



Version 21/04/2016

## COST Action FA1203

### Sustainable management of *Ambrosia artemisiifolia* in Europe

## FINAL ACHIEVEMENT REPORT (19/11/2012 – 18/11/2016)

**This report on the full lifetime of the Action is submitted by the MC Chair on behalf of the Management Committee.**

**Confidentiality:** This report, other than section II.D, is non-confidential. Section II.D is confidential to the Management Committee and the COST Association (including the Committee of Senior Officials, Scientific Committee and Administration).

#### **Executive summary of the Achievement Report:**

By affecting both the agricultural and the health sector, ragweed constitutes an ideal bridge species to tap on synergies between weed science and invasion science, which so far have developed as two rather distinct research areas, with different institutions and researchers involved. The Action has been successful in bringing together experts from both fields, but also from health, economy and social sciences. This unique combination allowed setting up interdisciplinary international collaborative projects and discussing the problem at a European scale, thus also providing a template for implementing integrated control measures against other invasive alien species across Europe. The Action presently counts over 250 registered participants from 30 COST member countries, 4 COST near neighbour countries, 1 COST member state and several institutions from other countries. Besides the initial four Working Groups, the Action has also initiated Task Forces in order to quickly respond to specific research needs. For the first time, WG1 brought together the major European research groups working on classical biological control of weeds, assessing both herbivores and pathogens as biological control agents. Two most successful international stakeholder workshops were held in Brussels and Budapest on the regulation of the import and release of biological control agents, and the conclusions and recommendations from the workshops were referred to the decision-making bodies of the different participating organizations for further consideration, including the EPPO/IOBC Panel. The TF *Ophraella* was built as a mini-version of SMARTER to quantify and evaluate the potential benefits and risks of the recently established North American leaf beetle *O. communa* in Europe; the data collected within TF *Ophraella* cover risks on non-target effects as well as impacts of this biocontrol agent on the target weed at the plant and the population level, on pollen release, on aerial pollen concentration and on the economic benefits due to reduced health costs. First joint studies show that the decrease in airborne *Ambrosia* pollen in 2013-2015 in the Milan area was at least partially due to biological control of ragweed by *O. communa*, and that health costs in the Rhone-Alps region could be reduced by c. 10 Mio €/year if the beetle would arrive and have a similar impact. The TF Population Dynamics monitored 50 ragweed populations across all Europe during 3 years, which forms the basis for a climate- and habitat-dependent model describing ragweed performance, and identifying the most effective habitat- and region-specific control strategies. WG 2 developed protocols for seed collection and storage, manuals for efficient vegetation management and for soil seed bank analysis, and initiated a joint experiment on best practice of viability tests of ragweed seeds. The TF Genetics elaborates and shares molecular markers and methods for studies on the general patterns of genetic variation, colonization history and spread of ragweed populations worldwide. WG3 organized an early workshop joining SMARTER participants to share experiences with *Ambrosia* control in various habitats, and resulting in a series of leaflets providing information on the currently best management practices in different habitats. It also raised awareness of all invasive ragweed species in Europe to the general public. WG4 developed an inventory of available health data in Europe and defined an action plan focusing on case studies in France and Italy to evaluate ragweed control measures. The integration of all levels of data started in the last Grant Period of SMARTER and will result in several multi-author interdisciplinary publications in 2017. Our Action contributed to the training of tens of early stage researchers (ESR) from all Europe on ragweed monitoring, experimentation and



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management with cutting edge technologies, and 34 Short Term Scientific Missions were performed, mainly by ESR. The Action has been very successful in attracting media attention (new paper articles, TV items, radio etc. in several participating countries), by providing information to the general public (e.g. information leaflets distributed among the public in many languages, production of educational items) and to communicate with stakeholders and stakeholder organizations (several international workshops with authorities from the local to the European level present). In addition, one of our key papers was chosen among the 100 most influential scientific papers of 2015. COST policies have been fulfilled in all categories and very well fulfilled with respect to all Inclusiveness Target Countries, Early Career Investigators, gender balance and international collaboration.





	and Biological control					
2	Vegetation management	Gerhard Karrer	Austria	1985	Male	77
3	Integration of management options	Per Kudsk	Denmark	NA	Male	22
4	Management evaluation	Vacant, but 3 subgroup coordinators	NA	NA	NA	64

**Other positions if applicable** (STSM Coordinator, WG Vice Leader, Task Force Leader...)

Position	Name	Country	Date of PhD	Gender
Training Coordinator	Maurizio Vurro	Italy	NA	Male
TF leader genetics	Valérie Le Corre	France	1997	Female
TF leader population dynamics	Suzanne Lommen	Switzerland	2013	Female
TF leader Northern Countries	Carsten Skjøth	United Kingdom	2009	Male
TF leader Ophraella	Urs Schaffner	Switzerland	1994	Male
WG1 Vice leader	Maurizio Vurro	Italy	NA	Male
WG2 Vice leader	Gabriela Kazinczi	Hungary	1995	Female
WG3 Vice leader	Bruno Chauvel	France	1991	Male
WG4 Vice leader-models	Carsten Ambelas Skjøth	UK	2009	Male
WG4 Vice leader-pollen	Matt Smith	UK	2004	Male
WG4 Vice leader-health	Letty de Weger	Netherlands	1988	Female

<b>Action website:</b>	<a href="http://www.ragweed.eu">www.ragweed.eu</a> (will be transferred to the site of the International Ragweed Society, Contactperson and chairmain is SMARTER member Maira Bonini: <a href="mailto:Mbonini@ats-milano.it">Mbonini@ats-milano.it</a> )
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## I.B. Achievement of MoU objectives and deliverables and additional outputs

### MoU objectives

MoU objective	Achieved Yes/ Partially/ No	Evidence of (partial) achievement
conduct trans-national and trans-sectoral cooperation in integrated management of ragweed, a flagship IAS in Europe.	Yes	A platform for the elaboration of context-specific control solutions and their impact evaluation at the local scale has been established such as the establishment of the action, the establishment of the WG groups, establishment of the web-page ( <a href="http://www.ragweed.eu">www.ragweed.eu</a> ). Specific examples are given in paper 4 and paper 6 in the publication list
promote and coordinate biological control and vegetation management schemes against ragweed and combine these new control measures with existing chemical and physical control methods to elaborate context-specific and synergistic control solutions	Yes	<p>Research on several biological control agents (invertebrates, pathogens, bacteria) was coordinated and partly initiated during the Action. Assessment of risks and benefits of the recently established <i>O. communa</i> have been conducted and provided to national competent authorities in France and Switzerland.</p> <p>Biological control and vegetation management schemes against ragweed have been promoted and coordinated intensively. Regarding biological control, two stakeholder meetings were organised, using ragweed and the accidental introduction of the candidate biocontrol agent <i>Ophraella communa</i> as a case study to discuss regulation of beneficial insects for biocontrol with local and European authorities. A training school on biological control was held for 10 young researchers.</p> <p>With respect to vegetation management, the most effective control methods of ragweed along roadsides by specific mowing regimes, and of sowing specific seed mixtures in arable land, were both published in scientific journals. A training school on Vegetation Management was held for young researchers and practitioners. Manuals for soil seed sampling and assessing the effect of vegetation management were printed and distributed. Integration with existing methods will be published in 2017.</p>
assess large-scale effects of proposed integrated management measures using coupled ecosystem and atmospheric models	Yes	<p>The first integrated model system – as proposed in the MoU– was produced by the ATOPICA project with active participation of several SMARTER participants, and published in Nature Geoscience (paper 7)</p> <p>Model assessing atmospheric pollen concentration in northern Italy before/after establishment of <i>O. communa</i> is underway and the first inventory for atmospheric models (before/after) is expected to be submitted early January 2017. This data is already delivered to the COSMO-Art group at Meteoswiss for operational forecasting.</p>
Connections with the two large integrated projects ATOPICA, PASODOBLE and ECLAIRE that deal with chemical and biological	Yes	The first integrated model system – as expected in the MoU– was produced by the ATOPICA project and published in Nature Geoscience (paper 7). Additional relevant manuscripts from PASODOBLE and ECLAIRE

