MULTIVARIATE ANALYSIS OF SELECTED HONEYBEE POPULATIONS IN AFRICA

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Gratiae Deo
cui gloriam omnem
et honerem et laudem
dedico

ABSTRACT

Morphometric characters and sting pheromones of worker honeybees, *Apis mellifera* Linnaeus were analysed by multivariate methods to characterise selected honeybee populations along five transects in Africa at a meso-scale level of sampling distance resolution. In some, but not all, areas pheromonal clusters were found to be coincident and concordant with the morphometric clusters, thus indicating that different honeybee traits have dispersed variably among populations. All transects were found to contain areas of significantly high variance. High intracolonial variance was taken to indicate localised genetic variation coupled with out-cross matings. Centroids of high intercolonial variance occured at and between cluster boundaries and were typical of transitions between, and rainfall-temperature discontinuities within, ecological-climatological zones, hence areas of ecological instability.

Principal component and stepwise discriminant analysis yielded three morphometric clusters corresponding to *A. m. sahariensis* and *A. m. intermissa* in Morocco and to *A. m. iberica* (with three biometric populations) in Spain, but no pheromone clusters. The combined morphometric and pheromonal variance spectra indicated regions of natural hybridisation along a Sahara-Pyrenees transect. In the Horn of Africa, discrete and statistically homogeneous populations were identified: *A. m. jemenitica*, *A. m. bandasii*, *A. m. sudanensis* in Ethiopia and an unclassified group in southwestern Somalia. Areas of high intercolonial variance were interpreted as zones of hybridisation between the populations. Along a transect in west central Africa, three distinct homogeneous populations and two zones of hybridisation were found. These bees were designated as *A. m. adansonii* whose

area of distribution was intruded by an un-named mountain group of bees and a third group, *A. m. jemenitica*. The delineation of the hybrid zones was supported by intercolonial variance spectra and these significant asymmetries were found to be coincident with transitions between the ecological-climatological zones. In southwestern Africa, two discrete homogeneous populations and a zone of hybridisation between them were identified: *A. m. scutellata* in northern South Africa and southern Namibia and *A. m. adansonii* in northern Namibia. Along a transect in the southeastern woodland savanna of Africa, three discrete populations were classified: *A. m. litorea* in Mozambique, *A. m. scutellata* in Zimbabwe and *A. m. adansonii* in northwestern Zambia. A zone of introgression between the last two subspecies occured in south-central Zambia and in the Zambezi valley.

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CHAPTER 1

INTRODUCTION

1.1 Perspective

The honeybee, *Apis mellifera*, is one of the most successful species in the animal kingdom with regard to its ability to adapt to great variations in climatic conditions. It originally evolved in the tropics from the mid-Tertiary period. During the Pleistocene epoch it underwent rapid evolution which culminated in the dramatic spread of the species over the whole African continent and the recolonisation of Europe (Ruttner, 1988). Radiation in these immensely varied environments has resulted in the evolution of three major lineages or groups of subspecies. Using the factor plot of a principal components analysis based on morphometric characters, Ruttner *et al.* (1978) showed that these major groups were distributed in the shape of a horizontal "Y" with one long branch (A) formed by the African subspecies south of the Sahara and two short branches (M) and (C) composed of the west European and the southeast European subspecies respectively. Ruttner *et al.* (1978) postulated that the three main branches evolved from a dispersal centre in northern Africa. These branches of subspecies are supported by mitochondrial DNA studies, although Garnery *et al.* (1992) deduced that the M branch evolved from Iran and not from the north of Africa (Moritz, 1994).

The extensive dispersion of *Apis mellifera* resulted in the diversification of certain characteristics such as morphology, behaviour, sensitivity to diseases and biochemical components (Ruttner, 1988; Cornuet and Garnery, 1991a). This led to the naming of several subspecies and/or ecotypes. According to Ruttner (1988), 24 subspecies corresponding to geographically or ecologically distinct regions have been discriminated and characterised statistically. The classification of honeybees into well-defined subspecies has been a complex and contentious issue with taxonomists. Opinions differ as to whether the observed geographic and ecologic variations between populations reflect distinct subspecies or geographical races (Ruttner, 1988, 1992) or adaptive ecotypes derived from adjacent populations (Kerr, 1992) and/or asynchronous gene fluctuations within a meta-population (Hepburn and Crewe, 1991).

1.2 Morphometrics

1.2.1 Historical background

Honeybees were among the first insects to be studied morphometrically. These studies originated in Russia in the early 1900's when there was a need to search for bees with long tongues for red clover pollination purposes (Daly, 1992). Apparently, the first exact measurements of parts of the honeybee exoskeleton were recorded by G.A. Koshevnikov in 1900 (Alpatov, 1929). Similar studies followed, such as those of Martynov (1901) and Kulagin (1906) dealing with variation problems in the honeybee (Alpatov, 1929). From a statistical point of view the biggest drawback of these early morphometric studies was the restricted number of observations used.

A breakthrough came in 1916 when Chochlov (1916) carried out the first morphometric study using an adequate number of honeybees for statistical analysis. He measured the proboscis of 1 899 bees representing six geographic races with three colonies per race and at least 100 bees per colony. Between 1924 and 1929 Michailov (1924, 1926) and Alpatov (1925, 1929) investigated the influence of different environmental factors on the variation of the honeybees based on a large collection of bees from many locations of the European Soviet Union. They found a positive (negative) linear relationship between the length of the proboscis (body size) and the latitudes of the localities along a transect from the Baltic Sea to the Caucasus mountains (Ruttner, 1988). Numerous other characters that could be easily measured from the body, wings and legs of honeybees were added by Alpatov to those used in the earlier morphometric studies. During the same period in the United States, several authors produced major papers on bee biometry (Merrill, 1922; Phillips, 1929). Basic sample statistics such as means, standard deviations, coefficients of variation, ratios of differences and correlation coefficients were calculated to compare the geographical variability within the species and to establish differences between European races.

G. Goetze added new characters to Alpatov's list of biometric variables, namely the lengths of sections of the cubital vein in the forewing (Goetze, 1930), lengths of hair on the abdomen (Goetze, 1940) and indices of wing venation (Goetze, 1964). The cubital index was derived from two of the cubital vein lengths and, based on simple univariate statistics, is still used by apiculturists for distinguishing among European races (Goetze, 1964; Ruttner, 1988; Daly, 1992). Until 1964, honeybee morphometric analysis relied solely on sample statistics and univariate methods. DuPraw (1964, 1965) was the first to introduce angles of wing venation and multivariate methods in bee morphometrics. Using 373 individual worker bees from Europe, Africa and Asia, he applied a discriminant function analysis to 15 variables all based on the pattern of venation in the forewing and was able to establish clusters (DuPraw, 1965) corresponding quite closely to the geographical races as currently defined (Ruttner, 1988). Multivariate methods were also used to discriminate between ecotypes within a race (Louis and Lefebvre, 1968; Tomassone and Fresnaye, 1971) and between genetic lines (Louis *et al.*, 1968).

Ruttner *et al.* (1978) introduced more characters than those used by Alpatov, Goetze and DuPraw and established a standard set of 40 variables which he used in the classification of honeybees of the world. Applying a stepwise discriminant analysis procedure, Ruttner *et al.* (1978) and Daly and Balling (1978) showed that the number of characters needed to discriminate races from each other could be reduced considerably. The characters entered into the discriminant analysis varied according to the region under investigation. Only ten characters were required for the adequate separation of honeybees of different geographic origin in Africa (Ruttner *et al.*, 1978). Indeed, Crewe *et al.* (1994) using the full set of Ruttner's characters showed that ten characters sufficed for the southern African region.

The introduction of multivariate analysis to bee morphometrics was a major breakthrough which led the way to other multivariate techniques: principal components and factor analyses used to detect clusters of colonies within populations (Ruttner *et al.*, 1978; Ruttner, 1988); stepwise discriminant analysis employed to confirm the separation of the clusters, to determine the most discriminatory variables and to calculate the percentages of correctly classified colonies (Ruttner, 1988; Daly, 1992); phenograms or dendrograms used to depict the distances (Mahalanobis distance and others) between the clusters (Tomassone and Fresnaye, 1971; Cornuet *et al.*, 1975; Cornuet and Garnery, 1991a; Daly, 1992); 75% - 95% confidence ellipses to test the significance of the discrimination (Cornuet, 1982); multivariate analysis of variance (MANOVA) to test for significant multivariate mean differences between the clusters (Rinderer *et al.*, 1990). Using these multivariate procedures in morphometrics, most of the 24 geographically defined races of *Apis mellifera* described by Ruttner can be easily discriminated (Cornuet and Garnery, 1991a). Rinderer *et al.* (1990) showed that good separations of even the F_1 hybrids of Africanised and European bees can be obtained using multivariate discriminant analysis.

1.2.2 Environmental effects

A number of authors, however, stressed the susceptability of morphological characters to environmental effects (Alpatov, 1929; Grout, 1937; Daly and Balling, 1978; Spivak *et al.*, 1988; Cornuet and Garnery, 1991a; Daly and Morse, 1991; Nazzi, 1992). Strong evidence of environmental influence on both the morphological and behavioural phenotype exists (Murphy, 1973; Falconer, 1989). The phenotypic variance, V_P, exhibited for a particular character in a population is defined as the sum of the genotypic variance, the environmental variance and the gene-environmental variance related to that character. This is summarised in a basic formula of quantitative genetics (Falconer, 1989):

$$V_P = \sigma_G^2 + \sigma_E^2 + \sigma_{GE}^2$$

where σ_G^2 = the genotypic variance

σ_E^2 = the environmental variance

σ_{GE}^2 = gene-environmental variance

Heritability h^2, a genetic parameter, is defined in the narrow sense as the ratio of the additive genetic variance, V_G, to the phenotypic variance, V_P (Falconer, 1989; Moritz and Southwick, 1992). The value of heritability ranges from zero (no genetic influence on the character) to one (all variation of the character is genetically produced). Heritability is, therefore, often referred to as the coefficient of genetic determination.

The influence of environmentally induced variation and genetic control cannot be separated easily (Thorpe, 1976). Szabo and Lefkovitch (1992) showed that the colour patterns of the honeybee are less than 40% heritable (i.e. $\sigma^2_G < 0.40$). This implies that more than 60% of the total phenotypic variance is attributed to environmental and gene-environmental variations and error (i.e. $\sigma^2_E + \sigma^2_{GE}$ + error > 0.60). Indeed the colour patterns of *Apis mellifera* queens were found to be correlated with temperature during pupal development resulting in darker pigmentation of the honeybees at lower temperatures (Tsurata *et al.*, 1989; Spivak *et al.*, 1990). Daly *et al.* (1991) found that feral honeybees, derived from stocks introduced to California over 100 years ago, have shown geographic variations. Also Nazzi (1992) showed that most of the angles of wing venation and other morphological characters associated with the forewing of hybrid honeybees were subjected to seasonal variation. Ruttner (1988) and Goetz and Koeniger (1992) stated that the size of the brood cell (as did Grout, 1937), quantity of brood and quality of brood food may influence the morphological characters. Since flowering plants are dependent on rainfall (Hepburn and Radloff, 1995) it can reasonably be assumed that the rainfall of an area might indirectly affect the quantity and quality of the food and hence influence the phenotypic characters as well.

Ruttner (1988) showed that a long-distance geocline of morphological characters and geographic latitude is present extending along the countries of the east coast of the Atlantic ocean from Scandinavia to the Cape of Good Hope. Measurements of body size, hair, proboscis and hind legs were found to be highly correlated with geographic latitude. Similar correlations exist between morphological characters and altitude indicating the presence of short-distance ecoclines (Mattu and Verma, 1984; Ruttner, 1988; Meixner *et al.*, 1989, 1994). These relationships, however, cannot be generalised as many exceptions are found among the geographic races of honeybees. One exception is that of *A. m. lamarckii*, a small, yellow bee and *A. m. intermissa major*, a large, black bee occurring at relatively similar latitudes (Ruttner, 1988). Another is that of a dark *A. m. monticola*-type and a very yellow *A. m. monticola*-type occurring at the same altitude in the highlands of Ethiopia (Ruttner, 1992; Radloff and Hepburn, 1997a).

Certain morphological characters have also been shown by a number of authors to exhibit high heritabilities. Roberts (1961) estimated high heritabilities for wing width, tongue length and cubital index of inbred and hybrid honeybees. The heritabilities of various fore and hind-wing areas, surfaces of tibia, femur and metatarsus, and hair lengths were estimated to be large and significant in honeybee workers (Poklukar and Kezić, 1994). Also Moritz and Klepsch (1985), working with laying workers of *A. m. capensis* and using both the sib analysis and the parent offspring regression methods, found that the estimates of h^2 for certain lengths and angles of venation in the forewing were high with small standard errors. Oldroyd *et al.* (1991), using the sib analysis method, also obtained high heritability estimates for body size and vein angle characters of ten honeybee populations. However, the estimated heritability values generally differed between the honeybee populations (Oldroyd *et al.*, 1991). Morphological characters in general seem to have higher heritabilities than behavioural characters associated with defensive behaviour of honeybee colonies (Collins *et al.*, 1984; Moritz *et al.*, 1987; Bienefeld and Pirchner, 1990).

The sib analysis method of estimating the heritability of worker characters involves the rearing of specimen workers in their maternal colony. This may reduce environmental effects and hence could result in larger estimates of heritablility. Oldroyd *et al.* (1991) showed that the estimated values of heritability declined by an average of approximately 41% when specimens were reared in non-maternal environments. Nonetheless, in spite of generally high heritabilities in certain morphological characters, Cornuet and Garnery (1991a) maintained that morphometrics "gives only an indirect and possibly biased measure of genetic diversity". Also, morphometric techniques were found to be unsuccessful in accurately detecting hybrid bees of various known degrees of Africanisation (Guzmán-Novoa *et al.*, 1994). Hence there is a need to use other discriminatory methods that are based on independent sources of information to discriminate between races of *Apis mellifera* (Spivak *et al.*, 1988). Nazzi (1992) suggested that genetic information should be included along with morphometrics when analysing the structure of honeybee populations. Recent developments in the use of gas chromatography and the applicability of the use of pheromones in measuring the intensity and direction of gene flow between honeybee populations (Hepburn *et al.*, 1994) has lead to further investigations into these genetic markers.

1.3 Alarm Pheromones

1.3.1 Alarm pheromone production and response to alarm pheromones

A vital part of honeybee colony defense is the coordination of the defensive response through the use of pheromones. Initially, Boch *et al.* (1962) identified isopentyl acetate as one of the active components of the alarm pheromone from the sting apparatus of worker bees. Shearer and Boch (1965) identified the mandibular gland alarm pheromone as 2-heptanone. Later studies of responsiveness of honeybees to pheromones showed that several additional compounds of the sting apparatus elicited defensive behaviour, whilst others were ineffective (Blum *et al.*, 1978; Collins and Blum, 1982, 1983; Pickett *et al.*, 1982; Free, 1987).

The production of certain sting alarm pheromones is correlated with the age of the honeybee (Boch and Shearer, 1966, 1967; Crewe and Hastings, 1976; Whiffler *et al.*, 1988). Peak concentrations of the pheromones were reached in bees approximately 14 to 16 days of age during the guarding and beginning-foraging phases. Sting alarm pheromone levels have also been shown to vary significantly between genetically and behaviourally different races of honeybees (Collins *et al.*, 1989; Hepburn *et al.*, 1994) and in hybrids of landrace crosses (Boch and Rothenbuhler, 1974). Hepburn *et al.* (1994) found that the guard bees of an exceptionally aggressive race, *A. m. scutellata*, produced significantly more sting pheromone than those of an extremely docile race, *A. m. capensis*. Also the pheromone variances for both these African races were significantly lower than those for bees identified as *A. m. scutellata* × *A. m. capensis* hybrids (Hepburn *et al.*, 1994).

The responses of honeybees to alarm pheromones have been extensively analysed for both individual pheromones and the pheromone bouquet (Al-Sa'ad *et al.*, 1985; Collins, 1979; Free, 1987; Robinson, 1987). The intensity, reaction time and duration of colony defensive behaviour is affected by the age of the workers (Collins and Rothenbuhler, 1978; Collins, 1980; Whiffler *et al.*, 1988) and colony strength (Collins and Rothenbuhler, 1978; Collins *et al.*, 1982) as well as by genetic (Collins, 1979; Collins *et al.*, 1982, 1987b, 1989; Collins and Rinderer, 1991; Stort and Gonçalves, 1991) and meteorological (Collins, 1981) factors. It has been shown that Africanised bees respond more quickly to alarm stimuli, in greater numbers and with more intensity than European honeybees (Collins *et al.*, 1982, 1989).

There are significant correlations between alarm pheromone concentrations and the intensity of the colony defensive responses (Boch and Shearer, 1971; Kerr *et al.*, 1974; Stort, 1974; Collins and Rothenbuhler, 1978; Collins *et al.*, 1989). These correlations suggest co-adaption of the genes which control the variation of both pheromone production and defensive behaviour (Collins *et al.*, 1989). Also, the constituents of the pheromonal bouquet (Collins *et al.*, 1987a) and behaviour (Collins *et al.*, 1984) are genetically correlated, indicating a common regulatory mechanism.

1.3.2 Heritabilities of sting pheromone genes

Collins and co-workers (1987a) estimated the heritabilities of twelve major alarm pheromones by using a nested mixed effect ANOVA model with a fixed bee type (Africanised or European) effect, a fixed queen line effect and a random sire-queen effect nested within the bee type. They calculated three h^2 values greater than one, which can arise when the estimation of h^2 is determined by imposing one constraint on to another equation, namely Rinderer's constraint that the sire-queen variance component estimates one quarter of the additive genetic variation (Rinderer, 1977) i.e. $\sigma_S^2 = \frac{1}{4} V_G$ imposed on the phenotypic variation relationship. The latter relationship states that the phenotypic variance is equal to the sum of the sire-queen variance component, sire-queen by queen line in bee type variance component and the residual variance component i.e. $V_P = \sigma_S^2 + \sigma_{SQ}^2 + \sigma_\varepsilon^2$ where σ_S^2, σ_{SQ}^2 and σ_ε^2 are estimated from the nested mixed effects ANOVA model (Collins *et al.*, 1987a).

Hence

$$h^2 = \frac{V_G}{V_P} = \frac{4\sigma_S^2}{\sigma_S^2 + \sigma_{SQ}^2 + \sigma_\varepsilon^2}.$$

Also, estimates of h^2 greater than unity may be due to experimental and estimation error

(Oldroyd *et al.*, 1991).

Nevertheless, Collins *et al.* (1987a) established that the h^2 values of most of the genes involved in the synthesis of the sting pheromone compounds are close to unity and it is therefore feasible to assume that the environmental and gene-environmental variations are negligible (but see Paxton *et al.*, 1994). Hence sting alarm pheromones should not be greatly affected by the environmental conditions and small differences in the pheromone composition should indicate a genetic difference within a population rather than an environmentally induced phenotypic difference. Unfortunately, the standard errors associated with the h^2 values computed by Collins *et al.* are high, resulting in wide confidence intervals for h^2, and indicating the possibility of a greater proportion of environmental variation effect than is implied by the h^2 estimates (Collins *et al.*, 1987a). Moritz and Hillesheim (1985), on the other hand, estimated the heritability of 9-ODA, a main component of queen substance in the mandibular glands of reproductive workers of the Cape honeybee, *A. m. capensis* Esch., to be 0.89 with a very small standard error of 0.007.

The constituents of the alarm pheromone exhibit high variances in hybrids of line crosses (Boch and Rothenbuhler, 1974), inter-racial crosses (Collins *et al.*, 1989) and in natural hybrid zones between races (Hepburn *et al.*, 1994). High variances indicate zones of hybridity (Falconer, 1989; Moritz and Kauhausen, 1984; Crewe *et al.*, 1994) where gene mixing between two populations has occurred. Because there is a high degree of heritability of the sting pheromones, a large proportion of the pheromonal variation assigned to hybrid bees must arise through introgression. Hence, the variance of the sting pheromone output was analysed to assess the introgression of this trait in the natural hybridisation process between the honeybee races of Africa.

1.4 Honeybee populations of Africa

1.4.1 Taxonomy of African honeybees

The taxonomy of the honeybees, *Apis mellifera*, of Africa has not been studied as thoroughly as that of the European populations. Although data collections have now been obtained from most of the countries, the samples generally have been small and sparse (Ruttner, 1988). Before 1958 it was undecided whether the honeybees south of the Sahara were distinct species of the genus *Apis* (Goetze, 1930, 1940; Maa, 1953) or an infraspecific form of *Apis mellifera* (Buttel-Reepen, 1906; Kerr and Laidlaw, 1956). In 1958, Kerr and Portugal-Araújo (1958) established by means of genetic crosses that the European and African races belong to a single species *Apis mellifera* Linnaeus.

In the pre- and early morphometric periods, bees were classified almost entirely according to colour and size. Because of the fairly uniform yellow pigmentation and small body size of most of the races of tropical Africa, this lead to the naming of all subsaharan bees firstly as "*unicolor* Latreille" (Buttel-Reepen, 1906) and later as "*adansonii* Latreille" (Alpatov, 1933, 1940). In 1958, Kerr and Portugal-Araújo (1958) named the subsaharan bee *Apis mellifera adansonii* Latreille. They also recognised *Apis mellifera capensis* Eschscholtz for those at the Cape of Good Hope, and *Apis mellifera unicolor* Latreille for the bees of Madagascar and neighbouring islands.

Subsequently, Smith (1961) defined three distinct races in Tanzania based on univariate analysis: *Apis mellifera litorea* along the coast of Tanzania; *Apis mellifera* *monticola* at altitudes higher than 2 400 m and *A. m. adansonii* for the most frequently found bee in the East African highlands. Goetze (1964), on the other hand, recognised two subspecies: *A. m. capensis* for the Cape region of South Africa and *A. m. adansonii* for the rest of Africa south of the Sahara desert, including Madagascar and neighbouring islands. With the introduction of multivariate morphometric procedures, Ruttner (1975, 1981) showed that the honeybees of west Africa from Senegal to at least the Congo are distinctly different from those of the highlands of east and South Africa. Consequently the name *A. m. adansonii* was restricted to the western strain and *Apis mellifera scutellata* Lepeletier to the bee of east and South African savanna.

1.4.2 The bees of west Africa

A. m. adansonii is a small yellow bee with a relatively short proboscis found in many countries along the west African coast from Senegal to the Congo or possibly Namibia (Ruttner, 1988, 1992). Early descriptions of these bees revealed extreme colour variations. According to Rueher (1926) and Aurelien (1950), three varieties of bees occur in the Congo and Zaire with yellow, black and grey abdomens. Other authors noted the occurrence of two kinds of bees in Zaire, a black one in the west (de Roeck, 1950) and at high altitudes in the east of the country (Dubois and Collart, 1950) and a yellow one elsewhere. N'diaye (1974, 1976) described the bees from Senegal as typically yellow bees but black ones are encountered at high altitudes where the climate is colder. The bees from Ivory Coast have also been recorded to have extreme colour variations from typically yellowish to very dark (Douhet, 1980; Borneck, 1976). Further south in Angola, Portugal-Araújo (1956) described bees with between two and four golden abdominal bands, whilst Rosario Nũnes and Tordo (1960) recorded bees with colouring varying from golden-brown to solid black.

A. m. adansonii is not limited to the coastline of west Africa but extends deep inland, colonising semi-arid zones and tropical rain forests as well. There seems to be no explanation as to why, in the whole of western Africa with all its climatically different zones, no distinct differentiation of *A. m. adansonii* into subspecific groups has occurred (Ruttner, 1992). Yet, Villières (1982) states that *A. m. adansonii* is extremely variable and may contain several ecotypes. The one known exception occurs in the mountainous regions of Cameroon where a big "*A. m. monticola*-like" yellow bee is found (Ruttner, 1992). Little is known about the demarcation of *A. m. adansonii* from *A. m. scutellata* both in the centre of the African continent and north of Namibia, nor about a possible border between *A. m. adansonii* and *Apis mellifera jemenitica* in the Sahel zone.

1.4.3 The bees of eastern and southern Africa

Bees of eastern and southern Africa have been designated into four subspecies and/or ecotypes (Ruttner, 1988, 1992; Kerr, 1992) at the continental macro-level: *A. m. scutellata* in the African thornbush and grass savanna from Ethiopia to the Cape province of South Africa; *A. m. capensis* in the Cape peninsula (Ruttner, 1977) and probably extending into the eastern Cape province (Crewe *et al.*, 1994); *A. m. litorea* in the flat coastal plains stretching from Somalia south to Mozambique and perhaps further south to the South African province of KwaZulu Natal; *A. m. monticola* in the mountain forests of Ethiopia, Kenya, Tanzania and Burundi at altitudes of 2 400-3 000 m (Meixner *et al.*, 1989, 1994; Ruttner, 1988, 1992).

The morphometry (Alpatov, 1933, 1940; Kerr and Portugal-Araújo, 1958; Goetze, 1964, Anderson and van Schalkwyk, 1977; Moritz and Kauhausen, 1984), behaviour (Whiffler *et al.*, 1988; Hepburn *et al.*, 1993) and reproductive biology (Onions, 1912;

Anderson, 1963; Ruttner, 1977; Hepburn and Crewe, 1990, 1991; Hepburn and Allsopp, 1994) of the two southern African races, *A. m. capensis* and *A. m. scutellata*, have been extensively analysed. Recent publications have confirmed that the two races can be resolved into distinct populations with coincident, but not concordant, hybrid zones between them using morphometrics (Crewe *et al.*, 1994), alarm pheromones (Hepburn *et al.*, 1994) and mtDNA haplotypes (Moritz *et al.*, 1994).

The situation appears to be different with respect to *A. m. scutellata* and its neighbouring subspecies, *A. m. litorea* and *A. m. monticola*, in east Africa. Studies by Smith (1961) and Ruttner (1975) revealed that a gradual variation in size correlated to altitude is present for the honeybees of Tanzania within a distance of only 300 km and a difference in altitude of 3 000 m, indicating a vertical short-distance ecocline between the races. Meixner *et al.* (1989) working with bees from the regions of Mt. Kilimanjaro and Mt. Meru reported that *A. m. monticola* is a separate race from *A. m. scutellata* showing no signs of hybridisation between them. These results were confirmed by Meixner *et al.* (1994), five years later, using bees collected from Mt. Kenya, Mt. Elgon and Ngong regions in Kenya based on both morphometric and allozymic analyses. The honeybees from the Ngong hills, however, showed some degree of hybridisation between the two races which may be correlated with the environmental changes from mountain forests and savanna to cultivated plantations in this region. Morphological regional variations are present within *A. m. monticola*. The mountain bees from Mt. Kilimanjaro are smaller in all characters studied than the bees from the directly neighbouring Mt. Meru (Ruttner, 1988; Meixner, 1989). Ruttner (1992) reports that some mountain bees from Ethiopia have a yellow pigmentation rather than the usual black colour (also Hepburn, unpublished observation). The same is true for the mountain bee in Malawi (Ruttner, 1992).

The study of allozymic variation generally allows the direct determination of genotypes (Cornuet and Garnery, 1991a). Hence, the clear separation between *A. m. scutellata* and *A. m. monticola* using allozymic analysis may suggest that *A. m. monticola* is a direct descendant of a former large, coherent population which existed across all the highlands of eastern Africa during the last pluvial, and is now restricted to the forested mountainous regions at altitudes above 2 000 m (Ruttner, 1988; Meixner *et al.*, 1989, 1994).

1.4.4 The bees of north and northeastern Africa

The bees of north and northeastern Africa can be presumed to have the capacity to survive high temperatures during the day, sub-zero winter temperatures in the interior at night, and long periods of drought. At the continental macro-level, Ruttner (1988) showed that these bees could be classified morphometrically into four subspecies and/or ecotypes: *A. m. lamarckii* restricted to the narrow Egyptian Nile Valley; *A. m. jemenitica* from Arabia, Somalia, Sudan and extending into Chad; *A. m. intermissa* in the Maghreb from Morocco (Barbier, 1974), Algeria (Br. Adam, 1983), Tunisia (Lebdi-Grissa *et al.*, 1991a) across to possibly Egypt(?); *A. m. sahariensis* wedged between the Atlas mountains and the Sahara desert.

A. m. lamarckii is well known for its conspicuous colour pattern of bright orange bands with shining black margins on the abdomen and its white pubescence (El-Banby, 1965; Ruttner, 1988). It has been claimed, on the basis of colouration, that this bee is the "primary race" from which all yellow bees stem (Br. Adam, 1983). Surprisingly, no significant regional variability was found within this race over a 600 km transect (Kaschef, 1959; Wafa *et al.*, 1965; Br. Adam, 1983, 1987). Ruttner (1988) showed that *A. m. lamarckii* belongs, statistically, among the subsaharan rather than the north African races. This is due to its yellow pigmentation and small, slender body size.

There is uncertainty about the distribution of the smallest known *Apis mellifera* race, *A. m. jemenitica*. Ruttner (1988) claimed that this race is found in the hot arid zones of eastern Africa and Arabia, from Chad, Sudan, Somalia to Saudi-Arabia, Yemen and Oman. Studies by Rashad and El-Sarrag (1978, 1980), Saeed (1981), Mohamed (1982), Mogga (1988) and El-Sarrag *et al.* (1992) revealed a high degree of variability in size, pigmentation and behaviour of the Sudanese honeybees between and within the provinces. It was suggested by Mogga (1988) that the bees of the Sudan belong to three distinct groups: *A. m. jemenitica*, the smallest bee of the semi-desert zone; *A. m. sudanensis*, the medium-sized bee of the forests and rich savanna regions; *A. m. bandasii*, the larger Sudanese bee along the border with Ethiopia. Using a more extensive data set, El-Sarrag *et al.* (1992) reported the existence of two subspecies with distribution zones different from those of Mogga: a small, yellow- banded bee, *A. m. sudanensis* distributed over all the Sudan south of the Nubian desert and a larger, mixed black-and-yellow bee, *A. m. nubica* distributed along the boundaries of Sudan with Ethiopia and Uganda. Woyke (1993) stated that the Sudanese bee is the *A. m. nubica* ecotype of *A. m. jemenitica*.

The small, yellow bee found in Chad, on the other hand, revealed no significant variability within an area of 1 000 km^2 around N'Djamena (Gadbin *et al.*, 1979). Similarly, Dutton *et al.* (1981) working with bees from Oman and Yemen, found no significant differences within and between the countries. Karpowicz (1989), however, reported great variability in body size between the smaller bees of the coastal plains of Oman and the relatively larger bees of the mountains in north Yemen. The bees of Somalia are described as bright yellow (Giavarini, 1937; Monaco, 1985). Ruttner (1992) recognised the bees of Somalia, Chad and Uganda as distinguishable subpopulations of *A. m. jemenitica*.

Even though there is considerable variation in size, on a macro-level *A. m. jemenitica* can still be separated morphometrically from *A. m. litorea* (Ruttner, 1992). However, differentiation by morphometrics seems more difficult for African than European bee populations (Gadbin *et al.*, 1979; Cornuet and Fresnaye, 1989).

Another bee that lives in environmental conditions of high aridity and great fluctuations in temperature is *A. m. sahariensis*. It has been described by Baldensperger (1924), Br. Adam (1983) and Haccour (1960, 1983) as a gentle, small yellow to reddish bee. *A. m. sahariensis* is restricted to a narrow zone in south Morocco and west Algeria by the Atlas mountains and the Sahara desert (Haccour, 1983). It was thought that this bee was isolated from the other Moroccan bees in the south by the barrier of the Atlas mountains (Haccour, 1960). However, Cornuet *et al.* (1988) found that the bees southwest of the Atlas range showed large morphological variations and interpreted this as a *A. m. sahariensis* × *A. m. intermissa* hybrid zone. In the same morphometric study, the bees of Morocco were discriminated into three distinct groups: the small, yellow bee *A. m. sahariensis* in the south; the larger, black bee *A. m. intermissa*, north-west of the Atlas range and the even larger black bee *A. m. major* (Ruttner, 1975) associated with the Rif and close to the Mediterranean coast (Cornuet *et al.*, 1988; Br. Adam, 1987). Intermediate morphological variability was found in the bees south of the Rif range indicating an *A. m. intermissa* × *A. m. major* hybrid zone (Cornuet *et al.*, 1988).

A. m. intermissa has morphological features close to those bees of southwest Europe (Paradeau, 1951; Hicheri and Bouderbala, 1969). Morphological studies show a gradual transition from *A. m. adansonii* to *A. m. iberica* in Spain, through *A. m. sahariensis*, *A. m. intermissa* and *A. m. major*, indicating a phylogenetic link between them (Ruttner *et al.*, 1978; Cornuet *et al.*, 1988; Cornuet and Fresnaye, 1989; Ruttner, 1992). Mitochondrial DNA haplotype data link *A. m. intermissa* with *A. m. scutellata*, *A. m. capensis* and *A. m. unicolor*. This suggests that the observed morphological transition across Spain has been brought about by secondary hybridisation between African and European lineages (Smith, 1991; Garnery *et al.*, 1992; Moritz, 1994).

1.5 Research objectives

The aim of the research presented in this thesis is to begin to assess population structure and, where possible, dynamics in the honeybees of Africa at a meso-scale level of sampling distance resolution. For practical purposes, "meso-scale" as used here means less than the distance that *A. m. scutellata* is inferred to have moved annually over the last 40 years since its introduction into Brazil (Soares and De Jong, 1992). Five transects, ranging from 1 000 km to 2 000 km each with an overall mean sampling distance resolution of approximately 160 km, were chosen to cut across areas in Africa where there are particular and biologically interesting uncertainties about population distributions and demarcation and/or hybridisation zones between adjacent populations.

Firstly, a transect from the western Sahara to the eastern Pyrenees was selected to assess the direction and extent of continued gene flow in the honeybees of north Africa and the Iberian peninsula. Secondly, a transect in northeastern Africa was used to assess the population distribution and probable boundaries between *A. m. scutellata*, *A. m. jemenitica* and *A. m. monticola*. Thirdly, a transect in west central Africa was chosen to possibly determine the demarcation between *A. m. adansonii* and *A. m. jemenitica* and to evaluate the presence of a "*A. m. monticola*-like" mountain bee. Fourthly, a transect in southwestern Africa was used to examine the population structure and possible boundary between *A. m. scutellata* and *A. m. adansonii* in Namibia. Fifthly, a transect in southeastern Africa was used to investigate the possible borderline between *A. m. scutellata* and *A. m. adansonii* in northern Zambia.

For this purpose, multivariate statistical procedures were applied, using characters of relatively low (morphometric) and high (pheromone) heritability to define distinct populations and possible areas of introgression in relation to climate, topography and relevant aspects of the biology of the honeybees in these five regions of Africa.

CHAPTER 2

MATERIALS AND METHODS

2.1 Study areas

The honeybees of Africa have been classified into several subspecies and/or ecotypes at the continental macro-scale level (Ruttner, 1988, 1992; Kerr, 1992). A spatial sampling resolution of approximately 1 000 kilometres was used in these previous studies, which covered an area of 30 million km^2. Sampling resolutions at a meso-scale level have in recent studies revealed morphometric variations within races which were previously undetectable at the macro-scale level (Cornuet and Fresnaye, 1989; El-Sarrag *et al.*, 1992; Lebdi-Grissa *et al.*, 1991b; Steele *et al.*, 1997). Thus, five transects were used with a mean sampling distance resolution of approximately 160 km. The distance, number of localities along the transect and average distance between each locality are given for each transect in Table 2.1.

Table 2.1 Transect distance (km), number of localities and distance between localities (km).

Transect	Distance (km)	Number of Localities	Distance between Localities (km)
1 Northwestern Africa to southeastern Spain	2 000	13	167
2 Northeastern Africa	1 100	8	138
3 West central Africa	1 000	9	125
4 Southwestern Africa	1 025	7	171
5 Southeastern Africa	1 500	8	214
	Total 6 625	Total 45	Mean 163

The rate at which Africanised honeybees have been advancing over 40 years in South and Central America has been estimated to be between 200-400 km per year (Taylor, 1977), 100-300 km per year (Ruttner, 1988), 350 km per year (Lobo *et al.*, 1989) and as high as 500 km per year (Otis, 1991). A sampling distance resolution of 160 kilometres between localities is well within the range of the possible annual movement of *A. m. scutellata* and is therefore used in this research to define "meso-scale" and to assess honeybee populations accordingly.

2.2 Morphometric data

Four to six colonies were sampled at each location along each of the transects, and a sample of approximately 100 randomly selected worker bees was taken with an insect net at the entrance of each hive. The bees were killed and preserved in 70% ethanol, and transported to the laboratory. All samples were collected in December or January. Anderson and van Schalkwyk (1977) and Ruttner (1988) demonstrated that between 10 and 20 bees would be a sufficient sample size for morphometric statistical analysis. Thus, for each colony, 20 bees served as the standard sample size.

The same eleven morphometric characters used in a previous study (Crewe *et al.*, 1994) that successfully classified colonies into two southern African races were measured. Their Ruttner (1988) numbers are given in brackets (except the wing angle MJI, see Ruttner, 1988, figure 6.9, page 73) as follows: length of cover hair on tergite 5 (1), length of proboscis (4), width of wax plate on sternite 3 (11), length of wax plate on sternite 3 (13), wing angle B4 (22), wing angle N23 (30), wing angle O26 (31), wing angle MJI, pigmentation of abdominal tergite 2 (32), pigmentation of scutellum (35) and pigmentation of scutellar plate (36). As noted in 1.2.1, Ruttner (1988) concluded that as few as 10 characters would be sufficient to morphometrically discriminate African races of honeybees and this was borne out by Crewe *et al.* (1994).

Measurements of characters associated with body size were made with a Wild M5A binocular microscope and a calibrated ocular micrometer. Angles of wing venation were measured by mounting the wings on projector slides and projecting the slide onto a SummaSketch III digitizer. The characters associated with pigmentation were assigned a value from 0 (very dark) to 9 (bright yellow) according to a pictorial colour code after Ruttner (1988). Approximately 41 000 morphometric measurements were taken for this study.

2.3 Pheromone data

Four to six colonies were sampled at each location along each of the transects. These colonies were the same as those used for the morphometric analysis. To reduce age effects, a sample of five to eight randomly selected guard bees (assumed to be at least two weeks old (Boch and Shearer, 1966; Whiffler *et al.*, 1988)) was taken from each hive. The sting apparatus was removed from each bee with forceps and immersed in 1 ml of dichloromethane (CH_2Cl_2) and sealed in a vial to prevent evaporation. In the laboratory these samples were kept at -20°C prior to gas chromatographic analysis. Extraction time under these conditions varied from two to six months.

The samples were measured with a Hewlett-Packard 5890 Series II gas chromatograph fitted with a bonded methyl silicone fused silica capillary column (0.3 mm x 25 m), using n-tetradecane ($C_{14}H_{30}$) as an internal standard. The signals from the flame ionisation detector were quantified with a Hewlett-Packard 3396 Series II integrator calibrated against authentic standards of sting pheromone constituents. Approximately 11 000 gas chromatographic measurements were made in this study. The percentages contributed by each pheromone compound to the total pheromone bouquet were determined. Percentages rather than the actual quantities were computed for the sting pheromone compounds because of the uncontrollable variations in pheromone levels associated with differing extraction times of the stings and also with age of the bees (Boch and Shearer, 1966; Whiffler *et al.*, 1988).

The following pheromone compounds were identified: isopentyl alcohol (1), n-butyl acetate (2), isopentyl acetate (3), benzyl alcohol (4), octyl acetate (5), 2-nonanol (6), benzyl acetate (7), n-decyl acetate (8) and n-octanol (9). (n-octanol was not identified in the northwestern, northeastern and southwestern Africa transect samples. The other two samples contained all nine pheromones.)

2.4 Multivariate statistical methods

The means and variances of each morphometric character and the percentage means and variances of each pheromone compound were calculated for each colony. Multivariate statistical analysis of the colony mean data included principal components analysis, factor analysis and stepwise linear discriminant analysis. The purpose of the principal components analysis was to detect the presence of possible clusters of colonies among the scatter of scores when the first two principal component scores were plotted on a plane.

A stepwise linear discriminant analysis was used to confirm the separation of the clusters and to determine the most discriminatory variables that entered the linear discriminant functions. These discriminant functions were then used to classify the colonies and to determine the percentages of those correctly classified. This classification procedure, however, may provide an overly optimistic estimate of the probability of correct classification. Therefore a jackknife procedure was carried out which classified each colony into a group with the highest *a posteriori* probability according to the discrimination functions computed from all the data except the colony being classified. This is repeated for each colony left out in turn (Lachenbruch and Mickey, 1968).

Wilks' lambda statistic was used to test for significant differences in the cluster vector of means of the characters entered into the discriminant functions. The distribution of the Λ statistic was approximated by the F distribution (Mardia *et al.*, 1979). Also the homogeneity of the within-group covariance matrices was tested by use of the likelihood ratio test. If the test for homogeneity was significant, quadratic discriminant functions were computed. In all transects, these quadratic functions produced the same classification results as the linear discriminant functions. Mahalanobis distances were calculated between the clusters and $100(1-\alpha)\%$ confidence ellipses constructed for each cluster for various values of α (Cornuet, 1982).

A factor analysis procedure using the character measurements of each bee was carried out to determine the first factor scores of each bee. This procedure was repeated using the colony means of each character to compute the first factor scores of each colony. The intra- and intercolonial variances of these factor scores were calculated at each locality and Levene's F statistic was used to test whether the variances were heterogeneous. This test procedure is based on an analysis of variance using the absolute deviation of each case from its locality mean (Brown and Forsythe, 1974).

The relations of population morphological variation with environmental variables were investigated by correlation and canonical correlation analyses. The significance of each canonical variable was tested using Bartlett's statistic whose distribution is approximated by a chi-square distribution. The sequential Bonferroni method of multiple tests of individual significance of correlations was used to ensure that the overall level of significance was not larger than 0.05 (Miller, 1981). The environmental variables used were temperature, rainfall, geographic latitude, longitude and altitude at each location and were taken from Jackson (1961) and Muller (1982).

2.5 Compositional data methods

The proportions of the pheromone compounds are subject to a unit-sum constraint. Let x_i, for i = 1,2,...,p, denote the proportion of the ith pheromone compound in a composition of p identified sting pheromone compounds. Then

$$x_1 + x_2 + \ldots + x_p = 1.$$

One of the difficulties experienced in compositional data analysis is that the covariances and correlations between the compositions are subject to a negative bias. Let the variance of x_i, covariance of x_i and x_j, and the correlation between x_i and x_j be denoted by $var(x_i)$, $cov(x_i,x_j)$ and $corr(x_i,x_j)$ respectively. Since for any i = 1,2,...,p

$$cov(x_i,\ x_1 + x_2 + \ldots + x_p) = 0$$

then for j = 1,2,...,p

$$\sum_{j \neq i} cov(x_i,x_j) = -\ var(x_i).$$

Hence, at least p of the entries in both the pxp covariance matrix, Σ, and the correlation matrix, **R**, of the proportions must be negative. The correlations are, therefore, not free to range over the usual interval (-1,1), subject to the correlation matrix being non-negative definite, and this leads to difficulties in interpreting the computed phenotypic correlations between the pheromone compounds.

Another difficulty arises when applying a principal components analysis to compositional data. The pxp covariance matrix, Σ, satisfies

$$\Sigma \mathbf{i} = \mathbf{0}$$

where **i** is a px1 vector of units and **0** is a px1 vector of zeros. Hence, the singular covariance matrix has a zero eigenvalue with corresponding eigenvector $\mathbf{i}/\sqrt{p}$. The remaining eigenvalues λ_j are, in general, positive with corresponding standardised eigenvectors β_j for $j = 1,2,\ldots,p-1$. The jth principal component is determined by $\beta_j'\mathbf{x}$ where **x** is a p-dimensional vector of components. The unfavourable properties of the covariances means that the principal components determined from Σ may fail to yield satisfactory results. The same problem is experienced when applying discriminant analysis procedures, since the discriminant functions are also derived from the covariance matrix Σ.

Because of the difficulties encountered when analysing compositional data, Aitchison (1981) proposed transforming the compositions to additive logratio compositions and then applying, wherever possible, standard multivariate statistical procedures. Aitchison (1981) defined a (p-1) x (p-1) logratio covariance matrix Σ^* by

$$\Sigma^* = \mathrm{cov}(\log(x_i/x_p), \log(x_j/x_p))$$

for $i,j = 1,2,\ldots, p-1$ and a (p-1) x 1 vector logratio mean by

$$\mu^* = E(\log(\mathbf{x}/x_p).$$

The covariance matrix Σ^* is generally nonsingular and has no negative bias restrictions imposed on it. A drawback, however, in using Σ^* is that the outcomes of certain statistical procedures (i.e. principal components analysis) may not be invariant to the common divisor used in the logratio transformation. The outcomes of hypothesis tests on the equality of μ^* and Σ^* between groups and discriminant analysis procedures are invariant on the choice of the common component divisor (Aitchison, 1986).

To obtain a logratio covariance matrix that is symmetric in the compositional parts and invariant to the common divisor, Aitchison (1983) introduced a pxp centred logratio covariance matrix $\mathbf{\Gamma}$ defined by

$$\mathbf{\Gamma} = \mathrm{cov}(\log(x_i/g(\mathbf{x})), \log(x_j/g(\mathbf{x})))$$

for i,j = 1,2, ..., p and where $g(\mathbf{x}) = (x_1 x_2 \ldots x_p)^{1/p}$ is the geometric mean. This covariance matrix is singular since $\mathbf{\Gamma i} = \mathbf{0}$ and hence for certain statistical methods a Moore-Penrose generalised inverse is required. When applying principal components analysis to compositional data, Aitchison (1983) proposed determining logcontrast principal components using the centred logratio covariance matrix $\mathbf{\Gamma}$.

For specifying the covariance structure of the p compositions, Aitchison (1984) defined a pxp variation matrix $\mathbf{T}$ where

$$\mathbf{T} = \mathrm{var}(\log(x_i/x_j)) \quad \text{for } i,j = 1,2, \ldots, p.$$

This variation matrix is symmetric with zeros along the main diagonal. It is not a covariance matrix but is used to give measures of the variability of one component x_i relative to another

x_j for i,j = 1,2, ..., p. The sum of ½ p(p-1) logratio variances is used to provide some measure of total variability for the composition of the identified alarm pheromones.

The main drawback to the logratio transformation method is that it is assumed that no component proportions are recorded as zero. Aitchison (1986) suggested that the rounded or trace zeros be replaced by "positive values smaller than the smallest recordable value". The smallest recordable gas chromatographic measurement of the peak areas of any identified pheromone compound was 10 000 integrator units. Hence for purposes of this research the areas that could not be measured below this value were replaced by 1 000 integrator units. The outcomes of the analysis were robust to the choice of the replacement value.

2.6 Neural networks method

Artificial neural networks have recently been applied to a wide variety of problem areas including pattern recognition, forecasting and classification (Coats and Fant, 1992; Lang *et al.*, 1990). In particular, considerable successes have been achieved when applying neural networks to classification problems (de Jongh and de Wet, 1993; Yoon *et al.*, 1993). Neural networks were motivated by research into the neuron systems of the human brain. Human information processing takes place through the interaction of many billions of neurons, each sending excitatory or inhibitory signals to other neurons.

Analogous to the brain, an artificial neural network is made up of several artificial neurons (referred to as processing nodes) which have many input paths and an output path. Typically, a neural network consists of an input layer of processing nodes, the number of which depends upon the dimension of the input vector being analysed; a series of intermediary or hidden layers containing nodes, the number depending upon the complexity of the patterns in the data set and finally an output layer consisting of nodes, the number depending upon the dimension of the output vector. The output value of the jth processing node in the hidden layer is defined by

$$O_j = h\left(\sum_{i=1}^{n} w_{ki}x_i - \theta_k \right)$$

where x_i is the ith input node for $i=1,2...,n$, w_{ki} is the connection weight between the ith node in the input layer and the kth node in the hidden layer, θ_k is a threshold value of the kth node in the hidden layer and h is some function which is often chosen to be of sigmoidal form.

A mathematical learning algorithm is used to train the neural network to detect relationships between the input data and the output values. This training continues and the connection weights which determine the strength of the connection between the processing nodes are adjusted until the difference between the observed and the derived output is minimised. The most common learning algorithm, called the back-propagation algorithm, was chosen for this study. This algorithm is a non-linear model which is distribution free. The sigmoidal output function used in the analysis was defined by

$$h(y) = (1 + \exp(-y))^{-1}.$$

In this research the input nodes in the input layer were the morphometric characters or the pheromone percentage compounds. The output layer corresponded to the clusters of colonies. The data sets were divided at random into a training set (70%) and a test set (30%). The training set was used to train the network while the test set was used to evaluate the performance of the network on data which had not been used during training. The data sets for each transect were analysed using NeuralWorks Predict system which selects the minimal set of relevant input nodes to give maximum overall performance in the classification of the colonies.

