originating from open-dumps are transported by air across to the Paraná River floodplain, being deposited also in lakes. Therefore, are fish species being directly impacted by this type of pollution? Unfortunately, we confirmed this in juveniles of *Prochilodus lineatus*.

Archives of Environmental Contamination and Toxicology
Microplastic ingestion in juvenile commercial fish: contrasting heavily polluted and lightly polluted lake environments
--Manuscript Draft--

Manuscript Number:	AECT-D-24-00634
Full Title:	Microplastic ingestion in juvenile commercial fish: contrasting heavily polluted and lightly polluted lake environments
Article Type:	Original Research
Keywords:	Microplastic; juvenile fish; ingestion; fluvial lake; open dump
Corresponding Author:	Nicolás A. Garello INALI: Instituto Nacional de Limnología ARGENTINA
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	INALI: Instituto Nacional de Limnología
Corresponding Author's Secondary Institution:	
First Author:	Nicolás A. Garello
First Author Secondary Information:	
Order of Authors:	Nicolás A. Garello Ana Pia Rabuffetti Pamela Vicens Martín Blettler Guido Rimondino Luis Espínola Pierre Girard
Order of Authors Secondary Information:	
Funding Information:	Universidad Nacional del Litoral (CAID 2021, Ref. 21820210100075LI) — Dr. Ana Pia Rabuffetti Rufford Foundation (40858-B) — Dr. Martín Blettler

Figure 4. Article recently submitted to Archives of Environmental Contamination and Toxicology.

iv) We are currently writing a second scientific manuscript focusing on the results of our testing of different sampling methodologies (Section 1) and on the findings from the first two sampling campaigns (conducted in open dumps, cities (center, peri-urban areas, and the floodplain). Tentative title: "From waste to air: Sources of atmospheric microplastics" (Figure 5).

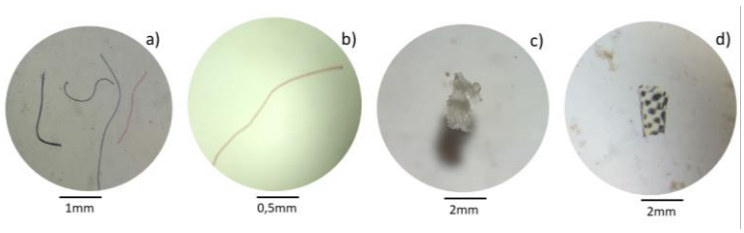

Figure 5. Examples of air-MPs detected in this study: fibers (a and b), fragment (c), and laminar MP (d).

v) Given the clear dominance of fiber-MPs in our samples, we are currently writing a paper-review focusing on the links between this MPs and textile industry/usage. Alma Ferraris is an engineering student helping us in this task (using academic search engines).

2.2) Legal action.

i) Open-dump closure. We met Ombudsman Mr. Jorge Henn. The meeting concluded with a key formal request from Mr. Henn to the Minister of Environment and Climate Change of the Province of Santa Fe, Mr. Enrique Estevez Boero, to close the Rincón open-dump. This letter is showed in Figure 6. As detailed in Section 1, our constant and persuasive efforts managed to gain traction in the media and within society, generating enough pressure for local government officials taking action, ultimately leading to the closure of the Rincón's open-dump. This is a highly significant achievement -shared with other stakeholders and institutions with whom we joined forces-. Unfortunately, we are not satisfied with the manner in which the closure was carried out, as it was explained earlier (Section 1)
https://eldespertadorweb.com.ar/2024/09/18/nuevamente-denuncian-el-mal-manejo-del-basural-en-callejon-pintos-aca-se-esta-enterrando-la-basura-de-vuelta/

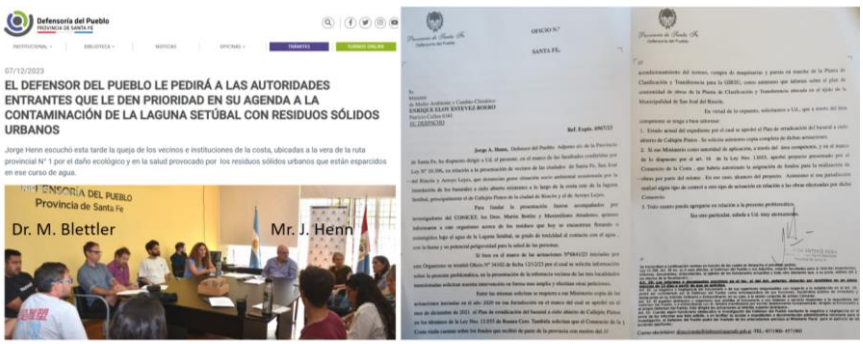

Figure 6. Meeting with Ombudsman Mr. J. Hann, which resulted in a formal letter calling for the urgent open dump closure to the Minister of Environment and Climate Change, who responded positively.

ii) In close collaboration with CAUCE, we filed and winning an injunction against the Municipality of Paraná for failing to respond to a request for public environmental information regarding the management of Urban Solid Waste in the city of Paraná. The case was assigned to the *Juzgado de Garantías* No. 7, presided by Judge Dr. Carola Bacaluzzo, who ruled to compel the Municipality to provide the requested information related to the management of urban solid waste collected by the Municipality of Paraná.
https://cauceecologico.org/?p=5228

2.3) Meetings, workshops, and media coverage.

