Pak.J.Bot., 25(1): 67-72, 1993.

SURVIVORSHIP PATTERNS OF SOME DESERT PLANTS

SEEMI AZIZ AND M AJMAL KHAN

Department of Botany,
University of Karachi, Karachi-75270, Pakistan.

Abstract

Survivorship pattern of some common summer annuals and perennials showed quite varied mortality patterns which can be tentatively grouped, according to Deevey system of classification. Annuals like *Indigofera cordifolia* and *I. hochsttetri* showed a gradual decrease in number of plants after initial lengthy recruitment period and appeared close to type II Deevey curve. However, annuals like *Eragrostis ciliaris, Aristida mutabilis, Cynodon dactylon* and *Tephrosia strigosa* showed little mortality at the early phase of life cycle and high mortality at the time of flowering and fruiting following type I Deevey curve. Perennials like *Blepharis sindica, Senna holosericea*, and *Corchorus depressus* initially showed a higher level of mortality leaving only few seedlings to continue their life cycle thus following type 3 Deevey curve.

Introduction

Desert vegetation is dominated by perennial shrubs. However after the rainfall a large number of annuals along with perennials are recruited in the community but only few individuals of each species are able to complete their life cycle. Plant species have characteristic patterns of survivorship depending on their schedules of germination, establishment, age of maturity and reproductive allocation. Survivorship patterns of plants in desert environment are related primarily to the presence of favorable moisture and number of seedlings present in a unit area. Payne & Maun (1984) observed considerable variations in the survivorship on their immediate environment.

Survivorship studies are helpful in understanding the life- history strategies of different species (Erickson, 1986) and their comparative study elucidates the effects of both physical and biotic environment on plant's survivorship (Lee & Hamrick, 1983). Survivorship pattern of desert plants is not very well understood (Khan, 1990; 1993; Zaman & Khan, 1992). This study reports the survivorship patterns of some desert plants found in maritime subtropical desert.

Materials and Methods

The study was carried out at the University of Karachi campus situated at Latitude 24°, 48' N, Longitude 65° 55' E, mean summer temperature 36°C and mean winter temperature 15 °C with 220 mm rainfall limited to monsoon season extending from June to August. The study area has been classified by Qadir *et al.*, (1966) as *Euphorbia, Grewia, Acacia* community situated in the low lying area. During the rain, water from the elevated area moves in this direction and brings top soil with it. This process repeated every year results in increased depth and water holding capacity of the soil.

During the monsoon period of 1988 (July 23 - September 24) and 1990 (August 4 - October 2), after substantial rainfall 20 permanent quadrats (20 x 20 cm), were established subjectively within 5 days of seedlings appearance. Data was obtained at regular intervals throughout the growing season and survivorship curves were constructed.

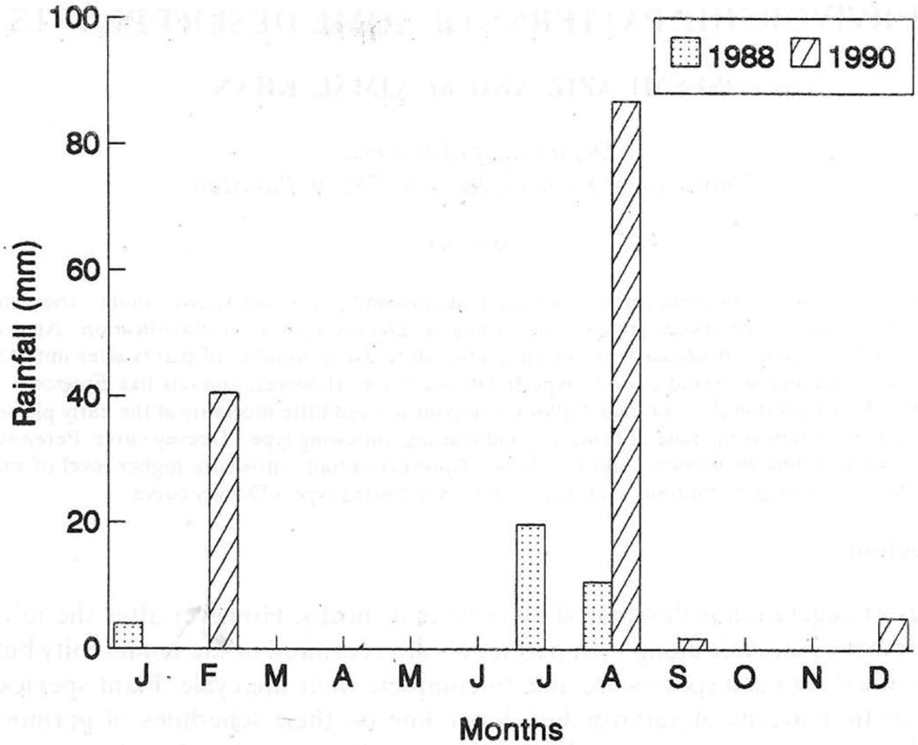

Fig. 1. Seasonal pattern of rainfall for the year 1988 and 1990.

