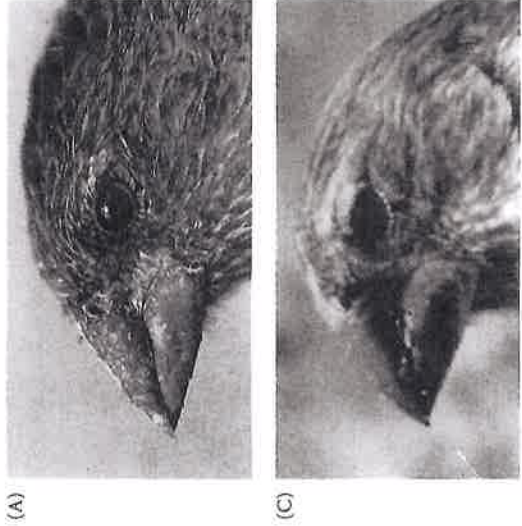


6-18

FIGURE 9.24 Character displacement in bill size in ground finches of the Galápagos Islands. The species *Geospiza fortis* and *G. fuliginosa* are more similar where they occur separately (A,B) than where they occur together (C,D). (A) *G. fortis* from the is-



land of Daphne Major; (B) *G. fuliginosa* from Hermanos; (C) *G. fortis* and (D) *G. fuliginosa* from Bahia Academia, Santa Cruz. (A by P. R. Grant; B by D. Schluter; C and D by W. Clark. From Grant 1986; photographs courtesy of P. R. Grant.)

61-91

FIGURE 18.19 A schematic illustration of niche partitioning among eight species of fruit pigeons (*Ptilinopus* and *Ducula*) from lowland rain forests in New Guinea. The species differ in fruits attract increasingly larger species of pigeons. Among the pigeons feeding on any one tree species, each pigeon species weighs about 1.5 times more than the next smaller species. The smaller species of pigeons feed from smaller, more peripheral branches. (After Diamond 1973.)

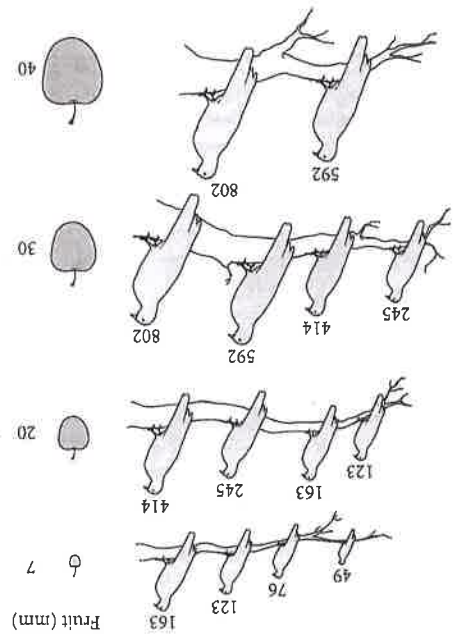


FIGURE 17.19 (A) Fitness or some measure of performance of two hypothetical phenotypes in relation to an environmental variable such as temperature. Phenotype 2, a generalist, has a broader tolerance than phenotype 1, a specialist, but has lower fitness or performance in its optimal environment than the specialist, illustrating a cost of adaptation. (B) An illustration of the cost of adaptation. Maximal running speed at various temperatures was measured for males of a small parasitoid wasp (*Aphidius ervi*) from numerous sib families. The log (ln) of the breadth of the performance curve (see Figure 17.20) is plotted against the speed for individual wasps (black circles) and family means (colored circles). The negative relationship implies a cost of broad tolerance, as shown in A, and the relationship among family means suggests that it has a genetic basis. (B after Gilchrist 1996.)

