STUDIES ON THE FEMALE REPRODUCTIVE TRACT OF INDIGENOUS SHEEP AND GOATS

BY

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The work of others is acknowledged and referenced. No part of this thesis has been submitted elsewhere for a degree or diploma.

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The race is not for the swift,

Nor the victory for the strong,

How are the mighty fallen! and

Lost in the victory of the weak.

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INTRODUCTION

Almost all temperate breeds of sheep and goats in their native environment are seasonal breeders and on the average produce a lamb or kid a year or three lambs or kids in two years.

Attempts to maximize production outputs by producing two lambs per ewe per year have proven very difficult and in recent times have been the subject of intensive investigation. In contrast, tropical breeds of sheep and goats in the tropics are generally believed to breed throughout the year. Whether breeds of sheep and goats indigenous to Nigeria, under prevailing conditions and management breed seasonally or throughout the year, is not known.

The reproductive activity of sheep and goats in temperate countries have been found to be influenced and in some cases limited by certain environmental factors. The most important of these appear to be the daylength (photoperiod), environmental temperature and the amount of available nutrient. Whether and how these environmental factors affect reproductive performance in indigenous sheep and goats in Nigeria is not known.

Reproduction is in itself a complex interaction of a multitude of factors. One such group of factors is lesions of the female reproductive tract which could result in infertility, sterility or other interference with reproduction. Here again little work has been done on this aspect in indigenous sheep and goats as seen in the literature.

The objectives of this study therefore were to provide information on the following:

(a) whether sheep and goats indigenous to Nigeria breed throughout the year or not;

(b) the relationship (if any) of their breeding pattern to daylength (photoperiod), environmental temperature and rainfall (nutrition);

(c) lesions of the female reproductive tract that affect reproduction.

At this time when the gap between supply and demand for livestock products in Nigeria is getting wider and wider this information would be important in proper livestock production planning. Not only will it give some insight into the reproductive potentials of these indigenous sheep and goats, it will indicate, hopefully, what factors might be favourably taken

advantage of and what factors could be expected to limit production in these breeds.

REVIEW OF LITERATURE

Nigerian breeds of sheep and goats

Sheep

Mason (1951, 1969), recognized and described three types of sheep in West Africa: the west African Dwarf, the West African long-legged and the Macina.

The West African Dwarf type is known in Nigeria as the Nigerian Dwarf. It is found in the whole area of West Africa south of latitude 14°N and is the only breed in the coastal area.

The three important breeds of the West African long-legged type are the Fulani, Arab or Maure and the Tuareg. All Fulani sheep are short-haired and have a convex profile. According to Mason (1951), the rams have well-developed horns carried horizontally on each side of the head with points directed outwards. Those of the ewe are smaller. Yan'kasa, Uda and Borno are three varieties of Fulani sheep that occur in Nigeria. The Y'ankasa is white with black eyes and nose. The

Uda, also known as Bali-Bali, Bororo, Houda, Louda, North Nigerian Fulani, Ouda or Pied, is always pied and characteristically the head and forequarters are coloured (black or fawn) with the hind end white. The Bornu, also known as Balandji, Balani, Bellani, Balonndi, Fellata, Weiladjo or White Bororo is white, sometimes with fawn spots. Two other varieties of Fulani sheep, the Samburu and Toronke are more likely to be found north of Nigeria. The Macina does not occur in Nigeria.

Goats

Webster and Wilson (1973) classified goats into four major types: European, Oriental, Asiatic and African.

They listed African Dwarf and Nigerian as distinctive African breeds and recognized two varieties of the African dwarf - true dwarfs and disproportionate dwarfs (achondroplastic). Both varieties of the African Dwarf as well as the Nigerian occur in Nigeria. They described the Nigerian as actually a conglomeration of large goat breeds found in West Africa and subdivided into a large number of sub-breeds, known by their district and colour e.g. Bornu white, Damagaran dapple-grey, Kano brown, Katsina light-brown and Red Sokoto.

Mason (1969) listed two breeds of goats as occurring in Nigeria: the West African Long-legged (known in Nigeria as the Nigerian) and the West African Dwarf. Varieties of the West African Long-legged are the Bornu white, Damagaran dapple-grey, Kano brown, Katsina light-brown, and Red Sokoto. Intermediates (crosses) of these with the West African Dwarf occur and apparently are included in the Nigerian breed. Mason (1951) described the West African Dwarf as corresponding closely in name, size and distribution to the dwarf sheep.

Beaton (1939) had earlier classified Nigerian goats into geographical colour varieties such as Sokoto red (not Red Sokoto), Kano brown, Bornu white and Damagaran dapple-grey in addition to the dwarf-black of the south.

Mason (1951) also listed the Sahel as a long-legged breed kept by the nomads and variously called Arab or Maure, Taureg or Fulani. There was no indication as to its occurrence or distribution in Nigeria.

In all of the foregoing it should be borne in mind that Mason (1969) states of his own classification that in some cases the distinction between a breed group or "type" divided into breeds and a breed divided into varieties is purely arbitrary.

A summary of the classifications of sheep and goats indigenous to Nigeria as stated by Beaton (1939), Mason (1951, 1969) and Webster and Wilson (1973) is presented in Appendix IV.

Reproductive performance

There appears to be considerable confusion in terminology in the various methods that have been used to measure reproductive performance in sheep and goats. Desvignes (1968) proposed standard terminology for these computations in sheep, the most commonly used of which appear to be % ewe lambing, lambing %, twinning % and weaning %. Similar indices are commonly used for goats.

Reproductive performance varies with the breed. Lambing and kidding percentages reported for various economic breeds commonly range from 100% to 200% with high extremes of over 400% (Spedding, 1970; Devendra and Burns, 1970). Isolated instances of very high litter sizes occur such as the nine lambs reported by Seljarnin (1960) from a Finnish sheep and the eight lambs delivered by a Romanov sheep (Smirnov, 1935). Twinning percentages commonly range from 5-60% or higher (Johansson and

Hanson, 1943; Benesch, 1952; Sacker and Trail, 1966; Devendra and Burns, 1970; Spedding, 1970). Haumesser (1975) reported 40.94% twinning rate and 1.47 average litter size for Maradi (Red Sokoto) goats in Niger. Of 1668 births, 936 were singles, 683 twins, 47 triplets and two quadruplets. Triplets, quadruplets and higher numbers occur with low frequency.

Breeding trials using the indigenous Uda and Y'ankasa sheep and crossbreeds of these to the imported Suffolk yielded lambing percentages of 114.3%, 88.1% and 100% respectively. Weaning percentages were 98.4%, 77.6% and 86.4% respectively (Brinckman, 1975). There is apparently no available data on indigenous goats.

Although two kiddings or lambings per year from a doe or ewe have been obtained (Smirnov, 1935; Masud, 1964; Copenhaver and Carter, 1966; Sacker and Trail, 1966), numerous work cited by Hunter (1968) and by Devendra and Burns (1970) indicated that three lambings or kiddings in two years is the level usually attained, especially in temperate breeds of sheep and goats which have a greater tendency to lamb or kid only once a year. Part of the problem has been prolonged post-partum service periods and the fact that seasonal anoestrus often intervenes (Hunter, 1968). It appears that ewes with short breeding seasons may be in their

normal seasonal anoestrus period while they are lactating and for this reason show no post-partum heat, or at most have a few silent ovulations after lambing. As far as more lambs per pregnancy are concerned, Hunter (1968) indicates that within most breeds so far studied, the heritability of the trait for multiple births is so low that the best potential for genetic progress is likely to be achieved by cross breeding. He cites several workers however, as having made satisfactory progress by selecting within breeds for multiple births.

Ovarian measurements, ovarian follicular counts, ovulation rates and embryonic and foetal counts provide valid information on reproductive activity (and by extrapolation reproductive performance) and are widely and routinely used in bovine and equine practice where the larger size of the animals permits rectal examination of the reproductive organs. From a practical point of view, early conception, regularity of lambing and the number of lambs born by a single ewe or a flock of ewes, are indications of ovarian activity (Roux, 1936). Grant (1934) attributed changes in size and weight of the ovaries in the ewe to changes in the size of the follicles and corpora lutea and not to changes in ovarian stroma. The findings of Hutchison and

Robertson (1966) of a highly significant correlation between ovarian wäght and the total follicular plus corpora lutea volume supports this view. Changes in ovarian dimensions therefore reflect variations in size and number of ovarian follicles and corpora lutea, the functional bodies of the ovary. The incidence of corpora lutea, which is the ultimate evidence of ovulation and the incidence of pregnancy are both also reliable evidence of reproductive activity. The significance of ovarian follicular size at various stages of the reproductive process is however, uncertain. Kammlade et al. (1952) and Hutchison and Robertson (1966) have observed in mid-anoestrum, ovarian follicles as large as those found during the inter-oestrus phase of the cycle. Alikhanov (1972) also found an increase in size of ovarian follicles during periods of relative sexual quiescence. During the oestrus cycle itself not all large follicles may necessarily ovulate. Eherer et al. (1976) found that all large follicles on the ovary observed at day ten of the oestrus cycle became atretic. In contrast the largest of the follicles observed on day 14 ovulated. The uncertainty is further deepened by the observation of Hunter (1964) of 15 cases of apparent oestrus during pregnancy, the occasional willingness of does to accept the male even when pregnant

(Wilson, 1957) and the finding of large follicles in the ovaries of pregnant ewes (Rexroad et al., 1975).

The details are largely unknown but it has been amply demonstrated that reproductive performance in female sheep and goats is affected by several factors that influence oestrus, conception, gestation and the preweaning period (e.g. reviews by Dutt, 1959; Hunter, 1968; Edey, 1969; Devendra and Burns, 1970). The most important of these factors appear to be the photoperiod, temperature and nutrition. Literature on the relative role of gross and histopathological lesions of the reproductive tract is virtually absent.

Effect of photoperiod on reproductive performance

Near the equator most tropical breeds of sheep and goats, reportedly, breed throughout the year (Devendra and Burns, 1970; Roberts, 1971). Haumesser (1975) also found this to be true of the Maradi (Red Sokoto) goats in Niger. The females gave birth throughout the year, with maximum occurrence (51.7%) from February to April.

In contrast although there are reports that even within a breed there can be quite different patterns of oestrus activity

(Wiggins, et al., 1970) most temperate breeds of sheep and goats are seasonally polyestrous (Hafez, 1975b; Devendra and Burns, 1970). In general, with decrease in light: dark ratio, whether naturally or artificially induced most temperate breeds of sheep and goats show increased sexual activity (Bissonnette, 1936; 1941; Yeates, 1956; Means et al., 1959, 1960; Godley et al., 1965). Devendra and Burns (1970) further state that although in most tropical goats oestrus occurs all the year round, whilst in temperate climates goats are seasonally polyestrous, such evidence as is available suggests that this is a matter of breed rather than climate or latitude. However, whether the observed seasonality is due to changes in external (environmental) light: dark ratio or due to an inherent rhythmic mechanism with alternating periods of activity and quiescence or both, has been debated for many years.

Bissonnette (1936, 1941) showed that certain mammals, including the goat, may be brought into oestrus by a reduction in daylength. Yeates (1956) reversed the seasonal pattern of incidence of oestrus in Merino ewes by artificially reversing the seasonal trend of daylight duration. Means et al. (1959) found that a reduction in daylength during the non-breeding

season was effective in the induction of oestrus: none of 28 ewes in a normal environment came on heat whereas 27 of 39 subjected to shorter daylength came on heat. In a controlled experiment involving one hundred sheep studied from April to June each year for three years Godley et al. (1965) also observed that 93.3% of ewes subjected to decreasing daylength exhibited oestrus compared to 58.3% of control ewes exposed to normal daylengths which during the period was increasing. To counter, Terry and Meites (1951); Clegg et al. (1965); Ducker et al. (1973) and Thibault and Levasseur (1975) indicate evidence for the possible existence of an inherent rhythm which controls oestrus activity in sheep. Terry and Meites (1951) showed that sheep kept for seven weeks in summer on 24 hours light, on no light or on daylight all continued to cycle. Earlier lambing in the group on 24 hours of light was the only obvious effect. Clegg et al. (1965) maintained ewes under a constant light: dark ratio (6 hours of light: 18 hours of dark) for three years. They found that although oestrus cycles became less regular, a cyclical pattern of increasing and decreasing reproductive activity was still apparent. Ducker et al. (1973) reported obtaining what they considered to be conclusive evidence for the existence of an inherent rhythm

which controls oestrual activity in sheep. In connection with the relative significance of endogenous and photoperiodic factors it is interesting that African Dwarf goats are reported to have maintained reproductive activity throughout the year for several generations in Germany and in Scotland (Devendra and Burns, 1970). Symington and Oliver (1966) made similar observations for tropical sheep in Rhodesia.

It is noteworthy that following autumn lambing of Rambouillet, Dorset and crossbred ewes Barker and Wiggins (1964) observed that 90% of the oestrus cycles of these ewes occurred during the period of increasing daylength (December 21st to June 21st) and over the two-year period of this observation 70% of those ewes which lambed prior to December 21st recommenced their oestrus cycles during this period. From this evidence Barker and Wiggins concluded that decreasing daylength is not necessary for the initiation of sexual activity in ewes. Watson and Radford (1955) also reported that in Australia there are many examples of the breeding season commencing while days are still increasing in length.

No one hypothesis serves to completely relate photoperiod to reproductive performance in sheep, but three have been

proposed (Radford, 1966). The first and most widely held is that decreasing daily photoperiod stimulates and increasing daily photoperiod inhibits reproductive activity (. Bissonnette, 1936, 1941; Yeates, 1956; Means et al., 1959, 1960; Godley et al. 1965). The second hypothesis, proposed by Ortavant et al. (1964), is that there is an optimal photoperiod for reproduction and values above or below this are inhibitory. Yet a third is that increasing light per day inhibits reproductive activity, which, after a period of rest, recurs without further stimulus, provided that the current light regime does not provide more than a maximum number of hours of light per day (Radford, 1966). Much less appears to be known for goats.

Effect of temperature on reproductive performance

Yeates (1953) found elevated ambient temperature not to affect the incidence of oestrus in sheep. Dutt (1959) however, cites later experiments of Carlton (1956) where elevated ambient temperature delayed onset of oestrus. Only 18 of 25 ewes kept at 90°F exhibited oestrus at the end of the experiment, by which time all of the 25 control ewes had already come on heat. He argues that the fact that ewes in Carlton's experiments were kept

at the test temperature continously after a change was initiated, instead of for a short period each day as Yeates (1956b) did, may have made the difference. Furthermore, ewes may not respond immediately to change in temperature; a latent period may be essential before anoestrual ewes respond to temperature changes.

Ovulation rate is not affected by elevated ambient temperature. Dutt et al. (1959) exposed sheared and unsheared ewes to an elevated room temperature of 90°F from day 12 of the oestrus cycle. Ovulation rates determined at slaughter three days after breeding them at the subsequent oestrus were not significantly different between them or as compared to control ewes. Alliston and Ulberg (1961) also found no difference in ovulation rate between ewes kept at 90°F and ewes kept at 70°F environmental temperature.

Heat stress has however, been found to increase the incidence of abnormal ova estimated at three days post breeding, conception failure and embryonic mortality especially within the first eight days of pregnancy (Dutt et al, 1959, Dutt, 1963; Thwaites, 1967). In the heat stressed ewe it appeared that either fewer sperm cells were getting to the site of fertilization or if they did, were unable to penetrate the ova. Whether lack of

sperm cells in the zona pellucida of ova from heated ewes was due to sperm failure or to defective ova were unanswered questions (Dutt, 1959).

Elevated ambient temperature also reduced the gestation period (Shelton and Huston (1967) as well as the birthweight of lambs (Yeates, 1953; 1956; Shelton, 1964; Cartwright and Thwaites, 1976). In does it induces low and erratic breeding efficiency (Devendra and Burns, 1970).

A reduction in ambient temperature has been shown by Dutt and Bush (1955) and Godley *et al.* (1965) to hasten the onset of the breeding season. It also increases the incidence of oestrus (Godley *et al.*, 1965).

Effect of nutrition on reproductive performance

The practice of improving the nutrition of the ewe prior to mating to increase the lambing percentage is known as flushing and is widely advocated and adopted in sheep producing countries (Coop, 1966b). The weight of evidence accruing from early observations, ovulation rate studies and field trials, and later experiments, support the conclusion that a rising plane of nutrition in the period immediately prior to mating does increase

lambing rate largely, if not entirely, through increasing ovulation rate (reviews by Coop, 1966b; Tassell, 1967; Edey, 1969). The converse is generally true. The findings of subsequent investigators (Gunn, et al., 1969; Bastiman, 1972; Lamond et al., 1973; Gunn and Doney, 1975; Bramley et al., 1976) have been in agreement with the previous conclusion. Coop (1966a) provided experimental evidence to support his suggestion that the flushing response was the resultant of a static effect due to increased liveweight irrespective of how and when the ewe obtained that liveweight together with a dynamic effect resulting from what has been termed the "rapidly rising condition". The nutrients causing the flushing effect have not been adequately defined but in investigations conducted so far feeds differing principally in digestibility have been used (Coop, 1966b; Tassell, 1967). Memon et al., (1969) have stated however, that in flushing ewes, an increased intake of protein is not necessary. Whether flushing increases or decreases the percentage of ewes holding on to first service is still unresolved but is not likely to be of great importance if rams are run with the ewes over a long mating period (Coop, 1966b). Although there is no agreement amongst research workers as to when flushing should start and end, the most common view would

be for four to six weeks of flushing; two to three weeks premating followed by the first three to four weeks of mating. There appears to be no advantage of flushing ewes after the majority of ewes have conceived since responses continue to be obtained for one to two weeks after flusing stops (Coop, 1966b).

Nutrition has other effects on reproductive performance. High levels of feeding increases lamb birthweight and improves viability of lambs (Reid, 1949). Under-feeding influences age at puberty (Hafez, 1975) and increases incidence of silent oestrus (Hafez, 1952; Allen and Lamming, 1961) and conception failure (Hafez, 1952). Although some results have been inconsistent or contrary, under-feeding apparently also increases embryonic mortality (El-Sheikh et al., 1955; Foote et al., 1959; Edey, 1965; Van Miekerk, 1968), is detrinental to foetal growth (Everitte, 1964) and increases pre-weaning mortality of lambs (McClymont and Lambourne, 1958; Trail and Sacker, 1966). That undernutrition late in pregnancy precipitates heavy losses of ewes and lambs due to pregnancy toxaemia is well known (Forbes and Singleton, 1964). The effect of undernutrition on length of gestation is uncertain (Alexander, 1956; Reid and Hinks, 1962), but appears to shorten it.

Hart and Miller (1937) found a limited intake of protein to have little effect on fertility in sheep. Thomson and Thomson

(1949) however, found that ewes on a restricted low-protein diet showed evidence of weakness after parturition, had little milk and maternal instinct was frequently impaired or absent. When the additional strain of twinning was present lamb vitality at birth was seriously impaired.

Sheep grazing on oestrogenic pastures may develop reproductive problems. This was first reported by Bennetts et al. (1946) from Western Australia. Sheep on early subterranean clover pastures exhibited various combinations of infertility, dystocia and uterine prolapse. The infertility resulted apparently from failure of conception, dystocia was associated with uterine inertia and involved the death of the full-term foetus, and uterine prolapse seen in both bred and unbred ewes typically occurred some months after the lambing season. The syndrome subsequently attracted much attention and has been extensively studied (Jubb and Kennedy, 1970). Davies and Nairn (1964) found a significant ($P \leq 0.002$) association between increasing cystic endometrium and reduced fertility in ewes that had grazed on pastures containing some subterranean clover.

Deficiencies of copper, cobalt, selenium, iodine, phosphorous, vitamin A have all been found by

previous workers to adversely affect reproductive performance in sheep and/or goats (Molokwu, 1976).

The relationship of rainfall to nutrition and hence to reproductive activity, though seldom stated, has long been recognized. Kelley (1939) reported a striking correlation between the incidence of twinning in a stud Merino flock and the average rainfall during and immediately before the mating season adding that the high rainfall of course improved feeding conditions. It would appear however, that exposure to rainfall per se shortly before or after mating reduces the percentage of multiple ovulations and increases the loss of ova (Doney and Gunn, 1972).

Lesions of the female reproductive tract

Malformations of the female reproductive tract are in almost all instances based on inhibited development of portions of the Mullerian ducts and their derivatives, or on aberrations of the pattern of fusion of the Mullerian ducts which normally produces the anterior vagina, cervix and uterine fundus (Jubb and Kennedy, 1970). In sheep and goats such malformations are rare, except for a high incidence of intersexes in goats

(Roberts, 1971). Hafez and Jainudeen (1966) have summarised the literature on intersexuality in farm animals; Marcum (1974) reviewed the freemartin syndrome. Freemartins occur in sheep (Ewen and Hummason, 1947; Alexander and Williams, 1964; Dennis, 1979) and all gradations of intersexuality from the predominantly male to the predominantly female type occur in goats (Eaton, 1943; Asdell, 1944; Kondo, 1949, 1952, 1955; Jamdar, 1955; Haugen, 1960; Lyngset, 1968). The internal and/or the external reproductive organs are modified in various ways. Intersexuality in goats appears to be an inherited condition due to a recessive gene linked to a dominant autosomal gene for hornlessness in certain breeds (Eaton, 1945; Bilgemre and Duzgunes, 1952; Brandsch, 1959). In his three-year study of the Red Maradi (Sokoto Red) goat of Niger, Haumesser (1975) encountered no intersexes. Both sexes of the breed are horned.

Hunter (1970) discovered a Merino and a German Merino ewe at laparotomy to be unicornual. The Merino was recorded as having lambed previously. O'Shea et al. (1974) reported on five ewes in which the left uterine horn was in each case congenitally absent. Dennis (1979) observed two lambs with uterine agenesis and four lambs with atresia vaginum. In one of the lambs both

uterine agenesis and atresia vaginum were present and in all cases there were developmental defects of other organs also. Roberts (1971) cited Dutt as having examined the reproductive tracts of 90 ewes and found no structural defects or other abnormalities that would be a barrier to fertilization, but found one ewe with a bifurcation of the cranial part of the vagina.

Roberts (1971) stated that lesions or diseases of the reproductive system in sheep and goats are similar in most respects to those in cattle. Reports are however, few, except for the numerous ones on specific infections such as brucellosis, vibriosis and toxoplasmosis. Indeed, Lyngset (1968) reporting on a slaughter-house survey of malformations and other pathological conditions in the genital tract of female goats in Norway remarked that he had found no report of a similar systematic investigation in goats. He cited a previous survey in sheep in which Gustafsson and Holmberg (1966) found a 6.4% incidence of pathological changes in 502 ewe genitalia. Lyngset himself recorded lesions and malformations in 69 (6.8%) of 1020 reproductive tracts of does examined. There have been a few subsequent reports - all in ewes and none

in goats. Nair and Raja (1972) examined 1050 ewe genitalia, 409 of which were pregnant. 1.6% of the 1050 reproductive tracts had lesions. Rao and Abdullah Khan (1974) conducted a slaughter-house survey in Ceylon. Of 5,365 female reproductive tracts of sheep, inclusive of 1,465 gravid ones, 417 (7.58%) showed lesions. Adams (1975) made a similar survey of sheep in Western Australia.

Marsh (1965) considered lesions such as metritis, pyometra and cysts and tumours of the ovaries to account for only a small percentage of infertility in sheep. Feldman (1932) stressed the rarity of genital tumours in goats. He also recorded leiomyomas of the uterus in two old ewes slaughtered for food. Granulosa cell tumours of the ovary have been reported in sheep (Casarosa, 1950; Lyngset, 1963) but are not common (Moulton, 1961). Monlux et al. (1956) described rare cases of lymphosarcoma or reticulum-cell sarcoma, myeloma and squamous cell carcinoma of the vulva of ewes.

McIntee and Olafson (1953) have reported that feeding chlorinated naphthalenes produced severe changes in the genital tract of ewes. These changes were characterized by an enlarged uterine horn and cervix due to marked squamous metaplasia with

profuse keratinization of the endometrial glands as well as keratinization and ulceration of the vulva. Adams (1975) recorded a single case of squamous metaplasia of the uterus.

Albrecht (1904) described hamartomas as malformations in which there is improper proportion or distribution of various tissues of an organ, with prominent excess of any one particular tissue. They arise in the course of the development of the body to its adult state and differ fundamentally from a tumour in that their growth is limited and coordinated with that of the rest of the body (Willis, 1960). They are tumour-like formations which are present at birth and cease to grow after the animal reaches maturity unless the mass is subjected to trauma, infection or vascular embarassment, resulting in thrombosis, oedema, haemorrhage, necrosis and proliferation of fibrous connective tissue. The smaller (vascular) hamartomas are composed principally of mature-appearing tortuous arteries and veins with relatively little intermuscular connective tissue (Jubb and Kennedy, 1970). There does not appear to have been any report in sheep or goats.

Ovarian hypoplasia, if it occurs in sheep and goats must be very rare. Lyngset (1968) encountered a single case of apparent

ovarian hypoplasia. However, he did not examine it histologically.

The term parovarian cyst refers to a variety of cystic structures located adjacent to the ovary. Such cysts may originate from remnants of either the mesonephric or para-mesonephric tubules and ducts (Jubb and Kennedy, 1970). The reported incidences of parovarian cysts in ewes are 2/1050 (Nair and Raja, 1972), 17.03% (Rao and Abdulla Khan, 1974) and 20.3% (Adams, 1975). Lyngset (1968) recorded a 1.1% incidence in does.

Ovarian cysts also occur. Rao and Abdullah Khan (1974), observed a 0.48% incidence of follicular cysts and a further 0.24% were stated to be polycystic. Lyngset (1968) recorded all follicles larger than 1.2cm as cysts. 27 of these were encountered in 24 reproductive tracts (approx. 2.4%). Although some were thick-walled no luteinization of the cysts could be macroscopically detected.

Fine bursal adhesions may result from ovulation tags which correspond to points of previous ovulation. They have not been reported to be of significance. Trauma and inflammation may cause more extensive adhesions which may interfere with the mobility of the fimbriae or obliterate the bursal sac (Jubb and

Kennedy, 1970). Nair and Raja (1972) and Adams (1975) recorded five cases each of ovario-bursal adhesions. Rao and Abdulla Khan (1974) have also reported as high an incidence as 76.97% of what they described as proliferative oophoritis with adhesions.

A single case each of ovarian abscess has been reported in goats (Lyngset, 1968) and in sheep (Nair and Raja, 1972). Adams (1975) observed 14 cases of salpingitis and 4 cases of hydrosalpinx in 487 ewes. Lyngset (1968) encountered a single case only of cystic enlargement of the fallopian tube in 1020 caprine tracts examined.

The finding of cystic endometrium associated with long-term feeding of ewes on oestrogenic pastures (Bennett et al., 1946) is widely known. Histologically, endometritis, cervicitis, squamous metaplasia of the cervix and the development of cervical glands are evident. Cervical and uterine cysts are grossly visible (Adams, 1976). Adams' observations in 1975, in Western Australia, probably reflect such oestrogenic effects. Of 487 uteri 18% had grossly visible endometrial cysts, 14% had microscopic cysts, 63 (13%) had endometritis, 19.5% had cervical cysts, 21% had chronic cervicitis and 8% of the ewes

had acute cervicitis. Where uterine and cervical cysts are due to long-term feeding on clover pastures, galactorrhoea, dystocia, uterine prolapse and more important, a severe progressive infertility are part of the syndrome (Bennetts, 1944; Bennetts et al., 1946). The infertility is permanent (Shinkel, 1948; Underwood, 1951).

In a study of ewes that had grazed for several years on subterranean clover, Davies and Nairn (1964) found a significant association between increasing score of severity of grossly visible endometrial cysts and the number of years in which an ewe failed to lamb. Adams (1973) also found a significant association between number of macroscopic uterine cysts and ovarian inactivity in 39 reproductive tracts from five to six-year old Corriedale ewes culled for aged from a commercial flock in which phyto-oestrogenism had been diagnosed.

Endometrial cysts found adjacent to the caruncles may also develop in some ewes during the process of uterine involution. According to Jubb and Kenney (1970), adhesion of the caruncular stalk to adjacent glandular tissue causes blockage of the underlying glands. The retention cysts enlarge progressively with age and care must be taken to differentiate them from oestrogen-induced cystic hyperplasia.

Nair and Raja (1972) referred to earlier, recorded the following in 1050 tracts: mucometra (1), pyometra (2) perimetritis (1), mummified foetuses (3) and macerated foetuses (6). Rao and Abdulla Khan (1974) observed 0.2% incidence of macerated foetuses, 0.2% foetal resorption and 0.7% metritis in 5365 reproductive tracts. Abscesses occurred in both the perimetrium and the broad ligament. Four cases of pyometra, two mummified foetuses and one foetal resorption were encountered by Adams (1975). Similar lesions occur in goats. Lyngset (1968) reported hydrometra (0.3%) metritis (0.6%) and macerated foetuses (0.6%) in 1020 caprine reproductive tracts.

Necrotic cervicovaginitis have been observed in ewes chiefly as a consequence of dystocia (Jubb and Kennedy, 1970). It is frequently fatal either due to a secondary peritonitis or the uterine complications of prolonged dystocia and foetal emphysema. Adams (1975) observed eight cases of vaginitis.

Rupture of the vaginal wall with eventration can occur. Ranby (1955) reported a case of dystocia in an ewe in which the vaginal wall tore about one centimetre from its junction with the cervix for about two-thirds of its circumference, and through this tear, the uterus, bladder, ovaries and mesentery

prolapsed. Haemorrhage was negligible. In 1961, White reported on a total of eight heavily pregnant ewes on three farms within 25 miles of Salisbury, Rhodesia, all in a single breeding season. The ewes were found either dead or dying with the small intestine prolapsed through a tear in the wall of the vagina, close to the cervix. The ewes had not previously shown any signs of illness or evidence of a prolapsed vagina. The author suggested sadism, but questioned the probability.

Cervical polyps, a vaginal fibroma, vaginal abscess, stricture of the vagina and inflammation of the canals of Gartner have all been recorded in goats (Lyngset, 1968). He also observed in one case a patent canal between the uterus and the bladder, with pieces of bone in both organs. A previous report of an anastomosis between the large intestine and the uterus is on record (Wells, 1952).

Southcott (1961) reviewed the literature on vulvitis in ewes and from his own observations considered the condition to be of dietary origin related to grazing on clover pastures. The significance of the disease appears to be mostly that the ventral commissure of the vulva is permanently shortened; it is associated with wetting of the breech with urine which pre-

disposes affected ewes to fly-strike. Tunnicliff (1949, 1960) and Marsh (1965) have described ulcerative dermatosis as causing necrotic, swollen and bleeding ulcers on the cutaneous and mucous surfaces of the lips of the vulva in sheep and goats. Only rarely is the vagina involved. Vesicular venereal disease may occasionally spread through a flock of sheep and goats (Williams, 1943; Hutyra *et al.*, 1946). The disease is characterized by papules, pustules and ulceration of the mucosa of the vestibule and vagina.

A large number of infectious organisms have been isolated from the reproductive tract of sheep (Quinlivan, 1970; Adams, 1975; Sawyer, 1977). Adams (1975) found the bacterial population of the uterus to be qualitatively similar to that found in cervices by Quinlivan (1970). The most common genera were Corynebacteria, Escherichia, Streptococci and Bacillus. According to Sawyer (1977) the bacterial population was actually small during the oestrus cycle and consisted mostly of *Escherichia coli*, Bacillus, Corynebacterium, Alcaligenes and Achromobacter spp. However, Sawyer (1977) observed a significant increase in the number of bacteria isolated and a change in the proportions of the bacteria isolated from ewes after embryos

were experimentally killed with colchicine. Much greater numbers of potentially pathogenic organisms, including Staphylococcus, Streptococcus, Corynebacterium pyogenes and Pasterurella multocida were isolated. He also observed a persistence of a large number of bacteria including potentially pathogenic types until eight days after embryonic death and inferred that this may account for some of the impaired fertility noted in ewes returning to service after embryo death (Edey, 1972; Sawyer and Knight, 1975). Adams (1975) had similarly observed subclinical infections of the uterus in 27% of ewes during the breeding season and suggested that bacterial infections may contribute to reproductive loss in the ewe, especially since a close association was shown between the presence of bacteria and the occurrence of endometritis and cysts of the cervix. E. coli and Streptococci were most commonly associated with endometritis.

Several infectious agents have been specifically noted as causes of abortion, perinatal mortality and infertility in sheep (Hindmarsh and Blumer, 1932; Stamp, 1950; Paulsen, 1953; Henning, 1956; Watson, 1962a; 1962b, 1962c; Gorrie, 1962; Smith, 1962; Dennis, 1967, 1972; Watson, 1973). These include Bacillus spp.,

Brucella spp., Bluetongue virus, the virus of Border Disease, Clostridium chauvoiei, Corynebacterium spp., Campylobacter foetus var intestinalis, Chlamydia causing Enzootic Abortion of Ewes, Ehrlichia phagocytophilia causing Tick Borne Fever, Leptospira spp., Listeria monocytogenes, Nairobi Sheep Disease virus, Salmonella spp., Toxoplasma gondii and a few fungi. The literatures on these specific infections are voluminous.

All infective agents causing abortion in sheep have in common placentitis. Placental lesions may be pathognomonic, suggestive or non-specific (Dennis, 1972). Stamp (1967) was of a similar opinion. He also believed placental lesions could be sufficiently characteristic for a tentative diagnosis to be made, such as in Enzootic Abortion of Ewes and Toxoplasmosis or non-specific, as in Vibriosis and Salmonella abortus ovis infection. He described the foetal membranes in Enzootic Abortion of Ewes as thickened with a leathery appearance. A cheesy yellowish deposit is typically found on both the cotyledons and the inter-cotyledonary surface. In T. gondii infection a typical infected placenta has cotyledons spotted with white nodules which are 1-2mm in diameter.

As on other aspects of reproduction, the literature on

infections of the reproductive tract of goats is very limited. Doyle (1939) experimentally demonstrated the abortifacient capacity of Brucella abortus in goats. Addo and Dennis (1977) isolated Corynebacterium pyogenes from metritis in one goat and one sheep. McCauley and Tieken (1968) also observed a psittacosis-lymphogranuloma-venereum (PLV) organism in stained cotyledon smears as well as isolated the PLV organism from the liver of a single aborted goat during an epizootic in a herd of milk goats in California, U.S.A.

Various chemicals, especially steroids and anthelmintics and various plants can cause abortion in sheep. Probably the most frequently cited are phenothiazine (Warwick et al., 1946) and locoweeds (James et al., 1967). No specific lesions of the reproductive tract are usually reported to be associated.

MATERIALS AND METHODS

Source of reproductive tracts

Reproductive tracts of female sheep and goats were collected from Zaria, Kaduna and Kano (Appendix I) on the first, second and third Tuesday of every month, respectively, for twelve months. The tracts were obtained from the slaughter slab in Zaria and the abattoirs in Kaduna and Kano. They were excised by cutting through the broad ligaments of the uterus and the vagina, as the carcasses were being hung up in line for meat inspection, in a random manner. Attempt was made to collect not less than five and not more than thirty reproductive tracts at a time. Each tract was placed in a separate polythene bag and kept on ice until examined.

Method of examination

All reproductive tracts were first examined grossly and categorized as being normal non-pregnant (NNP) abnormal non-pregnant (ANP) or pregnant (PREG).

The length (l) height (h) and width (w) of the left and

right ovaries of all tracts were measured in centimetres and counts of functional structures in the ovaries taken. The length of the ovary was measured as the distance between the anterior and posterior poles of the ovary, the heights as the distance between the attached and free border of the ovary and the width as the distance between the medial and lateral surfaces of the ovary.

Follicles less than 0.2cm in diameter were recorded as F_1; those 0.2-0.4cm in diameter as F_2 and all follicles over 0.4cm recorded as F_3. A fresh, haemorrhagic structure in the ovary was recorded as a corpus haemorrhagicum (C.H.). Firm structures in the ovary, varying in size and ranging from dark brown through yellow to cream in colour were recognised as corpora lutea (C.L.).

All tracts were incised from the vagina to the oviducts and the lumen examined. Where a tract was found to be grossly abnormal, the following tissues were taken for histopathological examination: a 0.25cm width of the left and right ovaries; 0.5-1cm length of the midsection of the left and right oviducts; 0.5-1cm length of the left and right uterine horns; 0.5-1cm length of the

uterine body; 0.5-1cm length of the midsection of cervix and 0.25-0.5cm length of the anterior vagina. The tissue samples were fixed for a minimum of three days in Bouin's solution and additional tissues in 10% buffered neutral formalin were indicated. They were then trimmed, processed (Drury and Wallington, 1973) stained with haematoxylin and eosin (and special stains were indicated) and examined microscopically at 10x, 20x, 120x and 320x magnification. Photographs were taken of both gross and microscopic lesions.

The number of foetus (es) present and their location(s) in the reproductive tract were recorded for all pregnant tracts.

Methods of analysis

The mean monthly dimensions of the ovaries, mean monthly incidence of corpora lutea (C.L.) and the percentage incidence of pregnancy (%P) in caprine reproductive tracts examined were calculated for each of the three towns. Similar calculations were made for ovine reproductive tracts collected from Kano and Kaduna.

Each of the foregoing parameters was plotted against monthly mean averages of day length, temperature and rainfall

for each of the three towns, for each species. The climatic data were obtained from meteorological stations in Kaduna and Samaru (Zaria).

The following statistical analyses were made for caprine reproductive tracts collected from Kano, Kaduna and Zaria.

A. Analysis of variance (Walpole, 1974):

(i) monthly mean length of ovary.

(ii) monlthy mean height of ovary.

(iii) monthly mean width of ovary.

(iv) monthly mean incidence of corpora lutea.

B. Chi Square (Walpole, 1974):

(i) monthly percentage incidence of pregnancy.

C. The tetrachoric coefficient of correlation (r_{tet}) between the following (Glass and Stanley, 1970):

(i) monthly mean length of ovary and daylength.

(ii) monthly mean height of ovary and daylength.

(iii) monthly mean width of ovary and daylength.

(iv) monthly mean incidence of corpora lutea and daylength.

(v) monthly percentage incidence of pregnancy and daylength.

(vi) monthly mean length of ovary and environmental temperature.

(vii) monthly mean height of ovary and environmental temperature.

(viii) monthly mean width of ovary and environmental temperature.

(ix) monthly mean incidence of corpora lutea and environmental temperature.

(x) monthly percentage incidence of pregnancy and environmental temperature.

(xi) monthly mean length of ovary and rainfall over or below 50mm per month.

(xii) monthly mean height of ovary and rainfall over or below 50mm per month.

(xiii) monthly mean width of ovary and rainfall over or below 50mm per month.

(xiv) monthly mean incidence of corpora lutea and rainfall over or below 50mm per month.

(xv) monthly percentage incidence of pregnancy and rainfall over or below 50mm per month.

Similar analyses were made for ovine reproductive tracts collected from Kano and Kaduna.

D. The percentage of abnormalities encountered and the incidence of each abnormality as a percentage of the total number of abnormalities encountered were also calculated, both for caprine and for ovine reproductive tracts examined.

RESULTS

Of a total of 134 pregnant caprine reproductive tracts examined, 89 (66.4%) had single foetuses, 44 (32.8%) had twins and one (0.7%) had triplets. Of 25 pregnant ovine reproductive tracts examined, 19 (76%) contained single foetuses, five (20%) had twins and one (4%) had triplets.

The mean monthly dimensions of ovaries, mean monthly incidence of corpora lutea and monthly percentage incidence of pregnancy in caprine reproductive tracts collected from Kano, Kaduna and Zaria are summarized in Tables 1-6. Similar data for ovine reproductive tracts are summarized in Tables 7-10. The details are presented in Appendix II (Tables 1-3) for caprine reproductive tracts and Appendix III (Tables 4-6) for ovine reproductive tracts.

Over the one year period the combined average dimensions of caprine ovaries, all three towns inclusive, were length = 1.68cm (n = 915), height = 1.26cm (n = 915) and width = 0.90cm (n = 915). Individual annual average dimensions for ovaries from the three towns were as follows: Kano - length = 1.63cm (n = 479), height = 1.21cm (n = 479) and width = 0.88cm (n = 479);

Kaduna - length = 1.76cm (n = 278), height = 1.31cm (n = 1.31) and width = 0.91cm (n = 278); Zaria - length = 1.65cm (n = 158), height = 1.25cm (n = 158) and width = 0.90cm (n = 158).

Only 16 ovine ovaries were measured from Zaria over the entire year and were therefore excluded from the following calculations of the combined average dimensions of ovine ovaries. Considering Kano and Kaduna sheep together the combined annual average ovine ovarian dimensions were length = 1.55cm (n = 178), height = 1.15cm (n = 178) and width = 0.81cm (n = 178). For Kano sheep, annual average ovarian dimensions were - length = 1.52cm (n = 98), height = 1.15cm (n = 98) and width = 0.83cm (n = 98). Annual average ovarian dimensions for Kaduna sheep were length = 1.57cm (n = 80), height = 1.14cm (n = 80) and width = 0.78cm (n = 80).

