

*A follow-up study examining airborne
Ambrosia pollen in the Milan area in 2014
in relation to the accidental introduction
of the ragweed leaf beetle Ophraella
communa*

**M. Bonini, B. Šikoparija, M. Prentović,
G. Cislighi, P. Colombo, C. Testoni,
Ł. Grewling, S. T. E. Lommen, H. Müller-
Schärer, et al.**

Aerobiologia

International Journal of Aerobiology -
including the online journal 'Physical
Aerobiology'

ISSN 0393-5965

Aerobiologia

DOI 10.1007/s10453-015-9406-2



Your article is protected by copyright and all rights are held exclusively by Springer Science +Business Media Dordrecht. This e-offprint is for personal use only and shall not be self-archived in electronic repositories. If you wish to self-archive your article, please use the accepted manuscript version for posting on your own website. You may further deposit the accepted manuscript version in any repository, provided it is only made publicly available 12 months after official publication or later and provided acknowledgement is given to the original source of publication and a link is inserted to the published article on Springer's website. The link must be accompanied by the following text: "The final publication is available at link.springer.com".

A follow-up study examining airborne *Ambrosia* pollen in the Milan area in 2014 in relation to the accidental introduction of the ragweed leaf beetle *Ophraella communa*

M. Bonini · B. Šikoparija · M. Prentović · G. Cislighi ·
P. Colombo · C. Testoni · L. Grewling · S. T. E. Lommen ·
H. Müller-Schärer · M. Smith

Received: 18 June 2015 / Accepted: 22 September 2015
© Springer Science+Business Media Dordrecht 2015

Keywords Aerobiology · Ragweed ·
Ophraella communa · Biocontrol agent

The North American invasive alien *Ambrosia artemisiifolia* L. (common or short ragweed) is considered to be an important weed in agriculture and source of highly allergenic pollen (Smith et al. 2013; Essl et al. 2015 references therein) in many parts of the world, including Europe. The oligophagous leaf beetle *Ophraella communa* LeSage 1986 (Coleoptera: Chrysomelidae) preferably feeds from *A.*

artemisiifolia, and is successfully used as a biological agent to control this weed in China (Zhou et al. 2014). It can prevent plants from producing seeds and pollen when it kills them before flowering. In 2013, this beetle was found to have accidentally established in Southern Switzerland and Northern Italy, with high incidence and densities in the Milan area (Müller-Schärer et al. 2014). The map showing the presence of the beetle has now been updated for 2014 (Fig. 1). We have previously shown, using linear regression models, that the exceptionally low amounts of airborne *Ambrosia* pollen observed in the Milan area in 2013 could not be explained by meteorology in that year. We therefore suggested that the decrease might be related to the presence of large numbers of *O. communa* (Bonini et al. 2015).

European COST Action FA1203 (SMARTER, <http://ragweed.eu>) “Task Force *Ophraella*” is continuing to monitor the dynamics of *O. communa* and *A. artemisiifolia* in Northern Italy. Atmospheric concentrations of *Ambrosia* pollen are also routinely monitored in the Milan region by sites belonging to the Italian Monitoring Network in Aerobiology (R.I.M.A.[®]) of the Italian Aerobiology Association (A.I.A.) using volumetric spore traps of the Hirst design (Hirst 1952) and following the standard methods of A.I.A.-R.I.M.A.[®] (2009). *Ambrosia* pollen data recorded at Legnano were used for the analysis, as this is the closest pollen-monitoring station to Malpensa airport where the meteorological data were collected (Fig. 1).

