IX International Conference

La Rochelle France
11-14 March, **2019**

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Control without Borders

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The IXth European Mosquito Control Association Conference 2019

Mosquito control without borders

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Table of contents

Brief Programme 07

Full Programme 08

Keynote Speaker Presentations 16

Oral Presentations 21

Poster Presentations 69

List of registered Participants 94

Brief Programme

	Sunday 10th March
17:00 - 19:00	Registration
	Monday 11th March
08:00 - 09:30	Registration
09:30 - 10:30	**Opening of the Conference, Welcome Address**
10:30 - 11:10	**Keynote lecture (Elkhan Gasimov)**
11:10 - 11:40	Coffee break
11:10 - 13:00	**Session 1: *Environmental prospects of mosquito control*** Chaired by Sébastien Chouin & Jan Lundström
13:00 - 14:30	Lunch
14:30 - 16:10	**Session 2: *Well-known and novel challenges in mosquito surveillance and control*** Chaired by Eleonora Flacio & Andrea Drago
16:10 - 16:40	Coffee Break
16:40 - 18:00	**Poster session**
18:00 - 19:30	EMCA Board meeting
19:30 - 21:30	Welcome cocktail
	Tuesday 12th March
09:00 - 10:40	**Session 3: *Achievements in mosquito surveillance and monitoring*** Chaired by Mihaela Kavran & Francis Schaffner
10:40 - 11:10	Coffee break
11:10 - 13:10	**Session 4: *Invasive mosquitoes and their control*** Chaired by Gaby Müller & Arjan Stroo
13:10 - 14:30	Lunch
14:30 - 16:10	**Session 5: *Surveillance and control of potential vector species*** Chaired by Luis Hernández-Triana & Peter Lüthy
16:10 - 16:30	Coffee break
16:30 - 18:00	**Round table: *Mosquito control in response to pathogen transmission risk in Europe***
18:00 - 19:00	EMCA Annual General Meeting
	Wednesday 13th March
09:00 - 09:40	**Keynote lecture (Rémi Foussadier)**
09:40 - 11:20	**Session 6: *Biotechnologies to reinvent mosquito control*** Chaired by Amandine Collado & Norbert Becker
11:20 - 11:40	Coffee break
11:40 - 13:20	**Session 7: *Public health issues and recent outbreaks in Europe*** Chaired by Elina Patsoula & Spiros Mourelatos
13:20 - 14:30	Lunch
Aftenoon	Visit of mosquito control project
Evening	Boat trip followed by conference dinner
	Thursday 14th March
09:00 - 10:40	**Session 8: *New technologies in mosquito control*** Chaired by Kamil Erguler & Sandra Gewehr
10:40 - 11:00	Coffee break
11:00 - 12:40	**Session 9: *Citizen science, communication and personal protection*** Chaired by Marina Torres & Rubén Bueno
12:40 - 13:30	Closing of the conference
13:30 - 14:30	Lunch

Full Programme

	Sunday 10th March
17:00 - 19:00	Registration
	Monday 11th March
08:00 - 09:30	Registration
09:30 - 10:30	**Opening of the Conference** **Welcome Address** Jan O. Lundström, President of EMCA Dominique Rabelle, President of EID ATLANTIQUE, board member of ADEGE
10:30 - 11:10	**Keynote lecture** ***Manual on prevention of establishment and control of mosquitoes of public health importance in the WHO European Region (with special reference to invasive mosquitoes)*** **Elkhan Gasimov,** World Health Organization Regional Office for Europe
11:10 - 11:40	**Coffee break**
	Session 1 (11:40 – 13:00) ***Environmental prospects of mosquito control*** Chaired by Sébastien Chouin & Jan Lundström
11:40 - 12:00	***Paper 1.1:*** General overview on efficacy evaluation and environmental risk assessment of insecticides under European law using Bti as an example **A. Kehrer,** C. Stang and C. Kuhn
12:00 - 12:20	***Paper 1.2:*** Developing mosquito control in highly protected natural wetland environments **J. O. Lundström** and M. Schäfer
12:20 - 12:40	***Paper 1.3:*** Assessment of an ambitious environmental policy **B. Frances,** A. Marie, R. Tounsi, D. Gindre, D. Moulis and C. Lagneau
12:40 – 13:00	***Paper 1.4:*** Lessons learned from 8 years of biological mosquito control with Bti in a borderline wetland in Austria **H. Jerrentrup**
13:00 - 14:30	**Lunch**
	Session 2 (14:30 - 16:10) ***Well-known and novel challenges in mosquito surveillance and control*** Chaired by Eleonora Flacio & Andrea Drago
14:30 - 14:50	***Paper 2.1:*** EID Atlantique, up and down of 50 years of mosquito control in Western France J. De Maupeou, **S. Chouin** and M. Marjolet

14:50 - 15:10	***Paper 2.2:*** Control of adult mosquitoes and effects on flower-visiting insects in urban green areas D. Corcos, L. Mazzon, P. Cerretti, M. Mei, E. Giussani, **A. Drago** and L. Marini
15:10 - 15:30	***Paper 2.3:*** Is *Aedes sticticus* a new invasive species in Western France? **S. Chouin,** J. De Maupeou, B. Le Hunsec and C. Courtin
15:30 - 15:50	***Paper 2.4:*** Coexistence in urban breeding sites among *Culex pipiens, Culiseta longiareolata* and *Aedes albopictus* in the Castellón province (East of Spain) **J. Herrezuelo-Antolín,** D. López-Peña, J.V. Falcó-Garí and R. Jiménez-Peydró
15:50 - 16:10	***Paper 2.5:*** Capacity building for the entomological surveillance in the Mediterranean area: MediLabSecure outcomes and follow-up M. Picard and **V. Robert**
16:10 - 16:40	**Coffee break**
16:40 - 18:00	**Poster session**
18:00 - 19:30	**EMCA Board meeting**
19:30 - 21:30	**Welcome cocktail**
	Tuesday 12th March
	Session 3 (09:00 - 10:40) ***Achievements in mosquito surveillance and monitoring*** Chaired by Mihaela Kavran & Francis Schaffner
09:00 - 09:20	***Paper 3.1:*** The new integrated system for risk-based surveillance of the invasive mosquito *Aedes albopictus* in Switzerland D. Ravasi, M. P. Antonovic, L. Azzimonti, M. Cannata, A. Danani, G. Del Rio, L. Engeler, V. Guidi, D. Huber, F. Mangili, A. Spataro, D. Strigaro, M. Tonolla, N. Vermes and **E. Flacio**
09:20 - 09:40	***Paper 3.2:*** The continuing spread of *Aedes japonicus* in Germany – an update **H. Kampen** and D. Werner
09:40 - 10:00	***Paper 3.3:*** Monitoring of *Aedes albopictus* (Diptera: *Culicidae*) in the Valencian Autonomous Region (East of Spain) **D. López-Peña,** Á. Lis-Cantín, J. Herrezuelo-Antolín and R. Jiménez-Peydró
10:00 - 10:20	***Paper 3.4:*** *Aedes albopictus* in Jena, Central Germany **H. Kampen,** C. Kuhlisch and D. Werner
10:20 - 10:40	***Paper 3.5:*** Outcomes of mosquito surveys in Ireland, Luxembourg, Russia and Abkhazia **F. Schaffner,** C. Ries, I. V. Patraman and M.V. Fyodorova
10:40 - 11:10	**Coffee break**

Full Programme

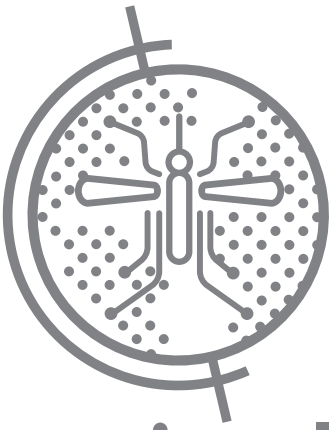
	Session 4 (11:10 - 13:10) ***Invasive mosquitoes and their control*** Chaired by Gaby Müller & Arjan Strooo
11:10 - 11:30	***Paper 4.1:*** The experience of controlling invasive *Aedes* mosquito species in Belgium **I. Deblauwe,** B. D'hondt, P. Gosselin, K. De Wolf and W. Van Bortel
11:30 - 11:50	***Paper 4.2:*** Invasive mosquito monitoring programmes in Switzerland in 2018 **L. Engeler,** E. Flacio, P. Müller and M. Tonolla
11:50 - 12:10	***Paper 4.3:*** Water associated areas as a key predictor for *Aedes albopictus* presence on a Mediterranean island **C. Barceló**, A. Sanz-Aguilar, R. Rosselló, M. Bengoa, M. Ruiz-Pérez, M. González-Calleja, D. Borràs, C. Paredes-Esquivel, M.A. Miranda and G. Tavecchia
12:10 - 12:30	***Paper 4.4:*** TIGREPAT: surveillance and control program of invasive *Aedes species* and related arboviruses in Northern Italy **M. Manica,** D. Arnoldi, R. Rosà and A. Rizzoli
12:30 - 12:50	***Paper 4.5:*** The INTERREG TIGER project: main outcomes of the tri-national surveillance network in 2018 **B. Mathieu,** X. Augsten, N. Becker, C. Bender, P. Bindler, L. Da-Silva, A. Graffmann, M. Gschwind, N. Hénon, K. Hoffmann, A.C. Honnen, A. Jöst, T. Krebs, E. Krupa, P. Müller, W.P. Pfitzner, B. Pluskota, O. Pompier, O. Renoux, F. Schaffner, L. Vavassori, G. Vogel and A. Kopf
12:50 - 13:10	***Paper 4.6:*** The *Aedes* Invasive Mosquito COST Action: promoting innovation and synergies in the field of surveillance and control of invasive *Aedes* arbovirus vectors in Europe **F. Schaffner,** F. Gunay, A. Michaelakis, A. D. Mihalca, D. Petric, J. Pinto, W. Wint and A. della Torre
13:10 - 14:30	**Lunch**
	Session 5 (14:30 - 16:10) ***Surveillance and control of potential vector species*** Chaired by Luis Hernández-Triana & Peter Lüthy
14:30 - 14:50	***Paper 5.1:*** Data on entomological surveillance activities and detection of West Nile virus in mosquito pools in Greece (2017-2018) **E. Patsoula,** S. Beleri, N. Tegos, D. Pervanidou, A. Vakali, V. Diamantopoulos, G. Balatsos, V. Karras, A. Michaelakis and C. Hadjichristodoulou
14:50 - 15:10	***Paper 5.2:*** 1999-2018, 20 years of *Aedes albopictus* surveillance and control in western France – successes and limits **S. Chouin,** J. De Maupeou, C. Smeraldi, C. Courtin and M. Marjolet

15:10 - 15:30	***Paper 5.3:*** Surveillance and control of mosquitoes in the french points of entry under the International Health Regulation **C. Jeannin,** Y. Perrin, S. Cornelie, O. Ferreira, Y. Firmin, F. Garcia, J.D. Gauchet, R. Tounsi and C. Lagneau
15:30 - 15:50	***Paper 5.4:*** The utility of mitochondrial and nuclear genetic markers in support of mosquito's biodiversity studies (Diptera, *Culicidae*) in La Rioja, northern central region of Spain I. Ruiz-Arrondo, L. **M. Hernández-Triana,** N. Nikolova and J. A. Oteo
15:50 - 16:10	***Paper 5.5:*** Hematophagic blackfly species (Diptera: *Simuliidae*) from eastern Spain. A potential risk for humans and livestock **D. López-Peña** and R. Jiménez-Peydró
16:10 - 16:30	**Coffee break**
16:30 - 18:00	**Round table** **Mosquito control in response to pathogen transmission risk in Europe** Chaired by S. Mourelatos & F. Schaffner with the participation of E. Gasimov, R. Bueno, A. Drago, and G. L'Ambert
18:00 - 19:00	**EMCA Annual General Meeting**
	Wednesday 13th March
09:00 - 09:40	**Keynote lecture** ***Mosquito control in France and its overseas territories: practices and evolution*** **Rémi Foussadier,** EID Rhône-Alpes, France
	Session 6 (09:40 - 11:20) ***Biotechnologies to reinvent mosquito control*** Chaired by Amandine Collado & Norbert Becker
09:40 - 10:00	***Paper 6.1:*** Oxitec self-limiting technology as a tool for urban mosquito control **A. Collado**
10:00 - 10:20	***Paper 6.2:*** Sterile Insect Technique (SIT) in an integrated control program against *Aedes albopictus* (Diptera: *Culicidae*) in South-West Germany **N. Becker,** X. Augsten, I. Ferstl, W. Fischer, A. Jöst, A. Lehner, T. Oo, A. Tokatlian Rodriguez and B. Pluskota
10:20 - 10:40	***Paper 6.3:*** Combined Sterile Insect Technique and Incompatible Insect Technique: preparation for the proof-of-concept in disease reduction using randomized control trial **P. Kittayapong,** S. Ninphanomchai, W. Limohpasmanee, C. Chansang, U. Chansang and P. Mongkalangoon

Full Programme

10:40 - 11:00	***Paper 6.4:*** Why not try the Sterile Insect Technique – a comment on the authorities' struggle for alternative floodwater mosquito control in Sweden **J. O. Lundström** and M. Schäfer
11:00 - 11:20	***Paper 6.5:*** Effect of Biosynthesized inorganic nanoparticles on Zika virus vector (*Aedes aegypti*): an eco-friendly approach for Mosquito control **R. Pandit**
11:20 - 11:40	**Coffee break**
	Session 7 (11:40 - 13:20) ***Public health issues and recent outbreaks in Europe*** Chaired by Elina Patsoula & Spiros Mourelatos
11:40 - 12:00	***Paper 7.1:*** Vector control strategy for malaria in Greece **S. Gewehr,** S. Kalaitzopoulou, N. Perros, N. Garlis, G. Vlachos, P. Tsagkaris, K. Iordanidis and S. Mourelatos
12:00 - 12:20	***Paper 7.2:*** Implementation of urgent preventive and response public health measures for diseases transmitted by *Aedes albopictus* in Greece D. Pervanidou, **E. Patsoula,** A. Vakali, A. Baka, A. Michaelakis, G. Balatsos, S. Beleri, G. Koliopoulos , T. Stavrou, T. Georgakopoulou, S. Tsiodras, A. Pappa, N. Vakalis and C. Hadjichristodoulou
12:20 - 12:40	***Paper 7.3:*** Integrated *Aedes* management for the control of *Aedes*-borne diseases **D. Roiz,** A. L. Wilson, T. W. Scott, D. M. Fonseca, F. Jourdain, P. Müller, R. Velayudhan and V. Corbel
12:40 - 13:00	***Paper 7.4:*** Control of mosquitoes transmitting WNV in Central Macedonia, Greece 2018 **S. Kalaitzopoulou,** S. Gewehr, P. Tsagaris and S. Mourelatos
13:00 - 13:20	***Paper 7.5:*** Evolution of the spread of the Asian tiger mosquito and arboviruses outbreaks in mainland France, 2018 **G. L'Ambert,** L. Chanaud, C. Jeannin, D. Moulis, J.-C. Mouret and C. Lagneau
13:20 - 14:30	**Lunch**
Afternoon	**Visit of mosquito control project**
Evening	**Boat trip followed by conference dinner**
	Thursday 14th March
	Session 8 (09:00 - 10:40) ***New technologies in mosquito control*** Chaired by Kamil Erguler & Sandra Gewehr

