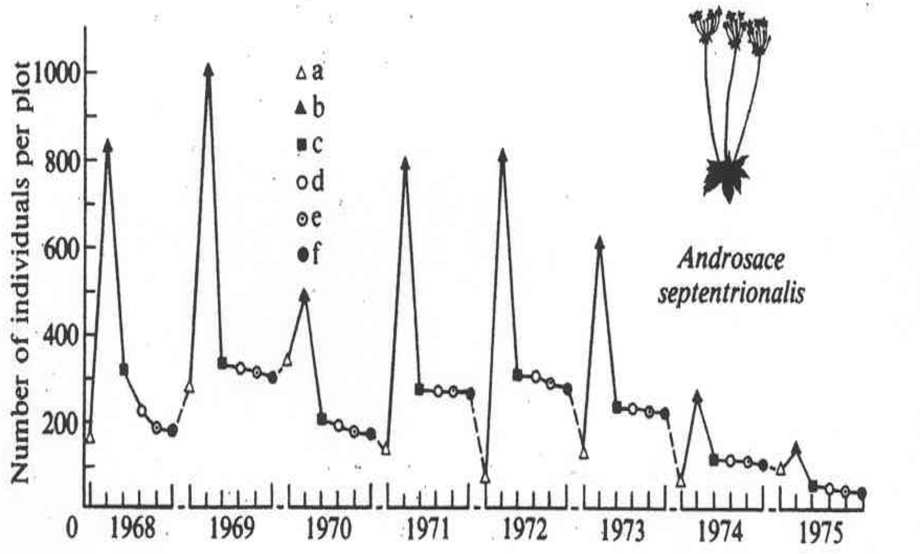
Plant Population Ecology II

- **Intraspecific competition**
- **Density independent regulation**
- **Density dependent regulation**
- **Changes in distribution of biomass**

Fig. 5.1 The population dynamics of *Androsace septentrionalis* over an 8-year period: (a) beginning of germination; (b) maximum germination; (c) end of seedling phase; (d) period of vegetative growth; (e) flowering; (f) fruiting. (From Symonides 1979b)



Intraspecific competition

- $\Delta N/\Delta t = r\,N_o\,(K-N/K)$

- K= carrying capacity
- Maximum sustainable population
- Can vary year to year due to environmental conditions

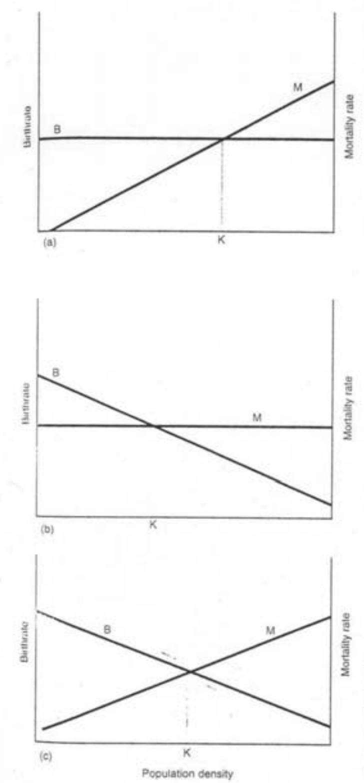


Figure 18.7 Population regulation requires density-dependent birthrates, mortality rates, or both. In (a) the birthrate is independent of population density but mortality increases with density. In (b) the mortality rate is independent of population density, but the birthrate declines as density increases until the population reaches *K*. In (c) both birthrate and death rate are density-dependent, and the population reaches equilibrium when the birthrate equals the death rate.

