

EUROPEAN INSECT OUTBREAKS AS POPULATION FLUCTUATIONS*

J. RICHARD CARPENTER
University of Oklahoma

Previous studies on insect population fluctuations have dealt chiefly with diurnation and seasonation: diurnal and seasonal phenomena. This study deals with fluctuations taking place over long periods of years—the phenomenon of annuation. The data used were the observations recorded in the literature concerning insect outbreaks in Europe and European Russia which are available in appreciable quantities for the period since the middle 18th century. There are no records of actual numbers of the insects present in any given year, but we are able to obtain from the data at hand a relative estimate of the numbers of insect species which underwent outbreak, i. e., were excessively abundant, in each year since about 1750. While there is, as might be expected, an increase in the numbers of insects reported yearly, particularly after about 1850, fluctuations in the numbers of yearly outbreaks are immediately evident. These fluctuations occurred synchronously throughout the deciduous forest portion of Europe from England, through France, Germany and Poland to Russia. The years when these peaks of outbreak prevalence occurred were 1744, '55, '69, '84, '97, 1809, '18, '28, '37, '46, '54, '63, '69, '72, '75, '83, '88?, '92, '96, 1902, '08, '13, '17?, '21?, '24, '28?, and '31?. A regression in the time interval between the peaks seems to indicate that perhaps this is a part of a much longer cycle.

Certain government reports for England and Wales and for Poland, which have appeared for the period since 1917, give more complete lists of outbreaks than were available previously. Analysis of the data given in these reports shows fluctuation peaks similar to the above: in Poland the peak years have been 1921, '24, and '29-30?; in England and Wales, 1921, '25, '28-9, and '32-3. A similar study made on the outbreak records for the taiga, forest-steppe, steppe, and semidesert of the USSR had data available for a shorter period, but showed different fluctuation patterns in each area, demonstrating that populations in different biotic and climatic areas react differently to the conditions of the same years.

It will not be until there are available more accurate records of this type for many more areas that the natural pulse of insect outbreaks can be analyzed, and the control measures planned in terms of these fluctuations. From the standpoint of ecology insect outbreaks are natural phenomena, the result of a number of interacting factors acting together to form a highly complex equilibrium. Factors important here are the nature of the biotic area concerned, the fluctuating environment and climate, the fluctuating physiological vigor and reproductive potential of the animal and its host plants, the effects of overcrowding on the developing animals, and the all-important problem of parasitism and predation. It is not until these factors are understood and the actual study of animal numbers in the field under observed conditions is made, that the subject of insect outbreaks can be scientifically approached and understood.

* Abstract of a paper to appear in the *Journal of Animal Ecology*, 1939.