

The ecological factors associated with the survival, establishment, and movement of *Aedes* spp. mosquitoes: A scoping review protocol

Authors: Keana Shahin¹, Olaf Berke¹, Ilaria Dorigatti², Victoria Ng³, Katie M. Clow¹

¹Department of Population Medicine, Ontario Veterinary College, University of Guelph
ON N1G 2W1 CANADA

²MRC Centre for Global Infectious Disease Analysis; and the Abdul Latif Jameel Institute for Disease and Emergency Analytics (J-IDEA), School of Public Health, Imperial College London.

³Public Health Risk Sciences Division, National Microbiology Laboratory Branch at Guelph, Public Health Agency of Canada, Guelph, Ontario, Canada

Author Contributions: This scoping review protocol was drafted by KS with guidance and input from KMC, VN, ID, and OB.

Funding

This project is funded by the Public Health Agency of Canada

Introduction

Rationale

Climate change is a growing concern globally. Climate-sensitive infectious diseases have increased in incidence in many areas of the world, including those associated with vectors such as ticks and mosquitos. Even modest increases in temperature can impact the range of some vectors species, as well as the animals they feed on (e.g., rodents and deer), which are important factors in the transmission of pathogens from vectors to humans or animals [1]. Moreover, increasing temperatures lead to shorter development time, increasing the lifespan of the vector [2]. It is anticipated that climate change will transform the landscape for mosquito-borne diseases (MBDs) in Canada [2].

Aedes aegypti, the yellow fever mosquito, and *Ae. albopictus*, the Asian tiger mosquito, previously could not survive in Canada's cool climate [3]; however, since 2016 *Ae. aegypti* and *Ae. albopictus* have been identified in Ontario, Canada [4], with the latter considered established in small parts of southern Ontario [5].

As climatic conditions continue to change, Canada may begin to see longer periods of warm weather overlapping with the active seasons of *Ae. aegypti* and *Ae. albopictus* in endemic countries, facilitating successful importation of exotic mosquitoes into Canada. These conditions could result in the following scenarios for importation: 1. a naïve mosquito being imported, 2. an infected person traveling, or 3. an infected mosquito being imported.

A scoping review will be conducted to describe the current state of knowledge on the ecological factors relevant to the survival and reproduction of *Ae. aegypti* and *Ae. albopictus* in countries with established vector populations as well as their importation into new areas.

Objective & Research Question

The objective of this protocol is to describe *a priori* the methodology for the scoping review. The research question is what ecological factors impact the distribution of *Ae. aegypti* and *Ae. albopictus*?

Methods

Protocol and Registration

This protocol was prepared using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extensions for Scoping Reviews (PRISMA-ScR) reporting guidelines and the methodological framework outlined by Arksey and O'Malley [6]. It will be published in the University of Guelph Atrium.

Eligibility Criteria

Eligible studies must meet the following criteria:

1. Text available in English or French
2. Published after January 1st 2010; this timeline was chosen to identify articles with current information in regard to climate
3. Primary peer-reviewed research articles
4. Focused on ecological factors (e.g., climatic conditions, seasonality, geographic range) and how they impact *Ae. aegypti* and *Ae. albopictus*

Information Sources

PubMed, Agricola, Web of Science, and CABI will be accessed to search for eligible studies. Citations will be uploaded to Covidence (Veritas Health Innovation, Melbourne, Australia; 2023) and de-duplicated using internal algorithms.

Search

Search terms were selected based on the above eligibility criteria (Table 1). These terms are restricted to articles published since 2010. The search will not include language restrictions.

Table 1. Proposed search terms for the scoping review.

Component	Search Terms
Variable 1: <i>Aedes</i> spp. mosquitoes	<i>Aedes aegypti</i> OR <i>Aedes albopictus</i> OR tiger mosquito* OR <i>Ae. aegypti</i> OR <i>Ae. albopictus</i>
Variable 2: Range	range OR distribution OR detect* OR surveil*
Variable 3: Ecological factors	Temperature OR humid* OR habitat OR precipitation OR weather OR climate* OR reservoir* OR suitab*

Selection Process

Level 1 screening includes title/abstract screening. It will be completed independently by KS and a second reviewer. A consensus between reviewers will be required to include/exclude articles from the scoping review.

The following questions will be used for level 1 screening:

1. Is the title/abstract in English or French?
Yes (neutral), No (exclude)
2. Was the article published in or after 2010?
Yes (neutral), No (exclude)
3. Is the article a primary research paper?
Yes (neutral), No (exclude)

4. Is the focus of the article on the ecology and surveillance of *Ae. aegypti* or *Ae. albopictus* mosquitoes?
Yes (neutral), No (exclude)

Level 2 screening involves full-text screening. This will be done by KS.

Eligibility will be determined with the following questions:

1. Is the full text available in English or French?
Yes (include), No (exclude)
2. Is the article published in or after 2010?
Yes (include), No (exclude)
3. Is this a primary research paper?
Yes (include), No (exclude)
4. Is the focus of the paper on the ecology and/or surveillance of *Ae. aegypti* or *Ae. albopictus*?
Yes (include), No (exclude)
5. Does the paper focus on *Ae. aegypti* or *Ae. albopictus* mosquitoes in countries where the vector species is established [7] OR does the paper focus on *Ae. aegypti* or *Ae. albopictus* being introduced to non-endemic countries (e.g., countries with a sporadic population or in which the population is introduced from endemic countries)?
Yes (include), No (exclude)

Data extraction

Data will be extracted by KS using Covidence. Authors will not be contacted to request clarification or missing information.

The following will be extracted:

- 1) Study characteristics including publication year, publication type, country where research was conducted, study design, data collected, method of data analysis
- 2) Ecological factors determined to influence the survival, reproduction, lifespan and/or importation of mosquitoes
- 3) Importation routes of mosquitoes
- 4) Study limitations

Critical Appraisal of Individual Sources of Evidence

The articles included in the scoping review will not be critically appraised.

References

1. Yang HM, Macoris MLG, Galvani KC, Andrighetti MT., Wanderley DMV. Assessing the effects of temperature on the population of *Aedes aegypti*, the vector of dengue. *Epidemiol Infect.* 2009;137:1188–202.
2. Ng V, Rees E, Lindsay L, Drebot M, Brownstone T, Sadeghieh T, et al. Could exotic mosquito-borne diseases emerge in Canada with climate change? *Canada Commun Dis Rep.* 2019;45(4).
3. Lindsay L. Present state of common vector-borne diseases in Canada. *Canada Commun Dis Rep.* 2016;6(10).
4. Giordano B V., Gasparotto A, Liang P, Nelder PM, Russell C, Hunter FF. Discovery of an *Aedes* (*Stegomyia*) *albopictus* population and first records of *Aedes* (*Stegomyia*) *aegypti* in Canada. *Med Vet Entomol.* 2020;34:10–6.
5. Russell C, Nelder M. Ontario Agency for Health Protection and Promotion (Public Health Ontario). *Vector-Borne Diseases 2017 Summary Report.* Toronto; 2018.
6. Fălcută E, Prioteasa LF, Horváth C, Păstrav IR, Schaffner F, Mihalca AD. The invasive Asian tiger mosquito *Aedes albopictus* in Romania: towards a country-wide colonization? *Parasitol Res.* 2020 Mar 1;119(3):841–5.