



May 2020

## MapVEu: part I - An introduction

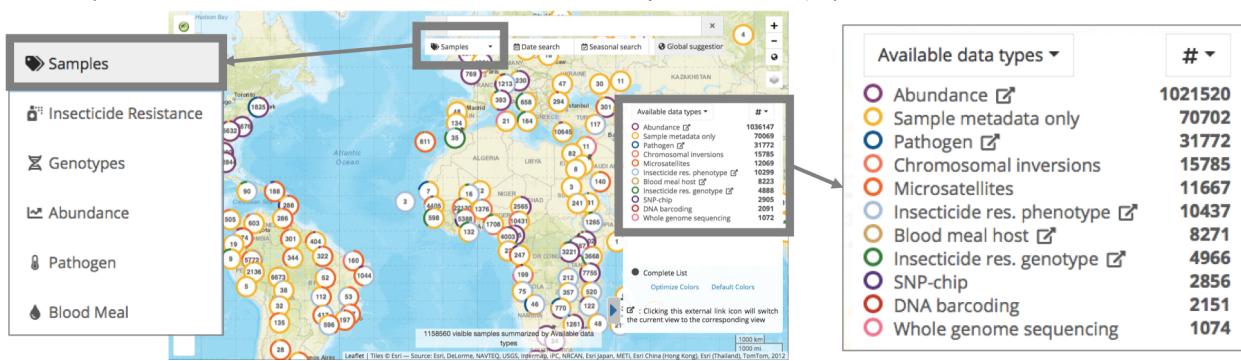
**Note:** this exercise uses VectorBase.org data as an example, but the same functionality will soon become available for other VEuPathDB resources

### Learning objectives:

- Use keywords, filters and ‘click and zoom’ to query and browse samples or assays
- Interpret the markers or points on the map, their colors and numbers
- Share a link of your current ‘interactive’ map view, not just a static screenshot
- Download the raw data
- Find the data providers/sources to cite them

Advanced features can be found in [part II](#) of this tutorial

MapVEu is part of our ongoing efforts to integrate genomic, phenotypic and population data as shown below (the # column indicates the number of samples or assays):



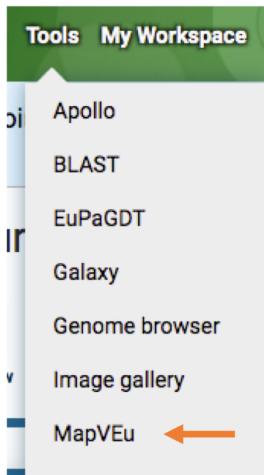
This icon indicates which data types have their own ‘map view’, click on them to switch views. An alternative way to change the view is by clicking the dropdown menu (top of the page). Currently there are six views and there are plans to include more, based on users needs. The markers in the map, such

us this one , indicate each data point and corresponding metadata including publication citation or DOI for unpublished datasets. Other menus and filters will be explained in more detail with the following [sample use case](#): Let’s explore the insecticide resistance state of *Anopheles gambiae sensu lato* in Ethiopia, for assays performed with the WHO paper kit diagnostic test (DT) for adults:

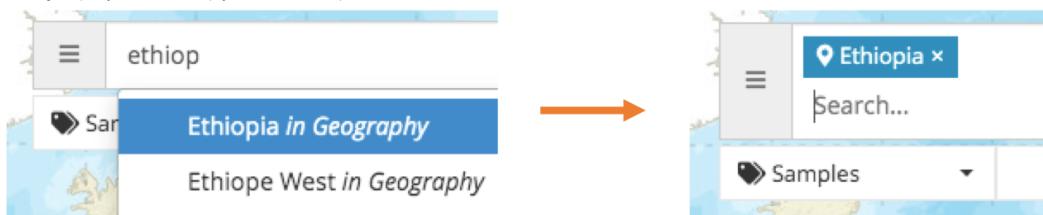
- How many different insecticides have been tested?
- What is the time span in years for the data collections?
- Are there insecticides with a mortality indicating insecticide susceptibility (i.e., ≥98% mortality)?
- Are there any insecticides with an increase in mortality suggesting possible resistance (i.e., 90–97% mortality)?
- For the last year in record, has there been any confirmed cases of resistance (i.e., <90% mortality)?
- How do I cite the data?

