A CONTRIBUTION TO THE BIOLOGY OF WARTHOG

(PHACOCHOERUS AFRICANUS, GMELIN)

IN THE SENGWA REGION OF RHODESIA.

by

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DISSERTATION SUBMITTED TO RHODES UNIVERSITY FOR THE

DEGREE OF DOCTOR OF PHILOSOPHY

DECEMBER, 1970.

C O N T E N T S

Volume II.

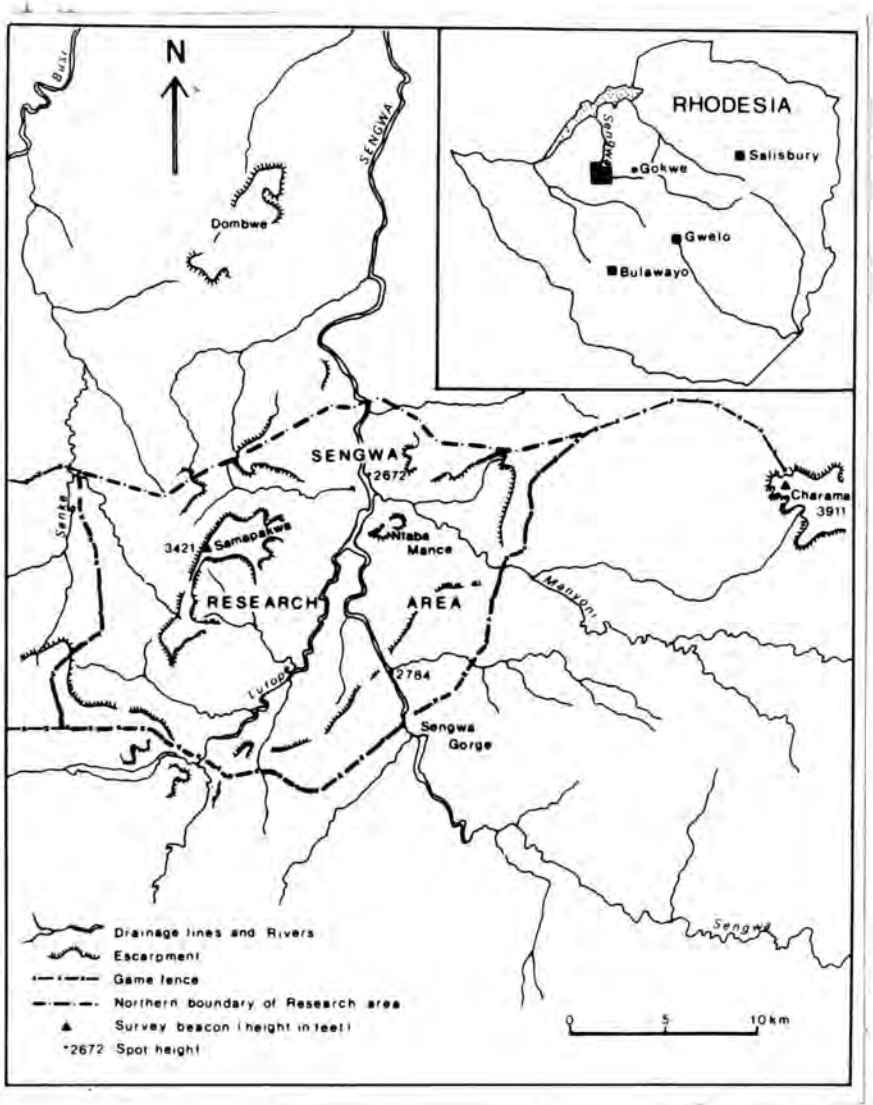


Fig. 1. Map showing the position of the Sengwa Research Area, its boundaries and main topographical features. The areas to the south, east and west of the game fence are controlled hunting areas.

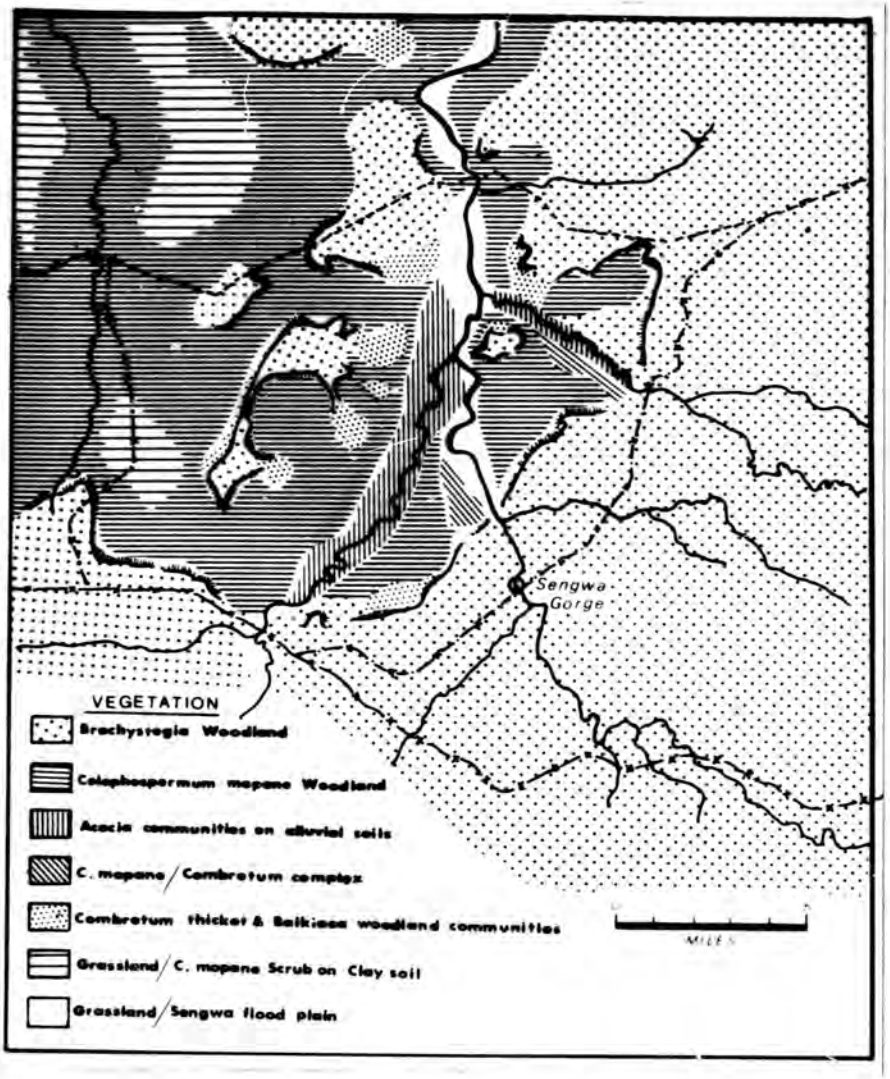


Fig. 2. Map showing the broad vegetation types of the Sengwa Research Area and surrounding areas.

(a) Brachystegia Woodland

(b) Colophospermum mopane Woodland

Fig. 3. Photographs of the main vegetation types occurring in the Sengwa Research Area.

(c) Acacia tortilis - Grewia communities on alluvial soils

(d) C.mopane - Combretum sp. - Tristachya Wooded and Bushed Grassland.

Fig. 3. Photographs of the main vegetation types occurring in the Sengwa Research Area.

(e) Combretum sp. Thicket

(f) Sengwa flood plain Grassland

Fig. 3. Photographs of the main vegetation types occurring in the Sengwa Research Area.

Fig. 4. (cont.) Solid triangle - recorders' field camp; open circle - artesian borehole; numerals within circles refer to vegetation types which are numbered in accordance with those described in Appendix 1 and the vegetation map (Appendix 1, Fig.1).

Physiognomic terms "Woodland", "Bushland" and "Grassland" and combinations of these are defined in Appendix 1 and abbreviations of these are shown in parenthesis below

Vegetation types

2	Brachystegia-Julbernardia mixed Woodland. (W)
4	Colophospermum mopane Woodland. (W)
4b	C.mopane type. "Cathedral mopane". (W)
4c	C.mopane type. "Eroded mopane". (W)
5	Acacia tortilis - Grewia Woodland + Bushland. (W + B)
7	Mixed Combretum-C.mopane-Erythroxylon Woodland + Bushland (W + B)
8	Commiphora - Combretum Wooded Bushland. (WB)
11	B.boehmii - Combretum - Hyparrhenia Wooded Grassland + Bushed Grassland. (WG + BG)
13	C.mopane - Combretum - Tristachya Wooded and Bushed Grassland (W.B.G.)
22	Sengwa flood plain Grassland. (G)
24	Sporobolus - Chloris short saline Grassland. (G)
25	Drainage line grassland in C.mopane. "Mopane vlei". (G or WG.)

Note: Transects are visible as thin white lines in the northern half of the photograph.

Fig. 4. Air photo of the Sengwa Experimental Area. Scale is approximately 1:40,000 or 2.5 cm = 1 km. The area covered by the photograph is shown in Fig. 6. (Copied from 1965, 1:80,000 Aerial Photography and reproduced here with permission of the Surveyor General, Salisbury) Legend continued opposite.

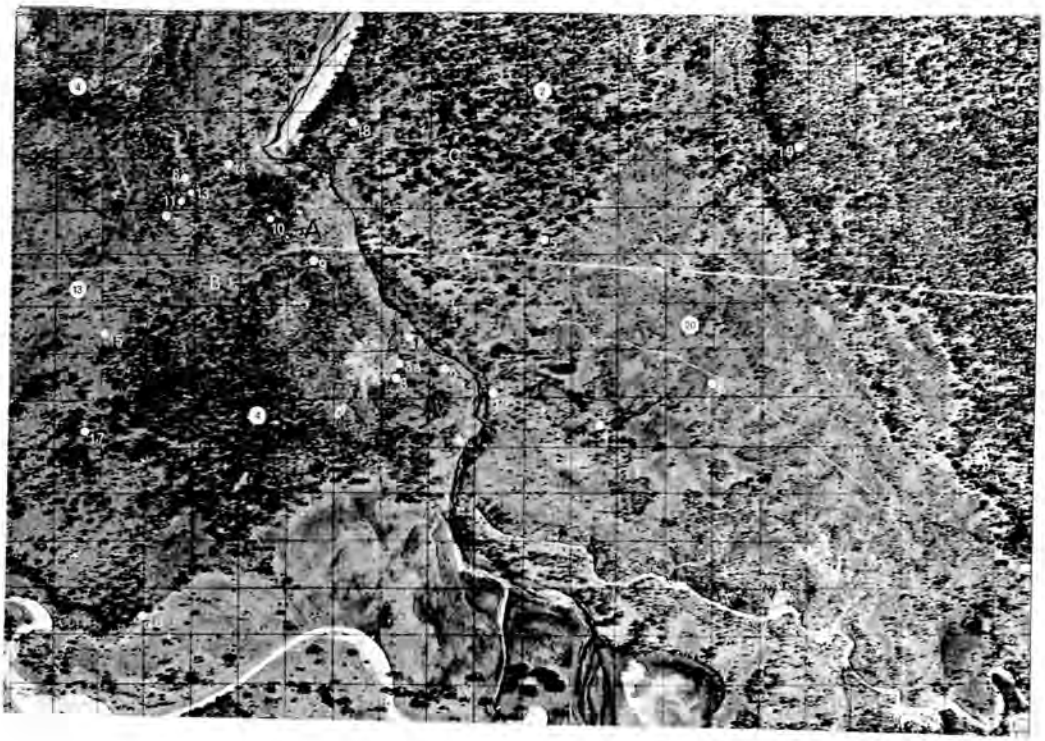


Fig. 5. Air photo of Sengwa Gorge area. A - author's house and offices; B - cook's village; C - main staff village. Holes used by tame warthog are marked by white dots and numbered 1 to 19. Numerals within white circles refer to vegetation types:

2 Brachystegia boehmii - Julbernardia mixed Woodland.

4 C.mopane Woodland

13 C.mopane - Combretum - Tristachya Wooded and Bushed Grassland

20 Short Aristida sp. Grassland with stunted C.mopane.

Grid squares are 100 yards x 100 yards.

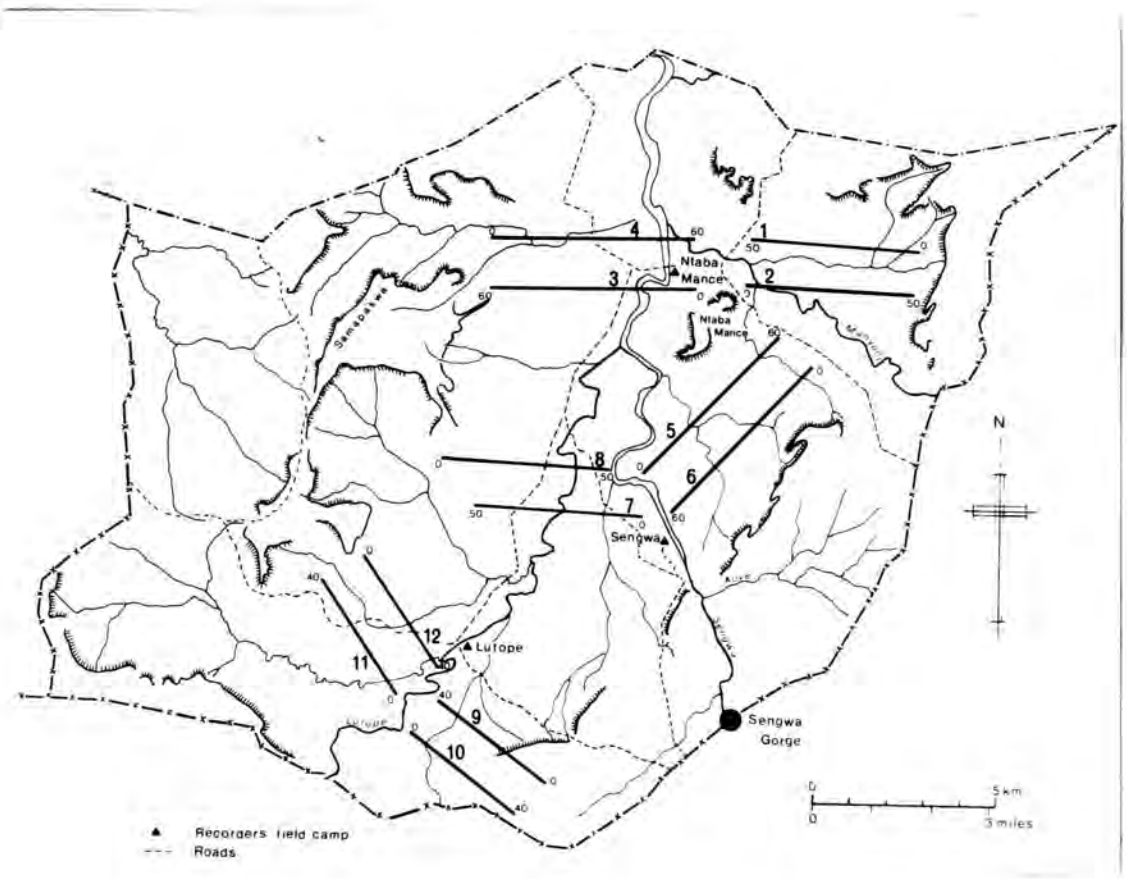


Fig. 6. Map showing location of permanent transects (1 to 12) and recorders' camps. Shaded area shows the Sengwa Experimental Area. Sector numbers at the ends of transects show transect length in 100 yard sectors and direction in which they are traversed.

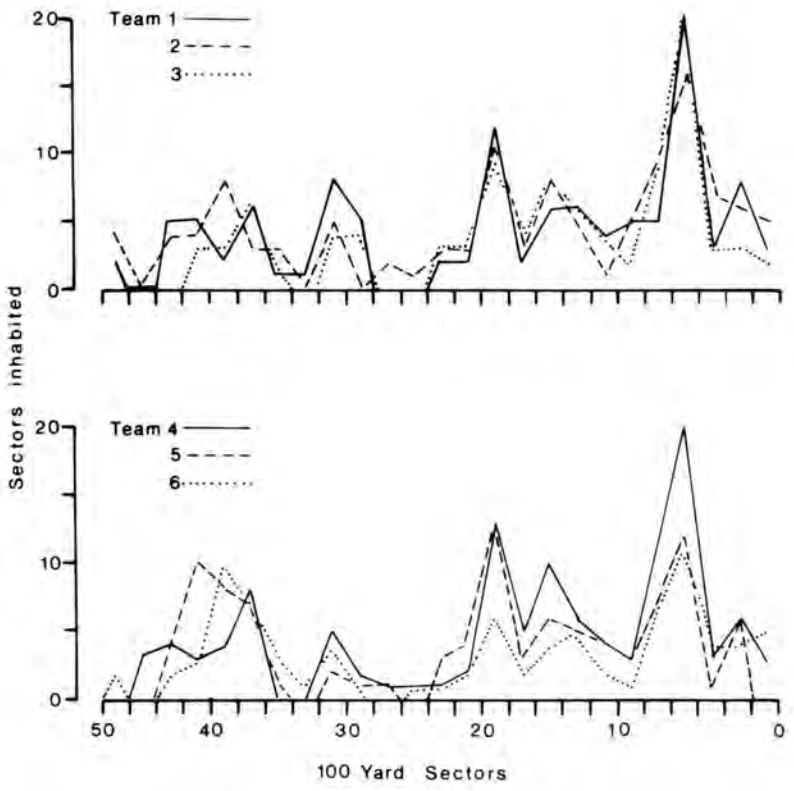


Fig. 7. Distribution of sectors inhabited by warthog on Transect 7 during the course of 5 traverses by 6 independent recording teams.

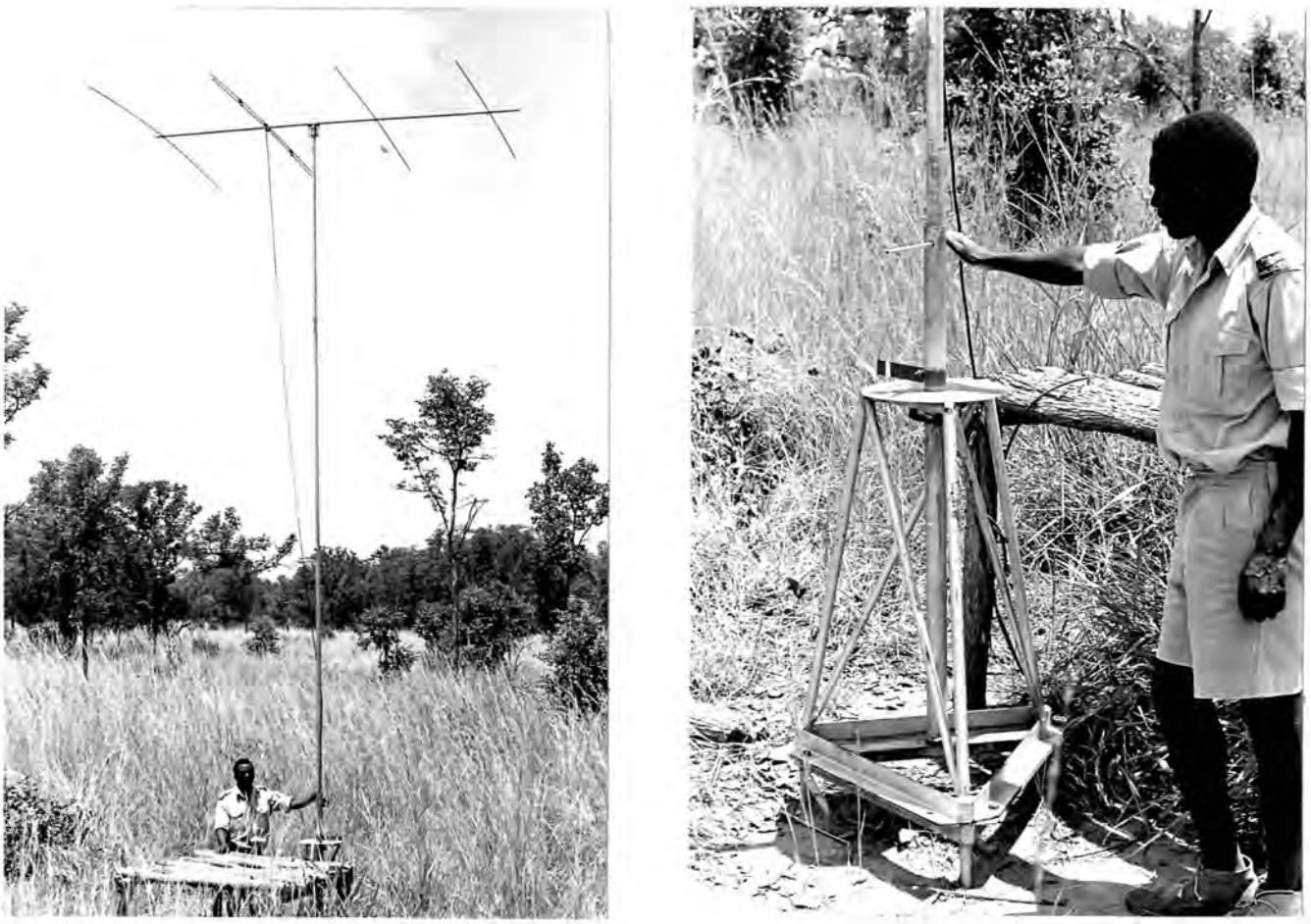
(a) Adult female warthog tagged with metal ear tag, plastic ear tag and ear notches. Collar is temporary p.v.c. type.

(b) Adult male warthog tagged with pluviac collar.

Fig.8. Warthog tags

(c) Adult female tagged with radio collar. Ear has also been notched. Blue tape covers collar joint and transmitter is situated under the neck.

Fig. 8. (cont.) Warthog tags.



(a) (b)

Fig. 9. Portable tracking station.

(a) Telescoping mast with yagi antenna.

(b) Detachable base with compass plate and pointer.

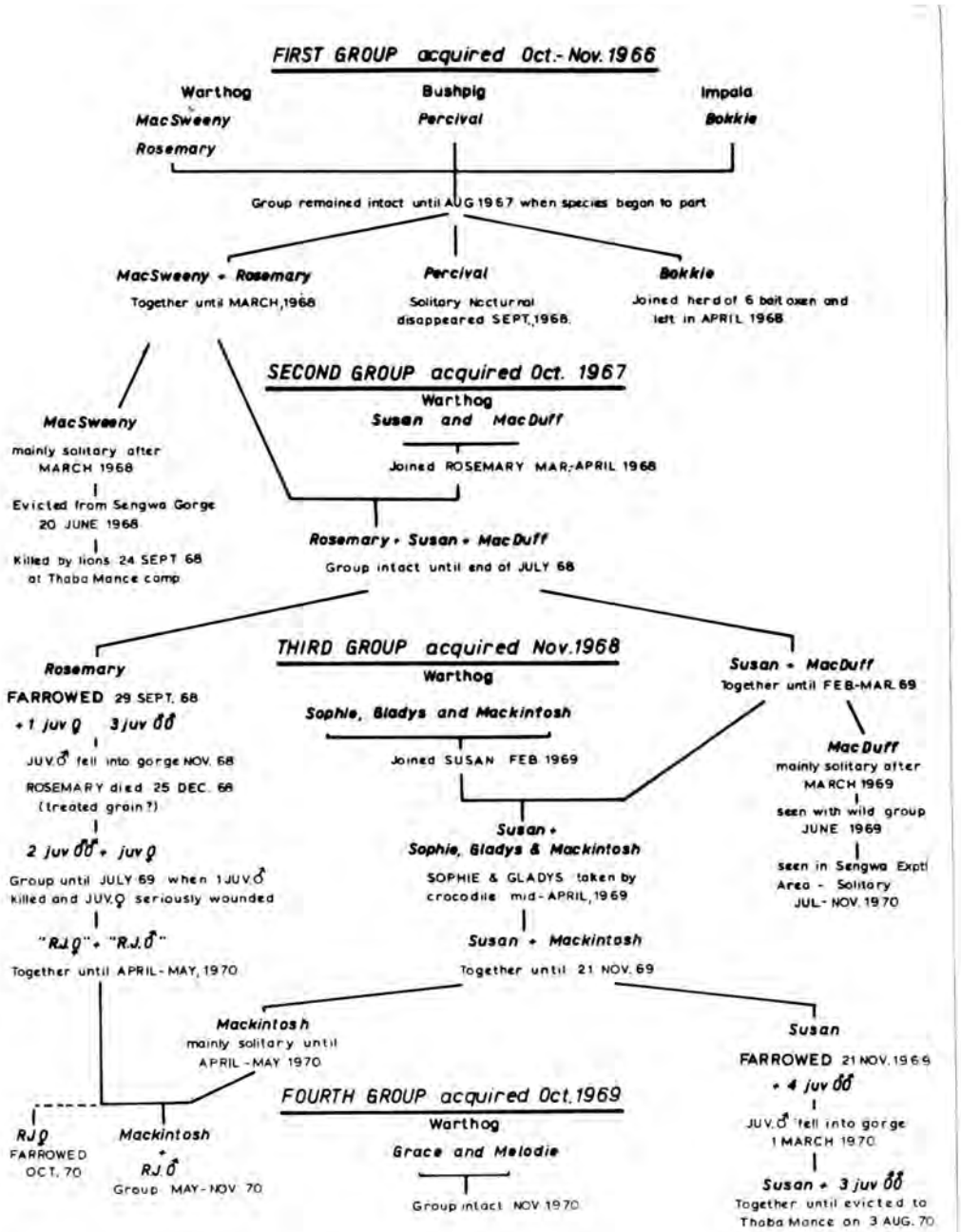


Fig. 10. Family groupings of tame free-ranging animals reared at Sengwa and used in this study.

Fig. 11. Two juvenile warthog in their sleeping box in the author's house. The animal on the left is nosing a hot water bottle wrapped in hessian.

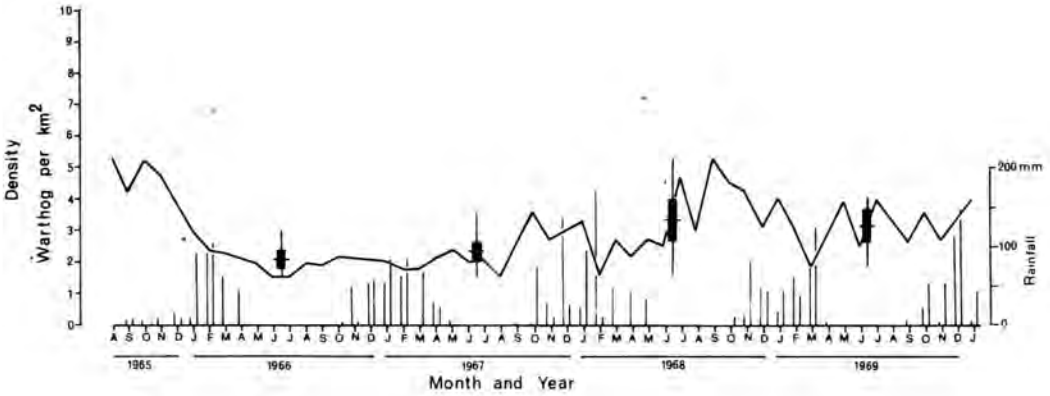


Fig. 12. Monthly densities of warthog in the transect area from August, 1965 to January, 1970. Mean density, ranges from 2 x standard error of the mean are shown for each year from 1966 through to 1969. Rainfall histogram shows precipitation measured at Sengwa Gorge for the first and second half of each month. Note the very low rainfall between September, 1965 and mid-January, 1966.

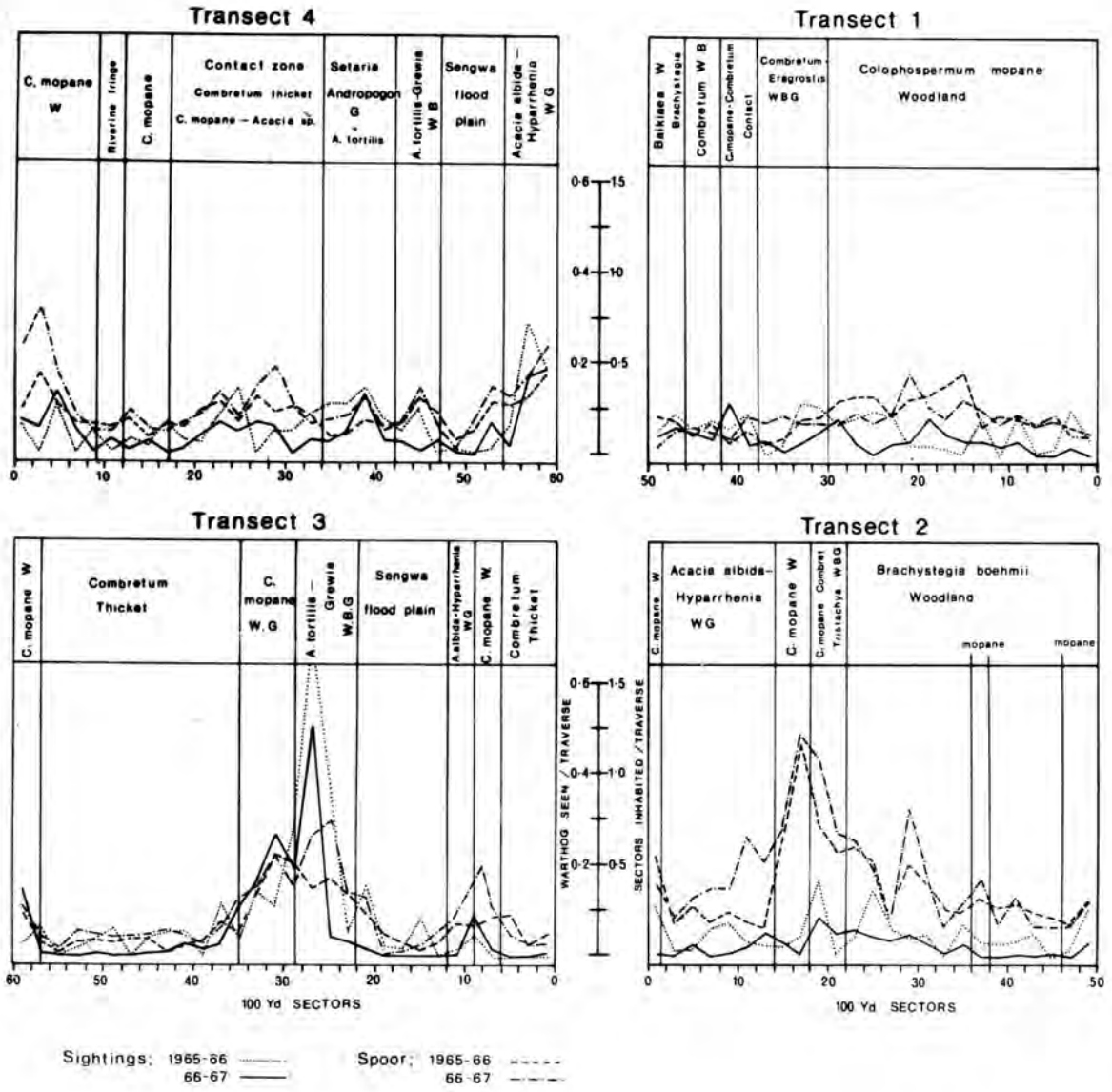


Fig. 13. Distribution of warthog seen and sectors inhabited (spoor crossings) on transects 1 to 4 during 1965-66 and 1966-67. (Continued opposite)

Fig. 13. (cont.) Two scales are given on the vertical axis both of which apply to the transects on either side of the scales. Values for adjacent pairs of 100 yard sectors have been combined to reduce excessive irregularity in the graphs. Graphs plotted for warthog seen show the number of sightings on each adjacent pair of sectors divided by the number of traverses made along the entire length of the transect. Sectors inhabited (spoor crossings) provide a measure of warthog activity at points along the transect. The derivation of this measure is explained on pages 16, 17 and 18 of Vol. I. Habitat types through which transects pass are shown above each graph. Abbreviations are: W-Woodland; B - Bushland; G - Grassland; W.G. - Wooded Grassland; W.B.G. - Wooded and Bushed Grassland; B.G. Bushed Grassland.

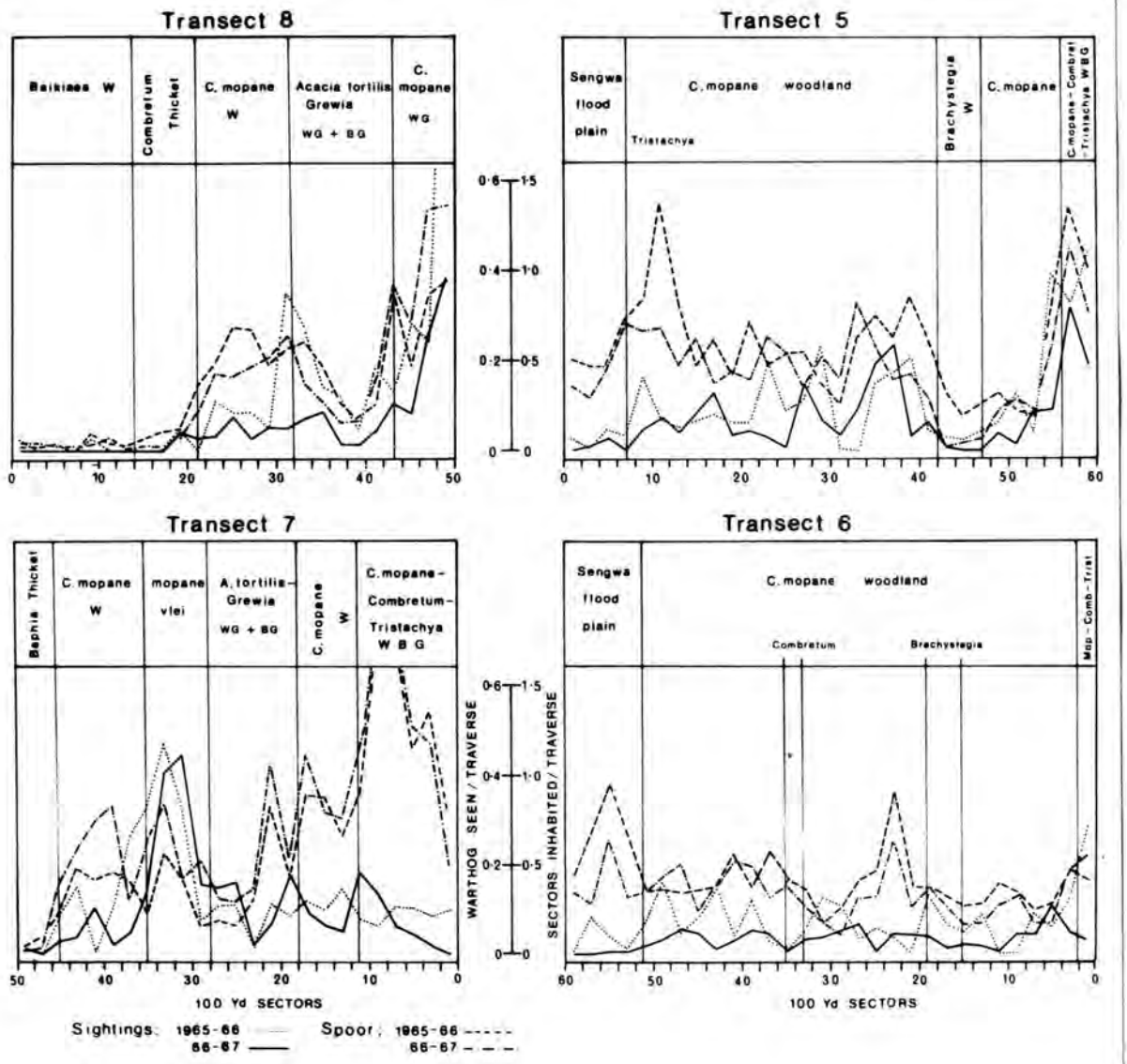


Fig. 14. Distribution of warthog seen and sectors inhabited (spoor crossings) on transects 5 - 8 during 1965-66 and 1966-67 Refer also to legend for Fig. 13.

