MONITORING OF MOSQUITO BREEDING SITES USING DRONES AND MULTISPECTRAL CAMERAS IN PERIURBAN AREAS OF SPAIN.

R. Bueno-Marí, M. García-Howlett, Á. Gil Arques, I. Miralles Betoret & C. Fernández Santamaria

[1]Research and Development (R+D) Department, Laboratorios Lokímica, Alicante, Spain.

INTERNATIONAL CONFERENCE ON URBAN PESTS — ICUP 2022 BARCELONA ES

lokímica laboratorios — AEROLOK lokímica

• Introduction

• Some *Aedes* mosquitoes, mainly *Aedes caspius* and *Aedes detritus*, cause relevant nuisances in urban and peri urban areas situated close to some wetlands in Spain. These floodwater mosquitoes are particularly difficult to control at larval stage after intensive rains, since they can quickly colonize large breeding sites (marshes, lagoons, temporary ponds, etc.) which are usually covered by dense vegetation. Consequently, a quick and precise identification process of potential breeding sites is essential to apply effective larval control measures.

• In this context, we developed a system to monitor flooded areas suitable for floodwater mosquito proliferation using drones and multispectral cameras. Multispectral sensors allow the identification of water accumulation (even fully covered by dense vegetation), thanks to longitudinal and transversal overlapped images that are taken and processed in the field only in few minutes.

• We expose some cases of regular surveillance of breeding sites in different wetlands of Eastern Spain using this novel technology, as well as it's validation process thanks to continuous terrestrial monitoring conducted. The final goal is to systematize the use of drones equipped with multispectral cameras as an Early Warning System (EWS) in mosquito surveillance and control programs.

• Material and Methods

• The identification of the study area is defined by geographic information systems. We have chosen as an example the study two areas known as Finca del Pou and Andanas, located in Nules, Castellón, carried out with fixed-wing drones and multispectral cameras (**Fig.1**).

• In the study area, the drone pilot takes the images during the day. The flight does not exceed the visual range of the pilot (VLOS). Less than 500 meters away. Sampling points distributed over the entire study area are obtained, forming a grid of points that will serve as a reference.

• The multispectral images taken in the field are processed using the Pix4DMapper tool. Using the appropriate software, it can be done fully controlled from the base station. The aircraft sensor takes images according to a programmed frequency and with transversal and longitudinal overlap between them, to allow their georeferencing. Through the PC, the images are processed giving them coordinates and combining them to obtain a single image of the overflown or orthomosaic terrain. Using the spectral index calculator, the NDWI (Normalized Difference Water Index) index is obtained. By applying the NDWI formula to the corresponding bands, we obtain as a result a raster with flood zones or water masses (**Fig.2**).

• The different spectral bands obtained with the multispectral camera allow us to calculate the different indexes to identify the vegetation cover, the level of soil moisture, the masses of water, the ditches, the pools, the type of vegetation or the type of soil, among other functions.

• Once this process is finished, the wetlands under study are identified and delimited and the water masses are sampled by means of a dipper.

Fig.1. Support materials used for the development of the project. On the left, fixed wings drone. On the right, Multispectral camera.