Here is the **step by step process** to answer these questions

1. To open the map, go to home page > Tools menu > MapVEu



2. By default, the map view is set to 'Samples', which aggregates ALL the data from the map. Use Ethiopia as a keyword. Notice how while you type, autocomplete suggests this word for the geography (ontology) category, select it



3. Before you click on the map, there are three markers. Now slowly begin to zoom in, notice the markers divide. Different alternatives to zooming include: click on the plus sign on the map (as shown in the image below), mouse wheel, double click marker, double click map, and shift-click to draw rectangle



4. The markers that will not divide any further are labeled with a pin

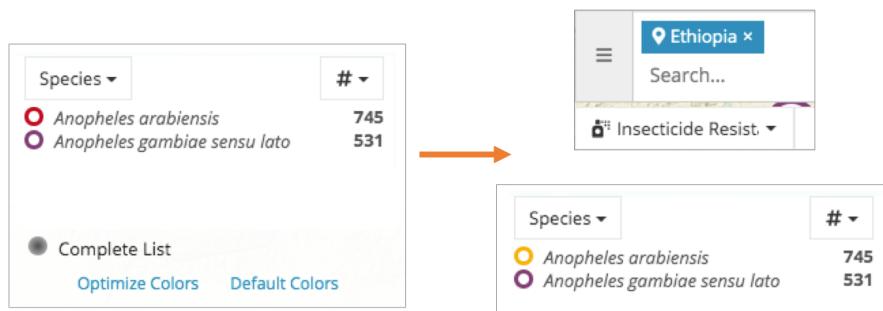


## 5. On the right hand side menu

Available data types ▾	# ▾
<input checked="" type="radio"/> Abundance ↗	3325
<input type="radio"/> Insecticide res. phenotype ↗	1239

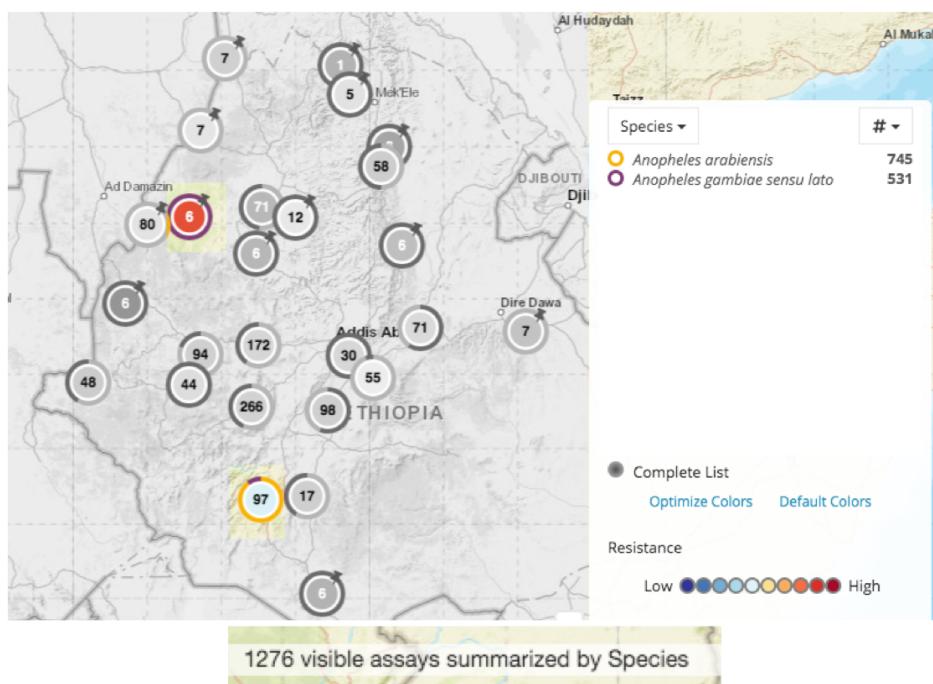
- Click on this icon  next to ‘insecticide resistance phenotype’. This will switch you from ‘samples’ to ‘insecticide resistance’ (IR) view. Except for the samples view, each other ‘view’ represents a SUBSET of the data. In IR view we are now visualizing assays, not samples
  - Note: this is different from a click on the text (‘insecticide resistance phenotype’), which will generate a query with these keywords in the same (Samples) view