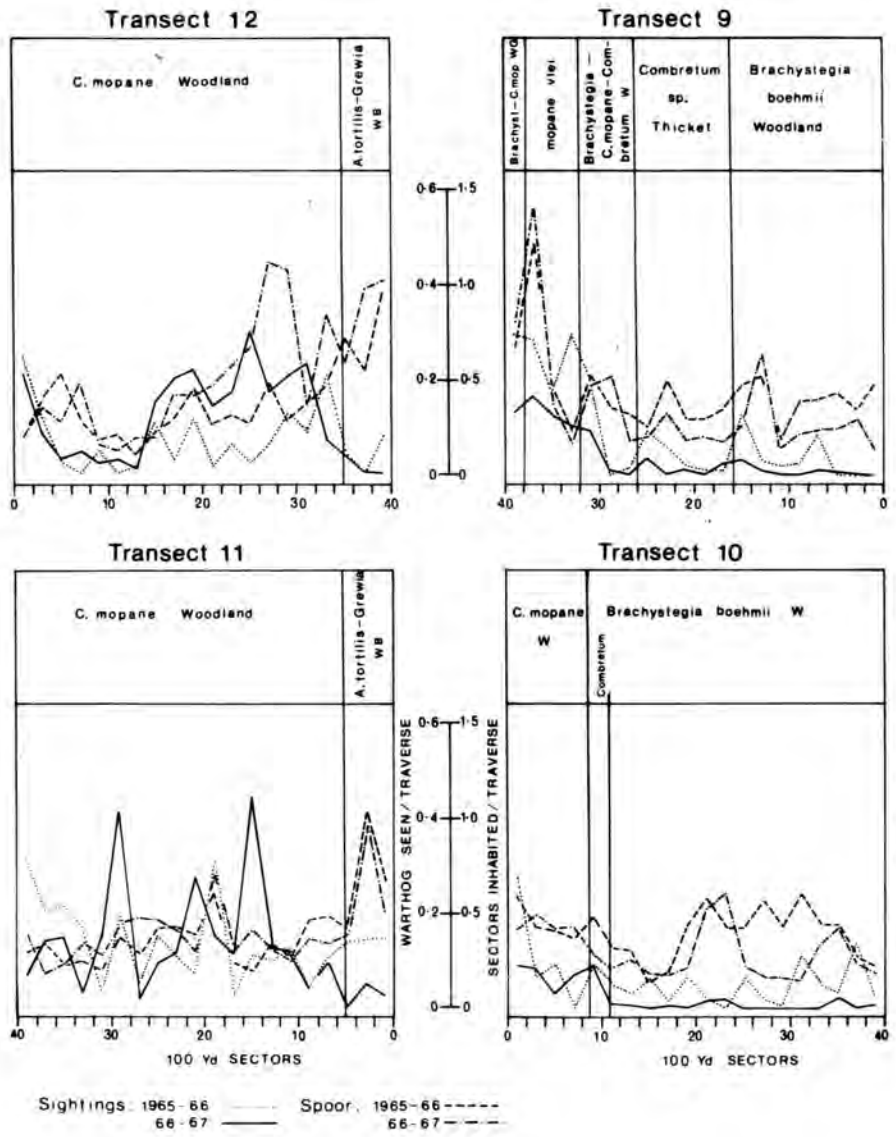


Fig. 15. Distribution of warthog seen and sectors inhabited (spoor crossings) on transects 9 - 12 during 1965-66 and 1966-67. Refer also to legend for Fig. 13.

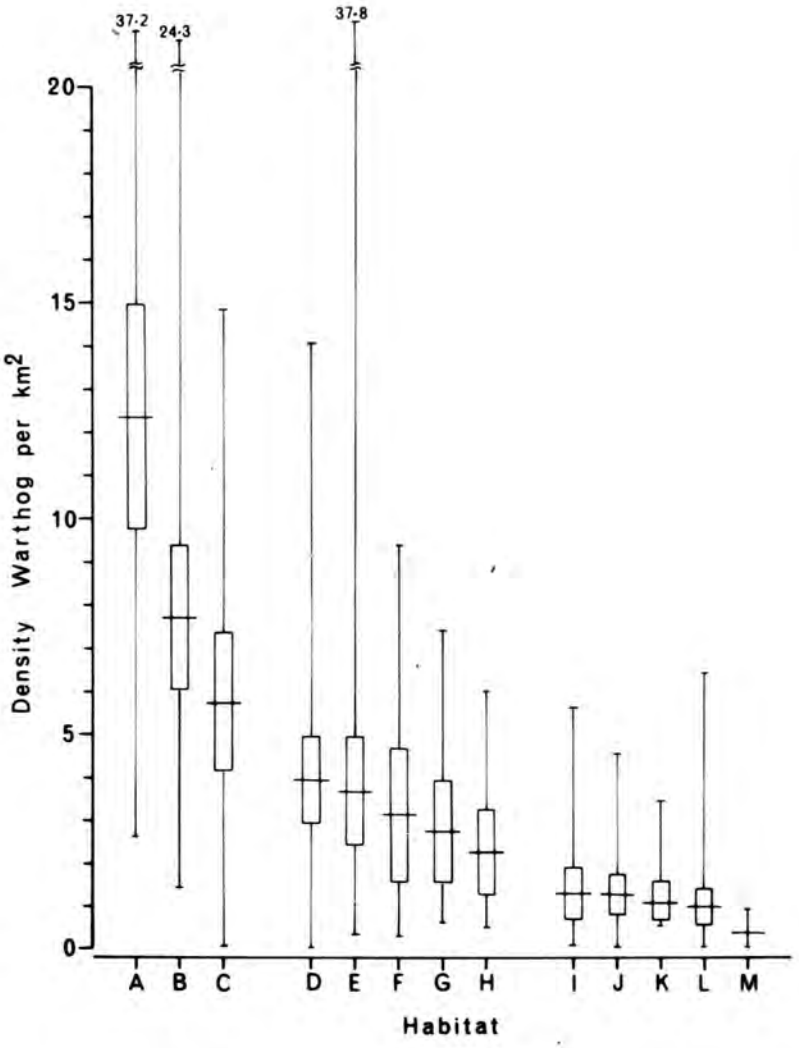


Fig. 16. Warthog densities in various habitats. Mean seasonal density, range and 2 x standard error of the mean are shown for each habitat type occurring on the transects. Habitat types are listed opposite.

Fig. 16. (cont.) Habitat types.

A - Drainage line grassland in C.mopane Woodland (mopane vlei)

B - Acacia tortilis - Grewia communities.

C - C.mopane - Combretum - Tristachya Wooded and Bushed Grassland.

D - "Various contacts"

E - C.mopane Woodland

F - Setaria - Andropogon Grassland with A.tortilis

G - Acacia albida - Hyparrhenia Wooded Grassland

H - Combretum Woodland and Wooded and Bushed Grassland

I - Brachystegia Woodland.

J - Brachystegia - C.mopane contacts.

K - Sengwa flood plain Grassland.

L - Combretum Thickets.

M - Baikiaea Woodland (and Baphia thickets).

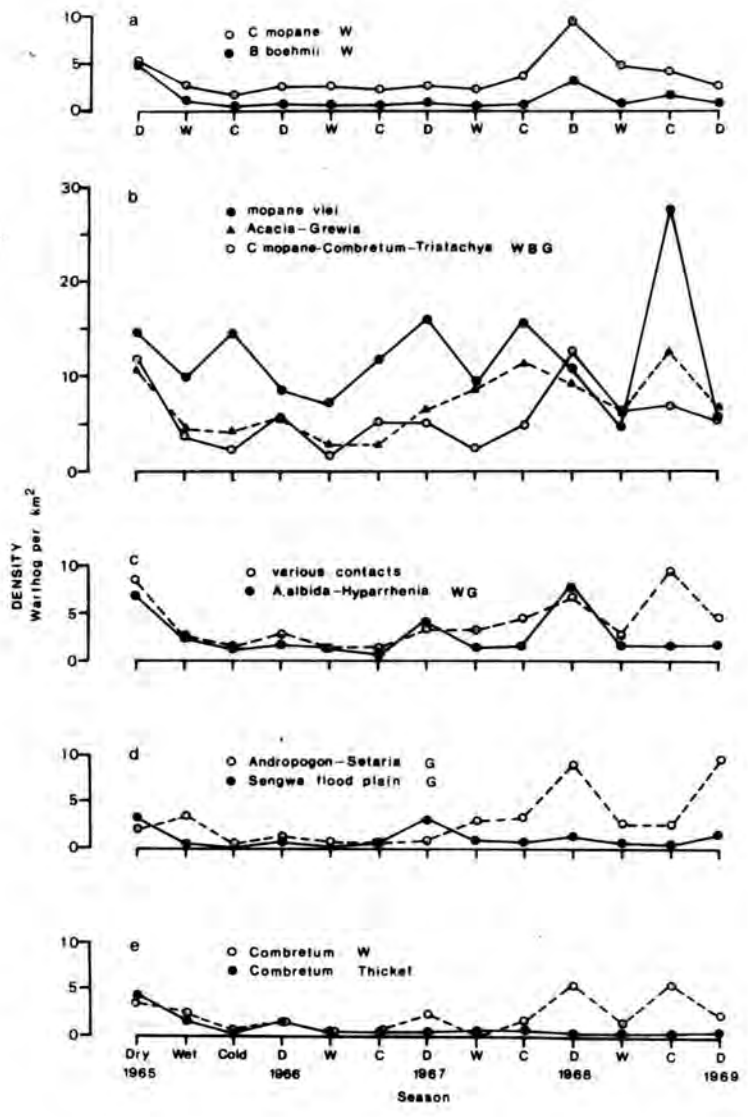


Fig. 17. Seasonal densities of warthog in various habitats. Physiognomic abbreviations: W - Woodland; W.B.G.- Wooded and Bushed Grassland; W.G. - Wooded Grassland; G - Grassland.

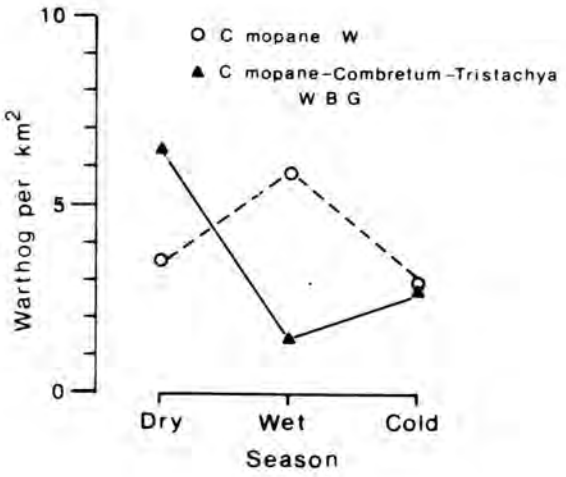


Fig. 18. Average dry, wet and cold season densities of warthog in C.mopane Woodland and C.mopane - Combretum - Tristachya Wooded and Bushed Grassland on Transects 7 and 8.

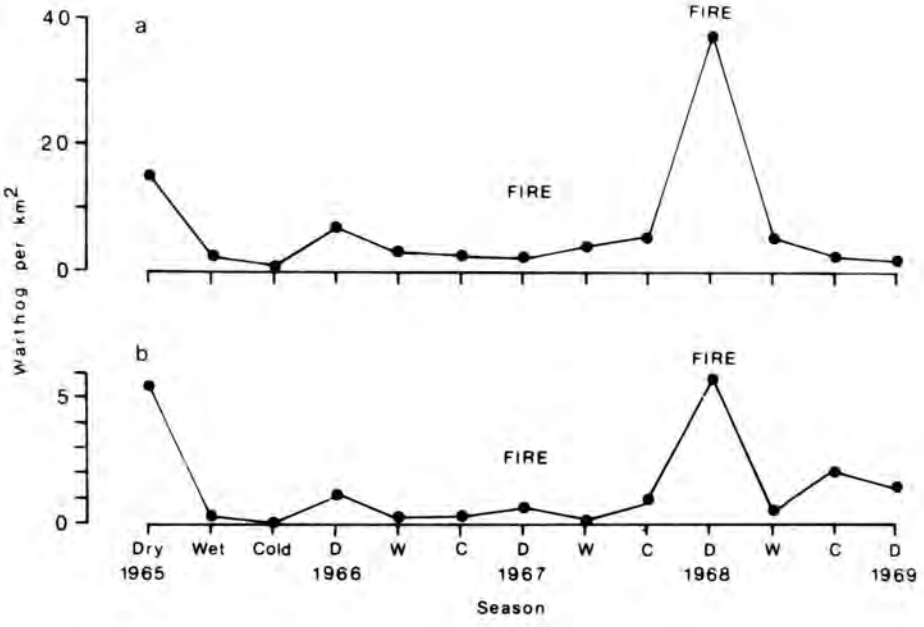


Fig. 19. Effects of fire on local densities of warthog. Seasonal densities of warthog in

(a) C. mopane Woodland area of Transect 9, and

(b) Brachystegia Woodland area of Transect 2.

Fires in 1967 were widespread but in 1968 they were very local.

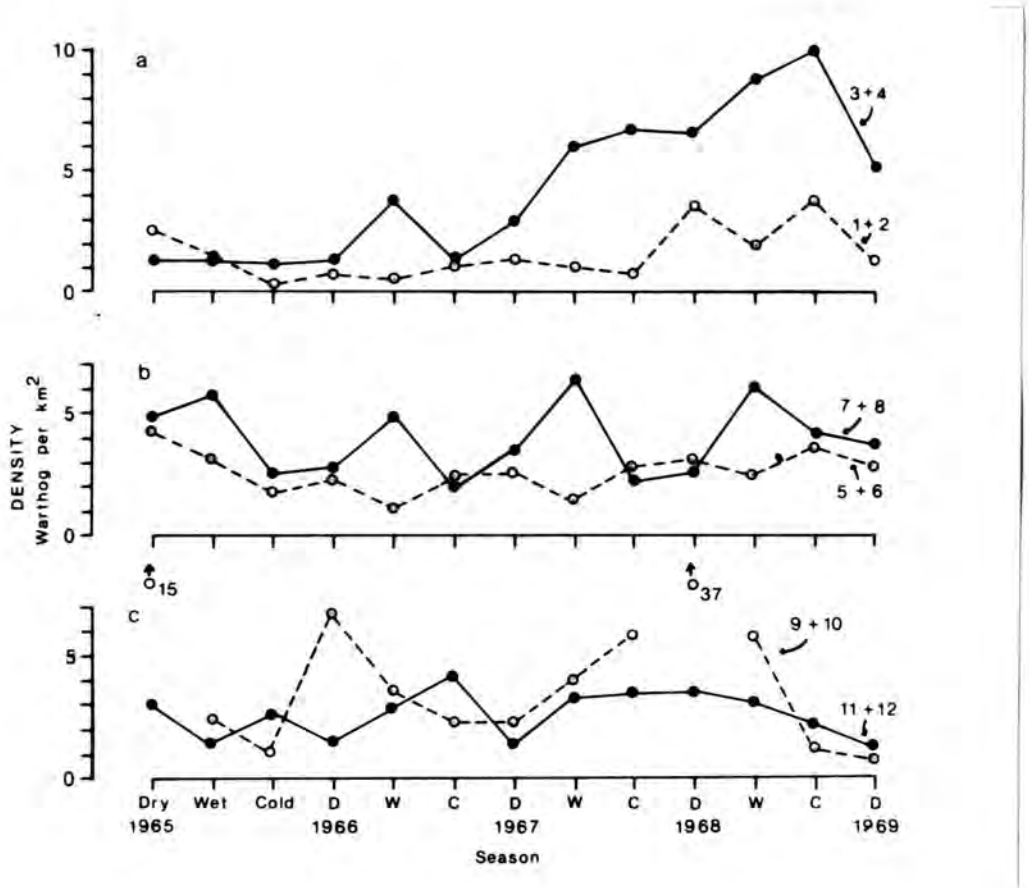


Fig. 20. Seasonal densities of warthog in 6 areas of C.mopane Woodland viz. :

(a) Transects 1 + 2 and 3 + 4;

(b) Transects 5 + 6 and 7 + 8;

(c) Transects 9 + 10 and 11 + 12.

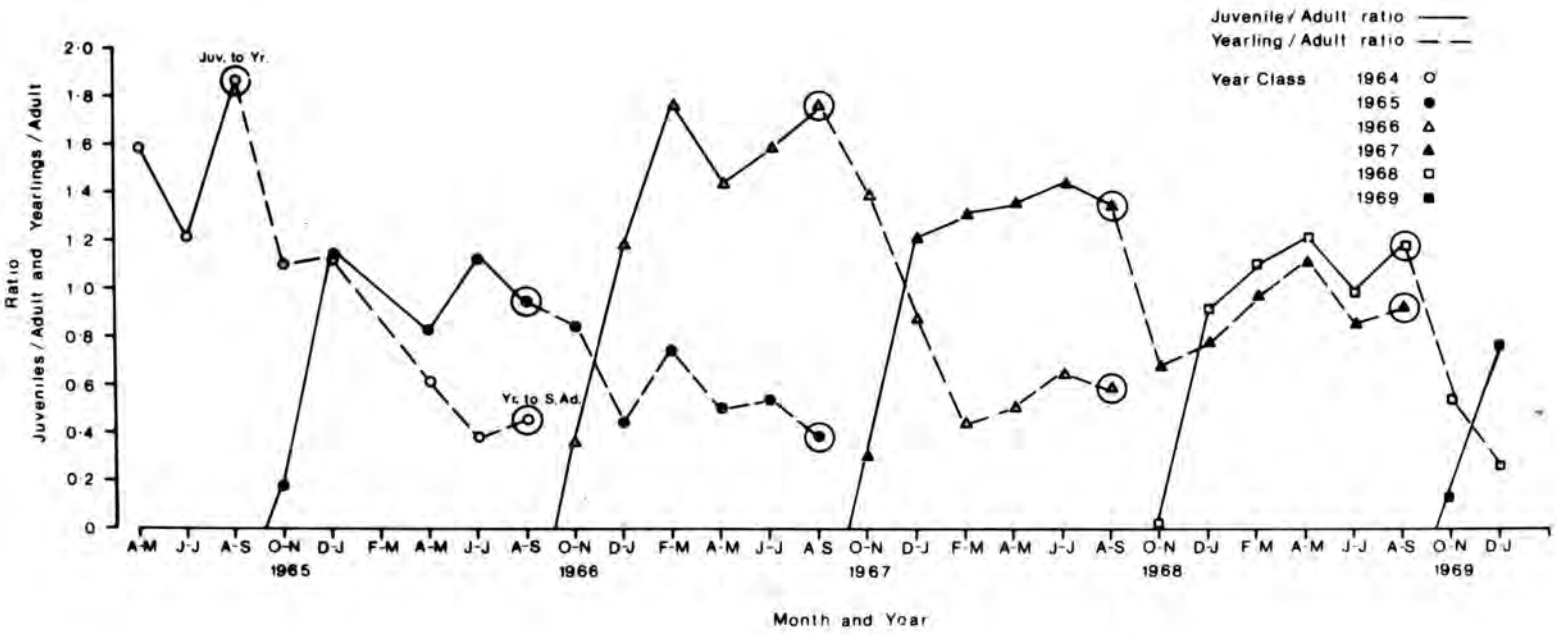


Fig. 21. Ratios of juveniles/adult and yearlings/adult warthog for each two month period from April, 1965 to January, 1970. (Data as in Table 7). Graphs have been ringed where, in accordance with ageing criteria established in Appendix 3, juveniles become yearlings (Juv. - Yr.) and where yearlings become sub-adults (Yr. - S.Ad.)

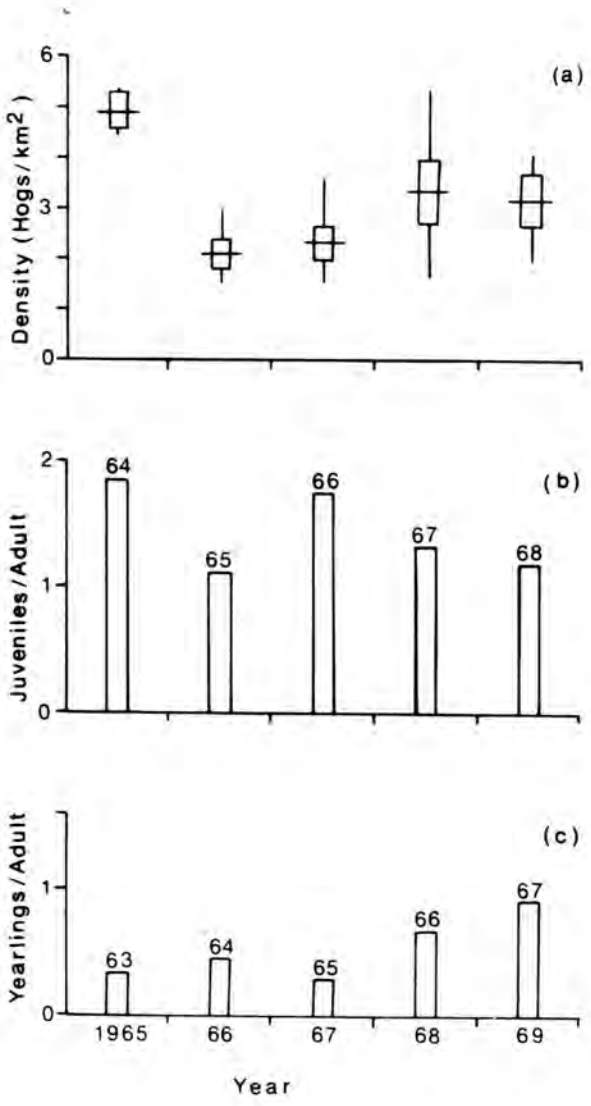


Fig. 22. Ratios of juveniles/adult and yearlings/adult in August - September each year. Figure above each column in (b) and (c) indicates the year in which the animals were born, i.e. their year class. Mean monthly density, range and 2 x standard error are shown for each year in (a).

Fig. 23. Grace and Melodie eating winged termites attracted to a lamp in the evening.

(a) Susan and juveniles grazing during wet season in C.mopane Woodland.

(b) Young warthog grazing Sporobolus marginatus.

Fig. 24. Grazing.

(a) Susan and juveniles shredding in a stand of Urochloa trichopus, February, 1970.

(b) Sophie shredding Echinochloa colonum on fringe of a pan.

Fig. 25. Shredding.

(a) Susan and Mackintosh rooting Digitaria during the dry season.

(b) Mackintosh about to ingest a rhizome of T.superba.

Fig. 26. Rooting.

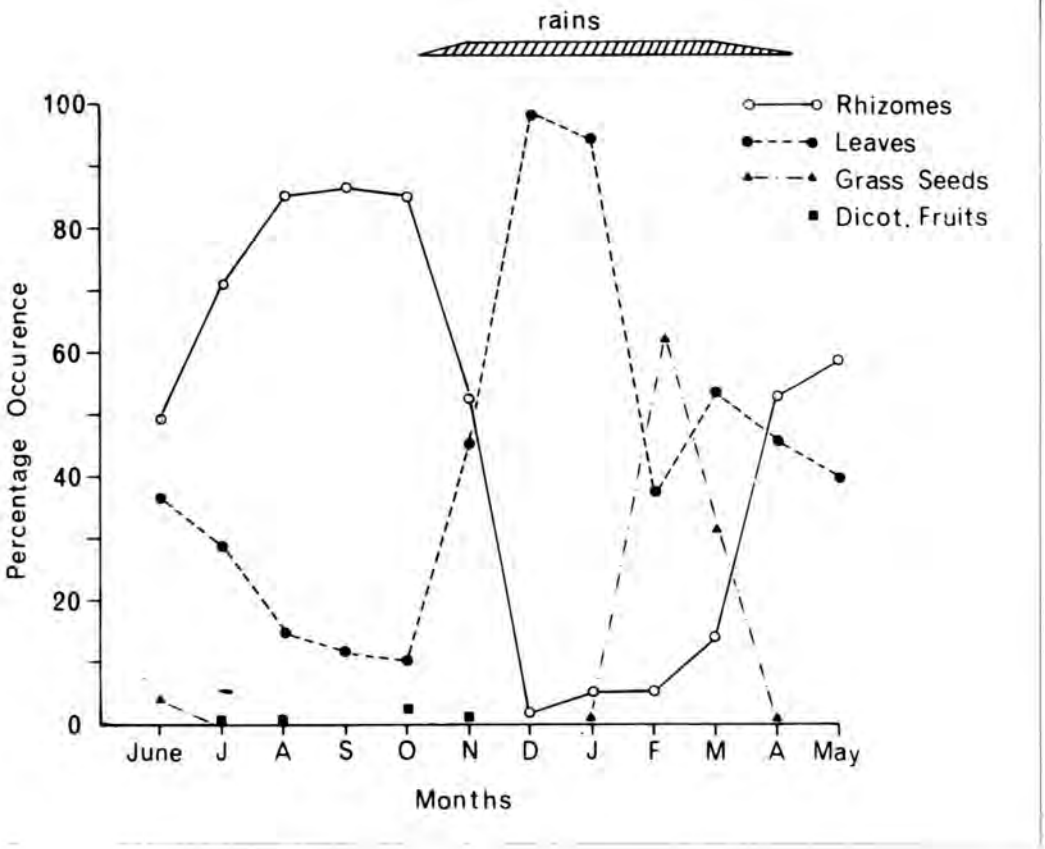


Fig. 27. Proportions of graminaceous leaf, seed and rhizome remains in warthog faecal samples collected in the Sengwa Research Area between June, 1966 and May, 1967. Remains of dicotyledonous fruits were found infrequently and points are not joined.

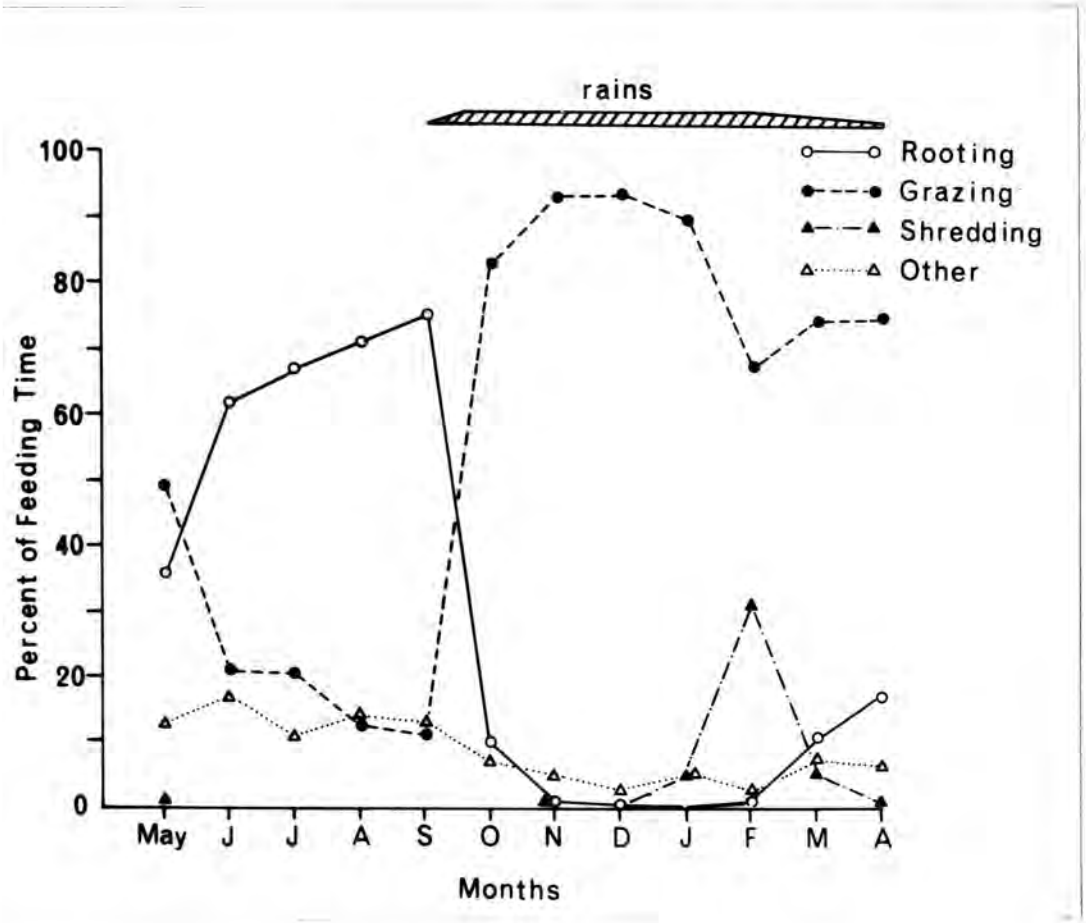


Fig. 28. Percentage of time spent grazing, rooting and shredding by tame warthog between May, 1969 and April, 1970. "Other" items included the mash tame animals were given as well as time spent scavenging in rubbish pits or feeding on morsels of food they found in the African Staff villages.

Fig. 29. (a) Temporary pan in C.mopane Woodland containing Oryza barthii which has been heavily rooted by warthog (May, 1966).

Fig. 29. (b) Rhizomes of Tristachya superba rooted out by a warthog.

(a)

(b)

Fig. 30. Profile views of (a) warthog and (b) bushpig.

(See text, page 76)

(a)

(b)

Fig. 31. Contrast between flexibility of (a) warthog and (b) bushpig lower lip.

Fig. 32. (a) C.mopane type 4b ("Cathedral mopane") showing well developed sward of Chloris - Sporobolus on seasonally waterlogged soil under tall C.mopane Woodland.

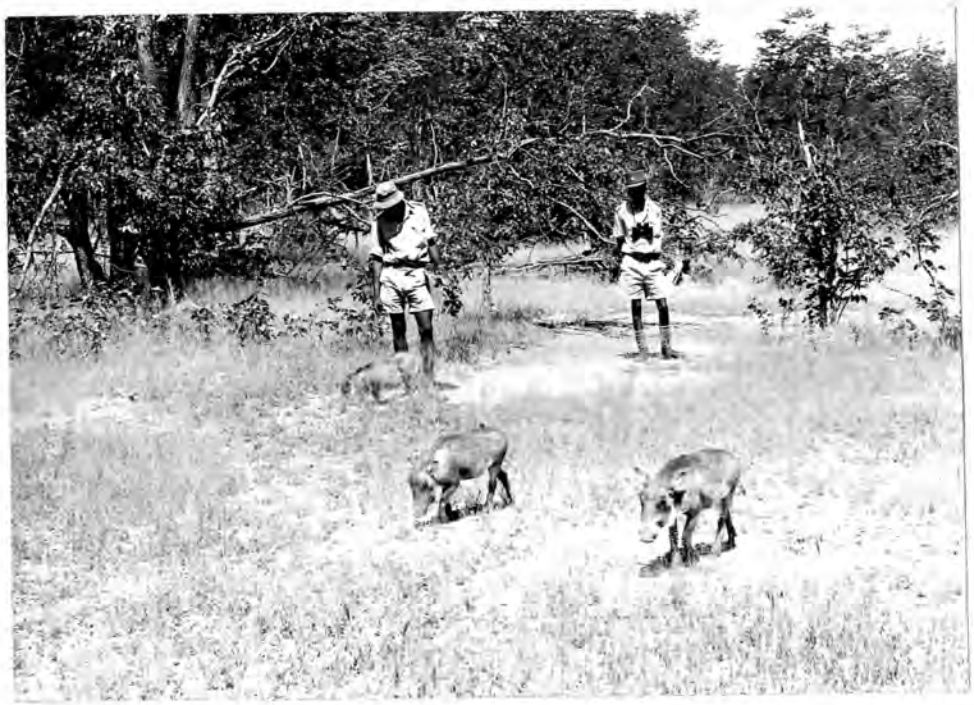


Fig. 32. (b) C.mopane type 4c ("Eroded mopane") showing bare patches interspersed with grass cover of Sporobolus and shorter sometimes stunted C.mopane. (Sophie, Gladys and Mackintosh in Sengwa Experimental Area.)

Fig. 33. Traverses of 1 square mile flyround grid showing (on transparency) distribution of Digitaria (D) and Tristachya (T), occurrence of warthog rooting (R) and dung heaps (F). Histograms for grasses and rooting sign represent the number of 1 yard x 1 yard plots on each 100 yard sector in which these items occurred. Histograms for dung heaps represent the number of dung heaps within each belt approximately 1 yard wide by 100 yards long multiplied by 10. Belt traverses were done on every second 100 yard sector of the grid and 5 to 10 paces off the path of the traverse.

Fig. 33. (continued). Vegetation types

4. C.mopane Woodland

4c. C.mopane type "Eroded mopane".

5. Acacia tortilis-Grewia Woodland + Bushland

8. Commiphora-Combretum Wooded Bushland

11. B.boehmii-Combretum-Hyparrhenia Wooded Grassland + Bushed Grassland

13. C.mopane-Combretum-Tristachya Wooded and Bushed Grassland.

24. Sporobolus-Chloris short saline Grassland.

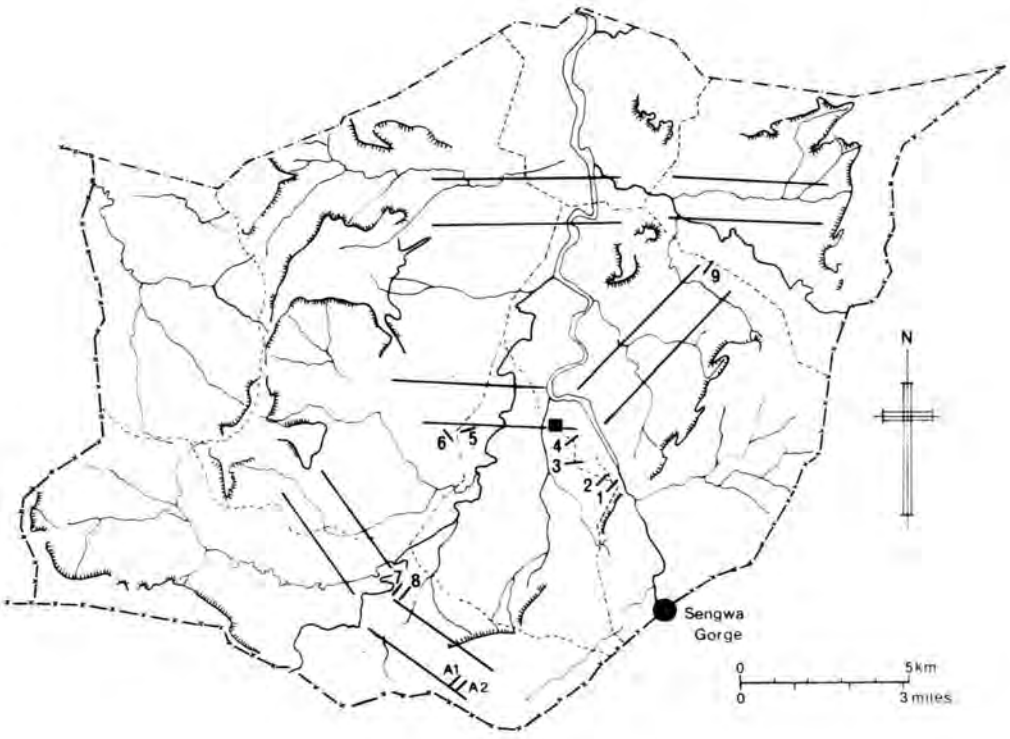


Fig. 34. Map of Research Area showing locations of traverses (1 to 9) in dry season feeding areas and two traverses in Brachystegia Woodland (A1 and A2). Position of plots from which rhizomes were extracted and weighed is shown by solid square. (See Table 20 for details of traverses and page 87 for data on weights of rhizomes.)

