Identification and Distribution of Mosquito Vectors of Medical Importance on the island of Cyprus (ID-Vec)

Technical Committee on Health
June 24, 2021

This action of the Technical Committee on Health is funded by the European Union and implemented by UNDP in coordination with OSASG
Agenda

• Welcome and Opening Remarks
  • Prof. Leonidas Phylactou, Co-Chair of the Technical Committee on Health
  • Dr. Cenk Soydan, Co-Chair of the Technical Committee on Health
  • Alain Joaris, Head of Cooperation, EUPSO, Cyprus Settlement Support
  • Angela Bargellini, Senior Political Affairs Officer, Office of the Special Adviser of the Secretary General on Cyprus
  • Jakhongir Khaydarov, Head of Office, UNDP - Cyprus

• Project implementation – objectives, activities, results and outputs

• Next Steps

• Questions and Answers
Opening Remarks
Mosquitoes: An emerging threat

An emerging threat

Mosquito-borne diseases in Europe

Some tropical mosquito-borne diseases are endemic in some parts of Africa, the Americas and Asia. They are the cause of substantial illness for more than a billion people worldwide.

Mosquitoes can carry infectious diseases from person to person and from place to place.
**Just one bite away from infection**

Different species of mosquitoes can carry different diseases

- **Invasive mosquitoes** are characterised by their ability to colonise new territories. A considerable increase in the spread of invasive mosquitoes has been observed in Europe since the late 1990s.

1. After its disappearance in the 20th century in Europe, *Aedes aegypti* has recently become established in Madeira. It is also present in some areas around the Black Sea coast.

2. *Aedes albopictus* is considered to be the most invasive mosquito species in the world. It is present in much of southern Europe.

3. *Culex pipiens* is the most widespread mosquito in Europe.

4. The *Anopheles* mosquito can be found from south-eastern Sweden to Portugal.

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- **Chikungunya**
  - Infected people suffer from fever and severe joint pain, which can last for months.

- **Zika**
  - Mild disease with low fever and rash, but most cases are asymptomatic. The risk of serious complications has been identified for some.

- **Dengue**
  - Most infected people have fever lasting seven days. More than 350 million cases are estimated worldwide per year. The most important mosquito-borne disease affecting humans.

- **West Nile fever**
  - Cases can be severe, most often among the elderly. An estimated 1 out of 140 to 220 persons infected can get severely sick.

- **Malaria**
  - Worldwide, approx. 450 000 deaths every year. Early diagnosis and prompt treatment can prevent illness and death. Prophylaxis is available.
Climate and transportation

Travel, trade and climate change influence mosquito and disease distribution

99% of all malaria cases in Europe are travel-related.

More than 5.8 million travellers entered Europe from dengue-affected areas in 2010.

It is predicted that future climate trends will increase the risk of establishment of *Aedes albopictus* in northern Europe, due to wetter and warmer conditions.

*Ae. albopictus* has moved from continent to continent via trade.

Rising temperatures in the summer months can contribute to West Nile fever affecting new areas in Europe.
**Local transmission**

Locally transmitted cases of mosquito-borne diseases in Europe

**Chikungunya and dengue, France 2010, 2014 and 2015**

*Anopheles albopictus (invasive)*

**Chikungunya and dengue – imported through travel**

Two locally acquired cases of dengue and chikungunya were diagnosed in southern France in August 2010. Further limited outbreaks of 12 cases of chikungunya in 2014 and seven cases of dengue in 2015 have also been reported.

**Dengue, Madeira 2012**

*Anopheles aegypti (invasive)*

**Dengue – imported through travel**

From 2012 to January 2013, the autonomous province of Madeira, Portugal, reported its first dengue outbreak, with 2,168 dengue cases. 87 patients returning from Madeira were diagnosed in other European countries with dengue infection.

**Dengue, Croatia 2010**

*Anopheles albopictus (invasive)*

**Dengue – imported through travel**

In the summer of 2010, a dengue case was identified in Germany after travelling to Croatia. Tests found an additional 15 people with evidence of recent dengue infection.