The relationship of the length (l) height (h) and width (w) of ovaries, as well as the mean incidence of corpora lutea (C.L.) and pecentage incidence of pregnancy (% P), to daylength, temperature and rainfall are presented graphically in Figs. 1-18 for caprine reproductive tracts and in Figs. 19-30 for ovine reproductive tracts.

With the exception of the mean monthly width of ovary in Zaria samples, all the mean monthly dimensions for goats in the

three towns investigated showed a highly significant variation from month to month (Table 11). There was a peak in ovarian dimensions in both Kano and Kaduna goats around December (Figs. 1 and 3). Similar results were obtained for Kano and Kaduna sheep.

A summary of the results of statistical analysis for monthly variation in ovarian dimensions, mean incidence of corpora lutea and percentage incidence of pregnancy is presented in Table 11 for caprine reproductive tracts and Table 12 for ovine reproductive tracts.

The variations in monthly mean incidence of corpora lutea were highly significant for goats in Kano and Kaduna and also significant for goats in Zaria. The differences in monthly percentage incidence of pregnancy were highly significant for Kano goats but not significant for Kaduna or Zaria goats (Table 11). There was a peak in both mean incidence of corpora lutea and percentage incidence of pregnancy for both Kano and Kaduna, around December. In almost every month, in all the three towns, foetuses at various stages of development were recorded, indicating breeding activity throughout the year.

For sheep, although the variation in monthly mean incidence of corpora lutea was not significant for Kano the differences in monthly percentage incidence of pregnancy for the same town were significant. The reverse was true of Kaduna sheep. The inconsistency may have been due to the fact that no ovine female genital tracts were obtained from Kaduna in October and November. However, there was the same tendency for a peak in mean incidence of corpora lutea and percentage incidence of pregnancy in both Kano and Kaduna at around December, although from February to September the incidence of pregnancy was rather erratic (Figs 20 and 22).

The results of statistical analysis for correlations between l, h, w, C.L., % P and the environmental factors are summarized in Table 11 for caprine reproductive tracts and Table 12 for ovine reproductive tracts.

For goats in Kaduna as well as Kano there was in every instance a negative correlation between all the reproductive criteria used and daylength. For Zaria there was either no correlation at all or the correlation was positive.

In Kaduna sheep, with the exception of ovarian length all the reproductive criteria were negatively correlated to daylength;

no correlation was found between daylength and changes in ovarian length. Daylength was again neither correlated to changes in ovarian length nor to monthly percentage incidence of pregnancy in Kano sheep, but there was a negative correlation between all the other reproductive criteria and daylength.

The results for Zaria were anomalous but it appears that generally, at least for Kano and Kaduna the breeding pattern of sheep and goats was negatively correlated to daylength. Figs. 1, 2, 3, 4, 19, 20, 21 and 22 further support this conclusion.

With the single exception of a weak positive correlation between environmental temperature and monthly mean length of ovary of Kaduna goats, in every instance there was a negative correlation between environmental temperature and all reproductive criteria for both Kano and Kaduna goats (Table 11). Results for Zaria goats were again anomalous; there was no correlation between environmental temperature and reproductive criteria except in the case of percentage incidence of pregnancy where the correlation was actually positive.

In Kano sheep there was a negative correlation between environmental temperature and all reproductive criteria except monthly mean incidence of corpora lutea.

Although no information is available for October for Kaduna goats and none for both October and November for Kaduna sheep, inspection of Figs. 7, 8, 9, 10, 23, 25 and 26 reveals a general tendency for the reproductive criteria in Kano and Kaduna to increase with decreasing environmental temperature and vice-versa.

With the single absence of correlation between mean length of ovary of sheep and rainfall, all the reproductive criteria for both Kano goats and sheep were positively correlated to rainfall. Results for Kaduna sheep and goats were rather inconsistent, but nonetheless the majority of the reproductive criteria were positively correlated to rainfall (Table 11 and 12). Results for Zaria were even more erratic. The reproductive criteria either bore no correlation to or were negatively correlated to rainfall.

The types and incidence of lesions of the female reproductive tract encountered in this study are summarized in Table 13 for caprine reproductive tracts and in Table 14 for ovine reproductive tracts.

Photographic illustrations of gross specimen and histo-pathological sections are presented in Figs. 31-47. Of 474

caprine reproductive tracts examined 46 (9.7%) had lesions or malformations as had 9 (9.09%) of 99 ovine tracts. 134 and 25 of the caprine and ovine reproductive tracts respectively were pregnant.

Four cases of fusion of the chorioallantoic foetal membranes were observed in goats, but none in sheep. In every instance the pregnancy was early, the embryos togehter with the amniotic vesicle measuring from 1.5 to 2.5cm. One was a triplet pregnancy, the other three, twins. The chorioallantoic membranes were continuous and could not be separated from each other without tearing the membranes.

A segmental defect of the left oviduct in conjunction with a hydrosalpinx was observed in one sheep (KN/22377/S4; Fig. 31). The aplastic portion measured about 0.5cm long. Wide sheets of fibrous tissue covered the dorsum of the uterine walls with several enmeshed caseated abscesses one to two centimetres in diameter. The oviduct on both sides of the aplastic portion were enlarged and contained clear serous fluid. Histologically, the salpingeal lumen was very much enlarged and there was a distinct lymphocytic infiltration of the serosa of the uterus. A single localized area of caseous necrosis was observed in the

serosa. A slight degree of epithelial desquamation had occurred but it was not certain whether this was a preparation artifact.

A vascular hamartoma was encountered in one ovine tract in this study (KN/22377/S3). It bilaterally involved the bases of both ovaries and the utero-ovarian blood vessels as well as the entire uterus, but not the cervix or vagina (Fig. 32). The utero-ovarian vessels appeared as large irregular vascular granulomas which on sectioning revealed numerous, cavernous spaces containing thick dark fluid. The uterine walls were indurated and contained numerous thick-walled blood vessels evident on sectioning (Fig. 33). The body of the uterus contained a small amount of purulo-sanguineous fluid. There were a few fibrin tags on both ovaries which were essentially static. The broad ligaments of the uterus were thickened and oedematous. Histologically, there were numerous thick-walled, muscular blood vessels - therefore arteries - with vasa vasora, and a proliferation of smaller vessels, throughout the stratum spongiosum of the endometrium and the myometrium (Fig. 34; Fig. 35). The majority of these vessels were thrombosed and the vessel walls and perivascular areas infiltrated mostly by

mononuclear cells and a few polymorphs. The bases of both ovaries and all sections of the uterus were involved.

In 474 caprine reproductive tracts 22 cases of parovarian cyst were encountered. Two were bilateral and one multiple but unilateral. No parovarian cysts were seen in the 99 ovine tracts.

One luteinized follicular cyst and onecystic corpus luteum were observed. The former measured 1.8cm in length, had the rounded outline of a follicle but felt unusually thick-walled (Fig. 37). Histologically a crescent-shaped section of luteal tissue lined about two-thirds of the follicular antrum and the remaining portion consisted of granulosa cells. The cystic corpus luteum had an ovulation papilla but was unusually fluctuant. On sectioning a large central cavity with a small amount of serous fluid was evident.

Ovariobursal adhesions were seen in both sheep and goats. In one goat it was bilateral and in another there was a secondary hydrosalpinx.

One caprine reproductive tract was encountered in which several macroscopic cysts, 2-3mm in diameter, were present at both utero-tubal junctions. These cysts contained clear colourless serous fluid. Histologically, there were several large

cysts in the endometrial stroma lined with cuboidal epithelium as well as numerous intra-epithelial cysts (Figs. 39 and 40). Uterine oedema was evident both grossly and histologically.

One case each of foetal mummification and early embryonic death and two cases of foetal maceration were recorded, all in goats.

In this study one pyometra was encountered in a goat (KD/10577/G1; Figs. 41 & 42). The uterus was very pale, tense and firm, the left horn slightly larger than the right. On incision it was found to be filled with thick creamy pus. The caruncles were unusually prominent.

Two cases each of metritis and endometritis were encountered in goats. Gross evidence of inflammation was never spectacular. In every instance it consisted of a few petechial and/or ecchymmotic haemorrhages in the mucosa and/or the serosa. In one tract the uterine mucosa additionally had a whitish granular appearance. Histologically they were characterized by varying degrees of hyperaemia, haemorrhages, oedema and leukocytic infiltration of the uterus mostly mononuclear with fewer polymorphs (Fig. 43).

One ovine tract had two parametrial abscesses lateral to the cervix and vagina. The cause was not immediately evident

and both grossly and histologically the reproductive tract was normal. A peculiar broad ligament consisting on the right side of only ligamentous strands from the base of the right ovary to the right oviduct and uterine bifurcation was also observed in one goat.

One ovine uterus had numerous irregular coppery-yellow spots about one millimetre in diameter all over the serosal surface. Other than a rather pronounced infiltration of the cervix and vagina by polymorphs no histological abnormalities were seen.

In both ovine and caprine were seen several flaccid uteri of varied size and with one horn often larger than the other. The cervix was usually open and on incision the uterus contained chocolate coloured to reddish, thick sticky material (KN/19477/G1; Figs. 44 and 45). Histological sections from such uteri were usually fragmented and/or stained poorly with H & E. In no instance was an F_3 (> 0.4cm) present in either ovary. One or two regressing C.L. were usually present.

What appeared to be foetal remnants were seen in one caprine uterus and cervix (KD/10577/G2; Fig. 46). Four small calcareous structures, one resembling a scapula and another

resembling a tibia were found in the left uterine horn. A fifth similar object resembling a piece of calvarium was found in the cervical lumen. There was no fluid in the lumen and the mucosa was clean. There were two regressing C.L. in the right ovary and two C.H. in the left.

Another caprine tract had a firm cicatrix extending from the dorsum of the right uterine horn through the intercornual septum to the ventrum of the uterus (KN/21677/G2; Fig. 47). Lodged in the cicatrix and visible in the uterine lumen but not outside it were two short white hairs. Histologically the site of the lesion consisted of fibrous connective tissue with a few giant cells of the Langhans type.

Table 1: Mean monthly dimensions (cm) of caprine ovaries collected from Kano

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Length	*n	47	45	43	53	45	33	40	24	31	32	34	52
	$\bar{X}$	1.61	1.62	1.59	1.63	1.69	1.78	1.75	1.71	1.55	1.48	1.54	1.66
	S.D.	0.25	0.30	0.21	0.24	0.25	0.22	0.20	0.26	0.23	0.26	0.18	0.21
Height	n	47	45	43	53	45	33	40	24	31	32	34	52
	$\bar{X}$	1.13	1.20	1.24	1.22	1.31	1.34	1.33	1.32	1.05	1.02	1.10	1.25
	S.D.	0.24	0.23	0.25	0.20	0.27	0.24	0.20	0.20	0.18	0.24	0.18	0.22
Width	n	47	45	43	53	43	33	40	24	31	32	34	52
	$\bar{X}$ c	0.81	0.92	0.83	0.88	0.95	0.99	1.00	0.95	0.78	0.73	0.83	0.87
	S.D.	0.21	0.17	0.17	0.20	0.20	0.23	0.13	0.14	0.11	0.13	0.18	0.16

*n = Sum of left and right ovaries

Table 2: Mean monthly incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in caprine reproductive tracts collected from Kano.

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Mean incidence of C.L	*n_1	47	45	43	53	43	33	40	24	31	32	34	52
	$\bar{X}$	0.34	0.24	0.44	0.49	0.51	0.76	0.73	0.33	0.10	0.06	0.12	0.19
	S.D.	0.48	0.53	0.70	0.72	0.83	0.79	0.72	0.56	0.30	0.25	0.33	0.40
% of incidence of pregnancy	**n_2	24	23	27	28	23	17	20	12	16	16	17	26
	%P	38	35	22	25	22	59	45	25	6	0	0	4

*n_1 = Sum of left and right ovaries

**n_2 = Number of reproductive tracts

Table 3: Mean monthly dimensions (cm) of caprine ovaries collected from Kaduna

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Length	*n	36	31	40	Not Sampled	20	30	20	11	26	16	20	28
	$\bar{X}$	1.66	1.72	1.76	-	1.67	2.00	1.71	1.74	1.90	1.67	1.79	1.77
	S.D.	0.26	0.26	0.27	-	0.20	0.16	0.18	0.27	0.36	0.41	0.16	0.18
Height	*n	36	31	40	Not Sampled	20	30	20	11	26	16	20	28
	$\bar{X}$	1.17	1.27	1.28	-	1.30	1.45	1.36	1.37	1.36	1.19	1.33	1.30
	S.D.	0.20	0.21	0.25	-	0.26	0.16	0.22	0.31	0.30	0.26	0.27	0.28
Width	*n	36	31	40	Not Sampled	20	30	20	11	26	16	20	28
	$\bar{X}$	0.76	0.92	0.80	-	0.87	1.10	0.97	0.94	0.97	0.86	0.93	0.90
	S.D.	0.16	0.20	0.15	-	0.22	0.16	0.21	0.22	0.23	0.19	0.14	0.18

*n = Sum of left and right ovaries

Table 4: Mean monthly incidence of copora lutea (C.L.) and percentage incidence of pregnancy (%P) in caprine reproductive tracts collected from Kaduna.

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Mean incidence of C.L.	$*n_1$	36	31	40	Not Sampled	20	30	20	11	26	16	20	28
	$\bar{X}$	0.33	0.35	0.28	-	0.40	0.80	0.65	0.27	0.54	0.19	0.30	0.32
	S.D.	0.48	0.61	0.51	-	0.68	0.71	0.59	0.47	0.71	0.40	0.66	0.48
% incidence of pregnancy	$**n_2$	18	15	20	Not Sampled	10	15	10	6	13	8	10	14
	%P	39	33	25	-	20	60	50	17	38	13	0	43

$*n_1$ = Sum of left and right ovaries

$**n_2$ = Number of reproductive tracts

Table 5: Mean monthly dimensions (cm) of caprine ovaries collected from Zaria

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Length	*n	12	11	25	12	13	14	18	11	7	13	10	12
	$\bar{X}$	1.64	1.94	1.63	1.74	1.40	1.58	1.61	1.63	1.76	1.62	1.63	1.65
	S.D.	0.34	0.30	0.25	0.15	0.28	0.29	0.23	0.22	0.14	0.29	0.19	0.27
Height	n	12	11	25	12	13	14	18	11	7	13	10	12
	$\bar{X}$	1.20	1.42	1.23	1.30	1.12	1.14	1.23	1.26	1.40	1.15	1.40	1.09
	S.D.	0.35	0.31	0.22	0.19	0.22	0.27	0.19	0.21	0.39	0.99	0.30	0.20
Width	n	12	11	25	12	13	14	18	11	7	13	10	12
	$\bar{X}$	0.83	0.99	0.89	0.94	0.76	0.85	0.89	0.95	0.97	0.88	0.90	0.91
	S.D.	0.15	0.22	0.19	0.36	0.13	0.19	0.17	0.16	0.25	0.17	0.22	0.21

*n = Sum of left and right ovaries

Table 6: Mean monthly incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in caprine reproductive tracts collected from Zaria

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Mean incidence of C.L.	$*n_1$	12	11	25	12	13	14	18	11	7	13	10	12
	$\bar{X}$	0.25	0.45	0.32	0.42	0.15	0.36	0.56	0.55	0.71	0.31	0.10	0.50
	S.D.	0.45	0.52	0.56	0.51	0.38	0.50	0.62	0.52	0.95	0.63	0.32	0.67
% incidence of pregnancy	$**n_2$	6	7	13	7	8	7	9	6	5	7	5	6
	%P	33	57	38	57	25	14	22	67	20	43	20	17

$*n_1$ = Sum of left and right ovaries

$**n_2$ = Number of reproductive tracts.

Table 7: Mean monthly dimensions (cm) of ovine ovaries collected from Kano

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Length	*n	6	14	5	4	10	6	10	3	8	14	12	6
	$\bar{X}$	1.10	1.49	1.52	1.38	1.83	1.83	1.56	1.57	1.59	1.61	1.32	1.48
	S.D.	0.13	0.27	0.43	0.44	0.34	0.33	0.18	0.29	0.22	0.24	0.21	0.08
Height	n	6	14	5	4	10	6	10	3	8	14	12	6
	$\bar{X}$	0.90	1.16	1.08	1.10	1.27	1.27	1.18	1.30	1.20	1.19	0.91	1.17
	S.D.	0.09	0.19	0.28	0.28	0.29	0.14	0.10	0.36	0.35	0.24	0.12	0.18
Width	n	6	14	5	4	10	6	10	3	8	14	12	6
	$\bar{X}$	0.70	0.81	0.84	0.78	0.82	0.98	0.88	1.13	0.84	0.79	0.59	0.83
	S.D.	0.13	0.21	0.30	0.21	0.29	0.17	0.12	0.32	0.12	0.16	0.09	0.15

*n = Sum of left and right ovaries.

Table 8: Mean monthly incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in ovine reproductive tracts collected from Kano

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Mean incidence of C.L.	$*n_1$	6	14	5	4	10	6	10	3	8	14	12	6
	$\bar{X}$	0.00	0.36	0.20	0.26	0.50	0.83	0.60	0.67	0.13	0.21	0.08	0.17
	S.D.	0.00	0.50	0.45	0.50	0.53	0.75	0.84	1.15	0.35	0.43	0.29	0.41
% incidence of pregnancy	$**n_2$	3	7	3	2	5	3	5	2	5	7	6	4
	%P	0	43	0	50	40	100	60	0	0	14	0	25

$*n_1$ = Sum of left and right ovaries.

$**n_2$ = Number of reproductive tracts.

Table 9: Mean monthly dimensions (cm) of ovine ovaries collected from Kaduna

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Length	*n	8	10	8	Not Sampled	No Ovine Tracts	10	11	4	6	10	5	8
	$\bar{X}$	1.45	1.54	1.41	-	-	1.93	1.54	1.83	1.52	1.44	1.48	1.55
	S.D.	0.25	0.41	0.24	-	-	0.19	0.29	0.19	0.28	0.45	0.04	0.14
Height	n	8	10	8	Not Sampled	No Ovine Tracts	10	11	4	6	10	5	8
	$\bar{X}$	1.15	1.23	1.03	-	-	1.24	1.22	1.20	1.03	1.01	0.96	1.2
	S.D.	0.15	0.35	0.24	-	-	0.16	0.24	0.00	0.23	0.27	0.15	0.22
Width	n	8	10	8	-	-	10	11	4	6	10	5	8
	$\bar{X}$	0.75	0.84	0.61	-	-	1.03	0.80	0.90	0.80	0.67	0.56	0.80
	S.D.	0.15	0.26	0.10	-	-	0.13	0.13	0.08	0.18	0.25	0.05	0.13

*n = Sum of left and right ovaries

Table 10: Mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in ovine tracts collected from Kaduna.

		1976						1977					
		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Mean Incidence of C.L.	*n_1	8	10	8	Not Sampled	No Ovine Tracts	10	11	4	6	10	5	8
	$\bar{X}$	0.50	0.40	0.88	-	-	0.70	0.64	0.00	0.17	0.10	0.00	1.00
	S.D.	0.53	0.52	0.83	-	-	0.82	0.92	0.00	0.41	0.32	0.00	0.76
% incidence of pregnancy	**n_2	4	5	4	Not Sampled	No Ovine Tracts	5	5	2	3	5	3	4
	%P	0	20	0	-	-	60	40	0	0	20	0	0

n_1 = Sum of left and right ovaries.

n_2 = Number of reproductive tracts.

Table 11: Summary of results of statistical analyses - Caprine

Analysis	Subject	Level of significance or correlation		
		Kano	Kaduna	Zaria
Variance	Monthly mean length of ovary.	Highly significant $f_{0.01}$ = 4.76 at DF(11, 467)	Highly significant $f_{0.01}$ = 4.76 at DF(10, 267)	Highly significant f0.01 = 2.77 at DF(11, 146)
Variance	Monthly mean height of ovary.	Highly significant $f_{0.01}$ = 8.24 at DF(11, 467)	Highly significant $f_{0.01}$ = 2.97 at DF(10, 267)	Highly significant f0.01 = 2.34 at DF(11, 146)
Variance	Monthly mean width of ovary.	Highly significant $f_{0.01}$ = 8.61 at DF(11, 465)	Highly significant $f_{0.01}$ = 7.53 at DF(10, 267)	Not significant f0.05 = 1.04 at DF(11, 146)
Variance	Monthly mean incidence of corpora lutea.	Highly significant $f_{0.01}$ = 5.34 at DF(11, 465)	Highly significant $f_{0.01}$ = 2.55 at DF(10, 267)	Significant f0.05 = 1.88 at DF(11, 146)
Chi-Square	Monthly incidence of pregnancy.	Highly significant $X^2_{0.01}$ = 39.44 at DF(11)	Not significant $X^2_{0.05}$ = 15.82 at DF(10)	Not significant $X^2_{0.05}$ = 10.14 at DF(11)
Correlation	Monthly mean length of ovary vs. Daylength.	-ve correlation; moderately strong r_{tet} = -0.73	-ve correlation r_{tet} -0.50	+ve correlation r_{tet} = +0.56
Correlation	Monthly mean height of ovary vs. Daylength.	-ve correlation r_{tet} = -0.50	-ve correlation; moderately strong r_{tet} = -0.68	No correlation r_{tet} = 0.00
Correlation	Monthly mean width of ovary vs. Daylength.	-ve correlation; weak r_{tet} = -0.27	-ve correlation r_{tet} = -0.41	+ve correlation r_{tet} = +0.56

Table 11: Continued

Analysis	Subject	Level of significance or correlation		
		Kano	Kaduna	Zaria
Correlation	Monthly mean incidence of corpora lutea. vs. Daylength.	-ve correlation; moderately strong $r_{tet} = -0.73$	-ve correlation $r_{tet} = -0.50$	No correlation $r_{tet} = 0.00$
Correlation	Monthly percentage incidence of pregnancy vs. Daylength.	-ve correlation $r_{tet} = -0.56$	-ve correlation $r_{tet} = -0.11$	No correlation $r_{tet} = 0.00$
Correlation	Monthly mean length of ovary vs. environmental temperature.	-ve correlation $r_{tet} = -0.50$	+ve correlation; weak $r_{tet} = +0.11$	No correlation $r_{tet} = 0.00$
Correlation	Monthly mean height of ovary vs. environmental temperature.	-ve correlation $r_{tet} = -0.50$	-ve correlation; weak $r_{tet} = -0.16$	No correlation $r_{tet} = 0.00$
Correlation	Monthly mean width of ovary vs. environmental temperature.	-ve correlation; moderately high $r_{tet} = -0.73$	-ve correlation $r_{tet} = -0.41$	No correlation $r_{tet} = 0.00$

Table 11: Continued

Analysis	Subject	Level of significance or correlation		
		Kano	Kaduna	Zaria
Correlation	Monthly mean incidence of corpora lutea vs. environmental temperature.	-ve correlation; weak $r_{tet} = -0.27$	-ve correlation; very strong $r_{tet} = -1.00$	No correlation $r_{tet} = 0.00$
Correlation	Monthly percentage incidence of pregnancy vs. environmental temperature.	-ve correlation $r_{tet} = -0.56$	-ve correlation; weak $r_{tet} = -0.11$	+ve correlation $r_{tet} = +0.50$
Correlation	Monthly mean length of ovary vs. Rainfall.	+ve correlation $r_{tet} = +0.50$	-ve correlation; weak $r_{tet} = -0.11$	-ve correlation $r_{tet} = -0.56$
Correlation	Monthly mean height of ovary vs. Rainfall.	+ve correlation; moderately $r_{tet} = +0.73$	+ve correlation; weak $r_{tet} = +0.16$	-ve correlation $r_{tet} = -0.56$
Correlation	Monthly mean width of ovary vs. Rainfall.	+ve correlation; weak $r_{tet} = +0.27$	-ve correlation; weak $r_{tet} = -0.16$	-ve correlation $r_{tet} = -0.56$
Correlation	Monthly mean incidence of corpora lutea vs. Rainfall	+ve correlation; moderately $r_{tet} = +0.73$	+ve correlation $r_{tet} = +0.50$	No correlation $r_{tet} = 0.00$
Correlation	Monthly percentage incidence of pregnancy vs. Rainfall.	+ve correlation $r_{tet} = +0.56$	+ve correlation; weak $r_{tet} = +0.11$	No correlation $r_{tet} = 0.00$

Table 12: Summary of results of statistical analyses - Ovine

Analysis	Subject	Level of significance or correlation		
		Kano	Kaduna	Zaria
Variance	Monthly mean length of ovary.	Highly significant $f_{0.01} = 4.55$ at DF(11, 86)	Highly significant $f_{0.01} = 2.76$ at DF(9, 70)	N O A N A L Y S I S
Variance	Monthly mean height of ovary.	Highly significant $f_{0.01} = 2.66$ at DF(11, 86)	Not significant $f_{0.05} = 1.63$ at DF(9, 70)	" "
Variance	Monthly mean width of ovary.	Highly significant $f_{0.01} = 3.10$ at DF(11, 86)	Highly significant $f_{0.01} = 5.11$ at DF(9, 70)	" "
Variance	Monthly mean incidence of corpora lutea.	Not significant $f_{0.05} = 1.64$ at DF(11, 86)	Significant $f_{0.05} = 2.19$ at DF(9, 70)	" "
Chi-Square	Monthly percentage incidence of pregnancy.	Significant $X^2_{0.05} = 20.38$ at DF(11)	Not significant $X^2_{0.05} = 12.29$ at DF(9)	" "
Correlation	Monthly mean length of ovary vs. Daylength	No correlation $r_{tet} = 0.00$	No correlation $r_{tet} = 0.00$	" "
Correlation	Monthly mean height of ovary vs. Daylength.	-ve correlation $r_{tet} = -0.50$	-ve correlation $r_{tet} = -0.56$	" "
Correlation	Monthly mean width of ovary vs. Daylength.	-ve correlation $r_{tet} = -0.50$	-ve correlation; weak $r_{tet} = -0.27$	" "
Correlation	Monthly mean incidence of corpora lutea vs. Daylength.	-ve correlation; weak $r_{tet} = -0.27$	-ve correlation; weak $r_{tet} = -0.27$	" "

Table 12: Continued

Analysis	Subject	Level of significance or correlation		
		Kano	Kaduna	Zaria
Correlation	Monthly mean length of ovary vs. Rainfall.	No correlation $r_{tet} = 0.00$	+ve correlation $r_{tet} = +0.31$	N O A N A L Y S I S
Correlation	Monthly mean height of ovary vs. Rainfall.	+ve correlation $r_{tet} = +0.50$	+ve correlation; $r_{tet} = +0.37$	" "
Correlation	Monthly mean width of ovary vs. Rainfall.	+ve correlation $r_{tet} = +0.50$	No correlation $r_{tet} = -0.0$	" "
Correlation	Monthly mean incidence of corpora lutea vs. Rainfall.	+ve correlation; weak $r_{tet} = +0.27$	+ve correlation $r_{tet} = +0.37$	" "
Correlation	Monthly percentage incidence of pregnancy vs. Rainfall.	+ve correlation; weak $r_{tet} = +0.27$	-ve correlation $r_{tet} = -0.37$	" "

Table 12: Continued

Analysis	Subject	Level of significance or correlation		
		Kano	Kaduna	Zaria
Correlation	Monthly percentage incidence of pregnancy vs. Daylength.	No correlation $r_{tet} = 0.00$	-ve correlation; moderately high $r_{tet} = -0.80$	N O A N A L Y S I S
Correlation	Monthly mean length of ovary vs. environmental temperature.	No correlation $r_{tet} = 0.00$	-ve correlation $r_{tet} = 0.61$	" "
Correlation	Monthly mean height of ovary vs. environmental temperature.	-ve correlation $r_{tet} = -0.50$	-ve correlation $r_{tet} = -0.56$	" "
Correlation	Monthly mean width of ovary vs. environmental temperature.	-ve correlation $r_{tet} = -0.50$	-ve correlation; weak $r_{tet} = -0.27$	" "
Correlation	Monthly mean incidence of corpora lutea vs. environmental temperature.	-ve correlation; weak $r_{tet} = -0.27$	+ve correlation $r_{tet} = +0.41$	" "
Correlation	Monthly percentage incidence of pregnancy vs. environmental temperature.	-ve correlation; weak $r_{tet} = -0.27$	-ve correlation $r_{tet} = -0.27$	" "

Table 13: Lesions in 474 female caprine reproductive tracts

Type of lesion	Number	% of lesions	% incidence
Cystic corpus luteum	1	2.17	0.21
Cystic endometrium	1	2.17	0.21
Early embryonic death	1	2.17	0.21
Endometritis	2	4.35	0.42
Fenestrated broad ligament	1	2.17	0.21
Foetal maceration	2	4.35	0.42
Foetal mummification	1	2.17	0.21
Fused chorioallantois	4	8.70	0.84
Luteinized follicular cyst	1	2.17	0.21
Metritis	2	4.35	0.42
Ovario-bursal adhesions	3	6.52	0.63
Parovarian cyst	22	47.83	4.64
Perimetrial adhesions	2	4.35	0.42
Pyometra	1	2.17	0.21
Retained foetal remnants	1	2.17	0.21
Trans-uterine cicatrix	1	2.17	0.21
Total	46	99.98	9.7

Table 14: Lesions in 99 female ovine reproductive tracts.

Type of lesion	Number	% of lesions	% incidence
Hydrosalpinx	2	22.22	2.02
Ovario-bursal adhesions	3	33.33	3.03
Parametrial abscess	1	11.11	1.01
Segmental aplasia	1	11.11	1.01
Serosal spots	1	11.11	1.01
Vascular hamartoma	1	11.11	1.01
Total	9	99.99	9.09

Fig. 1: Relationship of mean length, height and width of ovaries of Kano goats to daylength.

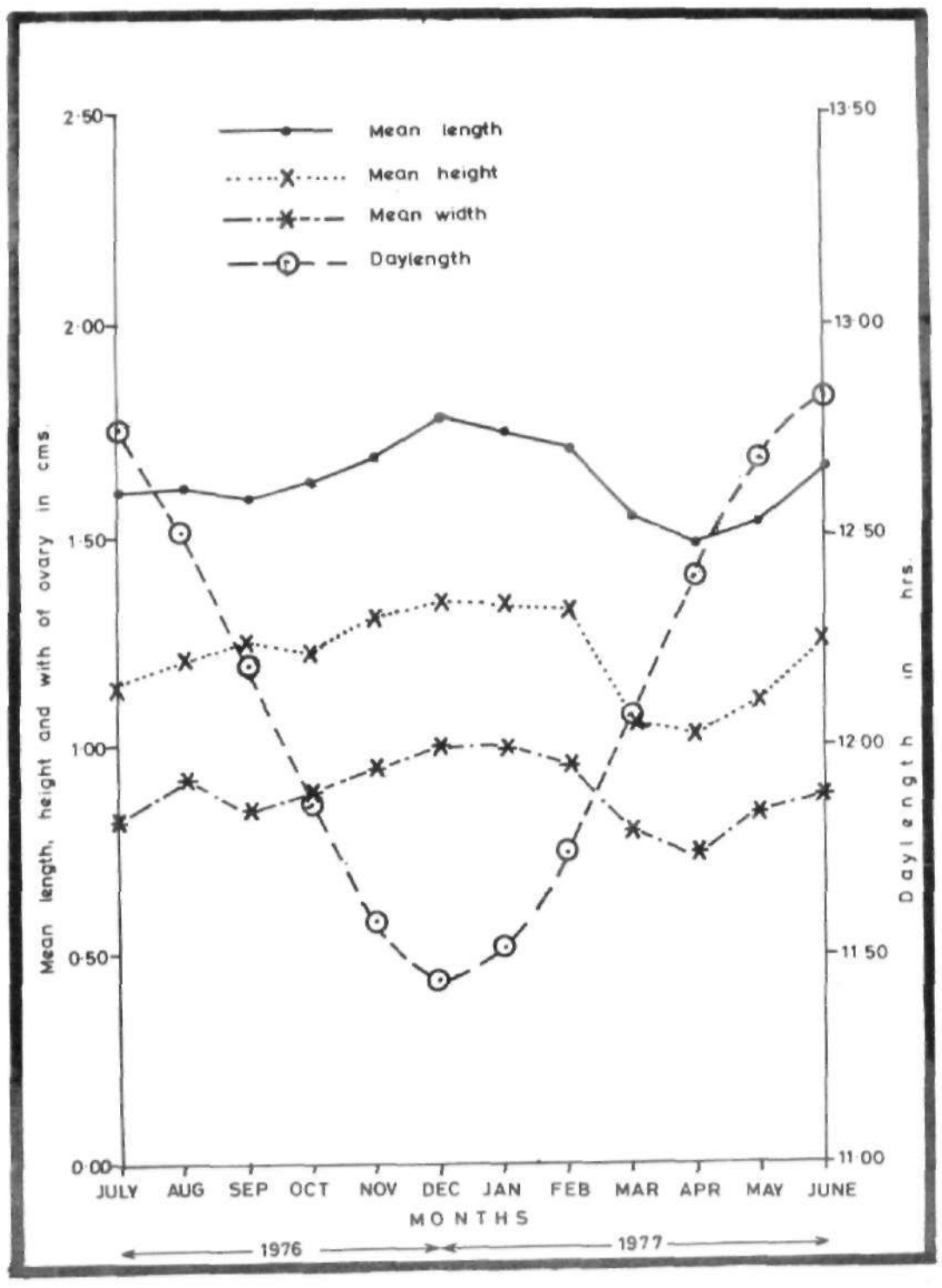

Mean length
Mean height
Mean width
Daylength
2·50
2·00
1·50
1·00
0·50
0·00
13·50
13·00
12 50
12 00
11 50
11 00
Mean length, height and width of ovary in cms.
Daylength in hrs.
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 2: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kano goats to daylenth.

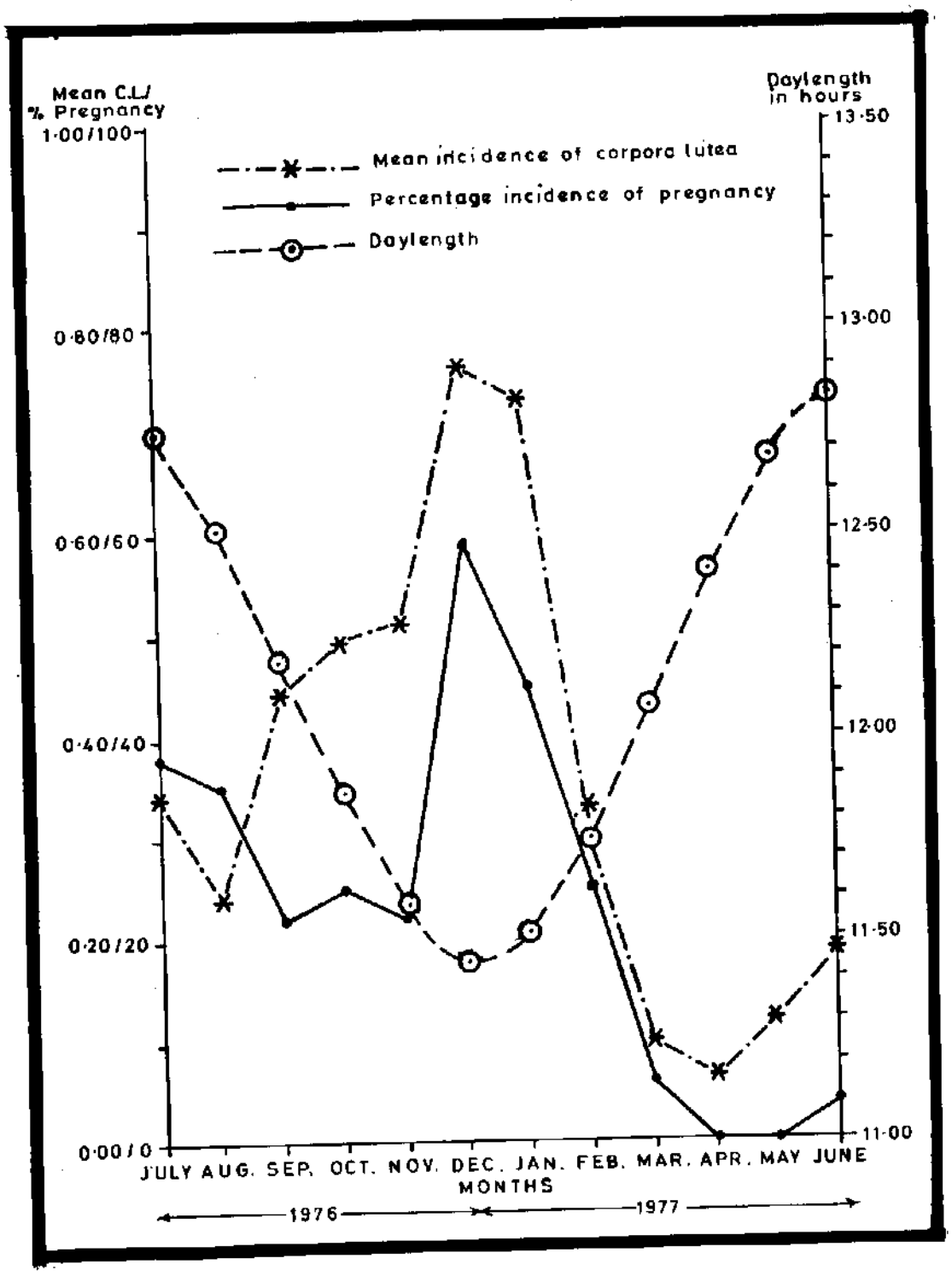

Mean C.L/
% Pregnancy
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·00/0
Daylength
in hours
13·50
13·00
12·50
12·00
11·50
11·00
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Daylength
JULY AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE
MONTHS
1976
1977

Fig. 3: Relationship of mean length, height and width of ovaries of Kaduna goats to daylength.

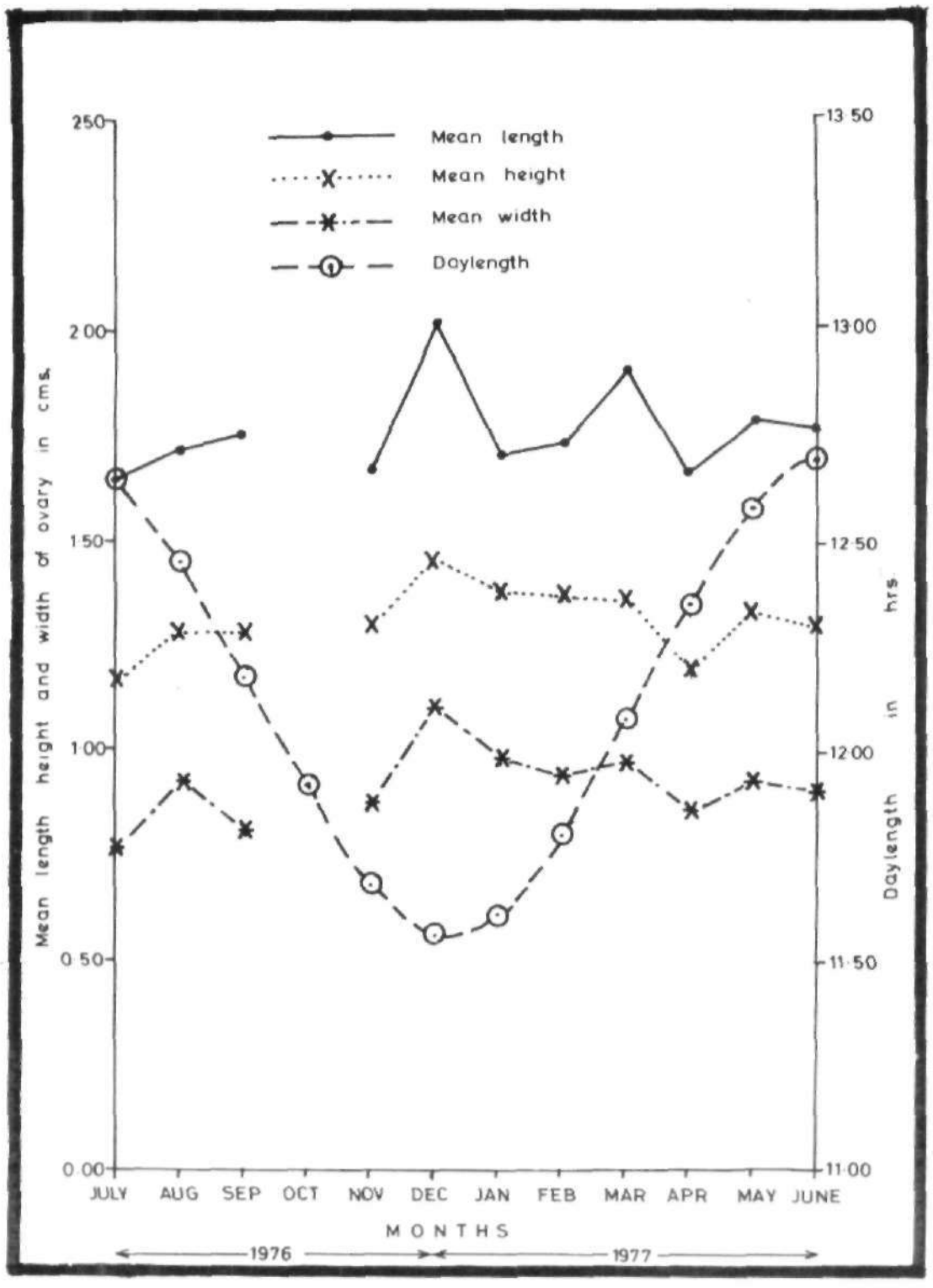

Mean length
Mean height
Mean width
Daylength
250
2·00
1·50
1·00
0·50
0·00
13·50
13·00
12·50
12·00
11·50
11·00
Mean length height and width of ovary in cms.
Daylength in hrs
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 4: Relationship of mean incidence of copora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kaduna goats to daylength.

