Ecological factors associated to the invasion by alien *Aedes* species in the province of Trento, northern Italy

FONDAZIONE EDMUND MACH
CENTRO RICERCA e INNOVAZIONE

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Arnoldi D.[1], Marini G.[1], Inama E.[1], Rosso F.[1], Tagliapietra V.[1], Dagostin F.[1] Rizzoli A.[1]

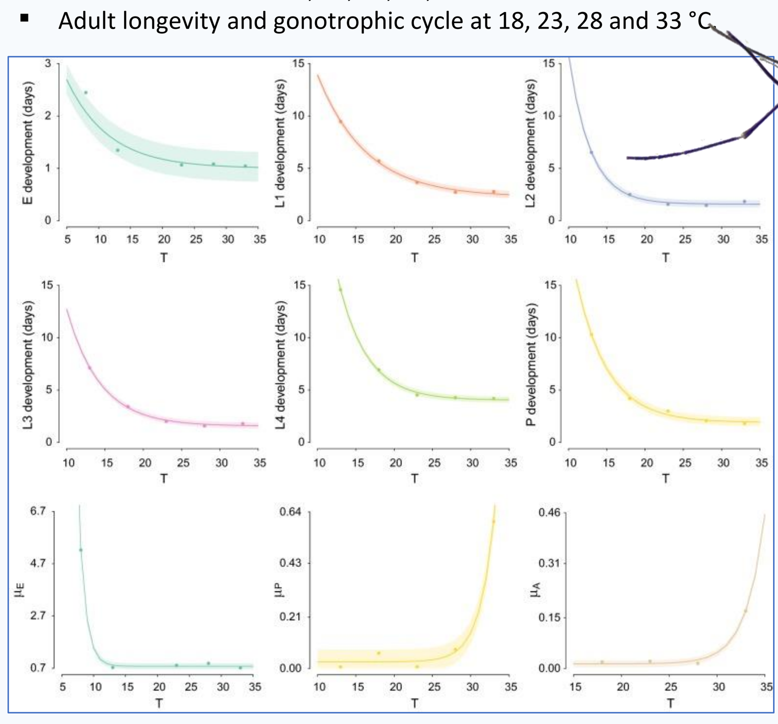
[1] Research and Innovation Centre, Fondazione Edmund Mach, San Michele all'Adige, TN, Italy

Aedes albopictus, *Ae. koreicus* and *Ae. japonicus* are of increasing public health concerns in Europe. In Trentino province (northern Italy), an established population of *Aedes albopictus* is reported since late 90' (1) whilst *Ae. koreicus* was detected for the first time in 2013 (2). The most recently introduced IMS in our province is *Ae. japonicus*, recorded in 2022 (Arnoldi D., personal communication). To get an insight into the ecological process affetting IMS abilty to establish into new areas and to obtain a number of parametrs of utility to develop risk maps and predictive mathematical models, we carried out a series of investigation combining filed observation and laboratory experiments. Here we summarise some of the results so far obtained.

Influence of temperature on the life cycle and population dynamics of *Aedes koreicus,* a new invasive alien species in Europe (3)

Materials and methods

- Hatching rate
  - Eggs tested at 8, 13, 23, 28 and 33°C.
- Survival rates and developmental times:
  - Larvae tested at 4, 13, 18, 23, 28 and 33°C
- Adult longevity and gonotrophic cycle at 18, 23, 28 and 33 °C



Temperature-dependent functions. Dots represent the experiments observations; shaded area represents 95% CI of predicted values. µ represents the Death Rate

