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Surveillance and control of *Culex* mosquitoes and *Aedes* invasive mosquitoes in Europe: questionnaire findings on current practice and needs

ECDC SURVEILLANCE & MONITORING

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** This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.*

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Abbreviations

AGES	Austrian Agency for health and Food security
Bs	<i>Lysinibacillus sphaericus</i>
Bti	<i>Bacillus thuringensis israelensis</i>
CPO	Contact Point for Operations
ECDC	European Centre for Disease Prevention and Control
EEA	European Economic Area
EU	European Union
IGR	Insect growth regulator
INSA	Portuguese Instituto Nacional de Saúde Doutor Ricardo Jorge
OCP	Operational Contact Point
PH	Public health
REVIVE	Rede de Vigilância de Vetores
SIT	Sterile Insect Technique
UK	United Kingdom
UKHSA	United Kingdom Health Security Agency
ULV	Ultra-low volume
WNV	West Nile virus

Executive summary

Europe is experiencing longer and more intense transmission seasons for mosquito-borne diseases, including for West Nile virus (WNV) infection as well as dengue and chikungunya virus disease. These developments increase the need for sustained mosquito surveillance and timely, effective control measures, but capacity and organisation vary across countries. This report describes how mosquito surveillance and control for *Culex* mosquitoes (vectors of WNV) and invasive *Aedes* mosquitoes are organised across EU/EEA countries, EU enlargement policy countries and the United Kingdom (UK), and identifies what is needed to strengthen preparedness and response.

The information on the surveillance and control of *Culex* mosquitoes and *Aedes* invasive mosquitoes was collected through an online questionnaire using EUSurvey. The survey was sent to the ECDC Operational Contact Points (OCPs) for Entomology from 30 EU/EEA countries, Contact Points for Operations (CPOs) of seven EU enlargement policy countries, and the UK contact point. In total, 26 out of 38 (68%) questionnaires sent out were completed and returned. Twenty one of the 30 EU/EEA countries, four out of the seven EU enlargement policy countries, and the UK replied to the questionnaire.

Between 2020 and 2025, surveillance of *Culex* (vectors of WNV) was conducted in 17 countries, with control measures implemented in 12. Activities vary considerably across countries and are often constrained by short-term funding and limited long-term planning. Adult mosquito control using biocides is common. In the same period (2020–2025), surveillance for *Aedes* invasive mosquitoes was carried out in 20 countries, with control activities in 17. Approaches differ widely, with preventive and elimination measures targeting immature stages through a mix of biocidal and non-biocidal tools, often supported by social mobilisation. However, reactive control remains largely ad hoc, typically focused on adult mosquitoes, and long-term funding and elimination strategies are often lacking. The organisation and execution of surveillance and control activities varies considerably between countries, depending on national structures and responsibilities which can explain why in some countries, the national authorities are in charge, and in others, it is the regional or even local authorities.

The survey results show that sustainable mosquito surveillance and control across Europe continues to face structural and operational challenges. Many programmes remain dependent on short-term funding and external support, and the integration of entomological expertise into public health systems varies across countries. The key findings are:

- Long-term investment, training, and coordination at the European level are important factors influencing vector surveillance and control within countries. Regular exchange and collaboration between Member States is important for sharing good practice, addressing common challenges, supporting coordinated responses, and strengthening preparedness for outbreaks and unusual vector-borne disease events, including cross-border mobilisation of expertise and resources.
- The effectiveness of surveillance and control activities are influenced by the clarity of roles and responsibilities and the level of coordination between national agencies, local authorities, and other stakeholders. The implementation of a comprehensive One Health approach can be an important aspect of coordination.
- Limited availability of cost–benefit analyses for vector surveillance and control activities is a constraint for evidence-based decision-making and resource allocation. Additional challenges are in the areas of data integration, systematic evaluation of control measures, and establishing a stronger evidence base linking vector abundance to disease transmission risk.
- There are variabilities in data management approaches, surveillance and control objectives, operational guidance, and the uptake of innovative tools. There is a need for measurable control targets, updated guidance, and environmentally responsible approaches to vector surveillance and control.
- There is a need for capacity-building among entomologists and professionals involved in surveillance and control activities at the local level. Continuous training and access to practical training materials are important for maintaining and strengthening competencies.
- Awareness of legal and regulatory frameworks, such as the EU Biocidal Products Regulation, is important to shape the implementation of vector surveillance and control in countries. There are both opportunities and limitations associated with the current regulatory environment, including variations in implementation across countries.
- There are differences in laboratory and field capacities across Member States. Access to technical expertise, harmonised methodologies, and support for vector identification, pathogen detection, and professional training are important components of effective surveillance and control systems.
- Insecticide or biocide resistance was included among the surveillance indicators by some respondents, and the broader questionnaire findings indicate that understanding resistance patterns is relevant for planning control activities.

Background

In 2021, the European Centre for Disease Prevention and Control (ECDC) published a report entitled 'Organisation of Vector Surveillance and Control in Europe', acknowledging the evolving epidemiological landscape of vector-borne diseases across EU/EEA countries, EU enlargement policy nations, European Neighbourhood Policy partner countries, and the UK [1]. The report, covering the period 2016–2020, identified the lack of funding and adequately trained personnel as the primary barriers to effective vector surveillance and control. Additionally, the involvement of numerous stakeholders was identified as an extra barrier, whilst emphasising the importance of coordination and collaboration for successful outcomes. Most ongoing vector surveillance activities were described as 'limited in time', a trend observed across all vector groups. The report suggested that establishing long-term, sustainable surveillance systems is not only needed but will also facilitate the development of lasting entomological capacity. Additionally, the lack of clearly defined roles and responsibilities in vector control was frequently cited as a challenge, hindering the formulation of effective procedures, guidelines, and strategic frameworks.

Recent changes in the epidemiology of West Nile virus (WNV) infection, the continued spread of *Aedes albopictus*, and the increasing occurrence of autochthonous transmission of dengue and chikungunya virus disease in Europe [2-5] prompted ECDC to commission an update of the previously mentioned report. This update focuses specifically on *Culex* mosquitoes (WNV vectors) and *Aedes* invasive mosquitoes, and describes the surveillance and control practices, identifies challenges and gaps. This report is intended to support public health stakeholders at both the national and European level, by enhancing their understanding of how vector surveillance and control is organised across countries, and, where feasible, to help address the identified challenges and gaps.

Methods

General overview of the questionnaire

The information on the organisation of surveillance and control of *Culex* mosquitoes and *Aedes* invasive mosquitoes was collected through an online questionnaire constructed and implemented using EUSurvey (<https://ec.europa.eu/eusurvey/home/welcome>). The questionnaire addressed *Culex* mosquitoes (WNV vectors) and *Aedes* invasive mosquitoes and was divided into six parts (see Annex 1 for details):

- Part 1 asked for general information;
- Part 2 and 3 covered the vector surveillance organisation of *Culex* mosquitoes and *Aedes* invasive mosquitoes in the country;
- Part 4 and 5 covered the vector control organisation of *Culex* mosquitoes and *Aedes* invasive mosquitoes in the country;
- Part 6 concluded with an open-ended question allowing respondents to share any additional information that could help clarify how mosquito surveillance and control are organized in their country.

In the questionnaire and report we use:

- **WNV vectors** referring to vectors of WNV including *Culex pipiens*, *Culex torrentium*, *Culex modestus*, *Culex perexiguus/univittatus*;
- ***Aedes* invasive mosquitoes** referring to two invasive *Aedes* mosquitoes in Europe that have high medical importance: *Aedes albopictus* and *Aedes aegypti*.

The respondents and target countries

On 28 May 2025, the questionnaire was sent to the officially nominated national contact points for mosquito surveillance and control: ECDC Operational Contact Points (OCPs) for Entomology in 30 EU/EEA countries, the Contact Points for Operations (CPOs) in seven EU enlargement policy countries, and the UK contact point. The invitations were administered through EUSurvey, so each respondent received a personal uniquely coded email invitation providing a unique link to the online survey document. Two reminders were sent.

Terms and framework

Levels of organisation

We considered three levels in the organisation of vector surveillance and control:

1. Policy making;
2. Decision-making, planning and evaluation;
3. Operational execution.

For the policy-making level, we aimed to identify the ministry with overall responsibility and legal authority for vector surveillance or control. At level two, we focused on the organisation or agency in charge of designing, planning, and evaluating the surveillance or control strategy — defining *what* needs to be done, *when*, and *where*. For the third level, operational execution, we asked about the organisation or agency responsible for carrying out the daily activities related to vector surveillance or control.

Definitions

Table provides an overview of the definitions that are applied throughout this questionnaire and the report.