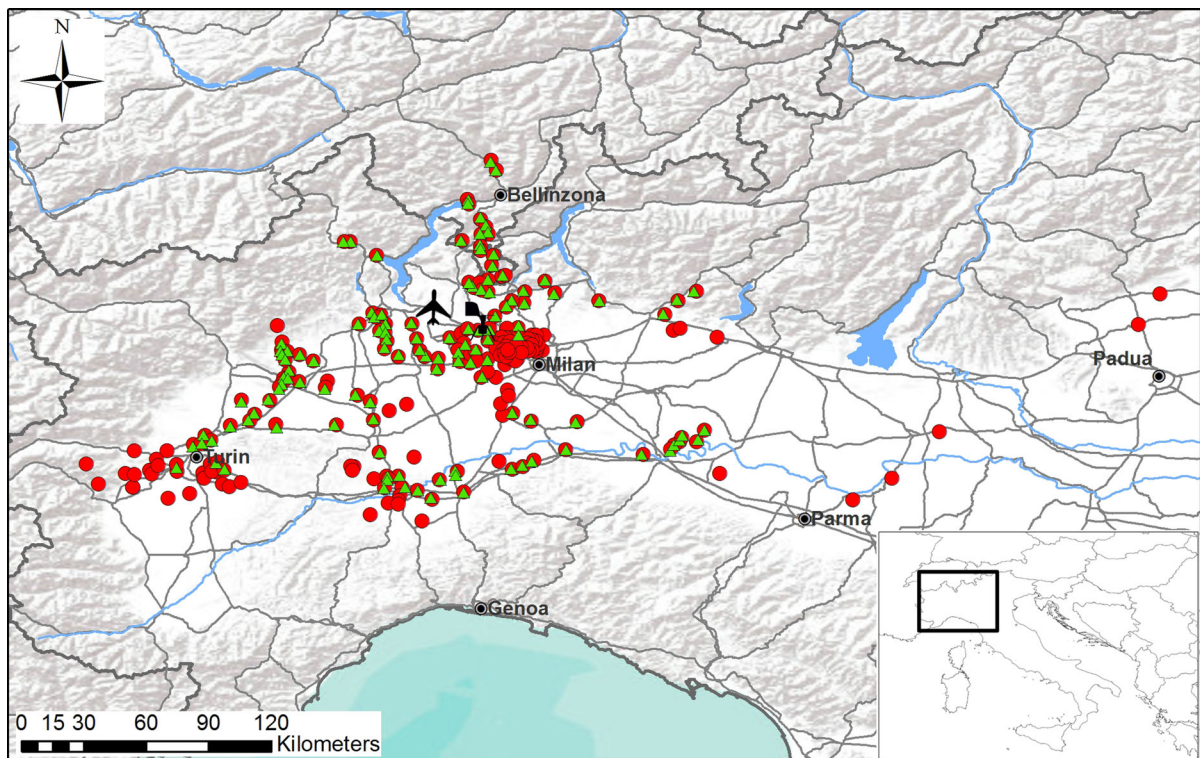
M. Bonini (✉) · G. Cislighi · P. Colombo · C. Testoni
Department of Medical Prevention, Public Health, Local
Health Authority of Milan 1, Parabiago, MI, Italy
e-mail: maira.bonini@aslmi1.mi.it

B. Šikoparija · M. Prentović
Laboratory for Palynology, Department of Biology and
Ecology, Faculty of Sciences, University of Novi Sad,
Novi Sad, Serbia

B. Šikoparija
BioSens Institute, Novi Sad, Serbia

L. Grewling · M. Smith
Laboratory of Aeropalynology, Faculty of Biology, Adam
Mickiewicz University, Poznań, Poland

S. T. E. Lommen · H. Müller-Schärer
Department of Biology, University of Fribourg, Fribourg,
Switzerland



LEGEND:

- ▲ *Ophraella* beetle presence 2013 ● *Ophraella* beetle presence 2014
 ✈ Malpensa Airport 📡 Legnano pollen monitoring station — Major roads

Fig. 1 The presence of the leaf beetle *Ophraella communa* in Southern Switzerland and Northern Italy in 2013 (Müller-Schärer et al. 2014) and in 2014. Legnano pollen-monitoring site and Malpensa airport, where the meteorological data are collected, are also shown

Minimum temperatures in March and June, humidity in June and the number of days with rainfall in September have previously been shown to significantly influence the amount of *Ambrosia* pollen recorded in the Milan region during August and September (Bonini et al. 2014, 2015). Conditions were generally warmer and wetter in 2014, compared to the previous year (Table 1). We therefore decided to examine airborne *Ambrosia* pollen levels and meteorological data recorded before and during the main flowering period of *Ambrosia* (August–September) in 2014, to see whether *Ambrosia* pollen levels were higher or lower than expected at this time. The variables of monthly meteorological data were consequently entered into one simple linear regression model and two multiple linear regression models that were constructed to predict the amount of *Ambrosia*

Table 1 Climate data recorded at Malpensa airport and accessed via <http://www.tutiempo.net>, showing 2014 values in relation to long-term mean for the period 1981–2010

	2013	2014	1981–2010
Mean annual T_m	6.50	7.60	5.93
Mean annual RN	150.00	167.00	127.14
T_m (March)	0.30	2.20	0.58
T_m (June)	13.50	14.60	13.60
H (June)	60.00	65.60	67.64
RN (September)	7.00	12.00	10.50

T_m minimum temperature (°C); H mean humidity (%); RN indicator for the occurrence of rain or drizzle

pollen recorded at Legnano (Table 2) as described in Bonini et al. (2015).