Results and Discussion

Seasonal pattern of rainfall distribution for the year 1988 and 1990 show that the amount of precipitation received during 1988 was considerably less than 1990 (Fig. 1). During 1990 rare winter rains were also observed.

Annuals like *Indigofera cordifolia* and *I. hochesttetri* showed a rapid increase in their population soon after rainfall which peaked during the mid of the life cycle. Thereafter increased mortality gradually decreased population (Fig.2AB). *Eragrostis ciliaris, Tephrosia strigosa, Aristida mutabilis, Cynodon dactylon* recruited immediately after rainfall (Fig.2CD, 3AB). Population initially showed some mortality and later stabilized during the middle phase of their life cycle. Mortality of plants significantly increased at the period of the initiation of flowering. This results in the substantial reduction in population size and few remaining individuals were able to complete their life-cycle.

Perennial populations displayed a rapid initial increase in the recruitment of population soon after rainfall which reached to its maximum after 25-30 days of germination. Seedling mortality increased significantly thereafter which caused a gradual reduction in population size (Fig.3CD, Fig.4). Only few individuals left in the population to produce flowers and fruits.

The shape of a survivorship curve is influenced by the life history characteristics of a species, density and by local environmental conditions. With exceptions, annuals often

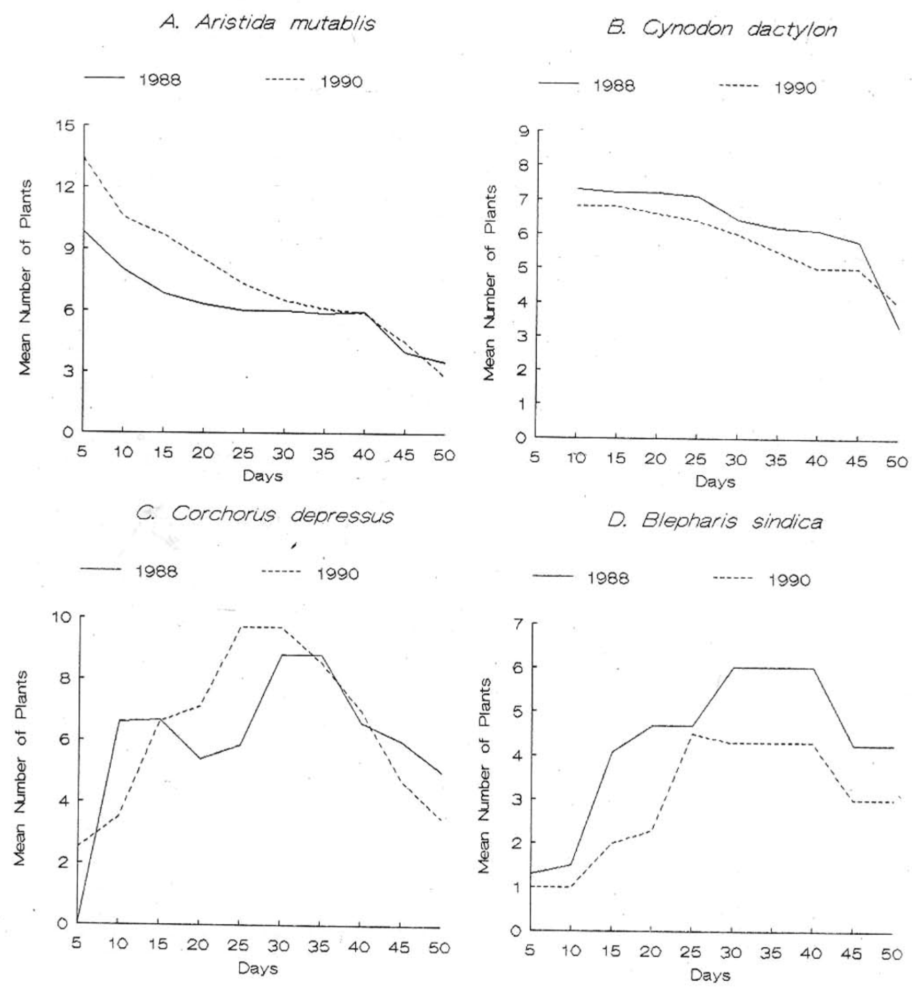

Fig. 3. Survivorship curve in 20 x 20 cm quadrats during 1988 and 1990 growing seasons. A, *Aristida mutabilis*; B, *Cynodon dactylon*; C, *Corchorus depressus* and D, *Blepharis sindica*.