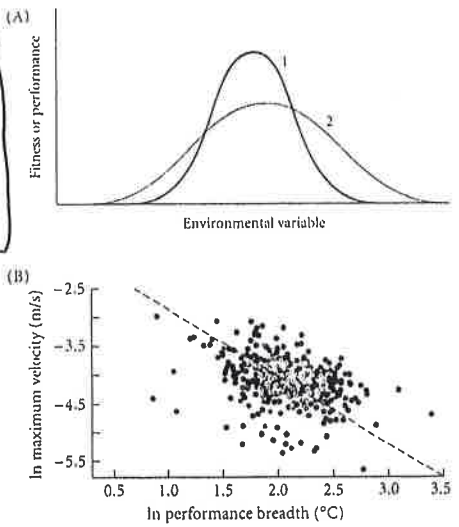


Рис. 79. Три разных случая перекрывания ниш в пространстве ресурсов двух видов с одинаковыми одномерными проекциями (стрелки). А. Измерения многомерного перекрывания (измерения совершенно независимы, а ось ортогональной проекции ниш частично задевает друг от друга, а одномерные проекции ниш не отражают истинного перекрывания).

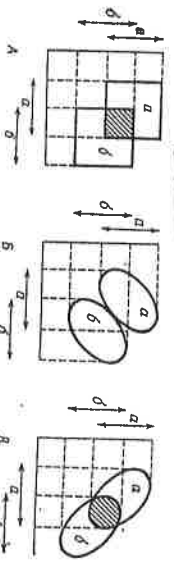
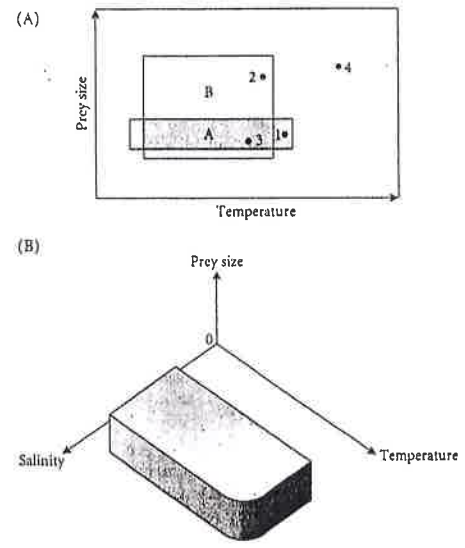


FIGURE 4.10 (A) The ecological niches of two species, A and B. Perhaps they are estuarine bivalves, each restricted to a range of temperatures and of particle (prey) sizes they can ingest. Each point in the space represents a combination of these two variables. If a locality presents only environments in the vicinity of point 3, both species could exist there, but they will compete. If the locality includes microhabitats represented by points 1 and 2, the species can coexist, because each can use a microhabitat or resource that the other does not. If the only microhabitats are near point 4, neither species can persist. (B) Three dimensions of the niche of a species are represented. The species can persist in a locality if it has combinations of the three variables that lie within the solid figure.