Table 1. The definitions used in the questionnaire and report

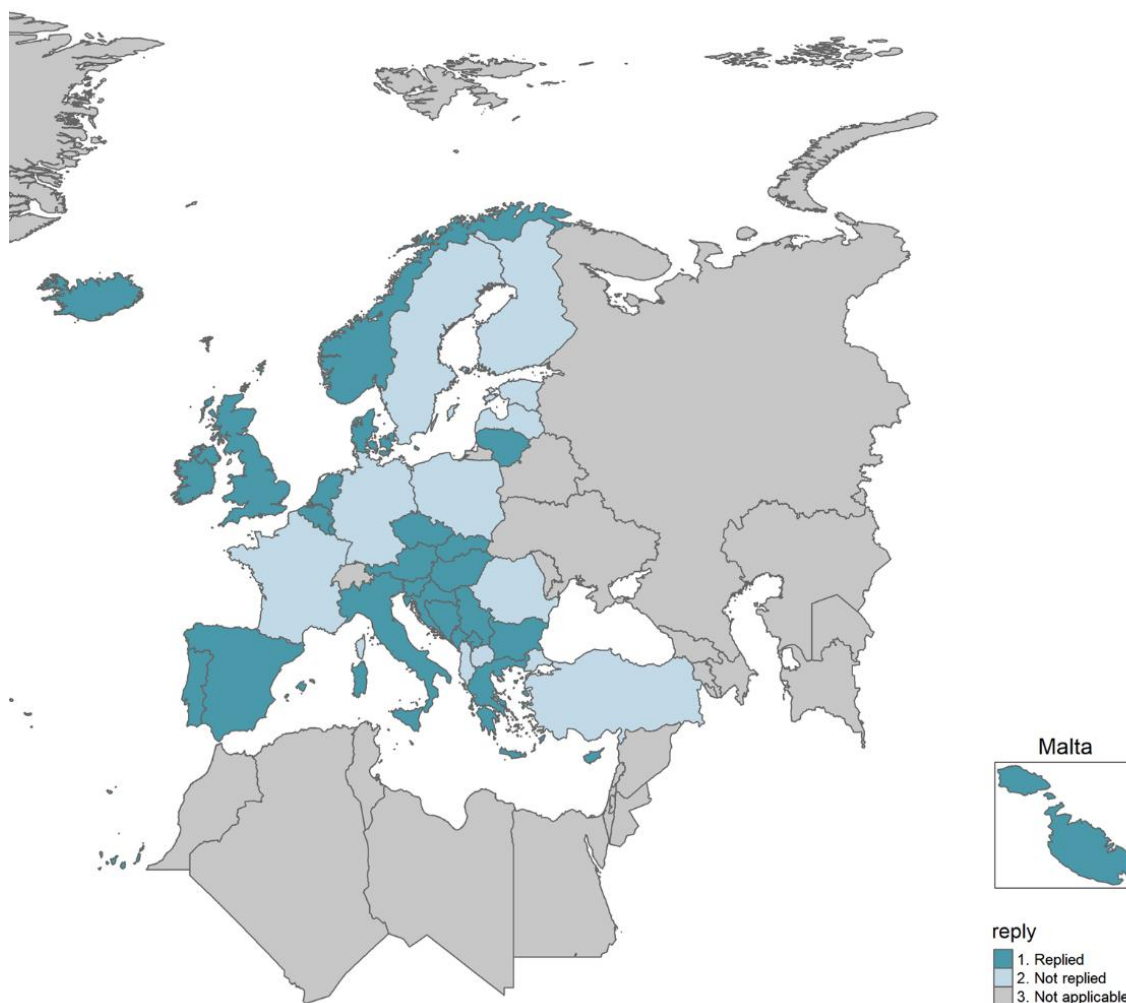
Term	Definition
Active mosquito surveillance	A system employing professional staff (e.g. from public agencies, academic institutes, private companies) to collect (often on a regular basis) information on mosquito-specific data.
Animals of veterinary importance	Animals of either economical or personal importance, such as cattle or pets, often living in close proximity to humans. Livestock and companion animals.
Deployment	An act of applying a system, e.g. spraying adulticide within an area around the home of a dengue case.
Implementation	Putting in place a system: e.g. for reactive mosquito control in case of a detection of an autochthonous case of dengue.
Mosquito control	Measures of any kind against mosquitoes, intended to limit their presence or abundance or their ability to transmit pathogens.
Mosquito surveillance	Continuous, systematic collection, analysis and interpretation of mosquito-specific data that can be used in planning, implementing and evaluating public or veterinary health practice.
Passive mosquito surveillance	A system by which the responsible authority/agency collates mosquito-specific data from all potential sources, without commissioning or funding field mosquito-sampling by professionals. Citizens' contributions to surveillance ('Citizen science') is considered as part of a passive surveillance system.
Preventive mosquito control	Planned mosquito control (can be triggered, e.g. by densities exceeding thresholds) aiming to reduce population densities and/or disease transmission risk
Reactive mosquito control	Mosquito control in response to a detection of an introduction of an exotic species, or an imported or autochthonous disease case.
Wildlife	Undomesticated animal species including abandoned/feral pets.

Results

Participating countries

In total 26 of 38 questionnaires sent out were completed and returned, resulting in a 68% response rate (Figure). Twenty one of the 30 EU/EEA countries, four out of the seven EU enlargement policy countries (Bosnia and Herzegovina, Kosovo¹, Montenegro, and Serbia), and the UK replied to the questionnaire. In this section, if five or more countries gave a particular response, they are not listed individually. If a particular response was given by less than five countries, then they are individually named.

Figure 1. Overview of the responding countries



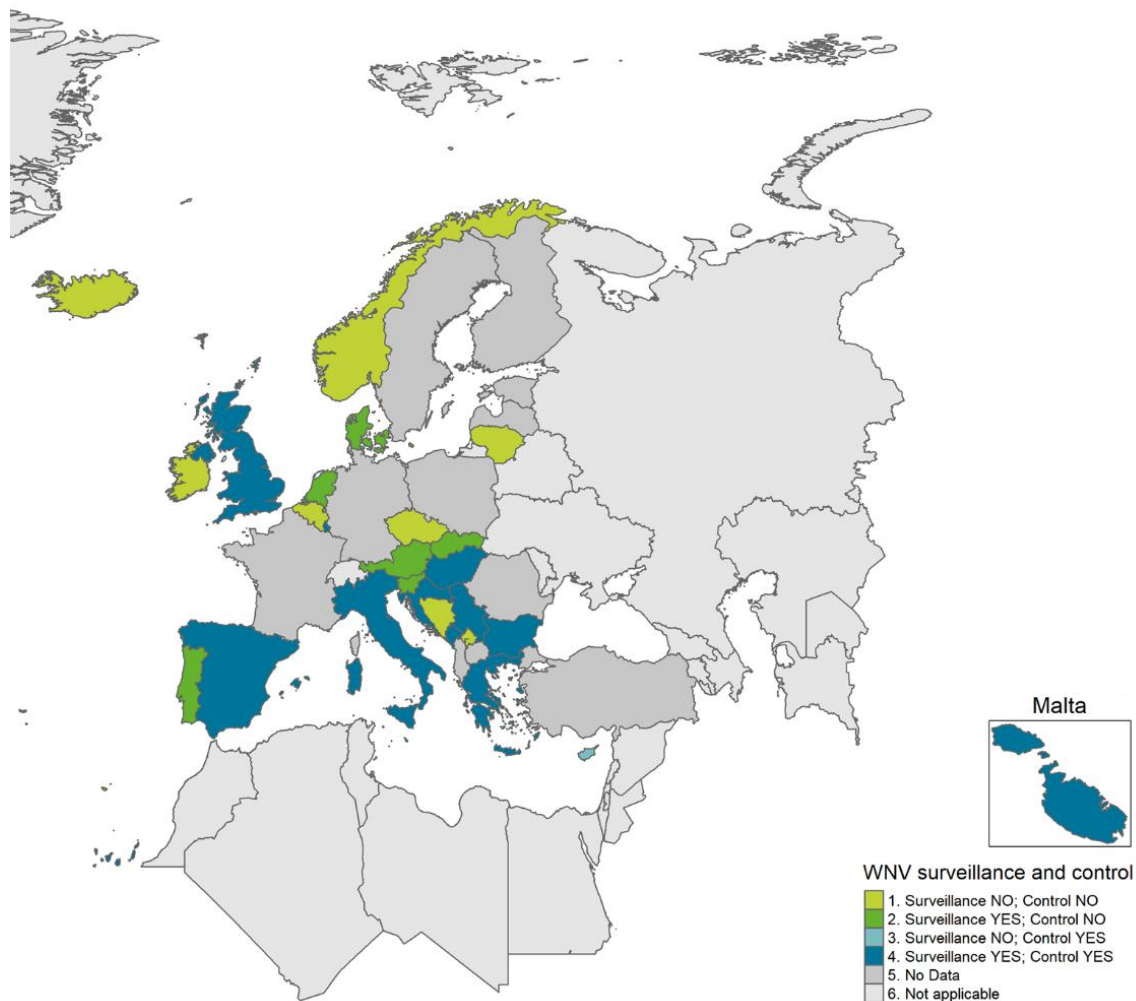
Culex mosquitoes: deployment of vector surveillance and control

Over the period January 2020–May 2025, surveillance of *Culex* mosquitoes was carried out in 17 of the 26 responding countries, while control measures were implemented in 12 countries (Figure). Among the nine countries that do not conduct *Culex* surveillance, the reported reasons include: WNV is not considered a public or veterinary health concern (5/9 countries), it is not seen as contributing to outbreak response (Ireland), there is no legal framework supporting surveillance implementation (Ireland, Kosovo and Norway), and there are limited resources (5/9 countries). One country (Cyprus) mentioned that they are currently building the capacity to implement *Culex* surveillance.

¹ This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ.

Among the 14 countries that do not conduct *Culex* control, the reasons mentioned for not implementing control are: the mosquito species group is not present (Iceland), it is not a public or veterinary health problem (7/14 countries), we do not have reliable mosquito control options (Portugal), or there is a lack of resources to implement mosquito control (Bosnia and Herzegovina, Kosovo and Portugal). One country (Slovenia) reported that control activities are only considered as an emergency response, triggered by the detection of a disease outbreak, rather than as part of an ongoing, proactive public health strategy. One country (the Netherlands) stated that it does not yet have evidence of reliable mosquito control options in the event of an outbreak and clarified that it only has some evidence on the reduction of *Culex* populations in urban areas with active *Aedes albopictus* eradication activities. Whereas various larvicides have been registered for use by pest management professionals, this is not yet the case for adulticides against *Culex*, and this will require approval from the responsible Dutch governmental agency.

Figure 2. Overview of the countries that implement vector surveillance and control of *Culex* mosquitoes that are WNV vectors



Surveillance of *Culex* mosquitoes

Why is *Culex* surveillance implemented?

For most of the countries (10/17 countries) that have implemented *Culex* vector surveillance, WNV is a public or veterinary health problem which informs the national response (9/10 countries) (Table). Other reasons provided for the implementation of WNV vector surveillance are: surveillance is part of the early detection of flaviviruses, tracking changes of vector population due to climate and land use changes, relevant for animal health (horses, domestic birds), as part of the insecticide resistance monitoring, out of research interest (project based), or to support risk assessment requested by the Ministry.

Table 2. The reasons provided why surveillance of *Culex* mosquitoes is implemented (multiple answers are possible) (n = 17)

Reasons	Number of countries
Is a public or veterinary health problem/priority	10
Mosquito surveillance informs response	9
There is a legal obligation	3
Other	5

The legal basis for implementing *Culex* surveillance in individual countries is as follows: as part of a legal framework on disease surveillance (5/17 countries); based on specific legislation related to mosquito surveillance (Croatia and Portugal); and linked to the International Health Regulations (Portugal). Greece mentioned that the surveillance is embedded in the National Action Plan for WNV. In Portugal, surveillance supports national veterinary and human health legislation aimed at controlling zoonoses, especially those with potential for outbreaks or cross-border transmission. In the UK, the *Culex* surveillance is linked to the UK National Security Risk Assessment and the National Adaptation Programme, which is related to the UK Climate Change Act.

Who is responsible and implements *Culex* surveillance?

Seven of the 17 countries implementing *Culex* surveillance state that their Ministry of Health, at the national level, has the overall responsibility and oversight of vector surveillance and is legally bound to it. One country (Montenegro) mentions that it is the Ministry of Health at the sub-national level, and for one country (Serbia), it is the Ministry of Agriculture at the sub-national level that has overall responsibility and oversight of vector surveillance, while for Croatia, both these ministries have responsibility at the sub-national level. In Spain, the responsibility of entomological surveillance is linked to the 17 regions. In Greece, the Ministry of Health (National Public Health Organization) is responsible for mosquito surveillance at the national level, and the Ministry of the Interior supervises the regional and municipal authorities which are responsible for mosquito management at the local level. In Hungary, the Ministry of Interior is responsible for *Culex* surveillance. In the UK, the UK Health Security Agency (UKHSA) coordinates mosquito surveillance with local partners.

In most countries, the *Culex* surveillance plan is designed at the national level (11/17 countries) by the Public or Veterinary health agency (8/17 countries). Other entities responsible for the actual design of the surveillance plan are: a dedicated agency (the Netherlands), a working group within a ministry (Italy, Luxembourg, and Portugal), or a scientific or academic institution (7/17 countries). In Spain, this is the responsibility of the regions. In Greece, the surveillance plan is designed by a Public Health Agency (the National Public Health Organization) at the national level, and by the regional, municipal public health and mosquito management authorities at the sub-national (regional and municipal) level.