air quality, climate change and ecosystems including possible feed-back mechanisms		are expected in 2017. Participants from ATOPICA, PASODOBLE and ECLAIRE are all active in SMARTER. A next generation model with feed-back mechanisms included will be used for trial forecast in UK in 2017.
assess the economic, environmental and social impact of the proposed interventions against common ragweed for the various stakeholders (private and public sector) and various spatial scales (local to Europe), taking into account its predicted future spread due to climate and land-use change	Yes	The first integrated model system – as proposed in the MoU– was produced by the ATOPICA project and published in Nature Geoscience (paper 7) – however without health, societal and economic impacts. An economic study on the potential costs and benefits of the accidentally introduced biocontrol agent <i>Ophraella communa</i> , linking ragweed presence, risk for sunflower, aerial pollen, and health costs, has been elaborated for France, and has been presented at several international meetings The study will be extended for a larger area and will be published in 2017.
capacity-building through Summer Schools and STSMs, especially for early stage researchers (ERS), in the field of understanding, managing and monitoring plant invasions.	Yes	34 STSM have been completed, mainly by early stage researchers, and representing topics of all WG and TFs. 4 summer Schools Have been organised, 1 on Biological Control by WG1, 1 on vegetation management by WG2, and 2 on aerobiology by WG4.
promote and assist the implementation of regulations for the import and release of BC organisms, and of management schemes against IAS of European-wide concern	Yes	This work was kick-started with a stakeholder workshop in Brussels in 2015 followed by an EPPO / SMARTER Workshop supported by IOBC, IBMA and CABI (all major parties involved in biocontrol, including NGOs and representatives of enterprises) in November 2016.

### MoU deliverables

MoU deliverable	Delivered Yes/ Partially/ No	Evidence of (partial) delivery
Elaboration of a coordinated European approach towards BC of Ambrosia in order to ensure that the test plant list covers closely related native species from the whole of Europe, to focus on host-range and impact assessment of the most promising classical biological control candidates, and on potential indirect effects on native ecosystems (food chain);	Yes	European-wide test plant list compiled to coordinate risk assessment studies in biological control projects against ragweed across Europe and to adjust results to the new regulations (European-wide risk assessment required). TF <i>Ophraella</i> and PhD on <i>Epiblema strenuana</i> (Israel) to collect data on non-target risks (sunflower, native plants) and impact data (impact on seed and pollen production) to assess potential of these insects for biological control in Europe and to support national decision makers in regulating these organisms; identification and study of the biology and impact of a newly detected mite <i>Aceria artemisiifoliae</i> species on ragweed in Serbia. Work on exotic biological control candidates: host-specificity studies with the beetle <i>Ophraella slobodkini</i> . Potential distribution maps of the main candidates for biological control of ragweed established for Europe. Protocol for surveys of herbivore communities established and tested in Sweden, Slovak Republic and Italy (incl. STSM by P. Toth).
Promote and coordinate experimental examination of	Yes	Two pathogens previously isolated from ragweed in Europe investigated for their use as inundative BC

selected pathogens isolated from the target weed in Europe for their potential as inundative BC agents against Ambrosia;		agents and rejected. Identification of the phytotoxic metabolites produced by plant pathogens and evaluation of their potential as natural and safe herbicides against Ambrosia underway; assessment of the suitability of plant-associated bacteria to control common ragweed underway.
Elaboration of Pest Risk Assessments for promising BC candidates for BC of Ambrosia at the European level.	Yes	Behavioural, host-specificity and impact studies conducted with <i>O. communa</i> in the frame of SMARTER; SMARTER provided these data to the National Authorities in France to conduct a PRA on <i>Ophraella communa</i> specifically for France.
Synthesis of previous and ongoing experiments aiming at Ambrosia control by vegetation management, including recommendations for setting up new experiments;	Yes	WG2 meeting in Samsun, June 2013: presentations of the state of the art in the fields of WG vegetation management (and ragweed biology); specific objectives were identified to future focus on the main aims of the Action. WG2 meeting in Berlin Nov. 2014 discussing and preparing protocols on soil seed bank analysis and experiments to determine optimal cutting schedule; WG2 meetings during the 4th International Symposium on Weeds and Invasive Plants - May 2014 in Montpellier France: (1) to finalize the manual on optimization of cutting experiments and seeding competing vegetation against ragweed, and (2) to finish the protocol on soil seed bank analysis. WG2 meeting in March 2015 in Vienna on ragweed seed biology aiming at the development of a protocol for a joint experiment of 10 European labs for the most efficient test of ragweed seed viability (available on SMARTER Extranet since April 2015). In March 2016 WG2 met in Novi Sad (Serbia) to finish the 2 <sup>nd</sup> edition of the soil seed bank analysis protocol; the last WG2 meeting in Vianden served to finish the manual on seed viability testing.
Manual (including common reporting) for testing the efficiency of vegetation control measures (printed and online);	Yes	WG2 provided (1) recommendations for setting up new mowing experiments and seeding competing vegetation ("manual for cutting experiments"), (2) a protocol for soil seed bank analysis to evaluate the sustainability of any control measure, and (3) a protocol for testing viability of ragweed seeds from any containment. All are available on SMARTER Extranet for download and 3 are also available as printed folders.
Reports and publications on best practice in vegetation management control.	Yes	4 papers were published by members of WG2 on vegetation management along roadsides (doi:10.1111/wbm.12051, doi: 10.1111/wre.12074, doi: 10.1111/wre.12143, , doi: 10.3897/neobiota.28.6838). More papers/reports to come
Recommendations for experimental assessment of integrated Ambrosia management measures, depending on region, habitat (including cropping systems) and stage of invasion;	Yes	A meeting was organised in February 2016 with the objective to discuss how to assess the effect of Ambrosia management applying a cost-benefit model. A conceptual model was developed which included a SMARTER derived dataset over France (Paper 1: Thibaudon et al, 2014). A traditional publication is in progress and planned for 2017.

Develop Ambrosia population models for different habitats to evaluate and model impact of management measures at the local scale;	Yes	The TF Population Dynamics was initiated to achieve this specific goal and met three times to coordinate activities. Over 25 team members conducted a 3-year demographic field survey of 50 ragweed populations across the European continent in 17 countries and hence produced the largest demographic database on ragweed existing. The TF developed a demographic model, which is now being parameterised with data from the survey. This already revealed important differences in dynamics between different habitats (publication in progress). The model is also being used to evaluate and model the impact of <i>Ophraella communa</i> (with TF <i>Ophraella</i> ) and vegetation management (with WG2), each resulting in a publication in 2017.
Protocol for the quick but reliable determination of ragweed in the soil seed bank;	Yes	WG2 provided a protocol for soil seed bank analysis to evaluate the sustainability of any control measure (available on SMARTER Extranet since June 2014). A second edition is uploaded and printed as folder. Additionally, the 'taxonomy group' initiated by WG2 and 3 provided a identification card for the most common 3 ragweed species in Europe, and an identification folder for all 6 known <i>Ambrosia</i> species in Europe to avoid misidentifications in future.
Scientific publications on the combined use of biological, chemical and bio-preventive weed measures	Pending (Yes)	A publication is planned for first half of 2017 summarizing existing measures in the participating countries and highlighting the contributions that SMARTER has made to the development of novel management strategies.
Construction of an integrated method that combines recorded data and coupled models for ragweed population development and reproduction (pollen and seeds) that will be used for evaluation of integrated management of Ambrosia;	Yes	The integration of all levels of data is planned for the final phase of SMARTER (and after) and an action plan with focus on case studies in France and Italy was formulated at the Brussels meeting in 2015. The TF Population Dynamics estimates seed and pollen production based on the demographic field survey to help linking this to impact on seed dynamics and human health (through pollen). WG4 has produced large scale base-line data sets for European-wide assessments (paper 9, Sikoparija et al, 2016). Relevant results produced by SMARTER participants from the ATOPICA, PASODOBLE and ECLAIRE projects have been produced or are underway (e.g. paper 7: Hamaoui-Laguel, Paper 7). The COSMO-Art model at Meteoswizz is running in forecast mode and applies integrated data from SMARTER as it has been shown that surface maps based on data-fusion of ragweed plant location, pollen data and ecosystems provides the best background data for the model (Zink et al, 2016)
Application and testing of ecological, economic and social impact assessment methods when developing habitat and region-specific recommendations for the management of Ambrosia	Pending (Yes)	An Inventory of available health data in Europe for further analysis was made. A plan was formulated at the meeting in Brussels and further discussed in Leiden in 2016. It is expected to be executed in 2017 as all components and data sets are now available.
Publications (both in disciplinary and interdisciplinary journals) and stakeholder reports (for	Yes	10 published papers are listed in the list of co-authored publications, while a longer list can be provided. A number of publications (e.g. as a results of STSMs) are