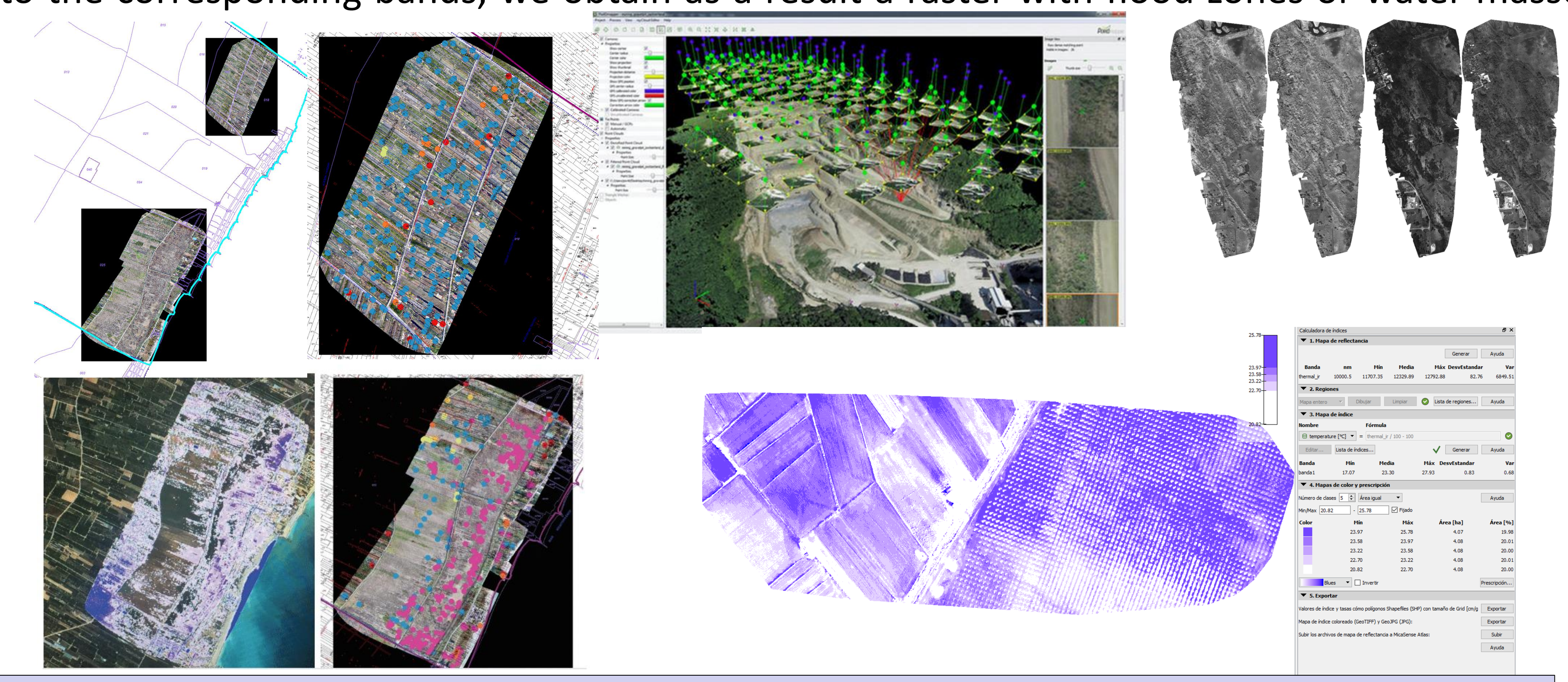


Fig.2. On the left we can locate the plots under study. Once the orthomosaic of the images captured at each of the established control points has been created, they are processed using the index calculator to obtain a GeoTiff with the result.

• Results

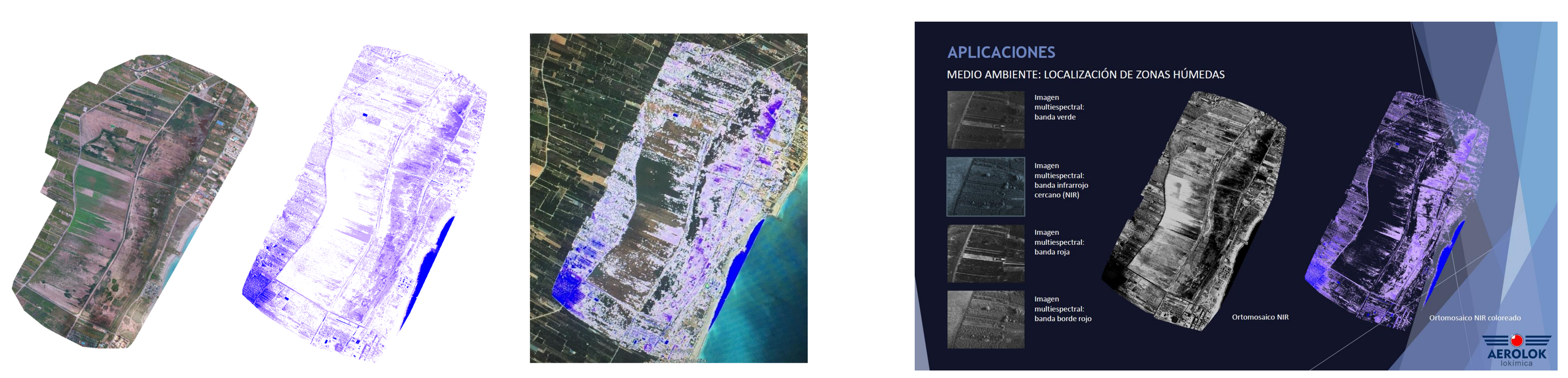
NDWI values can range from -1 to 1:

• Values between – 1 and 0: indicate surfaces without vegetation or water.
• Values close to 0: indicate areas with low vegetation cover or high water stress.
• Values between 0 and 1: indicate areas with increasing coverage and hydration.

As a result of the image processing, a GeoTiff is obtained whose values range between -1 and 1.

Values with intense blue colors indicate values above 0, while values with lighter blues or white color indicate values less than 0.

Finally, for the selection of the sampling areas, only those pixel values above 0.5 have been filtered.



Geolocation of the final GeoTiff layer on orthophoto.

Once the areas with values greater than 0.5 were obtained and filtered, a sampling was carried out in the identified area. The main objective was, first, to confirm the presence of water or high humidity in the flooded areas, and second, to identify the presence of adult mosquitoes or larvae. Adult mosquito sampling was performed by direct observation by a qualified entomologist, while larvae identification was performed using a dipper.

• Sampling confirmed the presence of water and wetland areas in the areas detected by multispectral imaging.
• Areas of depression with stagnant water, high levels of vegetation and soil with very high levels of waterlogging were detected.
• Larval and adult activity were also detected.

• Conclusions & Further Research

• In conclusion, we can confirm that the implementation of new technologies based on RPAS and DRONE combined with the modernization of new types of sensors and multispectral cameras constitute a safe and effective method for the identification and monitoring of mosquito foci in Spanish Mediterranean wetlands. These new technological tools are a fundamental support in integrated pest control. They have the capacity to provide quick and accurate identification of potential mosquito breeding areas. In addition, continuous monitoring allows us to forecast vector proliferation areas and anticipate the real problems and risk of a municipality or region.

• The implementation of new types of active sensors such as LIDAR (Light Detection and Ranging or Laser Imaging Detection and Ranging), Artificial Intelligence and Neural Networks or Synthetic Aperture Radar (SAR) constitute the future of technology in the field of mosquito and other urban pest management. These new tools and sensors, combined with GIS and remote sensing tools, is giving us the chance to obtain massive knowledge of the natural environment that was previously unimaginable.