The trend towards lower amounts of airborne *Ambrosia* pollen recorded at Legnano, which was

Table 2 Simple linear and standard multiple regression models for predicting the amount of airborne *Ambrosia* pollen recorded in August and September in Legnano

Model no.	Regression equation	Adj. R^2	p	Komolgorov–Smirnov test (p) ¹	Koenker–Basset test (p) ²
1	$5860.751 + 223.308 \cdot \text{RN (September)}$	0.308	0.045	0.200	0.252
2	$6234.579 - 380.312 \cdot T_m$ (March) $- 190.795 \cdot \text{RN}$ (September)	0.455	0.036	0.200	0.728
3	$10751.921 - 79.487 \cdot H$ (June) $- 209.352 \cdot \text{RN (September)}$	0.558	0.016	0.200	0.685

Models calibrated using data not included in model validation (Bonini et al. 2015). T_m (March) March averages of daily minimum temperatures (°C); H (June) June averages of daily relative humidity (%); RN (September) number of days with precipitation (rain or drizzle) in September

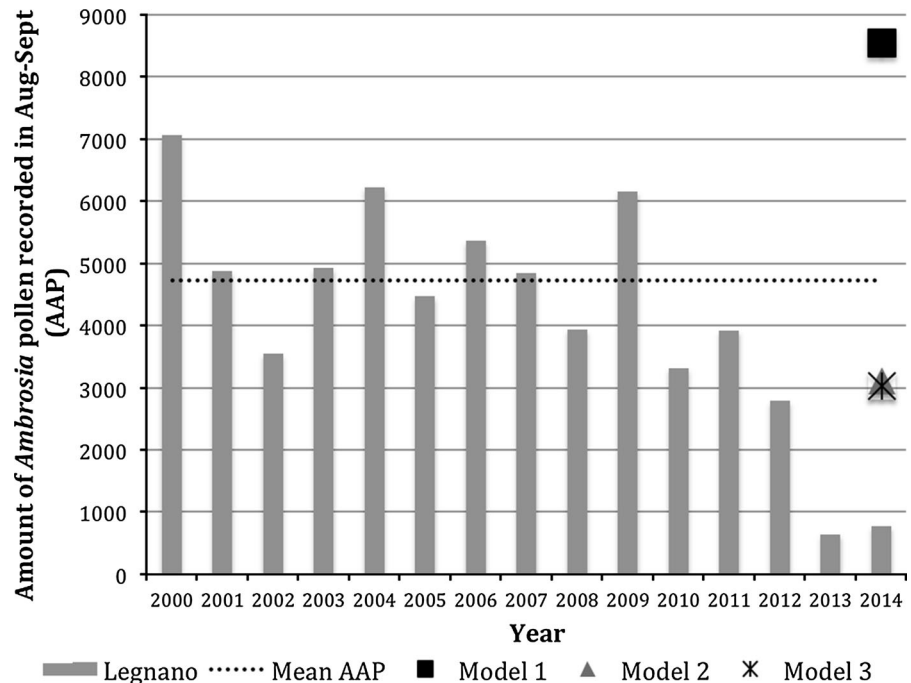
¹ $p > 0.05$ normality of residuals distribution is not violated

² $p > 0.05$ homogeneity of residual variance (homoscedasticity) is not violated

noted in the previous study, continued (Bonini et al. 2015). The 2014 airborne pollen season was the second lowest since 2000 (Fig. 2); this was repeated at the other two stations in the Milan area—Magenta and Rho (data not shown). The three linear regression models highly overestimated the amount of airborne *Ambrosia* pollen recorded in August and September in 2014 (Fig. 2), particularly the simple linear regression model that only included the number of days with precipitation in September (model 1). The two standard multiple regression models that used a

combination of March averages of daily minimum temperature and the number of days with precipitation in September (model 2) and June averages of daily relative humidity and the number of days with precipitation in September (model 3) were in closer agreement (in comparison with model 1), but the values were still too high (over 300 %). It is interesting to note that both models 2 and 3 predicted lower than average atmospheric concentrations of *Ambrosia* pollen in August and September 2014. As seen in our earlier study, the variables entered into these