in number of plants after initial lengthy recruitment period. Their survivorship pattern appeared close to type II Deevey curve. However, annuals like *Eragrostis ciliaris*, *Aristida mutabilis*, *Cynodon dactylon* and *Tephrosia strigosa* showed a little mortality at the early phase of life cycle and then population remained unchanged till the time of flowering. Flowering and fruiting period coincided with heavy mortality. These annuals appear to follow type I Deevey curve. Perennials like *Blepharis sindica*, *Senna holosericea* and *Corchorus depressus* have longer life cycle as compared to annuals. In their early phase of the life history, the perennials showed a higher level of mortality leaving only few seedlings to continue their life cycle following type III Deevey curve.

The probability and intensity of rainfall will be a significant factor in determining the survival. A good initial rain and continued moisture throughout season will result in one pattern, initial good rain and then drought will result in another and late rainfall will result into an entirely different one.

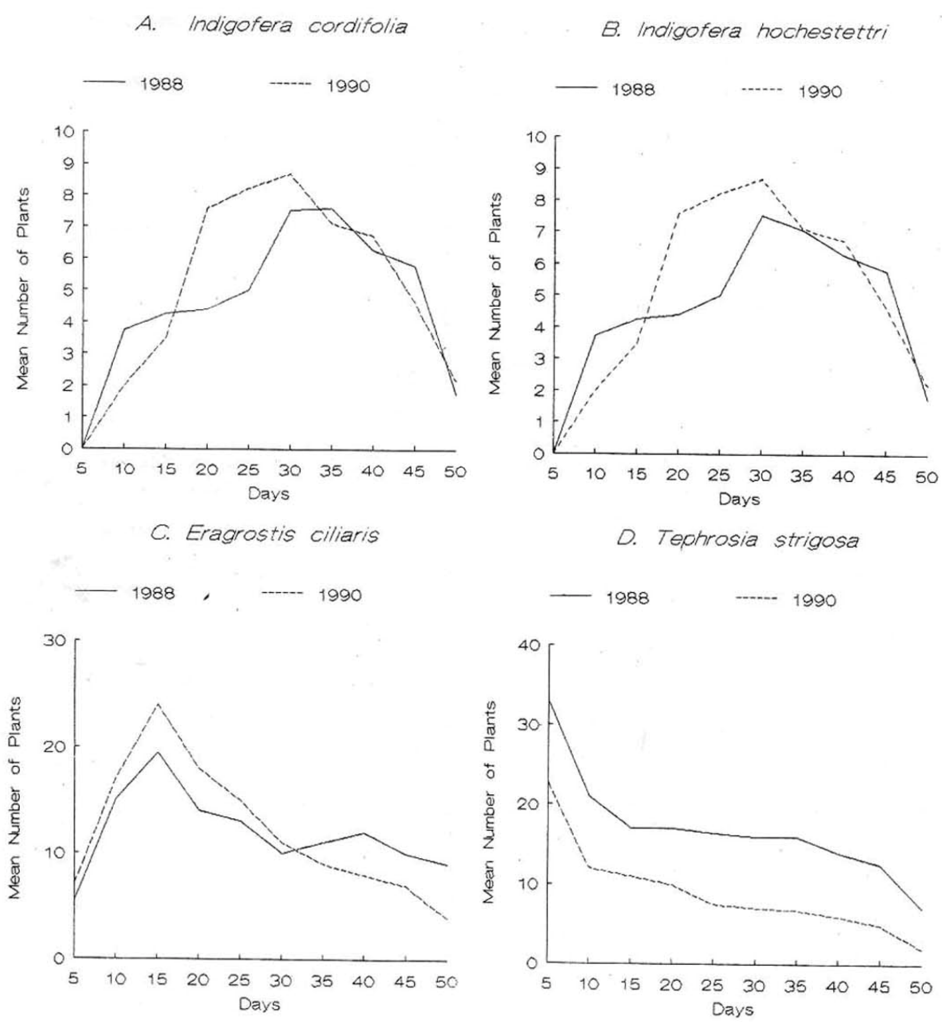

Fig. 2. Survivorship curve in 20 x 20 cm quadrats during 1988 and 1990 growing seasons. A, *Indigofera cordifolia; B, Indigofera hochestettri; C, Eragrostis ciliaris* and *D, Tephrosia strigosa.*

