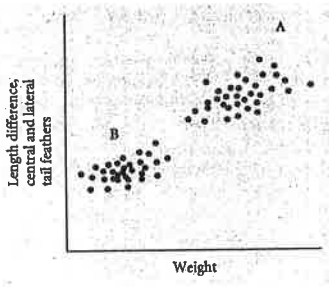
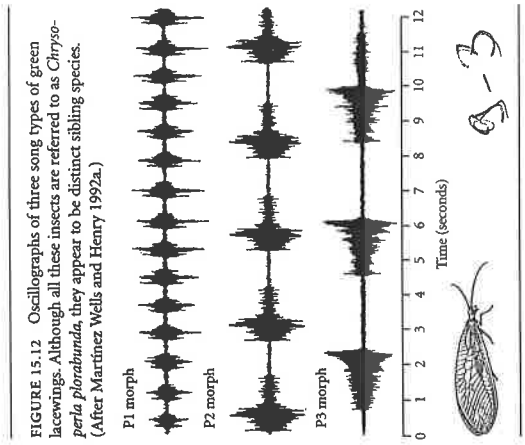
FIGURE 15.2 A hypothetical example of how different species usually form clusters of phenotypes, distinguishable by several characters. Each point represents an individual measured for two characters. These points might represent ravens (A) and carrion crows (B).



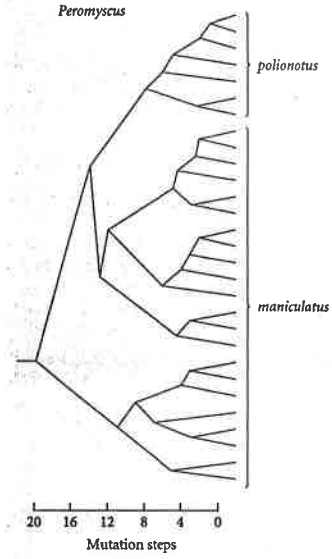
9-1

FIGURE 15.12 Oscillographs of three song types of green lacewings. Although all these insects are referred to as *Chrysoperla plorabunda*, they appear to be distinct sibling species. (After Martínez Wells and Henry 1992a.)



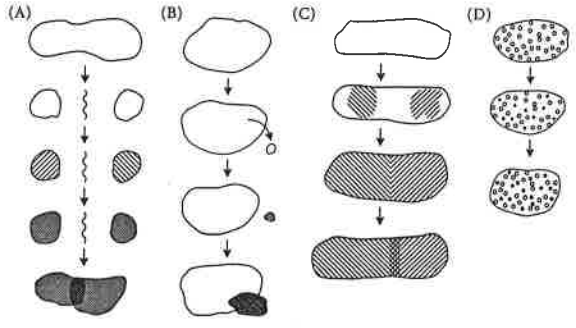
9-3

FIGURE 16.13 Relationships among mitochondrial DNA haplotypes in the widespread deer mouse, *Peromyscus maniculatus*, and the beach mouse, *P. polionotus*, distributed in the southeastern United States near the periphery of the distribution of *P. maniculatus*. The clades of haplotypes within *P. maniculatus* are localized within different regions throughout the United States. This gene tree implies that *P. polionotus* originated from a local, peripheral population of *P. maniculatus*. (After Avise 1994.)



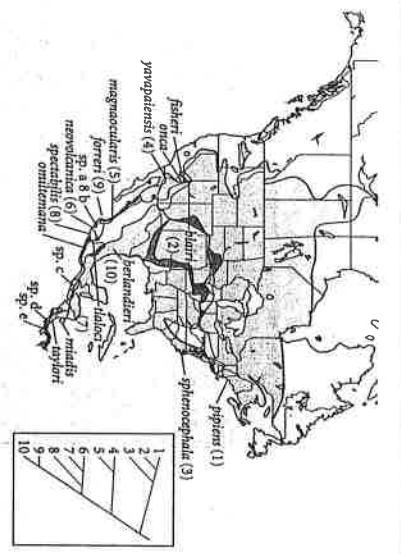
9-2

FIGURE 16.1 Diagrams of successive stages in each of four models of speciation, differing in geographic setting. (A) Allopatric speciation by vicariance. A physical barrier divides a widespread species into two populations, which diverge in features that cause reproductive incompatibility. They become sympatric if the barrier breaks down or if they disperse over it. (B) The peripatric, or founder effect, model of allopatric speciation. A localized colony diverges from a widespread "parent" species, which remains little changed. Range expansion may establish sympatry. (C) Parapatric speciation, in which populations of a widespread species diverge by adaptation to different environments. Divergent selection even at a narrow environmental discontinuity may oppose gene flow and result in reproductive isolation. (D) Sympatric speciation, in which genetic differences (white versus dark symbols) develop gradually among members of an initially randomly mating population, resulting in reproductive isolation.