09:00 - 09:20	***Paper 8.1:*** Evaluating the performance of MozzyJet, an aerial mosquito control vehicle to perform targeted, effective, and low-cost mosquito control **K. Erguler,** A. Agapiou, P. Antoniou, P. Vouterakos, A. Leonidou, C. Keleshis, J. M. Fawcett, J. Sciare and A. F. Martinou
09:20 - 09:40	***Paper 8.2:*** A novel technology to effectively repel mosquitoes, using electric fields **A. Rose,** F. Tanveer, E. Molins and K. Paaijmans
09:40 - 10:00	***Paper 8.3:*** Two plus one: the combination of two passive and one active mosquito trap may well be an *Aedes (Stegomyia)* control tool worthy of attention **A. Schuhbauer,** *M. Geier, A. E. Eiras amd S. A. Ritchie*
10:00 - 10:20	***Paper 8.4:*** The use of drones to control mosquitoes: feedbacks from EID Méditerranée **N. Sidos,** R. Tounsi and C. Lagneau
10:20 - 10:40	***Paper 8.5:*** Using artificial intelligence for guiding wide area mosquito control operations M. Iatrou, S. Kalaitzopoulou, **X. Tseni,** S. Gewehr and S. Mourelatos
10:40 - 11:00	**Coffee break**
	Session 9 (11:00 - 12:40) ***Citizen science, communication and personal protection*** Chaired by Marina Torres & Rubén Bueno
11:00 - 11:20	***Paper 9.1:*** Citizen Science ease the detection of new *Aedes* invasive mosquitoes: the case of *Aedes (Hulecoetomyia) japonicus japonicus* (Theobald 1901) in Spain R. Eritja, I. Ruiz-Arrondo, **S. Delacour-Estrella,** F. Schaffner, J. Álvarez-Chachero, M. Bengoa, M.-Á. Puig, R. Melero-Alcíbar, A. Oltra and F. Bartumeus
11:20 - 11:40	***Paper 9.2:*** News from the 'Mückenatlas' (2017–2018) **H. Kampen** and D. Werner
11:40 - 12:00	***Paper 9.3:*** The citizen science project 'Mueckenatlas': contributions of opportunistic data collection to mosquito research and public engagement in science **N. Pernat,** H. Kampen and D. Walther
12:00 - 12:20	***Paper 9.4:*** Spatial repellents, insecticides and their role in human protection **M. Moreno,** M.A. Miranda and R. Bueno
12:20 - 12:40	***Paper 9.5:*** How to communicate the problematic of vectors and associated diseases to the society **M. Torres**
12:40 - 13:30	**Closing of the conference**
13:30 - 14:30	**Lunch**



IX International Conference

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Keynote Speakers Presentations

Manual on prevention of establishment and control of mosquitoes of public health importance in the WHO European Region (with special reference to invasive mosquitoes)

Elkhan Gasimov,
WHO Regional Office for Europe, Copenhagen, Denmark

Introduction of invasive vector mosquitoes, together with the geographical expansion of some native vector mosquitoes, has substantially increased the threat of (re-) emerging VBDs in the European Region. Of most concern is the rapid expansion of the geographical range of *Aedes albopictus,* as well as reports of establishment of *Ae. aegypti* along coastal areas of the Black Sea region and on Madeira (Portugal). Recent local outbreaks of dengue and chikungunya on Madeira and in the Mediterranean basin serve as a stern reminder of the potential burden these developments may cause. The problem of invasive vector mosquitoes suggests that countries should have adequate systems in place for entomological surveillance and vector control that enable them to reduce the threat of re-emerging VBDs. This manual responds to the request from individual countries for practical guidance on vector control in the Region; it is also in line with the recently adopted Global Vector Control Response (2017–2030), which was passed by the World Health Assembly in 2017. Four scenarios for prevention and control activities are outlined: (1) an invasive vector mosquito is not established, but there is risk of introduction; (2) an invasive vector mosquito has locally established itself within a small area; (3) an invasive vector mosquito has become widely established; and (4) a vector mosquito is implicated in local transmission of disease pathogens. State-of-the-art methods of control are described, with a main focus on container-breeding *Aedes species.* These main methods of control are: source reduction; larviciding; screening of windows and doors; targeted residual spraying; and emergency space spraying. For each method, there is a detailed discussion of the available evidence concerning its effectiveness; methods of application; when and where it should be used; and how to monitor and evaluate it. In the context of each of the four scenarios, strategies of implementation of vector control are discussed. Each discussion starts with situation analysis and decision-making, and then moves to selection of methods for prevention and control, identification of needs and resources, exploration of partners in implementation, and methods of monitoring and evaluation. Special attention is given to outbreak preparedness. The final sections of the manual discuss regulatory aspects of vector control, particularly with respect to use of insecticides; legislation in support of preventive and control actions; and organizational aspects of vector control. It is proposed that an interministerial task force for vector control at country level is established, in line with the Global Vector Control Response.

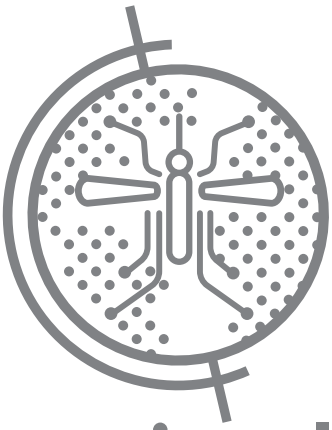
Mosquito control in France and its overseas territories: practices and evolution

Rémi Foussadier,
General Manager EID Rhône-Alpes, Chindrieux, France

In France, legislation on mosquito control dates back to the early 1960s. Earlier, the control was organised by the Ministry of Health for the purpose of public health to control mosquito populations responsible for malaria or dengue transmission in Corsica and the French overseas territories. To allow the development of tourism activities (especially along the Mediterranean coast), the French State has adopted, for France mainland (i.e. in the European continent), a specific law to limit mosquito populations that generate severe nuisance. This specific mosquito control has to be ensured by local government. Since 2004 with the arrival of the Asian tiger mosquito in France mainland, a mosquito vector control programme is also organised by the local government.

Due to concerns about the environmental impact of mosquito control activities, the French operators, united within the ADEGE, have joined their forces to propose integrated management compatible with sustainable development through a European Life + programme IMCM. Subsequently, nowadays the mosquito control operations follow the recommendations of the designed good practices' guide which are articulated according to 5 main axes: (1) To set up an entomological monitoring, consisting of the identification and survey of mosquito populations and of the global evaluation of the control actions' effectiveness; (2) To limit, first and foremost, the presence of larval breeding sites (suppression of water collections wherever possible) relying in particular on community participation, encouraged through education and communication; (3) Use, when necessary and in rational and sustainable manner, other control methods (biological, biocidal and genetic); (4) Evaluate regularly the effectiveness and the eventual impacts on health and environment in order to improve the control technics and manage and minimalize non-intentional effects;(5) Define action thresholds to maintain the sanitary risks to a level that is acceptable to the community. These axes will take into account sociological factors and geographical, political and economic situation.

Current working axes are oriented towards mass trapping, drone use and a permanent assessment of the environmental impact of mosquito control activities.



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Oral Presentations

paper 1.1

SESSION 01

General overview on efficacy evaluation and environmental risk assessment of insecticides under European law using *Bti* as an example

A. Kehrer, C. Stang, C. Kuhn

German Environment Agency, Woerlitzer Platz 1, 06844 Dessau-Rosslau, Germany

The use of insecticides for mosquito control in the EU is regulated by the Biocidal Products Regulation 528/2012 (BPR). Biocidal active substances (a.s.) used in those products can be chemical substances but also micro-organisms such as bacteria, viruses or fungi.
The authorisation process of biocides is divided into two central stages: the approval of a.s. on EU-level and the authorisation of products on national level.
A precondition for the authorisation of a biocidal product is the inclusion of the respective a.s. in the union-list of approved active substances of the BPR. The decision on this inclusion is the primary objective of the a.s. approval procedure. For that purpose, the applicant has to submit a dossier which includes all of the information necessary for a comprehensive assessment by the competent authorities. Therefore, among other things, efficacy has to be proven, and studies on the influence of the a.s. on the environment have to be provided. The a.s. can be approved only if the efficacy and one safe use for human health as well as for the environment could be demonstrated in the assessment. Assessment and approval need to be agreed between member states at EU-level.
After the inclusion of the a.s. on the union-list, applicants can apply for the authorisation of products containing the a.s. on national level. In order to receive the authorisation, the efficacy of the specific product has to be proven, and all the intended uses of the product must not result in unacceptable risks for human health or the environment.
As the whole authorisation process is a complex procedure, the presentation will give an overview of the regulatory data requirements and assessments required according to the BPR focusing on efficacy evaluation and environmental risk assessment using *Bti* as an example.

paper 1.2

SESSION 01

Developing mosquito control in highly protected natural wetland environments

J. O. Lundström[1,2] and M. Schäfer[1]

[1]*Biologisk Myggkontroll within NEDAB, Uppsala and Gysinge, Sweden*
[2]*Department of Medical Biochemistry and Microbiology, Uppsala University, Uppsala, Sweden*

Floodwater mosquitoes are a major cause of unbearable mosquito nuisance near wetlands, and wetlands are often protected both by national law and the European Natura 2000. Nine species of floodwater mosquitoes occur in Sweden and the strong flier *Aedes sticticus* is the leading cause of nuisance. The River Dalälven floodplains have the country's largest wet meadows, swamps and marshes producing *Aedes sticticus*. Measurements in August 2000 provided 60,000 mosquitoes per CDC-trap per night showing that the area has extreme mosquito abundance as confirmed by the numerous complaints about unbearable mosquito nuisance over several decades. In 2000, we commenced the development of efficient and environmentally safe *Aedes sticticus* control to protect the human population in seven municipalities and four counties. The strategy was to use aerial application of Bti in the form of VectoBac™ G. Since mosquito producing wetlands are protected by a complex system of laws, we need annual approvals from several authorities. Use of Bti in a Natura 2000 site and the use of a helicopter for the operation require the approval of the Swedish Environmental Protection Agency (SEPA). Since it is impossible to scientifically prove that Bti cannot cause any harm to any organism or biotope, the final decision is moved from SEPA to the Swedish Government. Conducting mosquito control in national park and nature reserves requires permission from the County Board. If an area is lacking this level of protection, the county administration can require that a submission according to the species protection act is approved before treatment. Finally, all landowners need to provide a written statement that allows mosquito control on their property. I will show the gradual development of mosquito control in highly protected environments, for example, the importance of a long-term environmental follow-up as a natural ingredient in sustainable floodwater mosquito control.

paper 1.3

SESSION 01

Assessment of an ambitious environmental policy

B. Frances, A. Marie, R. Tounsi, D. Gindre, D. Moulis, C. Lagneau

EID Méditerranée, Montpellier, France

Most of mosquitoes control activities of EID Méditerranée take place in protected coastal wetlands. For more than 10 years now, EID Méditerranée has been developing an environmental assessment policy for its activities. In this context, several measures have been put in place over the years to take this issue into account. The first approach was implemented more than 10 years ago in the EID Méditerranée area of actions. This environmental monitoring approach has made it possible to develop the environmental sensitivity of field technicians while providing the first elements of a response regarding the environmental assessment of our activities. Another regulatory mechanism concerns the assessment of the impact of our activities within Natura 2000 sites. Since 2010, a regulatory text has required mosquito control operators to carry out a prior assessment of their activities on Natura 2000 sites. In this context, EID Méditerranée immediately set up a process to assess the environmental impact of its activities on its territory. Additional measures concern the QSE (Quality, Safety, Security, and Environment) certification process, obtained by EID Méditerranée in 2015. As part of the Environment component of this approach, several actions have been carried out to limit our impact on the environment. This concerns improving the management of our operational effluents, improving our energy consumption and managing our waste. During this presentation, an assessment of each of these mechanisms will be made in order to define prospects for the coming years.

paper 1.4

SESSION 01

Lessons learned from 8 years of biological mosquito control with Bti in a borderline wetland in Austria

H. Jerrentrup

Society for biological mosquito control along Thaya and March, Austria

After 8 years of implementing a programme of biological mosquito control with BTI in a riverine transboundary wetland, some interesting conclusions are drawn concerning nature conservation and control. Analysis of the annual flood data shows that the "de facto" treated surface of wetlands are minimal in relation to the flooded areas. Also, the annual number of mapped nests of large birds from the EU-Birds Directive Annex I in the controlled areas in relation to the existing eyries is lower than 10 % - these nests are fixed in the GIS with a surrounding non-intervention zone. Nature conservation management measures carried out for habitat restoration of rare fish species in the area of March-Morava have reduced some of the most productive mosquito breeding sites especially by re-connecting and excavating silted oxbows. Finally, collaboration in round table meetings of the regional water management authorities, mosquito controllers and fishermen have solved local problems for the benefit of all sides.

paper 2.1

SESSION 02

EID Atlantique, up and down of 50 years of mosquito control in western France

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EID Atlantique is a French public agency dedicated to control mosquitoes providing the monitoring and control of wounding and potential vectors of disease mosquitoes. The agency covers a large part of the West Atlantic coast, from the Morbihan to the Gironde county. Since 1969, in a regulatory context specific to France, the political aims of mosquito control implemented by EID Atlantique is to ensure the comfort of live of the citizens, to limit the spread of mosquito-borne diseases and to support the economic development of tourism near wetlands favorable to the proliferation of mosquitoes. Major main activities of the agency are: entomological survey, diseases vectors and hurtful mosquitoes control, ecological expertise, public information and sensitization on public health and veterinary issues. During the 1970s, EID Atlantique, advised by a Scientific and Technical Council, has progressively extended its territory of intervention and developed new competences. Between the 1980s and 1990s, water management programmes were developed. However, the local political authorities have sometimes tried to stop mosquito control because of its efficiency and especially because of its cost. Since 2000, the spread of the Asian tiger mosquito *(Aedes albopictus)*, but also of local species *(Aedes sticticus)* have created nuisances in new areas. As for the treatments, EID Atlantique has been adapting tools and processes to use exclusively *Bacillus thuringiensis israelensis* as larvicide (VectoBac® WG, Bti strain AM65-52). More recently, new technologies and changing social behavior have prompted EID Atlantique to develop a smartphone application (iMoustique®) to gather mosquitoes reports within passive surveillance. Now, the risk management of mosquito-borne diseases (dengue, chikungunya, Usutu,...) appears to be the next challenge for mosquito control. For fifty years, EID Atlantique has built an integrated mosquito control system and sustained an accountable environmental commitment.
Key metrics:
60,000 acres of marshes and wetlands monitored; 185 municipalities; 65 permanent agents; 10 technical agencies; annual budget of 4 million euros.

paper 2.2

SESSION 02

Control of adult mosquitoes and effects on flower-visiting insects in urban green areas

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The tiger mosquito is a key vector of several human diseases and is considered a public health concern worldwide. The implementation of strategies aimed at maximising mosquito control without affecting non-target groups is of vital importance. Pyrethrum-based insecticides are the most commonly used broadspectrum adulticides worldwide. In a field trial, we tested the efficiency of pyrethroid vs. natural pyrethrum insecticides in reducing the mosquito population and how they affect the diversity of non-target flower-visiting insects in green urban areas. We found that only the pyrethroid insecticide was effective in reducing mosquito abundance, although its effects disappeared nine days after application. We also found that the two adulticides did not significantly affect the diversity of flower-visiting insects, probably because of their large body size and the difference in flying and foraging activity. In situations where adulticide use is required to control tiger mosquito populations, pyrethroid insecticides should be preferred over pyrethrum-based insecticides. To effectively control of tiger mosquito population while preventing intoxication of non-target flower-visiting insects, adulticide applications should be applied early in the morning and only on bushes and trees.

paper 2.3

SESSION 02

Is *Aedes sticticus* a new invasive species in western France?