**Chikungunya, Italy 2007**

*Anopheles albopictus (invasive)*

**Chikungunya – imported through travel, after an infected traveller returned from India**

It was the first locally transmitted chikungunya outbreak in Europe, with over 200 individuals affected. Since then it has been acknowledged that Europe is vulnerable to transmission of tropical arboviruses, particularly in areas where *Anopheles albopictus* is present.
PiCoordination and Information sharing

Project Implementation
Overview of the Action

• Implementation period: January 2020 - June 2021
• Objective: To establish a surveillance scheme with the aim to
  A) Identify mosquito vectors both native and invasive species at an island level focusing on regions at higher risk for disease transmission
  B) Map mosquito distribution to prioritize regions for which enhanced measures should be taken to control the mosquito population to protect public health
  C) Enhance capacity building of Greek Cypriots and Turkish Cypriots to identify mosquitoes of medical significance and to perform surveillance programs
  D) Increase public awareness on protection measures against mosquito bites
PiCoordination and Information sharing

Project Activities
1. Field activities

Sampling sites where BG-Sentinel traps, EVS traps and ovitraps were placed, and larval sampling performed.
Data Collection
• presence/absence
• distribution
• abundance
• population dynamics

Sampling:
• Oviposition traps (ovitraps)
• Larval sampling
• BG-Sentinel traps with BG-Lure and CO2 (dry ice) & EVS traps with CO2 (dry ice)
Egg surveillance

75 oviposition traps
- Black plastic bowls
- An oviposition support (e.g. a wooden stick)
- From 17th of November 2020 to the 23rd of January 2021
- Protection from rain, wind and direct sunlight
- In 8 region (Nicosia, Kyrenia, Morphou, Lefka, Mesaria, Famagusta, Trikomo and Karpasia)
- Check in weekly basis
Egg surveillance

Oviposition traps
Egg surveillance

24 oviposition traps
• potential points of entry
• closed to or under vegetation
• near buildings
Larvae surveillance

- Dipping submersion technique
- Dry season (18th of August 2020 to 31st of October 2020)
- Wet season (18th of February 2021 to 24th of February 2021)
- 29 sites for larvae surveillance
- In 8 region (Nicosia, Kyrenia, Morphou, Lefka, Mesaria, Famagusta, Trikomo and Karpasia)
Larvae surveillance
Larvae surveillance

- 350ml standard white dipper with extendable pole
- Five dips at each site
- If no larvae are collected, then it was extended to 10 dips
- Natural and manmade water collectors
Larvae surveillance

Larvae surveillance of rocky beaches
Larvae surveillance

Larvae surveillance of Limassol wetland

Larvae surveillance of Larnaca saltmarsh

Larvae surveillance of Paralimni

Larvae surveillance of Oroklini lake
Adult surveillance

BG-Sentinel Traps

- Data collection from BG-Sentinel traps in wet season (10\textsuperscript{th} of December 2020 to 30\textsuperscript{th} of January 2021)
- Placing at ground level (BG-Sentinel)
- Data collection from EVS traps in wet season (9\textsuperscript{th} of January 2021 to 23\textsuperscript{rd} of January 2021)
- Hanging on the trees (EVS)
- In 8 region (Nicosia, Kyrenia, Morphou, Lefka, Mesaria, Famagusta, Trikomo and Karpasia).
- 1 kg dry ice per day per trap

EVS Traps
Adult surveillance

**EVS Traps**

**Catch bags of EVS Traps**
Adult surveillance

BG-Sentinel Traps
Adult surveillance

**BG-Sentinel Traps**

- 23 sites
- urban,
- suburban or
- rural environments
- retain humidity
- protected from the wind
- easily accessible by the main roads

**Sampling on a biweekly basis**

**Dry season** (1st of July to 30th of September 2020)

**Wet season** (1st of October 2020 to 28th of February 2021)

**EVS Traps**
2. Laboratory analysis
Evaluation of eggs’ presence – larvae mounting

Evaluation of mosquito eggs’ presence

Mounting mosquito larvae
Morphological identification
Morphological identification
Morphological identification

