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The Geographical Distribution of Anopheles Species in Malaria-endemic and Non-endemic Areas of Honduras

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Editorial

Over the previous two decades, Honduras has maintained a significant drop in malaria cases. The current number of cases has been lowered by 97 percent when compared to the 35,125 cases in 2000. More than 96 percent of the cases in the country come from the department of Gracias a Dios and 99 percent of the cases are caused by Plasmodium falciparum. The biggest malaria hotspot in Honduras is Puerto Lempira near Gracias a Dios. In 2020, the country had 12 active malaria foci, mostly in Gracias a Dios and residual foci in Yoro, Bay Islands and El Paraso. Management strategies adopted in the nation to meet the objective of eradicating malaria by 2030 include entomological surveillance and vector mosquito population control [1].

The most common and ubiquitous species in the nation is Anopheles albimanus. The genus Anopheles (Culicidae: Anophelinae) has over 500 species divided into at least seven subgenera. Anopheles (*Anopheles crucians, Anopheles pseudopunctipennis*, *Anopheles vestitipennis, Anopheles punctimacula, Anopheles neomaculipalpus, Anopheles apicimacula, Anopheles gabaldoni* and *Anopheles albitarsis*), *Anopheles Nyssorhynchus* (*Anopheles albimanus* (*Anopheles neivai*). *Anopheles* (Nys.) *albimanus*, *Anopheles* (An.) *pseudopunctipennis*, *Anopheles* (Nys.) *darlingi* and *Anopheles* (Nys.) *albitarsis* are the four primary vector species of human malaria [2].

288 anophelines from five Honduran departments (Gracias a Dios, El Paraso, Comayagua, Cortés and Bay Islands) were discovered using morphology and molecular biology in this study. The relative quantity of mosquitos was also recorded, as was the lack of parasite DNA in the mosquito head/thorax. The findings presented here expand on a previous research published in 2020 that involved the taxonomic and molecular identification of 1320 Anopheles mosquitos collected in five Honduran departments (Gracias a Dios, El Paraso, Comayagua, Atlántida and Colón). The vast majority (73 percent) of the anophelines were gathered in the department of Gracias a Dios, which includes the La Moskitia area, which is shared with Nicaragua and is malaria-endemic [3].

The majority of the specimens (80 percent) were recognised as *An. albimanus*. Despite the biological variations across the research locations, this species was found in all five departments. *Anopheles albimanus* has been reported as the prevalent species throughout most of Mesoamerica and northern South America. *Anopheles albimanus* is a generalist species, able to live in a variety of settings and feed opportunistically on numerous hosts. This conclusion is also similar with a recent research done in Honduras, when 74 percent of anophelines discovered were *An. albimanus*. *An. albimanus* and *An. pseudopunctipennis* were the two most prevalent species in a study of 22,000 larvae of 13 species of anophelines collected in 19 states of Mexico.

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These two species were also shown to be the most numerous and extensively spread anophelines along Mexico's Pacific coast. Two recent investigations done among indigenous communities in Panama identified between 43 and 98 percent of mosquitos as *An. albimanus*. In Colombia, a retrospective descriptive study found that *An. albimanus, An. nuneztovari* s.l. and *An. darlingi* were the main malaria vectors in receptive areas and a study assessing the potential distribution of the three main malaria vectors in Colombia discovered that *An. albimanus* had the greatest niche breadth, primarily in coastal areas [4].

An. pseudopunctipennis, the second species discovered in this study and considered a prominent vector of malaria, was found solely in Comayagua. In Honduras, *An. pseudopunctipennis* appears to be a rare vector species. Escobar et al. reported 3.1 percent of mosquitos in Colón and Comayagua, however our research found fewer than 1%. The remaining 17.4 percent of mosquitos gathered are An. crucians, *An. argyritarsis, An. neomaculipalpus, An. vestitipennis, An. apicimacula* and *An. punctimacula*. Three of these species (*An. argyritarsis*, *An. apicimacula* and *An. neomaculipalpus*) were not described in the 2020 research thus are not considered prominent malaria vectors.

The fraction of two species gathered in Gracias a Dios has decreased significantly since the 2020 research. The season of the year in which the mosquitoes were collected, as well as the precise collection sites, may have impacted the variations in relative abundance of these species. The study's low number of unusual *Anopheles* species suggests that malaria control in Honduras should continue to focus on the most abundant Anopheles species, *An. albimanus* and *An. pseudopunctipennis*. There were no *An. darlingi* or *An. neivai* specimens obtained in this research, which might be attributed to the species' limited geographical range in Honduras, having only been documented in the department of Atlántida.

Finally, no mosquitos tested positive for Plasmodium DNA using traditional *mt cox1* gene PCR, which has been shown to be more sensitive than CSP antigen detection using ELISA. Several publications have reported Plasmodium spp.-infected mosquitos in Africa and the Amazon Basin of South America, where transmission rates are greater. The lack of infected mosquitoes was not surprising given the low number of malaria cases reported in Gracias a Dios, Bay Islands and El Paraso throughout the collecting years, as well as the lack of malaria cases in Cortés and Comayagua.

Given the country's existing epidemiological state, this result predicts that a higher number of samples will be required to discover sick mosquitos. The fundamental weakness of this follow-up study is the limited number of mosquitoes collected, despite several visits to five departments of the nation over three years. The low return on investment in sampling efforts may be linked to the time of year in which the collections were conducted or to other factors that are not fully understood. Future research should take these findings into consideration in order to enhance the sample size [5].

Conclusion

This study revises the distribution, diversity and abundance of *anopheline* populations in Honduras, indicating a significant prevalence of *Anopheline albimanus*. The sequences of three *anopheline* species obtained in Honduras are reported here for the first time (*An. argyritarsis*, *An. apicimacula* and *An. neomaculipalpus*). Our findings indicate that spatial isolation of An. *argyritarsis*

and *An. neomaculipalpus* populations in Central and South America is conceivable. This is also the first report of An. *albimanus* COI sequences from the Bay Islands island of Roatán, exhibiting evident gene flow compared to mainland populations.

Acknowledgement

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Conflict of Interest

No potential conflict of interest was reported by the authors.

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