Mabuya buettneri appears to closely resemble M. varia and lays its eggs during November and December, whereas M. maculilabris lays throughout the year with a peak from November to February.

M. buettneri apparently has a prolonged incubation period of four months which is exceptionally long for skinks. Mabuya varia has a two-month incubation period. Hatching success appears to be good as during the 10-day period during January 1976, 18 of 26 (69%) skinks captured were hatchlings and juveniles. Growth is rapid during the first two months, from a hatchling size of 22,0 mm S/V length to 35,5 mm (Figure 61), after which it begins to slow down. Again, a differential growth rate is apparent with the female achieving a greater size than the male (Figure 62).

Barbault (1976a)found that there was a differential mortality between the sexes and this appears also to be the case with Mabuya varia with some females and males reaching at most 23 months of age. Some females, therefore, survive two reproductive seasons, which may account for their success. The growth rate from recaptures indicate that both males and females grow at a mean rate of 0,12 mm/day, but this ranges from 0,3 mm/day to 0,01 mm/day, depending on the age and size of the animal (Figure 63). It is apparent from Figure 63 that the growth rate is depressed during the winter months but increases once summer and, therefore, warmer temperatures appear. Sexual maturity is reached by September when the males are seen with swollen hemipenes, while the females, if gravid, take on a bloom as mentioned previously. The lizards now have a mean S/V length of 53,79 mm and a mean mass of 3,36 (n = 111) at the age of eight months. However, some females are already sexually mature earlier at a S/V length of 49,5 mm (Figure 59) as at this stage the ova are already swelling in the ovary but have not migrated down the oviduct yet. Growth, however, continues gradually until the animals die off.

Figure 64 shows the distribution of the various size classes mentioned previously (Figure 60). From this it is apparent that there is an abnormal preponderance of males, particularly in the 51-55 mm and 56-60 mm size classes, which are attained at ages ranging from 8,25 and 9,25 to 13 months or more for females and males respectively. Thereafter, there is a preponderance of females which attain the largest sizes. The abnormally high abundance of males within the two size classes discussed previously is very difficult to explain except that it also occurs during the mating season and, therefore, at a time of greatest activity. This may induce the males

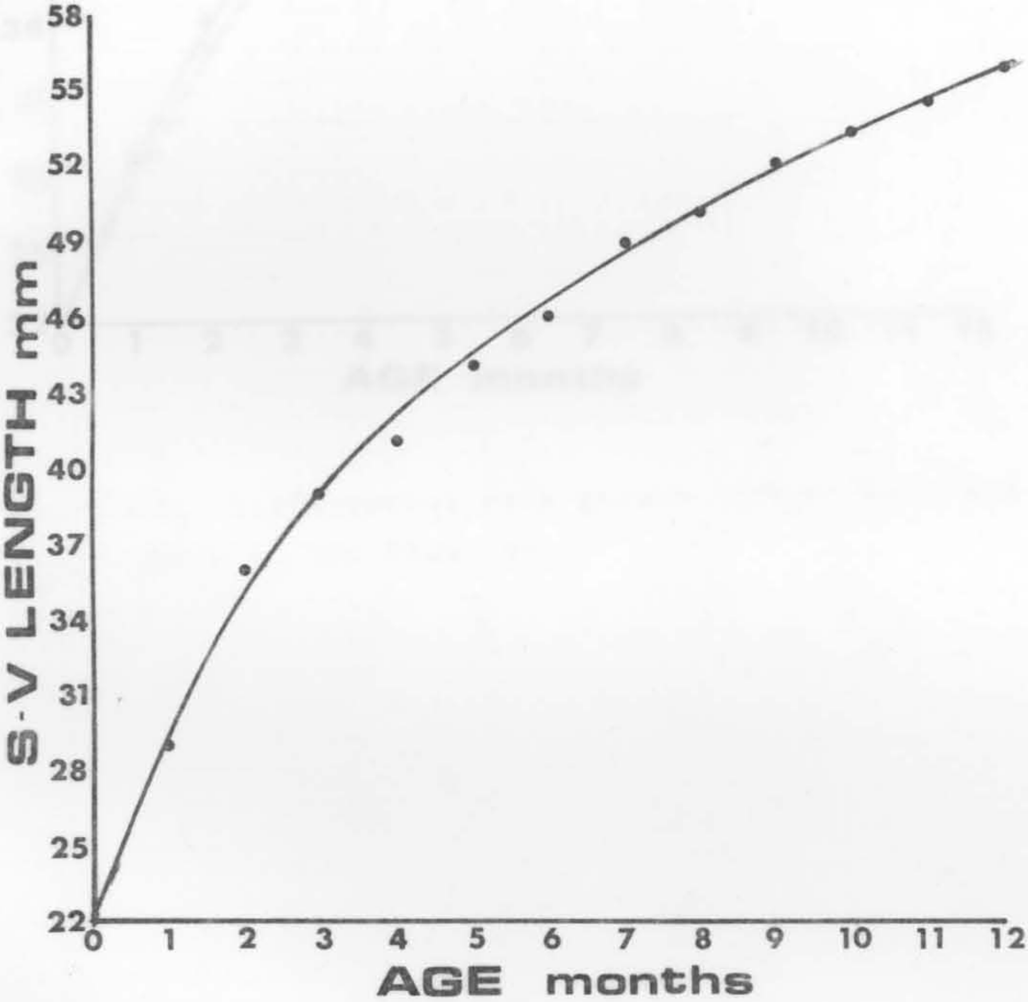

Figure 61. Mean growth rate of Mabuya varia in the Study Area.

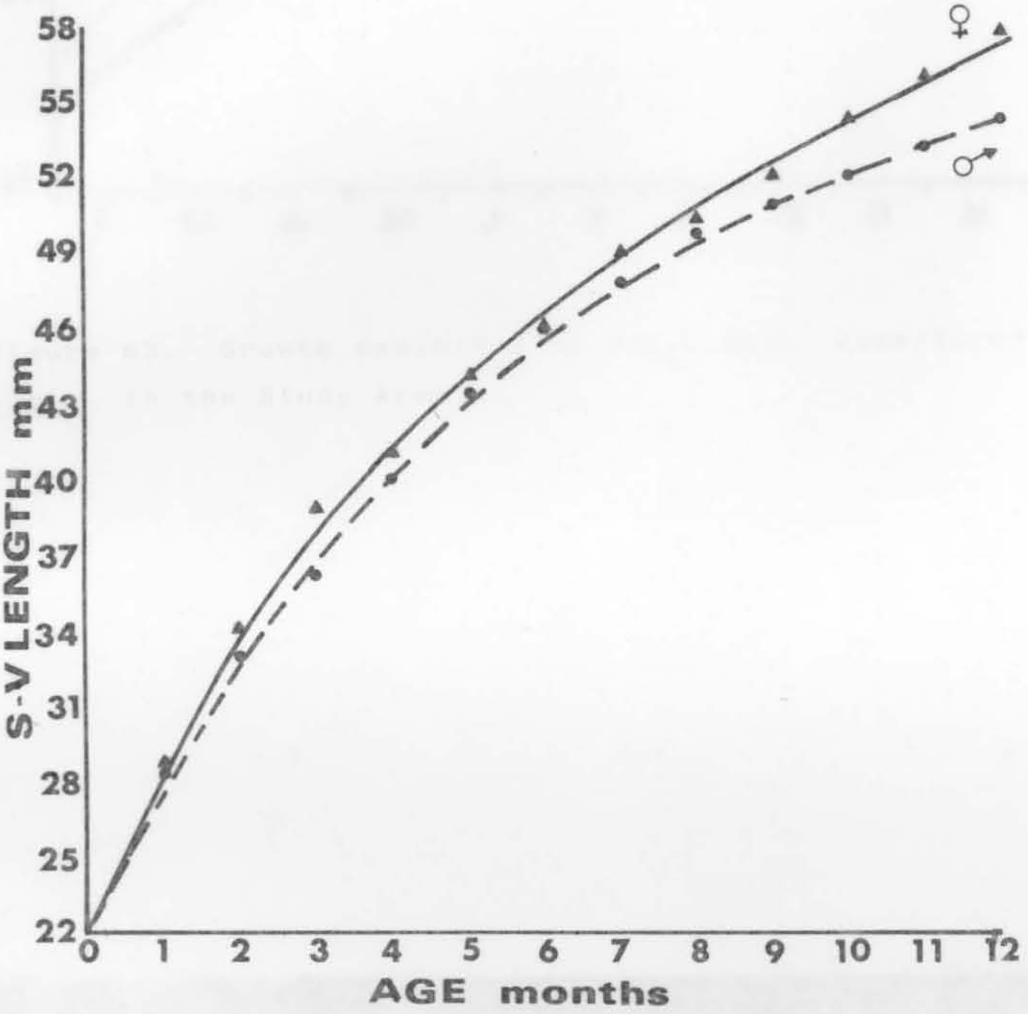

Figure 62. Differential mean growth rate of male and female Mabuya varia in the Study Area.

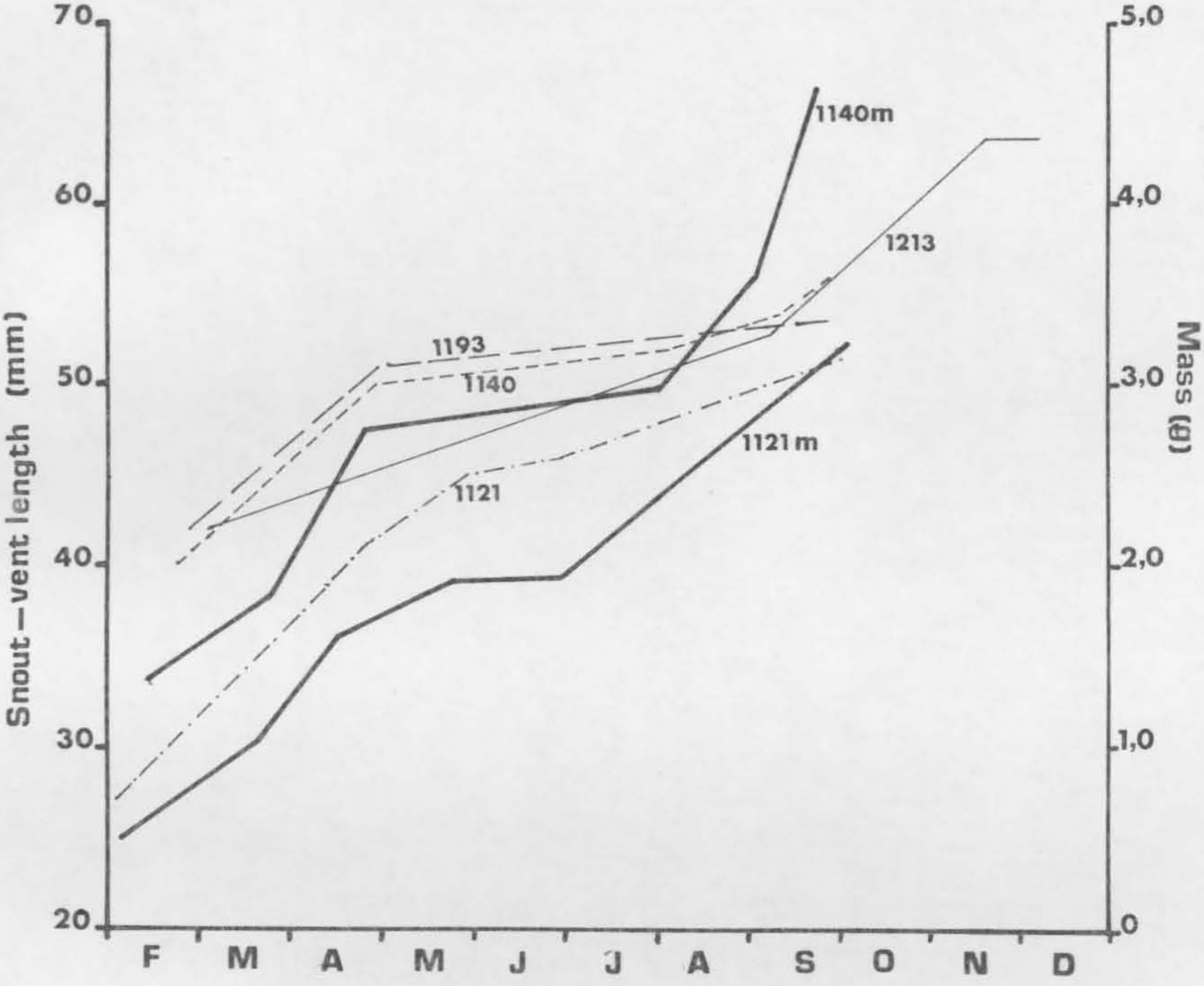

Figure 63. Growth exhibited by individual recaptured *Mabuya varia* in the Study Area.