An advantage of using artificial neural networks is that the method is distribution free. Although Fisher's original discriminant analysis procedure is distribution free, assumptions of multivariate normality of the explanatory variables with equal covariance matrices are necessary if the discriminant analysis is to be used to provide an optimal allocation rule to minimise the probability of misclassification.

CHAPTER 3

MORPHOMETRIC AND PHEROMONAL ANALYSES OF *APIS MELLIFERA* L. ALONG A TRANSECT FROM THE SAHARA TO THE PYRENEES

3.1 Summary

Pheromones and morphological characters of worker honeybees from Morocco and Spain were analysed with multivariate statistical methods. Principal components and stepwise discriminant analyses yielded three morphometric clusters corresponding to *A. m. sahariensis* and *A. m. intermissa* (including the ecotype *A. m. major*) in Morocco and to *A. m. iberica* (with three biometric populations) in Spain but no pheromone clusters. Intercolonial variances for all characters formed significant asymmetries within the areas of classically defined subspecies. These were complemented by the trends in intracolonial variance. At the population level there is a pulsatile oscillation of high and low variances along the transect which coincides with similar variations in allozyme and mitochondrial polymorphisms. The combined morphometric and pheromonal variance spectra indicate regions of natural hybridisation along a Sahara-Pyrenees transect.

3.2 Introduction

Honeybees native to the Maghreb derive from a common African lineage, part of which now coexists with the western European lineage on the Iberian peninsula (Ruttner, 1988; Smith *et al.*, 1991; Cornuet and Garnery, 1991a, b). The former are classified as the races *A. m. sahariensis*, *A. m. intermissa* and *A. m. major* (Cornuet *et al.*, 1988; Ruttner, 1988) and the latter as *A. m. iberica* (Goetze, 1964; Ruttner, 1988). However, biometric subgroups have been identified for both *A. m. intermissa* (Lebdi-Grissa *et al.*, 1991b) and *A. m. iberica* (Cornuet and Fresnaye, 1989; Orantes-Bermejo and Garcia-Fernández, 1995). There is also concommitant variation in the mtDNA haplotypes (Garnery *et al.*, 1995) and allozyme alleles (Smith and Glenn, 1994) for all four races.

Because the honeybees between the Sahara and the Pyrenees do not form a single panmictic population, as already shown by their biometric groups, both differentiation and hybridisation can be expected (Cornuet *et al.*, 1988; Garnery *et al.*, 1995). Factors currently affecting variation in the populations of these regions include marked climatic variations that result in fluctuating population sizes and phase shifts and time lags for the occurrence of crucial biological events in the annual cycle of the colony such as swarming and absconding (Paradeau, 1955; Haccour, 1960; Barbier, 1974; Second, 1974). It is also somewhat problematic that the bees of Morocco and Spain have not been combined in a single comparative study using the same suites of characters, localities and methods of statistical discrimination. Thus samples of honeybees collected from colonies along a transect through this region have been morphometrically and pheromonally analysed to determine their heteroscedastic characteristics and to identify possible zones of hybridisation.

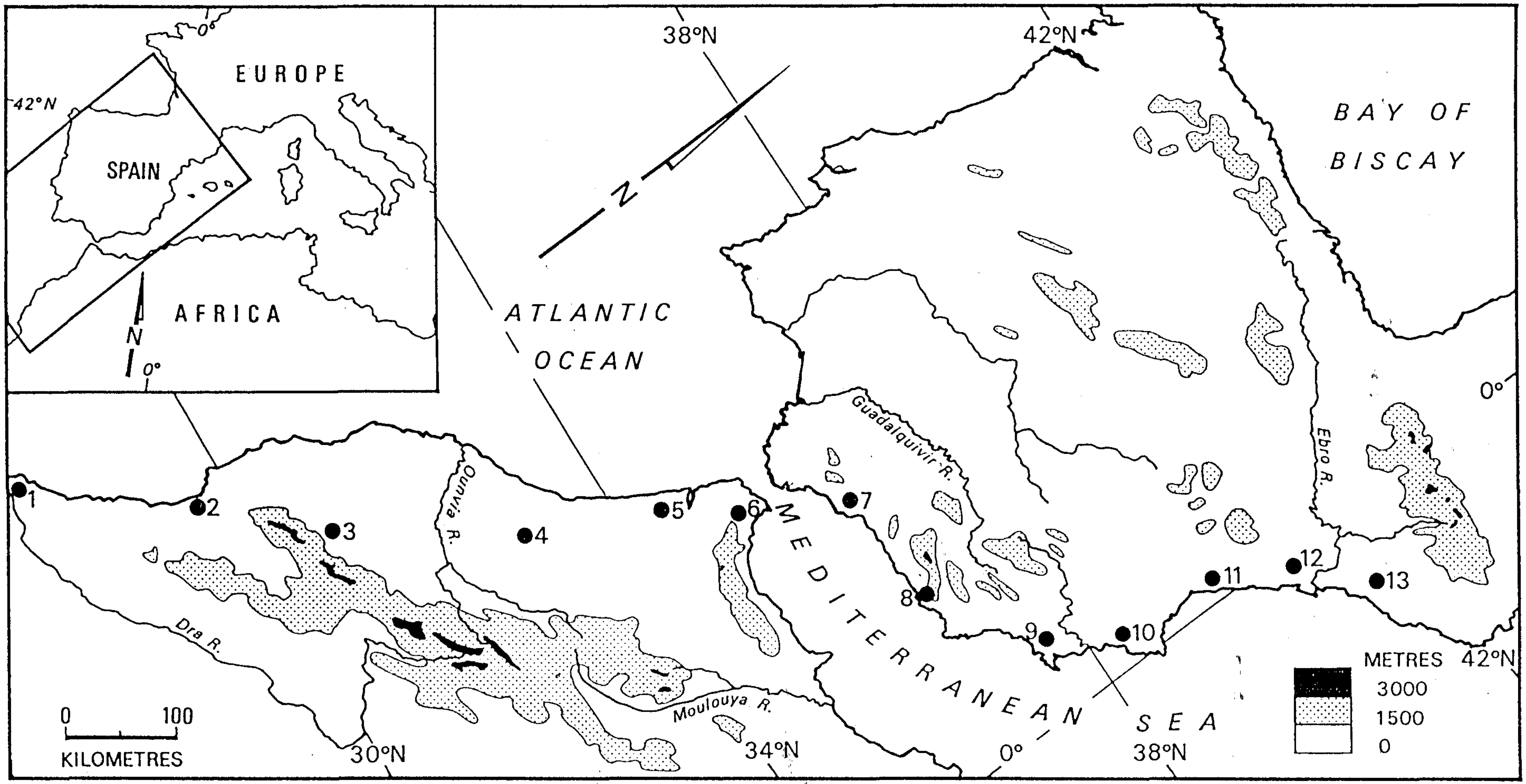
3.3 Materials

Worker honeybees were sampled from the colonies of small scale, fixed-site beekeepers at 13 different localities, extending from Tan Tan (28.30N 11.02W) in southwestern Morocco, through S. Rabat (30.00N 09.58W), Marrakech (31.49N 08.00W), Ez Zhiliga (33.18N 06.30W), Ksar-el-Kebir (35.04N 05.56W), to Tetouan (35.34N 05.22W) in northern Morocco, Alhaurin el Grande (36.44N 04.42W) in southern Spain, through Berja

(36.57N 02.56W), Totana (37.46N 01.30W), Callosa d'Ensania (38.40N 00.08W), Puerto de Sagunto (39.39N 00.17W), Benicarlo (40.25N 00.25E) to Montblanc (41.23N 01.10E) in northeastern Spain (Figure 3.1).

Morphometric measurements were made on at least 10 worker bees per colony, and five to six colonies were sampled at each locality. A total of 743 bees was used in the morphometric analysis. For the pheromone analyses guard bees were collected from the same five to six colonies per locality and 5 bees sampled per colony. A total of 370 bees was used in the pheromone analyses.

Figure 3.1 Localities in Morocco and Spain sampled in this study: Tan Tan (1), S. Rabat (2), Marrakech (3), Ez Zhiliga (4), Ksar-el-Kebir (5), Tetouan (6), Alhaurin el Grande (7), Berja (8), Totana (9), Callosa d'Ensania (10), Puertó de Sagunto (11), Benicarlo (12) and Montblanc (13).



3.4 Results

3.4.1 Morphometric analysis

In a principal components analysis of the morphometric characters of 73 colonies three factors with eigenvalues greater than 1 were isolated: factor 1: characters associated with size, length and width of wax plate on sternite 3 (13) and (11), length of proboscis (4), length of hair on tergite 5 (1) and pigmentation of tergite 2 (32); factor 2: pigmentation of scutellum (35) and scutellar plate (36); factor 3: angles of venation MJI and B4 (22). These factors accounted for 71.2% of the variance in the data. The loadings for each character had absolute value greater than 0.70. The graph of the factor scores from factor 1 and factor 2 showed three clusters, the colonies from Tan Tan and S. Rabat forming one cluster, those from Marrakech, Ez Zhiliga, Ksar-el-Kebir and Tetouan a second cluster, and all the colonies of Spain forming the third cluster.

A stepwise discriminant analysis using the colony means of the morphometric characters confirmed the separation of the three clusters (Figure 3.2). Table 3.1 shows the five characters entered into the linear discriminant functions ranked according to their discriminatory power. Each colony was assumed to have equal *a priori* probability of being in any cluster. The discriminant analysis procedure revealed that pigmentation of tergite 2 (32) best discriminated between the three groups. Two other characters to enter the discriminant functions were width of wax plate on sternite 3 (11) and length of hair on tergite 5 (1). These three characters had high factor loadings in factor 1 of the factor analysis.

Table 3.1 Morphological characters entered into the discriminant function ranked according to their discriminatory power.

Character entered	F statistic	df	p-value
pigmentation (32)	433.59	2,70	<0.0001
width of wax plate (11)	124.04	2,69	<0.0001
wing angle (30)	8.23	2,68	0.0006
wing angle (31)	6.05	2,67	0.0038
hair length (1)	7.59	2,66	0.0011

A discriminant analysis using the means of the most discriminatory characters (Table 3.1) was carried out and 100% correct classification into the three established clusters was obtained (Figure 3.2). Mahalanobis distances D^2 between the clusters were $D^2=24.14$ for 1 and 2, $D^2=83.97$ for 1 and 3, and $D^2=14.62$ for 2 and 3. In group 1, 100% of the colonies were classified correctly with *a posteriori* probability p=1.0 for 11 colonies and p=0.934 for the remaining 1 colony. In group 2, 100% of the colonies were classified correctly with *a posteriori* probability p=1.0 for 19 colonies and p=0.997 for 1 colony and in group 3, 100% correct classification was established with *a posteriori* probability p=1.0 for 40 colonies and p=0.980 for the remaining 1 colony. A jackknife procedure (Lachenbruch and Mickey, 1968) produced identical classification results (Table 3.2).

The neural networks procedure selected the following six morphometric characters as the input nodes: length of hair on tergite 5 (1), width of wax plate on sternite 3 (11), wing angles B4 (22) and O26 (31), pigmentation of scutellum (35) and of abdominal tergite 2 (32). No hidden layer was necessary to achieve 100% correct classification in both the training and test sets in all three clusters.

Figure 3.2 Discriminant analysis plot using the colony means of the morphometric data: cluster 1 is composed of colonies from Tan Tan and S. Rabat, cluster 2 is composed of colonies from Marrakech, Ez Zhiliga, Ksar-el-Kebir and Tetouan, cluster 3 is composed of colonies from Alhaurin el Grande, Berja, Totana, Callosa d'Ensania, Puerto de Sagunto, Benicarlo and Montblanc. Confidence ellipses are at the 95% level. CD = canonical distances from the common centroid of the morphoclusters.

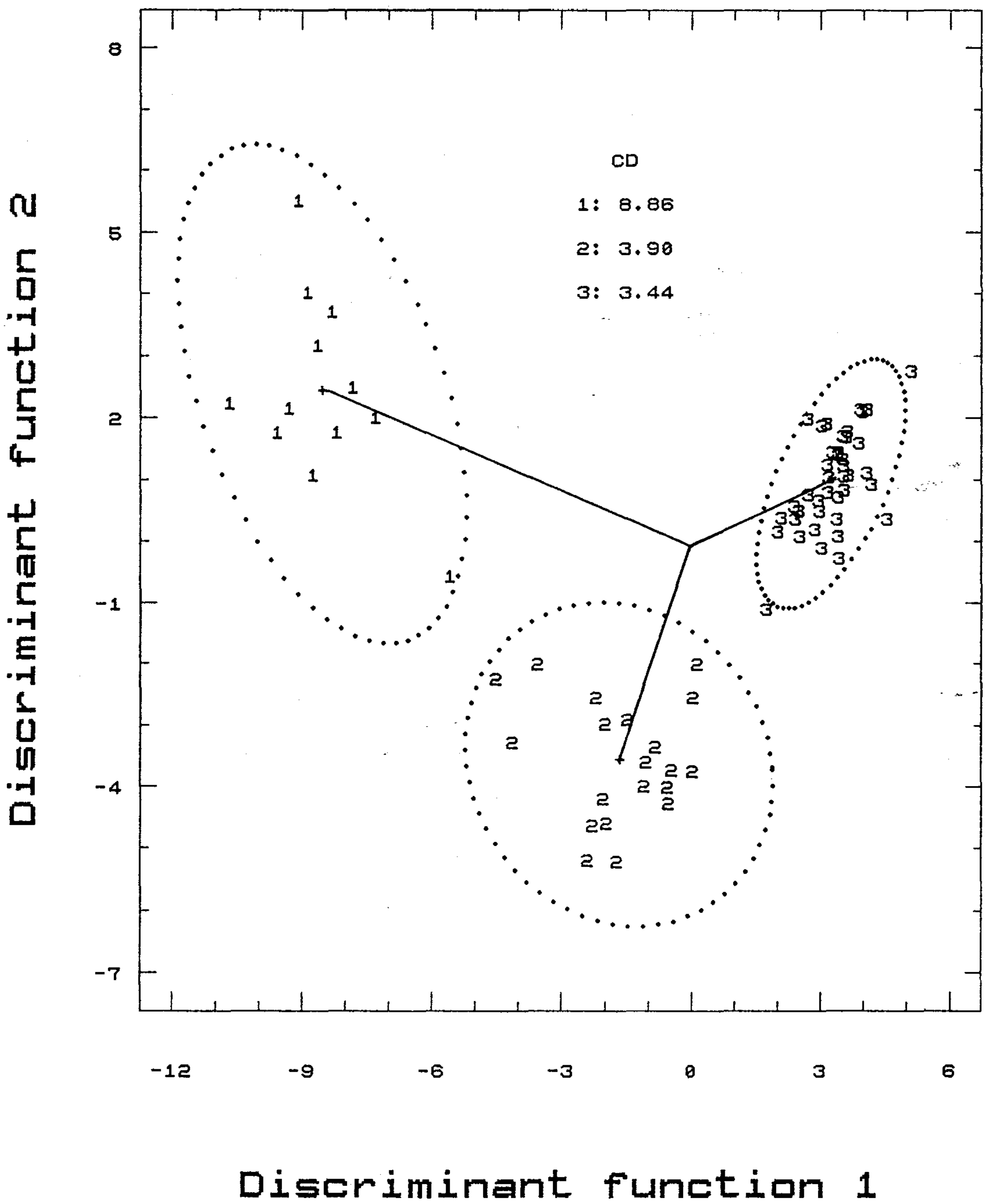


Table 3.2 Classification of colonies from Tan Tan and S. Rabat (group 1), Marrakech, Ez Zhiliga, Ksar-el-Kebir and Tetouan (group 2) and Alhaurin el Grande, Berja, Totana, Callosa d'Ensania, Puerto de Sagunto, Benicarlo and Montblanc (group 3).

	Classification Matrix				Jackknifed Classification			
Group	% Correct	Number of colonies			% Correct	Number of colonies		
1	100%	12	0	0	100%	12	0	0
2	100%	0	20	0	100%	0	20	0
3	100%	0	0	41	100%	0	0	41

To test for the equality of the group means for the characters used in the discriminant function, Wilks' lambda approximated by the F statistic was determined. A significant difference between the means of the three groups was verified ($\Lambda=0.0090$, 5,2,70 df, $F=125.86$, 10,132 df, $p<0.0001$). The covariance matrices were found to be significantly different ($-2\rho\log\Lambda=127.71$ with 30 df, $p<0.0001$). The computed quadratic discriminant functions produced the same classification results. The means and standard deviations of the 11 morphometric characters are shown in Table 3.3 for the three groups using all 743 bees from 13 localities. The phenotypic correlations between the characters are presented in Table 3.4.

Table 3.3 Means and standard deviations (s.d.) of discriminant morphometric characters (measurements in mm, angles in degrees).

	Group 1 n=120		**Group 2** n=213		**Group 3** n=410	
Character	Mean	s.d.	Mean	s.d.	Mean	s.d.
hair length (1)	0.19	0.03	0.22	0.05	0.29	0.06
proboscis length (4)	6.07	0.17	6.26	0.28	6.57	0.18
width of wax plate (11)	2.70	0.07	2.73	0.09	2.95	0.07
length of wax plate (13)	2.24	0.07	2.30	0.11	2.49	0.06
pigmentation (35)	2.77	1.70	0.15	0.41	0.39	0.49
pigmentation (36)	0.38	0.90	0.19	0.50	0.57	0.75
pigmentation (32)	7.36	2.17	1.87	1.25	1.23	0.51
wing angle B4 (22)	106.20	6.81	106.52	6.74	107.73	5.19
wing angle MJI	19.10	2.77	18.95	2.39	18.48	2.33
wing angle N23 (30)	79.24	5.24	75.59	6.42	81.54	4.51
wing angle O26 (31)	34.24	3.23	35.16	4.42	37.90	3.37

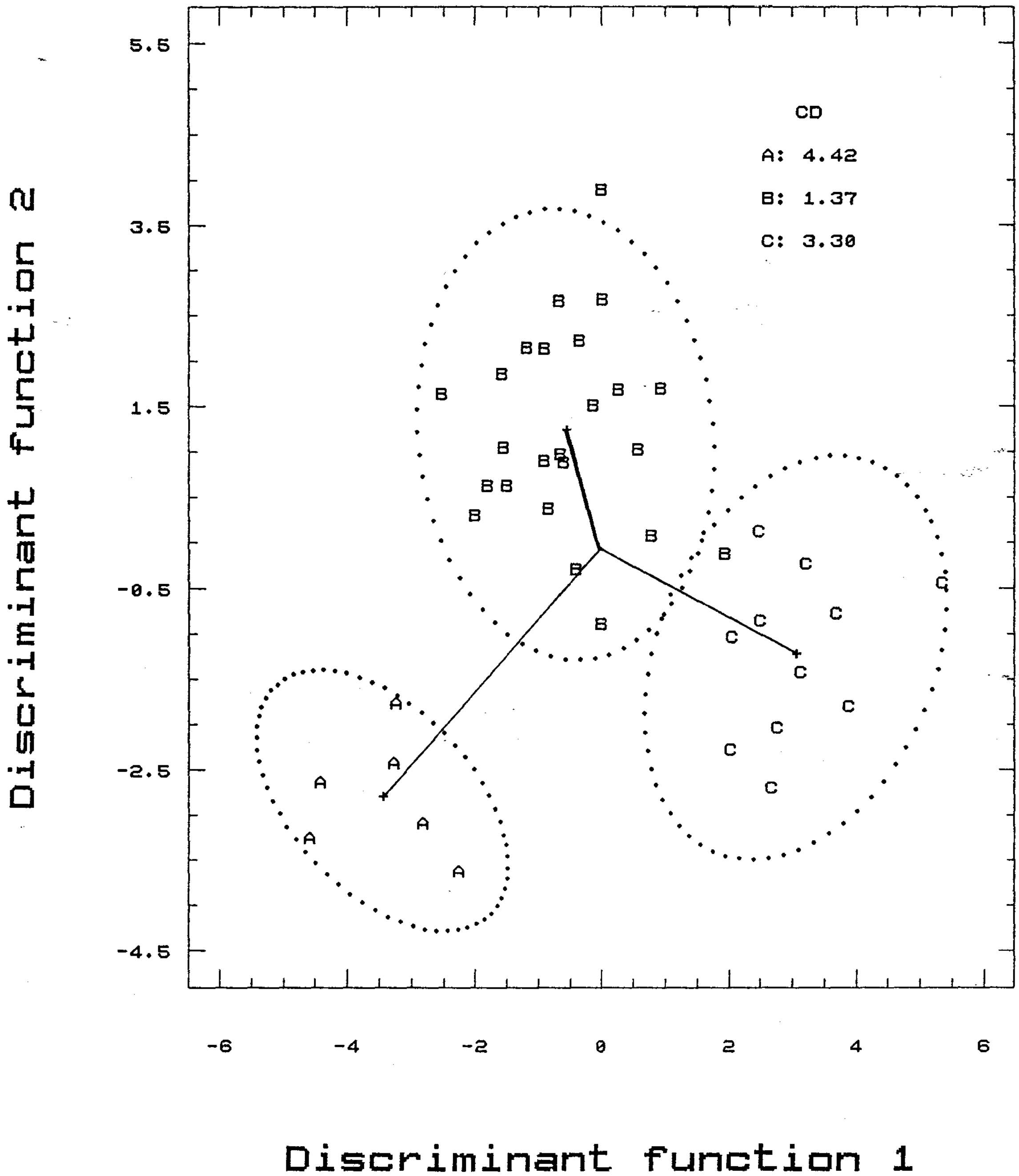
Table 3.4 Phenotypic correlations of the morphological characters from worker bees.

Character	(1)	(4)	(11)	(13)	(35)	(36)	(32)	(22)	MJI	(30)	(31)
(1)	1.00										
(4)	0.43	1.00									
(11)	0.57*	0.83*	1.00								
(13)	0.67*	0.86*	0.94*	1.00							
(35)	-0.43	-0.47	-0.39	-0.46	1.00						
(36)	0.04	0.23	0.33	0.27	0.23	1.00					
(32)	-0.54*	-0.64*	-0.61*	-0.66*	0.90*	-0.04	1.00				
(22)	0.19	0.26	0.22	0.20	-0.15	0.10	-0.16	1.00			
MJI	-0.22	-0.07	-0.18	-0.14	0.06	-0.24	0.18	-0.41	1.00		
(30)	0.35	0.40	0.55*	0.45	0.03	0.21	-0.13	0.02	0.03	1.00	
(31)	0.30	0.42	0.55*	0.49	-0.30	0.25	-0.42	-0.06	-0.14	0.32	1.00

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

A factor analysis was carried out using the colonies from Spain in order to establish any morphological differences among the different localities. Three biometric groups were found, group A comprising of colonies from Alhaurin el Grande (7), group B comprising of colonies from Berja (8), Totana (9), Callosa d' Ensania (10) and Puerto de Sagunto (11) and group C comprising of colonies from Benicarlo (12) and Montblanc (13) (Figure 3.3). A discriminant analysis confirmed these three biometric groups with 100% correct classification results in each group except one group B colony being classified as group C (Figure 3.3).

Figure 3.3 Discriminant analysis plot of the colonies in Spain using the means of the morphometric data. Biometric group A is composed of colonies from Alhaurin el Grande, biometric group B is composed of colonies from Berja, Totana, Callosa d'Ensania and Puerto de Sagunto and biometric group C is composed of colonies from Benicarlo and Montblanc. Confidence ellipses are at the 90% level. CD = canonical distances from the common centroid of the biometric groups.



A correlation analysis was used to assess the geographic variability in honeybees along the transect. Significant negative (positive) correlations (Table 3.5) between the measures related to body size and temperature and longitude (latitude) confirm the findings that larger bees are found in cooler areas (Ruttner, 1988). Significant positive (negative) correlatons (Table 3.5) between measures of pigmentation and temperature and longitude (latitude) confirm that darker bees are found in cooler regions (Ruttner, 1988). No significant correlations were found between the morphometric characters and altitude.

A canonical correlation analysis revealed a significant correlation between the set of environmental variables (temperature, rainfall and altitude) and the set of morphological charaters ($R=0.97$, $\chi^2=285.5$ with 33 df, $p<0.0001$). The largest squared multiple correlation was found between temperature and the set of morphometric variables ($R^2=0.93$, $p<0.0001$).

Table 3.5 Correlation coefficients (r) with corresponding p-values (p) between latitude, longitude, mean annual temperature, altitude, rainfall and the colony means of the morphometric characters.

	Latitude		**Longitude**		**Tmax**		**Altitude**		**Rainfall**	
Character	r	p	r	p	r	p	r	p	r	p
(1)	0.81*	<0.01	-0.82*	<0.01	-0.65*	<0.01	-0.01	0.92	0.22	0.07
(4)	0.70*	<0.01	-0.65*	<0.01	-0.64*	<0.01	-0.12	0.33	0.48*	<0.01
(11)	0.82*	<0.01	-0.82*	<0.01	-0.58*	<0.01	-0.29	0.01	0.31	0.01
(13)	0.88*	<0.01	-0.86*	<0.01	-0.68*	<0.01	-0.27	0.02	0.45*	<0.01
(35)	-0.64*	<0.01	0.57*	<0.01	0.85*	<0.01	-0.30	0.01	-0.47*	<0.01
(36)	0.19	0.10	-0.25	0.03	0.05	0.68	-0.16	0.17	0.15	0.20
(32)	-0.80*	<0.01	0.76*	<0.01	0.92*	<0.01	-0.25	0.03	-0.51*	<0.01
(22)	0.21	0.07	-0.21	0.07	-0.23	0.05	0.14	0.23	0.05	0.70
MJI	-0.23	0.05	0.29	0.01	0.14	0.24	-0.08	0.52	-0.05	0.65
(30)	0.36	<0.01	-0.40	<0.01	-0.15	0.20	-0.13	0.29	-0.19	0.11
(31)	0.49*	<0.01	-0.52*	<0.01	-0.31	0.01	0.09	0.46	-0.08	0.48

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

The first principal component coefficients of the morphometric characters were used to determine the factor score of each bee. The variances of these factor scores were used to test for homogeneity of the variances at each locality. A significant difference was found between the intracolonial variances (Table 3.6) over all the localities (Levene's test $F=4.54$ with 12,730 df, $p<0.0001$). When the variances were tested in pairs between localities it was found that the variances obtained at Tan Tan, S. Rabat, Ksar-el-Kebir and Tetouan were significantly different from Berja in southern Spain through to Montblanc in northeastern Spain.

A significant difference was also established between Montblanc and the other Spanish localities north of Berja (Levene's test in each case gave $p<0.001$ which is significant when using Bonferroni's adjustment in the level of significance for simultaneous testing). The intercolonial variances (Table 3.6) were computed by the same method but this time the colony means were used to determine the factor scores of each colony. No significant difference was found in the variances between localities ($F=1.57$ with 12,60 df, $p=0.1239$). However, larger variances were again obtained at Tan Tan, Ksar-el-Kebir and Tetouan.

Table 3.6 Intracolonial and intercolonial variances of factor scores of the morphometric data at each locality.

Locality	Intracolonial	Intercolonial
Tan Tan (1)	9.43*	6.45
S. Rabat (2)	11.25*	2.19
Marrakech (3)	6.72	2.75
Ez Zhiliga (4)	6.08	4.07
Ksar-el-Kebir (5)	10.44*	5.15
Tetouan (6)	10.87*	9.21
Alhaurin el Grande (7)	5.21	3.73
Berja (8)	3.13	0.76
Totana (9)	3.57	0.37
Callosa d'Ensania (10)	3.22	3.11
Puerto de Sagunto (11)	3.87	2.01
Benicarlo (12)	3.77	3.00
Montblanc (13)	6.09	1.81

* Significant ($p<0.01$).

3.4.2 Pheromone analysis

In a principal components analysis using the mean percentages of the eight compounds of the sting pheromone complex, the following three factors with eigenvalues greater than one were isolated and accounted for 70.4% of the variance of the data: factor 1: isopentyl acetate (3) and n-butyl acetate (2); factor 2: isopentyl alcohol (1), benzyl acetate (7) and 2-nonanol (6); factor 3: benzyl alcohol (4) and octyl acetate (5). The factor scores plot revealed no distinct clusters. Using the logratio transformed data of the sting compounds, two factors based on the logratio covariance matrix $\mathbf{\Gamma}$ were obtained: factor 1: isopentyl alcohol (1), 2-nonanol (6), benzyl acetate (7), n-decyl acetate (8); factor 2: n-butyl acetate (2), isopentyl acetate (3), benzyl alcohol (4), octyl acetate (5), accounting for 67.3% of the variance of the data. The graph of the factor scores plot again revealed no distinct clusters.

Stepwise discriminant analyses of the percentage and logratio data of the sting pheromone compounds were performed and the compounds ranked according to their discriminatory power (Tables 3.7 and 3.8).

Table 3.7 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using percentage data.

Pheromone entered	F statistic	df	p-value
octyl acetate (5)	15.43	12,61	<0.0001
isopentyl alcohol (1)	16.69	12,60	<0.0001
isopentyl acetate (3)	7.59	12,59	<0.0001

Table 3.8 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using logratio transformed data.

Pheromone entered	F statistic	df	p-value
isopentyl alcohol (1)	24.69	12,61	<0.0001
octyl acetate (5)	9.30	12,60	<0.0001
n-butyl acetate (2)	5.11	12,59	<0.0001
benzyl alcohol (4)	4.65	12,58	<0.0001

The linear discriminant functions using the most discriminatory pheromone compounds (Tables 3.7 and 3.8) correctly classified between 83.33% and 100% of the colonies from Tan Tan (1), S. Rabat (2), Tetouan (6), Alhaurin el Grande (7), Berja (8), Callosa d'Ensania (10), Puerto de Sagunto (11) and Benicarlo (12). Only between 16.67% and 66.67% of the colonies were correctly classified from Marrakech (3), Ez Zhiliga (4), Ksar-el-Kebir (5), Totana (9) and Montblanc (13).

The neural networks procedure used seven pheromone compounds as the input nodes and no hidden layer nodes in classifying the colonies into the morphometric clusters. Poor classification results were obtained in both the training (72.5%) and test (82.0%) sets.

Table 3.9 shows the mean percentages and standard deviations of the different pheromone compounds for each of the three morphometric groups. Three compounds, isopentyl acetate (3), 2-nonanol (6) and n-decyl acetate (8), were consistently dominant notes in the sting pheromone bouquet.

Table 3.9 Mean percentages and standard deviations (s.d.) of the sting pheromones.

	Group 1 n=60		**Group 2** n=105		**Group 3** n=205	
Pheromone compound	Mean	s.d.	Mean	s.d.	Mean	s.d.
isopentyl alcohol (1)	4.32	4.51	6.63	6.69	11.10	15.94
n-butyl acetate (2)	4.03	4.90	3.60	3.15	1.00	2.85
isopentyl acetate (3)	15.19	10.73	25.03	13.99	13.86	10.56
benzyl alcohol (4)	5.48	7.52	5.07	4.30	4.42	5.32
octyl acetate (5)	2.03	3.43	6.12	5.22	20.11	19.37
2-nonanol (6)	27.62	8.03	23.58	13.50	24.67	16.50
benzyl acetate (7)	10.64	9.22	8.71	5.62	6.04	5.29
n-decyl acetate (8)	30.70	27.07	21.26	17.56	18.82	17.12

The logratio ($\log(x_i/x_j)$ for $i<j$) means and variances of the pheromone compounds ($i,j=1$ to 8) are presented in Table 3.10. The logratio means of 2-nonanol (6) are negative for $i<6$ and positive for $6<j$, indicating that the percentage of this compound is consistently greater than that of the other pheromone compounds. The largest relative variation associated with 2-nonanol is with octyl acetate (5). The total variation of the pheromonal logratio variance matrix **T** is 108.65. The values of **T** for each group are 77.24, 92.24 and 113.23 respectively, revealing a larger variation in Spain.

Table 3.10 Pheromonal variation using logratio transformed data of eight alarm pheromone components. Logratio variances are above the diagonal and logratio means are below the diagonal.

Pheromone Compound	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	0.00	2.31	2.88	2.58	3.41	4.63	5.57	5.78
(2)	0.81	0.00	2.05	2.78	3.96	2.68	2.72	3.59
(3)	-0.79	-1.60	0.00	4.37	5.34	3.87	3.20	4.99
(4)	0.34	-0.46	1.14	0.00	3.18	3.24	4.22	4.45
(5)	-0.22	-1.03	0.57	-0.57	0.00	4.74	5.94	7.04
(6)	-1.20	-2.01	-0.41	-1.54	-0.98	0.00	2.14	3.52
(7)	0.09	-0.71	0.89	-0.47	0.32	1.30	0.00	3.47
(8)	-0.65	-1.46	0.14	-1.00	-0.43	0.55	-0.75	0.00

To test for heteroscedasticity in the variances of the sting pheromone percentage and logratio transformed data between localities, the first principal component coefficients of the percentage and logratio data were calculated and used to determine the factor scores of each bee. A significant difference between the intracolonial variances (Table 3.11) of these factor scores was found between the localities (percentage: Levene's test $F=2.86$ with 12,356 df, $p=0.0009$; logratio: $F=2.31$ with 12,356 df, $p=0.0076$). Multiple comparison tests showed that the variances of the pheromone percentages at Marrakech, Ksar-el-Kebir and Puerto de Sagunto and for the logratio data at Tan Tan, Marrakech and Ksar-el-Kebir were significantly different from the variances at the other localities ($p<0.0272$ in each case).

No significant difference was found between the intercolonial variances (Table 3.11) between localities using percentage data ($F=1.30$ with 12,61 df, $p=0.2444$). A significant difference at the 10% level was established between the intercolonial variances using the logratio data ($F=1.83$ with 12,61 df, $p=0.0633$). Again it is noted that the intercolonial variations are higher at Marrakech and Ksar-el-Kebir (percentage) and Ksar-el-Kebir (logratio).

Table 3.11 Intracolonial and intercolonial variances of the factor scores of the sting pheromone compounds at each locality.

Locality	Percentage Data		Logratio Data	
	intra-colonial	inter-colonial	intra-colonial	inter-colonial
Tan Tan (1)	18.91	11.80	2.43*	1.62
S. Rabat (2)	11.11	4.49	1.72	0.96
Marrakech (3)	25.64*	14.53	2.81*	1.28
Ez Zhiliga (4)	18.04	14.83	2.40	1.77
Ksar-el-Kebir (5)	21.35*	14.46	3.17*	2.56*
Tetouan (6)	16.17	4.13	1.99	0.54
Alhaurin el Grande (7)	14.69	11.46	2.16	1.42
Berja (8)	20.21	13.05	2.27	1.13
Totana (9)	18.97	12.80	1.86	1.27
Callosa d'Ensania (10)	17.97	11.26	1.96	0.55
Puerto de Sagunto (11)	20.74*	9.32	2.18	1.46
Benicarlo (12)	14.67	5.19	1.32	0.46
Montblanc (13)	15.90	7.59	2.06	1.39

* Significant ($p<0.05$).

3.5 Discussion

The principal components and discriminant function analyses delineated three morphometrically distinct clusters (Figure 3.2) and three biometric groups for cluster 3 (Figure 3.3) along the Sahara to Pyrenees transect (Figure 3.1). These results differ somewhat from those of Ruttner (1988) and Cornuet *et al.* (1988) in the appearance of two distinct clusters in their single cluster *A. m. intermissa* region. The single cluster for Spain matches that of Goetze (1964) and Ruttner (1988) and the three biometric groups correspond to those described by Cornuet and Fresnaye (1989) and Orantes-Bermejo and Garcia-Fernández (1995).

The clusters of Figure 3.2 and biometric groups of Figure 3.3 were derived from somewhat different character suites and localities from those sampled by the cited authors, so that fine differences in group resolution are to be expected. The clusters of Figure 3.2 correspond with the more traditional interpretation of the classification of races for this region (Ruttner, 1988) as follows: group 1 is *A. m. sahariensis*; group 2, *A. m. intermissa*; and group 3, *A. m. iberica*. The race *A. m. major* was not distinct in the analysis and may be regarded as an ecotype of *A. m. intermissa* (cf. Ruttner, 1988; Kerr, 1992). The biometric groups of Spain (Figure 3.3) are regarded as populations of *A. m. iberica*.

The principal components analyses of the sting pheromones yielded no clusters. However it is noteworthy that both 2-nonanol and isopentyl alcohol (from the sting pheromone) are distributed the full length of the transect (Table 3.9). The former is considered a dominant note of the African pheromonal bouquet, the latter of European races (Blum and Fales, 1988). The distribution of these genetic markers is consistent with the interpretation of a secondary contact between the African and western European lineages in this area (Garnery *et al.*, 1992).

The differences between the clusters (Figure 3.2) and biometric groups (Figure 3.3) are not evenly reflected in their variance spectra (Tables 3.6). Likewise, there are significant differences in the intercolonial variances for the ratios of the constituents in the bouquets of sting gland pheromones (Table 3.11) within but not between localities. The high intercolonial variances are also reflected in virtually mirror-image fashion at the intracolonial level (Tables 3.6 and 3.11). The latter values are interpreted as the probable result of multiple matings of queens with drones of differing allelic frequencies (Moritz and Southwick, 1992).

Collectively the variance differences form important asymmetries indicative of hybridisation between the races along the transect (Moritz and Kauhausen, 1984). The variance data (Tables 3.6 and 3.11) indicate four highly probable zones of hybridisation: (1) in southern Morocco locality 2 (S. Rabat) is an area of hybridisation between *A. m. sahariensis* and *A. m. intermissa*; (2) in northern Morocco, locality 6 (Tetouan) hybridisation between *A. m. intermissa* and ecotype *A. m. major*; (3) in southern Spain locality 7 (Alhaurin el Grande) hybridisation between *A. m. intermissa* × ecotype *A. m. major* and *A. m. iberica*; and (4) in northeastern Spain locality 13 (Montblanc) hybridisation between *A. m. iberica* and the *A. m. mellifera* of southeastern France.

The probability of correctly identifying areas of hybridisation based on relatively few colonies for each locality sampled could be affected by the relatedness of the queens. Here, the advice of Ruttner (1988) was followed: the more primitive the beekeeper, the purer the race. In this case "primitive" means making increase by trapping feral/wild swarms. All samples were collected from just such beekeepers who simply put swarms into unmanageable, frameless, straw hives (Morocco) or home-made and unmanaged boxes (Spain). Hence the likelihood of such simple apiaries being the products of only a few queen mothers seems to be extremely remote.

There is a clinal transition in the frequency of one allozyme from northeastern Spain to Morocco, others have the same frequency across the peninsula (Cornuet and Garnery, 1991b; Smith and Glenn, 1994). The frequency distributions of the African mtDNA haplotypes decrease with increasing latitude while the European haplotypes form a similar gradient in reverse. Points of highly significant heterogeneity in the frequency distribution of the haplotypes (Garnery *et al.*, 1995) coincide with the boundaries of the morphoclusters (Figure 3.2) when these data are grouped to correspond with the sample localities in this study and tested for significant heterogeneity (Morocco: $\chi^2=108.38$ with 18 df, $p<0.0001$; Spain: $\chi^2=132.01$ with 24 df, $p<0.0001$, Greenacre, 1988).

Possible extensions of the traditional interpretation of the variance distributions of the pheromonal, morphometric, allozyme and mtDNA characters in defining population structure along the transect may also be considered. The variances of the alarm pheromones are elevated at the Sahara and oscillate through most of Morocco and then with lower amplitude along the rest of the transect to the Pyrenees (Table 3.11). The morphometric variances also oscillate at the same amplitude but at half the frequency of the pheromones in Morocco (Table 3.6). In Spain both sets of oscillations are of the same amplitude but not in phase (Tables 3.6 and 3.11). The structure of the honeybee populations and dynamics of gene flow between them may be tentatively assessed on some ecological grounds.

Fluctuations in the sizes of honeybee populations must affect the probability and extent of gene flow within and between them. The climate associated with the transect creates a number of mobility and survival filters that could modulate gene flow. The area between Tan Tan and Montblanc is basically a winter-rainfall region (Jackson, 1961; Muller, 1982). In Morocco the dry season occurs during months 5-9 in the south gradually shifting to 7-9 in the north, resulting in a two-month phase lag for the onset and duration of the dry season. The dry summers when exacerbated by the sirocco can cause severe enough dearth for some 60-80% of colonies to succumb (Barbier, 1974). The dry season in Spain is far less severe and extends over months 6-8 (Muller, 1982).

Rainfall in winter gradually increases from about 50 mm per annum in southern Morocco to 900 mm at the north coast. Across the Mediterranean straits this heavy rain drops to about 200 mm near Totana, gradually increasing to 600 mm at the Pyrenees (Muller, 1982). However, there are rainfall discontinuities. Intense rainfall occurs in months 10-4 in southern and northern Morocco but is compressed to 11-2 in the central area. Similarly, there is a phase shift in central coastal Spain in relation to areas to the north and south. These phase shifts in rainfall, which can be expected to limit colony movement, occur at the ends of regions of homogeneity and between areas of relatively high heterogeneity (localities 4 (Ez Zhiliga) and 9 (Totana) to 10 (Callosa d'Ensania), Tables 3.6 and 3.11). Harsh winters may claim upwards of 80% of small colonies with limited stores (Haccour, 1960). On the other hand, assuming that rainfall intensity roughly translates into pollen and nectar biomass for an almost totally herbaceous bee flora (Damblon, 1988; Damblon and Lobreau-Callen, 1991), the population density of colonies should gradually increase from south to north in Morocco and this must affect the probability and extent of gene flow even if the consequences for variation have not yet been modelled mathematically.

Temperature also enters the equation because monthly temperature regimes also affect honeybee mobility. Taking 15° as suitable for honeybee flight (Nachtigall *et al.*, 1989; Hepburn *et al.*, 1993) and summing the months of the year twice to include those for which both maximum and minimum temperatures reach 15°, there is a 28% temperature reduction filter (month 9) between S. Rabat and Marrakech and another (months 7-8) of 22% between Callosa d'Ensania and Puerto de Sagunto. These areas can be regarded as flight-temperature filters with a tendency to reduce gene flow associated with absconding even if the effect must operate over several generations to affect genetic constitution.

Reproductive swarming results in colony displacements and drone congregation sites further enhance the probability of out-crossing (Tribe, 1982), the latter being conspicuously reflected in the intracolonial variances (Tables 3.6 and 3.11). The possible effects of climate on population homogeneity, or, introgression are particularly evident with regard to swarming. In Morocco the usual swarming season begins in month 2 in the south, gradually shifting to month 4 over the 1 000 km to the north coast. Precisely the same sequence is repeated, over the same distance, in Spain (Verdu Gallardo, Garcia Raso personal communications). While in both countries the swarming periods overlap, the extent of overlapping varies with locality. Thus at some localities swarming is temporally isolated from others. This amounts to bottlenecks, depending on whether swarming is early, late or average in any year for a sequence of localities.

The dynamic qualities of the honeybee populations along the 2 000 km transect from Sahara to the Pyrenees is quantified by a concurrence of very different genetic characteristics: the morphometric and pheromonal variances (Tables 3.6 and 3.11) and the mitochondrial (Garnery *et al.*, 1995) and allozyme (Smith and Glenn, 1994) polymorphisms. These traits oscillate through the region, their amplitudes diminishing at apparent climate-driven bottlenecks. Such areas can be explained in terms of phase shifts in climate which directly affect activities such as swarming and absconding and, ultimately, the currently observable structure of the honeybee populations of this region.

CHAPTER 4

MORPHOMETRIC AND PHEROMONAL ANALYSES OF *APIS MELLIFERA* L. ALONG A TRANSECT IN THE HORN OF AFRICA

4.1 Summary

Morphometric characters and sting pheromones of worker honeybees, *Apis mellifera* Linnaeus, were analysed by multivariate methods to delineate the honeybee populations of the Horn of Africa. Four discrete and statistically homogeneous populations were identified: *A. m. jemenitica*, *A. m. bandasii*, *A. m. sudanensis* in Ethiopia and an unclassified group in southwestern Somalia. Areas of high intercolonial variance are interpreted as zones of hybridisation between the populations.

4.2 Introduction

While morphometric and biogeographic analyses have provided a broad macrolevel framework for the classification of honeybees of the continent as subspecies and/or ecotypes (Ruttner, 1988, 1992; Kerr, 1992), the picture of the Horn of Africa is rather blurred. As a region, the Horn is physiographically and climatographically complex as well. The highlands of Ethiopia are well-watered and their tropical climate moderated by altitude. This starkly contrasts with the dry to desert plains and plateaux of Sudan to the west, the Galla-Somali plateaux to the east and desert of Eritrea to the north (van Chi-Bonnardel, 1973).

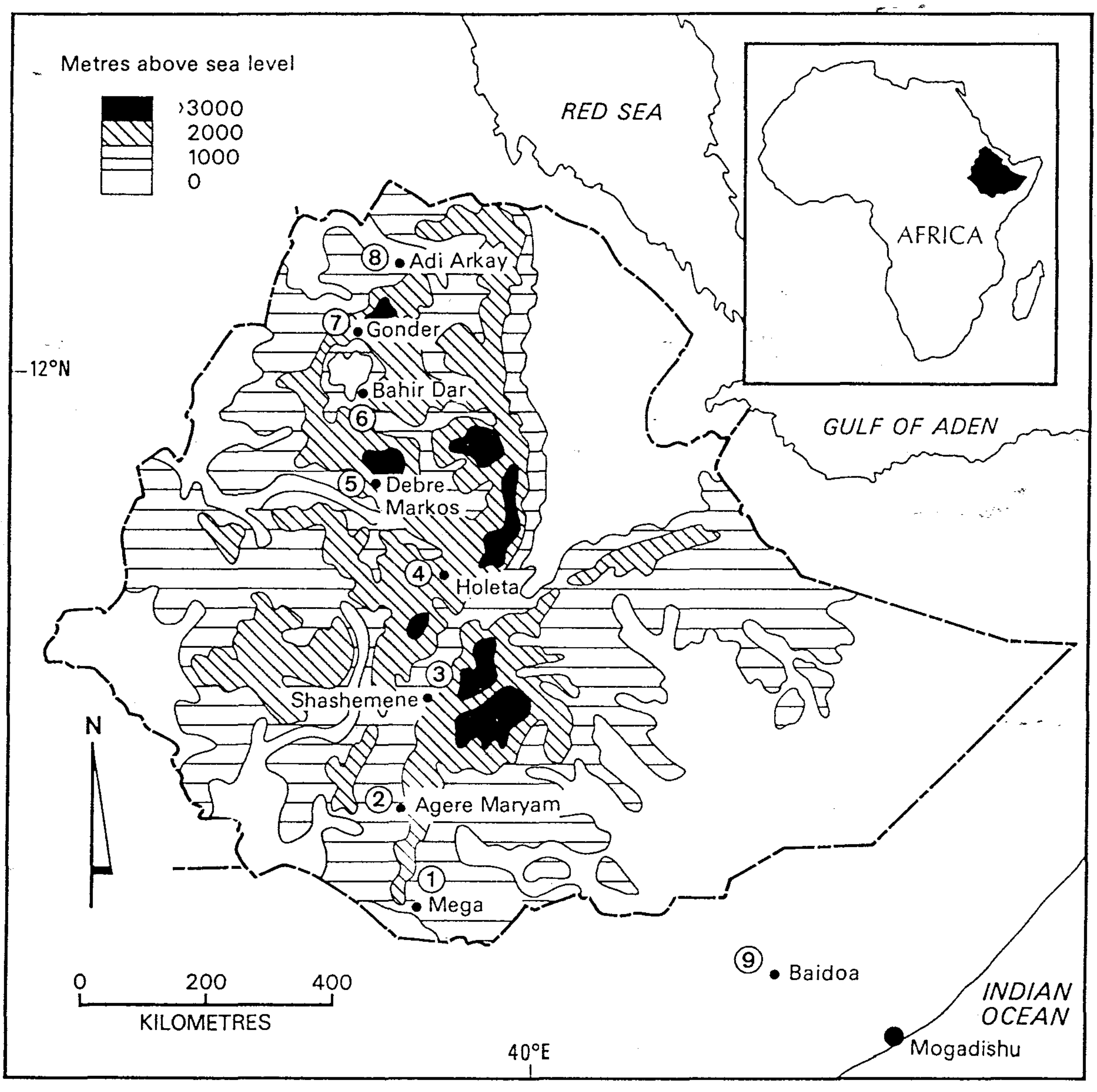
Previous analyses of the honeybees of Sudan indicated the occurrence of three subspecies: *A. m. jemenitica*, a small bee of the northern sahel; *A. m. bandasii*, a larger, darker bee of the central dry savanna; and *A. m. sudanensis* of the southern rich savanna

(Rashad and El-Sarrag, 1978, 1980; Mogga, 1988). Against this, others regard the last two groups of bees as either ecotypes or subpopulations of *A. m. jemenitica* (Ruttner, 1992; Woyke, 1993). To clarify the status of these taxa of honeybees and the extent of their distributions in the region, the honeybees of the Ethiopian highlands and a small sample from southwestern Somalia were examined to determine the magnitudes of differences between the populations and to define possible zones of hybridisation between them.