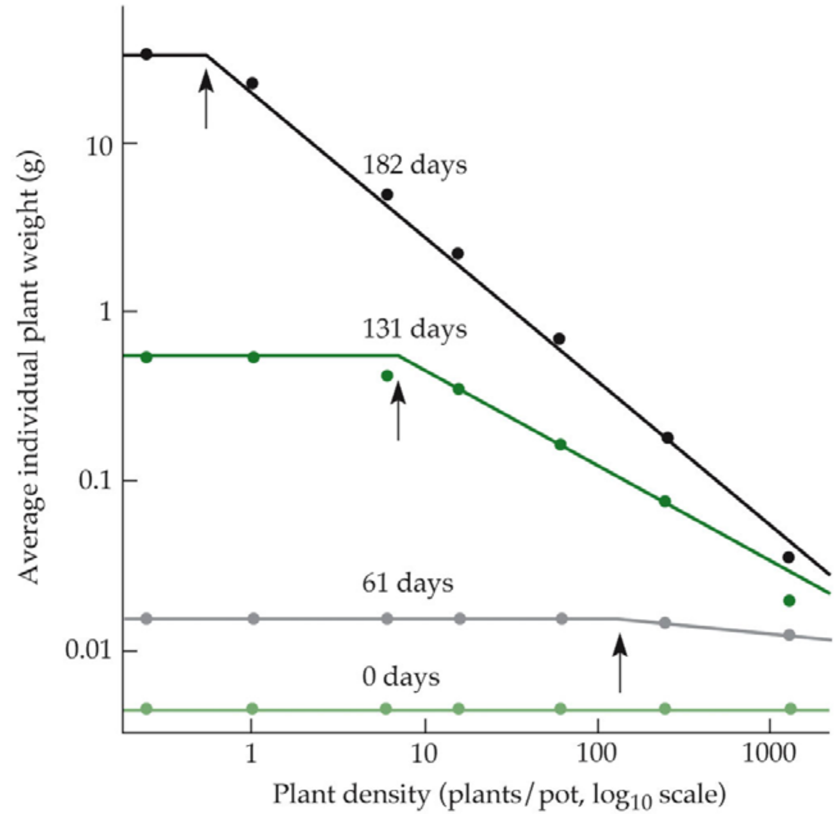
Density independent regulation

- Physical factors
- Freezes
- Volcanos
- Tsunami

Density dependent regulation

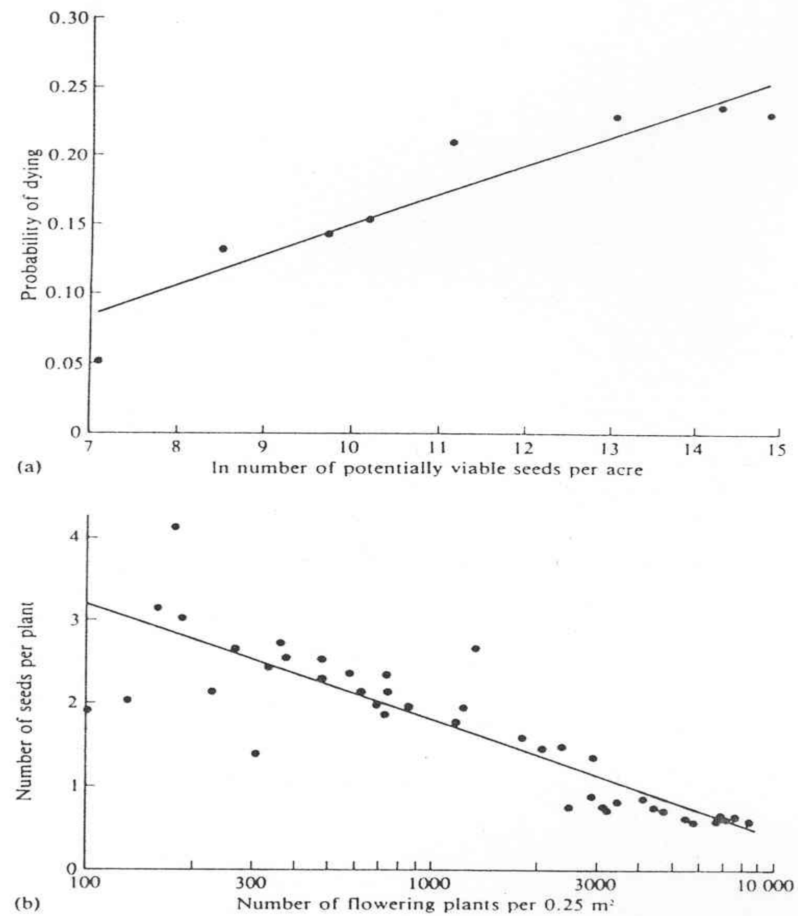
- requires density dependent mortality and birthrates
- factors which are density dependent
- resource depletion: ie; self-shading
- space depletion
- herbivory
- pollinator density
- seed predation



Birth and death changes

- seedling mortality
- biomass of lettuce
- plant mortality
- plant fecundity
- crop productivity

Fig. 5.2 Density-dependent processes in two plant populations: (a) mortality in a population of sugar maple establishing from seed (Hett 1971); (b) fecundity in experimentally manipulated natural populations of *Vulpia fasiculata*. (Watkinson and Harper 1978)



