ROCKY MOUNTAIN
JOURNAL OF MATHEMATICS
Volume 9, Number 1, Winter 1979

ON THE APPLICABILITY OF CURRENT POPULATION MODELS TO THE GROWTH OF INSECT POPULATIONS

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Since most models of population growth assume a stable age distribution, it is interesting to know which populations this may be relevant to and which not. In an environment in which fecundity and survivorship rates are constant, almost all populations will achieve a stable age distribution no matter what their original age distribution (Lotka, 1922). The problem with most insect populations, particularly in highly seasonal environments, is that the time when a population can grow is limited. This corresponds roughly to the growing season. So I asked, within the constraints of a normal growing season in the temperate zone, which insect species would be able to reach a S.A.D.?

I. **Methods.** My methods are straightforward and proceed through four steps. Full elaboration of this work has been presented elsewhere (Taylor, 1977).

1. **The physiological time axis.** The growth and development rates of insects depend upon temperature. Generally, these rates increase with temperature to the point where high temperatures have a deleterious effect. Thus, during mid-summer, insect populations would appear in normal clock time to grow faster than in spring and fall. In physiological time, development rates are approximately constant over a fairly broad range of temperatures. On this scale, then, the population growth rate does not vary so much with temperature. Below, a degree-day scale (Stinner, et al., 1974) has been used to overcome the problem of fluctuating temperature during the season.

2. **The equation for population growth.** I used Lotka's renewal equation to take into account age-dependent birth and death rates:

$$B(t) = \int_0^{\beta} B(t-a)\, m(a)\, l(a)\, da + G(t).$$

Only females are considered. This model includes the effects of the three basic ingredients in population growth: (i) births due to an *initial age distribution* occur in the $G(t)$ expression; (ii) *age-specific mortality*

Received by the editors on December 1, 1977.