COST Action
Final Achievement Report
(24/11/2014 to 23/11/2018)

FA1404: Improving current understanding and research for sustainable control of the poultry red mite Dermanyssus gallinae (COREMI)

The Action was approved by the Committee of Senior Officials (CSO) on 14-5-2014 and has the MoU reference COST 036/14.

This report was submitted on 20-12-2018 by the Action Chair on behalf of the Management Committee in fulfilment of the requirements of the rules for COST Action Management, Monitoring and Final Assessment.

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Action leadership and participants

Leadership positions

Position	Name	Contact details	Country*
Chair	Prof Olivier Sparagano	Ab8677@coventry.ac.uk +447974984403	United Kingdom

Position	Name	Contact details	Country*
Vice Chair	Prof Fiona Tomley	ftomley@rvc.ac.uk +441707666386	United Kingdom

Working groups

#	WG Title	# of participants	WG Leader	Country*
1	Developing alternative control measures	78	Dr Robert Finn robert.finn@northumbria.ac.uk	n/a
2	End users (One Health)-interdisciplinary approach	49	Prof Ekaterini Tiligada aityliga@med.uoa.gr	n/a
3	Genetic structure in a changing world	42	Dr Lise ROY lise.roy@univ-montp3.fr	n/a
4	Epidemiology, pathology, geographical mapping and surveillance tools	68	Dr Danijela Horvatek Tomic horvatek@vef.hr	n/a

Other key leadership positions

Position	Name	Contact details	Country*
STSM Coordinator	Prof Annunziata Giangaspero	annunziata.giangaspero@unifg.it	Italy
GH Scientific Representative	Prof Olivier Sparagano	Ab8677@coventry.ac.uk	United Kingdom

* The country displayed is: for the Action Chair, the country of the person's primary work affiliation; for the Vice Chair the country that nominated the person as a Management Committee Member, for all other leadership positions, if the person is a MC Member the country displayed is the country of nomination, otherwise it is the country of the person's primary work affiliation.

Participants

COST members having accepted the MoU

BE	08/07/2014	**BA**	05/02/2015	**HR**	04/06/2014	**CZ**	11/06/2014	**DK**	06/06/2014
FI	26/08/2014	**FR**	03/10/2014	**DE**	27/06/2014	**EL**	28/05/2014	**IL**	23/02/2015
IT	19/08/2014	**LV**	12/03/2015	**NL**	02/06/2014	**MK**	30/07/2015	**NO**	28/08/2014
PL	29/05/2014	**PT**	27/11/2014	**RO**	30/07/2015	**RS**	18/10/2014	**SK**	06/07/2014
SI	07/07/2015	**ES**	06/06/2014	**SE**	08/01/2015	**CH**	20/08/2014	**TR**	30/07/2015
UK	19/05/2014								

Other participants

Institution Name	Country
University of Guelph	Canada
Agricultural University of Tirana	Albania

Summary

Main aim/ objective

The main objective of the Action is to consolidate the existing expertise and knowledge on poultry red mite (PRM) and to generate a synergic/holistic approach to improve the health, welfare and productivity of the laying hens through more effective prevention and control of PRM.

The Action addressed this as described below

COREMI has successfully engaged with poultry producers, veterinarians and medical practitioners all over Europe through our website, events and dissemination activities. We also interacted with international companies and academics beyond the COST countries showing that our COREMI network is seen as the main network on PRM all over the world. Many joint scientific publications were published between COREMI members from different countries who had not published together before the COREMI CA was put in place. COREMI allowed ESRs to develop new research projects and for several COREMI groups to continue research together through two successful research grants. Our technical book and special issue (made of guidelines and state-of-the-art protocols and research papers, respectively) will become the legacy of our Action for years to come.

Action website

http://www.coremi.eu

Achievement of MoU objectives, deliverables and additional outputs/ achievements

MoU objectives

The Action reported the following achievement of its specific objectives.