practical implementations of integrated management solutions).		underway. More papers (e.g. doi:10.1111/wbm.12051) are produced which however do not fulfil the criteria of shared papers (e.g. two action participants and two different countries). Stakeholder communication has been carried out in form of traditional peer reviewed papers, reports, leaflets to stakeholders and on-line media such as TV and is available from <a href="http://www.ragweed.eu">www.ragweed.eu</a> .
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**Co-authored publications and FP7/ H2020 proposals**

The co-authored publications and FP7/ H2020 proposals/ projects resulting from the Action are listed on the page following the “Additional outputs and achievements” section.

**Additional outputs and achievements**

Please describe any other outputs and achievements, focusing in particular on those that contribute to the COST mission of “COST enables break-through scientific developments leading to new concepts and products and thereby contributes to strengthen Europe’s research and innovation capacities.”
Please describe any additional outputs and achievements from the Action

**Co-authored publications**

This table contains the (up to) ten most significant co-authored publications resulting from the Action. All publications are on the topic of the Action, co-authored by at least two Action participants from two different countries participating in the Action.

NO.	Bibliographic data (including: Title, Authors, Title of the periodical or the series, Issue number or volume, Publisher, Year of publication, Relevant pages)	Main author	Number of authors	Action participants listed among the authors (Name, country and role <sup>1</sup> )	WGs involved in publication	Date of submission (must be after Action start date)	Expected date of publication (if not already published)	Persistent link to publicly available version of the paper (if available) or the abstract	Is/Will open access <sup>2</sup> provided to this publication?	Is/ will COST be cited/ acknowledged in the publication?	Are/ will COST funds (be) implicated in this publication	Relevance to H2020 Societal Challenges <sup>3</sup> ?	Is it peer-reviewed?	Was the added value of the Action Network necessary for the publication?
1	Thibaudon M, Šikoparija B, Olivera G, Smith M & Skjøth CA (2014) Ragweed pollen source inventory for France – the second largest centre of Ambrosia in Europe. <i>Atmospheric Environment</i> . 83, 62–71	Thibaudon, M.	5	Thibaudon MC Member Šikoparija, MC Member Smith MC Member Skjøth MC Substitute	4	24 May 2013		<a href="http://www.sciencedirect.com/science/article/pii/S1352231013008108">http://www.sciencedirect.com/science/article/pii/S1352231013008108</a>	No	Yes	No	Yes	Yes	Yes
2	Thalmann, D J K, Kikodze, D, Khutsishvili, M, Kharazishvili, D, Guisan, A, Broennimann, O, Müller-Schärer, H (2014) Areas of high conservation value in Georgia: present and future threats by invasive alien plants. <i>Biological Invasions</i> . 17(4), 1041-1054	Broennimann, O. & Müller-Schärer, H. are joint senior authors	7	Kikodze MC Observer Broennimann WG Member Müller-Schärer MC Chair	1,2	Oct 2013		<a href="http://link.springer.com/article/10.1007%2Fs10530-014-0774-2">http://link.springer.com/article/10.1007%2Fs10530-014-0774-2</a>	No	Yes	No	Yes	Yes	Yes
3	Smith M, Cecchi L, Skjøth CA, Karrer G & Šikoparija B (2013) Common ragweed: A threat to environmental health in Europe. <i>Environment International</i> 61: 115–126.	Smith, M.	5	Smith MC Member Cecchi MC Member Skjøth MC Substitute Karrer MC Member Šikoparija, MC Member	4	1 April 2013		<a href="http://www.sciencedirect.com/science/article/pii/S0160412013001682">http://www.sciencedirect.com/science/article/pii/S0160412013001682</a>	No	Yes	No	Yes	Yes	Yes
4	Müller-Schärer H, Lommen S T E, Rossinelli M, Bonini M, Boriani M, Bosio G & Schaffner U (2014) Ophraella communa, the ragweed leaf beetle, has successfully landed in Europe: fortunate coincidence or threat? <i>Weed research</i> 54 (2): 109-119	Müller-Schärer H & Lommen STE are shared first author	7	Schärer MC Chair Bonini MC Member Schaffner MC Member	1	Oct 2014		<a href="http://onlinelibrary.wiley.com/doi/10.1111/wre.12072/full">http://onlinelibrary.wiley.com/doi/10.1111/wre.12072/full</a>	Yes	Yes	Yes	Yes	Yes	Yes
5	Karrer, G., Skjøth, C.A., Šikoparija, B., Smith, M., Berger, U., Essl, F. (2015) Ragweed (Ambrosia) pollen source inventory for Austria. <i>Science of The Total Environment</i> , 523, 120–128	Karrer, G.	6	Karrer MC Member Skjøth MC Substitute Šikoparija, MC Member Smith MC Member Essl MC Substitute	4	9 December 2014		<a href="http://www.sciencedirect.com/science/article/pii/S0048969715003927">http://www.sciencedirect.com/science/article/pii/S0048969715003927</a>	No	Yes	No	Yes	Yes	Yes
6	Bonini, M., Šikoparija, B., Prentović, M., Cislighi, G., Colombo, P., Testoni, C., Grewling, L., Lommen, S. T. E., Müller-Schärer, H. and Smith, M. (2015). Is the recent decrease in airborne Ambrosia pollen in the Milan area due to the accidental introduction of the ragweed leaf beetle <i>Ophraella communa</i> ? <i>Aerobiologia</i> , December	Bonini, M	10	Bonini MC Member Šikoparija, MC Member Testoni STSM	1,4	24 September 2014		<a href="http://link.springer.com/article/10.1007%2Fs10453-015-9380-8#page-1">http://link.springer.com/article/10.1007%2Fs10453-015-9380-8#page-1</a>  <i>Change The World, One Article At A Time (by Springer)- Best 2015 journal paper addressing the world's most pressing challenges.</i>	No	Yes	No	Yes	Yes	Yes

<sup>1</sup> MC Member/ MC Substitute/ MC Observer/ WG Member/ Training School Trainee/ STSM Recipient/ Other Action Participant

<sup>2</sup> Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

<sup>3</sup> H2020 Societal Challenges are "Health, demographic change and wellbeing"; "Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy"; "Secure, clean and efficient energy"; "Smart, green and integrated transport"; "Climate action, environment, resource efficiency and raw materials"; "Europe in a changing world - inclusive, innovative and reflective societies"; "Secure societies - protecting freedom and security of Europe and its citizens"

