IMPACT OF A SPRING DEFOLIATOR ON COMMON OAK

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INTRODUCTION

We have investigated the population dynamics of some common phyllophagous insects in oak stands of the forest-steppe zone and their impact on common oak (*Quercus robur* L.). Considerable attention has also been paid to mathematical modeling of the studied processes. All field data represent samples taken from the Tellerman oak grove in the Voronezh region, where repeated observations have been made from 1969 up to the present. Our particular concern is the green oak leaf roller (*Tortrix viridana* L.), which propagates in 70 to 100-year-old oak stands in the floodplain of the region.

Fig. 1 shows characteristics of the weather conditions from 1969 to 1988 as well as results of field observations and mathematical modeling of the oak leaf roller's population density and the defoliation of oak crowns. More detailed description of methods and discussion of results are given in Rubtsov (1983) and Rubtsov and Rubtsova (1984). Last year's data showed that in all oak forests in the region significant number of eggs died during the summer to autumn period. That alters our conception of the egg stage of the oak leaf roller as its most favorable stage, subject only to high mortality during severe and prolonged frosts.

DEFOLIATION IMPACTS

Our investigations show a close relation between degree of defoliation of a stand and the ratio of late wood/early wood. For example, after 20 percent defoliation, this ratio is about 3:5, whereas after 80 percent defoliation, it is only about 1:4.

We have studied the defoliation of oaks damaged by spring phyllophagous insects since 1984. Larval feeding on oak foliage varies with weather conditions but usually lasts 18 to 24 days. Foliage is destroyed both in buds and on growing shoots. Depending on different combinations of environmental conditions, trees features, and insect populations, the defoliations have different effects, causing substantial variability in refoliation processes.

We divided all shoots that regrew after defoliation into replacement shoots (from reserve and dormant buds) and secondary shoots (from new buds). In most of the cases, the crowns of defoliated oaks have both kinds of shoots. According to our data, the greater the degree of defoliation and the faster it is reached, the earlier a tree begins to refoliate and the greater the proportion of replacement shoots among the regrowth. As larvae began feeding in the upper parts of the crowns, defoliation of the upper two-thirds of the crowns was 80 to 100 percent and that of the lowest one-third only 30 to

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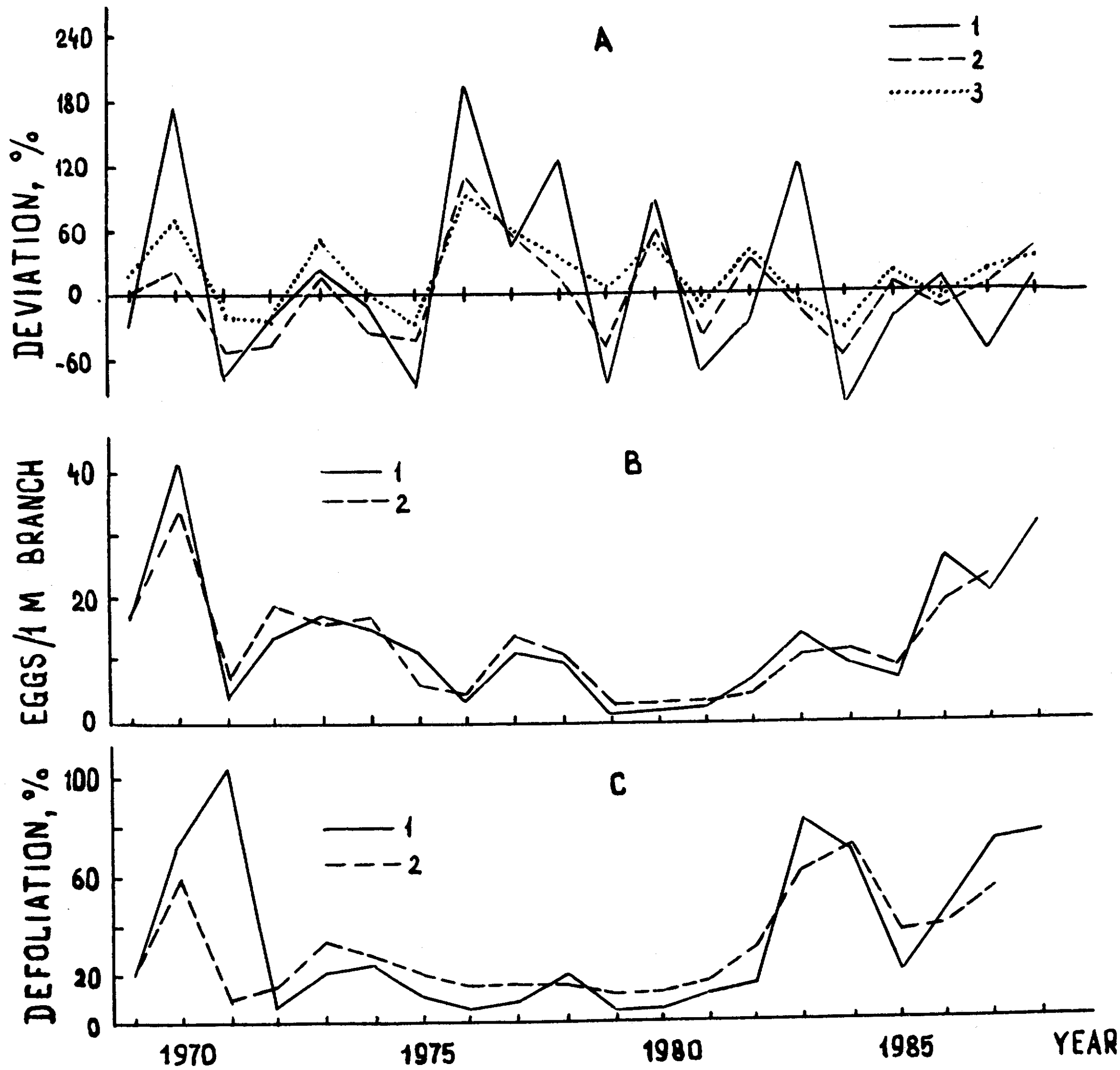