MoU objective	Level of achievement	Further information (hyperlink or other)
Stimulating research, education, exchange of knowledge and experience, and training of Early-Stage Researchers (ESRs) through established and novel routes.	76 - 100%	The organisers of COREMI Workshops and Training Schools gave priority participation to ESRs at these training events. We also offered to all STSM awardees (mainly ESRs) the opportunity to attend the annual COREMI conference with coverage of their travel expenses. ESRs were provided with the opportunity to present their work as invited speakers at the Annual conference - Eleanor Karp-Tatham From RVC, UK in Cluj, Romania (31stOct-November 2nd 2018) and Oeiras, Portugal (19-22/09/2017) and Aimee Lovers at the BEMB (11th-12th April 2017) from Netherlands. During our Annual conference we offered ESRs the opportunity to chair a session alongside a more senior member of the network to raise their profile on their CV and additionally, through establishing networks with other COREMI members.
Quick implementation of innovative ideas for PRM control as a result of the multidisciplinary and country wide networking community.	76 - 100%	Through our WG1 activities one of our members successfully gained a PhD degree (in 2017) and was supported by other COREMI members as supervisors from other countries (Dr Monique Mul (NL) being co-supervised by Dr David George (UK) who developed a new approach for the automatisation of poultry red mite (PRM) trapping methods. The same WG1 used the Montpellier Workshop (23rd-25th October 2015) to initiate a multi-country publication on control methods (in preparation) following an ESR workshop on PRM monitoring in Geel, Belgium (23rd-25th June 2015). Around our One Health activities (WG2, Environmental aspect), we interacted with a company in Canada (Mr Jeff Wilson from Novometric (www.novometrixinc.com) during our Workshop in Macedonia: March 27th 2018. 6 Cost Actions (supported financially by our COREMI budget) joined efforts to run a round table in Toulouse, France (July 9th-13th, 2018) at the ESOF conference and in collaboration with our COREMI Scientific Officer from the Cost Office. The Human aspect of the One Health activities were developed at a Meeting with medical practitioners in Itea, Greece (July 31st-August 3rd 2017).
Communication and discussion of relevant research by organising four workshops, of which at least one will be open for COST Action members and other international groups outside the consortium.	76 - 100%	At the following workshops we linked with non COREMI members: 1. Workshop with Novometrix from Canada in Skopje, Macedonia (March 27th 2018) ; 2. Workshop with British Egg Board Marketing in London (April 11th-12th, 2017); 3. Coordination meeting with medical practitioners in Athens (February 17th 2017) in preparation of our Training School in Itea, Greece); 4. Workshop with inviting medical practitioners and veterinarians to discuss identification of the PRM from both sectors' perspectives in Amsterdam (18-19 April 2016); 5. A Dutch pest control company was involved with our workshop in Amsterdam (Van Eck BV in Son, The Netherlands). Our annual conferences were always open to non COREMI members and we attracted industrial sponsorship to run such events from companies in Italy, Romania, Portugal, USA and with non-EU delegates coming from China, Korea or Brazil. Our One Health workshop was open to a company in Canada (Skopje, Macedonia workshop 2018),