	2015, Volume 31, Issue 4, pp 499–513			Recipient Grewling WG member Lommen, WG member administrator Müller- Schärer MC Chair Smith MC Member											
7	Lynda Hamaoui-Laguel, Robert Vautard, Li Liu, Fabien Solmon, Nicolas Viovy, Dmitry Khvorostyanov, Franz Essl, Isabelle Chuine, Augustin Colette, Mikhail A. Semenov, Alice Schafhauser, Jonathan Storkey, Michel Thibaudon and Michelle M. Epstein (2015), Effects of climate change and seed dispersal on airborne ragweed pollen loads in Europe <i>Nat Clim Change</i> . 2015. doi:10.1038/NCLIMATE2652	Lynda Hamaoui-Laguel	14	Jonathan Storkey WG member, Franz Essl MC Substitute, Michel Thibaudon MC member	2	15 Jan 2015	25 May 2015	<a href="http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate2652.html">http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate2652.html</a>	No	No	No	Yes	Yes	No	
8	Franz Essl, Krisztina Bir, Dietmar Brandes, Olivier Broennimann, James M. Bullock, Daniel S. Chapman, Bruno Chauvel, Stefan Dullinger, Boris Fumanal, Antoine Guisan, Gerhard Karrer, Gabriella Kazinczi, Christoph Kueffer, Beryl Laitung, Claude Lavoie, Michael Leitner, Thomas Mang, Dietmar Moser, Heinz Mueller-Schaerer, Blaise Petitpierre, Robert Richter, Urs Schaffner, Matt Smith, Uwe Starfinger, Robert Vautard, Gero Vogl, Moritz von der Lippe, Swen Follak (2015), <i>Journal of Ecology</i> , Volume 103, Issue 4, 1069–1098	Franz Essl	28	Essl MC Substitute, Broennimann, WG member, Chauvel, MC member, Guisan, WG member, Karrer, MC member, Kazinczi, WG member, Laitung, WG member, Mueller-Schaerer, MC Chair, Schaffner, MC member, Smith, MC member, Starfinger, MC member, von der Lippe, WG member, Follak, WG member	1, 2, 4	16 July 2014	8 Jun 2015	<a href="http://onlinelibrary.wiley.com/doi/10.1111/1365-2745.12424/">http://onlinelibrary.wiley.com/doi/10.1111/1365-2745.12424/</a>	No	Yes	No	Yes	Yes	Yes	
9	B. Sikoparija, C. A. Skjøth, S. Celenk, C. Testoni, T. Abramidze, K. Alm Kübler, J. Belmonte, U. Berger, M. Bonini, A. Charalampopoulos, A. Damialis, B. Clot, Å. Dahl, L. A. de Weger, R. Gehrig, M. Hendrickx, L. Hoebeke, N. Iancovici, A. Kofol Seliger, D. Magyar, G. Mányoki, S. Milkovska, D. Myszkowska, A. Páldy, C. H. Pashley, K. Rasmussen, O. Ritenberga, V. Rodinkova, O. Rybníček, V. Shalaboda, I. Šaulienė, J. Ščevková, B. Stjepanović, M. Thibaudon, C. Verstraeten, D. Vokou, R. Yankova, M. Smith (2016), Spatial and temporal variations in airborne Ambrosia pollen in Europe, <i>Aerobiologia</i> , in press	Branko Sikoparija	38	B. Sikoparija (MC), C. A. Skjøth (MC), S. Celenk (MC), J. Belmonte (MC), M. Bonini (MC), Å. Dahl (MC), L. A. de Weger (MC), D. Magyar (MC), D. Myszkowska (MC), I. Šaulienė (MC), M. Thibaudon (MC), D. Vokou (MC), M. Smith (MC)	4	15 May 2016	Dec 2016	<a href="http://link.springer.com/article/10.1007/s10453-016-9463-1">http://link.springer.com/article/10.1007/s10453-016-9463-1</a>	Yes	Yes	Yes	Yes	Yes	Yes	

10	Milakovic et al (2014) Management of roadside populations of invasive <i>Ambrosia artemisiifolia</i> by mowing. Weed Research 54 (3): 256-264	Milakovic	3	Milakovic, Karrer MC member WG leader	2		2014	DOI: 10.1111/wre.12074									
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### FP7/ H2020 Proposals and projects

This table contains FP7/ H2020 proposals/ projects spinning off from Action activities and including in the proposing consortium at least three Action participants from at least three different countries participating in the Action.

NO.	Title	Name and country of main proposer	Number of proposers	Action participants listed among the proposers (Name, country, role <sup>3</sup> in the Action)	Funding agency submitted to	Date submitted	Date results expected	Result	Call identifier	Relevance to H2020 Societal Challenges <sup>4</sup> ?	Was the added value of the Action Networking necessary for the proposal / project?
<b>Projects</b>											
1	List FP7/ H2020 projects resulting from the Action in this section of the table										
2											
<b>Proposals</b>											
	List FP7/ H2020 proposals submitted as a result of the Action in this section of the table										
	Integrated Weed Management: PRACTical Implementation and Solutions for Europe (IWM PRAISE)	Per Kudsk, Denmark	41	Per Kudsk (Denmark, coordinator), Bruno Chauvel (France), Urs Schaffner (Switzerland, work package leader), Jonathan Storkey (UK, work package leader)	Horizon 2020	13 September 2016	November/ December 2016				Yes, close collaboration established during COST-SMARTER
	AMBROMAN: MARIE SKŁODOWSKA-CURIE ACTIONS; Innovative Training Networks (ITN) Call: H2020-MSCA-ITN-2016	Alfons Oude Lansink, Netherlands	16	Alfons Oude Lansink (Netherlands, coordinator), Antoine Guisan (Switzerland), Heinz Müller-Schärer (Switzerland), Maira Bonini (Italy), Jordina Belmonte (Spain), Marion Seier (UK), Gerhard Karrer (Austria)	Horizon 2020	2015	May 2016	Rejected			Yes, the idea for AMBROMAN arose during SMARTER meetings

## I.C. Networking

### Added value of the Networking

General: the Action has brought together experts from multiple disciplines (researchers from natural sciences to health and social sciences) and professionals related to the ragweed problem. This unique combination has allowed the setting-up of interdisciplinary international collaborative projects (see publications), and allows to discuss the problem on a European scale (c.f. Brussels workshop Jan. 2015). The Action has also collected national facts about the ragweed distribution, its problematic consequences, its management, communication to the public, research activities and publications, from all participating countries. These fact sheets hence give an extended up to date overview of all these aspects for nearly the whole of Europe, from which Action members already benefit. In 2017 the information relevant for management will be published by WG3. The SMARTER network also allowed to quickly react to the accidental introduction of the leaf beetle *Ophraella communa* first observed by SMARTER members in 2013 in Southern Switzerland and Northern Italy, and to initiate studies on its target (control effectiveness) and potential non-target (biosafety studies) effects.

WG1: For the first time, WG1 brings together the major European research groups working on classical biological control of weeds, assessing either herbivores or pathogens as biological control agents. The stakeholder workshop in Brussels (organised by WG1 coordinator/Action Chair/Grant Holder, held Jan 2015) and the follow-up meeting under the lead of the European and Mediterranean Plant Protection Organization (EPPO) in autumn 2015 are largely influenced by the networking done within WG1.

TF Population Dynamics: The Task Force consists of over 25 members from 17 countries, that all took part in data collection by intensively monitoring *Ambrosia* populations throughout the entire European continent. Without the Action it would not have been possible to so effectively gather this group of people, and to have the financial resources to meet, which was essential to train and discuss the protocol that is strictly followed by all participants. This has resulted in the largest, most elaborate data set on ragweed demography from field populations, allowing climatic-and habitat-dependent modeling describing ragweed performance for whole Europe. Thanks to the Action, these models are now being used to for the first time make long-term projections about the effect of biocontrol (in collaboration with TF *Ophraella*, WG1) and vegetation management (WG2).

WG2: From the beginning, WG2 was very attractive for the participants (95 ticks by participants in the questionnaire). Within the WG2-focuses seed biology + soil seed bank analysis and vegetation management by mowing + competing vegetation, the respective specialists were enabled to personally exchange their experience in detail during the workshops in Samsun, Berlin, Montpellier and Vienna. Their input became manifest in an internal protocol for seed collection and storage, in manuals for mowing experiments (already applied by participants in Lithuania and Germany) and for soil seed bank analysis (transferred via STSMs). A joint experiment on best practice of viability tests of ragweed seeds was initiated and started in 2015 and will continue after the action. Identification tools were provided to prevent the common misidentifications in *Ambrosia*.