Seedling mortality

Fig. 5.3(a) An idealized diagram of density-dependent seedling mortality and density-dependent fecundity and their role in the regulation of a plant population. (b) An example of density-dependent mortality and density-dependent fecundity regulating population size in four experimental populations of an annual grass *Bromus tectorum*. (Data from Palmblad 1968)

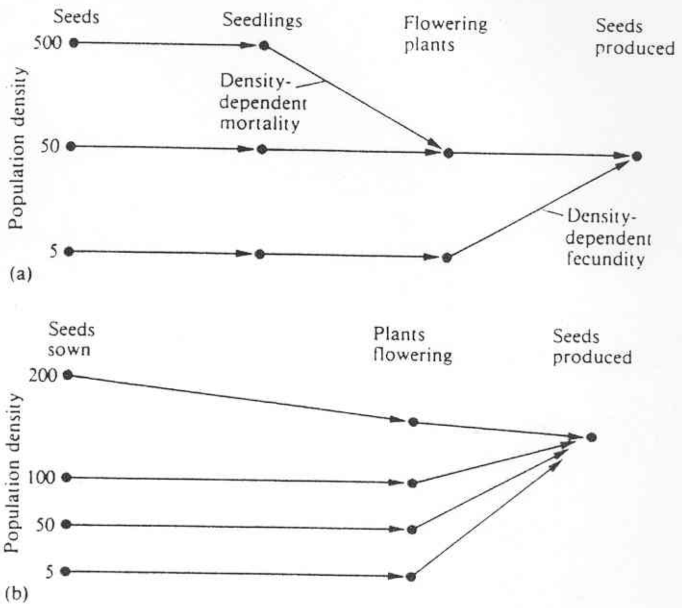
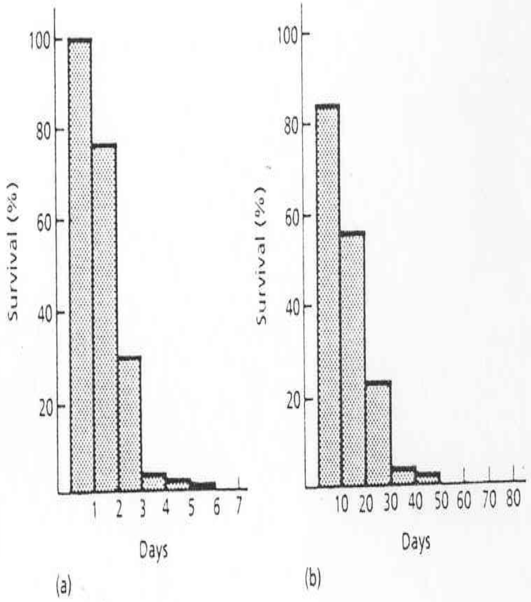
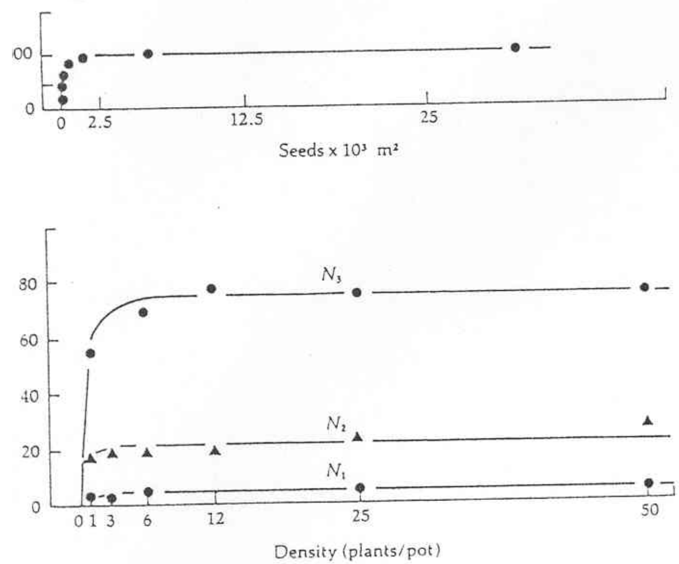


Fig. 4.10 Survival of seedlings from successive cohorts of: (a) *Androsace septentrionalis* emerging at daily intervals and (b) *Tragopogon heterospermus* emerging at 10-day intervals in natural populations on dunes in Poland (from Symonides 1977).



