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Polymorphism in bisexual reproductive patterns of cyclical parthenogens
A simulation approach using a rotifer growth model

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Abstract

A dynamic model based on six differential equations, developed in a previous paper by Serra and Carmona (1993) was modified and used to address the theoretical possibility of polymorphism for the strategies of mixis – i.e., strategies for bisexual phase induction – in cyclical parthenogens. The model focuses on rotifers and describes the growth rates for amictic (asexual) females, fertilizable mictic (sexual) females, mictic females that produce males, mictic females that produce resting eggs (i.e., sexual eggs), males and resting eggs, and takes into account the main constraints on mixis. Moreover, birth rates were assumed as time-dependent, which involved a limited period for population growth.

By using computer simulation we explored the evolution of the genotypes determining mixis ratio – defined as the proportion of the eggs produced from amictic females that develop into mictic females – and the timing of mixis induction. The assumptions on the genetic system did not qualitatively affect simulation conclusions. Our main findings are: (1) When mixis is induced, mixis ratios equal to one were selected, regardless the phenotype for the timing of mixis induction. (2) A fairly high degree of polymorphism was maintained for the genes determining the timing of mixis induction. (3) As a result from (1) and (2), at the evolutionary equilibrium, the population as a whole showed a steep increase of mixis ratio, from 0 to 1, during the sexual phase of the growth cycle. (4) If the moment of mixis induction is assumed to be based on an one-locus, two-allele genetic system, results show that genes determining an early mixis were more frequent than expected from optimization criteria. Therefore, at equilibrium, the number of resting eggs produced by the population was not maximized. We suggest that this finding is a result of the selection involved in a mating race among the sexual individuals in the population.

Keywords: Parthenogenesis; Population dynamics; Reproduction; Zooplankton

1. Introduction

Cyclical parthenogenesis is a mode of reproduction involving unisexual propagation periodically interrupted by a bisexual phase. This mode

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