WG3: As the very first action, WG3 organised a workshop bringing together SMARTER participants to share experiences with *Ambrosia* control in various habitats. The outcome of the workshop was a series of leaflets providing information on the currently best management practices in different habitats. Revised versions of the leaflets will be available on the SMARTER website for downloading and translation in early 2017.

WG4: A number of activities have been planned and are already executed in WG4. In particular it should be mentioned a European wide activity on ragweed pollen was initiated at one MC meetings and a final draft of the results was ready in summer 2015 during an STSM. The final publication was accepted in autumn 2016. As such this would not have happened without the action.

TF *Ophraella*: The TF *Ophraella* was the first TF created in SMARTER and was built as a mini-SMARTER that facilitates collaboration and coordination among scientists from multiple disciplines (weed scientists, ecologists, modellers, economists, health specialists, aerobiologists) to quantify and evaluate the potential benefits and risks by the recently established *Ophraella communa* in Europe. It also facilitates communication and collaboration with scientists from the native range of *O. communa* (USA) and from other areas where *O. communa* has established (Japan, China). Without this TF no concerted data

collection to assess the risks and benefits of <i>O. communa</i> in Europe would have been made, which would seriously hamper ongoing/future pest risk assessments on <i>O. communa</i> in Europe..			
The table below shows the extent to which it would have been possible to achieve each of the Action's objectives without the Action networking.			
MoU objective	Possibility of achievement without Action networking		
	Fully	Partially	Impossible
Copy from e-COST or Action MoU			
conduct trans-national and trans-sectoral cooperation in integrated management of ragweed, a flagship IAS in Europe.		X	
promote and coordinate biological control and vegetation management schemes against ragweed and combine these new control measures with existing chemical and physical control methods to elaborate context-specific and synergistic control solutions			X
assess large-scale effects of proposed integrated management measures using coupled ecosystem and atmospheric models		X	
Connections with the three large integrated projects ATOPICA, PASODOBLE and ECLAIRE that deal with chemical and biological air quality, climate change and ecosystems including possible feed-back mechanisms			X
assess the economic, environmental and social impact of the proposed interventions against common ragweed for the various stakeholders (private and public sector) and various spatial scales (local to Europe), taking into account its predicted future spread due to climate and land-use change			X
capacity-building through Summer Schools and STSMs, especially for early stage researchers (ERS), in the field of understanding, managing and monitoring plant invasions.			X
promote and assist the implementation of regulations for the import and release of BC organisms, and of management schemes against IAS of European-wide concern		X	
<b>Extent of the networking</b>			
<p>During the action priority has been given to STSM applications that are Early Career Investigators (ECIs)/ Young Researchers so that they constitute more than 50% of STSMs and so that there is nearly a fifty-fifty split on the gender balance. Focus has been on covering ITCs in the support both in form of STSMs and workshops. Gender balances has been ensured both at the senior level as well as the early career scientists so that chairs, WG leaders are male, but TF leaders WG substitute include male, female, senior and early career scientists, respectively. Below is a summary from each WG and the TF for population dynamics</p> <p><u>WG1:</u> WG1: Of the 28 SMARTER participants who expressed interest in biological control, some 20 regularly visit WG1 meetings and actively participate in the collaboration. Since the beginning of SMARTER, 1 PostDoc, one PhD and various MSc positions have been created. Also, 3 young researchers, of which 1 female, have been supported to perform a STSM in the frame of WG1.</p> <p><u>WG2:</u> The initial scope of the fields of interest represented by the participants of WG2 was very broad. They had to be focused on specific aspects of the life cycle of ragweed that are expected to be most sensitive to control measures like seed viability under different environments, establishment and growth in different communities, regrowth capacity after biomass losses and reduction of pollen and seed production. Thus the active members present within the workshops or communicating were reduced to about 50: 50 % females and 50 % males is perfectly balanced with respect to gender; from the active WG2 members were 52 % classified ECI and 48 % came from ITCs</p> <p><u>WG3:</u> Initially WG3 has focussed on compiling the experiences with Ambrosia management, from</p>			

countries where Ambrosia is most prevalent. This information was synthesised and made available in a popular form to stakeholders through leaflets. Next step is to compile the information provided by the participating countries and combine this information with the knowledge generated by the Action and possibly come up with novel management strategies.

WG4:WG4 has had a number of activities that were European-wide. It should here be named that the pollen activity includes nearly every European country (except Germany) and that this activity has had particular active participants in the group of young researchers and had participation that supports a gender balance and an author list beyond 30 with both male, female and early stage researchers. Two summer courses have been held in target countries for inclusiveness.

TF Population Dynamics: this TF managed well to involve females, ESR, and people from ITC: the Coordinator is a female ESR, the majority of the 25 TF members come from ITC, the majority is ESR, and both genders are represented in equal numbers. 5 young researchers, of which 3 female, and 2 from a ITC, have been supported to perform a STSM in the framework of this Task Force. All participants were invited for all 3 meetings of the TF. At least 10 participants continue activities initiated by the TF after the end of the Action.

TF Ophraella: An intensive collaboration has been put up among the various participants of this TF. One PhD and several MSc positions (including a field study in China) have been created to conduct research outlined and coordinated by TG Ophraella. Three young researchers, of which 1 female, have been supported to perform a STSM in the framework of this Task Force.

TF Genetics: the TF consists of 17 members from 10 countries, who are mainly interested in Population Genetics studies. The added value of the networking lies in the sharing of molecular markers and molecular methods. This will make independently conducted studies comparable and help establish general patterns of genetic variation and colonization routes in Europe. The action also offers collaboration opportunities to researchers who wish to start Population genetics studies in their country, but lack proper skills or laboratory equipment. This TF is very much integrated to the ‘taxonomy group’

TF Northern Countries: The TF has had two meetings: One with 15 members from each country around the North Sea and two countries around the Baltic Sea and a secondary meeting in Leiden two discuss publications and coordinate activities in a national spin-off project (2016-19) on next generation pollen forecasting and novel detection methods. They are therefore focusing on questions and experiments that relate to areas where ragweed has not yet invaded and integrating new activities funded by both national sources and Horizon2020 that will continue after SMARTER. The group has also been successful in attracting a Marie Curie Fellowship (2016-18) where the fellow comes from the SMARTER member in Gothenburg, Sweden and the coordinator is the SMARTER member in Worcester, UK. This project directly address one of the MoU: “deal with chemical and biological air quality, climate change and ecosystems including possible feed-back mechanisms” The group now offers expertise on novel detection methods on invasive species and advanced modelling

## I.D. Impacts

The impacts that have resulted, or might result from the Action are described in the following table.

Description of the impact	Type of impact <sup>4</sup>	Timing of impact <sup>5</sup>
Governmental initiative on preventing ragweed invasion in specific areas of the Northern Region Task Force area.	Societal	2015
Novel integrated management methods combining all available tools	Scientific/technological	2-5 years
A method for an early warning system on ragweed invasion	Scientific/technological	2-5 years
Project proposal submitted by a Czech colleague on allelopathic effects of and on ragweed; approved and started in 2014	Scientific: Improvement of basal knowledge	2014 onwards

<sup>4</sup> Scientific/ technological, Economic, Societal

<sup>5</sup> Achieved/ Foreseen within 2 years/ Foreseen 2-5 years/ Foreseen 5-10 years/ Foreseen 10+ years