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EID Atlantique, Rochefort- sur- Mer, France

Aedes sticticus is a species known to be widespread in many European countries. In 1991, this species was observed for the first time in the southern part of the territory under the responsibility of EID Atlantique. The breeding sites were localised near the river Ciron, close to the famous vineyard of Sauternes (South-east of Bordeaux, county of Gironde). For a long time, the nuisances due to this species were reported only in this area. Because of its high flying ability, *Aedes sticticus* dispersed and was identified in new areas of the county, and the associated nuisance began in the ensuing years. Recent data collected from studies, mosquito control monitoring and citizen passive surveillance, indicate that *Aedes sticticus* is spreading since several years from southern to the northern territory of EID Atlantique. Once established in an available area, this species is responsible of important nuisance reported by citizen. Based on these observations, questions appear: Can *Aedes sticticus* be considered as an invasive species in western France? What are the factors that are influencing its spread?

paper 2.4

SESSION 02

Coexistence in urban breeding sites among *Culex pipiens, Culiseta Longiareolata* and *Aedes albopictus* in the Castellón province (East of Spain)

J. Herrezuelo-Antolín, D. López-Peña, J.V. Falcó-Garí and R. Jiménez-Peydró

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The arrival of *Aedes albopictus* on the European continent and its fast expansion within Mediterranean countries has led to a notable increase in studies targeting the tiger mosquito. In this perspective, during 2016 and 2017, urban mosquito populations have been monitored in the province of Castellón to assess the coexistence of different species in their breeding sites.

Culex pipiens and *Culiseta longiareolata* are the two most common mosquito species in urban areas of the Valencian Autonomous Region. However, since the tiger mosquito was found for the first time in the region, in 2009, its colonisation of urban areas is increasing. Indeed, and thanks to its high adaptability, they are currently 334 municipalities out of 542 that are colonised. The competition between the mentioned species has been studied by other authors under laboratory conditions, but in this work we refer to data collected from their natural environment.

The present study aims to identify the factors that enable these species to share an ecological niche during larval development. For this, a sampling in the urban areas of the municipalities of the province of Castellón is performed, visiting them fortnightly, georeferencing each point with positive result and studying the environmental variables and biotic elements that can modulate development and competition among species.

paper 2.5

SESSION 02

Capacity building for the entomological surveillance in the Mediterranean area: MediLabSecure outcomes and follow-up

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As (re-)emerging arboviruses are threatening global health, the EU-funded MediLabSecure project (2014-2018) aims at enhancing, through a One Health approach, the preparedness and response to vector-borne diseases by establishing an integrated network of virology and entomology laboratories in 19 non-EU countries of the Mediterranean and Black Sea regions.
The main output and outcomes in the medical and veterinary entomology network are:

1) Networking: A strong network of 20 medical entomology laboratories has been established, that has enhanced sectoral, inter-sectoral and cross border collaboration. For five years, network members met and exchange on a semi-regular basis through various meetings, technical trainings, mailing-list, collaborative papers, etc.

2) Trainings and follow-up:

- Training modules were tailored allowing laboratories to develop capacity building in mosquito vector of arboviruses (sampling, determination and surveillance). About 60 people have been trained.
- External quality assessments (EQAs) was organised to assess the efficiency and accuracy of mosquito identification. Entomology lab members received a set of mosquitoes to identify; 19 labs responded. The correct identifications at species level were: 100% (three laboratories), 90–95% (four laboratories), 50–75% (six laboratories) and < 50% (six laboratories).

3) Tools:

- An electronic determination key for mosquito species (larvae and females), called "MosKeyTool" suitable for use in the whole Euro-Mediterranean-Middle East was produced. This tool provides the current knowledge for mosquito species determination of all the 128 known mosquito species in the area. It is downloadable for free since May 2017.
- Finally, a roadmap was realised to develop entomological surveillance systems on an effectiveness and sustainable basis to improve preparedness and response activities.

The MediLabSecure project is extended for another three years (2019-2021) with two new major components: the addition of an environmental component and the geographical extension to five West African Sahel countries.

paper 3.1

SESSION 03

A new integrated system for risk-based surveillance of invasive mosquito *Aedes albopictus* in Switzerland

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The continuous expansion of the invasive Asian tiger mosquito, *Aedes albopictus,* combined to its ability to transmit arboviruses (e.g. dengue, chikungunya) is raising major public health concern in Europe.
In Switzerland, *Ae. albopictus* is established in urban areas south of the Alps since 2007. According to predictions based on a climate-driven abundance model, the areas surrounding Lake Léman and, to some extent, the Swiss Plateau are suitable for the spread of *Ae. albopictus* north of the Alps, while other areas in Switzerland (e.g. the city of Zurich) seem currently too cold in winter for the survival of diapausing eggs. However, the particular climatic conditions existing in urban settings, where the species thrives, have not been taken into account in this large-scale model. The presence of urban heat islands and the milder winter conditions of urban microhabitats may increase the probability of diapausing eggs to overwinter and favour even more the colonisation of new cities. There is therefore an urgent need for appropriate monitoring tools and risk-based surveillance of *Ae. albopictus* populations.
In 2018, researchers from the University of Applied Science and Arts of Southern Switzerland (SUPSI) have joined forces in order to make data analysis and monitoring of *Ae. albopictus* more automated, dynamic and efficient, through the integration of multidisciplinary aspects such as mosquito surveillance expertise, data monitoring system and population modelling. The designed system focuses on the monitoring of urban catch basins, primarily on microclimate environmental sensing, data transmission, data acquisition and data dissemination. The gathered data are the input for an empirical machine-learning model for the prediction of spatial and temporal distribution of *Ae. albopictus* in Switzerland. This work is critical in order to support the activities of the newly created Swiss National Coordination Centre for the Monitoring and Control of Invasive Mosquitoes, managed by LMA (SUPSI).

paper 3.2

SESSION 03

The continuing spread of *Aedes japonicus* in Germany – an update

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In 2016, four populations of the invasive Asian bush mosquito *Aedes japonicus* were present in Germany, with three of them crossing borders to neighboring countries (France, Switzerland, Austria). During 2017 and 2018, the spread of this highly expansive species continued: three of the four populations grew substantially in terms of territory occupied, and local reproduction was demonstrated at numerous sites in between, and far from, the known populations. Already in 2017, merging of several populations began to show, and this trend was confirmed in 2018. By now, *Ae. japonicus* colonises a considerable part of the southern half of Germany, with higher population densities and more densely located sites of demonstration in the southwestern than in the southeastern part. In 2018, the species was found increasingly often close to the border to the Czech Republic in the east, and for the first time on the borders to Belgium, Luxemburg, and French Lorraine and northern Alsace in the west. Apparently, *Ae. japonicus* from Germany did cross the borders already to France and Luxemburg, and will probably do so to Belgium and the Czech Republic in 2019, if not happened already unrecognised. In Germany, a general northward spread is anticipated for 2019 as well as an increase in colonised areas in more northern parts of Bavaria and central east federal states.

paper 3.3

SESSION 03

Monitoring of *Aedes albopictus* (Diptera: Culicidae) in the Valencian Autonomous Region (East of Spain)

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The tiger mosquito *(Aedes albopictus)* was cited for the first time in the Valencian Autonomous Region in 2009 in the province of Alicante. Since then and until 2015, the number of municipalities with the verified presence of this important vector has risen up to 117. In relation to the fact that the colonisation of urban areas has increased rapidly year after year, the local government since 2016 decided to carry out a continuous monitoring in order to know the presence of *Ae. albopictus* in the villages, towns and cities of the afore mentioned region. This is of relevant importance because the Asian mosquito shows a high adaptability and also due to the favourable climatic conditions that characterise the study area.

As a result, the uninterrupted surveillance that has been carried out has evidenced the presence of *Ae. albopictus* in 334 of the 542 locations distributed throughout the region. This study analyses the inherent aspects of the establishment of this species, as well as its progression, and the factors that have contributed and facilitated its spread. In addition, it also aims at informing in real time about the displacement of the tiger mosquito to the regional government, allowing to adopt the appropriate measures to control their populations in the urban areas. In this perspective, it is intended to achieve a double objective that is to limit the spread as much as possible, and to control the populations to avoid any transmission of pathogenic agents, triggering worrisome diseases to the Valencian citizens.

paper 3.4

SESSION 03

Aedes albopictus in Jena, Central Germany

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In June 2015, two *Aedes albopictus* females collected in the City of Jena, federal state of Thuringia, Central Germany, were submitted to the 'Mueckenatlas' mosquito surveillance scheme. Immediate monitoring activities produced tiger mosquito eggs and larvae until late October, but only in one single cemetery close by the initial collection site. After the early detection of additional larvae in the same cemetery in early 2016, suggesting local overwintering, the City of Jena, in collaboration with the German mosquito monitoring programme (GMMP), started surveillance measures on a biweekly basis. In addition, the public was informed on how to avoid breeding sites, and the municipality's cemetery office was instructed to post information notes at the cemetery entrances and also take care of source reduction. Nevertheless, all developmental stages of *Ae. albopictus* were found in the same cemetery until late October, as well as in a close-by garden center which was later learnt to have imported plants from Italy already in 2014 with numerous mosquito larvae in their pots. In 2017, the species seemed eliminated in these locations but emerged in other parts of the city. As the further funding of the GMMP was not guaranteed at that time, the City of Jena was asked to take over the complete Ae. albopictus management costs for 2018, but refused to do so due to the low numbers of *Ae. albopictus* collected. Instead, they insisted in seeking support from the local university, despite that having no mosquito expert available. Further urging by the German National Mosquito Expert Committee to include the GMMP was unsuccessful. Irregularly inspections carried out by our group in 2018 continued to produce scattered *Ae. albopictus* specimens. Although population densities remained very low over the years, the tiger mosquito must now be considered established in Jena, probably representing the northernmost population at all.

paper 3.5

SESSION 03

Outcomes of mosquito surveys in Ireland, Luxembourg, Russia and Abkhazia

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Short mosquito surveys were implemented in 2018 throughout Europe and beyond with various aims. Here we present the main outcomes of three studies.
A fist survey was performed in Ireland in the frame of VectorNet (2014-2018). Because of gaps in mosquito distribution data, we collected updated data of native mosquito species (NMS) and assessed the presence of invasive mosquito species (IMS). No IMS were detected but 979 specimens from 9 NMS could be collected from 33 sites, confirming the occurrence of *Anopheles algeriensis,* and detecting two species new to Ireland, namely *Aedes geminus* and *Culex torrentium*.
A second survey was performed in Luxembourg. Subsequent to the report of an unusual mosquito by a citizen, revealing to be Ae. japonicus, the National Health Directorate of Luxembourg entrusted us a survey to confirm the presence and establishment of the species, and to assess its distribution. During three short missions, we inspected up to 106 sites out of 94 localities, focusing on water-holding containers by larval dipping. The study confirmed the presence of *Ae. japonicus* over at least 550 km square (21% of the country land) in the eastern part of the Grand Duchy. In addition, we detected two species new to Luxembourg, namely *Cx. hortensis* and *Culiseta longiareolata*.
The third survey, again in the frame of VectorNet, was performed in southern Russia and Abkhazia, aiming at assessing presence and spread of IMS in that region. Here we inspected 25 sites in Russia and 14 in Abkhazia, collecting 2,300 specimens belonging to 13 species. As main outcome, we confirm the establishment of *Ae. koreicus* in a small area of Russia, we did not find any *Ae. aegypti* in both Russia and Abkhazia, but *Ae. albopictus* showed to be highly abundant and to spread towards both North and West.

paper 4.1

SESSION 04

The experience of controlling invasive *Aedes mosquito* species in Belgium

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The first detections of invasive *Aedes mosquito* species in Belgium date back to 2000 *(Aedes albopictus),* 2002 *(Aedes japonicus)* and 2008 *(Aedes koreicus)*. In Belgium, the regional authorities (Flanders, Wallonia and Brussels) are responsible for the implementation of mosquito control. However, no control measures were implemented between 2000 and 2011. In 2012, the first vector control campaign against *Ae. japonicus* was implemented in the Walloon region. This campaign, initiated by the Walloon and communal authorities, continued from 2013 until 2015 with technical support from a private company. Between 2013 and 2016 *Ae. albopictus* was yearly detected by active monitoring in Flanders. These introductions were not always controlled or control was implemented with some delay. The lack of human resources at the regional level caused administrative delays, also related to the need for an exemption on the biocide regulation for appropriate larvicides. Besides, no professional operators were hired. From 2016 until now, the Flemish region engaged for the first time a pest control agency, however, supervision and evaluation of the control is still not sufficient. Although the Walloon region has experience with *Ae. japonicus* control, the control of *Ae. albopictus* is planned only in 2019 despite its detection in the region as early as in 2016 and 2018. Currently, the decision and implementation of control of invasive *Aedes* mosquitoes in Belgium is still ad hoc and not based on different epidemiological and entomological risk scenarios. Although political awareness is growing, there is an urgent need for an integrated surveillance and control management plan at national and regional levels setting out clear criteria for action, control methods and strategies with appropriate supervision and evaluation.

paper 4.2

Invasive mosquito monitoring programmes in Switzerland in 2018

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In Canton Ticino, Southern Switzerland, a long-term monitoring programme for invasive mosquitoes is in place since 2000. Additionally, in 2013 a National monitoring programme along the highways, in international airports, harbours and cargo railway stations was set up. This both programmes led to the detection of the invasive mosquito species *Aedes albopictus,* found for the first time in Ticino in 2003 and since spreading northwards. Moreover, two additional invasive species *Aedes japonicus* and *Aedes koreicus,* spreading from north-eastern Switzerland and from North Italy respectively are now also present in Ticino and are spreading across the country. In 2016 national guidelines for the surveillance and control of invasive *Aedes* mosquitoes in Switzerland where published and in 2017 a national competence network for the surveillance of invasive mosquitoes was set up. The Canton Graubünden started a monitoring programme in the valley bordering Ticino in 2016 which was extended in 2017 to other regions bordering Italy and along the A13 motorway. The interest to the topic of invasive mosquitoes is rising in Switzerland and lead to the establishment of further monitoring programmes in the cities of Basel and Zürich, in the Canton Glarus, and in the neighbouring Country Liechtenstein in 2017. The monitoring programme of the city of Basel was extended in 2018 to the neighbouring Cantons of Basel Landschaft and Aargau. The structure and concepts of these monitoring programmes will be presented as well as results obtained during 2018 and an overview of the situation about invasive mosquitoes in Switzerland.

paper 4.3

SESSION 04

Water associated areas as a key predictor for *Aedes albopictus* presence on a Mediterranean island

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The Asian tiger mosquito, *Aedes albopictus* (Diptera: *Culicidae*), is a highly invasive species and a competent vector of several arboviruses that have spread rapidly throughout the world. Investigating the habitat selection of this species at small to medium scales is essential to the planning of effective prevention and control campaigns. Detailed data for this species collected at 228 sites on Mallorca Island (Spain) in autumn 2015 were considered, three years after the first detection of the species on the island. Site occupancy models accounting for false negative detections and imperfect monitoring were used to evaluate the relationships between mosquito presence and habitat variables. We found that mosquito presence was negatively associated with altitude, probably as a result of greater human presence at low altitudes near the coast. Otherwise, the presence of *Ae. albopictus* was positively associated with swimming pools as a result of gardens, plants and sources of fresh water. These two variables were combined to predict the presence of the species across the entire island.

paper 4.4

SESSION 04

TIGREPAT: surveillance and control program of invasive *Aedes species* and related arboviruses in Northern Italy

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The establishment of *Aedes albopictus* and the possible invasion of *Aedes koreicus* and *Aedes japonicus* in Northern Italy have triggered the need to activate surveillance programmes and responsive control interventions in order to avoid epidemic outbreaks such as the chikungunya ones that happened in Italy in 2007 and 2017. Any preemptive or responsive actions planned by public health stakeholders should be evidence based. However, the commitment of stakeholders could be undermined by the costs and difficulties of maintaining surveillance systems and diseases prevention programmes, especially in face of decreasing budget and other more known health issues. Developing a monitoring system tailored to local entomological and epidemiological conditions is essential to optimise the cost-effort tradeoffs. Therefore, based on previous monitoring data we produced a statistical assessment of *Aedes* species adaptation to the Alps environment by using an occupancy model. Moreover, to provide evidence-base guidance to health authorities we estimated the transmission risks by mathematical modelling and ad-hoc collections of adult females. Finally, evidence-based guidelines discerning high or low-level risk areas and tailored monitoring and control programmes have been produced for the Province of Trento (Northern Italy).

paper 4.5

SESSION 04

The INTERREG TIGER project: main outcomes of the tri-national surveillance network in 2018

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The Upper Rhine region extends across three countries (France, Germany and Switzerland) and has been colonised by *Aedes albopictus* (Skuse) and *Aedes japonicus* (Theobald) in 2014 and 2012, respectively. In the framework of the operational programme INTERREG V Upper Rhine, the TIGER project (2018-2020) has the main objective to provide scientific and technical support to administrations and public institutions for the evaluation and management of the health risk related to invasive mosquitoes. To achieve that end, we defined 4 interconnected topics: expertise, training, prevention and communication.