We organized several meetings with different stakeholder and government authorities in Paraná, Santa Fe, and Rosario cities. Herein, we highlighting of them. i) Organization of the Workshop and Conference Series "From science to action: challenges and innovations in the face of plastic pollution". This significant event took place at the *Centro Científico, Tecnológico y Educativo Acuario del Río Paraná* (Rosario City) and featured the prominent participation of renowned scientist and activist Dr. Sedat Gündoğdu (Çukurova University, Turkey), along with other speakers (Dr. Martín Blettler and MSc. Clara Mitchell) and numerous attendees, including members of NGOs, the private sector, the Chamber of Commerce, government authorities from the Province of Santa Fe, academics, garbage collectors, and others. During the event, the project's initial results were presented and highlighted.

Figure 7. Flyer of the workshop at the *C. C. T. E. Acuario del Río Paraná*.

ii) Meeting with Fernando De La Rosa, Claudia Enrique (Secretary of Health and Environment), and the Integrated Solid Waste Management Board (GIRSU, Paraná City, Entre Ríos Province). There, the Municipality shared with local institutions and organizations the policies outlined for the treatment of organic and inorganic material in the city, including us and CAUCE Foundation representing the results achieved through this project. In this meeting, we warned the authorities that, given the dominance of MP-fibers, we must emphasize the need to integrate the textile industry into the circular economy. We also emphasized the need to reinstate street sweeping programs, as we found high concentrations of microplastics (MPs) in urban dust, particularly in the city center of Paraná.
https://www.parana.gob.ar/noticias/la-municipalidad-planifica-con-distintos-sectores-las-politicas-para-los-residuos-solidos-urbanos-en-parana

Finally, I attended the workshop "Assessment tools for opportunities in the city of Santa Fe: Solid Urban Waste", organized by UNL, Urban Ocean Program, and Santa Fe Government. In this meeting, I showed the results of our project and discussed about alternative solutions.

Figure 8. Workshop certificate of attendance.

As mentioned in Section 1, we highlighted the extensive media coverage we have received and how we believe we have effectively leveraged it to create social pressure on decision-makers. In addition to those mentioned above, we are including a few more examples:
https://gpscomunicacion.com/2024/06/24/detectaron-microplasticos-en-la-atmosfera-de-parana-encontramos-cantidades-asustadoras-dijo-martin-bletter-investigador-del-conicet-se-trata-del-primer-estudio-que-analiza-este-tipo-de-contami/
https://eraverde.com.ar/el-plastico-que-respiras-hallan-micro-particulas-en-la-atmosfera-de-parana/
https://vorterixlitoral.com/62266-alerta-ambiental-estudio-revela-alta-concentracion-de
And, finally, a reel produced by CAUCE Foundation about airborne MP pollution in the Paraná city
https://www.instagram.com/reel/C8NDqoDur1S/

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

3.a) Unfortunately, we were also unable to finalize a methodology for detecting microplastics (MPs) resulting from tire wear on vehicles traveling along roads. We are currently developing and testing a new methodology for this, based on the use of brushes (for sweeping) and handheld vacuum cleaners (for collecting MPs) to target this specific type of microplastic (Prata et al. 2024). We are aware that this method is not designed for atmospheric MPs, but we at least hope to capture tire-derived MPs.
3.b) We were unable to obtain legal access to the Paraná city open dump. The Municipality denied access, citing safety reasons. To tackle this issue, we replaced this open-dump by the "Leyes" one (Santa Fe Province, nearby Setúbal Lake).
3.c) Because the methodological sampling adjustments took longer than expected, we have not yet been able to publish a paper. However, we are currently working hard in this direction.

4. Describe the involvement of local communities and how they have benefitted from the project.

The involvement of local communities has been remarkable, exceeding our expectations. They have actively participated in the project, contributing to various activities such as awareness campaigns, and environmental monitoring. As a result, they have directly benefited from a cleaner and healthier environment, fostering a stronger sense of ownership and responsibility towards their local ecosystems. However, we once again emphasize that while the closure of the Rincón's open-dump is a significant achievement, we do not agree with the way it was carried out. Local community involved include: neighbors, members of environmental organizations, academics from the National University of Littoral (Santa Fe), local media, and government officials (pressured by us to get involved).

