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DEMOGRAPHIC STUDY OF *GYNANDROPSIS GYNANDRA* – A DESERT ANNUAL

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Abstract

The present study was designed to investigate the surviving patterns of *Gynandropsis gynandra* (L.) Briq., an annual herb widely distributed in the tropical and sub-tropical regions of the world. The plants exhibited Deevey Type I survivorship curve with mortality concentrated in the later stage of life. An initial increase in the number of individuals was observed with the onset of monsoon showers. The population size decreased with time due to the harsh environmental conditions, like short moisture period and high temperature. A gradual increase in the plant height (50–90 cm) elucidates progression of the population with the time. In the early stages of life, biomass allocation was mainly towards vegetative parts, following a progressive shift towards reproductive structures, in the later phase of life and the flowering starts in the third weak of life.

Key words: Demography, Growth, Biomass allocation, Annuals.

Introduction

Different plant communities play a challenging role in the field of ecological research (Hubbell, 2001), since they are responsible for the variations in the life patterns of plant populations (Schemske *et al.,* 1994). Demographic studies play a vital role in understanding the relationship between environment and survivorship patterns of populations (Erikson, 1986; Aziz & Shaukat, 2011). Moreover, it also provides numerical basis for the better understanding of life cycles of natural populations (Ogden, 1985). Besides, demographic research can provide cost effective solutions to global concerns of extinction and preservance of endangered plant species (Machinski *et al.,* 1997; Chesson, 2008). Since the dynamics of plant species are matter of concern for both local extinction and colonization of new population, (Eriksson & Ehrlen, 2001), demographic analysis is very much helpful in the prediction of resources required in future for the successful survival of a particular plant population.

Desert vegetation mainly comprises of perennials (Aziz & Khan, 1993; Matthies *et al.,* 2004), however summer annuals also appear in great numbers after monsoon showers. Moisture is the limiting factor in the arid and semi-arid regions and its availability is essential for the successful germination and growth of desert annuals, which contribute significantly to the biodiversity of arid regions. Due to their short life spans (usually one growing season), speedy maturity and ability to produce abundant and small easily dispersed seeds, annuals can serve to be an ideal models of ecological research.

Gynandropsis gynandra (L.) Briq. *(*Capparidaceae), is one of the most common annual species in our region. It has been reported to possess immense pharmacognostical significance (Petrus *et al.,* 2008) and is currently being used in indigenous medicine in many countries (Mishra *et al.,* 2011). Keeping the importance of this species, survivorship patterns of *G. gynandra* is studied. This study can provide useful information for conserving and restoring specific habitats to sustain its biodiversity and keep the plant populations at secure levels for future utilization. The present study is aimed to elucidate the demographic analysis, growth patterns, biomass allocation and fecundity of *G. gynandra.*

Materials and Methods

Study site: The site chosen for the study is located in the Karachi University Campus, Sindh (Lat. 24˚ 48 N., Long. 65˚ 55 E.). The summer temperature varies from 32–35˚C. Due to high temperature, the rate of evapotranspiration is also high. Disturbances like, grazing, mowing, trampling and to a lesser extent garbage dumping are common. The site is located in a semi-shady area where huge trees are present at random distances. Initially, the site showed low plant diversity but with the onset of monsoon showers, emergence of annual species was observed. Some commonly observed species included *Gynandropsis gynandra, Peristrophe bicalyculata, Corchorus* spp., *Achyranthes aspera, Cencharus* sp. and *Dichanthium annualatum.* Using the point-centered quarter method, it was determined that *Gynandropsis gynandra* was the dominant species in this area. Demographic data was collected using systematic sampling technique by placing 10 permanent quadrats (10×10 m^2). Quadrats were counted every week throughout the growing season. The number of plants surviving in each quadrat was counted. This data was used to construct conventional life table and survivorship curves. At every sampling date, two plants were randomly collected from outside of each quadrat. These plants were brought to the laboratory. Root and shoot length of each plant was recorded immediately. The plants were then wrapped in an aluminum foil and were allowed to dry in the oven at 80˚C for 48 hours. For each plant, the dry weight of component organs was recorded.