The evaluation and possible re-adjustments of the *Culex* surveillance plan in most countries (14/17 countries) is done by the same organisation or agency that develops the surveillance plan. In the Netherlands, the surveillance plan is part of a plan for cost-effective WNV surveillance for the Netherlands 2025, which is being developed by a One Health consortium composed of various different institutes and agencies, chaired by the Dutch National Institute for Public Health and the Environment. There was a previous plan for WNV surveillance and control 2021–2023.

Five of the 17 countries evaluate and re-adjustment the surveillance plan annually, four countries (Italy, Luxembourg, Netherlands, Spain) do this every two to five years and four countries (Serbia, Slovakia, Slovenia, UK) mentioned that they never evaluate and re-adjust the surveillance plan. For four countries (Bulgaria, Croatia, Hungary, Malta), the respondents did not know this information.

The execution of vector surveillance is mostly done by public/veterinary health agencies (10/17 countries), or scientific institutions. One country (Netherlands) has a dedicated agency for the execution of *Culex* surveillance. In three countries (Greece, Luxembourg, Spain), the surveillance is executed by private companies. In Greece, the national mosquito surveillance plan is executed by a Public Health Agency and scientific, academic, or research institutions, whereas the regional mosquito surveillance plans are executed by the regional and municipal public health/ mosquito management authorities through contracts with private companies. In Malta, the project-based surveillance was executed by the national infectious disease surveillance and control unit in collaboration with the 'Research Infrastructure Program on insect vectors of human and animal disease'. In Portugal, day-to-day mosquito surveillance activities, including field collection, species identification, and data reporting are executed by Local Public Health Units, under the coordination of regional public health entities and by the Reference Laboratory for Acarology and Entomology of the Instituto Nacional de Saúde (INSA). In Austria, the management of the traps is organised by the federal health directorates. This is organised differently depending on the federal state: in some, one person/institution (university, museum) is responsible for looking after all traps in the federal state, while in others individual locations are managed by employees of federal offices, employees of the Austrian Agency for Health and Food security (AGES), schools or private individuals. The samples are analysed by AGES. In the City of Vienna, the University of Veterinary Medicine is responsible for the implementation of the surveillance. In the UK, local landowners and local authorities assist with surveillance.

Operational overview of *Culex* vector surveillance

The *Culex* surveillance activities focus primarily on the abundance and seasonality of the vector species. Vector surveillance is also implemented to assess mosquito infection rates and as a xenomonitoring tool (Table). The main objectives of the surveillance are outbreak investigations and assessment of the level, place or time of transmission risk (Table).

Table 3. Indicators assessed by the *Culex* surveillance activities (multiple answers possible) (n = 17)

Indicator	Number of countries
Mosquito presence/absence	11
Mosquito abundance	13
Mosquito seasonality	12
Mosquito infection rate and xenomonitoring	13
Mosquito behavioural traits	3
Insecticide/biocide resistance	2
Don't know / NA	1
Other	1

Table 4. The objectives of the *Culex* surveillance (multiple answers possible) (n = 17)

Objective	Number of countries
Assessment of level, place and/or time of transmission risk	10
Assessment of nuisance levels	5
Investigation of outbreaks	12
Assess quality/efficiency of mosquito control intervention	6
Don't know / NA	2
Other	1

For the two most important objectives, i.e. assessment of level, place or time of transmission risk, and investigation of outbreaks, active surveillance is the primary type of surveillance. Depending on the objective, surveillance is implemented country-wide or in certain parts of the country. The reasons for the implementation of surveillance in certain parts of the country only are linked with the risk of WNV being restricted to those parts, the lack of resources to implement surveillance country-wide, linked to the actual organisation of the surveillance which is, in certain countries, regionally based, and the fact that *Culex* surveillance in certain countries is linked to *Aedes* invasive mosquito surveillance.

The funding for active surveillance related to most of the objectives, is limited in time. Funding of the active surveillance activities related to outbreak investigation, in seven out of 17 countries, is embedded in a long term (> 3 yr) strategy of disease risk assessment and control. Likewise, passive surveillance, in most of the countries which answered this question, is time-limited funding. Reporting of the surveillance indicators is voluntary in most countries, except for surveillance activities related to outbreak investigations (Table).

Table 5. Is reporting of the surveillance indicators voluntary or compulsory?

Objective	Compulsory	Voluntary	Don't know/NA
Prevention of establishment after introduction of exotic mosquito species	3	5	9
Assessment of level, place and/or time of transmission risk	5	7	5
Assessment of nuisance levels	0	8	9
Investigation of outbreaks	9	6	2
Assess quality/efficiency of mosquito control intervention	0	7	10

Control of *Culex* mosquitoes

Objectives of *Culex* vector control

Six of the 12 countries implementing *Culex* control use preventive control to reduce disease risk or nuisance. Eleven countries deploy reactive control after detection of cases to control an outbreak. One country (Hungary) stressed the fact that control is implemented primarily to decrease biting nuisance and one country (Greece) implements reactive control, in addition to after the detection of human cases and after the detection of WNV positive mosquito pools (*Culex pipiens*) or WNV positive animals.

Legal framework

Legal frameworks which provide certain tools or rights facilitating mosquito control seem to be limited. Only two countries (Cyprus, Spain) out of the 12 refer to 'the right to enter private property', two (Cyprus, Luxembourg) to 'tyre recycling regulation (e.g. storage regulations)', and three (Cyprus, Luxembourg, Spain) to 'Importation regulations'.

In Bulgaria, mosquito control falls within a broader pest-control ordinance issued by the Ministry of Health and the Ministry of Agriculture. The ordinance addresses general hygiene and pest-management obligations for public facilities, including disinfection, disinsection and deratisation measures when pests are present. In Greece, recommendations for the vector control activities are embedded in relevant circulars of the Ministry of Health on mosquito management. In Malta, there is no specific legal framework relating to vector control. However, the Public Health Act grants the Superintendent of Public Health the power to implement measures to protect the public from communicable diseases including arboviruses.

Who is responsible and implements *Culex* control

Preventive *Culex* control is under the responsibility of the Ministry of Health at national level in six of the 12 countries. In Croatia this responsibility lies with both the Ministry of Health at the sub-national level and the Ministry of Environment at the sub-national level. Reactive vector control is the responsibility of the Ministry of Health at the national level in five of the 12 countries. Other authorities responsible for *Culex* control are: regional authorities (Spain), Municipalities and Institute of Public Health of Montenegro (Montenegro), the regional and municipal authorities, supervised by the Ministry of Interior (Greece), the Ministry of Interior, Disaster Management (Hungary), Ministry of Public Administration and Local Self-Government at the national level, the Secretariat for Urbanism and Environmental Protection at the Vojvodina Province level and municipalities on the local level (Serbia), and local authorities (UK).

In five countries, preventive control is designed at the national level and in eight countries reactive control is designed at the national level. In Spain some regions develop their own plan and while others adopt the national plan.

The design of the control plan is done by different entities depending on the country (Table). In most countries (9/12 countries) the readjustments of these plans are done by the same agency as the once designing the plan. The frequency of the evaluation and re-adjustment is not known for six out of the 12 responders. Two countries (Greece, Montenegro) evaluate and re-adjust their plans every year.

Table 6. Who designs the actual control plan? (multiple answers possible) (n = 12)

	PREVENTIVE control plan	REACTIVE control plan
Dedicated agency	0	0
Working group within a ministry	3	5
Working group between ministries	2	3
Public/Veterinary Health Agency	3	4
Scientific/Academic institution	3	3
Private company or organisation	2	0
Don't know / NA	2	2
Other	2	2

In three (Croatia, Italy, Serbia) out of the 12 countries, funding for both preventive and reactive control is ad hoc and limited in time. In Greece, Hungary, Montenegro, Spain the funding of preventive control is embedded in a long-term strategy of disease control. In Cyprus, Greece, Montenegro and Spain the funding for reactive control is part of a long-term strategy. Four countries (Bulgaria, Cyprus, Malta, UK) did not answer this question or did not know.

The execution of preventive and reactive mosquito control in most countries is done by a Public or Veterinary health agency, or by a private company (Table). In the UK, this is the responsibility of the local authorities.

Table 7. Who is responsible for the execution of the *Culex* mosquito control in your country? (multiple answers possible) (n = 13)

	PREVENTIVE mosquito control	REACTIVE mosquito control
Dedicated agency	0	0
Public/Veterinary Health Agency	5	4
Scientific/Academic institution	1	1
Private company or organisation	5	5
Don't know / NA	3	4
Other	1	1

Operational overview of *Culex* control

A variety of methods are implemented to control *Culex*, with targeting adults with biocides as the most implemented in six (preventive control) and nine (reactive control) countries (Table). None of the countries implement innovative methods targeting adult *Culex* mosquitoes.

In Greece, recommended mosquito control methods are described in Ministry of Health guidance, including annual circulars on mosquito management and the national action plan for West Nile virus. Other methods used in countries are: source reduction, surface films, biological larvicide (Bti) and IGR larvicides (Italy); deltamethrin, fogging from truck and aerial (Hungary); pyriproxiphen targeting larvae at national level, diflubenzuron (Larvastop ZG), *Bti* (Vectobac), piriproxiphen (Larvastop Piriprox ZG) at provincial level (Vojvodina Province), at the level of municipalities *Bti* for larvae and pyrethroids for adults (ULV treatments) (Serbia); and Silmax and Bti (UK).