9-4

FIGURE 16.3 The distribution of one clade of species in the *Rana pipiens* (leopard frog) complex. Only recently have studies of the overlap zones (dark gray areas) between some of these forms show that they are reproductively isolated species. The largely allopatric or parapatric distributions of these species suggest that physical separation has enabled them to become differentiated. The greater number and narrower distributions of species in Mexico and Central America may be due to the mountainous topography, which affords more opportunities for isolation, and the longer residence time of populations in these areas, which were less affected by Pleistocene glaciations than more northern regions. (After Hillis 1988.)



9-5

FIGURE 16.11 Reproductive character displacement in female wing color of the damselfly *Calopteryx aequabilis*, *Calopteryx maculata* has dark wings that display little geographic variation. *Calopteryx aequabilis* has smaller wing spots and paler wings in regions where this species is sympatric with *C. maculata* than in more northern regions where it is allopatric. (After Waage 1979.)

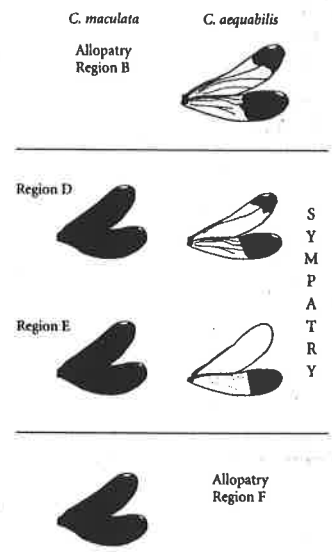
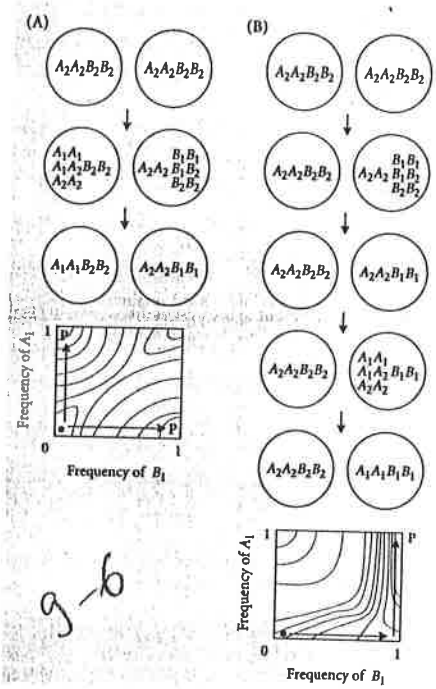


FIGURE 16.5 Two models of allele substitution leading to reproductive isolation between two populations, each initially composed of genotype $A_2A_2B_2B_2$. For each model, a possible adaptive landscape is shown, in which contour lines represent mean fitness as a function of allele frequencies at both loci (see Chapter 14). P represents a peak in the adaptive landscape. (A) Each population undergoes an allele substitution at a different locus. The hybrid combination $A_1A_2B_1B_2$ has low fitness (as indicated by the height of the landscape in its center) due to prezygotic or postzygotic incompatibility between A_1 and B_1. (B) Two successive substitutions occur at different loci in one of the populations; the other remains unchanged. The evolving population climbs an adaptive "ridge," first to the lower right and then to the upper right on the adaptive landscape. A hybrid population, located in the center of the landscape, again would have low fitness.