Initiation of the task force on Genetics	Scientific: Scientific collaboration and provision of common genetic tools	2014 onwards
Initiation of the taxonomy group (task force) by interacting members of WG 2 and WG3	Scientific: Scientific collaboration and clarification of taxonomic relationships and improve the identification rates	2015 onwards
Initiation of task force of Northern Groups	Scientific: Scientific collaboration and mitigation of invasions in ragweed free areas	2015 and onwards
Initiation of the task force on <i>Ophraella communa</i> from members of WG1	Scientific: Scientific collaboration and provision of scientific data for pest risk analysis of <i>O. communa</i> in Europe	2013 and onwards
Participation in French Governmental working group on pest risk analysis of the potential establishment of <i>Ophraella communa</i> in France	Societal	2014 and onwards
The initiation of the Task Force Population Dynamics and the start of their 3-year long European-wide field survey will generate a unique dataset on <i>Ambrosia</i> demography, being very large (covering nearly the entire European continent, and a 3-year period) and very detailed (covering the entire life cycle of the plants), exceeding any current dataset from field data. This will form the basis for a demographic model that will link environmental drivers (climate, habitat), with the experimental assessment of impacts, and consequences for <i>Ambrosia</i> spread and impact.	Scientific/technological: Scientific publications, scientific collaborations between many different countries	2016
Upon communication about <i>Ophraella communa</i> by the TF <i>Ophraella</i> , the French government initiated a Working Group that will perform assessment of the impact of this accidentally introduced biocontrol agent of ragweed. TF coordinator is involved as an expert.	Societal, political.	2016 and onwards
Within WG4 components for next generation atmospheric models is under development (e.g. paper 1). The development is expected to be usable in a range of models including the used models in SMARTER such as SILAM, COSMO-ART, HYSPLIT and WRF-Chem.	Scientific	2016 and onwards
Increased public awareness of ragweed identification, problems, management, and the option of biological control	Societal, political	2015 and onwards

### I.E Dissemination and exploitation of Action results

Describe the Action's dissemination and exploitation approach as well as all activities undertaken to ensure dissemination and exploitation of Action results and the effectiveness of these activities.			
Add description here			
Item/ activity	Target audience	Result	Hyperlink
The ENGAGE project, a 1-hour	Teachers and	1223 downloads of the instructions (January 2017)	<a href="#">ENGAGE</a>



class about <i>Ambrosia</i> and <i>Ophraella</i>	students		
SMARTER <i>Ophraella</i> recognition card in 4 languages	General public, stakeholders	Easy accessible information in several languages	<a href="#">Ophraella cards</a>
SMARTER Conference & Workshop: "Invasive plants management success & regulation" (Jan 2015)	Stakeholders, mainly at the European level, but also national authorities, and scientists	Draft outline of regulation of biological control of invasive plants in Europe developed; follow-up meeting under the lead of the European and Mediterranean Plant Protection Organization (EPPO) in autumn 2015	<a href="#">Conference &amp; Workshop</a>
2 items in TV programmes on biological control of <i>Ambrosia</i> broadcasted in german-speaking EU countries	General public	General public informed about the topic of the action (general problem and work of 2 groups)	<a href="#">TV programme</a>
SMARTER presentations @Neobiota Conference on invasive species (Turkey 2014)	Scientists	More scientists familiar with SMARTER, and the ragweed problem	<a href="#">SMARTER@Neobiota</a>
Press release - Biocontrol breakthrough could defeat allergenic ragweed in EU	General public, scientists, stakeholders	Many journal articles (see below)	<a href="#">Press release</a>
SMARTER poster in 14 European languages	General public, scientists	Higher visibility of the Action and the ragweed problem	<a href="#">SMARTER poster</a>
Video about SMARTER on Youtube	General public, scientists, stakeholders	Higher visibility of the Action and the ragweed problem	<a href="#">Youtube video</a>
Half day session on ragweed @ 4th International Symposium on Weeds and Invasive Plants (May 2014, Montpellier)	Scientists	Higher visibility of the Action and the ragweed problem	<a href="#">Symposium</a>
SMARTER poster on life-cycle of common ragweed	General public, stakeholders	Higher visibility of the Action and the ragweed problem	<a href="#">life-cycle poster</a>
SMARTER @ German Ambrosia meeting Berlin (Nov 2013)	stakeholders	Higher visibility of the Action, led to participants for the Task Force Population Dynamics	<a href="#">status and control of <i>Ambrosia artemisiifolia</i> in Germany</a>
Over 60 journal articles about the	General public,	Higher visibility of the Action and the ragweed problem in several European	<a href="#">Article in Freiburger Nachrichten</a>

appearance of <i>Ophraella</i> in Europe in several countries (NL, CH, IT, FR), including 1 in a major Swiss newspaper Freiburger Nachrichten	stakeholders	countries	
Invited presentations by SMARTER members on SMARTER research @ International Ragweed Society meeting at Rho (Italy, Apr 2014)	Scientists	Higher visibility of the Action and the ragweed problem	Presentations and posters <a href="http://irc.aslmi1.mi.it/">http://irc.aslmi1.mi.it/</a>
SMARTER Project Poster (2012)	General public, scientists, stakeholders	Initial Presentation of the Action and the ragweed problem	<a href="#">Project poster</a>
SMARTER website	General public, scientists, stakeholders	Higher visibility of the Action and the ragweed problem, background information	<a href="#">Homepage</a> (will be transferred to the website of the International Ragweed Society mid 2017)
Documentary on mowing ragweed in Austria	General public, stakeholders	Higher visibility of the Action and the ragweed problem, especially in Austria, and especially on mowing techniques	It was broadcasted on the famous science series <b>nano</b> on 3sat: <a href="http://www.3sat.de/mediathek/?mode=play&amp;obj=61080">http://www.3sat.de/mediathek/?mode=play&amp;obj=61080</a> The related online article can be found here: <a href="http://www.3sat.de/page/?source=/nano/umwelt/171731/index.html">http://www.3sat.de/page/?source=/nano/umwelt/171731/index.html</a>
Researchers meet Italian stakeholders meeting (Oct 2016, Italy)	Researchers, Stakeholders, general Public	Local researchers and politicians have been updated with latest research results on ragweed problematics and the risks and benefits of biological control by the leaf beetle <i>Ophraella communa</i> , and other locals have been informed by the TV that broadcasted news on this meeting. The Italian scientific journal 'Notiziario della Societa Botanica Italiana' will also publish the abstracts. Awareness of alien invasive species by the general public and land managers	<a href="#">weblog with link to TV broadcast and news article</a>
Printed and digital manual on soil seed bank	Researchers, Stakeholders	Standardization of seed bank analyses for researchers and stakeholders that want to know how many Ambrosia seeds occur in their soil, this standardization allows comparison	<a href="#">weblog with link to manual</a>

		between studies	
Printed and digital leaflet to recognise 6 Ambrosia species invading Europe	General public, scientists, stakeholders	Awareness of alien invasive species by the general public and land managers	<a href="#">weblog with link to recognition card</a>
3 of the key papers produced by SMARTER have been published open access	Scientists	Higher visibility of the Action and the ragweed problem among international scientists	<a href="http://link.springer.com/article/10.1007/s10453-016-9463-1">http://link.springer.com/article/10.1007/s10453-016-9463-1</a> and DOI: 10.1111/wre.12074 and <a href="http://onlinelibrary.wiley.com/doi/10.1111/wre.12072/full">http://onlinelibrary.wiley.com/doi/10.1111/wre.12072/full</a>
Captain Allergo goes international	General Public	The pedagogic game 'Captain Allergo' developed in France to teach school children about ragweed was brought to a Swiss school in 2015 thanks to SMARTER, raising awareness of alien invasive species by the general public	<a href="http://www.sciencedirect.com/science/article/pii/S1877032016001846">http://www.sciencedirect.com/science/article/pii/S1877032016001846</a>
Half day session on "Ragweed: impact and management" @ the 6th European Symposium on Aerobiology (Lyon, France, 19 July 2016.)	Scientists	Higher visibility of the Action and the ragweed problem among international scientists	<a href="http://www.alphavisa.com/esa/2016/">http://www.alphavisa.com/esa/2016/</a>
Final SMARTER Conference, abstract book and brochure with achievements of the Action	Scientists	Unknown yet, but aimed for visibility of the Action results by presenting scientific achievements in an open Conference preceding the famous Neobiota Conference on exotic species.	<a href="#">final SMARTER Conference</a>

### I.F Action success(es)

COST regularly communicates the successes of Actions. What aspect(s) (outcomes and/ or impacts, rather than activities) of this Action is/ are the most suitable for communication?