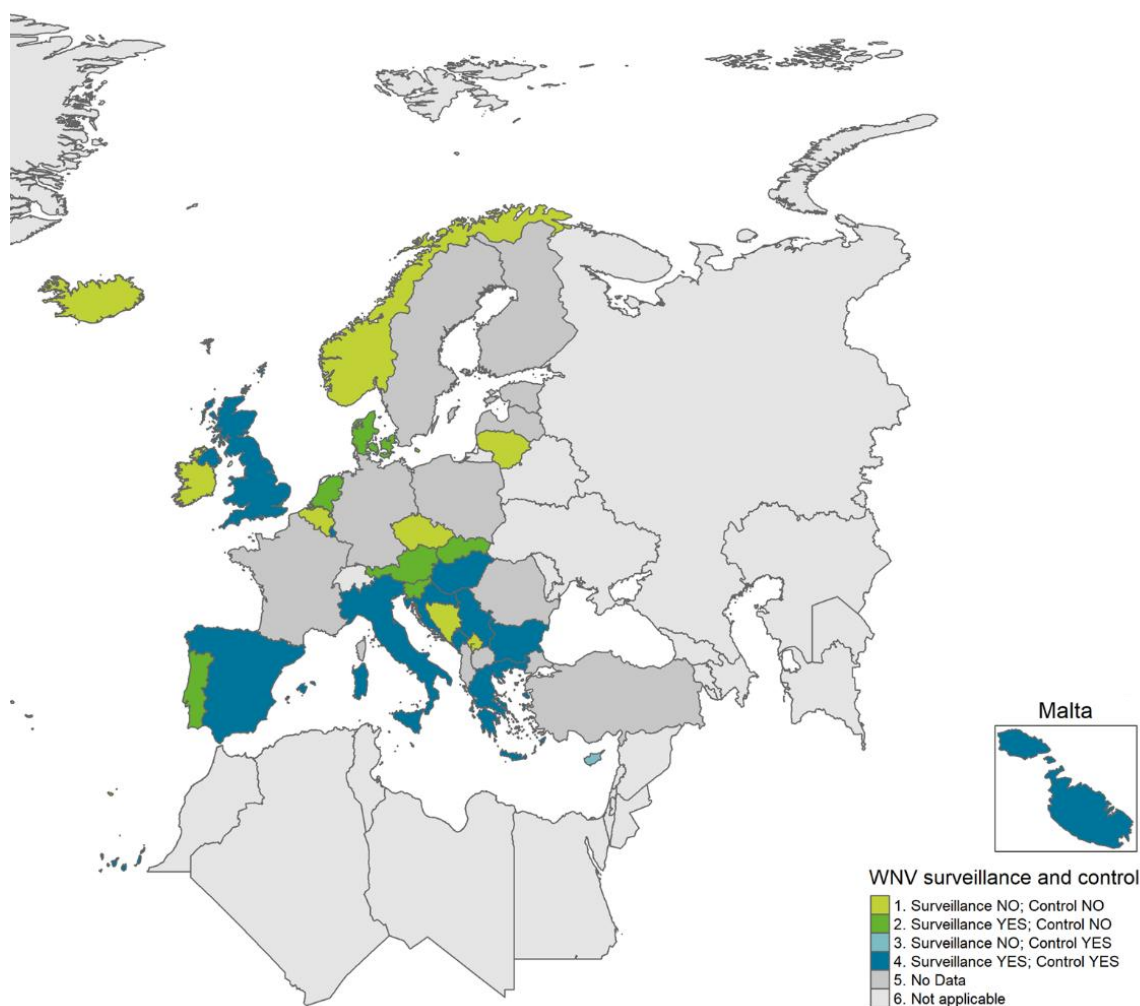
Table 8. What type of *Culex* mosquito control is implemented in your country? (multiple answers possible) (n = 13)

Type of control	PREVENTIVE mosquito control	REACTIVE mosquito control
Targeting immature stages using non-biocidal intervention	5	3
Targeting adults using biocides	6	9
Targeting adults using non-biocidal intervention	1	1
Environmental management	3	4
Targeting adult stages using innovative methods	0	0
Formalised social mobilization program	2	2
No Control	2	1
Don't know / NA	1	2
Other	0	0

Aedes invasive mosquitoes: deployment of vector surveillance and control

Over the period January 2020–May 2025, surveillance of invasive *Aedes* mosquitoes takes place in 20 countries, with control activities conducted in 17 countries (Figure). In total, six of the responding countries do not implement surveillance of *Aedes* invasive mosquitoes, because it is not a public or veterinary health problem or priority (Czechia, Lithuania, and Norway), there is a lack of resources (Bosnia and Herzegovina, Iceland, Kosovo, and Norway), and/or there is no legal framework (Kosovo and Norway). The reasons for not implementing *Aedes* invasive mosquito control are: the mosquito species group is not present (6/9 countries), they do not pose a public or veterinary health problem (Czechia and Norway), and/or there is a lack of resources to implement mosquito control (Bosnia and Herzegovina). One country (Slovenia) mentioned that control activities are considered only as an emergency response.

Figure 3. Overview of the countries that implement vector surveillance and control of *Aedes* invasive mosquitoes



Surveillance of *Aedes* invasive mosquitoes

Why is *Aedes* invasive mosquito surveillance implemented?

For 18 out of the 20 countries, the reason to implement *Aedes* invasive mosquito surveillance is the assessment of the introduction and spread of the invasive *Aedes* species. Surveillance also informs response (9/20 countries), and is a public or veterinary health function in eight out of 20 countries (Table).

Slovakia and Slovenia mentioned that they implement *Aedes* invasive mosquito surveillance out of research interest. Portugal refers to the compliance with EU and International Health Regulations: "*Portugal participates in EU-wide vector surveillance networks and must comply with International Health Regulations, especially at points of entry*". Denmark does not yet have exotic *Aedes* species, but the Ministry requires risk assessments for *Aedes albopictus* and other exotic vectors, and screening surveillance collections for exotic species has been in place since 2011. This is supplemented by research projects and passive surveillance through citizen science.

Table 9. The reason provided why surveillance of *Aedes* invasive mosquito vectors is implemented (multiple reasons are possible) (n = 20)

Reasons	Number of countries
Is a public or veterinary health problem/priority	8
Mosquito surveillance informs response	9
To assess the introduction and spread of invasive vector species	18
There is a legal obligation	5
Other	6

The legal basis for implementing *Aedes* invasive mosquito surveillance varies over responding countries: as part of a legal framework on disease surveillance (5/20) countries; linked to the International Health Regulations (Greece, Ireland, Portugal, and Spain); based on specific legislation related to mosquito surveillance (Croatia, The Netherlands and Portugal). Greece mentioned that the surveillance is embedded in Ministry of Health (Ministry of Health) circular on 'Vector management plan as response to DENV, CHIKV, ZIKV cases (2016)', and that mosquito surveillance targeting *Aedes* invasive species is implemented at points of entry according to the International Health Regulation, and referred to a circular of the Ministry of Health on basic hygiene requirements of the country's points of entry (ports) for preparedness and response against infectious diseases' cases (2023). The plan of prevention and control of vector-borne diseases is part of Portugal's legal and institutional response to protect public health from diseases such as dengue, chikungunya virus disease, and Zika virus disease, which can be transmitted by *Aedes* mosquitoes. Legal justification is also tied to the need for early detection of *Aedes* invasive species and rapid containment of outbreaks, which are essential under both national and international health regulations. The plan mandates coordinated action among health authorities, regional and local health entities, and other stakeholders, reinforcing the context for a legal and operational basis. This is under the Ministry of Health and funded by the state budget. The UK has a contingency plan which is actioned by the UK National Security Risk Assessment and the National Adaptation Programme, which is related to the UK Climate Change Act.

Who is responsible and implements *Aedes* invasive mosquito surveillance?

Ten of the 20 countries implementing *Aedes* invasive mosquito surveillance state that the Ministry of Health at the national level is responsible for the surveillance. In one country (Italy), the Ministry of Environment at the national level has the responsibility. One country (Montenegro) mentions that the Ministry of Health at sub-national has overall responsibility and oversight of vector surveillance. One country (Serbia) refers to the Ministry of Agriculture at the sub-national level, one country (Croatia) refers to both the Ministry of Health at the sub-national level and the Ministry of Agriculture at the sub-national level, and one country (Belgium) to both the Ministry of Health at the sub-national level and the Ministry of Environment at the sub-national level. In Spain, the responsibility of entomological surveillance lies with each of the 17 regions, and *Aedes* invasive mosquito surveillance at point of entry is the responsibility of the Ministry of Health. In Greece, the Ministry of Health (National Public Health Organization) is responsible for mosquito surveillance at the national level, and the Ministry of the Interior is supervising the regional and municipal authorities which are responsible for mosquito management at the local level. Also, in Hungary, the Ministry of Interior is responsible for the *Aedes* invasive mosquito surveillance. In the UK, the UKHSA coordinates mosquito surveillance, local authorities are required to help support this as per the national contingency plan.

In 14 out of the 20 countries, the *Aedes* invasive mosquito surveillance plan is designed at the national level by scientific or academic institutions (10/17 countries). Other entities responsible for the design of the surveillance plan are: public or veterinary health agencies (9/20 countries), a working group within a Ministry (Italy, Luxembourg, and Portugal), dedicated agency (The Netherlands), or working group between ministries (Belgium). In Spain this is the responsibility of the Regions and for points of entry the Ministry of Health organizes the surveillance subcontracting academic institutions. In Greece the surveillance plan is designed by a Public Health Agency (the National Public Health Organization) at national level, and by the regional, municipal public health and mosquito management authorities at sub-national (regional and municipal) level.

The evaluation and possible re-adjustments of the mosquito vector surveillance plan in most countries (18/20 countries) is done by the same organization or agency that develops the surveillance plan. In the Netherlands, the Dutch National Institute of Health organises an interdisciplinary group meeting twice a year and discusses the results of the previous year and the plans for the next. Nine of the 20 countries evaluate and re-adjust the surveillance plan annually, four countries (Italy, Luxembourg, Spain, UK) do this every two to five years and four countries (Austria, Slovakia, Slovenia, Serbia) said that they never evaluate and re-adjustment their surveillance plans.

The execution of the vector surveillance is mostly done by public or veterinary health agencies (11/20) or scientific institutions (11/20 countries). One country (Netherlands) has a dedicated agency for the execution of surveillance. In three countries (Greece, Luxembourg, Spain), mosquito surveillance is executed by private companies. In Greece, the national mosquito surveillance plan is executed by a Public Health Agency and scientific, academic, or research institutions, whereas the regional municipal public health and mosquito management authorities execute the mosquito surveillance activities through contracts with private companies, at subnational and local levels. In Portugal day-to-day mosquito surveillance activities are executed by Local Public Health Units under the coordination of regional public health entities and the Reference Laboratory for Acarology and Entomology of INSA. Additionally, efforts in these areas are occasionally carried out within the scope of research projects developed by academia or by public and private Portuguese research institutes. In Austria, the management of the traps is organised by the federal health directorates for national monitoring. This is organised differently depending on the federal state: in some, one person or institution is responsible for looking after all traps, while in others individual locations are managed by employees of federal offices, employees of AGES, or private individuals.

The samples are analysed by AGES. For the City of Vienna the University of Veterinary Medicine is responsible. In the UK local authorities implement surveillance, coordinated by UKHSA

Operational overview of *Aedes* invasive mosquito surveillance

The *Aedes* invasive mosquito surveillance activities focus primarily on the presence and absence of the vector species. Vector surveillance is also implemented to assess mosquito abundance and seasonality (Table). The main objectives of the surveillance are the prevention of establishment after introduction (12/20 countries) and the assessment of the level, place or time of transmission risk (10/20 countries) (Table).

Table 10. Indicators assessed by the *Aedes* invasive mosquito surveillance activities (multiple answers possible) (n = 20)

Indicator	Number of countries
Mosquito presence/absence	19
Mosquito abundance	11
Mosquito seasonality	14
Mosquito infection rate and xenomonitoring	6
Mosquito behavioural traits	4
Insecticide/biocide resistance	5
Don't know / NA	1
None	0
Other	1

Table 11. The objectives of the *Aedes* invasive mosquito surveillance (multiple answers possible) (n = 20)

Objective	Number of countries
Prevention of establishment after introduction of exotic mosquito species	12
Assessment of level, place and/or time of transmission risk	10
Assessment of nuisance levels	9
Investigation of outbreaks	7
Assess quality/efficiency of mosquito control intervention	7
Don't know / NA	1
Other	3

For the prevention of establishment after introduction of exotic mosquito species, eight countries rely on both active and passive surveillance (Table). This surveillance objective is implemented country-wide in eight out of the 20 countries. The assessment of level, place or time of transmission risk is based on active or a combination of active and passive surveillance (Table). The reasons for the implementation of surveillance in only certain parts of the country are because surveillance focuses on point of entry, that resources are limited both human capacity as financial allocations, or that the surveillance is a regional competence.