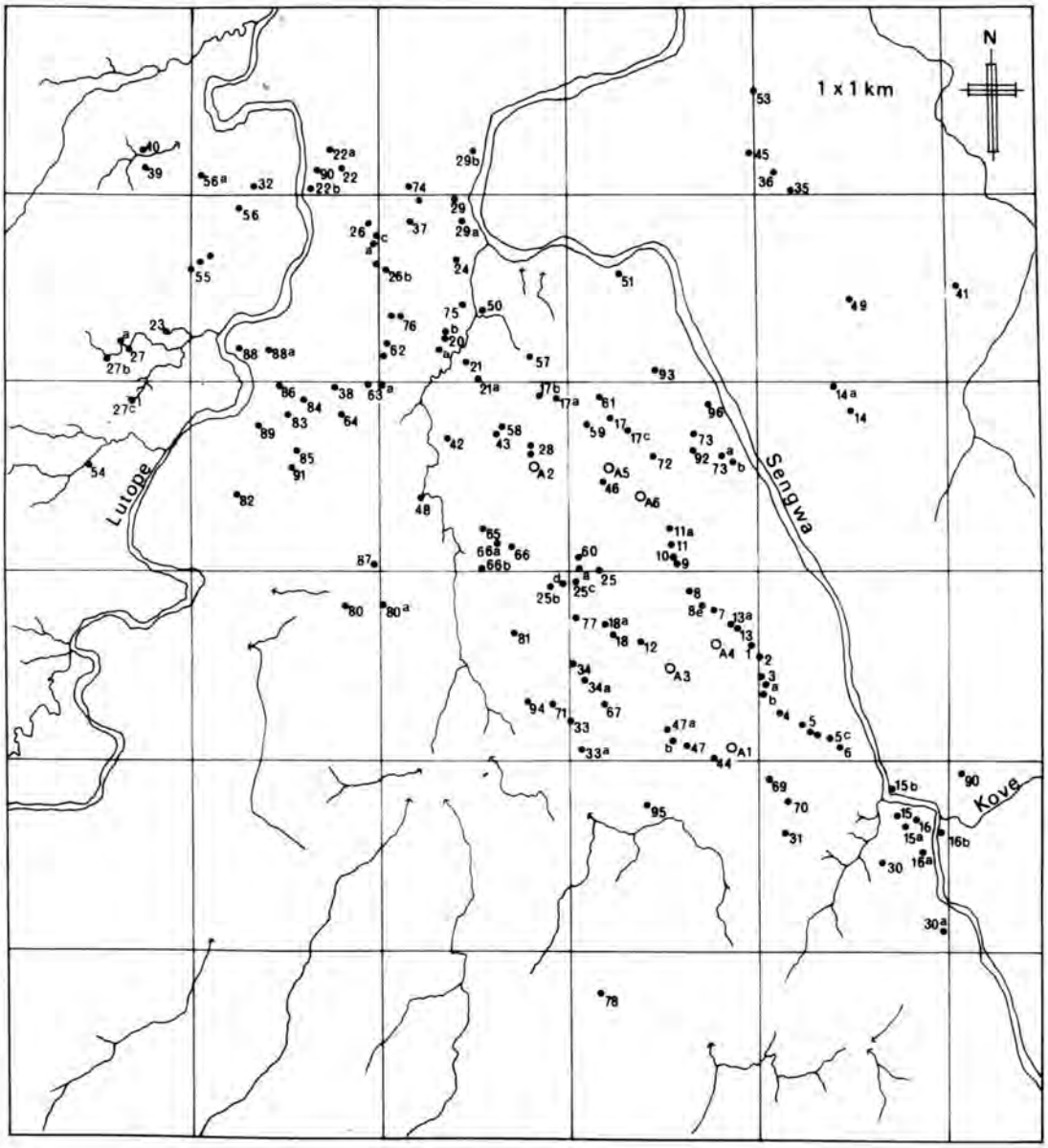


Fig. 35. Map of Sengwa Experimental Area showing registered warthog holes. Artificial holes (A1 to A6) are shown by open circles.

Fig. 36. Cave used by warthog (Hole 30a). The upper cave on the left forms the "hole" used by warthog.

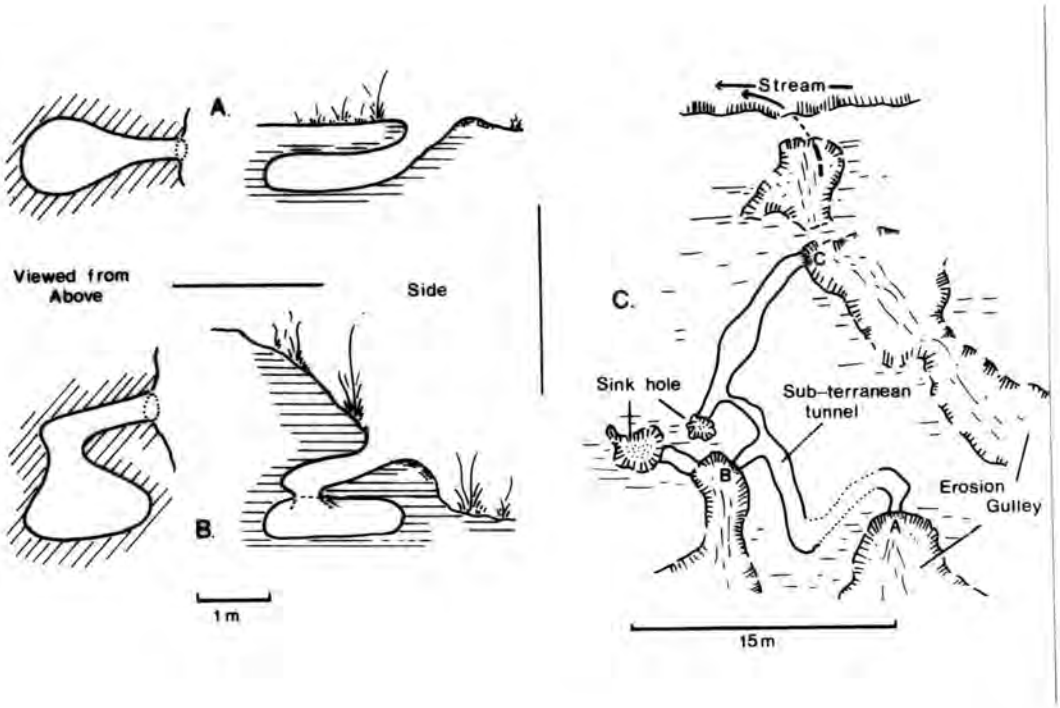


Fig. 37. Types of hole used by warthog.

(a) Simple antbear type on level ground.

(b) Antbear type hole in embankment on the edge of Sengwa flood plain. (Hole 5.)

(c) Erosion gulley type hole. (Hole 20a.) A, B and C are entrances used by warthog.

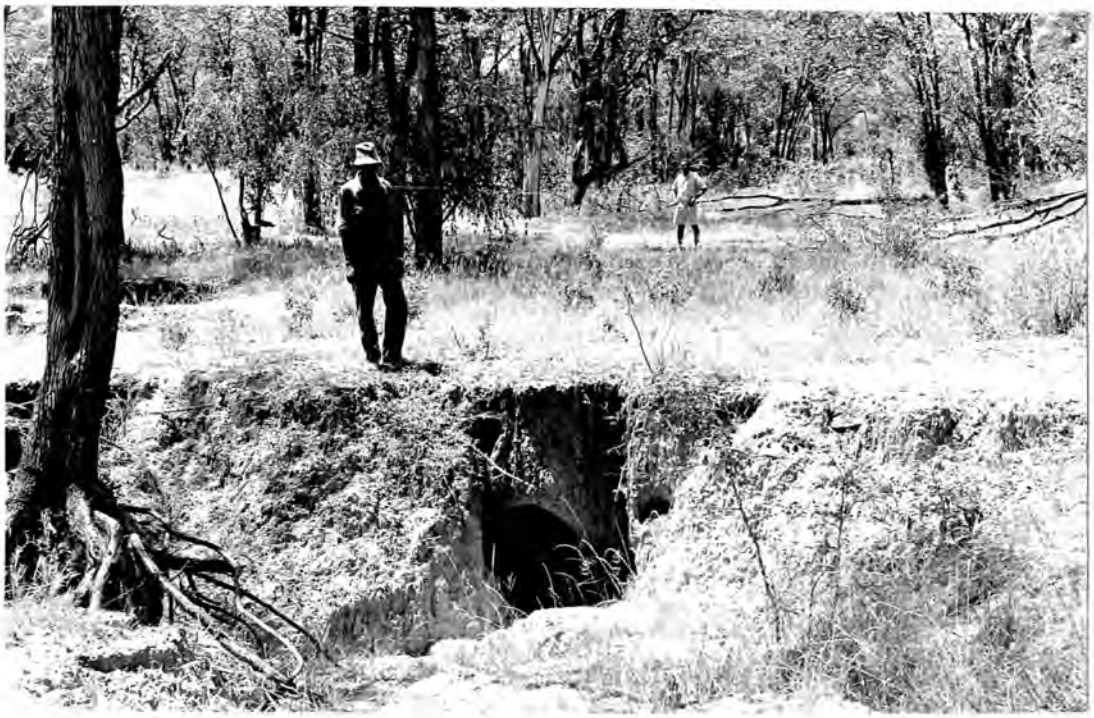


Fig. 38. Sink hole leading into subterranean gulley. Note second sink hole on the left. The gulley opens into a third sink hole just behind Scout in the background.

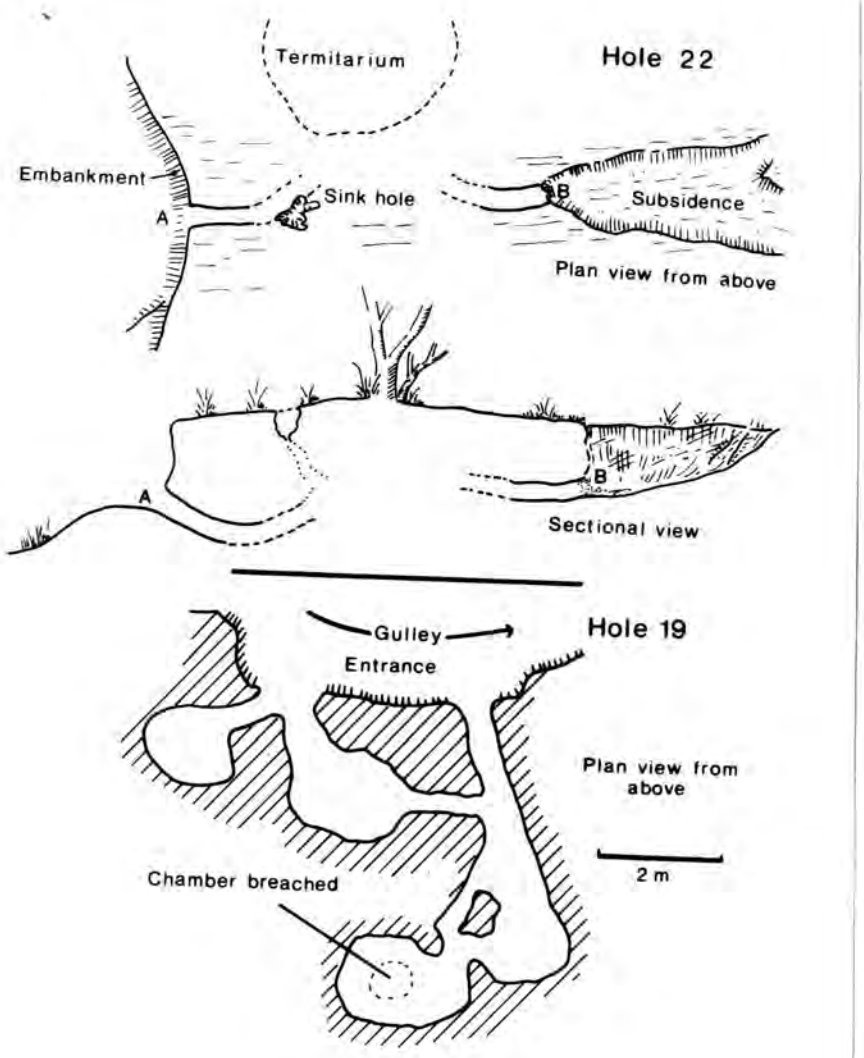


Fig. 39. Intermediate types of warthog hole (see text page 93). Diagrams of hole 22 show plan view from above and sectional view from A through to B.

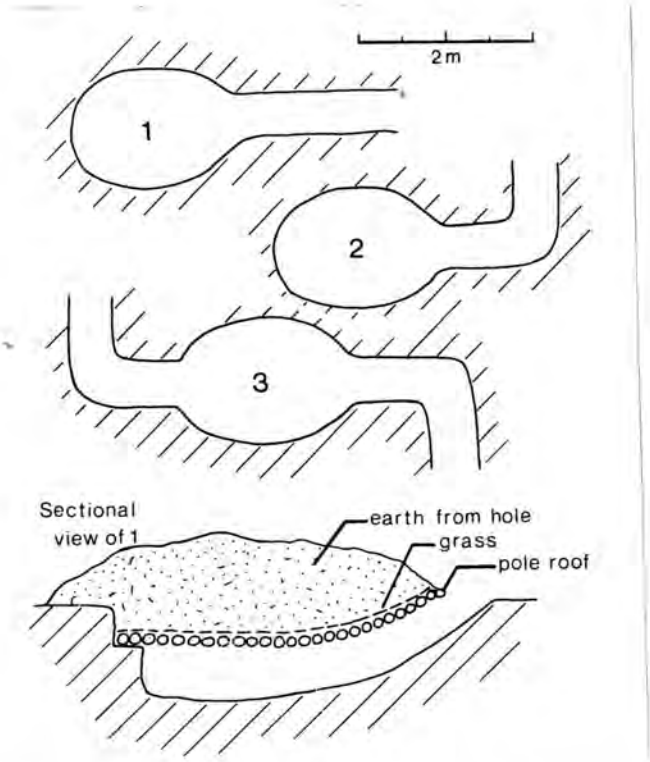


Fig. 40. (a) Three designs of artificial hole constructed in Sengwa Experimental Area. 1. Single straight tunnel. 2. Single curved tunnel. 3. Two curved tunnels.

Fig. 40. (b) Photograph to illustrate construction of an artificial hole.

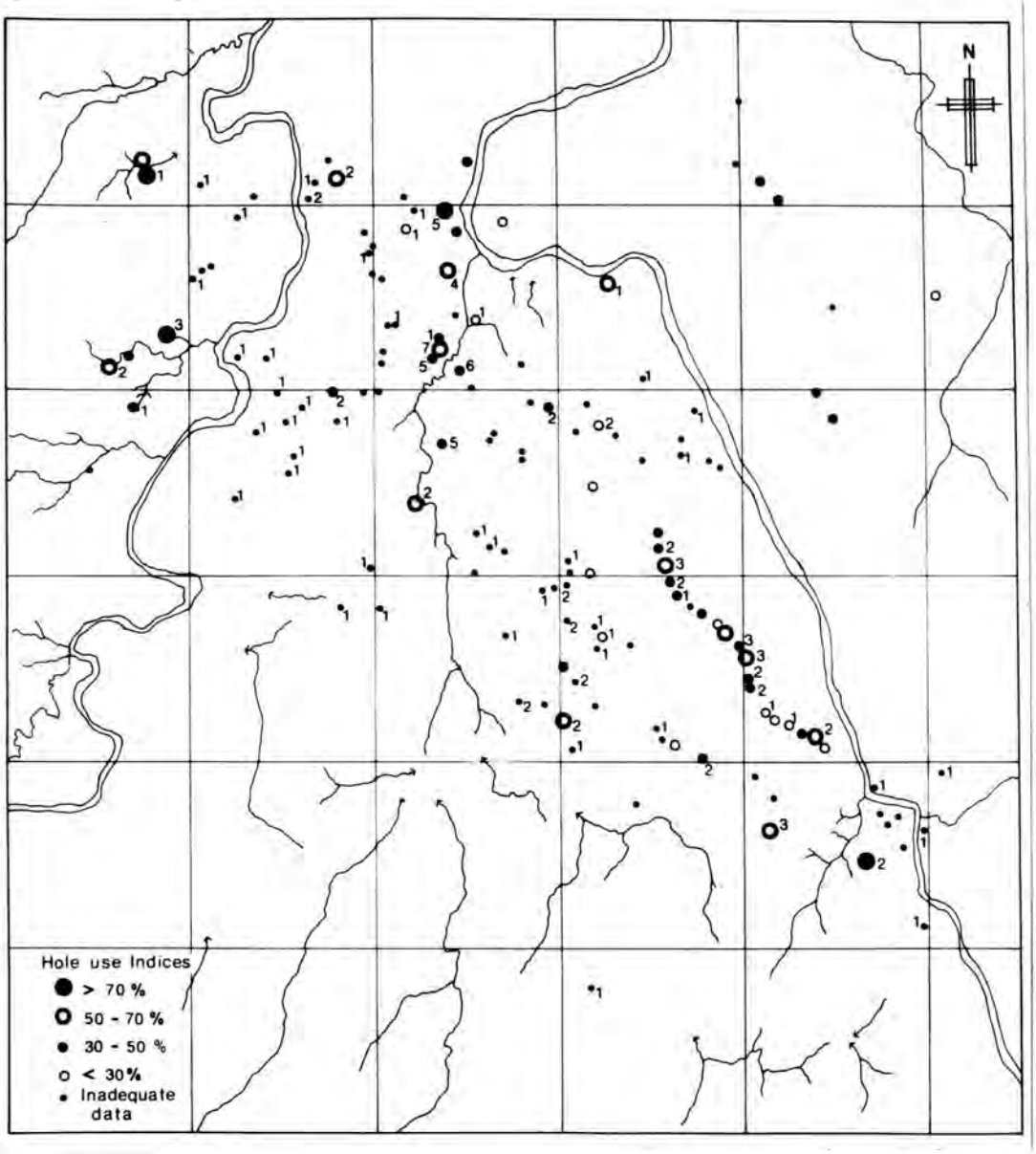


Fig. 41. Use indices of holes in the Sengwa Experimental Area. Numbers adjacent to holes represent the number of different tagged groups which have been recorded using the hole. (Data from Table 22).

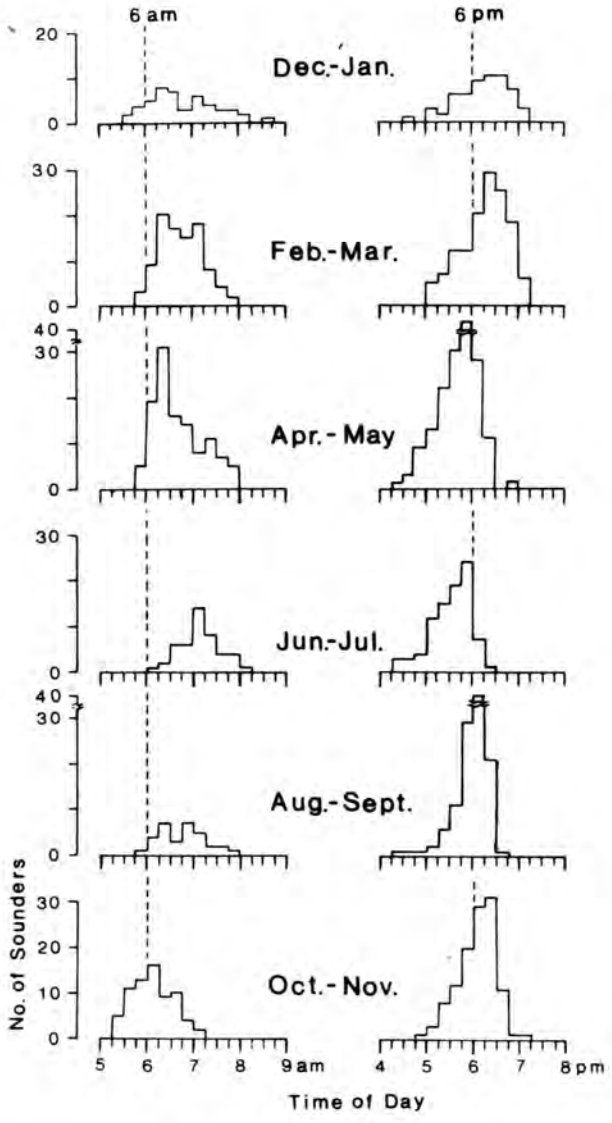


Fig. 42. Times at which warthog sounders have been recorded emerging from holes in the morning and entering them in the evening. Observations are grouped in 15 min. periods.

Fig. 43. Grass nests constructed by warthog on Redcliffe Island, Lake Kariba. (Photographs by G. Davison.)

Fig. 44. (a) Susan's juveniles inspecting a hollow at the top of a termite mound.

Fig. 44. (b) Juveniles emerging from a hole they have inspected.

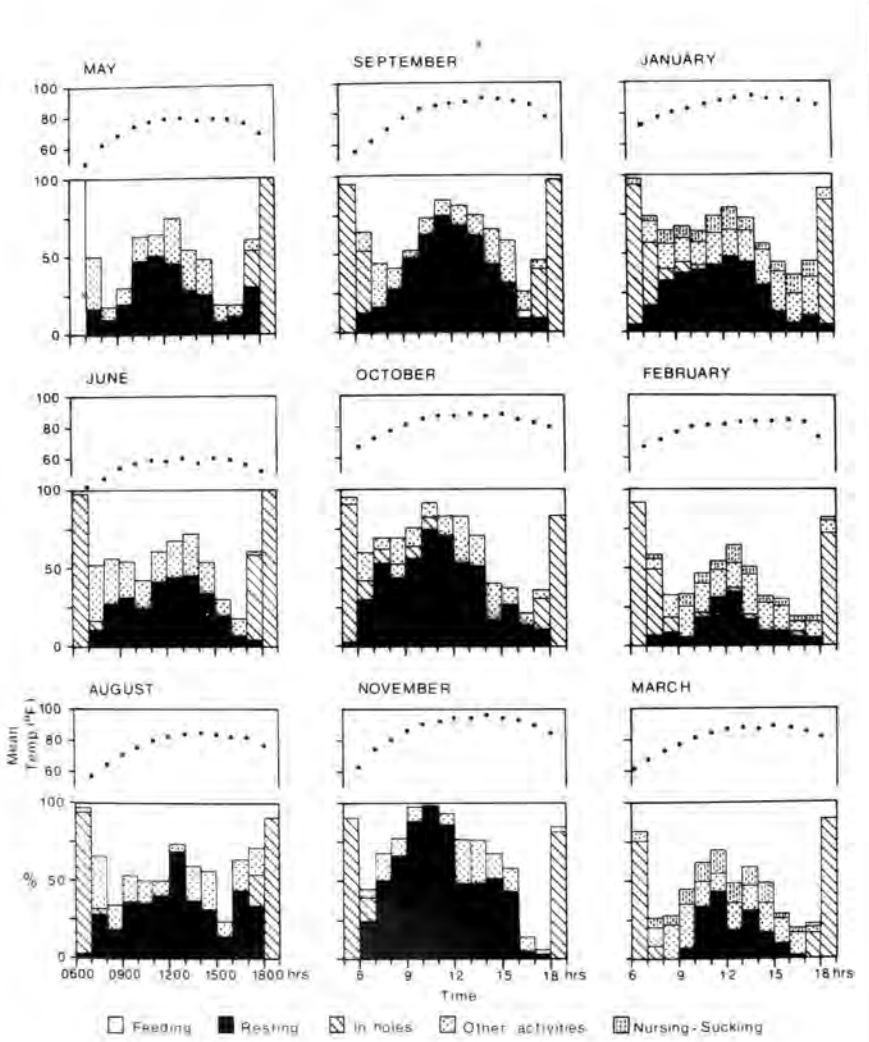


Fig. 45. Daily patterns of activity of tame free ranging warthog. Histograms show the mean time (expressed as a percentage) spent on various activities during each hour. Histograms are additive up the y axis, e.g. between 1500 and 1600 hours in November the animals spent, on average, 2% of their time resting, 2% on other activities and 96% of their time feeding. June, 1969 data have been omitted because temperatures were not recorded in that month. Data for May to November were derived from Susan and Mackintosh and for January to March from Susan and her juveniles (Table 2). In May between 0600 and 0700 hours the animals were in their pen and the blank space for that hour does not represent feeding activity.

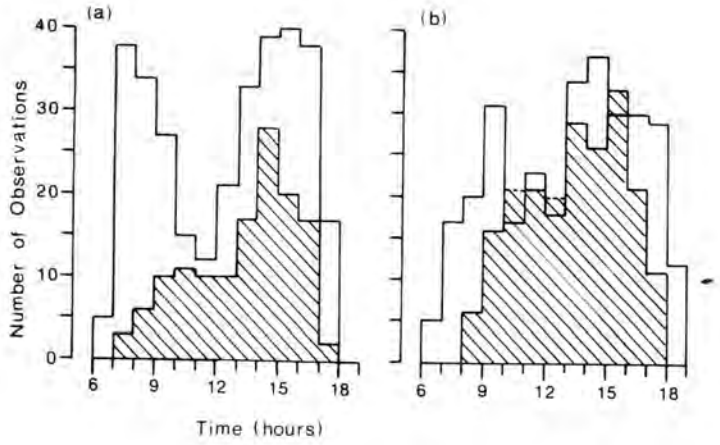


Fig. 46. Drinking and wallowing times.

(a) Dry season - Susan and Mackintosh

(b) Wet season - Susan and juveniles and Mackintosh.

Open columns = drinking

Shaded columns = wallowing

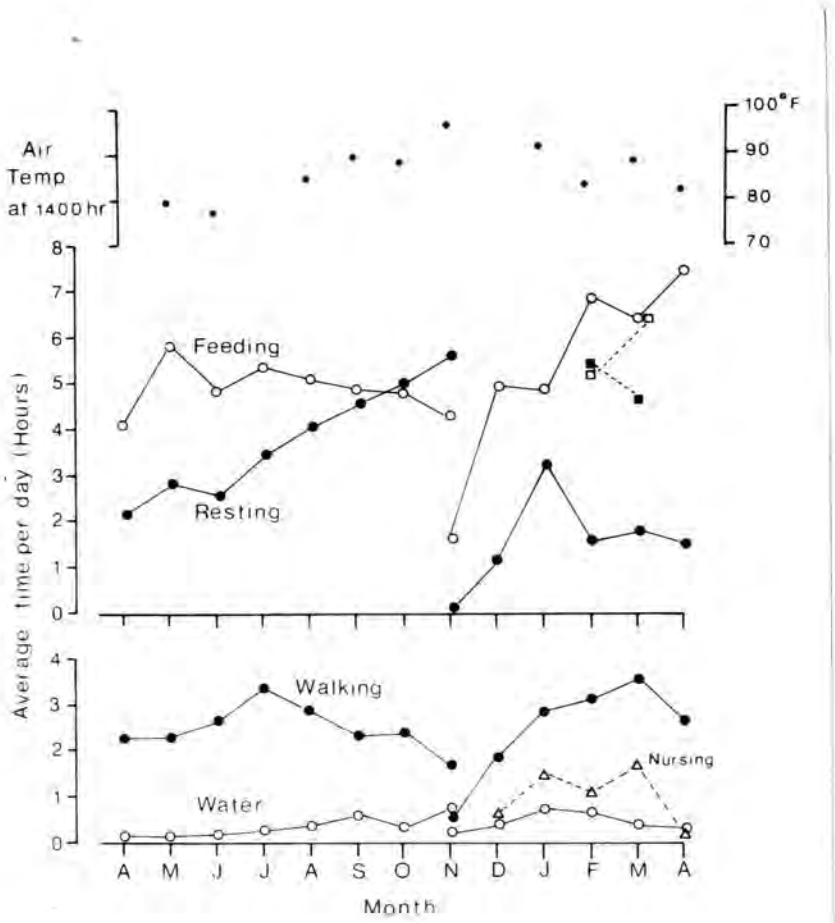


Fig. 47. Average times spent daily on feeding, resting, walking and nursing by tame warthog Time spent at water includes drinking and wallowing. Data from April to November 21, 1969 were for Susan and Mackintosh; from November 21, 1969 to April, 1970 were for Susan and Susan + juveniles. Records for Mackintosh during February and March are shown by squares and dashed lines.

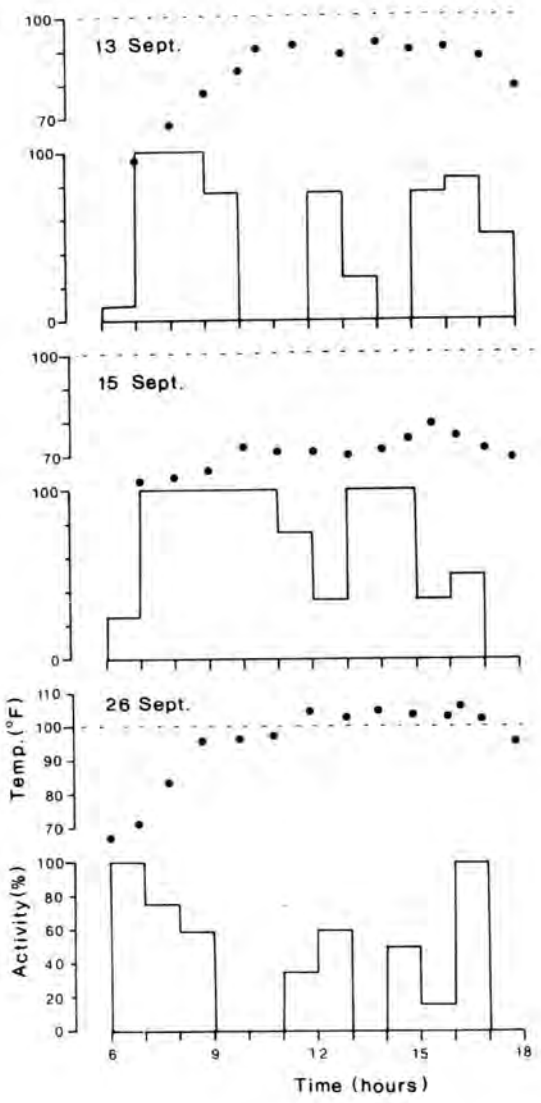


Fig. 48. Activity in relation to ambient temperature on three days during September, 1969. The sounder comprised Susan and Mackintosh. Days were selected by examining the activity patterns and only then were the temperature curves plotted.

Fig. 49. Tame warthog basking.

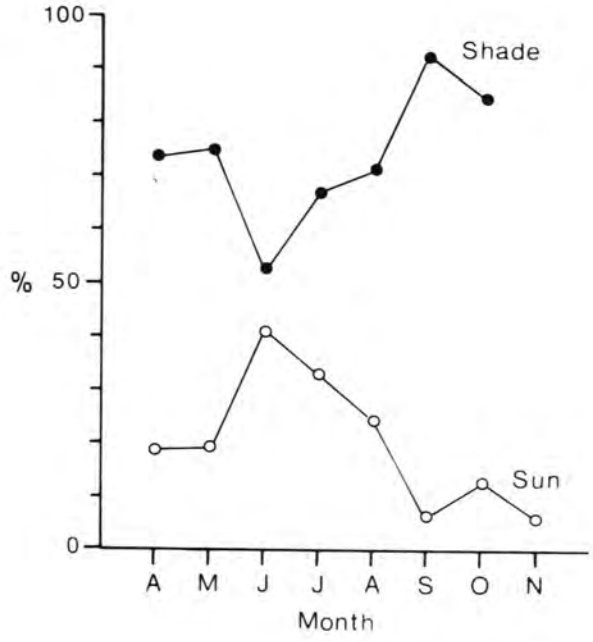


Fig. 50. Proportion of time spent resting in shade or sun by Susan and Mackintosh between April and November, 1969. (Data for April included Sophie and Gladys. - see Fig. 10.)

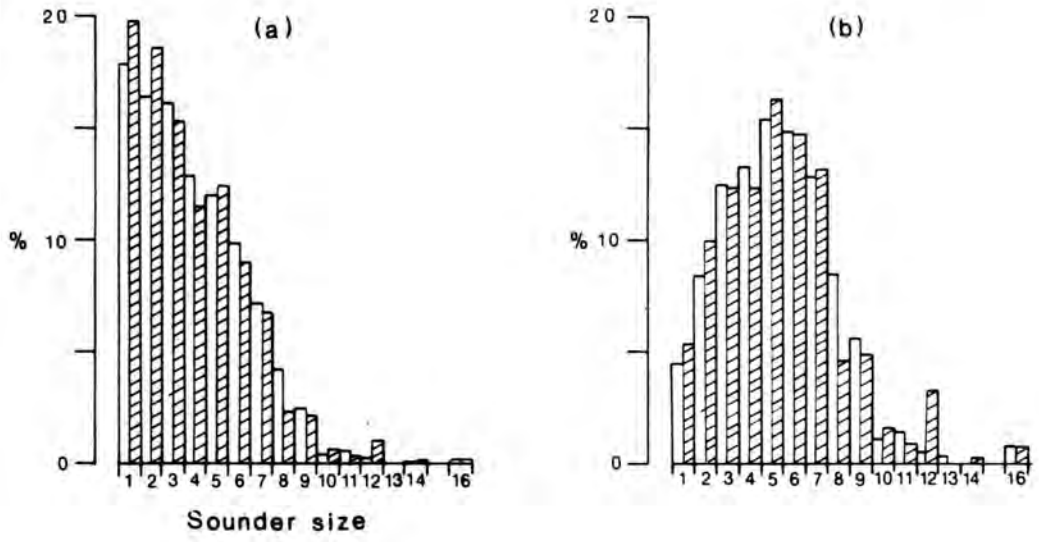


Fig. 51. (a) Frequency of warthog sounders of 1, 2, 3, ... 16 animals between December, 1966 and November, 1967 (open columns); and between December, 1968 and November, 1969 (closed columns).

(b) Distribution of animals according to sounder size. Samples as in (a) and Tables 24 and 25.

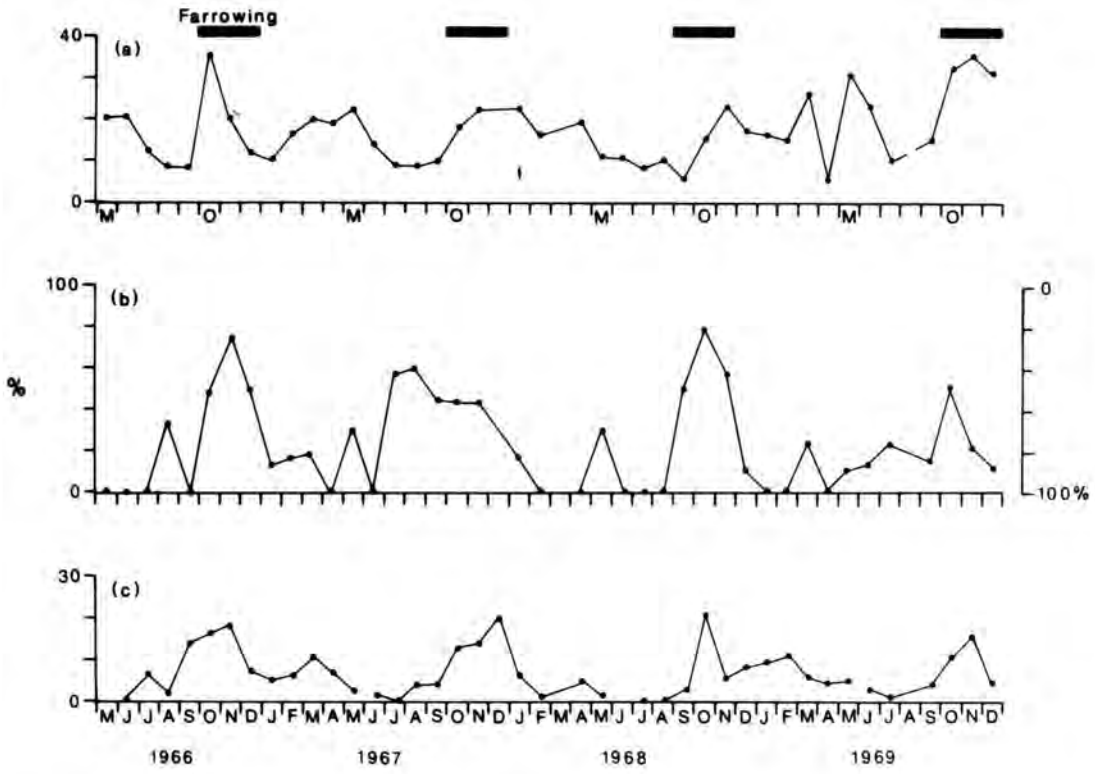


Fig. 52. Seasonal variation in the proportion of different sounder types.