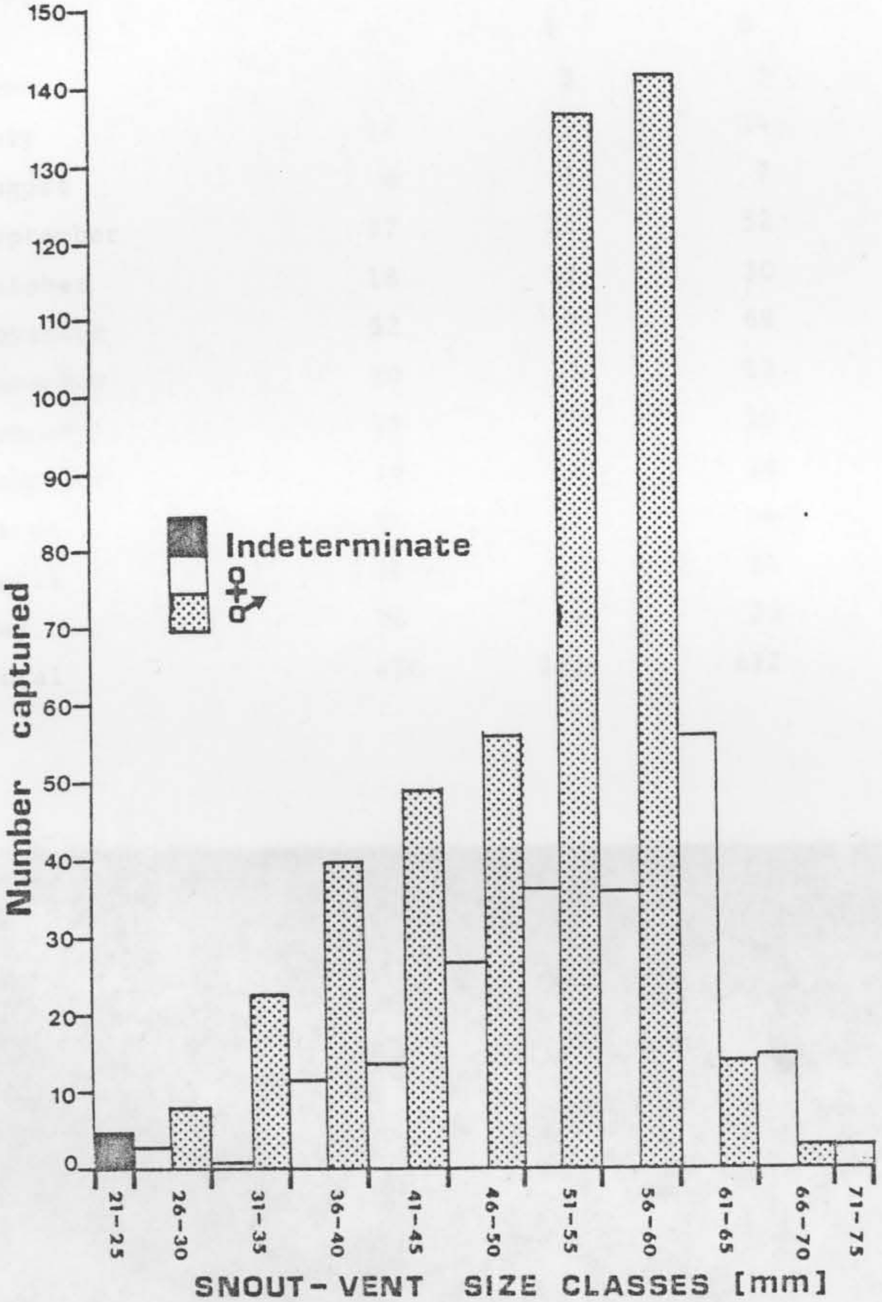

Figure 64. Frequency distribution of size classes and sex of Mabuya varia in the Study Area.

to forage further afield, particularly when the females occur at a ratio of nearly one to four. Greater search effort would be necessary in order to find a female which may, therefore, account for this great discrepancy.

As mentioned previously, there appears to be a differential die-off, males dying earlier than females. The sex ratio from the mark-recapture study can be seen in Table 36.

Table 36. Sex ratios of *Mabuya varia* during the period May 1975 to May 1977 in the *Burkea africana* - *Eragrostis pallens* Study Area.

Month	Male	Female	Total	Ratio Male : Female
May	1	4	5	1:4
June	1	3	4	1:3
July	5	2	4	1:0,40
August	12	1	13	1:0,80
September	43	16	59	1:0,37
October	59	14	73	1:0,24
November	22	14	36	1:0,64
December	13	4	17	1:0,31
January	15	1	16	1:0,67
February	36	18	54	1:0,50
March	10	8	18	1:0,80
April	26	8	34	1:0,31
May	4	1	5	1:0,25
June	2	3	5	1:1,50
July	11	3	14	1:0,27
August	6	1	7	1:0,17
September	27	25	52	1:0,93
October	18	12	30	1:0,67
November	52	17	69	1:0,33
December	10	3	13	1:0,30
January	13	7	20	1:0,54
February	26	10	36	1:0,38
March	26	18	44	1:0,69
April	16	5	21	1:0,31
May	16	4	20	1:0,25
Total	470	202	672	1:0,43

Table 36 (continued)

$\bar{x}$	18,8	8,08	26,88	1:0,43
1975	156,0	58,0		1:0,37
1976	217,0	100,0		1:0,46
1977	97,0	44,0		1:0,45

It is interesting to note the continual preponderance of males throughout the duration of the study with few exceptions. However, a more detailed breakdown after the reproductive season, i.e. from January of the following year at the age of 12 months of the current generation revealed that there is a reversal of this trend and adult females are more frequently captured than males (Table 37). Statistically it is not significant, based on the data, but there is a trend.

Table 37. Differential mortality among male and female Mabuya varia in the Burkea africana - Eragrostis pallens savanna over the period when the lizards are in their second year of life.

Month	Males captured	Females captured	Total	% Male:Female
J	10	6	16	62,50:37,50
F	12	19	31	38,71:61,29
M	6	11	17	35,29:64,71
A	1	5	6	16,67:83,33
M	0	2	2	0:100,00
J	0	0	0	0:0
J	1	0	1	100,00:0
A	0	0	0	0:0
S	1	1	2	50,00:50,00
O	4	2	6	67,00:33,00
N	3	4	7	42,86:57,14
Total	38	50	88	43,18:56,82

This tendency leads one to the conclusion that the males are dying earlier than females, the former mostly reaching 15 to 16 months of age as opposed to 16 to 17 months in the latter. Although both sexes may survive as long as 23 months, it can be seen that there are a greater percentage of females surviving on average than males.

Panaspis wahlbergi showed a similar reproductive cycle to that of Mabuya varia although being a much smaller lizard. They exhibit a marked chromatic sexual dimorphism with the males attaining a pinkish-orange ventrum from tip of chin to tip of tail, in the breeding season. During the remainder of the year, this colour fades or is not present at all but as the summer approaches, the ventrum gradually changes its hue until September when they are in full bloom. Although not always consistant, the males tend to have a broken dark-brown vertebral line extending from the nape to the base of the tail. Females tend to be uniform brown above. Table 38 shows the sex ratio of the snake-eyed skink over the period of one year.

Table 38. Sex ratios of Panaspis wahlbergi in the Burkea africana - Eragrostis pallens Study Area : May 1975 - May 1977.

Month	Male	Female	Total	Ratio
May	0	9	9	0:9,00
June	1	0	1	1:0,00
July	5	9	14	1:1,30
August	1	4	5	1:4,00
September	32	21	53	1:0,66
October	14	5	19	1:0,36
November	28	17	45	1:0,61
December	18	9	27	1:0,50
January	5	4	9	1:0,80
February	3	6	9	1:2,00
March	0	7	7	0:7,00
April	3	10	13	1:3,33
Total	110	201	311	1:1,83
$\bar{x}$	9,2	16,75	25,92	

From a sample of 75 skinks trapped during 1977, there were 1,42 females per male. It is, unfortunately, difficult to sex these lizards at hatchling size, so it is not possible to determine their ratio at birth. Mating takes place during early summer, i.e. from August to October. Table 39 shows the distribution of gravid females during the year. This means that ova deposition is distinctly seasonal with a pronounced peak during November, indicating a certain degree of synchronization.

Table 39. Seasonal variation in the rate of gravidity of *Panaspis wahlbergi* at Nylsvley : May 1975 - December 1977.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
♀ gravid	1	0	0	0	0	0	0	0	0	2	13	7
♀ adults (non-gravid)	5	3	1	3	1	0	5	3	20	15	25	17
% gravidity	16,67	0	0	0	0	0	0	0	0	11,76	34,21	29,17

This is in contrast to *Panaspis nimbaensis*, which on the Ivory Coast at Lamto breeds throughout the year with the exception of two months, November and December, i.e. mid-winter, Barbault (1974a). This again illustrates what effect seasonality of climate has on reptile populations. The females normally lay 3-6 eggs (7,0 x 4,4 mm) with a mean of 4,43 (n = 7). This is in effect double that of *P. nimbaensis* ($\bar{x}$ = 2,51), Barbault (*loc. cit.*) and illustrates the strategy of a seasonal lizard, because *P. nimbaensis* with its small clutch of eggs produces a mean of 5,0 clutches per year, whereas *P. wahlbergi* probably produces one and at the very most two clutches per season which is, therefore, from approximately half to almost equal that of the tropical lizard. Barbault (1974) recorded a mean incubation period of 41,8 days (range 36-50) which appears to be similar to that recorded at Nylsvley for *P. wahlbergi*. Hatchlings were only recorded during January, February and March (Figure 65), whereas gravid females with oviducal eggs were recorded during the preceding three months. However, this may vary from year to year as hatchlings and gravid females were found in January 1977. The hatchlings vary from 15,0 to 16,0 mm ($\bar{x}$ = 15,33 mm, n = 7) from snout to vent, with a mass of 0,1 g.

The distribution of the various size classes over the period is illustrated in Figure 65. It is again apparent that the species is short-lived. Very few individuals reach a ripe old age and size as can be seen from the gap between the larger size classes during January and November/December. Obviously most individuals die off or suffer predation.

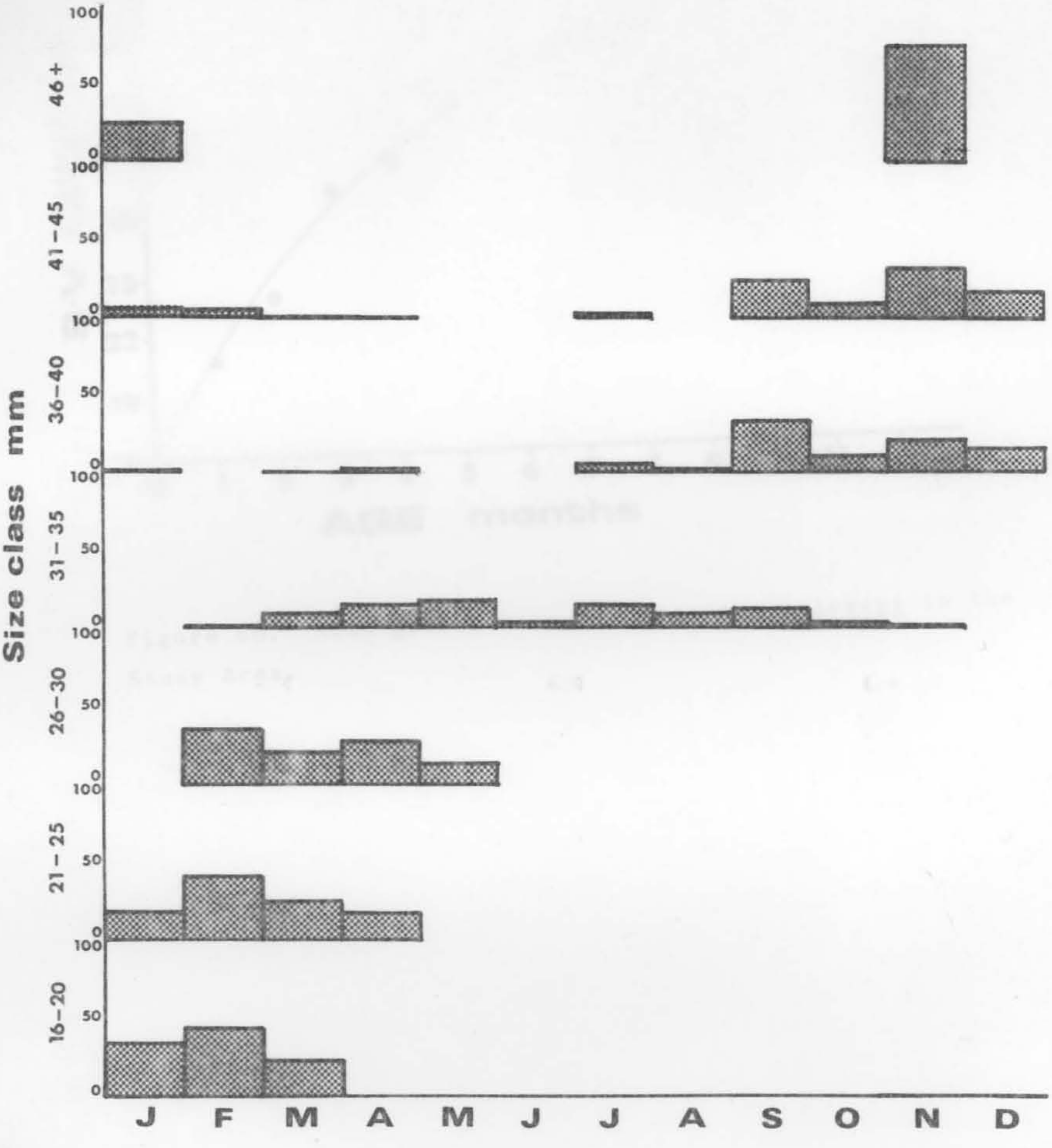

Figure 65. Monthly distribution of size classes of _Panaspis wahlbergi_ in the Study Area.