4.3 Materials

Worker honeybees were sampled from the colonies of small-scale, fixed-site beekeepers along a 1 100 km transect at an average inter-locality distance resolution of about 140 km from Mega (04.02N 38.19E) in southern Ethiopia, through Agere Maryam (05.13N 38.20E), Shashemene (07.13N 38.33E), Holeta (09.03N 38.42E), Debre Markos (10.19N 37.41E), Bahir Dar (11.33N 37.25E) and Gonder (12.39N 37.29E) to Adi Arkay (13.35N 37.57E) in northern Ethiopia (Figure 4.1). In addition a small sample of three colonies was collected at Baidoa (03.04N 43.48E), in southwestern Somalia.

Figure 4.1 Localities along the transect in Ethiopia sampled in this study: Mega (1), Agere Maryam (2), Shashemene (3), Holeta (4), Debre Markos (5), Bahir Dar (6), Gonder (7), Adi Arkay (8) and Baidoa (9), Somalia.



Morphometric measurements were made on samples of 20 worker bees per colony, and five or six colonies were sampled at each location (except Somalia where only three colonies were sampled). Because of peculiar post-mortem conditions, it was not always possible to obtain the traditionally extended proboscis measurements. This did not affect the morphometric results as the proboscis length was not one of the discriminatory variables selected in the analysis. A total of 916 bees was used in the morphometric analyses. For the pheromone analysis, eight guard bees were collected from the same colonies used for the morphometric analysis. A total of 323 bees (all from Ethiopia, none from Somalia) was used in the analysis.

4.4 Results

4.4.1 Morphometric analysis

In a principal components analysis of the morphometric characters of worker honeybees from 43 colonies, four factors with eigenvalues greater than one were isolated: factor 1: pigmentation of scutellum (35) and abdominal tergite 2 (32), length of hair on tergite 5 (1); factor 2: angles of wing venation N23 (30) and MJI; factor 3: width and length of wax plate on sternite 3 (11) and (13); factor 4: pigmentation of scutellar plate (36). These factors accounted for 77.5% of the variance in the data. The factor loadings for each character had absolute value greater than 0.68. The graph of the factor scores from factors 1 and 2 showed three morphoclusters: colonies from Adi Arkay, Gonder and Bahir Dar forming a cluster (1) in the upper right-hand quadrant of the plot; colonies from Debre Markos, Holeta and Shashemene forming a cluster (2) in the left-hand half of the plot and colonies from Mega forming a cluster (3) in the lower right-hand half. Colonies from Agere Maryam were scattered in both the left-hand half and lower right-hand half.

A stepwise discriminant analysis using the colony means of the morphometric characters confirmed the separation of the three clusters (Figure 4.2). Mahalanobis distances D^2 between the clusters were D^2=44.95 for 1 and 2, D^2=57.53 for 1 and 3 and D^2=23.47 for 2 and 3. Table 4.1 shows the six characters entered into the linear discriminant functions ranked according to their discriminatory power. Each colony was assumed to have equal *a priori* probability of being in any cluster. The two most discriminatory characters to enter the discriminant functions were both associated with size.

Figure 4.2 Discriminant analysis plot using the colony means of the morphometric data: cluster 1 is composed of colonies from Adi Arkay and Bahir Dar, cluster 2 is composed of colonies from Debre Markos, Holeta and Shashemene, cluster 3 is composed of colonies from Agere Maryam and Mega. Confidence ellipses are at the 90% level. CD = canonical distances from the common centroid of the morphoclusters.

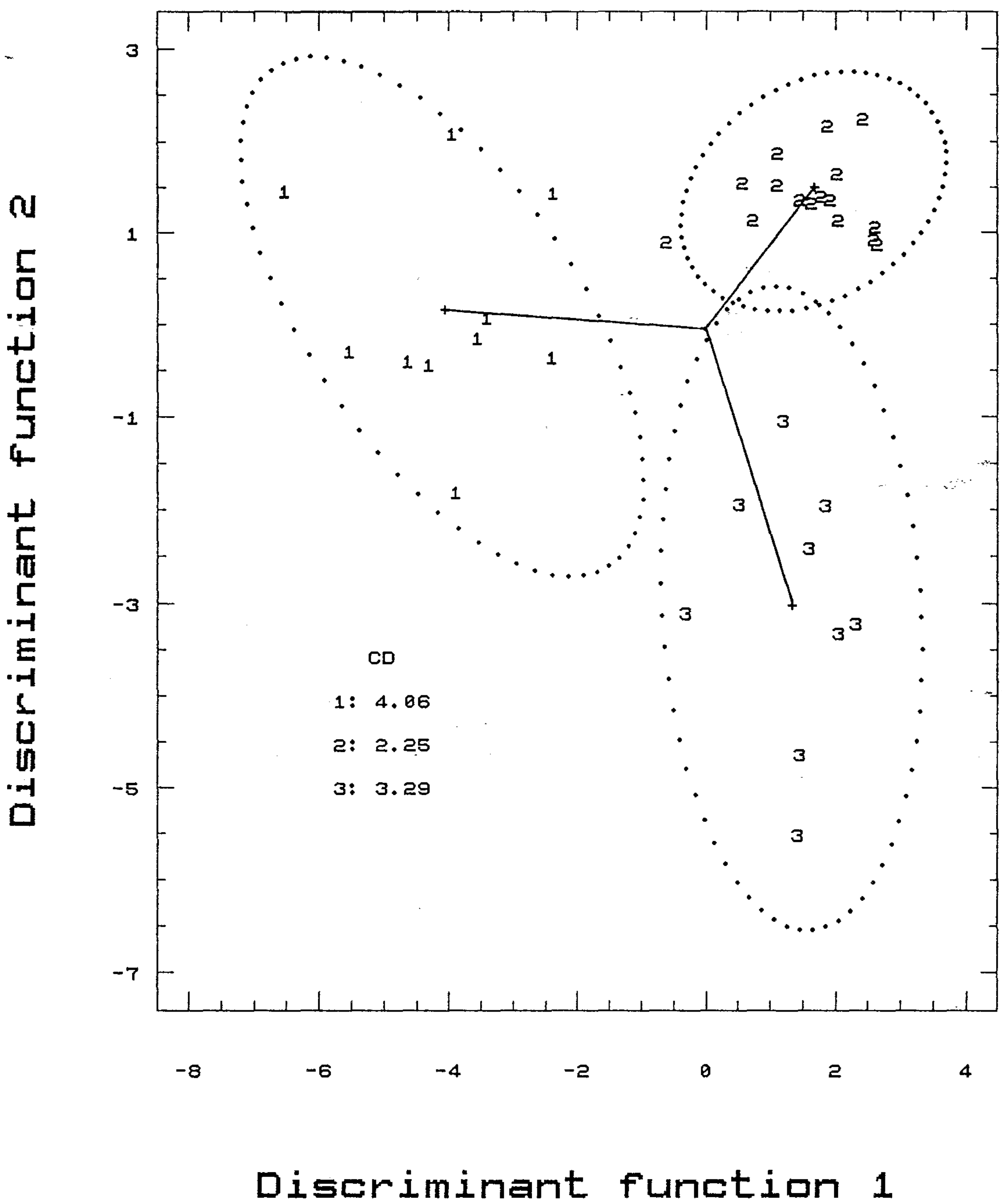


Table 4.1 Morphological characters entered into the discriminant function ranked according to their discriminatory power.

Character entered	F statistic	df	p-value
hair length (1)	25.50	2,40	<0.0001
width of wax plate (11)	16.01	2,39	<0.0001
pigmentation (36)	10.72	2,38	0.0002
wing angle (30)	10.88	2,37	0.0002
pigmentation (32)	9.35	2,36	0.0005
wing angle MJI	7.11	2,35	0.0026

The linear discriminant functions obtained using the most discriminatory characters (Table 4.1) classified 100% of the colonies from Adi Arkay and Bahir Dar correctly into group 1 with *a posteriori* probability p=1.0 for all 10 colonies; 100% of the colonies from Debre Markos, Holeta and Shashemene correctly into group 2 with *a posteriori* probability p=1.0 for 16 colonies and p=0.96 for one colony; 100% of the colonies from Agere Maryam and Mega correctly into group 3 with *a posteriori* probability p=1.0 for eight colonies and p=0.80 for one colony. Colonies from Gonder exhibited intermediate discriminant scores indicating a certain degree of hybridisation in this region. A jackknife procedure (Lachenbruch and Mickey, 1968) gave the same classification results except that one colony from Agere Maryam was misclassified into group 2 (Table 4.2).

Table 4.2 Classification of colonies from Adi Arkay and Bahir Dar (group 1), Debre Markos, Holeta and Shashemene (group 2) and Agere Maryam and Mega (group 3).

	Classification Matrix				Jackknifed Classification			
Group	% Correct	Number of colonies			% Correct	Number of colonies		
1	100%	10	0	0	100%	10	0	0
2	100%	0	17	0	100%	0	17	0
3	100%	0	0	9	89%	0	1	8

The neural networks classification procedure used ten morphological characters (excluding proboscis length (4)) in the input layer and no hidden layer in the analysis. In the training set, 100% correct classification was obtained. In the test set, 84.6% of the colonies were classified correctly with one colony from both groups 2 and 3 being misclassified.

To test the equality of the group means for the characters used in the discriminant function, Wilks' lambda approximated by the F statistic was determined. A significant difference was found between the means of the three groups ($\Lambda=0.0271$ with 6,2,33 df; $F=23.67$ with 12,56 df, $p<0.0001$). Since the test of homogeneity of the covariance matrices was found to be significant ($-2\rho\log\Lambda=98.0$ with 42 df, $p<0.0001$), quadratic discriminant functions were computed which produced identical classification results. The means and standard deviations of the 11 morphometric characters are shown in Table 4.3 for the three groups using all 856 bees from eight localities. The phenotypic correlations between the characters are presented in Table 4.4.

Table 4.3 Means and standard deviations (s.d.) of discriminant morphometric characters (measurements in mm, angles in degrees).

	Group 1 n=320		Group 2 n=338		Group 3 n=198	
Character	Mean	s.d.	Mean	s.d.	Mean	s.d.
hair length (1)	0.19	0.03	0.22	0.04	0.22	0.03
width of wax plate (11)	2.58	0.10	2.64	0.07	2.54	0.07
length of wax plate (13)	2.06	0.09	2.16	0.08	2.10	0.08
pigmentation (35)	2.00	2.24	0.15	0.47	0.67	1.33
pigmentation (36)	0.02	0.17	0.08	0.38	1.09	1.49
pigmentation (32)	4.50	4.17	1.26	2.00	3.98	4.07
wing angle B4 (22)	105.16	5.88	104.18	5.40	105.09	6.47
wing angle MJI	18.84	2.24	20.87	2.49	20.00	2.47
wing angle N23 (30)	80.88	4.30	84.85	4.52	81.41	4.59
wing angle O26 (31)	33.60	3.81	35.48	3.96	35.09	3.46
proboscis length (4), extended (n=159)	5.76	0.30	5.91	0.16	5.75	0.15
proboscis length (4), not extended (n=697)	4.62	0.17	4.85	0.20	4.83	0.26

Table 4.4 Phenotypic correlations of the morphological characters from worker bees.

Character	(1)	(4)	(11)	(13)	(35)	(36)	(32)	(22)	MJI	(30)	(31)
(1)	1.00										
(4)	0.54*	1.00									
(11)	0.31	0.25	1.00								
(13)	0.67*	0.53*	0.62*	1.00							
(35)	-0.63*	-0.50*	-0.12	-0.52*	1.00						
(36)	0.12	-0.09	-0.24	-0.05	-0.05	1.00					
(32)	-0.50*	-0.56*	-0.24	-0.52*	0.78*	0.47	1.00				
(22)	-0.03	0.00	0.06	0.03	-0.03	-0.18	-0.13	1.00			
MJI	0.42	0.27	0.05	0.29	-0.43	0.07	-0.29	-0.12	1.00		
(30)	0.30	0.08	0.04	0.30	-0.33	0.06	-0.15	-0.19	0.79*	1.00	
(31)	0.30	0.12	-0.01	0.37	-0.38	0.19	-0.19	-0.22	0.40	0.40	1.00

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

A correlation analysis was used to access the geographic variability in honeybees along the transect through Ethiopia. A significant correlation between pigmentation of scutellum (35) (scutellar plate (36)) and the mean annual maximum temperature (mean annual rainfall) was found, indicating that pigmentation is graded from black in cooler (wetter) regions to yellow in warmer (dryer) regions (Table 4.5). No significant correlations were found between characters associated with body size and angles of wing venation and the environmental variables (Table 4.5).

Table 4.5 Correlation coefficients (r) with corresponding p-values (p) between latitude, longitude, mean annual temperature, altitude, rainfall and the colony means of the morphometric characters.

	Latitude		Longitude		Tmax		Altitude		Rainfall	
Character	r	p	r	p	r	p	r	p	r	p
(1)	-0.61*	<0.01	0.55*	<0.01	-0.48	<0.01	0.38	0.01	-0.17	0.30
(4)	-0.52*	<0.01	0.66*	<0.01	-0.28	0.07	0.18	0.25	-0.17	0.27
(11)	0.20	0.21	-0.17	0.29	-0.01	0.93	0.12	0.46	0.34	0.03
(13)	-0.35	0.02	0.28	0.07	-0.42	0.01	0.40	0.01	0.05	0.75
(35)	0.51*	<0.01	-0.41	0.01	0.56*	<0.01	-0.48	<0.01	0.05	0.76
(36)	-0.60*	<0.01	0.27	0.09	-0.22	0.15	0.08	0.62	-0.60*	<0.01
(32)	0.18	0.24	-0.22	0.16	0.43	<0.01	-0.44	<0.01	-0.29	0.06
(22)	0.00	0.99	-0.04	0.79	-0.05	0.74	0.05	0.76	-0.12	0.45
MJI	-0.40	0.01	0.33	0.04	-0.17	0.27	0.00	0.99	-0.26	0.09
(30)	-0.27	0.08	0.20	0.20	-0.20	0.22	0.04	0.82	-0.27	0.09
(31)	-0.33	0.03	0.29	0.06	-0.36	0.02	0.29	0.06	-0.10	0.55

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

A canonical correlation analysis revealed a significant correlation between the set of environmental variables (temperature, rainfall and altitude) and the set of morphological characters ($R=0.83$, $\chi^2=75.4$ with 33 df, $p<0.0001$). The largest squared multiple correlation was found between rainfall and the set of morphometric variables ($R^2=0.69$, $p=0.0026$).

The first principal component coefficients of the morphometric characters were used to determine the factor scores of each bee. The variances of these factor scores were used to test for homogeneity of the variances at each locality. A significant difference was found between the intracolonial variances over all the localities (Table 4.6, Levene's test $F=15.00$ with 7,825 df, $p<0.0001$). In pair-wise tests between localities, the variances obtained from Adi Arkay, Gonder and Bahir Dar were significantly higher than the variances from the other localities along the transect.

The intercolonial variances were computed by the same method but this time the colony means were used to determine the factor score of each colony. A significant difference at the 10% level of significance was found in the variances between localities (Table 4.6, $F=2.10$ with 3,34 df, $p=0.0704$). Larger variances were obtained again at Gonder and at Holeta, indicating a degree of hybridisation at these localities.

Table 4.6 Intracolonial and intercolonial variances of factor scores of the morphometric data at each locality.

Locality	Intracolonial	Intercolonial
Mega (1)	4.20	1.37
Agere Maryam (2)	3.93	2.77
Shashemene (3)	3.50	3.52
Holeta (4)	3.69	4.46*
Debre Markos (5)	2.71	1.44
Bahir Dar (6)	4.85**	2.49
Gonder (7)	5.97**	5.30*
Adi Arkay (8)	5.11**	1.84

* Significant ($p<0.10$), ** ($p<0.01$).

The same eleven morphometric characters used in the analysis of Ethopian bees were measured on 60 worker bees from three colonies collected from Baidoa in southwestern Somalia at altitudes less than 500 m. They were an entirely fortuitous sample, but too small to have been included in the general discriminant analysis and were collected about 700 km from the nearest Ethiopian collection site. The results indicated the presence of a very small, yellow bee with characters (11), (13), (22), MJI, (35), (36) and (32) corresponding very closely to that of *A. m. litorea* sampled from Beira in Mozambique (Radloff *et al.*, 1997). However, the length of hair on tergite 5 (1) was shorter than that of *A. m. litorea* and corresponded more to the hair length of *A. m. jemenitica* (hair length: 0.17). A discriminant analysis performed on the combined data sets of Ethiopia and Somalia, and using the same discriminatory characters as listed in Table 4.1, resulted in 100% correct classification of all the colonies into four morphoclusters.

4.4.2 Pheromone analysis

In a principal components analysis using the mean percentages of the eight compounds of the sting pheromone complex, two factors with eigenvalues greater than one were isolated and accounted for 66.7% of the variance of the data: factor 1: benzyl acetate (7), n-decyl acetate (8), octyl acetate (5) and isopentyl alcohol (1); factor 2: n-butyl acetate (2), 2-nonanol (6) and isopentyl acetate (3). The factor scores plot did not reveal exactly the same clusters as in the morphometric analysis. The colonies at Adi Arkay, Gonder, Bahir Dar and Debre Markos formed a cluster, those from Holeta and Shashemene another, and colonies from Agere Maryam and Mega formed the third cluster.

Using the logratio transformed data of the sting pheromone compounds, three factors based on the logratio covariance matrix $\mathbf{\Gamma}$ were obtained: factor 1: benzyl acetate (7), isopentyl acetate (3), n-decyl acetate (8) and isopentyl alcohol (1); factor 2: n-butyl acetate (2) and 2-nonanol (6); factor 3: benzyl alcohol (4). The graph of the first two factor scores again showed the presence of the same three phero-clusters.

Table 4.7 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using percentage data.

Pheromone entered	F statistic	df	p-value
isopentyl acetate (3)	109.12	2,40	<0.0001
n-butyl acetate (2)	15.27	2,39	<0.0001
2-nonanol (6)	6.16	2,38	0.0048

Table 4.8 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using logratio transformed data.

Pheromone entered	F statistic	df	p-value
benzyl acetate (7)	46.29	2,40	<0.0001
2-nonanol (6)	41.40	2,39	<0.0001
n-butyl acetate (2)	10.49	2,38	0.0002
isopentyl alcohol (1)	3.91	2,37	0.0288

Stepwise discriminant analyses using the colony percentage and logratio data of the pheromones confirmed the separation of the three clusters. Tables 4.7 and 4.8 show the pheromones entered into the linear discriminant functions ranked according to their discriminatory power. The linear discriminant functions using the most discriminatory pheromone compounds (Table 4.7) gave 85.7% correct classification in cluster 1; 83.3% correct classification in cluster 2 and 90.0% correct classification in cluster 3. On the other hand, the linear discriminant functions using the logratio tranformed data (Table 4.8), correctly classified 100% of the colonies in all three phero-clusters. Using the jackknife procedure on the logratio transformed data, the same classification results were obtained except that one colony was misclassified in both clusters 1 and 3.

The neural networks procedure selected seven pheromone compounds (excluding octyl acetate (5)) as the input nodes. Five hidden layer nodes were used in the classification of the colonies into the phero-clusters. The network successfully classified 100% of the colonies in the training set and 84.6% in the test set with two colonies from phero-cluster 1 being misclassified into clusters 2 and 3.

Table 4.9 shows the percentages and standard deviations of the different pheromone compounds for each of the three groups.

Table 4.9 Mean percentages and standard deviations (s.d.) of the sting pheromones.

	Group 1 n=161		Group 2 n=88		Group 3 n=74	
Pheromone compound	Mean	s.d.	Mean	s.d.	Mean	s.d.
isopentyl alcohol (1)	5.92	11.51	10.10	8.14	11.27	10.59
n-butyl acetate (2)	16.02	14.66	31.15	23.65	4.07	4.77
isopentyl acetate (3)	2.66	4.72	9.05	11.99	30.17	22.23
benzyl alcohol (4)	8.86	12.30	12.10	14.09	11.45	14.71
octyl acetate (5)	8.08	10.34	17.15	16.90	21.21	14.63
2-nonanol (6)	5.26	7.58	3.09	7.48	16.75	14.92
benzyl acetate (7)	46.05	25.45	15.90	15.92	2.81	3.43
n-decyl acetate (8)	7.15	6.78	1.46	4.22	2.27	2.17

The logratio ($\log(x_i/x_j)$ for $i<j$) means and variances of the pheromone compounds ($i,j=1$ to 8) are presented in Table 4.10. The largest relative variation between two pheromone compounds is between isopentyl acetate (3) and benzyl acetate (8). The logratio means of benzyl acetate (7) are negative for $i<7$ and positive for $j=8$, indicating that the percentage of this compound is consistently greater than that of the other pheromone compounds. The total variation of the pheromonal ratio variance matrix **T** is 204.13. The values of **T** for each phero-cluster are 141.35, 218.16 and 98.08 respectively, revealing a larger variation in phero-cluster 2.

Table 4.10 Pheromonal variation using logratio transformed data of eight alarm pheromone components. Logratio variances are above the diagonal and logratio means are below the diagonal.

Pheromone Compound	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	0.00	4.76	7.14	5.26	4.80	6.97	9.72	8.78
(2)	-0.82	0.00	9.26	5.07	6.88	8.55	6.60	7.87
(3)	0.64	1.45	0.00	7.33	6.77	7.78	13.70	10.58
(4)	-0.28	0.53	-0.92	0.00	5.34	6.51	7.80	6.81
(5)	-0.48	0.34	-1.11	-0.19	0.00	5.59	8.90	7.08
(6)	0.58	1.39	-0.06	0.86	1.05	0.00	7.67	5.65
(7)	-0.93	-0.11	-1.57	-0.65	-0.45	-1.51	0.00	5.12
(8)	1.14	1.96	0.50	1.42	1.62	0.56	2.07	0.00

When the variances of the first factor scores of the sting pheromone percentage and logratio data were tested for homogeneity, a significant difference was found between the intracolonial variances over all the localities (Table 4.11, percentage: $F=11.95$ with 7,315 df, $p<0.0001$; logratio: $F=1.80$ with 7,315 df, $p=0.0873$). In multiple comparison tests, the variances of phero-cluster 1 were significantly different from the variances of the other phero-clusters (percentage), and the variances at Adi Arkay and Debre Markos were significantly different from the other localities (logratio).

A significant difference was also established between the intercolonial variances between localities (Table 4.11, percentage: $F=6.61$ with 7,35 df, $p<0.0001$; logratio: $F=2.65$ with 7,35 df, $p=0.0262$). Higher variances were found concentrated between Gonder and Debre Markos (percentage) and at Gonder and Debre Markos (logratio), confirming some degree of hybridisation in these regions.

Table 4.11 Intracolonial and intercolonial variances of the factor scores of the sting pheromone compounds at each locality.

Locality	Percentage data		Logratio data	
	intra-colonial	inter-colonial	intra-colonial	inter-colonial
Mega (1)	9.01	3.06	2.66	1.18
Agere Maryam (2)	9.84	5.96	1.99	1.41
Shashemene (3)	19.48	7.73	2.59	0.85
Holeta (4)	19.29	4.39	2.65	0.98
Debre Markos (5)	24.39**	24.94**	2.72*	2.46*
Bahir Dar (6)	31.42**	29.37**	1.73	1.11
Gonder (7)	30.54**	28.64**	2.39	1.91*
Adi Arkay (8)	22.10	6.47	3.02*	1.31

* Significant difference ($p<0.10$), ** ($p<0.01$).

4.5 Discussion

The honeybees revealed a high degree of variability both in size and pigmentation along the transect through Ethiopia. Mixed groups of black bees and yellow bees were found the whole length of the transect. These findings are similar to those of Rashad and El-Sarrag (1978, 1980), Saeed (1981), Mohamed (1982), Mogga (1988) and El-Sarrag *et al.* (1992) who showed high degrees of variability in size and pigmentation of the Sudanese honeybees between and within the provinces of Sudan.

In the northern regions of Ethiopia, a very small bee was observed (group 1), whose size matched the measurements of certain morphometric characters of bees found in the adjacent semi-desert region of Sudan (Mogga, 1988) as well as Chad (Ruttner, 1988). Their values compare as follows: hair length 0.19, Mogga 0.17-0.22, Ruttner 0.19-0.21; cubital index 2.40, Mogga 1.98-2.46, Ruttner 2.20-2.45. Both Mogga (1988) and Ruttner (1988) classified these bees as *A. m. jemenitica*. The size of the honeybees of group 1 also matched the measurements of the bees of northern Cameroon, which were classified as *A. m. jemenitica* (Radloff and Hepburn, 1997b). The worker bees exhibited mixed colours in the abdominal tergite 2 (32), black in 48% and yellow in 52% of the bees sampled in this region. Pigmentation of the scutellum (35) was mostly yellow. The bees of group 1 are classified as *A. m. jemenitica*.

In the central regions of Ethiopia, larger and darker bees (group 2) than those of group 1 were observed which corresponded in size to the bees found in the poor savanna regions of Sudan which were classified by Mogga (1988) as *A. m. bandasii* (hair length 0.22, Mogga: 0.19-0.22; cubital index 2.50, Mogga: 1.93-2.67). The colour of abdominal tergite 2 was black in 95% and yellow in 5% of the cases sampled in this region. Pigmentation of the scutellum was black in all cases. Thus group 2 is also regarded as *A. m. bandasii*.

Bees smaller than those of group 2, but larger than group 1 bees were found in southern Ethiopia (group 3). The means of certain morphometric characters (11, 13, 22, 31 and MJI) matched the corresponding mean values obtained from bees of southeastern Africa, which were classified as *A. m. scutellata* (Radloff *et al.*, 1997). However, pigmentation differed from that of *A. m. scutellata*. At Agere Maryam the ratio of black to yellow abdominal tergite 2 (32) was 5.25:1, whilst at Mega the ratio was 1:4.9.

El-Sarrag *et al.* (1992) found the ratio of black to yellow to be 1:2.6 for the Sudanese bees along the boundary with Ethiopia. Ruttner (1992) regarded these bees as belonging to an identifiable subpopulation of *A. m. jemenitica*, while Woyke (1993) treated them as an ecotype of this subspecies. On the other hand, Mogga (1988), whose work is the most comprehensive account on the bees of the Sudan, considered them to be *A. m. sudanensis*. These are all fine but important distinctions that will require direct DNA evidence for a final resolution, pending which these bees are here regarded as the subspecies *A. m. sudanensis* (*sensu* Mogga, 1988).

The fourth morphocluster of bees from Somalia is of unusual interest. Ruttner (1992) regarded the small yellow bees of the Somali deserts as a distinguishable subpopulation of *A. m. jemenitica* with affinities to the bees of the Arabian peninsula. This is because his samples were statistically distinguishable from the equally yellow but slightly larger *A. m. litorea* of the east African coast. However, in comparisons of 11 morphometric traits the bees of Baidoa closely correspond to *A. m. litorea* for seven characters, to *A. m. jemenitica* for four, with two characters being the same in all of the bees. This result is highly suggestive of hybridisation between the desert *A. m. jemenitica* and the coastal *A. m. litorea*, so that to classify this group would be inappropriate pending analysis of a broader spectrum of honeybees from Somalia and northeastern Kenya.

Thus, four statistically derived and homogeneous morphoclusters (=subspecies of Ruttner, 1988, 1992) are distinguishable at altitudes below 2400 m for the Horn of Africa: three along the transect through Ethiopia and adjacent Sudan, and a fourth in the desert of southwestern Somalia. No indication of *A. m. monticola*, a mountain subspecies of very high altitudes (Ruttner, 1988, 1992) was observed in the samples of the present study. Pheromonal clusters were also obtained for the bees of Ethiopia which were coincident with but not concordant with the morphoclusters (Tables 4.6 and 4.11). This is a common property of honeybee populations elsewhere in Africa and indicates the differential dispersion of various traits among honeybee populations (Hepburn *et al.*, 1994; Radloff *et al.*, 1996; Radloff and Hepburn, 1997b).

Areas of significant intercolonial variance (Tables 4.6 and 4.11) are evident and indicate centroids of genetic permeability between statistically defined populations, hence zones of hybridisation. These high variance centroids are closely associated with transitions between, and discontinuities of rainfall and temperature within, the different ecological-climatological zones that occur in the Horn of Africa.

CHAPTER 5

MORPHOMETRIC AND PHEROMONAL ANALYSES OF *APIS MELLIFERA* L. ALONG A TRANSECT IN WEST CENTRAL AFRICA

5.1 Summary

The morphometric characters and sting pheromones of worker honeybees, *Apis mellifera* Linnaeus, were analysed by multivariate methods to characterise their populations along a transect through three ecological-climatological zones in Cameroon. There are three distinct homogeneous populations and two zones of hybridisation. These bees are designated as *A. m. adansonii* whose area of distribution is intruded by an un-named mountain group of bees and a third group, *A. m. jemenitica.* The delineation of the hybrid zones is supported by intercolonial variance spectra and these significant asymmetries are coincident with transitions between the ecological-climatological zones.

5.2 Introduction

Ruttner's (1988, 1992) extensive biogeographic studies of honeybees provide a macro-level perspective of the apifauna of Africa. As such they also provide a framework for future meso-level analyses of population structure and dynamics. Recent publications document some of the complexity of these populations and demonstrate that structural asymmetries may be correlated with ecological-climatological shifts at regional or even local levels (Hepburn *et al.*, 1994; Hepburn and Radloff, 1996; Meixner *et al.*, 1989, 1994; Radloff *et al.*, 1996, 1997; Radloff and Hepburn, 1997a; Sheppard *et al.*, 1996). Such studies raise questions as to whether observed variations reflect distinct subspecies or geographical races (Ruttner, 1988, 1992), adaptive ecotypes derived from adjacent populations (Kerr, 1992) and/or the expression of genes fluctuating asynchronously (Hepburn and Crewe, 1991; Radloff *et al.*, 1996, 1997).

In the above context studies of the honeybee populations of west central Africa are in their infancy. For example, Meixner *et al.* (1989) included a few samples from Cameroon in their morphometric studies of east African honeybees and suggested (as did Ruttner, 1992) that population structure of the mountain bees in the west is analogous to, if not homologous with, that of Kenya and Tanzania some 3 000 km to the east. In addition, Gadbin *et al.* (1979) classified the homogeneous honeybees of southern Chad as the major west African subspecies, *A. m. adansonii*. However, in larger, continental revisions Ruttner (1988, 1992) assigned Gadbin's honeybees to the eastern, largely sahelian subspecies, *A. m. jemenitica*, and those of lowland Cameroon to the more tropical west African group, *A. m. adansonii* while montane forms were classified as *A. m. monticola*.

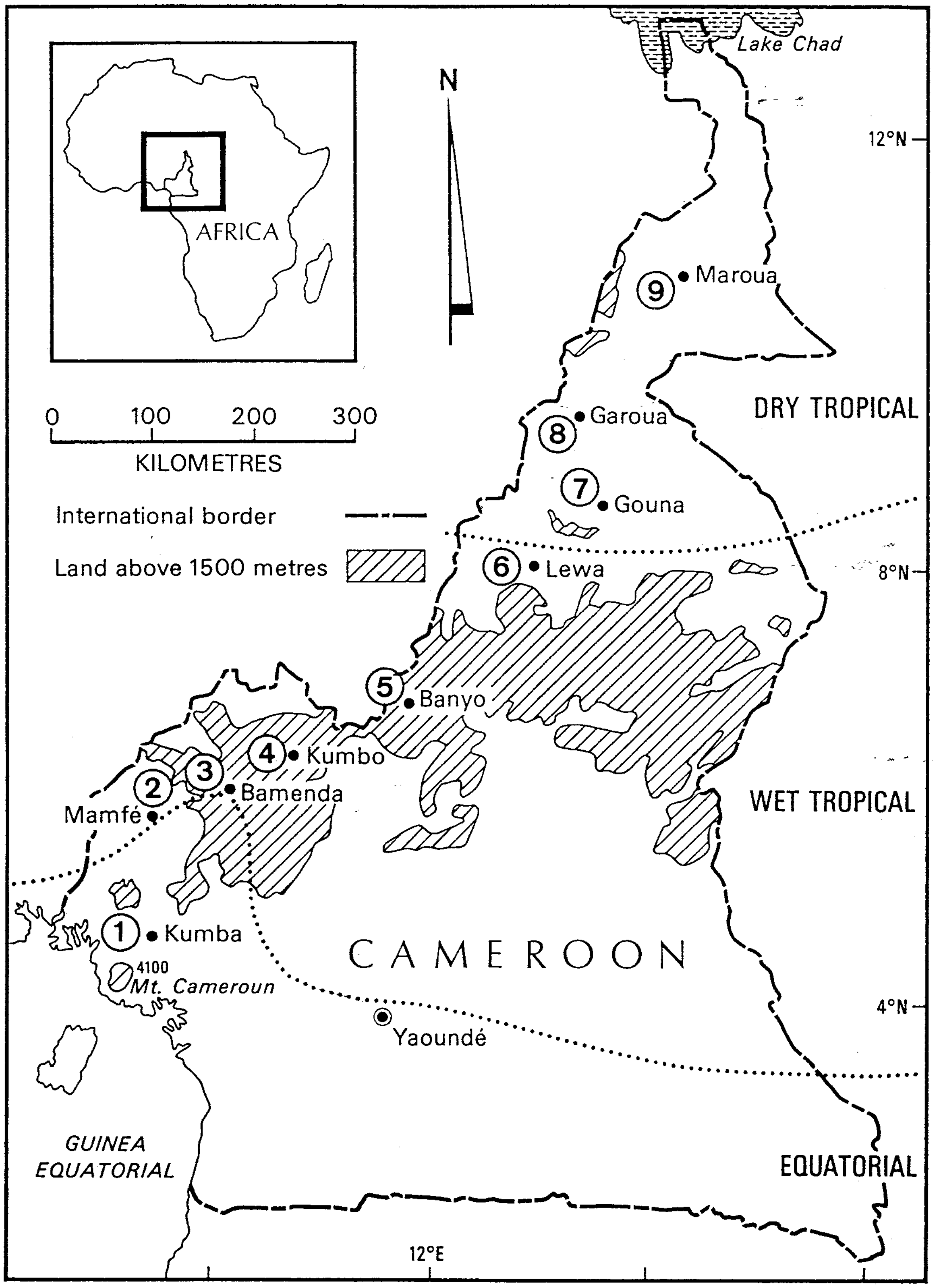
Cameroon itself is biogeographically extremely interesting as transitional between the equatorial and the arid in west central Africa. The region is a physiographical ensemble extending from sea level in the south through the Manengouba and Bambouto mountains, the Adamaoua massif and gradually descending into the depressed alluvial plains of the Lake Chad basin in the north (van Chi-Bonnardel, 1973). These physical transitions are associated with three fundamentally different ecological-climatological zones: equatorial, wet tropical and dry tropical (Walter, 1973, 1976). Accordingly, significant differences in the honeybee populations of the region might be expected to occur and to reflect these enormous environmental variations. Thus worker honeybees from this region were examined to assess population structure based on morphometric and pheromonal characters, features of relatively low and high heritability respectively (Moritz and Southwick, 1992; Collins *et al.*, 1987a).

5.3 Materials

Worker bees were sampled from the colonies of small scale, fixed-site beekeepers at nine localities along an approximate 1 000 km transect from Kumba (04.38N 09.25E) in the coastal region of southwestern Cameroon, through Mamfe (05.46N 09.17E), Bamenda (05.56N 10.10E), Kumbo (06.12N 10.40E), Banyo (06.45N 11.49E), Lewa (07.19N 13.35E), Gouna (08.32N 13.34E), Garoua (09.18N 13.24E) to Maroua (10.36N 14.20E) in northern Cameroon (Figure 5.1).

Morphometric measurements were made on 20 bees per colony and usually five colonies were sampled at each locality. Because of peculiar post-mortem conditions, it was not always possible to obtain the traditionally extended proboscis measurements. This did not affect the morphometric results as the proboscis length was not one of the discriminatory variables selected in the analysis. A total of 800 bees was used in the morphometric analysis. For the pheromone analysis between five and eight guard bees were collected from five colonies per locality and a total of 265 honeybees was used in the analysis.

Figure 5.1 Localities and ecological-climatological zones along the transect in Cameroon sampled in this study: Kumba (1), Mamfe (2), Bamenda (3), Kumbo (4), Banyo (5), Lewa (6), Gouna (7), Garoua (8) and Maroua(9).



5.4 Results

5.4.1 Morphometric analysis

In a principal components analysis of the morphometric characters of worker honeybees from 40 colonies, three factors with eigenvalues greater than one were isolated: factor 1: characters associated with size, length of hair on tergite 5 (1), length (13) and width (11) of wax plate on sternite 3, pigmentation of scutellum (35) and scutellar plate (36); factor 2: angles of wing venation N23 (30), O26 (31), MJI and pigmentation of tergite 2 (32); factor 3: wing angle B4 (22). These factors accounted for 76.1% of the variance in the data. The factor loadings for each character had absolute value greater than 0.65. The graph of the factor scores from factors 1 and 2 showed three clusters: colonies from Kumba, Mamfe, Kumbo, Banyo, Lewa and Gouna forming a cluster in the left-hand half of the plot, colonies from Bamenda forming a cluster in the upper left-hand quadrant and colonies from Garoua and Maroua forming a cluster in the right-hand half.

A stepwise discriminant analysis using the colony means of the morphometric characters confirmed the separation of the three clusters (Figure 5.2). Mahalanobis distances D^2 between the clusters were $D^2=37.99$ for 1 and 2, $D^2=24.60$ for 1 and 3 and $D^2=140.66$ for 2 and 3. Table 5.1 shows the five characters entered into the linear discriminant functions ranked according to their discriminatory power. Each colony was assumed to have equal *a priori* probability of being in any cluster.

Figure 5.2 Discriminant analysis plot using the colony means of the morphometric data: cluster 1 is composed of colonies from Kumba, Mamfe, Kumbo, Banyo, Lewa and Gouna, cluster 2 is composed of colonies from Bamenda and cluster 3 is composed of colonies from Garoua and Maroua. Confidence ellipses are at the 90% level. CD = canonical distances from the common centroid of the clusters.

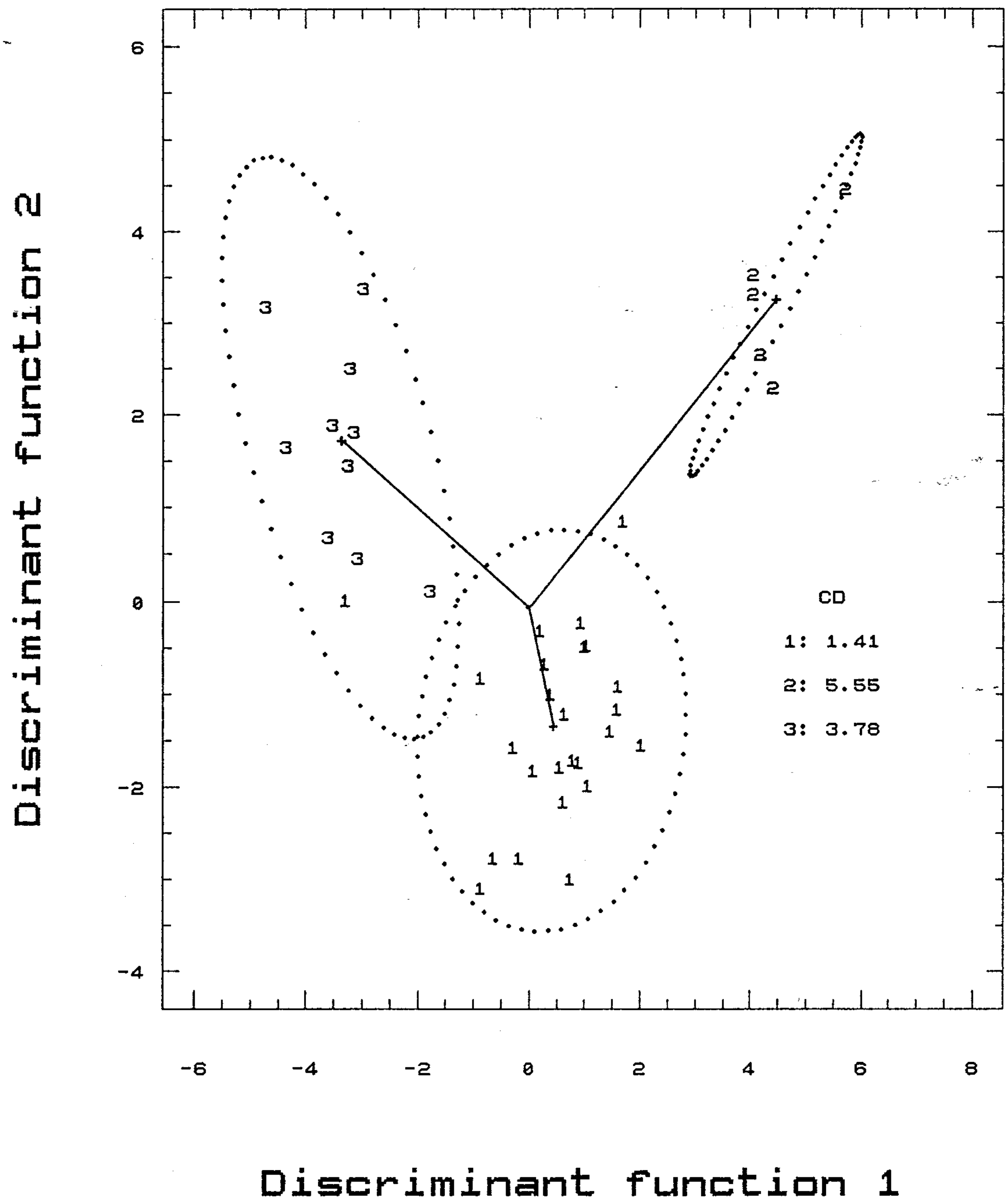


Table 5.1 Morphological characters entered into the discriminant function ranked according to their discriminatory power.

Character entered	F statistic	df	p-value
hair length (1)	89.74	2,37	<0.0001
pigmentation (35)	27.27	2,36	<0.0001
pigmentation (36)	7.60	2,35	0.0018
length of wax plate (13)	3.43	2,34	0.0439
pigmentation (32)	3.03	2,33	0.0619

The linear discriminant functions obtained using the most discriminatory characters classified 96% of the colonies from Kumba, Mamfe, Kumbo, Banyo, Lewa and Gouna correctly into group 1 with *a posteriori* probability p=1.0 for 23 colonies, p=0.98 for one colony and misclassified one colony from Gouna into group 3; 100% of the colonies from Bamenda correctly into group 2 with *a posteriori* probability p=1.0; 90% of the colonies from Garoua and Maroua correctly into group 3 with *a posteriori* probability p=1.0 for nine colonies and misclassified one colony from Garoua into group 1. Colonies from Garoua exhibited intermediate discriminant scores indicating a certain degree of hybridisation between group 1 and group 3. A jackknife procedure (Lachenbruch and Mickey, 1968) gave the same classification results. A linear discriminant analysis using characters associated with the size of the honeybee (length of hair on tergite 5 (1), width and length of wax plate on sternite 3 (11) and (13)) produced identical classification results, showing that the separation of the three clusters is not dependent on the pigmentation characters.

The neural networks procedure used the following six morphological characters in the input layer: length of hair on tergite 5 (1), width and length of wax plate on sternite 3 (11) and (13), angle of venation N23 (30), pigmentation of scutellum and scutellar plate (35) and (36). No hidden layer was used in the analysis. In the training set, 100% correct classification was obtained. In the test set, 91.7% of the colonies were classified correctly with one colony from group 2 being misclassified.

Table 5.2 Classification of colonies from Kumba, Mamfe, Kumbo, Banyo, Lewa and Gouna (group 1), Bamenda (group 2) and Garoua and Maroua (group 3).

	Classification Matrix				**Jackknifed Classification**			
Group	% Correct	Number of colonies			% Correct	Number of colonies		
1	96%	24	0	1	96%	24	0	1
2	100%	0	5	0	100%	0	5	0
3	90%	1	0	9	90%	1	0	9

To test the equality of the group means for the characters used in the discriminant function, Wilks' lambda approximated by the F statistic was determined. A significant difference was found between the means of the three groups ($\Lambda=0.0333$ with 5,2,37 df; $F=29.57$ with 10,66 df, $p<0.0001$). These results indicate that the honeybees of this region in west central Africa resolve morphometrically into three distinct populations: a discrete population in southern and central Cameroon, a discrete population of larger yellow honeybees in the southern mountainous regions and a discrete population of smaller honeybees in northern Cameroon. The means and standard deviations of the 11 morphometric characters are shown in Table 5.3 for the three groups using all 800 bees from nine localities. The phenotypic correlations between the characters are presented in Table 5.4.

Table 5.3 Means and standard deviations (s.d.) of discriminant morphometric characters (measurements in mm, angles in degrees).

Character	Group 1 n=500		Group 2 n=100		Group 3 n=200	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
hair length (1)	0.22	0.03	0.27	0.04	0.19	0.03
width of wax plate (11)	2.55	0.06	2.58	0.07	2.50	0.06
length of wax plate (13)	2.12	0.08	2.16	0.06	2.02	0.09
pigmentation (35)	6.17	1.47	6.25	1.39	2.46	2.20
pigmentation (36)	1.79	2.40	1.41	1.84	5.12	1.79
pigmentation (32)	8.52	0.68	7.43	1.09	8.80	0.40
wing angle B4 (22)	105.33	5.62	104.90	5.18	106.12	6.65
wing angle MJI	19.67	2.63	21.71	3.11	19.36	2.31
wing angle N23 (30)	83.46	5.22	85.91	5.15	80.50	4.39
wing angle O26 (31)	36.24	4.67	37.89	4.50	35.62	4.30
proboscis length (4), extended (n=190)	5.42	0.47	5.75	0.49	5.47	0.37
proboscis length (4), not extended (n=300)	5.00	0.22	5.09	0.13	4.77	0.19

Table 5.4 Phenotypic correlations of the morphological characters from worker bees.

Character	(1)	(4)	(11)	(13)	(35)	(36)	(32)	(22)	MJI	(30)	(31)
(1)	1.00										
(4)	0.43	1.00									
(11)	0.56*	0.57*	1.00								
(13)	0.69*	0.61*	0.77*	1.00							
(35)	0.66	0.58	0.48	0.65*	1.00						
(36)	-0.54	-0.36	-0.42	-0.52*	-0.51*	1.00					
(32)	-0.70*	-0.38	-0.54*	-0.61*	-0.39	0.11	1.00				
(22)	-0.13	0.08	-0.09	-0.10	-0.26	-0.03	0.12	1.00			
MJI	0.38	0.36	0.47	0.44	0.28	0.03	-0.52*	-0.22	1.00		
(30)	0.33	0.44	0.47	0.49	0.48	0.02	-0.64*	-0.27	0.72*	1.00	
(31)	0.18	0.30	0.30	0.22	0.24	-0.01	-0.47	0.03	0.61*	0.69*	1.00

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

A correlation analysis was used to assess the geographic variability in honeybees along the transect. No significant correlations (Table 5.5) were obtained between characters associated with body size and altitude, confirming that the variation is not merely due to ecological adaptation (Meixner *et al.*, 1989, 1994). Significant negative (positive) correlations (Table 5.5) between the characters related to body size and geographic latitude, longitude and temperature (rainfall) could be the result of the hybridisation of *A. m. adansonii* from the cooler, wetter southern and central regions with the smaller *A. m. jemenitica* in the hotter, dryer northern regions and not only the result of climate-correlated variation.

A canonical correlation analysis showed a significant correlation between the set of environmental variables (temperature, rainfall and altitude) and the set of morphological characters ($R=0.94$, $\chi^2=113.9$ with 33 df, $p<0.0001$). Large squared multiple correlations were found between rainfall and temperature and the set of morphometric variables (rainfall: $R^2=0.85$, $p<0.0001$; temperature: $R^2=0.75$, $p<0.0001$).

Table 5.5 Correlation coefficients (r) with corresponding p-values (p) between latitude, longitude, mean annual maximum temperature, altitude, rainfall and the colony means of the morphometric characters.