Reproductive growth was estimated at every sampling date by counting the number of flowers, fruits and seeds per plant. They were then dried to a constant dry weight (80˚C for 48hours) and weighed.

Results and Discussion

Life history theories tend to explain the inter-correlation and constraints by ecological factors (Winemiller, 2005). The demographic analysis of *Gynandropsis gynandra* elucidates an increased in the number of individuals in the early phase of life and decreased in the later part of life (Table 1). *G. gynandra* individuals appeared to complete their life cycle within nine weeks. It has been noted, that on account of unpredictable water regimes, annuals do not have extensive growth periods. Therefore, desert annuals are able to take advantage of short moist periods with initial rapid growth, early flowering and seed set so they can endure long. Short life cycle of *G. gynandra* can be considered adaptive strategy for their successful establishment in limited water supply.

G. gynandra individuals exhibited Deevey Type I (Deevey, 1947) survivorship curve (Fig. 1), showing an increase in the early phase of life cycle and loss of individuals in the later part of life. This might be due to low moisture levels in late September and lack of insulating protection to both humidity and cloud cover. Other natural phenomena such as allelopathy, grazing, pathogenic attacks etc., may also contribute towards increase in plant mortality with time. Similar results were also reported for *Ipomoea sindica* populations (Aziz & Shaukat, 2012).

The population of *G. gynandra* increased instantaneously following summer showers with a gradual increase in plant height (Fig. 2). This reflects to be a positive progression in the establishment of its population. Harper (1977) also reported that plant size is an important factor towards the establishment of a successful population. Fig. 3 illustrates the percent biomass allocation of *G. gynandra* individuals. Plant size and biomass allocation to component organs combine to make up the total productivity of a plant (Sugiyama & Bazzaz, 1998). It was observed that the biomass was initially higher in shoots, which can be considered as a survival strategy to withstand moisture depletion (Harper, 1977). It has been reported that green shoots are actively photosynthesizing and thus lead to the growth and biomass production in plants (Hossain *et al.,* 2012). Plants have limited resources to spend on growth, maintenance (survival) and reproduction, depending on the environmental conditions (Suter, 2007). Therefore, resource allocation is one of the fundamental features in the reproductive strategies of plants (Harper, 1977).

In the present study, initiation of flowering in *G. gynandra* individuals was observed in the third week of life (Table 2). In plants, the onset of reproduction is marked by the conversion of vegetative meristems to floral initials. Annuals tend to allocate most of their resources towards vegetative growth in the early part of their life. In the later stages of growth, these resources are diverted towards reproduction. This corresponds to the reason of shift of biomass allocation from vegetative organs to reproductive organs. The reproductive allocation of a plant species, therefore, may be a reflection of its survival approach (Harper & Ogden, 1970). Annuals tend reproduce earlier, just to avoid the drought after the monsoon period. That's why they allocate their most of the resources towards reproduction. However, long term demographic studies of *G. gynandra* on temporal and spatial scale are in progress, which will provide insights into the details of population dynamics. So that solid generalizations about survivorship, growth and fecundity will be categorized.

Table 1. Life table of *Gynandropsis gynandra* (L.) Briq.

Age	Number of individuals alive (lx)	Number of individuals dying(dx)	Stationary Population (Lx)	Residual life (Tx)	Age Specific Mortality (qx)	Life expectancy (ex)
1	1000	-76.9	103.85	8730.9	-0.08	8.4
2	1076.9	-692.3	1423.1	7692.4	-0.64	-5.4
3	1769.2	384.6	1692.3	6269.3	0.28	3.7
4	1615.4	384.6	1423.1	4577	0.24	3.2
5	1230.8	153.9	1153.9	3153.9	0.13	2.7
6	1076.9	307.7	923.1	2000	0.29	2.2
7	769.2	307.7	615.4	1076.9	0.4	1.7
8	461.5	153.8	384.6	461.5	0.33	1.2
9	307.7	307.7	76.9	76.9	1	1
10	0	0	0	0	0	0

Table 2. Reproductive phase of *Gynandropsis gynandra*.