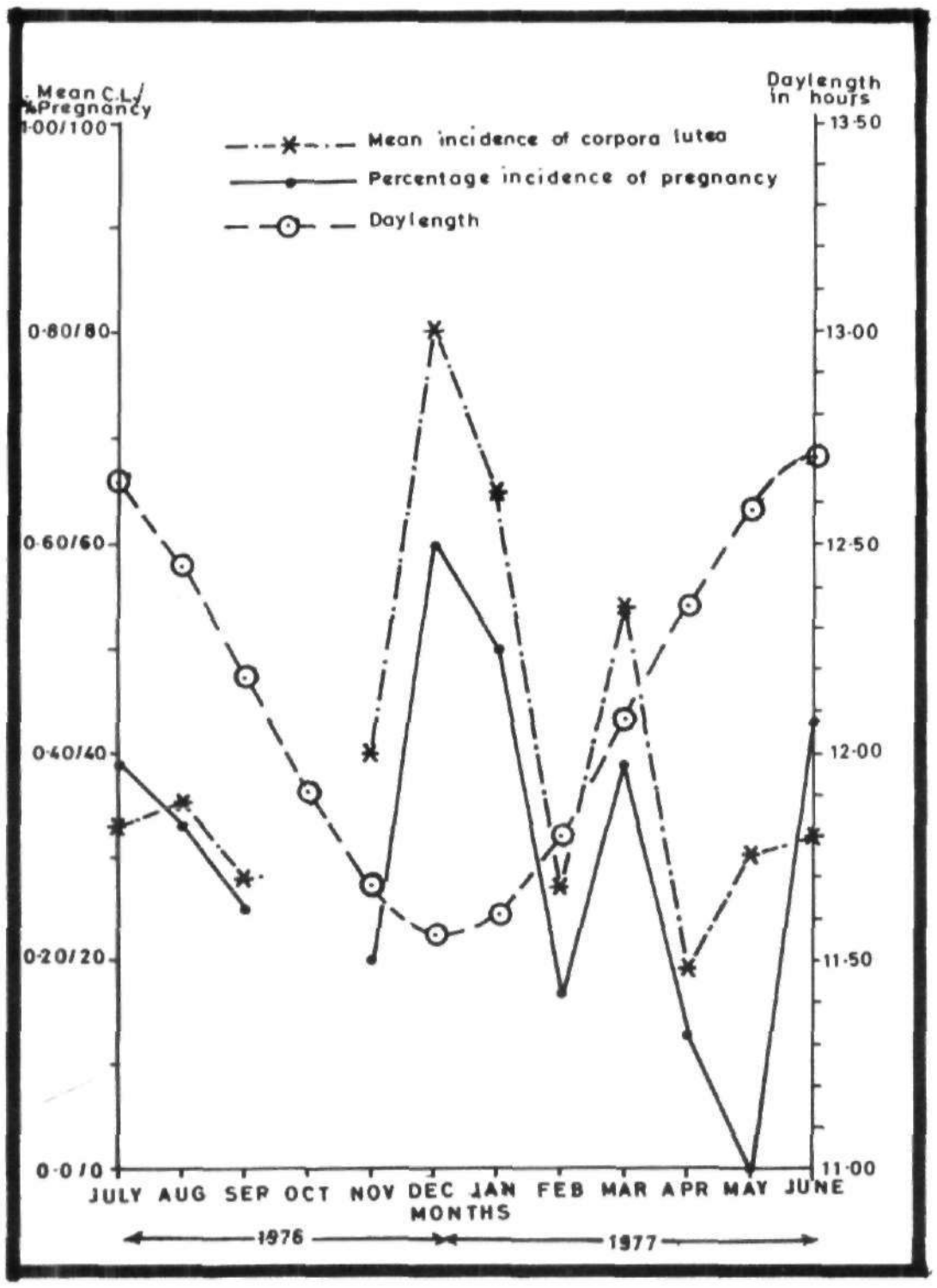

Mean C.L./ Pregnancy
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·0/0
Daylength in hours
13·50
13·00
12·50
12·00
11·50
11·00
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Daylength
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 5: Relationship of mean length, height and width of ovaries of Zaria goats to daylength.

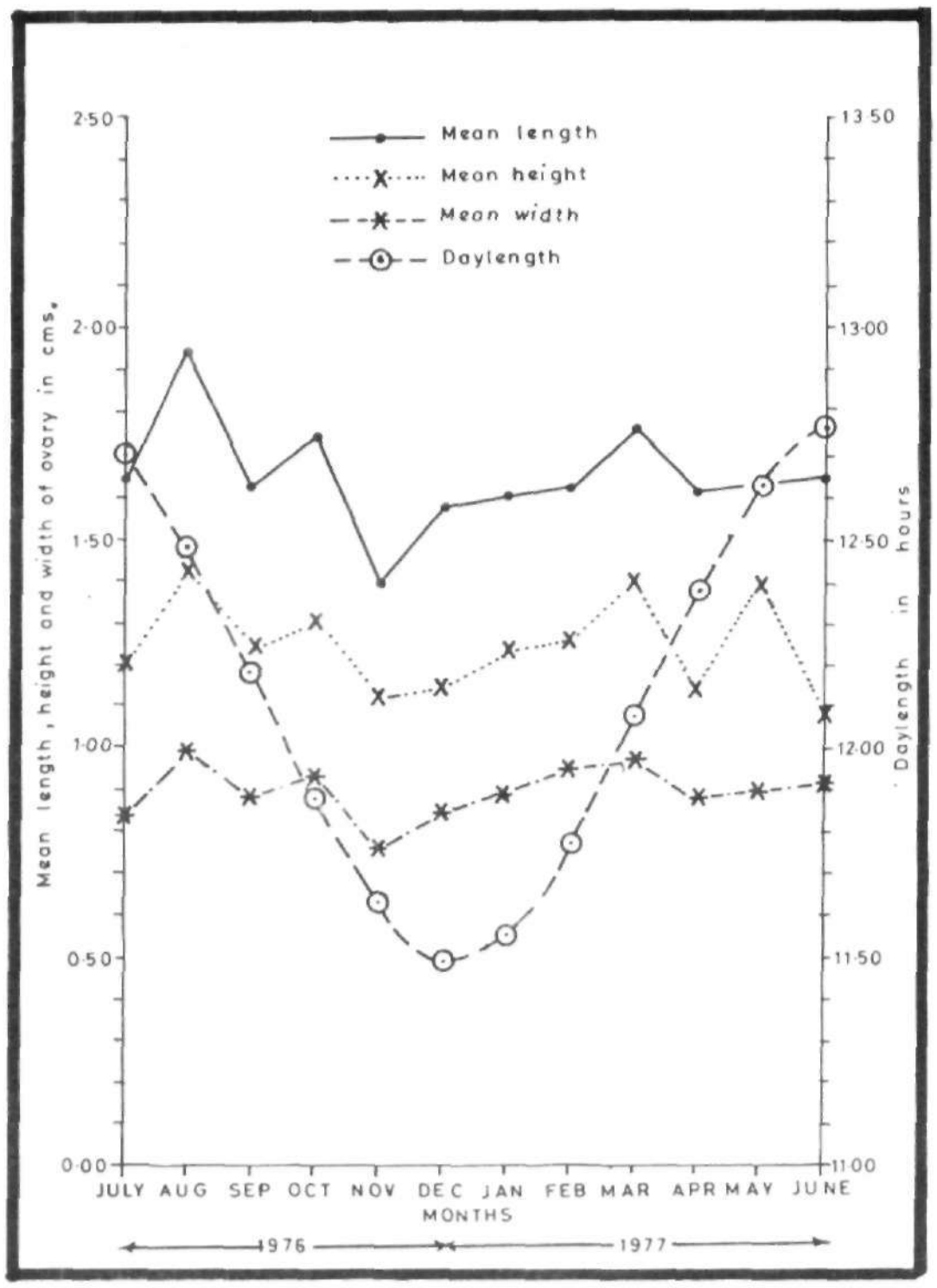
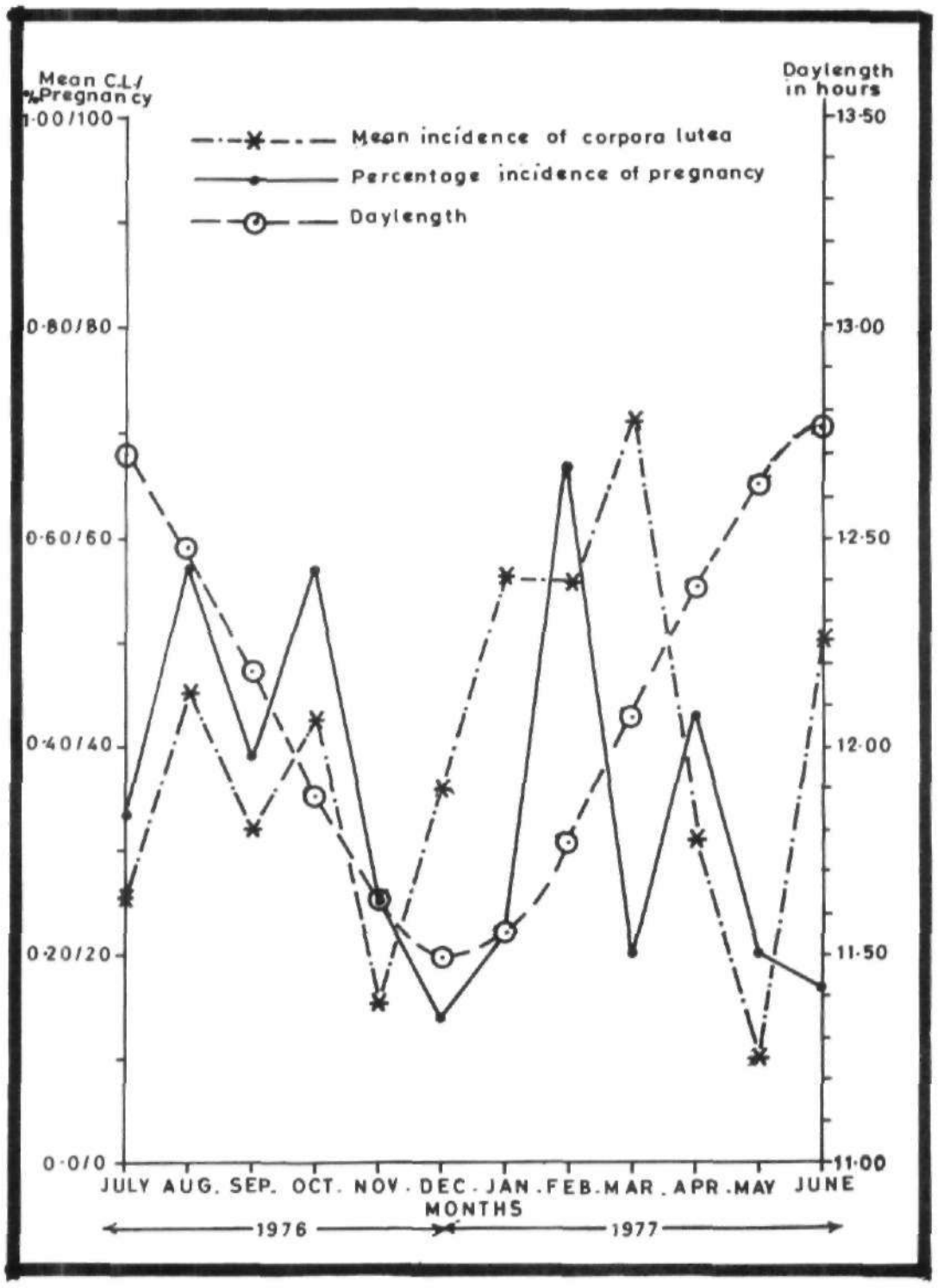

Mean length
Mean height
Mean width
Daylength
Mean length, height and width of ovary in cms.
Daylength in hours
2·50
2·00
1·50
1·00
0·50
0·00
13·50
13·00
12·50
12·00
11·50
11·00
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 6: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) to daylength.


Mean C.L./ Pregnancy
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·0/0
Daylength in hours
13·50
13·00
12·50
12·00
11·50
11·00
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Daylength
JULY AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE
MONTHS
1976
1977

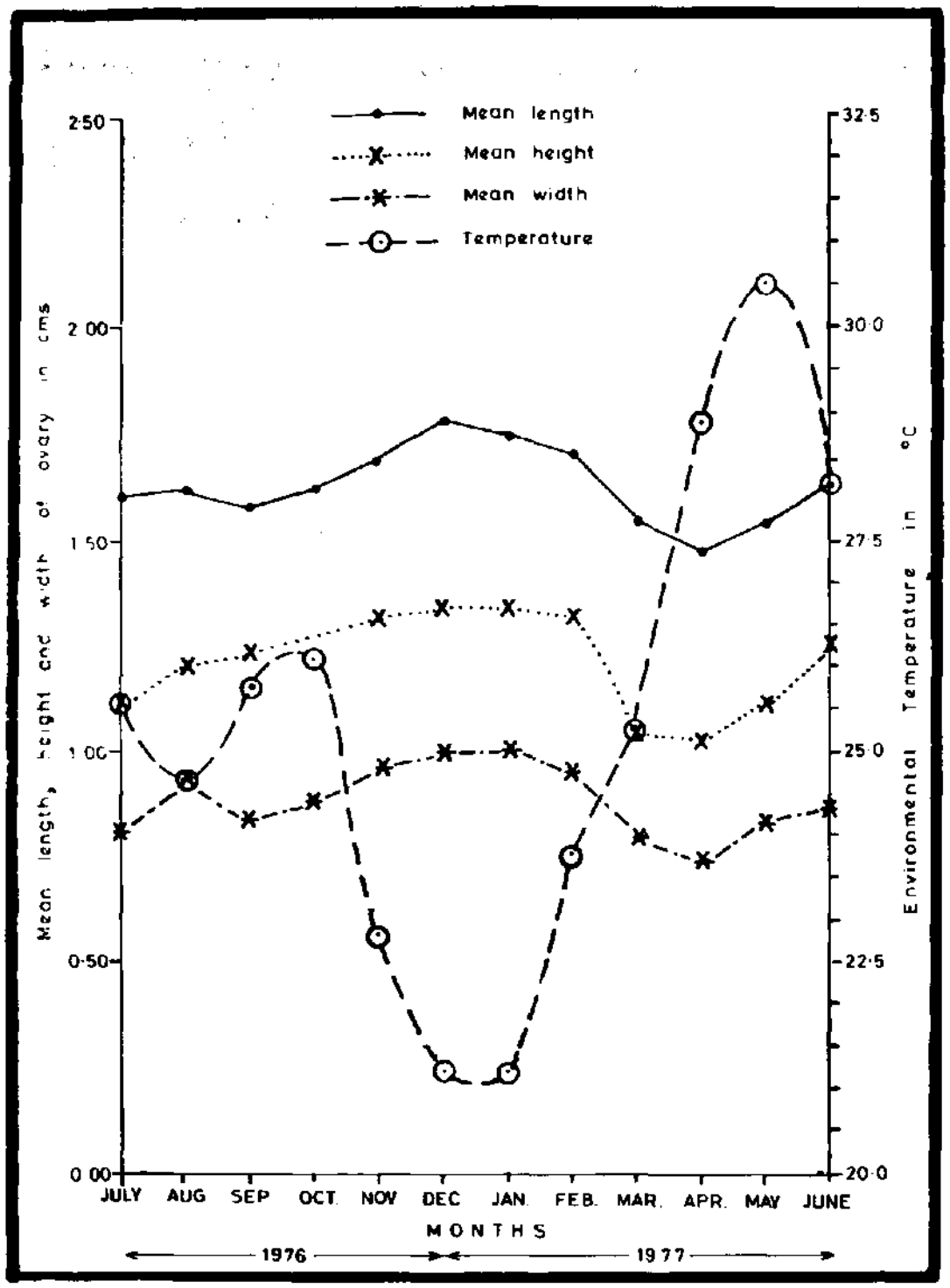

Mean length
Mean height
Mean width
Temperature
2·50
2·00
1·50
1·00
0·50
0·00
32·5
30·0
27·5
25·0
22·5
20·0
Mean length, height and width of ovary in cms
Environmental Temperature in °C
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
MONTHS
1976
1977

Fig. 8: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kano goats to environmental temperature.

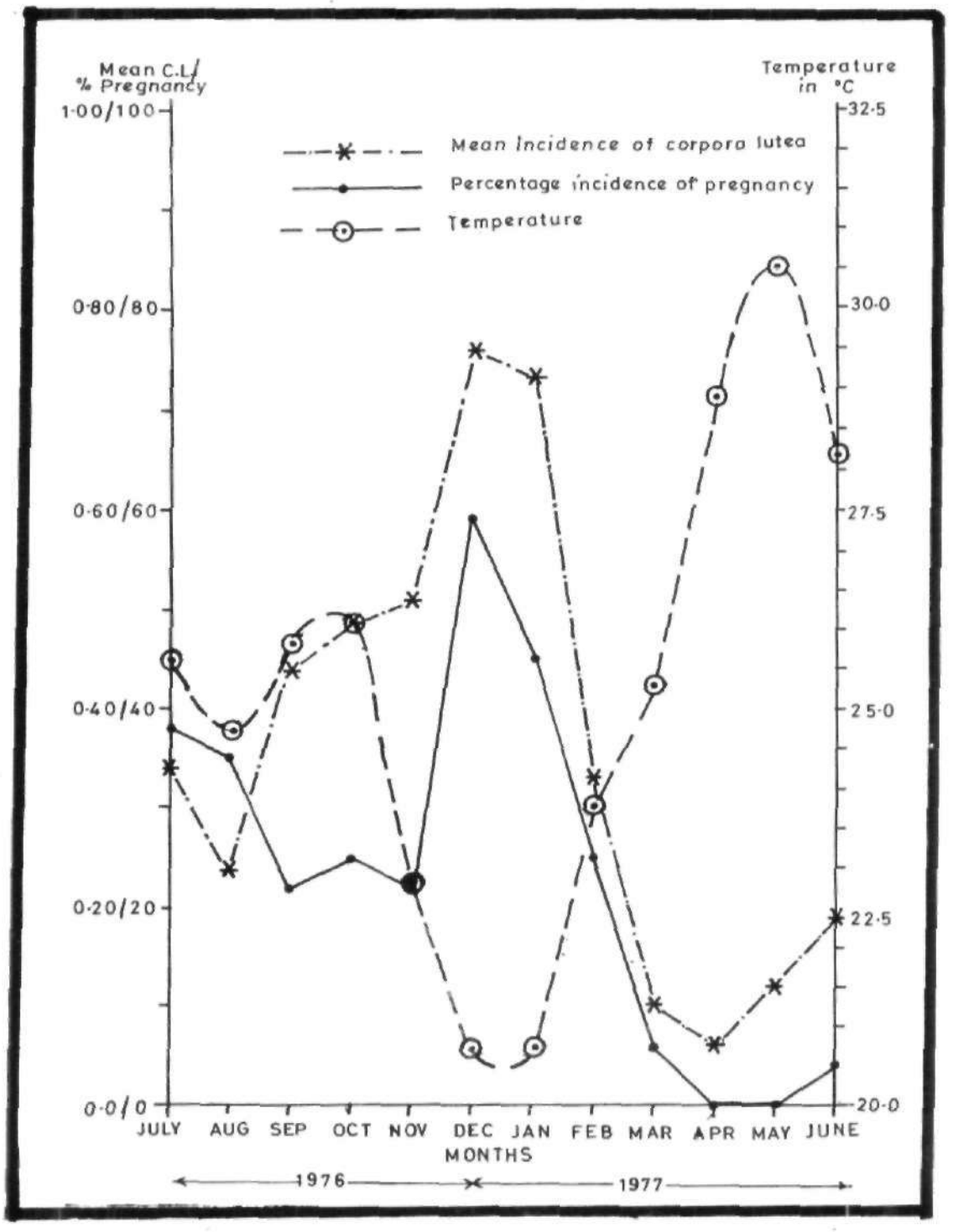

Mean C.L/
% Pregnancy
Temperature
in °C
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·0/0
32·5
30·0
27·5
25·0
22·5
20·0
Mean Incidence of corpora lutea
Percentage incidence of pregnancy
Temperature
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 9: Relationship of mean length, height and width of ovaries of Kaduna goats to environmental temperature.

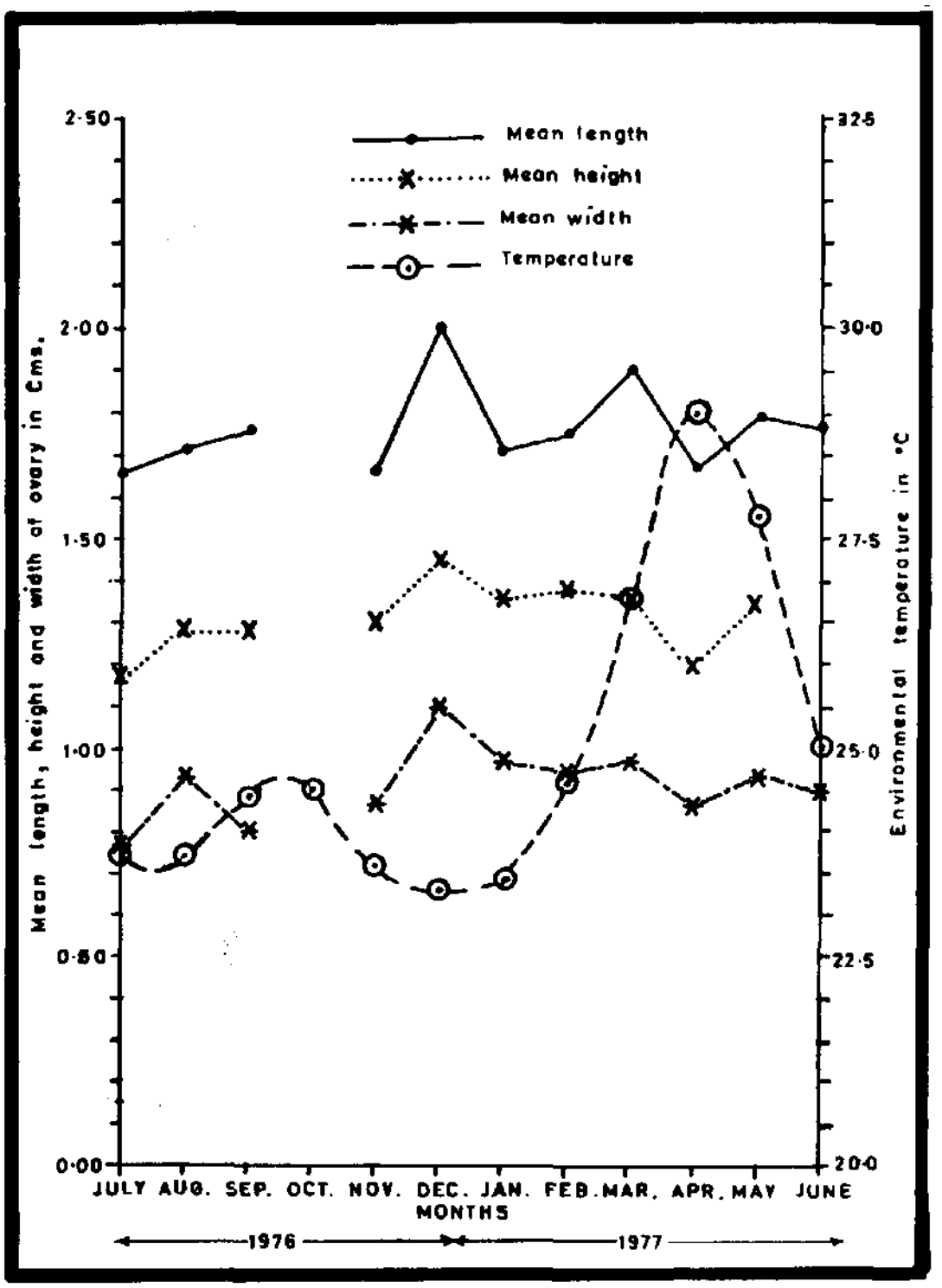

Mean length
Mean height
Mean width
Temperature
2·50
2·00
1·50
1·00
0·50
0·00
32·5
30·0
27·5
25·0
22·5
20·0
Mean length, height and width of ovary in Cms.
Environmental temperature in °C
JULY AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE
MONTHS
1976
1977

Fig. 10: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kaduna goats to environmental temperature.

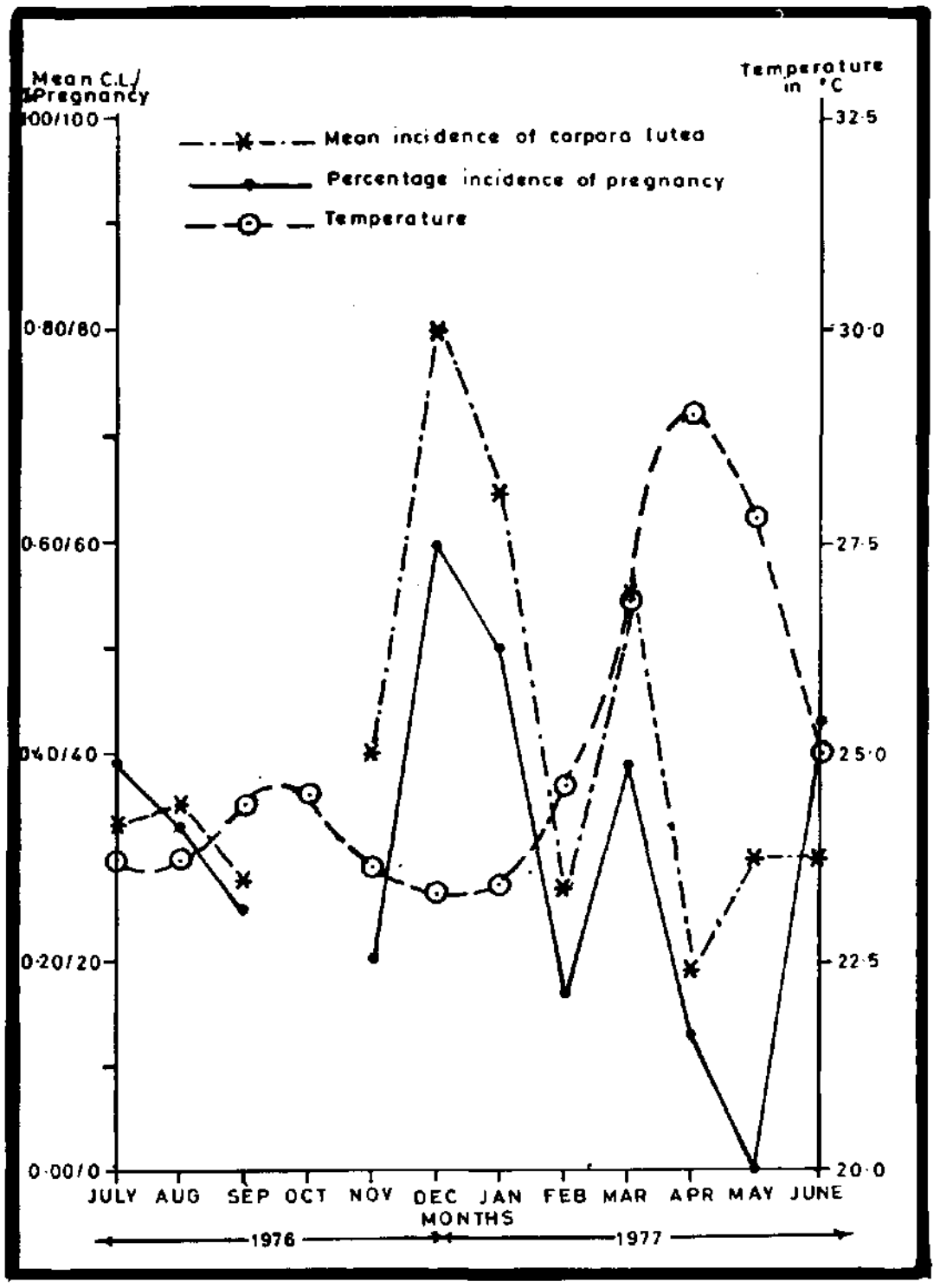

Mean C.L./ Pregnancy
Temperature in °C
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Temperature
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·00/0
32·5
30·0
27·5
25·0
22·5
20·0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 11: Relationship of mean length, height and width of ovaries of Zaria goats to environmental temperature.

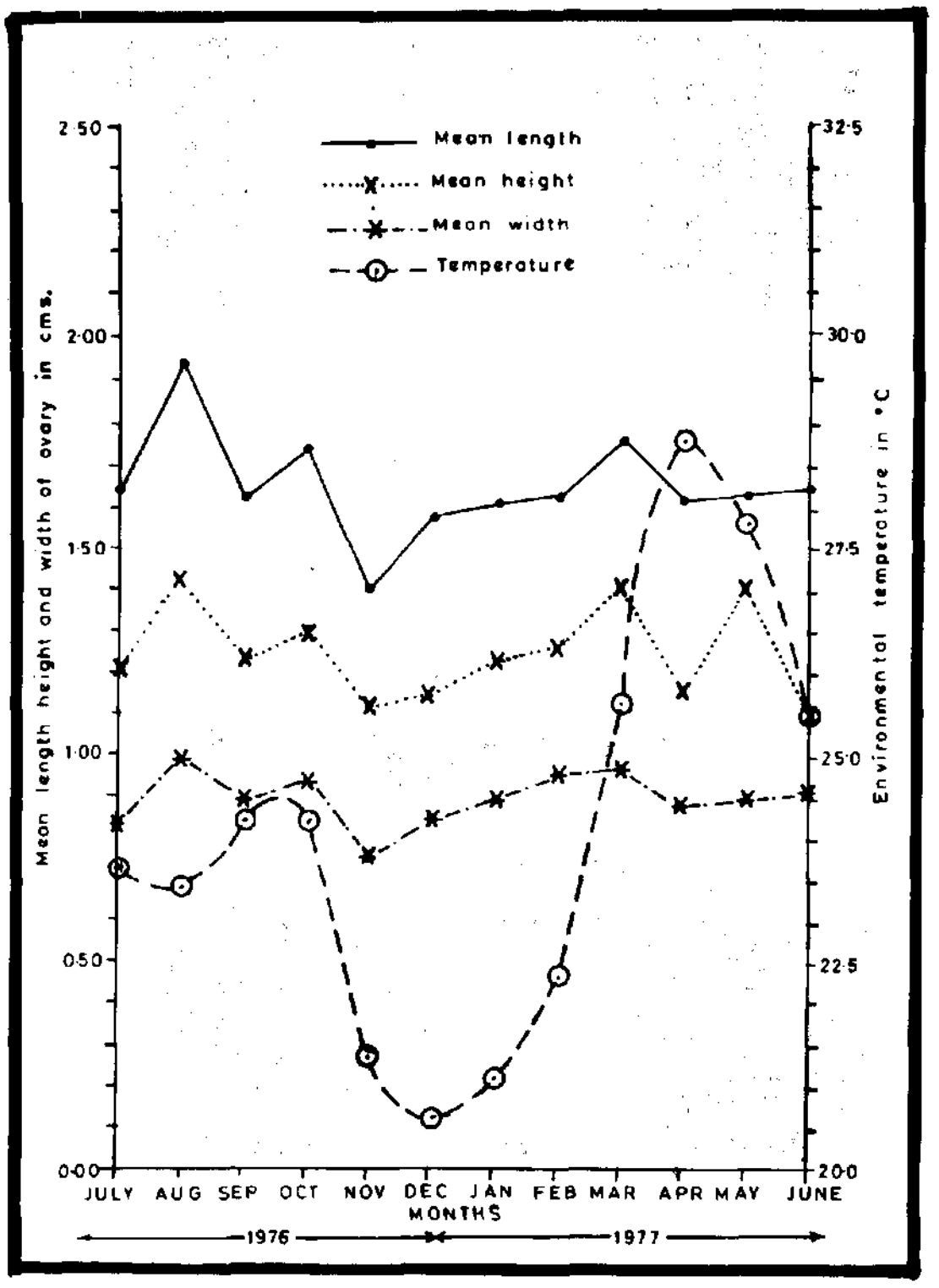

Mean length
Mean height
Mean width
Temperature
Mean length height and width of ovary in cms.
Environmental temperature in °C
2·50
2·00
1·50
1·00
0·50
0·00
32·5
30·0
27·5
25·0
22·5
20·0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig.12: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Zaria goats to environmental temperature.

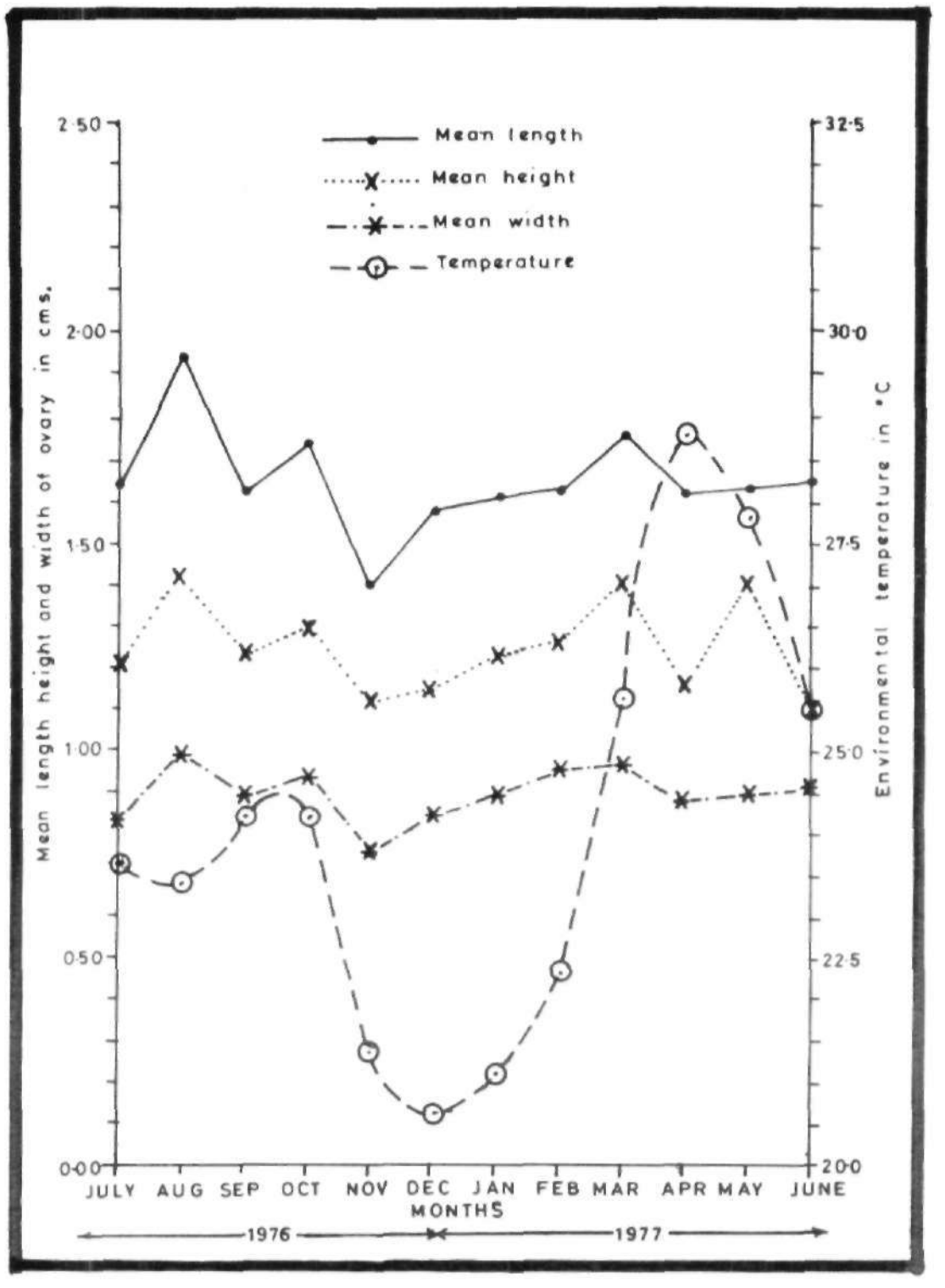

Mean length
Mean height
Mean width
Temperature
Mean length height and width of ovary in cms.
Environmental temperature in °C
2·50
2·00
1·50
1·00
0·50
0·00
32·5
30·0
27·5
25·0
22·5
20·0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig.12: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Zaria goats to environmental temperature.

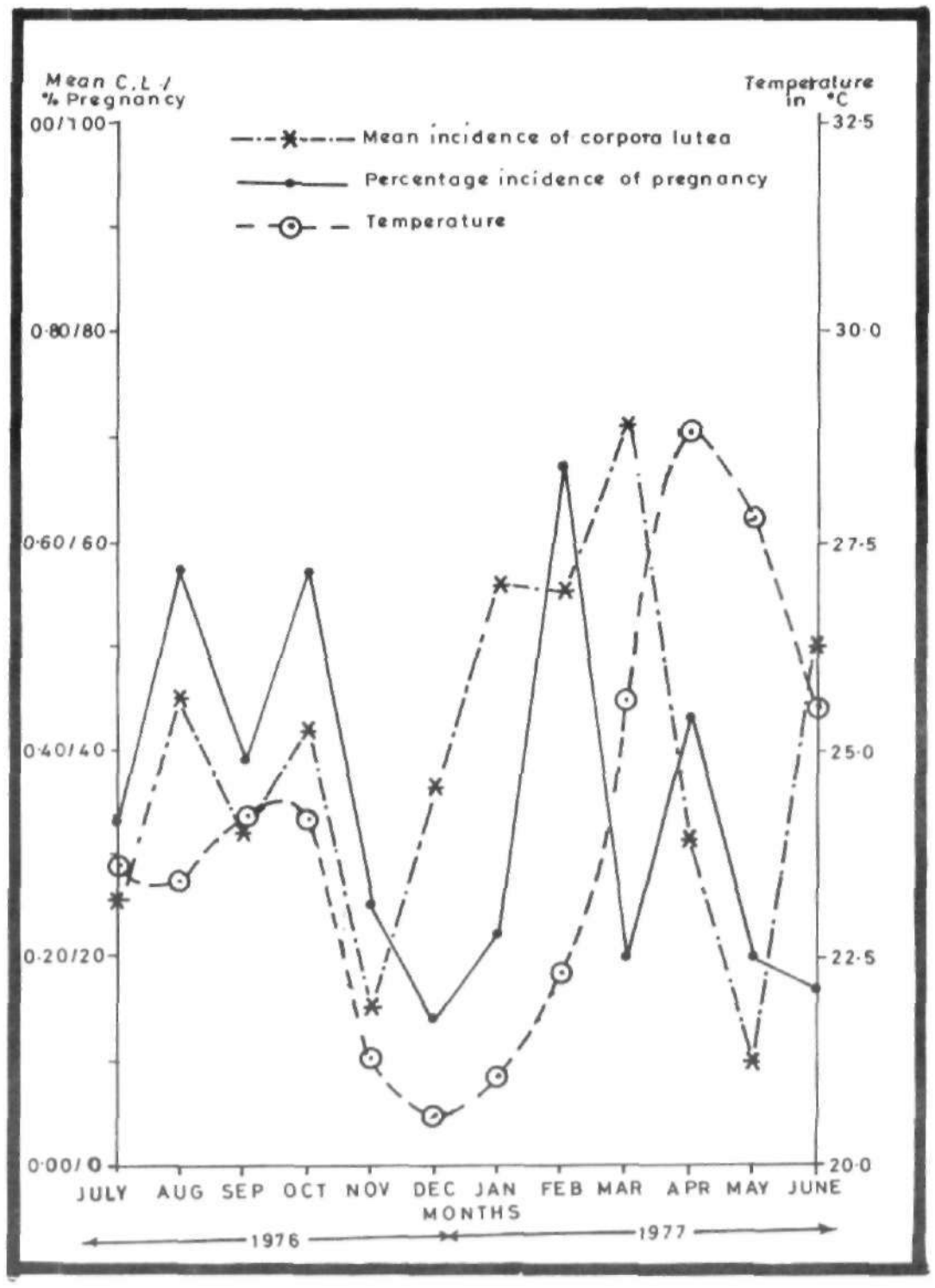

Mean C.L /
% Pregnancy
Temperature
in °C
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Temperature
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·00/0
32·5
30·0
27·5
25·0
22·5
20·0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 13: Relationship of mean length, height and with of ovaries of Kano goats to rainfall.

