CHAPTER 10
PHENOLOGY

INTRODUCTION

Phenology involves the study of the life cycle phases or activities of plants and animals and their temporal appearance throughout the year (Leith 1970). Van Rooyen *et al.* (1986) define phenology as the visible responses of organisms to a seasonally changing environment. Phenological events by definition usually coincide with the seasons. The seasonal availability of leaves, flowers and fruits is often an important factor affecting the distribution, diet and nutrition of animals (Hall-Martin 1974a, 1974b; Hall-Martin and Basson 1975).

Most survey methods of phenology consist of selecting a representative sample of a plant population and then observing the phenophases of these plants (Hall-Martin and Fuller 1975; Monasterio and Sarmiento 1976; Guy, Mahlangu and Charidza 1979; Borchart 1980; Reich and Borchart 1984; Van Rooyen, Theron and Grobbelaar 1986; Childes 1989). The various phenophases can then be placed into quantitative classes of abundance (0-25 %, 26-50 %, 51-75 %, 76-100 %) (Hall-Martin and Fuller 1975). Various difficulties have been encountered with such measures of abundance and Guy *et al.* (1979) and Childes (1989) used the abundance classes of Frankie *et al.* (1974, *In*: Guy *et al.* 1979) which only defined nil, few and many individuals. Borchart (1980) developed a scale for rating developmental stages in *Erythrina* spp. Van Rooyen *et al.* (1986) used a six-point scale to record rate, number and stage of each phenophase. The information can be displayed as a phenogram that gives the phenophases for each species over the same period of observation. In this way Van Rooyen *et al.* (1986) were able to describe the phenology of the most important plant species of the Roodeplaat Dam Nature Reserve. Various harvesting techniques have also been used in phenological studies (Opperman and Roberts 1978; Milton and Moll 1982; Prins 1988).

Phenology may therefore provide meaningful information to explain the seasonal aspects of ecological phenomena. The aims of the current phenological study were:

- To determine the seasonal availability of the leaves, flowers and fruits of the most important and conspicuous trees, shrubs, forbs and grasses in each of the homogeneous plant communities.
- To use these data to gain a greater insight into the extent to which the availability of plant species determines the habitat and plant food selection by herbivores.
- To use these data to assist in the assessment of the suitability of a habitat for a specific animal species.

METHODS

A total of 23 conspicuous plant species were marked with tags to collect the phenological data (Hall-Martin and Fuller 1985; Guy *et al.* 1979; Van Rooyen *et al.* 1986). Conspicuous plants are those with high cover-abundance values in Tables 6 to 9 and with a high constancy. The following qualitative and quantitative phenological variables were monitored for 10 individuals of each plant species for a period of 12 months (Van Rooyen *et al.* 1986):

1. Number of immature and mature leaves.
2. Leaf fall stage.
3. Leaf senescence stage.
4. Number of flower buds.
5. Number of open flowers.
6. Number of withered flowers and unripe fruit.
7. Fruit maturation stage.
8. Fruit discoloration stage.
9. Number of ripe fruit.
10. Dissemination rate of fruit and/or seeds.
11. Stage of dissemination.

Monthly observations were made from May 1998 to April 1999. The phenophases were recorded on a six-point scale (0, 1, 2, 3, 4, 5, 6) as given by Van Rooyen *et al.* (1986). A large number of a specific variable is awarded a high value, here a six and vice versa, where a zero or one is awarded. A high degree of a certain *stage* was also awarded a high value and vice versa. The first recording of a specific phenophase was regarded as the starting point of that phenophase (Van

Rooyen *et al.* 1986). For each observation date the mean of the data of individuals of each specific species was used to indicate the average stage of development for each species. The results are displayed in phenograms. The climatogram as presented in Figure 5 was used to interpret the influence of climate on the phenology of the plants of Sango Ranch.

RESULTS AND DISCUSSION

Phenograms for the 23 plant species examined are presented in Figure 91. Climatological data for the study area are given in Figure 5 in Chapter 2.