	Latitude		Longitude		Tmax		Altitude		Rainfall	
Character	r	p	r	p	r	p	r	p	r	p
(1)	-0.66*	<0.01	-0.60*	<0.01	-0.56*	<0.01	0.46	<0.01	0.46	<0.01
(4)	-0.61*	<0.01	-0.57*	<0.01	-0.56*	<0.01	0.37	0.02	0.53*	<0.01
(11)	-0.65*	<0.01	-0.67*	<0.01	-0.58*	<0.01	0.31	0.05	0.57*	<0.01
(13)	-0.84*	<0.01	-0.78*	<0.01	-0.74*	<0.01	0.45	<0.01	0.72*	<0.01
(35)	-0.82*	<0.01	-0.65*	<0.01	-0.64*	<0.01	0.29	0.07	0.68*	<0.01
(36)	0.44	<0.01	0.26	0.10	0.68*	<0.01	-0.59*	<0.01	-0.17	0.28
(32)	0.61*	<0.01	0.74*	<0.01	0.32	0.05	-0.07	0.66	-0.63*	<0.01
(22)	0.12	0.46	0.07	0.68	-0.12	0.46	0.24	0.14	-0.13	0.41
MJI	-0.44	<0.01	-0.48	<0.01	-0.23	0.15	0.11	0.51	0.45	<0.01
(30)	-0.65*	<0.01	-0.71*	<0.01	-0.30	0.06	-0.13	0.44	0.74*	<0.01
(31)	-0.38	0.01	-0.47	<0.01	-0.13	0.42	-0.10	0.53	0.48	<0.01

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

The first principal component coefficients of the morphometric characters were used to determine the factor scores of each bee. The variances of these factor scores were used to test for homogeneity of the variances at each locality. A significant difference was found between the intracolonial variances (Table 5.6) over all the localities (Levene's test F=8.38 with 8,771 df, $p<0.0001$). Variances from Bamenda and Garoua were significantly higher than the variances from the other localities.

The intercolonial variances were computed by the same method but this time the colony means were used to determine the factor score of each colony. A significant difference was found in the variances between localities (F=2.22 with 8,31 df, $p=0.0529$). Again, larger variances were obtained at Bamenda and Garoua indicating a certain degree of hybridisation at these localities.

Table 5.6 Intracolonial and intercolonial variances of factor scores of the morphometric data at each locality.

Locality	Intracolonial	Intercolonial
Kumba (1)	4.42	4.62
Mamfe (2)	2.87	1.86
Bamenda (3)	5.43*	6.36*
Kumbo (4)	3.18	1.54
Banyo (5)	3.83	2.37
Lewa (6)	3.94	1.78
Gouna (7)	4.79	4.74
Garoua (8)	5.61*	6.14*
Maroua (9)	3.57	2.22

* Significant ($p<0.05$).

5.4.2 Pheromone analysis

In a principal components analysis using the mean percentages of the nine compounds of the sting pheromone complex, three factors with eigenvalues greater than one were isolated and accounted for 69.5% of the variance of the data: factor 1: n-butyl acetate (2), benzyl acetate (7), isopentyl acetate (3); factor 2: octyl acetate (5), n-octanol (9); factor 3: benzyl alcohol (4), 2-nonanol (6). The factor scores plot did not reveal exactly the same clusters as in the morphometric analysis. The colonies at Kumba, Mamfe and Maroua formed a cluster, the colonies from Bamenda, Kumbo and Banyo formed another cluster and colonies from Lewa, Gouna and Garoua formed the third cluster. Using the logratio transformed data of the sting compounds, two factors based on the logratio covariance matrix **Γ** were obtained: factor 1: benzyl acetate (7), n-butyl acetate (2), n-decyl acetate (8), isopentyl acetate (3), 2-nonanol (6); factor 2: isopentyl alcohol (1), benzyl alcohol (4), n-octanol (9), octyl acetate (5), accounting for 62.8% of the variance of the data.

A stepwise discriminant analysis using the colony mean percentage and logratio data of the pheromones confirmed the separation of the three clusters. Tables 5.7 and 5.8 show the pheromones entered into the linear discriminant function ranked according to their discriminatory power.

Table 5.7 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using percentage data.

Pheromone entered	F statistic	df	p-value
isopentyl acetate (3)	38.29	2,35	<0.0001
benzyl acetate (7)	10.09	2,34	0.0004
2-nonanol (6)	4.07	2,33	0.0265

Table 5.8 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using logratio transformed data.

Pheromone entered	F statistic	df	p-value
isopentyl acetate (3)	25.68	2,35	<0.0001
2-nonanol (6)	2.92	2,34	0.0675
benzyl acetate (7)	3.15	2,33	0.0560

The linear discriminant functions using the most discriminatory pheromone compounds (Table 5.7) gave 100% correct classification in cluster 1; 91.7% correct classification in cluster 2 with one colony misclassified into cluster 1; 85.7% correct classification in cluster 3 with one colony misclassified into cluster 1, and one misclassified into cluster 2. Using the linear discriminant functions obtained from the logratio data (Table 5.8), 75%, 83.3% and 71.4% of the colonies were correctly classified in clusters 1, 2 and 3 respectively.

The neural networks procedure used six pheromone compounds (the same three compounds as used in the discriminant analysis, plus isopentyl alcohol (1), benzyl alcohol (4) and octyl acetate (5)) as the input nodes and three hidden layer nodes for the classification analysis. 100% correct classification was achieved in the training set and 91.7% in the test set with one colony being misclassified from group 2.

Table 5.9 shows the mean percentages and standard deviations of the different pheromone compounds for each of the three groups. Isopentyl acetate (3) is a more dominant note in the sting pheromone bouquet for group 3 than for groups 1 and 2.

A discriminant analysis procedure using the same cluster groupings as the morphometric analysis produced 68% correct classification in group 1 (four colonies misclassified into group 2 and four misclassified into group 3), 80% correct classification in group 2 (one colony misclassified into group 1) and 87.5% correct classification in group 3 (one colony misclassified into group 1).

Table 5.9 Mean percentages and standard deviations (s.d.) of the sting pheromones.

	Group 1 n=80		**Group 2** n=81		**Group 3** n=104	
Pheromone compound	Mean	s.d.	Mean	s.d.	Mean	s.d.
isopentyl alcohol (1)	6.57	4.36	9.50	10.66	8.34	3.92
n-butyl acetate (2)	29.59	25.69	13.16	8.12	12.74	11.57
isopentyl acetate (3)	5.97	5.19	13.51	7.77	22.06	10.03
benzyl alcohol (4)	4.68	5.03	9.32	12.63	7.71	5.23
octyl acetate (5)	12.04	9.03	12.47	6.33	10.54	7.00
2-nonanol (6)	19.79	14.86	16.19	7.19	20.40	12.04
benzyl acetate (7)	9.05	9.04	16.26	7.75	10.36	6.28
n-decyl acetate (8)	4.39	4.27	2.62	2.36	1.12	1.97
n-octanol (9)	7.92	6.92	6.98	5.67	6.74	7.29

The logratio ($\log(x_i/x_j)$ for $i<j$) means and variances of the pheromone compounds ($i,j=1$ to 9) are presented in Table 5.10. Larger relative variations are associated with n-decyl acetate. The logratio means of 2-nonanol (6) are negative for $i<6$ and positive for $6<j$, indicating that the percentage of this compound is consistently greater than that of the other pheromone compounds. The total variation of the pheromonal ratio variance matrix **T** is 155.21. The values of **T** for each group are 211.42, 87.35 and 122.01 respectively, revealing a larger variation in group 1.

Table 5.10 Pheromonal variation using logratio transformed data of nine alarm pheromone components. Logratio variances are above the diagonal and logratio means are below the diagonal.

Pheromone Compound	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	0.00	2.16	2.54	2.83	3.04	2.35	2.90	5.96	4.74
(2)	-0.63	0.00	4.03	4.62	3.04	3.81	4.51	4.90	4.52
(3)	-0.34	0.29	0.00	3.40	4.18	3.06	3.03	8.55	5.27
(4)	0.51	1.14	0.86	0.00	4.71	3.95	4.33	8.34	6.08
(5)	-0.21	0.42	0.13	-0.72	0.00	2.57	3.00	5.00	3.64
(6)	-0.74	-0.11	-0.40	-1.25	-0.53	0.00	1.66	6.53	4.17
(7)	-0.18	0.45	0.16	-0.70	0.03	0.56	0.00	6.91	4.13
(8)	2.32	2.95	2.66	1.81	2.53	3.06	2.50	0.00	6.91
(9)	0.66	1.29	1.00	0.15	0.87	1.40	0.84	-1.66	0.00

To test for heteroscedasticity in the variances of the sting pheromone percentage and logratio transformed data between localities, the first principal component coefficients of the compounds were calculated and used to determine the factor score of each bee. A significant difference between the intracolonial variances (Table 5.11) of these factor scores was found between the localities (percentage: Levene's test $F=22.64$ with 8,255 df, $p<0.0001$; logratio: $F=8.85$ with 8,255 df, $p<0.0001$). Multiple comparison tests showed that the variances of the pheromone percentages at Kumba, Mamfe and Garoua, and for the logratio data at Kumba, Mamfe and Gouna, were significantly different from the variances at the other localities.

A significant difference was established also between the intercolonial variances (Table 5.11) between localities (percentage: $F=12.59$ with 8,29 df, $p<0.0001$; logratio: $F=6.21$ with 8,29 df, $p=0.0001$). Again higher variances were found at Mamfe and Garoua (percentage) and Mamfe (logratio), confirming some degree of hybridisation in these regions.

Table 5.11 Intracolonial and intercolonial variances of the factor scores of the sting pheromone compounds at each locality.

Locality	Percentage Data		Logratio Data	
	intra-colonial	inter-colonial	intra-colonial	inter-colonial
Kumba (1)	20.69*	3.94	3.46*	1.35
Mamfe (2)	38.80*	40.51*	3.59*	3.49*
Bamenda (3)	12.15	6.70	1.29	0.70
Kumbo (4)	13.69	3.75	1.12	0.49
Banyo (5)	12.13	8.23	1.21	0.80
Lewa (6)	13.37	3.68	2.08	0.83
Gouna (7)	15.03	6.31	2.29*	1.19
Garoua (8)	20.36*	12.54*	2.01	1.29
Maroua (10)	15.56	4.80	1.61	0.15

* Significant ($p < 0.01$).

5.5 Discussion

The multivariate analyses of the morphometric features of worker honeybees from the Cameroon transect yielded three discrete groups. A disjunct first group was identified for southern and central Cameroon with an intrusion of bigger, yellowish bees in the mountains, the second group. A third group of small bees occurs in the northern plains. Typologically these would be respectively classified as *A. m. adansonii*, "*A. m. monticola*-like" and *A. m. jemenitica* following Ruttner (1988, 1992). Because of a substantial increase in the African honeybee data base and decrease in sampling distance over the recent past it is important to note how bees of the present study compare with others.

Discriminant analysis shows that the Cameroon cluster here defined as *A. m. adansonii* closely corresponds with similar bees from Zambia and Namibia (Radloff *et al.*, 1996, 1997), while those identified as *A. m. jemenitica* correspond with similar bees from southern Chad (Ruttner, 1988; Gadbin *et al.*, 1979). Those bees clustering as "*A. m. monticola*-like" from

Cameroon share few similarities with east African *A. m. monticola* (Meixner *et al.*, 1989), and while the western bees are conspicuously yellow, the eastern ones are black. Comparisons of the DNA profiles of these disjunct bee populations and/or controlled breeding trials would be needed to establish vicariance or to label the western ones as anything more than ecotypically "*A. m. monticola*-like" big yellow mountain bees such as also occur in Malawi (Ruttner, 1992).

The inherent limitations of a typological approach for defining subspecies of honeybees include the relatively low heritability of quantitative morphometric traits and the susceptibility of the phenotype to environmental effects (Roberts, 1961; Ruttner, 1988; Falconer, 1989; Guzmán-Novoa *et al.*, 1994). Thus the alarm pheromones of the worker bee sting gland are used as a more direct genetic probe because of their higher degree of heritability (Collins *et al.*, 1987a). The multivariate analyses of the sting pheromones yielded three clusters that are quite different from those obtained by morphometry. Indeed, if the pheromonal data are fitted to the clusters derived morphometrically, cluster predictability is only 78.5% and 10 colonies are misclassified. When the pheromonal data alone are analysed by discriminant function analysis, the number of misclassifications drops to three colonies and predictability increases to over 92.5% (percentage data).

In the absence of either physical barriers or reproductive isolating mechanisms that might restrict gene flow, continuous changes in characters between two adjacent populations can be expected, and these will be reflected in the variance spectra of characters examined (Futuyma, 1986). Also, in view of the significantly high variances in sting pheromone composition obtained both in landrace crosses of honeybees (Boch and Rothenbuhler, 1974) and in inter-subspecific crosses (Collins *et al.*, 1987a), the apparently irreconcilable differences between the morphometric and pheromonal clusters need to and can be resolved.

When the categories established by typological (morphometric) method are put aside and population structure redefined in terms of variance spectra for both suites of characters, it is seen that discrete regions of homogeneity (low variance) alternate with highly heterogeneous (high variance) areas (Tables 5.6 and 5.11). Thus there are three discrete and homogeneous populations of honeybees extending from southwestern to northern Cameroon: (1) one in the far south associated with Kumba; (2) another between Kumbo and Gouna; and (3) a northern population at Maroua presumably extending into Chad to the north and east.

There are two centroids of significantly high variance among the localities along the Cameroon transect. A northern centroid occurs in the area of Garoua where intercolonial variance for both morphometric and pheromonal characters are significantly high as well as coincident. Another centroid of high intercolonial variance for both the morphometric and pheromonal characters occurs in the Mamfe-Bamenda area (Tables 5.6 and 5.11). These two high variance regions are exactly matched by values for intracolonial variance, interpreted as the results of multiple matings by queens with several to many drones of varying allelic frequencies (Moritz and Southwick, 1992). The Mamfe-Bamenda area is interpreted as a zone of hybridisation between populations (1) and (2), and the Garoua area as the zone of transition and hybridisation between populations (2) and (3). It is noteworthy that both centroids of maximal intercolonial variance are geographically coincident with points of transition between the ecological-climatological zones. This physiographic asymmetry is further reflected in a significant relationship between intercolonial pheromonal variance versus zonal changes in temperature, rainfall and altitude ($R^2=0.89$, $p=0.0074$).

CHAPTER 6

MORPHOMETRIC AND PHEROMONAL ANALYSES OF *APIS MELLIFERA* L. ALONG A TRANSECT IN SOUTHWESTERN AFRICA

6.1 Summary

The morphometric characters and sting pheromones of worker honeybees (*Apis mellifera* L.) were analysed by multivariate methods to characterise their populations in southwestern Africa. There is a discrete homogeneous population in northern South Africa and southern Namibia classified as the race *A. m. scutellata*, a discrete population in northern Namibia classified as *A. m. adansonii* and a hybrid population between them.

6.2 Introduction

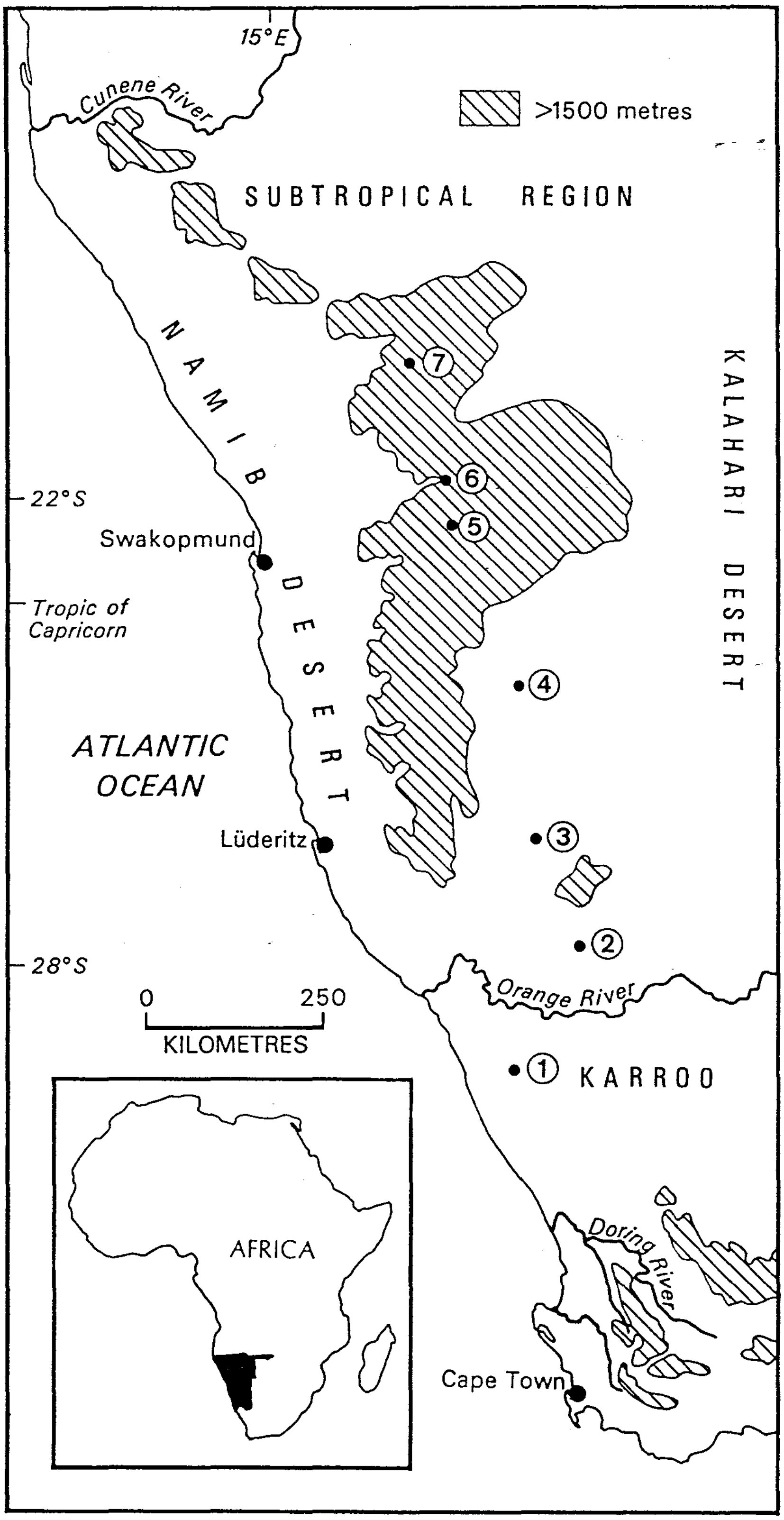
The honeybee subspecies of *Apis mellifera* L. of Africa have been characterised morphometrically, but very few bees from Namibia, and none from Angola were included in previous analyses (Ruttner, 1988, 1992). These two countries are geographically poised between the ranges of *A. m. scutellata* to the southeast (Hepburn and Crewe, 1991; Crewe *et al.*, 1994) and *A. m. adansonii* to the northwest (Ruttner, 1988, 1992). The colour patterns of drones from northern Namibia (Johannsmeier, 1973) and worker bees from Angola (Portugal-Araújo, 1956; Rosario Nũnes and Tordo, 1960) suggested that these bees could be *A. m. adansonii* or their hybrids with *A. m. scutellata*. On the other hand, sparse morphological data on bees from southern Namibia (Moritz and Kauhausen, 1984; Ruttner, 1992) suggested affinities with the *A. m. scutellata* of Botswana and the northern Cape Province of South Africa. Honeybees of southwestern Africa were studied morphometrically and pheromonally to characterise the populations and establish their subspecific characteristics.

6.3 Materials

Worker honeybees were sampled from the colonies of small scale, fixed-site beekeepers at seven localities along a 1 025 km transect extending from Nababeep (29.36S 17.46E) in northwestern South Africa through Karasburg (28.00S 18.43E), Keetmanshoop (26.36S 18.08E), Mariental (24.36S 17.59E), Windhoek (22.43S 17.06E), Okahandja (21.59S 16.58E) to Otjiwarongo (20.29S 16.36E) in northern Namibia (Figure 6.1).

Morphometric measurements were made on 20 alcohol-preserved workers from each colony and four colonies were sampled at each locality. A total of 560 bees was used in the morphometric analysis. For the pheromone analyses, guard bees were sampled from five to six colonies per locality. Four of these colonies at each locality were the same as those used for the morphometric analysis. A total of 200 honeybees was used in the pheromone analyses.

Figure 6.1 Localities in southwestern Africa sampled in this study: Nababeep (1), Karasburg (2), Keetmanshoop (3), Mariental (4), Windhoek (5), Okahandja (6) and Otjiwarongo (7).



6.4 Results

6.4.1 Morphometric analysis

In a principal components analysis of the morphometric measurements three factors with eigenvalues greater than one were isolated: factor 1: pigmentation of scutellum (35) and scutellar plate (36), angles of wing venation MJI and B4 (22); factor 2: width and length of wax plate on sternite 3 (11) and (13), angle of wing venation O26 (31); factor 3: length of proboscis (4), length of hair on tergite 5 (1), angle of wing venation N23 (30). These factors accounted for 60.54% of the variance in the data. The loadings for each character had absolute values greater than 0.60. The graph of factors 1 and 2 scores showed those colonies from Otjiwarongo forming a cluster in the right-hand half of the plot, while the colonies from Nababeep, Karasburg and Keetmanshoop clustered in the left-hand half. Colonies from Mariental, Windhoek and Okahandja were evenly scattered.

A stepwise discriminant analysis was used to verify the separation of the two clusters obtained from the factor analysis (Figure 6.2). The Mahalanobis distance between the two groups was 13.48. Table 6.1 gives the characters entered into the linear discriminant functions ranked according to their discriminatory power. Each colony was assumed to have equal *a priori* probability of being in any group.

Figure 6.2 Discriminant analysis plot using the colony means of the morphometric data: cluster 1 is composed of colonies from Nababeep, Karasburg, Keetmanshoop and cluster 2 is composed of colonies from Otjiwarongo. Confidence ellipses are at the 90% level. CD = canonical distances from the common centroid of the clusters.

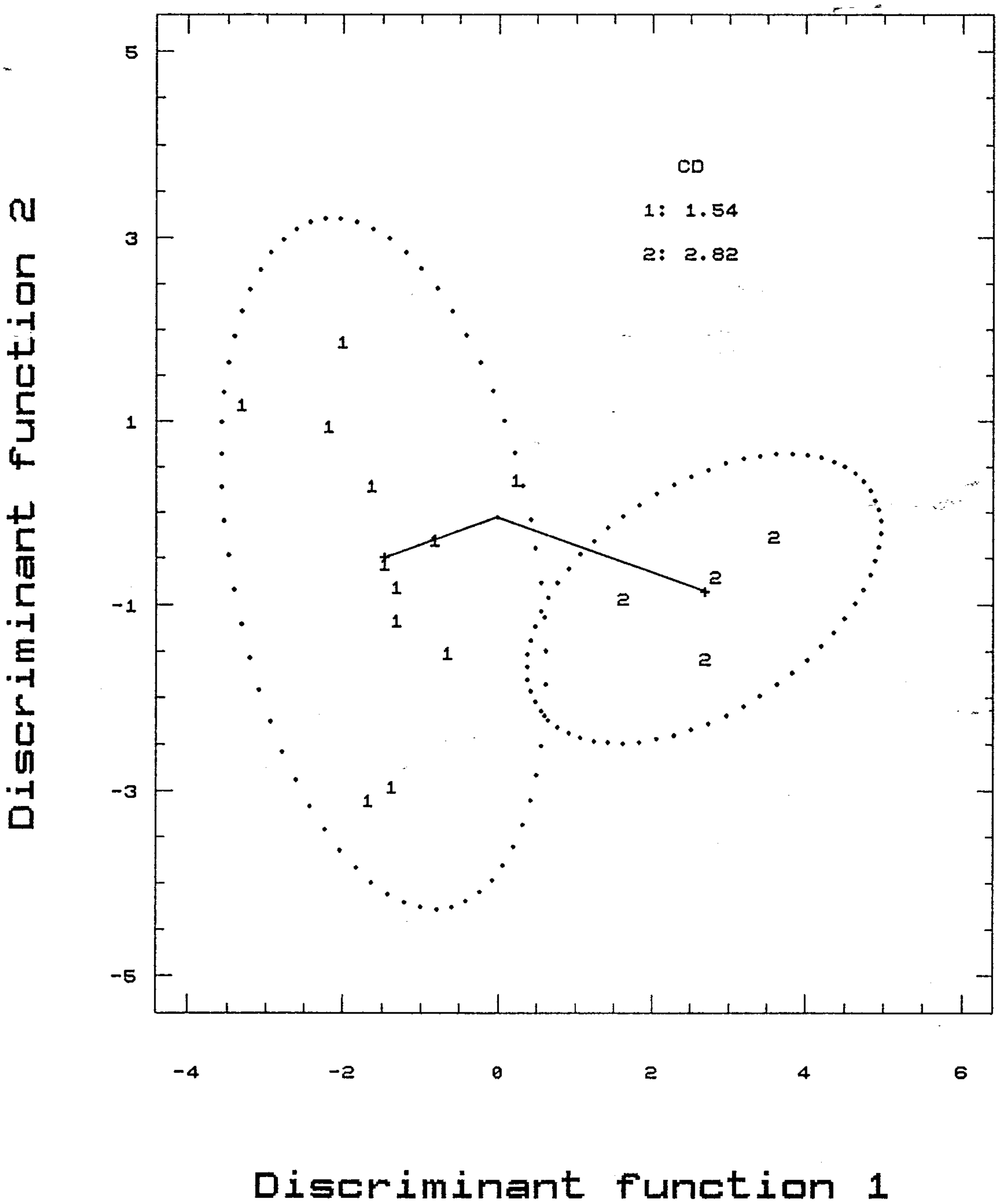


Table 6.1 Morphological characters entered into the discriminant function ranked according to their discriminatory power.

Character entered	F statistic	df	p-value
pigmentation (35)	20.90	1,14	0.0004
wing angle MJI	3.10	1,13	0.1016
wing angle (31)	4.45	1,12	0.0565
length of wax plate (13)	2.87	1,11	0.1182
width of wax plate (11)	5.77	1,10	0.0372

The discriminant analysis procedure revealed that pigmentation of the scutellum best discriminated between the two groups. The second character to enter the discriminant function was angle MJI of the wing venation. Both these characters had high factor loadings in factor 1 of the factor analysis. The next three characters to enter the discriminant function, wing angle O26 (31), width and length of wax plate on sternite 3 (13) and (11) were heavily loaded in factor 2.

The linear discriminant functions obtained using the five characters of Table 6.1 correctly classified all the colonies from Nababeep, Karasburg and Keetmanshoop into group 1 with *a posteriori* probability p=1.0 for 11 cases and p=0.97 in the remaining case. All the colonies from Otjiwarongo were correctly classified into group 2 with *a posteriori* probability p=1.0. Six colonies from Mariental, Windhoek and Okahandja were classified into group 1 and six into group 2. This classification procedure may provide an overly optimistic estimate of the probability of correct classification. A jackknife procedure (Lachenbruch and Mickey, 1968) was therefore carried out. The same classification results were obtained except that one colony from Keetmanshoop was misclassified into group 2 (Table 6.2).

Table 6.2 Classification of colonies from Nababeep, Karasburg, Keetmanshoop (group 1) and Otjiwarango (group 2).

	Classification Matrix			Jackknifed Classification		
Group	% Correct	Number of colonies		% Correct	Number of colonies	
1	100.0%	12	0	91.7%	11	1
2	100.0%	0	4	100.0%	0	4

The neural networks procedure selected the following eight morphological characters as the input layer nodes: length of proboscis (4), width of wax plate on sternite 3 (11), angles of venation B4 (22), N23 (30) and O26 (31), pigmentation of abdominal tergite 2 (32), pigmentation of scutellum and scutellar plate (35) and (36). Five hidden layer nodes were used in the classification analysis. 100% correct classification was obtained in the training set and 88.9% in the test set with one colony from group 1 being misclassified.

To test for the equality of the group means for the characters used in the discriminant function, Wilks' lambda approximated by the F statistic was determined. A significant difference was found between the means of the two groups (Λ=0.1188 with 5,1,14 df, F=14.838 with 5,10 df, p-value=0.0002). These results indicate that the honeybees of southwestern Africa resolve morphometrically into two distinct and homogeneous populations, one in the north and one in the south, with a heterogeneous population lying between them. The means and standard deviations of the 11 morphometric characters are shown in Table 6.3 for the two groups and the transition group using all 560 bees from seven localities. The phenotypic correlations between the characters are presented in Table 6.4.

Table 6.3 Means and standard deviations (s.d.) of discriminant morphometric characters (measurements in mm, angles in degrees).

Character	Group 1 n=240		Transition n=240		Group 2 n=80	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
hair length (1)	0.23	0.03	0.22	0.03	0.22	0.03
proboscis length (4)	5.69	0.37	5.71	0.31	5.87	0.16
width of wax plate (11)	2.62	0.08	2.57	0.05	2.60	0.10
length of wax plate (13)	2.16	0.08	2.15	0.06	2.14	0.07
pigmentation (35)	4.92	1.81	6.02	1.52	7.36	1.63
pigmentation (36)	1.58	2.11	3.05	2.50	4.20	1.69
pigmentation (32)	7.95	0.48	8.24	0.53	8.19	0.79
wing angle B4 (22)	104.98	6.08	103.44	6.20	103.33	6.02
wing angle MJI	20.47	2.57	21.01	2.17	23.25	2.61
wing angle N23 (30)	85.45	3.55	85.14	3.57	84.77	3.72
wing angle O26 (31)	37.35	3.92	36.81	4.06	37.30	3.38

Table 6.4 Phenotypic correlations of the morphological characters from worker bees.

Character	(1)	(4)	(11)	(13)	(35)	(36)	(32)	(22)	MJI	(30)	(31)
(1)	1.00										
(4)	-0.38	1.00									
(11)	0.01	0.10	1.00								
(13)	0.05	-0.16	0.49	1.00							
(35)	0.04	0.24	-0.03	-0.32	1.00						
(36)	-0.01	0.30	-0.40	-0.42	0.60*	1.00					
(32)	-0.08	-0.05	-0.21	0.05	0.24	0.28	1.00				
(22)	-0.08	0.18	-0.01	0.11	-0.36	-0.17	0.01	1.00			
MJI	-0.12	0.42	0.23	-0.07	0.53*	0.49	-0.01	-0.34	1.00		
(30)	0.28	-0.59*	0.12	0.06	-0.09	-0.02	0.13	-0.07	0.06	1.00	
(31)	-0.27	-0.05	0.41	0.30	-0.02	-0.02	-0.05	-0.14	0.44	0.35	1.00

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

A correlation analysis was used to assess the geographic variability in honeybees along the transect. No significant correlations (Table 6.5) were found between characters associated with body size and angles of wing venation and the environmental variables. A significant correlation between pigmentation and latitude was found, indicating that pigmentation is strongly graded from black in the south with a transition to yellow in the north (Table 6.5).

A canonical correlation analysis revealed no significant correlation between the set of environmental variables (temperature, rainfall and altitude) and the set of morphological characters (R=0.83, χ^2=44.6 with 33 df, p=0.0856).

Table 6.5 Correlation coefficients (r) with corresponding p-values (p) between latitude, longitude, mean annual temperature, altitude, rainfall and the colony means of the morphometric characters.

	Latitude		Longitude		Tmax		Altitude		Rainfall	
Character	r	p	r	p	r	p	r	p	r	p
(1)	0.20	0.30	0.16	0.43	-0.21	0.29	-0.19	0.32	-0.28	0.15
(4)	-0.29	0.13	-0.35	0.06	0.12	0.55	0.33	0.08	0.45	0.02
(11)	0.30	0.12	0.39	0.04	0.05	0.78	-0.26	0.19	-0.29	0.14
(13)	0.02	0.90	0.29	0.13	0.19	0.33	-0.06	0.76	-0.23	0.25
(35)	-0.61*	<0.01	-0.54*	<0.01	0.27	0.17	0.45	0.02	0.55*	<0.01
(36)	-0.44	0.02	-0.51	0.01	-0.01	0.97	0.35	0.07	0.38	0.05
(32)	-0.38	0.05	-0.25	0.19	0.30	0.11	0.12	0.55	0.26	0.19
(22)	0.24	0.22	0.24	0.21	0.04	0.82	-0.24	0.22	-0.19	0.34
MJI	-0.35	0.06	-0.38	0.05	0.04	0.86	0.33	0.09	0.33	0.08
(30)	0.23	0.24	0.18	0.36	-0.02	0.91	-0.41	0.03	-0.30	0.13
(31)	0.16	0.42	0.21	0.28	0.12	0.53	-0.30	0.12	-0.18	0.36

* Significant correlation (p<0.05) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

The first principal component coefficients of the morphometric characters were used to determine the factor scores of each bee. The variances of these factor scores were used to test the homogeneity of the intracolonial variances at each locality. A significant difference at the 10% level was found between the intracolonial variances (Table 6.6) over all the localities (Levene's test F=1.89 with 6,553 df, p=0.0808). Variances from Windhoek and Mariental were higher than the variances from other localities. The intercolonial variances were computed (Table 6.6) from the factor scores of each colony.

No significant difference was found in the intercolonial variances between localities ($F=1.29$ with 6,21 df, $p=0.3052$). However, larger variances were again found at Windhoek and Mariental (Table 6.6).

Table 6.6 Intracolonial and intercolonial variances of factor scores of the morphometric data at each locality.

Locality	Intracolonial	Intercolonial
Nababeep (1)	7.95	6.45
Karasburg (2)	6.81	2.50
Keetmanshoop (3)	5.81	2.43
Mariental (4)	9.80	9.86
Windhoek (5)	11.16*	9.92
Okahandja (6)	6.00	3.69
Otjiwarongo (7)	7.78	1.74

* Significant ($p<0.10$).

6.4.2 Pheromone analysis

In a principal components analysis using the mean percentages of the eight compounds of the sting pheromone complex, three factors with eigenvalues greater than one were isolated: factor 1: 2-nonanol (6), octyl acetate (5), n-butyl acetate (2); factor 2: isopentyl acetate (3), isopentyl alcohol (1), benzyl acetate (7); factor 3: n-decyl acetate (8), benzyl alcohol (4). These factors accounted for 66.39% of the variance of the data. The graph of factors 1 and 2 scores showed those colonies from Karasburg forming a cluster in the upper half of the plot. Using the logratio transformed data of the sting compounds, three factors based on the logratio covariance matrix $\mathbf{\Gamma}$ were obtained: factor 1: benzyl acetate (7), benzyl alcohol (4), 2-nonanol (6); factor 2: isopentyl acetate (3), isopentyl alcohol (1); factor 3: n-butyl acetate (2), n-decyl acetate (8), octyl acetate (5), accounting for 71.34% of the variance of the data. The graph of the factor scores plot again showed colonies from Karasburg forming a cluster.

Stepwise discriminant analyses of the percentage and logratio data of the sting pheromone compounds were performed and the compounds ranked according to their discriminatory power (Tables 6.7 and 6.8).

Table 6.7 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using percentage data.

Pheromone entered	F statistic	df	p-value
benzyl acetate (7)	16.29	6,33	<0.0001
benzyl alcohol (4)	5.97	6,32	0.0003
2-nonanol (6)	5.74	6,31	0.0004
isopentyl alcohol (1)	4.32	6,30	0.0030
isopentyl acetate (3)	2.41	6,29	0.0514

Table 6.8 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using logratio transformed data.

Pheromone entered	F statistic	df	p-value
benzyl alcohol (4)	13.50	6,33	<0.0001
benzyl acetate (7)	5.00	6,32	0.0010
octyl acetate (5)	5.57	6,31	0.0005

The linear discriminant functions obtained using the five pheromones of the percentage data (Table 6.7) correctly classified 83.3% of the colonies from Nababeep, 100% of the colonies from Karasburg and Keetmanshoop, 83.33% from Mariental, 66.67% from Windhoek and 100% from Okahandja and Otjiwarongo. Using the three most discriminatory compounds for the logratio analysis (Table 6.8), 100% correct classification was obtained at Karasburg, 83.3% at Nababeep, Mariental and Otjiwarongo, 80% at Keetmanshoop and

Okahandja and only 16.7% at Windhoek.

The neural networks procedure selected the following four pheromone compounds as the input nodes: benzyl alcohol (4), 2-nonanol (6), benzyl acetate (7) and n-decyl acetate (8). No hidden layer nodes were used in the classification of the colonies into the morphometric groups. Poor classification results were obtained in both the training (82.1%) and test (66.7%) sets.

The mean percentages and standard deviations of the sting pheromone compounds are shown in Table 6.9 for the two morphometric groups and the transition group using 200 bees. Two compounds, isopentyl acetate (3) and 2-nonanol (6), accounted for more than 50% of the pheromonal bouquet throughout the transect.

Table 6.9 Mean percentages and standard deviations (s.d.) of the sting pheromones.

	Group 1 n=85		**Transition** n=85		**Group 2** n=30	
Pheromone compound	Mean	s.d.	Mean	s.d.	Mean	s.d.
isopentyl alcohol (1)	4.42	5.46	2.82	3.29	3.52	2.90
n-butyl acetate (2)	8.65	6.82	9.58	11.34	7.65	5.67
isopentyl acetate (3)	22.55	17.24	23.70	17.61	37.31	21.55
benzyl alcohol (4)	3.34	6.27	6.33	10.56	7.26	5.99
octyl acetate (5)	9.77	10.07	8.33	10.42	9.12	7.49
2-nonanol (6)	31.60	25.36	40.19	28.51	21.73	20.02
benzyl acetate (7)	15.55	15.70	6.26	6.07	8.81	6.90
n-decyl acetate (8)	4.11	6.63	2.79	4.63	4.59	3.89

The logratio ($\log(x_i/x_j)$ for $i<j$) means and variances of the pheromone compounds ($i,j=1$ to 8) are presented in Table 6.10. The largest relative variation between two pheromone compounds is between benzyl alcohol (4) and benzyl acetate (7) (Table 6.10).

The fact that the mean of these two compounds (-1.51) is less than their standard deviation (3.54) indicates that the percentage of benzyl acetate is consistently greater than that of benzyl alcohol. On the other hand there is little relative variation between isopentyl alcohol (1) and isopentyl acetate (3). Again, the mean of these compounds (-2.59) is less than their standard deviation (1.72), showing that the percentage of isopentyl acetate is consistently greater than that of isopentyl alcohol. The total variation value of the pheromonal logratio variance matrix **T** is 211.69. The values of **T** for group 1, transition group and group 3 are 231.56, 223.13 and 79.81 respectively, revealing high variation in the central and southern regions of the transect.

Table 6.10 Pheromonal variation using logratio transformed data of eight alarm pheromone components. Logratio variances are above the diagonal and logratio means are below the diagonal.

Pheromone Compound	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	0.00	4.04	2.96	6.97	6.81	8.47	10.30	8.47
(2)	-1.27	0.00	3.28	6.81	4.67	8.41	8.64	8.12
(3)	-2.59	-1.32	0.00	6.66	6.97	6.00	7.51	7.18
(4)	0.77	1.85	3.16	0.00	7.29	11.09	12.53	8.24
(5)	-0.61	0.66	1.97	-1.19	0.00	11.63	10.37	8.94
(6)	-2.51	-1.24	0.08	-3.08	-1.90	0.00	5.38	6.55
(7)	-0.93	0.34	1.65	-1.51	-0.32	1.57	0.00	7.40
(8)	0.60	1.73	3.05	-0.12	1.07	2.97	1.39	0.00

Tests for heteroscedasticity in the intracolonial variances (Table 6.11) of the sting pheromone percentage and logratio data between localities revealed significant differences between the intracolonial variances (percentage: Levene's test $F=5.97$ with 6,193 df, $p<0.0001$; logratio: Levene's test $F=3.97$ with 6,193 df, $p=0.0009$). Larger variances were found in the region from Keetmanshoop to Okahandja using both methods of analysis. The intercolonial variances (Table 6.11) revealed larger variation at Windhoek and

Okahandja (percentage: F=2.15 with 6,33 df, p=0.0731; logratio: F=1.60 with 6,33 df, p=0.1790). High intercolonial variances were also found at Nababeep.

Table 6.11 Intracolonial and intercolonial variances of factor scores of the sting pheromone compounds at each locality.

	Percentage Data		Logratio Data	
Locality	**intra-colonial**	**inter-colonial**	**intra-colonial**	**inter-colonial**
Nababeep (1)	41.37	28.90	4.54	3.36
Karasburg (2)	19.77	7.79	2.59	2.07
Keetmanshoop (3)	42.72*	17.61	5.86*	2.68
Mariental (4)	47.90*	15.21	5.75*	1.79
Windhoek (5)	39.18	20.75	4.38	2.83
Okahandja (6)	42.73*	30.12*	5.11	3.02
Otjiwarongo (7)	33.95	15.88	3.44	1.34

* Significant ($p < 0.05$).

6.5 Discussion

The principal components analysis of the morphological characters of the honeybees of southwestern Africa established two distinct groups. The southern group includes bees from Nababeep, Karasburg and Keetmanshoop, while the northern group occurs at Otjiwarongo. In central Namibia the bees of Mariental, Windhoek and Okahandja are heterogeneous. These population differences are indicated in the discriminant analysis as well. Similarly, discriminant analysis of the percentage occurrence of sting pheromone compounds produced distinct northern and southern groups with highly heterogeneous intermediate localities. Combining the morphometric and pheromonal data, northern and southern groups emerge which are similar but not identical in respect of locality.

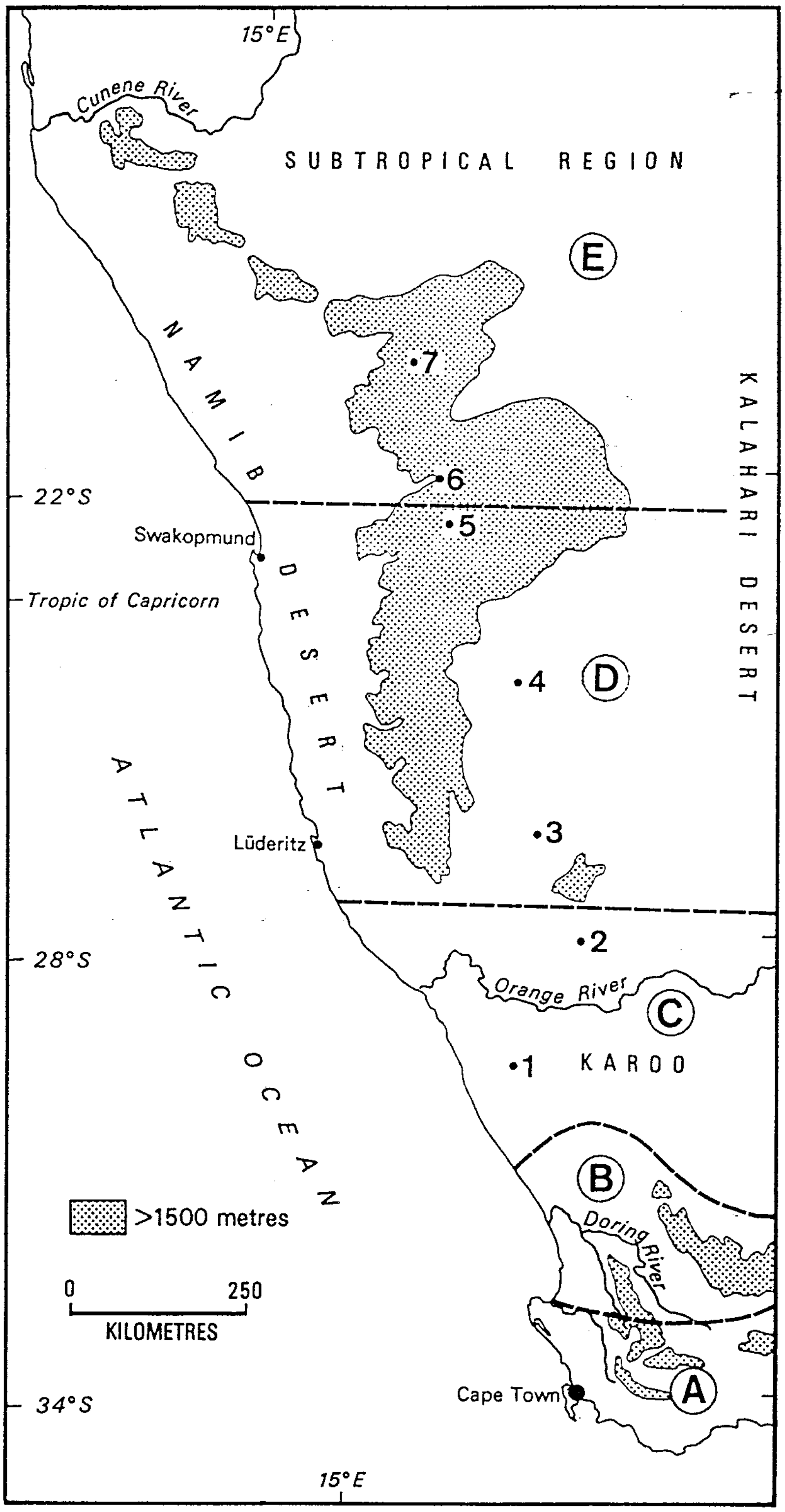
There is no apparent geographical barrier to gene flow between northern South Africa and southern Angola and gene flow should be facilitated by the complete cross-fertility of the races of *Apis mellifera* (Moritz and Southwick, 1992; Ruttner, 1992). Variance patterns should consequently reflect continuous changes in certain characters (clines) along a transect between significantly differing terminal populations to delineate a zone of hybridisation. This should result in clines with especially large variance values in the putative hybrid area (Falconer, 1989; Moritz and Kauhausen, 1984).

The genetic requirements are met in the case of the morphometric features by considering the intra- and intercolonial variances for the relevant localities (Table 6.6). The northern and southern areas have lower intra- and intercolonial variances than the high variance group: Mariental and Windhoek. The intra- and intercolonial variance values for the sting pheromones (Table 6.11) obtained from the analyses point to two distinct populations of honey bees in the region, with a broad zone of hybridisation between them (Figure 6.3).

The morphometric data of the present study, together with similar data for South Africa (Crewe *et al.*, 1994; Moritz and Kauhausen, 1984) indicate that the bees of the southern group are *A. m. scutellata*. The northern group is problematic because the honeybees of Angola have not been classified. Ruttner (1992) delineated the northern Namibian group as probably *A. m. adansonii*, but gave no morphometric data. However, morphometric data for three features of *A. m. adansonii* honeybees from Zambia, Zaire and the Central African Republic (Ruttner, personal communication 1993) and shared in common with the present data set correspond well with results obtained from northern Namibia. Consequently this group can be classified as *A. m. adansonii* in the Ruttner (1988) sense, or as *A. m. scutellata* ecotype *A. m. adansonii*, according to Kerr (1992).

Studies of natural introgression in native populations of honeybees are relatively few but they show that races or subspecies of honeybees investigated to date can be resolved into distinct populations with significant hybrid zones between them (Cornuet and Fresnaye, 1989; Moritz *et al.*, 1994; Smith *et al.*, 1991). The same is true of *A. m. capensis* and *A. m. scutellata* in South Africa (Hepburn *et al.*, 1994). Coupling the latter with the present data yields a transect (Figure 6.3) extending from Cape Algulhas into northern Namibia, along which a well-defined homogeneous population of *A. m. capensis* (A) gives way to a very heterogeneous hybrid zone (B) before the next distinct homogeneous population (C) of *A. m. scutellata* occurs. Moving northward this *A. m. scutellata* population gives way to another hybrid zone (D) in central Namibia, finally reaching another relatively homogeneous population (E), classified as *A. m. adansonii*.

Figure 6.3 Honeybee populations of southwestern Africa. Numbers 1-7 are the localities sampled from Nababeep to Otjiwarongo. Identifiable populations based on morphometric and pheromonal variance indicated are *A. m. capensis* (A), *A. m. capensis* × *A. m. scutellata* hybrid zone (B), (Hepburn *et al.*, 1994) *A. m. scutellata* (C), *A. m. scutellata* × *A. m. adansonii* hybrid zone (D) and *A. m. adansonii* (E).



CHAPTER 7

MORPHOMETRIC AND PHEROMONAL ANALYSES *APIS MELLIFERA* L. ALONG A TRANSECT IN SOUTHEASTERN AFRICA

7.1 Summary

The morphometric characters and sting pheromones of worker honeybees (*Apis mellifera* L.) were analysed by multivariate methods to identify discrete populations in the southeastern woodland savanna of Africa. A discrete population in Mozambique is classified as *A. m. litorea*, a second in Zimbabwe as *A. m. scutellata* and a third group in northwestern Zambia as *A. m. adansonii*. A zone of introgression between the last two subspecies occurs in south-central Zambia and in the Zambezi valley.