6. The filters in the right hand menu change from ‘available data types’ to ‘species’. Click on ‘optimize colors’ to have a better color contrast of the markers



7. This is how to interpret the exterior ring and interior circle of the markers:

- There are 6 assays for *gambiae sensu lato* with insecticide resistance (**red**)
  - There are 97 assays for *A. gambiae sensu lato* and *A. arabiensis*, with insecticide susceptibility (**blue**)

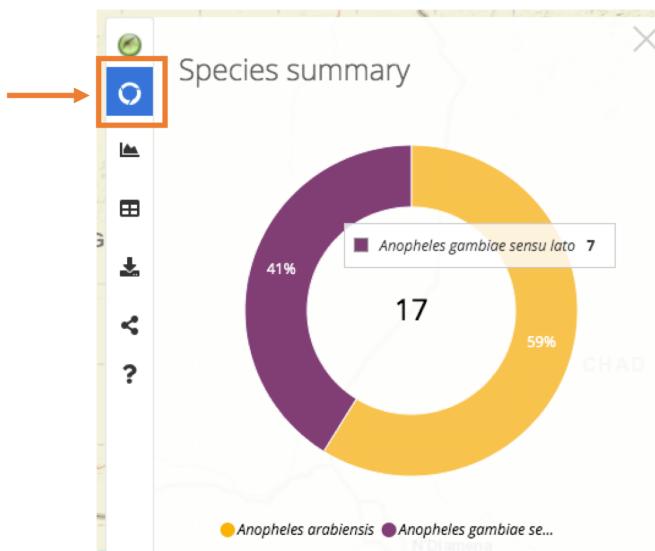


8. Click on a marker to obtain metadata about these samples and details about the values of insecticide resistance. For example, click in the one with the number 17

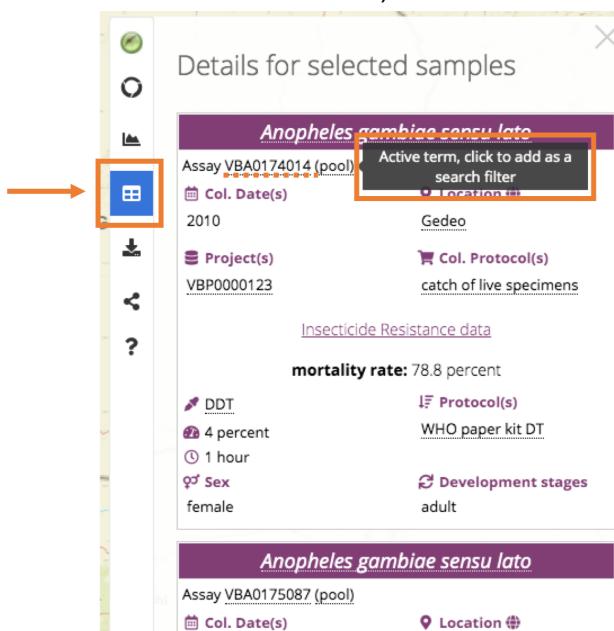


9. A side panel will open on the left of the map showing:

- a. Summary statistics for the species in percentages. Hover the mouse over the donut/plot to see the raw numbers