Resource depletion:

- Space
- Nutrient limitation



re 4-6 The relationship between yield (dry weight per unit area) population density for mature populations of *Trifolium subterraneum* nd mature populations of *Bromus unioloides* (b) grown at three levels trogen fertilization. (From C. M. Donald, 1951. *Australian Journal of cultural Research* 2:355–376.)

Lettuce

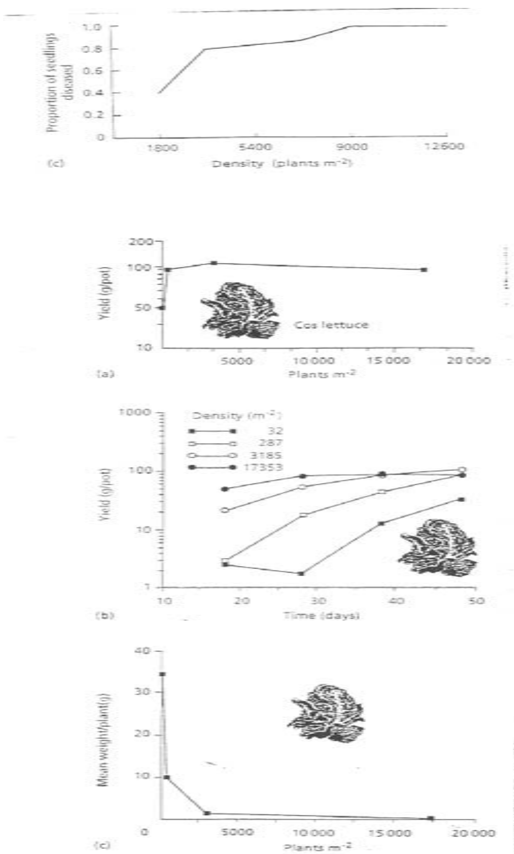


Fig. 4.1 The growth of a lettuce crop expressed as: (a) final yield from pots sown at different densities, (b) yield at different dates of harvest for different sowing densities, and (c) mean weight per plant at final harvest for different densities (from Scaife & Jones 1976).

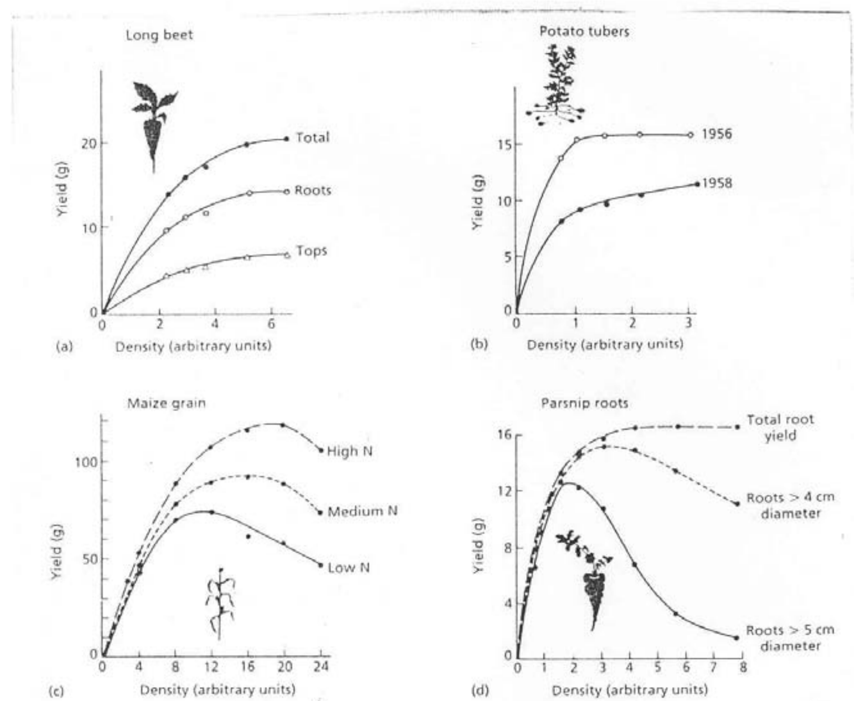


Fig. 4.2 Yield/density relationships in four crops (from Willey & Heath 1969).