During the first year (2018), the expertise issue focused on the common tri-national surveillance network and research tasks such as investigating active dispersal. The 656 ovitraps operated between May and November have shown that *Ae. albopictus,* present within the three countries of the Upper Rhine region, is currently limited to some cities and areas near motorways. The most widespread invasive mosquito in our area is *Ae. japonicus* whereas *Aedes koreicus* (Edwards) has been detected recently in the north limit (Germany) and the south (Switzerland) of the Upper Rhine region. Since the two latter species are morphologically very similar, a particular attention should be paid in future. In order to target vector control efforts more efficiently, active dispersal of *Ae. albopictus* and *Ae. japonicus* are investigated in the South of Switzerland and North-East of France respectively. The experiments undergone and work in progress on communication and prevention are presented. A tool enabling the local administrations to get access to up-to-date maps of the distribution of the invasive mosquitoes and new insights on dispersal capacity will help them to monitor potential health risks.

paper 4.6

SESSION 04

The *Aedes* Invasive Mosquito COST Action: promoting innovation and synergies in the field of surveillance and control of invasive *Aedes* arbovirus vectors in Europe

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The surveillance and control of *Aedes albopictus* and other *Aedes* Invasive Mosquito (AIM) species and the management of the risk of introduction and spread of exotic AIM-borne viruses (dengue; yellow fever; chikungunya; Japanese encephalitis and Zika) in Europe requires multidisciplinary research, cost-effective conventional/innovative methods, strong international and cross sectoral linkage, as well as better integration of public and private sector initiatives and a better informed and aware society. The AIM-COST Action **(http://www.aedescost.eu)** aims to remove the fragmentation in expertise and inconsistencies in the implementation of surveillance and control of AIM in European countries. COST (European Cooperation in Science and Technology) is a pan-European intergovernmental framework dedicated to networking activities for European researchers, engineers and scholars to jointly develop new ideas and initiatives across all scientific disciplines through trans-European coordination of nationally funded research activities **(www.cost.eu).** AIM-COST aims to promote innovation in the fields of AIM research, prevention and control (and more generally of medical/veterinary entomology and epidemiology of AIM-borne diseases) and to develop synergies between scientists, decision-makers, the private sector and civil society necessary to harmonise and rationalise sustainable approaches – both conventional and novel – for the surveillance, control, analysis and dissemination throughout Europe and beyond, by funding networking activities (meetings, training schools, short term scientific missions and dissemination activities).
Here we briefly present AIM-COST Action structure, objectives and working groups and planned activities. One of the first tasks is the assessment of needs in terms of guidelines for the surveillance and control of AIM, based on a questionnaire that everybody is invited to fill in **(https://ec.europa.eu/eusurvey/runner/AIMCOSTSURVEYFEB19).** New participants as well as members and cooperating-states can still join the Action, and are more than welcome.

paper 5.1

SESSION 05

Data on entomological surveillance activities and detection of West Nile virus in mosquito pools in Greece (2017-2018)

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West Nile virus (WNV) cases have been constantly recorded in Greece, from 2010-2014, with viral circulation being detected in different regional units of the country. The disease after a 2-year pause, re-emerged in 2017 with 48 human cases and in 2018 when Greece faced the second largest outbreak in Europe with 316 cases being recorded. Small scale entomological surveillance activities are carried out every year by several Regions, with the participation of subcontractors for the vector control programs aiming to record, monitor and control mosquito populations and detect the presence of WNV in case of an outbreak.

Mosquito traps were placed in rural and urban sites of the study areas; specimens were collected, morphologically characterized and pooled by date of collection, location and species types. Representative mosquito pools containing mainly *Culex pipiens,* were examined for the presence of WNV by a real-time PCR protocol. Ninety-four (94) pools from four Regions and 129 pools from five Regions of the country with recorded human cases, were examined for years 2017 and 2018, respectively.

The majority of adult mosquitoes collected for 2017-1018 belonged to *Culex pipiens,* the main vector responsible for WNV transmission in Greece. Positive pools were detected in Regions with human cases (22/94 for 2017, 12/129 for 2018).

Our findings confirm WNV circulation in areas of the country where the majority of human cases were recorded in 2017 and 2018. Taking into consideration the complex epidemiological profile of WNV and unforeseen changes in its circulation, outbreaks of WNV in Greece are expected in the future, therefore rendering systematic and continuous surveillance activities imperative for the implementation of timely and targeted interventions by local public health authorities.

paper 5.2

SESSION 05

1999-2018, 20 years of *Aedes albopictus* surveillance and control in western France – successes and limits

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The Asian tiger mosquito *(Aedes albopictus- Stegomyia albopicta)* was firstly intercepted in 1999 in Western France on an imported tires platform. This invasive species is spreading worldwide and has now established in many European countries. After the major chikungunya outbreak that occurred on the Reunion island in 2005-2006, the French Ministry of Health had set up a national plan to prevent dengue and chikungunya diseases. EID Atlantique is in charge of the surveillance along the West Atlantic coast of Western France, by the channel until the North Sea, from the Gironde County to the Belgian one.
The entomological monitoring is based on a huge ovitrap network strategically established on the highways resting areas and other points of entry of the territory (ports and airports), and specific sites of trade and storage. Due to this large scale territory to survey, EID Atlantique mobilizes community participation for passive surveillance of mosquitoes through a mobile application (iMoustique©). The combined use of all means of surveillance and control has sometimes made it successfully possible to delay the spread and limit the expansion of *Ae. albopictus*. However, the nuisance that it causes and the vector-borne disease risks induce a necessary resilience and implementation of new strategies of control.

paper 5.3

SESSION 05

Surveillance and control of mosquitoes in the french points of entry under the International Health Regulation

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As described in its revised version of 2005, the purpose of the International Health Regulation (WHO, 2005) is "to prevent, protect against, control and provide a public health response to the international spread of disease". Regarding vector-borne diseases, the aim is to prevent the dissemination of vectors by implementing surveillance and control measures at points of entry (ports and airports).
In France these measures have been transcribed in the national law in 2013. They focus mostly on mosquitoes and are mandatory in regions where *Aedes albopictus* is established. EID Méditerranée intervenes on behalf of six platform managers (four airports and two ports) in southern France. The approach is composed of three steps: (1) description of the geographical and entomological characteristics of the platform, (2) implementation of a surveillance programme and (3) definition of vector control measures.
The surveillance and control process consists in the mapping of the potential breeding sites, the inventory of the occurring species by larval and adult sampling around the whole year, and the identification of potential safety or environmental constraints. Then, the surveillance is based on the use of traps targeting host-seeking and gravid females, with thresholds triggering the implementation of control measures.
This surveillance system has allowed to identify the presence of *Aedes albopictus* in all the platforms and to reduce the risk of dissemination by implementing adequate actions. Moreover, in July 2018, one *Aedes aegypti* specimen has been caught in a host-seeking trap set in the port of Marseille. It has been morphologically identified and molecularly confirmed (sequencing of ND4 and COI genes). Beyond limiting vector export, this detection demonstrates the usefulness of the IHR to detect the introduction of invasive species.

paper 5.4

SESSION 05

The utility of mitochondrial and nuclear genetic markers in support of mosquito's biodiversity studies (Diptera, Culicidae) in La Rioja, northern central region of Spain

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Since Zika was declared a pandemic by the WHO in 2016, the Government of La Rioja (Northern Spain) implemented an entomological surveillance programme of mosquitoes in La Rioja region and beyond. Morphological identification of mosquitoes was supported using the mitochondrial cytochrome C oxidase subunit I (COI) and the internal transcribed spacer 2 (ITS2) genes analysis. Mosquito individuals used in this study were sampled using different collecting techniques such as BG-Sentinel® traps, human landing technique, ovitraps, collecting adults in resting places or catching immature stages by dipping. Mosquitoes were collected from 2016 to 2018 in several wetlands in the Autonomous Community of La Rioja (northern-central Spain) and a close area of Navarra region. The mosquito's community included 23 species associated with six genera: *Anopheles* (n=4), *Aedes* (n=7), *Culex* (n=6), *Culiseta* (n=4), *Uranotaenia* (n=1) and *Coquillettidia* (n=1). Thirteen species represent new records for La Rioja and Navarra regions. The overall mean distance was 0.135%; intraspecific genetic distances raged from 0.0% to 4.5%, while interspecific genetic distances varied from small values between *Ae. caspius/Ae. sticticus;* the most divergent pairs were *An. plumbeus/Cs. litorea*. We detected high level of genetic diversity in *An. algeriensis,* which might indicate the presence of cryptic diversity within the species. Analysis of the ITS2 sequences demonstrated that it can be used to separate members of the *An. maculipennis* s.l. This study increases the DNA barcode library of the Spanish mosquito fauna and highlighted taxonomic morphological problems with certain species, especially those in the genus *Culiseta*.

paper 5.5

SESSION 05

Hematophagic blackfly species (Diptera: Simuliidae) from eastern Spain. A potential risk for humans and livestock

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The presence of blackflies (Diptera: Simuliidae) in Spain has traditionally gone unnoticed until 1995, when they gave the first citizen complaints about this arthropod. From that moment and up to the present, populations of hematophagous species of these insects have been the cause of occasional outbreaks in different parts of the national territory. In addition, their anthropophagic and zoophilic habits make them potential vectors, whose interest is increasingly evident. For all these reasons, it is very important to know which species are causing the affections to human populations, which are also becoming more frequent and whose intensity is increasing. On the other hand, and mainly because simuliids have not shown an epidemiological problem in Spain that had required special attention from researchers, the studies have been scarce, punctual and partial. Therefore, due to recent events and the tendency of last years, it is of great importance to study deeply the ecology of the occurring species. Because it will allow the establishment of preventive plans to control the supernumerary populations, which allow their regulation avoiding the possible negative consequences of its vector potential in both livestock and in citizens. In fact, this has been done recently in several Spanish areas such as the Madrid and Valencian Autonomous Region, La Rioja, Córdoba, Murcia and the Aragonese and Catalan lands bathed by the Ebro River. Finally, we provide information regarding the species of both sanitary and veterinary interest in the eastern part of Spain and its possible implications in the future. Risk may result from the moving of human populations from places endemic for human onchocerciasis with the expansion of the aforementioned species overcoming their current borders distribution due to climate change. Risk may result from the moving of human populations from places endemic for human onchocerciasis with the expansion of the afore-mentioned species overcoming their current borders distribution due to climate change.

paper 6.1

SESSION 06

Oxitec self-limiting technology as a tool for urban mosquito control

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At Oxitec, we have genetically engineered a self-limiting *Aedes aegypti* strain (OX513A). Following male only releases, the progeny from mating with wild females inherit the self-limiting gene and die before reaching adulthood. Therefore, sustained releases of Oxitec male mosquitoes result in suppression of wild populations. Our OX513A self-limiting strain has proven its efficacy in numerous field trial sites and programmatic releases around the world, with over 80% suppression of wild *Ae. aegypti* populations in areas in Cayman, in Brazil and in Panama (Harris et al. 2011, Carvalho et al. 2015, Gorman et al. 2016). Since November 2018 Oxitec transitioned to a new version of the self-limiting *Ae. aegypti* strain where only the females die before reaching adulthood (strain OX5034O). This 2nd Generation Technology platform could significantly improve efforts by reducing the rearing cost, eliminating human exposure to biting females and helping diluting insecticide resistance genes into the targeted population.

paper 6.2

SESSION 06

Sterile Insect Technique (SIT) in an integrated control program against *Aedes albopictus* (Diptera: Culicidae) in South-West Germany

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Amongst ~30 mosquito species known to have established in new areas throughout the world, *Aedes albopictus* merits special recognition for its dispersal potential and especially for its significance as vector of human diseases. In Germany it was first recorded along highway A5 coming from Italy via Switzerland in 2007. From 2014 until 2017 established populations were recorded by passive monitoring in five cities in Southwest Germany. The Asian tiger mosquito is characterized by its high vector competence for more than 20 arboviruses amongst them are dengue, chikungunya and Zika viruses and therefore represents a significant health threat for humans and deserves special recognition concerning control. In our area the control efforts are based on three columns: community participation, door-to-door inspections including *B.t.i.* (VectoBac® WDG) applications and the Sterile Insect Technique (SIT). Thorough *B.t.i.* applications allow a reduction of the *Ae. albopictus* populations by more than 90%. A sufficient reduction of the larval population is achieved for more than a month when *B.t.i.* is applied at high dosage of about 50 ppm to the breeding sites. However, in areas of limited access or with cryptical breeding sites it is necessary to employ SIT to knock-down the remaining *Ae. albopictus* population. We hypothesise that we are able to eradicate the scattered populations in Germany when all control tools are thoroughly implemented with the support of the community and State authorities. In the presentation we highlight the results achieved so far and the future control strategy.

paper 6.3

SESSION 06

Combined Sterile Insect Technique and Incompatible Insect Technique: preparation for the proof-of-concept in disease reduction using randomized control trial

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Arboviral diseases, such as dengue, chikungunya, and Zika, are transmitted mainly by one mosquito vector species, *Aedes aegypti,* which distributed through out tropics and sub-tropics. Controlling this mosquito vector in disease endemic countries was not effective and high mobility and mortality are evidenced. New tools and strategies for vector control have been explored. Our group had previously reported a pilot trial to proof-of-concept in *Ae. aegypti* population suppression using the combined sterile insect technique and incompatible insect technique (SIT/IIT). Here we further reported our progress in the preparations to proof-of-concept in dengue incidence reduction using integrated vector control approach with SIT/IIT components in the Capital City of Bangkok. The preparations included 1) ethical approval process, 2) site selection using 10-year retrospective dengue incidences, 2) preliminary *Ae. aegypti* surveillance using ovitraps, 3) consultation meetings with stakeholders, 4) multi-sectorial collaborations and division of workload. Analysis of 10-year retrospective dengue incidences showed that there were 117,588 dengue reported cases in 50 districts of Bangkok with an average morbidity of 205.37 ± 111.36 per 100,000 population. Top ten sub-districts were considered and eventually 4 sub-districts were selected. After site visit and consultation with the local health authorities, 2 sub-districts with 20 clusters of 100-125 households were selected and randomly assigned as treatment and control. Preliminary entomological surveillance using ovitraps in the Center of Bangkok revealed that 94.05% of emerged mosquitoes were *Ae. aegypti* and 5.95% were *Ae. albopictus*. Mass production protocol of Wolbachia-infected *Ae. aegypti* were prepared and large-size mosquito cages were developed. Experiments on transportation of chilled mosquitoes were carried out and drone release of sterile males in collaboration with relevant authorities was considered. Implementation of sterile male release should be conducted after community/public engagement and massive release of the key message that "released male mosquitoes cannot bite and cannot transmit diseases".