Leaf phase

Only *Salvadora persica* was evergreen. Hall-Martin and Fuller (1975) also found this species to be evergreen in Malawi. Of the 11 tree and shrub species, *Acacia tortilis* subsp. *heteracantha, Colophospermum mopane* and *Cadaba termitaria* were semi-deciduous. These plants all started losing their leaves from July to August in the middle of the dry period. The lowest number of leaves was recorded from September to December at the end of the dry period. All the other species were deciduous, beginning to lose their leaves from July to August. In Malawi *Grewia flavescens* var. *flavescens* is also deciduous (Hall-Martin and Fuller 1975). All woody species, except *Acacia nigrescens* which was leafless from October to November, were leafless from September to October, at the end of the dry season and before the onset of the perhumid period from October to November (Figure 5). In Malawi, *Acacia nigrescens* bore leaves during the dry season (Hall-Martin and Fuller 1975). Leaf senescence and abscission are the result of water stress caused by water shortage at the onset of the dry season when water loss by transpiration exceeds water absorption through the roots (Reich and Borchart 1982). However, *Boscia mosambicensis* began dropping its leaves in December and was leafless in February during the peak rain season. This is normal because Hall-Martin and Fuller (1975) and Van Rooyen *et al.* (1986) believe that growth activities in woody savanna plants appear to be initiated by temperature or day-length changes, rather than rainfall.

Leaf emergence in the deciduous and semi-deciduous species is gradual and commenced from October to November just before the onset of the perhumid period. In the Sengwa Wildlife Research Area, Zimbabwe, leaf buds in nearly all

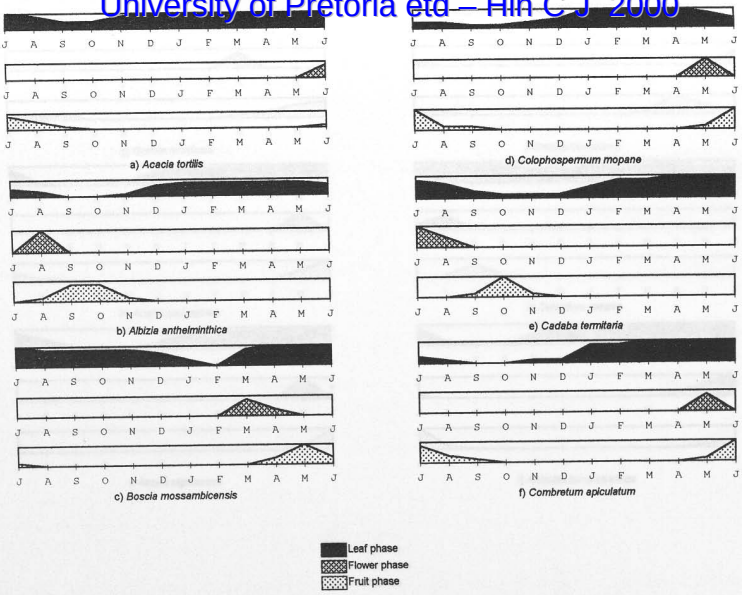
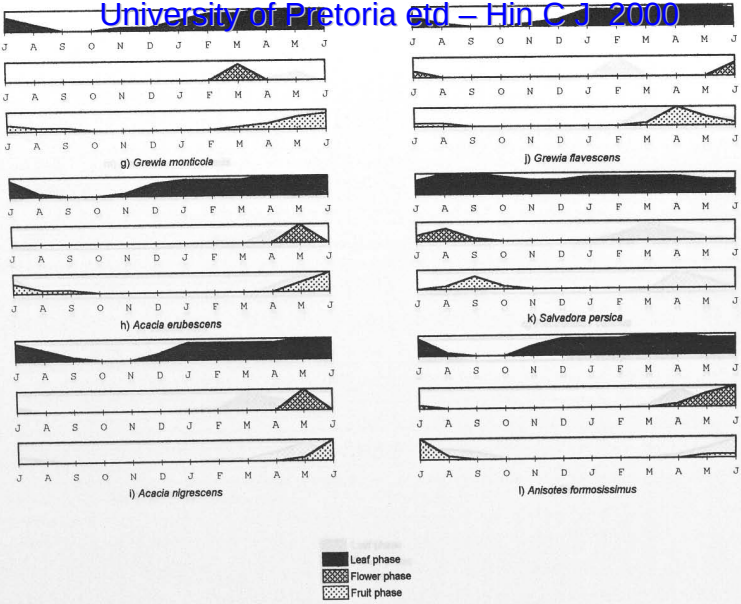


Figure. 91. Phenograms for the 23 species of plants on Sango Ranch, Save Valley Conservancy, Zimbabwe.



