Low effective population sizes in *Amblyomma variegatum* in West Africa: implication for the sustainability of acaricide-based control programs

K. Huber[1], S. Jacquet[2,1], R. Rivallan[3,4], H. Adakal[1,2,5], N. Vachiery[2,1], AM Risterucci[3,4], C. Chevillon[6]

Contact: karine.huber@cirad.fr

Amblyomma variegatum: a tick species of major veterinary importance for livestock

- Causes substantial economic losses by blood predation (low live weight gain, reduced milk yield) and physical injury (wound)
- Associated with dermatophilosis, and vector of *Ehrlichia ruminantium*, the agent of heartwater
- **The use of acaricides is still the most accurate way to protect cattle from all deleterious effects of *A. variegatum***

The **effective population size (*Ne*)**, an important parameter in population genetics
It translates census sizes of a real population into the size of an idealized population showing the same rate of loss of genetic diversity as the real population under study

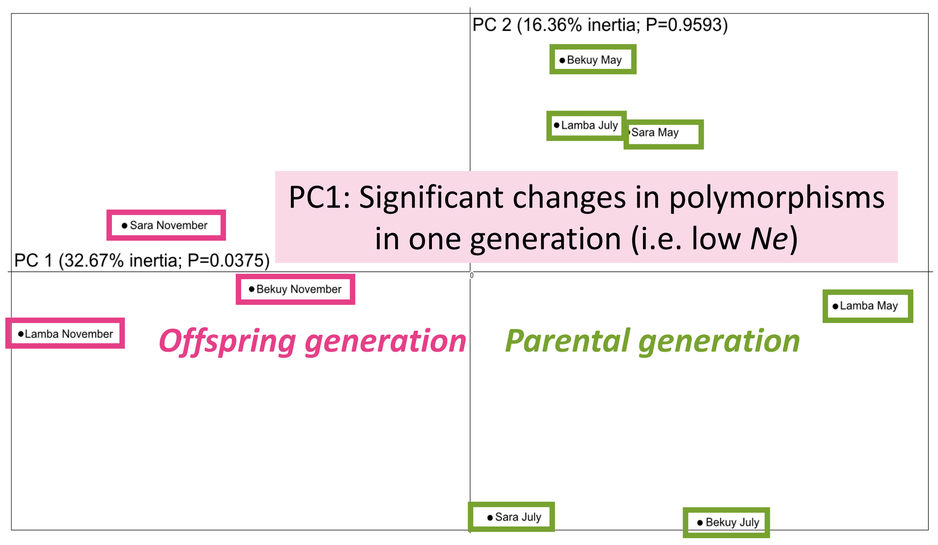
- The acquisition of new alleles (via mutation or migration) is proportional to *Ne*
- 1/*Ne* measures the impact of drift, i.e. the extant in loss/change in polymorphism per generation; selection (*s*) overcomes the impact of drift if and only if s >> 1/*Ne*

Low effective population sizes observed in Burkina Faso

The effective population sizes was estimated in three neighbor villages in Burkina Faso (Bekuy, Lamba, Sara)

- Development of a new set of eight microsatellite markers
- Two successive tick generations were sampled
- Estimation of *Ne* with two methods (a temporal based method and a method based on linkage disequilibrium)