Table 12. What type of *Aedes* invasive mosquito surveillance is implemented in your country for the objectives listed below? (n = 20)

Surveillance objective	Active	Passive	Active and Passive	None	Don't know /NA
Prevention of establishment after introduction of exotic mosquito species	4	2	8	6	0
Assessment of level, place and/or time of transmission risk	7	0	6	6	1
Assessment of nuisance levels	3	3	5	8	1
Investigation of outbreaks	4	1	3	10	2
Assess quality/efficiency of mosquito control intervention	6	1	1	10	2

Ten countries report that the funding of the active surveillance linked to the objective 'Prevention of establishment after introduction of exotic mosquito species' is embedded in a long term (> 3 yr) strategy of disease risk assessment and control (Table). In seven countries the 'Assessment of level, place and/or time of transmission risk' is linked to long-term funding. Many respondents did not know the funding mechanism related to passive surveillance. Both long-term and project-based funding mechanisms are available for passive surveillance.

Table 13. How do you classify the public funding for active (*Aedes* invasive) mosquito surveillance activities in your country? (n = 20)

Surveillance objective	Limited in time (e.g. project based)	Embedded in a long term (> 3 yr) strategy of disease risk assessment and control	Don't know/ NA
Prevention of establishment after introduction of exotic mosquito species	5	10	5
Assessment of level, place and/or time of transmission risk	7	7	6
Assessment of nuisance levels	5	6	9
Investigation of outbreaks	4	6	10
Assess quality/efficiency of mosquito control intervention	5	3	12

Reporting the surveillance indicators in most countries is voluntary, except for surveillance activities related to the prevention of establishment after introduction of exotic mosquito species and outbreak investigations (Table, Table).

Table 14. Is reporting of the surveillance indicators voluntary or compulsory? (n = 20)

Surveillance objective	Compulsory	Voluntary	Don't know/NA
Prevention of establishment after introduction of exotic mosquito species	7	6	7
Assessment of level, place and/or time of transmission risk	3	7	10
Assessment of nuisance levels	1	8	11
Investigation of outbreaks	7	6	7
Assess quality/efficiency of mosquito control intervention	0	8	12

Control of *Aedes* invasive mosquitoes

The objectives of *Aedes* invasive mosquito control

Twelve of the 17 countries implementing *Aedes* invasive mosquito control implement preventive control to reduce disease risk or nuisance. Eight countries deploy reactive control after detection of cases to control an outbreak and 10 countries implement control for the elimination of invasive *Aedes* mosquitoes after introductions. Other objectives for the implementation of *Aedes* invasive mosquito control are:

- reactive control after detection of imported cases of dengue, chikungunya virus disease or Zika virus disease, after risk assessment (Greece, Cyprus);
- complete eradication after detection of introduction (the Netherlands);
- evaluation of control methods i.e., testing the capacity for implementation and effectiveness of new tools and technologies. An example is the Sterile Insect Technique pilot trials in Portugal 2022–2024 (Portugal).

In Hungary there is no specified control against *Aedes* invasive mosquitoes, but it is part of the general nuisance control of mosquitoes.

The legal framework, which provides certain tools or rights facilitating mosquito control, seems to be limited. Six out of 17 countries refer to "Importation regulations", four countries (Cyprus, Netherlands, Spain, UK) refer to "the right to enter private property", and three (Cyprus, Luxembourg, Netherlands) to "tyre recycling regulation (e.g. storage regulations)".

Bulgaria has an ordinance for pest control from the MoH and the Ministry of Agriculture referring to all pests (insects, ticks and rodents) with public health importance. In Greece, recommendations for control activities are embedded in relevant circulars of the MoH on mosquito management. An inter-Ministerial Decision for mitigating the risk of importation of new *Aedes* invasive mosquitoes (through airplanes) is under final evaluation. Recommendations on mosquito management for mitigating the risk of importation of new *Aedes* invasive mosquitoes in ports and through high-risk trade products (e.g., tyres, lucky bamboo) have been communicated by the MoH to the relevant national authorities and Ministries [6]. In Malta, there is no specific legal framework relating to vector control. However, the Public Health Act does give power to the Superintendent of Public Health to institute measures to protect public health against communicable diseases including arboviral ones. In Portugal, there is no explicit national law that grants mosquito control entities the automatic right to enter private property for vector control. However, such access can be authorized in specific contexts under certain public health and civil protection framework.

Who is responsible and implements *Aedes* invasive mosquito control

The Ministry of Health at the national level is responsible for preventive *Aedes* invasive mosquito control in six of the 17 countries, for reactive control in seven of the 17 countries and for the elimination of invasive *Aedes* mosquitoes after introductions in eight countries.

In Montenegro, the Institute of Public Health, along with other governmental and private institutions, is responsible for the *Aedes* invasive mosquito control. In Greece, the regional and municipal authorities, supervised by the Ministry of Interior, are responsible for implementing mosquito management (surveillance and control). The Ministry of Health develops the nationwide mosquito management policy and guidance and issues circulars. In Portugal, local municipalities in collaboration with Local and Regional Public Health Units are responsible for on-the-ground mosquito control actions, such as larvicide applications, public awareness campaigns, and enforcement of local health regulations. In Hungary, the Directorate General for Disaster Management within the Ministry of Interior is the responsible entity, in Serbia the Ministry of Public, Administration and Local self-government at national level, the Secretariat for Urbanism and Environmental Protection at the Vojvodina Province level and municipalities at the local level, and in Austria the District administrative authority (Bezirksverwaltungsbehörde).

Both national and sub-national entities are involved in the design of the mosquito control plan. The working groups within ministries are important bodies in the design of the control plans, as well as scientific or academic institutions (Table).

The following countries have other entities responsible for the design of *Aedes* invasive control plans:

- **Spain:** regional and national. Some regions develop their own plan and some other adopt the national plan.
- **Montenegro:** Institute of Public Health of Montenegro, along with other governmental and private institutions.
- **Belgium:** subnational level, dedicated agency but not mandated by law; supported by expert advice.
- **Portugal:** Portugal does not currently have a single, unified national mosquito control plan publicly labelled as such. However, mosquito control is managed through a coordinated framework involving programmes and institutions: Rede de Vigilância de Vetores (REVIVE) programme and the local and regional health units implement control measures based on REVIVE data and Directorate General of Health recommendations; in the Autonomous Region of Madeira, there is an active control plan for the *Aedes aegypti* mosquito, coordinated by the Regional Health Directorate. This plan includes the 'PREV Mosquito Campaign' for the prevention and control of the *Aedes aegypti* mosquito.
- **Austria:** city/district/municipality.
- **Slovakia:** Bratislava municipality.

Table 15. Who designs the actual *Aedes* invasive mosquito control plan? (multiple answers possible) (n = 17)

Entity	PREVENTIVE control plan?	REACTIVE control plan?	ELIMINATION after introductions
Dedicated agency	0	1	1
Working group within a ministry	6	6	5
Working group between ministries	1	1	2
Public/Veterinary Health Agency	2	1	1
Scientific/Academic institution	3	3	3
Private company or organisation	1	0	1
Don't know / NA	2	5	2
Other	5	3	6

In most countries (up to 12/17) the readjustment of these plans is done by the same agency that designs the plan. One country (Portugal) is known to evaluate and re-adjust its plans every year regardless of the specific objectives. Belgium, Netherlands, Portugal do this linked to the control objective 'elimination of invasive *Aedes* mosquitoes after introductions' and Greece, Montenegro, Portugal evaluate their control plan every year referring to the objective 'preventive control of invasive *Aedes* mosquitoes to reduce disease risk'. The frequency of the evaluation and re-adjustment is not known for most of the countries.

Preventive *Aedes* invasive mosquito control is embedded in a long-term (>3 years) strategy of disease risk control in six out of 17 countries. Reactive control is funded on an ad hoc basis in six of the 17 countries and the funding mechanism for the elimination of invasive *Aedes* mosquitoes after introductions is reported as not known for 10 countries.

The execution of preventive and reactive mosquito control in most countries is done by a public or veterinary health agency, or by a private company (Table).

Table 16. Who is in charge of the execution of the *Aedes* invasive mosquito control in your country? (multiple answers possible) (n = 17)

Entity	PREVENTIVE mosquito control	REACTIVE mosquito control	ELIMINATION after introductions
Dedicated agency	1	0	0
Public/Veterinary Health Agency	5	5	4
Scientific/Academic institution	1	1	1
Private company or organisation	7	5	4
Don't know / NA	3	8	7
Other	4	3	3

Operational overview of *Aedes* invasive mosquito control

A variety of methods are implemented to control *Aedes* invasive mosquitoes. Preventive and elimination control is often based on targeting immature stages using non-biocidal intervention and formalised social mobilisation programmes. Reactive *Aedes* invasive mosquito control in seven countries is based on targeting adults using biocides (Table). Several countries reported the use of various larval and adult biocidal control measures (active ingredients and products), including the following:

- **Slovakia:** Distribution of Culiclin tablets and informational leaflets to households in affected areas.
- **Italy:** Implementation of source reduction, surface films, biological larvicide (Bti), and insect growth regulator (IGR) larvicides; adulticide spraying was also occasionally used.
- **Cyprus:** Application of Bti and Aquatain® biofilm.
- **Belgium:** Use of Aquabac® (Bti) granules, specifically deposited in non-removable water containers (e.g., barrels) and storm drains.
- **Netherlands:** Employment of Bti, Bs, and Aqua K-Othrine®.
- **Portugal:** Spraying of diluted VectoBac12AS® on stagnant water surfaces.
- **Hungary:** Fogging with deltamethrin.
- **Serbia:** pyriproxiphen targeting larvae at national level; diflubenzuron (Larvastop ZG), Bti (Vectobac), pyriproxiphen (Larvastop Piriprox ZG) at provincial level (Vojvodina Province); and bti against larvae and pyrethroids against adults (ULV treatments) at the municipal level. In protected areas only *Bti* is used.
- **UK:** Application of Silmax® and Bti.

This summary highlights the adoption of biocidal larval and adult control strategies across the countries.