- b. Metadata details for the selected samples (You could hover over and click the dotted lines to add the active term as a search filter)



10. Apply filters in the right hand side menu:

- Select the '**Species**' of interest to add it as a search term in the top box (or type the name directly in the search box)

The screenshot shows a search interface with a sidebar on the left containing dropdown menus for 'Species' (with options for Anopheles arabiensis and Anopheles gambiae sensu lato), 'Sample type', 'Collection protocol', 'Project', and 'Protocol'. A red arrow points from the 'Species' dropdown to the top search bar, which now displays 'Ethiopia x Anopheles gambiae sensu lato x Search...'. To the right of the search bar are two numerical counts: 745 and 531.

- Select the assay '**Protocol**' of interest to add it as a filter term in the top box (or type the name directly in the search box)

This screenshot illustrates the sequential application of filters. It starts with the same sidebar as the previous image. A second red arrow points from the 'Protocol' dropdown to another search interface. This second interface has its own sidebar with 'Protocol' selected (highlighted with a red box). It also shows a 'Protocol' dropdown with WHO paper kit DT and CDC bottle bioassay options, and a count of 1141 and 135. A third red arrow points from the bottom search bar of this second interface to a final search bar at the bottom, which now includes the previously applied filters: 'Ethiopia x Anopheles gambiae sensu lato x WHO paper kit DT x Search...'. The sidebar on the far left is identical to the first screenshot.

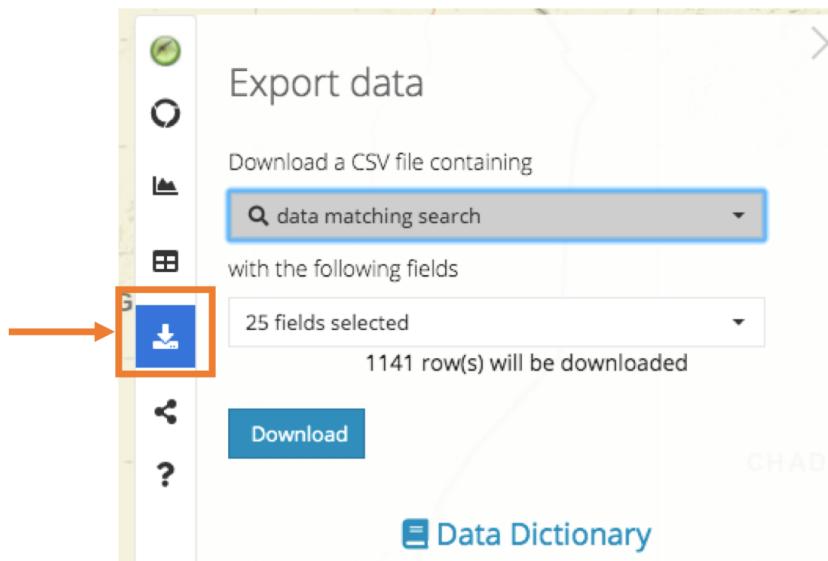
- Select '**Insecticide**' as a filter. As with the previous filters, you could click on any of them to add them as query terms, but the purpose here is actually to see them all

This screenshot shows a sidebar with an 'Insecticide' dropdown menu. The menu lists various insecticides with their corresponding counts: Deltamethrin (160), DDT (156), Bendiocarb (149), Propoxur (143), Pirimiphos-methyl (129), Fenitrothion (129), Malathion (109), Lambda-cyhalothrin (50), Permethrin (42), Etofenprox (35), Alpha-cypermethrin (34), and Clothianidin (5). A red arrow points from the 'Insecticide' dropdown to the bottom search bar, which now includes the filters: 'Ethiopia x Anopheles gambiae sensu lato x WHO paper kit DT x Search...'. The sidebar on the far left is identical to the first screenshot.