paper 6.4

SESSION 06

Why not try the Sterile Insect Technique – a comment on the authorities' struggle for alternative floodwater mosquito control in Sweden

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The floodwater mosquito *Aedes sticticus* causes massive nuisance in the River Dalälven flodplains, Central Sweden. During floods in the wet meadows, swamps and marshes, this mosquito is produced in astonishing abundance. Since 50,000 blood-seeking mosquitoes per CDC-trap-night is common and approximately 500 mosquitoes per trap-night are tolerated, a 99% reduction of abundance is required for successful control. Our control operation using VectoBac® G spread from helicopter, directed by advanced GIS-based analysis, achieves 98-100% reduction. This is appreciated by both locals and visitors, but however not by some authorities. The Swedish EPA financed a large project to find "more sustainable methods" for mosquito control and concluded it can be achieved 1) by changing the River Dalälven hydrology to remove summer floods, 2) by removing bush and using grazing cattle and hay mowing, and 3) by using VectoBac® G only as a complementary method. The conclusion on a log-term effect of grazing cattle and hay mowing relies on a single study showing reduced larval abundance in 2012. No long-term effects were seen in another set of larval abundance data over many years in areas with and without wetland restoration methods. We have suggested the Swedish EPA to support testing of a more efficient way of controlling *Aedes sticticus* without use of biological insecticide. The Sterile Insect Technique (SIT) is species specific and can potentially suppress a mosquito population even further than 99% reduction. The suggested strategy for testing SIT against *Aedes sticticus* in Sweden has been discussed with internationally respected researchers in the field, and the conclusion is that it is promising and worth of testing. However, Swedish EPA is still focused on only supporting studies on grazing and hay mowing against mosquitoes and shows no interest in other suggestions. Pros and cons of the alternatives will be summarized.

paper 6.5

SESSION 06

Effect of biosynthesized inorganic nanoparticles on Zika virus vector (*Aedes aegypti*): an eco-friendly approach for mosquito control

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Nanotechnology is a promising area in scientific community. Inorganic metal nanoparticles are attracting a global attention for creating a mark in improving the competency of pesticides and insecticides. Biologically synthesized silver nanoparticles (AgNPs), may better performance over chemical derived insecticides/ pesticides because of its small size, active secondary metabolites, ecofriendly, greater stability and water dispersibility nature. Formation of AgNPs is confirmed by UV-Vis Spectroscopy (UV-Vis), Transmission electron microscopy (TEM), Energy dispersive X-ray spectroscopy (EDAX), Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction spectroscopy analysis (XRD).

The study focuses on effect of AgNPs on *Aedes aegypti* late instar whole larvae by treating AgNPs to LD50 and LD20 dose. Later on by quantifying the activity of antioxidant enzymes and detoxifying enzymes like carboxylesterases (CarE), glutathione S-transferases (GST) and glucosidases (Glu), in the larvae. Activity of superoxide dismutase (SOD), glutathione reductase (GR), catalase (CAT), glutathione peroxidase (GSH-Px) were also altered compare to control and estimating the level of lipid peroxidation (LPO) was done by thiobarbituric acid reactive substances (TBARS). Activity of SOD and CAT were found significantly enhanced whereas activity of GR, GSH-Px enzymes were found to be decreased after the treatment with AgNPs. Thus it gives preliminary indication that NPs stimulate oxidative stress (OS) which may lead to programmed cell death through the accumulation of intracellular reactive oxygen species (ROS) in larvae which may act as effective defense mechanism against biosynthesized AgNPs treatment.

paper 7.1

SESSION 07

Vector control strategy for malaria in Greece

S. Gewehr, S. Kalaitzopoulou, N. Perros, N. Garlis, G. Vlachos, P. Tsagkaris, K. Iordanidis, S. Mourelatos

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In Greece, from 2009-2018, a total of 105 autochthonous malaria cases were recorded by the Greek CDC. These cases are located in 12 foci all over the country. Ecodevelopment has been involved in vector control projects in 6 out of them. The aim of vector control actions is the prevention of the reestablishment of malaria in Greece.
In the Eastern Mediterranean the most probable malaria vector is *Anopheles sacharovi* which is recorded all over Greece with particularly high abundances in rice cultivation areas (>80x higher abundances than in periurban areas). Ecodevelopment performs systematic adult monitoring with the use of CO2/light traps in all mosquito control projects. An insight in the different ecological and epidemiological settings in four regions of Greece will be given (Peloponnese, Western Greece, Crete and Central Macedonia) and the adaptation of control strategies against malaria will be accordingly shown.
Central pivot point of vector control actions is the implementation of a targeted response plan which includes a door to door approach, field investigation for the detection of new breeding sites, adult trapping, larviciding and adulticiding applications (Indoor residual spraying (IRS) and Outdoor Residual Spraying (ORS) and Ultra Low Volume (ULV) under specific circumstances).
In all cases, the most crucial factor for an effective vector control management (which method is to be implemented when and where) is the localization of potential hosts of Plasmodium, a difficult and sensitive procedure.
Protection of the population at risk can only be achieved combining intensive actions of the health care system and appropriate vector control applications.

SESSION 07

paper 7.2

Implementation of urgent preventive and response public health measures for diseases transmitted by *Aedes albopictus* in Greece

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During the past decade, autochthonous transmission of dengue and chikungunya viruses by *Aedes albopictus* has been recorded in southern Europe. Imported dengue, chikungunya and Zika cases are recorded on an annual basis in several European countries. Given that *Aedes albopictus* has been established in several areas in Greece, the risk of local transmission following the introduction of these viruses by viraemic travelers cannot be excluded. The Hellenic Ministry of Health published in 2016 a "Preparedness plan for vector management following the recording of Dengue, Chikungunya or Zika cases" and an expert advisory team was established for immediate risk assessment and response's guidance, with the aim to assess the risk of local transmission and implement targeted preventive and response measures.
Following the notification of each imported case, a case investigation was immediately conducted along with a targeted entomological investigation in areas visited by the viraemic patient. Risk assessment for local transmission was performed and urgent response measures were recommended to local authorities.
During 2016-2018, a total of five dengue, three chikungunya and five Zika cases were recorded in Greece; all imported. All cases were immediately investigated and personal mosquito protection during the viraemic period was recommended. Entomological investigation was conducted in the areas the viraemic patients visited, risk assessment was performed and the implementation of targeted response vector control measures was recommended to the responsible local public health authorities.
Given that the risk for local transmission of *Aedes*-borne diseases exists in Greece, enhanced surveillance is implemented, along with prevention and urgent response measures, in order to minimize this risk. It is crucial to continue implementing the preparedness plan for managing these public health threats.

paper 7.3

SESSION 07

Integrated *Aedes* management for the control of *Aedes*-borne diseases

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Diseases caused by *Aedes*-borne viruses, such as dengue, Zika, chikungunya and yellow fever, are emerging and re-emerging globally. The causes are multifactorial and include global trade, international travel, urbanisation, water storage practices, lack of resources of intervention and an inadequate evidence base for the public health impact of *Aedes* control tools. National authorities need comprehensive evidence-based guidance on how and when to implement *Aedes* control measures tailored to local entomological and epidemiological conditions.

This review is one of a series being conducted by the Worldwide Insecticide resistance Network (WIN). It describes a framework for implementing Integrated *Aedes* Management (IAM) to improve control of diseases caused by *Aedes*-borne viruses based on available evidence. IAM consists of a portfolio of operational actions and priorities for the control of *Aedes*-borne viruses that are tailored to different epidemiological and entomological risk scenarios. The framework has four activity pillars: i. integrated vector and disease surveillance, ii. vector control, iii. community mobilisation, and iv. intra- and inter-sectoral collaboration; and four supporting activities: i. capacity building, ii. research, iii. advocacy, and iv. policies and laws.

IAM supports implementation of the World Health Organization Global Vector Control Response (WHO GVCR) and provides a comprehensive framework for health authorities to devise and deliver sustainable, effective, integrated, community-based, locally-adapted vector control strategies in order to reduce the burden of *Aedes*-transmitted arboviruses. The success of

IAM requires strong commitment and leadership from governments to maintain proactive disease prevention programmes and preparedness.

paper 7.4

SESSION 07

Control of mosquitoes transmitting WNV in Central Macedonia, Greece 2018

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Ecodevelompent S.A., Thessaloniki, Greece

West Nile virus (WNV lineage 2) emerged in Central Macedonia, Northern Greece, in 2010 and until 2018, 988 confirmed WN fever cases were registered in humans all over Greece. 2010 was the turning point when larviciding control in Greece turned over into wide-area vector control aiming at *Culex spp*.

In 2018, a comeback of WNV occurred in Central Macedonia, with 117 human cases out of which 77 neuroinvasive (316 total cases in Greece, 241 WNND). A response plan to human WNF cases was conducted in order to control *Culex spp*. populations, consisted of the following actions:

1. Communication with the Public Health Authorities about the determination of probable infection locations
2. Focus investigation, gathering all the existed data about the location (recorded breeding sites, previous mosquito control applications, thorough field investigation)
3. Entomological surveillance using mosquito traps within a 500 m buffer zone and take into consideration previous samples
4. Exhaustive larviciding within 1 km around the focus/foci in public places
5. Door to door larviciding in a whole village (52 villages) and outdoor residual spraying in a radius of 300 m around the focus in villages and in 200 m around focus in densely built areas.
6. ULV adulticiding (90 applications in total) in villages < 10.000 inhabitants between 20:00-24:00 (repetition within 2-4 days).
7. Information to competent authorities

Also, weekly MIRs in pools of *Culex* of 50-100 individuals, and seroconversion rates in sentinels (chickens) were successfully used as early warning systems in space and time. The well-organized larviciding-based wide-area mosquito control project, the early detection of WNV, the appropriate investigation and the treatment of WNF cases on time, combined with the effective vector control measures, were the major components of the integrated strategy to fight against the WNV in Central Macedonia, Greece.

paper 7.5

SESSION 07

Evolution of the spread of the Asian tiger mosquito and arboviruses outbreaks in mainland France, 2018

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Two years after the reported introduction and establishment of the Asian tiger mosquito in mainland France (2004) the ministry of health designed a surveillance and response plan to prevent outbreaks of dengue, chikungunya and now Zika. This plan could be divided in two parts: the surveillance of the spread of *Aedes albopictus* in the country, and a rapid identification of the potential imported cases carriers of arboviruses to conduct vector control treatments in order to prevent autochthonous transmission.

In 2018, the spread of *Aedes albopictus* continued to increase, reaching last year around the half of the country, including the Paris region which represents a major hub for the colonization of the preserved West and North quarters of France. Like almost every year since 2010, autochthonous cases of dengue were reported, but this time they appeared in three different sites in the South of the country.

Also in 2018, the West Nile virus circulated widely in Europe, and almost 30 human cases were identified in France, which represent the most important circulation of this arbovirus in the country since 1964. Surprisingly, these outbreaks started quite early in the mosquito season (July/August) and lasted until late October; moreover, mammals infections were reported from highly urbanized areas while they used to be limited to the wetlands of the Rhone delta.

The actualized mapping of *Aedes albopictus* in the French region is presented, as the mosquito-borne cases in the South and the related vector-control responses applied against these arboviruses in France in 2018.

paper 8.1

SESSION 08

Evaluating the performance of MozzyJet, an aerial mosquito control vehicle to perform targeted, effective, and low-cost mosquito control

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Various activities that contribute to the overall management of mosquitoes have the potential to have an adverse impact on the environment especially in biodiversity hotspots such as wetlands of international importance. Equally, urban development in close proximity to the wetlands and other human activities can have variable effects on mosquito population dynamics and mosquito management activities and increase public pressure for more intensive control activities e.g. the use of chemical control. While mosquito control has improved considerably over the last decades, its success still depends on accessibility to mosquito breeding sites.

We developed an innovative aerial mosquito control vehicle (MozzyJet) to complement and augment traditional control methods as well as reach any mosquito breeding sites previously inaccessible to humans in an easy-to-use, low-cost, and environmentally friendly way. MozzyJet is based on the open-source BetaflightF4 advanced flight controller and iNav/iNav Configurator development platform. The framework is enhanced with an electronic spraying module to deliver a biological insecticide (BTI) precisely where and when it is needed.

Here, we report the results of a vector mortality study to determine the appropriate concentration and volume of the BTI solution to be used for aerial application. We report the optimization and calibration of the remote-controlled pressurized sprayer module for improved precision and effectiveness. The delivery system is subjected to a rigorous semi-field trial where larvae in medium-sized containers were sprayed in an environment resembling natural field conditions. This study will be the basis of an open-field trial where the effectiveness of MozzyJet will be tested over wetlands and access-restricted areas in Cyprus.

paper 8.2

SESSION 08

A novel technology to effectively repel mosquitoes, using electric fields

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We present results from laboratory experiments demonstrating that electric fields can efficiently repel mosquitoes.
Two sets of experiments were performed. In the first, two plastic insect cages were joined by a glass tunnel. An array of parallel plate electrodes was positioned in the middle of the glass tunnel. They were connected to an adjustable high voltage source. Hungry female mosquitoes *(Aedes aegypti)* were released into one cage. A volunteer then introduced his hand into the other cage, while a ventilator gently pulled air through the glass tunnel into the direction of the mosquitoes. To reach the hand, mosquitoes had to pass through the plates. When charged with an electric field of 1 kilovolt per centimetre (1kV/cm), more than 80% of mosquitoes were repelled, compared to the control. As the field strength was decreased, more and more mosquitoes passed through the barrier. When the electric field was turned off, mosquitoes passed freely.
A second set was performed using two rooms connected by a window with commercially available, metal window blinds. Mosquitoes (*Ae. aegypti* females) were released into one room, while a volunteer in the other room captured the mosquitoes entering through the window. When the blinds were charged with 1 kV or more, > 70% of mosquitoes were prevented from entering the second room with the volunteer.
In both cases, the strength of repellency depended on the strength of the electric fields and produced a sigmoid dose-response curve. The voltage source can be constructed in a way that it runs on 12 V DC, with the high-voltage output and the electrodes completely safe and harmless for humans and electronics.
(This research is made possible through the generous support of the United States Agency for International Development, USAID (Grant No: AID-OAA-F-16-00092)).

paper 8.3

SESSION 08

Two plus one: the combination of two passive and one active mosquito trap may well be an *Aedes* (*Stegomyia*) control tool worthy of attention

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Source reduction, traps for host-seeking females, or traps for gravid females may each significantly reduce mosquito populations. We argue that a combination of these methods would provide a robust and sustained vector control program.
Recent years have seen the establishment of a highly efficient trap for host-seeking *Aedes (Stegomyia)* spp., the BG-Sentinel (BGS). Originally used in surveillance and monitoring, research has also demonstrated its potential as a control tool, showing a significant reduction in Stegomyia abundance in intervention sites. The BG-Bowl is a novel BGS-type trap with the same efficacy but made to be constantly deployed in a household. It is cheaper, smaller, sturdy, and silent, with an energy consumption of less than 2.5 W.
The development of improved passive traps for oviposition site-seeking Stegomyia females has been equally successful, resulting in various new trap types, one being the Gravid Aedes Trap (BG-GAT). The BG-GAT can be a useful tool for capturing adult *Ae. aegypti* and Ae. albopictus. The low cost, practicality of operation and the high catch rates make the BG-GAT suitable for vector surveillance and projects requiring monitoring of mosquitoes for arboviruses, especially in developing countries. In Brazil, studies showed significant reduction abundance of gravid *Ae. aegypti* by BG-GAT. It has also outperformed the CDC's Autocidal Gravid Ovitrap (AGO) in Australian field comparisons.
We propose an area-wide *Aedes (Stegomyia)* spp. control strategy, based on an initial source reduction and a subsequent and permanent mass trapping using one active mosquito trap and two lethal ovitraps per household.