Figure 1. Weather conditions, oak leaf roller population density, and defoliation of oaks in the Tellerman oak forest from 1964 to 1988. A) hydro-thermal coefficient (HTC) deviations from the average values of many years: 1) HTC of May, 2) HTC of growing season (May to September), 3) annual HTC; B) oak leaf roller population density: 1) field data, 2) calculated data; C) oak stands defoliation: 1) field data, 2) calculated data.

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80 percent. In the latter case, secondary shoots were predominant. The greater the degree of foliage survival, moreover, the larger the share of secondary shoots among the regrowth. Since secondary shoots start growing later than replacement ones and have the lower growth rate, we can surmise that trees with a predominance of secondary shoots sustain a longer period of reduced foliage area.

Our 4-year observations show that trees with different degrees of defoliation have different numbers of reserve and dormant buds per 1 m of twigs at the end of summer. These findings are discussed at greater length by Utkina and Rubtsov (1989). Fig. 2 shows the average decrease in nongrowing buds for trees of slight and severe defoliation respectively. One can see that with slight defoliation (about 30 percent), the density of such buds is quite stable, whereas with severe defoliation

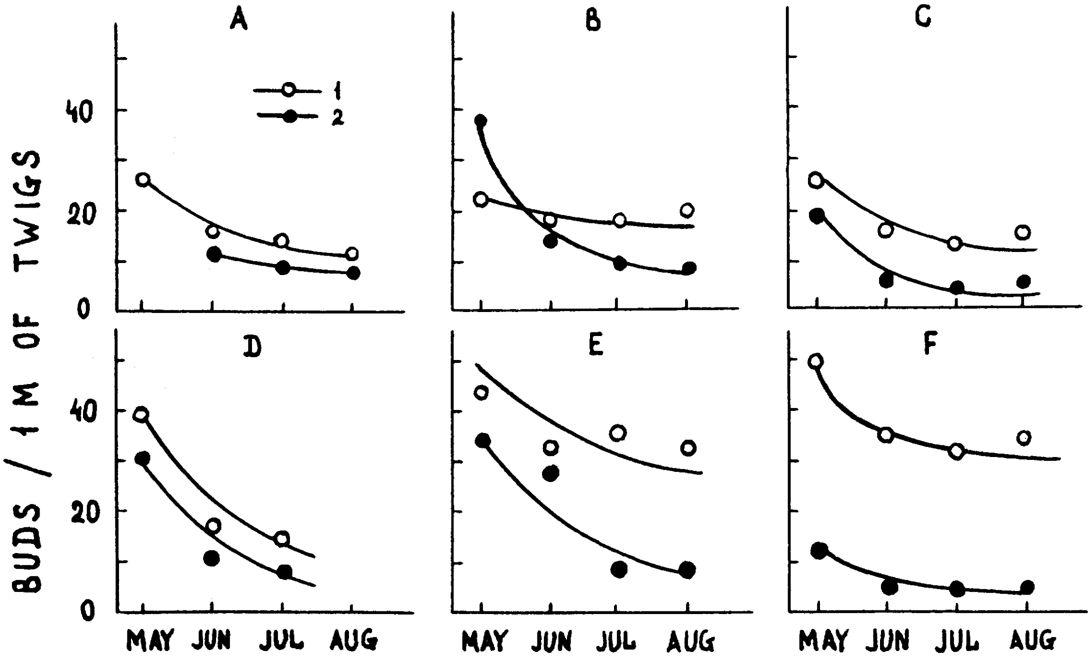

Figure 2. Numbers of nongrowing (reserved and dormant) buds in oak trees with 30 to 50 percent defoliation (1) and 75 to 100 percent defoliation (2). A), B), C), and D) 85-year-old stand from 1986 to 1989; E) and F) 105-year-old stand from 1987 to 1988.