Table 17. What type of *Aedes* invasive mosquito control is implemented in your country? (multiple answers possible) (n = 17)

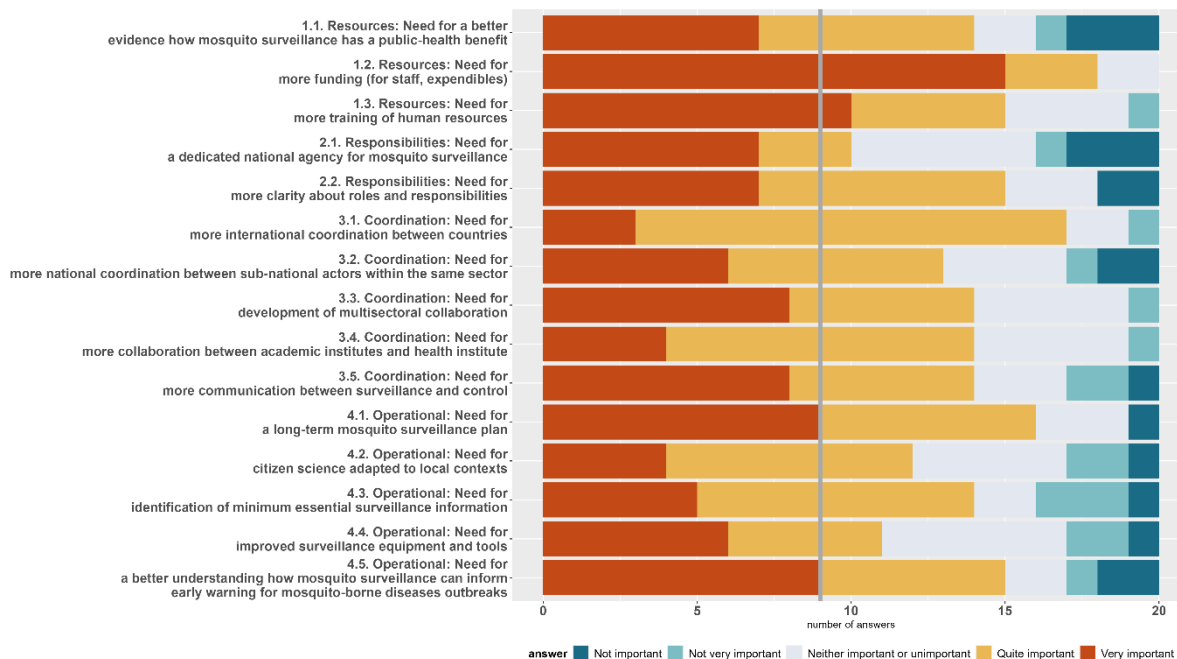
Control method	PREVENTIVE mosquito control	REACTIVE mosquito control	ELIMINATE after introductions
Targeting immature stages using non-biocidal intervention	9	3	8
Targeting adults using biocides	5	7	5
Targeting adults using non-biocidal intervention	3	1	3
Environmental management	6	3	4
Targeting adult stages using innovative methods	1	0	0
Formalised social mobilization program	7	4	6
No Control	3	2	4
Don't know / NA	2	8	2
Other	1	1	1

Needs identified related to vector surveillance and control

Vector surveillance

The need for both *Culex* and *Aedes* mosquito surveillance were rated from not important to very important using a Likert scale (Figure). For all domains, more than half of the respondents ranked the needs as important (i.e. combining quite important and very important). Half or more of the respondents rated the following needs as very important: the need for more funding; need for more training of human resources; need for a long-term mosquito plan; and need for a better understanding how mosquito surveillance can inform early warning for mosquito-borne diseases outbreaks. Also, the need for more international coordination between countries was rated highly.

Figure 4. Overview rating of needs for mosquito surveillance in terms of importance.

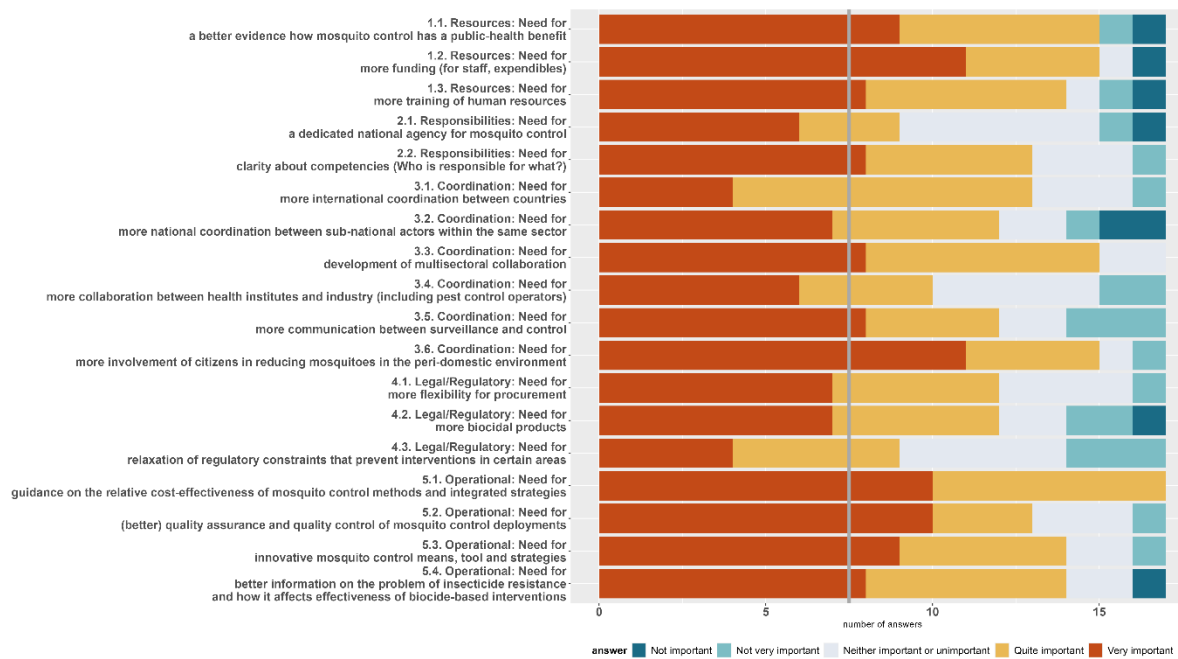


Vector control

The need for *Culex* and *Aedes* mosquito control were rated using a Likert scale (Figure). For all domains, more than half of the respondents ranked the needs as important (i.e. combining quite and very important). Needs rated as very important by more than half of the respondents are:

- **Resources**
 - Need for better evidence how mosquito control has a public-health benefit
 - Need for more funding (for staff, expendables)
 - Need for more training of human resources
- **Responsibilities**
 - Need for clarity about competencies (Who is responsible for what?)
- **Coordination**
 - Need for development of multisectoral collaboration
 - Need for more communication between surveillance and control
 - Need for more involvement of citizens in reducing mosquitoes in the peri-domestic environment
- **Operational**
 - Need for guidance on the relative cost-effectiveness of mosquito control methods and integrated strategies
 - Need for (better) quality assurance and quality control of mosquito control deployments
 - Need for innovative mosquito control means, tool and strategies
 - Need for better information on the problem of insecticide resistance and how it affects effectiveness of biocide-based interventions

Nine out of 17 countries reported that their budgets did not meet their control needs, while four (Cyprus, Italy, Luxembourg, the Netherlands) indicated that their budgets were sufficient to cover those needs.

Figure 5. Overview rating of needs for mosquito control in terms of importance

Discussion

Between 2020 and 2025, *Culex* surveillance was conducted in 17 of the 26 countries that responded to the questionnaire, while control measures were implemented in 12 countries. Among countries conducting surveillance, WNV was most often reported as a public and/or veterinary health concern, and surveillance activities were commonly described as informing response efforts. The questionnaire findings also show substantial variation in how surveillance and control activities are organised and implemented across countries. This variation reflects differences in national governance structures, legal mandates and the distribution of responsibilities between national, regional and local levels. The main reported objectives of *Culex* surveillance were outbreak investigation and assessment of the level, location and timing of transmission risk. Funding for *Culex* surveillance was often reported as limited in duration or project-based: only seven of the 17 countries conducting surveillance reported that outbreak-related surveillance activities were embedded in a long-term strategy (exceeding three years) for disease risk assessment and control. Countries reported using a range of control methods, with adult mosquito control using biocides being the most frequently reported approach.

Between 2020 and 2025, *Aedes* invasive mosquito surveillance was conducted in 20 of the 26 responding countries, and control activities were implemented in 17 countries. Surveillance was mainly used to assess the introduction and spread of invasive *Aedes* species. In several countries, it was also used to inform response efforts or to address public or veterinary health concerns. As with *Culex* mosquitoes, the organisation and implementation of *Aedes* mosquito surveillance and control varied across countries, reflecting differences in institutional structures, responsibilities and risk contexts. Some countries reported that preventive control was embedded in long-term strategies for disease risk reduction, while reactive control was often funded on an ad hoc basis. For elimination efforts following introductions, the funding mechanism was unclear or unknown in several countries. Respondents reported using a range of methods to control *Aedes* mosquitoes. Preventive and elimination measures commonly targeted immature stages and included both biocidal and non-biocidal interventions, often combined with formalised social mobilisation programmes. Reactive control, by contrast, was more often reported as targeting adult mosquitoes using biocides.

Previous work has identified several challenges related to vector surveillance and control in Europe. The ECDC report 'Organisation of Vector Surveillance and Control in Europe', published in 2021, described constraints including limited human and financial resources, complex organisational structures within countries, insufficient inter-governmental and inter-institutional cooperation, and unclear roles and responsibilities in the organisation and implementation of vector surveillance and control [1]. Similarly, the AIM-COST survey on *Aedes* invasive mosquito surveillance and control highlighted challenges related to limited political support, insufficient funding, shortages of trained personnel and weak coordination across governance levels [7]. It also reported that surveillance data were often underused in planning and that international guidance, although widely used, was not always well adapted to local contexts. The findings from the current questionnaire are consistent with several of these previously identified challenges, particularly in relation to funding, training, coordination, clarity of responsibilities, use of surveillance data, guidance and capacity-building.

The questionnaire findings are discussed below under four main themes: responsibilities and coordination, resources, legal and regulatory issues, and operational topics.

Responsibilities and coordination

- At the international level, respondents rated international coordination between countries as important for mosquito surveillance. This finding is relevant in the context of mosquitoes and vector-borne diseases that may affect more than one country. The questionnaire therefore suggests that respondents see value in cross-border exchange and collaboration, including through existing EU-level cooperation frameworks for serious cross-border threats to health.
- At the national level, questionnaire responses showed that responsibilities for mosquito surveillance and control vary considerably between countries. Depending on the country, these responsibilities may involve ministries, public or veterinary health agencies, regional or municipal authorities, scientific institutions and private companies. Due to this, there was a reported need for greater clarity about competencies, including who is responsible for specific aspects of surveillance and control.
- Respondents also rated the need for a long-term mosquito plan as important, particularly for surveillance, and identified clarity of responsibilities as an important area for better control. The questionnaire findings indicate that, in some countries, roles, funding arrangements and mechanisms for monitoring or evaluating implementation are not always clearly defined or consistently reported. Some countries reported using coordination mechanisms, working groups or dedicated agencies, but these arrangements differed between national contexts.
- The questionnaire findings also indicate that communication and collaboration across actors involved in mosquito surveillance and control remain relevant issues. Respondents identified multisectoral collaboration and improved communication between surveillance and control as important needs. Depending on the

- country, the actors involved may include public health institutions, veterinary or environmental authorities, local authorities, scientific institutions, private companies and, in some settings, citizens.
- Dedicated national committees play a key role in overcoming regulatory and operational barriers. For example, to ensure that vector control tools are available when needed, a specialised committee on biocides could support applicants in going through the approval processes.