Morphological identification of adult and larvae mosquito

Pinning of samples
Molecular identification

DNA extraction
Molecular identification

PCR

Gel electrophoresis
Molecular identification

DNA extraction

PCR
3. Data management
### Egg and adult surveillance

<table>
<thead>
<tr>
<th>Location name</th>
<th>Admin. unit (e.g., District NUTS3)</th>
<th>Place (e.g., town, village)</th>
<th>Postal code</th>
<th>Trap type (options: Outtraps, BG lures, CO2, CO2 + BG lures)</th>
<th>Land use (options: Urban, Suburban, Rural, Other)</th>
<th>Comment trap</th>
<th>Sample name (e.g., site, sample id)</th>
<th>Start date</th>
<th>Start time</th>
<th>Average temperature start date (only for traps with CO2)</th>
<th>End date</th>
<th>End time</th>
<th>Average temperature end date (only for traps with CO2)</th>
<th>End date</th>
<th>Comment trap</th>
<th>Trapping effort</th>
<th>Total number of eggs on tongue depressor</th>
<th>Total number of species (including those not counted)</th>
<th>Number of females (optional)</th>
<th>Number of males (optional)</th>
</tr>
</thead>
</table>

### Larvae surveillance

<table>
<thead>
<tr>
<th>Total number of larvae</th>
<th>Mosquito species</th>
<th>Life Stage</th>
<th>Life Stage</th>
<th>Life Stage</th>
<th>Life Stage</th>
<th>Identification method (options: Morphology, L, Mid/TOF, or PCR)</th>
<th>Site</th>
<th>Date (dd.mm.yyyy)</th>
<th>Depth (cm)</th>
<th>Comments</th>
<th>Temp (°C)</th>
<th>pH</th>
<th>evp[µg/ppm]</th>
<th>ORP[µV]</th>
<th>ECp[kΩ/cm]</th>
<th>EC Abs.[µΩ/cm]</th>
<th>EC Abs.[µΩ/cm]</th>
<th>TDS[ppm]</th>
<th>Sal.[ppm]</th>
<th>Sigma T[deg]</th>
<th>Press.[µg]</th>
<th>O.0[µg]</th>
<th>O.0[µg]</th>
</tr>
</thead>
</table>

| Total number of larvae | Species | Number of Larvae 1,2 stage | Number of Larvae 3,4 stage | Pupa | Method | Site | Date | Depth | Comments | Temp (°C) | pH | evp[µg/ppm] | ORP[µV] | ECp[kΩ/cm] | EC Abs.[µΩ/cm] | TDS[ppm] | Sal.[ppm] | Sigma T[deg] | Press.[µg] | O.0[µg] | O.0[µg] |
Challenges and opportunities
Challenges

- **Technical**
  - Lab activities
  - Delay in delivery of equipment and consumables
  - Implementation of the project
  - Movement restrictions due to Covid-19 pandemic

- **Administrative**
  - Onsite visits and quality control of collected specimens by the Expert
  - Surveillance in dry season
Opportunities

✓ Team work

✓ Collaboration between Technical Team and Expert Scientist
✓ UNDP support
✓ Effective coordination by the Project Coordinators
✓ Effective work of the Co-chairs

✓ Problem solving skills

✓ Research and application of various methods for molecular analysis

✓ Experience

✓ Surveillance network
✓ Standard protocols
✓ Database
✓ Identify major vector mosquitoes
PiCoordination and Information sharing

Project Results
A) Identifying mosquito vectors both native and invasive species at an island level focusing on regions at higher risk for disease transmission
Mosquito species

Mosquito larvae of natural breeding sites

<table>
<thead>
<tr>
<th>Wetland</th>
<th>Mosquito species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akrotiri wetland</td>
<td><em>Culex perexiguus</em>, <em>Culex pipiens</em>, <em>Culiseta subochrea</em>, <em>Culiseta annulata</em>, <em>Anopheles algeriensis</em>, <em>Aedes detritus</em>, <em>Aedes caspius</em></td>
</tr>
<tr>
<td>Larnaca saltmarsh</td>
<td><em>Culex pipiens</em>, <em>Aedes caspius</em>, <em>Aedes detritus</em>, <em>Culiseta subochrea</em>, <em>Culex modestus</em>, <em>Culex perexiguus</em></td>
</tr>
<tr>
<td>Oroklini lake</td>
<td><em>Culex modestus</em>, <em>Culex pipiens</em>, <em>Culex perexiguus</em></td>
</tr>
<tr>
<td>Paralimni lake</td>
<td><em>Culex perexiguus</em>, <em>Anopheles sacharovi</em>, <em>Aedes caspius</em></td>
</tr>
<tr>
<td>Rocky beaches</td>
<td><em>Aedes mariae</em></td>
</tr>
</tbody>
</table>