(a) Incidence of solitary adult and sub-adult warthog.

(b) Proportion of females amongst solitary adult and sub-adult warthog classified each month. (Proportion of ♂♂ from inverted scale on right of figure).

(c) Groups of juveniles or yearlings, or both, up to 18 months old. (i.e. juvenile groups from June to September each year and yearling and juvenile groups from September to May.)

Note: Proportions of solitary sounders and sounders of juveniles and yearlings are expressed as percentages of the total number of sounders classified in the field each month.

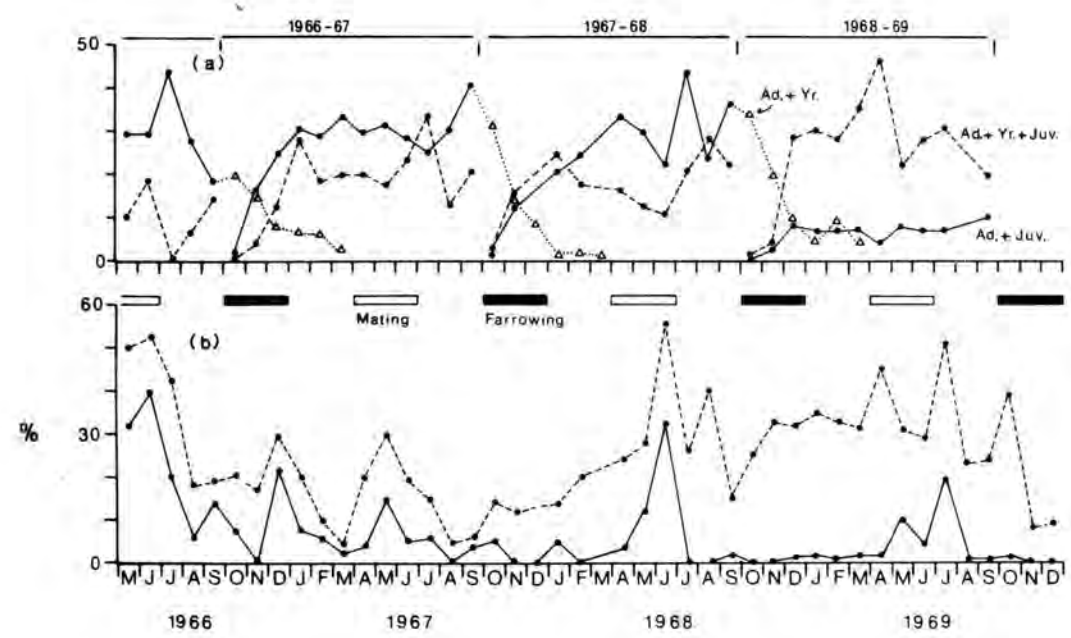


Fig. 53. Seasonal and annual variations in proportion of different sounder types:

(a) Adult + juvenile sounders (————————, Ad. + Juv.); adult + yearling + juvenile sounders (————————, Ad. + Yr. + Juv.); and adult + yearling sounders (.....,, Ad. + Yr.).

(b) Heterosexual sounders, which included males and females older than 12 months, (- - - - - - -); sounders which included females and a fully mature male(s), i.e. males older than 36 months, (————————).

Note: Proportions for (a) were derived from monthly samples of sounders in which all individuals were aged. Proportions for (b) were derived from monthly samples of sounders in which a sufficient number of individuals had been aged and sexed to determine the sounder's sexual status.

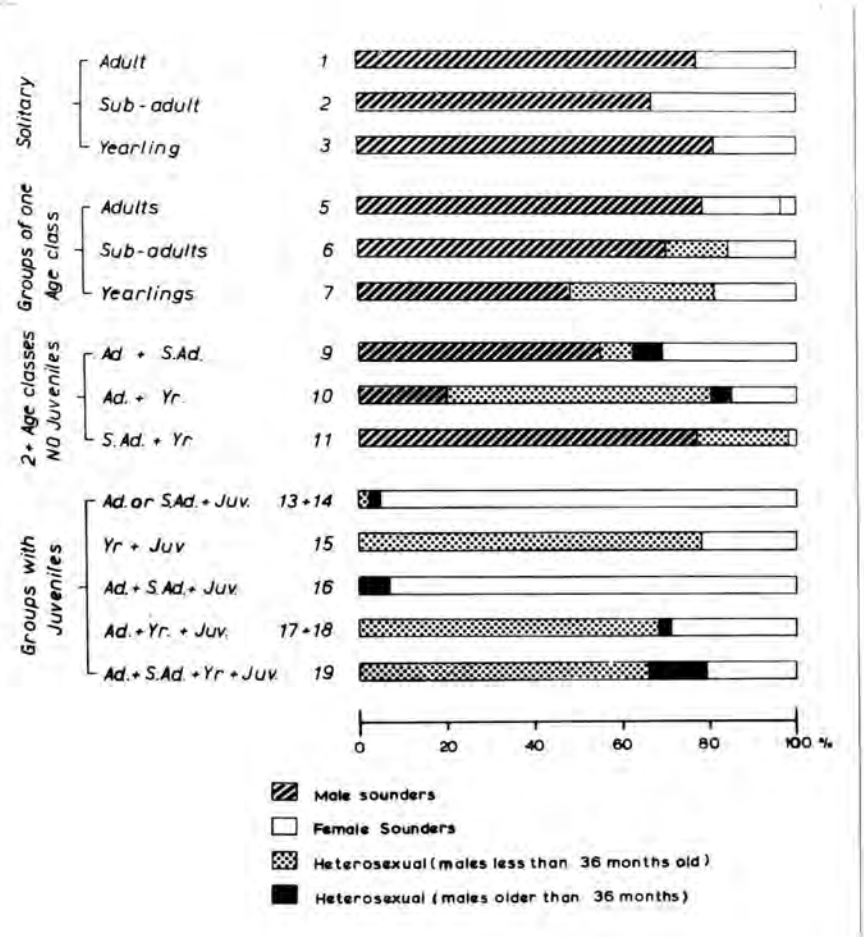


Fig. 54. Proportion of male, female and heterosexual sounders in each of the 19 sounder types defined by age composition. Data are from 1968 - 69 field classifications. Table 28.

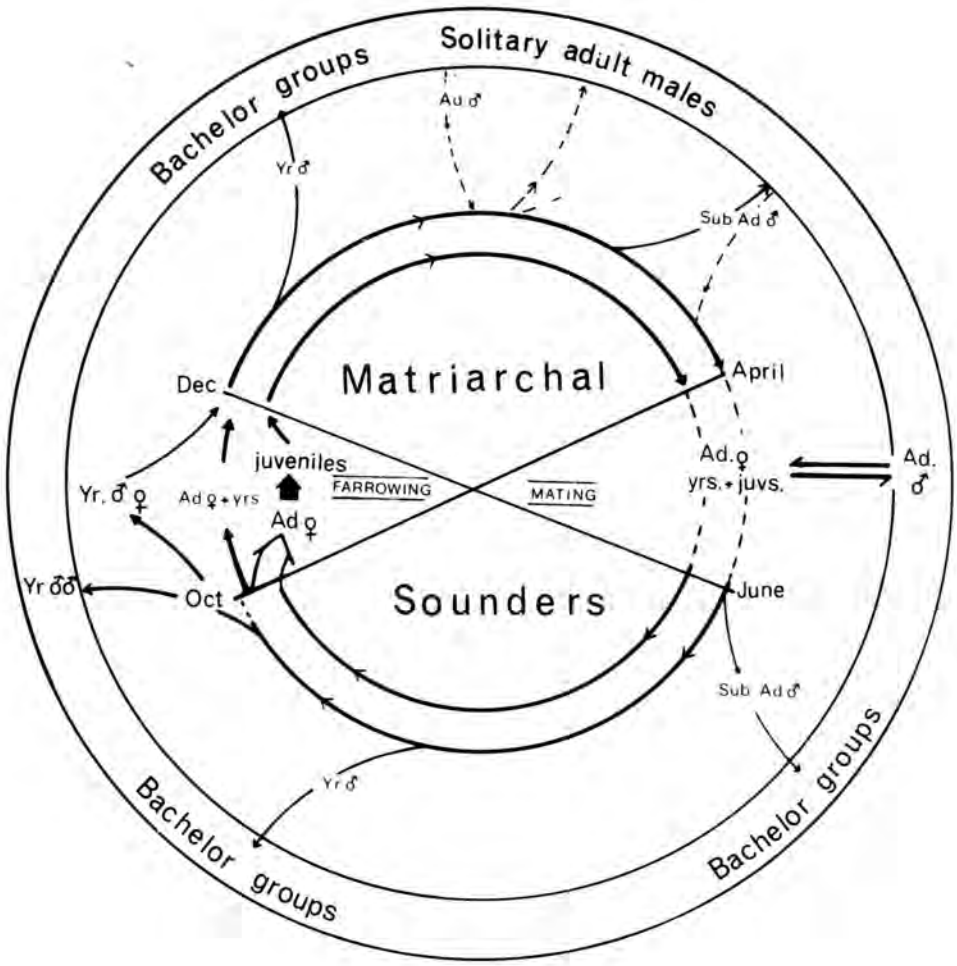


Fig. 55. Diagrammatic representation of warthog social structure. Matriarchal sounders are shown as the "central" social unit. Bachelor groups are formed by young males leaving the family group. Temporary sub-mature heterosexual sounders are formed during the farrowing season. Adult males join matriarchal sounders during the mating season only to court oestrus females and then leave. Transient associations (indicated by dotted arrows) between males and matriarchal sounders occur at other times of the year.

(a)

(b)

Fig. 56. Greeting between Susan (yearling female) and Sophie, Gladys and Mackintosh (juveniles), November, 1968; (a) shortly after nasal contact, (b) juveniles sniffing at Susan's pre-orbital area. (Photographs by M.S. Cumming)

(a)

(b)

Fig. 57. Susan and MacDuff grooming Rosemary, May, 1968. (a) grooming flank, (b) MacDuff grooming Rosemary's mane which shows slight pilo-erection.

Fig. 58. Mackintosh at 13 months of age showing typical moist and darkened pre-orbital area. Note trough leading from anterior corner of eye into rudimentary pit.

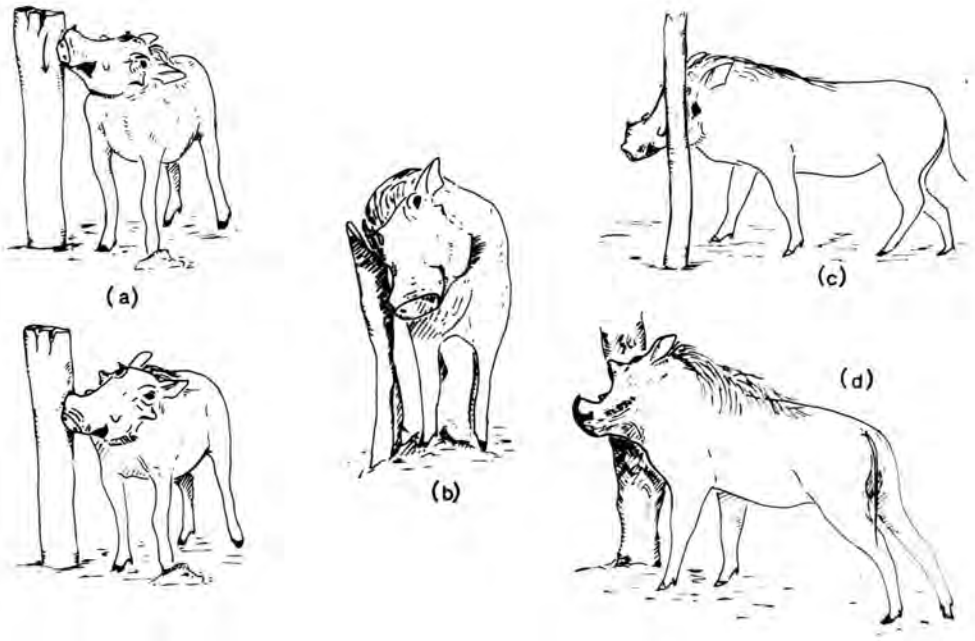


Fig. 59. Scent marking by warthog (traced from 16 mm film).
(a) Mouth wiping. (Mackintosh, 16 months old, February, 1970)
(b) Pre-orbital marking. (Susan, 20 months, May, 1969)
(c) and (d) Pre-orbital marking. (MacSweeny, 26 months, May, 1968)

Fig. 60. Adult male warthog mouth-wiping a stump after a wallow at the artesian borehole in the Sengwa Experimental Area (September, 1969). The two warthog to the left are sub-adult males.

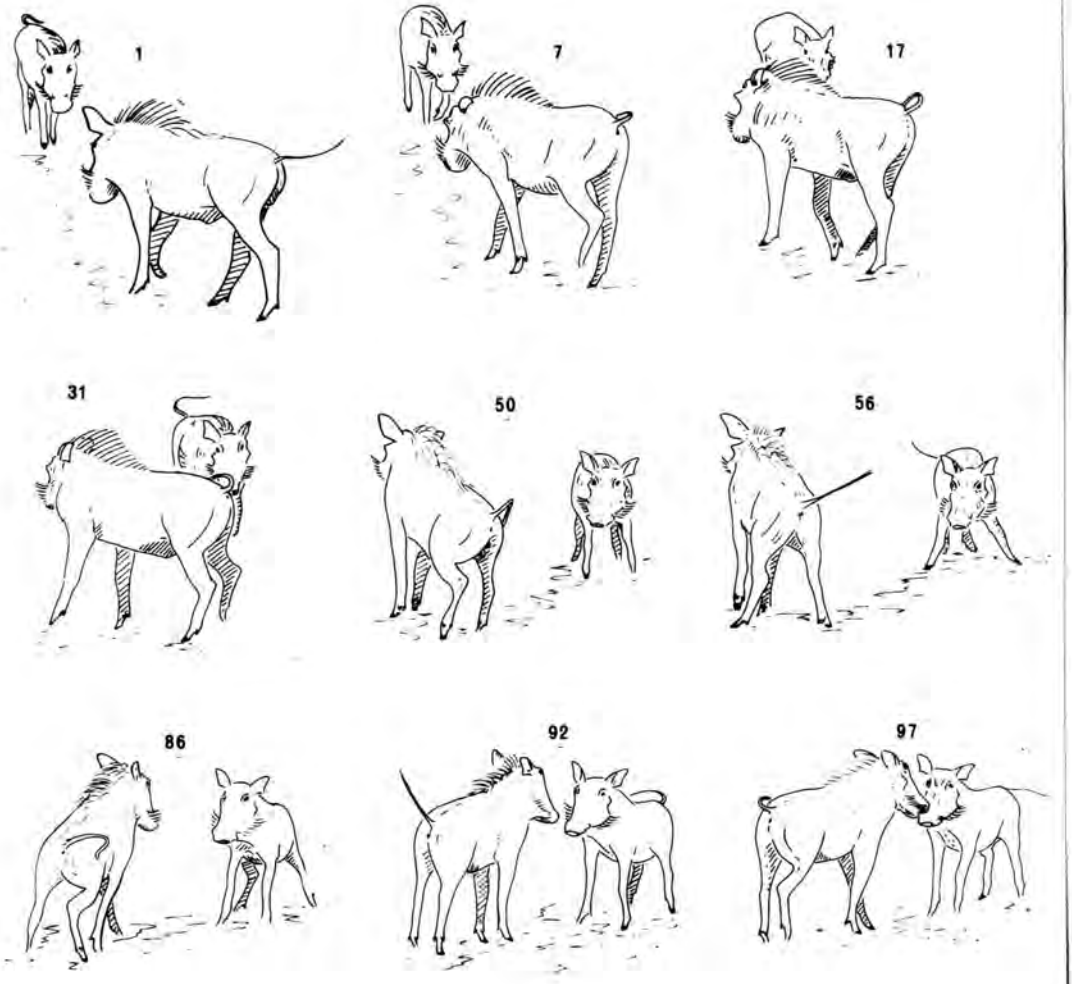


Fig. 61. Threat display by Mackintosh (nearest observer) to Rosemary's juvenile male (RJ male), May, 1969. Line drawings traced from 16 mm film shot at 24 f.p.s.; numbers refer to frames used. Mackintosh shows "offensive" threat while RJ ♂ shows "defensive" threat, particularly in frame 86. (Encounter described on page 154)

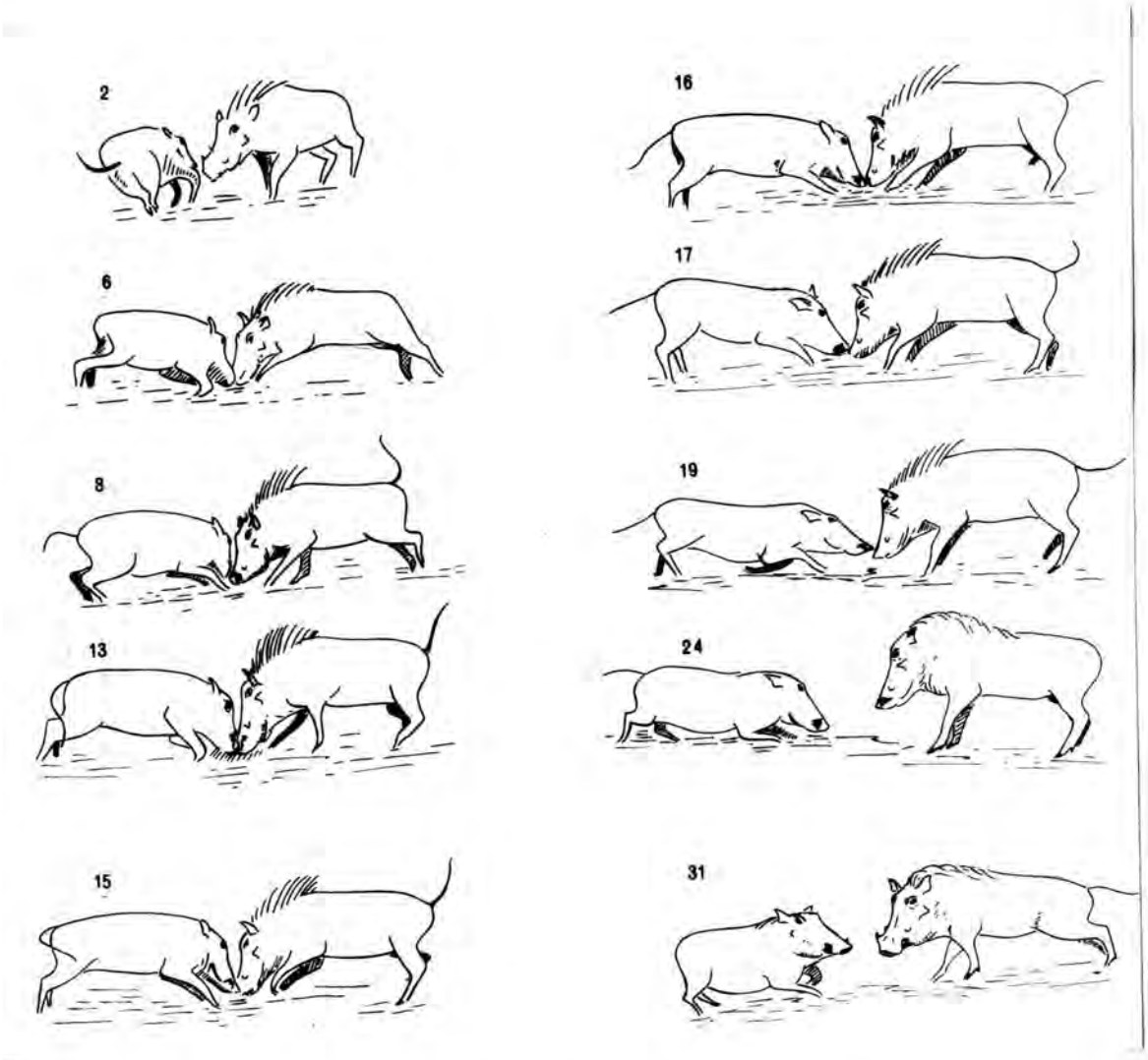


Fig. 62. MacSweeny (on right) attacking Rosemary, April, 1968.
Sequence illustrates speed of encounter and manner in which an animal (Rosemary) disengages from a fight.
(Encounter described on page 157 and referred to on page 164 & 167).
Drawn from 16 mm film shot at 24 f.p.s.

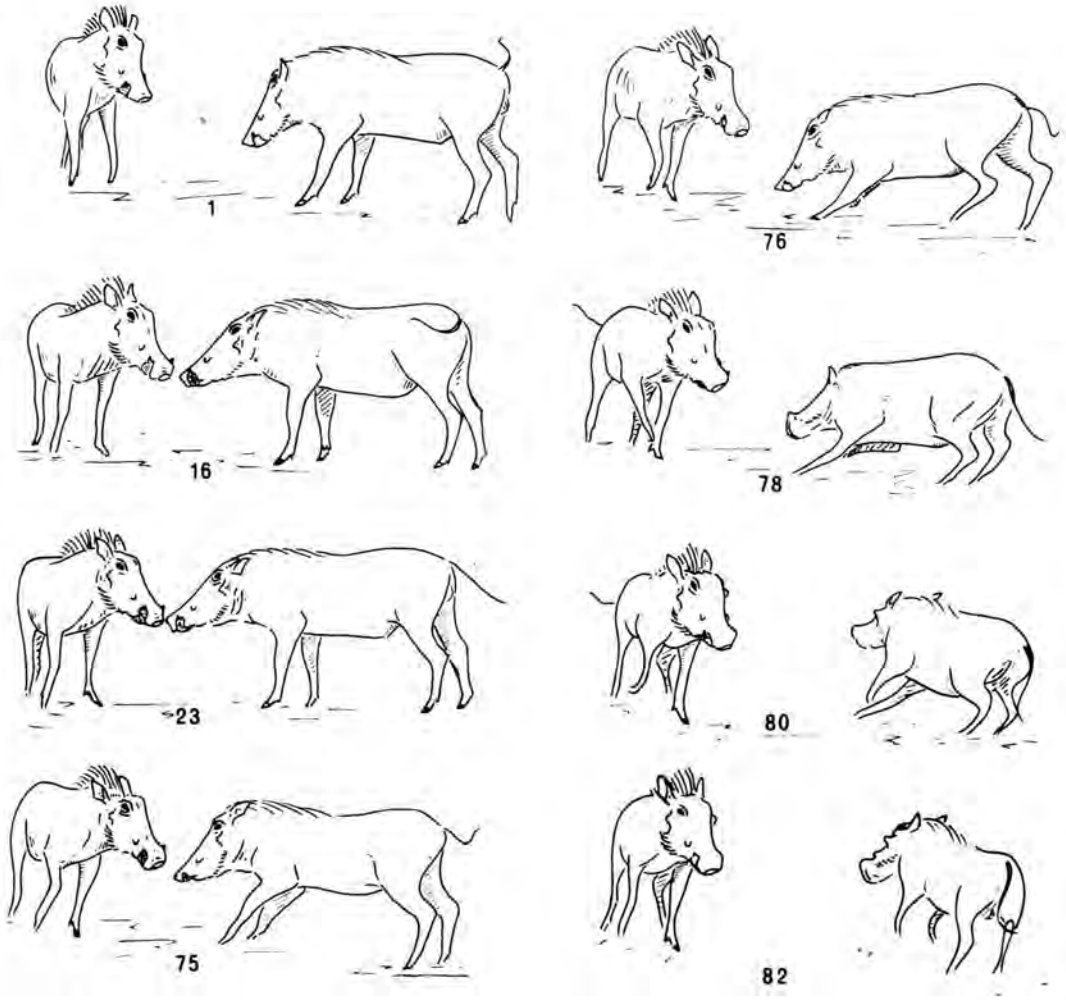


Fig. 63. Threat and submission. RJ ♂ (on left) threatening Mackintosh who after nasal contact of c. 2 secs. shows submissive ducking and running away. Traced from 16 mm film shot at 24 f.p.s.. Encounter described on page 159. Note similarity between submissive ducking posture in Frame 78 with initial movement in juvenile escape response shown in Frame 5 of Fig. 64.

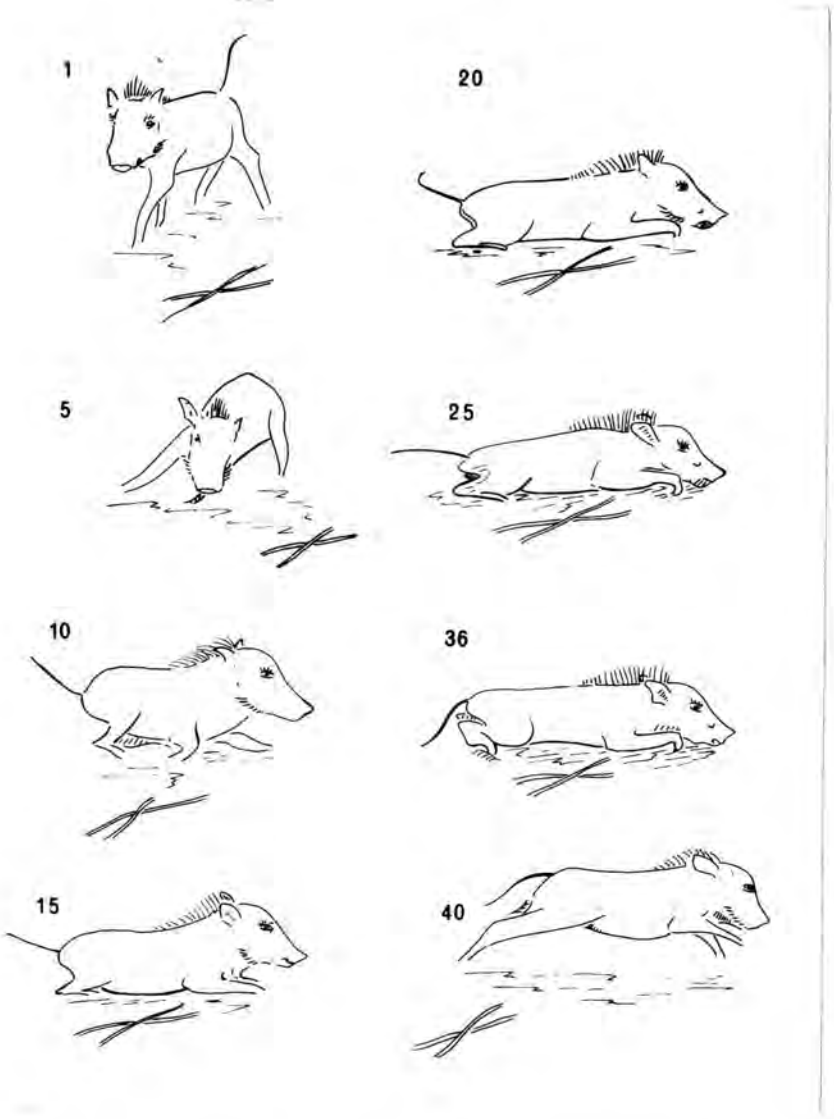


Fig. 64. Escape pattern shown by warthog in response to a **"roar"** during hole-centred phase (see page 178 and 182). Filmed sequence of MacSweeny at c. 3 weeks, October, 1966. The "roar" was given on frames 2 and 3 i e. immediately after frame 1 which shows him trotting towards camera. (filmed at 16 f.p s.).

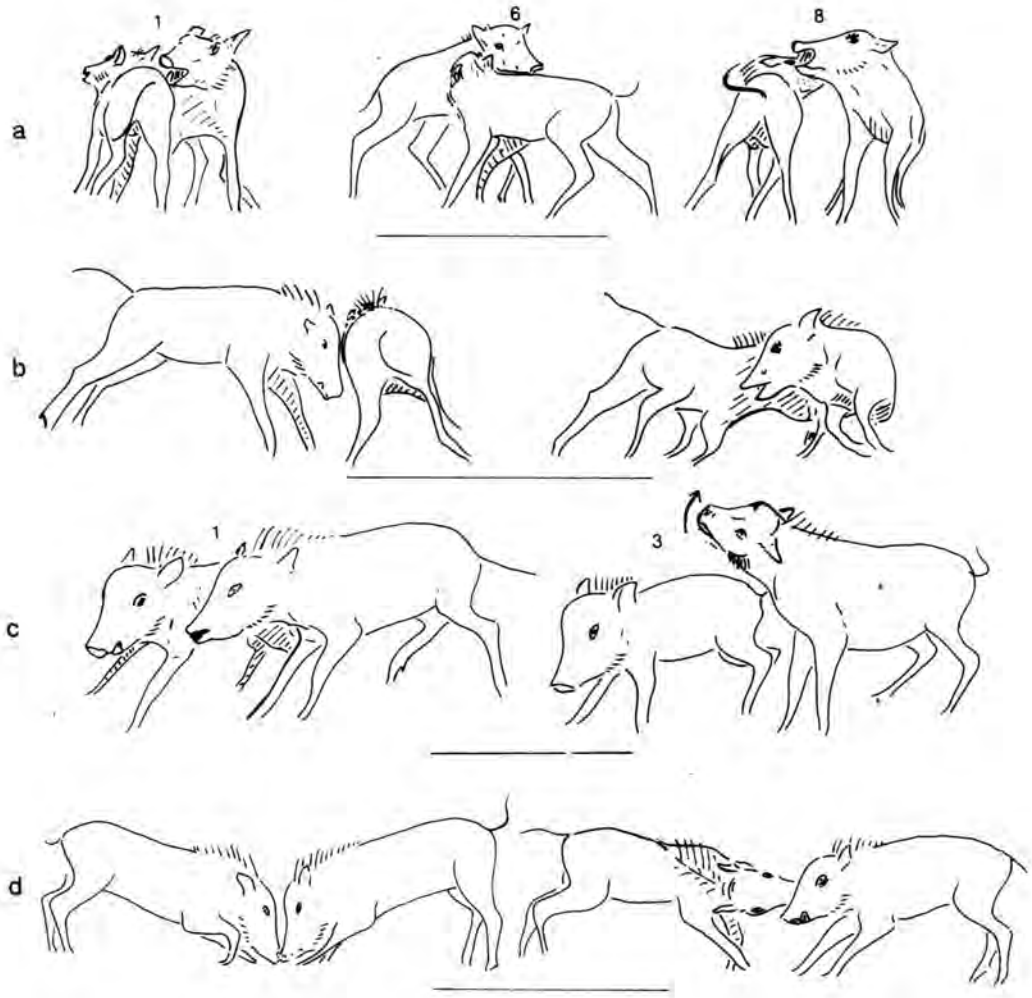


Fig. 65. Fighting in young warthog less than 1 month old.

(a) Lateral pushing and biting in anti-parallel position. (from a sequence - frame numbers indicated).

(b) Butting and pushing, disorientated fighting.

(c) Lateral fighting in parallel position. (Sequence)

(d) Elements of adult fighting showing frontal pushing and blows with bridge of snout against side of opponent's head.

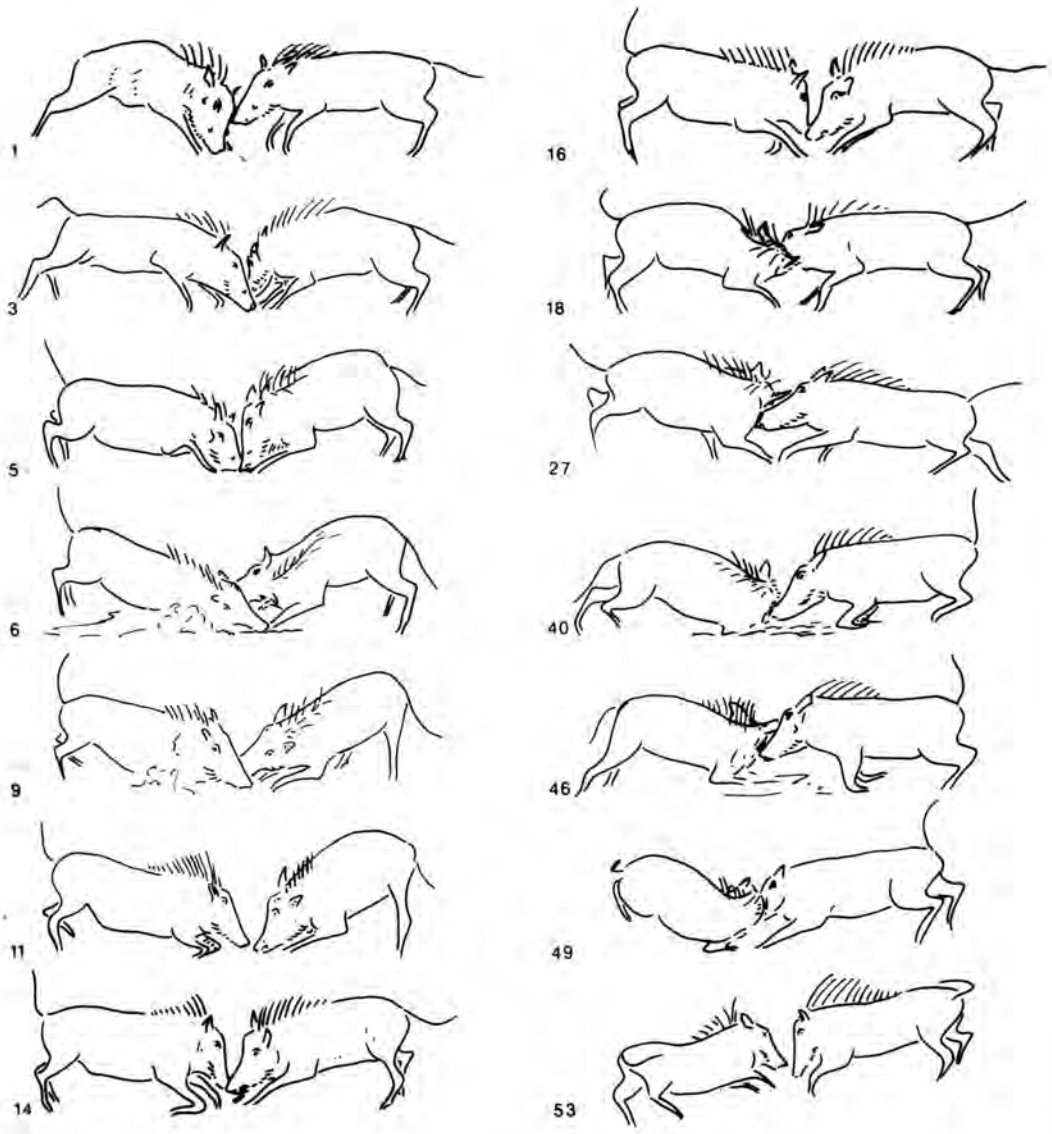


Fig. 66. Sequence from a serious fight between Mackintosh (on right and dominant animal) and RJ ♂ (on left). Note Mackintosh's blow against RJ ♂'s sub-orbital wart and neck in frame 6 and Mackintosh pushing against RJ ♂'s neck in frames 27 - 49. RJ ♂ was forced back c. 10 m between frame 19 and 53. After frame 53 frontal fighting again resumed.