(75 to 100 percent) the density of nongrowing buds declines from year to year. This is related to the fact that reserve buds open after defoliation, while some of them would be able to fill up the pool of dormant buds. Moreover, some share of the nongrowing reserve buds dry out in summer and fall. Fig. 3 shows the share of dead reserve buds to be largely independent of degree of defoliation. Comparison of foliage weight and area per 1 m of twigs in oak trees sustaining different degrees of defoliation suggests that, in general, refoliation is completed in defoliated crowns by the end of growing season.

One of the chief difficulties of mathematical modeling, especially of simulation modeling, is the weak data sets. In addition to such real deficiencies, moreover, there are methodological problems: inadequate structure and volume of data because of discrepancies between the final aim of the investigation, model structure and organization, and the system of field data sampling.

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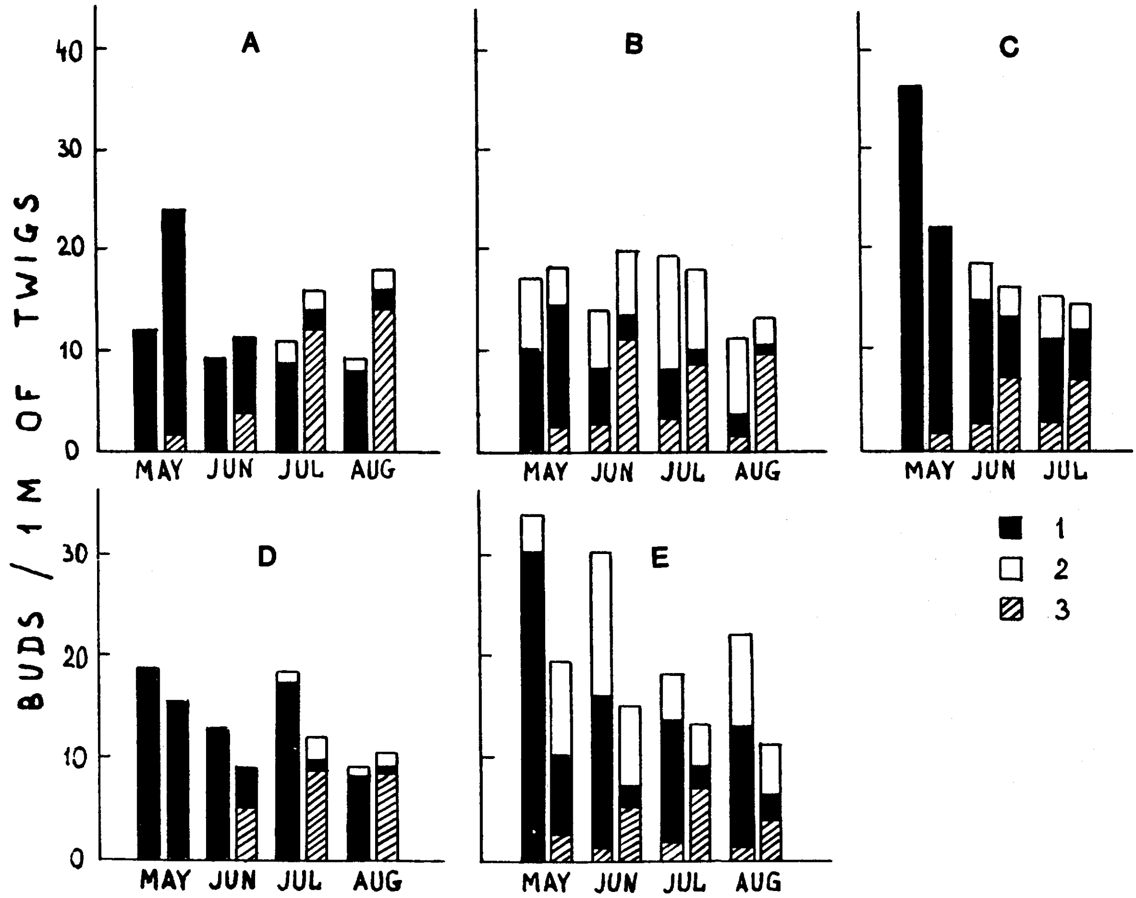

Figure 3. Numbers of reserved buds: in oak trees with 30 to 50 percent defoliation (left columns) and 75 to 100 percent (right columns). 1) alive, nongrowing; 2) dead; 3) buds grown after defoliation. A), B), and C) 85-year-old stand from 1987 to 1989; D) and E) 105-year-old stand in 1987-1988.

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