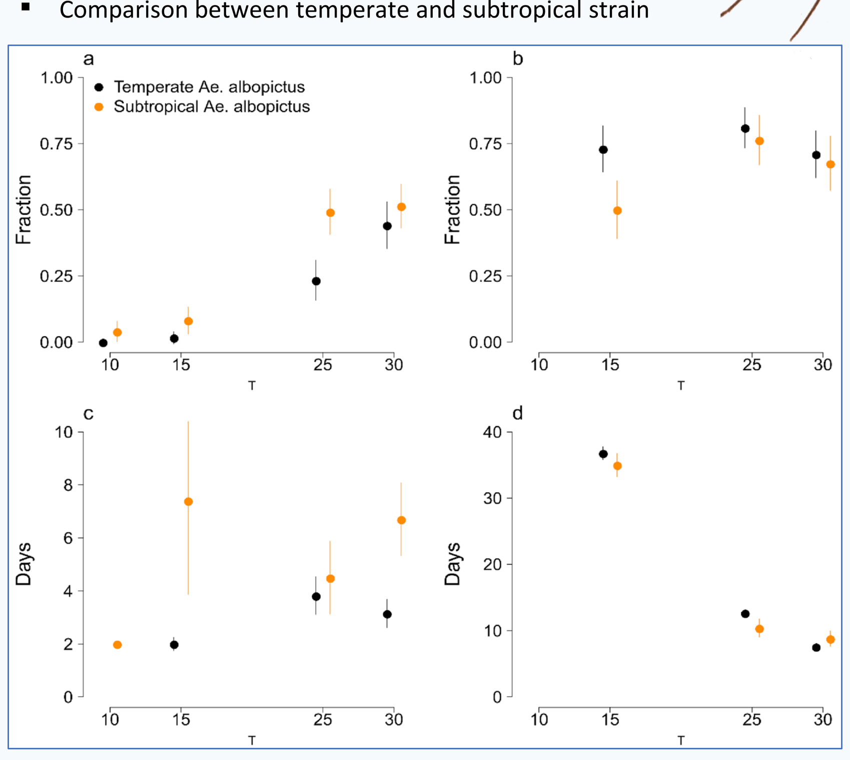
Main results

Temperate conditions of 23–28 °C seem to be very favorable, explaining the recent success of *Ae. koreicus* at establishing into new specific areas. Our results indicate *Ae. koreicus* is less adapted to local climatic conditions compared to *Ae. albopictus*.

Influence of Temperature on the Life-Cycle Dynamics of *Aedes albopictus* Population Established at Temperate Latitudes: A Laboratory Experiment (4)

Materials and methods

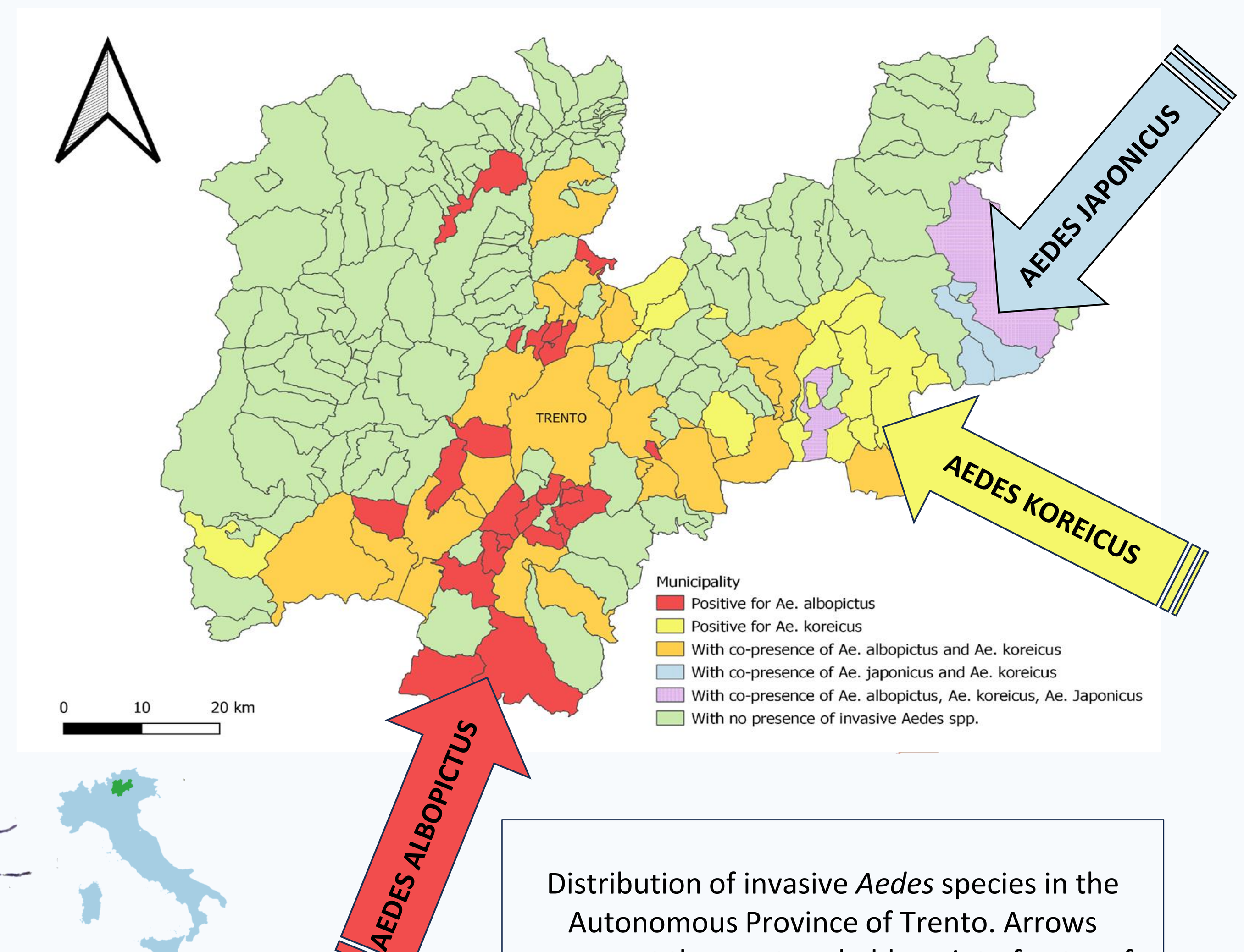
- Hatching rate
  - Eggs tested at 10, 15, 25, and 30°C.
- Survival rates and developmental times:
  - Larvae tested at 10, 15, 25, and 30°C.
- Adult longevity and gonotrophic cycle at 10, 15, 25, and 30°C.
- Comparison between temperate and subtropical strain