		In Oslo, (April 26th-27th, 2018) we organised a genomic workshop where research groups from several COREMI countries presented their work on genomics/transcriptomics of PRM to develop a consensus genomic map. At the Slovenian workshop, guidelines for epidemiological investigation and associated pathogens (21st-22nd august 2018, Ljubljana, Slovenia) were produced. Our workshops in Napoli, Italy (July 2nd-6th, 2018) and Toulouse, France (July 9th-13th, 2018) were part of larger international conferences: European Congress of Entomology (ECE) and Euroscience Open Forum (ESOF), respectively, which were attended by non COREMI members.
Creating a multi-functional website (part-secured for participants to exchange sensitive/marketable information and with an open access area for external stakeholders).	51 - 75%	The COREMI Core group and MC decided to have open access for our website information with no restricted access at all. Inclusion of Sensitive/Marketable information was discussed between WG members directly for example field trials of the Fluralaner with MSD Animal Health (USA) and COREMI members from Italy and Belgium (Cluj Conference), and at both Core group and MC meetings.The proceedings of the final conference in Cluj have been published in Scientia Parasitologica (ISSN 1582-1366) with abstracts from COREMI and non COREMI members.
Knowledge management and exchange (KME) with/to the scientific community, policy makers, primary producers, poultry breeding organisations, technology industries and Small and Medium Enterprises (SMEs) (to support IP development and commercialisation of activities). COREMI will pursue a dissemination strategy targeted to bridge the gap between specialised research forums and non-specialised groups, to more closely connect science to the general public and practitioners (medical and veterinarian practitioners) on this crucial issue. Tools including the Action website and popular social media will be used to this end.	76 - 100%	To maximise our interaction with many COREMI stakeholders we created a group of COREMI national coordinators to discuss a joint questionnaire to be sent to their national poultry farmers. COREMI not only put in place an informative website but we also created a ResearchGate, LinkedIn and Facebook pages to raise the profile with non COREMI stakeholders and engage in a more systematic way with practitioners. Several COREMI members joined an independent Facebook group called Skin Mite Support Group and several times help (for free) the general public via providing them with a route to send some of our members pictures and mite samples to be identified. The COREMI Chair was invited to speak on PRM at poultry producer conferences such as the Poultry Health Management Conference (November 7th 2018) in Loughborough, UK and to the European Poultry Conference in Dubrovnik (Croatia) in 2018 (17th-21st September. We also created leaflets specifically for veterinarian and poultry farmers such as the one created in Italy, with the Dutch poultry farmers or UK producers in collaboration with Tesco supermarkets (https://www.coremi.eu/working-groups/wg-1-developing-alternative-control-measures.html). A check list developed by a Dutch COREMI member (Mrs Aimee Lovers) was created following her involvement with Dutch medical practitioners helping them to develop a possible differential diagnostic of PRM versus non PRM infestations (not in the public domain yet)
European platform continuing its existence after the COST action period as a result of the	76 - 100%	The COREMI website will continue at least for another two years (2019 and 2020; already paid for). We are preparing a Special Issue in Avian Pathology (research papers) and a new Book based on guidelines and good practice related to monitoring, laboratory-related methodologies

gained insights and benefits achieved during that period.		Two international research projects have emerged during the life of the COREMI CA (Paragon and MiteControl grants) involving several COREMI members which will continue research activities beyond the life of our CA. A Marie Sklodowska Curie Fellowship has been applied for between an ESR from Italy and a COREMI member in UK (outcome not yet known). A Joint Serbian-Croatian project was also proposed to their respective national funding bodes on PRM and essential oils but we are still waiting for the outcome.

Deliverables

The Action reported the following deliverables:

Deliverable	Timing of deliverable	Further information (hyperlink or other)
Action webpage operational and Face Book page, Linkdin and Research Gate	Delivered	https://www.coremi.eu/home.html
Optimum PRM IPM protocols WG 1 and 2	Not delivered, but foreseen within 2 years	
Impact of PRM on the poultry industry and beyond (WG2) Surveillance: All available methods for monitoring D. gallinae in laying hen facilities are identified and discussed. The most promising monitoring methods and knowledge gaps are identified. (see results Montpellier workshop). http://www.coremi.eu/fileadmin/documents_organicresearch/coremi/Montpellier_22-23october-wkshp_minutes.pdf	Delivered	http://www.coremi.eu/fileadmin/documents_organicresearch/coremi/Montpellier_22-23october-wkshp_minutes.pdf
Identify house design improvements for PRM controls (WG1 &2)	Delivered	https://www.coremi.eu/home/event-item/article/1587.html
Training Manual for MITE identification This TS Course was held to train people with morpho-molecular characterization of mites. A secondary objective was understanding of the mite communities associated with poultry mites.	Delivered	https://www.coremi.eu/missions-and-training/training-school-september-2016.html
First indicators of genomic/proteomic candidates for future control WG3	Delivered	https://www.coremi.eu/home/event-item/article/1665.html
Questionnaire on Red Mite - Prevalence, economics, controls and housing	Not delivered, but foreseen within 2 years	
Google drive folder 1 (Molecular studies on PRM and associated organisms; WG3 Google drive folder 2 (studies on genetic bases of insecticide resistance; WG3))	Delivered	https://www.coremi.eu/fileadmin/documents_organicresearch/coremi/Genetic_bases_of_acaricide_resistance_reference_list.pdf
Collaborative short review on molecular studies having been published to date on PRM	Delivered	https://www.coremi.eu/resources/references.html
Abstract in proceeding about Economic Module development	Not delivered, but foreseen within 2 years	
Technical Report High Strategic Meeting (HSM), Amsterdam The technical report describes the scientific challenges discussed during the HSM, the conclusions which were made during the HSM and issues left to be discussed by the MC of the COST action FA1404-COREMI after the HSM.	Delivered	https://www.coremi.eu/home/event-item/article/1381.html
Protocol for monitoring. All available methods for monitoring D. gallinae in laying hen facilities are identified and discussed.	Not delivered, but foreseen within 2 years	
WG 4 Paper 1 - DHT - Title to be confirmed	Not delivered, but foreseen within 2 years	