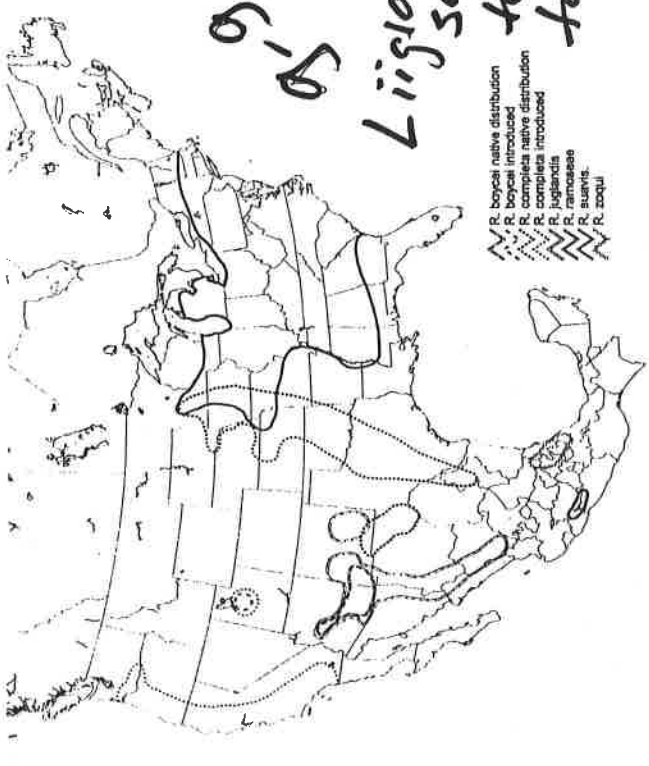


Fig. 3. The distribution of six *Rhagoletis suavis* group species including *R. boycei*, *R. completa*, *R. juglandis*, *R. ramosae*, *R suavis* and *R. zoqui*.

Fig. 2. The distribution of four *Rhagoletis pomonella* group species including *R. cornivora*, *R. mendax*, a new species infesting *Cornus florida*, and another new species infesting *Prunus umbelata* and *P. angustifolia*.

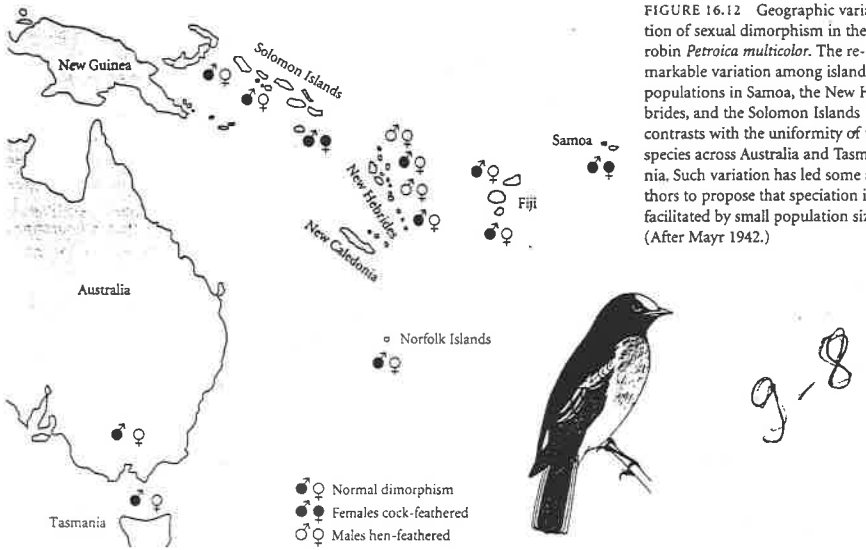


FIGURE 16.12 Geographic variation of sexual dimorphism in the robin *Petroica multicolor*. The remarkable variation among island populations in Samoa, the New Hebrides, and the Solomon Islands contrasts with the uniformity of the species across Australia and Tasmania. Such variation has led some authors to propose that speciation is facilitated by small population size. (After Mayr 1942.)