7.2 Introduction

The honeybees of Africa have recently been classified into several subspecies and/or ecotypes at the continental macro-level (Ruttner, 1988, 1992; Kerr, 1992). This biogeographic framework now makes it possible to begin to assess population structure in honeybees at a meso-scale spatial resolution. For this purpose, combined analyses of characters of low (morphometric) and high (pheromones) heritability have proven useful in defining the phenetic similarity of discrete populations while their heteroscedasticity or variance spectra can indicate areas of introgression between populations (Hepburn *et al.*, 1994; Hepburn and Radloff, 1996; Radloff *et al.*, 1996; Radloff and Hepburn, 1997a, b).

Honeybee populations were analysed from the southeastern woodland savanna of

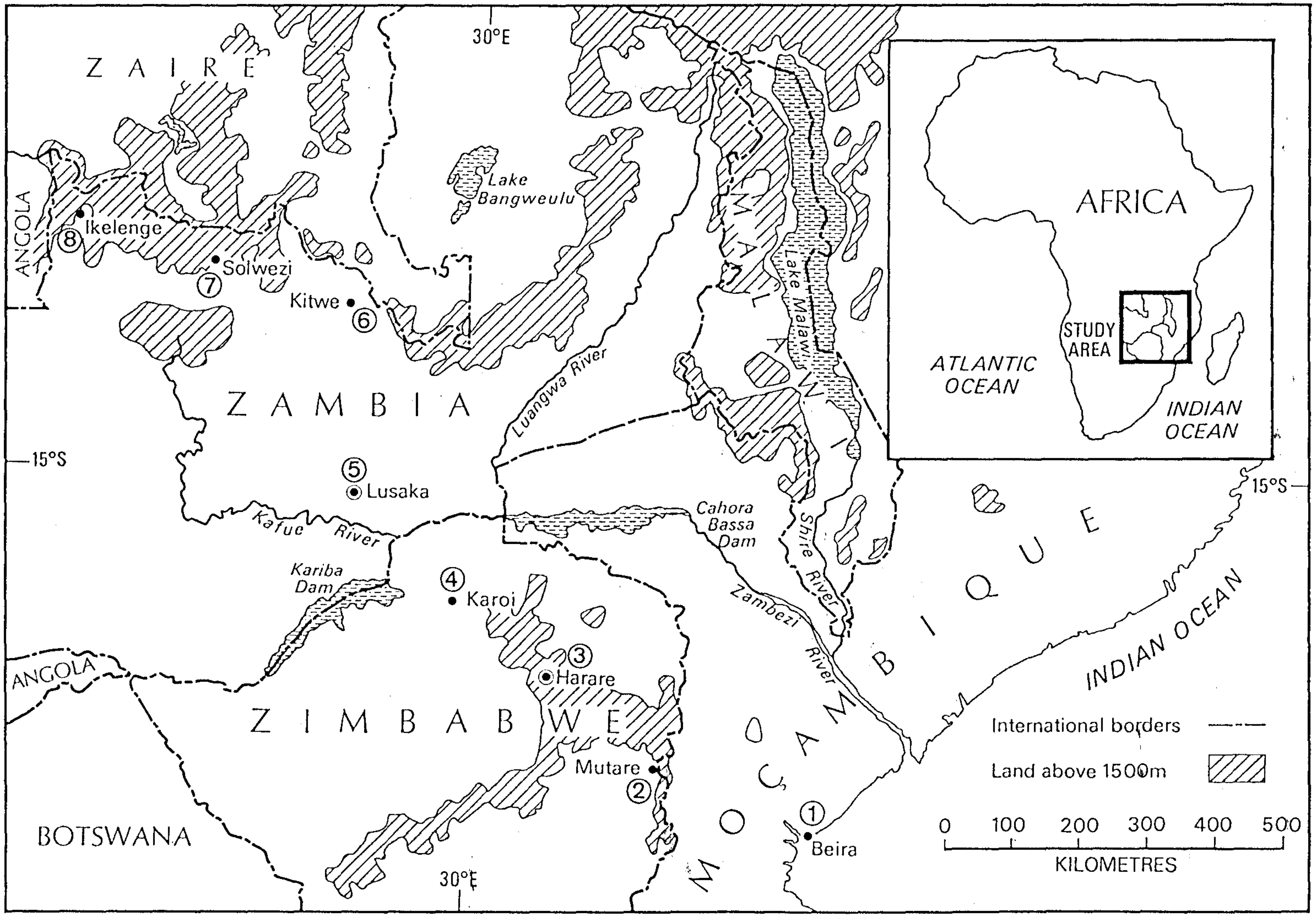
Africa, extending from coastal Mozambique through the highveld of Zimbabwe and into the mountains of northwestern Zambia. In terms of the prevailing biogeographic classification of honeybees (Ruttner, 1992), this represented a transect through the subspecific areas, respectively, of *A. m. litorea*, *A. m. scutellata* and *A. m. adansonii*. Multivariate statistics were used to define distinct populations in the region and possible areas of introgression in relation to climate, topography and relevant aspects of the biology of the honeybees.

7.3 Materials

Worker bees were sampled from the colonies of small-scale, fixed-site beekeepers at eight different localities extending along an approximate 1 500 km transect from Beira (1) in Mozambique, to Mutare (2) in southeastern Zimbabwe, through Harare (3) to Karoi (4) in northern Zimbabwe, Lusaka (5) in central Zambia, through Kitwe (6) and Solwezi (7) to Ikelenge (8) in northwestern Zambia (Figure 7.1).

Morphometric measurements were made on 20 bees per colony and usually six colonies were sampled at each locality. A total of 760 bees was used in the morphometric analysis. For the pheromone analysis five guard bees were collected from each of three to six colonies per locality. A total of 185 bees was used in the analysis.

Figure 7.1 Localities in Mozambique, Zimbabwe and Zambia sampled in this study: Beira (1), Mutare (2), Harare (3), Karoi (4), Lusaka (5), Kitwe (6), Solwezi (7) and Ikelenge (8).



7.4 Results

7.4.1 Morphometric analysis

In a principal components analysis of the morphometric characters of 38 colonies, four factors with eigenvalues greater than one were isolated: factor 1: characters associated with size: length of wax plate on sternite 3 (13), length of proboscis (4) and length of hair on tergite 5 (1); factor 2: angles of wing venation N23 (30) and MJI; factor 3: pigmentation of scutellum (35) and angle of wing venation B4 (22); factor 4: width of wax plate on sternite 3 (11) and pigmentation of scutellar plate (36). These factors accounted for 67.8% of the variance in the data. The loadings for each character had absolute value greater than 0.60. The graph of the factor scores from factors 1 and 2 showed three clusters: colonies from Beira forming a cluster in the lower right-hand quadrant of the plot; colonies from Mutare, Harare and Karoi forming a cluster in the lower left-hand quadrant, and colonies from Kitwe, Solwezi and Ikelenge forming a cluster in the upper right-hand quadrant. Colonies from Lusaka were evenly scattered.

A stepwise discriminant analysis using the colony means of the morphometric characters confirmed the separation of the three clusters (Figure 7.2). Mahalanobis distances D^2 between the clusters were $D^2=73.99$ for 1 and 2, $D^2=101.32$ for 1 and 3 and $D^2=9.54$ for 2 and 3.

Figure 7.2 Discriminant analysis plot using the colony means of the morphometric data: cluster 1 is composed of colonies from Beira (1); cluster 2 is composed of colonies from Mutare (2), Harare (3) and Karoi (4); cluster 3 is composed of colonies from Kitwe (6), Solwezi (7) and Ikelenge (8). Confidence ellipses are at the 90% level. CD = canonical distances from the common centroid of the clusters.

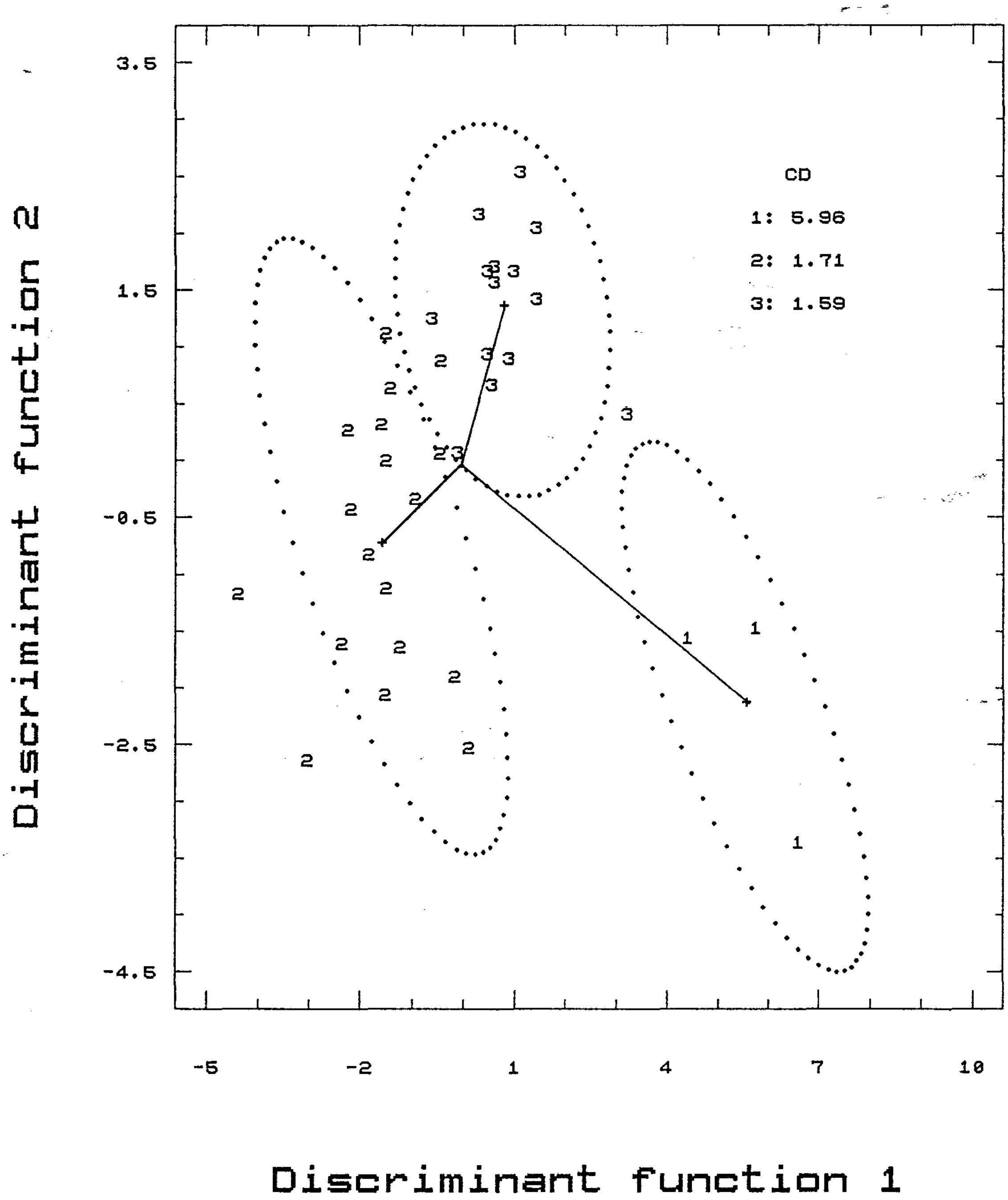


Table 7.1 shows the four characters entered into the linear discriminant functions ranked according to their discriminatory power. Three of these characters are related to size. Each colony was assumed to have equal *a priori* probability of being in any cluster. The discriminant analysis procedure revealed that characters associated with body size, length and width of wax plate on sternite 3 (13) and (11) and length of proboscis (4), were the better discriminatory characters.

Table 7.1 Morphological characters entered into the discriminant function ranked according to their discriminatory power.

Character entered	F statistic	df	p-value
length of wax plate (13)	32.84	2,32	<0.0001
wing angle (30)	11.15	2,31	0.0002
length of proboscis (4)	5.80	2,30	0.0074
width of wax plate (11)	4.24	2,29	0.0242

The linear discriminant functions obtained using the means of the most discriminatory characters classified 100% of the colonies from Beira correctly into group 1 with *a posteriori* probability $p=1.0$; 94.4% of the colonies from Mutare, Harare and Karoi correctly into group 2 with *a posteriori* probability $p=1.0$ for seven colonies, $0.9<p<1.0$ for seven colonies and $0.6<p<0.9$ for three colonies, and 92.9% of the colonies from Kitwe, Solwezi and Ikelenge correctly into group 3 with *a posteriori* probability $p=1.0$ for five colonies, $0.9<p<1.0$ for six colonies and $0.8<p<0.9$ for two colonies. Colonies from Lusaka were classified into both groups 2 and 3. A jackknife procedure (Lachenbruch and Mickey, 1968) produced the same classification results except for one colony from Karoi which was misclassified into group 3, and one colony from Kitwe which was misclassified into group 2.

Table 7.2 Classification of colonies from Beira (group 1), Mutare, Harare and Karoi (group 2), and Kitwe, Solwezi and Ikelenge (group 3).

	Classification Matrix				**Jackknifed Classification**			
Group	% Correct	Number of colonies			% Correct	Number of colonies		
1	100.0%	3	0	0	100.0%	3	0	0
2	94.4%	0	17	1	88.9%	0	16	2
3	92.9%	0	1	13	85.7%	0	2	12

The following nine morphological characters were used in the input layer of a neural networks analysis: length of proboscis (4), width and length of wax plate on sternite 3 (11) and (13), angles of venation B4 (22), N23 (30), O26 (31) and MJI, pigmentation of scutellum and scutellar plate (35) and (36). The hidden layer consisted of two nodes. The procedure classified all the colonies correctly in the training set (100%) and misclassified one colony from group 2 in the test set (91.7%).

To test for the equality of the group means for the characters used in the discriminant function, Wilks' lambda approximated by the F statistic was determined. A significant difference was found between the means of the three groups ($\Lambda=0.1063$ with 4,2,32 df; $F=14.99$ with 8,58 df, $p<0.0001$). These results indicate that the honeybees of this region in southern Africa resolve morphometrically into three distinct and homogenous populations: a discrete population in Mozambique; a discrete population in Zimbabwe; a discrete population in northwestern Zambia and a heterogeneous population in south-central Zambia. The means and standard deviations of the 11 morphometric characters are shown in Table 7.3 for the three groups, and for the transition group, using all 760 bees from eight localities. The phenotypic correlations between the characters are presented in Table 7.4.

Table 7.3 Means and standard deviations (s.d.) of discriminant morphometric characters (measurements in mm, angles in degrees).

	Group 1 n=60		Group 2 n=360		Transition n=58		Group 3 n=280	
Character	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
hair length (1)	0.21	0.03	0.24	0.03	0.22	0.03	0.23	0.03
proboscis length (4)	5.40	0.33	5.96	0.15	5.99	0.10	5.86	0.24
width of wax plate (11)	2.51	0.07	2.54	0.07	2.55	0.07	2.51	0.06
length of wax plate (13)	1.99	0.07	2.13	0.07	2.13	0.05	2.11	0.05
pigmentation (35)	5.57	1.36	5.26	1.70	5.31	1.84	5.29	2.09
pigmentation (36)	1.02	1.42	1.77	1.37	0.83	1.26	1.25	1.64
pigmentation (32)	8.65	0.48	8.35	0.92	8.36	0.52	8.32	1.00
wing angle B4 (22)	105.24	6.20	104.62	6.20	102.78	5.24	102.00	5.87
wing angle MJI	18.83	2.24	19.04	2.63	20.36	2.28	20.98	2.63
wing angle N23 (30)	78.77	4.14	78.83	4.19	83.54	3.86	82.59	4.08
wing angle O26 (31)	35.02	3.61	35.33	3.92	36.94	4.06	36.50	3.93

Table 7.4 Phenotypic correlations of the morphological characters from worker bees.

Character	(1)	(4)	(11)	(13)	(35)	(36)	(32)	(22)	MJI	(30)	(31)
(1)	1.00										
(4)	0.36	1.00									
(11)	0.10	0.29	1.00								
(13)	0.44	0.70*	0.45	1.00							
(35)	-0.26	-0.16	-0.13	-0.12	1.00						
(36)	0.19	0.15	0.02	0.21	0.15	1.00					
(32)	-0.34	-0.31	-0.08	-0.29	0.34	-0.08	1.00				
(22)	-0.00	-0.09	0.36	-0.01	0.17	0.11	-0.01	1.00			
MJI	-0.19	0.07	-0.14	0.07	0.16	-0.26	-0.12	-0.11	1.00		
(30)	-0.30	0.15	-0.01	0.08	0.26	-0.33	0.02	-0.32	0.64*	1.00	
(31)	-0.17	0.09	-0.09	0.04	0.20	-0.08	0.01	-0.04	0.21	0.36	1.00

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

A correlation analysis was used to assess the climate-correlated variation in honeybees along the transect. Significant variations in certain body size characters correlated to increasing altitude and decreasing temperatures were observed (Table 7.5). Also certain angles of venation were significantly correlated to geographic latitude and longitude. No significant correlations were found between pigmentation and the environmental variables

(Table 7.5).

A canonical correlation analysis showed a significant correlation between the set of environmental variables (temperature, rainfall and altitude) and the set of morphological characters ($R=0.89$, $\chi^2=80.6$ with 33 df, $p<0.0001$). The largest squared multiple correlation was between temperature and the set of morphometric variables ($R^2=0.76$, $p=0.0008$).

Table 7.5 Correlation coefficients (r) with corresponding p-values (p) between latitude, longitude, mean annual temperature, altitude, rainfall and the colony means of the morphometric characters.

	Latitude		Longitude		Tmax		Altitude		Rainfall	
Character	r	p	r	p	r	p	r	p	r	p
(1)	0.06	0.70	-0.04	0.82	-0.41	0.01	0.25	0.12	-0.27	0.10
(4)	-0.10	0.57	-0.22	0.18	-0.51	<0.01	0.43	0.01	-0.51	<0.01
(11)	0.38	0.02	0.40	0.01	-0.44	0.01	-0.21	0.21	-0.46	<0.01
(13)	-0.04	0.82	-0.11	0.50	-0.64*	<0.01	0.43	0.01	-0.56*	<0.01
(35)	0.07	0.66	0.09	0.60	-0.09	0.59	-0.18	0.28	-0.01	0.96
(36)	0.26	0.12	0.33	0.04	-0.28	0.09	-0.04	0.80	-0.27	0.10
(32)	0.14	0.42	0.13	0.45	0.10	0.56	-0.07	0.68	0.06	0.74
(22)	0.53*	<0.01	0.62*	<0.01	-0.38	0.02	-0.57*	<0.01	-0.32	0.05
MJI	-0.52*	<0.01	-0.43	0.01	0.21	0.22	0.17	0.30	0.35	0.03
(30)	-0.60*	<0.01	-0.57*	<0.01	0.34	0.04	0.27	0.10	0.37	0.02
(31)	-0.25	0.13	-0.18	0.27	0.11	0.50	0.08	0.63	0.10	0.53

* Significant correlation ($p<0.05$) as determined by Bonferroni's adjustment in the level of significance for simultaneous testing.

The factor score of each bee was calculated from the first principal component function, and the variances of these factor scores were used to test for homogeneity of the variances at each locality. A significant difference was found between the intracolonial variances (Table 7.6) over all the localities (Levene's test $F=2.30$ with 7,752 df, $p=0.0251$). Larger variances were found at Karoi and Kitwe.

The intercolonial variances (Table 7.6) were computed by the same method, but this time the colony means were used to determine the factor scores of each colony. No significant difference was found in the variances between localities (F=1.40 with 7,30 df, p=0.2415). However, the intercolonial variation was again higher between the Karoi and Kitwe regions.

Table 7.6 Intracolonial and intercolonial variances of factor scores of the morphometric data at each locality.

Locality	Intracolonial	Intercolonial
Beira (1)	4.92	1.02
Mutare (2)	5.27	2.72
Harare (3)	5.64	2.22
Karoi (4)	6.17*	4.73
Lusaka (5)	4.77	3.45
Kitwe (6)	5.85	3.36
Solwezi (7)	5.02	3.33
Ikelenge (8)	4.90	2.79

* Significant ($p<0.05$).

7.4.2 Pheromone analysis

In a principal components analysis using the mean percentages of the nine compounds of the sting pheromone complex, three factors with eigenvalues greater than one were isolated and accounted for 74.2% of the variance of the data: factor 1: isopentyl acetate (3), benzyl acetate (7), n-octanol (9) and isopentyl alcohol (1); factor 2: 2-nonanol (6) and n-butyl acetate (2); factor 3: n-decyl acetate (9) and benzyl alcohol (4). The factor scores plot revealed the same three clusters indicated in the morphometric analysis. A stepwise discriminant analysis of the colony mean percentages of the sting compounds confirmed the separation of the three clusters (Figure 7.3). Using the logratio transformed data of the sting pheromone compounds, two factors based on the logratio covariance matrix **Γ** were obtained: factor 1: n-decyl acetate (8), isopentyl alcohol (1), benzyl alcohol (4), isopentyl acetate (3), octyl acetate (5); factor 2: n-butyl acetate (2), 2-nonanol (6), benzyl acetate (7), n-octanol (9), accounting for 68.6% of the variance of the data. The factor scores plot again showed the colonies from Beira forming a cluster in the upper left-hand quadrant of the plot. Tables 7.7 and 7.8 show the pheromones entered into the linear discriminant functions ranked according to their discriminatory power.

Figure 7.3 Discriminant analysis plot using the mean percentages of the sting pheromone data: cluster 1 is composed of colonies from Beira (1); cluster 2 is composed of colonies from Mutare (2), Harare (3) and Karoi (4); cluster 3 is composed of colonies from Kitwe (6), Solwezi (7) and Ikelenge (8). Confidence ellipses are at the 90% level. CD = canonical distances from the common centroid of the clusters.

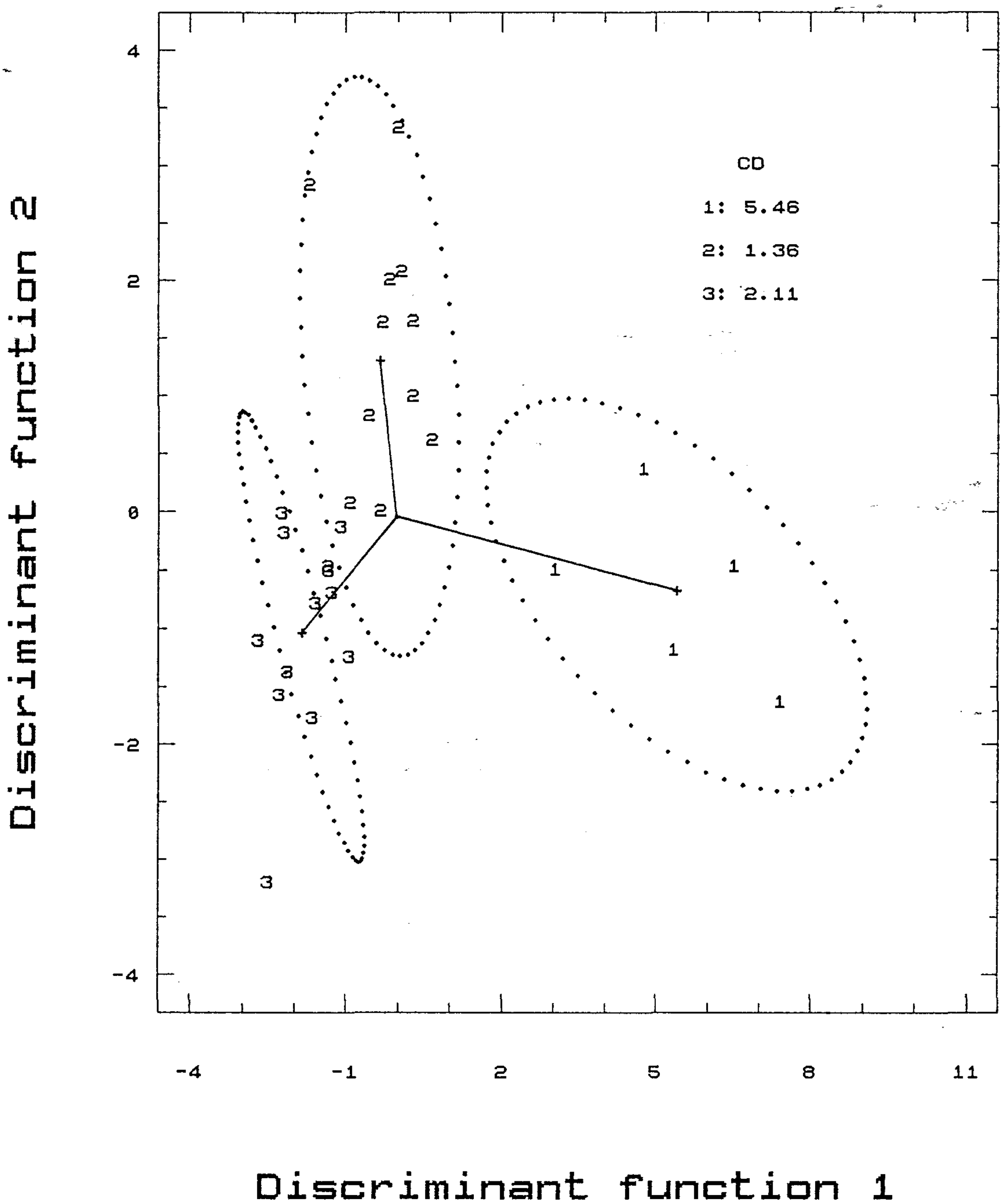


Table 7.7 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using percentage data.

Pheromone entered	F statistic	df	p-value
n-octanol (9)	38.08	2,32	<0.0001
benzyl alcohol (4)	8.29	2,31	0.0013
benzyl acetate (7)	6.35	2,30	0.0050
isopentyl acetate (3)	4.91	2,29	0.0146
n-butyl acetate (2)	3.71	2,28	0.0372

Table 7.8 Sting pheromone compounds entered into the discriminant function ranked according to their discriminatory power using logratio transformed data.

Pheromone entered	F statistic	df	p-value
isopentyl alcohol (1)	41.85	2,32	<0.0001
benzyl alcohol (4)	14.35	2,31	<0.0001
n-butyl acetate (2)	7.05	2,30	0.0031
octyl acetate (5)	3.68	2,29	0.0376

The linear discriminant functions obtained using the colony means of the most discriminatory compounds (Table 7.7) classified 100% of the colonies from Beira correctly into group 1, sixteen of eighteen colonies (88.9%) from Mutare, Harare and Karoi correctly into group 2 and eleven of twelve colonies (91.7%) from Kitwe, Solwezi and Ikelenge correctly into group 3. A significant difference was found between the population mean percentages between the three groups (Λ=0.0800 with 5,2,32 df; F=14.20 with 10,56 df, $p<0.0001$). These results again indicate the presence of three distinct homogeneous populations in this southern African region. The classification results using the most discriminatory compounds of the logratio transformed data were 100%, 94.4% and 83.3% for groups 1, 2 and 3 respectively.

The neural networks procedure used eight of the nine pheromone compounds (excluding isopentyl acetate (3)) as the nodes in the input layer. Three hidden layer nodes were used in the classification analysis. 100% correct classification was achieved in the training set and 91.7% in the test set with one colony from Lusaka being misclassified.

The means and standard deviations of the nine pheromone compounds are shown in Table 7.9 for the three groups and the transition group, using all 185 bees from eight localities.

Table 7.9 Mean percentages and standard deviations (s.d.) of the sting pheromones.

	Group 1 n=23		**Group 2** n=90		**Transition** n=12		**Group 3** n=60	
Pheromone compound	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
isopentyl alcohol (1)	1.90	2.88	4.99	3.47	5.93	8.42	5.89	3.69
n-butyl acetate (2)	17.45	7.19	7.86	6.14	5.15	7.66	8.73	10.74
isopentyl acetate (3)	3.89	4.16	7.94	4.97	12.38	10.38	11.02	4.74
benzyl alcohol (4)	2.27	4.06	5.60	2.89	5.35	6.56	4.95	2.64
octyl acetate (5)	23.69	11.33	15.09	9.51	14.11	14.69	12.21	7.71
2-nonanol (6)	14.59	12.60	30.44	16.26	19.86	12.05	26.25	12.79
benzyl acetate (7)	8.60	9.91	17.07	7.08	20.46	11.52	22.46	8.43
n-decyl acetate (8)	9.97	10.18	5.94	6.64	13.92	19.61	4.16	1.85
n-octanol (9)	17.63	10.42	5.07	4.47	2.85	2.86	4.31	3.84

The logratio ($\log(x_i/x_j)$ for $i<j$) means and variances of the pheromone compounds ($i,j=1$ to 9) are presented in Table 7.10. The smallest relative variation between two pheromone compounds is between isopentyl alcohol (1) and isopentyl acetate (3). The logratio means of 2-nonanol (6) are negative for $i<6$ and positive for $6<j$, indicating that the percentage of this compound is consistently greater than that of the other pheromone compounds. The total variation of the pheromonal logratio variance matrix **T** is 55.34. The values of **T** for the three groups and for the transition region are 57.23, 46.88, 32.92 and

68.22 respectively, revealing higher variation in the transition area.

Table 7.10 Pheromonal variation using logratio transformed data of nine alarm pheromone components. Logratio variances are above the diagonal and logratio means are below the diagonal.

Pheromone Compound	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	0.00	1.43	0.52	0.53	1.49	1.62	0.96	1.03	2.57
(2)	-0.49	0.00	1.57	1.48	1.00	2.43	1.91	1.30	1.46
(3)	-0.56	-0.07	0.00	0.71	1.69	1.34	0.89	1.46	2.62
(4)	-0.01	0.48	0.55	0.00	1.62	1.58	0.80	1.32	2.42
(5)	-1.14	-0.64	-0.58	-1.12	0.00	1.76	1.47	0.88	1.59
(6)	-1.64	-1.15	-1.08	-1.63	-0.51	0.00	0.99	1.83	2.97
(7)	-1.34	-0.85	-0.78	-1.33	-0.21	0.30	0.00	1.43	2.72
(8)	-0.22	0.28	0.34	-0.21	0.92	1.43	1.12	0.00	1.94
(9)	0.10	0.59	0.65	0.11	1.23	1.74	1.44	0.31	0.00

To test for heteroscedasticity in the variances of the sting pheromone percentage and logratio transformed data between localities, the first principal component coefficients of the pheromone compounds were calculated and used to determine the factor scores of each bee. Although no significant difference was found between the intracolonial variances (Table 7.11) of these factor scores (percentage: Levene's test, $F=1.73$ with 7,177 df, $p=0.1041$; logratio: $F=1.17$ with 7,177 df, $p=0.3240$), higher variance was evident in the transition region at Lusaka.

No significant difference was found in the intercolonial variances (Table 7.11) between localities using the percentage data ($F=1.63$ with 7,30 df, $p=0.1665$). However larger intercolonial variation was established at Lusaka. A significant difference was established between the intercolonial variances using the logratio data ($F=3.79$ with 7,30 df, $p=0.0046$). Higher intercolonial variation was also found at Lusaka (Table 7.11).

Table 7.11 Intracolonial and intercolonial variances of factor scores of the sting pheromone compounds at each locality.

Locality	Percentage Data		Logratio Data	
	intra-colonial	inter-colonial	intra-colonial	inter-colonial
Beira (1)	23.32	16.49	2.11	1.81
Mutare (2)	17.94	12.62	1.82	1.40
Harare (3)	20.82	6.91	1.63	0.47
Karoi (4)	16.91	7.96	2.05	1.03
Lusaka (5)	27.50	22.31	2.82	3.29*
Kitwe (6)	20.54	7.72	1.80	0.62
Solwezi (7)	11.29	6.03	1.15	0.57
Ikelenge (8)	19.25	7.21	1.53	0.43

* Significant ($p<0.01$).

7.5 Discussion

The suite of multivariate analyses employed in this study establish three morphometrically and pheromonally distinct populations (Figures 7.2 and 7.3). The bees of Mozambique correspond to *A. m. litorea*, which may extend northwards along the coastal plain to the Kenya-Somalia region (Ruttner, 1988, 1992). A second group begins above the escarpment at the Chimanimani mountains and extends across Zimbabwe, very probably as far as the Zambezi valley. This group is part of a contiguous subspecies, *A. m. scutellata*, extending the length of the east African highlands from South Africa to Ethiopia (Ruttner, 1988, 1992; Crewe *et al.*, 1994). The third group, in northwestern Zambia, corresponds to *A. m. adansonii* which is spread throughout west Africa and southwards to northern Namibia and Zambia (Ruttner, 1992; Radloff *et al.*, 1996).

The multivariate analyses also demonstrate that the bees of south-central Zambia, centred on Lusaka and the Zambezi River Valley were consistently misclassified, and are thus morphometrically and pheromonally extremely heterogeneous (Figures 7.2 and 7.3).

This is characteristic of zones of introgression between different discrete honeybee populations (Hepburn and Radloff, 1996; Radloff *et al.*, 1996) and in this case indicates a hybrid zone between *A. m. adansonii* to the northwest of Zambia and *A. m. scutellata* to the southeast in Zimbabwe. Because morphological traits are of generally low heritability (Falconer, 1989; Moritz and Southwick, 1992), further support for a hybrid zone is derived from the high heritability of sting pheromones (Collins *et al.*, 1987a). The pheromonal variances of the Lusaka material are significantly greater (logratio) than those of all other localities, and reflect the heteroscedasticity associated with other hybrid zones in southern Africa (Hepburn *et al.*, 1994; Radloff *et al.*, 1996).

The structure of the honeybee populations along the transect is further reflected in their variance spectra. While clinal changes in the traits measured might have been expected in the absence of barriers to gene flow, there were few significant correlations between change in latitude and both bee size and pigmentation (Table 7.5). Although no significant difference in pheromonal intracolonial variance was observed there are clinal asymmetries in the morphometric characters at Karoi and in the pheromones at Lusaka (Tables 7.6 and 7.11). Intracolonial variation is attributed to the multiple matings of queens with several-to-many drones of differing allelic frequencies (Moritz and Southwick, 1992). The significantly high intercolonial variances in the pheromones associated with the Lusaka area are interpreted as direct evidence for introgression between *A. m. adansonii* and *A. m. scutellata* in this region.

While statistical inference is a powerful adjunct to the delineation of subspecific groups, explanations for the results obtained must be sought in a biogeographic context.

Gene flow within and between honeybee populations requires movements of the kind associated with swarming and, especially in Africa, absconding and migrations. The chances of such movements being successful are heavily dependent on environmental conditions. The entire area between Beira and Ikelenge falls within a single ecological-climatological zone of tropical savanna woodland with a long dry season (Walter, 1973; Cole, 1986). Nonetheless variations occur along this transect that positively bear on the current distributions of the three subspecific groups indicated in Figures 7.2 and 7.3.

Throughout the year the plains of Mozambique are consistently some 8°C warmer than the highveld above the escarpment of the Chimanimani mountains at Mutare. Here the transition in temperature profiles is quite abrupt (Jackson, 1961) and this is the probable border between *A. m. litorea* and *A. m. scutellata*. It can be inferred that the average cost of basal metabolism at the higher temperatures of Mozambique is significantly in excess of that on the Zimbabwean highveld and should require physiological or behavioural adaptations for this region (Worswick, 1987; Nachtigall *et al.*, 1989; Balderrama *et al.*, 1992). There is little variation in the annual temperature profiles across the highveld except for a thermal discontinuity at the Zambezi River Valley, which is some 6°C warmer than all of the areas along the 1 200 km expanse from Mutare to Ikelenge (Jackson, 1961). This discontinuity is geographically proximate to the zone of introgression between *A. m. scutellata* and *A. m. adansonii*.

Swarming, absconding and migrations by the honeybees of Africa occur throughout the year, but there are still peak periods for seasonal movements. In general, the main swarming/migration period occurs in months 8-11 across Mozambique and Zimbabwe, the end of which varies with the onset of the rainy season (Papadopoulo, 1969; McIntosh, 1990; Coleman, personal communication). Since the development of massive gum (*Eucalyptus* spp.) plantations, a second swarming season has begun to develop on the Zimbabwean highveld in months 2-4 (Coleman, personal communication).

Swarming in Zambia is particularly closely tied to the flowering of the bee forage trees *Brachystegia* in months 8-9 and *Julbernardia* in months 3-4 in the Lusaka-Kitwe areas. However, a *Brachystegia* presence is greatly reduced to the northwest, and there is a single swarming/migration season at the higher altitudes of Solwezi and Ikelenge during months 8-9 (Silberrad, 1976; Chupa, personal communication). Thus this intercalation of a second swarming season on the Zimbabwean highveld coupled to two synchronous swarming seasons in south-central Zambia provide a phenological corridor that should, in principle, increase the probability of gene flow in the zone of introgression between *A. m. scutellata* and *A. m. adansonii* as it now exists.

A further biological indication of an introgression zone is related to honeybee aggressiveness. It is the long-standing opinion of experienced apiculturists that the honeybees of Zambia are considerably more aggressive than those to the south in Zimbabwe. Indeed, both Coleman in Zimbabwe and Chupa in Zambia agree on this point (personal communications) and both also aver that there is a marked transition in aggressiveness associated with the Zambezi River Valley. In this context it is particularly noteworthy that isopentyl acetate (a potent releaser of stinging behaviour, Kerr *et al.*, 1974) reaches its highest percentage as a pheromonal constituent in the *A. m. adansonii* of Zambia and in the introgression zone with *A. m. scutellata* (Table 7.9, group 3 and transition group respectively).

In summary, the delineation of three subspecies of honeybees along a transect from coastal Mozambique to the mountains of northwestern Zambia and the identification of a zone of introgression is established through multivariate analyses. These interpretations are strongly supported by correlative data of the sting gland pheromones and field experience of honeybee aggressiveness. The geographic distributions of these groups of honeybees are also associated with asymmetries of climate along the transect. Finally, the swarming and migratory seasons of the bee groups facilitate their introgression in the Zambezi River Valley.

CHAPTER 8

CONCLUSIONS

8.1 Summary

Multivariate analyses of morphometric and pheromonal characteristics of worker honeybees from five transects through northwestern, northeastern, west central, southwestern and southeastern Africa yielded sequences of statistically defined morphoclusters (=subspecies, *sensu* Ruttner, 1988) alternating with heterogeneous zones of introgression. In some, but not all, areas pheromonal clusters were found to be coincident and concordant with the morphometric clusters, thus indicating that different honeybee traits have dispersed variably among populations.

All transects were found to contain areas of significantly high variance. High intracolonial variance is taken to indicate localised genetic variation coupled with out-cross matings. Centroids of high intercolonial variance occurred at and between cluster boundaries and were typical of transitions between, and rainfall-temperature discontinuities within, ecological-climatological zones, hence areas of ecological instability.

8.2 Classification methods

Two methods of classification were used in the analyses of the morphometric and pheromonal characteristics: multivariate discriminant and artificial neural networks techniques. In all transects, the number of characters selected for classification purposes by the neural networks procedure was greater than the number used in the discriminant method. Better classification results were obtained using the neural networks models compared with those using discriminant analysis, but this difference in performance was most probably due to the larger number of characters used in the former models.

When comparing the phenotypic correlations from the five transects (Tables 3.4, 4.4, 5.4, 6.4 and 7.4) it is noted that in the northeastern, northwestern and west central transects, significant correlations were found between certain morphological characters related to size (1 and 13; 4 and 13; 11 and 13), and between pigmentation and size (1 and 32; 4 and 32). In the southwestern and southeastern transects, on the other hand, very few significant correlations were observed between the morphometric characters.

For the sting pheromonal analyses, percentage and logratio transformed data were used. Although the number of factors with eigenvalues greater than one was often not the same for both data sets, the factor scores plots differed only slightly. In the discriminant analyses, some but not all pheromone compounds entered into the disciminant functions were the same when using percentage and logratio data (Tables 3.7 and 3.8, 4.7 and 4.8, 5.7 and 5.8, 6.7 and 6.8, 7.7 and 7.8). Also the number of pheromones entered into the models differed. Using the percentage data, 82.1% of the total number of colonies were classified correctly into the phero-clusters, compared with 79.7% for the logratio data. The regions of high intercolonial and intracolonial variance using the logratio data were found to be mostly coincident with the regions of high variance using the percentage data, indicating that the negative bias property of the percentage covariance matrix Σ had only a minor effect on the results of the pheromonal analysis.

The percentage compositions of the sting pheromones revealed that 2-nonanol (6) was a consistently dominant note of the pheromonal bouquet in northwestern, west central, southwestern and southeastern Africa (Tables 3.9, 5.9, 6.9 and 7.9; Blum and Fales, 1988). This was not evident for the transect in northeastern Africa, where benzyl acetate (7) was found to be most dominant (Table 4.9).

The total variation of the pheromonal logratio variance matrix **T** for each phero-cluster revealed larger variation in the hybridisation zones present along the transects in west central, southwestern and southeastern Africa. It was not possible to compare the values of **T** between the transects because of the different number of pheromones identified in the sting pheromone bouquet.

8.3 Morphometric analyses of the combined data from all five transects

8.3.1 Classification analyses

The morphometric data (excluding length of proboscis (4) because of post-mortem conditions) of the five transects were combined. A stepwise linear discriminant analysis using the morphometric means of the colonies from each locality confirmed the separation of ten morphoclusters: (1) *A. m. sahariensis* in southern Morocco; (2) *A. m. intermissa* in central and northern Morocco; (3) *A. m. iberica* in Spain; (4) *A. m. jemenitica* in northern Cameroon and northern Ethiopia; (5) *A. m. bandasii* in central Ethiopia; (6) *A. m. sudanensis* in southern Ethiopia; (7) *A. m. adansonii* in southern and central Cameroon, northern Namibia and northwestern Zambia; (8) "*A. m. monticola*-like" in the southern mountainous regions of Cameroon; (9) *A. m. scutellata* in southern Namibia and Zimbabwe; (10) *A. m. litorea* in Mozambique. Table 8.1 shows the seven characters entered into the linear discriminant functions ranked according to their discriminatory power.

Table 8.1 Morphological characters entered into the discriminant function ranked according to their discriminatory power.

Character entered	F statistic	df	p-value
length of wax plate (13)	241.82	9,194	<0.0001
pigmentation (35)	124.98	9.193	<0.0001
wing angle (30)	12.39	9,192	<0.0001
pigmentation (32)	10.20	9,191	<0.0001
width of wax plate (11)	10.28	9,190	<0.0001
hair length (1)	7.12	9,189	<0.0001
pigmentation (36)	4.58	9,187	<0.0001

100% correct classifications of the colonies were obtained using the linear discriminant functions in morphoclusters 1, 2, 3, 5, 8 and 10 (Table 8.2). Poor classification results were obtained for *A. m. jemenitica* and *A. m. sudanensis*, with ten colonies from *A. m. jemenitica* classified as *A. m. bandasii*, *A. m. sudanensis* and *A. m. litorea*, and six colonies from *A. m. sudanensis* classified as *A. m. bandasii* and *A. m. jemenitica*. This result confirms the difficulty in classifying the honeybees in northeastern Africa. Poor identification results were also obtained for *A. m. scutellata* and *A. m. adansonii*, with many colonies from *A. m. scutellata* being misclassified as *A. m. adansonii* and vice versa.

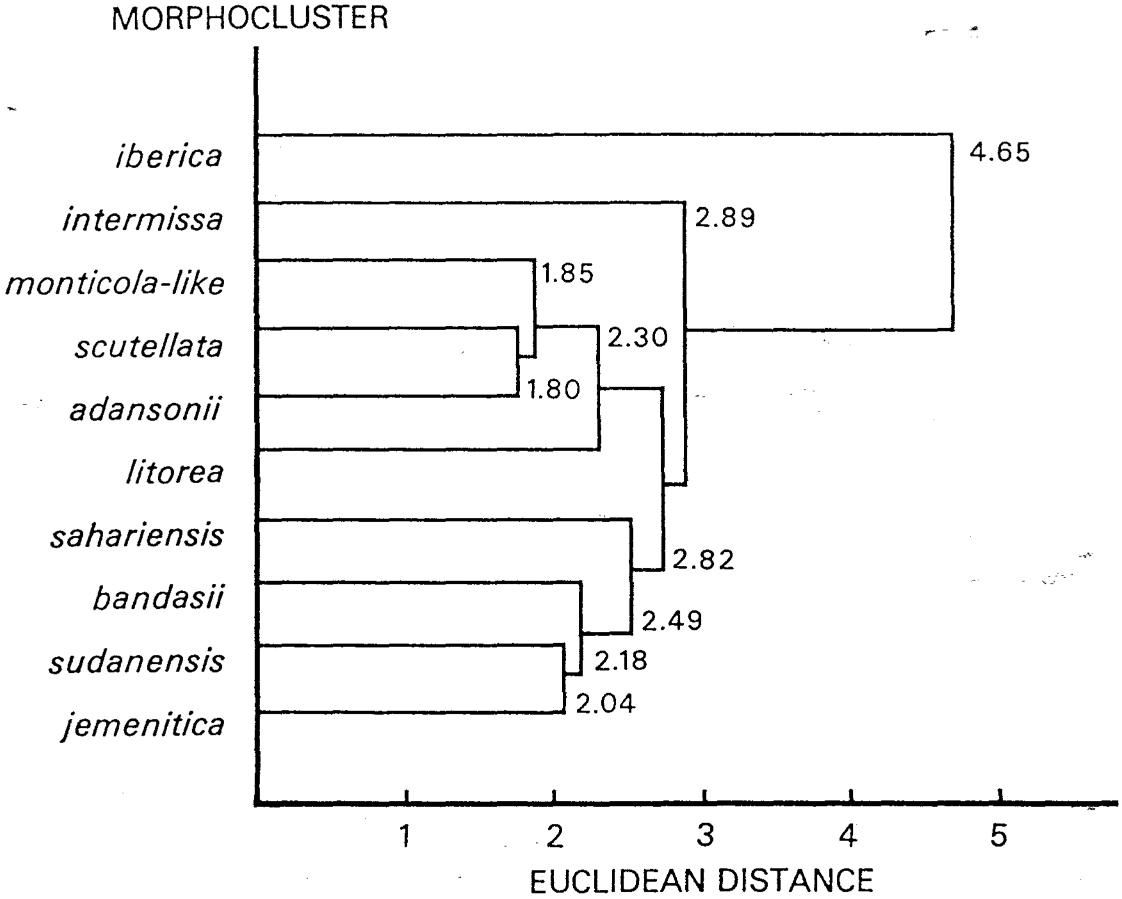
Table 8.2 Classification of colonies from the five transects into ten morphoclusters.

Morphocluster	Discriminant analysis % Correct	Discriminant analysis Number misclassified	Neural networks analysis % Correct	Neural networks analysis Number misclassified	Number of colonies
1 *A. m. sahariensis*	100%	0	100%	0	12
2 *A. m. intermissa*	100%	0	100%	0	20
3 *A. m. iberica*	100%	0	98%	1	41
4 *A. m. jemenitica*	62%	10	96%	1	26
5 *A. m. bandasii*	100%	0	94%	1	17
6 *A. m. sudanensis*	33%	6	78%	2	9
7 *A. m. adansonii*	63%	14	82%	7	38
8 "*A. m. monticola*-like"	100%	0	100%	0	5
9 *A. m. scutellata*	80%	6	93%	2	30
10 *A. m. litorea*	100%	0	100%	0	3
Total	82%	36	93%	14	201

The neural networks procedure using the combined data from the five transects selected ten morphometric characters (excluding wing angle O26 (31)) as the input nodes. Four hidden layer nodes were used in the classification of the colonies into the ten morphoclusters. The network successfully classified 95.0% of the colonies in the training set and 88.5% in the test set. Better classification results were obtained with this method than with the discriminant analysis method (Table 8.2), but it must be noted that the neural networks procedure used ten characters in the network whilst seven were used in the discriminant analysis procedure (Table 8.1).

A cluster analysis using the morphocluster means of the morphometric characters was carried out. The following dendrogram (Figure 8.1) shows the sequence of cluster formation and the Euclidean distances of each cluster as it was formed. The first cluster formation was between *A. m. scutellata* and *A. m. adansonii*, indicating small differences in the morphological characters. The "*A. m. monticola*-like" group and *A. m. litorea* were added to this cluster at the second and fifth formation. Another formation of clusters was produced with *A. m. jemenitica*, *A. m. sudanensis*, *A. m. bandasii* and *A. m. sahariensis*. *A. m. iberica* was the last to enter the cluster formation, indicating large morphological differences between the European *A. m. iberica* and the other truly African morphoclusters. These Euclidean distances support the results of the Mahalanobis distances found between the morphoclusters along each transect. The largest D^2 was determined between the *A. m. jemenitica* and "*A. m. monticola*-like" groups in west central Africa as noted in 5.4.1, and low values of D^2 were found between *A. m. adansonii* and *A. m. scutellata* in both southwestern and southeastern Africa, as noted in 6.4.1 and 7.4.1 respectively.