Resources

- The questionnaire findings indicate that funding and human-resource capacity are important issues for mosquito surveillance and control. For surveillance, respondents rated the need for more funding, more training for staff and a long-term mosquito plan as highly important. Several countries reported time-limited or project-based funding arrangements. For vector control, respondents rated the need for more funding for staff and expendables, more training of staff and better evidence on the public-health benefit of mosquito control as very important. The responses also showed variability in funding arrangements across countries, with some activities funded on an ad hoc or time-limited basis and others embedded in longer-term strategies.
- In countries where municipalities, local authorities, public or veterinary health agencies, scientific institutions or private companies are involved in implementation, respondents' emphasis on training points to the importance they attach to maintaining practical competencies for data collection, surveillance, control activities and response-related procedures.
- Citizen involvement was also identified by respondents as relevant to mosquito control. In particular, the need for more involvement of citizens in reducing mosquitoes in the peri-domestic environment was rated as important in the control-related needs assessment. This indicates that public participation, particularly source reduction around homes, is perceived by respondents as one component of mosquito control efforts.

Legal and regulatory issues

- The questionnaire findings indicate that legal and regulatory arrangements for mosquito control vary across countries and may influence how control activities are planned and implemented. For both *Culex* and *Aedes* invasive mosquito control, only a limited number of countries reported legal frameworks providing specific tools or rights to facilitate control activities, such as access to private property, importation regulations or tyre-storage regulations. Some countries also reported that mosquito control responsibilities are held at local or municipal level, while planning, oversight and implementation may involve different authorities or sectors. These findings indicate that, in some settings, the organisation of mosquito control may be shaped by fragmented responsibilities, variable legal mandates and differences in local implementation capacity.
- Respondents also described country-specific arrangements that may affect the responsiveness of control activities. In some settings, mosquito control planning appeared to be linked to annual or predefined planning and funding cycles, while surveillance information, field assessments or changing epidemiological and entomological conditions may not always be fully integrated into planning processes. The questionnaire findings therefore suggest that, in some contexts, planned control activities and evolving operational needs may not always be fully aligned, although the extent and implications of this vary between countries.

Operational topics

- The questionnaire findings indicate that data availability, data use and monitoring of relevant vector indicators are important operational issues for mosquito surveillance and control. Surveillance activities reported by countries commonly included indicators such as mosquito presence or absence, abundance, seasonality and infection rates, and less frequently behavioural traits or insecticide/biocide resistance. Respondents also rated the need for a better understanding of how mosquito surveillance can inform early warning for mosquito-borne disease outbreaks as very important. These findings indicate that respondents perceive the use of surveillance data for risk assessment and response as an important area for further strengthening.
- The findings also point to knowledge gaps in the relationship between vector indicators and disease risk. While several countries reported using surveillance to assess the level, location or timing of transmission risk, respondents also rated the need for better evidence on the public-health benefit of mosquito control as very important. The questionnaire also identified a need for measurable control targets. Together, these findings suggest that the links between mosquito abundance, biting rates, transmission risk and operational thresholds are not consistently defined across countries.

- Evaluation of control activities also appeared to vary across countries. Some countries reported that surveillance or control plans are evaluated and readjusted regularly, while others reported that this is done less frequently, never, or that the frequency is unknown. Respondents also identified updated guidance and practical protocols, as well as better evidence on the effectiveness and public-health benefit of control measures, as important. These findings indicate that the evidence available to assess and compare control approaches remains uneven across countries.
- Cost-benefit and cost-effectiveness considerations were also identified as relevant operational gaps. The questionnaire findings indicate that evidence on the public-health benefit of mosquito control and information to support efficient allocation of resources remain important areas for respondents. This includes better understanding of the relative value of proactive and reactive control approaches, although the availability of such analyses appears limited and varies by country.

Conclusions

This report provides an overview of the organisation of surveillance and control of *Culex* mosquitoes, as vectors of West Nile virus, and invasive *Aedes* mosquitoes in the EU/EEA countries, EU enlargement policy countries and the UK. It also summarises the needs identified to improve this by questionnaire respondents.

The questionnaire findings show that mosquito surveillance and control are implemented in many responding countries, but that their organisation, objectives, funding arrangements, legal frameworks and operational approaches vary considerably. For both *Culex* and invasive *Aedes* mosquitoes, activities are shaped by differences in national and sub-national responsibilities, available resources, technical capacity and perceived public or veterinary health priorities.

Across the responses, several recurring needs were identified by respondents. These included funding and human-resource capacity, training, coordination within and between countries, clarity of responsibilities, legal and regulatory arrangements, laboratory and field capacity, monitoring of insecticide or biocide resistance, and evidence to support the assessment of surveillance and control activities. Respondents also highlighted gaps in the evidence base, including the relationship between vector indicators and disease risk, the public health benefit of control measures, and the definition of measurable control targets.

Overall, the questionnaire findings indicate that mosquito surveillance and control in Europe are characterised by diverse national arrangements and different levels of capacity, while several common operational and evidence-related needs are shared across countries.

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Annex 1. Questionnaire

PART 1. General questions

1.1. What is your name?; **1.2.** What is your country?; **1.3.** What is your email? If you provide this we assume that you give us permission to contact you about your answers.; **1.4.** What is your affiliation?; **1.5.** What is your role/function within your organization?; **1.6.** Would you like to be acknowledged in any report on this survey? (Y/N); **1.7.** Who did you consult to complete this questionnaire? Please provide name, institution and role/function of the institution.

1.8. Please indicate whether in the last 5 years (2020–present) any type of surveillance or control was deployed* or planned in your country (*see definitions)

Surveillance of WNV vectors (Y/N); Control of WNV vectors (Y/N); Surveillance of *Aedes* invasive mosquitoes (Y/N); Control of *Aedes* invasive mosquitoes (Y/N)

PART 2. Questions if no surveillance implemented in your country

2.1. If no surveillance is carried out in your country, please specify the reason why mosquito surveillance was not implemented in your country. Multiple reasons per mosquito group are possible (specify for WNV vectors and *Aedes* invasive species)

1. Vector-borne disease(s) transmitted by this mosquito group is NOT a public or veterinary health problem/priority in the country; 2. Mosquito surveillance does not contribute to response and control of vector-borne diseases; 3. There is no legal framework within which mosquito surveillance can be organised; 4. There is a lack of resources to implement mosquito surveillance; 5. Other (please specify - for each mosquito group); 6 Don't know /NA

PART 3. Questions about mosquito surveillance

3.1. If YES, please specify the reason why surveillance was implemented. Multiple reasons per mosquito group are possible.

1. Vector-borne diseases transmitted by this mosquito group are a public or veterinary health problem/priority in the country; 2. Mosquito surveillance informs response to and control of vector-borne diseases; 3. Mosquito surveillance is needed to assess the introduction and spread of invasive vector species; 4. There is a legal obligation; 5. Other (please specify for each mosquito group); 6 Don't know /NA

3.2. If mosquito surveillance was implemented in a context of a legal framework, can you specify below. Multiple reasons per mosquito group are possible.

1. Related to the International Health Regulation of surveillance at points of entry; 2. Embedded in a legal framework on diseases surveillance in the country; 3. Based on a specific legislation on mosquito surveillance in the country; 4. Other (please specify, for each mosquito group); None; Don't know /NA

3.3. Which ministry is responsible for mosquito surveillance? Here we ask the ministry that has the overall responsibility and oversight of mosquito surveillance and is legally bound to it. Multiple ministries per disease (group) are possible if the responsibility is joint. This is organizational level 1 (Fig.1). Please specify for each mosquito group.

1. Ministry of Health at national level; 2. Ministry of Agriculture of national level; 3. Ministry of Environment at national level; 4. Ministry of Health at sub-national level; 5. Ministry of Agriculture at sub-national level; 6. Ministry of Environment at sub-national level; Other (please specify for each disease); None; Don't know /NA

3.4. Is the surveillance plan per mosquito group designed at national or at sub-national level? A plan can be designed at national level, but targeting only specific areas e.g. points of entry or areas at risk for vector-borne diseases, or depending on levels of establishment or ecological conditions, but, in those situations, you should check 'national'. Please specify for each mosquito group.

1. National; 2. Sub-national

3.5. Who designs the actual mosquito surveillance plan? Here we ask for the organization/agency that is responsible for designing a plan on "what, when, and where" needs to be done related to mosquito surveillance. This is at organizational level 2 (Fig.1). Please specify for each mosquito group.

1. Dedicated agency; 2. Working group within a ministry; 3. Working group between ministries; 4. Public/Veterinary health agency; 5. Scientific/Academic institution; 6. Private company or organization; 7. Other (please specify for each mosquito group); 8. None; 9. Don't know /NA

3.6. Specify which organization/agency is responsible for designing of the actual mosquito surveillance plan by providing the name of the agency and their website. It can be more than one if e.g. the design of the actual mosquito surveillance plan is at sub-national level. If you believe further explanation is necessary, you can provide an extra comment.

Mosquito vectors of WNV: Name, website, Comment;
Aedes Invasive mosquitoes: name, website, Comment

3.7. Who is responsible for the evaluation and possible re-adjustments of the mosquito surveillance plan? Multiple answers per mosquito group are possible.

1. The same organization/agency that develops the surveillance plan; 2. Other (Please specify for each mosquito group); Don't know /NA

3.8. How often is the evaluation and re-adjustment of the surveillance plan done? Specify per mosquito group.

1. Each year; 2. Every 2 – 5 years; 3. Less often than every 5 years; 4. Never

3.9. If mosquito surveillance is implemented, who executes the mosquito surveillance in your country? Here we ask for the organization or agency that carries out the day-to-day mosquito surveillance activities. organizational level 3 (Fig.1). Specify for each mosquito group.

1. Dedicated agency; 2. Public/Veterinary health agency; 3. Scientific/Academic institution; 4. Private company or organization; 5. Other (please specify for each mosquito group); None; Don't know/NA

3.10. Specify which organizations/agencies are responsible for the execution of the mosquito surveillance. Provide their name and website. If you believe further explanation is necessary you can provide an extra comment.