6-16
ЭКОЛОГИЧЕСКАЯ НИША 273

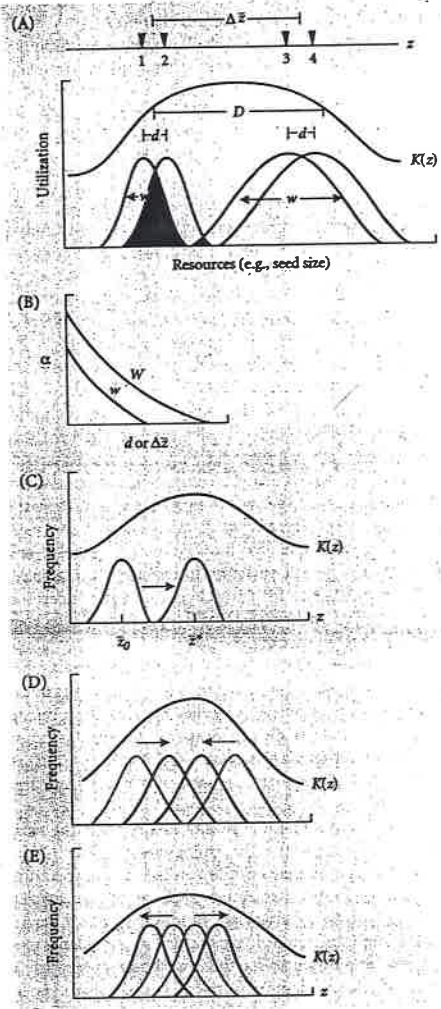


FIGURE 18.20 Formulation and results of a model of the evolution of competitors. (A) The model. Each phenotype z (e.g., beak size) has a bell-shaped curve portraying its utilization of resources (e.g., seeds of different sizes). Here, phenotypes 1 and 2 belong to one species, and 3 and 4 to another. The difference in mean phenotype between the species is $\Delta \bar{z}$, and the difference between the average resources used by the two species is D . The breadth of each phenotype's resource utilization curve (its within-phenotype niche width) is w , which is greater for phenotypes 3 and 4 than for 1 and 2. The degree of competition between two phenotypes i and j (α_{ij}) is proportional to the overlap of their utilization curves, shown as darkened regions for phenotypes 1 and 2 and for 2 and 3. The area of overlap is directly proportional to w and inversely proportional to d , the difference in the phenotypes' mean utilization curves. The abundance of different resources is shown by the curve $K(z)$, which specifies the equilibrium density that a population composed solely of each possible phenotype (z) would attain. (B) The competition coefficient between phenotypes, α , is a function of the difference between phenotypes within a species (d) or between species ($\Delta \bar{z}$). (C) Evolution of a solitary species, assuming heritability of the variation among phenotypes. (Here the utilization curve of the species as a whole is shown, not the variation among conspecific phenotypes.) The mean phenotype evolves to an equilibrium (\bar{z}^*) that matches the most abundant resources, thus maximizing population density. (D) Evolution of two species from initial positions (gray curves) to equilibrium positions (black curves) when resources have a narrow frequency distribution and the species are initially very different. Character convergence occurs. (E) The same, when resources have a broad frequency distribution and the species are initially similar. Character displacement occurs.

6-20

FIGURE 18.6 (A) The limnetic (L) and benthic (B) morphs of three-spined sticklebacks, which differ in body form, mouth size, and the number of gill rakers, the short projections on the inner edge of the gill arches shown at the left. (B) Success of prey capture by each morph in both benthic and limnetic habi-

tats. Each form was more successful, in terms of the volume of prey captured per strike, in its own habitat. Hybrids (H) had lower success than expected if they had equaled the average of their parents (gray line). (After Schluter 1993.)

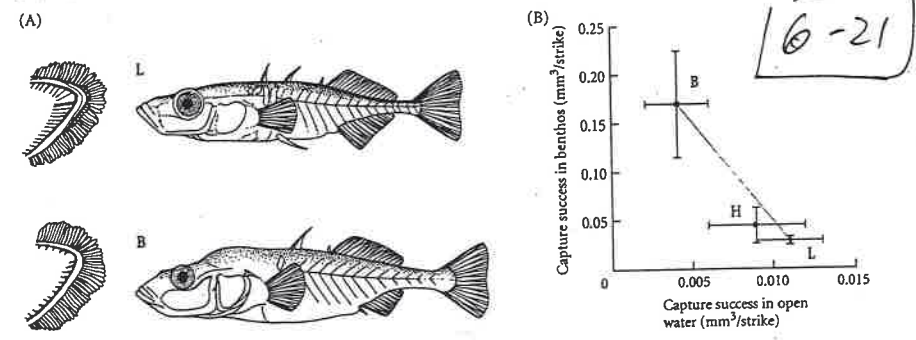
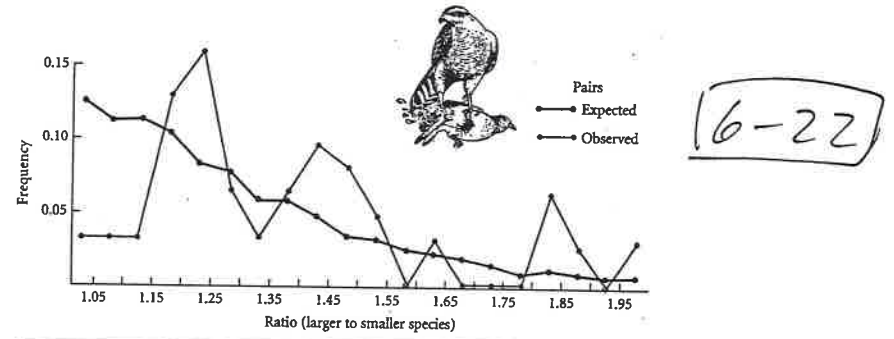