paper 8.4

SESSION 08

The use of drones to control mosquitoes: Feedbacks from EID Méditerranée

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Since early 2018, we are experimenting the use of sprayer drones to control mosquito larvae populations in operational conditions. In particular to treat small breeding sites difficult to access or for environmental issues, such as fragmented spots or ditches.
We acquired a 10 litres payload capacity gear with 15 minutes of battery back-up per flight. Two agents have successfully passed pilot certification and all the French officials' approvals have been obtained.
During all the flights, the pilot must always see the drone (distance lower than 200 m). The drone is not allowed to fly over populated areas or at a distance lower than 30 m close to people. All the flights are realized with automatic procedures. Agents digitalize treatment zones on a laptop which automatically plans and controls the flights. The pilot manages general safety of the treatment. The other operator manages all the logistics (products, preparations, batteries…). Operational conditions are on equal terms than usual larvicide treatments (application rates, products …).
Finally, we notice that all the treatments are really effective against mosquitoes on different Aedes species and under any conditions (e.g. seasons). We estimate that the precision of the gear for the reliability of values as speed, altitude, path, gives guaranties for the application rate, and that's the key to success.
However, there are a lot of constraints with this type of treatment (human resources, logistics, accessibility, security procedures, technical possibilities, official's approvals…), and all mosquitoes breeding sites cannot be treated using this method. It is as effective as ground applications, without any comparison to bigger aerial means as by planes or by helicopters. With precision, control, reliability and traceability, drones are fitting good practices for mosquito control.

paper 8.5

SESSION 08

Using artificial intelligence for guiding wide area mosquito control operations

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"e-bite" is an in-house developed electronic platform for managerial, operational and communication purposes between field managers, technicians and contracting authorities. It is designed for real time digital data recording of larvae sampling, spraying actions and other observations by field operators, using smartphones or tablets in the field.
In 2017, "e-bite" was used systematically in the Region of Central Macedonia by 18 out of 37 operational units. In 2018, it was applied by 55 out of 66 operational units in 5 regions all over Greece. Data recordings included (1) date, (2) region, (3) municipality, (4) village, (5) breeding sites (34.440), (6) mosquito larvae abundances (5 levels of abundance), and (7) development stages (5 stages) for the three main mosquito genera *(Aedes, Anopheles and Culex)*. In Central Macedonia, each breeding site is connected to the GIS server and to the nearest meteorological station (17 stations).
In order to construct a predictive model for the breeding sites with high probability of *Culex* abundances, predictive analytics with ensemble learning was used (extreme gradient boosting). The input variables of the model were ranked according to their relative weighted importance as follows: Surface of larviciding treatment, field observations (difficulties in access and/ or spraying, flow rate etc.), type of breeding sites (21 categories), date and hydrometeorogical conditions (max. temperature, min. temperature, average wind speed, average temperature, on the date of sample collection, and the total monthly rain).
The predictive model was trained using real data from Central Macedonia for 2017 (24.864 observations) resulting in an accuracy score of 89.73% (model development and crossed validation). The model ran with 2018 data (48.311) resulting in an accuracy score of 85% (independent validation).
These findings are very promising, and the applied methodology will be incorporated into the weekly scheduling and guiding of 37 operational units for the mosquito control operations in Central Macedonia in 2019.

paper 9.1

SESSION 09

Citizen science ease the detection of new *Aedes* Invasive Mosquitoes: the case of *Aedes* (Hulecoetomyia) *japonicus japonicus* (Theobald 1901) in Spain

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Aedes japonicus is an invasive vector mosquito from Southeast Asia which has been spreading across central Europe since the year 2000. Nevertheless, there has been no record of the species in Spain until now.
We report the first detection of *Ae. japonicus* in Spain, at its southernmost location in Europe. This finding was triggered by the citizen science platform Mosquito Alert. In June 2018, a citizen sent a report via the Mosquito Alert app from the municipality of Siero in the Asturias region (NW Spain) containing pictures of a female mosquito compatible with *Ae. japonicus*. Further information was requested from the participant, who subsequently provided several larvae and adults that could be classified as *Ae. japonicus*. In July, a field mission confirmed its presence at the original site and in several locations up to 9 km away, suggesting a long-time establishment. The strong media impact in Asturias derived from the discovery raised local participation in the Mosquito Alert project, resulting in further evidence from surrounding areas.
Whilst in the laboratory *Ae. japonicus* is a competent vector for several mosquito-borne pathogens, to date only West Nile virus is a concern based on field evidence. Nonetheless, this virus has yet not been detected in Asturias so the vectorial risk is currently considered low. The opportunity and effectiveness of combining citizensourced data to traditional surveillance methods are discussed.

paper 9.2

SESSION 09

News from the "Mückenatlas" (2017–2018)

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Until the end of 2016, the German citizen science project, Mueckenatlas' registered close to 15.000 submitted postal items including more than 80.000 mosquito specimens. In 2017 and 2018, another ca. 7.500 postal items with approximately 40.000 mosquito specimens were received. As in the previous years, these contained numerous *Aedes albopictus* and *Aedes japonicus* specimens, but, in contrast to previous years, no further invasive *Aedes* species. Submission of *Ae. albopictus* and *Ae. japonicus* arriving until mid-autumn 2018 were followed up by checking the collection sites and their surroundings as well as close-by cemeteries for aquatic stages. No *Ae. albopictus* reproduction was found in new areas, but submissions were made from known distribution areas such in Freiburg, Heidelberg and Jena. *Aedes japonicus* specimens were also submitted from inside and outside known areas of colonization, and subsequent findings of larvae at and around collection sites in areas not previously known to be colonized suggested further spread. Several submissions of both species reached the 'Mueckenatlas' team only in late autumn 2018 from places which could not be checked in the same year anymore due to the end of the mosquito season. In addition to the invasive species, 'Mueckenatlas' submissions contributed to the re-discovery of the extremely rare native species *Aedes refiki*.

paper 9.3

SESSION 09

The citizen science project "Mückenatlas": contributions of opportunistic data collection to mosquito research and public engagement in science

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Over the past eight years, mosquito surveillance has been revived in Germany by a nationwide concerted approach involving several research institutions and private companies. In addition to methodologically placed traps (random by raster), the citizen science project 'Muecken¬atlas' (mosquito atlas) has been deployed as a passive surveillance instrument since 2012. Thanks to a broad media coverage on national, federal and regional levels as well as the fact that mosquitoes constitute an omnipresent topicality for many people, the 'Mueckenatlas' has proven a very successful tool, with regard to both science and science communication. So far, more than 22.000 postal items with over 120.000 mosquitoes were submitted from all over Germany.
We have now begun to assess the 'Mueckenatlas' performance and utility on different levels. Firstly, we determined the scientific output the project has generated so far based on corresponding publications. In a second step, the data collected between 2012 and 2017 have been analysed in terms of a big data approach to identify major trends and findings from both a scientific and science communication project's perspective. From a scientific point of view, we are currently working on a proof of concept to use the passive surveillance data for spatial and temporal distribution analysis of selected mosquito species. With regard to science communication, we include a media coverage dataset to search for correlations between outreach activities and submissions. First key numbers and research results of this ongoing investigation will be presented.

paper 9.4

SESSION 09

Spatial repellents, insecticides and their role in human protection

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Over the past two decades vector-borne pathogens (VBPs) have been on the move, creating new challenges for public health. Some are exotic pathogens that have been introduced into new regions, and others are endemic species that have increased their incidences or have started to infect local human populations for the first time.
For many diseases transmitted by insect vectors human residences play a major role in the transmission cycle, being the front line for the development of the larval forms and/or the first place where biting adults contact both people and domestic animals.
Since mosquito adult biting rate represents one of the parameters in the vector capacity, it is theoretically possible to prevent the spread of mosquito-borne diseases by disrupting host-seeking and feeding. In that way, insecticides and repellents used as a personal protection in domestic areas (indoor and outdoor) are considered as a valuable tool for preventing mosquito-borne disease transmission. Among these technologies, "spatial repellents" are promising alternatives to the currently used "topical repellents". Here, we review its potential use at domestic level for preventing mosquito biting, as well as current constraints due to market regulations that may limit its development.

paper 9.5

SESSION 09

How to communicate the problematic of vectors and associated diseases to the society

M. Torres

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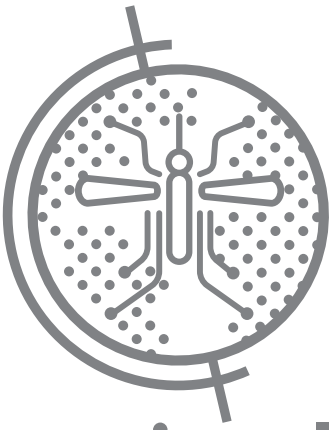
The arrival of new vectors of diseases in Europe during the recent years brings the necessity to explain to the society the risks of having these species living with us daily such as mosquitos.
People need responses of the situation and the danger of vector-borne diseases, so experts in entomology, medicine, virology, research center and the public administrations faces many times with the necessity to give information and recommendations to the general public.
The communication of such topics is not an easy work and needs to be properly prepared in order to avoid any confusing or unnecessary alarming situation. Scientific communicators and the media play a very important role, but they need the support of experts to make it successful.
We are going to see different situations dealing with vector-borne diseases news and learn some tips to communicate better these topics to the society.



IX International Conference

La Rochelle France
11-14 March, **2019**

Poster Presentations

poster 01

POSTER SESSION

A novel sensor system for mosquito traps to determine mosquito species, sex and age

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In order to improve mosquito surveillance, a novel optoelectronic sensor prototype that captures the shadow of the mosquito while is being sucked into a mosquito commercial trap was evaluated to classify species, sex and age. This is the first time that it is performed under forced flight conditions of a fan-based mosquito trap, where the natural wing-beat is distorted. Well-stablished *Culex pipiens, Aedes albopictus* and *Aedes aegypti* mosquito colonies were used to test the sensor. Various algorithms on different feature combinations were trained and optimized for machine learning to recognize automatically mosquitoes' sex, age and species. The sensor was capable of distinguishing between genus and sex in terms of fundamental frequency, showing that the fundamental frequency was higher in males than females and higher in mosquitoes of *Aedes* than in *Culex* genus. The system proposed in the present study is useful for genus classification with accuracy values that ranged from 93.83% to 95.73%. Regarding gender identification, male and female were discriminated with more than 93.11% of accuracy after machine learning techniques. This information will be important for arbovirus surveillance programs since the females are the unique implied in arbovirus transmission. The accuracy in terms of age ranged from 69.81% to 90.97%, allowing to know how old the mosquito population is, providing useful data due to the importance of the age in vector capacity. More data and training in laboratory are being carried out to optimize the sensor to better classify mosquito species, sex and age.

poster 02

POSTER SESSION

Small- and large-scale tools for mosquito control containing an IGR-type larvicide active substance, s-methoprene

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Due to climate change, mass tourism and delivery of goods, proliferation of invasive mosquito species, potential vectors of dangerous diseases (e.g. *Aedes albopictus* which can transmit zika, dengue and chikungunya viruses) have speeded up. In the lack of effective, safe and selective adulticides, mosquito larvicide treatments using biological agents or IGRs have increasing impact in effective mosquito control.
The IGR-type active substance, S-methoprene is a juvenile hormone analogue. S-methoprene has strong capacity to control even high levels of mosquito infestation by preventing the development of larvae into the adult, reproductive stage. Based on the results of many efficacy trials conducted in Hungary, Australia, France and Italy, two formulations, BIOPREN® 4 GR Mosquito Larvicide Granule and BIOPREN® Flea and Mosquito Pump Spray were selected as representative products for professional, large-scale and non-professional, household (small- scale) control of mosquitoes.
BIOPREN® 4 GR Mosquito Larvicide Granule contains 0.4 w/w% S-methoprene in microencapsulated and free form. Microencapsulated S-methoprene displays a delayed effect since capsule wall provides protection against sunlight and ensures slow release of S-methoprene into the water. This results in 2-3 weeks long residuality in the field. The product can be used outdoor by PCOs to treat water holding sites (inland waters, sewage work pools, flooded areas, unused pools and water reservoirs except for drinking water) against Culex and Aedes species.
BIOPREN® Flea and Mosquito Larvicide Pump Spray contains free S-methoprene (0.03 w/w%) providing 1 week long residuality in the field. This ready-to-use product is intended to be used in and around the house by amateurs especially for controlling *Aedes albopictus* in smaller water holding features (rain water holding drums, flower pot underplates, puddles, gutters, barrows, tyres, buckets, etc.) and/or small natural or artificial depressions which may serve as mosquito breeding sites.
Evaluation of BPR dossiers of both products is in the final stage.

poster 03

POSTER SESSION

Breeding sites preferences and surveillance of *Aedes mariae* (Sergent & Sergent) (Diptera, *Culicidae*) in a touristic Mediterranean coastal area of Spain

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Tourism, the main economic sector in Mallorca, is commonly affected by mosquito nuisances during the high season. The species *Aedes mariae* breed in rock-pool coastal zones usually related with touristic destinations. However, poor information is currently available about the bioecology of its larvae. The study has been conducted in the coastal town of Sa Colònia de Sant Jordi (Balearic Islands, Spain). Two BG- Sentinel were set in two different hotels to determine the adult activity, phenology and species composition in the area. In addition, biochemical data of the rook-pool breeding sites of *Ae. mariae* such as pH, salinity, conductivity and temperature were analysed by using a multiparametric tester in order to figure out the oviposition preferences of this species. The most abundant species collected by adult traps were *Culex pipiens* s.l. (70%), while Ae. mariae represented only the 6% of the samples. Water properties in the rearing spots indicated that high conductivity, salinity and TDS decreased the probability of finding *Ae. mariae* larvae in the sampled points. The low adult abundance and the perturbation of the breeding sites due to tides, waves and precipitation in coastal zones should be considered in further studies and the control of *Ae. mariae* species.

poster 04

POSTER SESSION

Barrier treatment against tiger mosquitoes: not always a good option

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Tiger mosquitoes in urban areas are the cause of the decline in the quality of life, mainly in houses with gardens. Perimeter Adulticide treatments are a common solution, but they involve a wide variety of risks. Several factors affect the efficacy of these treatments, but an initial inspection can predict its persistence. The first action should be eliminate the breeding spots inside the area, but even with a chemical treatment outside mosquitoes can re-entrance. Two gardens from Mallorca (one treated and one as control) have been monitored with BG Sentinels (and BG Counter) to determine the efficacy of the treatment and the time without mosquitoes. The short persistence of the treatment has been associated to a near rearing spot and to the discontinuous vegetation barrier. It is very important to determine these scenarios in order to not complete ineffective treatments. In gardens with few vegetation in the perimeter the use of adulticides should not be recommended.

poster 05

POSTER SESSION

Guidelines for the management of mosquitoes and blackflies in Spain

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In 2018, ANECPLA (the Spanish Association of Pest Control Companies) edited a Guideline with the objective to establish technical criteria that serve as a model for the design and implementation of Mosquito and Simulid Management Plans in our country, considering the current scientific, technical and operational knowledge. To undertake this objective, a technical working group composed by different representatives of public mosquito control services, universities, municipal and regional administrations, pest management companies and ANECPLA was established. According to main challenges related to mosquitoes and blackflies management identified by the working group, 10 different chapters were developed in the Guideline:

1) General issues related to mosquitoes and blackflies management: municipal action framework and main items to be considered in a Vector Management Plan (VMP).
2) VMP of common mosquito *(Culex pipiens)* in urban and periurban environments
3) VMP of floodwater mosquitoes (*Aedes caspius* and others) in wetlands
4) VMP of exotic mosquitoes (*Aedes albopictus* and others)
5) VMP of blackflies
6) VMP in arbovirus local transmission context
7) Communication and citizen participation
8) Personal protection measures and use of repellents
9) New mosquito control strategies and tools
10) Technical and economic criteria for public tenders

Overview and main conclusions of each chapter will be deeply discussed in the presentation. Finally, it is important to remark that this document has had a very positive response among mosquito control technicians and companies in Spain, even being a helpful tool for supervisors of public administration in charge of mosquito control programs.