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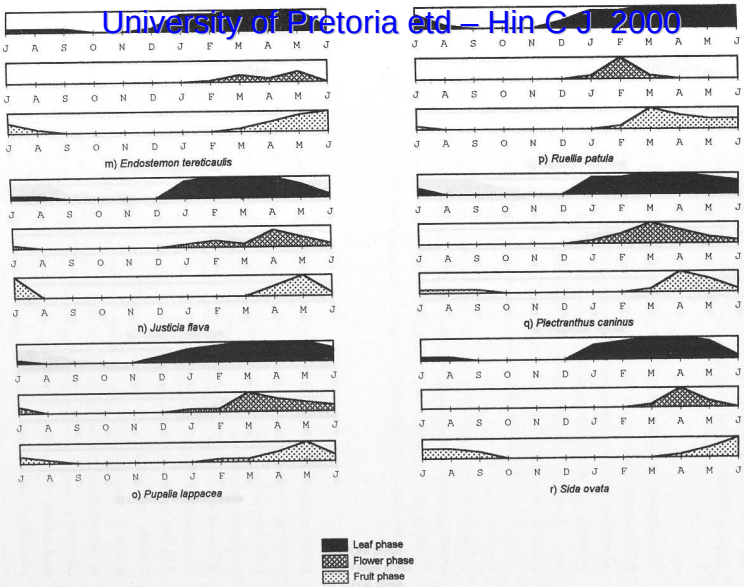

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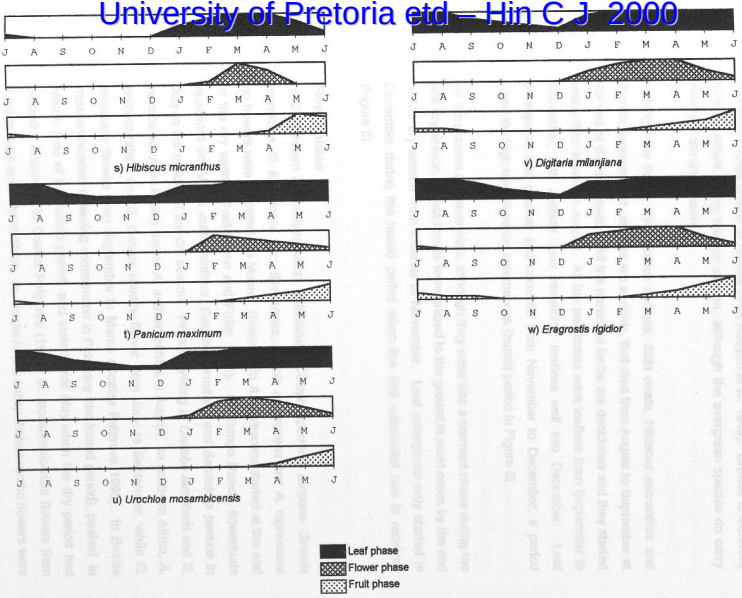

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the woody species were observed between August and December with a peak in October (Guy *et al.* 1979). On Sango Ranch, leaf emergence in *Boscia mosambicensis* began from February to March, towards the end of the rainy season. An increase in the water potential within the plant above a certain threshold causes growth to resume (Van Rooyen *et al.* 1986). Browse is therefore most abundant during the wet season, although the evergreen species do carry leaves in the dry season.

Amongst the herbs, *Plectranthus caninus*, *Sida ovata, Hibiscus micranthus* and *Pupalia lappacea* var. *velutina* are annuals, that died from August to September at the end of the dry season. All the perennial herbs are deciduous and they started losing their leaves in August. All the perennials were leafless from September to November, with *Justicia flava* remaining leafless well into December. Leaf emergence was gradual and occurred from November to December, a period when the high rainfall period commences (humid period in Figure 5).

All the grasses are perennials, although they enter into a dormant phase during the late dry season. Grass leaves were grazed to the ground in most cases by the end of the dry season from October to November. Leaf emergence only started in December during the humid period when the first substantial rain is received (Figure 5).

