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# Joint inference of adaptive and demographic history from temporal population genomic data

Miguel Navascués, Vitor A.C. Pavinato, Stéphane De Mita, Jean-Michel Marin

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7/10/2019



# Joint inference of adaptive and demographic history from temporal population genomic data

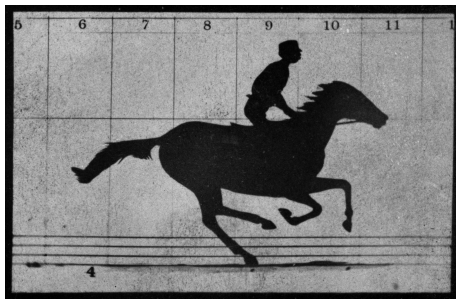
Miguel Navascués, Vitor A.C. Pavinato, Stéphane De Mita, Jean-Michel Marin



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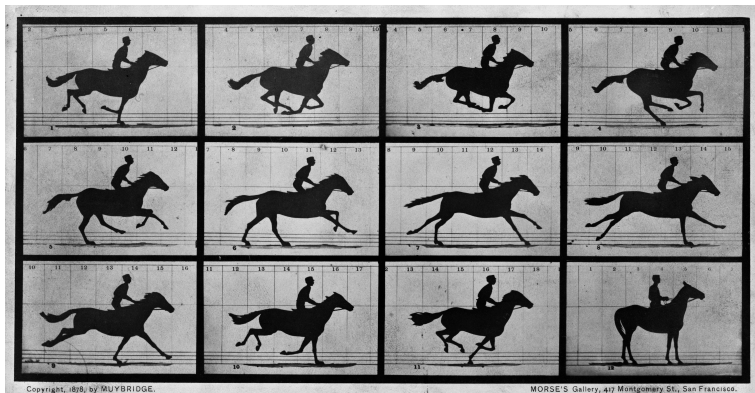
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## Temporal genetic data for the study of evolution





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## Joint Inference of Demography and Selection

- Demographic inference assumes that effect of selection in genome-wide patterns of diversity can be ignored
- Selection inference focuses on detecting loci under selection (outliers)

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forward simulation + approximate Bayesian computation *via* random forest

equilibrium mutation-drift-selection

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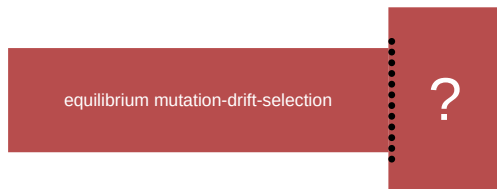
forward simulation + approximate Bayesian computation *via* random forest

equilibrium mutation-drift-selection

?

## Model and approach

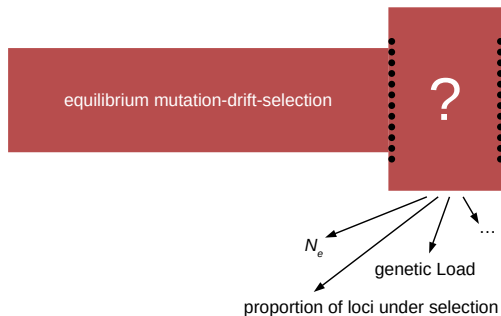
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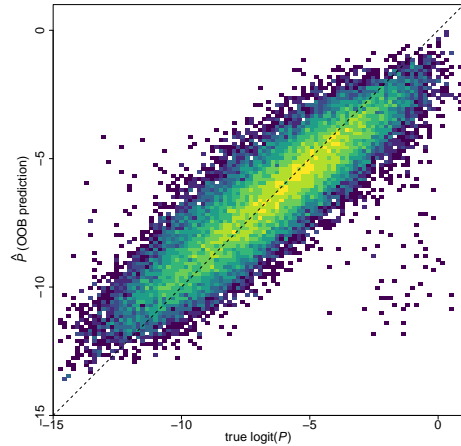
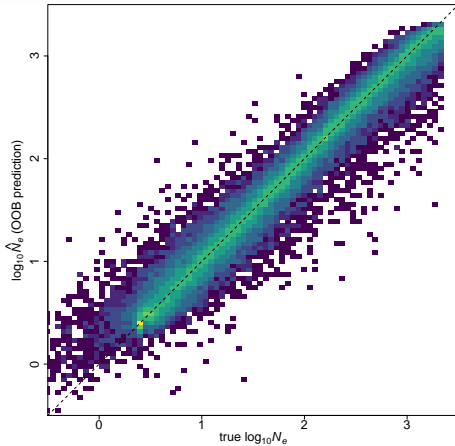
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# Demography and Selection