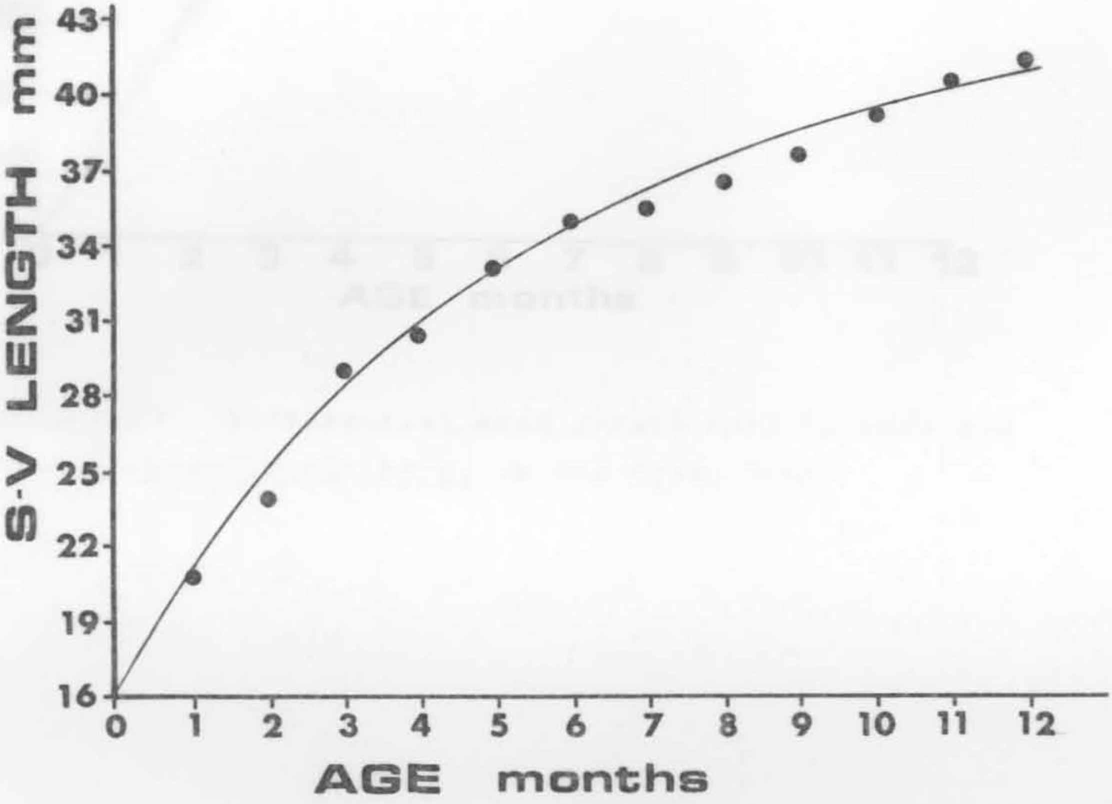

Figure 66. Mean growth rate of Panaspis wahlbergi in the Study Area.

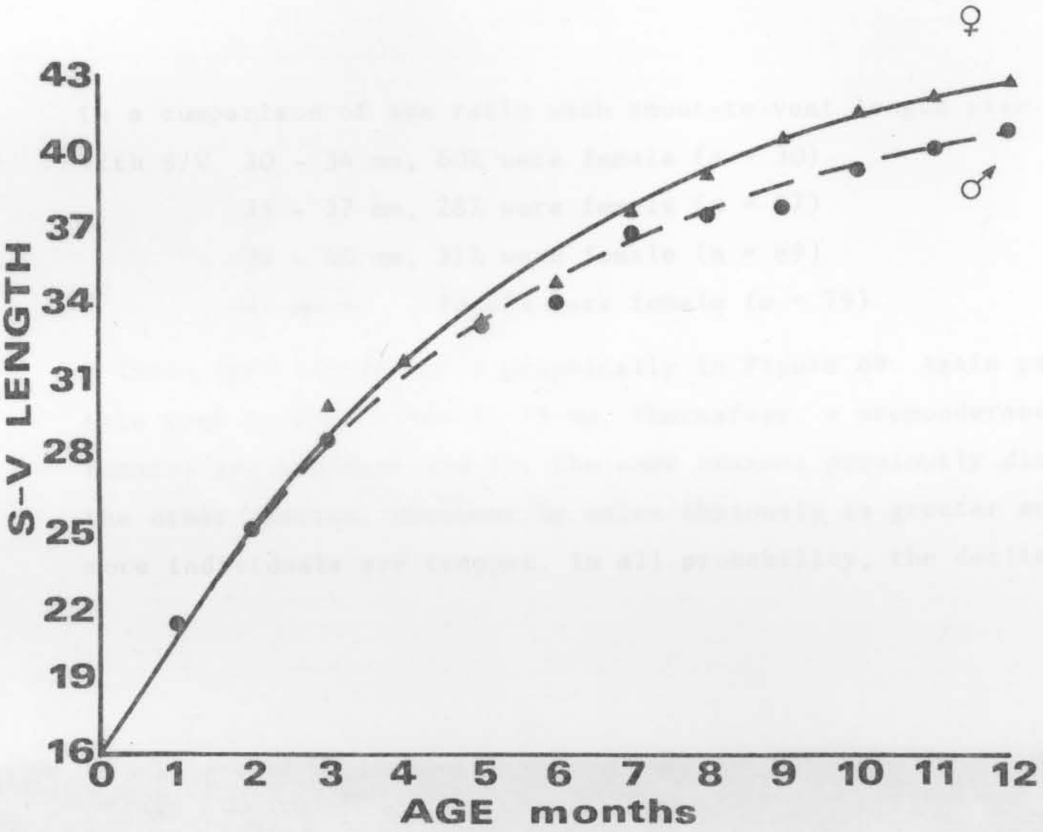

Figure 67. Differential mean growth rate of male and female Panaspis wahlbergi in the Study Area.

Growth is relatively rapid for the initial three months, but thereafter gradually slows down but never stops (Figure 66). A differential growth rate is also apparent with females reaching a greater size than males (Figure 67). Sexual maturity is achieved in eight months with a snout-to-vent length of 37 mm onwards. Figure 68 exhibits the range in size of gravid females. A slightly skewed poisson distribution is apparent - possibly on account of the relatively small sample. However, S/V length of between 41-43,0 mm are the most frequent with a peak at 42,0 mm. This would indicate a female between 8 - 11 months

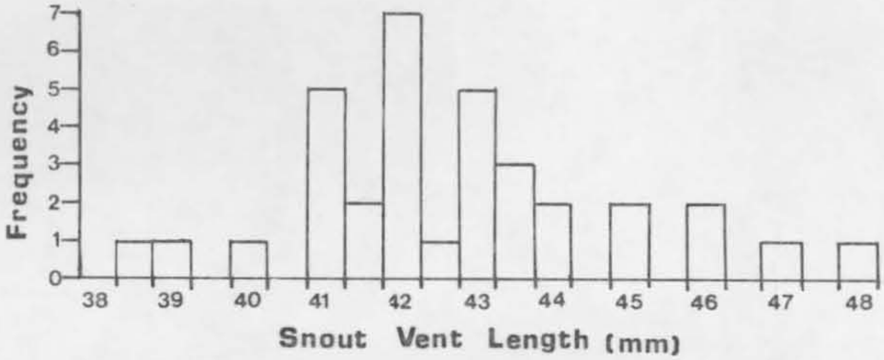

Figure 68. Size class frequency distribution of gravid <u>Panaspis</u> <u>wahlbergi</u> in the Study Area.

In a comparison of sex ratio with snout-to-vent length size classes, those with S/V 30 - 34 mm, 60% were female (n = 30)

35 - 37 mm, 28% were female (n = 57)
38 - 40 mm, 31% were female (n = 89)
41 mm + 73,42% were female (n = 79)

These data are depicted graphically in Figure 69. Again parity is evident, this time in size class 31-35 mm. Thereafter, a preponderance of males and females are manifest and for the same reasons previously discussed under the other species. Movement by males obviously is greater and therefore more individuals are trapped. In all probability, the decline in the next size class, apart from being smaller animals, also indicate greater predation on males, as will be discussed later.

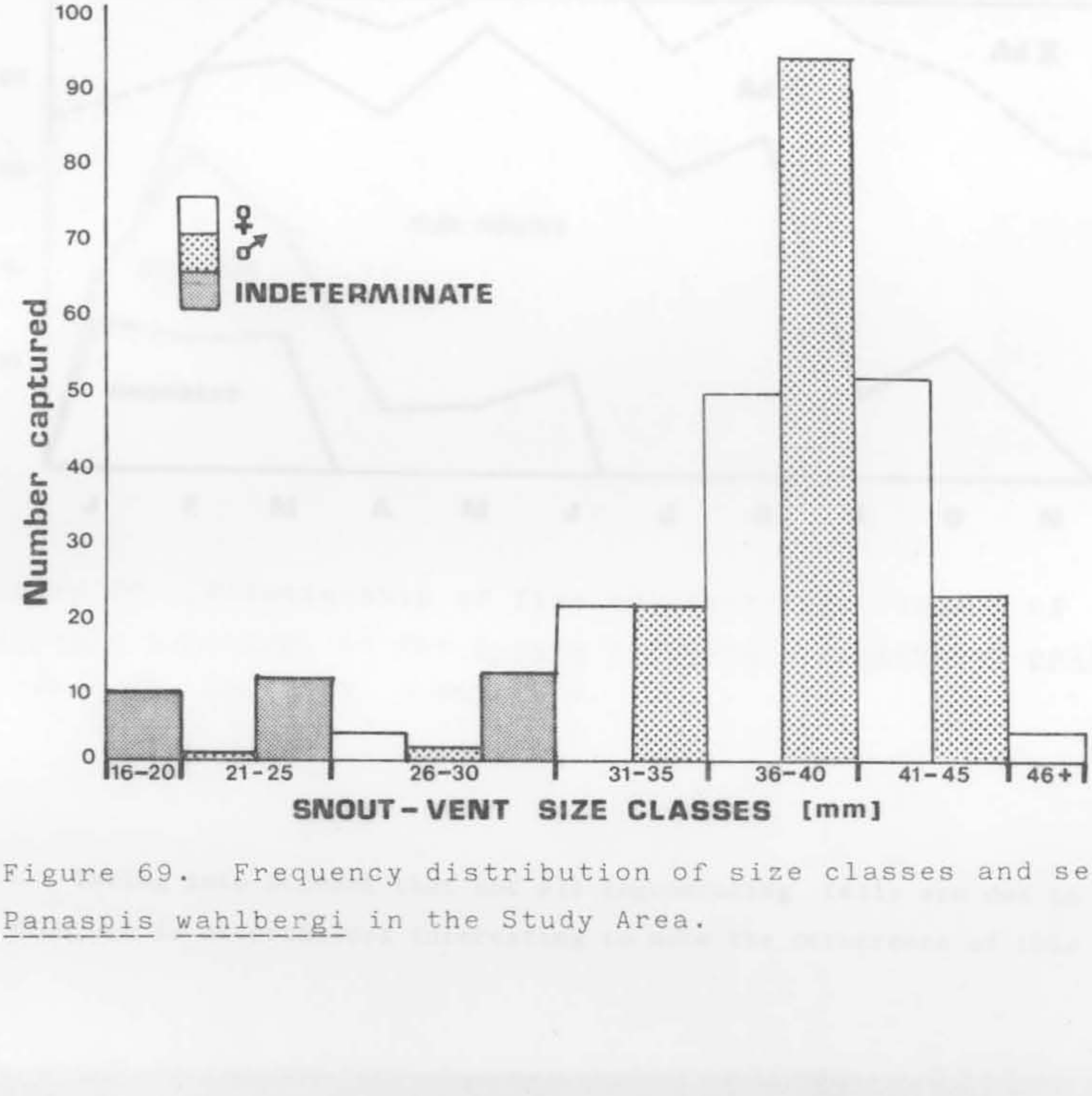

Figure 69. Frequency distribution of size classes and sex of Panaspis wahlbergi in the Study Area.

These data support Figure 67 but also show how variable the sex ratio can be. The largest lizards were females attaining a maximum length of 47,0 mm S/V whereas the largest male had a recorded length of 43,0 mm S/V. There also appears to be a differential mortality with adult females being found into April. This is, however, exceptional and most die by the end of April of the year following birth, at the age of 13 to 15 months. The males have a potential life span of 10 to 12 months. This is very similar to that of P.nimbaensis where the males reach on average 9,8 months and the females 13,1 months. From the size groups, four and possibly five categories can be recognised as follows:

Neonates, including hatchlings and juveniles up to the age of one month, therefore < 22 mm ;
Juveniles (23-28 mm) which are arbitrarily separated from subadults (29-36 mm); and
The adults which are arbitrarily separated into two groups.

Adult I (37-41 mm) mostly male and the smaller females, most of which do not appear to live beyond December of the year of hatching or the age of 11 months.

Adult II (42 +), mostly females which may live on for another two to four months.

Figure 70 shows the seasonal distribution of these categories during twelve months. The distinct brief breeding season is a feature of the lizard. Growth is rapid and mortality is probably high.