Comparison between temperate *Ae. albopictus* (black) and subtropical *Ae. albopictus* (orange) results for each tested temperature (10, 15, 25, and 30 °C). (a): Fraction of hatched eggs; (b): fraction of L1 larvae that successfully reached the adult stage; (c): length of time between immersion of eggs in water and hatching response; (d): duration of development from L1 to adult. Points: average values. Vertical lines: 95% Confidence Intervals (average ±1.96·SE).

Main results

After 20 years from invasion, temperate immature individuals have successfully adapted to colder conditions compared to subtropical populations. This adaptation might increase the length of the breeding season and could allow the colonization of areas at higher altitude, resulting in an overall increased risk for the potential transmission of *Ae. albopictus*-borne pathogens.

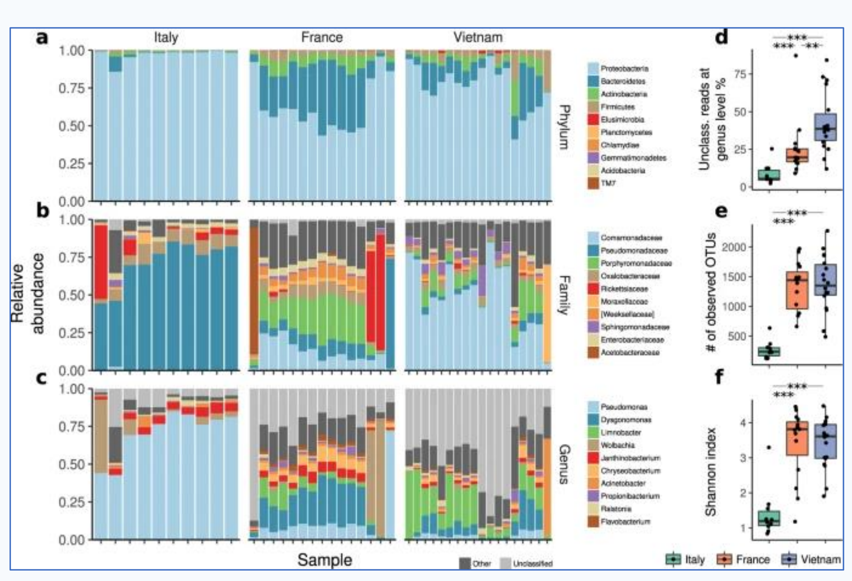


Distribution of invasive *Aedes* species in the Autonomous Province of Trento. Arrows represent the most probable point of entry of each species in the Province

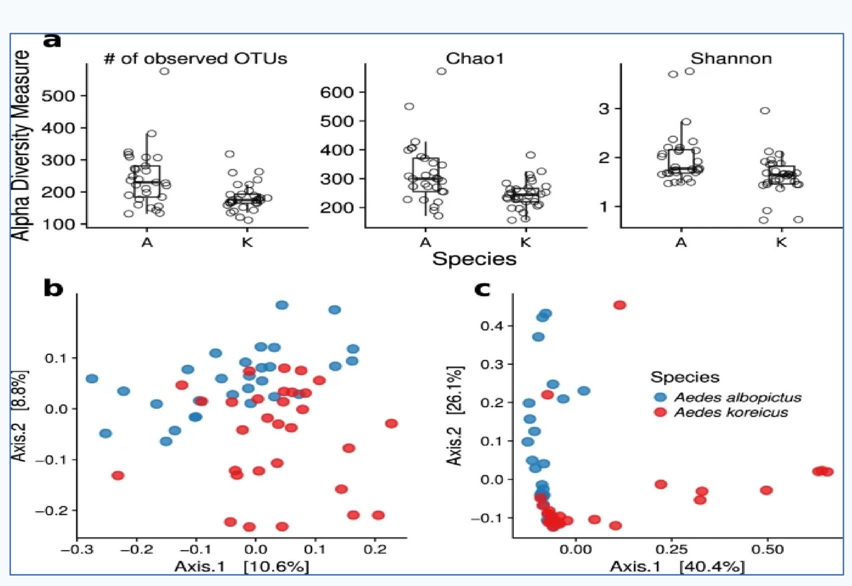
Reduced diversity of gut microbiota in two *Aedes* mosquitoes species in areas of recent invasion (5)