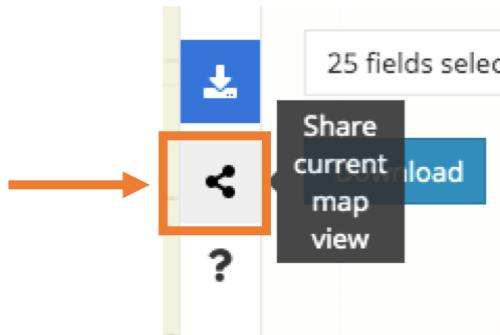
11. Click on 'Date Search'. Click on each date range. Delete (click on the x) the ones with no data. To activate all the date ranges with data click + command/control

The screenshot shows the 'Date search' section of the interface. It features a search bar with '2005-2009,2010-2014,2015-now x'. Below the search bar are several date range buttons: '1985-1989', '1990-1994', '1995-1999', '2000-2004', '2005-2009' (which is highlighted in blue), '2010-2014', and '2015-now'. At the bottom of the date search section are buttons for 'Insecticide Resistance', 'Date search' (which is active), 'Seasonal search', and 'Global suggestions'.

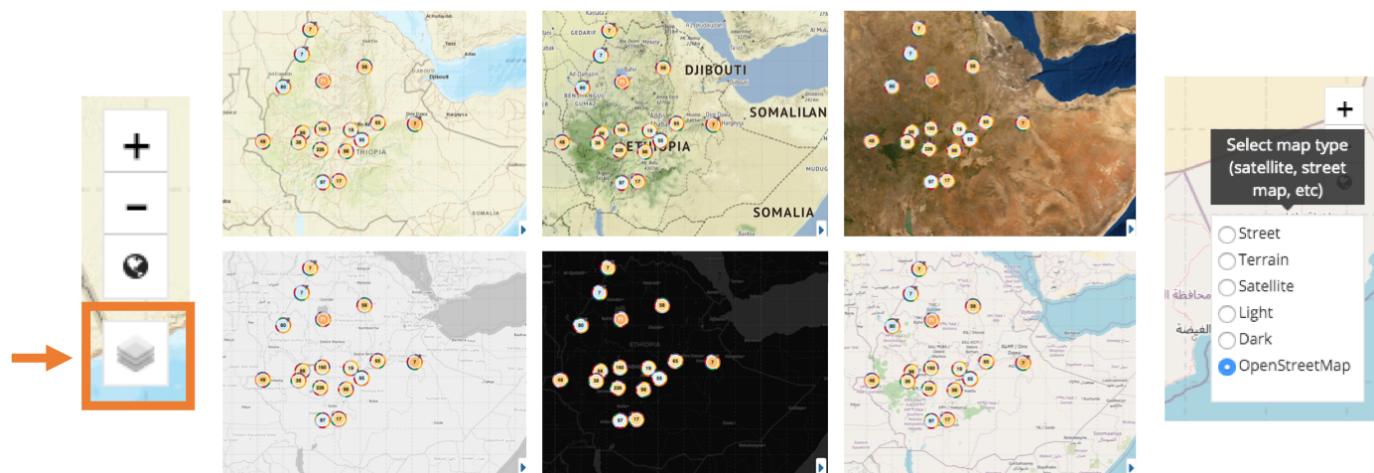
12. Download the csv file for the ‘data matching search’ and all ‘25 fields selected’, which can be opened in programs such as Excel