Adult mosquitoes – BG-Sentinel and EVS traps

<table>
<thead>
<tr>
<th>Adult mosquitoes identified</th>
<th>Mosquito species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Culex perexiguus</em></td>
</tr>
<tr>
<td></td>
<td><em>Culex pipiens</em></td>
</tr>
<tr>
<td></td>
<td><em>Culex spp.</em></td>
</tr>
<tr>
<td></td>
<td><em>Culiseta longiareolata</em></td>
</tr>
<tr>
<td></td>
<td><em>Aedes detritus</em></td>
</tr>
<tr>
<td></td>
<td><em>Culiseta spp.</em></td>
</tr>
<tr>
<td></td>
<td><em>Aedes caspius</em></td>
</tr>
<tr>
<td></td>
<td><em>Aedes mariae</em></td>
</tr>
<tr>
<td></td>
<td><em>Culex theileri</em></td>
</tr>
</tbody>
</table>
B) Mapping mosquito distribution to prioritize regions for which enhanced measures needs to be taken to control the mosquito population to protect public health
Larvae distribution and abundance (dry season)
Larvae distribution and abundance (wet season)
Adult mosquito distribution (dry season – BG-Sentinel)
Adult mosquito abundance (dry season – BG-Sentinel)
N.B. Mosquito eggs were not deposited in the placed ovitraps during wet season 2020 - 2021.
Adult mosquito distribution (wet season – EVS)

N.B. Mosquito eggs were not deposited in the placed ovitraps during wet season 2020 - 2021.
Adult mosquito abundance (wet season – BG-Sentinel-EVS)
Adult mosquito distribution and abundance (wet season – BG-Sentinel)

<table>
<thead>
<tr>
<th>Surveillance region</th>
<th>Female (average)</th>
<th>Male (average)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicosia</td>
<td>1.22</td>
<td>1.11</td>
<td>2.33</td>
</tr>
<tr>
<td>Lefka</td>
<td>0.88</td>
<td>0.63</td>
<td>1.51</td>
</tr>
<tr>
<td>Morphou</td>
<td>2.11</td>
<td>0.56</td>
<td>2.67</td>
</tr>
<tr>
<td>Famagusta</td>
<td>10.67</td>
<td>24</td>
<td>34.67</td>
</tr>
<tr>
<td>Trikomo</td>
<td>0.79</td>
<td>0.86</td>
<td>1.64</td>
</tr>
<tr>
<td>Karpasia</td>
<td>0.13</td>
<td>0.13</td>
<td>0.26</td>
</tr>
<tr>
<td>Mesaria</td>
<td>0.73</td>
<td>0.13</td>
<td>0.87</td>
</tr>
<tr>
<td>Kyrenia</td>
<td>1.7</td>
<td>0.15</td>
<td>1.85</td>
</tr>
</tbody>
</table>
## Adult mosquito distribution and abundance (wet season – EVS)

<table>
<thead>
<tr>
<th>Surveillance region</th>
<th>Female (average)</th>
<th>Male (average)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicosia</td>
<td>0.6</td>
<td>0</td>
<td>0.6</td>
</tr>
<tr>
<td>Lefka</td>
<td>0.2</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Guzelyurt</td>
<td>0.8</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td>Kyrenia</td>
<td>0.2</td>
<td>0</td>
<td>0.2</td>
</tr>
<tr>
<td>Famagusta</td>
<td>12.2</td>
<td>0.4</td>
<td>12.6</td>
</tr>
<tr>
<td>Trikomo</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Heat map for female *Culex pipiens*
C) Enhancing capacity building of Greek Cypriots and Turkish Cypriots to identify mosquitoes of medical significance and to perform surveillance programs
Two virtual training events took place on the 28th and 29th of July 2020 due to mobility restrictions due to the COVID-19 pandemic. In total, more than fifty participants participated in both trainings.
D) Increasing public awareness on protection measures against mosquito bites
A video emphasizing the importance of collaboration between Greek Cypriots and Turkish Cypriots to achieve common health protection and environmental goals and the importance of mosquito surveillance in MBD prevention.
A leaflet focusing on
- self-protection measures against mosquito bites
- how the public can prevent mosquitoes from entering their homes
- how to minimize breeding sites at residences.