Materials and methods

- We compared the microbiota of *Ae. albopictus* collected in Italy with those reported in populations from France and Vietnam
- We compared microbial community of wild-caught *Ae. albopictus* and *Ae. koreicus* collected in Trentino Province
- Metataxonomic analysis based on High Troughput Sequencing (HTS)



Taxonomical composition of Italian, French and Vietnamese *Ae. albopictus* microbiota (**a**) by Phylum, (**b**) by family, (**c**) by genus. Box-plot of the % of unclassified reads at genus level per country (**d**); numbers of observed OTUs per country (**e**) and Shannon index per country (**f**). **p < 0.05, ***p < 0.01.



Comparison of α- and β-diversity for *Ae. albopictus* (A) and *Ae. koreicus* (K). (**a**) Observed number of OTUs, Chao1 estimator and Shannon entropy. In all cases the difference was statistically significant (P = 0.0027, 8.4×10^{-4} and 9.5×10^{-4} for number of OTUs, Chao1 and Shannon entropy, respectively, Wilcoxon rank-sum test). (**b**) Principal coordinates analyses (PCoA) of unweighted (**b**) and weighted (**c**) UniFrac distances.

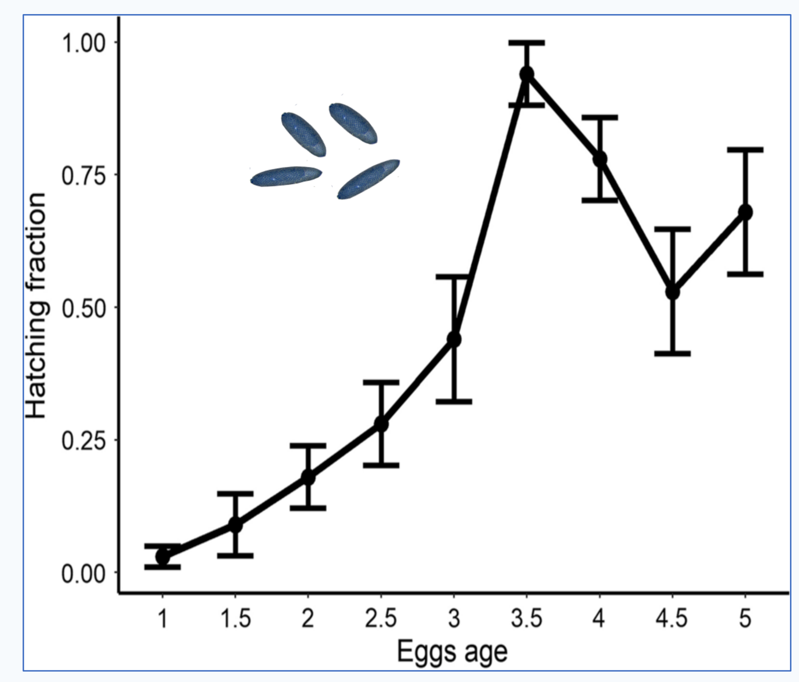
Main results

Gut microbiota diversity can be used as a measure of fitness of a wild species invading a new habitat and can affect their vectorial competence. The taxonomic structure at the Phylum, Family and Genus levels showed clear diversification between the Italian, French and Vietnamese populations with a simplified microbiota structure in the Italian population. The large shared core microbiota among the two *Aedes* species suggests a common environmental exposure in the breeding sites. Nonetheless, *Ae. albopictus* showed a higher richness and a different composition, as highlighted by α- and β-diversity. This could be partly explained by the fact that *Ae. albopictus* colonized the area about 15 years before *Ae. koreicus.*

Diapause characterization in the invasive alien mosquito species *Aedes koreicus*: a laboratory experiment (6)

Materials and methods

- Eggs were tested for hatching 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, and 5 months (30–150 days) after oviposition.
- Hatching tests performed under constant temperature (21 ± 1 °C) and a photoperiod of 16L:8D with 1 h of dawn and 1 h of dusk.



