

ORIGINAL ARTICLE

Loss and gain of sexual reproduction in the same stick insect

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Abstract

The outcome of competition between different reproductive strategies within a single species can be used to infer selective advantage of the winning strategy. Where multiple populations have independently lost or gained sexual reproduction it is possible to investigate whether the advantage is contingent on local conditions. In the New Zealand stick insect *Clitarchus hookeri* three populations are distinguished by recent change in reproductive strategy and we determine their likely origins. One parthenogenetic population has established in the United Kingdom and we provide evidence that sexual reproduction has been lost in this population. We identify the sexual population from which the parthenogenetic population was derived, but show that the UK females have a post-mating barrier to fertilisation. We also demonstrate

parthenogenetic lineage appears to have resulted from range ex
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one of their X chromosomes and to test our assumption that half the

evaluate the clock-like behaviour of the data. The posterior probability of nonzero rate variance was close to zero (mean of rate variance ~ 0.0014), and therefore a simpler strict-clock model was used in sub

identify optimal K based on the posterior probability of the data for a given K, and the Delta-K (Evanno, Regnaut, & Goudet, 2005).

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Stick insect eggs were imported into New Zealand from the UK (n = 922). These eggs were the product of nine females (genera collected from the parthenogenetic population of Clitarchus

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genotypes to clusters met an optimal fit to the genetic data with three population clusters ($K = 3$). Under this model, individuals collected from the same location had high probabilities of being assigned to the same cluster (Figure 3). Samples from northern New Zealand sexual populations grouped together (Opanuku, Stony Bay, Karapiro; Figure 3). This cluster of northern sexual populations also included the three individuals from East Cape, where males have a monogamous mating system. The UK Isles of Scilly specimens grouped with high assignment probability with the Taranaki samples, and the south-eastern New Zealand populations formed the third group. The population from Wilton in 2016 clustered with the south-eastern asexual lineage, with high assignment probability (0.71–0.99). The small sample ($n =$

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 were part of the typical parthenogenetic lineage in this region, but
 their nuclear genomes contained alleles from two different geno-
 typic clusters (sexual Taranaki and local parthenogenetic), resulting
 in a signal of mixture expressed as low assignment probabilities to
 clusters (Figure 3). Population samples separated by 10 years, (2003
 and 2013) indicated introgression and establishment of sexual re-
 production occurred prior to 2003, but high heterozygosity was re-
 tained in 2013.

If males had arisen via spontaneous loss of an X chromosome
 in situ (scenario 3: male genesis) only local nuclear alleles and local

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