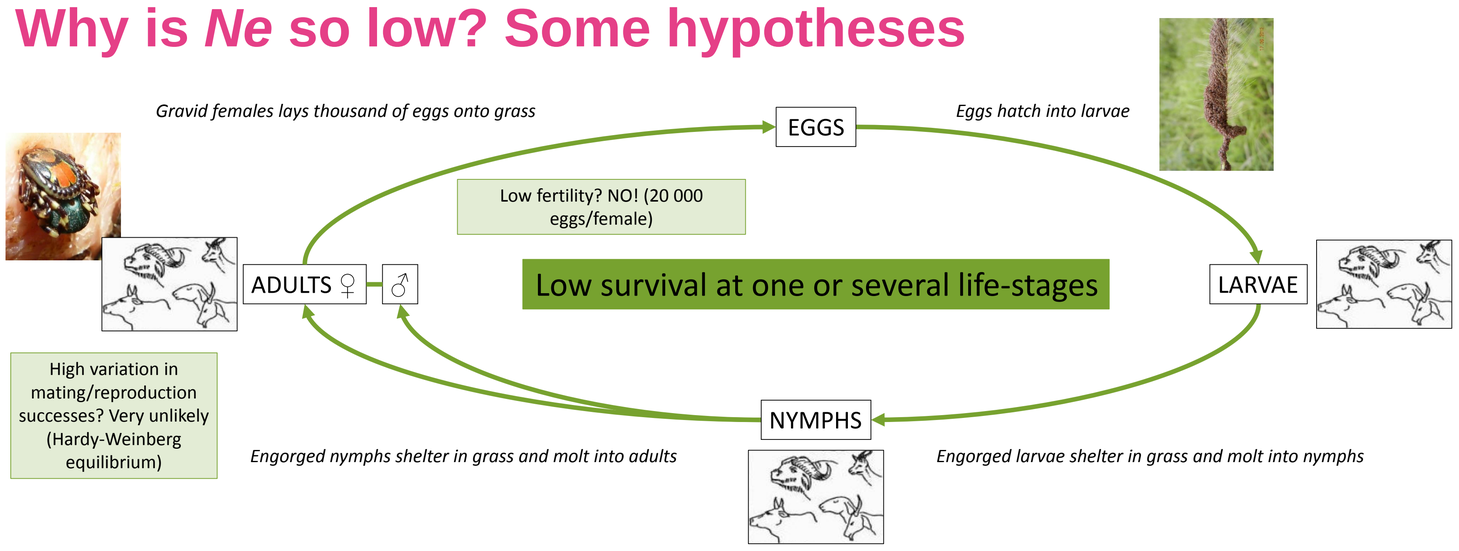
***Ne* estimates for *A. variegatum* in Burkina Faso : 11 ≤ *Ne* ≤ 23 per village and generation[a]**



Because of short geographic distances between the three villages (~10 km) and cattle sharing grazing areas, low geographic genetic differentiation is observed (PC2)

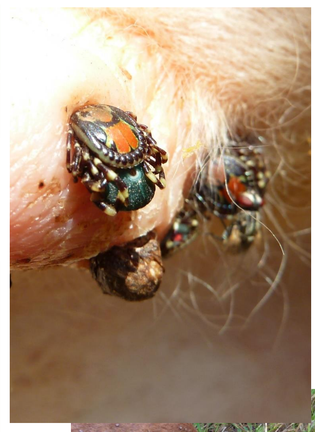
Principal component analysis (PCA) of multilocus genotypic composition

Why is *Ne* so low? Some hypotheses



Two contrasting situations regarding acaricide resistance

	Amblyomma variegatum	*Rhipicephalus microplus*[b,c]
Country	Burkina Faso	New Caledonia
Ne	≤ 23 per village per generation	~ 1000 per cattle herd
Probability of apparition by mutation of a new allele conferring acaricide resistance ∝ *Ne*	+	+++
Acaricide selection pressure (*s*)	Moderate	High
Probability that an allele conferring acaricide resistance may disappear from tick population ∝ 1/*Ne* unless *s* >> 1/*Ne*	+++	+
Observed acaricide resistance	Not reported	Frequently reported



(a) HUBER, K. , JACQUET, S. , RIVALLAN, R. , ADAKAL, H. , VACHIERY, N. , RISTERUCCI, A.M., CHEVILLON, C. (2018), Low effective population sizes in *Amblyomma variegatum*, the tropical bont tick. Ticks and Tick-borne Diseases. https://doi.org/10.1016/j.ttbdis.2018.08.019 (b) KOFFI, B. B., DE MEEÛS, T. , BARRÉ, N. , DURAND, P. , ARNATHAU, C. and CHEVILLON, C. (2006), Founder effects, inbreeding and effective sizes in the Southern cattle tick: the effect of transmission dynamics and implications for pest management. Molecular Ecology, 15: 4603-4611. doi:10.1111/j.1365-294X.2006.03098.x (c) CHEVILLON, C., DUCORNEZ, S., DE MEEÛS, T., KOFFI, B. B., GAÏA, H., DELATHIÈRE, J.-M., BARRÉ, N. (2007), Accumulation of acaricide resistance mechanisms in *Rhipicephalus* (*Boophilus*) *microplus* (Acari: Ixodidae) populations from New Caledonia Island. Veterinary Parasitology, 147: 276-288. https://doi.org/10.1016/j.vetpar.2007.05.003.

1. ASTRE, Univ Montpellier, CIRAD, INRA, Montpellier, France; 2. CIRAD, UMR ASTRE, F-34398 Montpellier, France; 3. CIRAD, UMR AGAP, F-34398 Montpellier, France; 4. AGAP, Univ Montpellier, CIRAD, INRA, Montpellier SupAgro, Montpellier, France; 5. CIRDES URBIO, 01 BP 454, Bobo-Dioulasso 01, Burkina Faso; 6. MIVEGEC, Univ Montpellier, CNRS, IRD, Montpellier, France

INRA SCIENCE & IMPACT

cirad