

THE POPULATION DYNAMICS OF PERENNIAL CHENOPOD SHRUBS IN SEMI-ARID WESTERN NEW SOUTH WALES

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This thesis deals with some aspects of the population ecology of arid zone perennial chenopod shrubs. It examined the effects of grazing on the population dynamics of *Atriplex vesicaria*, *Maireana astrotricha* and *Maireana pyramidata*, the influence of weather on recruitment and survival of *Atriplex vesicaria* and the effects of various microtopographical features on seedling survival of *Atriplex vesicaria*.

In 1977, 17 transects measuring 100 m by 1 m were established on a sheep grazing property near Broken Hill in western New South Wales. Data were collected approximately quarterly of shrub size (height and diameter), presence or absence of recruits and various soil conditions. In 1980, a further 12 ungrazed transects were established in 12 of the original 17 paddocks, resulting in a total of 12 paired and five unpaired transects.

Using data collected between 1980 and 1987 from the paired transects, it was shown that moderate levels of grazing did not affect the population dynamics of the three shrubs at distances of 1,200 to 1,500 m from the water point. The grazing rate, which was generally regarded as being representative of district practices, was less conservative than that recommended by the New South Wales Soil Conservation Service. The density of *Atriplex vesicaria* shrubs declined markedly over the period but not as a result of grazing.

Turn-over rates for *Atriplex vesicaria* were quite high ranging from about 20%/year for shrubs greater than 10 cm tall to 50%/year for populations comprising small and large shrubs. Turn-over rates for the *Maireana* spp. were low, between 1%/year and 8%/year for large and whole populations respectively, reflecting the more stable nature of the *Maireana* populations. The only population parameter found to be significantly affected by grazing was shrub size. In late 1982, as conditions turned dry and drought approached, heights and diameters of grazed shrubs decreased much more rapidly than ungrazed shrubs, but following rain and a resumption of good seasonal conditions in late 1983, grazed shrubs quickly returned to sizes similar to ungrazed.

The dynamics of recruitment and survival of small (less than 10 cm tall) *Atriplex vesicaria* shrubs was investigated more closely. No attempt was made to investigate the mechanics of recruitment for *Maireana* spp. shrubs as recruitment in these species was an uncommon event. A poor relationship was found between recruitment and the size of the large shrub population so recruitment data were expressed in total numbers rather than as a ratio with the large shrub component of the population. Recruitment of *Atriplex vesicaria* was not an unusual event, occurring 20 times out of the 21 recording periods between May 1977 and December 1988.

Recruitment occurred in all seasons and the magnitude of the event was best correlated, though poorly, with the amount of rainfall in the preceding six month period.

There were no significant differences in survival of individual recruits between grazed and ungrazed cohorts. Population half-lives were 7.9 months and 6.8 months for grazed and ungrazed populations respectively, and survivorship varied between cohorts. The 1985/86 summer drought killed many shrubs irrespective of their age but the 1982/83 drought killed only those shrubs established after mid-1980. Generally there was a close relationship between survival of large shrubs and survival of small shrubs. At any time period, a large proportion (60%) of the population comprised individuals less than two years old, and at the end of the observations only 8% of those present had been present when observations commenced in 1977.

The relationship between survival of small and large shrubs and rainfall and evaporation was examined. Survival of small shrubs ranged widely from 25 to 100%/month at rainfall levels of less than 25 mm/month and above this exceeded 60%/month. Survival of large shrubs never fell below 80%/month.

These results question the belief that management of saltbush stands is most critical following the large germination events. As recruitment occurred often and was not highly correlated with seasonal conditions, and survival was independent of the size of the recruitment event, land managers must be prepared to make the necessary management decisions following all recruitment events and not merely those large events.

The final area of research dealt with the effects of various soil and topographical features on survival of *Atriplex vesicaria* recruits. A large number of seedling sites were classified according to scald status (that is, scalded or unscalded), microtopographical location (that is, hummock, plain, slope or depression), soil surface status (that is, litter, stone, sand, cryptogamic crust or bare), and proximity to mature shrubs (that is, near a live shrub, near a dead shrub or in the open). Using data from five cohorts representing 3,254 recruits, significant effects of microsite on survival were found at various sites and times but there was no consistent trend of enhanced survival from particular microsites for particular cohorts. This indicates that site favourability is not fixed but that it changes over time as a result of many complex interactions.