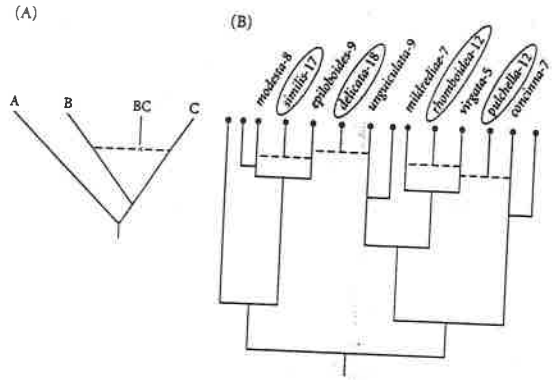


FIGURE 16.21 (A) When a new species (BC) arises by hybridization, the phylogeny of the taxon is not fully divergent, but reticulate (netlike). (B) Part of a large, complex phylogeny postulated for the plant genus *Clarkia*, in which hybridization has frequently given rise to species (circled) with chromosomes derived from both parent species. The gametic (haploid) chromosome number is given after each species' name. Unlabeled branches indicate the positions of other clades. (After Lewis and Lewis 1955.)

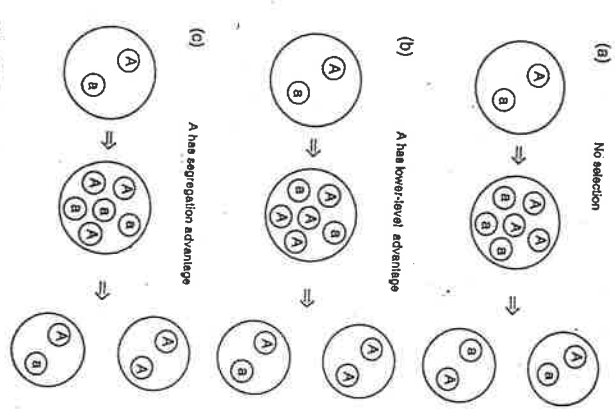


Fig. 10.4 Two-level selection. The left-hand column represents newly formed cells; each, for example, with two mitochondria (*A* and *a*). The middle column represents mitochondrial replication. The right-hand column represents the result of cell duplication. (a) No selection at lower level; (b) lower-level selection favoring *A*; (c) biased segregation favoring *A*.

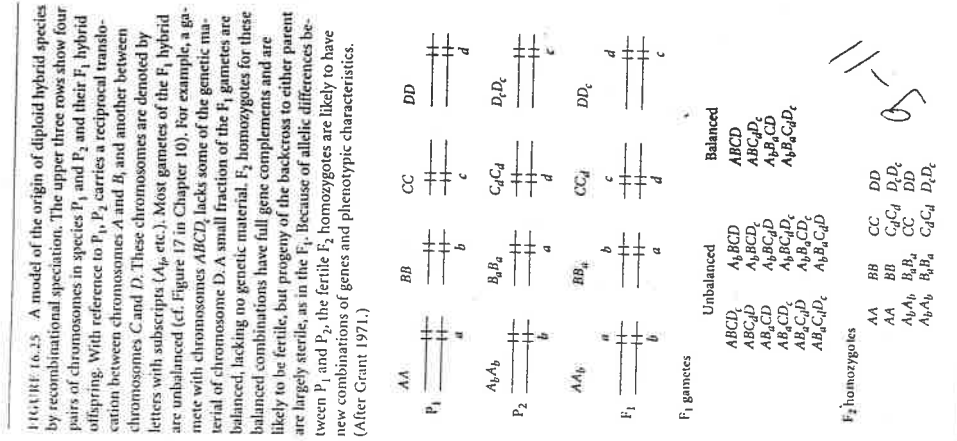


FIGURE 16.25 A model of the origin of diploid hybrid species by recombinational speciation. The upper three rows show four pairs of chromosomes in species P_1 and P_2 and their F_1 hybrid offspring. With reference to P_1, P_2 carries a reciprocal translocation between chromosomes *A* and *B*, and another between chromosomes *C* and *D*. These chromosomes are denoted by letters with subscripts (A_b, etc.). Most gametes of the F_1 hybrid are unbalanced (cf. Figure 17 in Chapter 10). For example, a gamete with chromosomes *ABCD*, lacks some of the genetic material of chromosome D. A small fraction of the F_1 gametes are balanced, lacking no genetic material. F_2 homozygotes for these balanced combinations have full gene complements and are likely to be fertile, but progeny of the backcross to either parent are largely sterile, as in the F_1. Because of allelic differences between P_1 and P_2, the fertile F_2 homozygotes are likely to have new combinations of genes and phenotypic characteristics. (After Grant 1971.)