have type I curves, mononcarpic perennials type II and other perennials type III curves (Silvertown, 1982). Recruitments from seeds are more intermittent among many herbaceous perennials but environmental disturbances is still important to them. Grazing have been shown to affect plant survivorship, in some case actually enhancing survival (Savory & Parson, 1980). These factors also affect fecundity which is influenced by individual plant age or size and by population density as well.

In the desert ecosystem availability of moisture with the onset of the rainfall triggers germination. In Sindh desert, rainfall usually occurs during the monsoon period from June to August. In between, there are some dry rainless years and some with insignificant rain for germination. Seeds remain dormant in the soil for couple of years without getting proper cue for germination. Annuals and perennials show quite varied mortality patterns and can be tentatively grouped based on Deevey system of classification (Deevey, 1947). Annuals like *Indigofera cordifolia* and *I. hochesttetri* showed a gradual decrease

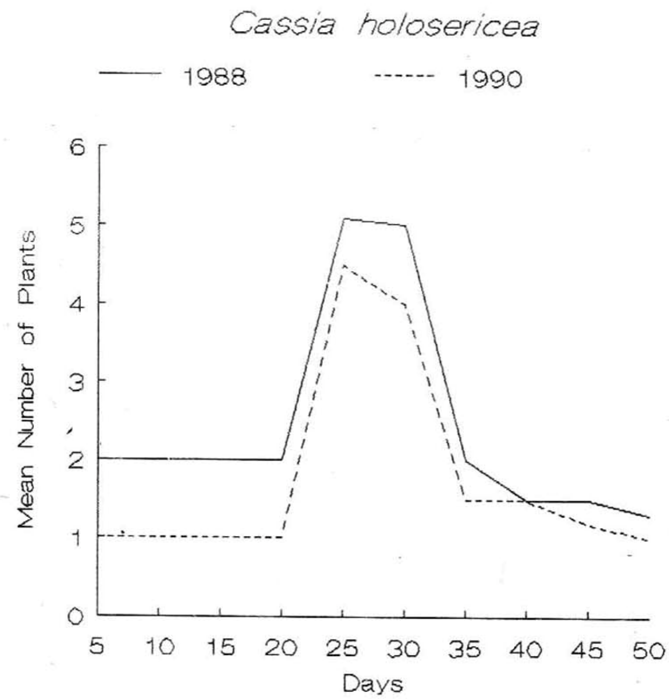

Fig. 4. Survivorship curve of *Senna holosericea* in 20 x 20 cm quadrats during 1988 and 1990 growing seasons.

Death of summer annuals may be caused by various biotic and abiotic factors. Primary factors of mortality in the present study seem to be the high density and progressively increasing drought. Similar results are reported for *Salicornia europaea* (Jefferies *et al.*, 1981); *Bromus tectorum* (Mack & Pyke, 1983) and *Atriplex triangularis* (Khan & Ungar, 1986). Secondary cause of seedling mortality could be grazing and trampling.

Virtually most of the annual populations, which grow in either disturbed or stressed habitats, show Deevey I type seedlings survivorship curve. *Alyssum alyssoides* and *Leavenworthia stylosa* colonize bare soil (Baskin & Baskin, 1972; 1974), *Cerastium atrovirens* is the plant of sand dunes (Mack, 1976), *Salicornia europaea* grows on tidal mud (Jefferies *et al.*, 1981), and *Sedum smalii* and *Minuarta uniflora* both annuals growing on rock outcrops where seedlings are liable to be washed away by rain (Sharitz & McCormick, 1975). The survivorship of perennial shrubs like *Acacia burkittii* (Crisp & Lange, 1986) and *Artemisia tripartita* (West *et al.*, 1979) showed a Deevey III type of the survivorship curve. The data presented in this paper agrees with these findings.

Synchronous emergence of annuals in an area led to crowded conditions. Individuals came in closer contact with each other and competition among them for light, nutrients and space increased. To avoid the uncongenial conditions of the desert, most of the annuals reproduced earlier and were short-lived. It shows that their growth periods do not overlapped with other species. It is not proper to categorize the survivorship for particular species only from one or two year's data, but some generalizations may be reached by comparing different species.

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(Received for Publication 9 July 1992)