WG 4 Paper 2 - DHT - Title to be confirmed	Not delivered, but foreseen within 2 years	
IPM paper - A literature review of available controls and IPM strategies employed in PRM control was completed in year 1 and draft paper prepared	Not delivered, but foreseen within 2 years	
On farm advice protocol/Guideline to better control D. gallinae using IPM	Delivered	https://www.coremi.eu/fileadmin/documents_organicresearch/coremi/On-farm_monitoring_protocol__under_construction_.pdf
Conference Proceedings for all COREMI conferences	Delivered	https://www.coremi.eu/meetings.html
One Health paper on the findings of the HSM in Amsterdam	Delivered	https://www.coremi.eu/fileadmin/documents_organicresearch/coremi/Draft_programme_COREMI_Cluj_2018.pdf
Review and publish papers addressing knowledge gaps for PRM and controls	Not delivered, but foreseen within 2 years	
Training manual from the Israel Training school	Delivered	https://www.coremi.eu/missions-and-training/training-school-september-2016.html
Publish individual country data arising from questionnaire (WG1-4)	Not delivered, but foreseen within 2 years	
A pan-EU analysis of questionnaire data will be performed and the data published/presented internationally as a collaborative effort of COREMI members.	Not delivered, but foreseen within 2 years	https://www.coremi.eu/meetings.html
Dissemination of questionnaire findings and IPM to stakeholders	Not delivered, but foreseen within 2 years	
Paper on population dynamics model	Not foreseen	
Decision tree for GP’s to improve the identification of clinical effects of PRM on humans	Not foreseen	
Training school One health resulting in a manual or protocol	Delivered	https://www.coremi.eu/missions-and-training/one-health-training-school-summer-2017-greece.html
Abstract in proceedings about the effect of PRM on farm economics	Delivered	https://www.coremi.eu/home/event-item/article/1685.html
WG4 to start mapping mite infestations at the Europe level (years 3-4)	Not delivered, but foreseen within 2 years	

Additional outputs/ achievements

The following outputs/ achievements also resulted from the Action:

The Action reported 8 publications on the topic of the Action, co-authored by at least two Action participants from two countries participating in the Action, and for which the Action networking was necessary.

Co-authored Action publications - peer-reviewed

1. doi:10.1007/s00248-017-0993-z

Title	Comparison of Microbiomes between Red Poultry Mite Populations (Dermanyssus gallinae): Predominance of Bartonella-like Bacteria
Authors	Jan Hubert; Tomas Erban; Jan Kopecky; Bruno Sopko; Marta Nesvorna; Martina Lichovnikova; Sabine Schicht; Christina Strube; Olivier Sparagano
DOI	doi:10.1007/s00248-017-0993-z
Type	Journal article
Published in	Microbial Ecology
Published by	Springer Nature
ISSNs	0095-3628; 1432-184X
Links	http://link.springer.com/article/10.1007/s00248-017-0993-z/fulltext.html; http://link.springer.com/content/pdf/10.1007/s00248-017-0993-z.pdf

