

### 8.3 THE ADAPTIVE SIGNIFICANCE OF SEX

1. Linkage disequilibrium is reduced by sexual reproduction with random mating
2. Many species are capable of both sexual and asexual reproduction (aphids, *Volvox*, hydra [Figs.8.16]).
3. parthenogenesis: reproduction from unfertilized eggs

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#### Which Reproductive Mode is Better? Sexual or Asexual

1. Null Model (Maynard Smith, 1978) has two assumptions
  - A. number of offspring a female can produce depends only on the amount of food she can gather, not her mode of reproduction
  - B. The probability that an offspring will survive to reproduce does not depend on whether that offspring was produced sexually or asexually

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#### Difficulties and Costs Associated with Sexual Reproduction

1. costs in time, energy, increased predation risk
2. potential exposure to sexually transmitted diseases
3. Sexual reproduction is slower than asexual. The fraction of the population that are asexual females increases every generation. [Fig. 8.17]

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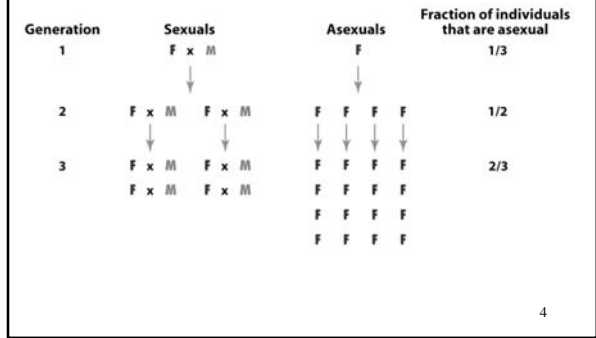
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Fig.8.17 The reproductive advantage of asexual females




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### Difficulties and Costs Associated with Sexual Reproduction

1. costs of meiosis:
  - A. offspring only share half of each parent's genes.
  - B. if the environment is stable the recombinant offspring may not be well adapted.
- 2.

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### WHY SEXUAL REPRODUCTION?

1. Maynard Smith's first assumption is correct.
  - A. In most species, including mammals, males only contribute genes.
2. Maynard Smith's second assumption is not correct.
  - A. Under some conditions, descendants produced by sexual reproduction have a higher fitness than descendants produced by asexual reproduction. Experiment with flour beetles shows this [Fig. 8.18].

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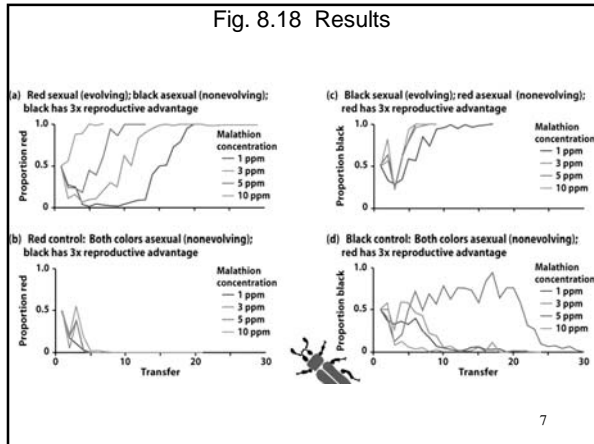
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Fig. 8.18 Results




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### Sex in Populations Means Genetic Recombination

1. Sex reduces linkage disequilibrium.
2. This is the only consequence of sex.
3. What creates linkage disequilibrium?
  - A. Genetic drift.
  - B. Selection on multilocus genotypes.

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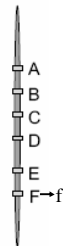
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### Genetic Drift, in Combination with Mutation, Can Make Sex Beneficial

1. Asexual reproduction leads to accumulation of deleterious alleles (**genetic load**), which can cause extinction.
2. Figure: Six loci with no mutations; (one mutation  $F \rightarrow f$ )



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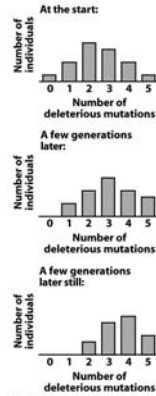
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Mueller's ratchet  
(Fig. 8.20).

1. Sexual reproduction can reverse this process




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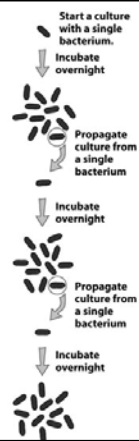
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Experimental demonstration of Muller's Ratchet (Fig. 8.21)

1. Bacterial populations subjected to periodic bottlenecks over 1700 generations.
2. None of the bottlenecked populations had higher fitness.




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Muller's Ratchet, Drift, and Sex.

1. Drift produces linkage disequilibrium.
2. Sex recreates favorable multilocus genotypes.
3. Muller's ratchet is long-term
4. However, the advantage of sex accrues over just a few generations

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Selection Imposed by a Changing Environment Can Make Sex Beneficial

1. Selection not drift can account for sexual reproduction.
2. To avoid extinction, a population must constantly evolve in response to the changing environment: = RED QUEEN HYPOTHESIS

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Selection Imposed by a Changing Environment Can Make Sex Beneficial

3. Sex is a short-term adaptation to rapid environmental change.
4. Sex recreates now-favorable multilocus genotypes that were recently eliminated by selection and sexual reproduction is therefore strongly selected for.

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EVOLUTIONARY ARMS RACE

1. Parasites and their hosts are engaged in a constant struggle, with the host evolving defenses and the parasite evolving mechanisms to counter the host's defenses.
2. A parasite might select in favor of a certain multilocus genotype in one generation, and in favor of a different multilocus genotype in another generation. [Fig. 8.22]

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