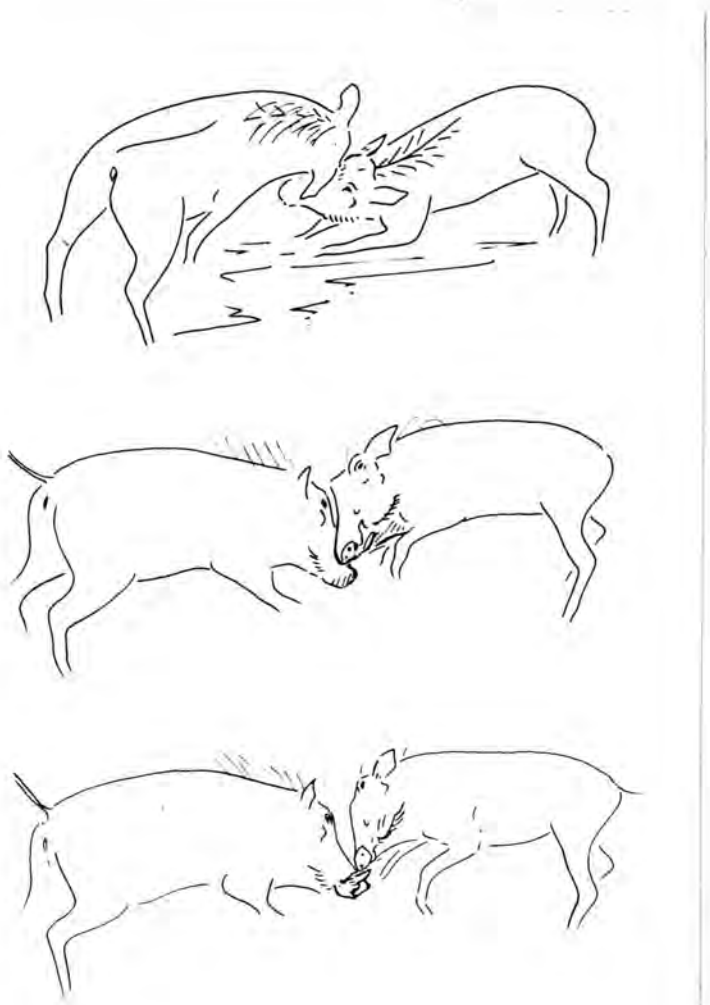


Fig. 67. Rosemary attacking MacDuff, October, 1969. Rosemary on left and 2 years old (recently farrowed) and MacDuff, 1 year old. (Tracings from 16 mm film.)

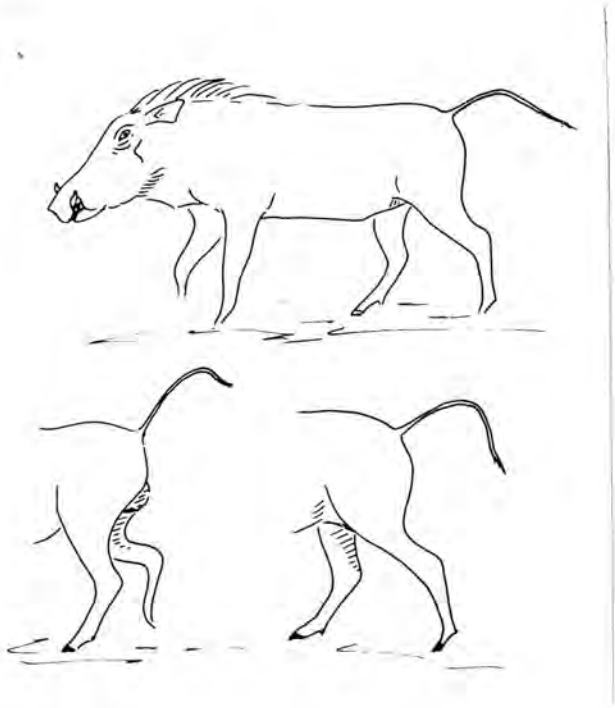


Fig. 68. Bent position of tail during courtship walk by male.
(From 16 mm film of MacSweeny, April, 1968.)

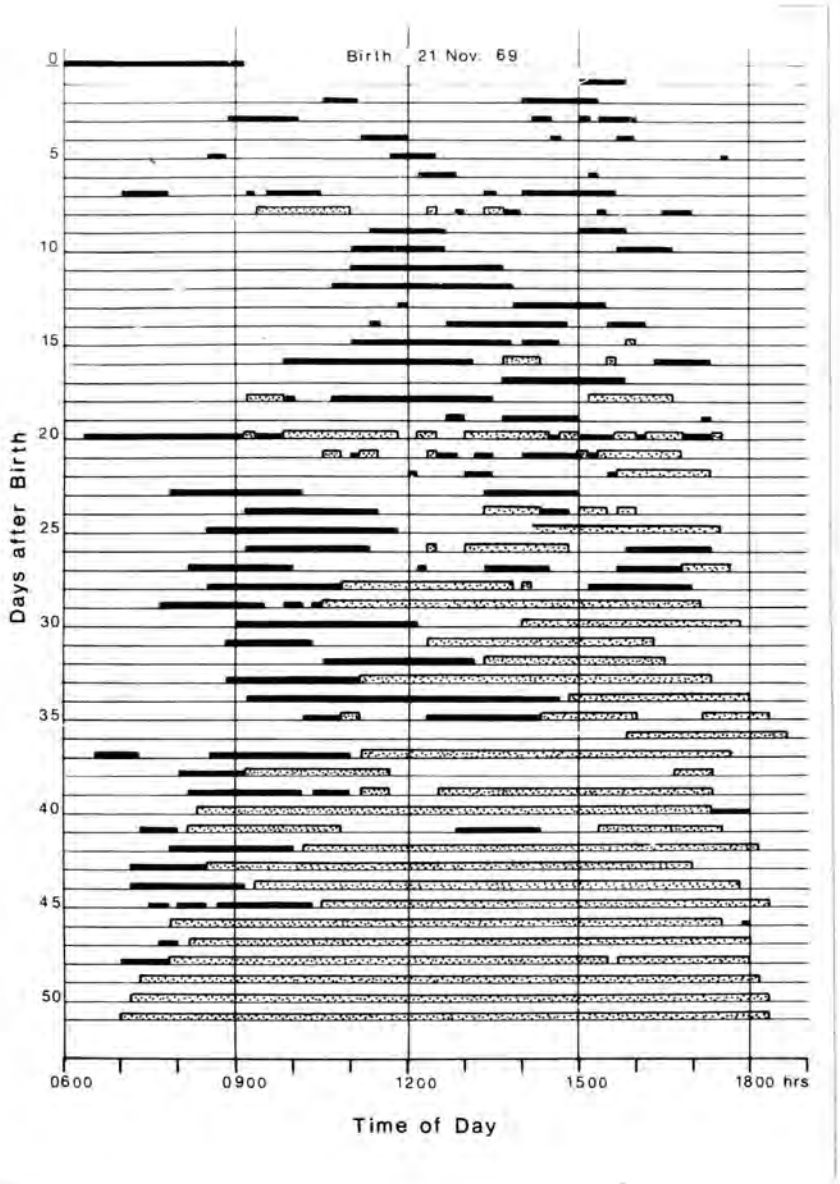


Fig. 69. Periods spent out of the hole by Susan (solid line) and by Susan with her juveniles (shaded portion) each day for 51 days after parturition. After 48 days juveniles regularly accompanied their mother whenever she left the hole.

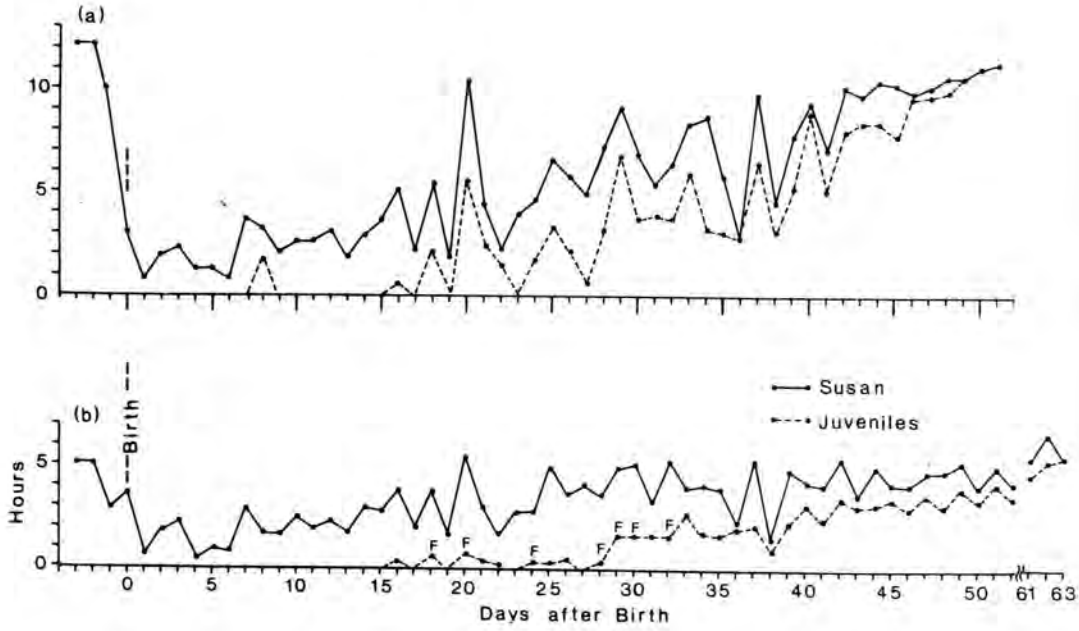


Fig. 70. (a) Time spent out of the hole each day by Susan (solid line) and by Susan with her juveniles (broken line) up to 52 days after parturition.

(b) Time spent feeding each day by Susan (solid line) and by her juveniles (broken line) up to 63 days after parturition. "F" indicates days on which juveniles ate Susan's freshly dropped faeces. Time spent feeding by juveniles is the average for 4 animals and does not include time spent suckling.

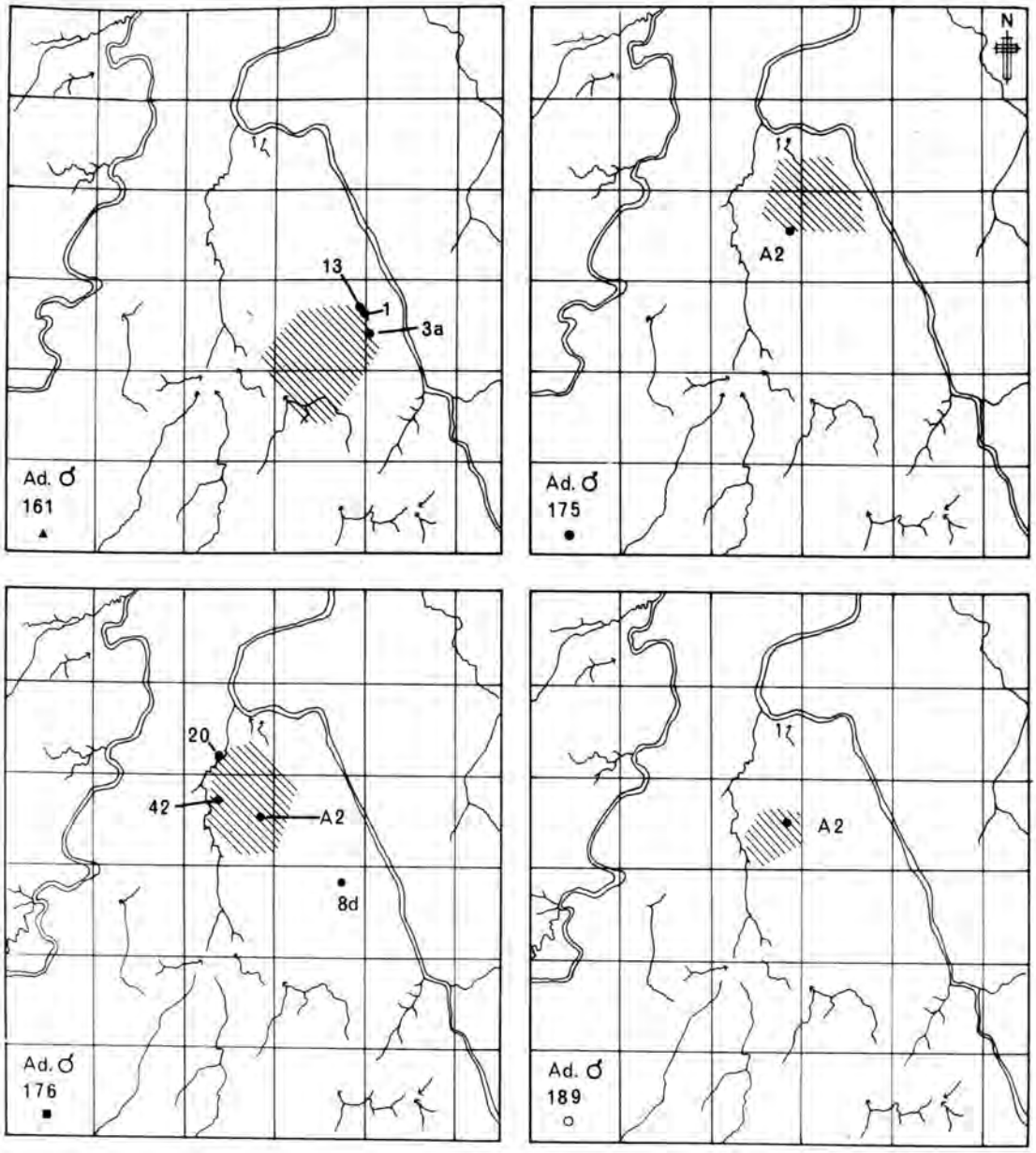


Fig. 71. Home ranges (shaded areas) of radio tagged Ad.♂♂ 161, 175, 176 and 189 in Sengwa Experimental Area. Holes used (solid circle and number) by each animal are also shown. Symbol under the identifying number of each animal (in lower left corner of each map) refers to symbol in Fig. 78 where sightings are plotted. Ad. ♂ 189 was seen 2 km south and 2 km north, 3 and 5 months respectively, after the home range shown here was determined (see Fig. 78 and page 187).
Grid squares = 1 km x 1 km.

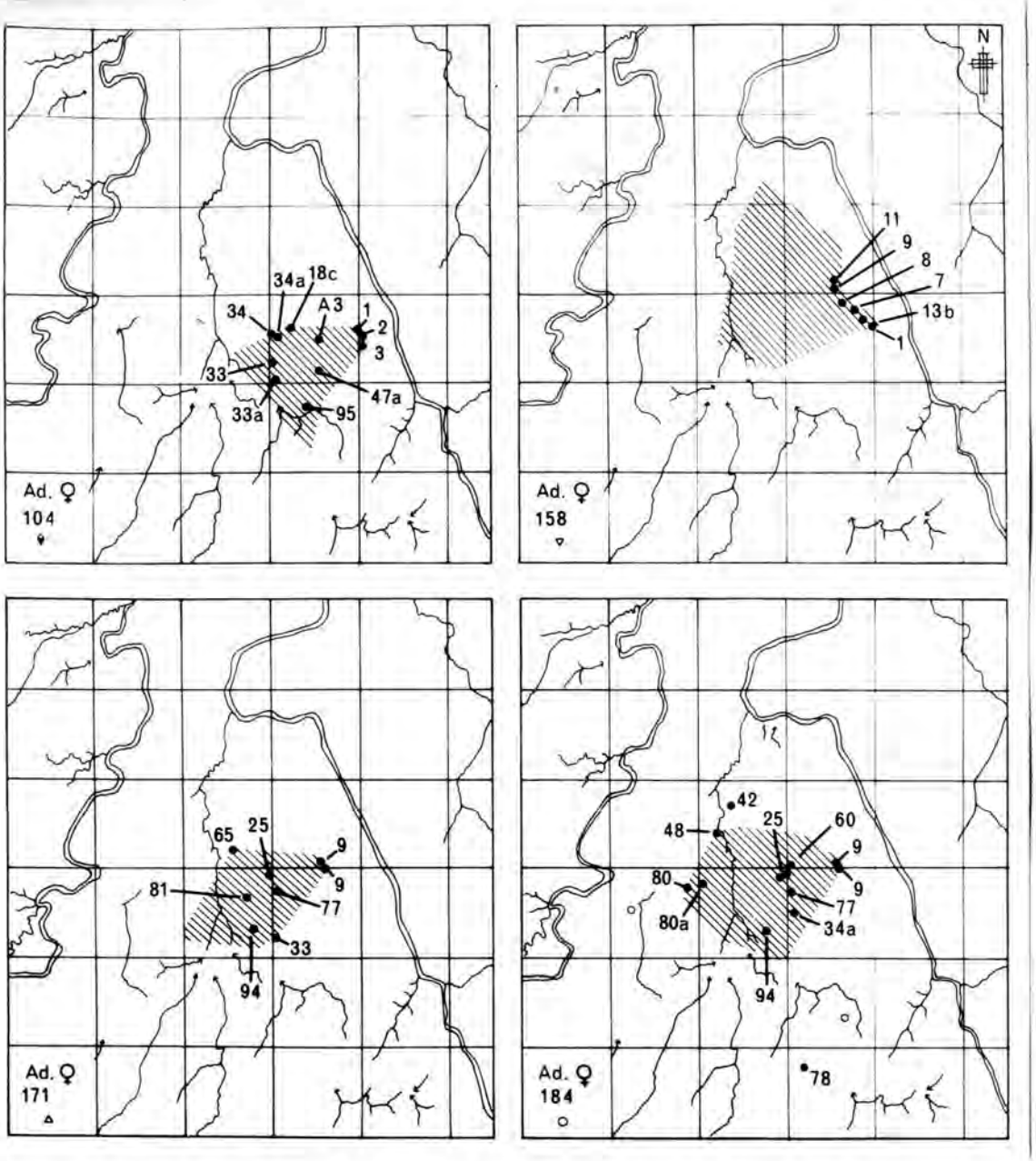


Fig. 72. Home ranges (shaded areas) of radio tagged Ad. ♀♀ 104, 158, 171 and 184 in Sengwa Experimental Area. Holes used (closed circle and number) by each animal are also shown. Symbol under the identifying number of each animal (in lower left corner of each map) refers to symbol in Fig. 77 where sightings are plotted in Clan area B. Two sightings of Ad. ♀ 184 outside the home range area shown are indicated by open circles. Hole 78 was used when Ad. ♀ 184 moved temporarily to a burnt area in October, 1969. (See page 191). Grid squares = 1 km x 1 km.

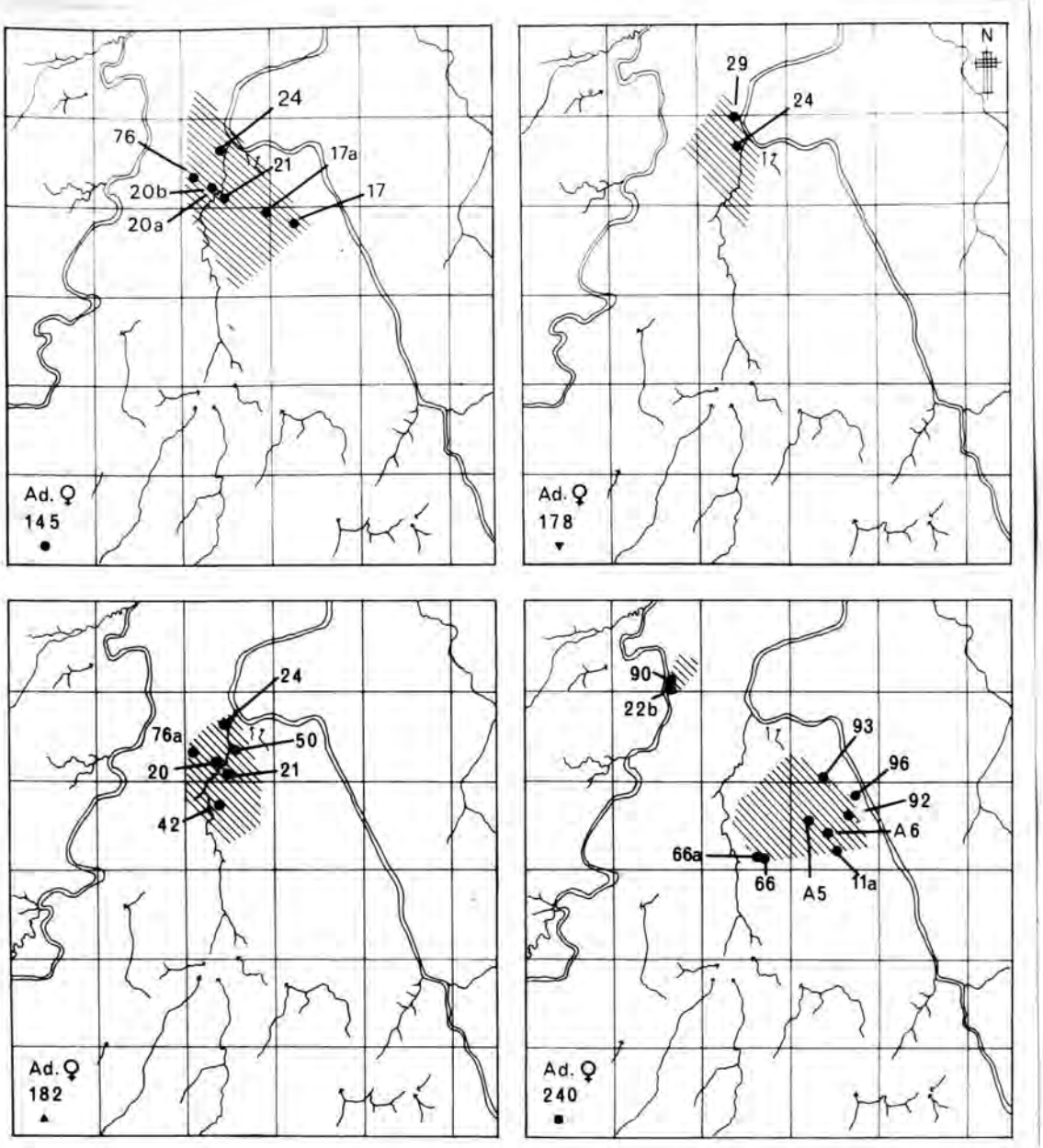


Fig. 73. Home ranges (shaded areas) of radio tagged Ad. ♀♀ 145, 178, 182 and 240 in Sengwa Experimental Area. Holes used (closed circle and number) by each animal are shown. Symbol under the identifying number of each animal (in lower left corner of each map) refers to symbol in Fig. 77 where sightings are plotted in Clan area C. The "divided" home range of Ad. ♀ 240 is discussed on page 196.

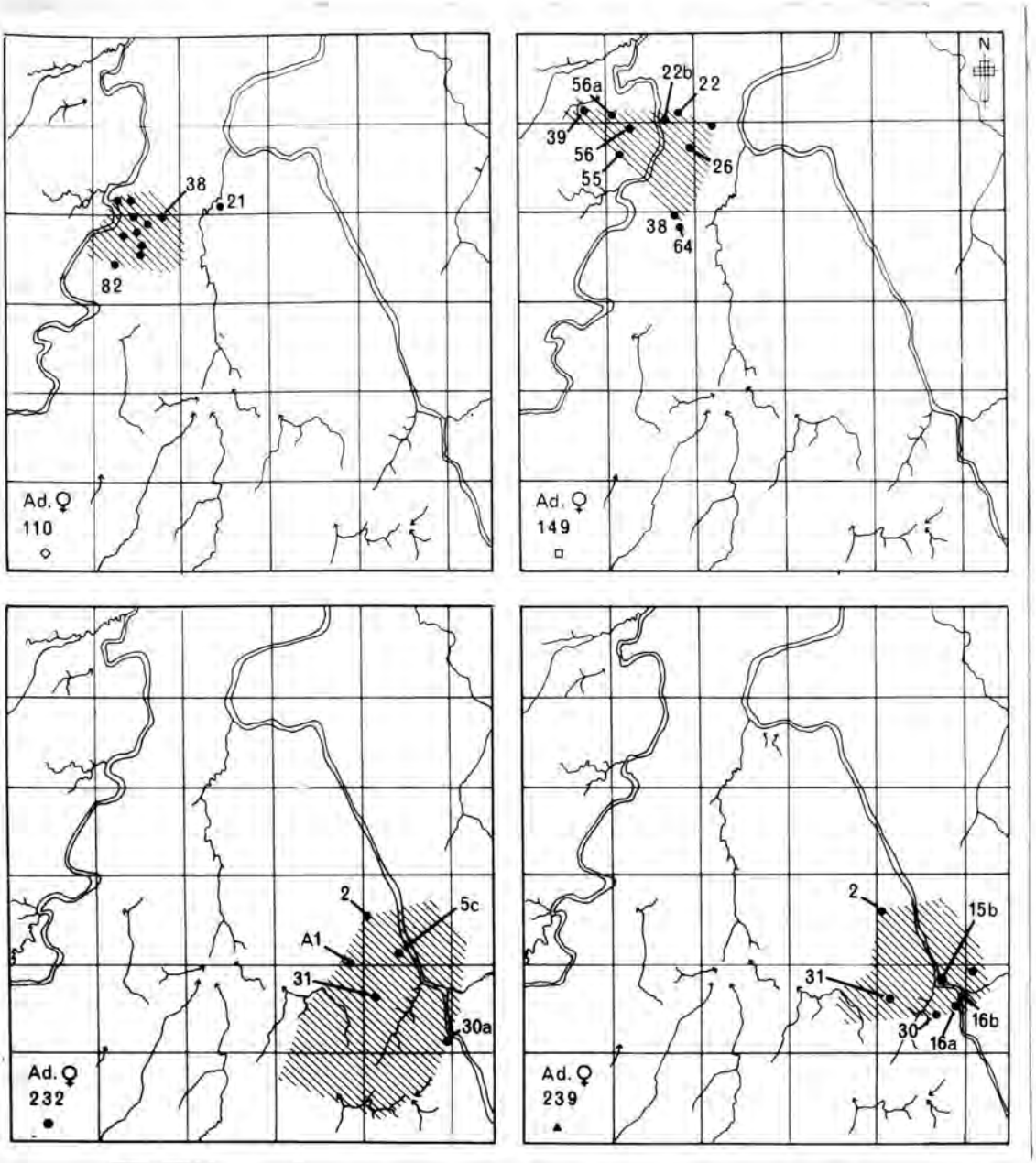


Fig. 74. Home ranges (shaded areas) of radio tagged Ad. ♀♀ 110, 149, 232 and 239 in Sengwa Experimental Area. Holes used (solid circle and number) by each animal are also shown. Symbol under the identifying number of each animal (in lower left corner of each map) refers to symbol in Fig. 77 where sightings are plotted; Ad. ♀♀ 110 and 149 in Clan area D, and Ad. ♀♀ 232 and 239 in Clan area A.
Grid squares = 1 km x 1 km.

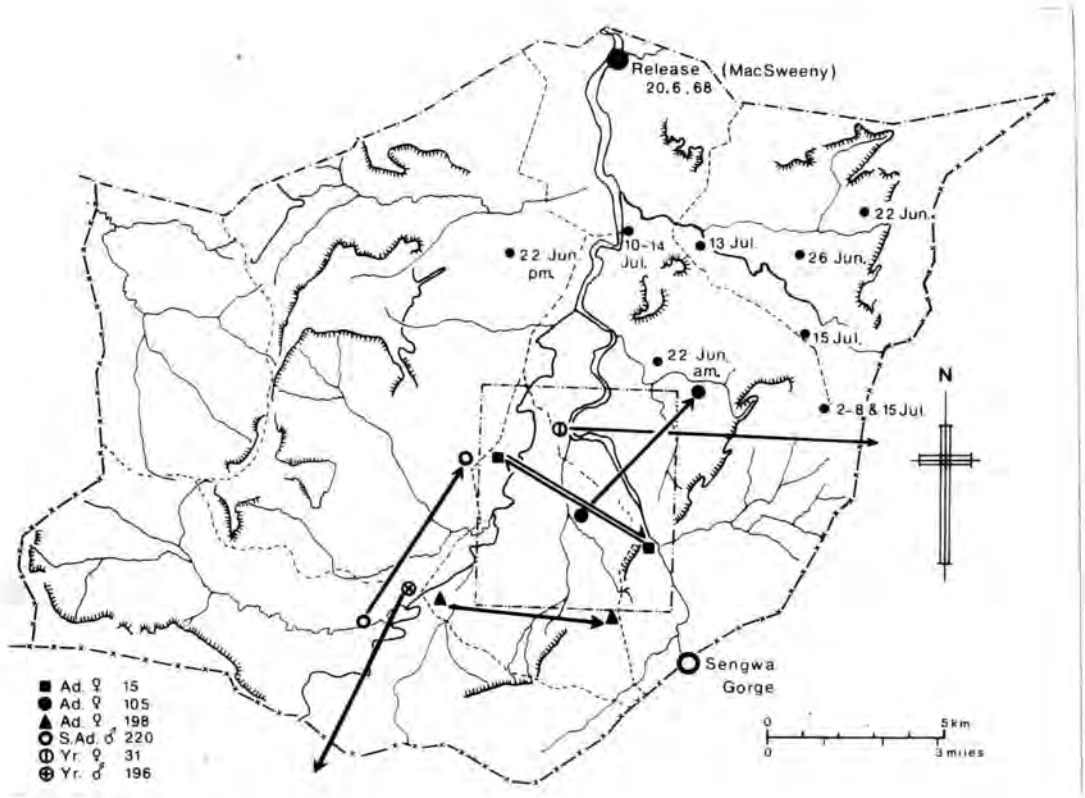


Fig. 75. Map of Sengwa Experimental Area showing movements of MacSweeny (closed circle and dates) after he was moved from Sengwa Gorge on 20th June, 1968, to the northern boundary of the Research Area. Exceptional movements of wild, tagged warthog are also shown from points of capture to sighting or recovery (symbols linked by arrows). See page 188 for details of Ad. ♀ 15, Ad. ♀ 105 etc.

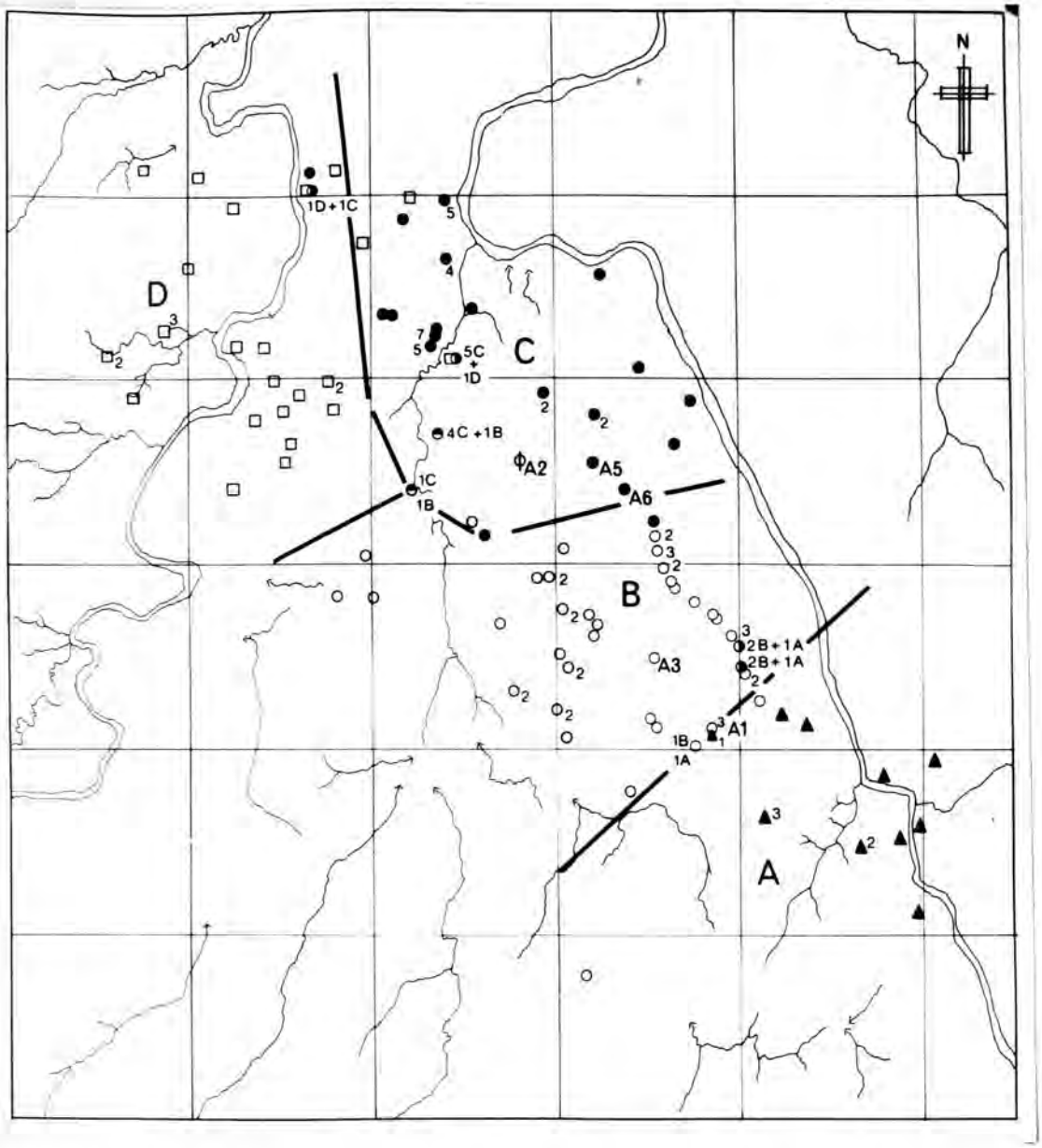


Fig. 76. Patterns of hole use. Holes used by sounders or individuals of Clan A (solid triangle), Clan B (open circle), Clan C (closed circle) and Clan D (open square) are shown. Numbers adjacent to holes indicate the number of sounders which have been recorded using the hole. Holes without numbers have been used by a single sounder. Where holes have been used by groups from two clans the number of groups from each clan using the hole is shown thus: 2B + 1A which shows that 2 sounders from Clan B and 1 sounder from Clan A have used the hole. Artificial hole A1 comprises 3 holes; A1 - 3 was used by a sounder from Clan B (open circle and figure 3) and A1 - 1 was used by a sounder from Clan A (closed triangle and figure 1). The status of Artificial hole A2 (Φ) is uncertain.