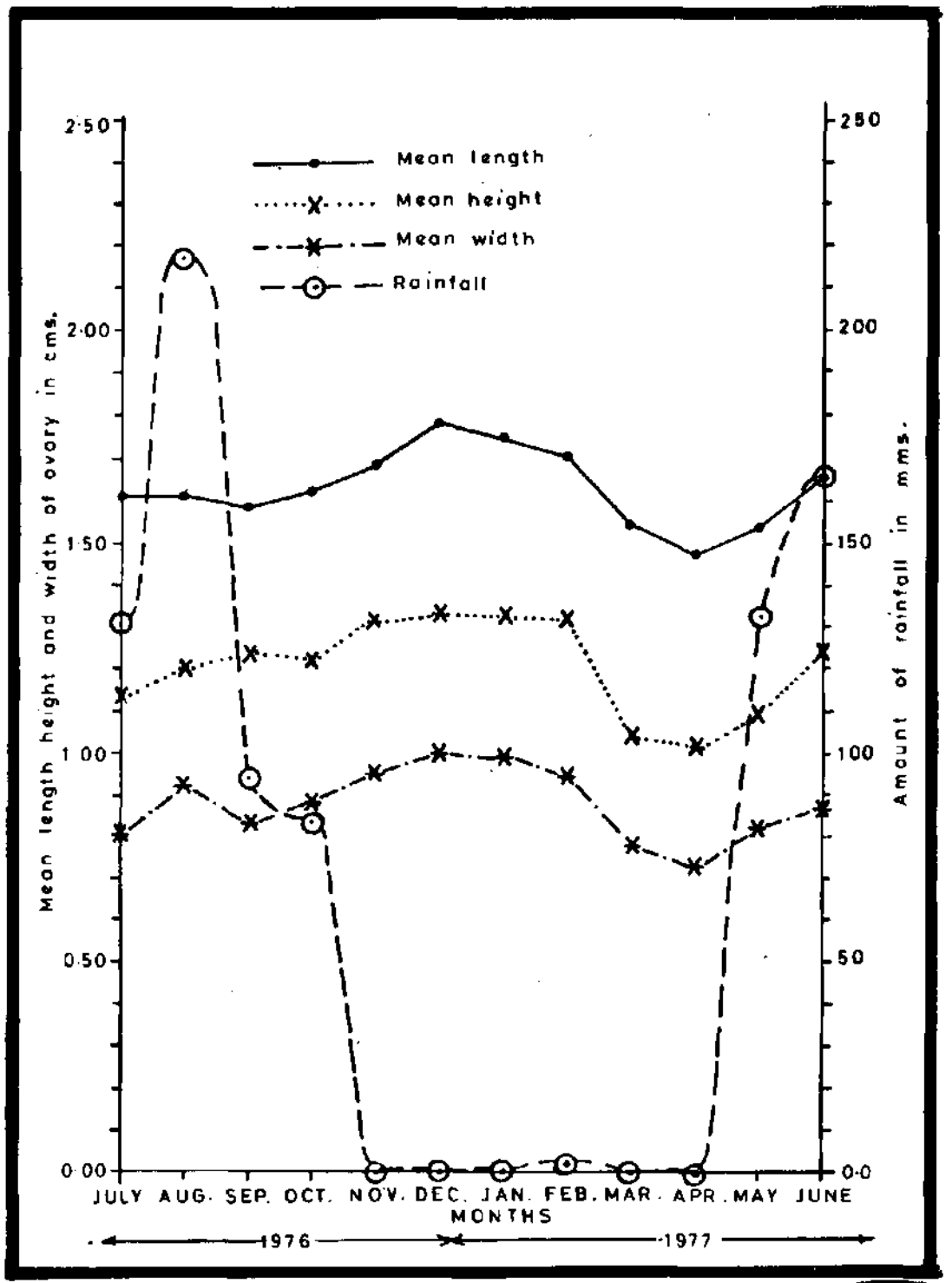

Mean length
Mean height
Mean width
Rainfall
Mean length height and width of ovary in cms.
Amount of rainfall in mms.
2·50
2·00
1·50
1·00
0·50
0·00
250
200
150
100
50
0·0
JULY AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE
MONTHS
1976
1977

Fig. 14: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kano goats to rainfall.

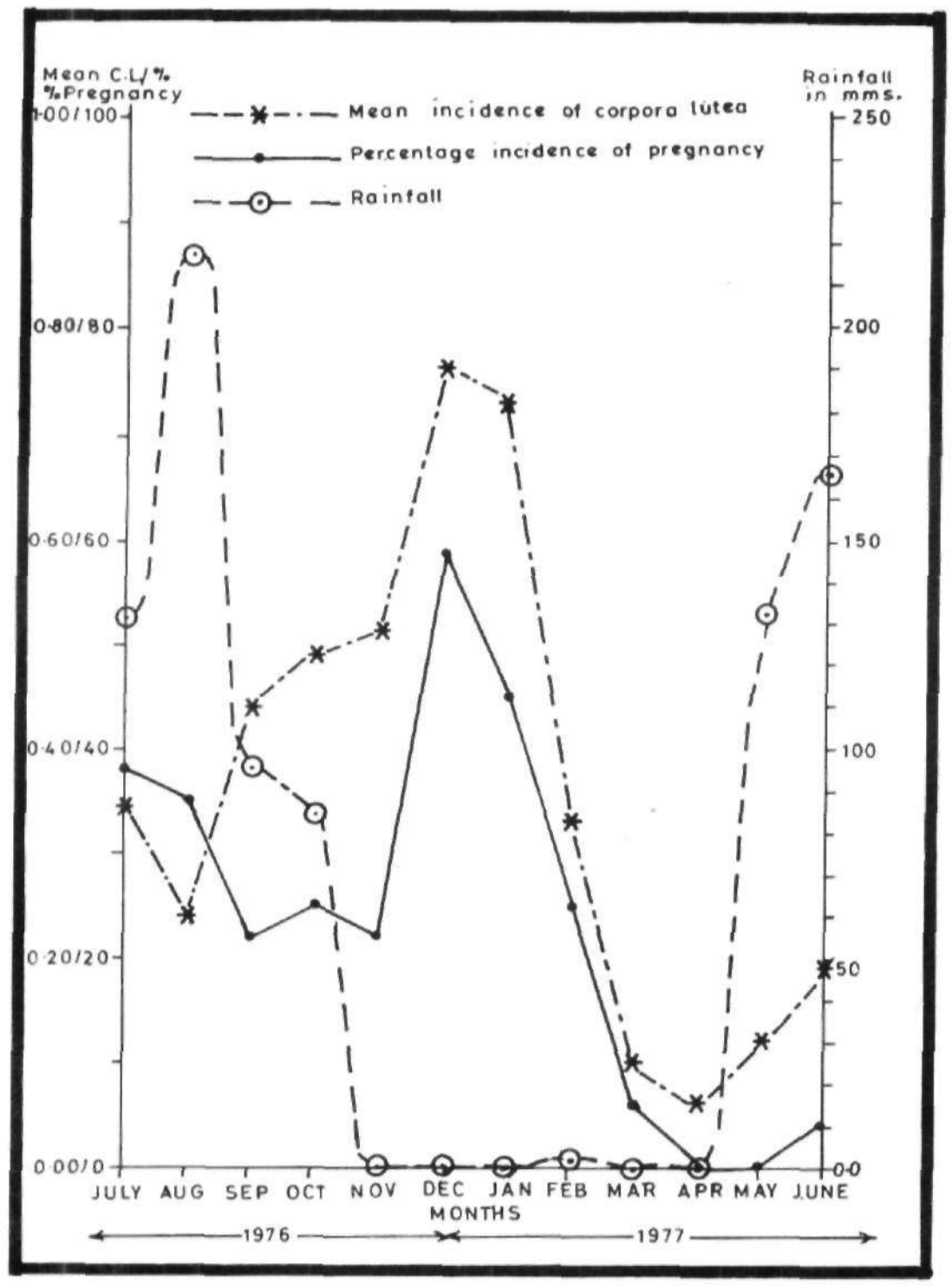

Mean C.L/%
%Pregnancy
Rainfall
in mms.
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Rainfall
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·00/0
250
200
150
100
50
0·0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 15: Relationship of mean length, height and width of ovaries of Kaduna goats to rainfall.

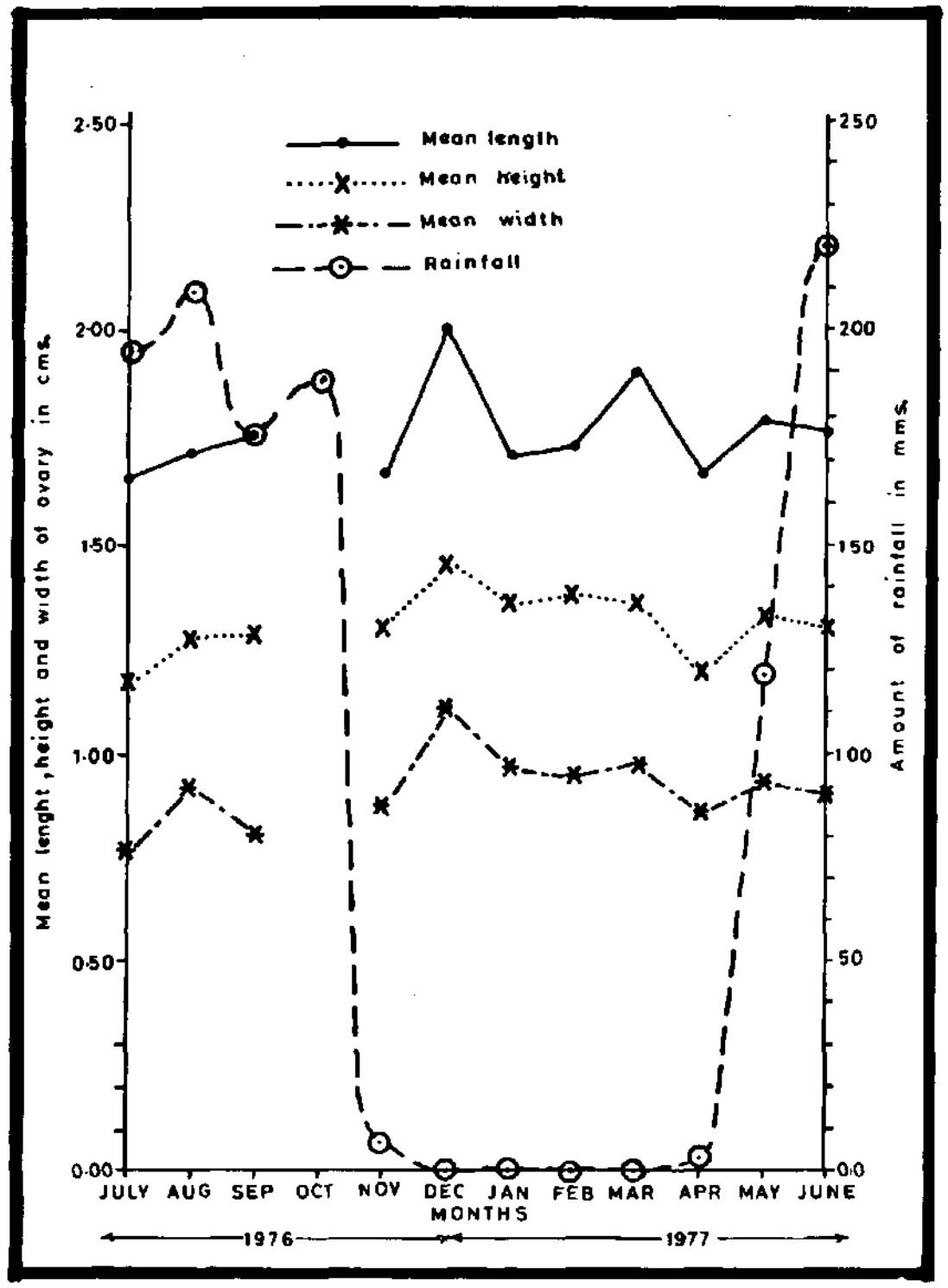

Mean length
Mean Height
Mean width
Rainfall
2·50
2·00
1·50
1·00
0·50
0·00
250
200
150
100
50
0·0
Mean lenght, height and width of ovary in cms.
Amount of rainfall in mms.
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 16: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kaduna goats to rainfall.

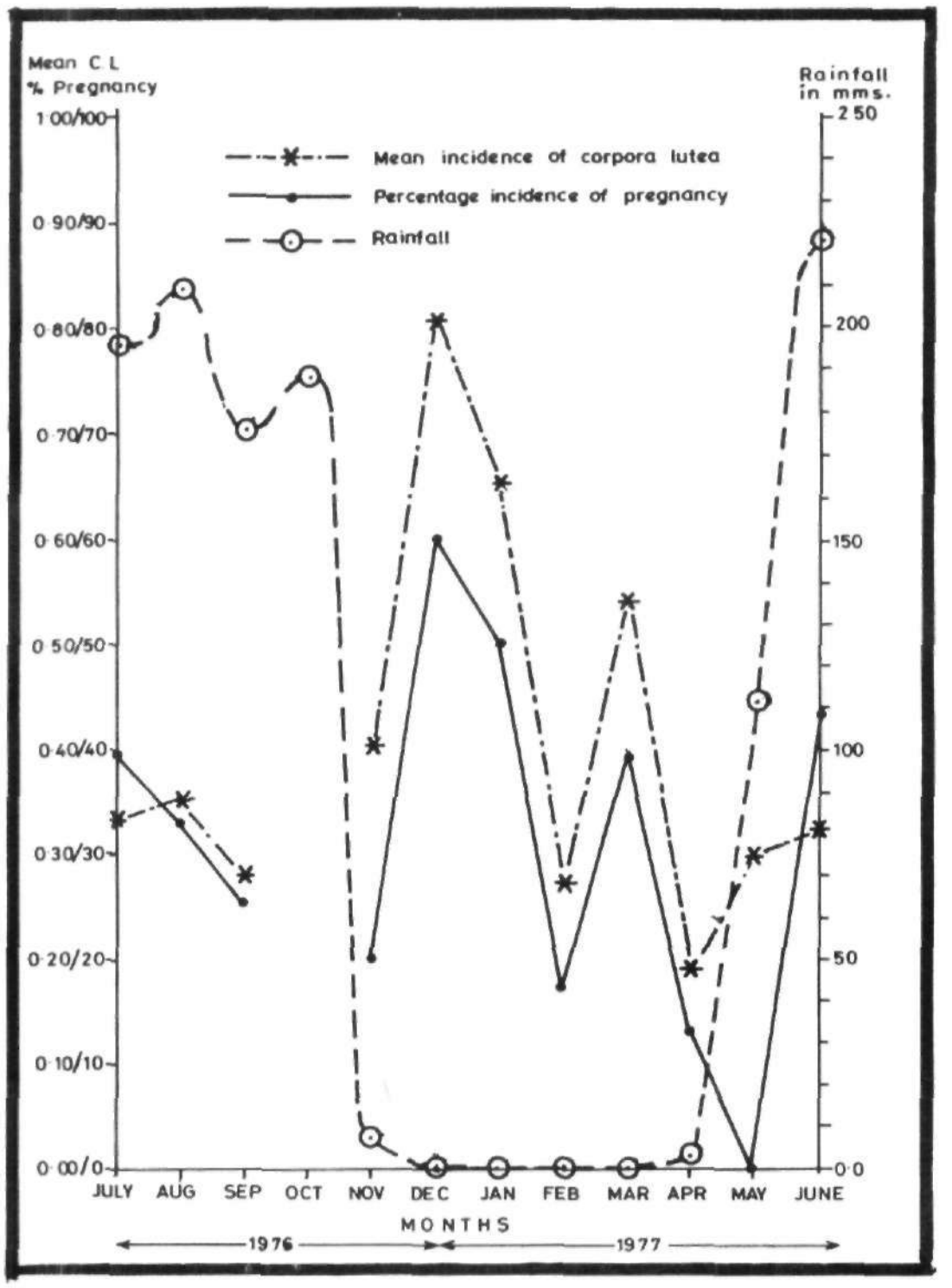

Mean C L
% Pregnancy
1·00/100
0·90/90
0·80/80
0·70/70
0·60/60
0·50/50
0·40/40
0·30/30
0·20/20
0·10/10
0·00/0
Rainfall
in mms.
250
200
150
100
50
0·0
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Rainfall
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
MONTHS
1976
1977

Fig. 17: Relationship of mean length, height and width of ovaries of Zaria goats to rainfall.

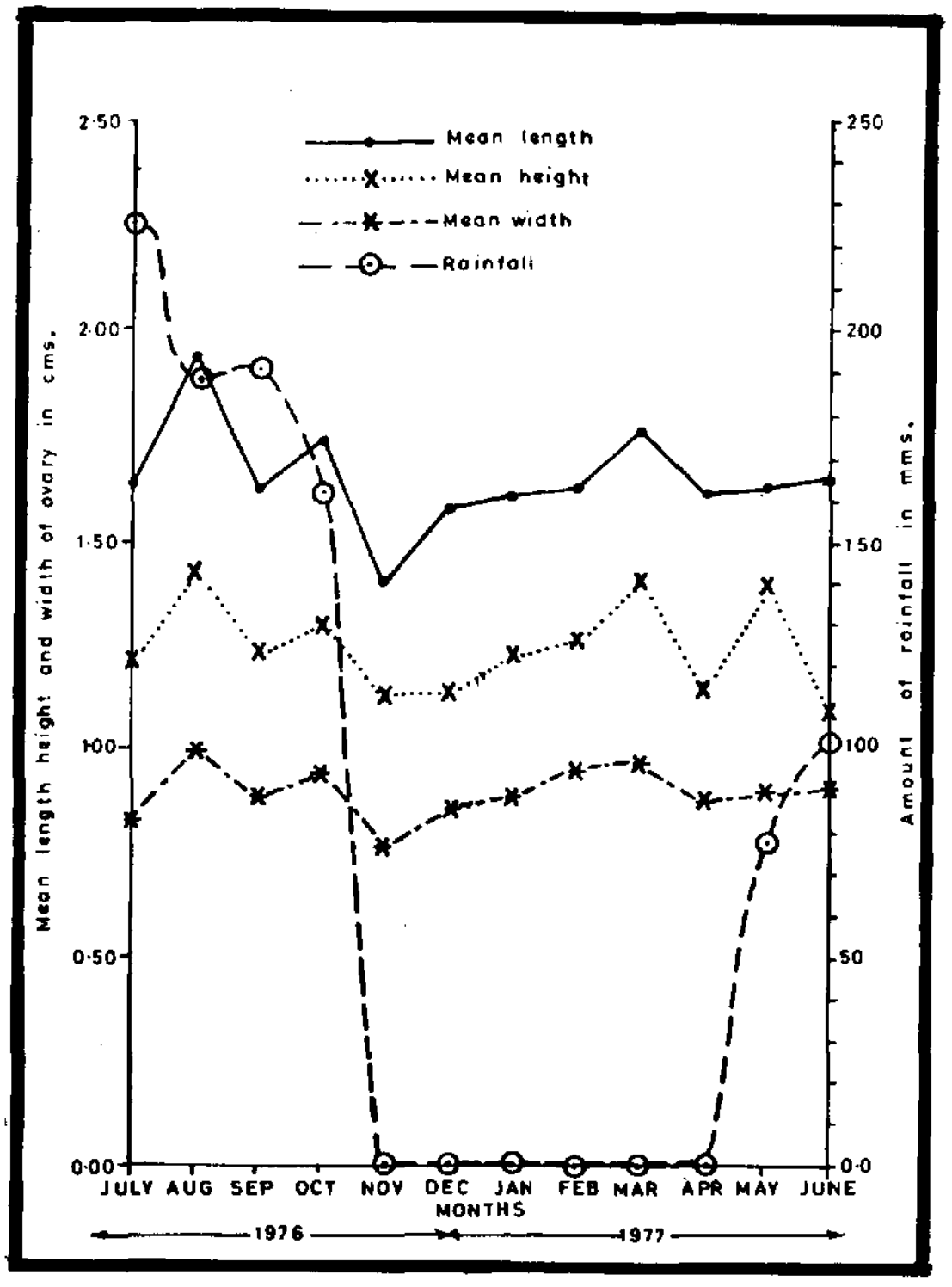

Mean length
Mean height
Mean width
Rainfall
2·50
2·00
1·50
1·00
0·50
0·00
250
200
150
100
50
0·0
Mean length height and width of ovary in cms.
Amount of rainfall in mms.
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 18: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy in Zaria goats to rainfall.

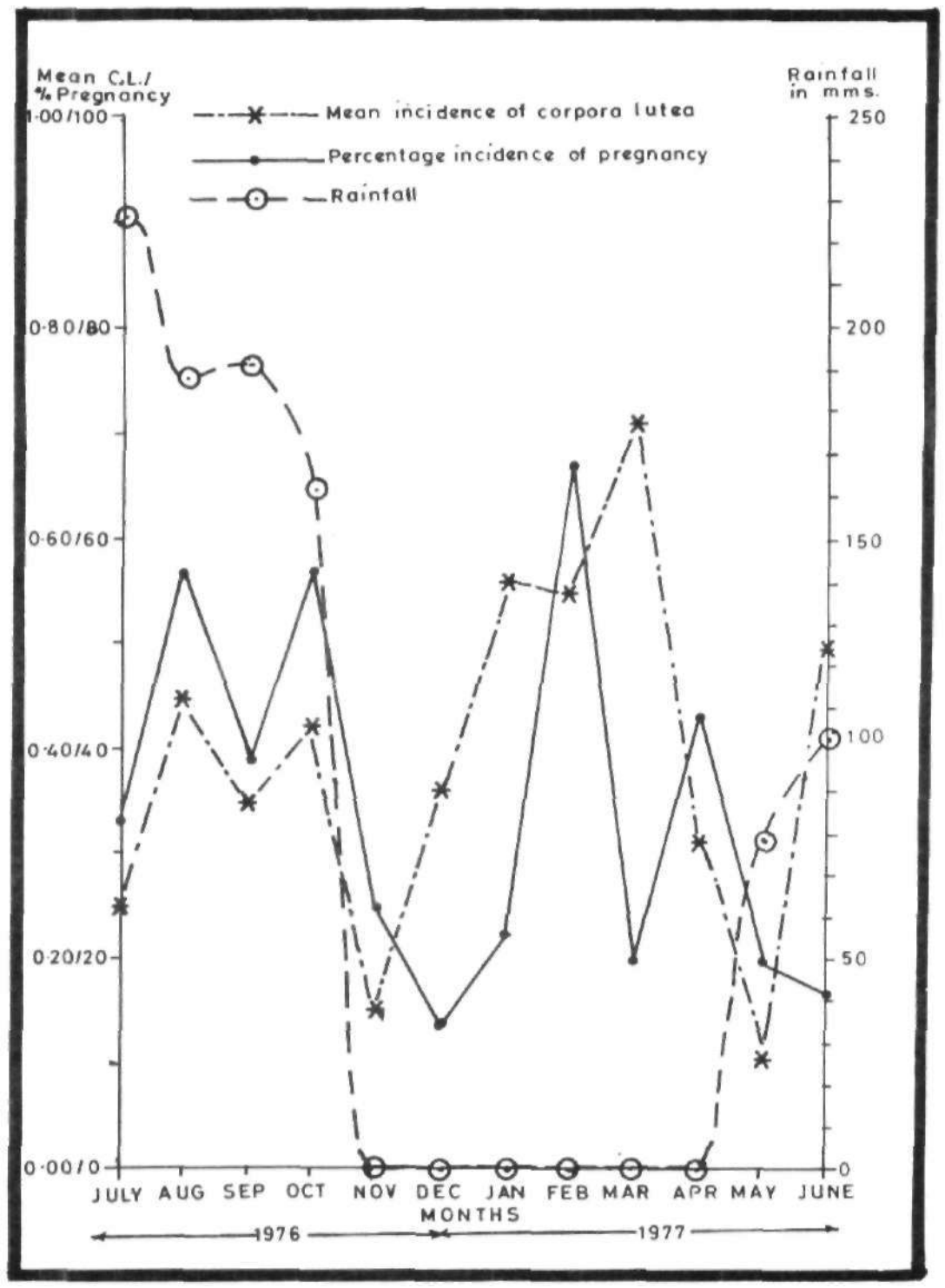

Mean C.L./
% Pregnancy
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·00/0
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Rainfall
Rainfall
in mms.
250
200
150
100
50
0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 19: Relationship of mean length, height and width of ovaries of Kano sheep to daylength.

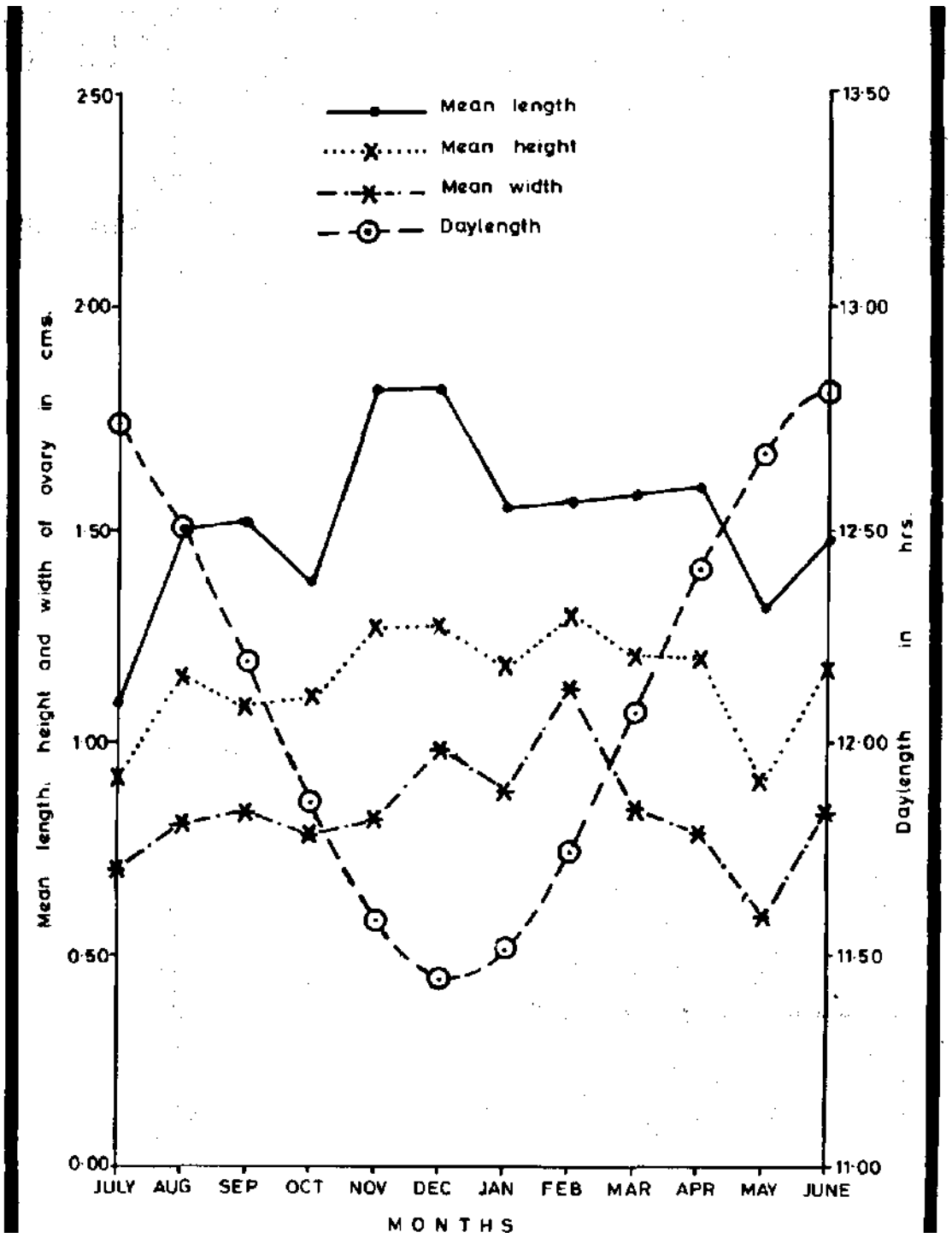

Mean length
Mean height
Mean width
Daylength
2·50
2·00
1·50
1·00
0·50
0·00
13·50
13·00
12·50
12·00
11·50
11·00
Mean length, height and width of ovary in cms.
Daylength in hrs.
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS

Fig. 20: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Yana-Yi

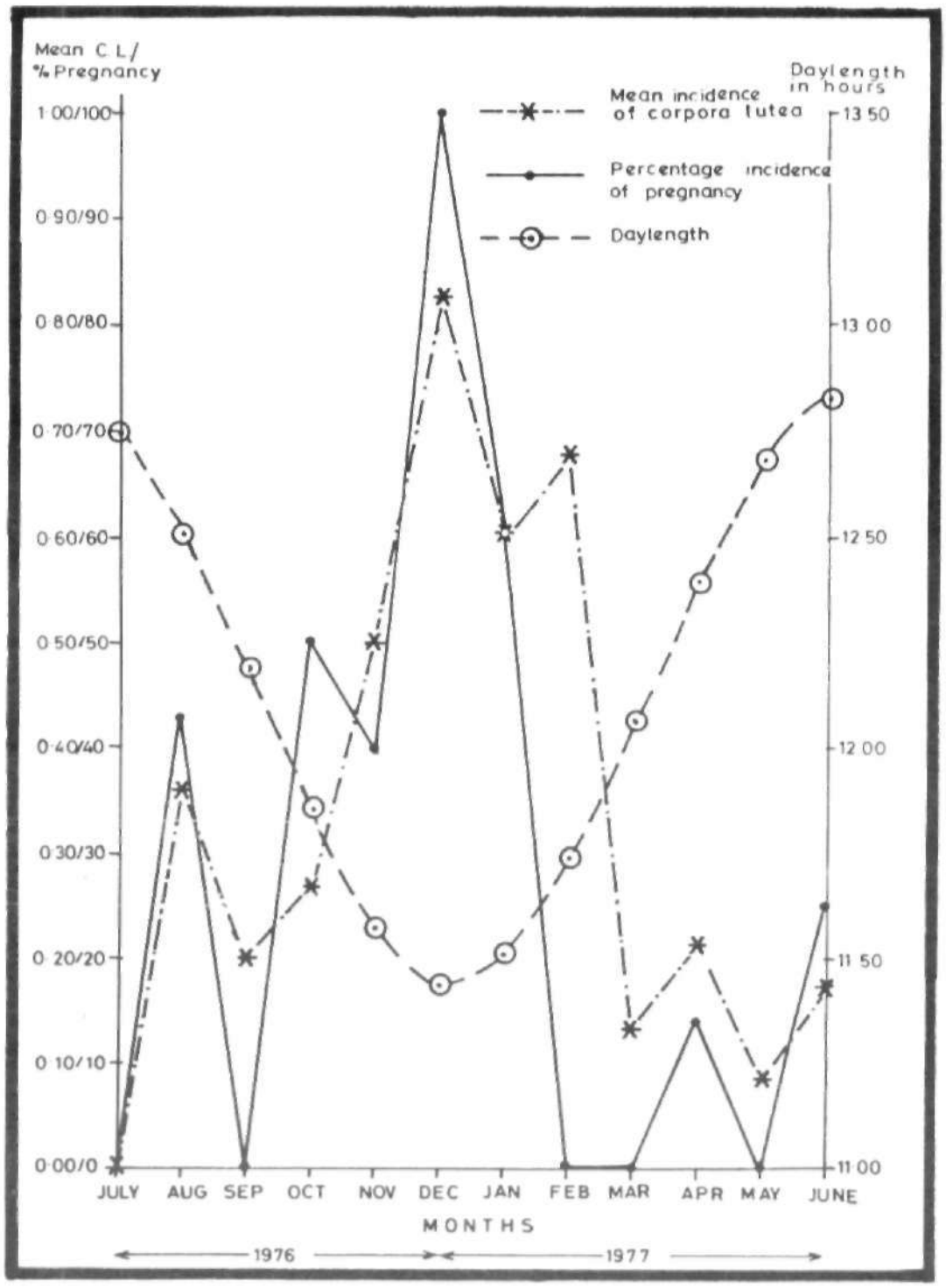

Mean C L/
% Pregnancy
Daylength
in hours
1·00/100
0·90/90
0·80/80
0·70/70
0·60/60
0·50/50
0·40/40
0·30/30
0·20/20
0·10/10
0·00/0
13·50
13·00
12·50
12·00
11·50
11·00
Mean incidence
of corpora lutea
Percentage incidence
of pregnancy
Daylength
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
MONTHS
1976
1977

Fig. 21: Relationship of mean length, height and width of ovaries of Kaduna sheep to daylength.

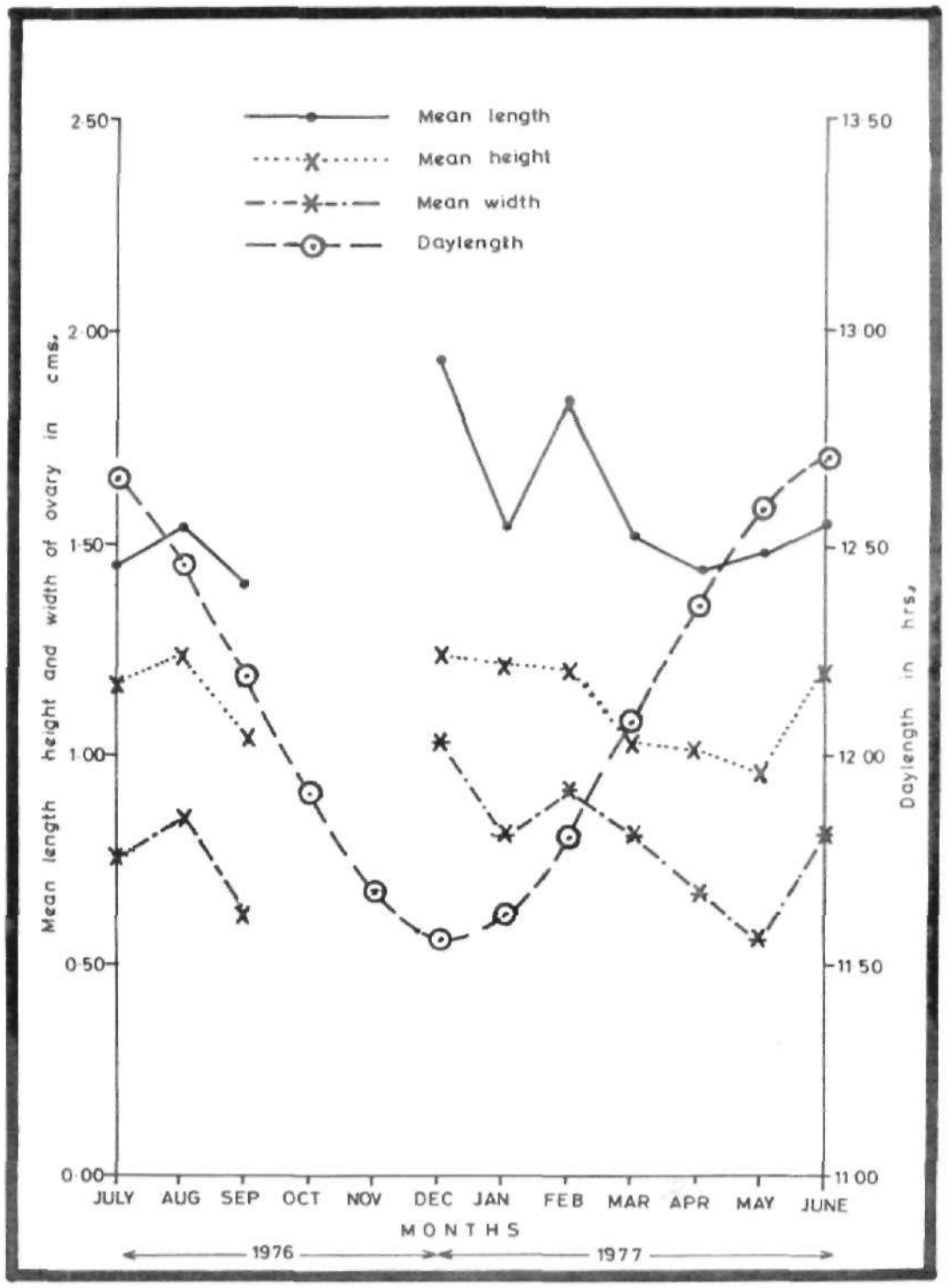

Mean length
Mean height
Mean width
Daylength
2·50
2·00
1·50
1·00
0·50
0·00
13 50
13 00
12 50
12 00
11 50
11 00
Mean length height and width of ovary in cms.
Daylength in hrs.
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
MONTHS
1976
1977

Fig. 22: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kaduna sheep to daylength.

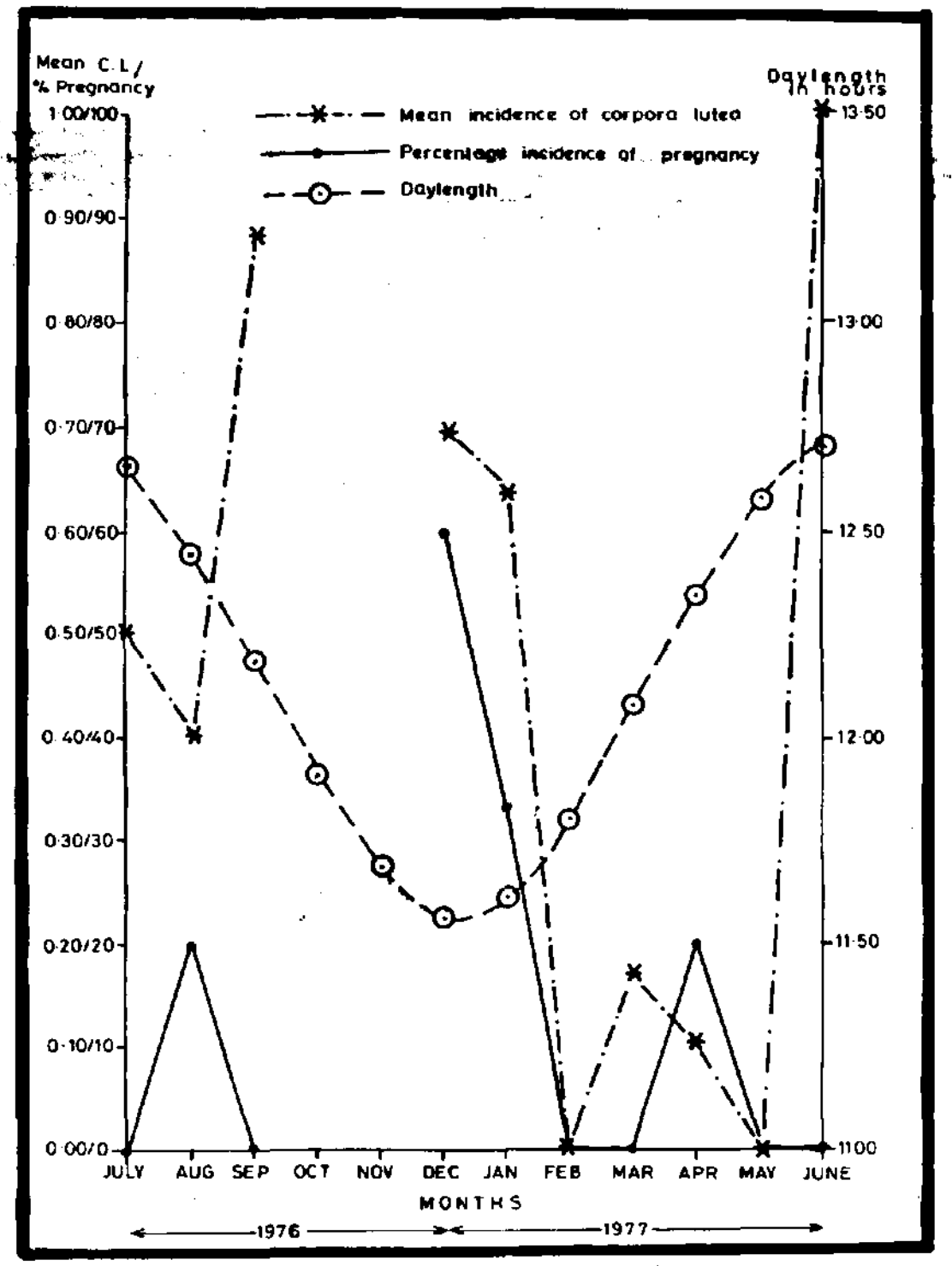

Mean C.L/
% Pregnancy
1·00/100
0·90/90
0·80/80
0·70/70
0·60/60
0·50/50
0·40/40
0·30/30
0·20/20
0·10/10
0·00/0
Daylength
in hours
13·50
13·00
12·50
12·00
11·50
1100
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Daylength
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
MONTHS
1976
1977

Fig. 23: Relationship of mean length, height and width of ovaries of Kano sheep to environmental temperature.