<p>Due to the hierarchical structure of the Action, where some Working Groups provide input to others, that again provide input to others, most ground-breaking outcomes and the highest impact is expected at the end of the Action.</p> <p>Scientific Breakthroughs: Important scientific results are listed in the section on co-authored publications, including a paper in Nature Climate Change.</p> <p>Technology and Socioeconomic breakthrough: WG2: Advices for the adaptive mowing regime along roadsides as one of the most affected habitat type and spreading corridor</p> <p>Capacity building: WorkGroups a) Detection of the exotic insect <i>Ophraella communa</i> in Italy/Switzerland b) stakeholder meeting in Brussels on regulation of classical biological control of invasive plants across Europe, with all major European stakeholders attending; follow-up project by European and Mediterranean Plant Protection Organization (EPPO) in autumn 2015; c) Draft test plant list for PRA of classical biological control agents of ragweed established</p> <p>Capacity building: Task Forces Several Task Forces have successfully been established and have led to joint research projects. The TF <i>Ophraella</i> has met many times, and already performed over ten collaborative experiments and surveys in 2014, and in 2015 a new series of over 10 experiments at over 10 locations are executed. This includes a) Monitoring of the spread and impacts of <i>O. communa</i> in Europe b) Participation in French national working group (led by Anses) to assess risks and benefits of a potential establishment and spread of <i>Ophraella communa</i> in France; results will inform both plant health and human health policies in France. c) Thanks to the Action, a gender-balanced group of 17 countries (mainly ESR from ICT) that did not know each other before, got to know each other and work together during 3 years on ragweed demography. The joint work is expected to be the basis for breakthrough papers in management and science, by providing understanding of ragweed dynamics in the field and by forecasting long-term management success. Northern Countries was established in month 14 and it has met only twice, but where the second time (2016) was to coordinate new activities funded by national sources and a horizon2020 project with SMARTER activities and secure sustainable collaboration beyond SMARTER. This has been a success and the group now operates 2 national projects on pollen and invasive species (until 2019) and has secured a Marie Curie Fellowship from the Gothenburg group to join the Worcester group (2016-18)The TF Genetics has met twice and supported 3 STSMs. Some joint research projects are being built up and should lead to scientific advances in 2015 and 2016. Another inter-WG “taxonomy group” started to work on adapted determination keys for Ambrosia species outside the American continent during spring 2015.</p> <p>Capacity building: Training Schools and STSMs: At the date of the report, a total of 24 applications for STSMs were</p>	<p>Dimension of the success</p> <ul style="list-style-type: none"> <li>■ Breakthrough: scientific, technological or socioeconomic</li> <li>■ Policy implementation (specify which policy)</li> <li>■ Capacity building</li> </ul>
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submitted, 20 out of them completed by the end of May 2015. On average, they have a duration of 21 days and a cost of around 2,100 Euro each. The applicants belonged to 13 different countries. With regard to the destinations, 9 different countries were chosen by applicants to carry out their research. A total of 8 main themes (i.e.: biocontrol, pollen, population models, molecular genetics, ragweed populations, seeds, soil sampling and networking) were the subjects of the STSMs, with studies on biological control agents and pollen the most preferred ones). Gender balance was almost perfectly matched, with 11 females and 13 male applications. Most of them (17) were submitted by ESRs.

From a scientific point of view, STSMs are first of all allowing to strengthen the existing networks, by allowing scientists to go to another institution or laboratory in another COST Country (to foster collaboration, to learn a new technique or to take measurements using instruments and/or methods not available in their own institution/laboratory. Moreover, they proved to be a unique opportunity for the SMARTER network to renew the interest towards some scientific disciplines that tended to fade in these last years (e.g. weed management, biological control) and to assign a new look to the "old-fashioned" weed scientists. Indeed, scientists managing this "invasion" would need to be well trained in a number of cutting edge technologies and disciplines that poorly have been in contact with each other in the traditional weed science. The use of drones for weed mapping and detection, smart technologies for precise and environmentally friendly herbicide application, genetics for understanding the evolutionary spread of the invasion, biotechnologies for identifying and monitoring biocontrol agents, just to make a few examples, have scarcely been used all together in weed science. Thus, the presence of such a multitude of expertise in the network is giving the opportunity to train ESRs on a pool of connected topics, helping them to put together all these advanced approaches, with the final aim to create a new generation of open-minded weed scientists.

The was held in Vienna, Austria and Munich/Freising, Germany from 27 July to 1 August 2015, and was dedicated to "**Controlling Common Ragweed by Vegetation Management**

The second was the **12th European Course on Basic Aerobiology**, and was held from 20 to 26 July 2015 at the Faculty of Biology and Agriculture of the University of Rzeszów in southeastern Poland with a specific focus on detection ragweed and possible misclassifications

The third course was the **8<sup>th</sup> Advanced Aerobiology Course**, and was held from 16 to 22 August 2015 at the Šiauliai University, in Šiauliai, Lithuania with a specific focus on integrated modelling in relation to vegetation and the atmosphere by using ragweed as an example.

The main achievements for the first courses were: Skills on designing, performing, analyzing and evaluating mowing/cutting experiments with and without competition aiming at the control of common ragweed (*Ambrosia artemisiifolia*). Training of how to measure and analyze the most relevant response variables for control efficacy. Knowledge about how to quickly evaluate field experiments with respect to efficacy in harming spontaneous ragweed populations.

The second course's main objectives are: Aerobiology is the study of

<p>airborne particles of biological origin that are passively transported in the air, their sources, release, dispersion, deposition and impacts. Students will be trained on: science and application of aerobiology; sampling techniques; laboratory techniques used in sample preparation and analysis; identification of selected pollen and fungal spores by light microscopy (with particular focus on Ambrosia); knowledge of the relationships between Aerobiology and health.</p> <p>The third course, having the theme “From phenology to sophisticated forecasting”, will have the main aims to reconsider some of the problems (phenology, invasive plant species, data analysis and quality, etc.) and, more importantly, force students to shed new light on issues to do the credible aerobiology.</p> <p>Policy implementation: c.f. collaboration with EPPO, IOBC and EFSA.</p>	

## II. Management Report

### II.A. Overview of expenditure

The table below summarises the Action’s expenditure throughout its four year life.

GP starts and end dates	GP1 01/02/2013- 01/06/2014	GP2 02/06/2014- 31/05/2015	GP3 01/06/2015- 31/04/2016	GP4 01/05/2016- 18/11/2016	Total 01/02/2013- 18/11/2016
Grant holder	University of Fribourg	University of Fribourg	University of Fribourg	University of Fribourg	University of Fribourg
Meetings	159,786.42	88,806.17	25,932.14	78,288.49	352,813.22
Training Schools	0	0	25,380.50	14,868.00	40,248.50
STSMs	13,524.00	28,300.00	11,750.00	21,250.00	74,824.00
Dissemination	11,904.00	14,160.00	0	9,500.00	35,564.00
OERSA	0	0	0	0	0
Total Scientific Expenditure	185,214.00	131,266.17	63,062.64	123,906.49	50,3449.30
FSAC	27,781.67	19,689.54	9447.65	18,585.97	75,504.83
Total	212,996.00	150,955.71	72,510.29	142,492.46	578,954.50

<sup>1</sup> OERSA = Other Expenses Related to Scientific Expenditure (e.g. bank charges)

<sup>2</sup> FSAC = Amount received by Grant Holder for Financial Scientific and Administrative Coordination

### II.B. Budget and Participation management

#### II.B.1 Budget spent in relation to individuals/ institutions outside participating COST countries

This partition of the budget on meetings is € 3753,46 in grant period 1 and € 6948,40 in grant period 2. Two STSMs to China is in total €4946 in grant period 1 and €0 on STSMs to outside participating COST countries in grant period 2, 3 and 4

The table below describes the added value STSMs to approved institutions in IPC or NNC or Specific Organisations and any STSMs from an approved institution in an NNC to a participating COST country.