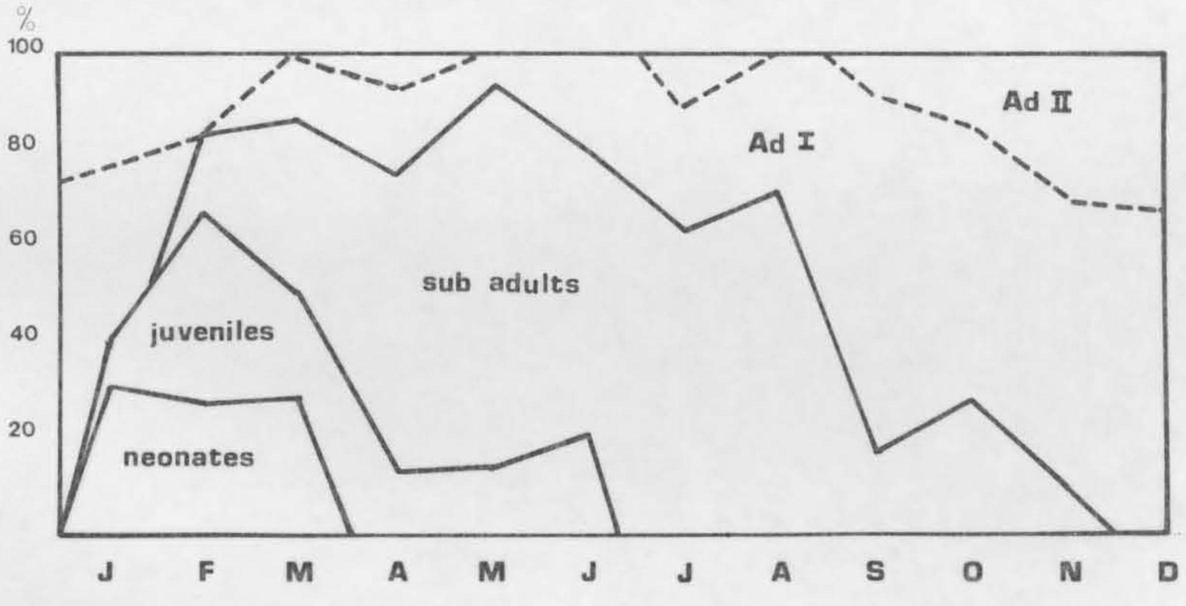

Figure 70. Relationship of five arbitrary age classes of Panaspis wahlbergi in the Burkea africana - Eragrostis pallens Study Area, May 1975 - May 1977.

Taking into account that not all regenerating tails are due to predation, it is nevertheless interesting to note the occurrence of this phenomenon during the year. Table 40 shows this distribution as follows:

Table 40. Seasonal variation in regenerating tails from captured lizards (May 1975 to May 1977).

	Males		Indeterminate		Females		
Month	Reg.	Nor.	Reg.	Nor.	Reg.	Nor.	%
January	2	4	0	2	3	2	38,46
February	1	2	0	9	3	3	22,20
March	0	0	1	7	1	5	14,29
April	0	3	0	5	4	5	23,53
May	0	0	0	5	1	8	7,14
June	0	1	1	1	1	1	40,00
July	2	3	0	1	4	8	33,33
August	1	4	1	2	2	6	25,00
September	11	27	0	0	9	15	32,26
October	11	15	0	0	9	6	48,78
November	10	21	0	0	14	11	42,86
December	10	13	0	0	10	8	48,78

It can clearly be seen that there is a distinct increase towards the end of the year. This cannot only be ascribed to an increase in abundance and movements of the lizards but, possibly because the animals are larger they are more easily seen. Although the samples are relatively small, the relative percentage of regenerating tails in males and females also show an apparent disproportionate slant towards females (Table 41).

Table 41. Monthly variation in regenerating tails between male and female _Panaspis_ _wahlbergi_ on the Nylsvley Nature Reserve : May 1975 to May 1977.

Month	Males	Females
January	33,00%	60,00%
February	33,33%	50,00%
March	0	16,67%
April	0	44,44%
May	0	11,11%
June	0	50,00%
July	40,00%	33,33%
August	20,00%	25,00%
September	28,95%	37,50%

Table 41 (Continued)

Month	Males	Females
October	42,31%	60,00%
November	32,26%	56,00%
December	43,48%	55,56%

This slant is especially so towards the larger sized skinks and may hinge on their being more visible to predators, at this time of the year. No instances of intraspecific agonistic behaviour was seen during the study. Therefore, a relatively high predation pressure is being exerted on the population. Barbault (1974a) postulates that the population of Panaspis nimbaensis are controlled by two factors, namely drought (direct effect) and predation (delayed effect), the rate of mortality of different age classes evidence a considerable downward trend in the total fecundity of the population, with the recruitement of new adults and the average fecundity of females also decreasing.

Lygodactylus capensis (Cape dwarf gecko) is the most abundant lizard in the savanna ecosystem at Nylsvley. They are typical geckos and oviparous, laying two hard-shelled eggs at a time. These are originally soft-shelled but upon contact with the air, the shell hardens to its brittle consistancy. The eggs are normally joined at one end and, therefore, appear to be laid in pairs, altough there is only a single egg per oviduct. Occasionally single eggs may be laid. Egg size varies from 6,5-7,5 x 5,6-6,0 mm (n = 20). Mating appears to take place throughout the year. Observations were recorded in May, September and October. Mating was observed on one occasion when the male was seen lying on top of the female with fore-limbs clasping the female midway between the fore and hindlimbs. One of his hind-legs straddles the female near the cloaca and behind her hind-legs. The other hind-foot was supporting them on one side. The female's legs were spread out. No neck bite was observed. The male's tail was twisted under that of the female and the cloacas were in contact. Observed copulation lasted for a minimum of 16 min. but the animals had already begun prior to my arrival. On separating, both appeared to drag their cloacas and the male moved off with an arched tail while the cloacas are dragged on the branch, much the same as they do when they defecate. With the exception of January, February and March, the eggs are laid throughout the year (Figure 71) and there are two distinct periods, namely a long period from April to August and again from November to December. Although there are no data corresponding to the month of October at Nylsvley, it is evident from subsequent data that gravid females may also have been found during this month. However, the months of September and October show a low rate of egg-laying, which may be overemphasized at Nylsvley.

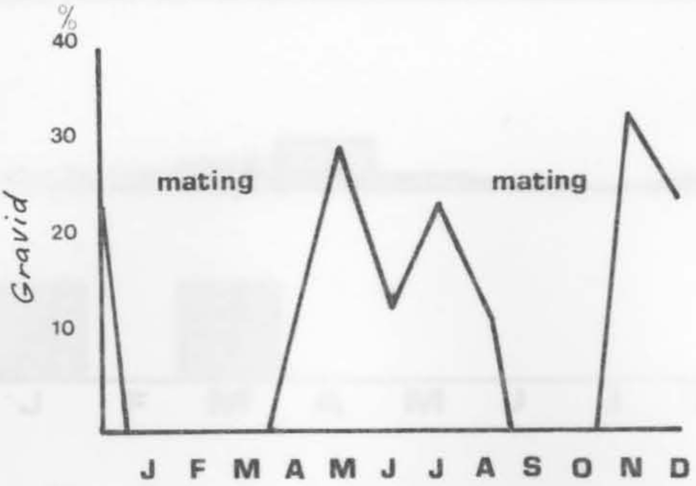

Figure 71. Distribution of breeding seasons of Lygodactylus capensis in the Study Area.

The eggs take two months to incubate and although most young hatch during January to March (Figure 72), it is apparent that hatchlings should also be found during mid-winter. It is not clear why this discrepancy occurred. There is a very even age distribution throughout the population (Figure 72)which indicates therefore that these animals live in excess of one season and possibly even two. The hatchlings or neonates only measure between 13,0 mm and 15,0 mm at birth with a mass of 0,09-0,10 g, but growth is relatively rapid and the geckos reach sexual maturity within eight months. Growth, however, continues (Figure 73) but after 10 months gradually declines, probably as a result of egg-laying at this time of the year. It is probable that the adults succumb after 15 months, but some enter the following reproductive season (See also Figure 72).

The longest age record of a marked gecko is that of a male captured and marked as a juvenile during June 1975 and was recovered at various intervals, finally totalling 634 days. Measurements range from 23,0 S/V on the initial capture, with a probable age of five months to 35,0 mm during April 1976, 308 days later, achieving a mean growth rate of 0,039 mm/day.

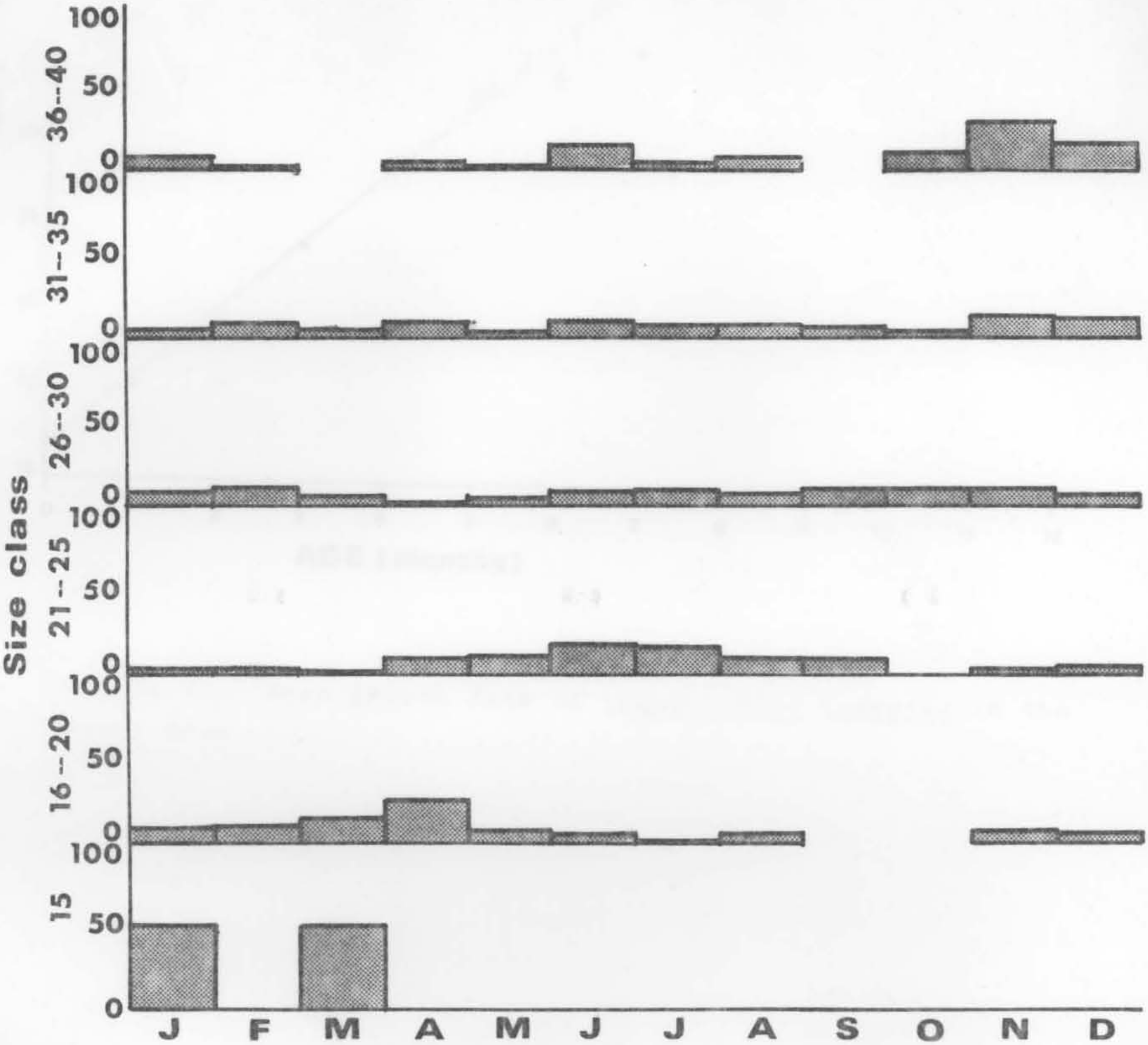

Figure 72. Monthly distribution of size classes of Lygodactylus capensis in the Study Area.