Weeks	Number of flowers/ plant	Number of fruits/ plant	Number of seeds/ fruit	Number of seeds/ plant
1	0 ± 0	0 ± 0	0 ± 0	0 ± 0
2	0 ± 0	0 ± 0	0 ± 0	0 ± 0
3	0.4 ± 0.1	0 ± 0	0 ± 0	0 ± 0
4	6.6 ± 1.1	2.7 ± 0.7	32.45 ± 6.4	100.85 ± 2.1
5	5.3 ± 1.1	5.8 ± 0.9	39.62 ± 3.3	218.1 ± 2.9
6	0.8 ± 0.5	7 ± 1.0	38.5 ± 4.2	250.35 ± 3.1
7	0.25 ± 0.2	10.7 ± 0.8	44.45 ± 1.7	476.4 ± 3.8
8	0.05 ± 0.05	14.15 ± 1.2	37.48 ± 1.1	514.95 ± 3.5
9	0 ± 0	17.1 ± 1.4	36.86 ± 2.1	606.15 ± 4.9

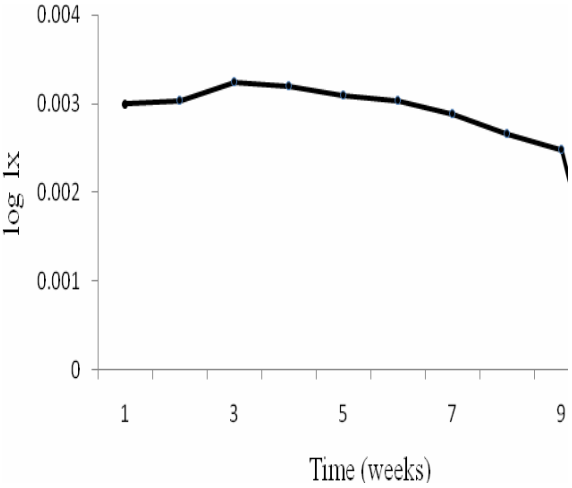

Fig.1. Survivorship curve for *Gynandropsis gynandra*.

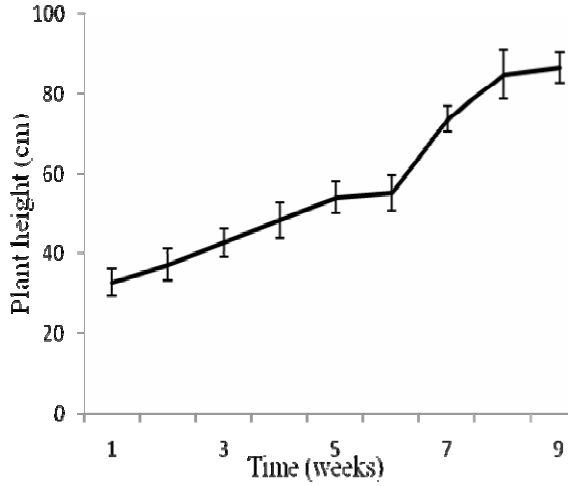

Fig.2. Plant height (cm) of *Gynandropsis gynandra*.

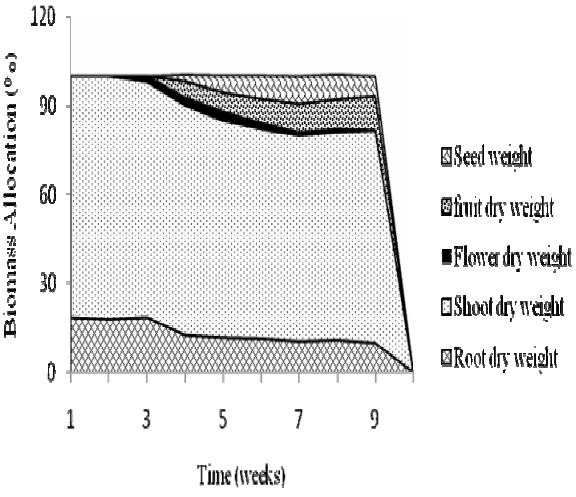

Fig. 3. Percentage biomass allocation to component organs of *Gynandropsis gynandra*.