Mosquito vectors of WNV: Name, website, Comment;
Invasive *Aedes* mosquitoes: name, website, Comment

3.11.	What indicators do mosquito surveillance activities assess in your country? Multiple answers per mosquito group are possible
	1. Mosquito presence/absence; 2. Mosquito abundance; 3. Mosquito seasonality; 4. Mosquito infection rate and xenomonitoring; 5. Mosquito behavioural traits; 6. Insecticide/biocide resistance; 7. Other (please specify for each mosquito group); None; Don't know/NA
3.12.	What are the mosquito surveillance objectives in your country? Multiple answers per mosquito group are possible.
	1. Prevention of establishment after introduction of exotic mosquito species; 2. Assessment of level, place and/or time of transmission risk; 3. Assessment of nuisance levels; 4. Investigation of (ongoing) outbreaks (ad hoc, event based); 5. Assess quality/efficiency of mosquito control interventions; 6. Other (please specify for each mosquito group); Don't know/NA
3.13.	What type of mosquito surveillance is implemented in your country for the indicators listed below? See definition of active and passive surveillance above. Provide this for following activities: WNV vectors: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy; Aedes invasive mosquitoes: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy
	1. Active; 2. Passive; 3. Active and passive; None, Don't know/NA
3.14.	Where is the mosquito surveillance activity implemented? Specify for each mosquito group and activity. Provide this for following activities: WNV vectors: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy; Aedes invasive mosquitoes: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy
	1. Country wide; 2. Certain parts of the country; Don't know/NA
3.15.	If mosquito surveillance is implemented in certain parts of the country, please specify why, for each activity: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy;
	Mosquito vectors of WNV; <i>Aedes</i> Invasive mosquitoes
3.16.	How do you classify the public funding for ACTIVE mosquito surveillance activities in your country? Per indicator and mosquito group. WNV vectors: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy; Aedes invasive mosquitoes: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy.
	ACTIVE surveillance: 1. Limited in time (e.g. project based); 2. Embedded in a long-term (>3 years) strategy of disease risk assessment and control; 3. Don't know/NA PASSIVE surveillance: 1. Limited in time (e.g. project based); 2. Embedded in a long-term (>3 years) strategy of disease risk assessment and control; 3. Don't know/NA
3.17.	Please specify for each surveillance indicator (see 2.13), whether reporting to the national level is voluntary or compulsory. WNV vectors: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy; Aedes invasive mosquitoes: Prevention of establishment after introduction of exotic mosquito species; Assessment of level, place and/or time of transmission risk; Assessment of nuisance levels; Investigation of (ongoing) outbreaks (ad hoc, event based); Assessment of control efficacy
	1. Voluntary; 2. Compulsory 3. Don't know/NA
3.18.	Please rate the following needs for mosquito surveillance in your country (on a Likert scale) in terms of importance. Resources: Need for a better evidence how mosquito surveillance has a public-health benefit; Need for more funding (for staff, expendables); Need for more training of human resources (irrespective of funding for mosquito surveillance being available, there is not enough knowledge and capacity); Responsibilities: Need for a dedicated national agency for mosquito surveillance; Need for more clarity about roles and responsibilities (which authority is responsible for what); Coordination: Need for more international coordination between countries; Need for more national coordination between sub-national actors within the same sector; Need for development of multisectoral collaboration; Need for more collaboration between academic institutes and health institutes; Need for more communication between surveillance and control; Operational: Need for a long-term mosquito surveillance plan; Need for citizen science adapted to local contexts; Need for identification of minimum essential surveillance information; Need for improved surveillance equipment and tools, e.g. traps, mosquito apps, species identification/diagnostic solutions; Need for a better understanding how mosquito surveillance can inform early warning for mosquito-borne diseases outbreaks
	1. Not important; 2. Not very important; 3. Neither important or unimportant; Quite important; Very important
3.19.	Please identify any additional needs regarding mosquito surveillance in your country, or put "none" or "unknown"
	Free text
PART 4. Questions if no control implemented	
4.1.	If no control is carried out in your country, please specify the reason why mosquito control was not implemented in your country. Multiple answers per group are possible.
	1. The mosquito species group is not present; 2. mosquito-borne disease(s) transmitted by this mosquito group is not considered a public or veterinary health problem; 3. We don't have reliable mosquito control options for this mosquito group; 4. There is no legal framework within which control can be organised; 5. Other (please specify for each mosquito group); 6. Don't know/NA

PART 5. Questions about reactive and preventive mosquito control

5.1. If YES please specify the objectives. Multiple answers per group are possible.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; 3. Other (please specify); **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak; 4. Other (please specify)

Yes; No; Don't know/NA

5.2. Is there a legal framework which provides certain tools or rights facilitating mosquito control? Multiple answers per group are possible.

1. The right to enter private property; 2. Tyre recycling regulation (e.g. storage regulations); 3. Importation regulations; 4. Other (please specify for each mosquito group); 5. There is no legal framework; Don't know/NA

5.3. Which ministry is responsible for mosquito control? Here we ask the ministry that has the overall responsibility and oversight of mosquito control and is legally bound to it. Multiple ministries per disease (group) are possible if the responsibility is joint. This is at organizational level 1 (Fig.1).

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak

1. Ministry of Health at national level; 2. Ministry of Agriculture of national level; 3. Ministry of Environment at national level; 4. Ministry of Health at sub-national level; 5. Ministry of Agriculture at sub-national level; 6. Ministry of Environment at sub-national level; Other (please specify for each disease); None; Don't know /NA

5.4. Is the actual mosquito control plan (on "what, when, and where" needs to be done regarding mosquito control) designed at national or at sub-national level? Specify for each objective.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak

1. National; 2. Sub-national (specify which level, e.g. province, municipality); Other

5.5. Who designs the actual control plan? Here we ask for the organization/agency that is responsible to design a plan on "what, when, and where" needs to be done regarding mosquito control. This is at organizational level 2 (Fig.1). Specify for each objective.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak

1. Dedicated agency mandated by law; 2. Working group within a ministry; 3. Working group between ministries; 4. Public/Veterinary health agency; 5. Scientific/Academic institution; 6. Private company or organization; 7. Other (please specify for each objective); 8. Don't know/NA

5.6. Specify which organization/agency is responsible for the design of the mosquito control plan by providing the name of the agency and the website. If you believe further explanation is necessary, you can provide an extra comment. Specify for each objective.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak

Agency Name; Agency Website; Comment

5.7. Who is responsible for the evaluation and possible re-adjustments of the mosquito control plan? Specify for each objective.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak

1. The same organization/agency that develops the control plan; 2. Other; Don't know/NA

5.7a & 5.7b. If OTHER, please specify which organization/agency that is responsible for the evaluation and possible re-adjustments. Provide the name of the agency and their website. If you believe further explanation is necessary, you can provide an extra comment.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak

Agency Name; Agency Website; Comment

5.8. Is the control plan monitored and evaluated for impact and effectiveness? If YES, how? Put "none" or "unknown" if you don't know.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; **Aedes invasive mosquitoes:** 1. Elimination of invasive *Aedes* mosquitoes after introductions; 2. Preventive control of invasive *Aedes* mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak

Free text

5.9. How often is the evaluation and re-adjustment of the mosquito control plan done? Specify for each objective.

WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; Aedes invasive mosquitoes: 1. Elimination of invasive <i>Aedes</i> mosquitoes after introductions; 2. Preventive control of invasive <i>Aedes</i> mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak
1. Each year; 2. Every 2 – 5 years; 3. Every 6 years or longer; 4. Never; Don't know/NA
5.10. How do you classify public funding for mosquito control in your country? Specify for each objective. WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; Aedes invasive mosquitoes: 1. Elimination of invasive <i>Aedes</i> mosquitoes after introductions; 2. Preventive control of invasive <i>Aedes</i> mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak
1. Ad hoc and limited in time (e.g. for protecting mass gathering outdoor events); 2. Embedded in a long-term strategy (> 3 years) of disease risk control; Don't know
5.11. Who is in charge of the execution of the mosquito control in your country? Here we ask who carries out the day-to-day activities of mosquito control. This is at organizational level 3 (Fig.1). Specify for each objective. WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; Aedes invasive mosquitoes: 1. Elimination of invasive <i>Aedes</i> mosquitoes after introductions; 2. Preventive control of invasive <i>Aedes</i> mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak
1. Dedicated agency; 2. Public/Veterinary health agency; 3. Scientific/Academic institution; 4. Private company or organization; 5. Other (please specify for each objective); Don't know/NA
3.12. Specify which organization/agency is responsible for the execution of the mosquito control. Please provide the name of the organization/agency and their website. There can be more than one if e.g. the execution of the mosquito control is at sub-national level. If the responsibility is at municipality level, please provide a few representative examples and explain in the free text space below. WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; Aedes invasive mosquitoes: 1. Elimination of invasive <i>Aedes</i> mosquitoes after introductions; 2. Preventive control of invasive <i>Aedes</i> mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak
Agency Name; Agency Website; Comment
5.13a. Please provide examples of municipalities responsible for WNV vector control. Put "none" or "unknown" if you don't know WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak;
municipalities
5.13b. Please provide examples of municipalities responsible for Aedes invasive mosquito control. Put "none" or "unknown" if you don't know Aedes invasive mosquitoes: 1. Elimination of invasive <i>Aedes</i> mosquitoes after introductions; 2. Preventive control of invasive <i>Aedes</i> mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak
municipalities
5.14. What type of mosquito control is implemented in your country (irrespective of deployment)? Multiple answers per group and objective are possible. WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; Aedes invasive mosquitoes: 1. Elimination of invasive <i>Aedes</i> mosquitoes after introductions; 2. Preventive control of invasive <i>Aedes</i> mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak
1. Targeting immature stages using nonbiocidal intervention (such as source reduction, surface films and Biological control such as copepods or fish); 2. Targeting adults using biocides; 3. Targeting adults using non-biocidal intervention (such as mass trapping); 4. Environmental management; 5. Targeting adult stages using innovative methods such as SIT; 6. Formalised social mobilization program; 7. Other (please specify for each objective); 8. No control; Don't know /NA
5.15. For each of the mosquito control types listed above, please provide details about the method (e.g. active ingredient, formulation, method of administration, and, if possible, the annual public budget for this activity). WNV vectors: 1. Preventive control of mosquito vectors of WNV to reduce disease risk (and/or nuisance); 2. Reactive control after detection of WNV cases to control an outbreak; Aedes invasive mosquitoes: 1. Elimination of invasive <i>Aedes</i> mosquitoes after introductions; 2. Preventive control of invasive <i>Aedes</i> mosquitoes to reduce disease risk (and/or nuisance); 3. Reactive control after detection of autochthonous cases of dengue, chikungunya or Zika to control an outbreak
Free text
5.16. What is the overall mosquito control annual budget in your country? If you don't know put "none" or "unknown"
Free text
5.17. Is this budget covering all vector control needs?
Yes; No; Don't know/NA
5.18. Please rate the following needs for mosquito control in your country (on a Likert scale) in terms of importance. Resources: Need for better evidence on how investing in mosquito control has a public health benefit; Need for more funding (for staff, consumables); Need for more training of human resources (irrespective of funding for mosquito control being available, there is not enough knowledge and capacity); Responsibilities: Need for a dedicated (national) agency for mosquito control; Need for clarity about competencies (Who is responsible for what?); Coordination: Need for more international coordination between countries; Need for more (national) coordination between sub-national actors within the same sector; Need for development of multisectoral collaboration; Need for more collaboration between health institutes and

industry (including pest control operators); Need for more involvement of citizens in reducing mosquitos in the peri-domestic environment; Need for more communication between surveillance and control; **Legislation/Regulation:** Need for more flexibility for procurement; Need for more biocidal products; Need for relaxation of regulatory constraints that prevent interventions in certain areas; Operational considerations: Need for more flexibility for procurement; Need for more biocidal products; Need for relaxation of regulatory constraints that prevent interventions in certain areas; Need for guidance on the relative cost-effectiveness of mosquito control methods and integrated strategies; Need for (better) quality assurance and quality control of mosquito control deployments; Need for innovative mosquito control means, tool and strategies; Need for better information on the problem of insecticide resistance and how it affects effectiveness of biocide-based interventions

5.19. Please identify any additional needs regarding mosquito control in your country.

Free text

PART 6. Space for general comments

6.1. Please provide any additional information that you think is important for us to understand the organization of mosquito surveillance and control in your country.

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