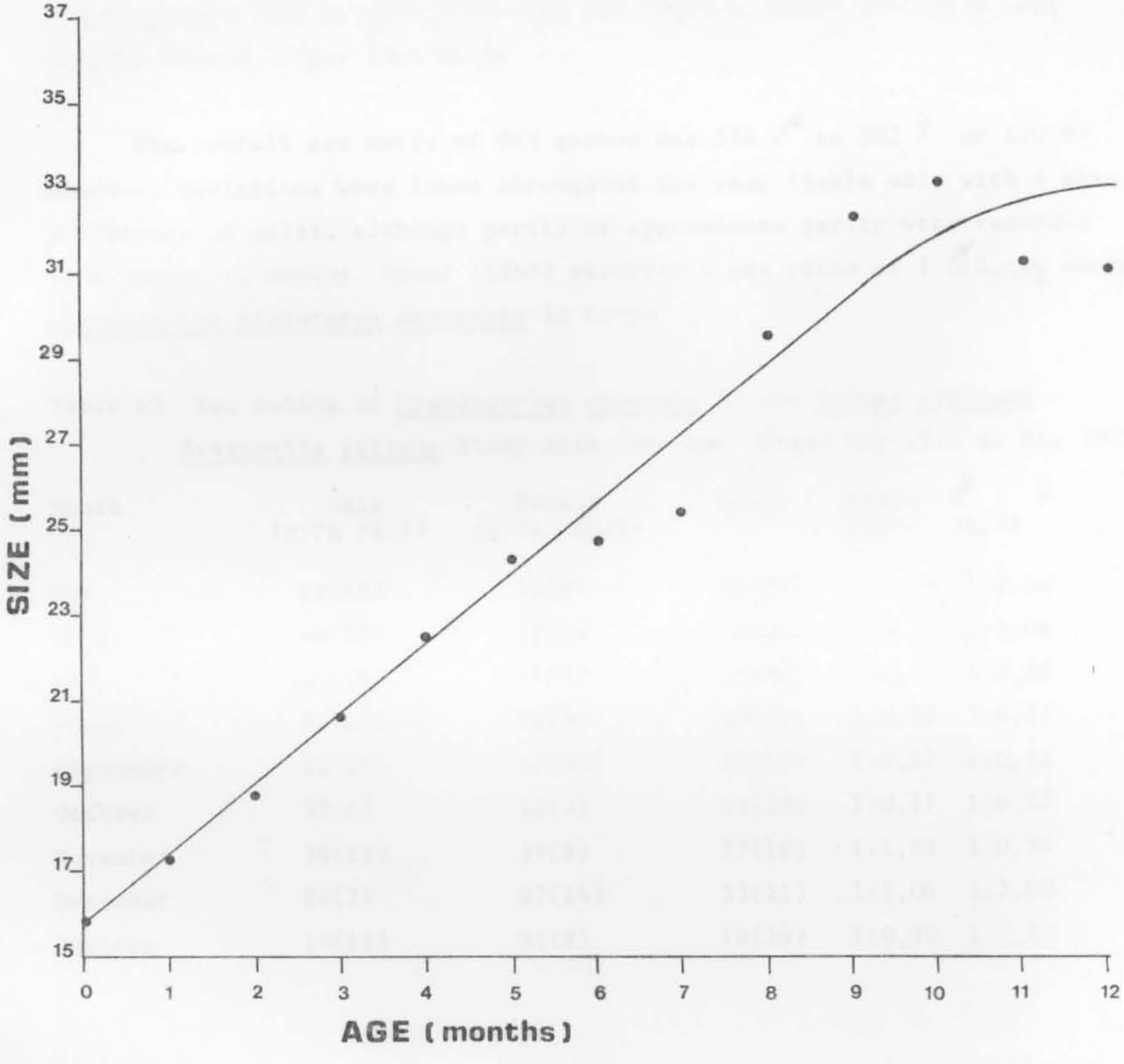

Figure 73. Mean growth rate of Lygodactylus capensis in the Study Area.

Thereafter, no further growth was measured over the following 326 days. This lizard was, therefore, 634 days plus approximately 150 days, 784 days old on the date of last capture (Figure 74). Various other geckos were captured over lesser lengths of time, achieving a mean growth rate of 0,047 mm/day (n = 71) with a range of 0,007 mm/day to 0,193 mm/day, depending on the age and size of the lizard (Figure 75). There is an apparent negative linear correlation between growth rate and size. However, two seasons, winter and summer, influence the growth rate. During winter the growth rate is low or ceases altogether, while during summer, growth rate may be exceptionally high even for adult animals. This accounts for the large scattering to be seen on the graph which almost obscures the relationship.

Figure 76 illustrates the distribution of size classes and the typical pattern observed among the other species of lizards is apparent. Parity is approached in the 21-25 mm size class but, thereafter, the males dominate until the largest size class is reached, which indicates that females become larger than males.

The overall sex ratio of 883 geckos was 561 ♂ to 322 ♀ or 1:0,57. However, variations were found throughout the year (Table 42), with a preponderance of males, although parity or approximate parity were recorded in a number of months. Greer (1967) recorded a sex ratio of 1 ♂:2,10♀ among <u>Lygodactylus picturatus keniensis</u> in Kenya.

Table 42. Sex ratios of <u>Lygodactylus capensis</u> in the <u>Burkea africana</u> - <u>Eragrostis pallens</u> Study Area over the period May 1975 to May 1976

Month	Male 75/76 76/77	Female 75/76 &6/77	Total	Ratio ♂ : ♀ 75/76	 76/77
May	19(16)	14(8)	33(24)	1:0,74	1:0,50
June	40(15)	15(16)	55)31)	1:0,37	1:1,06
July	31(16)	24(9)	55(25)	1:0,77	1:0,56
August	25(11)	18(9)	43(20)	1:0,72	1:0,82
September	23(19)	12(10)	35(29)	1:0,52	1:0,52
October	21(6)	12(4)	33(10)	1:0,57	1:0,67
November	38(13)	39(5)	77(18)	1:1,03	1:0,38
December	26(7)	27(14)	53(21)	1:1,04	1:2,00
January	10(11)	9(18)	19(29)	1:0,90	1:1,63

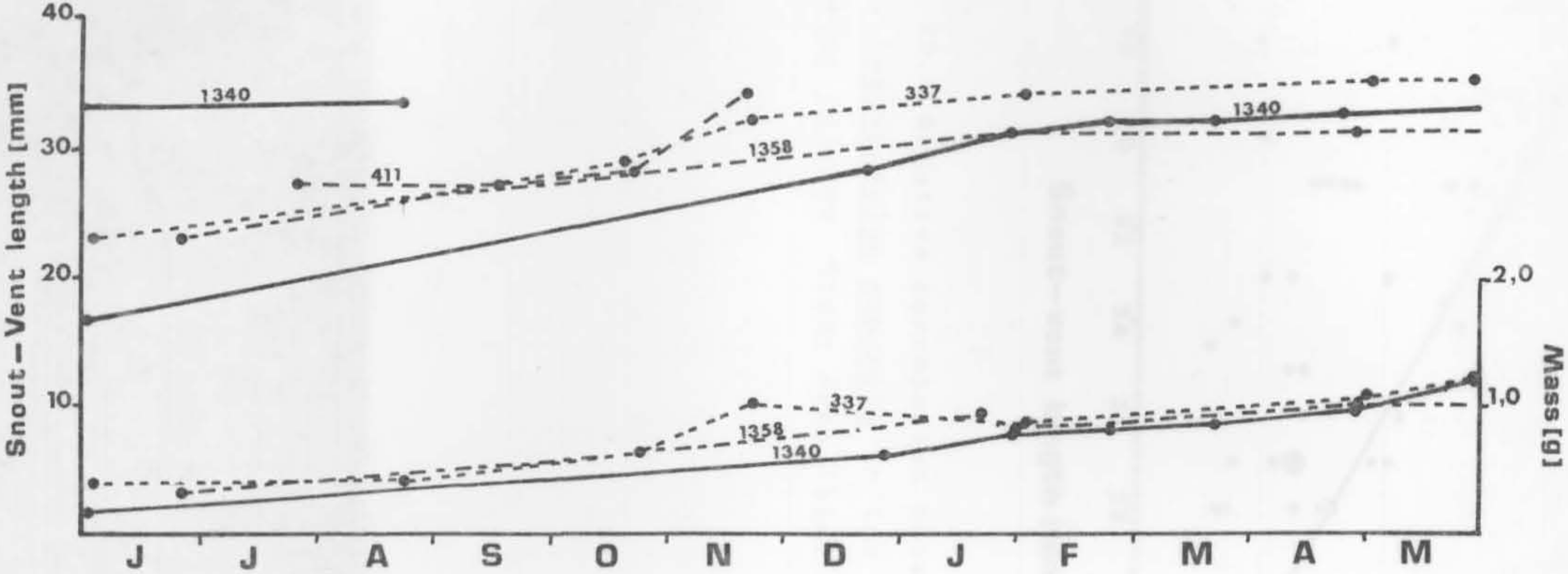

Figure 74. Growth exhibited by individual recaptured *Lygodactylus capensis* in the Study Area.

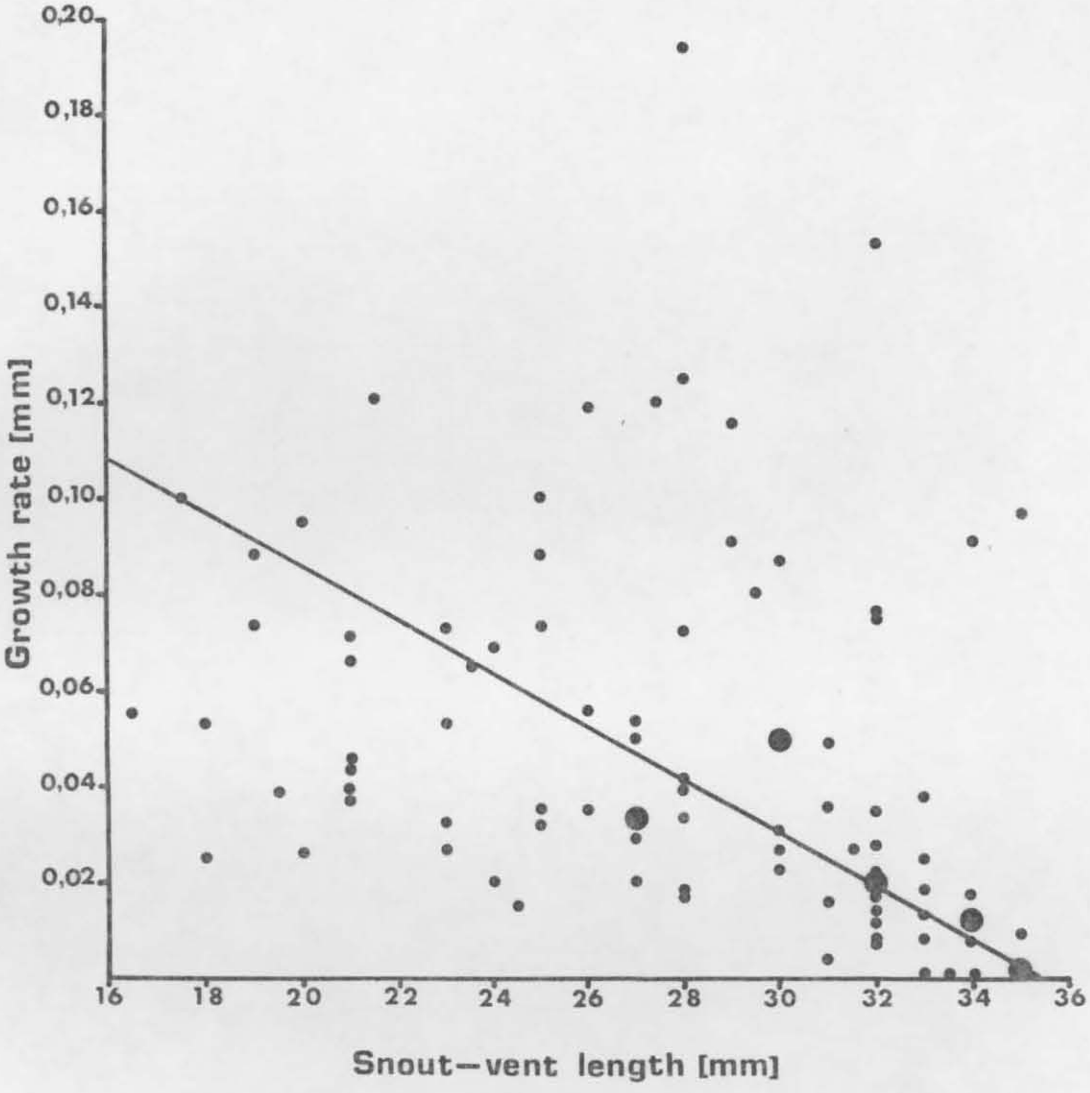

Figure 75. Negative correlation between growth rate and size of *Lygodactylus capensis* in the *Burkea africana* - *Eragrostis pallens* Study Area (Line drawn by eye).

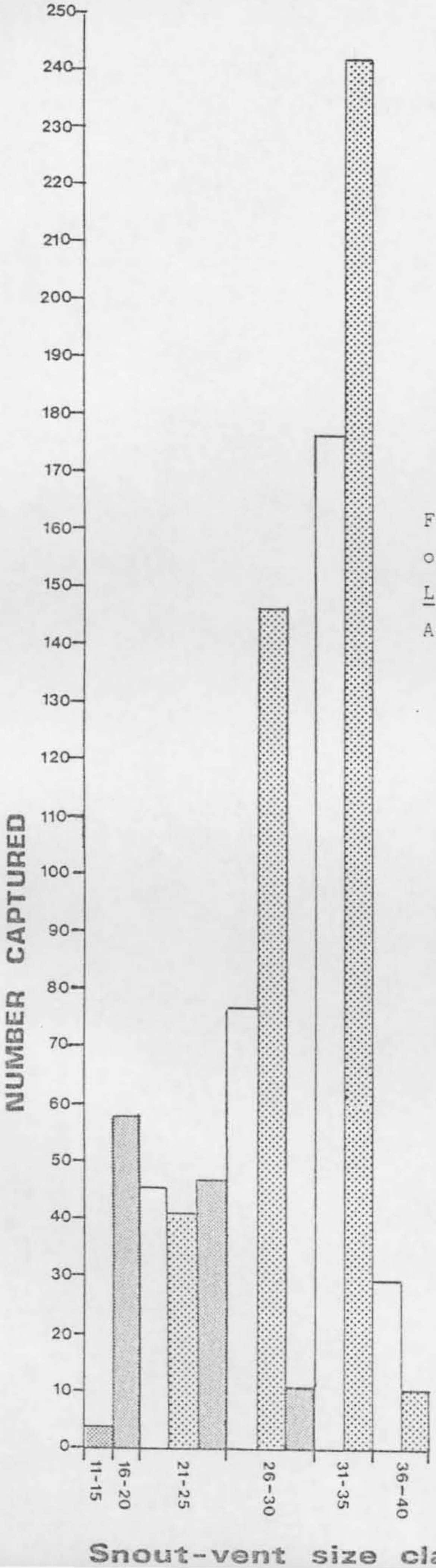

Figure 76. Frequency distribution of size classes and sex of <u>Lygodactylus</u> <u>capensis</u> in the Study Area.