2. doi:10.1016/j.vetpar.2017.07.027

Title	Development of a model forecasting Dermanyssus gallinae's population dynamics for advancing Integrated Pest Management in laying hen facilities
Authors	Monique F. Mul; Johan W. van Riel; Lise Roy; Johan Zoons; Geert André; David R. George; Bastiaan G. Meerburg; Marcel Dicke; Simon van Mourik; Peter W.G. Groot Koerkamp
DOI	doi:10.1016/j.vetpar.2017.07.027
Type	Journal article
Published in	Veterinary Parasitology
Published by	Elsevier BV
ISSN	0304-4017
Subjects	General Veterinary; Parasitology
Links	https://api.elsevier.com/content/article/PII:S0304401717303278?httpAccept=text/xml; https://api.elsevier.com/content/article/PII:S0304401717303278?httpAccept=text/plain

3. doi:10.1111/pim.12539

Title	Avian mite dermatitis: Diagnostic challenges and unmet needs
Authors	A. Kavallari; T. Küster; E. Papadopoulos; L. S. Hondema; Ø. Øines; J. Skov; O. Sparagano; E. Tiligada
DOI	doi:10.1111/pim.12539
Type	Journal article
Published in	Parasite Immunology
Published by	Wiley
ISSN	0141-9838
Subjects	Immunology; Parasitology
Links	https://api.wiley.com/onlinelibrary/tdm/v1/articles/10.1111%2Fpim.12539; http://onlinelibrary.wiley.com/wol1/doi/10.1111/pim.12539/fullpdf

4. doi:10.1186/s13071-017-2292-4

Title	Poultry red mite (Dermanyssus gallinae) infestation: a broad impact parasitological disease that still remains a significant challenge for the egg-laying industry in Europe
Authors	Annie Sigognault Flochlay; Emmanuel Thomas; Olivier Sparagano
DOI	doi:10.1186/s13071-017-2292-4
Type	Journal article
Published in	Parasites & Vectors
Published by	Springer Nature
ISSN	1756-3305
Link	http://link.springer.com/content/pdf/10.1186/s13071-017-2292-4.pdf

5. doi:10.1637/11327-111415-Reg

Title	Associations Between the Level of Biosecurity and Occurrence ofDermanyssus gallinaeandSalmonellaspp. in Layer Farms
Authors	Driton Sylejmani; Arben Musliu; Naser Ramadani; Olivier Sparagano; Afrim Hamidi
DOI	doi:10.1637/11327-111415-Reg
Type	Journal article
Published in	Avian Diseases
Published by	American Association of Avian Pathologists (AAAP)
ISSNs	0005-2086; 1938-4351

6. doi:10.1016/j.vetpar.2015.08.028

Title	Arthropods and associated arthropod-borne diseases transmitted by migrating birds. The case of ticks and tick-borne pathogens
Authors	Olivier Sparagano; David George; Annunziata Giangaspero; Eva Špitalská

	DOI	doi:10.1016/j.vetpar.2015.08.028
	Type	Journal article
	Published in	Veterinary Parasitology
	Published by	Elsevier BV
	ISSN	0304-4017
	Subjects	General Veterinary; Parasitology
	Links	https://api.elsevier.com/content/article/PII:S0304401715300091?httpAccept=text/xml; https://api.elsevier.com/content/article/PII:S0304401715300091?httpAccept=text/plain
7. doi:10.1007/s10493-015-9923-2	Title	Validation of an automated mite counter for Dermanyssus gallinae in experimental laying hen cages
	Authors	Monique F. Mul; Johan W. van Riel; Bastiaan G. Meerburg; Marcel Dicke; David R. George; Peter W. G. Groot Koerkamp
	DOI	doi:10.1007/s10493-015-9923-2
	Type	Journal article
	Published in	Experimental and Applied Acarology
	Published by	Springer Nature
	ISSNs	0168-8162; 1572-9702
	Subjects	Ecology; Insect Science; General Medicine
	Link	http://link.springer.com/content/pdf/10.1007/s10493-015-9923-2
8. doi:10.1186/s13071-015-0768-7	Title	Should the poultry red mite Dermanyssus gallinae be of wider concern for veterinary and medical science?
	Authors	David R George; Robert D Finn; Kirsty M Graham; Monique F Mul; Veronika Maurer; Claire Valiente Moro; Olivier AE Sparagano
	DOI	doi:10.1186/s13071-015-0768-7
	Type	Journal article
	Published in	Parasites & Vectors
	Published by	Springer Nature
	ISSN	1756-3305
	Link	http://link.springer.com/content/pdf/10.1186/s13071-015-0768-7