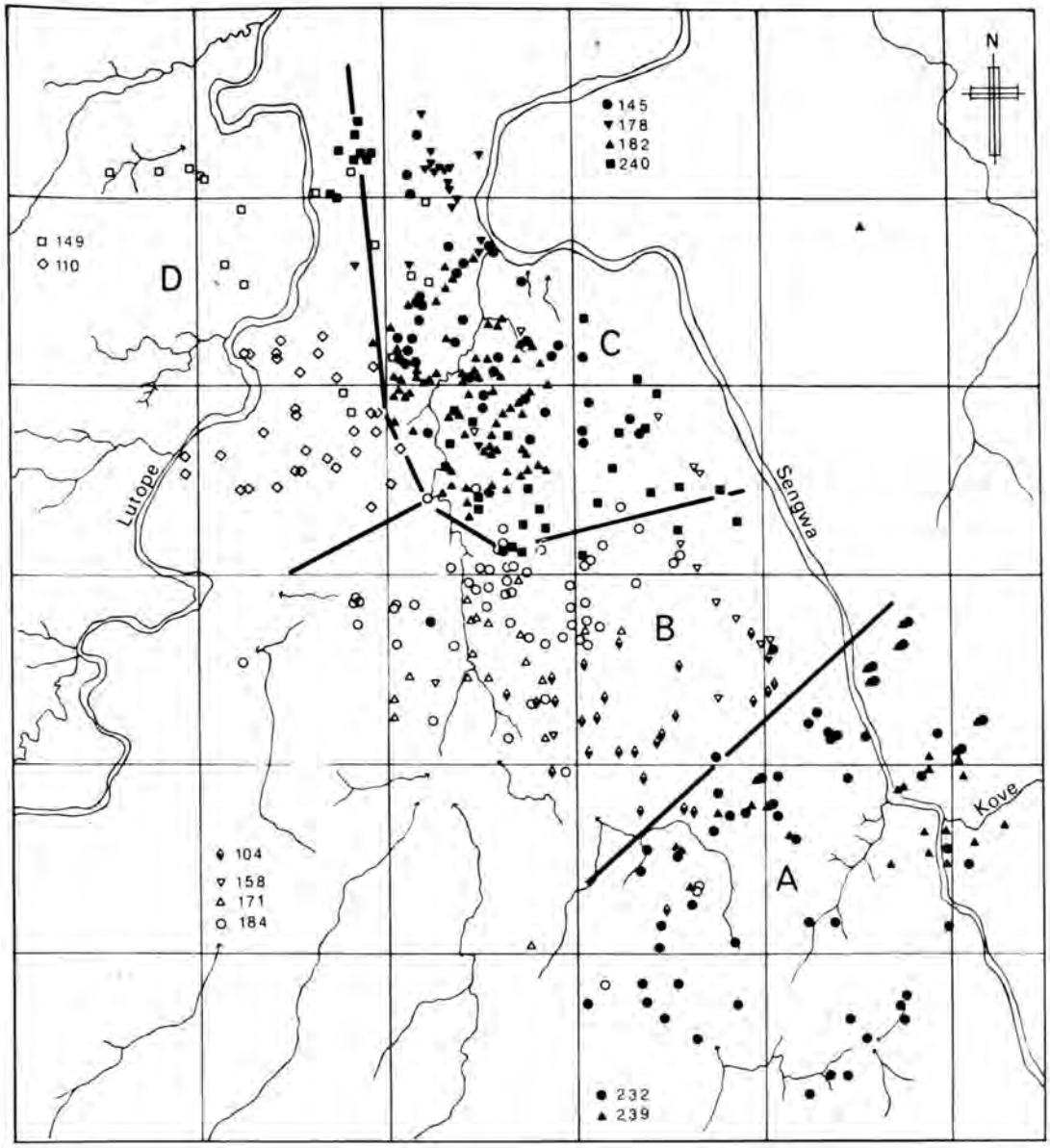


Fig. 77. Sightings of radio tagged adult female warthog in Sengwa Experimental Area. Each symbol represents a separate sighting but where two contacts have been made at the same locality, such as at a hole, a single symbol is shown. A, B, C and D refer to clans which have been recognised (See Fig. 76 and page 194). Identifying number of each animal and its symbol is shown next to clan area, e.g. in Clan C solid circle is symbol for Ad. ♀ 145, inverted solid triangle is symbol for Ad. ♀ 178. Home ranges are shown separately in Figs. 72 - 74 together with the holes each animal has used.

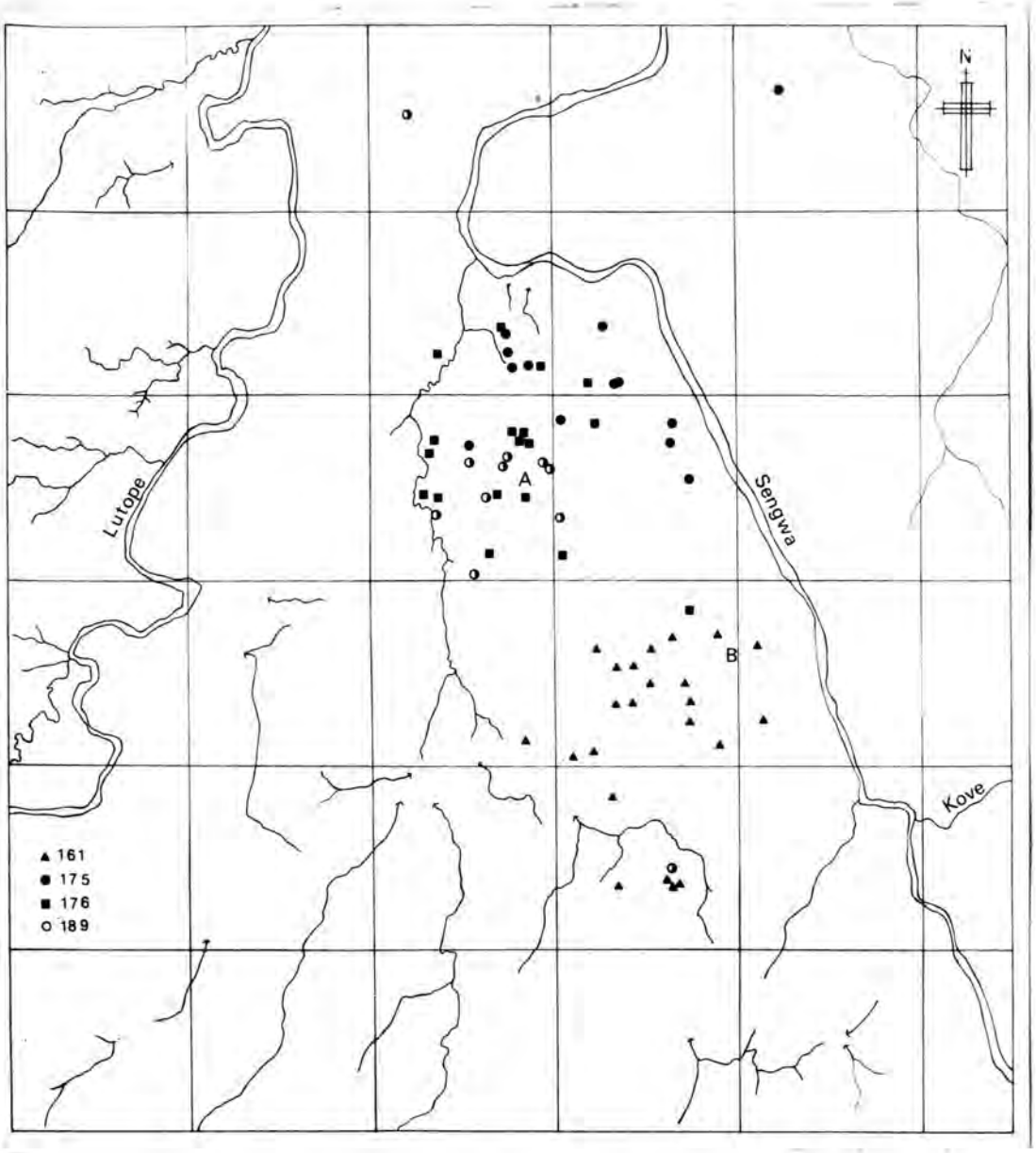


Fig. 78. Sightings of radio tagged Ad ♂♂ 161, 175, 176 and 189 in the Sengwa Experimental Area. Each symbol represents a separate sighting; a key is given on the left of the figure. "A" shows the position of artificial hole A2 where Ad. ♂♂ 175, 176 and 189 were captured. "B" shows the hole (No. 1) where Ad. ♂ 161 was captured. Home ranges are shown for each animal in Fig. 71.

Scale: Grid squares = 1 km x 1 km.

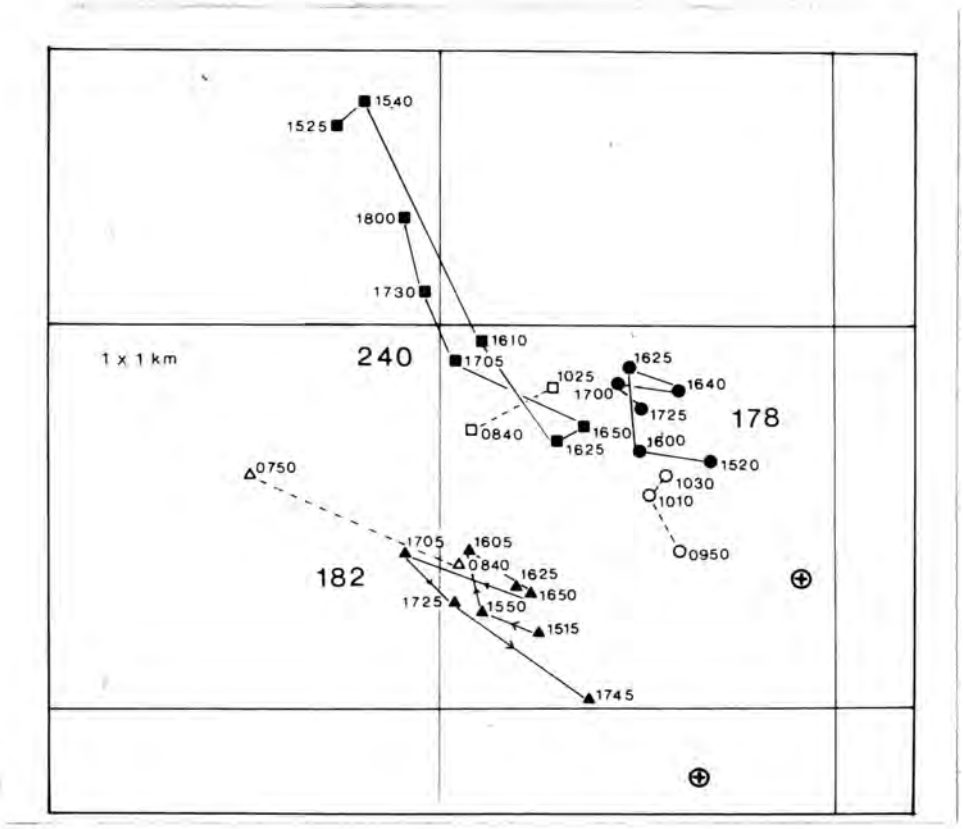


Fig. 79. Movements of sounders within a clan area. Radio fixes of Ad. ♀♀ 178, 182 and 240 obtained from portable tracking stations (circle enclosing +) during an afternoon and the following morning (14 and 15 January, 1970). Time of each radio fix is shown in hours.

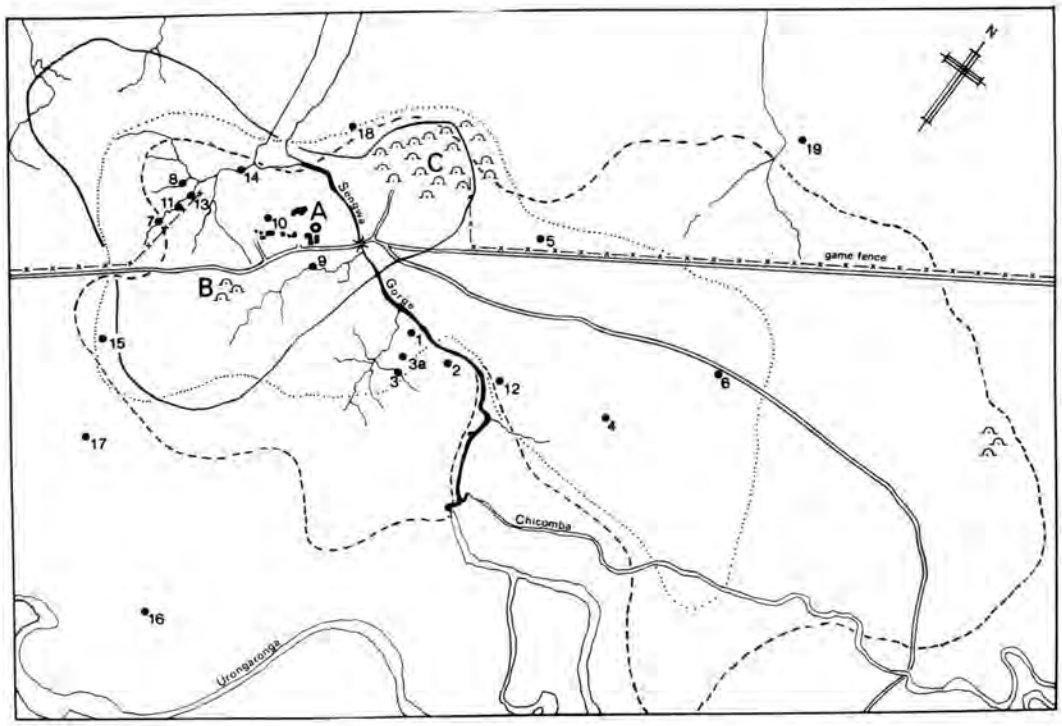


Fig. 80. Home ranges of Rosemary and juveniles (------) from October to December, 1968; Susan and MacDuff (.....) from October, 1968 to February, 1969; Susan + Sophie, Gladys and Mackintosh during March and April, 1969. Note overlap of home ranges of Rosemary + juveniles and Susan + MacDuff. Rosemary, Susan and MacDuff formed a single sounder before Rosemary farrowed.

Scale: $\frac{1}{2}$ inch = 200 yards.

A = Author's house. Open circle below A shows locality of pen and artificial hole used by tame warthog

B = Cook's village.

C = Main African staff village.

Solid circles with adjacent numbers show holes used by the tame warthog. Holes 14 - 19 were not used by the above groups when their home ranges were determined.

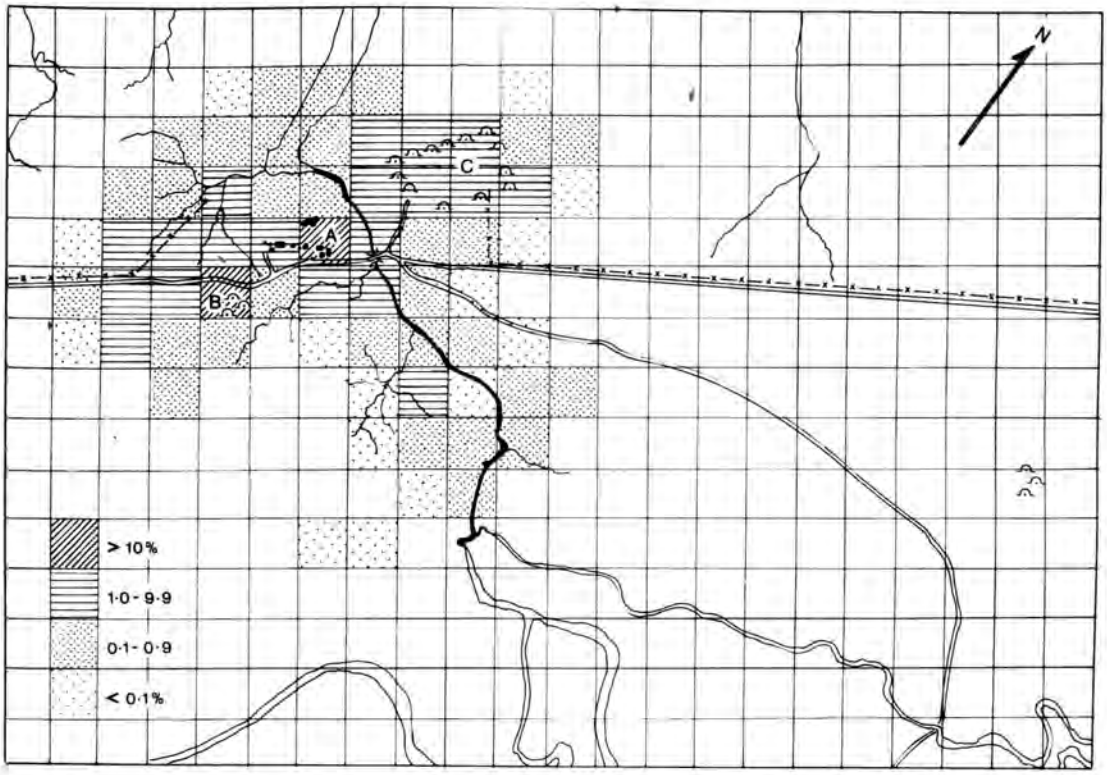


Fig. 81. Home range use by Susan and Mackintosh between May and November, 1969. Shadings indicate percentage of total observations in each 100 yard x 100 yard grid square. Total number of observations, made at 10 minute intervals between time hogs emerged from their hole in the morning and entered in the evening, was 4,650.

A = Author's house

B = Cook's village

C = Main staff village

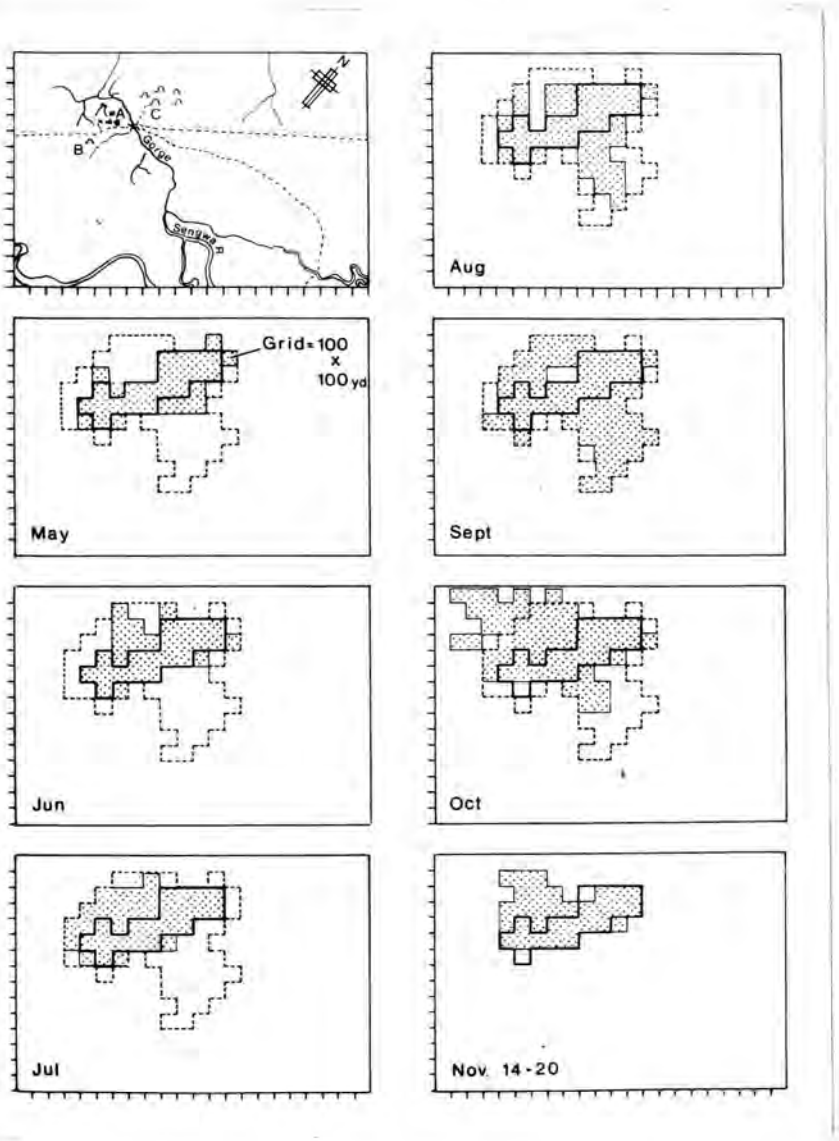


Fig. 82. Monthly home ranges of Susan and Mackintosh (shaded area) between May and November, 1969. Broken line indicates overall dry season home range of Fig. 81 and full line encloses area used in all months.
In upper right figure A = Author's house, B = Cook's village, C = Main staff village.

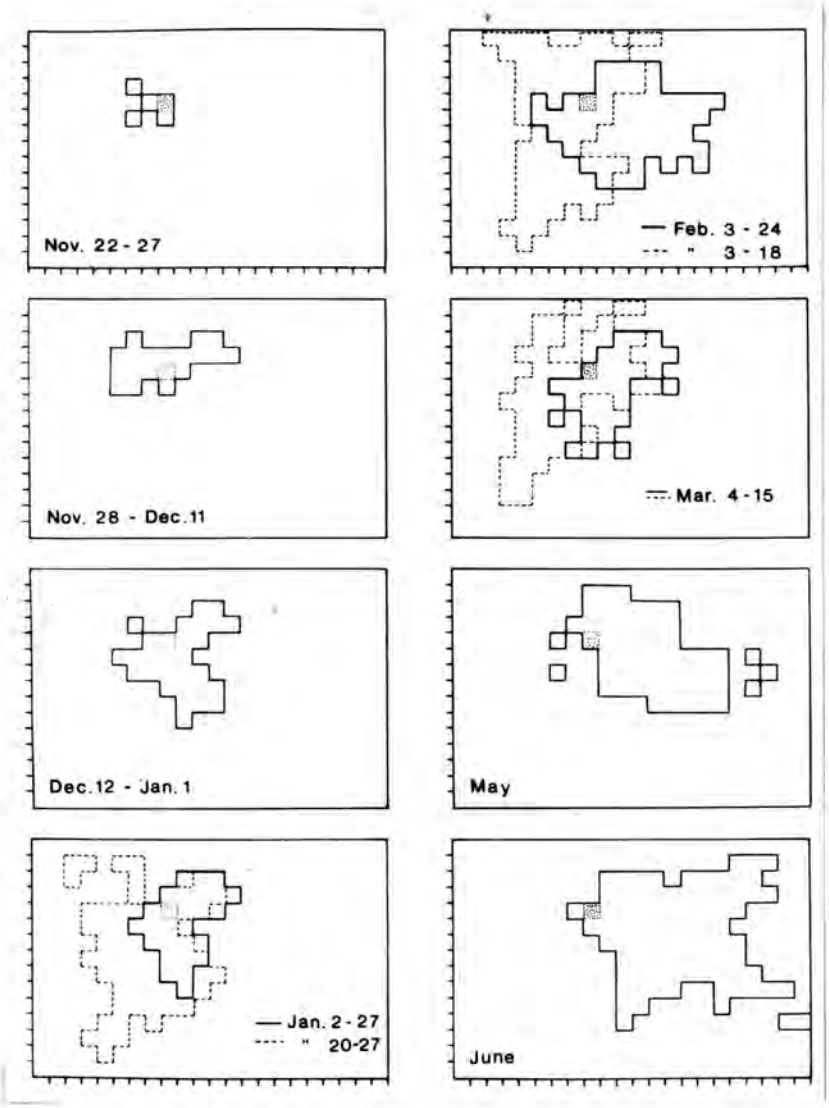
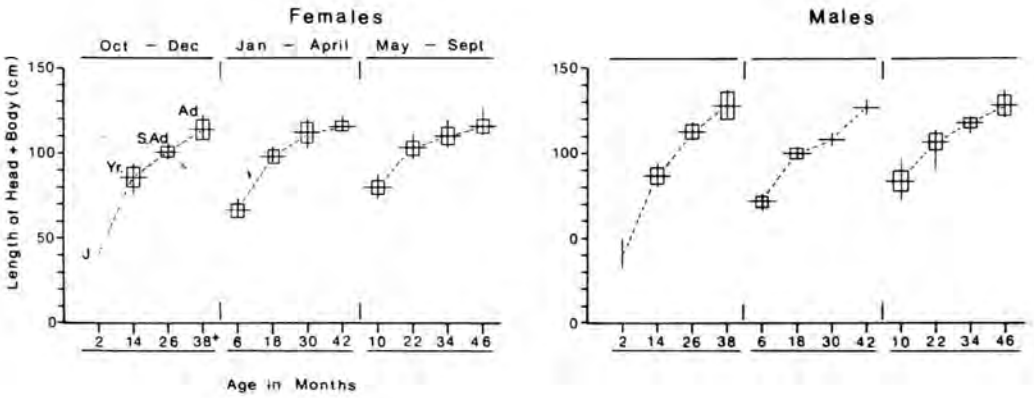


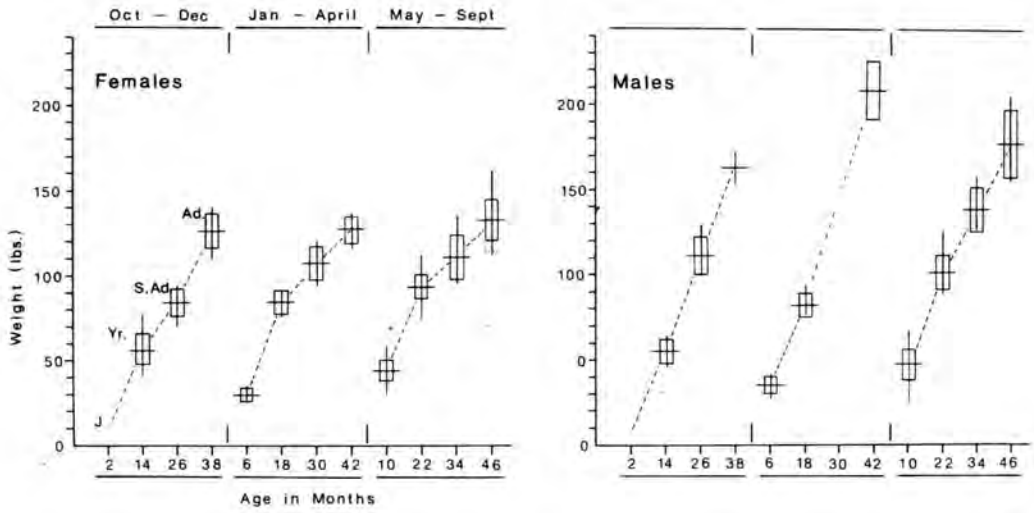
Fig. 83. Home range determinations for Susan and juveniles (full line) and for Mackintosh (broken line) between November, 1969 and June, 1970. Shaded grid square is where author's house is situated.

Grid squares = 100 yards x 100 yards

Note: Mackintosh evaded observers after April.



Appendix 3. Fig. 2. Head and body lengths of adult, sub-adult, yearling and juvenile warthog during three periods of the year. Horizontal bars represent sample mean, vertical bars the range and rectangles the mean ± one standard deviation.



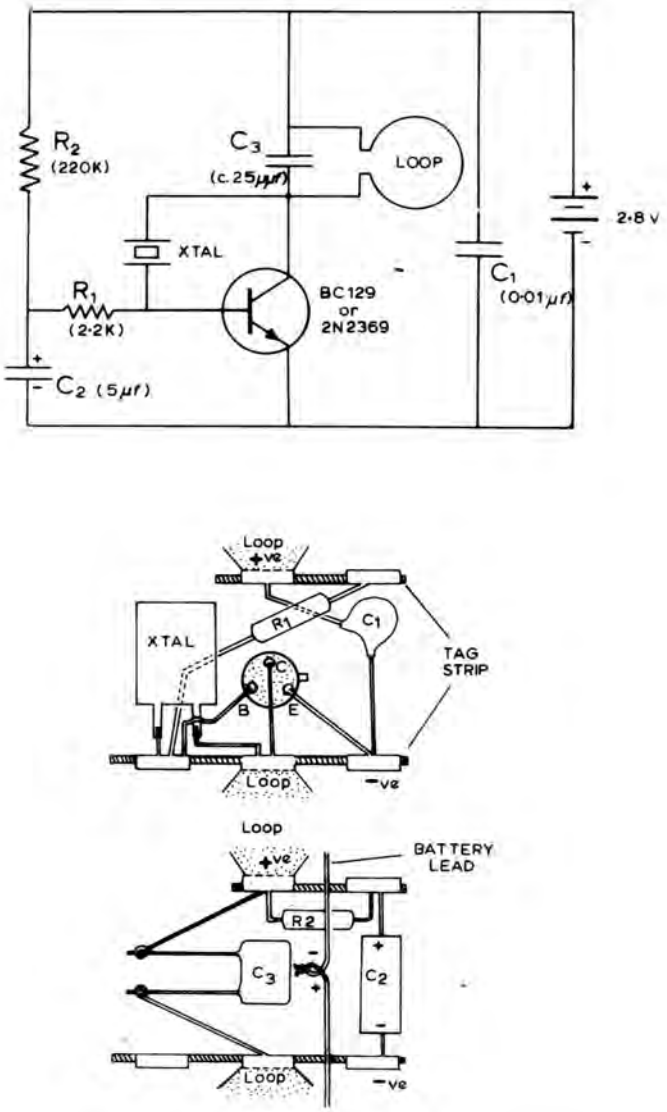
Appendix 3, Fig. 3. Weights of adult, sub-adult, yearling and juvenile warthog during three periods of the year. Symbols as in Fig. 2.

Appendix 4, Fig. 1. Tunnel-shaped net set at entrance to warthog hole.

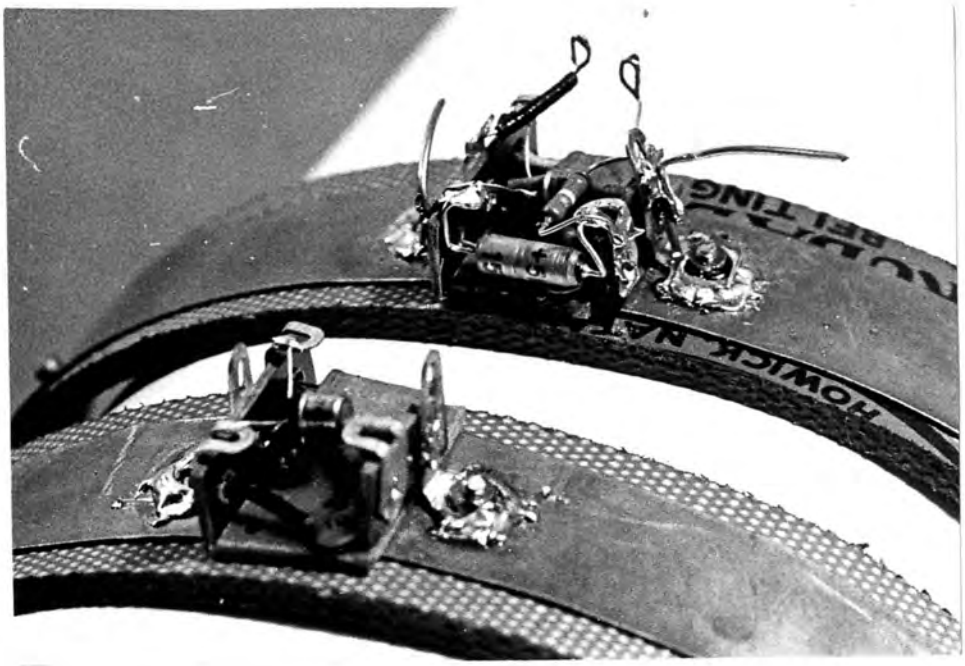
Appendix 4, Fig. 2. Method of carrying net when rushing onto hole.

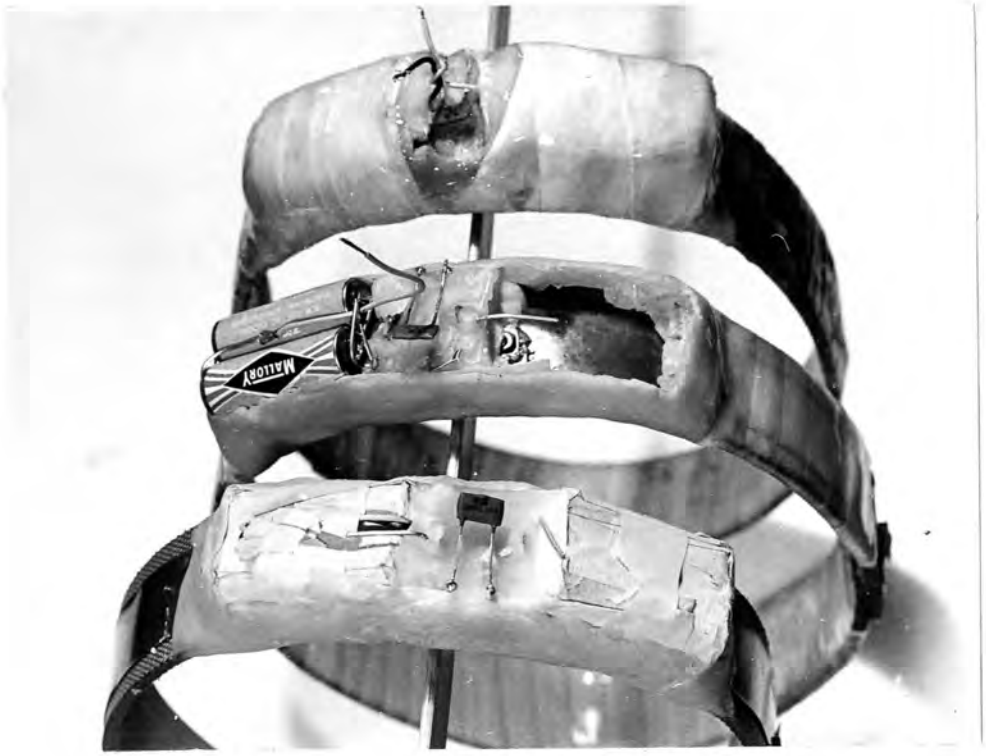
Appendix 4, Fig. 3. Adult female warthog bound and being held down.

Appendix 4, Fig. 4. Shoulder harness fitted to a tame warthog
(Other tags are illustrated in Fig. 8.)



Appendix 5, Fig. 1. Transmitter circuit (upper diagram) and arrangement of transmitter components (centre and lower diagrams). Components in centre diagram lie nearest the collar while those in the lower diagram are situated above them (see also Fig. 2)





Appendix 5, Fig. 2. Photographs of collar construction and final stages of potting.

Appendix 5, Fig. 3. Recovered radio collar with large pack of adhering mud. (see Appendix 5, page 6).

TABLE 1.

List of large mammals occurring in Sengwa Research Area. An indication of the abundance of various species is also given. Abundance figures are based on the transect data and, in the case of elephants, on aerial surveys. These data are approximations and intended only to give a general impression of the game community in the Research Area of 150 sq. miles.

Colloquial name	Binomial	Abundance
Elephant	Loxodonta africana (Blumenbach)	150 - 250
Rhinoceros	Diceros bicornis (L.)	1 or 2
Zebra	Equus burchelli Gray	up to 200
Bushpig	Potamochoerus porcus (L.)	very uncommon *
Warthog	Phacochoerus africanus (Gmelin)	1,300 +
Duiker	Sylvicapra grimmia (L.)	numerous
Grysbok	Raphiceros sharpei Thomas	numerous
Klipspringer	Oreotragus oreotragus (Zimmerman)	common
Reedbuck	Redunca arundinum (Boddaert)	200
Waterbuck	Kobus ellipsiprymnus (Ogilby)	100 - 200
Impala	Aepyceros melampus (Lichtenstein)	2,000 +
Roan	Hippotragus equinus (Desmarest)	up to 15
Sable	Hippotragus niger (Harris)	75
Bushbuck	Tragelaphus scriptus (Pallas)	numerous in riverine areas
Kudu	Strepsiceros strepsiceros (Pallas)	400 - 800
Eland	Taurotragus oryx (Pallas)	uncommon
Buffalo	Syncerus caffer (Sparrman)	200 - 300
Predators		
Jackal	Canis adustus Sundeval	common
Wild Dog	Lycaon pictus (Temminck)	occasional small pack
Hyaena	Crocuta crocuta (Erxleben)	fairly numerous
Serval	Felis serval Schreber	? occurs
Leopard	Panthera pardus (L.)	? numerous
Lion	Panthera leo (L.)	5 - 20
Cheetah	Acinonyx jubatus (Schreber)	occasionally seen

* Limited in distribution to large thickets and very seldom seen (3 times in 5 years) - Spoor and rooting sign are also seldom encountered.