Figure 8.1 Dendrogram of the sequence of cluster formation with corresponding Euclidean distances for different subspecies of *Apis mellifera*.



8.3.2 Correlation and variance analyses

A canonical correlation analysis performed on all five transects yielded a significant correlation between the full set of morphological characters and the full set of environmental variables (Table 8.3). In these comparisons, temperature variation was the most significant factor in the relationship (R^2=0.62, p<0.0001). Similarly, Levene's test was used to test for significant differences in the variations in temperature, rainfall and altitude over all five transects. Significantly larger variations in temperature (F=10.6, p<0.0001), rainfall (F=56.4, p<0.0001) and altitude (F=13.3, p<0.0001) were found along the west central transect and in temperature along the northwestern transect.

Table 8.3 Canonical correlations between the full set of morphological characters and the set of environmental variables (temperature, rainfall and altitude) for each transect.

Transect	Canonical correlation	χ^2-statistic	df	p-value
Northwestern	0.97	285.6	33	<0.0001
Northeastern	0.83	75.4	33	<0.0001
West central	0.94	113.9	33	<0.0001
Southwestern	0.83	44.6	33	0.0856
Southeastern	0.89	80.6	33	<0.0001
Combined	0.91	610.6	33	<0.0001

It was not possible to analyse the combined pheromonal data from the five transects because of the unequal numbers of sting pheromones identified at each transect.

8.4 Biogeographical correlates of population variance

8.4.1 Introductory remarks

Explanations of statistical inferences about honeybee populations must ultimately incorporate the ecological settings in which they occur. Ideally, the population should be interpreted in a context of topography and climate on the one hand, and the phenologies of flowering and colony cycles on the other (Ruttner, 1988, 1992). For Africa, another layer of complexity comes with colony movements (reproductive swarming, but especially migrations and amalgamation) that alter the probability of gene flow within and between populations.

A morphometrically discrete honeybee population is based on group homogeneity obtained through multivariate analysis (Ruttner *et al.*, 1978; Ruttner, 1988). In the absence of physical, phenological or reproductive barriers, clinal changes between adjacent populations may be reflected in their variance spectra (Futuyma, 1986). The variance may also indicate the "genetic permeability of statistical boundaries" between neighbouring populations and sometimes also the direction of flow at a point in time. In this thesis the variance spectra of morphological and pheromonal data between and among the clusters of several African subspecies of honeybees have been defined and probable zones of introgression have been indicated. The interpretation of variance analysis of populations becomes biologically more meaningful in a biogeographical context. Hence the structure and variance characteristics of honeybee populations are discussed with reference to the biogeographical contexts in which the bees actually live.

8.4.2 Northwestern Africa and Southern Europe

Comprehensive multivariate analyses of the worker honeybees along a transect from the Sahara to the Pyrenees unequivocally established the occurrence of three major morphoclusters, classified as *A. m. sahariensis, A. m. intermissa* and *A. m. iberica*. In addition, the *A. m. iberica* cluster could be resolved into three biometric subgroups; the morphoclusters and subgroups also formed six distinct mtDNA categories (Table 8.4). Similar analyses of the sting pheromones yielded no distinct clusters (Hepburn and Radloff, 1996).

A canonical correlation analysis revealed a significant correlation ($R=0.97$) between the set of morphological characters and the set of environmental variables (Table 8.3). The largest squared multiple correlation was found between temperature and the set of morphometric variables ($R^2=0.93$, $p<0.0001$).

The structure and variance characteristics of the honeybee populations extending between the Sahara and the Pyrenees can be related to prevailing climatic and biological factors (Table 8.4). The area is a winter rainfall region but with notable discontinuities (Jackson, 1961; Muller, 1982). There is a phase change in the dry season from months 5-9 in the south to 7-9 in the north of Morocco; that of Spain is further reduced to months 6-8. There are also discontinuities in rainfall, which is most intense for months 10-4 in the south and north, but compressed to months 11-2 in the central area of Morocco. A similar pattern occurs in Spain (Jackson, 1961; Muller, 1982). These factors of climate are reflected in the flowering phenologies of the principal bee plants which in turn drive the annual colony cycle (Hepburn and Radloff, 1995).

Similarly there are important discontinuities in the temperature profiles of the transect (S. Rabat and Puerto de Sagunto), where equableness for honeybee flight is significantly reduced. The swarming season (Table 8.4) begins early in southern Morocco, gradually shifting over the 1 000 km to the north coast; the same sequence is repeated in southern and eastern Spain (Verdu Gallardo, Garcia Raso, personal communications). The degree of overlapping of swarming seasons between adjacent localities varies from year to year. The general trend of the data shows that centroids of high variance (near edges of clusters defined morphometrically or by mtDNA analysis) are typically associated with climatic and biological areas of transition (Table 8.4), which are regions of ecological instability.

8.4.3 Northeastern Africa

Multivariate analyses of worker honeybees along a north-south transect through the highlands of Ethiopia yielded three morphometrically distinct clusters which are designated (Table 8.5) from north to south as *A. m. jemenitica*, *A. m. bandasii* and *A. m. sudanensis* (*sensu* Mogga, 1988). This is tentative because the taxonomy of the honeybees of the whole Horn of Africa requires resolution on a comparative basis for the entire region. A factor scores plot of the pheromonal data, supported by discriminant analysis, yielded three clusters that differed slightly from those defined morphometrically (Table 8.5).

A significant canonical correlation (R=0.83) was established between the set of morphological characters and the set of environmental variables (Table 8.3). The largest squared multiple correlation was found between rainfall and the set of morphometric variables (R^2=0.69, p=0.0026).

Ethiopia is a mountainous country of tortuous relief. The central highlands are well-watered and the temperatures are moderated by altitudes which average more than 2 000 m. While the highlands lack large variations in temperature, rainfall discontinuities and transitions along the transect are pronounced (Table 8.5). Rainfall diminishes from south to north and is intense during months 6-10 with a correspondingly long dry season, months 11-5 (Jackson, 1961; van Chi-Bonnardel, 1973). Despite widespread beekeeping activity in this region, it is extremely sparsely documented in the apicultural literature.

There are two major centroids of significantly high variance for this region (Table 8.5). The most notable one, to the north, occurs within *A. m. jemenitica* and transgresses into *A. m. bandasii*. The boundary between the two clusters is climatically transitional between dry tropical and sahelian zones. The second centroid, at Holeta (a suburb of Addis Abeba), is associated with a thin wedge of sahelian climate between two dry tropical zones.

8.4.4 West Central Africa

Multivariate analyses of worker honeybees along a transect from southwestern to northeastern Cameroon showed that these honeybees resolved into three distinct morphoclusters. The honeybees of southern and central Cameroon are classified as *A. m. adansonii*, whose distribution is intruded in the southern mountains by a large, "*A. m. monticola*-like" bee, while those in the north consist of a discrete population of the smaller *A. m. jemenitica* (Table 8.6). A factor scores plot of the pheromonal data revealed clusters, confirmed by discriminant analysis, that differed somewhat from the morphometric ones (Radloff and Hepburn, 1997b).

A significant canonical correlation ($R=0.83$) was obtained between the set of morphological characters and the set of environmental variables (Table 8.3). Larger squared multiple correlations were determined between rainfall and temperature and the set of morphometric variables (rainfall: $R^2=0.85$, $p<0.0001$; temperature: $R^2=0.75$, $p<0.0001$).

Population structure of the west central African honeybees can be related to the climatic and biological conditions of the regions studied. Cameroon is transitional between the equatorial and the arid: a physiographic ensemble extending from sea level, through mountains and massif, gradually descending into depressed alluvial plains in the northern interior (van Chi-Bonnardel, 1973). The physical transitions are associated with different ecological-climatological zones (Walter, 1973, 1976) and significant differences in the honeybee populations of the region reflect the environmental variation (Table 8.6).

There are two centroids of significantly high variance in the region: one centred on Garoua and another in the Mamfe-Bamenda area (Table 8.6). The two centroids are interpreted, respectively, as zones of hybridisation between *A. m. adansonii* and the "*A. m. monticola*-like" group to the south, and between *A. m. adansonii* and *A. m. jemenitica* to the north. It is evident from Table 8.6 that the high variance distribution in the honeybees is coincident with ecological-climatological transitions and their associated discontinuities in temperature and rainfall, indicators of ecological instability. Obviously hybridisation between honeybees of adjacent localities is facilitated by the extent to which their swarming and migration periods overlap (Table 8.6).

8.4.5 Southwestern Africa

Multivariate analyses of worker honeybees along a transect from the Cape peninsula in South Africa to northern Namibia established the occurrence of three distinct and homogeneous morphoclusters. These are classified as *A. m. capensis* in the southern-most Cape, *A. m. scutellata* in northern South Africa and southern Namibia, and *A. m. adansonii* in the far north (Table 8.7). A factor scores plot of the pheromonal data yielded clusters that differed substantially from those defined in the morphometric analysis (Hepburn *et al.*, 1994; Radloff *et al.*, 1996).

A canonical correlation analysis showed no significant correlation between the set of morphological characters and the set of environmental variables (Table 8.3).

The multivariate analyses of the bees of southwestern Africa (Table 8.7) show a northward progression from *A. m. capensis* at the Cape peninsula, through *A. m. scutellata* and to *A. m. adansonii* in northern Namibia. Areas of introgression and hybridisation can be anticipated from the variance distributions in relation to the climatic zones (Table 8.7). High variances are associated with edge effects between different climatic zones, and with areas where there are local discontinuities in the rainfall and temperature profiles. The honeybee populations of this region of southwestern Africa appear far less stable than the others studied, as evidenced by the distribution widths of high variance values and relatively small morphocluster areas. It is also evident that overlap in swarming also shifts in conjunction with climatic transition.

8.4.6 Southeastern Africa

Multivariate analyses of worker honeybees along a transect from coastal Mozambique through the highlands of Zimbabwe and on to northwestern Zambia indicate that these honeybees morphometrically resolve into three distinct populations. These groups are respectively classified as *A. m. litorea*, *A. m. scutellata* and *A. m. adansonii*, and are distributed as shown in Table 8.8. The factor scores plot of the principal components analysis of the sting pheromones, and confirmed by discriminant analysis, yielded precisely the same three clusters as obtained in the morphometric analysis (Radloff *et al.*, 1997).

A significant canonical correlation ($R=0.89$) was found between the set of morphological characters and the set of environmental variables (Table 8.3). The largest squared multiple correlation was between temperature and the set of morphometric variables ($R^2=0.76$, $p=0.0008$).

In southeastern Africa the whole of the Beira-Ikelenge region falls in the same dry climatic zone (Walter, 1973; Cole, 1986), but variations occur. The plains of Mozambique are +8°C above the Zimbabwe highveld, and the temperature transition at the Mutare escarpment is abrupt. The temperature profile across the highveld is rather uniform except for a +6°C discontinuity at the Zambezi River Valley (Jackson, 1961). This area is a centroid of high variance values and of introgression between *A. m. adansonii* and *A. m. scutellata* (Table 8.8).

The asymmetries in pheromonal variance between Karoi and Lusaka are reflected in whole colony defense. The bees of Zambia are regarded as more aggressive than those of Zimbabwe, with a marked transition associated with the Zambezi River Valley (Coleman, Chupa, personal communications). It is notable that isopentyl acetate, a potent releaser of stinging behaviour (Kerr *et al.*, 1974) reaches its highest percentage of the pheromonal bouquet near Lusaka (Radloff *et al.*, 1997).

The distribution of swarming and migration shows considerable overlap across the transect (Table 8.8) but a second swarming season (months 2-4) has developed in recent decades with the introduction of *Eucalyptus* plantations into the Karoi region (Coleman, personal communication). The intercalation of another swarm period, coupled to those of south central Zambia, provides a considerable corridor for gene flow and further instability in a region that is already a centroid of high variance. Reduced contact through swarming and migration in the bees of Zambia is related to flowering. In the Lusaka-Kitwe area *Brachystegia* and *Julbernardia* support two swarm periods; but *Brachystegia* is virtually absent from the Solwezi-Ikelenge region, leaving a single swarming season (Table 8.8, Silberrad, 1976; Chupa, personal communication) and, notably lower levels of variance in northwestern Zambia.

8.5 Conclusion

Statistically-derived and homogeneous morphoclusters (compatible with the subspecies classification of Ruttner, 1988) occur in all the transects of Africa investigated (Tables 8.4-8.8). The linear distance occupied by a subspecific morphocluster, where two boundaries could be measured (n=7), averages 475±282 km. The width of introgression zones between two adjacent populations is 125±146 km, which is within the annual dispersal capacity of these honeybees (Soares and De Jong, 1992). Statistically homogeneous pheromonal clusters may be both coincident and concordant with the morphoclusters (Mozambique, Zimbabwe and Zambia), only coincident and not concordant (Ethiopia, South Africa, Namibia, and Cameroon) or entirely absent (Morocco). That different honeybee traits disperse between populations to differing distances and, presumably, at different rates is consistent with many other observations (Hepburn *et al.*, 1994; Moritz *et al.*, 1994; Garnery *et al.*, 1995).

All of the transects contain areas of significantly high intracolonial and intercolonial variance. The former is interpreted as evidence pointing to a high intrinsic genetic variation in localised drone congregation sites, as well as a high percentage of out-cross matings (Moritz and Southwick, 1992). Centroids of high intercolonial variance suggest a high genetic "permeability" in the statistical boundaries of populations resulting in introgression zones between neighbouring populations. Centroids of high variance are closely associated with transitions between, and discontinuities in rainfall and temperature within, ecological-climatological zones. Finally, high levels of statistical heterogeneity within and between populations go hand-in-hand with ecological instability (Table 8.3).

Table 8.4 Morphometric and mtDNA clusters, morphometric and pheromonal variances, and swarming for different subspecies of *Apis mellifera* in different climatic zones of northwestern Africa (Morocco) and southern Europe (Spain).

Localities	Distance (km)[1]	Morphometric clusters	mtDNA clusters[3]	Morphometric Variance		Pheromonal Variance		Swarming & Migration	Climatic Zones	Remarks
				Inter-colonial	Intra-colonial	Inter-colonial	Intra-colonial			
Spain										
Montblanc	148			1.81	6.09*	11.80	18.91	3-4		
Benicarlo	102	[2]		3.00	3.77	4.49	11.11	3-4	[4]	
Puerto de Sagunto	120			2.01	3.87	14.53	25.64*	3-4	[4]	
Callosa d'Ensania	102	*iberica* [2]		3.11	3.22	14.83	18.04	3-4		T°Δ[5]
Totana	153			0.37	3.57	14.46	21.35*	2-3		RΔ[5]
Berja	106	[2]		0.76	3.13	4.13	16.17	2-3	[4] mediter-	
Alhaurin el Grande	143			3.73	5.21	11.46	14.69	2-3	ranean	
Morocco										
Tetouan	102			9.21	10.87*	13.05	20.21	3-5		RΔ[5]
Ksar-el-Kebir	190	*intermissa*		5.15	10.44*	12.80	18.97	3-5		
Ez Zhiliga	245			4.07	6.08	11.26	17.97	3-5		
Marrakech	176			2.75	6.72	9.32	20.74*	2-4		RΔ[5]
S. Rabat	273			2.19	11.25*	5.19	14.67	2-4		T°Δ,RΔ[5]
Tan Tan		*sahariensis*		6.45	9.43*	7.59	15.90	2-4	desert	

[1] The value next to a locality is the distance to the locality immediately below it.
[2] Biometric subgroups at the 90% confidence level.
[3] Significantly different heterogeneity groups derived from the data of Garnery *et al.* (1995) using the test of Greenacre (1988).
[4] Altitude moderated.
[5] Area where there is a major shift in prevailing temperature, T°Δ, or rainfall, RΔ.
* Significant ($p<0.01$).

Table 8.5 Morphometric clusters, morphometric and pheromonal variances, swarming and migration for different subspecies of *Apis mellifera* in different climatic zones of northeastern Africa (Ethiopia).

Localities	Distance (km)[1]	Morphometric clusters[2]	Morphometric Variance: Inter-colonial	Morphometric Variance: Intra-colonial	Pheromonal Variance: Inter-colonial	Pheromonal Variance: Intra-colonial	Swarming & Migration[3]	Climatic Zones	Remarks
Adi Arkay	116	*jemenitica*	1.84	5.11**	6.47	22.10	5-6	dry tropical[4]	
Gonder	117		5.30*	5.97**	28.64**	30.54**	9-11		
Bahir Dar	124		2.49	4.85**	29.27**	31.42**	9-11		RΔ[5]
Debre Markos	141	*bandasii*	1.44	2.71	24.94**	24.39**	9-11		
Holeta	209		4.46*	3.69	4.39	19.29	9-11	sahelian[4]	RΔ[5]
Shashemene	181		3.52	3.50	7.73	19.48	5-6	dry tropical[4]	RΔ[5]
Agere Maryam	186	*sudanensis*	2.77	3.95	5.96	9.84	9-11		
Mega			1.37	4.20	3.06	9.01	9-11	desert[4]	RΔ[5]

[1] The value next to a locality is the distance to the locality immediately below it.
[2] Subspecific names for this region *sensu* Mogga, 1988; in Ruttner 1988 system, all would be *A. m. jemenitica*.
[3] Swarming periods inferred from Kassaye (1990).
[4] Altitude moderated.
[5] Area where there is a major shift in prevailing rainfall, RΔ.
* Significant ($p<0.05$),** ($p<0.01$).

Table 8.6 Morphometric clusters, morphometric and pheromonal variances, swarming and migration for different subspecies of *Apis mellifera* in different climatic zones of west central Africa (Cameroon).

Localities	Distance (km)[1]	Morphometric clusters	Morphometric Variance		Pheromonal Variance		Swarming & Migration	Climatic Zones	Remarks
			Inter-colonial	Intra-colonial	Inter-colonial	Intra-colonial			
Maroua	176	}	2.22	3.57	4.80	15.56	9-10,4-5	} dry	
Garoua	56	} *jemenitica*	6.14*	5.61**	12.54**	20.36**	9-10,4-5	} tropical	
Gouna	116	}	4.74	4.79	6.31	15.03	9-10,4-5	}	} T°Δ,RΔ[3]
Lewa	160	} *adansonii*	1.78	3.94	3.68	13.37	11-12,2-3,5-6	}	}
Banyo	120	}	2.37	3.83	8.23	12.13	8-9,2-3	} wet	
Kumbo	60	}	1.54	3.18	3.75	13.69	8-9,2-3	} tropical	}
Bamenda	76	} "*monticola*-like"	6.36*	5.43**	6.70	12.15	8-9,2-3	}	} T°Δ[3]
Mamfe	24	}	1.86	2.87	40.51**	38.80**	9-10,2-3	[2] }	
Kumba		} *adansonii*	4.62	4.42	3.94	20.69**	9-10,2-3	} equatorial	

[1] The value next to a locality is the distance to the locality immediately below it.
[2] Altitude moderated.
[3] Area where there is a major shift in prevailing temperature, T°Δ, or rainfall, RΔ.
* Significant ($p<0.05$), ** ($p<0.01$).

Table 8.7 Morphometric clusters, morphometric and pheromonal variances, swarming and migration for different subspecies of *Apis mellifera* in different climatic zones of southwestern Africa (South Africa and Namibia).

Localities	Distance (km)[1]	Morphometric clusters	Morphometric Variance		Pheromonal Variance		Swarming & Migration	Climatic Zones	Remarks
			Inter-colonial	Intra-colonial	Inter-colonial	Intra-colonial			
Namibia									
Otjiwarongo	152	*adansonii*	1.74	7.78	15.88	33.95	8-9	dry tropical	$R\Delta^{2}$
Okahandja	62		3.69	6.00	30.12*	42.73**	8-9	sahelian	
Windhoek	207		9.92	11.16*	20.75	39.18	9-10		$R\Delta^{2}$
Mariental	200		9.86	9.80	15.21	47.90**	9-10		
Keetmanshoop	145		2.43	5.81	17.61	42.72**	9-10	desert	
Karasburg	169		2.50	6.81	7.79	19.77	9-10		$T^{\circ}\Delta^{2}$
South Africa		*scutellata*							$R\Delta^{2}$
Nababeep	148		6.45	7.95	28.90	41.37	7-8		
Bitterfontein	159		6.26	10.48*			8-9	sahelian	$T^{\circ}\Delta^{2}$ $R\Delta^{2}$
Citrusdal	145		9.72	9.98			9-10		
Cape Town		*capensis*	3.32	7.66			9-12	mediterranean	

[1] The value next to a locality is the distance to the locality immediately below it.
[2] Area where there is a major shift in prevailing temperature, $T^{\circ}\Delta$, or rainfall, $R\Delta$.
* Significant ($p<0.10$), ** ($p<0.01$).

Table 8.8 Morphometric clusters, morphometric and pheromonal variances, swarming and migration for different subspecies of *Apis mellifera* in the woodland savanna of southeastern Africa (Mozambique, Zimbabwe and Zambia).

Localities	Distance (km)[1]	Morphometric clusters	Morphometric Variance: Inter-colonial	Morphometric Variance: Intra-colonial	Pheromonal Variance: Inter-colonial	Pheromonal Variance: Intra-colonial	Swarming & Migration	Climatic Zones	Remarks
Zambia									
Ikelenge	200	*adansonii*	2.79	4.90	7.21	19.25	8-9	dry tropical	
Solwezi	172	*adansonii*	3.33	5.02	6.03	11.29	8-9		
Kitwe	202	*adansonii*	3.36	5.85	7.72	20.54	8-9,3-4		
Lusaka	286		3.45	4.77	22.31**	27.50	8-10,3-4		T°Δ,RΔ[3]
Zimbabwe									
Karoi	162	*scutellata*	4.73	6.17*	7.96	16.91	8-10,3-4[2]		
Harare	124	*scutellata*	2.22	5.64	6.91	20.82	8-10		T°Δ[3]
Mutare	238	*scutellata*	2.72	5.27	12.62	17.94	9-11		
Mozambique									
Beira		*litorea*	1.02	4.92	16.49	23.32	9-11		

[1] The value next to a locality is the distance to the locality immediately below it.
[2] Facultative swarming associated with development of *Eucalyptus* plantations in recent decades.
[3] Area where there is a major shift in prevailing temperature, T°Δ, or rainfall, RΔ.
* Significant ($p<0.05$), ** ($p<0.01$).

CHAPTER 9

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MULTIVARIATE ANALYSIS OF SELECTED HONEYBEE POPULATIONS IN AFRICA

VOLUME 2

CHAPTER 10

APPENDIX

Morphometric and pheromone data

Morphometric column labels:

Ruttner (1988) numbers are given in brackets.
(Measurements in mm, angles in degrees and pigmentation coded from 0 to 9)

C: colony
S: sample
(1): length of cover hair on tergite 5
(4): length of proboscis
(11): width of wax plate on sternite 3
(13): length of wax plate on sternite 3
(22): wing angle B4
MJI: wing angle MJI
(30): wing angle N23
(31): wing angle O26
(35): pigmentation of scutellum
(36): pigmentation of scutellar plate
(32): pigmentation of abdominal tergite 2

Pheromone column labels:

(Measurements in percentages)

C: colony
S: sample
P1: isopentyl alcohol
P2: n-butyl acetate
P3: isopentyl acetate
P4: benzyl alcohol
P5: octyl acetate
P6: 2-nonanol
P7: benzyl acetate
P8: n-decyl acetate
P9: n-octanol

10.1 Northwestern Africa and Southern Europe

10.1.1 Morphometric Data

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Tan Tan	1	1	0.16	6.16	2.73	2.22	109.0	16.0	82.0	38.0	1	0	7
Tan Tan	1	2	0.16	6.24	2.69	2.26	105.0	16.0	81.0	34.0	2	0	8
Tan Tan	1	3	0.20	6.24	2.69	2.14	100.0	17.0	78.0	38.0	4	0	8
Tan Tan	1	4	0.18	6.08	2.81	2.30	107.0	24.0	78.0	36.0	2	0	8
Tan Tan	1	5	0.20	5.92	2.65	2.26	106.0	18.0	76.0	43.0	4	0	9
Tan Tan	1	6	0.18	6.24	2.81	2.26	104.0	17.0	77.0	37.0	2	0	8
Tan Tan	1	7	0.18	6.16	2.81	2.26	101.0	20.0	74.0	31.0	3	0	7
Tan Tan	1	8	0.16	6.24	2.69	2.22	101.0	18.0	73.0	30.0	0	0	1
Tan Tan	1	9	0.18	6.32	2.69	2.26	95.0	23.0	74.0	37.0	4	0	8
Tan Tan	1	10	0.22	6.16	2.77	2.34	108.0	21.0	80.0	39.0	5	0	8
Tan Tan	2	1	0.18	6.16	2.57	2.18	114.0	20.0	82.0	33.0	0	1	6
Tan Tan	2	2	0.20	6.16	2.65	2.14	97.0	21.0	80.0	36.0	4	1	8
Tan Tan	2	3	0.22	6.08	2.69	2.22	100.0	23.0	82.0	32.0	4	1	8
Tan Tan	2	4	0.20	6.00	2.65	2.14	104.0	19.0	77.0	31.0	4	1	8
Tan Tan	2	5	0.16	6.00	2.61	2.22	113.0	18.0	76.0	33.0	6	2	8
Tan Tan	2	6	0.18	5.92	2.69	2.18	108.0	19.0	80.0	35.0	2	1	8
Tan Tan	2	7	0.18	6.08	2.65	2.10	102.0	20.0	81.0	33.0	4	1	8
Tan Tan	2	8	0.20	6.08	2.69	2.22	106.0	19.0	77.0	35.0	1	1	3
Tan Tan	2	9	0.20	6.08	2.65	2.10	112.0	18.0	76.0	30.0	1	1	7
Tan Tan	2	10	0.20	6.16	2.69	2.14	102.0	20.0	79.0	38.0	5	2	8
Tan Tan	3	1	0.16	6.08	2.65	2.30	116.0	21.0	78.0	38.0	3	0	8
Tan Tan	3	2	0.16	6.00	2.57	2.30	112.0	21.0	85.0	31.0	3	0	8
Tan Tan	3	3	0.22	6.24	2.69	2.34	119.0	23.0	76.0	38.0	2	0	8
Tan Tan	3	4	0.20	6.16	2.65	2.26	91.0	19.0	73.0	27.0	0	0	3
Tan Tan	3	5	0.18	6.24	2.69	2.18	104.0	21.0	80.0	30.0	4	0	7
Tan Tan	3	6	0.14	5.76	2.69	2.38	112.0	19.0	74.0	35.0	4	0	9
Tan Tan	3	7	0.22	6.16	2.65	2.26	107.0	17.0	78.0	36.0	4	0	8
Tan Tan	3	8	0.18	6.16	2.65	2.18	110.0	23.0	80.0	35.0	0	0	1
Tan Tan	3	9	0.16	6.24	2.77	2.30	100.0	20.0	73.0	34.0	2	0	8
Tan Tan	3	10	0.16	6.00	2.77	2.34	113.0	15.0	81.0	35.0	4	0	9
Tan Tan	4	1	0.22	6.08	2.81	2.38	90.0	22.0	84.0	37.0	4	0	9
Tan Tan	4	2	0.20	6.08	2.69	2.30	98.0	20.0	83.0	32.0	5	0	9
Tan Tan	4	3	0.24	6.24	2.77	2.34	96.0	21.0	84.0	35.0	4	0	7
Tan Tan	4	4	0.24	6.08	2.65	2.30	99.0	21.0	87.0	31.0	5	0	9
Tan Tan	4	5	0.22	6.08	2.69	2.30	100.0	24.0	83.0	32.0	4	0	9
Tan Tan	4	6	0.20	6.08	2.73	2.30	96.0	21.0	81.0	28.0	5	0	9
Tan Tan	4	7	0.22	6.16	2.81	2.30	100.0	21.0	81.0	34.0	4	0	9
Tan Tan	4	8	0.18	6.00	2.77	2.34	97.0	19.0	80.0	33.0	5	0	9
Tan Tan	4	9	0.22	6.08	2.69	2.26	105.0	19.0	78.0	35.0	5	0	8
Tan Tan	4	10	0.20	6.00	2.65	2.22	104.0	22.0	81.0	37.0	4	0	8
Tan Tan	5	1	0.26	5.92	2.65	2.18	102.0	18.0	79.0	33.0	0	0	3
Tan Tan	5	2	0.22	6.08	2.61	2.14	112.0	21.0	80.0	30.0	0	0	2
Tan Tan	5	3	0.20	5.92	2.61	2.14	101.0	18.0	92.0	42.0	2	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Tan Tan	5	4	0.18	6.16	2.69	2.22	110.0	16.0	79.0	33.0	6	0	8
Tan Tan	5	5	0.18	6.00	2.69	2.18	101.0	16.0	80.0	35.0	2	0	8
Tan Tan	5	6	0.24	6.16	2.65	2.14	111.0	17.0	86.0	28.0	0	0	1
Tan Tan	5	7	0.18	5.92	2.81	2.22	111.0	21.0	81.0	32.0	2	0	9
Tan Tan	5	8	0.20	5.92	2.65	2.22	95.0	18.0	89.0	36.0	2	0	8
Tan Tan	5	9	0.18	5.92	2.81	2.14	110.0	17.0	82.0	33.0	6	0	8
Tan Tan	5	10	0.26	5.84	2.73	2.30	104.0	20.0	79.0	39.0	5	0	8
Tan Tan	6	1	0.18	5.92	2.57	2.14	99.0	20.0	82.0	37.0	4	0	9
Tan Tan	6	2	0.16	6.08	2.65	2.26	108.0	21.0	79.0	39.0	4	0	9
Tan Tan	6	3	0.22	5.76	2.61	2.18	98.0	20.0	78.0	24.0	2	0	9
Tan Tan	6	4	0.18	5.92	2.57	2.18	108.0	20.0	78.0	34.0	4	0	9
Tan Tan	6	5	0.20	5.76	2.57	2.06	92.0	21.0	79.0	34.0	4	0	7
Tan Tan	6	6	0.20	6.00	2.61	2.22	103.0	19.0	77.0	41.0	4	0	8
Tan Tan	6	7	0.18	6.08	2.69	2.22	95.0	23.0	84.0	31.0	4	0	9
Tan Tan	6	8	0.20	6.16	2.69	2.06	107.0	22.0	74.0	31.0	2	0	8
Tan Tan	6	9	0.18	5.92	2.61	2.14	109.0	19.0	71.0	32.0	4	0	8
Tan Tan	6	10	0.18	6.00	2.69	2.18	99.0	22.0	77.0	34.0	4	0	8
S Rabat	1	1	0.22	6.16	2.73	2.26	104.0	18.0	77.0	40.0	2	0	7
S Rabat	1	2	0.22	6.16	2.69	2.26	104.0	18.0	84.0	33.0	0	0	6
S Rabat	1	3	0.20	6.08	2.65	2.26	115.0	22.0	87.0	33.0	0	0	5
S Rabat	1	4	0.22	6.00	2.61	2.22	112.0	16.0	73.0	29.0	2	0	9
S Rabat	1	5	0.20	6.00	2.53	2.22	100.0	19.0	77.0	33.0	1	0	8
S Rabat	1	6	0.22	6.08	2.73	2.26	97.0	21.0	83.0	35.0	0	0	1
S Rabat	1	7	0.18	5.92	2.77	2.26	116.0	21.0	79.0	35.0	1	1	6
S Rabat	1	8	0.22	6.16	2.77	2.34	104.0	20.0	87.0	40.0	1	0	1
S Rabat	1	9	0.18	5.68	2.77	2.22	91.0	19.0	79.0	33.0	0	0	2
S Rabat	1	10	0.20	6.08	2.77	2.26	97.0	18.0	80.0	34.0	0	0	2
S Rabat	2	1	0.20	6.00	2.77	2.22	112.0	18.0	81.0	31.0	3	0	2
S Rabat	2	2	0.22	6.32	2.73	2.30	98.0	15.0	83.0	39.0	2	1	8
S Rabat	2	3	0.22	6.16	2.77	2.26	113.0	16.0	76.0	36.0	2	0	9
S Rabat	2	4	0.20	6.32	2.77	2.38	119.0	18.0	85.0	33.0	2	0	8
S Rabat	2	5	0.18	5.84	2.77	2.38	103.0	17.0	79.0	34.0	2	0	8
S Rabat	2	6	0.22	5.84	2.69	2.26	115.0	17.0	81.0	34.0	3	0	8
S Rabat	2	7	0.20	5.92	2.81	2.42	110.0	18.0	72.0	36.0	2	1	8
S Rabat	2	8	0.22	6.00	2.73	2.26	106.0	16.0	74.0	32.0	4	0	8
S Rabat	2	9	0.20	6.00	2.73	2.18	112.0	17.0	81.0	36.0	4	1	8
S Rabat	2	10	0.18	5.92	2.73	2.22	110.0	18.0	72.0	31.0	4	0	8
S Rabat	3	1	0.20	6.16	2.81	2.26	111.0	19.0	76.0	40.0	0	0	2
S Rabat	3	2	0.20	6.32	2.77	2.38	98.0	14.0	76.0	38.0	4	0	8
S Rabat	3	3	0.18	6.32	2.73	2.26	105.0	36.0	87.0	34.0	2	0	9
S Rabat	3	4	0.22	6.00	2.69	2.26	101.0	17.0	82.0	39.0	1	0	8
S Rabat	3	5	0.18	5.68	2.77	2.30	116.0	20.0	79.0	32.0	1	0	9
S Rabat	3	6	0.22	6.24	2.77	2.34	107.0	19.0	77.0	29.0	2	1	9
S Rabat	3	7	0.18	6.16	2.73	2.18	99.0	19.0	76.0	34.0	2	1	9
S Rabat	3	8	0.14	5.92	2.69	2.14	105.0	19.0	83.0	40.0	2		9
S Rabat	3	9	0.24	6.32	2.73	2.22	121.0	18.0	84.0	34.0	0	0	8
S Rabat	3	10	0.18	6.16	2.69	2.38	110.0	23.0	86.0	38.0	2	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
S Rabat	4	1	0.20	6.16	2.73	2.26	103.0	16.0	79.0	36.0	2	1	9
S Rabat	4	2	0.26	5.92	2.65	2.22	109.0	14.0	82.0	35.0	5	4	9
S Rabat	4	3	0.20	6.24	2.73	2.30	114.0	14.0	75.0	36.0	4	2	8
S Rabat	4	4	0.20	6.40	2.77	2.30	111.0	18.0	80.0	36.0	5	0	9
S Rabat	4	5	0.22	6.32	2.89	2.30	112.0	19.0	85.0	36.0	5	4	9
S Rabat	4	6	0.16	5.92	2.57	2.18	99.0	20.0	83.0	34.0	4	1	9
S Rabat	4	7	0.20	6.40	2.85	2.22	113.0	18.0	83.0	38.0	6	3	8
S Rabat	4	8	0.22	6.00	2.53	2.18	107.0	16.0	76.0	33.0	5	2	9
S Rabat	4	9	0.22	6.16	2.65	2.22	107.0	18.0	80.0	34.0	4	1	8
S Rabat	4	10	0.20	6.08	2.69	2.30	115.0	22.0	72.0	36.0	1	6	8
S Rabat	5	1	0.24	5.84	2.57	2.06	108.0	22.0	79.0	30.0	2	1	8
S Rabat	5	2	0.18	6.00	2.73	2.26	115.0	21.0	83.0	33.0	4	1	7
S Rabat	5	3	0.16	6.08	2.65	2.22	104.0	19.0	87.0	32.0	5	0	8
S Rabat	5	4	0.24	6.24	2.65	2.26	108.0	21.0	81.0	35.0	2	0	8
S Rabat	5	5	0.20	6.00	2.69	2.26	117.0	17.0	78.0	31.0	2	0	8
S Rabat	5	6	0.22	6.00	2.69	2.22	103.0	19.0	77.0	36.0	5	0	9
S Rabat	5	7	0.18	6.00	2.57	2.06	107.0	18.0	83.0	30.0	1	0	3
S Rabat	5	8	0.26	6.00	2.65	2.18	108.0	15.0	89.0	33.0	2	0	9
S Rabat	5	9	0.16	5.92	2.57	2.18	112.0	20.0	88.0	33.0	4	1	7
S Rabat	5	10	0.20	6.08	2.61	2.18	104.0	17.0	48.0	33.0	2	0	8
S Rabat	6	1	0.14	5.60	2.65	2.18	115.0	16.0	77.0	34.0	3	0	8
S Rabat	6	2	0.14	6.16	2.77	2.18	110.0	15.0	69.0	32.0	2	0	8
S Rabat	6	3	0.16	6.24	2.69	2.26	116.0	18.0	79.0	32.0	0	0	3
S Rabat	6	4	0.14	6.40	2.73	2.18	110.0	22.0	81.0	33.0	2	0	8
S Rabat	6	5	0.14	6.40	2.77	2.26	116.0	20.0	69.0	36.0	1	0	8
S Rabat	6	6	0.20	6.40	2.81	2.30	109.0	17.0	72.0	30.0	2	0	8
S Rabat	6	7	0.14	6.16	2.81	2.34	110.0	19.0	75.0	34.0	0	0	8
S Rabat	6	8	0.18	6.24	2.77	2.26	118.0	15.0	80.0	31.0	2	0	8
S Rabat	6	9	0.20	6.24	2.73	2.26	102.0	19.0	82.0	34.0	4	0	8
S Rabat	6	10	0.18	5.60	2.69	2.26	113.0	16.0	72.0	38.0	5	0	8
Marrakech	1	1	0.20	6.24	2.65	2.14	102.0	15.0	70.0	36.0	0	0	2
Marrakech	1	2	0.14	6.08	2.69	2.18	109.0	14.0	73.0	46.0	1	0	2
Marrakech	1	3	0.12	5.68	2.73	2.10	108.0	16.0	74.0	41.0	0	0	1
Marrakech	1	4	0.16	6.08	2.61	2.18	111.0	14.0	77.0	46.0	1	0	2
Marrakech	1	5	0.12	6.24	2.69	2.14	109.0	15.0	84.0	40.0	0	0	1
Marrakech	1	6	0.18	6.16	2.57	2.14	92.0	17.0	80.0	37.0	0	0	2
Marrakech	1	7	0.16	6.08	2.57	2.10	83.0	18.0	78.0	40.0	0	0	2
Marrakech	1	8	0.20	6.08	2.69	2.10	96.0	18.0	68.0	46.0	1	1	3
Marrakech	1	9	0.22	5.52	2.69	2.22	102.0	20.0	82.0	36.0	0	0	1
Marrakech	1	10	0.18	5.76	2.50	2.22	100.0	13.0	81.0	39.0	1	0	2
Marrakech	2	1	0.18	6.32	2.69	2.30	114.0	18.0	78.0	37.0	1	0	3
Marrakech	2	2	0.18	6.56	2.69	2.30	103.0	21.0	77.0	41.0	1	0	3
Marrakech	2	3	0.20	6.48	2.69	2.30	106.0	18.0	74.0	39.0	1	0	3
Marrakech	2	4	0.22	6.40	2.73	2.30	107.0	18.0	78.0	38.0	1	0	3
Marrakech	2	5	0.16	6.32	2.69	2.30	107.0	18.0	75.0	38.0	1	0	3
Marrakech	2	6	0.16	6.32	2.65	2.22	106.0	22.0	74.0	32.0	1	0	3
Marrakech	2	7	0.18	5.60	2.69	2.30	118.0	17.0	72.0	32.0	1	0	6

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Marrakech	2	8	0.22	6.00	2.85	2.26	106.0	20.0	80.0	34.0	1	0	4
Marrakech	2	9	0.18	5.92	2.77	2.34	98.0	18.0	74.0	42.0	0	0	3
Marrakech	2	10	0.18	6.32	2.81	2.34	105.0	19.0	71.0	25.0	0	0	3
Marrakech	3	1	0.20	5.84	2.77	2.18	107.0	22.0	74.0	41.0	0	0	2
Marrakech	3	2	0.18	6.16	2.57	2.22	99.0	21.0	78.0	39.0	0	0	1
Marrakech	3	3	0.18	6.24	2.65	2.18	99.0	20.0	76.0	40.0	0	0	1
Marrakech	3	4	0.20	6.32	2.69	2.30	95.0	20.0	64.0	41.0	0	0	2
Marrakech	3	5	0.20	6.24	2.69	2.14	110.0	17.0	69.0	37.0	0	0	1
Marrakech	3	6	0.18	6.16	2.69	2.22	106.0	20.0	71.0	45.0	0	0	2
Marrakech	3	7	0.18	5.60	2.61	2.14	95.0	17.0	79.0	39.0	0	0	2
Marrakech	3	8	0.20	6.16	2.69	2.34	99.0	21.0	81.0	37.0	0	0	2
Marrakech	3	9	0.22	6.16	2.65	2.14	106.0	18.0	67.0	40.0	0	1	3
Marrakech	3	10	0.16	6.08	2.57	2.14	103.0	22.0	78.0	37.0	0	0	2
Marrakech	4	1	0.26	5.76	2.73	2.22	112.0	18.0	81.0	36.0	0	0	2
Marrakech	4	2	0.26	5.84	2.53	2.26	99.0	20.0	85.0	36.0	0	0	2
Marrakech	4	3	0.16	6.08	2.69	2.26	99.0	18.0	78.0	37.0	0	0	1
Marrakech	4	4	0.22	6.16	2.81	2.18	113.0	22.0	85.0	36.0	0	0	1
Marrakech	4	5	0.24	5.92	2.77	2.26	104.0	16.0	73.0	39.0	0	0	1
Marrakech	4	6	0.20	5.68	2.77	2.30	98.0	21.0	73.0	39.0	0	1	3
Marrakech	4	7	0.20	6.00	2.73	2.30	113.0	23.0	78.0	34.0	0	0	2
Marrakech	4	8	0.24	5.92	2.69	2.22	114.0	20.0	76.0	34.0	0	1	1
Marrakech	4	9	0.22	5.84	2.73	2.22	98.0	19.0	79.0	38.0	0	0	1
Marrakech	4	10	0.18	5.76	2.73	2.14	98.0	24.0	79.0	35.0	0	0	1
Marrakech	5	1	0.16	5.84	2.57	2.18	96.0	16.0	69.0	37.0	0	0	1
Marrakech	5	2	0.22	6.56	2.69	2.22	94.0	23.0	74.0	38.0	0	1	3
Marrakech	5	3	0.22	5.92	2.69	2.26	99.0	26.0	82.0	37.0	0	1	3
Marrakech	5	4	0.20	6.00	2.69	2.26	104.0	17.0	70.0	37.0	0	1	3
Marrakech	5	5	0.24	5.76	2.57	2.14	102.0	19.0	79.0	36.0	0	1	2
Marrakech	5	6	0.26	6.00	2.69	2.26	92.0	25.0	86.0	42.0	0	1	3
Marrakech	5	7	0.22	5.76	2.57	2.18	97.0	23.0	86.0	44.0	1	1	3
Marrakech	5	8	0.18	5.76	2.65	2.26	103.0	16.0	73.0	32.0	0	1	1
Marrakech	5	9	0.22	5.76	2.69	2.18	95.0	22.0	77.0	38.0	0	0	1
Marrakech	5	10	0.22	5.68	2.57	2.22	95.0	23.0	79.0	38.0	1	1	2
Marrakech	6	1	0.18	6.24	2.73	2.26	99.0	22.0	76.0	43.0	2	0	8
Marrakech	6	2	0.18	6.08	2.77	2.26	99.0	19.0	79.0	35.0	2	0	8
Marrakech	6	3	0.14	6.24	2.73	2.18	109.0	18.0	71.0	41.0	0	0	1
Marrakech	6	4	0.18	5.76	2.69	2.18	104.0	18.0	73.0	45.0	2	0	9
Marrakech	6	5	0.18	6.40	2.73	2.26	110.0	19.0	75.0	40.0	2	0	8
Marrakech	6	6	0.16	5.84	2.69	2.14	104.0	20.0	74.0	37.0	0	0	1
Marrakech	6	7	0.14	5.84	2.65	2.14	109.0	19.0	71.0	41.0	0	0	3
Marrakech	6	8	0.20	6.24	2.73	2.22	99.0	21.0	78.0	46.0	0	0	1
Marrakech	6	9	0.14	6.16	2.61	2.10	94.0	19.0	66.0	37.0	0	1	3
Marrakech	6	10	0.16	6.08	2.61	2.10	109.0	19.0	74.0	37.0	0	0	1
Ez Zhiliga	1	1	0.20	5.92	2.73	2.30	118.0	15.0	73.0	32.0	0	0	3
Ez Zhiliga	1	2	0.34	6.00	2.73	2.30	115.0	18.0	87.0	31.0	0	0	2
Ez Zhiliga	1	3	0.26	6.32	2.85	2.30	117.0	18.0	75.0	40.0	0	0	1
Ez Zhiliga	1	4	0.32	5.76	2.73	2.22	110.0	18.0	78.0	36.0	0	0	3