Flower phase

In *Combretum apiculatum* subsp. *apiculatum, Colophospermum mopane*, *Grewia monticola*, *G. flavescens* var. *flavescens*, *Acacia erubescens* and *A. nigrescens* no flowers were recorded. In Malawi, flowering in *A. nigrescens* started at the end of the dry season (Hall-Martin and Fuller 1975). On Sango Ranch, flowerbuds appeared on *Albizia anthelminthica*, *Cadaba termitaria* and *Salvadora persica* in July in the middle of the dry season. Peak flowering in *Cadaba termitaria* and *S. persica* occurred in July and in *A. anthelminthica* in August. In southern Africa, *A. anthelminthica* and *S. persica* usually flower from June to September, while *C. termitaria* flowers from September to March (Coates Palgrave 1995). In *Boscia mossambicensis* flowering commenced in February (the humid period), peaked in March (end of the humid period) and lasted until May when the dry period had started. According to Coates Palgrave (1995) *B. mossambicensis* flowers from April to June in southern Africa. In *Acacia tortilis* subsp. *heteracantha* flowers were

recorded in only two of the 10 individuals in the dry season from May to June. In the Northern Province, South Africa, *Acacia tortilis* subsp. *heteracantha* flowered from January to March (Milton 1987), while Coates Palgrave (1995) states that flowering is from November to January. According to Milton (1987) the phenology of *A. tortilis* subsp. *heteracantha* is constant throughout southern Africa. According to Van Rooyen *et al.* (1986), *C. apiculatum* subsp. *apiculatum* tends to flower at the same time each year regardless of the variation in climatic conditions from year to year. The stimulus for flowering is probably some constant external variable such as photoperiod (Alvim and Alvim 1978, In: Van Rooyen *et al.* 1986). In the Sengwa Wildlife Research Area, Zimbabwe, flower buds were seen on most species at about the same time that the leaf buds emerged (Guy *et al.* 1979). In Sengwa, the formation of flower buds of *Colophospermum mopane* was delayed until after the leaf flush.

With the exception of *Anisotes formosissimus*, flowering in the herbs commenced from December to February during the humid period. *Anisotes formosissimus* began flowering in March at the end of the perhumid period. Peak flowering for all herbs occurred from March to May at the end of the perhumid period and the onset of the dry period. Flowering ended in all species, except for *Ruellia patula*, which ended in April, from July to August in the middle of the dry period.

In the grasses flowering started fom December to January at the peak of the humid period and peaked from February to March at the end of the humid period. In all the grasses the flowers lasted until June. Flowering in grasses is initiated by a certain daylength or a certain sequence of daylengths as well as favourable growing conditions (Wolfson and Tainton 1999). *Urochloa mosambicensis, Eragrostis rigidior* and *Panicum maximum* usually flower from October to July (Van Oudtshoorn 1992), while *Digitaria milanjiana* flowers from January to February (Gibbs Russell, Watson, Koekemoer, Smook, Barker, Anderson and Dallwitz 1991).

Fruit phase

Fruiting in all the woody species, except *Cadaba termitaria*, commenced towards the end of the perhumid period and the onset of the dry period from February to May. Fruit in these species ripened during the middle of the dry season from May to July and disseminated at the end of the dry season from August to October.

This corresponds with information from elsewhere in southern Africa (Coates Palgrave 1995) Fruit first appeared on *Cadaba termitaria* in the middle of the dry period in August. Ripening occurred in the late dry season in October and dissemination took place from November to December during the humid period. In most cases fruiting followed directly after flowering. In all the other species fruiting occurred during the wet season. Fruit is therefore available throughout the year, but it is more abundant during the late wet season.

The fruit phase in the herbs started from the middle of and towards the end of the humid period from January to March. Fruit ripened in the dry period from April to June and disseminated in the middle to late dry period from August to October.

The grasses followed a similar pattern to the forbs, except that seeds in all four species examined here ripened simultaneously in July.

CONCLUSION

The phenological patterns in the plant species monitored here follow the phenological patterns of these species elsewhere in southern Africa. From the results it is clear that savanna plants show an annual alteration between a period of minimal activity and one of maximum development (Monasterio and Sarmiento 1976). During the dry season these plants enter into a phase of semi- to full dormancy, while in the wet season a period of intense assimilation and vegetative and reproductive growth occurs. However, some plants are active physiologically in the dry season and this ensures a constant supply of food in the form of leaves, flowers and fruit throughout the year. Plant species in different habitats also have different phenologies which also contributes to this phenomenon of providing a constant supply of food throughout the year (Hall-Martin and Fuller 1975, Guy *et al.* 1979). Quantities of food on offer to animals therefore shift between different species groups and, hence, also between habitats.