TABLE 2.

Periods during which activities of tame free-ranging warthog were recorded. Activities and locality were recorded at intervals of 10 minutes throughout the day except in April, 1969 when activities were recorded for half day periods. Abbreviations for animals names are : S - Susan ; M - Mackintosh ; So - Sophie ; G - Gladys. 4J or 3J refers to Susan's offspring which were born on 31st November, 1969.

Month	~~Animal or group~~ Animal or group	Dates observed	No of days
April 1969	S + M + So + G	4-10,12,15	11
	S + M	16,18-21,23,24,26	9
May	S + M	4-14	11
June	S + M	2-9	8
		14-25.	12
July	S + M	4,5,7-22	18
August	S + M	17-28	12
September	S + M	10-27	18
October	S + M	18-29	12
November	S + M	14-21	8
	S + 4J	22-30	9
	M alone	22-25	4
December	S + 4J	1-31	31
January 1970	S + 4J	1-27	27
	M alone	20-27	8
February	S + 4J	3-24	22
	M alone	3-18	18
May	S + 3J	4-15	12
	M alone	5,7,8,10-15,21,23, 26	12
April	S + 3J	15-26	12

TABLE 3.

Summary of transect density data for warthog. Number of animals seen, number of traverses of entire transect system and mean of monthly densities for each year are given.

Year	Number of warthog seen	Number of Traverses	Mean Monthly Density/km^2.	Months (N)	S.E.*	Mean ± 2 x S.E.
1965	1,888	32	4.97	4	0.412	4.56 - 5.38
1966	3,516	196	2.10	11	0.135	1.82 - 2.36
1967	4,869	235	2.32	12	0.177	1.97 - 2.66
1968	7,249	256	3.34	12	0.321	2.70 - 3.98
1969	5,122	188	3.17	9	0.507	2.66 - 3.68
Total	22,644	907				

* S.E. = Standard error of mean.

TABLE 4.

Areas and proportions of various habitats sampled in transect area.

Habitat	Area sampled Dry Season	Area sampled Wet Season	% of Total Transect Area Dry Season	% of Total Transect Area Wet Season
Drainage line grassland in C.mopane (mopane vlei)	21.2	14.8	2.31	1.87
Acacia tortilis-Grewia communities	54.3	24.0	5.93	3.03
C.mopane-Combretum sp.-Tristachya W.B.G.	30.6	26.7	3.34	3.37
Various contacts	43.0	30.5	4.69	3.85
C.mopane woodland	453.5	453.5	49.51	57.19
Setaria-Andropogon grassland with A.tortilis	41.6	2.5	4.54	0.32
Acacia albida-Hyparrhenia W.G.	32.0	17.1	3.49	2.16
Combretum woodland and W.B.G.	14.2	14.2	1.55	1.79
Brachystegia woodland	90.0	90.0	9.83	11.35
Brachystegia-C.mopane contacts	22.0	22.0	2.40	2.77
Sengwa flood plain grassland	69.4	53.6	7.58	6.76
Combretum thickets	30.3	30.3	3.31	3.82
Baikiaea woodland and Baphia thickets	14.1	14.1	1.52	1.78
	916.2 ha	793.3 ha		

Note : Areas were determined from visibility profiles (page 16 of text).

TABLE 5.

Warthog densities (warthog/km^2) in various habitats. (Data plotted in Fig. 16)

Habitat	N.*	Mean	S.D.	S.E.	Mean ± 2 x S.E.	Range
A. C.mopane vlei	26	12.33	6.57	1.29	9.75 - 14.91	2.62 - 37.20
B. Acacia tortilis-Grewia communities	39	7.70	5.20	0.84	6.02 - 9.38	1.44 - 24.25
C. C.mopane-Combretum sp.-Tristachya W.B.G.	26	5.73	4.06	0.80	4.13 - 7.33	0 - 14.83
D. Various contacts	39	3.91	3.10	0.50	2.91 - 4.91	0 - 14.03
E. C.mopane woodland	78	3.68	5.57	0.63	2.42 - 4.94	0.35 - 37.87
F. Setaria-Andropogon grassland & A.tortilis	13	3.12	2.81	0.78	1.56 - 4.68	0.28 - 9.38
G. Acacia albida-Hyparrhenia W.G.	13	2.73	2.14	0.59	1.55 - 3.91	0.60 - 7.38
H. Combretum woodland & W.B.G.	13	2.25	1.77	0.49	1.27 - 3.23	0.48 - 5.97
I. Brachystegia woodland	26	1.27	1.54	0.30	0.67 - 1.87	0.02 - 5.55
J. Brachystegia-C.mopane contacts	26	1.09	1.43	0.22	0.65 - 1.53	0 - 4.49
K. Sengwa flood plain grassland	13	1.24	0.82	0.23	0.78 - 1.70	0.54 - 3.35
L. Combretum thickets	39	0.95	1.35	0.22	0.51 - 1.39	0 - 6.40
M. Baikiaea woodland	13	0.34				0 - 0.85

* N. = number of seasonal density determinations. For example, in C.mopane woodland, there are 6 "plots" of this habitat (one "plot" on each transect pair) and from the dry season of 1965 to the dry season of 1969 13 density determinations were made for each plot, i.e. 78 seasonal density determinations.

S.D. = Standard deviation

S.E. = Standard error of mean.

TABLE 5a.

Mean seasonal habitat densities. (Warthog/km^2)

Habitat	Dry 1965	Wet	Cold	Dry 1966	Wet	Cold	Dry 1967	Wet	Cold	Dry 1968	Wet	Cold	Dry 1969	Overall Mean(2)
Mopane vlei	14.55	9.92	14.28	8.69	7.01	11.35	15.89	9.26	15.46	10.64	4.88	27.51	6.25	12.23
A.tortilis-Grewia communities	10.42	4.35	4.08	5.66	2.68	2.89	6.48	8.68	11.17	9.48	6.17	12.32	6.71	7.51
C.mopane-Combretum-Tristachya W.B.G	11.69	3.88	2.31	5.45	1.69	5.12	5.17	2.46	4.89	12.57	6.08	6.92	5.78	5.72
Various contacts	8.04	2.49	1.33	2.86	1.06	1.11	3.31	3.25	4.28	6.72	2.78	9.58	4.34	3.91
C.mopane woodland	5.25	2.66	1.61	2.59	2.82	2.22	2.37	3.68	3.52	9.56	4.92	4.17	2.60	3.68
Setaria-Andropogon G.+ A.tortilis	1.10	3.50	0.28	1.24	0.10	0.50	0.84	2.98	3.19	8.61	2.27	2.87	9.38	3.12
Acacia albida-Hyparrhenia W.G.	6.90	2.50	1.22	2.90	2.60	0.60	3.84	1.13	1.53	7.38	1.46	1.46	1.90	2.73
Combretum woodland & W.B.G.	3.69	2.38	0.73	1.72	0.48	0.79	2.45	0.12	1.71	5.20	1.81	5.97	2.15	2.25
Brachystegia woodland	4.99	1.06	0.19	0.78	0.47	0.51	0.89	0.27	0.94	3.06	0.41	1.94	0.91	1.27
Brachystegia-C.mopane contacts	3.35	1.59	1.29	1.71	0.74	0.43	1.48	0.54	1.26	2.06	0.12	1.12	0.43	1.24
Sengwa Flood plain grassland	3.03	0.19	-	0.76	0.05	0.35	3.19	0.99	0.71	1.34	0.82	0.27	1.93	1.09
Combretum thickets	4.13	1.60	-	1.90	0.33	0.56	0.36	0.59	0.85	0.49	0.52	0.32	0.97	0.95
Baikiaea W. & Baphia thickets	0.85	0.50	-	0.20	0.40	-	0.75	0.62	0.10	0.77	-	0.30	-	0.34
Total :	67.20	34.90	27.37	37.12	20.87	26.43	46.94	34.57	49.61	77.90	32.24	74.75	43.35	
Mean(1)	5.17	2.68	2.11	2.86	1.61	2.03	3.61	2.66	3.82	5.99	2.48	5.75	3.34	

Note : Density figures given in the body of the table are mean densities for each season for each habitat type. For example in C.mopane there are 6 areas (one on each pair of transects) for which a seasonal density figure was calculated. The mean of these density determinations for each season is given here. Means (1) and (2) are thus properly means of means. The mean for each habitat type between Dry season 1965 and Dry season 1969 is given in Table 5. Data are plotted in Fig. 17.

TABLE 6.

Warthog densities and habitat features in 6 areas of C.mopane woodland.

Area	Mean Seasonal Density ± 2 x S.E.	Range	Habitat features
Transects 1 and 2	1.6 ± 0.57	0.6 - 3.8	Dry, poorly grassed area with Aristida sp. predominating. Surrounded by Brachystegia and Combretum communities. Few warthog holes.
Transects 3 and 4	4.4 ± 1.05	1.1 - 10.0	Taller woodland than on 1 and 2 and also has areas of Sporobolus-Chloris grassland. Water in Sengwa River. Spring near western end of Transect 3. Many erosion-gulley type holes and adjacent to Acacia-Grewia communities.
Transects 5 and 6	2.5 ± 0.58	1.0 - 4.3	Uniform C.mopane woodland with an almost closed canopy. Grass cover mainly Aristida sp. except in drainage lines where O.barthii is present in some seasons. Holes few although many on edge of Sengwa flood plain. C.mopane - Combretum sp.-Tristachya habitat to east of woodland.
Transects 7 and 8	4.01 ± 0.82	2.0 - 6.1	Sporobolus-Chloris grass cover in most parts except to west of Lutope River. Water available in Sengwa River. Adjacent to Acacia riparian communities and C.mopane-Combretum sp.-Tristachya. Many erosion-gulley type holes.
Transect 9	6.96 ± 5.4 * 4.2 ± 2.2	0.9 - 37.9 0.9 - 15.3	Part of this area is in open C.mopane which approaches mopane vlei habitat. Remainder is closed, poorly grassed woodland. Holes occur in nearby Lutope flood plain. Adjacent to B. boehmii-Combretum-Hyparrhenia habitat and water readily available in Lutope River.
Transects 11 and 12	2.6 ± 0.50	1.4 - 4.1	Open C.mopane woodland. Grassland is predominantly Aristida sp. Densities higher on Transect 11 than 12. Transect 11 passes near drainage line grassland in C.mopane (mopane vlei) which is well used by hogs. Holes in drainages to south east and water in Lutope River throughout the year.

* including an extreme season in which a density of 37.9 hogs/km^2 was observed.

S.E. Standard error of mean.

TABLE 7.

Numbers of adults, yearlings and juveniles classified in each two-month period between April, 1965 and January, 1970. Ratios of juveniles/adult and yearling/adult are plotted in Fig. 22.

Month & Year of Sample	Year Class	Number observed and classified				Ratio	
		Adult	Yr.	Juv.	Total	Juv./Ad.	Yr./Ad.
Apr.-May 1965	1964+	26	1	41	68	1.58	0.38
June-Jul.		47	5	57	109	1.21	0.11
Aug.-Sep.		32	11	60	103	1.87	0.34
Oct.-Nov.	1965	323	355	54	732	0.17	1.10
Dec.-Jan.1966		100	112	125	337	1.13	1.12
Feb.-Mar. *		107	65	89	261	0.83	0.61
June-Jul.		85	32	109	226	1.28	0.38
Aug.-Sep.		129	59	120	308	0.93	0.46
Oct.-Nov.	1966	129	109	47	285	0.36	0.84
Dec.-Jan.1967		260	114	308	682	1.18	0.44
Feb.-Mar.		169	126	299	594	1.77	0.75
Apr.-May		240	121	344	705	1.43	0.50
Jun.-Jul.		241	129	380	750	1.58	0.54
Aug.-Sep.		211	82	371	664	1.76	0.39
Oct.-Nov.	1967	387	539	116	1042	0.30	1.39
Dec.-Jan.1968		76	66	92	234	1.21	0.87
Feb.-Mar.		99	43	130	272	1.31	0.43
Apr.-May		257	131	346	734	1.35	0.51
Jun.-Jul.		121	79	173	373	1.43	0.65
Aug.-Sep.		223	131	299	653	1.34	0.58
Oct.-Nov.	1968	525	358	47	930	0.09	0.68
Dec.-Jan.1969		307	235	281	823	0.92	0.77
Feb.-Mar.		302	296	320	918	1.10	0.98
Apr.-May		239	253	268	760	1.12	1.10
Jun.-Jul.		309	263	304	774	0.98	0.85
Aug.-Sep.		467	428	552	1447	1.18	0.92
Oct.-Nov.	1969	361	197	45	603	0.13	0.55
Dec.-Jan.1970		249	69	188	506	0.76	0.28

* 10 animals classified and included in April-May sample.

Figures given against Feb-Mar, 1966 are for April-May. Row for Feb-Mar should be blank.

+ Year class refers to juveniles. Yearlings are of previous year-class - i.e. 1963.

TABLE 8

Comparison of ratios of juveniles/adult and yearlings/adult warthog from field classifications and from a captured sample.

	Field classifications.	Captured.
Total sample	609	44
Number of adults	197	14
Number of yearlings	139	11 *
Number of juveniles	273	20
Ratio juveniles/adult	1.39	1.43
Ratio yearlings/adult	0.71	0.79

(* 3 yearlings which escaped through the nets during capture have been included in the sample).

Data were obtained in the Lutope Experimental Area during August, 1969. Field classifications represent the sum of animals classified during August; many individuals were seen and classified more than once during the 24 day capture operation.

TABLE 9.

Proportion of males in adult and sub-adult warthog classified in the field between October, 1965, and September, 1969, and ratios of sexually mature animals during the mating season.

(a) Proportion of ♂♂ in adult population.

Months	1965-66		1966-67		1967-68		1968-69	
	N.*	♂♂ %	N.	♂♂ %	N.	♂♂ %	N.	♂♂ %
Oct. - Nov.	-	-	-	-	204	29.9	235	35.3
Dec. - Jan.	-	-	-	-	66	42.4	177	30.5
Feb. - Mar.	-	-	137	29.9	63	25.4	185	21.6
Apr. - May	-	-	155	40.7	152	30.3	166	27.7
June - Jul.	-	-	156	19.9	75	18.7	201	34.3
Aug. - Sep.	-	-	104	17.3	159	22.6	212	44.8

Samples were small during 1965-66 and distinctions between adult and sub-adult animals were not always made.

(b) Proportion of ♂♂ in adults + sub-adults.

Months	1965-66		1966-67		1967-68		1968-69	
	N.	♂♂ %	N.	♂♂ %	N.	♂♂ %	N.	♂♂ %
Oct. - Nov.	254	44.0	101	39.6	292	35.3	446	50.0
Dec. - Jan.	47	40.4	201	46.3	87	46.0	267	47.6
Feb. - Mar.	-	-	146	29.5	84	39.3	273	40.7
Apr. - May	49	53.1	176	37.4	220	41.4	227	42.3
June - July	40	46.3	177	23.7	101	27.7	261	39.1
Aug. - Sep.	52	46.1	139	21.6	199	30.2	293	54.6

(c) Proportion of fully mature ♂♂ (42 months +) to mature ♀♀ (18 months +)

Year	Months	Numbers classified			Ratio
		♂♂	♀♀	♂♂ %	♂ : ♀♀
1966-67	Apr. - May	94	338	21.8	1 : 3.6
1967-68	Apr. - May	60	270	18.2	1 : 4.5
1968-69	Apr. - May	115	423	21.4	1 : 3.7

(d) Proportion of mature ♂♂ (30 months +) to mature ♀♀ (18 months +)

Year	Months	Numbers classified			Ratio
		♂♂	♀♀	♂♂ %	♂ : ♀♀
1966-67	Apr. - May	108	338	24.2	1 : 3.1
1967-68	Apr. - May	119	270	30.5	1 : 2.3
1968-69	Apr. - May	198	423	31.9	1 : 2.1

* N. = Number of animals classified in each two month period.

TABLE 10

Yearling losses in 1964 to 1967 year classes

	1964	1965	1966	1967	1968
a	1.85	0.93	1.76	1.34	1.19
b	0.45	0.39	0.58	0.92	0.42
a - b	0.40	0.54	0.18	0.42	-
% loss	75%	58%	67%	31%	-

Percentage annual decline in the yearling population is calculated from the following expression :

$$\% \text{ yearling loss} = \frac{a - b}{a} \times 100$$

a = recruitment of juveniles into yearling class (juvenile/adult ratio in September).

b = recruitment of yearlings into adult class (yearling/adult ratio of the following year).

Data are plotted in Fig. 22.

TABLE 11

Sex ratio of Warthog

Totals of animals classified between October, 1965, and January, 1970

Population Category	Number of Hogs Classified	Sex ratio ♂♂ : ♀♀	X^2	Probability*
Overall	7,134	43.5 : 56.5	77.52	< 0.001
Juveniles	289	45.3 : 54.7	2.53	> 0.1
Yearlings	2,067	51.5 : 48.5	1.80	> 0.1
Sub-adults	1,140	61.5 : 38.5	60.2	< 0.001
Adults	3,638	33.2 : 64.8	411.8	< 0.001
Adults + sub-adults	4,778	39.9 : 60.1	193.68	< 0.001

* Hypothesis tested. Sex ratio = 50 : 50. Sex ratio differed significantly from 50 : 50 in all but juvenile and yearling age classes.

TABLE 12.

Sex ratio in each year (all age classes)

Year	Number of Hogs Classified	Sex ratio ♂ : ♀	χ^2	Probability (Sex ratio = 50 : 50)
A. 1965/66	557	46.3 : 53.7	3.02	<0.1 ; >0.05
B. 1966/67	1,296	34.0 : 66.0	133.52	<0.001
C. 1967/68	1,517	40.6 : 59.4	53.54	<0.001
D. 1968/69	3,070	47.8 : 52.2	58.84	<0.02 ; >0.01

Hypotheses tested: (i) Overall sex ratio in each year = 50 : 50.

(ii) Sex ratio the same in each year i.e. A = B = C = D $\chi^2 = 77.7$, d.f. = 3. $P < 0.001$ and overall sex ratio differed during four year period.

TABLE 13

Proportion of adult, sub-adult and yearling males in each year (Oct-Sept)

Year	Proportion of ♂♂ in Age Class			
	Adults	Ad. + S.Ad.	S.Ad.	Yearling
A. 1965-66	-	45.2 +	-	50.7 o
B. 1966-67	33.5	33.1	29.1	33.7
C. 1967-68	27.9	36.0	58.3 ++	47.8 o
D. 1968-69	30.3	43.9	73.1	56.2
Adjusted 68/69	38.6 ++	43.9	50	

Hypotheses : (i) Sex ratio = 50 : 50 for each proportion in table

\+ = $P < 0.05$
++ = $P < 0.01$
o = $P > 0.05$

Sex ratio differed significantly from 50 : 50 except in yearlings during 1965-66 and 1967-68.

(ii) A = B = C = D for each age class i.e. sex ratio was same in each year.

Adults $X_2^2 = 5.93$ d.f. = 2 $P > 0.05 : < 0.10$
Ad. + S.Ad. $X_2^2 = 42.50$ d.f. = 3 $P < 0.001$
Sub-adults $X_2^2 = 76.05$ d.f. = 2 $P < 0.001$
Yearlings $X^2 = 59.72$ d.f. = 3 $P < 0.001$

Sex ratio the same in adults between 1966 and 1969 but differed in S.Ad and yearlings.

Note : Adjusted values for proportion of ♂♂ in 1968-69 were obtained by assuming a sex ratio of parity in sub-adults and additional ♂♂ in the classified sample of sub-adults were included in the adult category.

TABLE 14.

Summary of warthog sex ratio data from various sources.

A. Field classifications.

Author	Country	Sex ratios					
		% ♂♂	:	% ♀♀	♂	:	♀♀ (1)
Bourliere (1965)	Congo	34.2	:	65.8	1	:	1.9
Child et al. (1968)	Botswana	* 27.5	:	72.5	1	:	2.6
Cumming (this report)	Rhodesia	+ 33.2	:	64.8	1	:	2.0
Dasmann and Mossman (1962)	Rhodesia	≠ 42.2	:	57.8	1	:	1.4
Fradrich (1965)	Kenya	35.4	:	64.6	1	:	1.8
Jarman (1968)	Rhodesia	50.0	:	50.0	1	:	1

(* Calculated from quoted figures of 57.3 ♂♂ : 100 ♀♀).

(≠ Calculated from quoted figures of 73 ♂♂ : 100 ♀♀ - Henderson's Ranch)

(+ Ratios for adults, see Table 11 for overall ratio.)

B. Kill or capture records

Author	Area in Rhodesia	Sex ratios					
		% ♂♂	:	% ♀♀	♂	:	♀♀
Child (1968)	Kariba islands	50	:	50	1	:	1
	Nagupande	50	:	50	1	:	1
Dasmann and Mossman (1962)	Henderson's Ranch	51.9	:	48.1	1	:	0.9
Jarman (1968)	Kariba (Operation Noah)	* 43.6	:	56.4	1	:	1.3
Junor (1960)	Kariba (Operation Noah)	+ 35.1	:	64.3	1	:	1.8

(* Calculated from data given on page 119 of Jarman's thesis)

(+ Calculated from data given by Junor, 1960)

(1) Sum of ♀♀, or % of ♀♀, divided by sum of ♂♂, or % of ♂♂.

TABLE 15.

Numbers of male and female warthog shot on Tsetse controlled hunting operations in north western Rhodesia.

A. Sebungwe Controlled Hunting Area.

Year	Males N.	Males %	Females N.	Females %	Total
1964 - 65	996	46	1,178	54	2,174
1965 - 66	252	51	240	49	492
1966 - 67	410	49	430	51	840
Totals :	1,658	47%	1,848	53%	3,506

$X^2 = 10.148$ $P < 0.005$, Ratio differs significantly from 50 : 50

B. Gokwe - Sanyati - Sessami Controlled Hunting Area.

Year	Males N.	Males %	Females N.	Females %	Total
1964 - 65	556	52.5	504	47.5	1,060
1965 - 66	92	46.5	106	53.5	198
1966 - 67	252	41	364	59	616
Totals :	900	48	974	52	1,874

$X^2 = 2.92$ $P > 0.05$, < 0.10, Ratio not significantly different from 50 : 50.

Data compiled by Mr. A. G. Robertson from records of the Tsetse and Trypanosomiasis Control Branch of the Department of Veterinary Services.

TABLE 16.

Species of grass eaten by warthog in the Sengwa Research Area. Table indicates whether record was derived from the field or from tame warthog, or both; the part of the plant eaten and in which season the record(s) were made. Abbreviations (under season) are : lvs. = leaves, b.l. = swollen basal portion of leaf; inf. = inflorescence and rh. = rhizome.

Species	Source of Record		Part of plant eaten				Season in which recorded	
	Wild hogs	Tame hogs	Leaves	Swollen Basal lvs. or stem	Rhizomes	Inflores-cence	Wet Season	Cold & Dry Season.
Aristida curvata		X	X				X	
rhiniochloa		X	X				X	
Brachyachne patentiflora		X	X				X	
Brachiaria brizantha		X	X				X	
eruciformis		X	X				X	
grossa	X	X	X			X	X	
nigropedata	X	X	X				X	
Chloris virgata	X	X	X			X	X	
Cynodon dactylon	X	X	X				X	X
Dactyloctenium giganteum	X	X	X			X	X	
Digitaria milanjiana	X	X	X		X		X lvs	X rh.
Echinochloa colonum	X	X	X			X	X	
pyramidalis		X			X			X
Eragrostis denudata		X	X				X	
rigidior		X	X				X	
rotifer		X	X				X	
superba		X	X				X	
sp.(sp.no.2/ 69 Sengwa)		X	X				X	
Heteropogon contortus	X			X				X
Hyparrhenia rufa	X	X			X			X
Leersia hexandra	X	X				X	X	
Oryza barthii		X			X			X
Panicum maximum		X	X			X	X	
Phragmites sp.		X			X			X
Sacciolepis africana	X	X	X	X			X	
Schizachyrium jeffreysii	X		X				X	X
Schmidtia pappophoroides		X	X				X	
Setaria pallide-fusca		X	X			X	X	
sphacelata	X		X	X			X	X b.l.
Sorghum versicolor		X				X	X	
Sporobolus albomarginatus	X	X	X			X	X	X
angustifolius		X	X			X	X	
festivus		X	X			X	X	
marginatus	X	X	X			X	X	X lvs.
panicoides		X	X			X	X	
Tristachya superba	X	X	X		X		X lvs	X rh.
Urochloa bolbodes	X	X	X	X		X	X lvs	X b.l.
pullulans	X	X	X			X	X	
trichopus	X	X	X			X	X	

TABLE 17.

Summary of wet season feeding minutes recorded on tame free ranging warthog during February and March in 1967, 1968 and 1969. Times given against each species are those during which animals spent cropping the respective grass (see page 20 for method in which minutes were recorded.) "Favoured" species are underlined.

Species eaten	Feeding time in minutes	% of total feeding time.
Brachiaria grossa	3.13	1.1
Brachyachne patentiflora	2.75	0.95
Chloris virgata	65.73	22.67
Dactyloctenium sp.	1.07	0.37
Digitaria milanjiana leaves	24.70	8.51
roots	6.15	2.12
Echinochloa colonum	1.42	0.49
Eragrostis sp.	7.13	2.46
Panicum maximum	2.45	0.84
Setaria pallide-fusca	18.37	6.33
Sporobolus angustifolius	0.25	0.09
Sporobolus festivus	28.80	9.93
Sporobolus marginatus	67.54	23.29
Sorghum versicolor	0.45	0.02
Tristachya superba	4.45	1.53
Urochloa pullulans	23.99	8.27
Urochloa trichopus	16.60	5.72
Unidentified grasses	4.85	1.67
Liliaceous plants	4.50	1.85
Portulaca hereroense	3.50	1.21
Ipomoea sp.	3.20	1.00
Totals :	291.03	100.42

TABLE 18.

Summary of feeding minutes recorded on two tame warthog during September 1969.

(a) Minutes Recorded :

	Feeding	Walking	Other	Total
Susan	68.99	15.0	6.01	90
Mackintosh	89.62	20.78	9.60	120
Total	158.61	35.78	15.61	210
%	75.53	17.03	7.04	

(b) Time spent feeding on various grass species :

Species and part of plant eaten.	Feeding Time (mins.) Susan	Mackintosh	Total	% of Total Feeding Time
Digitaria milanjiana (rhizomes)	53.99	15.45	69.44	43.8%
Tristachya superba (rhizomes)	10.95	69.27	80.22	50.6%
Hyparrhenia rufa (rhizomes)	0.45	-	0.45	0.3%
Schmidtia pappophoroides (leaves)	1.35	-	1.35	0.9%
Eragrostis sp. (leaves)	1.75	-	1.75	1.1%
Urochloa bolbodes (leaves)	-	1.90	1.90	1.2%
Schizachyrium (leaves)	0.20	3.00	3.20	2.0%
Unidentified (leaves)	0.30	-	0.30	0.2%
	68.99	89.62	158.61	100.1

Differences between Susan and Mackintosh in amount of time spent on D.milanjiana and T.superba reflect differences in the sites at which minutes were recorded rather than individual differences.

TABLE 19.

Comparison of rhinarium digging by warthog and bushpig. Observations made on tame free ranging animals at Sengwa Gorge (see page 76 *et seq.* Vol. I).

	WARTHOG	BUSHPIG
Soil type	Dig in very hard, even baked earth, as well as soft earth. Seldom in litter.	Dig in moist or loose earth; find breaking through encrusted ground difficult. Dig and turn over litter.
Type of Excavation	A shallow, often rounded depression or scooping. If many, then usually discrete but may overlap. (Fig.29b)	Deeper, almost ploughed appearance. Often extensive, irregular or furrowed.
Stance when digging.	Almost invariably resting on fore-carpals (callosities present even in foetus) and will walk on these.	Very seldom rests on fore-carpals and, if so, does not walk on them. Callosites on carpals not evident. Snout touches ground from standing position or as it walks along.
Rooting movement	Sharp forward scoop; often with a follow-through. Movement repeated if hole inadequate or food not found. Animal stays in one place.	Generally thrusts or pushes snout into and about in the earth and extends digging. May show scooping action. Animal moves around.
Digging in non-feeding situations	i) Shovel soil out of burrows with snout. May use feet to dig.	i) Does not live in burrow but scrapes resting place with feet before lying down.
	ii) Extensive (compulsive?) shovelling with snout while wallowing.	ii) Digs in mud while wallowing but to lesser extent than warthog.
	iii) Exaggerated shovelling in mounds of loose earth or sand accompanied by "play".	iii) Not stimulated by mounds of sand or loose earth except to look for food.
Types of food excavated by digging	Only observed digging for rhizomes of grasses and roots of other monocot. species.	Observed digging for roots of monocots. and dicots. (even large sections of tree roots), insects and grubs, old bones, frogs.

TABLE 20.

Frequency of rooting and main dry season foods in some vegetation types.

Traverse Number	Percentage of plots with : Rooting	T.superba	D.milanjiana	Vegetation type and comments
A1	nil	80	nil	Brachystegia woodland - small patch of rooting at end of traverse
A2	nil	40	nil	Brachystegia woodland.
1	64	92	12	C.mopane-Combretum sp.-Tristachya grassland
2	64	64	?	C.mopane-Combretum sp.-Tristachya grassland
3	76	56	?	C.mopane-Combretum sp.-Tristachya grassland. Rank Andropogon on 16% of plots
4	64	48	?	C.mopane-Combretum sp.-Tristachya grassland. Andropogon on 70% of plots
5	80	nil	100	C.mopane wooded grassland. 12 groups of faeces.
6	80	nil	100	D.milanjiana rooted but difficult to locate without inspecting rhizomes of grasses. Also Hyparrhenia co-dominant. 9 faecal groups on 6 and no Hyparrhenia.
7	72	28	36	Brachystegia-C.mopane wooded and bushed grassland.
8	64	20	4	Brachystegia-C.mopane wooded and bushed grassland.
9	56	32	?	C.mopane-Combretum sp.-Tristachya grassland

Traverses were each 250 yards long. Width of traverse approximately 3 ft.

Plots were 10 yard lengths of traverse. Traverses made in October 1967.

TABLE 21.

Number of times warthog have been observed using each of three types of artifical hole.

	Hole type. 1 single straight tunnel	2 single curved tunnel	3 two curved tunnels
Set 1	11	9	7
Set 2	6	16	19
Totals :	17	25	26

Note : The three types of hole within each set (illustrated in Fig. 40) were spaced approximately 15 m apart. Locations of Artificial Holes A1 (set 1) and A2 (set 2) within the Sengwa Experimental Area are shown in Fig. 35.

TABLE 22

Use indices of holes in the Sengwa Experimental Area. Visits represent spoor inspections and observation periods at the hole. Index gives the number of times holes were judged to be in use (spoor inspections) + number of times warthog were seen using the hole (observation periods) as a percentage of the total number of visits to the hole. Indices are mapped in Fig. 41, holes and hole numbers are shown in Fig. 35.

Hole Number	Visits	Use Index (%)	Hole Number	Visits	Use Index (%)
1	98	42	23	111	70
2	158	54	24	211	59
3	88	38	25	66	22
3a	47	46	27a	91	43
4	94	26	27b	72	52
4a	70	12	27c	69	39
5	84	25	29	224	78
5b	90	45	29a	68	43
5c	22	51	29b	47	47
6	66	10	30	91	70
7	121	32	31	118	49
8	98	33	33	132	53
9 - 10	205	56	34	96	38
9a	89	35	35	59	48
11	130	41	36	53	47
11a	73	33	37	99	29
13	132	53	38	75	32
13a	67	23	39	65	70
14	50	40	40	61	55
14a	58	32	41	48	25
17	97	27	42	103	31
17a	56	34	44	48	44
18	90	26	46	39	20
19	86	75	47	46	24
20	277	56	48	81	59
20a	278	45	50	38	27
20b	133	44	51	58	52
20c	133	3			
21	135	44			
22	142	53			

TABLE 23.

Wallowing and temperature in tame free-ranging warthog. Table includes all observations of wallowing made during the course of recording daily activities between 4 April, 1969 and 21 November, 1969. Wallowing records on those dates on which temperature was not, for one or other reason, recorded have been excluded, e.g. no thermometers were available during July when daily activities were recorded for 18 days (Table 2). Air temperatures were measured at the site of wallowing using a whirling psychrometer.

Air temperature (^{o}F)	Number of records
below 69	0
70 - 74	1
75 - 79	6
80 - 84	32
85 - 89	41
90 - 94	27
95 - 99	12
100 - 104	3
	Total : 122

TABLE 24.

Size of warthog sounders seen between December 1966 and November 1967

Sounder size	Dec.-Jan. N.*	Dec.-Jan. %+	Feb.-Mar. N.	Feb.-Mar. %	Apr.-May N.	Apr.-May %	June-July N.	June-July %	Aug.-Sept. N.	Aug.-Sept. %	Oct.-Nov. N.	Oct.-Nov. %	Total	Overall %
1	17	10.9	33	22.9	39	22.8	30	15.0	24	13.1	69	21.3	212	18.0
2	26	16.7	15	10.4	15	8.8	29	14.5	40	21.9	69	21.3	194	16.5
3	13	8.3	16	11.1	26	15.2	43	21.5	31	16.9	62	19.1	191	16.2
4	28	18.0	12	8.3	17	9.9	26	13.0	25	13.7	44	13.6	152	12.9
5	20	12.8	21	14.6	21	12.3	31	15.5	16	8.7	32	9.9	141	12.0
6	18	11.5	19	13.2	18	10.5	16	8.0	27	14.8	16	4.9	114	9.7
7	12	7.7	11	7.6	16	9.4	12	6.0	13	7.1	20	6.2	84	7.1
8	10	10.9	6	4.2	12	7.0	7	3.5	4	2.2	10	3.1	49	4.2
9	8	5.1	5	3.47	5	2.9	4	2.0	3	1.6	1	0.31	26	2.2
10	1	0.64	2	1.39			1	0.5			1	0.31	5	0.4
11	1	0.62	4	2.78	1	0.58							6	0.5
12							1	0.5			1	0.31	2	0.2
13					1	0.58							1	0.1
14														
15														
16	2	1.28											2	0.2
Total	156		144		171		200		183		325		1179	
Mean Group size	4.6		3.9		4.1		3.9		3.8		3.3		3.9	

* N. = number of groups seen

\+ % = percentage of groups

TABLE 25.

Sizes of warthog sounder seen between December 1968 and November 1969.

Sounder size	Dec.-Jan. N. *	Dec.-Jan. % +	Feb.-Mar. N.	Feb.-Mar. %	Apr.-May N.	Apr.-May %	June-July N.	June-July %	Aug.-Sept. N.	Aug.-Sept. %	Oct.-Nov. N.	Oct.-Nov. %	Total	Overall %
1	27	15.2	51	21.2	48	21.23	44	18.5	32	16.1	63	25.3	265	19.9
2	33	18.5	31	12.9	30	13.3	47	19.8	40	20.0	67	26.9	248	18.6
3	22	12.4	41	17.0	26	11.5	31	13.0	45	22.6	39	15.7	204	15.3
4	22	12.4	21	8.7	22	9.7	29	12.2	31	15.6	28	11.3	153	11.5
5	22	12.4	29	12.0	26	11.5	20	8.4	29	14.0	36	14.5	162	12.2
6	17	9.6	19	7.9	30	13.3	37	15.6	12	6.0	8	3.2	123	9.2
7	15	8.4	27	11.2	18	8.0	17	7.1	9	4.5	7	2.8	93	7.0
8	3	1.7	7	2.9	11	4.9	7	2.9			1	0.4	29	2.2
9	7	3.9	6	2.5	9	4.0	4	1.7	1	0.5			27	2.0
10	2	1.1	3	1.2	3	1.3							8	0.6
11			2	0.8			2	0.8					4	0.3
12	6	3.4	5	2.1	2	0.9							13	1.0
13														
14					1	0.4							1	0.1
15														
16	2	1.4											2	0.2
Total	178		242		226		238		199		249		1332	
Mean group size	4.4		4.1		4.2		3.8		3.3		2.9		3.7	

* N. = number of groups seen.
\+ % = percentage of groups

TABLE 26.