FIGURE 4.18 Coexisting species of bird-eating hawks (*Accipiter*) are more different in body size than expected at random. Hawks of different sizes feed on different species of prey. The data imply either that species can coexist only if they differ in prey, or that coexisting species evolve differences in prey use, to reduce competition. The colored line represents the proportion

of pairs of coexisting species, worldwide, with a given ratio of body sizes. The black line is the expected proportion of pairs of species with a given body size ratio, if the world's 47 species of *Accipiter* were paired at random. Few observed pairs of coexisting species have a low ratio (i.e., nearly equal), although many such pairs would be expected at random. (After Schoener 1984.)



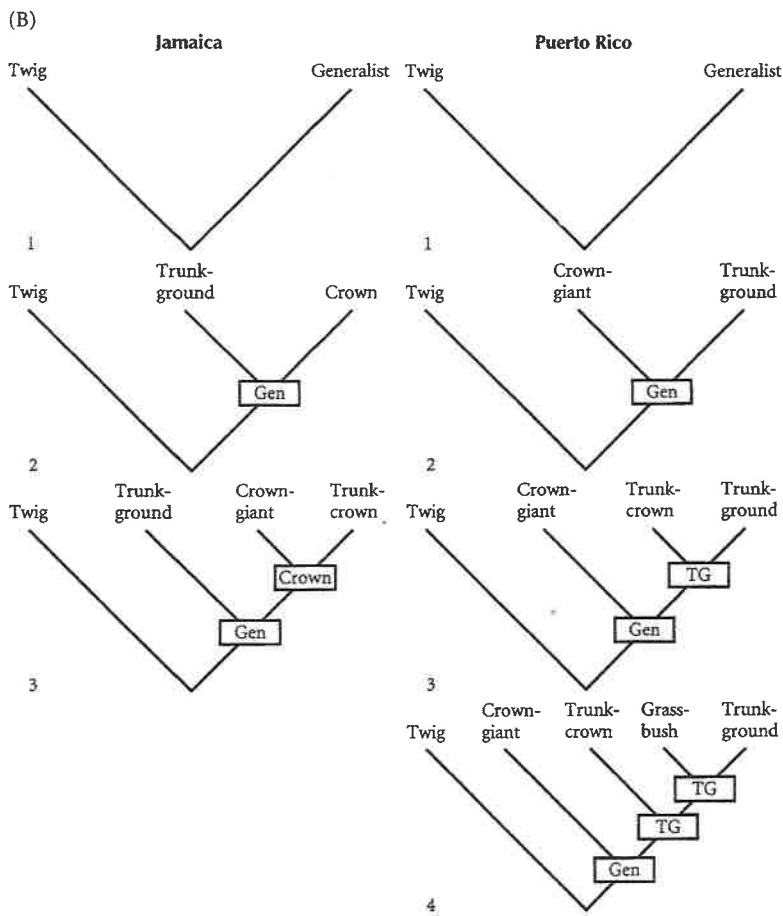
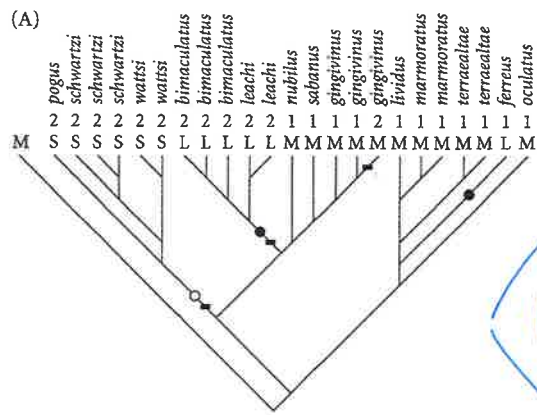