Table 42 continued.

Month	Males 75/76 76/77	Females 75/76 76/77	Total	Ratio ♂ : ♀ 75/76	 76/77
February	32(18)	13(5)	45(23)	1:0,41	1:0,28
March	14(17)	6(9)	20(26)	1:0,43	1:0,53
April	18(15)	12(14)	30(29)	1:0,67	1:0,93
Total	397(164)	201(121)	598(285)	1:0,51	1:0,74
$\bar{x}$	33,1(13,7)	16,75(10,1)	49,85	1:0,68	1:0,51

Sexual dimorphism in this species, is restricted to the adults, whereby the males have a row of precloacal pores anterior to the vent. This, however, only appears when the animal is about six months of age with a S/V length of 27,0 mm. It is assumed that this coincides with the achievement of sexual maturity. Greer (loc.cit)states that this is also the case with the similar sized Lygodactylus picturatus keniensis where preanal pores appear in males at a snout/vent length of 26-27 mm. The smallest female with developing ova, found during this study was 28,0 mm S/V which is similar to that established by Greer (loc.cit.) Size and, therefore, age is important in determining fecundity. In a sample of 54 gravid females, plotted against S/V length, it is apparent that females with a S/V length of 33,0 mm have the highest frequency (Figure 77) and the total distribution exhibits a poisson distribution. Fecundity increases rapidly with age and decreases more abruptly.

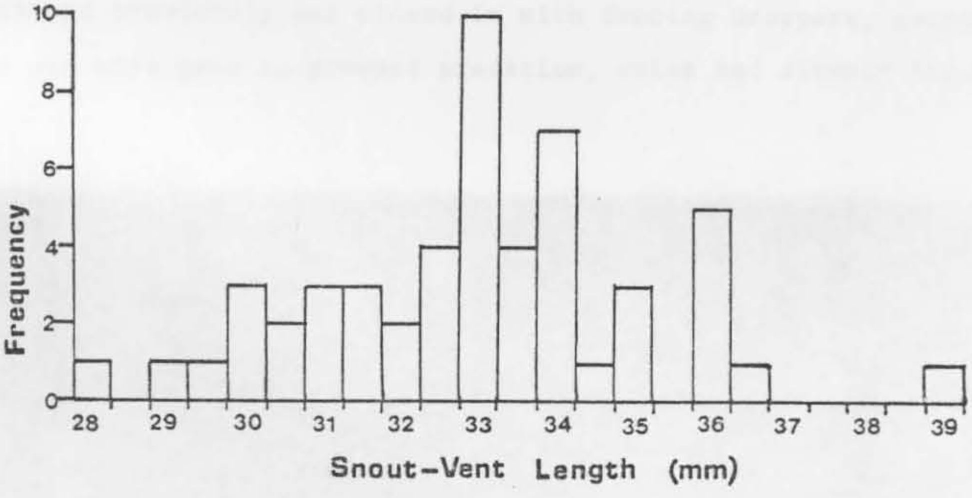

Figure 77. Size class frequency distribution of gravid Lygodactylus capensis in the Study Area.

The eggs are normally laid under loose bark on the bole or branches of the tree or stumps and also in any sheltering declevity especially those of woodborer beetles. Usually a single pair is found but if the site is particularly favourable, then up to seven pairs may be found together as well as the broken remains of older layings. Whether this is the work of a single female or that of more than one is not known, but it is presumed to be the latter.

Few data were obtained about the remaining species except that juveniles were captured during mid-summer, that is January, February and March. These include Pachydactylus bibronii, Agama atricollis, Chamaeleo dilepis and Gerrhosaurus flavigularis. An exception to this is the veld monitor (Varanus exanthematicus albigularis). The veld monitor was observed copulating during August and September. All observed instances of egg-laying (n = 5) during 1976 took place during November, while a nest which had been opened up by mongooses and contained dry egg shells was found early in December, also indicating a laying during November. Signs of digging and one animal actually involved were observed during September 1977, indicating an earlier season contrary to other species such as Ichnotropis which starts late. All nesting attempts were along the roads bordering on and in the Ecosystem Study Area. It appears that road construction creates conditions suitable for nesting sites. One female, however, was seen to dig at five different sites before selecting a sixth which proved suitable. Digging followed the pattern previously described for Ichnotropis capensis, after which she reversed back into the hole and deposited her eggs. The hole was 90-100 cm and approximately 30 cm below the surface. Egg-laying in this instance took a minimum of 100 min. and may take as long as 120 min. A total of twelve eggs was laid after which the female emerged, raked some soil back into the hole and then entered and tamped the soil down with her snout. This pattern predominated throughout the covering period which took 34 min. after which she moved off and investigated one of her previously dug holes, which she then also began closing but abandoned it and wandered away.

Cowles (1930) in a study of the Nile monitor (Varanus niloticus) observed an incubation period of 10 months, but in captivity eggs took three months to hatch (H. Erasmus pers. comm.). The nest of the veld monitor mentioned previously was closed in with fencing droppers, galvanised sheet iron and wire mesh to prevent predation, which had already begun one day after laying. The nest had been opened by mongooses, probably banded mongoose (*Mungos mungo*) and two eggs removed. However, I closed the nest again and left it as natural as possible for a period of 12 months after which on not finding any juveniles, the nest was opened up and the eggs opened. In some of the eggs only bones remained but others still had the decomposing remains of fully developed neonates. This indicates that the incubation period could be ten months. In addition, very small juveniles approximating hatchling size were captured during November, which also tends to support the above evidence. It is probable that under artificial conditions, hatching may take place very much sooner, as temperature and humidity do not fluctuate to the extent of that in the wild, where the eggs probably develop marginally during the winter months, if at all.

Amphibians

It was already mentioned that large numbers of amphibians were resident in the *Burkea africana* - *Eragrostis pallens* savanna in the Study Area. They are completely seasonal in activity, being ultimately totally dependent on rainfall for activity, including reproduction. It was mentioned previously that there are eleven species resident in the Study Area but only three species are common. The most abundant is *Bufo garmani* or northern mottled toad. Although by virtue of its glandular skin it is able to move about on the soil surface before any of the other amphibian species, it is dependent on surface water for egg-laying and development.

As is the case with the lizards, *Bufo garmani* hibernates, but over an extended period from May to September. Once the toads emerge they forage for food but as soon as substantial rain has fallen, they move off down to the turf vlei. This appears to take place during October/November, but is variable as it depends on adequate rainfall to form pools in which breeding is possible. Mating occurs in situ as the males call to attract females and during amplexus the eggs are deposited in the water. While it is possible to sex the adults externally, this was not possible for the small immatures and juveniles. Sex ratios, therefore, only pertain to the adults. Sexual dimorphism is found with the male having a dark gular region as opposed to the marbled white of the female, while he also has pads on his thumbs with which he retains a hold on the female during aplexus. The mean sex ratio of adult toads over the months September to January, for the two years 1975/76 and 76/77 is 1♂ : 1,44 ♀ n = 320, although there is variation from month to month (Table 43). This variation is directly attributable to movement of these amphibians into and out of the Study Area.

Table 43. Sex ratios of *Bufo garmani* over the period May 1975 to May 1977 in the *Burkea africana* - *Eragrostis pallens* Study Area.

Month	Male	Female	Total	Ratio (♂ : ♀)
May	0	1	1	0:1
September	7	2	9	1:0,28
October	22	14	36	1:0,63
November	3	7	10	1:2,33
December	1	11	12	1:11,0
January	2	13	15	1:6,5
February	3	9	12	1:3,0
March	4	4	8	1:1,0
April	0	0	0	0:0
May	0	0	0	0:0
September	28	18	46	1:0,64
October	24	14	38	1:0,58
November	1	4	5	1:4,0
December	0	20	20	0:20,0
January	2	28	30	1:14,0
February	10	10	20	1:1
March	0	0	0	0:0
April	2	0	2	1:0,0
May	22	34	56	1:1,54
Total	131	189	320	1:1,44 ($\bar{x}$)

Bufo garmani females lay 12 000 to 20 000 eggs, Taylor (1982), which hatch and metamorphose during November, December and January and the juvenile toads return to the Study Area during January and February (Figure 78). Depending on temperature and rainfall, the eggs hatch within 24 hrs and metamorphosis is completed in 64 days, with the juvenile toads being 9 mm in S/V length and a mass of 13 mgm, Taylor(*loc. cit.*). The toads then move further away from the pond and become increasingly nocturnal but grow at a rapid rate, reaching an average Snout/Vent length of 31 mm and a mass of 165 mgm in 21 days. It is at this stage that the toadlets enter the Study Area. According to Taylor (*loc.cit.*) therefore the toadlets achieve a growth rate of 1,05 mm/day.

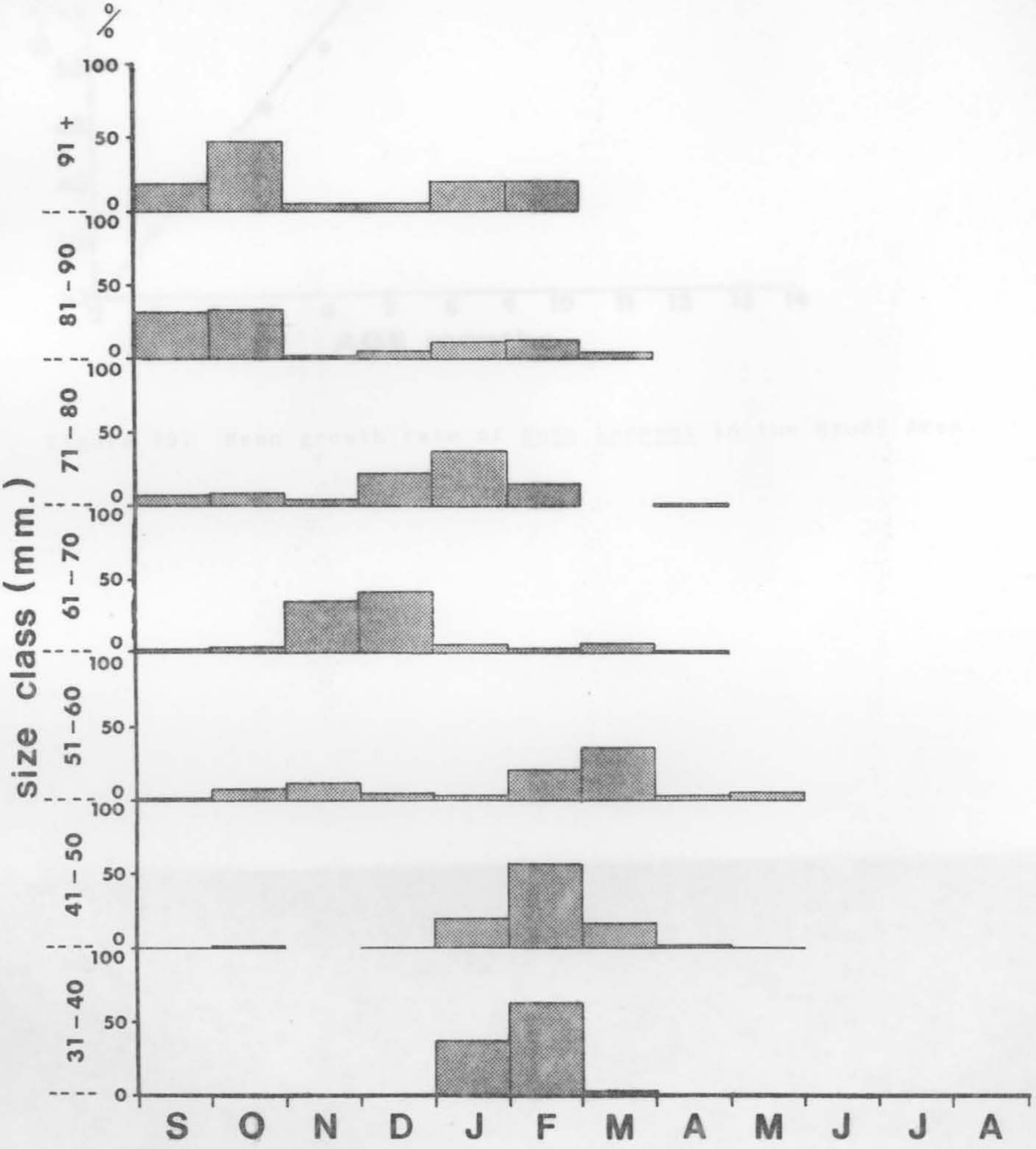

Figure 78. Monthly distribution of size classes of *Bufo garmani* in the *Burkea africana* - *Eragrostis pallens* Study Area.