Download the Guideline through: **http://www.anecpla.com/documentos/70294.pdf**

poster 06

POSTER SESSION

Potential of different entomopathogenic fungi as control agents for the Asian tiger mosquito, *Aedes albopictus* Skuse

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Invasive mosquito species are an actual nuisance and represent an increasingly severe threat for public health as some of them are involved in transmission cycles of emergent exotic diseases. The majority of the products traditionally used to control mosquitoes become inefficacious due to insecticide-resistance or because they have been outlawed due to environmental concerns. These reasons emphasize the need to research new and more ecological strategies to fight IMS.
Studies have been carried out to evaluate the pathogenic activity of four strains of *Beauveria bassiana* (Bals.) Vuillemin and one of *Metarhizium anisopliae* (Metsch.) Sorokin, against larvae and adult specimens of *Aedes albopictus.* The effects of fungal infection in female fecundity and fertility have also been studied. The adult susceptibility trials were performed by spraying insects with fungal suspensions ranging from 1x106 to 1x109 conidia/ml, using a Potter Tower. The larvicidal activity was evaluated by exposing L3 larvae to 1x107 and 1x108 conidia/ml fungal suspensions.
Two strains of B. *bassiana* showed levels of virulence significantly higher than the rest of the studied strains. Rf12/02 was the most active strain, showing a LT50 of 6.81 days and a LT90 of 7.94 days at 1x108 conidia/ml. The *Bbcom* strain showed levels of 6.60 and 7.79 days for the previously mentioned parameters. In our trial conditions, some strains affected the fecundity and fertility of tiger mosquito, whereas, results were not statistically significant.
Finally, the *M. anisopliae* strain exhibited an important larvicidal activity, reaching 100% mortality in 3.5 days at the concentration of 1x108 conidios/ml.

poster 07

POSTER SESSION

Evaluation of the public health risk for autochthonous transmissions of mosquito-borne viruses in southern Switzerland

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Epidemics of mosquito-borne diseases are becoming more frequent around the world. The threat of arboviral infections has recently reached continental Europe with several locally transmitted chikungunya and dengue fever cases. Several factors influence the likelihood of an arboviral outbreak, such as the density of human and mosquito populations, the seasonal temperature, the competence of the local mosquito population to transmit the virus, etc. Establishing threshold values over which an autochthonous arbovirus transmission may occur can help decision-making for the timely adoption of intervention measures in the occurrence of imported cases.
In Switzerland, autochthonous cases have not been reported so far although the presence of the vector *Aedes albopictus* (the Asian tiger mosquito) in densely populated urban areas of southern Switzerland (i.e., cantons of Ticino and Grisons) increases the risk of indigenous transmissions following imported cases. In 2017 and 2018, we assessed the potential risk of an outbreak of arboviral diseases in some municipalities of Canton of Ticino where the vector *Ae. albopictus* is established. The *Ae. albopictus* population density in five urban areas of Canton Ticino was evaluated during the mosquito active season by mean number of Ae. albopictus bites per human per day (estimated by human landing collection) and the risk of outbreak in case of introduction of chikungunya, dengue, or Zika viruses was estimated. In the five localities investigated, no epidemic risk seemed to be present for any of the arboviruses taken into consideration in the first moths (i.e., mid-May to end of July) of tiger mosquito activity. In case of introduction of chikungunya (mutated or not), dengue (serotype 1) or Zika (African lineage) during mid-end August, an epidemic could have occurred in all the municipalities investigated. In mid-end September, the introduction of same arboviruses could have led to an epidemic in three of the five municipalities investigated.

poster 08

POSTER SESSION

Update on wetland mosquito fauna in southern Switzerland (Ticino)

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With the goal to update knowledge about wetland mosquito fauna in the canton of Ticino (southern Switzerland), mosquitoes were sampled monthly between June and September 2018. To also check for nuisance for nearby residents, sampling sites were located in 2 nature reserves as well as in adjacent urban areas. Centers for Disease Control (CDC) miniature light traps were used to collect adults. Larval stages were sampled using a standard pint dipper. A total of 20'311 mosquitoes (both juvenile and adult stages) were collected at 26 sampling sites.

The majority of mosquitoes were caught at the "Bolle di Magadino" (1500 ha), a protected meadow landscape of international importance. A total of 17 different species were recorded. All species identified in earlier studies (2003 – 2011) were confirmed in 2018. The share of *Aedes sticticus* has decreased relatively to *Aedes vexans*. Also *Ae. cantans* has been found far less frequently. The species complex Anopheles maculipennis s.l. has become more abundant compared to earlier studies. Still its density currently does not pose a risk of malaria disease transmission. Generally, the sites in the surrounding settlements did not produce high catch numbers.

The second protected area, "lake Muzzano" (22 ha) shows an equally rich diversity of species with 13 different mosquito species caught. However, this reserve and the nearby urban areas are largely dominated by *Coquillettidia* species (both *Cq. richiardii* and *Cq. buxtoni*) and *Cx. pipiens*. Larval treatments against the former are difficult to implement and could have a considerable ecological impact. New approaches to control should be discussed.

poster 09

POSTER SESSION

Risk maps of *Aedes albopictus* (Diptera: *Culicidae*) in Valencian Autonomous Region (Spain)

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Mosquitoes are the most important vector group in the world, being *Aedes albopictus* one of the most important species. For this reason, since the tiger mosquito was first detected in the Valencian Autonomous Region in 2009, the concern at a sanitary level has been increasing, not only at a local level, but also because it is a region with an important tourism sector in which environmental conditions favour the proliferation of these dipterous populations.

We present a series of risk maps made by using a Geographic Information System (GIS) to understand the disease transmission capacity of the different mosquito species that are part of the Valencian entomophauna. For its elaboration, the phenology of the species and the parameters that condition them have been studied for the last two years. Therefore, the taking samples and the study of both, environmental variables and physic-chemical variables, as well as biotic elements that may affect the development of the populations were carried out. Moreover, it is important to emphasise that the sampling points were selected according to the altitude, since it is known as a limiting factor for the distribution of the species, and visited periodically, georeferencing each of them to facilitate their location.

poster 10

POSTER SESSION

Invasive mosquito surveillance and the first record of *Aedes japonicus* in Serbia

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Aedes albopictus successfully invaded more than 20 European countries. Continuous introduction to Serbia has been detected from 2009 at the main border crossing to Croatia and from 2013 at the main border to Montenegro. Introductions were restricted to border crossings, frequented petrol stations and toll pays and had not been revealed in the inner parts of the country so far. Since 2017, population overwintered and established at the main border crossing to Croatia.

In 2018 surveillance was widened to all (eight) border crossings to Croatia, three sites close to the border crossing to Bosnia and Herzegovina and the second largest city in the country, Novi Sad (northern Serbia). The surveillance was carried out by the ovitraps. The Masonite strips were collected, and water inspected bi-weekly. If larvae had already been hatched in traps, all individuals were collected and transferred to the laboratory for rearing, until adults emerged. Mosquitoes from collected eggs were also reared in the laboratory. Adults were morphologically identified.

In total, 21,611 eggs were collected. *Ae. albopictus* was recorded on eleven out of twelve locations. Mean number of eggs of *Ae. albopictus* collected per ovitrap in Novi Sad varied between 102.4 and 672.2 for the period August – end of October. However, oviposition in lesser numbers continued until December 7th.

Aedes japonicus was identified twice, at the samples from the same small border crossing to Croatia, situated north from the main one. The first record was in August and the second in September. It is assumed that *Ae. japonicus* population introduced to Serbia originates from Croatia, where these species has been recorded since 2013. Molecular methods will prove origin.

Two native mosquito species *Culex pipiens* complex and *Aedes geniculatus* were present in ovitraps too.

The research was supported by the MESTD of the Republic of Serbia (projects III43007 and TR31084), and the Secretariat for Urbanism and Environment Protection of Vojvodina Province.

poster 11

POSTER SESSION

Establishment of the Vector Control Association (VecCA) to Fight Vectors and Vector-Borne Diseases: History, Present Organization and Future Activities

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Environmental changes, caused by human settlement, create vulnerable populations and ecosystems and contribute to the emergence of global hotspots of emerging infectious diseases. Vector-borne diseases, such as malaria, dengue, chikungunya and Zika diseases, are important public health problems and high economic burdens. Controlling the major mosquito vectors by reducing their populations is the only measure used to reduce disease risk and disease incidences. In addition, due to the complexity of disease emergence, trans-disciplinary and socio-ecological strategies are needed to successfully implement vector control approaches. Based on these facts, cross-linkage among various disciplines is needed for any successful implementation. In 2006, World Health Organization (WHO/TDR) in collaboration with the International Development Research Centre (IDRC), Canada had launched the multi-country initiative called "Eco-Bio-Social Approach to Dengue Research in Asia" which led to the collaborative effort for multi-disciplinary research teams in six countries in Asia. Following this initiative, IDRC in collaboration with CIDA, AusAID and Global Health Research Initiative had launched another multi-country initiative called "Ecohealth Approaches to Emerging Infectious Diseases" (EcoEID) in 2011 which also included another six countries in Southeast Asia. The EcoHealth Network was established since then in order to cross-link the two initiatives and the multidisciplinary teams working on vector-borne and zoonotic diseases in Asia and beyond. From 2019, with the help of the European Mosquito Control Association (EMCA), the Vector Control Association (VecCA) was formed in Asia-Pacific to formally provide the platform for networking of multi-disciplinary teams from universities, governmental authorities, NGOs including researchers and practitioners, who work to fight vectors and vector-borne diseases across the globe. Here we present the history, the organization and the future activities of this newly established international VecCA.

poster 12

POSTER SESSION

Control of blackflies (Diptera: *Simuliidae*) in Valencian Autonomous Region (Spain)

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In view of the growing influence of climate change on local climatology, which is causing variations in precipitation as well as in the duration and intensity of periods of drought, other factors must be taken into account. Among them, stand out the improvement of the state of quality of lotic waters due to the application of laws, which control the waste from urban areas, factories and farms, and the establishment of ecological flows to the exits of reservoirs and swamps. Consequently, these events are favoring the establishment, growth and dispersion of some botanical species, which are usually used by the immature simuliid stages as substrate of adhesion. All this is resulting in the proliferation and spread of the populations of these diptera, colonizing stretches of rivers whose eutrophication and poor state of conservation some years ago limited their presence. In addition, and to make matters worse, the extensive cattle industry is being year by year reduced in the inland villages. As a result, the females of the autogenous species perform more and more their bites on the citizens located in human populations near their breeding points, due mainly to the low availability of their usual hosts, the domestic livestock. Therefore, the annoyance caused are having important public health consequences ought to the severe allergic reactions that many citizens are suffering. Because of that, is utterly important to carry out a correct control of those populations of blackflies that can be considered pests because of their direct relationship with hematophagic behaviors on the human being. In relation to this, several treatments have been carried out in several breeding points close to human populations, whose citizens have been affected with assiduity. Data are provided regarding the effectiveness of the larvicide product used.

poster 13

POSTER SESSION

Evolution of arbovirosis surveillance and control in the city of Barcelona (Spain) 2014-2018

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In recent years, arboviruses have become one of the most important risks to public health in Europe. The increase of dengue, chikungunya and zika outbreaks worldwide, have contributed to the arrival of imported cases to Europe, which have made possible the occurrence of autochthonous cases in different European countries, including Spain where 6 locally acquired dengue cases were notified in 2018.

Our presentation analyzes the surveillance and control tasks conducted to minimize the impact of imported *Aedes*-borne viruses (dengue, zika and chikungunya) in Barcelona. In the period 2014-2018, a total of 373 imported cases of dengue, zika and chikungunya were confirmed in Barcelona. The strongest link between different arbovirus infection and countries visited can be established as follows:

- Chikungunya: Bolivia, Republica Dominicana and Ecuador.
- Dengue: Thailand, Indonesia and India.
- Zika: Republica Dominicana, Cuba and Nicaragua.

A total of 191 entomological inspections were conducted at patients' homes (domiciliary entomological surveys), while 281 monitoring activities were accomplished in public areas (patients' homes surroundings).

To minimize the risk of arbovirus transmission, different vector control interventions were applied. Most of those interventions were larvicide treatments in catch basins, as well as mechanical elimination of small breeding sites and even isolated adulticides only in specific and justified cases.

Regarding to arbovirus surveillance in local populations of mosquitoes, we employed BG-Sentinel traps (Biogents®) and entomological aspirators (Backpack and/or InsectaVac aspirators from Bioquip®) to collect *Ae. albopictus* females in the influence area of imported cases. Females collected were processed and molecularly analyzed for arbovirus detection. All samples of local mosquitoes analyzed were negative to dengue, zika or chikungunya.

It is essential to highlight the importance of maintaining the surveillance and control program of mosquito-borne arboviruses in the city, through the application of a multidisciplinary protocol involving different agents: medicals of primary care centers, diagnostic laboratories, epidemiologists and entomologists, among others.

poster 14

POSTER SESSION

Searching for powerful semiochemicals in the development of new *Aedes albopictus* control tools

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The Asian tiger mosquito *Aedes albopictus* (Skuse) (Diptera: *Culicidae*) is a highly antropophilic invasive species and competent vector of several arbovirus of public health importance. Reducing human risk of acquiring a mosquito-transmitted disease involves decreasing the probability of host-vector contact through suppression of vector abundance. Thus, new control strategies, more ecological and environmentally acceptable, are been demanded. Some options could be the development of lure&Kill or Lure&Infect approaches which are highly selective and eco-friendly strategies. However, the success of this methodology relies on the discovery of powerful semiochemicals, attractants and stimulants of oviposition, which still need to be discovered.

Based on the previous statements, a study was conducted to evaluate the oviposition behaviour of gravid *Ae. albopictus* females to water-baited ovitraps (control) and leaf infusion-baited ovitraps. Leaf infusions were obtained from bamboo and different oaks (*Quercus virginiana* Mill., *Quercus macrocarpa* Michx. and *Quercus robur* L.). Experiments were performed both, in laboratory and field conditions.

In laboratory conditions, only the leaf infusion obtained from dried fallen leaves of *Q. robur* elicited ovipositional responses from gravid females compared to control showing an oviposition activity index (OAI) of +0.46. All the other leaf infusions were negative stimulating oviposition. Moreover, except for Q. virginiana leaf infusion which showed no effect in ovipositional response (OAI = -0.25), these infusions, with OAI levels ranging from -0.62 to -0.86, suggested oviposition repellent effects as established when OAI is below -0.3. In field conditions, however, only bamboo and *Q. macrocarpa* infusions continued causing repellent effect in oviposition whereas Q. robur leaf infusion confirmed its oviposition stimulant activity (OAI = +0.8). In this casa, *Q. virginiana* leaf infusion was shown as an ovipositional stimulant with an OAI = +0.5 in spite of its neutral activity in laboratory conditions.