FIGURE 18.22 (A) Phylogeny of *Anolis* species and populations in the small islands of the Lesser Antilles. For each population, the number indicates the number of species on the island that it occupies, and the letter indicates body size (S = small, M = medium, L = large). The distribution of character states implies that the common ancestor was a medium-sized lizard on a one-species island. Body size has increased twice (solid circles) and decreased once (open circle). Two-species islands usually have a small and a large species, not due to independent character displacement on each island, but rather to colonization by members of small and large-bodied clades. (B) The evolution of *Anolis* community structure in Jamaica and Puerto Rico. The species on each island form a monophyletic group, although similar ecomorphs, using corresponding habitats, occur on the two islands. The ecomorphs of the common ancestors have been reconstructed, using parsimony, from the phylogenies of the living species. From this reconstruction, the history of ecological divergence on each island can be inferred, and is shown in sequential stages from top to bottom. Symbols for the ecomorphs of common ancestors include Gen = generalist, TG = trunk-ground. A "crown-giant" is a large lizard that lives in the crowns of trees. (From Losos 1992.)

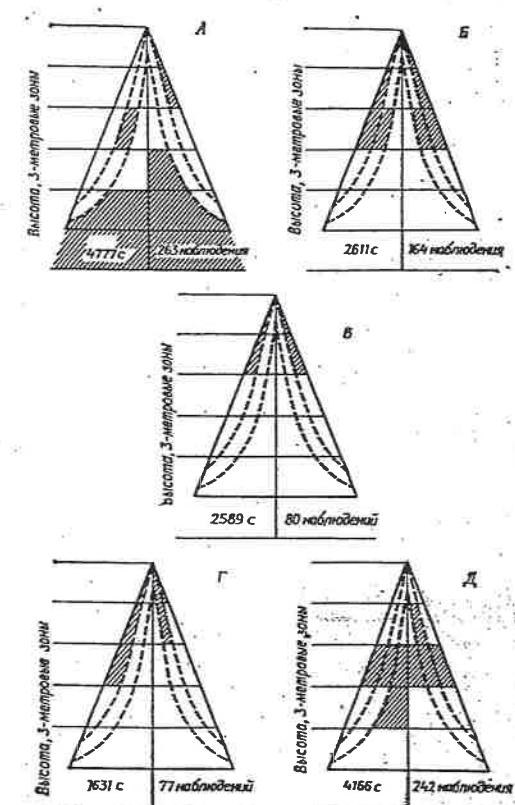


Рис. 6.9. Дифференцированное использование разных частей деревьев хвойного леса пятью симпатрическими видами слявок (род *Dendroica*). Штриховкой отмечены те участки, где преимущественно кормится тот или иной вид. В правой части каждой схемы показано использование, оцененное по общему числу зарегистрированных птиц, в левой — по общему времени наблюдений (объем выборки указан в нижней части каждой схемы). А — желтоголовая слявка; Б — черноголовая слявка; В — *Dendroica tigrina*; Г — *D. fusca*; Д — каштановая слявка. (По MacArthur, 1958. С разрешения Duke University Press.)

Кудас *Dendroica*
 lüged kasutavad pusi
 võla eri osi.

7-2

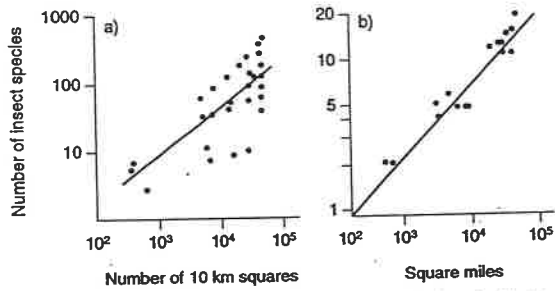


Figure 8.2. Numbers of insect species found on plants in relation to the distribution area of plants. a) Numbers of species of all phytophagous insects on British trees in relation to the abundance of the tree species. Abundance is based on the number of 10km squares in which each genus of tree occurs (after Strong, Lawton and Southwood, 1984). b) Numbers of leaf-mining lepidopteran species in relation to area covered by species of oaks in North America (after Opler, 1974).