5. Are there any plans to continue this work?

Sure. We will continue working until we achieve the immediate goals that we have not yet fully reached yet: 1) the publication of at least 3 scientific papers based on the results of the project's results; 2) refining the methodology to capture and measure MPs produced by vehicle tires; 3) demanding the right to Access Public Information from the Municipality of Rincón, requesting details on the management and planning of the new dumpsite -without ensuring structural and/or management improvements- which was placed just 1 km downstream of that one we successfully closed; 4) continuing to raise public awareness of the project results through mass media, as we have been doing. Additionally, we aim to establish clearer connections between MP-fibers (dominant in all samples) and the textile industry/consumption. We also hope to continue working with public government authorities, proposing mitigation measures such as improvements in urban solid waste management, street sweeping, and environmental education.

6. How do you plan to share the results of your work with others?

Through media outlets (interviews), organizing new meetings and workshops for the general and specialized public, collaborations with environmental organizations, and the publication of scientific papers. In addition, we are analyzing financing alternatives, in collaboration with Dr. Sedat Gündoğdu and his team at Cukurova University, to expand the research line of aerial Fiber-MPs (origin, distribution patterns, and fate).

7. Looking ahead, what do you feel are the important next steps?

Building such close ties with government authorities is not easy, especially when they belong to different political parties and ideologies. However, it is essential if real change want to be achieved. Strengthening these links is necessary, but we must not lose sight of the fact that political-party interests are often prioritized over environmental

concerns, so we must establish relationships with this awareness in mind. At the scientific level, we plan to continue this line of research to strengthen ourselves as a scientific and activist group and gain more credibility and impact both nationally and internationally.

8. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes, we used the RF logo on the flyer promoting the workshop and conference series at the *Acuario Río Paraná* in Rosario city. The RF is also listed as the funding source in the acknowledgment section of the paper submitted to *Archives of Environmental Contamination and Toxicology*: "This study was funded by a grant from The Rufford Foundation (1st Booster Grant, 40858-B) awarded to M. Blettler". In the numerous media interviews, RF was always mentioned, but unfortunately, in some of them, this information was not explicitly stated, likely due to language barriers (a situation that was beyond our control).

9. Provide a full list of all the members of your team and their role in the project.

1. Dr. Martin Blettler. Scientist (INALI, CONICET-UNL). Leader of the project.
2. MSc Valeria Enderle. Lawyer. Executive Director CAUCE Foundation. She organized and carried out every legal action, including the request for access to information from the Municipality of Paraná, which was initially denied and later granted by order of a judge who intervened thanks to her efforts. She was also instrumental in organizing each meeting and workshop, disseminating the results on airborne microplastics, and making CAUCE's network and infrastructure available for the project.
3. Dr. Camila Costa. Architecture and Urbanism teacher (UNL). She played a key role in the distribution and mapping of sampling sites, as well as in raising awareness and securing the involvement of the authorities at the University (UNL).
4. Dr. Luis A. Espinola (Scientist; INALI, CONICET-UNL). PhD in Ecology. He was, and continues to be, responsible for organizing the data-bases and conducting the statistical analyses required for scientific publications. He was also involved in the field sampling efforts.
5. Elie Abrial. Scientist. He was involved in the sampling campaigns, data-processing and paper-writing.
6. Nicolás Garello. Post-PhD student. He was involved on each task of this project, particularly sampling campaigns, sample-processing and social media-dissemination.
7. Giuliana De La Motta and Lucía Gauna. Biodiversity students (FHUC, UNL). They were trained in field and laboratory activities, playing a key role in the sample processing and MPs counting and classification under microscopy.

Key-collaborators (not included in the original purpose):

8. Dr. Sedat Gündoğdu (Turkey). Taking advantage of the timely scientific visit of Dr. Gündoğdu to our laboratory at INALI, he immediately expressed interest in getting involved in our project. He participated in sampling, fieldwork, scientific talks, and workshops. His input is highly valuable for the papers we are currently writing.
9. Alma Ferraris. Engineering student (UNL). She is currently performing another data-set based on the systematic revision of papers on airborne Fiber-MPs and Textile industry.
10. Maria Luz Fernández. Engineering student (UNL). She is helping to process the MP samples under microscopy.

10. Any other comments?

Unfortunately, the estimated duration of the project was not enough to meet all our expectations and objectives. This was mainly due to serious methodological challenges we faced at the beginning of the project, which we -fortunately- managed to overcome by adjusting and developing an optimal air-MP sampling protocol suited to our capabilities and environment features. However, despite some delays, we are continuing to work on this wonderful project and will be sharing updates with RF in the coming months (new publications, public talks, media coverage, etc.). Our aim remains to achieve all of the objectives as outlined in the original proposal, including a mini-documentary.