References

Aziz, S. and S.S. Shaukat. 2011. Demographic studies of *Ipomoea sindica* Stapf., a desert summer annual. *Pak. J. Bot.*, 43(6): 3035-3040.

Aziz, S. and S.S. Shaukat. 2012. Population ecology of *Cleome viscosa* L., a desert summer annual. *Pak. J. of Bot.*, 44(5): 1633-1638.

Aziz, S. and A. Khan. 1993. Survivorship patterns of some desert plants. *Pak. J. Bot.*, 25(1): 67-72.3

Chesson, P. 2008. Quantifying and testing species coexistence mechanisms. In: (Eds.): Valladares, F., A. Camacho., A. Elosegui., C. Gracia., M. Estrada. and J.C. Senar. Unity in Diversity: *Reflections on Ecology after the Legacy of Ramon Margalef*. Foundation BBVA, Bilbao, pp. 119-164.

Deevey, E. S. 1947. Life tables for natural populations of animals. *Quart. Rev. Biol.*, 22: 283-314.

Erickson, O. 1986. Survivorship, reproduction and dynamics of ramets of *Potentilla anserina* on a Baltic seashore meadow. *Vegetatio.*, 67:17-25.

Eriksson, O. and J. Ehrlén. 2001. Landscape fragmentation and the viability of plant populations. In: *Integrating ecology and evolution in a spatial context*. (Eds.): Silvertown, J. and J. Antonovics. Blackwell Science Publishers, UK, pp. 157-175.

Harper, J. L. 1977. Population Biology of plants. Academic Press, London.

Harper, J.L. and J. Ogden. 1970. The reproductive strategy of higher plants. The concept of strategy with special reference to *Senecio vulgaris* L. *J. Ecol*., 58: 681-698.

Hossain, M.D., M.M. Hanafi, G. Saleh, M. Foroughi, R. Behmaram and Z. Noori. 2012. Growth, photosynthesis and biomass allocation of different Kenaf (*Hibiscus cannabinus* L.) accessions grown on sandy soil. *Aust. J. Crop Sci.*, 6(3):480-487.

Hubbell, S.P. 2001. *The unified neutral theory of Biodiversity and Biogeography*. Princeton University Press, New Jersey.

Maschinski, J., R. Fyre and S. Rutman. 1997. Demography and population viability of an endangered plant species before and after protection from Trampling. *Conservation Biol.*, 11: 990-999.

Matthies, D., I. Brauer, W. Maibom and T. Tscharntke. 2004. Population size and the risk of local extinction: empirical evidence from rare plants. *Oikos*, 105: 481-488.

Mishra, S.S., S.K. Moharana and M.R. Dash. 2011. Review on *Cleome gynandra*. *IJRPC.*, 1(3) ISSN: 2231-2781.

Ogden, J. 1985. An introduction to plant demography with Special reference to New Zealand trees. *New Zealand J. of Bot.*, 23: 751-772.

Petrus, A.J.A., G. Suguna, K. Kadavul and T. Anbazhagi. 2008. Studies on the pharmacognostical and in vitro antioxidant potential of *Cleome gynandra* Linn. leaves. *Natural Product Radiance*, 8(2): 151-157.

Schemske, D.W., B.C. Husband, M.H. Ruckelshaus, C. Goodwillie, I.M. Parker and J.G. Bishop. 1994. Evaluating approaches to the conservation of rare and endangered plants. *Ecology*, 75: 584-606.

Sugiyama, S. and F.A. Bazzaz. 1998. Size dependence of reproductive allocation: the influence of resource availability, competition and genetic identity. *Funct. Ecol.*, 12: 280-288.

Suter, M., D. Ramseier and S. Guesewell. 2007. Convergence patterns and multiple species interactions in a designed plant mixture of five species. *Oecologia*, 151: 499-511.

Winemiller, K.O. 2005. *Life history strategies, population regulation, and implications for fisheries management.* NRC Research Press.

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