Does joint inference work?

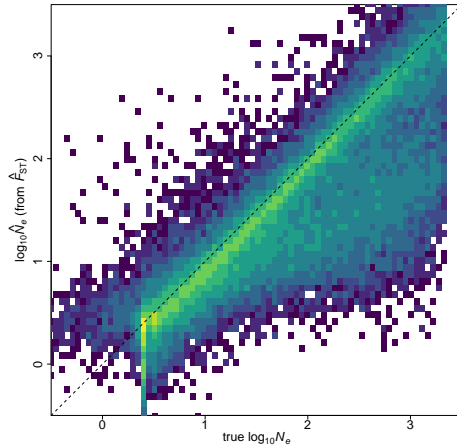
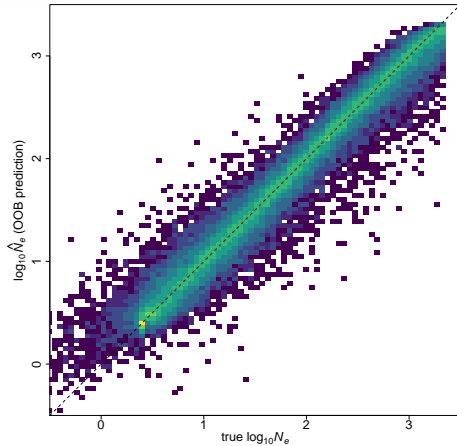
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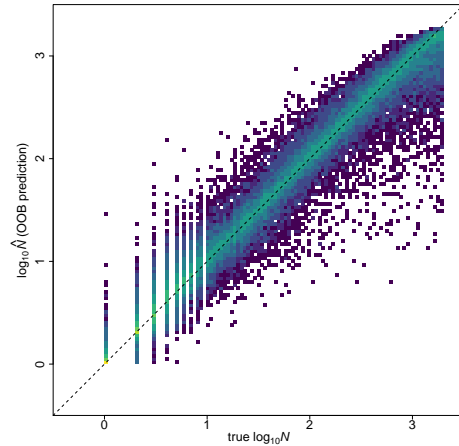
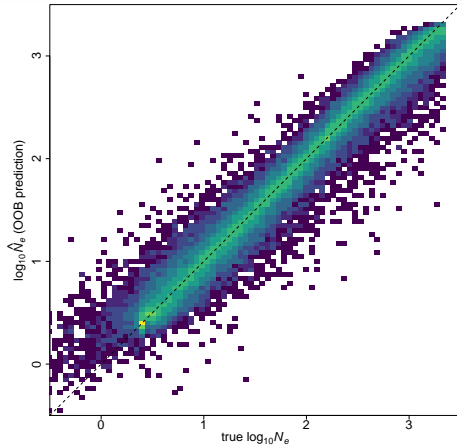
## Genetic Drift (“demography”)

Does inference of “demography” account for the action of selection?