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Ez Zhiliga	1	5	0.24	5.92	2.69	2.22	113.0	17.0	70.0	32.0	0	0	3
Ez Zhiliga	1	6	0.26	6.48	2.81	2.38	118.0	18.0	80.0	31.0	0	0	2
Ez Zhiliga	1	7	0.30	6.32	2.65	2.22	114.0	16.0	70.0	33.0	0	0	2
Ez Zhiliga	1	8	0.28	6.48	2.69	2.30	111.0	17.0	75.0	39.0	0	0	2
Ez Zhiliga	1	9	0.22	6.24	2.57	2.10	112.0	17.0	84.0	33.0	0	0	3
Ez Zhiliga	1	10	0.34	6.40	2.65	2.26	113.0	17.0	85.0	36.0	0	0	2
Ez Zhiliga	2	1	0.32	6.08	2.65	2.30	111.0	20.0	79.0	34.0	1	0	2
Ez Zhiliga	2	2	0.30	6.24	2.61	2.30	117.0	17.0	79.0	30.0	1	0	1
Ez Zhiliga	2	3	0.26	6.08	2.65	2.22	116.0	15.0	70.0	26.0	1	1	1
Ez Zhiliga	2	4	0.30	6.32	2.73	2.14	106.0	17.0	72.0	31.0	0	0	1
Ez Zhiliga	2	5	0.18	6.16	2.65	2.22	120.0	17.0	79.0	37.0	0	0	1
Ez Zhiliga	2	6	0.26	6.16	2.61	2.22	119.0	16.0	77.0	29.0	1	2	1
Ez Zhiliga	2	7	0.20	6.16	2.57	2.22	122.0	19.0	77.0	28.0	0	0	2
Ez Zhiliga	2	8	0.18	6.32	2.57	2.14	119.0	15.0	78.0	29.0	0	0	1
Ez Zhiliga	2	9	0.24	6.00	2.73	2.34	104.0	18.0	77.0	30.0	0	0	1
Ez Zhiliga	2	10	0.24	6.32	2.61	2.14	118.0	20.0	76.0	28.0	1	1	1
Ez Zhiliga	3	1	0.26	6.40	2.73	2.46	111.0	17.0	72.0	35.0	0	0	1
Ez Zhiliga	3	2	0.20	6.48	2.57	2.26	118.0	15.0	81.0	36.0	0	0	1
Ez Zhiliga	3	3	0.30	6.32	2.69	2.34	107.0	19.0	75.0	40.0	0	0	1
Ez Zhiliga	3	4	0.30	6.40	2.73	2.34	109.0	18.0	70.0	38.0	0	0	1
Ez Zhiliga	3	5	0.18	6.48	2.69	2.26	101.0	16.0	71.0	36.0	0	0	2
Ez Zhiliga	3	6	0.20	6.48	2.77	2.34	111.0	17.0	77.0	39.0	0	0	1
Ez Zhiliga	3	7	0.26	6.40	2.73	2.30	99.0	20.0	76.0	37.0	0	0	1
Ez Zhiliga	3	8	0.20	6.32	2.81	2.34	106.0	17.0	82.0	33.0	0	0	1
Ez Zhiliga	3	9	0.20	6.56	2.65	2.34	111.0	13.0	83.0	36.0	1	1	1
Ez Zhiliga	3	10	0.30	6.32	2.73	2.34	107.0	21.0	81.0	41.0	0	1	1
Ez Zhiliga	4	1	0.34	6.32	2.65	2.26	106.0	20.0	75.0	33.0	0	0	2
Ez Zhiliga	4	2	0.24	6.24	2.61	2.26	110.0	14.0	80.0	29.0	0	0	3
Ez Zhiliga	4	3	0.26	6.32	2.65	2.26	109.0	19.0	86.0	34.0	0	0	2
Ez Zhiliga	4	4	0.26	6.32	2.61	2.22	116.0	19.0	83.0	37.0	0	0	2
Ez Zhiliga	4	5	0.30	6.40	2.53	2.26	112.0	17.0	78.0	34.0	0	0	2
Ez Zhiliga	4	6	0.22	6.48	2.69	2.26	99.0	17.0	86.0	35.0	1	1	2
Ez Zhiliga	4	7	0.30	6.32	2.73	2.26	106.0	16.0	81.0	41.0	0	0	1
Ez Zhiliga	4	8	0.30	6.32	2.85	2.38	108.0	18.0	82.0	36.0	0	0	2
Ez Zhiliga	4	9	0.34	6.40	2.69	2.42	117.0	15.0	76.0	37.0	0	0	1
Ez Zhiliga	4	10	0.18	6.32	2.61	2.26	109.0	18.0	87.0	35.0	0	0	2
Ez Zhiliga	5	1	0.20	6.40	2.65	2.30	105.0	20.0	81.0	30.0	0	0	6
Ez Zhiliga	5	2	0.18	6.08	2.61	2.18	108.0	18.0	83.0	30.0	0	0	2
Ez Zhiliga	5	3	0.24	6.32	2.73	2.30	107.0	19.0	82.0	29.0	0	0	4
Ez Zhiliga	5	4	0.22	6.16	2.73	2.26	103.0	25.0	75.0	34.0	0	0	3
Ez Zhiliga	5	5	0.28	6.16	2.65	2.30	107.0	20.0	76.0	35.0	0	0	2
Ez Zhiliga	5	6	0.22	6.32	2.61	2.26	106.0	25.0	81.0	34.0	0	0	4
Ez Zhiliga	5	7	0.26	6.08	2.65	2.18	109.0	18.0	79.0	30.0	0	0	2
Ez Zhiliga	5	8	0.30	6.32	2.57	2.14	113.0	23.0	84.0	39.0	0	0	2
Ez Zhiliga	5	9	0.20	6.16	2.57	2.18	109.0	21.0	84.0	29.0	0	0	2
Ez Zhiliga	5	10	0.22	6.40	2.73	2.30	108.0	22.0	78.0	34.0	0	0	4
Ksar-El-K	1	1	0.24	6.56	2.85	2.42	102.0	18.0	75.0	36.0	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Ksar-El-K	1	2	0.22	6.64	2.77	2.38	104.0	20.0	80.0	37.0	0	0	1
Ksar-El-K	1	3	0.30	5.84	2.85	2.34	107.0	17.0	61.0	28.0	0	0	2
Ksar-El-K	1	4	0.24	6.16	2.81	2.34	103.0	21.0	78.0	36.0	0	0	2
Ksar-El-K	1	5	0.22	6.24	2.89	2.50	100.0	22.0	65.0	33.0	0	0	1
Ksar-El-K	1	6	0.28	5.60	2.77	2.42	97.0	23.0	78.0	33.0	0	0	1
Ksar-El-K	1	7	0.22	5.52	2.69	2.22	100.0	18.0	81.0	28.0	0	0	1
Ksar-El-K	1	8	0.22	6.24	2.53	2.26	109.0	20.0	76.0	35.0	0	0	2
Ksar-El-K	1	9	0.24	6.32	2.69	2.34	105.0	24.0	80.0	31.0	0	0	1
Ksar-El-K	1	10	0.26	5.84	2.69	2.34	108.0	15.0	64.0	31.0	0	0	1
Ksar-El-K	1	11	0.28	5.60	2.69	2.22	90.0	22.0	78.0	39.0	0	0	1
Ksar-El-K	1	12	0.20	6.48	2.85	2.46	113.0	20.0	72.0	31.0	0	0	1
Ksar-El-K	1	13	0.28	6.24	2.89	2.34	102.0	19.0	71.0	28.0	0	0	1
Ksar-El-K	2	1	0.20	6.40	2.85	2.38	112.0	20.0	85.0	34.0	0	0	2
Ksar-El-K	2	2	0.22	5.84	2.81	2.46	101.0	22.0	80.0	33.0	0	2	1
Ksar-El-K	2	3	0.22	6.32	2.77	2.34	108.0	21.0	76.0	37.0	1	1	3
Ksar-El-K	2	4	0.22	6.40	2.85	2.34	94.0	18.0	55.0	32.0	0	1	1
Ksar-El-K	2	5	0.26	6.64	2.85	2.42	112.0	20.0	77.0	31.0	0	1	2
Ksar-El-K	2	6	0.20	6.48	2.93	2.38	114.0	19.0	81.0	35.0	0	1	2
Ksar-El-K	2	7	0.20	6.40	2.85	2.53	95.0	19.0	80.0	35.0	0	0	1
Ksar-El-K	2	8	0.22	6.48	2.85	2.46	102.0	21.0	53.0	34.0	0	0	1
Ksar-El-K	2	9	0.18	6.72	2.65	2.34	117.0	19.0	56.0	32.0	0	1	1
Ksar-El-K	2	10	0.22	6.48	2.69	2.26	110.0	21.0	53.0	33.0	1	0	1
Ksar-El-K	2	11	0.24	6.56	2.77	2.46	109.0	20.0	70.0	33.0	0	0	1
Ksar-El-K	2	12	0.20	6.40	2.77	2.34	102.0	18.0	70.0	28.0	0	0	2
Ksar-El-K	2	13	0.18	6.56	2.73	2.38	105.0	18.0	69.0	41.0	0	2	1
Ksar-El-K	2	14	0.26	6.32	2.85	2.46	93.0	19.0	74.0	34.0	0	1	1
Ksar-El-K	2	15	0.22	6.08	2.65	2.42	116.0	19.0	77.0	33.0	0	0	2
Ksar-El-K	2	16	0.28	6.56	2.85	2.42	109.0	17.0	72.0	39.0	0	0	1
Ksar-El-K	2	17	0.20	6.32	2.81	2.42	117.0	18.0	75.0	30.0	0	1	2
Ksar-El-K	2	18	0.22	6.48	2.73	2.38	108.0	25.0	77.0	38.0	0	0	1
Ksar-El-K	2	19	0.28	6.32	2.81	2.30	111.0	23.0	76.0	36.0	0	0	1
Ksar-El-K	2	20	0.28	6.24	2.97	2.50	114.0	18.0	82.0	36.0	0	0	1
Ksar-El-K	3	1	0.18	6.48	2.89	2.30	108.0	17.0	77.0	39.0	0	0	1
Ksar-El-K	3	2	0.22	6.56	2.69	2.34	116.0	18.0	81.0	33.0	0	0	1
Ksar-El-K	3	3	0.22	6.24	2.85	2.38	96.0	20.0	72.0	33.0	0	0	2
Ksar-El-K	3	4	0.22	6.32	2.77	2.38	116.0	19.0	81.0	34.0	0	0	1
Ksar-El-K	3	5	0.26	6.48	2.89	2.34	111.0	19.0	75.0	36.0	0	0	1
Ksar-El-K	3	6	0.20	5.92	2.81	2.38	115.0	18.0	75.0	36.0	0	0	2
Ksar-El-K	3	7	0.20	6.24	2.77	2.46	111.0	23.0	83.0	32.0	0	0	1
Ksar-El-K	3	8	0.24	6.48	2.77	2.26	108.0	16.0	74.0	35.0	0	0	1
Ksar-El-K	3	9	0.22	6.16	2.77	2.26	109.0	17.0	76.0	36.0	0	0	2
Ksar-El-K	3	10	0.18	6.56	2.77	2.26	114.0	20.0	85.0	43.0	0	0	1
Ksar-El-K	4	1	0.18	6.40	2.73	2.26	112.0	20.0	85.0	30.0	0	0	3
Ksar-El-K	4	2	0.18	6.48	2.77	2.22	109.0	16.0	82.0	32.0	0	0	3
Ksar-El-K	4	3	0.22	6.16	2.77	2.38	111.0	17.0	78.0	35.0	0	0	1
Ksar-El-K	4	4	0.22	6.48	2.73	2.34	117.0	20.0	55.0	35.0	0	0	1
Ksar-El-K	4	5	0.22	6.00	2.73	2.42	114.0	19.0	76.0	31.0	0	0	2

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Ksar-El-K	4	6	0.20	6.16	2.77	2.42	119.0	17.0	79.0	33.0	0	0	3
Ksar-El-K	4	7	0.20	6.24	2.81	2.38	114.0	18.0	83.0	44.0	0	0	3
Ksar-El-K	4	8	0.20	6.08	2.73	2.34	114.0	18.0	76.0	36.0	0	0	1
Ksar-El-K	4	9	0.20	6.32	2.65	2.18	109.0	21.0	79.0	38.0	1	4	1
Ksar-El-K	4	10	0.22	6.00	2.73	2.26	112.0	18.0	72.0	26.0	0	0	3
Ksar-El-K	5	1	0.20	6.16	2.57	1.98	103.0	20.0	79.0	37.0	0	0	2
Ksar-El-K	5	2	0.20	6.56	2.77	2.38	112.0	18.0	71.0	28.0	0	0	1
Ksar-El-K	5	3	0.20	6.56	2.85	2.34	113.0	16.0	73.0	31.0	0	0	1
Ksar-El-K	5	4	0.22	6.48	2.81	2.34	107.0	18.0	63.0	39.0	0	0	1
Ksar-El-K	5	5	0.20	6.32	2.73	2.30	104.0	19.0	87.0	39.0	0	0	1
Ksar-El-K	5	6	0.24	5.92	2.85	2.46	100.0	17.0	65.0	31.0	0	0	1
Ksar-El-K	5	7	0.24	6.40	2.77	2.46	104.0	17.0	67.0	35.0	0	0	1
Ksar-El-K	5	8	0.18	6.24	2.93	2.26	108.0	21.0	77.0	35.0	0	0	1
Ksar-El-K	5	9	0.18	6.48	2.77	2.34	100.0	19.0	83.0	34.0	0	0	1
Ksar-El-K	5	10	0.22	6.32	2.77	2.38	112.0	18.0	76.0	38.0	0	0	1
Ksar-El-K	6	1	0.26	6.40	2.73	2.34	113.0	21.0	70.0	34.0	0	0	1
Ksar-El-K	6	2	0.22	6.64	2.85	2.38	98.0	20.0	75.0	28.0	0	0	1
Ksar-El-K	6	3	0.18	6.32	2.65	2.30	109.0	21.0	73.0	31.0	0	0	1
Ksar-El-K	6	4	0.22	6.56	2.73	2.34	101.0	17.0	71.0	30.0	0	0	1
Ksar-El-K	6	5	0.24	6.64	2.89	2.38	106.0	20.0	75.0	37.0	0	1	1
Ksar-El-K	6	6	0.22	6.32	2.89	2.42	104.0	18.0	76.0	43.0	0	0	1
Ksar-El-K	6	7	0.24	6.56	2.77	2.26	104.0	20.0	75.0	42.0	0	0	1
Ksar-El-K	6	8	0.16	6.56	2.89	2.46	104.0	17.0	70.0	31.0	0	0	1
Ksar-El-K	6	9	0.22	6.48	2.77	2.30	99.0	18.0	72.0	30.0	0	0	1
Ksar-El-K	6	10	0.22	6.64	2.77	2.26	113.0	17.0	76.0	31.0	0	0	2
Tetouan	1	1	0.22	6.48	2.73	2.38	104.0	19.0	76.0	34.0	0	0	1
Tetouan	1	2	0.22	6.56	2.65	2.34	106.0	23.0	70.0	40.0	0	0	2
Tetouan	1	3	0.24	6.64	2.89	2.42	100.0	20.0	73.0	31.0	0	0	2
Tetouan	1	4	0.20	6.24	2.69	2.38	108.0	23.0	74.0	38.0	0	0	2
Tetouan	1	5	0.22	6.48	2.89	2.42	101.0	23.0	75.0	40.0	0	1	2
Tetouan	1	6	0.34	6.56	2.65	2.38	98.0	18.0	65.0	33.0	0	0	2
Tetouan	1	7	0.28	6.32	2.77	2.42	105.0	22.0	82.0	35.0	0	0	1
Tetouan	1	8	0.28	6.48	2.77	2.46	108.0	25.0	86.0	33.0	0	2	3
Tetouan	1	9	0.26	6.64	2.77	2.34	98.0	20.0	74.0	28.0	1	0	2
Tetouan	1	10	0.32	6.72	2.85	2.42	102.0	18.0	76.0	28.0	0	0	1
Tetouan	2	1	0.26	6.00	2.69	2.42	111.0	16.0	76.0	31.0	0	0	2
Tetouan	2	2	0.30	6.56	2.81	2.38	101.0	19.0	65.0	27.0	0	0	2
Tetouan	2	3	0.18	6.72	2.81	2.34	101.0	18.0	73.0	29.0	0	0	1
Tetouan	2	4	0.32	6.72	2.81	2.30	105.0	20.0	78.0	44.0	0	0	2
Tetouan	2	5	0.32	6.72	2.81	2.34	105.0	22.0	55.0	24.0	0	0	2
Tetouan	2	6	0.24	6.72	2.73	2.42	103.0	17.0	64.0	32.0	0	1	2
Tetouan	2	7	0.28	6.64	2.77	2.46	108.0	19.0	71.0	33.0	0	0	3
Tetouan	2	8	0.20	6.48	2.77	2.42	98.0	18.0	74.0	31.0	0	0	2
Tetouan	2	9	0.30	6.64	2.77	2.73	111.0	20.0	68.0	31.0	0	0	2
Tetouan	2	10	0.28	6.40	2.73	2.34	102.0	20.0	73.0	32.0	0	0	1
Tetouan	3	1	0.26	6.64	2.85	2.42	107.0	18.0	67.0	33.0	0	0	1
Tetouan	3	2	0.28	6.64	2.89	2.50	113.0	16.0	69.0	31.0	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Tetouan	3	3	0.24	6.40	2.81	2.46	107.0	18.0	82.0	36.0	0	0	2
Tetouan	3	4	0.28	6.56	2.81	2.34	104.0	21.0	75.0	35.0	0	0	1
Tetouan	3	5	0.24	6.56	2.93	2.42	109.0	19.0	71.0	36.0	0	0	2
Tetouan	3	6	0.26	6.32	2.81	2.38	111.0	19.0	73.0	38.0	0	0	1
Tetouan	3	7	0.26	6.56	2.81	2.50	108.0	19.0	70.0	34.0	0	0	2
Tetouan	3	8	0.28	6.64	2.73	2.38	105.0	18.0	80.0	31.0	0	0	2
Tetouan	3	9	0.26	6.40	2.85	2.42	101.0	18.0	88.0	40.0	0	1	2
Tetouan	3	10	0.30	6.56	2.81	2.50	108.0	19.0	81.0	34.0	0	0	2
Alhaurin	1	1	0.18	6.48	2.89	2.53	109.0	20.0	83.0	44.0	0	0	1
Alhaurin	1	2	0.18	6.72	2.93	2.57	111.0	18.0	71.0	39.0	0	0	1
Alhaurin	1	3	0.22	6.80	2.93	2.50	110.0	16.0	73.0	37.0	0	0	1
Alhaurin	1	4	0.20	6.48	2.85	2.46	112.0	15.0	71.0	35.0	0	0	1
Alhaurin	1	5	0.30	6.72	2.89	2.46	109.0	19.0	75.0	35.0	0	0	1
Alhaurin	1	6	0.20	6.48	2.81	2.46	107.0	21.0	75.0	36.0	1	0	1
Alhaurin	1	7	0.20	6.56	3.05	2.50	108.0	19.0	76.0	38.0	0	0	2
Alhaurin	1	8	0.34	6.56	2.97	2.46	103.0	21.0	82.0	41.0	0	0	2
Alhaurin	1	9	0.18	6.72	2.89	2.46	114.0	17.0	69.0	35.0	0	1	2
Alhaurin	1	10	0.20	6.80	2.89	2.46	103.0	16.0	72.0	37.0	0	1	1
Alhaurin	2	1	0.18	6.72	2.85	2.42	103.0	17.0	85.0	38.0	0	0	1
Alhaurin	2	2	0.20	6.88	2.89	2.46	107.0	24.0	87.0	43.0	1	0	2
Alhaurin	2	3	0.22	6.88	2.89	2.46	111.0	16.0	81.0	32.0	1	1	2
Alhaurin	2	4	0.20	6.88	2.89	2.46	98.0	16.0	81.0	32.0	1	1	2
Alhaurin	2	5	0.26	6.80	2.93	2.50	114.0	18.0	83.0	41.0	1	1	2
Alhaurin	2	6	0.22	6.88	2.93	2.53	117.0	18.0	85.0	38.0	1	0	1
Alhaurin	2	7	0.22	6.96	2.97	2.46	107.0	17.0	78.0	33.0	0	0	1
Alhaurin	2	8	0.24	6.80	2.89	2.53	115.0	19.0	86.0	31.0	1	0	1
Alhaurin	2	9	0.26	6.80	2.93	2.53	113.0	19.0	82.0	35.0	0	0	1
Alhaurin	2	10	0.22	6.88	2.97	2.46	100.0	19.0	81.0	37.0	0	0	1
Alhaurin	3	1	0.26	6.72	2.93	2.57	96.0	22.0	91.0	38.0	0	0	1
Alhaurin	3	2	0.28	6.72	2.97	2.46	110.0	17.0	82.0	37.0	0	0	0
Alhaurin	3	3	0.20	6.80	2.81	2.50	100.0	19.0	83.0	36.0	0	0	1
Alhaurin	3	4	0.24	6.72	2.89	2.46	104.0	17.0	78.0	40.0	0	1	1
Alhaurin	3	5	0.36	6.72	3.01	2.46	103.0	18.0	80.0	34.0	0	0	1
Alhaurin	3	6	0.28	6.88	2.97	2.57	109.0	21.0	84.0	36.0	0	0	1
Alhaurin	3	7	0.30	6.56	2.81	2.42	104.0	21.0	85.0	42.0	1	1	1
Alhaurin	3	8	0.28	6.56	2.89	2.53	101.0	17.0	80.0	41.0	0	0	1
Alhaurin	3	9	0.24	6.88	2.81	2.42	95.0	20.0	85.0	41.0	0	1	1
Alhaurin	3	10	0.26	6.96	3.01	2.61	98.0	19.0	86.0	38.0	0	0	1
Alhaurin	4	1	0.22	6.80	2.93	2.53	108.0	21.0	82.0	38.0	0	0	1
Alhaurin	4	2	0.20	6.88	3.01	2.42	103.0	25.0	90.0	38.0	0	0	1
Alhaurin	4	3	0.22	6.88	3.01	2.53	107.0	23.0	88.0	36.0	0	0	1
Alhaurin	4	4	0.24	6.96	3.09	2.53	108.0	23.0	93.0	40.0	0	0	1
Alhaurin	4	5	0.24	6.72	2.97	2.53	110.0	25.0	93.0	31.0	0	0	2
Alhaurin	4	6	0.20	6.88	2.97	2.50	109.0	22.0	91.0	34.0	0	0	1
Alhaurin	4	7	0.22	6.88	2.93	2.46	115.0	19.0	93.0	39.0	0	0	1
Alhaurin	4	8	0.28	6.88	3.01	2.53	118.0	23.0	88.0	38.0	0	0	2
Alhaurin	4	9	0.30	7.04	3.09	2.65	114.0	21.0	83.0	37.0	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Alhaurin	4	10	0.18	6.88	2.97	2.53	93.0	21.0	84.0	41.0	0	0	1
Alhaurin	5	1	0.18	6.80	2.89	2.46	106.0	21.0	70.0	33.0	0	0	1
Alhaurin	5	2	0.22	6.80	2.93	2.50	114.0	22.0	83.0	39.0	0	0	1
Alhaurin	5	3	0.22	6.80	2.89	2.50	102.0	20.0	79.0	39.0	0	0	1
Alhaurin	5	4	0.20	6.96	2.97	2.53	107.0	19.0	87.0	43.0	0	0	1
Alhaurin	5	5	0.22	6.72	2.93	2.42	111.0	21.0	82.0	40.0	0	0	1
Alhaurin	5	6	0.22	6.72	2.93	2.50	113.0	24.0	81.0	38.0	0	0	1
Alhaurin	5	7	0.20	6.96	2.97	2.50	118.0	20.0	86.0	38.0	0	1	2
Alhaurin	5	8	0.16	6.72	2.89	2.46	111.0	22.0	74.0	41.0	1	1	1
Alhaurin	5	9	0.18	6.96	2.93	2.50	116.0	19.0	79.0	41.0	0	0	1
Alhaurin	5	10	0.24	6.88	2.97	2.42	100.0	22.0	84.0	44.0	0	0	0
Alhaurin	6	1	0.24	7.12	3.05	2.61	109.0	19.0	85.0	38.0	0	0	1
Alhaurin	6	2	0.24	7.04	3.01	2.53	107.0	21.0	86.0	42.0	0	1	2
Alhaurin	6	3	0.28	7.04	2.97	2.57	106.0	17.0	83.0	36.0	0	1	1
Alhaurin	6	4	0.28	7.12	3.01	2.50	107.0	22.0	85.0	40.0	0	0	2
Alhaurin	6	5	0.20	6.80	3.01	2.50	104.0	18.0	78.0	42.0	0	0	1
Alhaurin	6	6	0.24	6.96	2.97	2.53	112.0	19.0	82.0	37.0	0	0	1
Alhaurin	6	7	0.28	6.72	2.97	2.53	103.0	18.0	86.0	35.0	0	2	1
Alhaurin	6	8	0.24	6.80	2.93	2.53	107.0	20.0	85.0	41.0	0	1	1
Alhaurin	6	9	0.22	6.96	2.97	2.61	101.0	18.0	76.0	41.0	0	0	1
Alhaurin	6	10	0.26	6.88	2.97	2.46	109.0	18.0	81.0	34.0	0	2	2
Berja	1	1	0.26	6.80	3.13	2.50	113.0	21.0	78.0	42.0	1	0	1
Berja	1	2	0.16	6.80	2.97	2.53	107.0	22.0	86.0	42.0	0	0	2
Berja	1	3	0.28	6.96	3.01	2.53	113.0	20.0	84.0	35.0	1	2	1
Berja	1	4	0.28	6.80	2.97	2.53	110.0	19.0	77.0	42.0	2	1	1
Berja	1	5	0.26	6.72	3.01	2.53	105.0	21.0	84.0	37.0	1	2	1
Berja	1	6	0.28	6.64	2.89	2.53	111.0	20.0	84.0	37.0	0	0	1
Berja	1	7	0.28	6.72	2.89	2.53	117.0	16.0	72.0	36.0	1	2	1
Berja	1	8	0.28	6.64	3.05	2.57	107.0	22.0	84.0	35.0	0	0	1
Berja	1	9	0.24	6.80	2.97	2.53	116.0	17.0	72.0	37.0	1	2	1
Berja	1	10	0.30	6.64	2.89	2.42	113.0	15.0	81.0	41.0	1	1	1
Berja	2	1	0.22	6.64	3.21	2.34	106.0	19.0	84.0	40.0	1	1	1
Berja	2	2	0.22	6.64	2.93	2.42	104.0	17.0	83.0	41.0	0	0	1
Berja	2	3	0.20	6.72	3.01	2.50	109.0	16.0	74.0	35.0	1	1	1
Berja	2	4	0.24	6.64	2.97	2.46	106.0	21.0	83.0	40.0	1	1	1
Berja	2	5	0.24	6.64	2.93	2.38	110.0	19.0	82.0	40.0	1	1	1
Berja	2	6	0.22	6.64	2.93	2.42	105.0	19.0	80.0	39.0	1	1	1
Berja	2	7	0.22	6.80	3.01	2.46	106.0	15.0	81.0	34.0	1	1	1
Berja	2	8	0.24	6.56	2.93	2.50	105.0	19.0	88.0	29.0	0	0	1
Berja	2	9	0.22	6.80	3.01	2.50	107.0	21.0	84.0	41.0	0	0	1
Berja	2	10	0.26	6.80	3.05	2.53	114.0	22.0	87.0	40.0	1	1	2
Berja	3	1	0.24	6.56	3.05	2.50	112.0	18.0	80.0	42.0	0	0	1
Berja	3	2	0.30	6.48	2.93	2.38	109.0	16.0	79.0	42.0	1	2	2
Berja	3	3	0.26	6.88	3.05	2.50	115.0	20.0	83.0	34.0	1	2	1
Berja	3	4	0.32	6.64	2.93	2.50	101.0	16.0	81.0	36.0	0	0	1
Berja	3	5	0.30	6.48	3.05	2.53	115.0	19.0	85.0	36.0	0	0	2
Berja	3	6	0.32	6.32	2.97	2.53	107.0	17.0	84.0	41.0	1	2	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Berja	3	7	0.20	6.40	2.89	2.38	115.0	19.0	84.0	39.0	0	0	1
Berja	3	8	0.26	6.64	2.93	2.50	103.0	20.0	81.0	40.0	0	0	2
Berja	3	9	0.22	6.56	2.89	2.42	113.0	19.0	85.0	42.0	0	0	1
Berja	3	10	0.30	6.64	2.97	2.53	104.0	16.0	80.0	36.0	0	0	2
Berja	4	1	0.34	6.56	2.93	2.50	109.0	19.0	83.0	38.0	0	0	1
Berja	4	2	0.32	6.48	2.97	2.42	110.0	19.0	89.0	39.0	1	1	1
Berja	4	3	0.34	6.56	3.05	2.53	98.0	22.0	85.0	34.0	1	0	1
Berja	4	4	0.32	6.48	3.05	2.50	108.0	24.0	89.0	39.0	0	0	1
Berja	4	5	0.32	6.48	2.97	2.38	102.0	19.0	87.0	33.0	0	0	1
Berja	4	6	0.32	6.48	2.85	2.42	106.0	18.0	80.0	38.0	0	0	1
Berja	4	7	0.34	6.64	2.97	2.53	106.0	19.0	78.0	35.0	0	0	1
Berja	4	8	0.34	6.64	3.05	2.46	111.0	18.0	85.0	35.0	0	0	1
Berja	4	9	0.38	6.32	2.85	2.42	110.0	19.0	83.0	37.0	0	0	1
Berja	4	10	0.30	6.56	2.93	2.42	108.0	13.0	81.0	35.0	0	0	1
Berja	5	1	0.28	6.72	2.89	2.42	111.0	15.0	78.0	34.0	1	1	1
Berja	5	2	0.30	6.72	3.05	2.50	106.0	21.0	83.0	36.0	1	1	2
Berja	5	3	0.24	6.72	3.09	2.46	102.0	20.0	88.0	41.0	1	1	2
Berja	5	4	0.28	6.72	3.01	2.50	99.0	22.0	88.0	40.0	1	1	2
Berja	5	5	0.30	6.72	2.89	2.53	104.0	17.0	86.0	33.0	1	1	1
Berja	5	6	0.22	6.64	3.09	2.50	108.0	20.0	84.0	35.0	1	0	1
Berja	5	7	0.20	6.64	2.97	2.53	108.0	20.0	85.0	37.0	0	0	1
Berja	5	8	0.24	6.64	3.01	2.46	101.0	22.0	91.0	43.0	0	0	1
Berja	5	9	0.30	6.56	2.85	2.38	99.0	22.0	87.0	43.0	0	0	1
Berja	5	10	0.28	6.80	2.97	2.53	111.0	17.0	83.0	34.0	1	1	1
Berja	6	1	0.24	6.72	2.97	2.46	118.0	22.0	82.0	39.0	0	0	1
Berja	6	2	0.28	6.64	2.93	2.46	105.0	17.0	81.0	32.0	1	2	2
Berja	6	3	0.26	6.48	2.97	2.53	116.0	20.0	81.0	36.0	1	2	1
Berja	6	4	0.30	6.56	2.93	2.42	122.0	20.0	82.0	36.0	1	2	2
Berja	6	5	0.22	6.64	3.01	2.42	104.0	19.0	80.0	35.0	1	2	2
Berja	6	6	0.34	6.64	2.89	2.38	109.0	17.0	83.0	38.0	0	0	2
Berja	6	7	0.40	6.24	2.93	2.50	114.0	17.0	79.0	40.0	0	0	2
Berja	6	8	0.30	6.64	2.93	2.50	112.0	17.0	75.0	33.0	1	2	1
Berja	6	9	0.26	6.56	2.97	2.42	118.0	31.0	82.0	30.0	1	1	1
Berja	6	10	0.30	6.64	2.97	2.38	109.0	14.0	81.0	31.0	0	0	1
Totana	1	1	0.34	6.56	3.05	2.57	111.0	16.0	78.0	39.0	0	0	1
Totana	1	2	0.28	6.56	2.97	2.50	112.0	19.0	76.0	40.0	1	0	2
Totana	1	3	0.30	6.00	2.89	2.42	101.0	18.0	80.0	35.0	0	0	1
Totana	1	4	0.18	6.40	2.89	2.53	104.0	17.0	80.0	39.0	1	1	1
Totana	1	5	0.24	6.40	2.89	2.46	106.0	19.0	86.0	40.0	0	0	0
Totana	1	6	0.22	6.32	2.93	2.50	114.0	19.0	80.0	38.0	0	0	1
Totana	1	7	0.20	6.24	2.93	2.42	110.0	19.0	85.0	39.0	0	0	1
Totana	1	8	0.28	6.40	2.93	2.53	109.0	20.0	87.0	41.0	0	0	1
Totana	1	9	0.26	6.56	2.93	2.53	114.0	17.0	80.0	41.0	0	0	2
Totana	1	10	0.24	5.60	2.89	2.38	106.0	21.0	84.0	40.0	1	1	1
Totana	2	1	0.24	6.56	2.89	2.53	102.0	17.0	78.0	39.0	1	2	2
Totana	2	2	0.20	6.56	2.93	2.42	101.0	17.0	85.0	41.0	1	1	1
Totana	2	3	0.26	6.80	2.93	2.53	98.0	14.0	88.0	44.0	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Totana	2	4	0.28	6.72	2.93	2.46	104.0	21.0	80.0	31.0	1	0	2
Totana	2	5	0.24	6.64	2.89	2.50	104.0	15.0	83.0	35.0	1	1	2
Totana	2	6	0.22	6.80	3.01	2.53	104.0	17.0	77.0	39.0	1	1	1
Totana	2	7	0.24	6.56	2.97	2.46	108.0	23.0	82.0	45.0	1	1	1
Totana	2	8	0.26	6.56	2.93	2.50	115.0	18.0	84.0	42.0	0	1	1
Totana	2	9	0.28	6.88	3.05	2.50	115.0	16.0	85.0	40.0	1	0	1
Totana	2	10	0.28	6.64	2.93	2.50	120.0	16.0	77.0	42.0	1	1	1
Totana	3	1	0.28	6.40	2.93	2.53	113.0	16.0	78.0	40.0	0	0	1
Totana	3	2	0.30	6.56	2.97	2.50	110.0	21.0	81.0	40.0	0	0	1
Totana	3	3	0.34	6.56	2.85	2.42	115.0	18.0	75.0	38.0	0	0	1
Totana	3	4	0.32	6.64	2.93	2.50	116.0	17.0	75.0	41.0	0	1	1
Totana	3	5	0.24	6.48	3.01	2.46	119.0	16.0	77.0	39.0	0	0	1
Totana	3	6	0.36	6.48	2.89	2.50	108.0	16.0	84.0	38.0	0	0	2
Totana	3	7	0.28	6.56	2.93	2.50	112.0	17.0	79.0	35.0	0	0	1
Totana	3	8	0.20	6.72	3.05	2.57	112.0	18.0	81.0	36.0	0	1	1
Totana	3	9	0.40	6.40	2.93	2.73	113.0	17.0	72.0	40.0	0	0	1
Totana	3	10	0.32	6.64	2.97	2.57	107.0	18.0	71.0	41.0	0	0	1
Totana	4	1	0.20	6.40	2.85	2.38	112.0	17.0	80.0	37.0	1	2	1
Totana	4	2	0.28	6.56	2.93	2.42	105.0	20.0	77.0	40.0	0	0	1
Totana	4	3	0.24	6.24	2.85	2.50	107.0	18.0	74.0	41.0	0	0	1
Totana	4	4	0.24	6.40	2.93	2.42	105.0	18.0	82.0	38.0	0	0	2
Totana	4	5	0.24	6.48	2.97	2.50	113.0	16.0	73.0	41.0	0	0	1
Totana	4	6	0.22	6.32	2.97	2.50	112.0	18.0	79.0	37.0	0	0	1
Totana	4	7	0.26	6.48	2.97	2.50	102.0	18.0	78.0	36.0	1	1	2
Totana	4	8	0.20	6.56	2.93	2.46	111.0	17.0	75.0	41.0	0	0	1
Totana	4	9	0.26	6.56	2.89	2.46	108.0	19.0	86.0	39.0	0	0	1
Totana	4	10	0.30	6.56	2.89	2.46	117.0	21.0	82.0	40.0	1	1	2
Totana	5	1	0.18	6.48	3.09	2.50	110.0	19.0	83.0	35.0	0	0	1
Totana	5	2	0.20	6.56	3.01	2.50	103.0	22.0	87.0	38.0	0	0	1
Totana	5	3	0.30	6.48	2.89	2.53	107.0	16.0	79.0	41.0	0	0	1
Totana	5	4	0.26	6.40	2.93	2.46	109.0	19.0	77.0	38.0	0	0	1
Totana	5	5	0.24	6.40	3.01	2.46	108.0	19.0	85.0	33.0	0	0	1
Totana	5	6	0.30	6.48	3.01	2.38	115.0	22.0	88.0	39.0	0	0	2
Totana	5	7	0.24	6.40	2.97	2.38	112.0	19.0	82.0	36.0	0	0	1
Totana	5	8	0.26	6.64	2.93	2.50	109.0	19.0	85.0	39.0	0	0	1
Totana	5	9	0.22	6.48	3.01	2.46	95.0	20.0	87.0	41.0	0	0	1
Totana	5	10	0.24	6.32	2.89	2.42	101.0	18.0	83.0	45.0	0	1	2
Totana	6	1	0.22	6.56	3.05	2.42	104.0	16.0	72.0	38.0	0	0	2
Totana	6	2	0.20	6.56	2.97	2.42	106.0	17.0	77.0	38.0	0	1	1
Totana	6	3	0.26	6.56	2.97	2.46	117.0	18.0	81.0	36.0	1	1	1
Totana	6	4	0.30	6.64	2.93	2.42	107.0	15.0	80.0	34.0	0	0	1
Totana	6	5	0.26	6.72	2.85	2.46	109.0	19.0	92.0	39.0	0	0	1
Totana	6	6	0.18	6.48	2.97	2.46	116.0	16.0	81.0	38.0	0	0	2
Totana	6	7	0.24	6.72	2.97	2.34	105.0	16.0	78.0	38.0	1	1	1
Totana	6	8	0.30	6.56	2.93	2.38	108.0	18.0	88.0	34.0	0	0	1
Totana	6	9	0.28	6.48	2.93	2.34	113.0	18.0	82.0	38.0	0	0	1
Totana	6	10	0.30	6.48	2.97	2.38	110.0	15.0	87.0	39.0	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Collosa	1	1	0.32	6.56	3.09	2.53	110.0	16.0	77.0	43.0	1	2	1
Collosa	1	2	0.30	6.56	3.05	2.53	107.0	18.0	78.0	41.0	1	2	2
Collosa	1	3	0.28	6.64	3.05	2.53	116.0	21.0	88.0	38.0	1	2	2
Collosa	1	4	0.30	6.64	3.05	2.50	115.0	14.0	78.0	40.0	1	1	1
Collosa	1	5	0.34	6.40	2.97	2.46	106.0	16.0	81.0	40.0	1	1	1
Collosa	1	6	0.26	6.64	2.89	2.46	114.0	22.0	88.0	38.0	1	1	1
Collosa	1	7	0.28	6.64	3.09	2.53	114.0	17.0	85.0	44.0	1	2	1
Collosa	1	8	0.30	6.64	3.05	2.50	108.0	17.0	81.0	38.0	1	1	1
Collosa	1	9	0.34	6.64	3.09	2.50	111.0	19.0	86.0	39.0	0	0	2
Collosa	1	10	0.32	6.56	2.97	2.50	107.0	15.0	77.0	50.0	1	2	1
Collosa	2	1	0.28	6.64	2.97	2.50	106.0	18.0	78.0	29.0	0	0	0
Collosa	2	2	0.26	6.56	3.05	2.50	105.0	18.0	84.0	38.0	1	2	1
Collosa	2	3	0.22	6.32	2.89	2.42	106.0	18.0	79.0	32.0	1	1	1
Collosa	2	4	0.28	6.24	2.93	2.46	110.0	18.0	82.0	38.0	1	1	1
Collosa	2	5	0.30	6.40	2.81	2.50	110.0	17.0	84.0	39.0	0	0	1
Collosa	2	6	0.34	6.64	2.97	2.46	114.0	15.0	77.0	37.0	1	2	1
Collosa	2	7	0.30	6.64	2.93	2.42	111.0	16.0	73.0	34.0	0	1	2
Collosa	2	8	0.26	6.56	3.09	2.53	110.0	17.0	80.0	37.0	1	2	1
Collosa	2	9	0.22	6.64	3.01	2.50	110.0	18.0	84.0	36.0	1	1	1
Collosa	2	10	0.30	6.56	3.01	2.50	114.0	14.0	80.0	36.0	1	2	1
Collosa	3	1	0.34	6.56	2.89	2.46	108.0	19.0	83.0	33.0	1	1	1
Collosa	3	2	0.28	6.56	3.01	2.50	106.0	15.0	77.0	35.0	0	0	1
Collosa	3	3	0.30	6.64	2.97	2.46	107.0	21.0	84.0	35.0	1	1	1
Collosa	3	4	0.30	6.40	2.85	2.42	103.0	16.0	82.0	36.0	0	0	1
Collosa	3	5	0.32	6.48	2.97	2.57	107.0	14.0	77.0	36.0	0	0	1
Collosa	3	6	0.30	6.64	2.93	2.53	115.0	16.0	72.0	39.0	0	0	1
Collosa	3	7	0.26	6.64	2.97	2.46	105.0	17.0	79.0	38.0	0	0	1
Collosa	3	8	0.28	6.64	3.01	2.57	106.0	18.0	89.0	38.0	1	1	1
Collosa	3	9	0.28	6.64	3.01	2.53	111.0	17.0	82.0	30.0	0	0	1
Collosa	3	10	0.28	6.64	2.97	2.53	110.0	15.0	77.0	38.0	1	2	1
Collosa	4	1	0.24	6.56	2.93	2.46	110.0	21.0	89.0	43.0	1	1	1
Collosa	4	2	0.26	6.80	2.93	2.46	110.0	16.0	83.0	38.0	1	2	1
Collosa	4	3	0.20	6.72	3.05	2.57	105.0	20.0	90.0	33.0	1	2	1
Collosa	4	4	0.32	6.56	2.89	2.53	100.0	20.0	88.0	39.0	0	0	1
Collosa	4	5	0.26	6.64	3.01	2.53	106.0	20.0	78.0	36.0	1	1	1
Collosa	4	6	0.28	6.64	2.85	2.42	99.0	20.0	81.0	40.0	1	2	1
Collosa	4	7	0.28	6.72	3.01	2.50	98.0	17.0	84.0	42.0	1	2	1
Collosa	4	8	0.26	6.64	2.93	2.53	106.0	18.0	81.0	38.0	0	1	1
Collosa	4	9	0.24	6.64	2.93	2.42	102.0	23.0	88.0	42.0	1	1	1
Collosa	4	10	0.30	6.48	2.85	2.38	102.0	22.0	88.0	41.0	1	1	1
Collosa	5	1	0.40	6.64	2.85	2.42	107.0	16.0	75.0	46.0	0	0	1
Collosa	5	2	0.36	6.64	2.89	2.46	106.0	19.0	81.0	43.0	1	1	1
Collosa	5	3	0.32	6.56	2.89	2.50	105.0	16.0	77.0	41.0	0	1	1
Collosa	5	4	0.30	6.56	2.97	2.50	108.0	16.0	79.0	40.0	1	2	1
Collosa	5	5	0.34	6.64	2.85	2.53	117.0	18.0	81.0	34.0	1	2	1
Collosa	5	6	0.34	6.64	2.89	2.57	115.0	17.0	81.0	43.0	1	1	2
Collosa	5	7	0.32	6.72	2.97	2.50	112.0	18.0	84.0	41.0	1	2	2

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Collosa	5	8	0.42	6.56	2.85	2.46	114.0	18.0	78.0	38.0	1	2	2
Collosa	5	9	0.34	6.48	2.81	2.42	114.0	15.0	79.0	36.0	0	0	2
Collosa	5	10	0.34	6.56	2.93	2.50	105.0	16.0	78.0	43.0	0	1	2
Collosa	6	1	0.24	6.56	2.93	2.61	93.0	18.0	87.0	42.0	1	1	3
Collosa	6	2	0.28	6.40	3.05	2.53	101.0	21.0	88.0	40.0	1	1	2
Collosa	6	3	0.26	6.64	2.93	2.53	111.0	18.0	78.0	40.0	1	2	2
Collosa	6	4	0.22	6.64	2.93	2.46	107.0	17.0	78.0	41.0	1	3	3
Collosa	6	5	0.20	6.64	3.01	2.57	106.0	17.0	78.0	39.0	1	1	3
Collosa	6	6	0.30	6.72	3.01	2.53	105.0	19.0	76.0	39.0	1	1	2
Collosa	6	7	0.20	6.56	2.97	2.50	112.0	18.0	77.0	44.0	0	0	1
Collosa	6	8	0.30	6.64	3.09	2.57	108.0	16.0	72.0	43.0	1	2	2
Collosa	6	9	0.28	6.72	2.97	2.53	107.0	17.0	75.0	40.0	1	1	1
Collosa	6	10	0.26	6.64	2.89	2.57	103.0	17.0	79.0	41.0	1	2	2
Puerto de	1	1	0.24	6.64	3.01	2.50	109.0	17.0	80.0	38.0	1	1	1
Puerto de	1	2	0.30	6.48	3.09	2.57	110.0	17.0	79.0	35.0	1	1	1
Puerto de	1	3	0.22	6.64	2.97	2.57	107.0	19.0	81.0	39.0	0	0	2
Puerto de	1	4	0.30	6.48	2.93	2.50	104.0	14.0	82.0	42.0	1	1	1
Puerto de	1	5	0.26	6.64	2.97	2.57	114.0	20.0	85.0	39.0	1	1	2
Puerto de	1	6	0.28	6.64	3.01	2.46	98.0	21.0	85.0	40.0	1	1	1
Puerto de	1	7	0.30	6.40	3.13	2.65	108.0	17.0	82.0	40.0	1	1	1
Puerto de	1	8	0.28	6.56	3.05	2.57	114.0	18.0	81.0	39.0	1	1	1
Puerto de	1	9	0.30	6.48	3.01	2.46	113.0	19.0	79.0	37.0	1	2	1
Puerto de	1	10	0.32	6.48	2.93	2.46	105.0	19.0	78.0	37.0	1	2	2
Puerto de	2	1	0.16	6.48	3.13	2.53	106.0	17.0	82.0	34.0	0	1	1
Puerto de	2	2	0.26	6.72	3.05	2.57	106.0	17.0	80.0	32.0	1	1	1
Puerto de	2	3	0.30	6.64	3.05	2.53	113.0	18.0	86.0	36.0	1	2	1
Puerto de	2	4	0.26	6.64	2.97	2.38	110.0	20.0	88.0	39.0	1	1	1
Puerto de	2	5	0.24	6.56	3.01	2.50	104.0	14.0	77.0	35.0	1	1	2
Puerto de	2	6	0.30	6.56	3.01	2.50	114.0	18.0	82.0	38.0	1	1	0
Puerto de	2	7	0.24	6.64	2.89	2.46	108.0	18.0	83.0	36.0	1	1	1
Puerto de	2	8	0.28	6.56	2.93	2.50	112.0	18.0	85.0	43.0	0	1	1
Puerto de	2	9	0.30	6.48	3.01	2.50	111.0	15.0	81.0	34.0	1	1	1
Puerto de	2	10	0.30	6.56	3.01	2.50	117.0	16.0	81.0	28.0	0	0	1
Puerto de	3	1	0.24	6.48	2.85	2.53	106.0	16.0	81.0	37.0	1	1	1
Puerto de	3	2	0.30	6.40	2.89	2.46	108.0	19.0	84.0	37.0	1	2	2
Puerto de	3	3	0.30	6.48	3.05	2.46	106.0	16.0	76.0	31.0	1	1	2
Puerto de	3	4	0.24	6.48	2.97	2.53	113.0	21.0	88.0	38.0	1	1	2
Puerto de	3	5	0.28	6.48	2.85	2.53	105.0	16.0	75.0	40.0	1	1	1
Puerto de	3	6	0.28	5.68	2.85	2.53	105.0	16.0	75.0	40.0	1	1	1
Puerto de	3	7	0.26	6.48	2.89	2.53	106.0	17.0	81.0	32.0	1	2	1
Puerto de	3	8	0.28	6.48	2.89	2.50	114.0	20.0	77.0	29.0	0	1	1
Puerto de	3	9	0.22	6.48	2.89	2.46	112.0	20.0	81.0	38.0	1	1	2
Puerto de	3	10	0.28	6.48	2.89	2.50	100.0	18.0	77.0	34.0	1	2	1
Puerto de	4	1	0.28	6.56	3.05	2.57	103.0	18.0	78.0	36.0	0	2	2
Puerto de	4	2	0.28	6.56	2.93	2.53	106.0	19.0	81.0	39.0	1	2	1
Puerto de	4	3	0.32	6.48	3.09	2.53	103.0	15.0	82.0	39.0	1	1	1
Puerto de	4	4	0.30	6.48	3.05	2.50	114.0	17.0	78.0	37.0	0	1	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Puerto de	4	5	0.22	6.56	3.01	2.57	107.0	20.0	85.0	38.0	1	1	1
Puerto de	4	6	0.34	6.48	2.89	2.50	102.0	21.0	88.0	37.0	1	1	1
Puerto de	4	7	0.24	6.40	3.01	2.50	108.0	16.0	79.0	40.0	1	2	1
Puerto de	4	8	0.28	6.40	3.01	2.50	107.0	19.0	80.0	39.0	0	2	2
Puerto de	4	9	0.30	6.48	3.09	2.53	109.0	17.0	79.0	38.0	0	2	1
Puerto de	4	10	0.30	6.48	2.89	2.53	101.0	17.0	81.0	43.0	1	2	2
Puerto de	5	1	0.24	6.32	2.85	2.50	107.0	17.0	85.0	42.0	1	1	1
Puerto de	5	2	0.28	6.48	3.01	2.42	108.0	15.0	79.0	34.0	1	2	1
Puerto de	5	3	0.28	6.40	2.93	2.50	107.0	18.0	87.0	36.0	1	1	2
Puerto de	5	4	0.26	6.56	2.93	2.50	96.0	21.0	82.0	41.0	1	2	1
Puerto de	5	5	0.28	6.56	2.93	2.50	111.0	17.0	83.0	37.0	1	1	1
Puerto de	5	6	0.24	6.64	2.97	2.46	118.0	16.0	90.0	35.0	0	1	1
Puerto de	5	7	0.30	6.56	3.13	2.57	102.0	17.0	89.0	37.0	1	2	2
Puerto de	5	8	0.24	6.48	2.97	2.53	106.0	17.0	84.0	38.0	1	1	1
Puerto de	5	9	0.28	6.64	3.01	2.53	103.0	19.0	80.0	35.0	1	1	2
Puerto de	5	10	0.32	6.56	2.97	2.50	101.0	17.0	87.0	38.0	0	1	3
Puerto de	6	1	0.36	6.48	2.89	2.57	105.0	17.0	76.0	34.0	1	1	1
Puerto de	6	2	0.30	6.64	2.89	2.53	102.0	18.0	79.0	37.0	1	0	2
Puerto de	6	3	0.28	6.56	3.01	2.53	103.0	19.0	85.0	40.0	1	2	1
Puerto de	6	4	0.28	6.24	2.81	2.42	102.0	20.0	81.0	41.0	1	2	1
Puerto de	6	5	0.30	6.48	2.93	2.53	103.0	22.0	83.0	39.0	0	0	1
Puerto de	6	6	0.28	6.32	2.93	2.46	104.0	20.0	86.0	42.0	1	2	1
Puerto de	6	7	0.28	6.56	2.85	2.50	104.0	17.0	79.0	38.0	1	2	2
Puerto de	6	8	0.22	6.40	3.01	2.57	93.0	22.0	80.0	41.0	1	1	1
Puerto de	6	9	0.30	6.48	3.01	2.46	102.0	22.0	83.0	37.0	1	2	2
Puerto de	6	10	0.32	6.56	2.97	2.46	101.0	17.0	81.0	33.0	0	0	2
Benicarlo	1	1	0.32	6.40	2.97	2.57	110.0	17.0	83.0	38.0	0	0	1
Benicarlo	1	2	0.34	6.56	2.93	2.46	108.0	20.0	86.0	44.0	0	0	1
Benicarlo	1	3	0.38	6.80	2.89	2.50	109.0	17.0	84.0	38.0	0	0	1
Benicarlo	1	4	0.34	6.48	2.85	2.46	114.0	21.0	83.0	36.0	0	0	1
Benicarlo	1	5	0.38	6.64	3.09	2.57	111.0	18.0	87.0	37.0	0	0	1
Benicarlo	1	6	0.38	6.56	2.89	2.42	107.0	20.0	88.0	40.0	0	0	1
Benicarlo	1	7	0.36	6.56	2.89	2.50	105.0	17.0	87.0	38.0	0	0	1
Benicarlo	1	8	0.34	6.72	2.85	2.57	103.0	17.0	82.0	35.0	0	0	1
Benicarlo	1	9	0.34	6.56	2.97	2.46	107.0	20.0	85.0	39.0	0	0	2
Benicarlo	1	10	0.36	6.64	2.89	2.53	111.0	14.0	79.0	34.0	0	0	2
Benicarlo	2	1	0.32	6.40	2.93	2.50	99.0	19.0	82.0	34.0	1	0	1
Benicarlo	2	2	0.30	6.32	2.85	2.38	114.0	19.0	87.0	41.0	0	0	1
Benicarlo	2	3	0.36	6.48	2.93	2.50	104.0	17.0	83.0	40.0	0	0	1
Benicarlo	2	4	0.32	6.48	2.93	2.53	104.0	16.0	87.0	40.0	1	0	1
Benicarlo	2	5	0.32	6.56	2.93	2.50	102.0	16.0	80.0	40.0	0	0	1
Benicarlo	2	6	0.36	6.56	2.93	2.61	107.0	15.0	80.0	40.0	0	0	2
Benicarlo	2	7	0.38	6.24	2.85	2.38	106.0	16.0	75.0	38.0	0	0	1
Benicarlo	2	8	0.36	6.48	2.89	2.53	103.0	18.0	87.0	39.0	1	0	1
Benicarlo	2	9	0.38	6.32	2.93	2.61	112.0	17.0	82.0	37.0	1	0	2
Benicarlo	2	10	0.32	6.32	3.01	2.50	109.0	21.0	83.0	39.0	0	0	1
Benicarlo	3	1	0.26	6.32	2.81	2.50	105.0	17.0	81.0	38.0	0	0	2

