

# Ovitrap Monitor detailed user guide

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## 1 Overview

*Ovitrap Monitor* is an open source, user-friendly web application that allows to count mosquito eggs from low-medium resolution mobile phones pictures and generates automatic indices, plots and maps. It can be used in all operating systems and devices with internet access. Users can register, upload pictures and ovitrap location data, and once they process the pictures, i.e., perform the mosquito egg counting, the records are saved in an electronic database from where automated time series plots and maps are built.

The counting algorithm (back-end) is written in Python and it is based on [OpenCV](#) and [Numpy](#) routines. It consists of two main parts:

- ovitrap stick isolation within the picture, and
- eggs' identification and counting.

The ovitrap stick isolation part involves color space conversion, Canny edge detection and morphological closing operation, thresholding and bounding box computation to extract the area to be further used only. Once the picture only features the ovitrap stick, the second part, i.e., eggs identification and counting starts. Three parameters are computed automatically based on the image width: the minimum egg area, maximum egg area and maximum cluster area. Finally, the algorithm requires the

user to input a threshold value that will be used to separate the eggs from the rest of the stick based on their darkness. After some intermediate checks, for each retained single egg candidate, the counter is incremented by one and for each retained cluster candidate, the algorithm estimates the number of eggs by dividing its area by the average single egg area and increment the counter accordingly.

As the algorithm and application was developed in the context of an operational surveillance system, we assume weekly data input (i.e., the date assigned to each uploaded picture is that of the previous Monday). Furthermore, our counting algorithm was mostly tested with wooden sticks, especially tongue depressors, as this is the egg laying substrate used by the Health Ministry authorities from Cordoba province in Argentina, whom we collaborated with.

This tool has been developed under the European Commission H2020 [EXPOSURE](#) project, grant number 734541. The project consortium provides it as open source software for research and use by health organisations. Commercial use is not allowed without the explicit permission of the developers.

## 2 Using the *Ovitrap Monitor* app

### 2.1 Register/Log in

*Ovitrap Monitor* requires users to create their account to be able to use the application, as the database and storage of pictures works on a per-user basis. Once the user is registered, they need to log in with their username and password to access all of the application's functionalities.

### 2.2 Upload ovitrap locations

If users are interested in getting map representations of their data, they should upload a GeoJSON file with ovitrap's location code and coordinates. The codes in this file will then be used to match ovitrap pictures codes and join with the counts for each time step. To upload ovitrap locations go to "Settings". The GeoJSON file should be of the following form:

```
{
  "type": "FeatureCollection",
  "name": "ovitrap_locations_epsg_4326",
  "crs": {
    "type": "name",
    "properties": {
      "name": "urn:ogc:def:crs:OGC:1.3:CRS84"
    }
  },
  "features": [
    {
      "type": "Feature",
      "properties": { "id": "CE16" },
      "geometry": {
        "type": "Point",
        "coordinates": [ -64.233792594323717, -31.382644735276333 ]
      }
    },
    {
      "type": "Feature",
      "properties": { "id": "N012" },
      "geometry": {
        "type": "Point",
```

```

    "coordinates": [ -64.217827642817312, -31.398976461490523 ]
  }
]
}

```

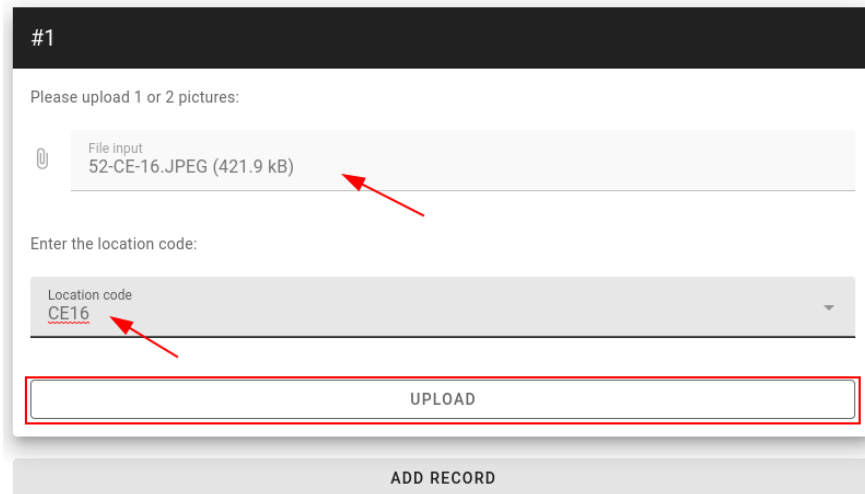
and coordinates should be in EPSG:4326.