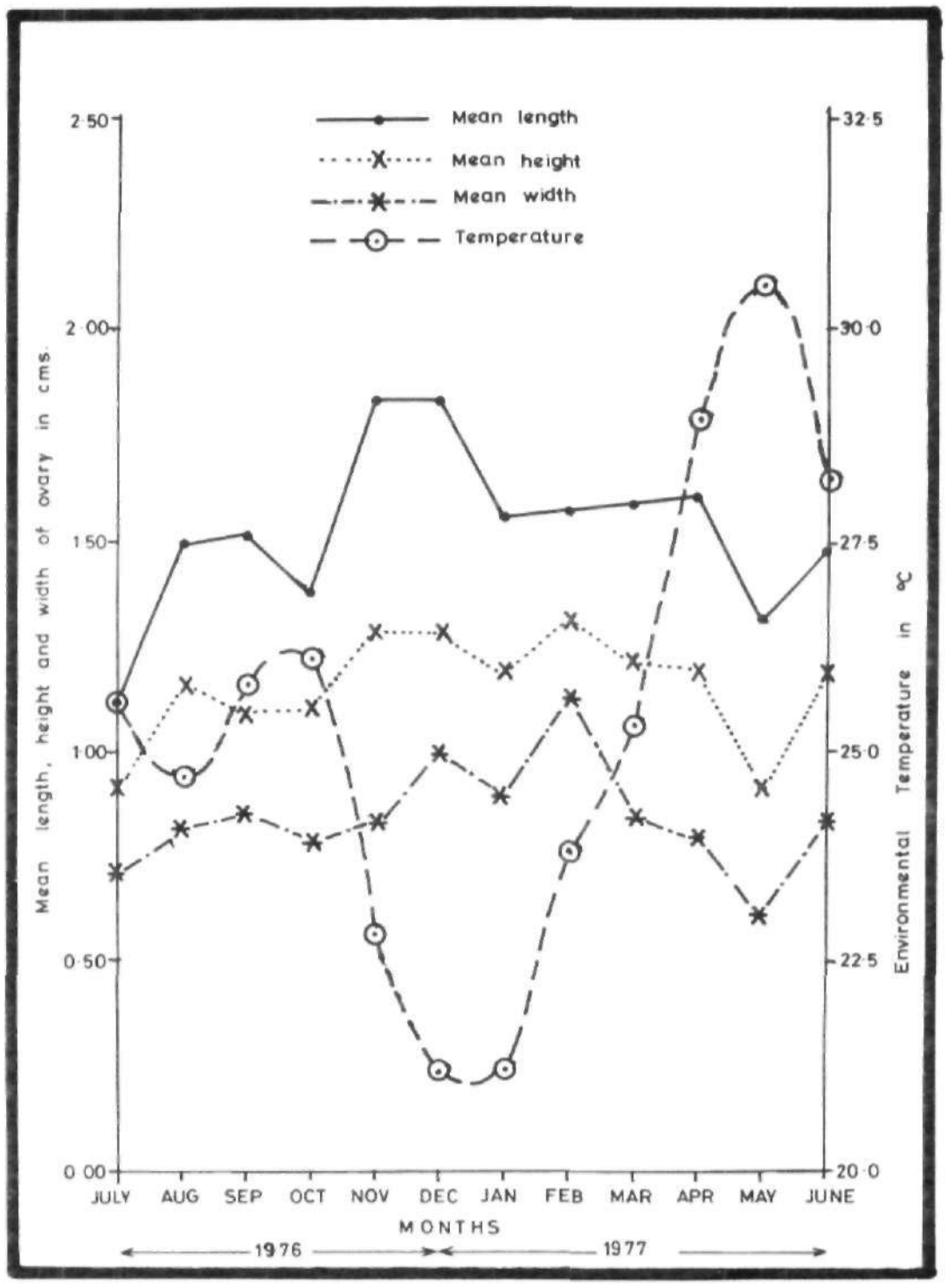

Mean length
Mean height
Mean width
Temperature
2·50
2·00
1·50
1·00
0·50
0 00
32·5
30·0
27·5
25·0
22·5
20·0
Mean length, height and width of ovary in cms.
Environmental Temperature in °C
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 24: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kano sheep to environmental temperature.

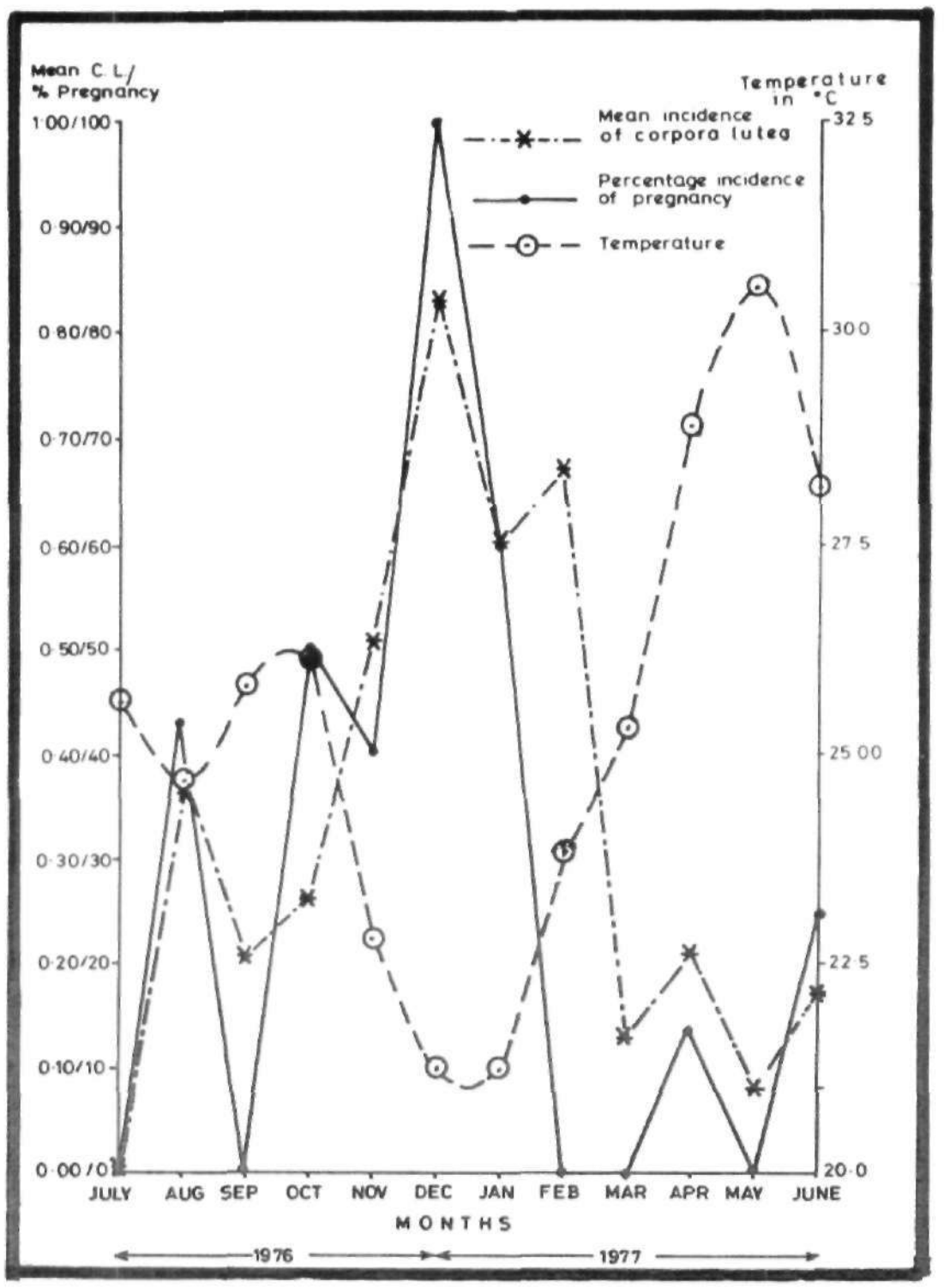

Mean C.L/
% Pregnancy
Temperature
in °C
Mean incidence
of corpora lutea
Percentage incidence
of pregnancy
Temperature
1·00/100
0·90/90
0·80/80
0·70/70
0·60/60
0·50/50
0·40/40
0·30/30
0·20/20
0·10/10
0·00/0
32·5
30·0
27·5
25·00
22·5
20·0
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
MONTHS
1976
1977

Fig. 25: Relationship of mean length, height and width of ovaries of Kaduna sheep to environmental temperature.

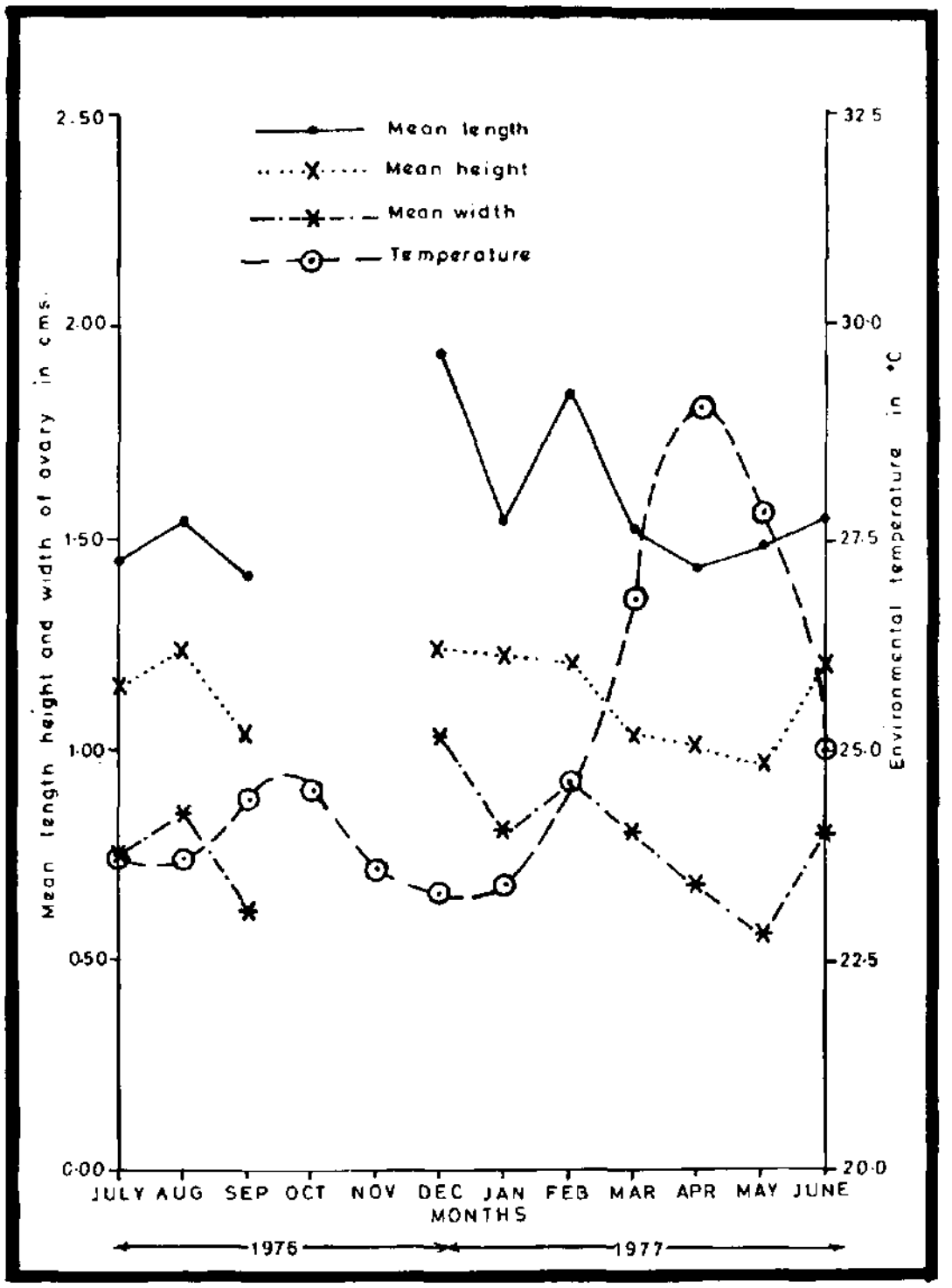

Mean length
Mean height
Mean width
Temperature
2.50
2.00
1.50
1.00
0.50
0.00
32.5
30.0
27.5
25.0
22.5
20.0
Mean length height and width of ovary in cms.
Environmental temperature in °C
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 26: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kaduna sheep to environmental temperature.

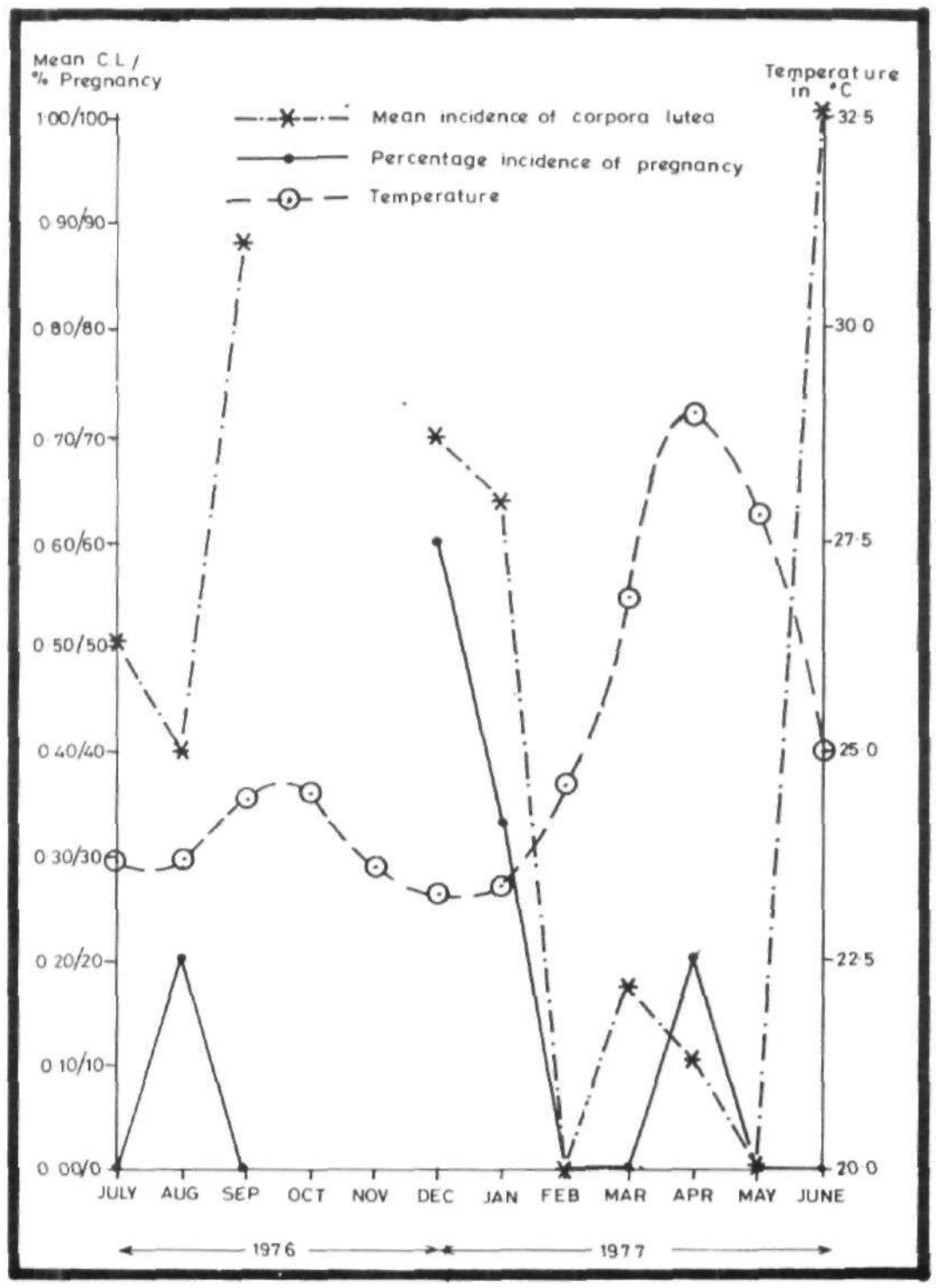

Mean C.L /
% Pregnancy
Temperature
in °C
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Temperature
1·00/100
0·90/90
0·80/80
0·70/70
0·60/60
0·50/50
0·40/40
0·30/30
0·20/20
0·10/10
0·00/0
32·5
30·0
27·5
25·0
22·5
20·0
JULY
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
1976
1977

Fig. 27: Relationship of mean length, height and width of ovaries of Kano sheep to rainfall.

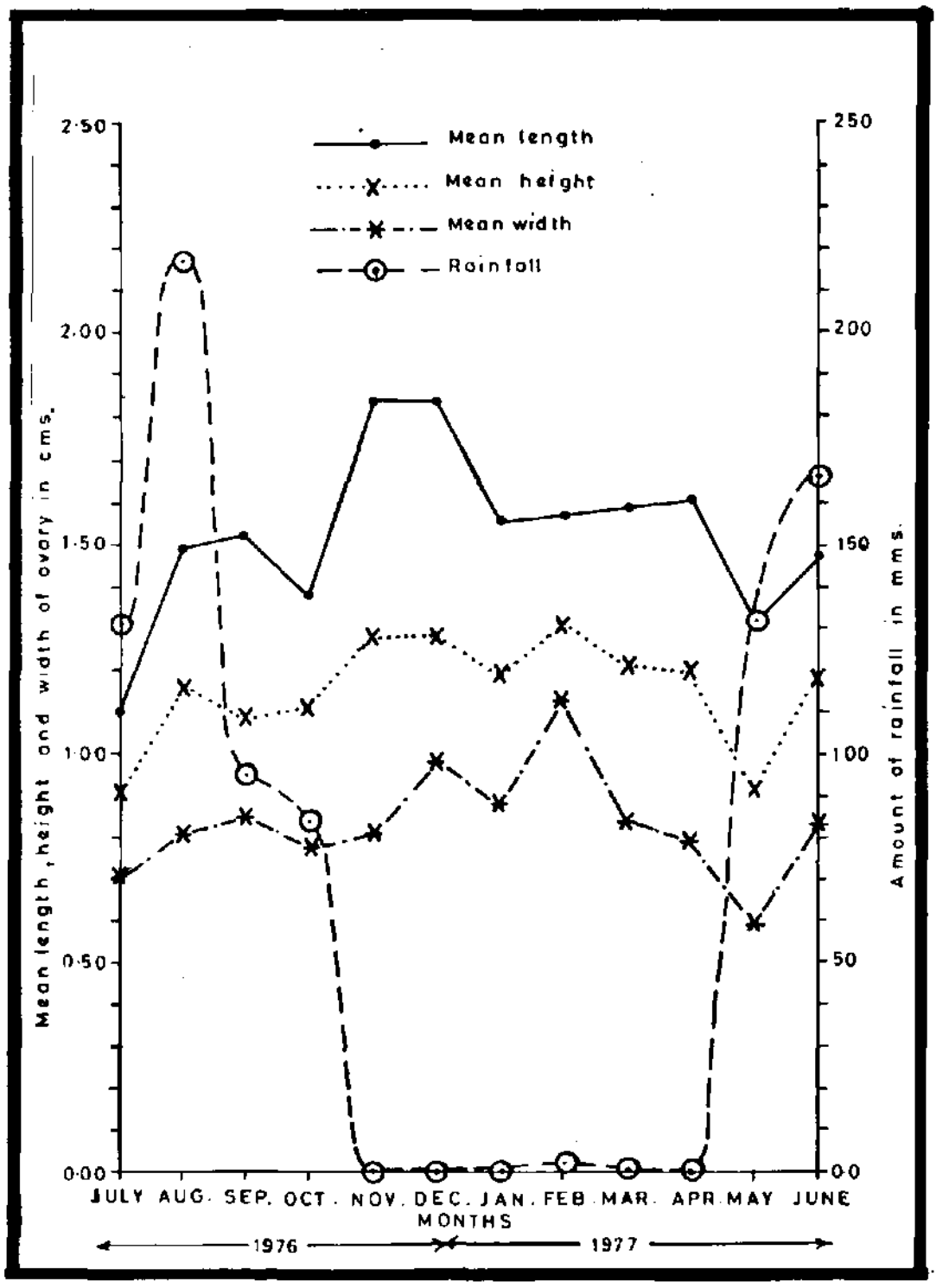

Mean length
Mean height
Mean width
Rainfall
2·50
2·00
1·50
1·00
0·50
0·00
250
200
150
100
50
00
Mean length, height and width of ovary in cms.
Amount of rainfall in mms.
JULY AUG. SEP. OCT. NOV. DEC. JAN. FEB MAR. APR MAY JUNE
MONTHS
1976
1977

Fig. 28: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) to rainfall.

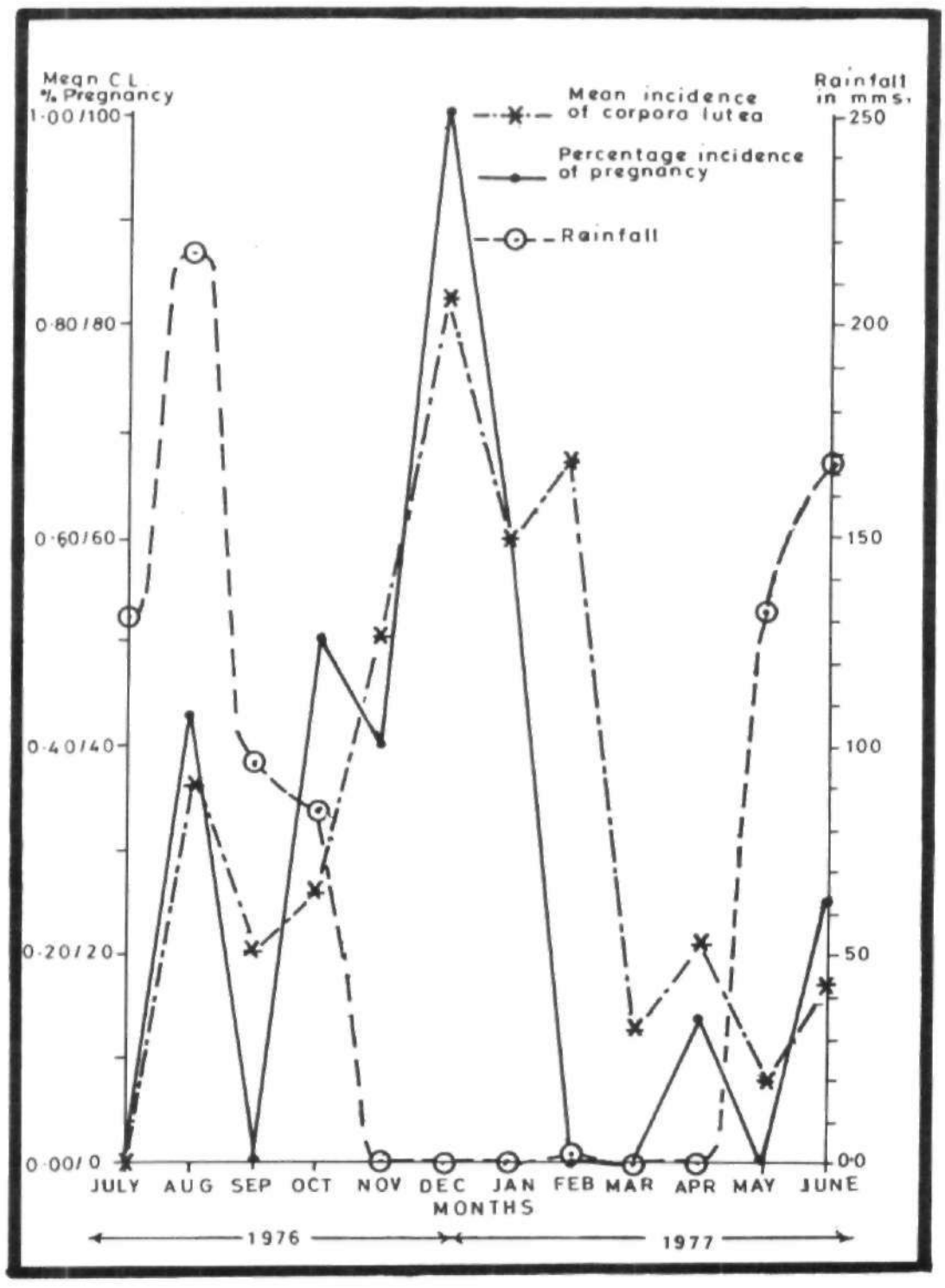

Mean C L
% Pregnancy
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·00/0
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Rainfall
Rainfall in mms.
250
200
150
100
50
0·0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 29: Relationship of mean length, height and width of ovaries of Kaduna sheep to rainfall.

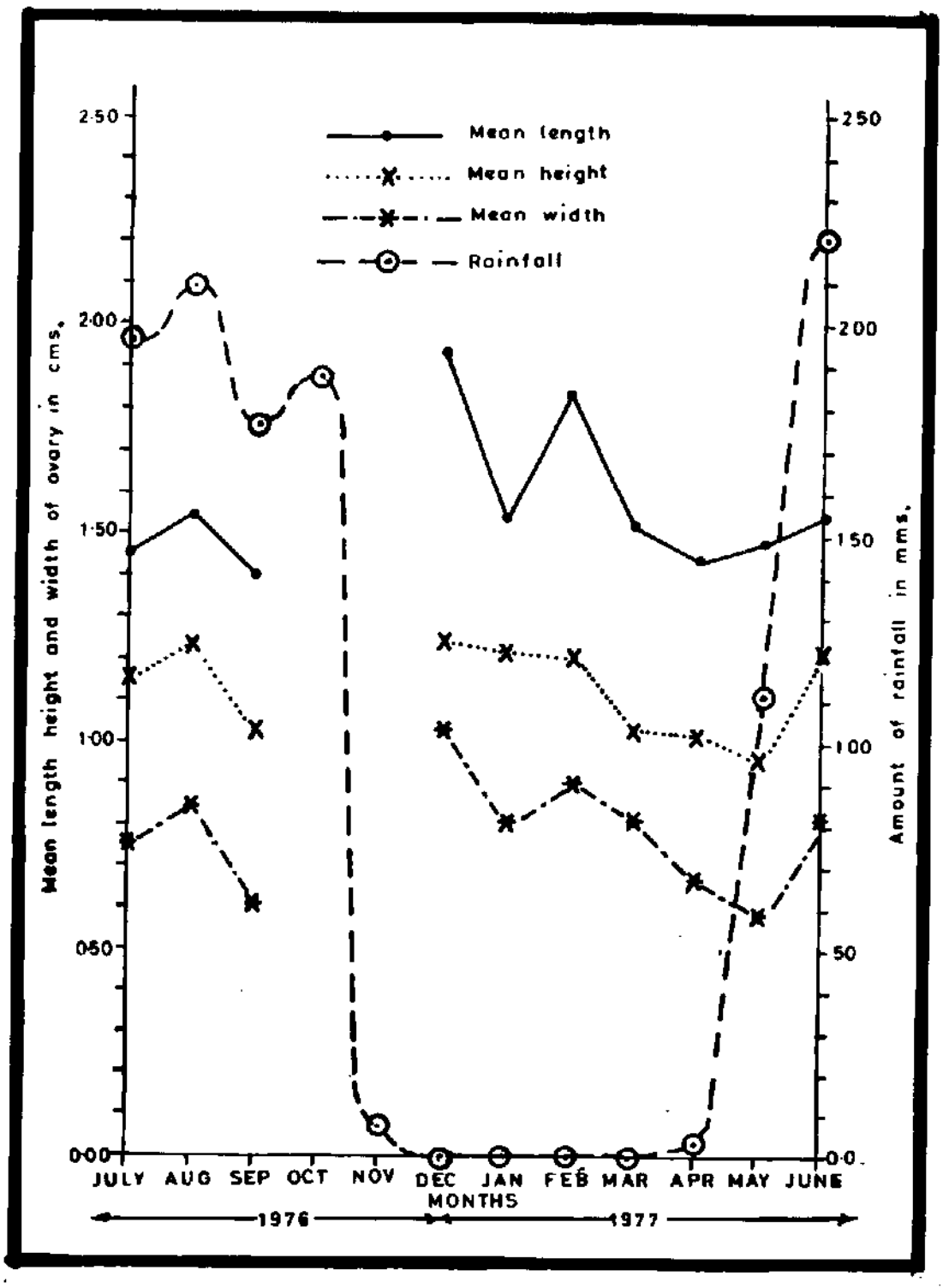

Mean length
Mean height
Mean width
Rainfall
Mean length height and width of ovary in cms.
Amount of rainfall in mms.
2·50
2·00
1·50
1·00
0·50
0·00
250
200
150
100
50
0·0
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 30: Relationship of mean incidence of corpora lutea (C.L.) and percentage incidence of pregnancy (%P) in Kaduna sheep to rainfall.

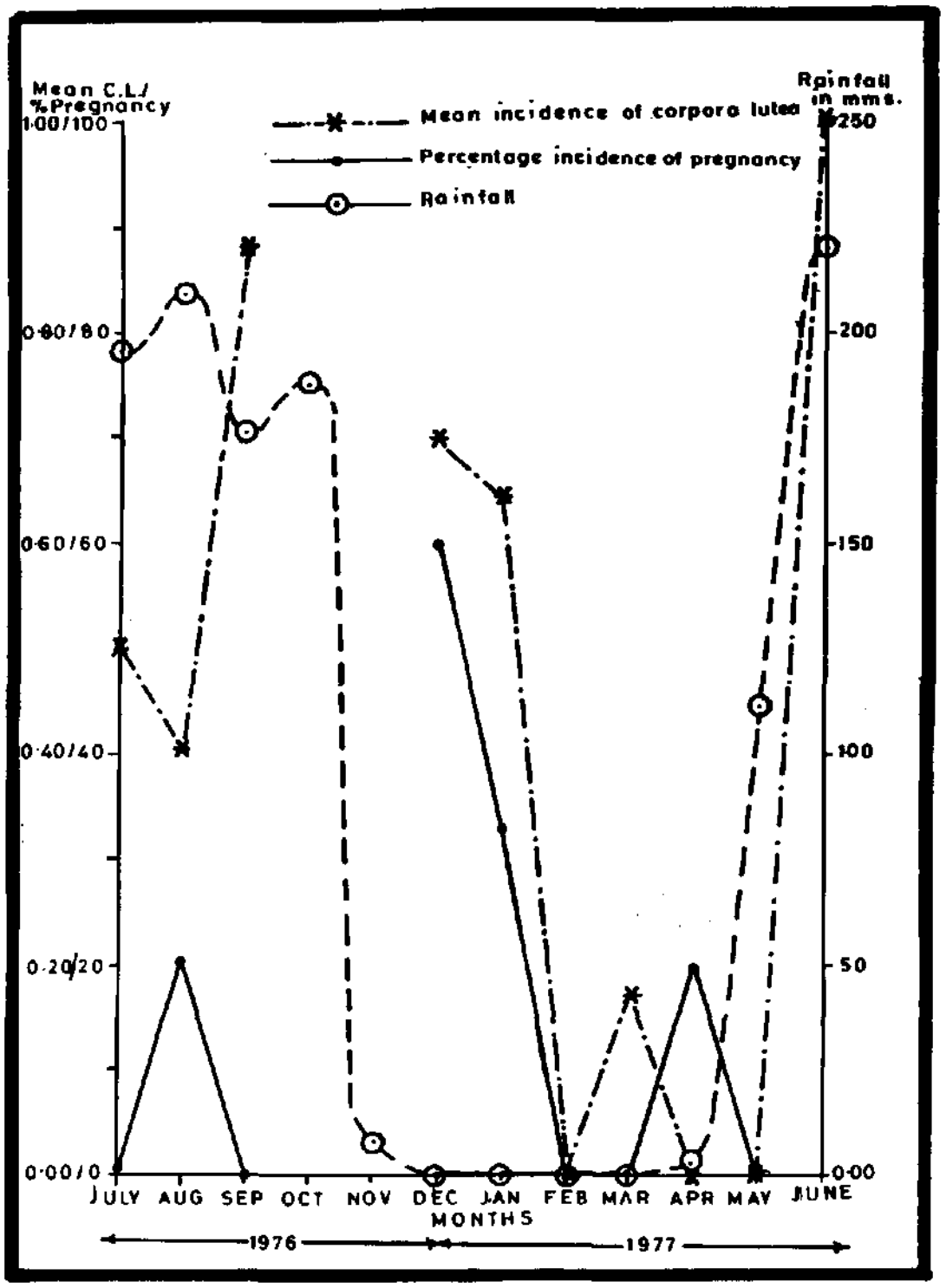
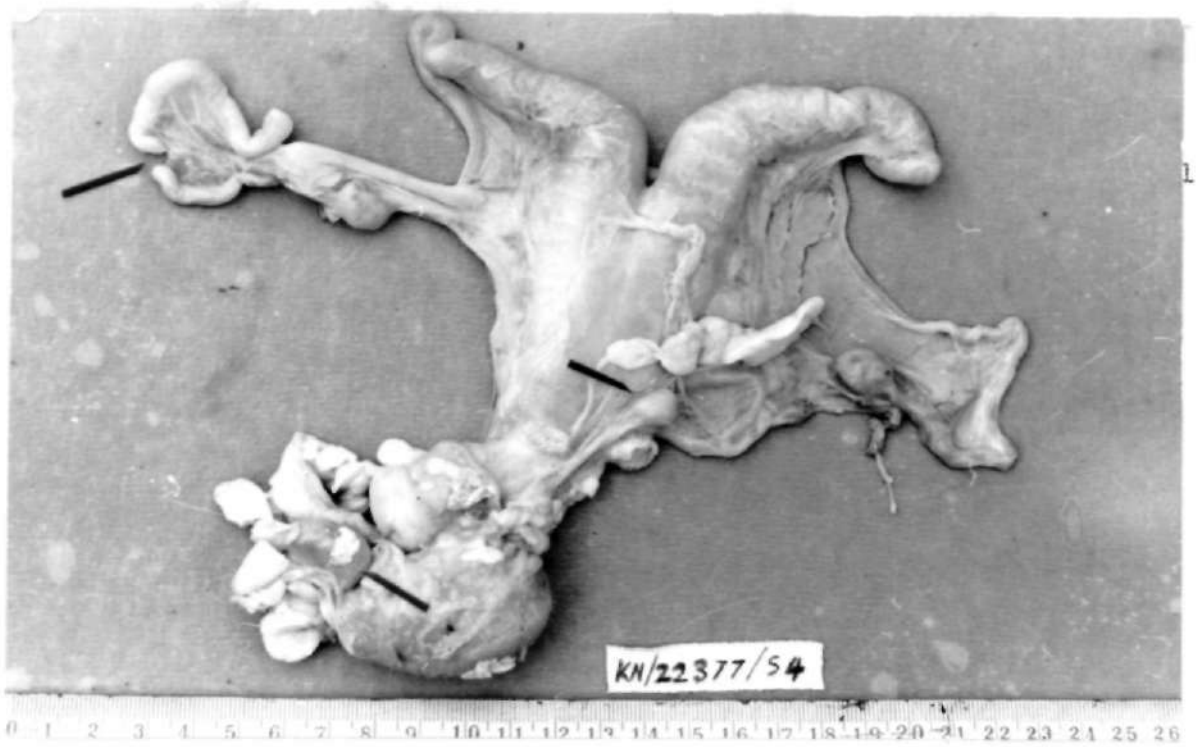

Mean C.L./
%Pregnancy
Rainfall
in mms.
Mean incidence of corpora lutea
Percentage incidence of pregnancy
Rainfall
1·00/100
0·80/80
0·60/60
0·40/40
0·20/20
0·00/0
250
200
150
100
50
0·00
JULY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUNE
MONTHS
1976
1977

Fig. 31: Ovine reproductive tract showing segmental aplasia and hydrosalpinx (topmost black arrow) and caseated abscesses (lower black arrows).

Fig. 32: Ovine reproductive tract showing bilateral vascular hamartoma (a) and ovaries (black arrows).


KN/22377/54

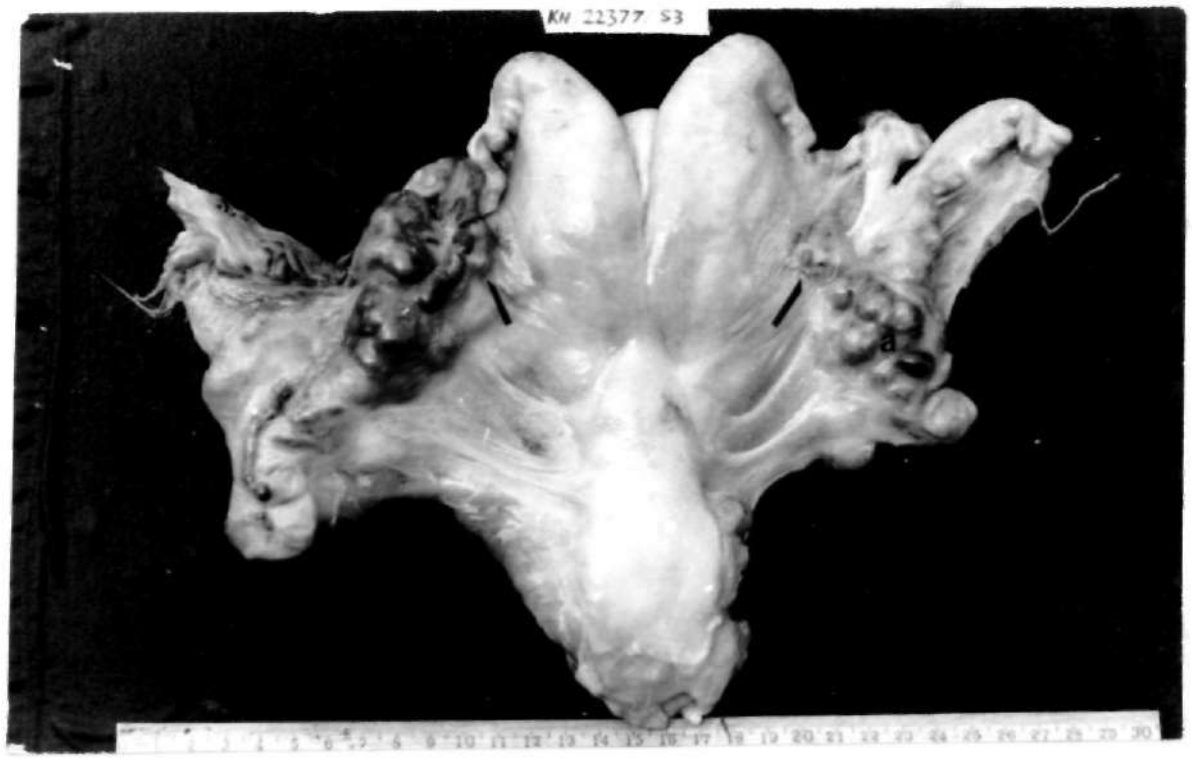

KN 22377 53

Fig. 33: Vascular hamartoma in an ovine uterus incised to show large vascular channels with partially clotted blood (lower left corner).

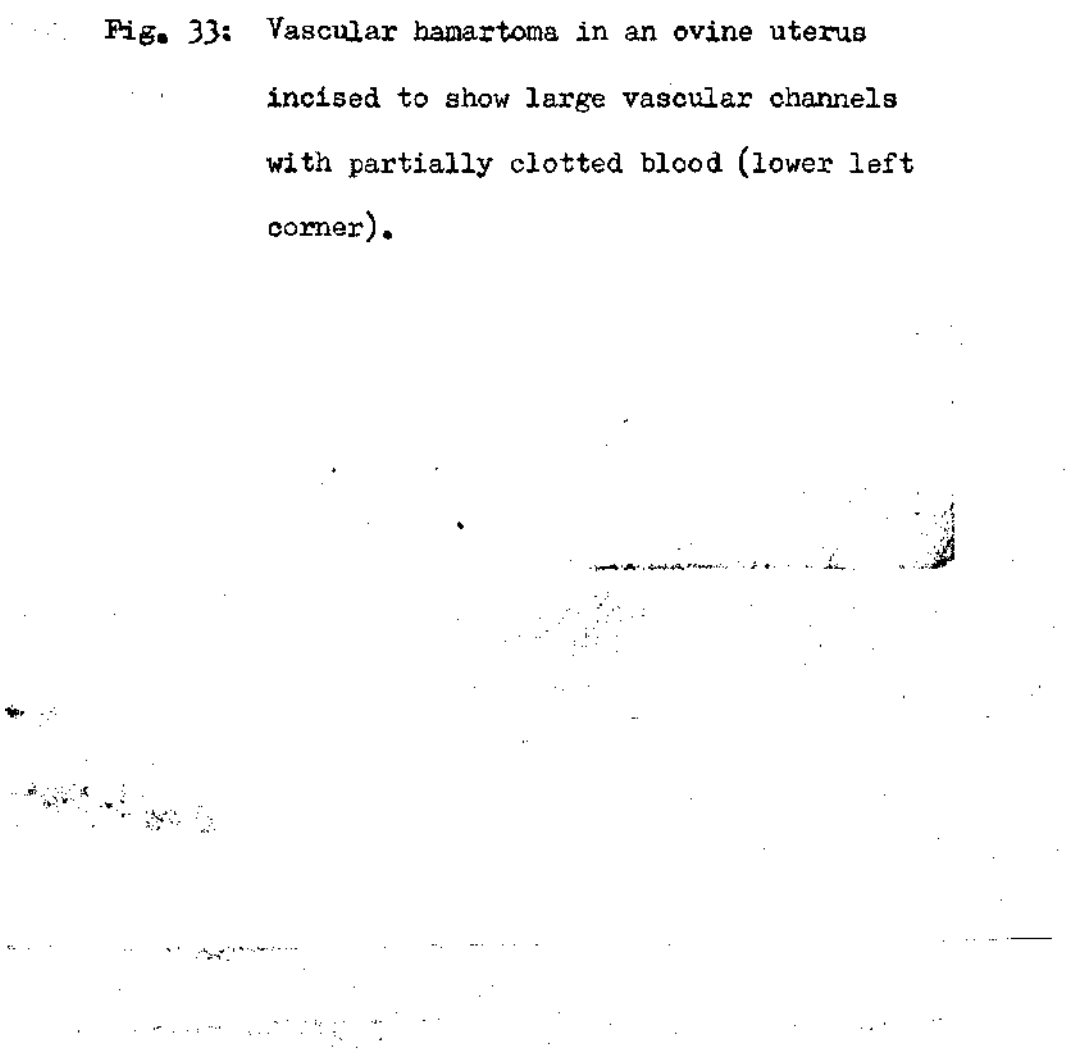


Fig. 34: Blood vessel in an ovine uterus with vascular hamartoma showing blood clot and surrounding oedema (320x). H & E.