Changing distributions

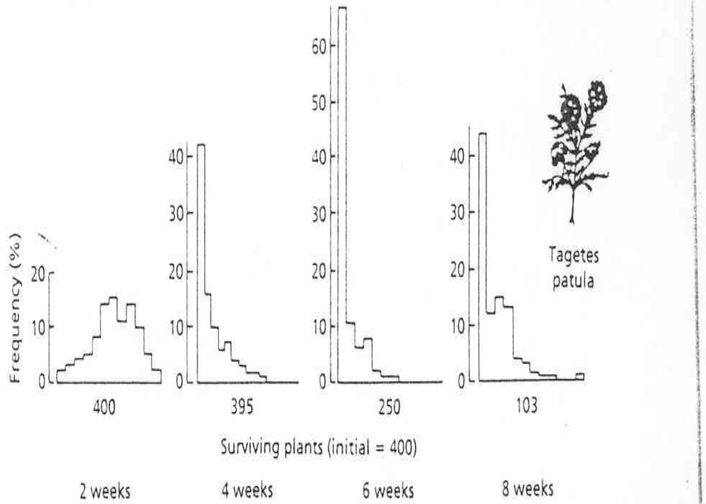
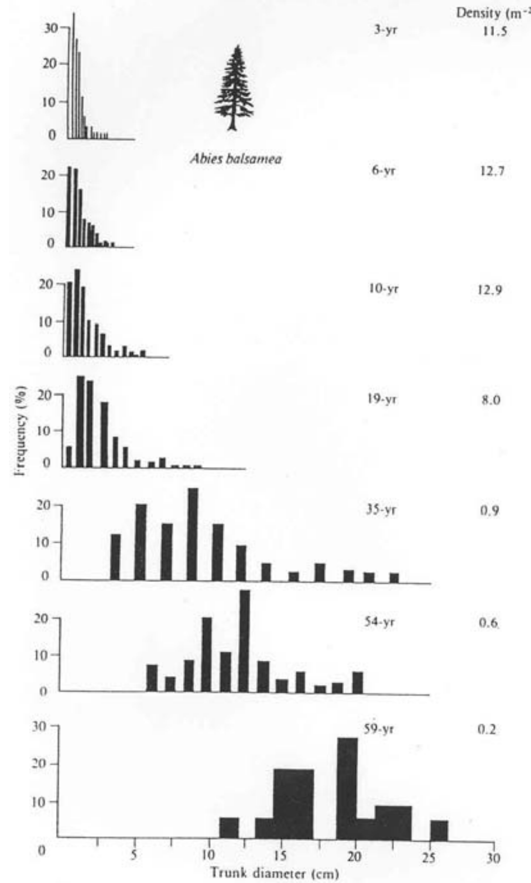


Fig. 4.7 The changing distribution of individual plant weight in a population of marigolds (*Tagetes patula*) with time. Frequencies are shown in 12 equal intervals in the range of weights present at each date (from Ford 1975).