## 2.3 Upload ovitrap pictures

Users can upload one or optionally two (front and back) pictures per ovitrap station (Figure 1). Importantly, they must not forget to add or select from the dropdown menu, the ovitrap location code. This will ensure a proper join of the counts performed afterwards with old records in the database.

### Upload

For each stick, you can upload either the front picture or both the front and the back picture. Please make sure to enter the location code when uploading the stick pictures.



#1

Please upload 1 or 2 pictures:

File input  
52-CE-16.JPEG (421.9 kB)

Enter the location code:

Location code  
CE16

UPLOAD

ADD RECORD

Figure 1: Upload a picture

## 2.4 Process the ovitrap pictures

Once the user completed the upload of positive ovitrap pictures, they will find all of them under the **Database** section. There, users are able to filter and sort records by location code, date or process status (i.e., processed or not). To process each ovitrap picture just click over a record in the database and the counting interface window will open with a threshold value set by default. Users can zoom in and out, update the bounding box and move the slider until they are happy with the egg count obtained (Figure 2). Furthermore, they can directly edit the count by inputting a corrected value, if for some reason, usually stained stick, low contrast or debris, any of the above options does not provide an acceptable egg count. Once happy with the count obtained, users should save the count and proceed with the next record. The database will be updated accordingly.

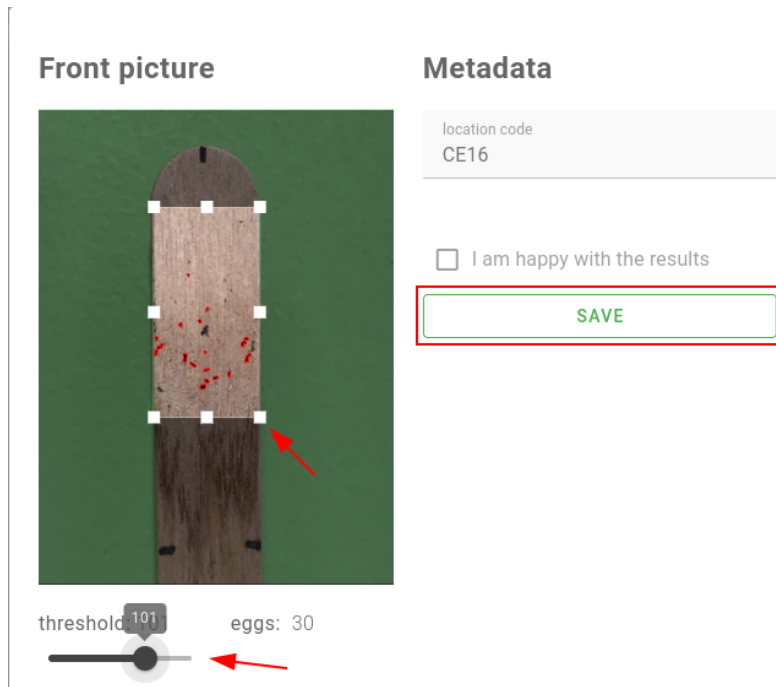


Figure 2: Count window

## 2.5 See the automatic report

Once the counting is complete for all ovitraps of a certain date, users will get some basic stats, plots and maps automatically. The application computes the positive ovitrap rate, the mean number of eggs and the change rate with respect to the previous week (Figure 3). The time series plot shows the mean number of eggs per week bounded by the 10th and 90th percentile. The time series is displayed by default with weekly time steps, but it can also be aggregated and displayed monthly. Users can download both the weekly or monthly plots and csv files with the data, i.e., ovitrap code, date and counts. Furthermore, if the user uploaded the GeoJSON file with the ovitrap locations, they will get two interactive maps displayed: one with the ovitrap counts represented by the size of the symbols and the second representing the change in egg counts regarding the previous week. Blue dots will show locations where the egg counts decreased and red dots, locations where egg counts increased.

## 3 Recommendations for better results

### 3.1 Camera quality

Users should set the quality of their mobile phone cameras to **fine** in order to get the best possible resolution. This is very important as the size of eggs is dependant on image size.

### 3.2 Background and light conditions

When taking ovitrap sticks pictures, users should search for a contrasting but homogeneous background, and no shadows. Good illumination conditions are a must and we advice to build a setting where the stick is in straight standing position. It's also recommended to use a tripod to hold the phone and avoid getting blurry pictures.