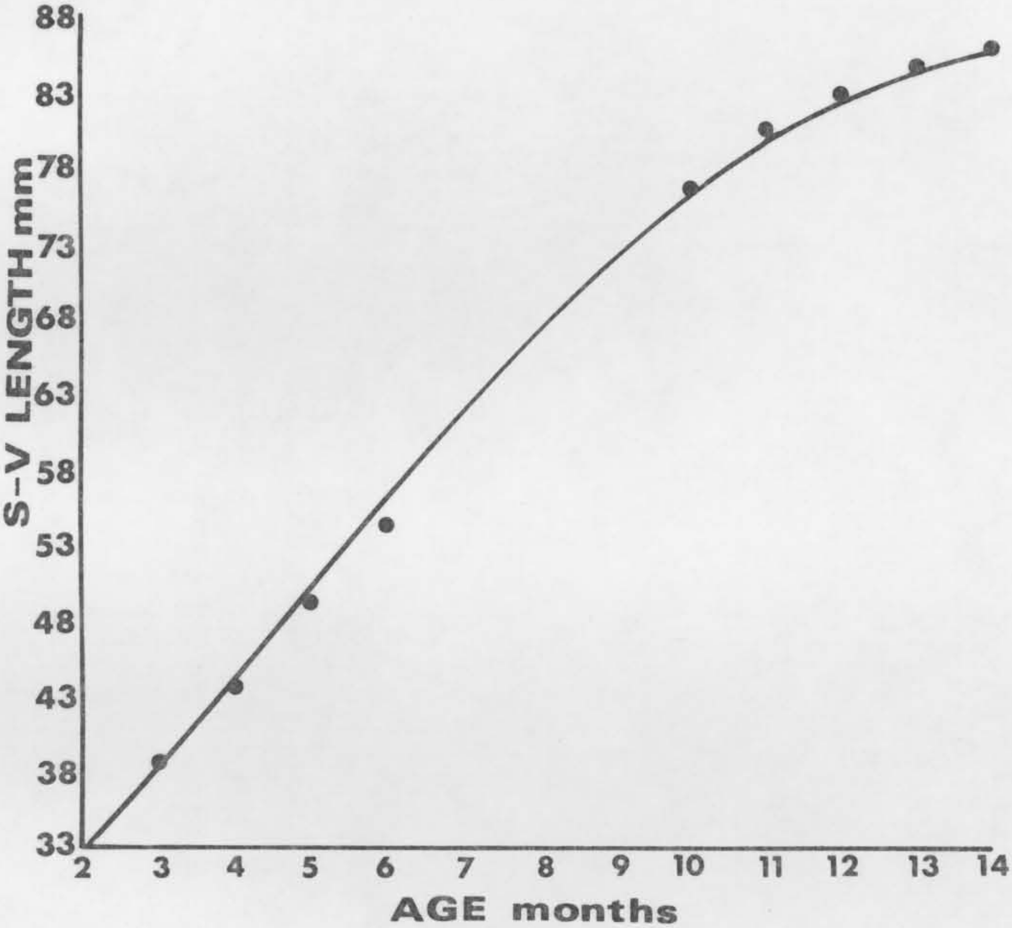

Figure 79. Mean growth rate of Bufo garmani in the Study Area.

Figure 78 shows the distribution of size classes according to the months of the year. Growth is relatively rapid from 33,0 mm snout-to-vent length to 86,0 mm within a period of 12 months (Figure 79) or approximately 0,145 mm/day. Sexual maturity is, therefore, achieved at the age of nine months and in readiness for the breeding season. Figure 80 shows the frequency distribution of size classes. The exclusion of the young animals which were not sexable from the Figure would have produced a more even distribution, although still somewhat skewed to the larger size classes.

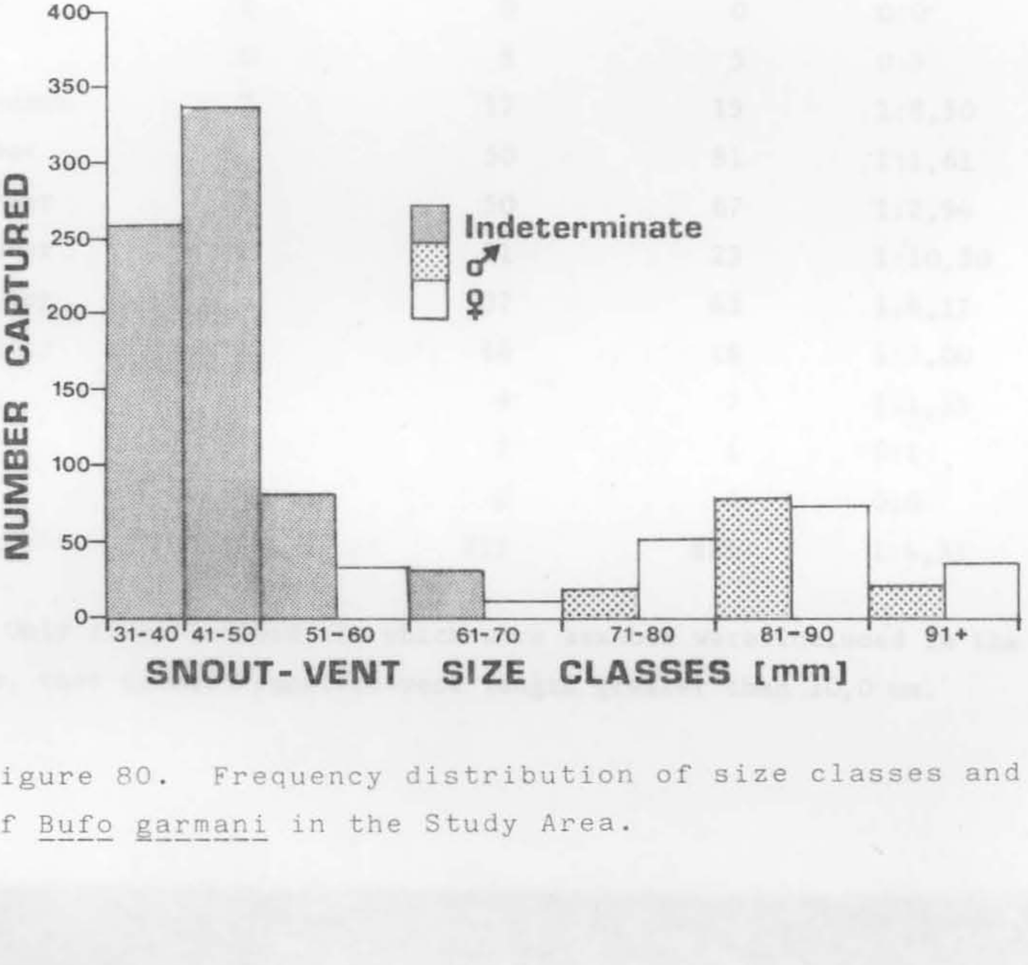

Figure 80. Frequency distribution of size classes and sex of Bufo garmani in the Study Area.

The other very abundant species is Kassina senegalensis or bubbling kassina, which is absolutely dependent on rainfall and surface moisture. Like the toads, they are therefore completely seasonal. Large numbers hibernate in the Burkea africana - Eragrostis pallens savanna. On account of the fact that metamorphosis and juvenile growth is rapid, the frogs actually enter the Study Area as subadults. This may account for the distribution of the smallest size class throughout the active season from September to May. However, these frogs also move down to the turf vlei during periods of heavy rainfall and breed in the shallow pools in the company of the previous species. Breeding probably takes place at the same time as the roads after which they return to the Study Area between November and March.

These amphibians also display a sexual dimorphism when adult. The male has a black gular plate while the female is immaculate. The mean male to female ratio is 1♂ : 4,51 ♀ . As with *Bufo garmani*, there is tremendous variation from month to month, which is directly correlated to rainfall. If rainfall is abundant then the Kassinas are abundant but if the period is dry then few frogs will venture forth. Table 44 shows the monthly fluctuations.

Table 44. Variations in sex ratio of *Kassina senegalensis* over the period May 1975 to May 1977 on the Nylsvley Nature Reserve.

Month	Male	Female	Total	Ratio (♂ : ♀)
May	2	4	6	1:2,00
October	2	19	21	1:9,50
November	36	111	147	1:3,08
December	23	120	143	1:5,21
January	12	97	109	1:8,08
February	15	104	119	1:6,93
March	5	63	68	1:12,60
April	0	0	0	0:0
May	0	5	5	0:5
September	2	17	19	1:8,50
October	31	50	81	1:1,61
November	17	50	67	1:2,94
December	2	21	23	1:10,50
Janurary	6	37	43	1:6,17
February	2	14	16	1:7,00
March	3	4	7	1:1,33
April	0	1	1	0:1
May	0	0	0	0:0
Total	159	717	875	1:4,51

Only those individuals which were sexable were included in the above Table, that is with snout-to-vent length greater than 30,0 mm.

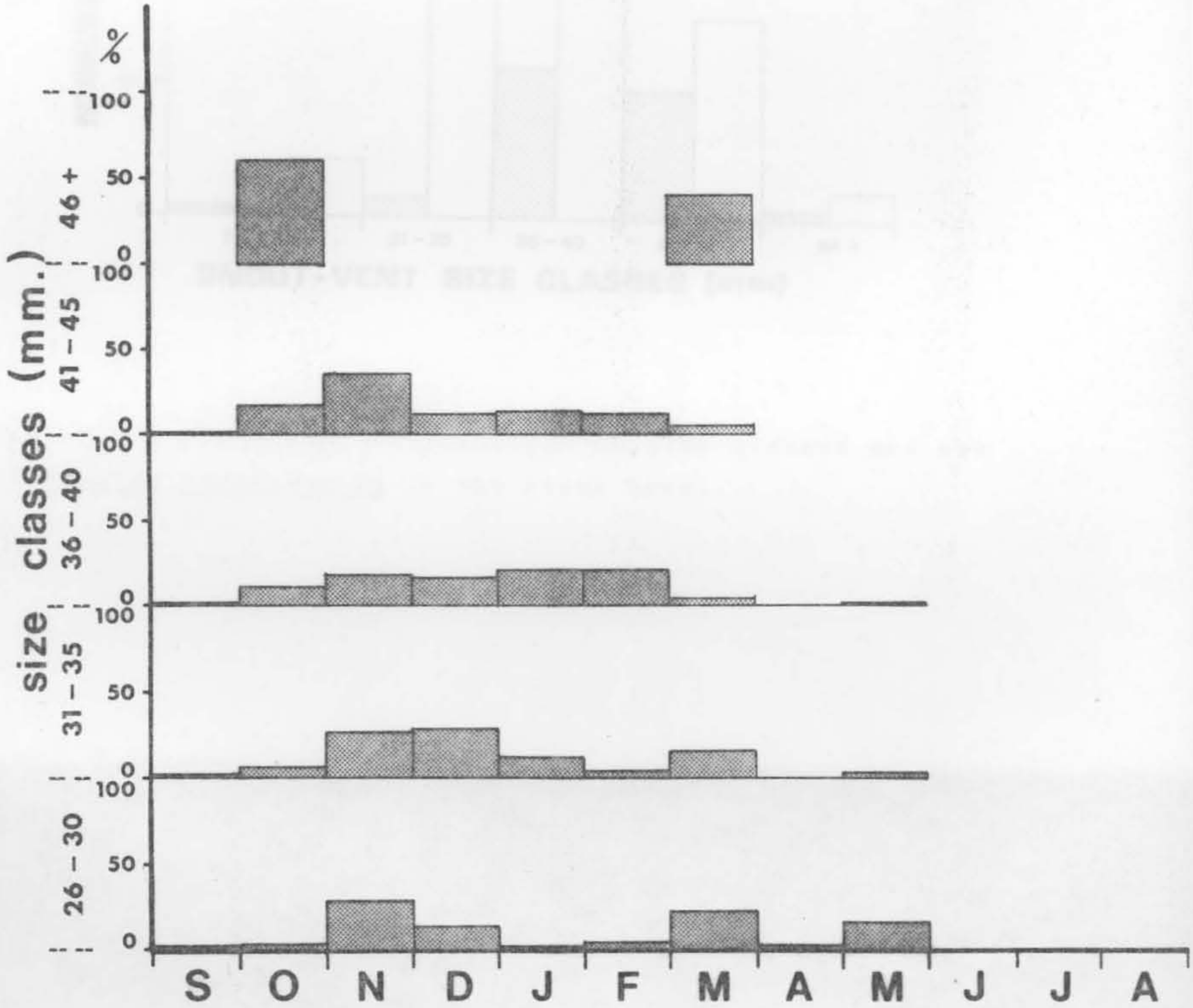

Figure 81. Monthly distribution of size classes of Kassina senegalensis in the Study Area.

It can be seen that there is preponderance of females. Each female can potentially lay 400 eggs. This ensures that adequate numbers survive. According to Carruthers (1982), they breed between October and the end of January. Metamorphosis takes place after 50 to 60 days, which correlates well with the size classes captured in the Study Area over this period (Figure 69). The smallest individual to be captured was 22,0 mm snout-to-vent length, while the largest was a female 53,5 mm in size. Figure 81 shows the distribution of size classes within the population on a yearly basis, while Figure 82 exhibits the frequency of each size class, which approximates a poisson distribution.