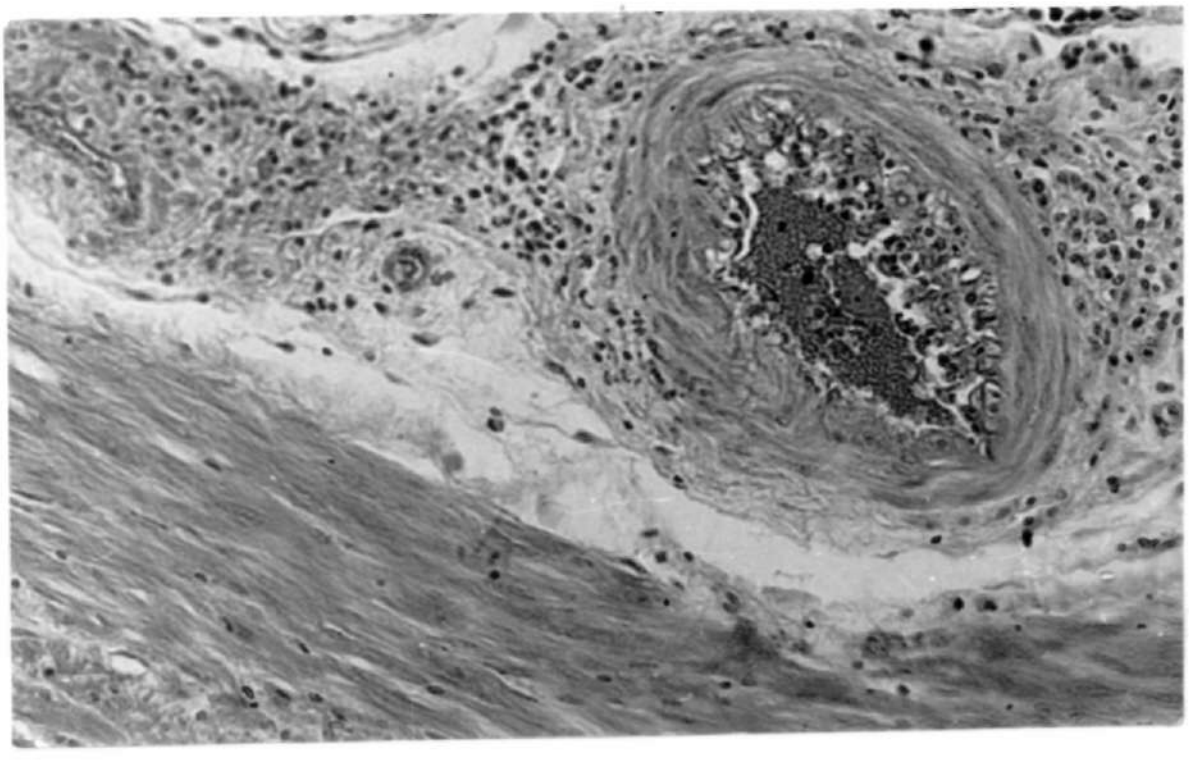


Fig. 35: A hamartomatous ovine reproductive tract showing a thick-walled blood vessel (a) with vasa vasora (b). (120x) H & E.

Fig. 36: Caprine reproductive tract showing parovarian cyst (white arrow).


KD/1537


KD/10577/51

Fig. 39: Caprine utero-tubal junction showing intra-epithelial cysts. (20x). H & E.

Fig. 40: Caprine utero-tubal junction showing intraepithelial cysts (a), dilated uterine glands (b) and oedema (c). (120x) H & E.



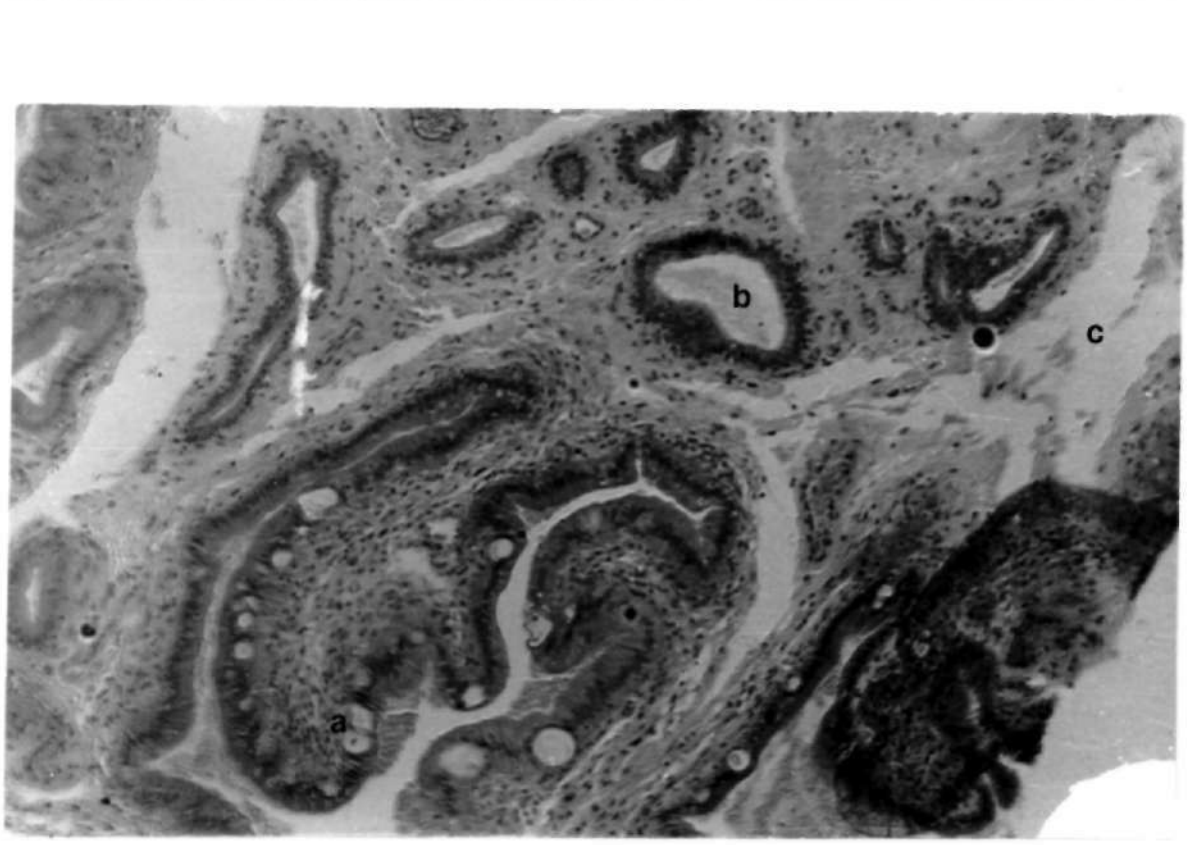
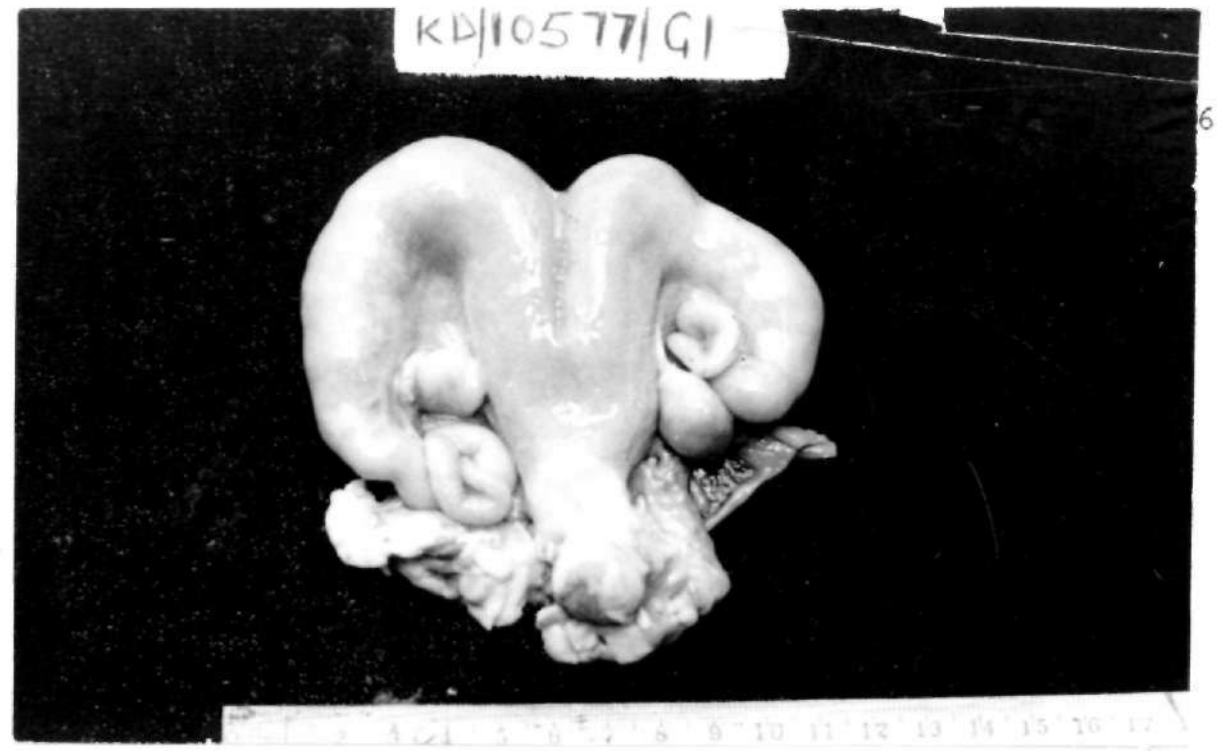

b
c
a

Fig. 41: Caprine reproductive tract showing pyometra.

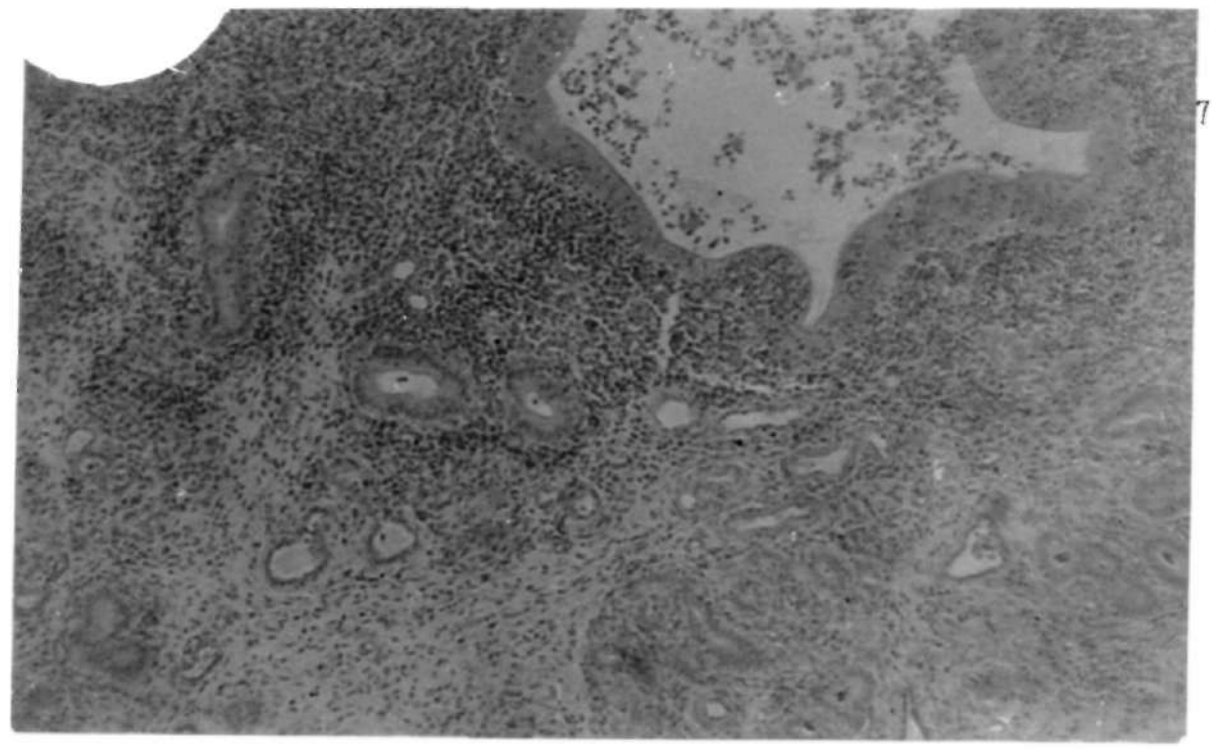
Fig. 42: Caprine reproductive tract with pyometra, incised to show purulent uterine contents (point of scissors).


KD/10577/G1


KD/10577/G1

Fig. 43: Caprine reproductive tract showing endometritis. (x 10). H & E.

Fig. 44: Postparturient caprine reproductive tract showing assymmetrical reproductive horns (white arrow) and open cervix (probe inserted; bottom).




KN/1947/61
2 3 4 5 6 7 8 9 10 11 12 14 15 16 17 18 19 20 21 22 23 24 25 26

Fig. 45: Postparturient caprine reproductive tract incised to show sticky chocolate-coloured uterine contents (white arrow).

Fig. 46: Caprine reproductive tract showing retained foetal remnant (arrows; top left corner).


KN/19477/G1
0cm 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20


KD/10577/G2

Fig. 47: Caprine reproductive tract showing a trans-uterine cicatrix on the ventrum (black arrow).


KN/21677/G2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

DISCUSSION

Reproductive performance

The design of this study was such that what were determined were the unborn litter sizes and this should be expected to be slightly higher than actual lambing/kidding rates, the difference being accounted for by possible pre-natal losses and should be interpreted as such.

The 32.8% twinning rate for indigenous goats (mean litter size = 1.34) was within the range commonly reported (Devendra and Burns, 1970). It however, does not measure up to such prolific breeds as the Kambing Katjang goats of West Malaysia (66% twins), the Anglo-Nubian of Mauritius (96.6% multiple births), the Saanen of Israel (54% twins), the Barbari (69% twins) or the Black Bengal goats (78% multiple births), of India or the Ma T'ou of Central China (Devendra and Burns, 1970). The results obtained were lower than the 40.94% twinning rate (mean litter size = 1.47) reported by Haumesser (1975). Presumably he was reporting on pure-bred Red Sokoto goats whereas this study necessarily pools more than one breed. Environmental

management and/or genetic differences may also have contributed to the different performance.

The 20% twinning rate (mean litter size = 1.28) observed for indigenous sheep was comparable to observations on most British sheep breeds but does not measure up to such prolific breeds as the East Friesian, Wensleydale, Finnish Landrace, Romanov or the Wrizosowka - in which litter sizes average 2.96, 1.82, 2.0 to 4.0, 1.95 to 2.31 and 1.85 respectively (Spedding, 1970).

It may be advisable therefore to select for multiple births within indigenous breeds of sheep and goats and crossbreed them to more prolific exotic breeds to increase the incidence of multiple births. Selection of any such breeds should of course take into proper account other desirable or undesirable traits.

The lambing percentage (100%) reported by Brinckman (1975) for indigenous Uda and Y'ankasa crossbred to the imported Suffolk, at Shika, appears not to have yielded a higher lambing percentage than is predicted here for indigenous sheep. However, he may not have been selecting for increase in multiple births. Furthermore, his figures were of actual lambings which, as was stated earlier, should be expected to be lower than the unborn litter sizes reported here.

Variations in reproductive activity

As criteria of reproductive activity, changes in ovarian dimensions, incidence of corpora lutea and incidence of pregnancy were used in this study. In view of the present uncertainty as to the significance of ovarian follicular size at various stages of the reproductive process, this parameter was not used as reliable criterion of reproductive activity.

It would appear from the results that sheep and goats in at least Kano and Kaduna breed throughout the year; but they varied in reproductive activity over the year, showing an increase from about October, peaking around December and tailing off after February.

The results for Zaria were inconclusive; but then, for Zaria the findings of this study were generally not in agreement with the findings in Kano and Kaduna. This may have been due to one or more factors including the small number of genital tracts obtained from Zaria for examination (Zaria - 86 goats and 8 sheep, compared to Kaduna - 139 goats and 40 sheep and Kano - 249 goats and 52 sheep). Hence no statistical analysis for Zaria sheep was attempted. Also sheep and goats in Zaria

may have been subjected to some different unknown management procedure(s).

It was not determined in this study whether the peak in mean incidence of corpora lutea was largely due to an increase in the number of ewes/does ovulating or due to an increase in ovulation rate. The foetuses in pregnant uteri were not aged so it is also not possible to conclude from this study when the greatest number of conceptions actually occurred. From examination of the data and graphs (especially Figs. 1, 2 and 4), it would seem however, that most conceptions occurred around October/November and that most parturitions should therefore be expected in March/April.

The finding that sheep and goats in the area studied breed throught the year is in agreement with the reports of Devendra and Burns (1970), Roberts (1971) and Haumesser (1975). The latter also noted a maximum occurrence of births in Red Sokoto goats in Niger from February to April. This period corresponds almost exactly to the March/April peak kidding period predicted in this study. The climate, environment and management of Red Sokoto goats in Niger may be different from those of indigenous goats in the area here studied. If these differences exist then perhaps they were not sufficiently great to produce a

difference in breeding pattern. Alternatively, the correspondence of peak kidding period may be evidence of an inherent "breed" characteristic.

One very significant inference is that indigenous sheep and goats in this area can be bred at any time of the year. This removes one obstacle to increased productivity encountered in breeds with short breeding seasons (Hunter, 1968). No anoestrus season is to be expected here; therefore, provided the service period can be shortened and no other factors found limiting, it should be possible to obtain two lambings/kiddings per year from indigenous sheep and goats. Whether the observed natural peak in reproductive activity (October/November) indicates an optimum breeding period and whether breeding at other times of the year will yield poor results will have to be determined. Various management considerations such as availability of food, adverse environmental conditions, disease problems, etc., will have to be taken into account also, but the capacity to conceive does not as of now appear to be a limiting factor.

Relationship of reproductive activity to daylength

The results for Zaria were anomalous. For Kano and Kaduna with decreasing daylength the reproductive criteria in both

sheep and goats increased. The opposite was the case with increasing daylength. This observation is consistent with those of Bissonnette, (1936, 1941); Yeates, (1956); Means et al. (1959, 1960); Godley et al. (1965). No causative relationship is however, here proven; that will have to await further studies. If as Devendra and Burns (1970) indicate, seasonal or aseasonal breeding is a breed characteristic rather than the effect of climate or latitude, then little benefit in terms of productivity is to be expected from any manipulations of the daylength. In any case is it likely to be an expensive venture. On the other hand if a causal relationship is found to exist between daylength and reproductive activity in indigenous sheep and goats it is conceivable that the increase in reproductive activity found here for the no more than 1.2 to 1.3 hours annual variation in daylength could be compounded to advantage by manipulating daylength. If the gains in number of females coming on heat prove to be similar to those obtained by Mean et al. (1959) - 69.2% (27/39) experimental compared to 0% (0/28) control ewes - or Godley et al. (1965) - 93.3% experimental compared to 58.3% control ewes - it might well be worth considering.

In view of the highly significant monthly variation in ovarian length in both Kano and Kaduna sheep (see Table 12) it is rather difficult to explain the absence of any correlation between that criterion and daylength. If there had been no significant monthly variation in ovarian length in the two towns it might have been postulated that most functional bodies did not occur at the ovarian poles and therefore whatever correlation could be drawn between daylength and the other reproductive criteria would not hold for changes in ovarian length.

Relationship of reproductive activity to environmental temperature

It is concluded from a consideration of the results that at least for Kaduna and Kano the breeding pattern in sheep and goats was generally, negatively correlated to environmental temperature. There was a tendency for the reproductive criteria to increase from October, peak at about December and tail off after February, whereas for both towns environmental temperature decreased from a peak in October, was at its lowest in December and rose through February to peak at its highest in April/May. No data on reproductive tracts of goats in Kaduna were obtained

for October. For Kaduna sheep data for October and November were again not available. This abscence may have contributed to the single anomalies in correlation of reproductive criteria to environmental temperature for each species. Although no causal relationship is hereby drawn between environmental temperature and the reproductive criteria, the results obtained here were consistent with previous reports on the negative effects of high environmental temperature on reproductive activity (Dutt et al., 1959), Devendra and Burns, 1970) and the beneficial effects of a reduction in environmental temperature on reproductive activity (Dutt and Bush, 1955; Godley et al.,1965).

Corpus luteum may be merely cyclic, where no embryo is present, or may be supporting a fertilized ovum or early embryo. Where early embryonic death and resorption have occurred, a corpus luteum may still be present and indistinguishable from cyclic corpora lutea in unmated ewes. Where several ovulations occur but only one embryo implants, a corpus luteum will be formed and maintained on each ovulation site. Furthermore even after the last embryo or foetus dies the corpora lutea can be maintained for some time by degenerate

remains of mummified or macerated foetuses or pyometra. The corpora lutea examined in this study could correspond to any of the foregoing. However, in a situation where elevated ambient temperature induced an increased incidence of abnormal ova, subsequent to fertilization the conceptus would more than likely perish and the supporting corpus luteum would proceed to regress. Similarly where elevated ambient temperature induced conception failure and total embryonic mortality the corresponding corpora lutea would proceed to regress. In any of the foregoing instances the total number of corpora lutea would decrease and simulate the findings of this study - viz. a negative correlation between the reproductive criteria and environmental temperature. The decrease in ovarian dimensions would of course be resultant from the decrease in corpora lutea. A "low and erratic breeding efficiency in does" (Devendra and Burns, 1970) would result in similar results for the same reasons.

Experiments on the deleterious effects of high ambient temperature on the reproductive process have usually compared the effects of from 90°F to 100°F to control temperatures of 70°F or "normal ambient temperature" (presumably below 70°F). Peak

environmental temperatures in Kano, Kaduna and Kaura approximate 85°F and it is quite possible that the deleterious effects reported at temperatures of 90°F could be operative in indigenous sheep and goats during such peak heat periods. Thwaites (1967b) reported that acclimatization and diurnal variation in temperature can modify the effects of high temperature but continuous exposure to temperature which raise rectal temperatures by 2-3°F will usually kill all embryos (Thwaites, 1967a).

An interesting feature of the results here obtained was the "continuous" negative correlation of the reproductive criteria to environmental temperature. Inspection of Figs. 8, 9, 10, 23 and 24 supports this observation which has not been previously reported. Studies so far conducted have compared effects at discrete ambient temperatures and it should be interesting in the future to investigate further this apparent continuous inverse relationship. The degree of correlation obtained here was not consistently high for all the three towns, so perhaps this observation should be interpreted with caution. Dutt (1963) suggested that the harmful effects from temperature stress might result from either a direct effect of a rise in body temperature, biochemical effects such as a change in enzyme

activity or metabolic function or a disturbance in endocrine balance. Investigation of whether these harmful effects are exerted in a discrete manner or continuously could throw some light on Dutt's suggestions.

Relationship of reproductive activity to rainfall (nutrition)

In the area studied, growth of herbage is very much dependent on the seasonal rainfall pattern. From about January to April there is little forage available to sheep and goats. With the advent of the rains in April however, grass grows rapidly affording ample grazing from then till about October/November when with the cessation of the rains the quantity and nutritive value of herbage declines rapidly. By virtue of its relationship to available nutrient therefore, rainfall should be expected to be indirectly related and positively correlated to reproductive activity. The results were consistent with previous reports of the beneficial effects of improved nutrition (Coop, 1966a, 1966b; Tassell, 1967; Edey, 1969; Gunn et al., 1969; Bastiman, 1972; Lamond et al., 1973; Gunn and Doney, 1973; Bramley et al., 1976) and the deleterious effects of low planes of nutrition (Hafez, 1952, El-Sheikh et al., 1955;

Foote et al., 1959; Allen and Lamming, 1961; Edey, 1965; Van Miekerk, 1968).

Those reproductive criteria in Kano and Kaduna sheep and goats that either bore no correlation to or were negatively correlated to rainfall may be reflections of improper management such as exposure to rainfall, respiratory diseases and helminthiasis. As noted before such exposure to rainfall per se shortly before or after mating can reduce the percentage of multiple ovulations and increase the loss of ova (Doney and Gunn, 1972). The absence of correlation or negative correlation of the reproductive criteria in Zaria goats to rainfall, while appearing to conform to its inconsistency with findings for Kano and Kaduna, may be further evidence of a regional mis-management, in this case possibly direct exposure to rainfall.

Inspection of Figs. 13, 14, 15, 16, 28 and 29 reveals that shortly after monthly rainfall figures dropped below about 50mm in October/November, there was a general decrease in the reproductive criteria; the reverse appeared to be true, for both sheep and goats, the reproductive criteria showing an upward trend while rainfall remained above 50mm per month between April and November. It is not unlikely that this figure of about 50mm per month is the amount of rainfall required in this geographical area to

maintain adequate supply of forage to sheep and goats, below which figure there will be a natural drop in reproductive activity. Reid (1949) has observed that the response of wild and domestic animals to the supply of food is so definite that it seems that nature, in an attempt to ensure species survival, has provided animals with a protective mechanism for either reducing or ceasing reproduction under adverse conditions. The observed downward trend in the reproductive criteria after November/December will of course be partly due to parturitions peaking about April, as has been indicated, but a reduction in ovarian activity and disturbances of gestation as a result of a worsening nutrient supply would definitely contribute to the downward trend.

Attempt was made to statistically relate the observed increase or decrease in the reproductive criteria to level of rainfall one, two, three or four months prior to that time. Although this would not have provided precise information on a flushing effect along the lines reviewed by Coop (1966b), it would have indicated how soon an increase or a decrease in rainfall would be reflected in an increase or a decrease in reproductive activity in indigenous sheep and goats. Unfortunately,

probably because in each of the three towns under study rainfall is generally zero (below 10mm) for six consecutive months of the year, any significant time-lag relationship that may have existed over the remaining six months was obscured. Within a three month negative time-lag the tetrachoric coefficients of correlation between the reproductive criteria and rainfall were virtually the same. By the fourth month it was erratic.

Lesions of the female reproductive tract

The incidences of lesions found in this study are not far different from previous reports. It is difficult to compare Adams' (1975) report with any other, because of the predominance and very high incidence of clover disease lesions - cervical cysts and squamous metaplasia or goblet cell hyperplasia of the epithelium in 76% of ewes and endometritis in 24% of ewes.

No intersexes were encountered in this study. That both sexes of the Red Sokoto goat, the predominant breed in the area studied, have horns, may be relevant to the lack of intersexes. The absence is in consonance with the observations of Haumesser (1975) in the same breed and previous association of the malformation with hornlessness in goats (Hafez and Jainudeen, 1966).

The results of this study are apparently in disagreement with Arthur's (1977) statement that in the majority of twin or triplet pregnancies of sheep contiguous chorionic sacs coalesce and in many cases the allantoic cavities are confluent. Of the five twin and one triplet pregnancies encountered in sheep, none had fused chorioallantoic foetal membranes. Perhaps the number of multiple pregnancies seen here are too few to draw conclusions from. Only four cases of fused chorioallantoic membranes were seen out of 45 multiple pregnancies in goats and in no instance was there evident anastomosis of the foetal placental blood vessels. The latter, would have raised the possibility of freemartinism. Whether vasdular anastomosis would occur later in pregnancy is left to speculation.

An unusually small ovary measuring 1.0 x 0.6 x 0.3cm was encountered in a goat (KN/20776/G3). However, there was a single small follicle at the oviductal pole. The contralateral ovary was completely enmeshed in ovario-bursal adhesions. Although both ovaries appeared to be histologically normal they were obviously non-cyclic and it is not unlikely that the fertility of such a goat would be impaired.

The segmental aplasia seen in conjunction with a hydrosalpinx may be the first recorded incidence of segmental aplasia

of the oviduct in either sheep or goat. Jubb and Kennedy (1970) considered that a total or large segmental defect of aplastic type in the oviduct is likely to be secondary to a gonadal defect - either hermaphroditism, gonadal agenesis or free-martinism (?). In this case no such gonadal defect was evident. It might be suggested from the fibrous adhesions with enmeshed abscesses and mononuclear cell infiltration of the uterine serosa, but not of the endometrium, that the hydrosalpinx was secondary to a peritonitis and salpingitis. However, a remnant of the occluded oviduct would have persisted; in this case it was not detectable. The hydrosalpinx was therefore more likely secondary to a congenital segmental aplasia and coincidental to the serosal adhesions and the abscesses. These lesions should be expected to influence the reproductive performance of the ewe; segmental aplasia by imposing a physical obstruction to the passage of gametes and hydrosapinx most likely additionally by influencing the environment of the gametes and conceptus (if ever conception occurs).

The vascular hamartoma encountered in this study (KN/22377/S3) is probably the first report of its kind in sheep or goats and the first occurrence in a uterus. There have been previous reports in ovaries of sows and cows (Jubb and Kennedy,

1970), canine liver (McGavin and Henry, 1972) and lungs of a dog (Njoku et al., 1972). The effect of the vascular hamartoma on the reproductive performance of this ewe can only be speculated. However, the fact that both ovaries, involved only at the base, were static, may be an indication of the severity of the effect of the hamartoma.

It is interesting that whereas 22 cases of parovarian cysts were encountered in 474 caprine reproductive tracts (two were bilateral and one multiple but unilateral) not a single parovarian cyst was seen in 99 ovine tracts. This might reflect breed rather than species differences since Lyngset (1968) recorded only 1.1% incidence in goats (Norway) whereas in sheep Rao and Abdulla Khan (1974), recorded 17.03% incidence in Ceylon and Adams (1975) recorded 20.3% in Australia. Parovarian cysts have not been reported to have any effect on reproductive performance. Results of this study, however, raise the question of just how innocuous parovarian cysts are. Of the total of 22 caprine tracts in which parovarian cysts were observed only two (KN/161176/G1 and KN/211276/G11) were pregnant. Ovarian inactivity did not appear to be a factor since in every instance there was at least an F_2 in at least one ovary and F_3 and C.L. were not infrequently present. No

histological lesions were observed to be common to tracts with parovarian cysts. Some of the cysts were very closely apposed to the ovary or oviduct (e.g. Fig. 36) but in no such case was a parovarian cyst found to be occluding the ovarian bursa or oviduct or to communicate with them. A further interesting feature was their apparent high incidence in particular months. Three of the six incidences in Kaduna were observed in December 1976 and four of 12 incidences in Kano in March 1976. This condition may warrant further study especially considering that it constituted 47.83% of all caprine lesions encountered. However, the number of observed parovarian cysts may be too few to conclude from. Tapeworm cysticerci were observed close to the ovary or oviduct and these of course must be differentiated from parovarian cysts by the presence of an invaginated scolex.

Not much appears to be known about the signficance of ovarian cysts in species other than the bovine and porcine. In the two cases seen in this study (one luteinized follicular cyst and one cystic corpus luteum - both caprine) the rest of the reproductive tract was essentially normal; whether there would have been any accompanying clinical signs is not known.

Ovarian activity as evidenced by presence of developing follicles and corpora lutea in ovaries with ovario-bursal adhesions was similar to ovarian activity in ovaries without ovario-bursal adhesions, for the time of the year. However, in no single instance was a sheep or goat with ovario-bursal adhesions pregnant. Perhaps the three goats and three sheep involved are a rather small sample to conclude from, but the unanimity of association may indicate an adverse effect of ovario-bursal adhesions, even when unilateral, on reproductive performance. In one tract (KN/22377/G15) a broad sheet of fibrous connective tissue extended across the dorsum of both uterine horns about the level of their bifurcation and enmeshed the right ovary. In the single bilateral case (KN/161176/G19) adhesions were limited to the ovaries but were extensive. The left ovary contained only a few small follicles but the right ovary contained several large as well as small follicles and a well-matured corpus luteum. A secondary hydrosalpinx was associated with one ovario-bursal adhesion (KD/10577/S1; Fig.38). Injection of coloured fluid proved the hydrosalpingitic portion to be open through to the right uterine horn but not to the right ovary. Both right and left ovaries on histological examination contained only a few secondary and several atretic

follicles - although this was not unusual for the time of year (May). The oviduct lumen was distended but histologically normal. It would appear then that these ovariobursal adhesions can result either from a peritonitis e.g. KN/22377/G15, or a localized inflammation, most likely ascending from the oviduct, e.g. KN/61176/G19).

In the caprine tract with cystic utero-tubal junctions (KD/91176/G3) the location of the cysts on mucosal folds rather than at the base of the caruncles make their aetiology as post-involutionary retention cysts rather unlikely. The possibility of a prolonged oestrogenic stimulation such as in "clover disease" should be considered. It is not unlikely that some local plants are oestrogenic, and might have been grazed on by this goat considering the rather indiscriminate foraging habits of goats especially during the dry season. The uterine oedema seen in the tract may have been due to the post-ovulatory state of the tract since there was a corpus haemorrhagicum in the right ovary.

The mummified foetus seen was during advanced pregnancy. The foetal membranes and uterine wall were closely applied to it and foetal membrane fluds were virtually absent. One case of early embryonic death and two cases of foetal maceration

were recorded. In both categories the conceptuses were obviously autolyzed and the foetal fluid was present. They were differentiated on the basis of estimated age, based on the criteria employed by Nair and Raja (1972) and the original work of Green and Winters (1945). The latter considered the period of the embryo to end about the 35th day by which time genesis of the main organs and systems is complete. His pictorial presentation makes rough age comparison easy. Nair and Raja (1972) took differentiation of the digits to occur at about day 35-42, when the conceptus should be recognized as a foetus.

It would appear that pyometra is quite rare in both sheep and goats. Lyngset (1968) found none in 1020 caprine reproductive tracts; in sheep Nair and Raja (1972) found only two in 1050 uteri; Adams (1975), four in 487 tracts. Only one case was seen in this study (KD/10577/G1). Pyometra seldom resolves spontaneously and this doe would most likely have remained anoestrous and sterile.

All the cases of embryonic resorption, foetal maceration, foetal mummification and pyometra occurred in goats and none in sheep. As in cattle, in all these conditions a corpus luteum was present in one or both ovaries. The persistence of

the corpus lutem has been attributed to an absence or interference with pathways of the uterine luteolytic mechanism (Ginter, 1968).

Diagnosis of endometritis or metritis, especially during the follicular phase of the oestrus cycle, was limited to cases where histological evidence of inflammation, was so pronounced as to be unequivocal. It is therefore likely that the actual incidence of the two conditions is higher than the two cases each of metritis and endometritis reported here. With regards to the possible consequences on reproductive performance, Smith, Jones and Hunt (1972) have stated that the principal effect of (catarrhal) endometritis is to prevent conception.

Perimetrial adhesions were observed in two caprine tracts one of which also had ovario-bursal adhesions (KN/20776/G3). Although they seemed quite separate it is possible that the two sets of adhesions were of similar aetiology. A satisfactory specific Prussian-blue stain for hemosiderin could not be obtained but it is not unlikely that the coppery-yellow spots seen on the serosa of one uterus (KN/20776/S1) represented old sites of haemorrhage. The flaccid uteri containing chocolate-coloured debris (e.g. KN/19477/G1) were considered to be recently post-parturient and normal. In one goat (KN/141276/G3)

in addition to several F_1 (< 0.2cm) in both ovaries, one ovary had two corpus haemorrhagicum (C.H.) and the other a regressing C.L. The tract contained only a small amount of the chocolate-coloured material. This tract was probably in its first post-partum oestrus.

It would appear that the calcareous structures found in the uterus and cervix (KD/10577/G2) were remnants of one or two macerating foetuses that had been partially expelled, probably spontaneously, on regression of the two C.L. The two C.H. probably represented a subsequent oestrus. The longer this condition had persisted, the greater would be the damage to the endometrium and the reproductive performance of the affected goat. It would appear from the normal size of the uterus (involuted), the clean state of the uterine mucosa and the presence of two C.H. that in this case the reproductive competence of the doe had either not been too severely impaired or had been regained. It is postulated that the trans-uterine cicatrix seen in one caprine tract (KD/10577/G2) represents the site from which a foetus, hairs from which were still lodged in the cicatrix, escaped from the uterus into the abdominal cavity. Because the rest of the uterus was grossly

and histologically normal, the uterine rupture more likely occurred during dystocia possibly due to inability of the cervix to dilate at term, or lay assistance rather than as a result of any severe uterine inflammation or physical trauma.

SUMMARY

Of a total of 134 pregnant caprine reproductive tracts examined, 89 (66.4%) had single foetuses, 44 (32.8%) had twins and one (0.7%) had triplets. Average litter size was 1.34. 25 pregnant ovine reproductive tracts were examined. Of these, 19 (76%) contained single foetuses, five (20%) had twins and one (4%) had triplets. Average litter size was 1.28. These results were not spectacular but comparable to breeds elsewhere in the world.

Sheep and goats in at least Kano and Kaduna breed throughout the year; but they did vary in reproductive activity over the year, showing an increase from about October, peaking around December and tailing off after February. Most conceptions probably occurred around October/November and most parturitions should be expected in March/April. The implications of these findings for sheep and goat production are briefly discussed.

The results for Zaria were anomalous but it appears that generally, at least for Kano and Kaduna the breeding pattern of sheep and goats were negatively correlated to daylength and

environmental temperature and positively correlated to rainfall (nutrition).

Of 474 caprine reproductive tracts examined 46 (9.7%) had lesions as had nine (9.09%) of 99 ovine tracts. 134 and 25 of the caprine and ovine tracts respectively were pregnant. Although several previously unreported lesions in both sheep and goats were encountered, generally neither their type nor the incidences differed greatly from the few previous reports from elsewhere in the world. Several of the lesions were at least potentially capable of interfering with reproductive performance.