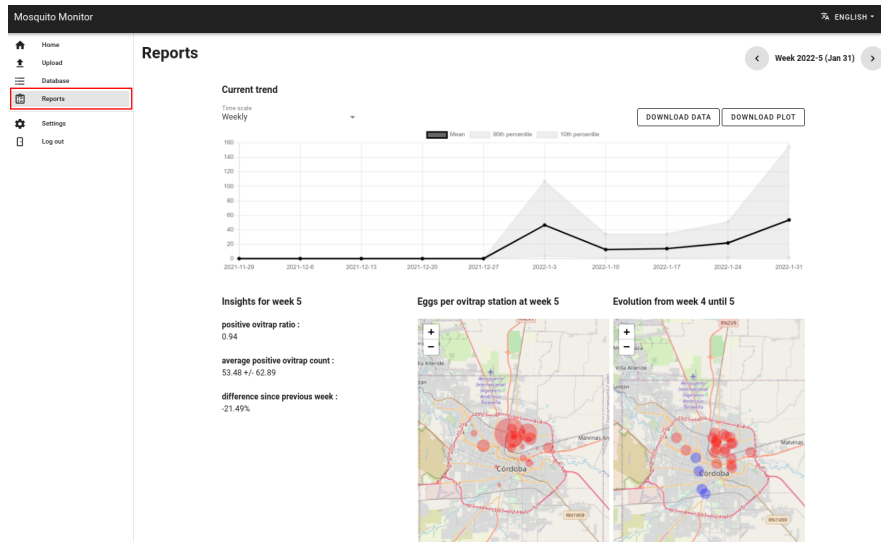


Figure 3: Report section

### 3.3 Editing counts

If after several trials and errors, the user is not happy with the egg count obtained, they can always edit the count to the estimated number themselves (Figure 4). They just need to click over the count to be able to edit it.

### 3.4 Adding negative ovitraps to the database

Users do not need to take pictures of negative ovitraps (i.e., ovitraps with no eggs). Instead, to keep track of all ovitraps in the surveillance, they can just add the ovitrap code and (zero) count under the upload section (Figure 5). This record will then be stored with the others in the database.

## 4 A note on data storage

Ovitrap pictures uploaded by users are stored on an AWS S3 bucket. There's currently no limit for the picture storage. However, users should be aware that this can change in the future if Amazon policy changes. Therefore, if users want to keep copies of the ovitrap pics, they are recommended to do regular back-ups.

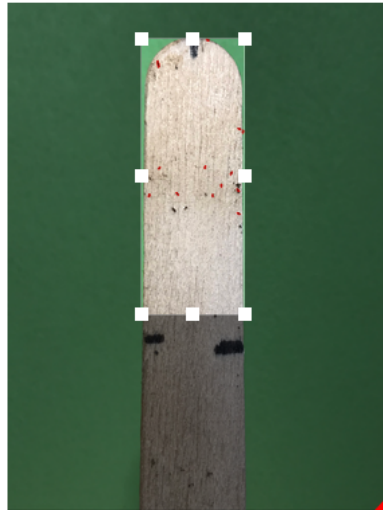
All metadata and egg counts on the other hand, are stored in a free Heroku SQL database. All data is stored together, but users can only see and modify data of their own. The limit of this database is a total amount of 10000 rows. Again, users are encouraged to back up their data, i.e. download the records from time to time.

## 5 Links to the source code and sample data set

- Web application (Fron-end): <https://gitlab.com/charles.hamesse/ovitrap-monitor-client>
- Egg counting algorithm (Back-end): <https://gitlab.com/charles.hamesse/ovitrap-monitor-server>
- Sample data set (300 ovitrap pictures and observed counts): <https://zenodo.org/record/6962536>

If you want to report bugs or errors, please contact us via the issue tracking system within the repositories, or via email at: [Charles.Hamesse@ugent.be](mailto:Charles.Hamesse@ugent.be) and [veroandreo@gmail.com](mailto:veroandreo@gmail.com).

## Front picture



## Metadata

### Date

Feb 21 2022

### Location code

location code  
CE-1

### Save

Click, enter the right count and save

☐ I am happy with the results

SAVE

CLOSE

Threshold: 95



eggs  
13

13

Figure 4: Edit counts

## Upload

For each stick, you can upload either the front picture or both the front and the back picture. Please make sure to enter the location code when uploading the stick pictures.

#1

Enter the location code:

location code  
CE10

If there are eggs on the stick, please upload a front picture and (optionally) a back picture:

file input

Otherwise, directly enter the number of eggs:

number of eggs  
0

UPLOAD

Figure 5: Add records with zero eggs