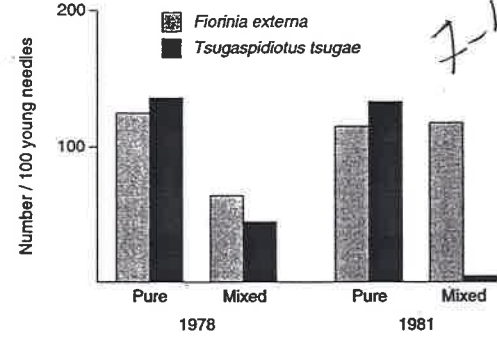


Figure 8.4. An example of competitive interactions among two species of scale insect, *Fiorinia externa* and *Tsugaspidiotus tsugae*, that inhabit hemlock trees, and utilize the same parts of the tree and the same types of needles. Average density of each species is shown for sampling periods in 1978 and 1981. In mixed stands, *F. externa* gives evidence of outcompeting *T. tsugae* (after McClure, 1980).

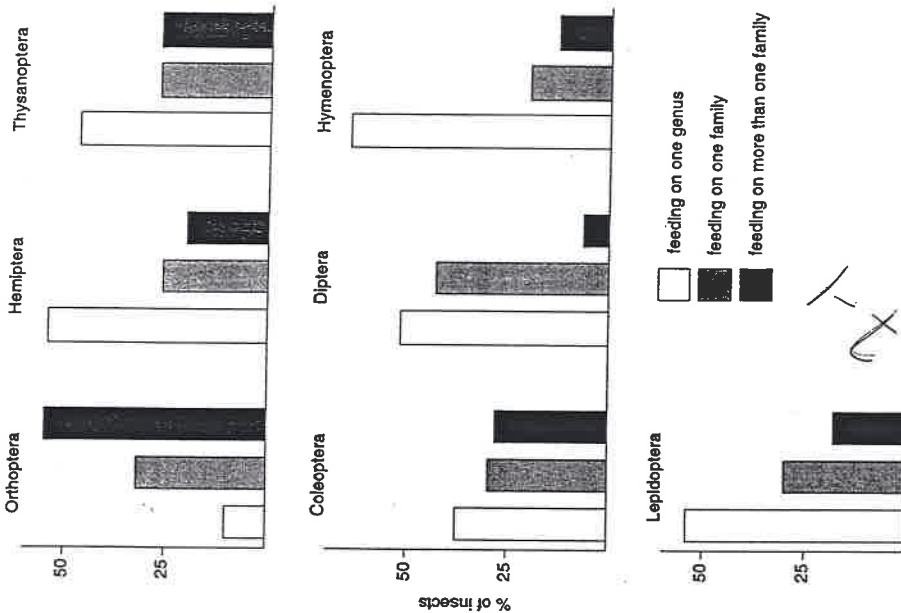


Figure 8.1. Host-plant specificity of insects from different orders, showing the percentage of species that feed on one genus, one family or more than one family. Percentages for Orthoptera are based on all species of grasshoppers for which critical food analyses have been carried out, percentages for all other orders are based on data for the British fauna (from Chapman, 1982).

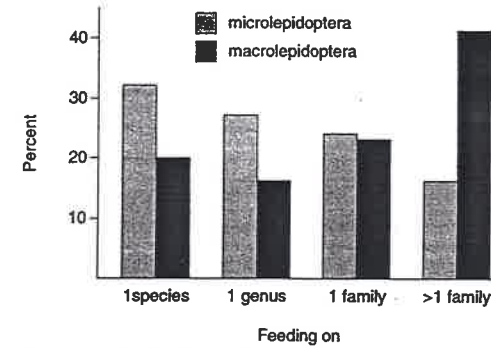


Figure 8.1. Relative diet breadths of macro- and microlepidoptera in Britain. Bigger percentages of microlepidoptera feed within one plant species or genus, while larger percentages of macrolepidoptera feed on plants in more than one family (after Gaston and Reavey, 1989).