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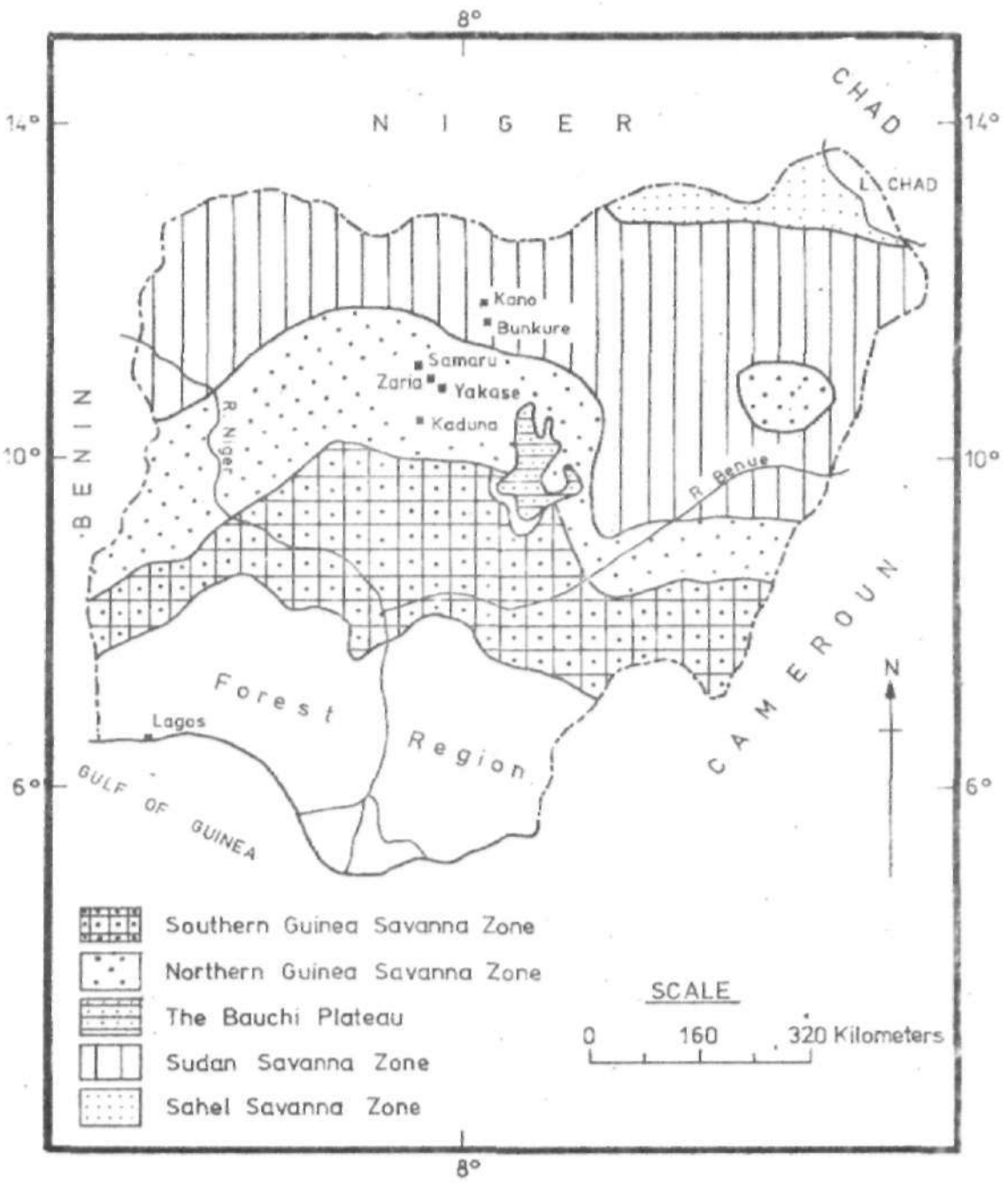

8°
14°
10°
6°
NIGER
CHAD
BENIN
CAMEROUN
L. CHAD
Kano
Bunkure
Samaru
Zaria
Yakase
Kaduna
R. Niger
R. Benue
Forest
Region
Lagos
GULF OF GUINEA
N
Southern Guinea Savanna Zone
Northern Guinea Savanna Zone
The Bauchi Plateau
Sudan Savanna Zone
Sahel Savanna Zone
SCALE
0 160 320 Kilometers

Table 1: Ovarian dimensions, ovarian functional bodies and gross status of caprine reproductive tracts collected from Kano.

Code No.	Left Ovary							Right Ovary							
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	Gross Status
KN/20776/G1	1.8	1.0	0.7	–	–	–	–	1.8	0.8	1.0	2	–	–	–	NNP
KN/20776/G2	1.3	1.0	0.8	1	–	–	–	1.5	1.0	0.7	–	–	–	–	NNP
KN/20776/G3	1.0	0.6	0.3	1	–	–	–	1.9	1.3	1.1	2	1	1	1	ANP
KN/20776/G4	1.5	0.8	0.6	–	1	–	–	1.4	1.0	1.0	–	2	–	–	NNP
KN/20776/G5	1.9	1.2	0.9	1	–	–	–	1.8	1.2	1.1	3	–	–	–	ANP
KN/20776/G6	1.3	0.9	0.6	3	–	1	–	1.2	0.8	0.5	1	–	–	–	NNP
KN/20776/G7	1.6	1.1	0.8	–	–	–	1	1.4	1.0	0.5	1	1	–	–	ANP
KN/20776/G8	1.8	1.3	0.9	2	–	–	–	1.4	1.1	0.7	–	1	–	–	NNP
KN/20776/G9	1.2	1.4	0.9	–	1	–	–	1.8	1.2	0.8	1	1	–	–	NNP
KN/20776/G10	1.7	0.7	1.0	2	–	–	1	1.7	1.3	0.9	5	–	–	1	NNP
KN/20776/G11	1.5	1.1	0.6	2	1	–	–	1.5	1.1	0.7	3	–	–	1	NNP
KN/20776/G12	1.6	1.3	1.0	1	1	–	–	1.5	1.1	0.8	2	–	–	–	NNP
KN/20776/G13	1.5	1.0	0.8	3	1	–	1	1.3	0.9	0.7	2	–	–	–	NNP
KN/20776/G14	C	U	T	O	F	F		1.3	0.9	0.8	–	2	–	–	NNP
KN/20776/G15	1.7	1.0	0.6	–	–	–	–	1.6	0.9	0.7	2	–	2	–	NNP
KN/20776/G16	1.4	1.0	0.5	1	1	–	–	1.5	1.0	0.8	3	–	–	1	PREG
KN/20776/G17	1.9	1.3	1.3	5	–	–	1	1.5	1.0	0.8	4	1	–	–	PREG
KN/20776/G18	2.0	1.2	0.9	2	–	–	1	1.8	1.2	0.8	–	–	–	1	PREG
KN/20776/G19	1.5	1.2	1.1	4	1	–	–	1.7	1.1	1.2	2	–	–	1	PREG
KN/20776/G20	2.0	1.6	0.7	2	–	–	–	2.0	1.7	1.2	–	–	–	1	PREG
KN/20776/G21	1.9	1.4	0.8	3	–	–	–	2.0	1.7	1.0	–	–	–	1	PREG
KN/20776/G22	1.7	1.3	0.5	2	–	–	–	2.1	1.4	0.8	–	–	–	1	PREG
KN/20776/G23	1.7	1.2	0.5	1	–	–	–	1.5	1.3	1.0	–	–	–	1	PREG
KN/20776/G24	1.6	1.1	0.7	4	–	–	–	1.5	1.4	0.8	–	–	–	1	PREG

NNP = Normal Non-pregnant; ANP = Abnormal Non-pregnant; PREG = Pregnant
L = Length of ovary in cm.; H = Height of ovary in cm.; W = Width of ovary in cm.

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/17876/G1	1.7	1.1	0.9	-	-	-	-	C	U	T	O	F	F		PREG
KN/17876/G2	1.6	1.5	1.3	1	-	-	2	1.4	1.1	0.9	1	1	-	-	PREG
KN/17876/G3	1.7	1.2	1.1	-	-	-	1	1.4	1.0	0.8	2	2	-	-	PREG
KN/17876/G4	1.8	1.1	0.7	2	1	1	-	1.9	1.5	0.9	-	-	-	1	PREG
KN/17876/G5	1.4	0.9	0.7	-	-	-	-	1.4	1.4	1.0	1	-	-	1	PREG
KN/17876/G6	1.2	1.2	1.0	6	-	-	-	1.9	1.5	1.1	-	-	-	1	PREG
KN/17876/G7	1.8	1.6	1.1	1	-	-	1	1.5	1.2	0.7	2	-	-	-	PREG
KN/17876/G8	2.0	1.5	1.1	1	-	-	2	2.0	1.2	1.0	1	-	-	-	PREG
KN/17876/G9	1.2	1.2	0.8	3	-	-	-	1.0	0.8	0.6	-	-	-	-	NNP
KN/17876/G10	1.7	1.4	0.7	1	-	3	-	1.5	1.2	0.9	2	1	1	-	NNP
KN/17876/G11	2.0	1.1	1.0	2	-	-	-	2.0	1.2	1.0	3	-	-	-	NNP
KN/17876/G12	1.1	1.2	0.7	1	1	-	-	1.1	1.4	0.8	1	-	-	-	NNP
KN/17876/G13	1.5	1.0	1.0	-	4	-	-	1.7	1.0	0.9	-	3	-	-	NNP
KN/17876/G14	1.8	1.6	1.1	-	-	-	-	1.8	1.2	1.0	-	-	-	-	NNP
KN/17876/G15	1.1	0.9	0.6	3	-	-	-	1.0	0.9	0.7	-	-	-	-	NNP
KN/17876/G16	1.5	1.0	0.7	6	-	-	-	1.5	1.2	0.8	4	-	-	1	NNP
KN/17876/G17	1.6	0.8	0.8	3	-	-	-	1.8	1.3	0.9	6	2	-	-	NNP
KN/17876/G18	1.7	1.2	0.8	4	-	-	-	2.0	1.8	1.2	-	1	-	1	NNP
KN/17876/G19	1.8	1.1	0.9	1	-	-	-	1.9	1.3	1.1	1	1	2	-	NNP
KN/17876/G20	1.5	1.1	1.2	1	-	-	-	1.6	1.4	1.0	2	1	-	-	NNP
KN/17876/G21	1.7	1.4	1.0	1	-	1	-	1.7	0.8	1.1	-	-	-	-	NNP
KN/17876/G22	2.0	1.0	1.1	-	-	2	-	2.0	1.4	1.1	2	-	-	-	NNP
KN/17876/G23	1.7	1.1	0.8	-	-	-	-	1.5	1.2	0.8	1	-	-	-	NNP

NNP = Normal Non-pregnant; ANP = Abnormal Non-pregnant; PREG = Pregnant

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/21976/G1	C	U	T	O	F	F		1.4	1.2	0.9	1	1	-	-	NNP
KN/21976/G2	1.7	1.4	1.1	1	1	1	-	C	U	T	O	F	F		ANP
KN/21976/G3	1.5	1.0	0.7	1	-	-	-	1.6	1.0	0.8	1	1	-	-	NNP
KN/21976/G4	1.4	1.3	0.8	-	-	-	-	1.7	1.5	0.7	-	-	-	-	NNP
KN/21976/G5	C	U	T	O	F	F		1.8	1.3	0.7	1	2	-	-	NNP
KN/21976/G6	1.7	1.3	0.9	-	-	-	-	1.7	1.4	0.8	2	-	-	-	NNP
KN/21976/G7	1.7	1.1	0.7	1	-	-	-	1.7	1.1	0.8	-	-	-	-	NNP
KN/21976/G8	1.6	1.3	0.9	2	-	-	2	1.2	0.8	0.5	-	-	-	-	PREG
KN/21976/G9	1.5	1.0	0.8	2	-	-	-	1.6	1.5	0.9	2	-	-	1	NNP
KN/21976/G10	1.3	0.9	0.6	-	-	-	-	1.5	1.3	0.9	-	1	-	2	NNP
KN/21976/G11	1.8	1.6	1.2	2	1	-	-	1.4	1.1	0.8	1	-	-	-	NNP
KN/21976/G12	C	U	T	O	F	F		C	U	T	O	F	F		NNP
KN/21976/G13	1.1	0.9	0.7	1	-	-	-	1.4	1.2	0.7	-	-	2	-	NNP
KN/21976/G14	1.3	1.0	0.8	-	2	-	-	1.2	1.0	0.7	4	-	-	-	NNP
KN/21976/G15	C	U	T	O	F	F		C	U	T	O	F	F		NNP
KN/21976/G16	1.9	1.2	0.9	1	-	-	1	1.7	1.4	0.9	2	1	-	1	NNP
KN/21976/G17	1.7	1.4	1.0	1	-	-	1	1.6	1.8	0.8	-	-	-	1	NNP
KN/21976/G18	1.8	1.8	1.0	2	-	-	2	2.0	1.4	1.1	1	3	-	1	PREG
KN/21976/G19	2.1	1.5	1.1	-	-	-	2	C	U	T	O	F	F		PREG
KN/21976/G20	1.6	1.1	0.8	1	-	-	-	1.6	1.0	0.8	-	1	-	-	NNP
KN/21976/G21	1.4	1.3	0.9	-	-	1	-	1.4	1.1	0.7	-	1	-	1	NNP
KN/21976/G22	1.7	1.4	0.9	1	-	-	1	1.8	1.6	1.2	2	1	-	1	ANP
KN/21976/G23	1.6	1.2	0.8	1	1	-	-	1.5	0.8	0.6	-	1	-	-	NNP
KN/21976/G24	1.6	1.1	0.6	1	1	-	-	1.6	1.5	0.7	1	-	1	-	NNP
KN/21976/G25	C	U	T	O	F	F		C	U	T	O	F	F		PREG
KN/21976/G26	1.4	1.0	0.6	-	-	-	-	C	U	F	O	F	F		PREG
KN/21976/G27	1.7	1.2	0.7	1	2	-	-	1.9	1.5	1.1	-	-	-	2	PREG

Table 1: Continued

	Left Ovary							Right Ovary							
Code No.	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	Gross Status
KN/19076/G1	1.4	1.0	0.5	-	-	-	-	1.3	1.0	0.5	-	-	-	-	NNP
KN/19076/G2	1.6	1.3	1.0	2	1	-	1	1.4	0.9	0.6	-	-	-	-	NNP
KN/19076/G3	1.8	1.5	1.1	-	-	-	-	1.8	1.4	1.0	2	-	-	-	NNP
KN/19076/G4	1.3	1.0	0.6	-	-	-	-	1.5	1.2	0.8	1	2	-	-	NNP
KN/19076/G5	1.4	1.1	0.9	1	-	-	-	1.9	1.2	1.1	2	-	-	1	NNP
KN/19076/G6	1.7	1.2	1.0	1	1	-	-	1.5	1.1	0.7	1	-	-	1	NNP
KN/19076/G7	1.9	1.4	1.0	-	-	-	-	1.7	1.4	0.7	-	-	-	-	NNP
KN/19076/G8	1.6	1.4	0.8	-	-	-	-	1.8	1.3	0.8	-	-	-	1	ANP
KN/19076/G9	1.7	1.3	0.8	-	-	-	-	C	U	T	O	F	F		PREG
KN/19076/G10	1.4	1.2	0.9	-	-	-	3	1.3	1.4	1.0	1	1	-	1	NNP
KN/19076/G11	1.9	1.6	1.1	2	-	-	1	1.7	1.4	0.8	1	-	-	1	NNP
KN/19076/G12	1.4	1.6	1.0	1	-	-	1	1.8	1.7	1.1	2	-	-	1	NNP
KN/19076/G13	1.5	0.9	0.7	1	-	-	-	1.3	1.1	0.8	-	2	-	-	NNP
KN/19076/G14	1.4	1.1	0.7	1	-	-	-	1.4	1.0	0.6	-	-	-	-	NNP
KN/19076/G15	1.5	1.1	0.7	-	-	-	-	1.5	1.1	0.7	-	-	-	1	NNP
KN/19076/G16	1.7	1.2	1.1	-	1	-	-	1.2	1.2	1.2	2	-	-	1	PREG
KN/19076/G17	1.6	1.2	0.7	-	-	-	1	2.0	1.7	1.3	1	3	-	2	NNP
KN/19076/G18	1.7	1.2	1.0	-	-	-	1	1.9	1.3	0.7	3	-	-	-	NNP
KN/19076/G19	1.7	1.0	1.0	2	-	-	1	1.6	1.0	0.8	-	-	-	-	NNP
KN/19076/G20	1.8	1.4	0.8	-	-	-	-	1.9	1.2	0.9	1	-	1	-	NNP
KN/19076/G21	1.8	1.1	0.9	-	-	-	-	1.9	0.9	0.9	-	-	-	-	NNP
KN/19076/G22	1.3	1.0	1.1	1	1	-	-	1.1	1.0	0.9	1	-	-	-	NNP
KN/19076/G23	2.1	1.3	0.9	4	-	-	2	1.6	1.1	0.7	1	-	-	-	NNP
KN/19076/G24	1.5	1.1	1.0	1	2	-	-	C	U	T	O	F	F		PREG
KN/19076/G25	1.8	1.2	0.9	1	-	-	-	2.2	1.6	1.5	2	-	-	2	PREG
KN/19076/G26	1.8	1.1	0.6	-	-	-	-	2.0	1.4	1.1	2	-	-	1	PREG
KN/19076/G27	1.5	1.1	1.0	1	2	-	-	C	U	T	O	F	F		PREG
KN/19076/G28	1.5	1.1	0.8	1	1	-	-	1.8	1.2	1.0	-	1	-	2	PREG

Table 1: Continued

	Left Ovary							Right Ovary							
Code No.	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	Gross Status
KN/161176/G1	1.7	1.6	1.2	-	-	-	2	1.5	1.2	0.9	3	-	-	-	PREG
KN/161176/G2	1.7	1.6	1.1	1	2	-	1	1.5	1.2	0.8	1	-	-	-	PREG
KN/161176/G3	2.7	1.7	1.3	-	-	-	2	1.7	1.5	0.8	1	-	-	-	PREG
KN/161176/G4	1.6	1.2	0.8	-	-	-	-	1.9	1.6	1.1	3	1	-	2	PREG
KN/161176/G5	C	U	T	O	F	F		1.7	1.5	0.9	-	-	-	-	NNP
KN/161176/G6	1.3	1.8	1.1	1	-	-	3	1.5	1.2	0.9	-	-	-	-	PREG
KN/161176/G7	1.5	1.1	0.9	-	-	-	1	1.6	1.1	0.8	-	-	-	-	NNP
KN/161176/G8	1.8	1.9	1.1	1	-	-	2	1.7	1.3	0.8	1	-	-	-	NNP
KN/161176/G9	1.3	1.1	0.8	2	-	-	-	1.7	1.5	1.0	-	-	-	1	NNP
KN/161176/G10	1.6	0.9	0.7	-	-	-	-	1.6	1.0	1.0	2	-	-	-	NNP
KN/161176/G11	1.4	1.0	0.7	-	-	-	-	1.4	1.7	1.2	-	-	1	-	ANP
KN/161176/G12	2.0	1.3	1.2	2	2	-	1	2.0	1.6	1.4	3	1	-	1	NNP
KN/161176/G13	1.5	1.2	0.8	-	-	-	-	1.7	1.3	0.9	1	-	-	-	NNP
KN/161176/G14	1.4	1.1	1.0	1	-	1	-	1.6	1.1	0.9	1	1	-	-	NNP
KN/161176/G15	1.7	1.5	1.0	2	1	-	-	1.9	1.4	1.4	3	-	-	1	NNP
KN/161176/G16	1.7	1.0	0.7	1	-	-	-	1.8	1.0	0.7	-	-	-	-	NNP
KN/161176/G17	1.2	1.1	0.9	2	-	-	-	1.5	1.1	0.8	1	-	-	-	NNP
KN/161176/G18	1.5	1.2	0.8	-	2	-	-	2.0	1.8	1.0	1	-	-	2	NNP
KN/161176/G19	1.6	1.0	A D H E S I O N S					2.0	1.6	A D H E S I O N S					ANP
KN/161176/G20	1.9	1.4	0.9	-	-	-	-	1.7	1.6	0.9	-	-	-	-	NNP
KN/161176/G21	1.9	1.5	1.2	4	-	-	1	1.7	1.2	0.8	2	1	-	-	NNP
KN/161176/G22	1.8	1.0	0.8	-	-	-	-	1.7	1.2	0.7	-	-	-	-	NNP

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/161176/23	1.9	1.1	0.8	1	1	-	-	2.0	1.0	1.3	-	1	-	2	NNP
KN/211276/G1	2.1	1.8	1.2	-	-	-	1	2.1	1.4	1.0	4	3	-	1	NNP
KN/211276/G2	1.8	1.2	1.4	2	1	-	3	1.8	1.2	0.9	-	2	-	-	ANP
KN/211276/G3	1.7	1.1	1.0	-	-	2	-	1.7	1.2	1.0	-	-	-	-	NNP
KN/211276/G4	1.8	1.3	0.8	2	-	-	-	2.1	1.8	1.2	-	-	-	1	PREG
KN/211276/G5	1.7	1.3	1.1	2	-	-	-	2.0	1.5	1.7	-	-	-	1	PREG
KN/211276/G6	1.5	1.4	0.6	-	-	-	-	2.2	1.7	1.0	1	-	-	3	PREG
KN/211276/G7	1.7	1.8	1.1	1	1	-	1	1.8	1.6	0.9	-	2	-	1	PREG
KN/211276/G8	1.7	1.2	0.8	4	-	-	-	1.6	1.4	1.0	-	-	-	1	PREG
KN/211276/G9	1.8	1.6	1.0	-	1	-	1	C	U	T	O	F	F		PREG
KN/211276/G10	1.7	1.2	1.2	-	-	-	2	1.5	1.1	0.8	1	1	-	-	PREG
KN/211276/G11	1.8	1.6	1.2	1	1	-	1	1.8	1.3	1.0	-	-	-	1	PREG
KN/211276/G12	1.9	1.5	0.9	-	-	-	1	1.9	1.4	0.9	-	-	-	1	PREG
KN/211276/G13	1.9	1.4	0.7	1	-	-	1	2.2	1.2	1.1	2	-	-	1	PREG
KN/211276/G14	1.9	1.2	0.9	1	-	-	1	1.8	1.0	0.9	1	1	-	-	NNP
KN/211276/G15	1.1	0.9	0.5	-	-	-	-	1.6	1.1	0.9	2	-	-	-	NNP
KN/211276/G16	1.5	1.0	0.7	-	-	-	1	1.6	1.4	0.8	2	-	1	-	NNP
KN/211276/G17	1.8	1.0	1.0	1	1	-	-	1.7	1.4	1.3	1	-	-	1	NNP
KN/15277/G1	1.5	1.1	0.8	-	-	-	-	1.8	1.7	1.3	7	1	-	1	ANP
KN/15277/G2	2.0	1.6	1.1	2	1	-	-	2.3	1.7	1.2	1	-	-	2	NNP
KN/15277/G3	2.1	1.3	1.0	2	-	-	-	1.8	1.6	1.1	1	-	-	1	PREG
KN/15277/G4	1.9	1.4	0.8	2	2	-	-	2.0	1.5	1.0	-	-	-	1	PREG

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/18177/G1	1.8	1.2	1.0	1	2	-	-	1.8	1.1	1.0	1	-	1	1	ANP
KN/18177/G2	1.8	1.1	0.8	-	-	2	1	1.4	1.2	0.8	2	-	-	-	ANP
KN/18177/G3	2.0	1.4	1.1	2	-	-	2	1.6	1.3	0.9	3	-	-	1	PREG
KN/18177/G4	2.0	1.2	1.0	2	1	-	1	1.9	1.1	0.8	-	-	-	1	PREG
KN/18177/G5	1.5	1.1	0.8	3	-	-	-	2.0	1.2	1.0	2	2	-	1	PREG
KN/18177/G6	1.6	1.3	1.0	2	-	-	1	1.5	1.0	0.9	3	-	-	-	PREG
KN/18177/G7	1.5	1.1	0.8	1	-	-	-	1.9	1.5	1.2	3	-	-	2	PREG
KN/18177/G8	2.1	1.8	1.2	-	1	-	2	1.4	1.0	0.8	2	-	-	-	PREG
KN/18177/G9	1.6	1.4	1.0	-	-	-	1	1.6	1.3	1.0	2	-	-	1	PREG
KN/18177/G10	1.7	1.2	0.9	2	1	-	-	1.8	1.3	0.9	-	-	-	1	PREG
KN/18177/G11	2.0	1.6	1.1	1	-	-	2	1.7	1.2	0.9	2	-	-	-	PREG
KN/18177/G12	1.6	1.3	0.9	3	-	1	-	1.9	1.4	1.0	2	-	1	1	NNP
KN/18177/G13	1.5	1.1	0.8	3	-	-	-	1.9	1.3	1.1	1	-	-	2	NNP
KN/18177/G14	1.4	1.1	0.9	2	-	-	1	1.7	1.3	1.0	1	2	-	-	NNP
KN/18177/G15	1.8	1.5	1.1	1	-	-	1	1.9	1.6	1.1	3	1	-	1	NNP
KN/18177/G16	2.0	1.7	1.2	2	2	2	-	1.9	1.4	1.0	-	2	-	-	NNP
KN/18177/G17	1.6	1.3	1.0	2	-	-	-	2.1	1.7	1.2	2	1	-	2	NNP
KN/18177/G18	1.9	1.4	1.2	3	2	-	1	1.7	1.6	1.1	-	1	1	-	NNP
KN/18177/G19	1.6	1.2	1.1	1	1	1	-	1.8	1.5	1.2	2	-	2	-	NNP
KN/18177/G20	1.6	1.4	1.1	3	1	-	1	1.9	1.6	1.1	1	2	-	1	NNP

Table 1 Continued

CODE NO.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH.	CL.	L	H	W	F_2	F_3	CH.	CL.	
KN/15277/G1	1.5	1.1	0.8	-	-	-	-	1.8	1.7	1.3	7	1	-	1	ANP
KN/15277/G2	2.0	1.6	1.1	2	1	-	-	2.3	1.7	1.2	1	-	-	2	NNP
KN/15277/G3	2.1	1.3	1.0	2	-	-	-	1.8	1.6	1.1	1	-	-	1	PREG
KN15277/G4	1.9	1.4	0.8	2	2	-	-	2.0	1.5	1.0	-	-	-	1	PREG

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KM/15277/G5	1.5	1.2	0.7	2	–	–	–	1.8	1.5	1.1	–	2	–	1	PREG
KM/15277/G6	1.4	1.1	0.8	–	–	–	1	1.7	1.2	0.9	3	2	1	–	NNP
KM/15277/G7	1.5	1.4	1.0	–	1	–	–	1.5	1.1	0.9	1	–	–	–	NNP
KM/15277/G8	1.7	1.1	0.9	3	–	–	–	1.4	1.1	0.9	2	–	–	–	NNP
KM/15277/G9	1.9	1.2	0.9	2	–	–	–	1.8	1.3	1.0	–	2	–	–	NNP
KM/15277/G10	1.4	1.2	0.9	2	–	–	–	1.4	1.3	0.8	2	–	–	–	NNP
KM/15277/G11	1.6	1.1	0.9	–	1	–	–	1.4	1.2	0.8	2	–	–	–	NNP
KM/15277/G12	2.0	1.4	1.0	–	2	–	–	1.6	1.4	1.0	–	1	–	1	ANP
KM/22377/G1	1.9	1.1	0.8	–	–	–	–	1.8	1.1	1.1	–	2	–	–	NNP
KM/22377/G2	1.5	0.9	0.8	1	–	–	–	1.3	0.8	0.7	–	–	–	–	NNP
KM/22377/G3	1.6	1.0	0.8	3	–	–	–	1.6	0.9	0.6	–	–	–	–	NNP
KM/22377/G4	2.0	1.3	0.8	–	–	–	–	1.8	1.3	0.8	–	–	–	–	NNP
KM/22377/G5	1.7	0.8	0.7	–	–	1	–	1.6	1.0	0.7	1	–	–	–	NNP
KM/22377/G6	2.0	1.1	0.7	–	–	–	–	1.6	1.3	0.9	1	1	–	–	NNP
KM/22377/G7	1.4	0.8	0.7	1	–	–	–	1.2	1.0	0.6	2	–	–	–	INP
KM/22377/G8	1.4	1.1	0.8	–	–	–	–	1.4	1.2	0.8	2	–	–	–	NNP
KM/22377/G9	1.3	0.8	0.8	–	–	1	–	1.3	0.9	0.7	1	–	–	–	NNP
KM/22377/G10	1.6	1.0	0.7	–	–	–	–	1.6	1.1	0.9	1	1	–	1	NNP
KM/22377/G11	1.3	0.9	0.7	1	–	–	–	1.1	0.9	0.6	–	–	–	–	ANP
KM/22377/G12	1.4	1.0	0.8	2	–	–	–	1.3	0.9	0.7	1	–	–	–	ANP
KM/22377/G13	1.7	1.3	0.8	2	–	–	–	1.5	1.0	0.7	–	–	–	–	ANP
KM/22377/G14	1.6	1.1	0.9	–	–	–	1	1.4	1.2	0.9	1	–	–	–	ANP
KM/22377/G15	1.8	1.3	0.9	–	–	–	–	ANDROGENS							ANP
KM/22377/G16	1.6	1.5	1.0	–	–	–	1	1.7	1.1	0.8	–	1	–	–	PREG

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/1977/G1	1.5	0.9	0.7	–	–	–	–	1.5	0.9	0.7	–	–	–	1	NNP
KN/1977/G2	1.4	0.8	0.5	–	–	–	–	1.7	1.0	0.8	–	–	–	1	NNP
KN/1977/G3	1.5	0.7	0.7	–	–	–	–	1.8	1.1	0.7	–	1	–	–	NNP
KN/1977/G4	1.6	1.0	0.7	–	–	–	–	1.7	1.0	0.7	–	–	–	–	NNP
KN/1977/G5	1.2	0.8	0.6	–	–	–	–	1.1	0.8	0.6	–	–	–	–	NNP
KN/1977/G6	1.2	0.8	0.7	–	–	–	–	1.2	0.9	0.7	–	–	–	–	NNP
KN/1977/G7	1.5	1.0	0.7	–	–	–	–	1.3	0.8	0.6	1	–	–	–	NNP
KN/1977/G8	1.4	0.9	0.6	–	–	–	–	1.3	0.9	0.6	–	–	–	–	NNP
KN/1977/G9	1.5	1.0	0.8	1	–	–	–	1.6	1.1	0.7	–	1	–	–	NNP
KN/1977/G10	1.2	1.0	0.6	–	–	–	–	1.2	0.9	0.8	–	1	–	–	NNP
KN/1977/G11	1.8	1.2	0.9	–	–	–	–	1.6	1.5	0.9	–	–	–	–	NNP
KN/1977/G12	1.3	0.9	1.0	–	1	–	–	0.9	0.7	0.4	–	–	–	–	NNP
KN/1977/G13	1.9	1.2	0.8	1	–	–	–	1.6	1.1	0.7	–	–	–	–	NNP
KN/1977/G14	1.6	1.1	0.7	–	–	–	–	1.5	1.2	0.8	2	–	–	–	NNP
KN/1977/G15	1.4	1.0	0.9	–	–	–	–	1.5	1.1	0.8	–	–	–	–	NNP
KN/1977/G16	2.2	1.6	0.9	–	–	–	–	1.6	1.7	0.9	–	–	–	–	NNP
KN/1977/G1	1.6	1.1	0.7	1	–	–	–	1.6	1.3	0.7	1	–	–	–	NNP
KN/1977/G2	1.6	1.0	0.8	–	1	–	–	1.4	1.3	0.9	1	–	–	–	NNP
KN/1977/G3	1.7	1.2	0.8	2	–	–	–	1.5	1.0	0.7	–	–	–	–	NNP
KN/1977/G4	1.8	1.0	1.0	2	–	–	–	1.8	1.4	0.9	1	1	–	–	NNP
KN/1977/G5	1.6	1.0	0.7	–	–	–	1	1.3	0.9	0.6	–	–	–	–	NNP
KN/1977/G6	1.7	0.8	0.7	–	–	–	–	1.8	1.0	1.0	1	–	–	–	NNP
KN/1977/G7	1.4	1.0	0.8	–	–	–	–	1.5	1.2	0.8	–	–	–	–	NNP

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/17577/G8	1.3	1.0	0.6	-	-	-	-	1.4	0.9	0.7	1	-	-	-	NNP
KN/17577/G9	1.4	1.0	0.8	-	-	-	-	1.4	1.0	0.7	1	-	-	-	NNP
KN/17577/G10	1.5	1.0	0.6	-	-	-	-	1.2	0.9	0.7	-	-	-	-	NNP
KN/17577/G11	1.5	1.1	0.9	1	-	-	-	1.8	1.6	1.3	-	-	-	1	NNP
KN/17577/G12	1.5	1.4	1.0	2	1	-	1	1.5	1.2	0.8	-	-	-	-	NNP
KN/17577/G13	1.7	1.0	0.8	-	-	-	-	1.7	1.1	0.9	1	-	-	-	NNP
KN/17577/G14	1.5	1.2	0.8	-	-	-	-	1.4	1.0	0.9	1	-	-	-	NNP
KN/17577/G15	1.8	1.4	1.4	-	-	-	-	1.1	1.4	1.0	-	-	-	1	NNP
KN/17577/G16	1.8	1.1	0.8	-	-	1	-	1.6	1.1	1.0	-	-	-	-	NNP
KN/17577/G17	1.5	1.0	0.8	-	-	-	-	1.4	0.9	0.7	-	-	-	-	NNP
KN/21677/G1	1.7	1.3	0.9	-	1	-	-	1.4	1.2	0.7	-	-	-	-	ANP
KN/21677/G2	1.9	1.2	0.8	-	-	-	-	1.6	1.2	0.9	-	-	-	-	ANP
KN/21677/G3	1.5	1.2	0.7	1	1	-	-	1.4	1.3	1.0	-	-	-	1	PREG
KN/21677/G4	1.8	1.1	0.8	1	-	-	-	1.5	1.4	0.9	1	1	-	-	NNP
KN/21677/G5	1.9	1.1	0.8	1	1	-	-	1.5	1.0	0.7	-	-	-	-	NNP
KN/21677/G6	1.8	1.3	0.9	2	1	-	-	1.6	1.4	0.9	-	1	-	-	NNP
KN/21677/G7	1.8	1.2	0.9	-	-	-	1	1.4	1.1	0.8	-	1	-	-	NNP
KN/21677/G8	1.5	1.6	1.3	-	2	-	1	1.5	1.8	1.4	-	-	-	1	NNP
KN/21677/G9	1.8	1.3	0.8	-	-	-	-	1.7	1.4	0.9	-	-	-	-	NNP
KN/21677/G10	1.8	1.1	1.0	2	-	-	-	1.6	1.2	0.9	-	1	-	-	NNP
KN/21677/G11	2.0	1.5	1.1	1	-	1	-	2.0	1.3	1.1	-	-	1	-	NNP
KN/21677/G12	2.1	1.6	0.9	-	-	-	-	2.2	1.5	0.8	-	-	-	-	NNP
KN/21677/G13	1.7	1.1	0.9	1	-	-	-	1.6	1.2	0.8	1	-	-	-	NNP

Table 1: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/21677/G14	1.4	1.0	0.7	-	-	-	-	1.5	1.2	0.8	1	-	-	-	NNP
KN/21677/G15	1.9	1.5	0.9	-	-	-	-	1.8	1.2	0.9	-	-	-	-	NNP
KN/21677/G16	1.8	1.4	1.0	-	-	-	-	1.6	1.3	1.0	1	-	-	-	NNP
KN/21677/G17	1.8	1.3	0.9	-	-	-	-	1.7	1.4	1.1	3	-	-	-	NNP
KN/21677/G18	1.8	1.8	0.8	-	-	-	1	1.8	1.3	0.9	1	-	-	1	NNP
KN/21677/G19	1.5	0.9	0.8	-	-	-	-	1.5	1.0	0.6	-	-	-	-	NNP
KN/21677/G20	1.8	1.4	1.0	-	-	-	1	1.4	1.2	1.0	-	1	-	-	NNP
KN/21677/G21	1.7	1.1	0.8	-	-	-	-	1.9	1.4	0.9	-	-	-	-	NNP
KN/21677/G22	1.4	1.0	0.7	-	-	-	-	1.3	0.9	0.7	-	-	-	-	NNP
KN/21677/G23	1.8	1.1	0.7	-	1	-	-	1.5	1.0	0.8	-	-	-	1	NNP
KN/21677/G24	1.7	1.4	1.0	-	1	-	1	1.4	0.8	0.7	-	-	-	1	NNP
KN/21677/G25	1.5	1.3	0.9	-	-	-	-	1.6	1.4	0.7	-	-	-	-	NNP
KN/21677/G26	1.4	1.0	0.5	-	-	-	-	1.3	0.9	0.7	1	1	-	-	NNP

Table 2: Ovarian dimensions, ovarian functional bodies and gross status of caprine reproductive tracts collected from Kaduna.