Percentage occurrence of large sounders (6 or more warthog) during the year.

Months	1966-67	1968-69
Dec. - Jan.	33.3	29.2
Feb. - Mar.	32.6	28.6
Apr. - May	31.0	24.8
Jun. - July	20.5	28.5
Aug. - Sept.	25.7	11.1
Oct. - Nov.	15.7	6.4

A χ^2 test of association between the frequency of large sounders and time of year reveals a significant association between the two variables. For the 1966-67 data $\chi^2 = 33.13$; d.f. = 5; $P \leq 0.001$. The decline of large sounders during the dry season is even more evident in the 1969 data. (See Tables 24 and 25 for numbers of sounders observed.)

TABLE 27.

Percentage occurrence of sounder types based on age.

	Sounder type based on Age Structure	% Occurrence											
		Oct.1965 - Sep.1966			Oct.1966 - Sep.1967			Oct.1967 - Sep.1968			Sep.1968 - Oct.1969			Total		
		N.+	%		N.	%		N.	%		N.	%				
Solitary Animals	1. Adult	51	14.9		147	13.5		92	11.5		153	13.3		443	13.1	
	2. Sub-adult	7	2.1		34	3.1		31	3.9		60	5.2		132	3.9	
	3. Yearling	2	0.6	18.4*	17	1.6	19.21	15	1.9	17.3	20	1.7	20.2	54	1.6	19.05
	4. Juvenile	3	0.9		11	1.0								14	0.4	
Groups of only one age class	5. Adults	55	16.1		58	5.3		33	4.1		23	2.0		169	5.0	
	6. Sub-adults	10	2.9		26	2.4		30	3.9		63	5.5		129	3.8	
	7. Yearlings	33	9.7	31.6	75	6.9	16.08	75	9.4	18.2	80	7.0	15.7	263	7.8	17.98
	8. Juveniles	9	2.6		16	1.5		7	0.88		14	1.2		46	1.4	
Groups of mixed age class but no juveniles	9. Adult + Sub-adult	4	1.2		28	2.6		39	4.9		54	4.7		125	3.7	
	10. Adult + Yearling	39	11.4		75	6.9		90	11.3		107	9.3		311	9.2	
	11. Sub-Adult + Yearling	4	1.2	14.6	20	1.8	12.59	24	3.0	22.7	68	5.9	21.9	116	3.4	18.37
	12. Ad. + S.Ad. + Yr.	3	0.9		14	1.3		28	3.5		23	2.0		68	2.0	
Groups which include juveniles	13. Adult + Juveniles	73	21.4		258	23.7		164	20.6		82	7.1		577	17.1	
	14. Sub-Adult + Juveniles			22.5	36	2.9	27.21	7	0.88	21.8	5	0.4	10.1	44	1.3	19.64
	15. Yearling + Juveniles	4	1.2		6	0.55		3	0.40		29	2.5		42	1.2	
	16. Ad. + S.Ad. + Juv.	2	0.6		50	4.6		23	2.9		24	2.1		99	2.9	
	17. Ad. + Yr. + Juv.	42	12.2		195	17.9		106	13.3		296	25.8		630	18.7	
	18. S.Ad. + Yr. + Juv.			13.2	7	0.6	24.91	11	1.4	19.9	14	1.2	32.1	41	1.2	24.97
	19. Ad. + S.Ad. + Yr. + Juv	1	0.3		19	1.8		19	2.4		19	2.4		34	3.0	
Total		342			1088			797			1149			3376		

\+ = number of sounders classified in the field

* = sum of percentages within cell

TABLE 28.

Percentage occurrence of sounder types based on Age and Sex in 1968 - 1969 sample.

	Sounder type based on Age Structure	Male Sounders N.(1)	% of Sounder type.	Female Sounders N.	% of Sounder type	Heterosexual Sounders N.(*)	% of Sounder type(+)	Total N.	% of Total	
Solitary Animals	1 Adult	134	77.5	39	22.5	-	-	173	16.9)	27.2% ≠
	2 Sub-adult	60	67	29	33	-	-	89	8.7)	
	3 Yearling	13	81	3	19	-	-	16	1.6)	
	4 Juvenile									
Groups of animals of only one age class	5 Adults	22	78.5	1	3.5	5 (5)	18 (1.8)	28	2.7)	14.7%
	6 Sub-adults	49	70	11	16	10	14	70	6.9)	
	7 Yearlings	25	48	10	29	17	33	52	5.1)	
	8 Juveniles									
Groups of mixed Age classes but no juveniles	9 Adult + Sub-adult	42	55	24	31	11 (5)	14 (6.5)	77	7.5)	23.9%
	10 Adult + Yearling	18	19.8	14	16	59 (4)	64 (4.5)	91	8.9)	
	11 S.Ad. + Yearling	50	77	1	1	14	22	65	6.4)	
	12 Ad. + S.Ad. + Yr.	4	36.5			7	63.5	11	1.1)	
Groups of animals which include juveniles	13 Adult + Juveniles			71	95	4 (2)	5 (2.5)	75	7.3)	9.6%
	14 S.Ad. + Juveniles			5				5	0.5)	
	15 Yearling + Juvenile			4	22	14	78	18	1.8)	
	16 Ad. + S.Ad. + Juv.			12	92	1	8	13	1.3)	24.6%
	17 Ad. + Yr. + Juv.			56	28	146 (7)	72 (3.5)	202	19.8)	
	18 S.Ad. + Yr. + Juv.			2	29	5	71	7	0.7)	
	19 Ad. + S.Ad. + Yr. + Juv.			6	21	23 (4)	79 (14)	29	2.8)	
	Totals :	417	40.8	217	21.3	316 (27)	31.0 (2.6)	1021		
	less Solitary	207	20.7							

* = number of heterosexual sounders which included Ad. ♂♂

\+ = percentage of heterosexual sounders which included Ad. ♂♂

≠ = sum of percentages within cell.

(1) = number of sounders classified in field.

TABLE 29.

Number of nursing - suckling periods per day for Susan and her juveniles. Full data are available and the limited information presented here is merely to indicate order of decline in nursing - suckling frequency per day during lactation.
(Juveniles born on November 21, 1969).

Date of Observation	Number of Nursing-suckling Periods	Date of Observation	Number of Nursing-suckling Periods
Jan. 4	11	Mar. 6	12
5	15	7	12
6	15	8	14
7	14	9	12
8	15	10	15
18	16	21	14
19	18	22	12
20	18	23	11
21	18	24	15
22	16	25	12
Feb. 3	11	April 5	8) half
4	12	7	8) day
5	14	9	7) only
6	13	12	7)
7	11	16	8
20	12	17	5
21	15	18	3
22	12	19	3
23	13	20	1
24	15	21	0 weaned

Note : Nursing-suckling could not be observed while animals were inside their hole.

TABLE 30.

Group cohesion in tame free ranging warthog. Table provides a measure of the degree to which members of a group act in concert, namely the percentage of time (or number of observations made at intervals of 10 minutes) all animals in the group are engaged in the same activity (i.e. eating, resting, walking, etc.).

Group	Month	Total number of 10 minute Observations	Observations in which all members of the group were engaged in the same activity.	
			Number	%
Susan and Mackintosh	May, 1969	719	618	86.0
	June	733	641	87.4
	July	1177	1015	86.2
	August	795	692	87.0
	September	1194	1043	87.4
	October	813	671	82.5
	November	500	421	84.2
Susan and Juveniles	December	490	215	43.9
	January, 1970	777	492	63.3
	February	1176	968	82.3
	March	798	682	85.5
	April	785	662	84.3
Juveniles only	December	490	344	70.2
	January 1970	777	606	78.0
	February	1176	1062	90.3
	March	798	737	92.4
	April	785	730	93.6

Observations of Susan and her juveniles do not include those times when Susan and her juveniles were in a hole or when Susan had left her juveniles in their hole.

Susan was accompanied by 4 juveniles during December to February and by 3 juveniles during March and April.

TABLE 31.

Size of home ranges of radio-tagged warthog. Months in which animals were tracked, the dates between which they were observed and the number of times they were seen are also shown.

Warthog	Months in which tracked during : 1968	1969	1970	Overall period of observation	Number of sightings Tracked by radio	Other	Home range Area (ha)
Ad. ♀ 104	-	-	Jan. Feb.	Aug. 67 - Feb. 70	18	27	93
110	-	Nov. Dec.	Jan. Feb.	Sep. 66 - Feb. 70	36		65
145	Sep. Oct.	Apr. May, Jun.	-	Sep. 68 - Jan. 70	37	47	120
149	Sep. Oct.	-	-	Sep. 68 - Dec. 68	12	6	104
158	Oct.	-	-	Oct. 68 - Jan. 70	2	13	198
171	-	Feb. Mar. Oct.	-	Feb. 69 - Jan. 70	18	22	184
178	-	Dec.	Jan. Feb.	Apr. 69 - Feb. 70	16	18	62
182	-	Apr. May-Jul. Sep. Dec.	Jan. Feb.	Apr. 69 - Feb. 70	45	42	86
184	-	May - Jul. Oct. - Dec.	Jan. Feb.	Mar. 69 - Feb. 70	44	14	130
232	-	Dec.	Jan. Feb.	Dec. 69 - Feb. 70	35	2	330
239	-	Dec.	Jan. Feb.	Dec. 69 - Feb. 70	16	-	65
240	-	Dec.	Jan. Feb.	Dec. 69 - Feb. 70	28	2	123
Ad. ♂ 161	Oct. Nov.	-	-	Oct. 68 - Jun. 69	16	5	112
175	-	Apr.	-	Apr. 69 - Apr. 69	10	-	78
176	-	Apr. - Jun.	-	Apr. 69 - Jul. 69	10	3	70
189	-	Jun. - Jul.	-	June 69 - Dec. 69	10	2	(31)*
Rosemary & Juv.	-	-	-	Oct. 68 - Dec. 68			140
Susan & Mack.	-	-	-	May 69 - Sep. 69	4,000		55
Susan & Juv.	-	-	-	June 70	c. 600		62
Mackintosh	-	-	-	Feb. 70	c. 600		64

* = Ad. ♀ 189 was later seen 2 km north and 2 km south of home range area determined in June - July. (see Fig. 71)

TABLE 32.

Movements and recaptures of tagged warthog.

Animal	Date of Capture	Hole	Date of Recapture	Hole	Distance km	Time months
Yr. ♀ 3	12. 8.66	19	15. 3.67	19	0	7
Ad. ♀ 4	12. 8.66	19	15. 3.67	19	0	7
S.Ad. ♀ 12	14. 9.66	24	17. 3.67	21	0.60	6
* Yr. ♀ 17	5.10.66	31	9. 8.69	64	0.15	34
* Yr. ♀ 18	5.10.66	31	9. 8.69	64	0.15	34
Yr. ♀ 30 or 32	18.10.66	29or 29a	12.12.69	24	0.30	38
Yr. ♀ 31	18.10.66	29a	13.12.67	shot	(15.0)	13
Ad. ♂ 42	13. 2.67	20a	21. 9.67	21	0.13	8
Ad. ♀ 50	15. 3.67	19	26. 4.67	19	0	1.25
Ad. ♀ 100	15. 8.67	42	12. 2.69	42	0	17
Ad. ♀ 104	18. 8.67	34	15.12.69.	A3	0.50	27
			17. 1.70	33	0.62	1
12 changed	13.12.67	21	11. 9.68	17a	0.46	18
to Ad. ♀ 145	11. 9.68	17a	13. 3.69	20b	0.63	6
			25. 3.69	24	0.46	0.5
			21. 5.69	24	0	2
Ad. ♀ 149	14. 9.69	22	23.11.69	56a	0.80	2
Yr. ♀ 156	26. 9.68	8	9.12.69	A6	0.66	1.5
Ad. ♀ 158	10.10.68	7	10. 3.69	11	0.4	5
Yr. ♀ 159	10.10.68	7	10. 3.69	11	0.4	5
Ad. ♀ 171	14. 2.69	10	18.10.69	10	0	9
Yr. ♂ 172	14. 2.69	10	21.10.69	78	2.35	9
Ad. ♀ 178	25. 4.69	24	12.12.69	24	0	7.5
Ad. ♀ 179	25. 4.69	24	12.12.69	24	0	7.5
Ad. ♀ 182	25. 4.69	24	26. 6.69	76a	0.42	2
			11.12.69	20	0.27	5.5
Ad. ♀ 184	17. 5.69	10	21.10.69	78	2.35	6
Yr. ♀ 185	17. 5.69	10	21.10.69	78	2.35	6
Juv. ♂ 186	17. 5.69	10	21.10.69	78	2.35	6
Yr. ♀ 190	26. 6.69	76a	11.12.69	20	0.27	5.5
24 Hogs			29 Recapt.		16.62 Av. 0.57 km	

Note. * Yr. ♀ 17 and Ad. ♀ 18 were caught and recaptured in the Lutope Experimental Area.

Average distance moved between points of capture was 0.57 km i.e. excepting the movement of 15 km by Yr. ♀ 31 who was shot outside the Research Area.

TABLE 33.

Percentage of observations of radio tagged warthog feeding in different grassland types during the wet and dry seasons.

		Habitat.		
	N *	Short grass (C.mopane woodland) areas	Tall grass (Digitaria - Tristachya various vegetation types)	Other
Wet Season	94	65%	8.5%	26.5%+
Cold and Dry Season	55	20%≠	71.0%	9.1%

* Number of contacts with radio tagged animals.

≠ 50% of these observations were of grazing in Acacia-Grewia during November when grass was short.

\+ 50% of these observations were of rooting.

Note : Apart from the exceptions noted above, observations during the cold and dry season were of rooting and observations during the wet season were of grazing.

TABLE 34.

Clans in Sengwa Experimental Area. Hole(s) in which animal was captured, month(s) of capture and holes used by each animal (sounder) are shown. Where a hole has been used more than once the number of observations of the animal using the hole are given in parenthesis. Data are summarised in Fig. 76 and holes used by tagged animals are are shown in Figs. 71 - 74. Holes are mapped in Fig. 35.

	Warthog	Hole at which captured	Month of Capture.	Holes used and number of observations - if used more than once	Holes * shared	
Clan A	Ad ♂ 36	31	Oct.66	Inspected hole 13 soon after capture.		Tag found near 31
	Ad ♀ 43	5	Feb.67	3, 44.	3	Tag found near 44
	Ad ♀ 232	31	Oct.69	A1-3, 30a(6), 5c(4), 30(3), 31, 90	2	
	Ad ♀ 239	31	Dec.69	5c, 30, 15b, 16a		
Clan B	Ad ♀ 93	7	Aug.67	8a, 13(2)		
	Ad ♀ 97	2	Aug.67.	47, 44	44	
	Ad ♀ 104	34, A-3,33	Aug.67,Dec.69 Jan.70.	1, 2(11), 3a(2), 47a(3), A-1, A-3(2), 33(7), 33a, 34a, 95.		
	Yr ♀ 156,157	8, A-6,	Sep.68,Dec.69	A-2, 2, 10, 8		with Ad ♀ 240 (Cl. C?) when using A-6
	Yr ♀ 159,160	7, 11	Oct.68,Mar.69	11		
	Ad ♀ 158	7, 11	Oct.68,Mar.69	8, 10, 1, 13b,		
	Ad ♀ 171	10,	Feb.69,Oct.69	9a, 10(9), 18a, 25d, 33(2), 34a, 65(2), 77(3), 81		
	Yr ♂ 172	10, 78	Feb.69,Oct.69	48(7), 25d(2),		caught with 171 in Feb. then joined 184
	Ad ♀ 184	10, 78	May69, Oct.69	9a, 9b, 10(5), 25d(2), 34a, 60(4), 77(4) 78, 80(2), 80a, 94, 25b.	42, 48(7)	
Clan C	Ad ♂ 11	20a	Aug.66.	21 (collar found in hole).		
	Yr ♀ 12	24, 21	Sep.66,Mar.67			= Ad ♀ 145
	Yr ♂ 27	29	Oct.66.	29.		
	Yr ♀ 30 or 32	29 or 29a,24	Oct.66,Dec.69	29, 24		= Ad ♀ 241
	Ad ♂ 42	20a, 21	Feb.67,Sep.67	Collar, found near 38		
	Ad ♀ 47	29	Feb.67	24(12), 29(2), 20, 37		
	Ad ♀ 58	21	Mar.67.	20(2), 29(1),		
	Ad ♀ 100	42	Aug.67,Feb.69	20a(5), 20(5), 42(3), 21(2), 48(3)	48(3)	
	Ad ♀ 112	17a.	Sep.67.	21(2)		
	Ad ♀ 145	17a, 20b, 24(twice)	Sep.68,Mar.69 Mar.69,May 69	17, 20(2), 20a(2), 20b(2), 24(14), 76		
	Yr ♂ 169	42.	Feb.69.	20(2), 20a(5),		
	Ad ♀ 182	24, 76a, 20	Apr.69,Jun.69 Dec.69.	20(18), 24(3), 21, 76a, 42(6), 20(3), 50	42	
	Ad ♀ 178	24	Apr.69,Dec.69	24,(7), 29(7)		
	Ad ♀ 240	A-6	Dec.69	A-5, 22b(2), 92, 93, 66a, 90, 96.		
Clan D	Ad ♂ 2	23	Aug.66	Inspected Hole 7		
	Ad ♀ 15	23	Sep.66	27b(3), (tried Hole 30, see Fig. 75).		
	Ad ♀ 16	23	Sep.66	Tag found at 27c		
	Ad ♀ 71	27b	May 67	27c		
	Ad ♀ 72	27b	May 67.	27c(3)		
	Ad ♀ 110	21, 38	Sep.67,Oct.69	82(3), 83, 84, 85, 86, 87, 88, 91		
	Ad ♀ 149	22, 56a	Sep.68,Nov.68	22, 22b, 38, 39, 55b, 56a, 62, (29d)		Used a hole near 29 (29d) on one night
	Ad ♀ 150	22,	Sep.68	Collar found in 23, 55.		

* Holes shared with other Clans.

Note : Ad. ♀♀ 15 and 16 were captured together.
Ad. ♀♀ 71 and 72 were captured together.
Ad. ♀♀ 149 and 150 were captured together.

TABLE 35.

Warthog densities (warthog per km^2) from various sources

Author	Country	Locality	Warthog density
Bourliere (1965)	Congo	Kagera National Park	0.9
		Garamba National Park	0.13
		Lake Edward South	1.2
		North	1.3
Child (1968)*	Rhodesia	Kariba islands	3.96
Dasmann & Mossman (1962) *	Rhodesia	Henderson's Ranch	1.3
		Wankie National Park, Main Camp	2.3
		Robins Camp	13.1
		Victoria Falls National Park	2.6
Field & Laws (1970)	Uganda	Queen Elizabeth National Park (various habitats)	0.02 - 7.62
Lamprey (1964) *	Tanzania	Tarangire Game Reserve (various years)	0.8 - 1.4
Petrides & Swank (1965)	Uganda	Queen Elizabeth National Park	
		Lightly grazed area	0.1
		Moderately grazed area	2.2
		Heavily over-grazed areas	6.9 and 19.7
This study	Rhodesia	Sengwa Research Area	
		Average transect density	3.2
		Mopane vleis (over 4 yrs.)	~~14.7~~ 12.3
		Baikiaea woodland "	0.35

* Converted from densities quoted in warthog/sq. mile.

	JANUARY - APRIL	MAY - SEPTEMBER	1st Oct. OCTOBER - DECEMBER
ADULTS	♂ As for May - September though may be obviously more barrel shaped. Tusks of younger not as prominent as Old males. Visibly more mature than Sub-Adults. ♀ Well rounded and elongated body, mature aspect, Tusks prominent 2"+. Nipples may be evident. (37 months +)	♂ Large in size - 160 - 200 + lbs. Infra-orbital and supra-oral warts very prominent and often sagging. Long in body. Back with evident saddle. Head large with widely curved tusks often broken or rounded at ends. Testes prominent. ♀ Well rounded elongated body. Weight 115 to 160 lbs. Infra-orbital wart evident but not prominent. Tusks well developed, curved 2" + showing beyond upper lip. Nipples generally elongated. (42 months +)	As for May - September period but 34 - 38 month old animals may in some instances be distinguished from old and fully mature animals in general appearance, tusk and wart size (i.e. if seen together). (34 months and older)
SUB-ADULTS	♂ Body dimensions may reach or pass those of an Adult sow. Weight up to 160 lbs. Tusks prominent compared with those of yearling. Snout broader than mature sow and warts more evident. ♀ Adult dimensions though head lacks mature appearance. Neck thinner and body generally lighter in appearance - weight 95 to 120 lbs. Tusks poorly developed compared with mature sow and up to about 1¼ ins. protruding from upper lip. (25 - 32 months)	♂ Tusks well developed but little if any upward sweep, sharply pointed. Adult body dimensions but lacking mature appearance - saddle not generally evident. Weight c. 150 - 160 lbs. Warts prominent. ♀ Adult dimensions. Generally indistinguishable from Adult sow except occasionally on the basis of less well developed tusks and lighter build. Infra-orbital warts evident. (30 - 36 months)	♂ Up to about 2 ins. of tusk protruding but not very prominent. Head more mature in appearance than yearling of July - August. Withers immature in appearance. Weight 100 - 130 lbs. Head and body shorter than Adult ♀ ♀ Lighter in build than Adult ♀, up to 1¼ ins. of tusk protruding though generally less. May be accompanied by litter. (22 - 27 months)
YEARLINGS	♂ & ♀ Rapid gain in weight during this period and size and weight soon reach that of May - September period. Tusks - little more than ½" protrudes. Warts poorly developed. Head visibly smaller than Sub-Adults. Head and Body length about 6" shorter than Adult sow and shoulder height about 3" less. (♀ reach sexual maturity in May) (13 - 20 months)	Little difference between ♂♂ and ♀♀ though warts more developed and tusks slightly larger in ♂♂. (Not very evident in the field) Testes evident in ♂♂ but not bulging. Almost Adult dimensions but shorter in head and body length. Lighter in build than Sub-Adult and lacking in mature aspect of Adult. Warts and tusks are comparitively weakly developed. Tusks about ½" to 1" protruding. Weight 75 - 115 lbs. (♂♂ heavier than ♀♀). (18 - 24 months)	♂♂ warts slightly more conspicuous than in ♀♀ and ♂ slightly heavier in build otherwise little sexual dimorphism evident. Sex classification based on testis and penal button. About ¾ adult dimensions. Weight - 50 to 60 lbs. Tusks begin to protrude above upper lip but only up to ½" or so. (10 - 15 months)
JUVENILES	By May the head is less rounded in profile and milk canines may sometimes be visible. Shoulder height and body length from ½ to 2/3 that of Adult sow. Weight 25 to 40 lbs. from March to May. Penal button and scrotal sac (darkly pigmented even at this age) may allow sexes to be distinguished when at very close range and using binoculars. (3 - 7 months)	About 2/3 to ¾ of Ad. dimensions. Tusks NOT protruding beyond upper lip. Thin and immature in appearance. Weight up to 60 lbs. though generally about 45 - 50 lbs. No marked sexual differences though supra-oral warts, penal button and testis may enable males to be identified at close range with the aid of binoculars. (7 - 12 months)	Up to about 10 ins. at the shoulder. Small and thin weighing less than 150 Head rounded in profile. Often barely visible even in relatively short grass cover. (Up to 3 months old)

APPENDIX 4, TABLE 1.

Efficiency of Capture Technique.

Year	Total No. Capture Days	No. Successful Capture Days	% Successful Days	Total No. Holes attempted	No. of Holes at which success	% Successful Holes	No. Holes attempt/day	Total No. of Hogs	No. caught per Hole
1966	27	18	66%	29	20	69%	1.074	41	2.05
1967	30	21	70%	33	21	63.63%	1.100	90	4.29
1968	13	9	69%	15	11	73%	1.153	46	4.18
1969 a	15	11	73%	19	13	68%	1.266	39	3.25
1969 b	15	10	66.6%	22	12	54.5%	1.466	41	3.42
Total	100	69	69%	118	78	66.1%		257	3.29

APPENDIX 4, TABLE 2.

Operation times for successful days.

Year	Time of blocking holes		Waiting time from time set to emergence of hogs		Handling time from emergence to release	
	Av.	Range	Av.	Range	Av.	Range
1967	0554hrs.	0520-0630	57mins.	0mins. - 4hrs.15mins.	1hr.27mins.	30mins. - 2hrs.10mins.
1968	0530hrs.	0440-0600	29mins.	0mins. - 2hrs.32mins.	1hr.25mins.	28mins. - 2hrs.27mins.
1969 a	0536hrs.	0510-0545	27mins.	2mins. - 3hrs. 0mins.	1hr.47mins.	1hr. 15mins. - 2hrs.57mins.
1969 b	0523hrs.	0500-0540	35mins.	3mins. - 1hrs.35mins.	1hr. 4mins.	25mins. - 2hrs.10mins.

In 1966 once waited for 13 hrs. and then pulled warthog out of hole.

In 1970 once waited for 30 hrs. before hogs emerged.

APPENDIX 4, TABLE 3.

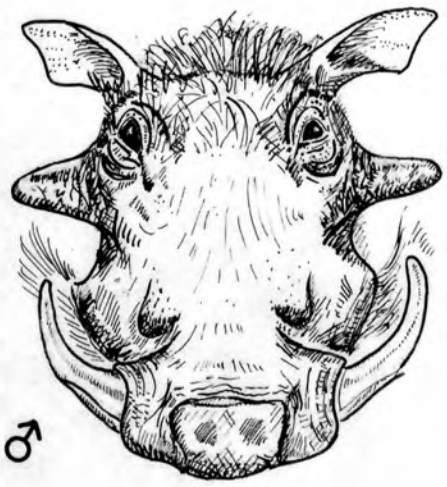
Escapes. (See App 4. page 6.

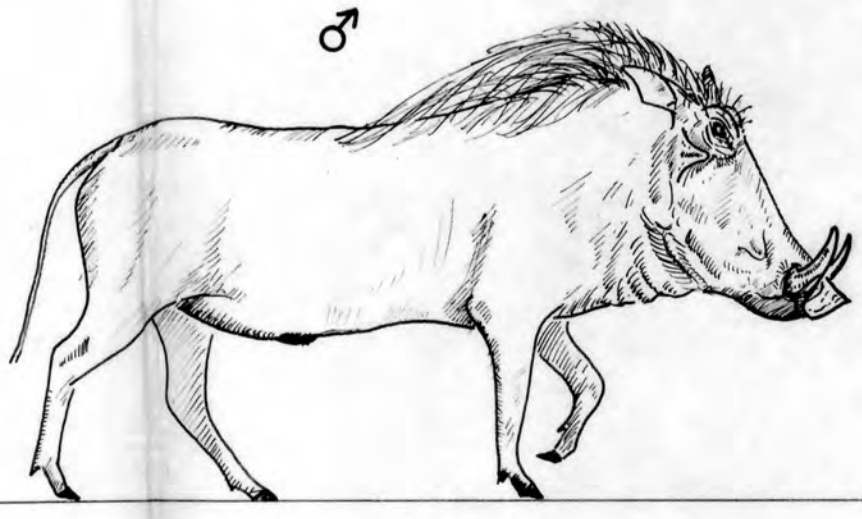
Year	Total No. Caught	No. escaped from net	No. returned into or left in Hole	Total missed	% lost	No. destroyed	% Mortality
1966	41	11	?	11	26.8% +	nil	nil
1967	90	8	7 +	15	16.6%	2	2.2
1968	46	nil	nil	-	nil	2	4.3
1969 a	39	4	4	8	20.5%	nil	nil
1969 b	41	7	nil	7	17.1%	1	2.4
	257	30	11 +	41	16.0%	5	1.95%

Appendix 3. Fig. 1. A guide to age and sex classification of warthog in the field. (See also Appendix 3. Table 1.)

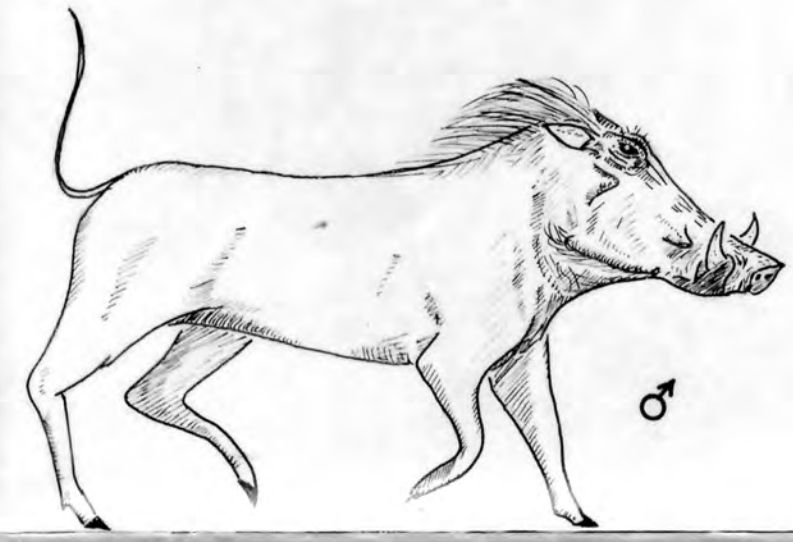
February — June — September

Adult

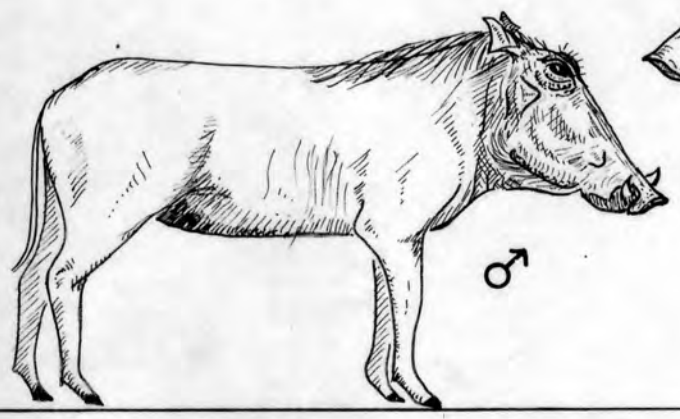




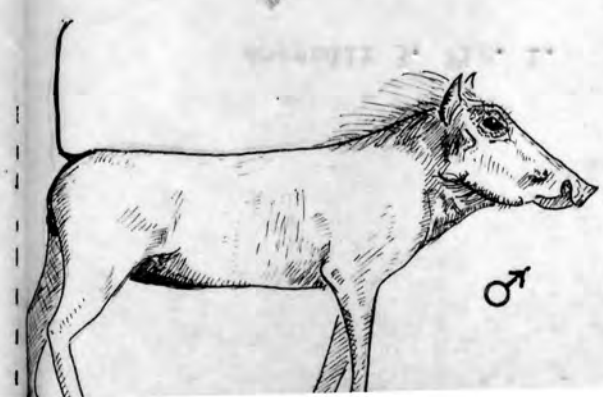
Sub-adult



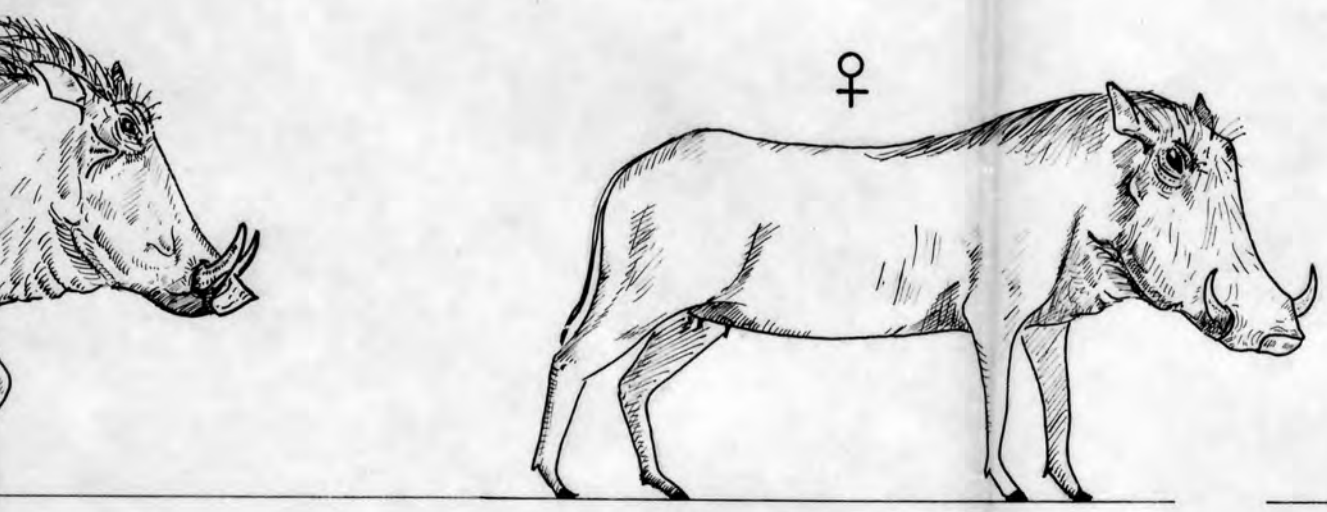
Yearling

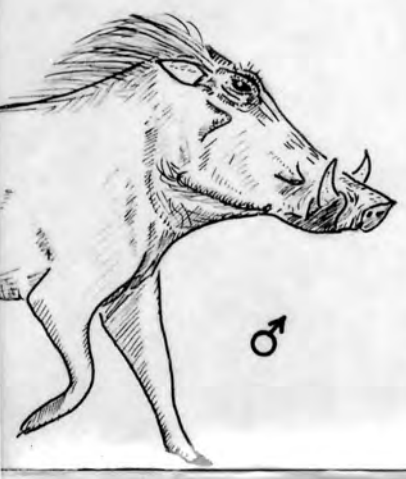


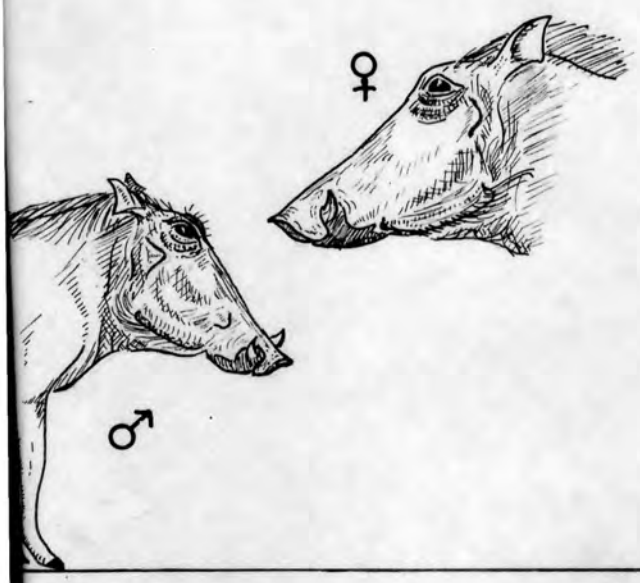
Juvenile



September







October – January