Projects

"N/A"

Other outputs / achievements

The following other outputs/ achievements contributing to the COST mission resulted from the Action:

1. Contribution from COREMI members to dialogue through the Facebook Skin mite Support Group and numerous emails to the Chair from the general public asking for advice against what was perceived as a mite infestation in their home.

Impacts

The Action reported the following impact(s):

Description of the impact, i.e. what will change, and for whom, as a result of what the Action achieved	Type of impact	Timing of impact
The COREMI Chair was approached by MSD Animal Health in the USA to prepare an e-learning module on PRM for the technical and marketing workforce of this multinational company (237 MSD staff had done and validated this e-module by September 2018).	• Scientific / Technological	Achieved
A COREMI substitute from Italy (Marianna Marangi) has applied with another COREMI member from UK for a Marie Sklodowska-Curie Fellowship) in 2018. COREMI members were successful for the PARAGON EU grant with other non-COREMI members in 2017 and in 2018 other COREMI members were awarded the MITE Control EU grant as well.	• Scientific / Technological	Foreseen two-to-five years

Dissemination and exploitation of Action results

Dissemination and exploitation approach of the Action

The Action's dissemination and exploitation approach as well as all activities undertaken to ensure dissemination and exploitation of Action results and the outcomes of these activities are described below.

The COREMI approach was to target the industry, poultry farmer associations, medical and veterinary practitioners and policy makers. In terms of exploitation it was done at COREMI member level who applied for grants (PARAGON and MITEControl).

Dissemination meetings funded by the Action

The Action did not fund any Dissemination Meetings

Other dissemination activities

The Action also undertook the following dissemination activities:

Activity	MSD Animal Health invited several COREMI members to have a dialogue about priorities for PRM control and treatments before the launch of their new anti-PRM product. Such event led to a report published by MSD Animal Health.
Target	MSD Animal Health staff had access to such internal report and those receiving it from MSD Animal Health
Outcome	MSD Animal Health has every year sent representatives to our annual conference and used COREMI members in several EU countries to validate field trials for their new product.
Link	https://www.exzolt.com/support/e-learning.aspx

Exploitation activities

The Action undertook the following activities to ensure exploitation (use, in particular in a commercial context) of the Action's achievements:

No exploitation activities were reported by the Action.

Action Success(es)

The Action’s two most significant successes were the following:

- The Coremi Chair developed with Bill Vaughn (Director, Global Marketing poultry at MSD Animal Health) an online training module for their technical and marketing staff before the launch of their PRM control product called Exoltz.

Action Expenditure

The table below shows the budget allocated to the Action for each Grant Period:

#	Grant Period	Start Date	End Date	Budget allocated to Action (EUR)
1	CGA-FA1404-1	1-1-2015	31-8-2015	56,684.91 (EUR)
2	CGA-FA1404-1B	1-9-2015	30-4-2016	123,114.89 (EUR)
3	AGA-FA1404-3	1-5-2016	30-4-2017	130,985.00 (EUR)
4	AGA-FA1404-4	1-5-2017	30-4-2018	144,999.99 (EUR)
5	AGA-FA1404-5	1-5-2018	23-11-2018	105,998.95 (EUR)