**PROTECTION MEASURES AGAINST MOSQUITO BITES**

As an initiative of the "Identification and Distribution of Mosquito Vectors of Medical Importance on the island of Cyprus (ID-VEc)" project, Technical Committee on Health.

Mosquito species are an infamous nuisance to humans and they have the ability to affect our quality of life, outdoor working conditions, athletic and leisure activities. Even just one mosquito entering your home can ruin your whole evening while enjoying a movie or can lead to poor sleep due to buzzing near your ear all night.

To prevent mosquito bites, take the following steps:

1. Eliminate standing water from all sources – natural and artificial.
2. Clean debris from rain gutters to allow proper drainage.
3. Empty and/or change the water in potted plant trays, bird baths, fountains, and watering pools at least once a week to prevent mosquito development.
4. Check around air conditioner units and avoid puddles.
5. Eliminate seepage from cisterns, cesspools, and septic tanks.
6. Drain or cover temporary pools of water within.
7. Keep swimming pool water treated and circulating.
8. Cover unused containers that can collect rainwater when not in use.
9. Grid holes in the bottom of the swings to allow any water to drain.
10. Fill in tree holes and hollow stumps that hold water with sand.

**HOW TO ELIMINATE MOSQUITO BREEDING SOURCES FROM YOUR HOME**

- Eliminate standing water from all sources – natural and artificial.
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- Grid holes in the bottom of the swings to allow any water to drain.
- Fill in tree holes and hollow stumps that hold water with sand.

**HOW TO PROTECT YOURSELF FROM MOSQUITO BITES**

**PHYSICAL MEASURES**

- Prevent mosquitoes from coming close to you in the first place.
- Tudor window and door screens. If they are not already in place, completely cover baby carriages and beds with netting.
- Ensure that all door and window screens do not have tears or holes and that they are tightly fitted.

**PERSONAL PROTECTION**

- A mosquito’s first choice for biting is your bare, unprotected skin. When going outside, especially at times when mosquitoes are active, make sure you wear appropriate clothing that is difficult for the mosquitoes to penetrate. Wear light-colored, loose-fitting, long-armed shirts and long pants.
- Hose insect repellent containing DEET or picaridin are the most effective. Always follow the instructions on the label.

**HOW TO CONTROL MOSquito LARVAE**

- For larval stage, mosquitoes are concentrated, less mobile and more accessible.

**HABITAT MANAGEMENT**

- Involvement of the community is essential to these interventions, especially rural areas. Citizens and residents of these areas play a crucial role in mosquito surveillance and control by eliminating breeding sites, by notifying the competent authorities about their presence in different environments.
- Successful control efforts are those combining breeding source removal with other means of control.

What would happen if we used a magic wand to get rid of all the mosquitoes in the world?

**DID YOU KNOW THAT YOU COULD BE BREEDING MOSQUITOES IN YOUR OWN HOME?**

The mosquito life cycle consists of four stages: egg, larva, pupa, and adult. Female mosquitoes bite animals and humans in order to produce eggs. Our blood provides them with the nutrients necessary for developing eggs. In a few days’ time, eggs are either deposited directly on water, or on surfaces of water-holding containers or on the ground. Female mosquitoes need water for the first three stages of their life cycle. It is essential to monitor standing water sources. These can be:

- Standing water in rain gutters, old tires, buckets, plastic covers, toys, maribou, or any other container where mosquitoes can breed.
- Water in bird baths, fountains, wading pools, rain barrels, and wild plant leaves.
- Temporary and/or swimming pools, rock pools.
- Channels, marches, rainwater flooding area.

**References**


This action is of the Technical Committee on Health is funded by the European Union and implemented by UNDP in coordination with UNDESA.

**Leaflet**

“Disease vector is any agent which carries and transmits an infectious pathogen into another living organism.”

[4] Do not forget that although they can be perceived as a nuisance, not all of them bite. Mosquitoes are a critical food source for flying beings at the bottom of the food chain.”
Next Steps
From distribution and abundance maps to risk maps

• Island-wide survey for native and invasive mosquito vectors (egg, larvae and adults) – Dry and wet season | Pathogen screening

• VBD Integrated Management Plan

• Early warning system for mosquito outbreaks / MBDs

• Enhance citizen science and public sensitivity regarding VBDs

• Increase public awareness on prevention and protection measures

• Establish the fundamental pillars for integrated vector management
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Questions and Answers
Thank you for your attention!