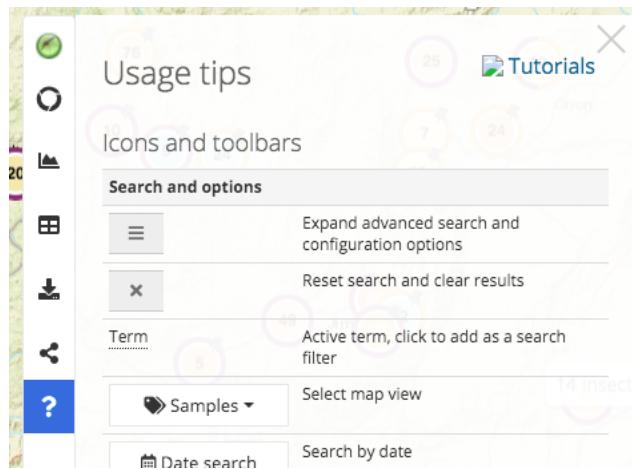
13. Share the map link in your paper or with a colleague, the link is ‘interactive’ and not just a static screenshot



- Your colleague can edit the map too, including change its background



14. The ‘Data Dictionary’ (Step 12), ‘Usage tips’ and ‘Tutorials’ options provide help about the use of the map



## Results interpretation

From the map visual interface we can see that there are 1141 assays summarized by insecticide, tested with WHO paper kit DT, for *Anopheles gambiae sensu lato* in Ethiopia. These samples have a mix of resistant and susceptible phenotypes

- How many different insecticides have been tested?: Twelve, the specific list can be found in figure 10.c
- In what year did the data collection start and finish?: 2006 to 2017, detailed years in the csv file

From the csv file we downloaded, the following questions can be answered:

- Are there insecticides with a mortality indicating insecticide susceptibility (i.e.,  $\geq 98\%$  mortality)?: There are nine insecticides with a mortality indicating insecticide susceptibility: bendiocarb, clothianidin, deltamethrin, fenitrothion, lambda-cyhalothrin, malathion, permethrin, pirimiphos-methyl and propoxur
- Are there any insecticides with an increase in mortality suggesting possible resistance (i.e., 90–97% mortality)?: No
- For the last year on record, has there been any confirmed cases of resistance (i.e., <90% mortality)?: No. In 2017, the only insecticide tested was Clotianidin and it showed 100% mortality
- How do I cite the data?: in the csv file there is a column called citations with DOIs and PubMed IDs if available

## **How to cite MapVEu data in your publications?**

- Submitting to MapVEu and referencing your own data:

## Data availability.

Microsatellite and SNP genotypes were deposited in VectorBase<sup>48 49</sup>, PopBio projects: VBP0000201 (new data), and VBP0000138, VBP0000176-177 (previously published data). Sequencing data were deposited in NCBI under accession numbers [MF371160-MF371174](#) and [MG241351-MG241354](#).

Gloria-Soria, A., Lima, A., Lovin, D.D., Cunningham, J.M., Severson, D.W., & Powell, J.R. (2018). Origin of a High-Latitude Population of *Aedes aegypti* in Washington, DC. *The American journal of tropical medicine and hygiene*, 98(2), 445-52.

- Using and citing data submitted by others:

combinations of keywords. Additionally, we searched for data meeting our criteria in the following data repositories: BioTIME(37), GPDD(38), the LTER repository ([www.lternet.edu](#)), Knowledge Network Biocomplexity (<https://knb.ecoinformatics.org/>), the LTREB database, the Global Biodiversity Information Facility ([www.gbif.org](#)) and VectorBase (39). This yielded 166 studies from which data could be extracted. We extracted time series of insect abundance and /

Van Klink, R., Bowler, D.E., Gongalsky, K.B., Swengel, A.B., Gentile, A., & Chase, J.M. (2020). Meta-analysis reveals declines in terrestrial but increases in freshwater insect abundances. *Science* (New York, N.Y.), 368(6489), 417-20.

## How can a reader from your paper can find the data in MapVEu?

This is how a reader from Gloria-Soria et al 2018 (reference above), could query for the data: In the 'Samples' view, type the VectorBase project IDs, VBP\* in the search box. In this case, the filters show that the data are classified as microsatellites and SNPs

