Summary

Classic methods of population genetics can be applied for traits not affecting generation length. However, important components of life histories, such as age and size at maturation, schedule of growth and reproduction in years following reproduction, or aging, usually change generation length. To study the evolution of such traits optimization methods are applied at present, and the results are sensitive to the fitness measure. There is common but false believe that the Malthusian parameter r (the solution of Euler-Lotka equation), measuring population growth rate, is a universal measure of fitness. This cannot be the case, because populations cannot grow without limits, as it was rightly pointed out by Darwin. Just the difference between the potential for growth and lack of growth in reality defines the strength of natural selection, able to produce all adaptations, including life history traits. Because most populations are on average around their equilibrium size in their evolutionary history, such values of life history traits should be selected for, for which $r = 0$ (net reproductive rate $R = 1$), whereas all other values lead to $r < 0$ ($R < 1$). In other words, the most fit strategy gives $r = 0$, and the population cannot be invaded by a mutant or migrant representing other strategies.

In growing populations the increase of population density is a selective pressure toward early maturation at a small body size. In stable populations delayed maturation can evolve, and long period of growth may lead to large or even huge body size. Optimal age and size at maturity depends on mortality, and in seasonal environments mortality shapes also the schedule of resource allocation to growth and reproduction in the years following maturation. Mortality sources can be divided into external, i.e., independent of organism's state (predation, catastrophes) and internal, dependent on aging. Low external mortality selects for delayed maturation, large body size and slow aging.