Association of temperature and cold season eggs mortality with the population dynamics of *Aedes aegypti* in Buenos Aires City

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Introduction

Previous studies showed a heterogeneous distribution of *Aedes aegypti* in the city of Buenos Aires, with favorable areas in the periphery and less favorable areas near the city center and the Rio de la Plata River **(Figure 1)**. The aim of this work was to study the effect of temperature and mortality of eggs as possible causal factors for the mentioned heterogeneity.

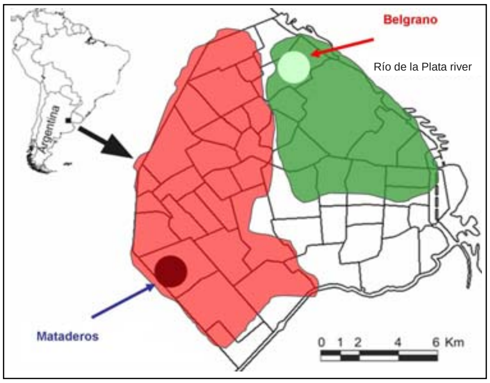

Figure 1. Location of favorable and less favorable areas for *Aedes aegypti* in Buenos Aires City (shaded areas), and of study sites in the present study (circles)

Figure 2. Detail of the study sites: a) Aerial photographs; b) Schematic view of the location of the ovitraps used in the field work.

Materials and Methods

Two study sites were selected, one located in the favorable area (Mataderos) and the other in the less favorable area (Belgrano) (**Figure 1**). Winter eggs mortality was studied by exposing eggs to natural conditions during a three months period. Temperature variations were measured hourly throughout a one year period, and oviposition activity of *Aedes aegypti* was monitored during the warm season (September-May) with ovitraps distributed evenly in public areas at each study site (**Figure 2**). The following simulations of *Aedes aegypti* population dynamics were performed with a existing mathematical model: a) using temperatures of each site (daily eggs mortality equal); b) using the estimated daily eggs mortality of each site (temperature variation equal); c) combining daily eggs mortality and temperature data measured at each site. The latter simulations of oviposition activity were compared to field data. The effects of temperature (alone), of eggs mortality (alone), and temperature and eggs mortality (combined) on oviposition activity were assessed by analyzing differences of oviposition data (Mataderos less Belgrano) in results of a), b), and c) simulations respectively.

Results

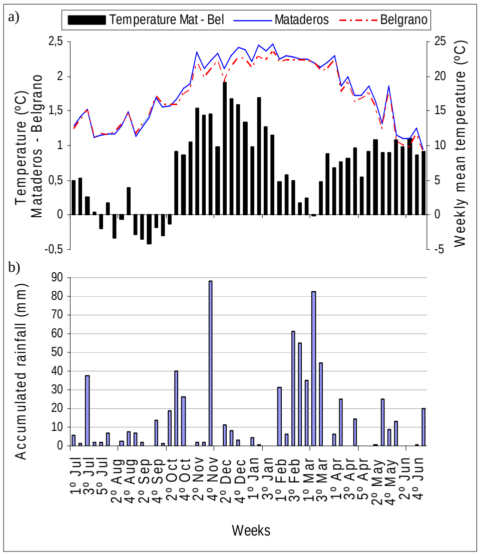

Figure 3. Weekly meteorological data throughout the study period: a) average temperature (lines) and differences of Mataderos less Belgrano (bars); b) cumulative rainfall at Buenos Aires City meteorological station.

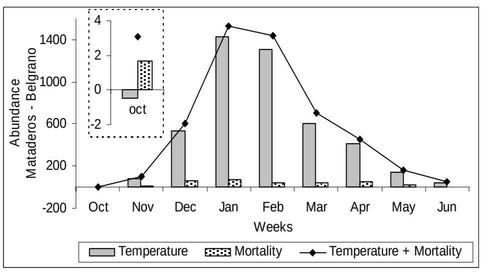

Figure 5. Differences (Mataderos less Belgrano) of monthly average of simulated oviposition data. Detail for October in the upper left.

The cumulative winter mortality of *Aedes aegypti* eggs was 8% (daily mortality proportion = 0.001) in Mataderos (favorable area) and 50% (daily mortality proportion = 0.008) in Belgrano (less favorable area). Average temperature values were slightly higher in Mataderos than in Belgrano during most of the year, except at the end of the winter season (August and September). The largest differences were recorded during the spring season in November-December (Figure 3a). Ovitraps showed higher oviposition activity in the favorable area (Mataderos) than in the less favorable area (Belgrano) during the whole study period, and differences of one order of magnitude were recorded at some dates. Similarly, the simulated oviposition activity of *Aedes aegypti* showed higher values for Mataderos than for Belgrano during the whole study period, and a delay of one month was observed in the peak of activity between both sites. Furthermore for each site the peak of the simulated oviposition was delayed approximately four weeks as compared to the oviposition peak observed in the ovitrap study (Figure 4). The delayed increase in field measured oviposition activity was coincident with the drought period recorded during de early summer (December and January) (Figure 3b). The comparison of differences between sites in simulated *Aedes aegypti* oviposition activity, showed a ten times larger effect of temperature than of eggs mortality during most of the study period. The only exception was observed during the beginning of the oviposition season (October), when temperature dependent simulations showed that Belgrano attained higher values than Mataderos (Figure 5).

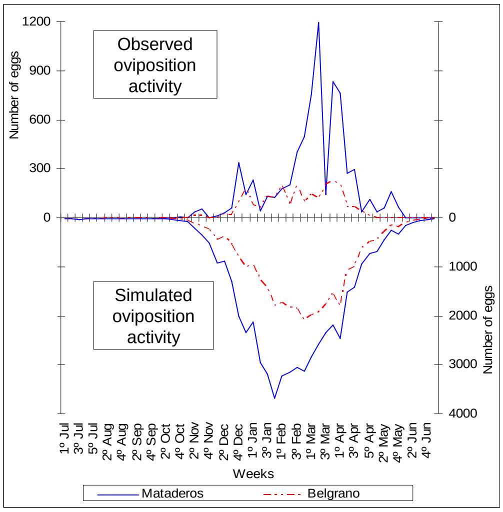

Figure 4. Oviposition activity in the favorable (Mataderos) and the less favorable (Belgrano) sites: a) observed field data (upper half of graph; b) simulated data obtained by the mathematical model (lower half of graph).

Discussion

Differences between field (ovitraps) and simulated (model) oviposition data show that rainfall might be a variable with a significant influence on *Aedes aegypti* population dynamics, thus rainfall should be included in future versions of the mathematical model. The results obtained by the mathematical model suggest that among the studied variables (temperature and eggs mortality) the former is more important in determining the heterogeneity in *Aedes aegypti* abundance in Buenos Aires City. Despite the differences observed between study sites, in eggs mortality appears to have no significant impact on population dynamics of *Aedes aegypti*.