Studies aimed at identifying the antennally active leaf infusion compounds through Gas Chromatography and Gas-Mass Spectrometry, both coupled with electroantennographic detection, are in progress.

poster 15

POSTER SESSION

Molecular investigation of selected *Anopheles* population in East Attica regional unit, Greece

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The genus *Anopheles* comprises 500 species worldwide, 60 of which are capable of transmitting human malaria or filariasis. Greece is a malaria-free country since 1974, yet a limited annual number of imported or locally acquired cases is being recorded ever since. Previous studies have recorded 15 different Anopheles species, with *An. sacharovi* being the major malaria vector, along with *An. maculipennis, An. superpictus* and *An. hyrcanus* acting on a secondary basis or as potential malaria vectors, respectively. Inability of morphological identification of certain species such as those of the *An. maculipennis* complex, creates the urgent need for alternative laboratory approaches. The aim is the identification of members of the *An. maculipennis* complex in the area of East Attika, Greece, by using a PCR protocol for two different target genes.
A total number of 293 BG-Sentinel (CO2) traps were set in the area of East Attika regional unit, from June 2017 up to December 2018. Adult mosquitoes were morphologically identified in the entomological laboratory of the department. A PCR protocol, amplifying the ITS2 (ribosomal target) and COI (mitochondrial target) genes, was implemented thereafter for identification of specimens belonging to the *An. maculipennis* complex. Selected PCR products (472-543 bps for the ITS2 gene and 522 bps for the COI gene) were purified and sent for sequencing analysis.
Amplification products for the ITS2 and COI genes were obtained by the samples tested. A total of 26 representative purified PCR products (14 for ITS2 and 12 for COI, respectively) were prepared for sequencing analysis.
The application of PCR protocols in the ITS2 and COI regions can assist in the identification to the species level of mosquitoes of the *An. maculipennis* complex which cannot be morphologically identified only by use of conventional entomological methods and is of particular interest given that members of the complex are considered as important malaria vectors.

poster 16

POSTER SESSION

Retrospective investigation of selected *Anopheles hyrcanus* populations in Greece by using a combined PCR-RFLP approach

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The *Anopheles hyrcanus* group of mosquitoes includes about 30 closely related species, some of which have been implicated as vectors of malaria parasites, in particular *Plasmodium vivax. An.hyrcanus* prefers floodplain forests, reeds and rice fields for larval development and is spread across Eurasia. Greece is amongst the European countries fulfilling the abovementioned climatic profile and therefore monitoring and surveillance are important. Limitations in terms of the taxonomy of the current species, pose a further obstacle in terms of morphological identification of sibling species. Therefore, molecular protocols have been applied, in an attempt to reliably overcome limitations in morphological identification of various *An. hyrcanus* specimens.
The aim is the characterization of Anopheles hyrcanus specimens collected from the Thessaloniki and Serres regional units, by using a combined PCR-RFLP molecular protocol in two different target genes.
A total number of 262 samples, collected in 2012 and 2014, were retrospectively investigated. Mosquito samples were initially morphologically identified in the entomological laboratory of the department. A PCR protocol, amplifying the ITS2 and COI genes, was applied thereafter. The HpaII RFLP was used for the ITS2 PCR products and the ApoI RFLP was used for the COI PCR products, respectively.
Amplification products for the ITS2 and COI genes were obtained by tested samples. A total of 17 representative purified PCR products (nine for ITS2 and eight for COI, respectively) were sent for sequencing analysis.
Implementation of a simple PCR methodology in the ITS2 and COI regions can assist towards the identification to species level of collected *Anopheles hyrcanus* mosquitoes and will contribute to our knowledge of the *Anopheles hyrcanus* group in Greece and its role as potential malaria vector.

poster 17

POSTER SESSION

Current distribution of a newly established population of *Aedes koreicus* in south-western Germany

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The East Asian mosquito species *Aedes koreicus* is native to Korea, north-eastern China, eastern Russia and small parts of Japan. It was first recorded out of its native range in Belgium in 2008. Another population has established in northern Italy, were it was recorded for the first time in 2011 and has expanded its distribution quite fast. Other recordings from Switzerland, European Russia, Slovenia and Hungary followed. In Germany the species was first recorded in 2015 with a single female individual in the south of the country.

In 2016, a single larva of *Ae. koreicus* was collected in a cemetery vase in the city of Wiesbaden in south-western Germany. The morphological identification was confirmed by sequencing of a region within the nad4 sequence. In 2017 it could be shown that a population had established over an area of about 50 km^2. Four cemeteries were found positive in a distance of about 5 km to each other.

In 2018 the surveilled area was extended in order to determine the whole expansion of the populated area. Larvae were collected from cemetery vases at least in one cemetery per grid cell in a 5x5 km grid. Compared to 2017, *Ae. koreicus* was found in two additional cemeteries in one grid cell further to the north and one to the east. In the southernmost cemetery that was positive for the species in the former year no larvae could be collected in 2018. The species was found together with larvae *of Aedes j. japonicus, Aedes geniculatus, Culex pipiens* or *Culex torrentium* and *Anopheles plumbeus*.

poster 18

Entomological surveillance in the Mediterranean area: how far harmonisation?

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The Mediterranean basin is historically a hotspot for trade, transport and migration. As a result, countries surrounding the Mediterranean Sea share common public health threats. Among them, vector borne diseases, and in particular mosquito-borne viral diseases, are prime candidates as (re)emerging diseases and are likely to spread across the area. Improving preparedness and response capacities to these threats at the regional level is therefore a major issue.
MediLabSecure is a European project aimed at improving the surveillance and monitoring of mosquito-borne viral diseases. This framework offers guidance for harmonising entomological surveillance around the Mediterranean area by establishing common, evidence-based standards to promote best practices and identify the most appropriate surveillance activities while optimising financial and human resources.
Robust surveillance systems are required to address the globalization of emerging arboviruses. The prevention and management of mosquito-borne viral diseases must be addressed in the prism of a One Health Strategy that includes entomological surveillance as an integral part of policy. Entomological surveillance systems should be designed according to the entomological and epidemiological context and must have well-defined objectives in order to effect a tailored and graduated response. We therefore construct different scenarios according to different entomological and epidemiological contexts and set out detailed objectives of surveillance. The development of multidisciplinary network involving both academics and public authorities will provide resources to address these health challenges by promoting good practices in surveillance (design of surveillance systems, data collection,...), and through the sharing of effective knowledge and information. This network will also contribute to capacity building and stronger collaborations at both the local and regional levels. Finally, concrete guidance is offered on the vector of the main arbovirus, based on the current situation in the area.

poster 19

POSTER SESSION

Autochthonous Malaria cases in Belgium from 1970 to 2015

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The last indigenous case in Belgium was described in 1938 and Europe was declared Malaria Free in 1975. However, since late seventies the occurrence of several cases of malaria in Belgium and in Europe in patients who had never traveled to endemic areas, raised the attention to new ways of transmission. Autochthonous malaria is defined as a case transmitted by local or imported mosquitoes, excluding imported, transfusion, accidental or congenitally acquired malaria. Even though imported malaria has long been recognized as an important health hazard to travelers in Belgium, unexplained autochthonous malaria cases are much less well recognized and understood despite their periodic occurrence.

We describe the epidemiological data and the clinical features of the autochthonous malaria cases occurred in Belgium between 1970-2015, based on a review of the Belgian surveillance data and the literature. When available, control measures around each case were also checked and described.

In total, 19 cases of autochthonous cases were detected in Belgium between 1972 and 2015, of which 18 due to *Plasmodium falciparum* and 1 to *Plasmodium ovale*. Of the 15 known outcomes, 3 were cured and 2 died. For 15 of them the potential source of infection was determined as airport malaria and for 3 it remains unclear.

In Belgium, although the reintroduction of malaria is believed to be unlikely, autochthonous cases will continue to occur particularly since travelers and migration flows from the southern countries to Europe are intensifying. Although identification of the source of contamination is difficult and not always possible, thorough investigations around cases are necessary even if competent mosquitoes are not present in order to avoid local transmission. There exists the need for increased awareness of potential autochthonous cases; efforts should be made to ensure prompt detection, notification, treatment of cases and timely implementation of public health control measures.

poster 20

POSTER SESSION

Mosquito monitoring in South Bohemia (Czech Republic). West Nile virus (lineage 2) detected in *Culex modestus* in 2018

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The mosquito fauna has been monitored in the Třeboň Basin (South Bohemia, average altitude of 453 m a.s.l.) since 2012. The area contains numerous fish ponds, wetlands, peat bogs, temporarily inundated meadows and floodplain forests – all sites suitable for widespread mosquito larvae breeding. For mosquito collection, different methods were used. Mosquito females, possible vectors of West Nile Virus (WNV), were trapped by Encephalitis Vector Surveillance traps (EVS) with CO2 as attractant. Traps were placed on approximately 30 sites, mostly close to ponds, especially to their reed zones (*Phragmites australis*). Twenty-nine mosquito species have been identified in the study area, with *Uranotaenia unguiculata* and *Anopheles hyrcanus* being new to the region. The area north of the Třeboň city (49°N, 14°46´E) is one of the northernmost points of regular occurrence of these thermophilic species in Europe. In 2016-2018, we collected Culex modestus, a proven vector of West Nile Virus, which was then very abundant species in pond reed vegetation. Interestingly, the *Cx. modestus* females were most active during afternoon hours. Almost no biting activity of *Cx. modestus* females was observed outside the reed zones. No WNV was detected in Cx. modestus in the catches made in 2016-2017. In summer 2018, we focused on trapping *Cx. modestus* in the Nature Reserve for migratory birds of the Velký Tisý and in neighbouring ponds. The June-September catches of *Cx. modestus* (>25,000 females) were screened for the presence of WNV. To date, a total 4,151 Cx. modestus females have been examined by molecular methods. In the sample 33 (consisted of 50 specimens), caught from 9 to 12 September in reeds of the Velký Tisý pond (49°4´41´´N, 14°45´20´´E), WNV lineage 2 was detected using specific one step RT-PCR with primers designed for amplification of WNV-2. Obtained WNV strain is identical to other WNV strains circulating now in Europe.
The study was supported by MH CZ-DRO (National Institute of Public Health-NIPH,75010330).

poster 21

POSTER SESSION

Distribution chart for Euro-Mediterranean mosquitoes (western Palaearctic region)

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The MediLabSecure project aims at consolidating a laboratory network for surveillance and training on viruses that are pathogenic to humans and/or animals. It includes countries of the Mediterranean and Black Sea regions that have common sea borders and, as a result, share common public health issues and threats. Within the framework of this project, the medical entomology group produced MosKeyTool version 2 , a freely available interactive identification key for mosquito species (larvae and females) distributed in the Euro-Mediterranean-Middle East region. It provides the current knowledge for the identification of the 131 mosquito species encounted in the area and can be used by experts as well as non-expert entomologists.
VectorNet is a "European network for sharing data on the geographic distribution of arthropod vectors, transmitting human and animal disease agents" launched by the European Centre for Disease Prevention and Control (ECDC) and the European Food Safety Authority (EFSA). The network of medical entomologists and public health professionals, already established during the former VBORNET project (2009-2013), was extended to include veterinary entomologists and veterinarians working in the field of vectors and/or vector-borne diseases in Europe and countries surrounding the Mediterranean Basin (2014-2018).
As a result, and a step in the capacity building process for the territories these projects focus on, we provide an updated distribution chart of the Euro-Mediterranean mosquito species. The total number of species accounts for 145. The status of each species for a defined geographic unit is given according to five categories: 'Present native', 'Present introduced', 'Uncertain for presence or absence', 'Absent extinct' and 'Absent never observed'.

poster 22

POSTER SESSION

Microclimatic conditions of mosquitoes' resting sites in Germany

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Pathogen transmission models commonly integrate standard climatic data from metrological stations. However, these data do not necessarily reflect the microclimatic conditions of mosquitoes' resting sites. Mosquitoes use these shelter sites e.g. during development and maturation of eggs. Thus, the climatic conditions in the resting sites may influence the duration of the extrinsic incubation period of a pathogen in the vector. The objectives of our study were 1) to investigate the resting site preferences of mosquitoes and, 2) to compare the microclimate of these habitats with data from weather stations.
We investigated mosquitoes' resting sites in 20 study sites in Germany (10 in 2017 and 10 in 2018). Those sites were associated with different types of wetland habitats. At each site, mosquitoes were collected with a hand-made aspirator from May to October. Artificial (= garden pop-up bags, 76 l) and natural resting sites (e.g. understory vegetation) were sampled at three heights (0, 2 and 5 m). In addition, temperature was logged hourly in the different resting sites. Subsequently, we extracted meteorological data from the nearest weather station of each study site to predict the microclimate of these shelters.
Sampling results showed distinct species-specific preferences for the different resting site types. Mosquitoes of the genus *Culiseta* and *Anopheles* preferred artificial resting sites, whereby species of the genus Aedes were predominant in natural resting sites. In addition, most mosquitoes preferred resting sites near the ground (below 2 m). On average, the microclimate within the shelter sites were slightly cooler than common weather data (mean: 0.2°C, SD: 2.5°C). Based on the regression model, it was possible to predict the microclimate in the resting sites with a high precision ($R^2 = 0.89$). The next steps will include the analyses of species-specific and habitat-specific microclimate preferences to refine epidemiological models and risk assessment tools.

POSTER SESSION

poster 23

Evaluation of the efficacy of Aquatain against *Culex pipiens* and *Aedes albopictus* larvae in catch basins using a floating monitor system

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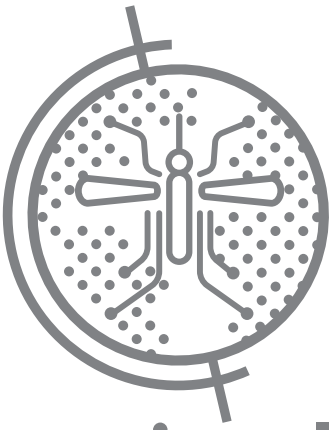
Aedes albopictus and *Culex pipiens* are commonly distributed in Italy and represent the main species found in catch basins. The application of a silicon-based film product like Aquatain is a new tool recently introduced for catch basins treatment. The particular way of action of Aquatain makes the monitoring of larvae by dipping a not appropriate approach to evaluate its efficacy. The larval hypoxia caused by Aquatain makes larvae die or lay on the bottom therefore when samples of water are kept larvae can be collected but it doesn't mean they will develop in adult as the hypoxia could kill them before the conclusion of the development cycle. If larvae are not present in the samples, it doesn't mean there are no larvae in the catch basins because they may lay on the bottom. Aquatain was tested in field using a Floating Monitor System to evaluate the adult emerging. The test was performed applying the product in 25 catch basins, while 25 more catch basins were used as control. Two applications were performed, one dosage was tested. The floating system (EFMS) is done of a plastic cylinder 25 cm diameter and 6 cm high, close on the top by a mosquito net. Monitoring was performed every week. Heavy rain seems to affect the efficacy of the product even if it is not clear the reason. If the no intensive showers happen the product show to be affective for not less than 4 weeks.



IX International Conference

La Rochelle France
11-14 March, **2019**

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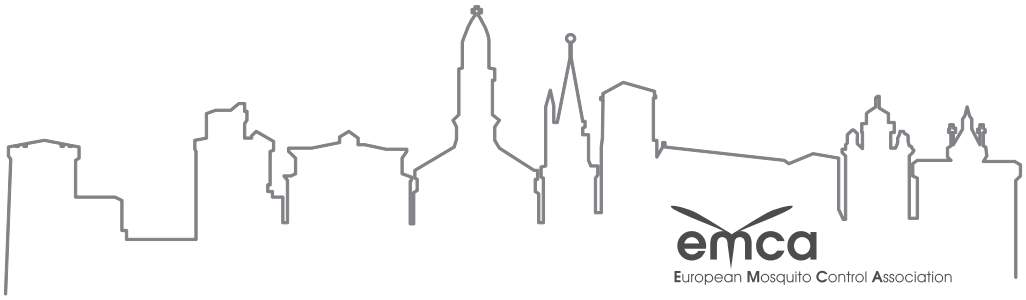

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