Allelic dropouts, null alleles or rare sex detection in clonal organisms: simulations and application to real data sets

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Session 16
Introduction

Difficulty of direct observation for Pathogens and their vectors

improvement of DNA amplification techniques during the last few decades

spatio-temporal variability of molecular markers

Inferring of basic ecological Parameters such as: reproduction unit size, dispersal, spatial organization and mode of reproduction of the populations

Microsatellite markers
Primer1 → ATATATATAT
TATATATATA Primer2
Primer1 → ATATATATATATATATATAT Primer2

Population genetics tools

PCR: Polymerase Chain Reaction

30 - 40 cycles of 3 steps:

Step 1: denaturation
1 min at 94 °C

Step 2: annealing
45 seconds at 54 °C
forward and reverse primers

Step 3: extension
2 minutes at 72 °C
only dNTPs
**Introduction**

$F_{IS}$: a measure of the deficit of heterozygote/panmixia, resulting from the reproductive system

For a clonal rate ($c$) of 100% → strongly negative $F_{IS}$ values are expected (Balloux et al., 2003)

A useful criterion for detecting very low rates of recombination in clonal organisms

Allelic dropouts and null alleles

Genetic markers (microsatellite)

Amorce 1  ATATATATATATATATATATA  Amorce 2

Amorce 1  ATATATATATATATATATATA  Amorce 2

For $99.99 \leq c \leq 95$ → Large variance $F_{IS}$ values are observed between loci
Genetic tools: $H_S$ and $F_{IS}$

$H_S$: Genetic diversity

$F_{IS} - \text{obs/analysed data}$: Local heterozygote deficit

For purely clonal population

$$F_{IS} = \frac{H_S - 1}{H_S} = F_{IS} - \text{exp/ clonal reproduction}$$

$$\Delta F_{IS} = F_{IS} - \text{exp} - F_{IS} - \text{obs}$$

$$|\Delta F_{IS}| \leq 0.05 \times |F_{IS - \text{exp}}| = \text{Superimposition des } F_{IS}$$
Methodology

- Criterion for allelic dropouts, null alleles and rare sex detection

![Graph showing the proportion of superimposed points (F_{IS - obs}) and the criterion (F_{IS - exp})]

Proportion of superimposed points (%) => Criterion
Simulations

- Different models of populations
- Variable proportions of allelic dropouts, null alleles and rare sex

Reinterpretation of real datasets

- *T. brucei gambienses* of Guinean foci (Kaboré *et al.* 2011)
- *T. evansi* from Sudan (Salim *et al.*, 2011)
Results

Comparison of allelic dropouts, null allele and rare sex effects
Reinterpretation: *T. brucei gambienses* of Guinean foci (Kaboré *et al.* 2011)
Results

Reinterpretation: *T. evansi* from Sudan (Salim *et al.*, 2011)
✓ The method based on the relationship between $H_s$ and $F_{IS}$ under the hypothesis of clonal reproduction is useful.

✓ It is valid for less than 50% of poorly amplified alleles.

✓ It is not a palliative but represent a useful decision criterion for regenotyping problematic data.
Thank you for your attention.