THE INFLUENCE OF CLIMATE AND WEATHER ON THE MEAN DENSITY LEVEL, THE FLUCTUATIONS AND THE REGULATION OF ANIMAL POPULATIONS

by

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INTRODUCTION

It has long been recognized that climate and weather can influence animal numbers considerably, affecting both reproduction and mortality and to a less extent also emigration and immigration. In my opinion the following distinctions in the actions of physical factors on the numbers of animals have to be made (see fig. 1 and 2):

1. The same animal species may be numerous in definite areas and rare or absent in others, due to climatic influences. In this paper we indicate this effect of climate as the influence on the mean density level of the population.

2. A definite population may have a high density in one generation or year and a low density in the next, due to weather influences. We shall indicate this effect of weather as the influence on density fluctuations.

3. In natural populations high and low densities rarely occur in more than two or three successive generations. Hence, at high density the mortality and emigration rates ultimately exceed the reproductive
Fig. 1. Model of the range of distribution of an animal species. It is assumed that the differences in mean density level are caused by climate. Outside the hatched areas the species does not occur. The figures refer to mean density levels. At P1, P2 and P3 the density has been measured during eleven successive generations, the results of which are shown in fig. 2.

and immigration rates. At low density it is just the reverse. Due to this effect populations in general show very restricted fluctuations, as compared with the theoretical possibilities of geometric increase. These fluctuations occur around a constant mean density level (Smith, 1935) if the habitat does not change and if there is no trend in climate. This means that during a high number of generations reproduction and immigration counterbalance mortality and emigration. We indicate this phenomenon as the regulation of population density. It is claimed by some authors that this regulating effect can be brought about by the operation of density related factors. Others hold that restricted fluctuations around a constant mean density level can be maintained under the influence of the ever changing weather, which is not related to density.

This paper is mainly concerned with the proof that weather as such cannot regulate the numbers of animals. To make my point of view as clear as possible some reference will first be given to the influences on mean density level and fluctuations. From the general viewpoint