Grantee		Host		Date	Topic and value added to the Action
Institution	Country	Institution	Country		
Yan Sun, University of Fribourg & CABI		Chinese Academy of Sciences (CAS),		22/07/2013-	The main purpose of this STSM was to start building-up a seed collection bank within

Switzerland, Switzerland	the Chinese Academy of Agricultural Sciences (CAAS) and, the Agriculture Bureau and Academy of Agricultural Sciences (AAS) from Hubei, Hunan and Jiangxi provinces. CHINA	06/08/2013	COST-SMARTER and to prepare a postdoc project at UC Berkeley on “Herbivores as drivers of demography and evolutionary change? A case study of common ragweed and potential insect biological control agents”.
Heinz Müller-Schärer, University of Fribourg, Switzerland	Wuhan Botanical Garden/Institute, Chinese Academy of Sciences, CHINA	22/07/2013-06/08/2013	The main objective of this STSM was to strengthening our research collaboration with China within SMARTER by initiating and establishing joint experiments on host-specificity and impact studies of biological control (BC) candidates, to gain knowledge on mass rearing and field releasing BC agents and to arrange for shipments of selected BC candidates into quarantines in Europe. As a follow-up, a MSc student conducted field studies at the CAAS Langfang Station, Beijing in 2014.

### Invited Speakers

The table below highlights the added value of Invited Speakers from COST countries that have not accepted the MoU and/ or non-participating NNC, IPC or Specific Organisations whose participation at a meeting or Training School was reimbursed by the Action.

Participant name	Institution	Country	Event date	Topic and added value to the Action
Harald Meimberg	CIBIO, Research Center in Biodiversity and Genetic Resources, Vairao	Portugal	Meeting TF Genetics, Dijon	Highly experienced in molecular tools he initiated the development of new marker sets for population genetics of ragweed. He was quickly integrated into the TF genetics and started collaboration with labs working already in this field.
Peter Mason	Agriculture and Agri-Food Canada	Canada	Meeting Brussels, 21/22 January 2015	Regulations of classical biological control in North America; PM, who is involved in almost all activities regarding regulation of biological control in North America, provided an overview of the state of the art
Helia Marchante	Centre for Functional Ecology, University of Coimbra, 3001-455 Coimbra	Portugal	Meeting Brussels, 21/22 January 2015	Experiences from accidentally introduced biocontrol agents against an invasive plant in Portugal, which was very helpful to identify problems in the current regulation with respect to the use of biocontrol agents in the EU
Yuya Fukano	Tokyo University of Agriculture and Technology	Japan	TF Ophraella meeting Lugano April 2015	Exchange knowledge about Ophraella communa, the species that has recently been accidentally introduced in Europe and had introduced Japan earlier

Dissemination meetings					
The table below highlights the added value of Dissemination Meetings financed from Action funds.					
Participant name	Role	Country	Date	Location	Topic and added value to the Action
Heinz Müller-Schärer	MC chair	USA	13-22 March 2015	Stony Brook Univ., NY, USA	create awareness and discuss our ongoing COST SMARTER Action with world leading experts in invasion biology and more specifically in the phylogeny of one of our most promising biological control organisms ( <i>Ophraella communa</i> ); get feedback, advise and develop joint studies

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## II.D. Specific matters

This section is **confidential** to the Management Committee, and the COST Association (Administration, Scientific Committee and Committee of Senior Officials); and is not included in the version of the report that is published on the COST website.

The Action encountered the following particular difficulties in the implementation of the Action (e.g. imbalances of participation across the Working Groups, inactive country representatives).
We did not encounter major problems in the implementation of the Action. However, it has been a great challenge to cope with the several changing rules, budget periods etc. and the strong recommendation to not organize any events around the end/beginning of budget periods. This latter imposed a great constraint as our Action, whose activities rely on the growing seasons to perform joint field experiments, mutual visits, organisational meetings and training schools and these activities happened to often coincide with the budget period. It also took us some time to find the real national experts, due to the fact that MC members are delegated by their country and are not all so actively involved. We were disappointed in the very limited possibility to spend money on activities that in our view fit perfectly to the aim of COST (e.g. production of an App for scientists and the general public was not considered eligible) Finally please note the enormous administrative load to coordinate a large COST Action, which is only partially covered by FSAC.
The MC did not accept the pending intentions to accept the MoU shown in Section I.A for the following reason.
Not relevant

### II.D.1 Suggestions for improvements to COST framework/ procedures

The COST Association is committed to the continuous improvement of the COST framework.

Please describe below any improvements that you believe should be made to COST.
-Speed up e-COST in general (e.g. it now takes a while to record payments of all individual participants of meetings) -further develop automatic tools in e-cost (e.g. allowing amending an existing budget plan instead of re-encoding all from scratch) -relax rules about amending budgets at the end of the budget period (in order to use the remaining budget usefully). In practice there is always budget left since one wants to avoid overspending.

### II.D.2 Sustaining the network beyond the Action

If there are plans to sustain the network beyond the end of the Action please describe these below.
Cost action activities and the website will be transferred to the International ragweed society (IRS)

### II.D.3 Emerging topics/ developments in the field of the Action

Please describe any emerging topics or potentially important future developments identified during the Action and that could potentially be addressed by future COST activities such as Actions S&T Conferences or Exploratory Workshops.
No comments

## Annex 1

### Definitions:

<b>COST Action Challenge (main aim)</b>	“The research question addressed by the COST Action targeting scientific, technological, and / or socioeconomic problems”
<b>COST Action Innovation</b>	“The creation and / or development of new or improved concepts, products, processes, services, and / or technologies that are made available to markets, governments and society”
<b>COST Action objectives</b>	“COST Action objectives are the results that an Action needs to achieve in order to respond to meet its challenge. These are SMART (Specific, Measurable, Achievable, Relevant, Timely) and twofold: research coordination objectives and capacity building objectives.”
<b>COST Action research coordination objectives</b>	“Achieving these objectives turns COST Actions from initially scattered teams into one transnational team and leverages the existing funded research. These objectives entail the distribution of tasks, sharing of knowledge and know-how, and the creation of synergies among Action participants to achieve specific outputs.”
<b>COST Action capacity building objectives</b>	“Achieving these objectives entail building critical mass to drive scientific progress, thereby strengthening the European Research Area. They can be achieved by the delivery of specific outputs and / or through network features or types and levels of participation.”
<b>COST Action networking activities</b>	“any activities organised by the COST Action (whether or not directly funded by COST) in order to achieve research coordination and capacity building objectives.”
<b>COST Action networking tools</b>	“instruments through which eligible activities can be funded”
<b>COST Action outputs</b>	“direct results from the COST Action activities. These can be codified knowledge, tacit knowledge, technology, and societal applications.”
<b>COST Action impact</b>	“the short- to long-term scientific, technological, and / or socioeconomic changes produced by a COST Action, directly or indirectly, intended or unintended.”
<b>COST Action deliverable</b>	“a distinct, expected and tangible output of the Action, meaningful in terms of the Action’s overall objectives such as a report, a document, a technical diagram, a software etc. Action deliverables are used to measure its progress and success.”
<b>COST Action milestones</b>	“Control points in the Action that help to chart progress. They are also needed at intermediary points so that, if problems have arisen, corrective measures can be taken. A milestone may be a critical decision point in the Action where, for example, the MC must decide which of several technologies to adopt for further development (e.g. core group and MC meetings, mid-term reviews)”
<b>Inclusiveness Target Country (ITC):</b>	Current COST Member Countries targeted by the COST inclusiveness Policy (“Inclusiveness Target Countries” (ITC)): EU 13 (Bulgaria, Cyprus, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovenia, Slovakia), EU candidate countries (the former Yugoslav Republic of Macedonia, Montenegro, Republic of Serbia, Turkey) and potential EU candidate countries (Bosnia and Herzegovina). In addition, to comply with the EC criteria for ‘Spreading Excellence and Widening Participation’, Portugal and Luxemburg are included.