Fig. 2 The amount of *Ambrosia* pollen recorded annually during August–September (AAP) from 2000 to 2014 at Legnano situated in the Northwest of the Province of Milan. The results of the three linear regression models used to predict the AAP in 2014 are also shown in relation to the 2000–2012 mean. Note that the mean does not include *Ambrosia* pollen data previously used to test the models (2009, 2010 and 2013)



models were all negatively correlated with the amount of airborne *Ambrosia* pollen (Bonini et al. 2015). It therefore appears that the generally warmer and wetter conditions experienced at these times were not conducive to the production and dispersal of *Ambrosia* pollen, and so lower than average pollen levels were to be expected. However, this still does not explain the extremely low levels of atmospheric *Ambrosia* pollen recorded in 2014.

In conclusion, we provide evidence that the presence of *O. communis* may again explain the lower levels of *Ambrosia* pollen recorded in the Milan region in 2014. Although the densities of *O. communis* observed in 2014 were lower than those in 2013, we did observe that the beetle was feeding on the male flower heads. Damaged capitula had either fallen off before anthesis or contained retarded florets, thereby notably reducing the amount of available pollen (S. Lommen; personal observation, unpublished results). Ongoing research aims to experimentally study the effect of meteorology on *Ophraella* development, and on the impact of *Ophraella* on *Ambrosia* plant survival, pollen production and pollen release along an elevational gradient starting from the Milan area northwards.

Acknowledgments We acknowledge support from EU COST Action FA1203 “Sustainable management of *Ambrosia artemisiifolia* in Europe (SMARTER)” (<http://ragweed.eu>). This work was partly financed by ECOST-STSM-FA1203-250415-058150 to MS. Many thanks to Olivier Broennimann (University of Lausanne, Switzerland) for helping to produce Fig. 1.

References

- A.I.A.-R.I.M.A.[®] (2009). *Manuale di gestione e qualità della rete italiana di monitoraggio in Aerobiologia*. Bologna: R.I.M.A.[®]. ISBN: 978-88-900277-1-0: 1–148.
- Bonini, M., Šikoparija, B., Prentović, M., Cislighi, G., Colombo, P., Grewling, L., et al. (2014). Seasonal variations in the amount airborne ragweed pollen in Milan in relation to environmental factors. *Third International Ragweed Conference*, Rho, Italy, April 3–4, 2014.
- Bonini, M., Šikoparija, B., Prentović, M., Cislighi, G., Colombo, P., Testoni, C., et al. (2015). Is the recent decrease in airborne *Ambrosia* pollen in the Milan area due to the accidental introduction of the ragweed leaf beetle *Ophraella communis*? *Aerobiologia*. doi:[10.1007/s10453-015-9380-8](https://doi.org/10.1007/s10453-015-9380-8).
- Essl, F., Biró, K., Brandes, D., Broennimann, O., Bullock, J. M., Chapman, D. S., et al. (2015). Biological flora of the British Isles: *Ambrosia artemisiifolia*. *Journal of Ecology*, 104(4), 1069–1098.
- Hirst, J. M. (1952). An automatic volumetric spore trap. *The Annals of Applied Biology*, 39(2), 257–265.
- Müller-Schärer, H., Lommen, S. T. E., Rossinelli, M., Bonini, M., Boriani, M., Bosio, G., & Schaffner, U. (2014). *Ophraella communis*, the ragweed leaf beetle, has successfully landed in Europe: Fortunate coincidence or threat? *Weed Research*, 54(2), 109–119.
- Smith, M., Cecchi, L., Skjoth, C. A., Karrer, G., & Šikoparija, B. (2013). Common ragweed: A threat to environmental health in Europe. *Environment International*, 61, 115–126.
- Zhou, Z.-S., Chen, H.-S., Zheng, X.-W., Guo, J.-Y., Guo, W., Li, M., et al. (2014). Control of the invasive weed *Ambrosia artemisiifolia* with *Ophraella communis* and *Epiblema strenuana*. *Biocontrol Science and Technology*, 24(8), 950–964.