# Genetic Drift ("demography")



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# Is there adaptive diversity? (Genetic Load)

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- This is **NOT** Mutation Load
- The presence of beneficial mutations creates Substitution Load, it shows that there is adaptive diversity
- $L = 0$ : there is not genetic diversity to adapt to environmental pressures
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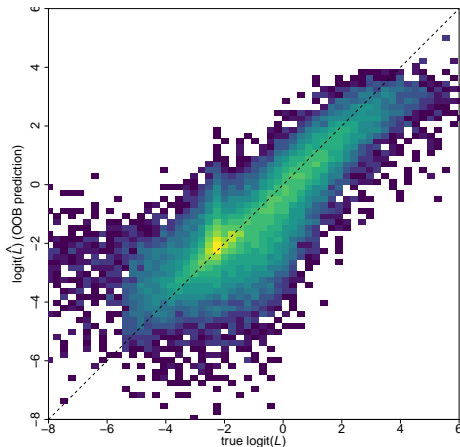
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## Is there adaptive diversity? (Genetic Load)



Is evolutionary rescue likely? ( $\theta P_S = 4N_e\mu P_S$ )

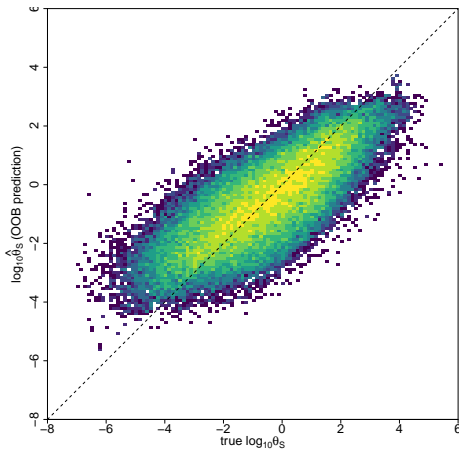
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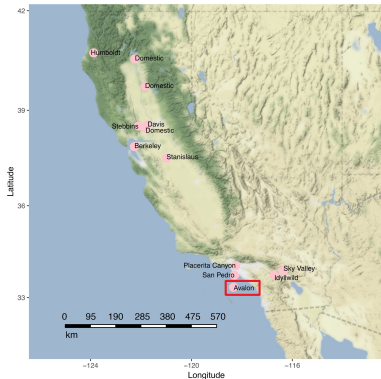


## Feral honey bee in California



Photo Andreas Trepte, [photo-natur.net](http://photo-natur.net), CC-BY-SA

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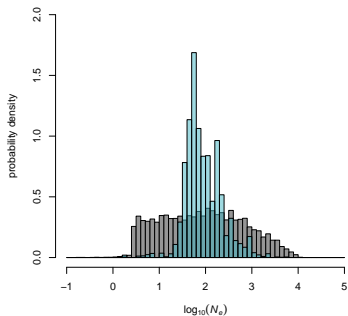
Cridland *et al.* (2018) GBE [doi:10.1093/gbe/evy007](https://doi.org/10.1093/gbe/evy007)

- Avalon, Catalina Island (Los Angeles)
- Samples from 1910 (2) & 2014 (5)
- Genome resequencing (236Mbp)
- 1 year = 1 generation

## Results bees

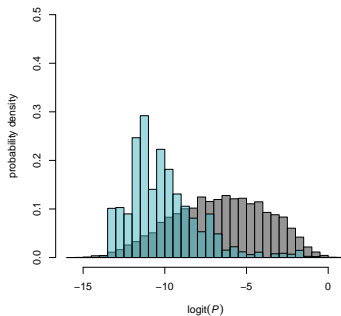
$$\hat{N}_e = 90$$

$$95\%CI(23-887)$$



$$\hat{P} = 4 \times 10^{-5}$$

$$95\%CI(10^{-6}-10^{-2})$$



## Conclusions & Perspectives

- Estimation of demography in the presence of pervasive selection
- Estimation of adaptive potential of populations
- Practical limitations: improve computational efficiency
- Model limitations:
  - ▶ Background selection
  - ▶ Adaptation from standing variation
  - ▶ Complex demography (migration/structure)
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# Thanks

InterLabex AGRO, CEMEB & NUMEV Postdoctoral Grant 2016



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