Fraction of hatched eggs for each tested age (in months). Points: average values. Vertical lines: 95% Confidence Intervals (average ± 1.96·standard error, SE)

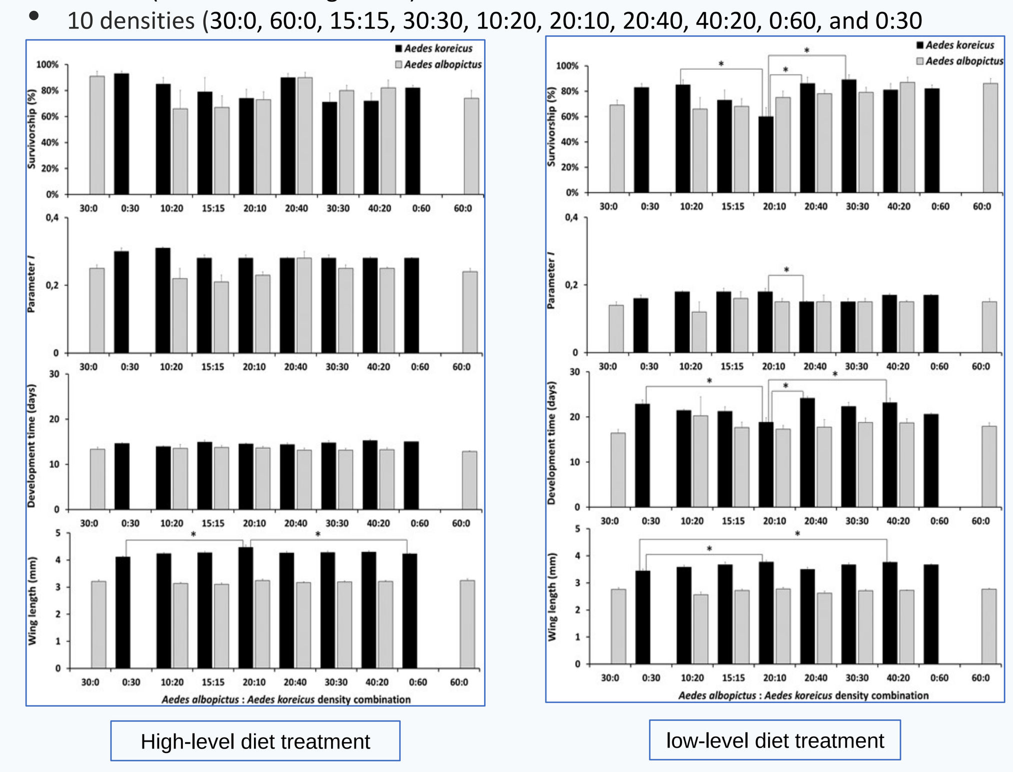
Main results

Aedes koreicus diapausing eggs require at least 3 months in order to hatch with substantial success. The optimal age (0.94 probability of successful hatch) seems to be around 3.5 months (about 100 days).

Weak Larval Competition Between Two Invasive Mosquitoes *Aedes koreicus* and *Aedes albopictus* (Diptera: Culicidae) (7)

Materials and methods

- 2 diets (low level and high level)
- 10 densities (30:0, 60:0, 15:15, 30:30, 10:20, 20:10, 20:40, 40:20, 0:60, and 0:30



Mean (± standard error) survivorship (%), parameter I, development time (d), and wing length (mm) of *Ae. koreicus* and *Ae. albopictus* across *Ae. albopictus*: *Ae. koreicus* density combinations in high/low-level diet treatments. The condition-specific population performance parameter "I" was calculated using the day of emergence of the females and their wing length as described by (8). The development time and the wing length were considered for females only. Pairwise differences were tested using the Tuckey's HSD test. Significant differences between density combinations are indicated by an asterisk.

Main results

Aedes albopictus developed faster than *Ae. koreicus* regardless of diet and density combination treatments. Our results show weak larval competition between *Ae. koreicus* and *Ae. albopictus* with a slight advantage of the latter species. On the other hand, the presence of *Ae. albopictus* seems to favor the emergence of larger *Ae. koreicus* females.

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(4) Marini, Giovanni, et al. "Influence of temperature on the life-cycle dynamics of *Aedes albopictus* population established at temperate latitudes: A laboratory experiment." *Insects* 11.11 (2020): 808.

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