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/13776/G1	1.7	1.1	0.9	-	-	-	1	1.8	1.3	0.8	-	-	-	1	NNP
KD/13776/G2	1.6	1.2	0.8	-	-	-	-	1.6	1.2	0.7	-	-	-	-	NNP
KD/13776/G3	1.8	1.1	0.9	2	-	-	-	1.6	1.2	0.7	-	-	-	-	NNP
KD/13776/G4	1.4	0.9	0.7	2	1	-	-	1.6	1.0	0.6	-	-	-	-	ANP
KD/13776/G5	1.4	0.9	0.6	-	-	-	-	1.2	0.8	0.6	-	-	-	-	NNP
KD/13776/G6	1.6	1.1	0.8	-	-	-	-	1.5	1.2	0.8	1	3	-	-	NNP
KD/13776/G7	1.5	1.2	0.8	2	1	-	-	1.2	1.4	0.8	2	1	-	-	NNP
KD/13776/G8	1.5	1.1	0.8	-	1	-	-	1.3	1.0	0.6	1	-	-	-	NNP
KD/13776/G9	1.6	1.8	0.7	1	-	-	-	1.9	1.2	0.8	-	1	-	-	NNP
KD/13776/G10	1.5	1.0	0.7	-	-	-	-	1.4	1.0	0.7	-	-	2	-	NNP
KD/13776/G11	2.1	1.1	0.8	-	-	-	1	1.9	1.3	0.8	2	-	-	1	PREG
KD/13776/G12	1.4	1.4	0.8	-	-	-	1	1.4	0.8	0.4	-	1	-	-	PREG
KD/13776/G13	1.5	1.2	0.6	1	-	-	-	1.9	1.3	1.0	2	1	-	1	PREG
KD/13776/G14	2.0	1.2	0.7	1	-	-	1	1.8	1.3	0.8	2	-	-	1	PREG
KD/13776/G15	1.7	1.0	0.5	-	-	-	-	2.1	1.4	0.9	-	-	-	1	PREG
KD/13776/G16	2.0	1.1	0.9	2	-	-	1	1.6	1.0	0.8	-	1	-	-	PREG
KD/13776/G17	1.6	1.3	0.6	-	-	-	-	1.9	1.5	1.0	-	-	-	1	PREG
KD/13776/G18	1.9	1.2	0.8	2	-	-	-	2.2	1.4	1.3	-	-	-	1	NNP

Table 2: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/10876/G1	1.4	0.9	0.8	-	-	-	-	1.4	1.1	1.2	-	-	-	-	NNP
KD/10876/G2	1.5	1.2	0.9	3	-	-	-	1.3	1.4	0.9	1	3	-	-	NNP
KD/10876/G3	2.0	1.2	1.0	3	-	-	-	1.9	1.3	0.8	-	-	-	-	NNP
KD/10876/G4	2.0	1.4	1.0	-	-	-	-	1.7	1.3	0.9	-	-	-	-	NNP
KD/10876/G5	1.5	1.2	0.9	-	1	-	1	1.8	1.3	1.3	-	-	-	-	NNP
KD/10876/G6	1.6	1.2	0.7	1	-	-	-	1.6	1.1	0.8	2	-	-	-	NNP
KD/10876/G7	1.8	1.4	1.0	1	1	-	-	1.5	1.2	0.8	1	-	-	-	NNP
KD/10876/G8	1.8	1.2	0.9	2	-	-	1	1.7	1.3	1.1	5	1	-	1	NNP
KD/10876/G9	1.8	1.5	1.1	2	2	-	-	1.8	1.3	1.2	-	2	-	-	NNP
KD/10876/G10	1.7	1.3	1.1	3	2	-	2	1.7	1.2	1.0	2	-	-	-	NNP
KD/10876/G11	C	U	T	O	F	F		2.5	1.7	1.3	-	-	-	2	PREG
KD/10876/G12	2.0	1.3	1.0	-	-	-	1	1.6	1.2	0.6	1	-	-	-	PREG
KD/10876/G13	2.0	1.5	0.9	2	-	-	1	1.8	1.8	0.6	-	-	-	-	PREG
KD/10876/G14	1.2	0.7	0.6	-	-	-	-	1.5	1.0	0.8	1	2	1	-	NNP
KD/10876/G15	1.6	1.3	0.5	-	-	1	-	1.7	1.3	1.0	-	-	-	1	PREG
KD/10876/G16	1.8	1.2	0.8	-	-	-	-	2.0	1.5	1.1	-	-	-	1	PREG
KD/14976/G1	2.0	1.2	0.8	-	-	-	-	2.0	1.5	1.1	-	-	-	1	PREG
KD/14976/G2	2.3	1.5	0.9	-	1	-	1	1.8	1.3	0.8	-	-	-	-	PREG
KD/14976/G3	1.8	1.8	0.9	1	-	-	1	1.5	1.5	0.8	-	-	-	1	PREG
KD/14976/G4	1.9	1.3	0.6	1	-	-	-	2.0	1.7	1.1	1	-	-	1	PREG
KD/14976/G5	1.7	1.1	0.7	1	-	-	-	1.7	1.5	1.1	-	-	-	1	PREG

Table 2: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/14976/G6	1.5	1.0	0.8	1	-	-	-	1.4	0.9	0.6	-	-	-	-	NNP
KD/14976/G7	1.5	1.2	0.8	1	-	-	-	1.5	1.1	0.8	1	1	-	-	NNP
KD/14976/G8	2.0	1.5	1.0	2	-	-	-	2.0	1.3	1.0	1	3	-	-	NNP
KD/14976/G9	1.5	1.1	0.9	3	-	-	1	1.5	1.0	0.9	3	-	-	-	NNP
KD/14976/G10	1.6	1.1	0.6	-	-	-	-	1.8	1.2	0.8	-	1	-	-	NNP
KD/14976/G11	1.9	1.3	0.9	1	-	-	-	2.2	1.6	0.9	2	-	-	-	NNP
KD/14976/G12	1.8	1.2	0.8	1	-	-	-	1.8	1.6	0.7	-	1	-	2	NNP
KD/14976/G13	1.7	1.2	0.7	-	-	-	-	1.8	1.5	0.9	-	1	-	-	NNP
KD/14976/G14	1.5	1.1	0.7	1	-	1	-	1.5	1.0	0.7	2	-	-	-	NNP
KD/14976/G15	1.9	1.8	0.9	1	-	-	-	1.9	1.5	0.8	-	-	-	-	NNP
KD/14976/G16	1.8	1.1	0.7	1	-	-	-	1.5	1.1	0.6	-	-	-	-	NNP
KD/14976/G17	1.1	0.9	0.6	-	-	-	1	1.1	0.8	0.5	1	-	-	-	NNP
KD/14976/G18	2.0	1.3	0.8	1	-	-	-	2.1	1.6	1.0	2	-	-	-	NNP
KD/14976/G19	2.0	1.1	0.7	-	-	-	1	1.8	1.1	0.6	-	-	-	-	NNP
KD/14976/G20	2.0	1.2	0.7	1	-	1	-	1.8	1.2	0.8	3	1	-	-	NNP
KD/91176/G1	1.7	1.5	0.9	-	1	-	-	1.7	1.4	0.9	-	-	-	1	NNP
KD/91176/G2	1.6	0.9	0.6	-	-	-	-	1.5	0.9	0.6	-	-	-	-	NNP
KD/91176/G3	1.9	1.5	1.1	1	1	-	-	1.8	1.6	1.2	-	-	1	-	ANP
KD/91176/G4	1.6	1.4	0.9	1	-	-	2	1.2	0.9	0.5	-	-	-	-	PREG
KD/91176/G5	1.6	1.4	1.3	3	1	-	1	1.6	1.7	1.0	-	2	-	1	NNP
KD/91176/G6	1.5	1.1	0.6	-	-	-	-	1.6	1.3	0.9	2	-	1	-	NNP

Table 2: Continued

Code No.	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	Gross Status
KD/91176/G7	1.8	1.3	1.0	-	1	-	-	1.6	1.2	0.7	2	-	-	-	NNP
KD/91176/G8	1.5	1.1	0.8	2	-	-	1	1.6	1.2	0.9	-	1	-	-	NNP
KD/91176/G9	2.1	1.4	1.0	-	-	-	-	2.0	1.8	1.1	2	-	-	2	PREG
KD/91176/G10	1.6	1.1	0.6	1	-	-	-	1.8	1.2	0.8	-	1	-	-	NNP
KD/141276/G1	1.8	1.5	1.0	2	-	-	-	2.1	1.4	1.3	2	1	-	1	ANP
KD/141276/G2	2.2	1.6	1.0	-	-	-	-	2.2	1.6	1.3	3	2	1	-	ANP
KD/141276/G3	2.0	1.6	1.0	-	1	1	-	1.9	1.4	1.1	-	-	-	1	ANP
KD/141276/G4	2.2	1.7	1.1	-	-	-	2	1.8	1.1	1.0	2	-	-	-	PREG
KD/141276/G5	2.0	1.6	0.8	2	1	-	-	2.0	1.3	1.2	-	-	-	1	PREG
KD/141276/G6	1.9	1.4	0.9	3	-	-	1	1.9	1.3	1.2	-	-	-	1	PREG
KD/141276/G7	1.8	1.4	1.1	2	-	-	-	2.1	1.5	1.2	1	-	-	2	PREG
KD/141276/G8	1.9	1.3	1.0	-	-	-	1	1.9	1.3	1.2	1	1	-	-	PREG
KD/141276/G9	1.8	1.2	0.9	1	-	-	-	2.3	1.6	1.4	2	-	-	2	PREG
KD/141276/G10	2.0	1.6	1.1	1	-	-	1	1.9	1.4	1.2	1	-	-	1	PREG
KD/141276/G11	1.9	1.6	1.0	1	-	-	1	1.9	1.5	1.2	1	-	-	1	PREG
KD/141276/G12	2.2	1.7	1.2	-	-	-	2	2.2	1.4	1.1	1	1	-	-	PREG
KD/141276/G13	2.1	1.4	0.9	2	-	-	1	1.9	1.4	1.0	2	-	-	1	NNP
KD/141276/G14	2.4	1.7	1.2	1	3	1	-	1.9	1.3	1.2	1	-	1	-	NNP
KD/141276/G15	1.8	1.2	0.8	1	-	-	1	2.0	1.5	1.4	2	-	-	2	NNP

Table 2: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/11177/G1	1.6	1.8	1.4	1	-	-	1	1.7	1.5	1.5	-	3	-	-	PREG
KD/11177/G2	1.8	1.3	1.0	6	-	-	-	1.8	1.5	1.1	-	-	-	1	PREG
KD/11177/G3	1.5	1.2	1.0	2	1	-	-	1.6	1.4	1.0	-	-	-	1	PREG
KD/11177/G4	1.9	1.4	0.9	-	-	-	1	1.6	1.4	0.8	2	-	-	-	PREG
KD/11177/G5	1.6	1.1	0.9	1	-	-	-	1.9	1.5	1.0	-	-	-	1	PREG
KD/11177/G6	1.7	1.1	0.8	2	-	1	-	1.8	1.1	0.7	-	-	1	1	NNP
KD/11177/G7	1.9	1.6	1.0	-	-	-	2	2.2	1.6	1.1	-	-	-	1	NNP
KD/11177/G8	1.5	1.7	1.0	-	2	-	1	1.7	1.4	0.9	-	-	-	1	NNP
KD/11177/G9	1.5	1.1	0.6	-	-	-	-	1.5	1.2	1.0	1	-	-	1	NNP
KD/11177/G10	1.5	1.0	0.8	1	-	-	-	1.8	1.3	0.9	1	-	-	1	NNP
KD/8277/G1	1.7	1.0	0.8	1	1	-	-	C	U	T	O	F	F		NNP
KD/8277/G2	2.3	1.4	1.1	-	-	-	1	1.9	1.8	1.2	2	-	-	1	ANP
KD/8277/G3	1.4	1.2	0.8	-	-	-	-	1.6	1.4	1.1	-	1	-	-	NNP
KD/8277/G4	1.5	1.0	0.7	1	-	-	-	1.4	1.0	0.5	-	-	-	-	NNP
KD/8277/G5	1.7	1.5	0.9	1	-	-	-	2.0	1.9	1.2	-	-	-	1	PREG
KD/8277/G6	1.7	1.5	1.1	1	-	-	-	1.9	1.4	0.9	-	1	-	-	NNP
KD/15377/G1	2.1	1.5	1.0	1	1	-	1	2.3	1.5	1.2	7	3	-	1	NNP
KD/15377/G2	2.5	2.1	1.6	7	2	-	1	1.7	1.4	0.8	1	1	-	-	ANP
KD/15377/G3	1.7	1.3	1.0	2	2	-	-	1.7	1.9	1.3	2	1	-	1	NNP
KD/15377/G4	1.6	1.0	0.7	-	-	-	-	1.3	0.8	0.7	-	1	-	-	NNP
KD/15377/G5	1.4	1.0	0.7	-	-	-	-	1.6	1.2	0.8	-	-	-	-	NNP
KD/15377/G6	2.0	1.3	1.1	1	-	-	-	2.1	1.4	1.0	1	-	-	-	NNP

Table 2: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/15377/G7	1.9	1.1	0.8	-	-	-	-	1.8	1.0	0.6	-	-	-	-	NNP
KD/15377/G8	1.7	1.2	1.1	-	-	-	-	1.9	1.5	1.2	-	3	-	-	NNP
KD/15377/G9	1.9	1.5	0.9	1	1	-	2	1.8	1.3	1.0	1	5	-	-	PREG
KD/15377/G10	1.9	1.4	0.9	-	-	-	1	1.2	0.9	0.6	-	-	-	-	PREG
KD/15377/G11	2.5	1.7	1.1	-	-	-	1	2.4	1.7	1.1	1	1	-	2	PREG
KD/15377/G12	2.0	1.3	0.9	1	-	-	1	2.2	1.3	0.9	2	-	-	1	PREG
KD/15377/G13	1.7	1.4	0.9	-	-	-	-	2.5	1.7	1.2	1	-	-	2	PREG
KD/12477/G1	1.5	1.3	0.8	5	1	-	-	1.6	1.2	0.7	1	-	-	1	NNP
KD/12477/G2	2.1	1.6	1.2	-	-	-	1	2.3	1.8	1.0	2	1	-	1	PREG
KD/12477/G3	1.3	1.0	1.2	1	-	-	-	1.4	1.0	1.0	2	1	-	-	NNP
KD/12477/G4	1.6	1.3	0.9	-	1	-	-	1.7	1.3	0.8	-	-	-	-	NNP
KD/12477/G5	2.1	1.1	0.8	1	-	-	-	2.0	1.2	0.7	2	-	-	-	NNP
KD/12477/G6	1.9	1.1	0.9	-	-	-	-	2.0	1.3	1.0	1	-	-	-	NNP
KD/12477/G7	1.8	1.1	0.9	-	-	-	-	1.6	1.1	0.8	1	-	-	-	NNP
KD/12477/G8	0.9	0.8	0.5	-	-	-	-	0.9	0.8	0.6	1	-	-	-	NNP
KD/10577/G1	1.7	1.5	0.9	-	-	-	-	2.1	1.5	1.0	1	1	-	1	ANP
KD/10577/G2	1.9	2.0	0.9	-	1	2	-	1.9	1.8	1.2	2	1	-	2	ANP
KD/10577/G3	1.8	1.1	0.8	-	-	-	-	1.8	1.2	0.9	1	-	-	-	NNP
KD/10577/G4	1.8	1.4	0.9	-	-	2	-	1.7	1.3	1.0	1	-	1	-	NNP
KD/10577/G5	1.7	1.0	0.7	-	-	-	-	1.5	1.1	0.7	-	-	-	-	NNP
KD/10577/G6	1.8	1.0	0.8	-	-	-	-	2.0	1.5	1.1	1	1	-	2	NNP
KD/10577/G7	1.6	1.0	0.8	-	-	-	-	1.4	1.1	0.8	1	-	-	-	NNP

Table 2: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/10577/G8	1.7	1.2	0.8	-	-	-	-	1.9	1.3	1.0	-	-	-	-	NNP
KD/10577/G9	1.9	1.5	1.0	1	-	-	-	1.9	1.2	1.0	-	-	-	-	NNP
KD/10577/G10	1.8	1.4	1.1	-	1	1	-	1.8	1.4	1.1	-	-	-	1	NNP
KD/14677/G1	1.9	1.5	1.1	7	-	-	1	1.8	1.7	1.1	2	-	-	1	PREG
KD/14677/G2	2.0	1.4	0.9	-	1	-	-	1.9	2.1	1.3	-	-	-	1	PREG
KD/14677/G3	1.8	1.0	0.8	-	-	-	1	1.8	1.0	0.7	2	-	-	-	PREG
KD/14677/G4	1.5	1.2	0.8	-	-	-	-	2.0	1.5	1.1	-	-	-	1	PREG
KD/14677/G5	1.9	1.2	1.0	-	-	-	1	1.6	1.3	0.9	-	-	-	-	PREG
KD/14677/G6	1.9	0.9	0.7	-	-	-	-	1.7	1.4	1.1	-	-	-	1	PREG
KD/14677/G7	1.9	1.3	0.8	2	-	-	-	1.6	1.3	0.7	-	-	-	-	NNP
KD/14677/G8	1.9	1.6	1.3	-	2	-	-	1.9	1.5	1.0	1	-	-	1	NNP
KD/14677/G9	1.8	1.1	0.8	-	-	-	-	1.3	0.8	0.7	-	-	-	-	NNP
KD/14677/G10	1.6	1.2	0.8	-	-	-	-	1.5	1.2	0.9	1	-	-	-	NNP
KD/14677/G11	1.9	1.1	0.9	-	-	1	-	2.0	1.3	0.8	-	-	1	-	NNP
KD/14677/G12	1.9	1.1	0.9	1	-	-	-	1.7	1.4	0.8	1	-	-	-	NNP
KD/14677/G13	1.6	1.1	0.8	1	1	1	-	1.5	1.0	0.6	-	-	1	-	NNP
KD/14677/G14	1.8	1.4	0.9	1	-	-	-	1.8	1.7	1.0	-	-	-	1	NNP

Table 3: Ovarian dimensions, ovarian functional bodies and gross status of caprine reproductive tracts collected from Zaria.

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
ZA/6776/G1	2.0	2.0	1.1	1	-	-	1	1.6	1.1	0.9	-	-	-	-	NNP
ZA/6776/G2	1.3	0.8	0.5	-	-	-	-	1.3	1.0	0.7	1	-	-	-	ANP
ZA/6776/G3	1.4	1.1	0.8	-	-	-	-	1.5	1.4	0.8	3	1	-	-	NNP
ZA/6776/G4	1.4	1.0	0.8	-	-	-	-	1.4	1.0	0.8	4	-	-	-	NNP
ZA/6776/G5	2.0	1.7	0.9	-	-	-	1	1.6	1.0	1.0	-	-	-	-	NNP
ZA/6776/G6	2.4	1.3	0.9	-	-	-	1	1.8	1.0	0.8	-	-	-	-	NNP
ZA/3876/G1	1.6	1.0	0.9	4	-	-	-	1.7	1.6	1.3	4	2	-	2	NNP
ZA/3876/G2	1.7	1.1	0.7	1	-	-	-	1.8	1.1	0.8	1	-	-	1	NNP
ZA/3876/G3	2.5	1.5	1.1	-	-	-	1	1.9	1.4	0.9	2	1	-	-	NNP
ZA/3876/G4	1.8	1.9	1.0	-	1	-	-	2.0	1.3	0.8	1	-	1	-	PREG
ZA/3876/G5		C	U	T	O	F	F	1.8	1.6	1.1	3	-	-	1	PREG
ZA/3876/G6	2.5	1.9	1.4	-	-	-	1	2.0	1.2	0.9	-	-	-	-	PREG
ZA/7976/G1	1.3	1.4	0.8	-	1	-	-	1.9	1.7	1.3	-	1	-	1	PREG
ZA/7976/G2	2.1	1.4	1.2	2	-	-	1	2.0	1.6	1.0	2	-	-	1	PREG
ZA/7976/G3	2.0	1.4	1.0	-	-	-	1	1.6	0.9	0.6	1	-	-	-	PREG
ZA/7976/G4	1.4	1.2	0.8	2	1	-	-	1.7	1.5	1.0	-	-	-	1	PREG
ZA/7976/G5	1.6	1.2	0.9	1	-	-	1	1.6	0.9	0.6	2	3	1	-	PREG
ZA/7976/G6	1.5	1.1	1.0	6	-	-	-	1.6	1.2	0.9	2	-	-	-	NNP
ZA/7976/G7	1.5	1.1	0.8	-	-	-	-	1.5	1.1	0.8	6	-	-	-	NNP
ZA/7976/G8	1.2	1.1	1.0	1	1	-	-	2.1	1.6	1.3	-	-	-	2	NNP

Table 3: Continued

Code No.	Left Ovary L	H	W	F_2	F_3	CH	CL	Right Ovary L	H	W	F_2	F_3	CH	CL	Gross Status
ZA/7976/G9	1.5	1.0	0.7	3	1	-	-	1.4	1.1	0.7	1	1	1	-	NNP
ZA/7976/G10	1.5	1.0	0.9	1	-	-	-	1.8	1.2	0.9	2	2	-	-	NNP
ZA/7976/G11	1.7	1.2	0.8	10	1	-	-	1.6	1.2	0.9	2	1	-	-	NNP
ZA/7976/G12	1.3	1.1	0.7	-	-	-	-	1.5	1.2	0.7	1	1	-	-	NNP
ZA/7976/G13		C U T O F F						1.9	1.4	1.0	1	1	-	-	NNP
ZA/51076/G1		D A M A G E D							D A M A G E D						-
ZA/51076/G2	1.8	1.2	0.8	-	-	-	-	1.6	1.2	0.7	1	-	-	-	NNP
ZA/51076/G3	1.8	1.2	0.8	-	-	-	-	1.6	1.2	0.7	1	-	-	-	NNP
ZA/51076/G4	1.6	1.0	0.6	4	-	-	-	1.9	1.4	1.3	4	1	-	1	PREG
ZA/51076/G5	1.7	1.4	1.1	1	1	-	1	1.5	1.4	0.8	1	-	-	-	PREG
ZA/51076/G6	1.9	1.6	1.0	2	-	-	1	1.8	1.1	1.8	3	-	-	1	PREG
ZA/51076/G7	1.7	1.6	1.2	-	-	-	1	2.0	1.3	0.5	-	-	-	-	PREG
ZA/21176/G1		C U T O F F							C U T O F F						PREG
ZA/21176/G2	2.0	1.4	1.0	1	1	-	1	1.6	1.2	0.7	-	-	-	-	PREG
ZA/21176/G3	1.4	0.9	0.6	1	-	-	-	1.6	1.4	1.0	2	2	-	1	NNP
ZA/21176/G4	1.2	1.0	0.8	2	-	-	-	1.3	1.1	0.7	2	-	-	-	NNP
ZA/21176/G5	1.5	1.3	0.8	-	-	-	-	1.6	1.4	0.8	1	-	-	-	NNP
ZA/21176/G6		C U T O F F						1.5	1.2	0.8	1	1	-	-	NNP
ZA/21176/G7	1.0	0.9	0.7	-	-	-	-	1.0	1.0	0.7	-	-	-	-	NNP
ZA/21176/G8	1.3	0.9	0.7	1	-	-	-	1.2	0.8	0.6	-	-	-	-	NNP

Table 3: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
ZA/71276/G1	1.4	1.0	0.8	-	1	-	-	1.3	0.9	0.5	-	-	-	-	NNP
ZA/71276/G2	1.4	0.9	0.8	-	2	-	-	1.0	0.7	0.5	-	-	-	-	ANP
ZA/71276/G3	1.7	1.0	0.9	1	-	1	-	1.8	1.1	1.0	3	-	1	1	NNP
ZA/71276/G4	1.6	1.1	0.7	-	-	-	-	1.8	1.2	0.9	-	-	-	-	NNP
ZA/71276/G5	1.8	1.3	1.0	4	-	1	-	2.0	1.5	1.0	2	-	1	1	NNP
ZA/71276/G6	2.0	0.9	0.9	-	-	-	1	1.4	1.2	0.8	1	2	-	1	NNP
ZA/71276/G7	1.4	1.4	0.9	2	-	-	-	1.5	1.7	1.2	1	-	-	1	PREG
ZA/4177/G1	1.6	1.3	0.7	2	-	-	2	2.0	1.5	1.3	1	1	-	1	NNP
ZA/4177/G2	1.7	1.2	1.1	-	-	-	1	1.4	1.1	0.8	-	1	-	-	PREG
ZA/4177/G3	1.7	1.2	1.0	-	-	-	-	1.7	1.5	1.0	-	2	-	1	NNP
ZA/4177/G4	1.7	1.3	0.9	10	4	-	-	1.7	1.5	1.0	-	-	-	1	PREG
ZA/4177/G5	1.2	1.0	0.6	1	-	-	-	1.3	1.0	0.8	2	1	-	-	ANP
ZA/4177/G6	1.8	1.2	1.0	-	-	-	1	1.7	1.1	0.9	1	-	-	1	NNP
ZA/4177/G7	1.9	1.2	0.9	3	-	-	-	1.6	1.2	0.8	-	-	-	-	NNP
ZA/4177/G8	1.8	1.3	0.9	-	-	-	-	1.3	1.0	0.7	-	-	-	-	NNP
ZA/4177/G9	1.2	1.0	0.7	-	-	-	1	1.7	1.6	1.0	1	1	-	1	NNP
ZA/1277/G1	1.6	1.1	0.9	-	-	-	1	1.3	1.0	0.8	2	1	-	-	PREG
ZA/1277/G2	1.5	1.3	1.0	-	-	-	1	1.7	1.4	1.1	1	2	-	1	PREG
ZA/1277/G3	1.6	1.7	1.0	-	-	-	1	1.4	1.2	0.8	2	1	-	-	PREG
ZA/1277/G4	1.5	1.1	0.8	-	-	-	-	2.0	1.5	1.2	-	-	-	1	PREG
ZA/1277/G5	1.7	1.2	0.8	-	-	-	-	C	U	T	O	F	F		NNP
ZA/1277/G6	2.0	1.3	1.2	2	-	1	1	1.6	1.1	0.9	1	1	-	-	NNP

Table 3: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
ZA/8377/G1		C	U	T	O	F	F		C	U	T	O	F	F	NNP
ZA/8377/G2	1.6	0.9	0.7	-	-	-	-	1.7	1.2	0.7	2	-	-	-	NNP
ZA/8377/G3	1.8	2.0	1.3	5	-	-	2	1.6	1.2	1.0	4	3	-	2	NNP
ZA/8377/G4	1.8	1.5	0.9	3	-	-	-	2.0	1.2	0.9	3	-	-	-	NNP
ZA/8377/G5	1.8	1.8	1.3	1	1	-	1		C	U	T	O	F	F	PREG
ZA/5477/G1	1.4	1.0	0.7	-	-	-	-	1.4	1.0	0.8	-	2	-	-	NNP
ZA/5477/G2	1.5	1.0	0.8	-	-	-	-	1.4	1.2	0.8	2	1	-	-	NNP
ZA/5477/G3	1.8	1.2	1.2	3	1	2	-	1.6	1.1	0.8	-	1	-	-	NNP
ZA/5477/G4	1.4	0.9	0.8	1	2	-	-	1.2	1.0	0.8	1	1	-	-	NNP
ZA/5477/G5		C	U	T	O	F	F	1.6	1.1	1.0	-	1	-	1	PREG
ZA/5477/G6	2.0	1.3	1.0	3	2	-	-	2.2	1.6	1.2	-	-	-	2	PREG
ZA/5477/G7	1.9	1.4	0.9	-	-	-	1	1.6	1.1	0.7	1	-	-	-	PREG
ZA/3577/G1	1.6	1.1	0.7	-	-	-	-	1.5	1.2	0.7	-	-	-	-	NNP
ZA/3577/G2	1.5	2.0	1.1	-	1	-	-	1.5	1.8	1.1	1	-	-	-	NNP
ZA/3577/G3	1.5	1.4	1.2	1	1	-	-	1.4	1.4	0.9	-	-	-	-	NNP
ZA/3577/G4	1.9	1.3	0.9	-	-	-	-	1.9	1.5	0.5	-	-	-	-	NNP
ZA/3577/G5	1.6	1.1	0.9	2	-	-	-	1.9	1.2	1.0	1	-	-	1	PREG

Table 3: Continued

Code No.	Left Ovary L	H	W	F_2	F_3	CH	CL	Right Ovary L	H	W	F_2	F_3	CH	CL	Gross Status
ZA/7677/G1	1.9	1.3	1.0	-	-	-	1	2.0	1.4	1.1	1	1	-	1	PREG
ZA/7677/G2	2.2	1.4	1.3	1	1	-	2	1.6	1.1	0.8	-	-	-	-	NNP
ZA/7677/G3	1.5	1.0	1.0	1	-	-	-	1.7	1.0	0.8	-	-	-	-	NNP
ZA/7677/G4	1.5	0.9	0.7	2	-	-	-	1.5	0.9	0.7	-	-	-	-	NNP
ZA/7677/G5	1.7	1.3	1.1	-	-	-	1	1.6	1.0	0.8	-	-	-	-	NNP
ZA/7677/G6	1.2	0.9	0.6	-	-	-	-	1.4	0.9	1.0	-	1	-	1	ANP

Table 4: Ovarian dimensions, ovarian functional bodies and gross status of ovine reproductive tracts collected from Kano.

	Left Ovary							Right Ovary							
Code No.	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	Gross Status
KN/20776/S1	1.0	0.8	0.5	3	-	1	-	1.2	0.9	0.8	2	-	-	-	ANP
KN/20776/S2	1.2	1.0	0.8	-	2	-	-	0.9	0.8	0.6	2	-	-	-	NNP
KN/20776/S3	1.2	1.0	0.8	3	1	-	-	1.1	0.9	0.7	-	1	-	-	NNP
KN/17876/S1	1.8	1.5	0.8	-	-	-	1	1.6	1.2	0.6	-	-	-	-	PREG
KN/17876/S2	1.4	1.0	0.7	1	-	-	1	1.6	1.5	1.1	4	1	-	1	PREG
KN/17876/S3	1.6	1.2	1.1	-	-	1	1	1.1	1.0	0.6	5	-	-	-	PREG
KN/17876/S4	1.1	0.9	0.5	-	-	-	-	1.2	1.1	0.7	-	-	-	-	NNP
KN/17876/S5	1.3	1.3	0.9	-	-	1	-	1.2	0.9	0.8	-	-	-	-	NNP
KN/17876/S6	1.8	1.1	0.9	2	-	-	-	1.8	1.3	1.1	1	-	-	-	NNP
KN/17876/S7	1.6	1.1	1.0	-	-	-	1	1.8	1.2	0.6	1	-	-	-	NNP
KN/21976/S1	2.1	1.2	1.2	-	1	-	1	1.6	1.2	1.0	1	-	-	-	NNP
KN/21976/S2		C	U	T	O	F	F	1.7	1.4	0.9	1	3	-	-	NNP
KN/21976/S3	1.1	0.9	0.7	1	1	-	-	1.1	0.7	0.4	-	-	-	-	NNP
KN/191076/S1	1.3	0.9	0.8	-	-	-	-	1.2	1.1	0.8	-	1	-	-	NNP
KN/191076/S2	1.1	0.9	0.5	-	-	-	-	1.9	1.5	1.0	-	-	-	1	PREG

Table 4: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/161176/S1	1.8	1.2	0.6	-	-	-	-	1.9	1.6	0.7	-	-	-	1	PREG
KN/161176/S2	1.8	1.3	1.1	-	-	-	1	2.3	1.2	1.0	2	-	-	1	PREG
KN/161176/S3	1.8	1.0	0.5	-	-	-	-	1.5	1.2	0.5	-	-	-	-	NNP
KN/161176/S4	1.3	0.9	0.6	-	-	-	-	1.5	1.0	0.8	-	-	-	-	NNP
KN/161176/S5	2.1	1.5	1.3	-	-	-	1	2.3	1.8	1.1	2	-	-	1	NNP
KN/211276/S1	2.4	1.3	1.2	-	-	-	2	1.6	1.2	0.9	-	-	-	-	PREG
KN/211276/S2	1.7	1.3	1.2	-	-	-	1	1.5	1.1	0.8	-	-	-	-	PREG
KN/211276/S3	2.0	1.2	0.9	-	-	-	1	1.8	1.5	0.9	1	2	-	1	PREG
KN/18177/S1	1.2	1.0	0.8	2	-	-	-	1.7	1.1	0.8	-	-	-	2	PREG
KN/18177/S2	1.6	1.2	0.7	1	2	-	-	1.4	1.3	0.9	-	2	-	-	NNP
KN/18177/S3	1.8	1.3	0.9	2	-	-	1	1.6	1.1	0.8	-	-	-	-	PREG
KN/18177/S4	1.4	1.1	0.8	3	1	-	-	1.6	1.3	1.1	4	2	-	-	NNP
KN/18177/S5	1.7	1.2	1.0	3	1	-	2	1.6	1.2	1.0	2	-	-	1	PREG
KN/15277/S1	1.4	1.2	1.0	-	-	-	-	1.9	1.7	1.5	2	2	-	2	NNP
KN/15277/S2	C U T O F F							1.4	1.0	0.9	1	-	-	-	NNP
KN/22377/S1	1.3	0.7	0.9	1	-	-	-	1.4	1.4	0.7	-	-	1	-	NNP
KN/22377/S2	1.9	1.1	0.7	-	-	1	-	1.4	0.9	0.8	1	-	-	-	NNP
KN/22377/S3	1.8	1.5	0.8	-	-	-	-	1.8	1.8	1.0	-	-	-	-	ANP
KN/22377/S4	1.5	1.1	0.8	-	-	-	1	1.6	1.1	1.0	-	2	-	-	ANP

Table 4: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KN/19477/S1	1.7	1.2	0.9	-	-	-	-	1.9	1.0	0.7	1	1	1	-	NNP
KN/19477/S2	1.8	1.3	0.9	1	1	-	-	1.7	1.1	0.9	1	-	-	-	NNP
KN/19477/S3	1.4	0.9	0.8	-	-	-	-	1.3	1.0	0.6	-	-	-	-	NNP
KN/19477/S4	1.8	1.8	1.1	-	1	-	1	1.5	1.1	0.7	1	-	-	-	NNP
KN/19477/S5	2.0	0.9	0.7	-	-	-	-	1.8	1.5	0.9	-	-	-	1	NNP
KN/19477/S6	1.4	1.2	0.8	1	-	-	-	1.4	1.2	0.6	-	-	-	-	NNP
KN/19477/S7	1.7	1.3	0.9	-	-	-	1	1.2	1.1	0.5	-	-	-	-	PREG
KN/17577/S1	1.7	1.1	0.7	-	-	-	1	1.5	1.1	0.8	-	-	-	-	NNP
KN/17577/S2	1.4	0.9	0.6	-	-	-		1.6	1.0	0.6	-	-	-	-	NNP
KN/17577/S3	1.2	0.7	0.5	-	-	-	-	1.1	0.9	0.5	-	-	-	-	NNP
KN/17577/S4	1.3	0.9	0.6	-	-	-	-	1.1	0.8	0.6	-	-	-	-	ANP
KN/17577/S5	1.1	0.9	0.6	-	-	-	-	1.1	0.8	0.6	-	-	-	-	NNP
KN/17577/S6	1.4	0.9	0.5	-	-	-	-	1.3	0.9	0.5	-	-	-	-	NNP
KN/21677/S1	1.6	1.5	1.1	1	-	-	1	1.4	1.2	0.8	-	-	-	-	PREG
KN/21677/S2	1.5	1.1	0.9	-	2	-	-	1.4	1.0	0.7	1	1	-	-	NNP
KN/21677/S3	1.5	1.1	0.7	-	-	-	-	1.5	1.1	0.8	-	-	-	-	NNP

Table 5: Ovarian dimensions, ovarian functional bodies and gross status of ovine reproductive tracts collected from Kaduna.

	Left Ovary							Right Ovary							
Code No.	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	Gross Status
KD/13776/S1	1.7	1.3	0.9	3	1	-	1	1.2	1.0	0.6	1	-	-	-	NNP
KD/13776/S2	1.8	1.4	1.0	-	-	-	1	1.6	1.2	0.8	2	-	-	1	NNP
KD/13776/S3	1.3	1.0	0.8	2	1	-	-	1.2	1.0	0.6	-	1	-	-	NNP
KD/13776/S4	1.2	1.1	0.6	-	-	-	-	1.3	1.2	0.7	1	-	-	1	NNP
KD/10876/S1	1.4	1.0	0.9	-	2	-	1	1.5	1.0	1.0	-	-	-	1	NNP
KD/10876/S2	2.0	1.5	1.1	-	-	-	-	2.7	1.6	1.1	-	-	2	-	PREG
KD/10876/S3	0.9	0.8	0.3	-	-	-	-	1.2	0.9	0.5	-	-	-	-	NNP
KD/10876/S4	1.4	1.5	0.8	5	-	-	1	1.2	0.9	0.8	1	-	-	-	NNP
KD/10876/S5	1.9	1.8	0.9	-	-	3	1	1.7	1.3	1.0	-	-	2	-	NNP
KD/14976/S1	1.5	1.0	0.8	1	2	-	-	1.7	1.2	0.7	-	1	-	-	ANP
KD/14976/S2	1.3	0.9	0.6	-	-	-	-	1.1	0.8	0.6	-	-	-	2	NNP
KD/14976/S3	1.2	0.8	0.5	-	-	-	1	1.2	0.8	0.5	-	-	-	2	NNP
KD/14976/S4	1.7	1.4	0.6	-	-	-	1	1.6	1.3	0.6	-	-	-	1	NNP
OCTOBER 1976	N O T S A M P L E D							N O T S A M P L E D							-
NOVEMBER 1976	N O O V I N E T R A C T S							N O O V I N E T R A C T S							-

Table 5: Continued

Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/141276/S1	2.3	1.5	1.2	-	-	-	2	2.0	1.4	1.2	2	-	-	1	PREG
KD/141276/S2	2.1	1.4	1.1	1	-	-	1	1.9	1.1	0.9	3	-	-	-	PREG
KD/141276/S3	1.6	1.0	0.8	2	-	-	-	1.9	1.2	1.1	-	-	-	2	PREG
KD/141276/S4	1.8	1.2	0.9	2	-	-	-	1.9	1.1	1.1	2	-	-	1	NNP
KD/141276/S5	2.0	1.2	1.0	3	-	1	-	1.8	1.3	1.0	-	2	1	-	NNP
KD/11177/S1	1.3	0.9	0.7	-	1	-	-	1.6	1.1	0.8	-	-	-	1	NNP
KD/11177/S2	1.6	1.2	0.7	-	1	-	-	1.7	1.7	1.0	-	-	-	1	PREG
KD/11177/S3	1.4	1.0	0.8	-	1	-	-	1.3	1.3	0.9	-	-	-	1	NNP
KD/11177/S4	1.5	1.5	0.9	1	-	1	1	1.5	1.0	0.6	-	-	-	-	NNP
KD/11177/S5	1.3	1.2	0.7	1	-	-	-	2.3	1.4	1.0	1	-	-	3	PREG
KD/11177/S6	1.2	1.1	0.7	-	-	-	-	C U T O F F							NNP
KD/8277/S1	1.8	1.2	0.9	1	-	-	-	1.7	1.2	0.9	-	-	-	-	NNP
KD/8277/S2	2.1	1.2	1.0	1	-	-	-	1.7	1.2	0.8	-	-	-	-	NNP
KD/15377/S1	1.6	1.0	0.8	3	1	-	-	2.0	1.4	1.1	1	-	-	1	ANP
KD/15377/S2	1.2	0.8	0.6	-	-	-	-	1.3	0.8	0.7	-	-	-	-	NNP
KD/15377/S3	1.5	1.1	0.9	1	-	-	-	1.5	1.1	0.7	-	-	-	-	NNP

Table 5: Continued

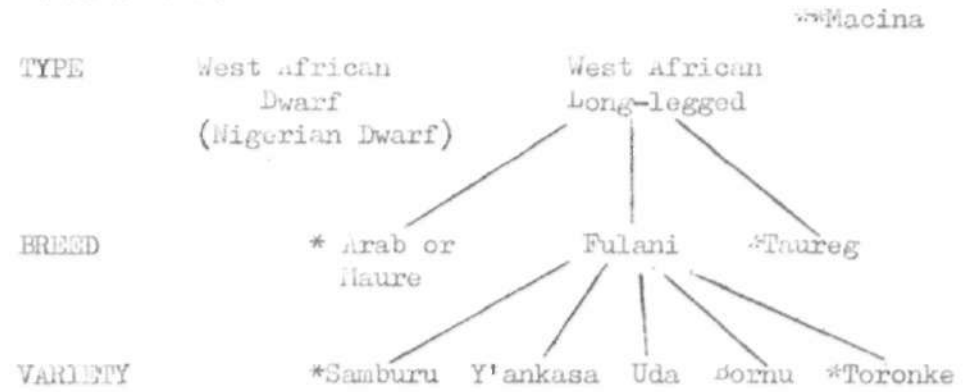
Code No.	Left Ovary							Right Ovary							Gross Status
	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	
KD/12477/S1	2.5	1.6	1.2	-	-	-	1	1.9	1.4	1.0	2	-	-	-	PREG
KD/12477/S2	1.4	1.0	0.7	-	-	-	-	1.4	1.0	0.7	-	-	-	-	NNP
KD/12477/S3	1.4	0.9	0.6	-	-	-	-	1.3	0.8	0.5	-	-	-	-	NNP
KD/12477/S4	1.2	0.9	0.5	-	-	-	-	1.1	0.8	0.5	-	-	-	-	NNP
KD/12477/S5	1.2	0.8	0.5	-	-	-	-	1.0	0.9	0.5	-	-	-	-	NNP
KD/10577/S1	1.5	1.1	0.5	-	-	-	-	A D H E S I O N S							ANP
KD/10577/S2	1.5	0.8	0.6	-	-	-	-	1.4	0.8	0.5	-	-	-	-	NNP
KD/10577/S3	1.5	1.0	0.6	-	-	-	-	1.5	1.1	0.6	-	-	-	-	NNP
KD/14677/S1	1.5	1.0	0.7	-	-	-	1	1.6	1.4	0.9	1	-	-	1	NNP
KD/14677/S2	1.6	1.2	0.9	2	-	-	1	1.7	1.5	1.0	1	-	-	2	NNP
KD/14677/S3	1.3	0.9	0.6	4	1	-	-	1.4	1.0	0.8	3	-	-	1	NNP
KD/14677/S4	1.7	1.4	0.8	2	-	-	2	1.6	1.2	0.7	2	-	-	-	NNP

Table 6: Ovarian dimensions, ovarian functional bodies and gross status of ovine reproductive tracts collected from Zania.

	Left Ovary							Right Ovary							
Code No.	L	H	W	F_2	F_3	CH	CL	L	H	W	F_2	F_3	CH	CL	Gross Status
ZA/6776/S2	1.8	0.9	0.8	1	-	1	-	1.9	1.1	1.0	-	1	1	-	NNP
ZA/6776/S1	1.4	0.9	0.5	-	-	-	-	1.2	0.9	0.5	-	-	-	-	NNP
ZA/3876/S1	1.9	1.5	0.8	-	-	-	-	2.2	2.3	1.2	1	-	-	2	PREG
ZA/71276/S1	1.5	1.2	0.8	-	-	-	1	1.0	0.8	0.5	-	-	-	-	PREG
ZA/4177/S1	1.2	1.1	0.6	-	-	-	-	1.2	1.1	1.0	-	-	1	-	NNP
ZA/4177/S2	1.2	0.8	0.6	-	-	-	-	1.2	0.8	0.6	-	-	-	-	NNP
ZA/1277/S1	1.1	0.9	0.6	-	-	-	-	1.4	1.3	0.8	-	-	-	1	NNP
ZA/5477/S1	1.8	1.3	0.9	-	-	-	1	C	U	T	O	F	F		PREG

Sheep

A. Mason (1951, 1969)

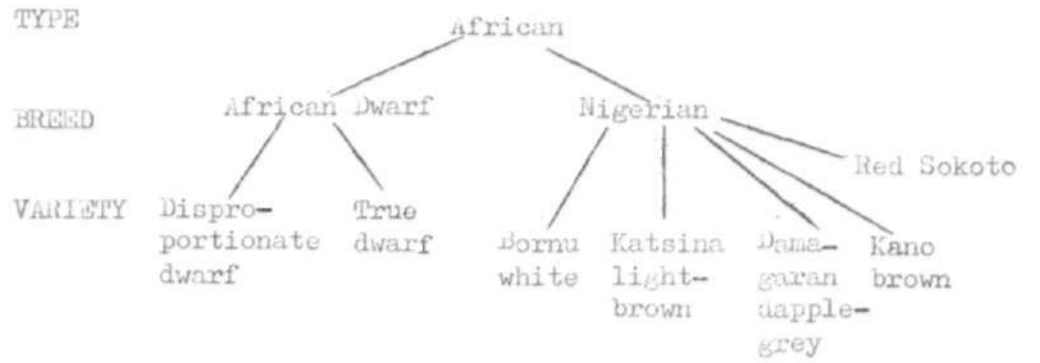


* Migratory herds only. Originate from North or North-West of Nigeria.

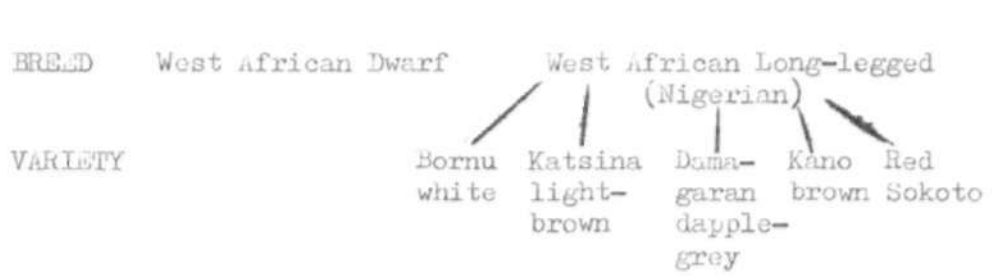
** Not likely to be in Nigeria.

Goats

A. Webster and Wilson (1973)



B. Mason (1969) ?



C. Beaton (1939)

TYPE	?				
BREED	?				
VARIETY	dwarf-black (i.e. Fouta-Djallon)	Bonu white	Damagaran dapple-grey	Kano brown	Sokoto red

App. IV. Classifications of sheep and goats in Nigeria.
Source: Beaton, 1939; Mason, 1951, 1969; Webster & Wilson, 1973.