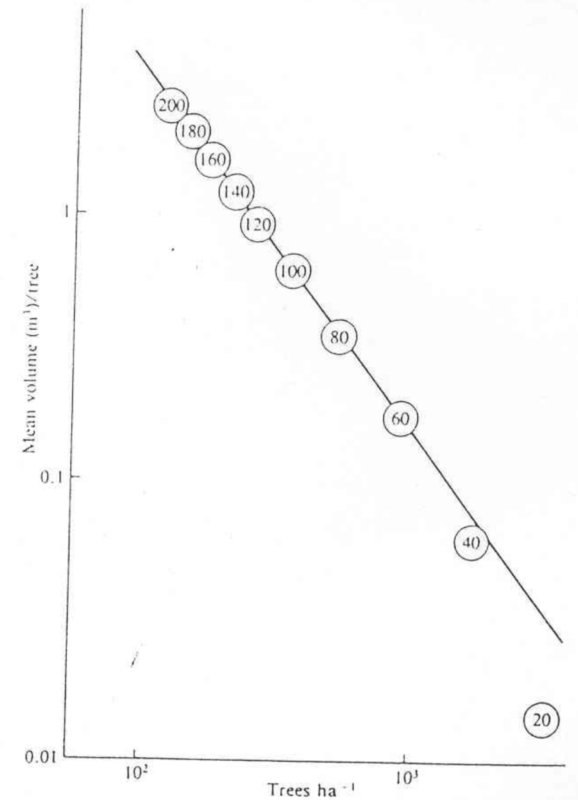
due to different growth rates

large individuals suppress the growth of small ones

Self-Thinning rule

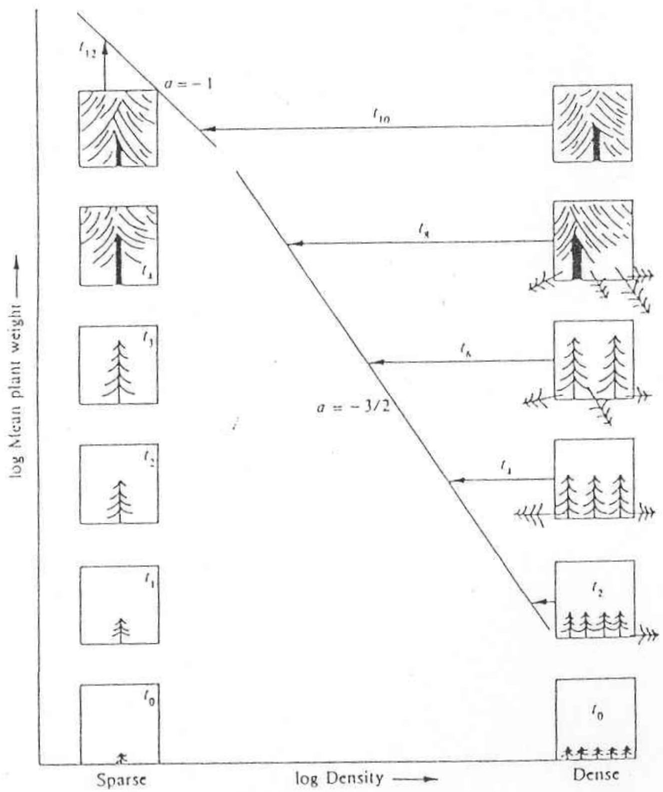
- 3/2 relationship
- - wt/density
- plant biomass = (constant) * (density)^-3/2
- Yield = C * d ^ -1/2

Fig. 5.8 The relationship between log mean volume per tree and log density of trees in ten stands of ponderosa pine. The age of each forest stand is indicated for each point on the graph. (From White 1980)



Self-thinning

Fig. 5.7 The progress of a sparse and a dense tree population through time, illustrating the main features of the −3/2 thinning process.



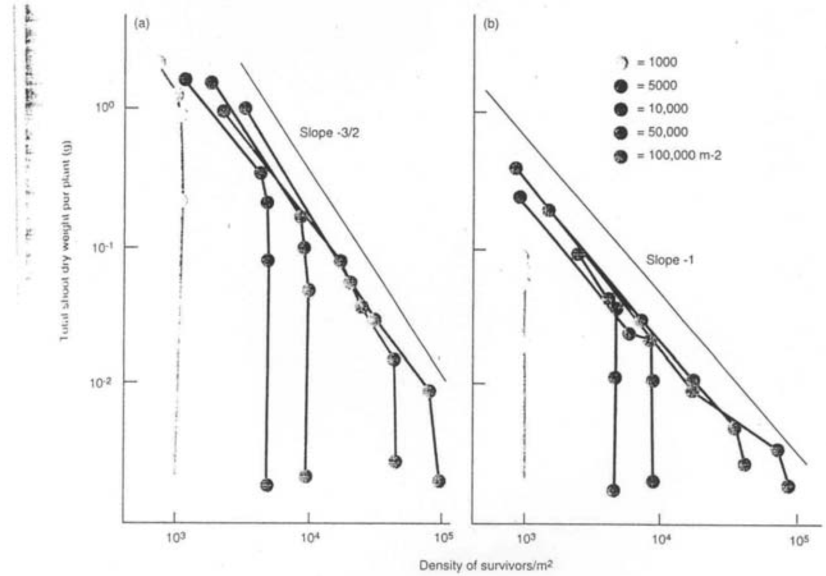


Figure 18.15 Self-thinning slopes for perennial ryegrass (*Lolium perenne*) sown at five different densities under two light conditions: (a) 0 percent shade; (b) 83 percent shade. The populations were harvested on five successive occasions, indicated by the vertical lines. Note that the denser populations reached and followed the −3/2 slope of self-thinning much sooner than the less dense populations. The last to reach it was the population with the thinnest density, but regardless of starting density all lines converged at a similar final density. (From Lonsdale and Watkinson 1982: 433.)

- **Still in debate**
- **Upper limit**