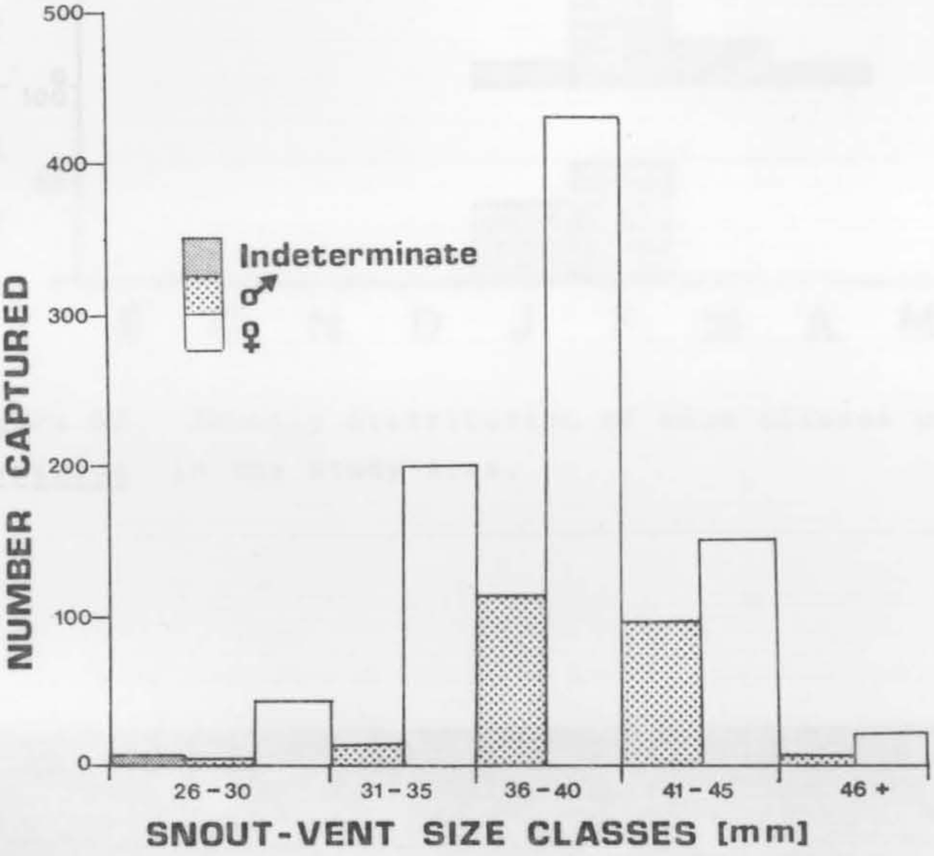

Figure 82. Frequency distribution of size classes and sex of Kassina senegalensis in the Study Area.

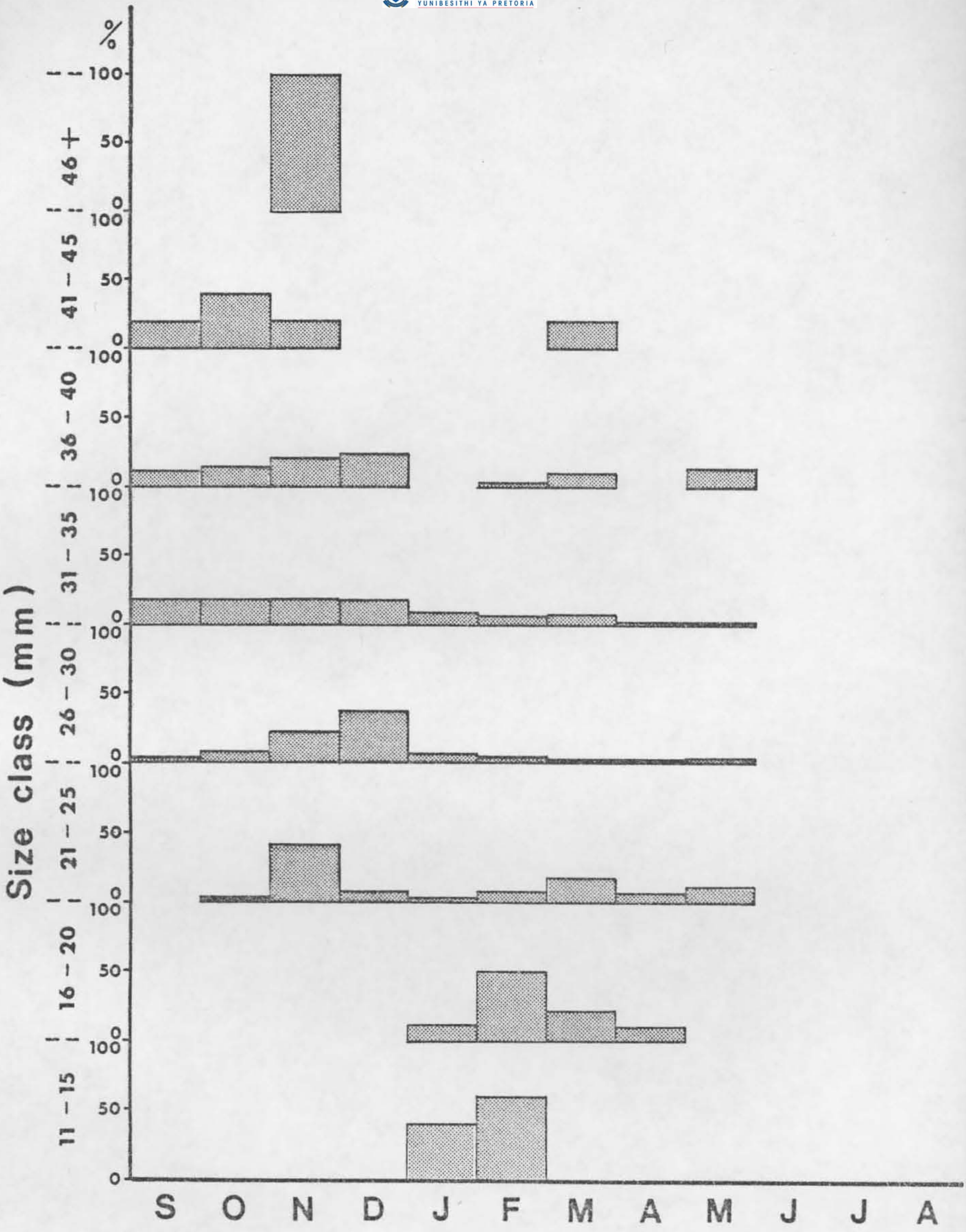

Figure 83. Monthly distribution of size classes of *Breviceps adspersus* in the Study Area.

The third most abundant amphibian in the Study Area is *Breviceps a. adspersus*, the common short-headed frog, which is a member of a unique genus of amphibian which are independent of surface water for reproduction. Wager (1960), Poynton & Pritchard (1976), give descriptions of mating, tunnelling and egg-laying. Egg number varies from 17 to 46 and eggs are deposited in the soil in a nest approximately 20,0 to 45,0 cm below the surface, depending on the degree of exposure of the nest. The female may often be found under cover within close proximity of the nest. Poynton & Pritchard (*loc. cit.*) mentioned that two burrows had double entrances placed 23 cm and 28 cm apart respectively. The average length of each fork was 21 cm and the total lengths of the burrows being 51 and 56 cm respectively. In both cases, a female inhabited one fork and the male the other, both being found about 30 cm below the surface. According to Wager (*loc.cit.*), incubation and metamorphosis take from six to eight weeks after ova deposition. These hatchlings, approximately 6,0 mm in size, then burrow out and disperse. Figure 83 shows the distribution of size classes over one calendar year. It can be seen that the smallest individuals are found during January and February, which indicates an ova deposition during December/January or at a time when rainfall has moistened the soil to a satisfactory depth to avoid excessive dehydration of the eggs. Figure 84 exhibits the frequency of each size class. A poisson distribution is apparent.

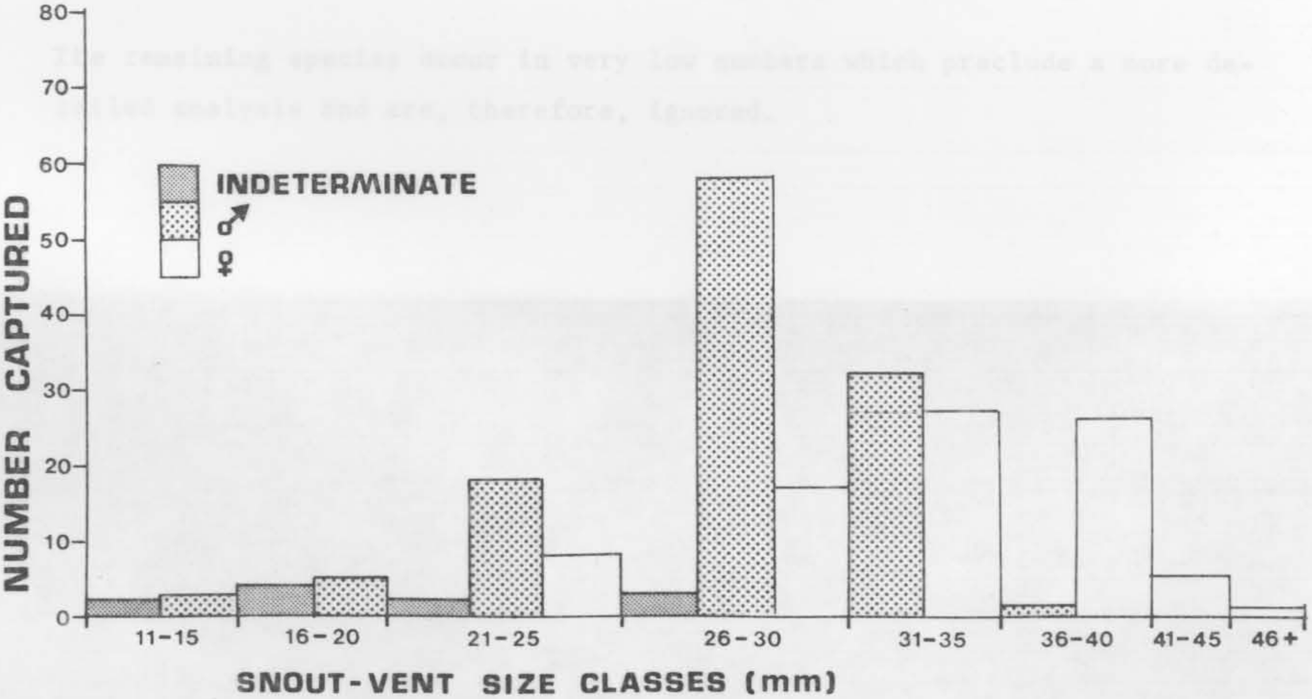

Figure 84. Frequency distribution of size classes and sex of *Breviceps adspersus* in the Study Area.

During the 1975/76 season, activity only started during October, whereas the 1976/77 season activity started in September. This is dependent on rainfall. During the rainy season the amphibians would be heard calling both during the day as well as during the evening or early morning, provided atmospheric humidity was high. However, it was mostly after thunder showers that they moved about on the surface foraging for termites and ants.

They display a limited chromatic sexual dimorphism consisting of a black throat in males as opposed to gray-black diffuse patterns in females. The latter also tended to be larger than the males. In a random sample of 20 males and 20 females, the males averaged 25,85 mm snout-to-vent length, as opposed to 35,2 mm for the females. This is no doubt important to the reproductive biology of the species as the male is attached during amplexus to the rear of the female by a chemical glandular exudate and the female burrows backwards down into the soil with the male attached to a level where the spherical nest site is hollowed out. Apparently the male also assists in this digging process, Wager (loc. cit.).

The mean sex ratio is 1♂: 0,71 ♀ but varies from month to month (Table 45). On account of the limited sample size (200), it was necessary to lump the data for the same months of different years.

Table 45. Sex ratio of Breviceps a. adspersus over the period May 1975 to May 1977 in the Nylsvley Nature Reserve.

Month	Male	Female	Total	Ratio
May	8	8	16	1:1,00
September	9	8	17	1:0,89
October	10	12	22	1:1,20
November	31	16	47	1:0,51
December	32	14	46	1:0,44
January	6	5	11	1:0,83
February	9	6	15	1:0,67
March	9	10	19	1:1,11
April	3	4	7	1:1,33
Total	117	83	200	1:0,71

The remaining species occur in very low numbers which preclude a more detailed analysis and are, therefore, ignored.

From the aforegoing it would appear that most amphibian species show a sex ratio slanted towards an abundance of females. This may be the result of a reproductive system which relies on the reaction of females to calling males and, therefore, ensures that a calling male will always make contact with a female in reproductive condition. At the same time it also enhances gene pool mixing. However, it does not explain the approach to parity exhibited by both *Bufo garmani* and *Breviceps a. adspersus*. It may have to do with the possibility that a male may be able to mate with more than one female, particularly if for some reasons it is more sought after than another. Mention has already been made in this respect for *Bufo garmani* and it probably pertains to the other species as well.

Of all amphibian species, *Breviceps adspersus* is the only true resident of the *Burkea africana*-*Eragrostis pallens* savanna, as it is present throughout the year whereas all the other species must leave in order to breed. Therefore there is always a loss to the *Burkea africana* - *Eragrostis pallens* savanna by amphibians moving out of the area to breed.