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Benicarlo	3	2	0.28	6.48	2.85	2.50	108.0	18.0	79.0	37.0	1	2	1
Benicarlo	3	3	0.34	6.32	2.85	2.50	104.0	21.0	83.0	39.0	0	0	1
Benicarlo	3	4	0.36	6.40	2.89	2.57	110.0	19.0	76.0	37.0	0	0	1
Benicarlo	3	5	0.30	6.32	3.01	2.57	114.0	22.0	76.0	40.0	0	0	1
Benicarlo	3	6	0.36	6.56	2.93	2.53	103.0	16.0	76.0	31.0	0	0	1
Benicarlo	3	7	0.30	6.40	2.93	2.42	112.0	20.0	83.0	36.0	0	0	1
Benicarlo	3	8	0.34	6.40	2.85	2.42	108.0	20.0	79.0	37.0	0	0	1
Benicarlo	3	9	0.40	6.56	2.93	2.53	104.0	17.0	76.0	40.0	0	0	1
Benicarlo	3	10	0.36	6.40	3.01	2.42	106.0	20.0	81.0	36.0	0	0	1
Benicarlo	4	1	0.28	6.56	3.01	2.57	104.0	22.0	86.0	44.0	0	0	1
Benicarlo	4	2	0.38	6.48	2.97	2.57	107.0	22.0	85.0	34.0	0	0	1
Benicarlo	4	3	0.46	6.48	2.85	2.53	114.0	20.0	84.0	36.0	0	0	1
Benicarlo	4	4	0.34	6.56	2.97	2.53	104.0	19.0	83.0	35.0	0	0	3
Benicarlo	4	5	0.40	6.48	2.97	2.61	100.0	20.0	81.0	35.0	0	0	2
Benicarlo	4	6	0.32	6.56	2.89	2.57	101.0	18.0	78.0	36.0	0	0	1
Benicarlo	4	7	0.38	6.64	3.01	2.57	94.0	19.0	84.0	34.0	0	0	3
Benicarlo	4	8	0.26	6.48	2.93	2.53	107.0	21.0	79.0	40.0	0	0	1
Benicarlo	4	9	0.26	6.56	2.93	2.53	106.0	21.0	84.0	37.0	0	0	2
Benicarlo	4	10	0.36	6.56	2.93	2.53	101.0	22.0	85.0	36.0	0	0	3
Benicarlo	5	1	0.28	6.56	2.89	2.46	112.0	16.0	84.0	31.0	0	0	1
Benicarlo	5	2	0.36	6.48	2.93	2.46	105.0	19.0	82.0	35.0	0	0	1
Benicarlo	5	3	0.32	6.32	2.89	2.42	97.0	19.0	84.0	35.0	0	0	1
Benicarlo	5	4	0.34	6.40	3.05	2.50	101.0	20.0	90.0	40.0	0	0	1
Benicarlo	5	5	0.40	6.56	2.97	2.53	94.0	17.0	83.0	40.0	0	1	1
Benicarlo	5	6	0.38	6.40	2.93	2.42	95.0	18.0	83.0	35.0	0	0	1
Benicarlo	5	7	0.38	6.32	2.89	2.53	100.0	18.0	81.0	35.0	0	0	1
Benicarlo	5	8	0.34	6.32	2.89	2.42	108.0	16.0	81.0	36.0	0	0	1
Benicarlo	5	9	0.30	6.40	2.93	2.50	107.0	20.0	84.0	34.0	0	0	1
Benicarlo	5	10	0.32	6.32	2.93	2.38	113.0	20.0	89.0	28.0	0	0	1
Montblanc	1	1	0.36	6.40	2.89	2.46	106.0	18.0	75.0	39.0	0	0	1
Montblanc	1	2	0.42	6.48	2.93	2.57	113.0	22.0	83.0	42.0	0	0	1
Montblanc	1	3	0.32	6.40	2.89	2.50	106.0	15.0	70.0	34.0	0	0	0
Montblanc	1	4	0.32	6.48	2.85	2.53	108.0	16.0	77.0	28.0	0	0	2
Montblanc	1	5	0.38	6.48	2.85	2.50	108.0	16.0	74.0	37.0	0	0	1
Montblanc	1	6	0.40	6.48	2.89	2.46	112.0	16.0	68.0	36.0	0	0	1
Montblanc	1	7	0.30	6.48	2.89	2.53	109.0	18.0	75.0	39.0	0	0	1
Montblanc	1	8	0.42	6.40	2.93	2.53	111.0	25.0	87.0	38.0	0	0	1
Montblanc	1	9	0.38	6.40	2.89	2.50	110.0	18.0	78.0	39.0	0	1	1
Montblanc	1	10	0.40	6.40	2.89	2.53	109.0	18.0	78.0	41.0	0	0	1
Montblanc	2	1	0.38	6.48	2.97	2.46	104.0	14.0	79.0	33.0	0	0	1
Montblanc	2	2	0.42	6.40	2.97	2.53	117.0	16.0	78.0	35.0	0	0	1
Montblanc	2	3	0.44	6.32	2.81	2.34	102.0	16.0	82.0	30.0	0	0	2
Montblanc	2	4	0.42	6.56	2.89	2.50	113.0	17.0	87.0	44.0	0	0	2
Montblanc	2	5	0.46	6.40	3.05	2.53	109.0	17.0	87.0	39.0	0	0	1
Montblanc	2	6	0.40	6.24	2.89	2.42	104.0	17.0	79.0	43.0	1	0	1
Montblanc	2	7	0.46	6.64	3.01	2.61	106.0	15.0	72.0	30.0	0	0	1
Montblanc	2	8	0.46	6.40	2.89	2.42	102.0	17.0	79.0	37.0	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Montblanc	2	9	0.50	6.24	2.85	2.42	109.0	18.0	84.0	46.0	0	0	1
Montblanc	2	10	0.42	6.40	2.97	2.46	105.0	18.0	73.0	35.0	0	0	1
Montblanc	3	1	0.36	6.40	2.85	2.50	106.0	21.0	87.0	38.0	0	0	1
Montblanc	3	2	0.32	6.40	2.89	2.46	103.0	21.0	88.0	39.0	0	0	1
Montblanc	3	3	0.36	6.56	2.85	2.42	108.0	19.0	82.0	38.0	0	0	2
Montblanc	3	4	0.38	6.40	2.89	2.38	108.0	18.0	78.0	40.0	0	0	1
Montblanc	3	5	0.30	6.24	2.81	2.38	106.0	20.0	76.0	32.0	0	0	1
Montblanc	3	6	0.34	6.32	2.77	2.42	101.0	14.0	79.0	33.0	1	1	1
Montblanc	3	7	0.38	6.40	3.05	2.53	101.0	18.0	83.0	31.0	0	0	1
Montblanc	3	8	0.32	6.40	2.89	2.50	102.0	19.0	88.0	35.0	0	0	1
Montblanc	3	9	0.32	6.24	2.77	2.42	110.0	21.0	89.0	38.0	0	0	2
Montblanc	3	10	0.36	6.48	2.93	2.53	104.0	22.0	86.0	36.0	0	0	1
Montblanc	4	1	0.32	6.40	2.81	2.42	112.0	18.0	84.0	36.0	1	2	1
Montblanc	4	2	0.34	6.48	2.97	2.53	110.0	18.0	85.0	44.0	0	0	1
Montblanc	4	3	0.38	6.48	2.89	2.53	115.0	20.0	83.0	40.0	1	2	1
Montblanc	4	4	0.30	6.40	2.81	2.42	111.0	21.0	83.0	37.0	0	0	1
Montblanc	4	5	0.34	6.40	2.89	2.50	109.0	16.0	77.0	35.0	0	0	1
Montblanc	4	6	0.40	6.32	2.93	2.46	110.0	17.0	76.0	38.0	1	2	1
Montblanc	4	7	0.34	6.48	2.85	2.38	110.0	20.0	84.0	38.0	0	0	1
Montblanc	4	8	0.30	6.40	2.85	2.38	113.0	18.0	78.0	36.0	0	0	1
Montblanc	4	9	0.36	6.48	3.01	2.50	98.0	16.0	77.0	41.0	0	0	1
Montblanc	4	10	0.40	6.24	2.77	2.42	117.0	20.0	86.0	36.0	0	0	1
Montblanc	5	1	0.40	6.64	3.09	2.57	111.0	18.0	85.0	40.0	0	0	1
Montblanc	5	2	0.42	6.40	2.89	2.46	113.0	17.0	81.0	38.0	1	0	1
Montblanc	5	3	0.38	6.32	2.97	2.50	100.0	20.0	79.0	35.0	0	0	1
Montblanc	5	4	0.42	6.56	3.01	2.46	114.0	18.0	85.0	43.0	0	0	2
Montblanc	5	5	0.36	6.72	2.97	2.57	109.0	19.0	87.0	40.0	0	0	1
Montblanc	5	6	0.32	6.64	2.97	2.61	105.0	17.0	86.0	40.0	0	0	1
Montblanc	5	7	0.34	6.48	2.81	2.42	114.0	20.0	81.0	38.0	0	0	1
Montblanc	5	8	0.38	6.40	2.93	2.42	106.0	22.0	86.0	42.0	1	0	3
Montblanc	5	9	0.36	6.48	2.89	2.53	103.0	16.0	78.0	37.0	0	0	1
Montblanc	5	10	0.40	6.40	2.89	2.53	118.0	16.0	77.0	33.0	0	0	1
Montblanc	6	1	0.38	6.56	2.85	2.46	109.0	20.0	77.0	37.0	0	0	1
Montblanc	6	2	0.42	6.40	2.85	2.34	109.0	23.0	80.0	39.0	0	0	0
Montblanc	6	3	0.40	6.64	2.97	2.46	114.0	19.0	74.0	42.0	0	0	0
Montblanc	6	4	0.34	6.48	2.85	2.50	107.0	24.0	80.0	41.0	0	0	1
Montblanc	6	5	0.42	6.32	2.93	2.46	120.0	20.0	79.0	41.0	0	0	1
Montblanc	6	6	0.44	6.56	2.93	2.57	107.0	21.0	84.0	42.0	0	0	1
Montblanc	6	7	0.40	6.72	2.85	2.50	105.0	20.0	81.0	37.0	0	0	2
Montblanc	6	8	0.40	6.40	2.97	2.53	110.0	17.0	79.0	42.0	0	0	1
Montblanc	6	9	0.40	6.40	2.85	2.38	107.0	20.0	76.0	44.0	0	0	1
Montblanc	6	10	0.42	6.48	2.85	2.46	109.0	24.0	75.0	42.0	0	0	1

10.1.2 Pheromone Data

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Tan Tan	1	1	6.07	6.07	34.36	0.61	0.61	26.12	18.62	7.56
Tan Tan	1	2	5.28	5.20	25.40	0.52	0.52	19.94	36.37	6.78
Tan Tan	1	3	17.19	29.38	29.38	17.19	1.72	1.72	1.72	1.72
Tan Tan	1	4	6.46	9.37	31.50	0.31	19.87	12.62	11.22	8.67
Tan Tan	1	5	3.47	9.62	41.61	0.35	0.35	23.45	14.82	6.33
Tan Tan	2	1	7.05	7.05	25.39	0.70	0.70	22.54	29.51	7.05
Tan Tan	2	2	3.08	7.56	23.26	0.31	8.20	41.00	13.50	3.08
Tan Tan	2	3	6.78	6.78	13.29	0.68	0.68	44.61	20.42	6.78
Tan Tan	2	4	5.13	5.17	23.07	0.51	0.51	31.08	24.00	10.53
Tan Tan	2	5	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Tan Tan	3	1	27.11	32.23	2.71	2.71	2.71	27.11	2.71	2.71
Tan Tan	3	2	21.13	14.75	59.53	0.92	0.92	0.92	0.92	0.92
Tan Tan	3	3	13.98	6.01	29.17	4.70	20.79	19.69	5.19	0.47
Tan Tan	3	4	4.22	6.80	19.71	0.42	26.94	24.59	16.90	0.42
Tan Tan	3	5	3.13	3.29	20.07	4.30	5.47	45.05	15.93	2.76
Tan Tan	4	1	1.73	2.14	17.60	7.49	4.32	22.30	36.89	7.54
Tan Tan	4	2	4.98	4.98	15.32	0.50	0.50	28.82	33.12	11.78
Tan Tan	4	3	1.03	1.79	10.99	6.75	1.03	29.34	42.79	6.28
Tan Tan	4	4	21.32	2.13	32.28	2.13	2.13	35.75	2.13	2.13
Tan Tan	4	5	3.70	2.61	26.37	10.28	0.25	19.90	32.44	4.45
Tan Tan	5	1	1.43	1.43	4.45	23.12	13.70	26.24	24.82	4.82
Tan Tan	5	2	1.54	2.42	17.40	10.31	2.46	29.60	34.75	1.52
Tan Tan	5	3	7.84	13.84	46.35	0.78	0.78	10.17	12.40	7.84
Tan Tan	5	4	5.34	7.93	33.82	4.56	16.56	10.53	14.37	6.90
Tan Tan	5	5	7.04	3.36	6.59	45.59	0.34	15.96	12.93	8.20
Tan Tan	6	1	13.31	13.31	24.87	1.33	1.33	18.25	14.28	13.31
Tan Tan	6	2	11.15	11.15	28.50	1.12	1.12	24.67	11.15	11.15
Tan Tan	6	3	3.85	3.85	38.46	3.85	3.85	38.46	3.85	3.85
Tan Tan	6	4	5.88	5.88	5.88	58.82	5.88	5.88	5.88	5.88
Tan Tan	6	5	8.27	0.83	8.51	22.00	0.83	34.37	13.98	11.22
S. Rabat	1	1	0.79	0.79	0.79	7.92	0.79	14.95	7.92	66.04
S. Rabat	1	2	0.53	0.53	0.53	0.53	0.53	73.28	5.28	18.81
S. Rabat	1	3	3.38	3.38	3.38	3.38	3.38	3.38	3.38	76.36
S. Rabat	1	4	1.65	1.65	1.65	1.65	1.65	27.46	1.65	62.63
S. Rabat	1	5	1.08	10.85	10.85	10.85	1.08	24.97	1.08	39.23
S. Rabat	2	1	1.12	1.12	23.41	1.12	1.12	19.38	11.22	41.50
S. Rabat	2	2	1.81	1.81	18.06	1.81	1.81	30.42	1.81	42.50
S. Rabat	2	3	0.25	0.25	2.52	0.25	0.25	75.71	2.52	18.23
S. Rabat	2	4	5.61	5.61	5.61	5.61	5.61	5.61	5.61	60.74
S. Rabat	2	5	1.16	1.16	11.62	1.16	1.16	25.34	11.62	46.77
S. Rabat	3	1	0.99	0.99	0.99	9.93	0.99	11.80	0.99	73.30
S. Rabat	3	2	2.15	2.15	2.15	2.15	2.15	30.69	2.15	56.43
S. Rabat	3	3	2.38	2.38	2.38	2.38	2.38	28.60	2.38	57.12
S. Rabat	3	4	0.63	0.63	0.63	0.63	0.63	7.86	0.63	88.39
S. Rabat	3	5	1.02	1.02	10.20	1.02	1.02	18.75	10.20	56.77

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
S. Rabat	4	1	2.01	2.01	2.01	2.01	2.01	25.78	2.01	62.14
S. Rabat	4	2	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
S. Rabat	4	3	2.51	2.51	2.51	2.51	2.51	28.51	2.51	56.43
S. Rabat	4	4	1.59	1.59	1.59	1.59	1.59	21.21	1.59	69.28
S. Rabat	4	5	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
S. Rabat	5	1	0.80	0.80	8.04	18.80	0.80	29.55	0.80	40.40
S. Rabat	5	2	1.58	1.58	15.77	1.58	1.58	74.77	1.58	1.58
S. Rabat	5	3	6.51	0.65	6.51	0.65	0.65	19.02	6.51	59.48
S. Rabat	5	4	0.48	0.48	4.85	6.08	0.48	18.29	5.94	63.39
S. Rabat	5	5	5.19	0.52	5.19	5.19	0.52	0.52	5.19	77.70
S. Rabat	6	1	0.73	0.73	7.28	9.56	0.73	16.02	7.28	57.67
S. Rabat	6	2	11.84	1.18	11.84	1.18	1.18	31.17	11.84	29.77
S. Rabat	6	3	1.33	1.33	1.33	1.33	1.33	19.32	1.33	72.71
S. Rabat	6	4	1.64	1.64	16.39	1.64	1.64	21.32	16.39	39.36
S. Rabat	6	5	1.56	1.56	15.56	1.56	1.56	24.69	15.56	37.97
Marrakech	1	1	1.68	1.32	25.94	4.94	0.93	34.48	21.96	8.75
Marrakech	1	2	4.20	3.41	0.66	3.76	8.94	61.57	8.40	9.06
Marrakech	1	3	3.40	9.83	26.11	7.98	34.25	11.28	0.34	6.81
Marrakech	1	4	16.28	1.77	39.65	2.85	8.50	19.59	3.11	8.25
Marrakech	1	5	19.82	4.83	21.35	3.40	10.70	25.38	3.86	10.67
Marrakech	2	1	14.45	9.14	38.45	3.60	4.23	17.83	3.60	8.69
Marrakech	2	2	6.86	8.32	1.06	2.50	13.14	40.86	4.80	22.46
Marrakech	2	3	6.47	5.36	22.30	3.04	11.47	34.34	3.51	13.53
Marrakech	2	4	1.54	1.44	1.44	8.51	2.15	58.21	7.99	18.72
Marrakech	2	5	5.88	5.88	5.88	5.88	5.88	5.88	5.88	58.82
Marrakech	3	1	38.46	3.85	38.46	3.85	3.85	3.85	3.85	3.85
Marrakech	3	2	5.39	8.87	35.35	0.40	25.43	16.16	4.41	3.99
Marrakech	3	3	11.36	13.00	51.21	0.74	0.74	14.80	0.74	7.41
Marrakech	3	4	6.03	10.29	22.05	2.36	2.30	34.81	15.23	6.92
Marrakech	3	5	8.73	11.89	27.83	5.74	5.01	19.82	15.31	5.67
Marrakech	4	1	0.68	0.68	6.78	0.68	0.68	16.65	9.19	64.67
Marrakech	4	2	11.97	0.15	9.19	15.99	0.15	29.44	0.15	32.98
Marrakech	4	3	5.38	0.54	5.38	5.38	5.38	13.34	5.38	59.21
Marrakech	4	4	10.56	1.06	1.06	43.92	1.06	22.36	1.06	18.95
Marrakech	4	5	2.01	2.01	2.01	2.01	2.01	28.31	2.01	59.63
Marrakech	5	1	0.75	0.75	0.75	7.52	7.52	10.99	7.52	64.19
Marrakech	5	2	3.29	3.29	3.29	3.29	3.29	40.47	3.29	39.81
Marrakech	5	3	9.94	27.70	32.20	3.75	8.92	2.62	0.26	14.61
Marrakech	5	4	13.65	29.41	30.20	5.95	19.22	0.53	0.53	0.53
Marrakech	5	5	1.32	1.32	13.23	1.32	1.32	31.16	13.23	37.10
Marrakech	6	1	1.23	1.23	12.28	1.23	12.28	23.00	1.23	47.51
Marrakech	6	2	0.68	0.68	6.84	29.63	6.84	21.43	6.84	27.05
Marrakech	6	3	0.84	0.84	8.35	0.84	8.35	17.67	8.35	54.77
Marrakech	6	4	0.55	0.55	5.51	0.55	0.55	18.36	5.65	68.28
Marrakech	6	5	0.80	0.80	8.01	8.01	8.01	14.57	8.01	51.79
Ez Zhiliga	1	1	1.56	1.56	15.59	1.56	1.56	31.01	1.56	45.60
Ez Zhiliga	1	2	0.84	0.84	8.38	0.84	0.84	16.45	8.38	63.44

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Ez Zhiliga	1	3	1.48	1.48	14.77	1.48	1.48	29.50	14.77	35.06
Ez Zhiliga	1	4	5.88	5.88	58.82	5.88	5.88	5.88	5.88	5.88
Ez Zhiliga	1	5	0.39	0.39	3.92	10.37	0.39	11.26	3.92	69.35
Ez Zhiliga	2	1	1.32	1.32	13.17	1.32	1.32	67.08	13.17	1.32
Ez Zhiliga	2	2	9.89	0.99	9.89	0.99	0.99	64.95	11.31	0.99
Ez Zhiliga	2	3	1.51	1.51	15.13	1.51	1.51	28.10	15.13	35.58
Ez Zhiliga	2	4	1.65	1.65	16.52	1.65	1.65	58.69	16.52	1.65
Ez Zhiliga	2	5	1.03	1.03	10.31	1.03	1.03	73.91	10.63	1.03
Ez Zhiliga	3	1	2.35	2.35	2.35	2.35	2.35	41.66	2.35	44.27
Ez Zhiliga	3	2	0.42	0.42	4.17	4.61	0.42	20.03	4.17	65.76
Ez Zhiliga	3	3	0.71	0.71	7.12	0.71	0.71	21.48	7.12	61.42
Ez Zhiliga	3	4	1.36	1.36	1.36	1.36	1.36	23.09	13.56	56.57
Ez Zhiliga	3	5	0.76	0.76	7.72	11.80	0.76	67.79	9.64	0.76
Ez Zhiliga	4	1	12.95	12.95	12.95	1.30	17.03	40.23	1.30	1.30
Ez Zhiliga	4	2	0.67	0.67	6.75	0.67	0.67	18.64	7.98	63.94
Ez Zhiliga	4	3	1.51	1.51	15.07	1.51	1.51	32.63	15.07	31.19
Ez Zhiliga	4	4	0.90	0.90	0.90	9.03	0.90	12.88	0.90	73.57
Ez Zhiliga	4	5	0.82	0.82	8.16	0.82	0.82	29.81	10.95	47.81
Ez Zhiliga	5	1	1.63	1.63	16.34	1.63	1.63	59.16	16.34	1.63
Ez Zhiliga	5	2	1.25	1.25	12.46	13.80	1.25	20.29	12.46	37.25
Ez Zhiliga	5	3	0.87	0.87	8.68	0.87	0.87	20.85	8.68	58.33
Ez Zhiliga	5	4	2.27	2.27	22.70	2.27	2.27	41.81	24.14	2.27
Ez Zhiliga	5	5	1.33	1.33	13.33	13.33	1.33	54.67	13.33	1.33
Ez Zhiliga	6	1	5.31	5.31	5.31	39.58	16.63	0.53	26.80	0.53
Ez Zhiliga	6	2	1.82	1.82	1.82	1.82	18.25	1.82	1.82	70.81
Ez Zhiliga	6	3	6.32	0.63	6.32	6.32	0.63	0.63	9.76	69.38
Ez Zhiliga	6	4	2.66	2.66	26.55	2.66	33.62	2.66	26.55	2.66
Ez Zhiliga	6	5	3.56	3.56	35.59	3.56	3.56	3.56	43.05	3.56
Ksar-El-K	1	1	17.94	3.88	48.39	0.39	17.36	4.88	0.39	6.77
Ksar-El-K	1	2	6.16	3.31	60.62	0.23	0.23	11.25	13.09	5.11
Ksar-El-K	1	3	12.57	1.17	48.14	1.17	1.17	1.17	21.11	13.48
Ksar-El-K	1	4	12.78	6.15	57.91	0.62	0.62	14.69	0.62	6.62
Ksar-El-K	1	5	1.85	13.63	22.94	4.13	0.13	23.01	29.05	5.26
Ksar-El-K	2	1	10.43	10.43	36.08	1.04	22.70	17.23	1.04	1.04
Ksar-El-K	2	2	6.42	6.52	44.07	34.55	0.64	0.64	0.64	6.51
Ksar-El-K	2	3	2.80	2.09	30.05	8.91	0.84	23.75	25.85	5.70
Ksar-El-K	2	4	9.67	4.71	72.76	0.42	0.42	6.22	0.42	5.39
Ksar-El-K	2	5	11.21	6.88	38.92	12.37	0.69	6.88	6.88	16.17
Ksar-El-K	3	1	30.69	3.07	50.90	3.07	3.07	3.07	3.07	3.07
Ksar-El-K	3	2	3.63	3.59	43.45	1.54	4.89	21.07	10.56	11.28
Ksar-El-K	3	3	3.86	2.52	28.44	6.19	0.25	29.97	22.21	6.56
Ksar-El-K	3	4	10.34	6.36	45.23	2.22	12.77	16.53	2.22	4.33
Ksar-El-K	3	5	2.10	6.37	34.67	0.18	0.18	36.27	11.22	9.00
Ksar-El-K	4	1	12.42	12.42	1.24	23.65	1.24	21.29	1.24	26.49
Ksar-El-K	4	2	17.53	1.36	74.33	1.36	1.36	1.36	1.36	1.36
Ksar-El-K	4	3	36.36	5.02	10.19	5.98	18.12	5.68	0.46	18.20
Ksar-El-K	4	4	25.69	6.47	64.60	0.65	0.65	0.65	0.65	0.65

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Ksar-El-K	4	5	7.66	4.76	56.92	0.41	11.12	9.31	4.10	5.72
Ksar-El-K	5	1	11.85	6.25	27.91	0.63	24.70	21.78	0.63	6.25
Ksar-El-K	5	2	16.16	4.00	42.71	3.72	15.88	8.67	0.37	8.48
Ksar-El-K	5	3	17.02	8.03	47.68	2.75	19.88	1.22	0.09	3.33
Ksar-El-K	5	4	61.41	0.13	7.01	3.03	17.15	8.91	0.13	2.21
Ksar-El-K	5	5	12.26	8.10	31.07	2.46	22.08	18.74	2.58	2.72
Ksar-El-K	6	1	3.62	4.04	46.52	1.41	16.12	19.02	7.69	1.58
Ksar-El-K	6	2	6.09	6.61	41.59	0.39	15.02	15.32	7.66	7.32
Ksar-El-K	6	3	7.17	4.52	45.49	0.29	10.53	21.97	5.26	4.78
Ksar-El-K	6	4	3.50	5.97	45.84	0.20	5.75	23.76	10.37	4.62
Ksar-El-K	6	5	2.96	1.09	2.87	5.62	1.38	30.56	30.56	24.96
Tetouan	1	1	4.06	2.59	26.40	4.41	5.59	33.46	12.56	10.91
Tetouan	1	2	1.10	2.21	19.52	0.93	1.10	45.40	13.02	16.72
Tetouan	1	3	1.32	4.31	12.12	4.77	6.56	47.27	18.82	4.82
Tetouan	1	4	5.05	4.42	45.33	6.67	23.63	3.05	0.29	11.55
Tetouan	1	5	9.67	8.21	41.28	5.79	0.16	18.39	5.44	11.07
Tetouan	2	1	2.76	8.68	19.68	1.38	12.04	41.56	9.74	4.15
Tetouan	2	2	4.94	1.70	39.59	3.49	2.75	28.28	13.37	5.88
Tetouan	2	3	2.44	3.94	22.74	12.06	18.94	28.66	2.99	8.24
Tetouan	2	4	4.30	1.47	36.44	3.82	2.62	30.46	13.79	7.10
Tetouan	2	5	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Tetouan	3	1	1.82	5.98	21.46	25.77	6.25	26.59	7.08	5.06
Tetouan	3	2	4.38	0.32	29.90	33.34	5.35	10.90	12.04	3.76
Tetouan	3	3	3.48	0.19	9.89	15.48	2.83	41.90	19.54	6.69
Tetouan	3	4	4.00	3.67	42.52	1.05	4.44	22.45	11.35	10.53
Tetouan	3	5	2.77	4.92	43.13	4.72	4.44	1.75	20.13	18.14
Alhaurin	1	1	19.13	2.16	7.91	18.67	47.81	3.89	0.22	0.22
Alhaurin	1	2	25.08	2.78	3.95	23.09	20.60	11.33	0.28	12.90
Alhaurin	1	3	65.60	0.60	20.08	5.97	5.97	0.60	0.60	0.60
Alhaurin	1	4	46.12	0.42	11.32	4.21	4.21	27.67	0.42	5.62
Alhaurin	1	5	78.24	0.34	16.72	0.34	3.36	0.34	0.34	0.34
Alhaurin	2	1	41.99	0.51	5.09	5.09	45.80	0.51	0.51	0.51
Alhaurin	2	2	27.10	0.94	9.43	9.43	50.28	0.94	0.94	0.94
Alhaurin	2	3	21.59	0.59	11.06	5.87	59.13	0.59	0.59	0.59
Alhaurin	2	4	28.39	0.21	8.55	2.11	55.13	3.30	0.21	2.11
Alhaurin	2	5	29.54	0.70	7.05	0.70	59.89	0.70	0.70	0.70
Alhaurin	3	1	15.09	0.83	8.34	8.34	53.70	12.02	0.83	0.83
Alhaurin	3	2	22.73	2.27	2.27	22.73	22.73	22.73	2.27	2.27
Alhaurin	3	3	19.36	0.76	0.76	0.76	51.08	25.76	0.76	0.76
Alhaurin	3	4	9.55	0.32	44.69	0.32	30.03	6.44	3.23	5.42
Alhaurin	3	5	14.60	0.32	6.57	5.06	42.84	24.11	3.25	3.25
Alhaurin	4	1	41.10	0.27	3.53	4.14	47.71	2.71	0.27	0.27
Alhaurin	4	2	19.38	0.42	1.75	11.43	58.50	7.91	0.57	0.04
Alhaurin	4	3	18.25	0.19	1.91	3.30	68.48	7.49	0.19	0.19
Alhaurin	4	4	20.34	0.21	3.48	2.07	64.74	2.07	0.21	6.88
Alhaurin	4	5	20.34	0.19	2.68	4.65	63.67	5.92	0.19	2.36
Alhaurin	5	1	3.10	0.14	1.86	4.38	86.58	3.66	0.14	0.14

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Alhaurin	5	2	69.75	0.38	17.76	3.79	3.79	0.38	0.38	3.79
Alhaurin	5	3	56.08	0.20	14.73	0.20	0.20	23.66	2.05	2.90
Alhaurin	5	4	81.10	0.40	12.91	3.99	0.40	0.40	0.40	0.40
Alhaurin	5	5	77.58	0.32	14.36	0.32	3.55	3.22	0.32	0.32
Alhaurin	6	1	75.91	0.22	14.46	2.18	2.18	2.18	0.22	2.65
Alhaurin	6	2	78.62	0.15	15.00	1.47	0.15	1.89	0.15	2.58
Alhaurin	6	3	69.31	0.25	22.52	2.48	2.48	2.48	0.25	0.25
Alhaurin	6	4	62.23	0.27	25.77	2.69	0.27	3.28	0.27	5.22
Alhaurin	6	5	2.40	0.24	75.91	13.28	2.40	5.29	0.24	0.24
Berja	1	1	1.48	0.13	0.13	6.70	70.63	14.27	5.09	1.56
Berja	1	2	6.88	2.44	0.24	0.24	83.27	0.24	2.44	4.25
Berja	1	3	1.54	0.14	1.68	8.30	6.51	34.86	33.77	13.20
Berja	1	4	5.48	0.47	0.47	23.14	24.59	40.73	0.47	4.66
Berja	1	5	1.09	0.08	0.08	8.11	70.75	16.80	0.85	2.24
Berja	2	1	6.66	3.42	0.34	14.74	43.76	27.33	0.34	3.42
Berja	2	2	9.37	9.37	0.94	9.88	11.85	9.37	0.94	48.29
Berja	2	3	23.11	7.55	0.75	33.88	0.75	23.43	0.75	9.77
Berja	2	4	2.21	0.22	0.22	17.47	49.06	23.57	2.21	5.03
Berja	2	5	3.24	3.24	0.32	8.13	49.70	14.78	12.01	8.57
Berja	3	1	0.52	0.52	5.21	22.53	32.60	32.90	5.21	0.52
Berja	3	2	0.76	0.76	7.56	0.76	87.90	0.76	0.76	0.76
Berja	3	3	1.28	1.28	1.28	12.83	79.47	1.28	1.28	1.28
Berja	3	4	6.48	0.48	4.82	7.95	74.49	0.48	0.48	4.82
Berja	3	5	6.22	3.70	3.92	12.86	65.65	6.91	0.37	0.37
Berja	4	1	5.15	0.48	0.48	6.93	50.32	35.69	0.48	0.48
Berja	4	2	2.04	2.04	47.27	4.29	36.66	2.61	2.56	2.52
Berja	4	3	7.02	0.37	0.37	11.33	63.26	16.93	0.37	0.37
Berja	4	4	1.58	1.09	19.55	0.11	58.49	10.88	3.44	4.86
Berja	4	5	4.20	0.40	0.40	11.73	53.61	24.43	0.40	4.82
Berja	5	1	11.69	0.45	0.45	46.03	0.45	33.66	0.45	6.83
Berja	5	2	24.26	1.79	17.88	32.83	1.79	17.88	1.79	1.79
Berja	5	3	5.38	0.54	0.54	14.35	58.48	14.11	0.54	6.07
Berja	5	4	3.17	0.22	0.22	3.78	90.00	2.17	0.22	0.22
Berja	5	5	1.42	0.41	0.04	7.83	83.18	5.89	0.41	0.81
Berja	6	1	1.10	0.30	0.03	10.61	71.99	15.19	0.30	0.47
Berja	6	2	1.95	0.16	0.16	16.15	48.68	30.96	0.16	1.79
Berja	6	3	1.06	0.73	0.07	10.78	70.99	10.92	2.36	3.09
Berja	6	4	1.59	0.16	0.16	7.09	81.45	9.23	0.16	0.16
Berja	6	5	0.74	0.83	0.68	2.97	54.42	25.53	6.55	8.28
Totana	1	1	1.72	1.72	17.16	1.72	1.72	54.49	19.76	1.72
Totana	1	2	0.78	0.78	79.35	0.78	0.78	15.95	0.78	0.78
Totana	1	3	0.29	0.29	70.83	0.29	2.99	17.20	7.81	0.29
Totana	1	4	0.63	0.63	11.72	0.63	7.40	58.83	19.53	0.63
Totana	1	5	2.21	2.21	24.72	22.14	22.14	2.21	22.14	2.21
Totana	2	1	2.49	2.49	24.92	2.49	2.49	37.69	24.92	2.49
Totana	2	2	1.68	1.68	16.80	1.68	16.80	1.68	16.80	42.89
Totana	2	3	3.85	3.85	38.46	3.85	38.46	3.85	3.85	3.85

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Totana	2	4	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Totana	2	5	1.70	1.70	1.70	1.70	1.70	17.88	17.00	56.62
Totana	3	1	2.02	2.02	2.02	2.02	2.02	24.55	20.16	45.20
Totana	3	2	1.87	1.87	18.67	1.87	1.87	21.24	18.67	33.95
Totana	3	3	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Totana	3	4	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Totana	3	5	1.62	1.62	1.62	1.62	1.62	16.20	1.62	74.08
Totana	4	1	1.69	1.69	16.86	1.69	1.69	54.69	20.02	1.69
Totana	4	2	1.20	1.20	11.98	1.20	1.20	19.11	11.98	52.14
Totana	4	3	2.00	2.00	19.99	2.00	2.00	26.30	19.99	25.73
Totana	4	4	1.96	1.96	19.65	1.96	1.96	19.65	19.65	33.20
Totana	4	5	1.65	1.65	16.52	1.65	1.65	29.28	16.52	31.07
Totana	5	1	1.96	1.96	1.96	1.96	1.96	20.84	19.56	49.82
Totana	5	2	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Totana	5	3	1.71	1.71	17.08	1.71	1.71	17.08	1.71	57.31
Totana	5	4	0.63	0.63	6.33	0.63	6.32	37.75	14.21	33.49
Totana	5	5	2.29	2.29	22.93	2.29	2.29	22.93	2.29	42.68
Totana	6	1	1.55	1.55	15.52	1.55	1.55	15.52	15.52	47.23
Totana	6	2	1.74	1.74	17.42	1.74	1.74	27.30	17.42	30.90
Totana	6	3	2.52	2.52	2.52	2.52	2.52	25.22	2.52	59.64
Totana	6	4	1.46	1.46	14.64	1.46	1.46	26.78	14.64	38.09
Totana	6	5	1.70	1.70	16.95	1.70	1.70	24.28	16.95	35.03
Callosa	1	1	7.99	0.25	5.65	4.66	5.96	61.30	13.93	0.25
Callosa	1	2	2.06	2.06	20.64	2.06	2.06	37.71	2.06	31.33
Callosa	1	3	2.86	2.86	28.57	2.86	28.57	2.86	28.57	2.86
Callosa	1	4	0.90	0.90	9.05	0.90	13.68	27.49	11.61	35.46
Callosa	1	5	1.48	1.48	14.79	1.48	14.79	49.70	14.79	1.48
Callosa	2	1	0.80	0.80	7.98	0.80	7.98	14.58	9.02	58.05
Callosa	2	2	1.48	1.48	14.78	1.48	14.78	46.46	18.07	1.48
Callosa	2	3	5.54	0.55	5.54	0.55	9.88	15.09	10.76	52.08
Callosa	2	4	8.98	0.90	0.90	0.90	0.90	0.90	0.90	85.64
Callosa	2	5	13.55	1.35	13.55	1.35	13.55	1.35	13.55	41.74
Callosa	3	1	1.59	1.59	15.85	1.59	15.85	1.59	15.85	46.10
Callosa	3	2	1.57	1.57	15.68	1.57	15.68	15.68	1.57	46.68
Callosa	3	3	1.56	1.56	15.64	1.56	15.64	41.27	21.19	1.56
Callosa	3	4	1.01	1.01	10.06	1.01	1.01	14.89	10.06	60.97
Callosa	3	5	1.33	1.33	13.32	1.33	13.32	27.96	13.32	28.09
Callosa	4	1	1.45	1.45	14.52	1.45	28.06	37.09	14.52	1.45
Callosa	4	2	2.86	2.86	28.57	2.86	28.57	28.57	2.86	2.86
Callosa	4	3	1.55	1.55	15.50	1.55	15.50	17.39	1.55	45.42
Callosa	4	4	1.01	1.01	10.15	1.01	10.15	17.84	10.15	48.67
Callosa	4	5	1.14	1.14	11.44	1.14	14.64	28.43	11.95	30.11
Callosa	5	1	3.24	3.24	3.24	3.24	3.24	3.24	3.24	77.35
Callosa	5	2	1.59	1.59	15.89	1.59	15.89	16.05	15.89	31.50
Callosa	5	3	1.18	1.18	11.82	1.18	11.82	13.79	11.82	47.21
Callosa	5	4	2.28	2.28	22.76	2.28	22.76	43.09	2.28	2.28
Callosa	5	5	2.60	2.60	2.60	2.60	25.95	25.95	2.60	35.11

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Callosa	6	1	1.65	1.65	16.48	1.65	36.76	38.52	1.65	1.65
Callosa	6	2	58.82	5.88	5.88	5.88	5.88	5.88	5.88	5.88
Callosa	6	3	1.33	1.33	13.34	1.33	13.34	17.85	13.34	38.13
Callosa	6	4	28.57	2.86	2.86	2.86	28.57	28.57	2.86	2.86
Callosa	6	5	1.72	1.72	17.25	1.72	1.72	25.37	17.25	33.24
Puerto de	1	1	8.02	3.29	25.94	5.93	5.23	14.32	10.48	26.80
Puerto de	1	2	0.93	0.93	0.93	18.88	18.92	40.79	9.31	9.31
Puerto de	1	3	21.37	1.18	1.18	33.22	1.18	1.18	1.18	39.51
Puerto de	1	4	26.04	5.53	16.15	10.02	22.92	7.41	0.55	11.39
Puerto de	1	5	11.96	0.27	27.59	5.61	42.60	2.72	0.27	8.98
Puerto de	2	1	0.60	0.60	48.63	6.04	32.54	0.60	10.38	0.60
Puerto de	2	2	7.58	3.64	39.34	4.06	3.64	3.64	0.36	37.74
Puerto de	2	3	39.91	15.58	8.71	10.18	8.57	5.05	0.50	11.49
Puerto de	2	4	18.28	4.59	65.81	0.37	6.25	0.37	0.37	3.96
Puerto de	2	5	16.39	6.77	27.79	8.05	11.59	6.77	0.68	21.96
Puerto de	3	1	0.90	0.90	12.48	18.64	9.01	48.15	0.90	9.01
Puerto de	3	2	15.52	2.98	37.13	18.32	5.22	12.35	6.17	2.33
Puerto de	3	3	25.42	59.34	2.54	2.54	2.54	2.54	2.54	2.54
Puerto de	3	4	29.71	6.05	44.81	5.30	7.39	6.15	0.29	0.29
Puerto de	3	5	35.81	3.66	42.50	3.66	6.57	3.78	0.37	3.66
Puerto de	4	1	17.37	1.00	29.80	11.99	27.81	10.03	1.00	1.00
Puerto de	4	2	25.32	8.51	8.51	0.85	27.38	8.51	8.51	12.42
Puerto de	4	3	9.30	0.32	61.45	3.15	1.20	14.80	5.61	4.17
Puerto de	4	4	33.41	1.70	49.78	4.43	5.41	2.19	0.15	2.92
Puerto de	4	5	24.36	3.73	34.54	0.23	31.23	0.23	0.23	5.43
Puerto de	5	1	25.59	6.61	37.05	6.61	16.22	6.61	0.66	0.66
Puerto de	5	2	46.44	0.53	13.27	7.51	30.65	0.53	0.53	0.53
Puerto de	5	3	58.56	0.59	8.26	0.59	24.91	5.90	0.59	0.59
Puerto de	5	4	24.93	0.66	7.94	14.99	15.27	0.66	0.66	34.88
Puerto de	5	5	16.98	0.42	4.21	4.21	11.05	62.30	0.42	0.42
Puerto de	6	1	17.98	1.90	18.64	4.02	33.23	17.40	2.59	4.23
Puerto de	6	2	11.50	1.06	27.39	11.38	10.58	12.61	1.06	24.42
Puerto de	6	3	22.55	3.64	46.59	4.20	9.51	3.30	3.30	6.92
Puerto de	6	4	13.39	3.81	60.65	2.60	4.79	8.88	2.60	3.27
Puerto de	6	5	23.11	7.14	24.36	7.14	17.97	7.14	0.71	12.43
Benicarlo	1	1	3.45	3.45	3.45	3.45	3.45	34.51	3.45	44.79
Benicarlo	1	2	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Benicarlo	1	3	1.33	1.33	13.27	1.33	13.27	17.97	13.27	38.23
Benicarlo	1	4	1.82	1.82	18.25	1.82	18.25	37.95	18.25	1.82
Benicarlo	1	5	1.34	1.34	13.35	1.34	13.35	26.72	13.35	29.22
Benicarlo	2	1	1.99	1.99	19.92	1.99	19.92	19.92	1.99	32.28
Benicarlo	2	2	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Benicarlo	2	3	1.53	1.53	15.26	1.53	15.26	48.10	15.26	1.53
Benicarlo	2	4	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Benicarlo	2	5	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Benicarlo	3	1	2.63	2.63	2.63	2.63	26.32	57.88	2.63	2.63
Benicarlo	3	2	1.62	1.62	16.16	1.62	16.16	45.07	16.16	1.62

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Benicarlo	3	3	1.72	1.72	17.25	1.72	17.25	41.36	17.25	1.72
Benicarlo	3	4	1.85	1.85	18.46	1.85	18.46	37.24	18.46	1.85
Benicarlo	3	5	2.28	2.28	2.28	2.28	2.28	36.32	2.28	50.02
Benicarlo	4	1	3.74	3.74	3.74	3.74	3.74	37.40	3.74	40.16
Benicarlo	4	2	5.88	5.88	5.88	5.88	5.88	5.88	5.88	58.82
Benicarlo	4	3	2.56	2.56	2.56	2.56	25.64	25.64	2.56	35.91
Benicarlo	4	4	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Benicarlo	4	5	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Benicarlo	5	1	1.94	1.94	19.40	1.94	1.94	29.53	19.40	23.92
Benicarlo	5	2	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Benicarlo	5	3	1.93	1.93	19.27	1.93	1.93	25.71	1.93	45.39
Benicarlo	5	4	2.82	2.82	29.55	28.18	2.82	2.82	28.18	2.82
Benicarlo	5	5	1.46	1.46	1.46	1.46	65.01	26.24	1.46	1.46
Montblanc	1	1	2.68	2.68	2.68	2.68	26.83	26.83	2.68	32.91
Montblanc	1	2	1.54	1.54	1.54	15.40	15.40	1.54	1.54	61.51
Montblanc	1	3	1.32	1.32	1.32	1.32	13.25	15.35	1.32	64.78
Montblanc	1	4	1.56	1.56	15.63	1.56	15.63	25.85	15.63	22.58
Montblanc	1	5	14.77	1.48	1.48	14.77	1.48	15.76	1.48	48.79
Montblanc	2	1	1.88	1.88	18.82	1.88	1.88	20.02	1.88	51.76
Montblanc	2	2	1.12	1.12	11.21	1.12	1.12	22.33	11.21	50.76
Montblanc	2	3	9.61	0.96	9.61	9.61	9.61	9.69	9.61	41.29
Montblanc	2	4	3.35	3.35	3.35	3.35	3.35	33.51	3.35	46.38
Montblanc	2	5	13.16	1.32	13.16	1.32	13.16	13.74	13.16	31.01
Montblanc	3	1	1.52	1.52	15.18	1.52	1.52	62.04	15.18	1.52
Montblanc	3	2	1.19	1.19	11.89	1.19	11.89	25.75	11.89	35.01
Montblanc	3	3	1.52	1.52	15.17	1.52	1.52	26.93	15.17	36.66
Montblanc	3	4	1.58	1.58	15.76	1.58	1.58	22.62	1.58	53.74
Montblanc	3	5	1.28	1.28	12.83	1.28	1.28	26.08	12.83	43.12
Montblanc	4	1	1.09	1.09	10.93	1.09	1.09	21.25	10.93	52.52
Montblanc	4	2	1.83	1.83	18.34	1.83	1.83	54.15	18.34	1.83
Montblanc	4	3	58.82	5.88	5.88	5.88	5.88	5.88	5.88	5.88
Montblanc	4	4	0.86	0.86	8.64	0.86	0.86	20.92	8.64	58.35
Montblanc	4	5	0.34	0.34	3.44	12.11	14.27	7.73	4.44	57.32
Montblanc	5	1	1.37	1.37	13.66	1.37	1.37	21.43	13.66	45.79
Montblanc	5	2	1.27	1.27	12.72	1.27	1.27	21.19	12.72	48.28
Montblanc	5	3	1.60	1.60	16.01	1.60	16.01	21.89	1.60	39.68
Montblanc	5	4	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Montblanc	5	5	1.67	1.67	16.67	1.67	18.31	41.68	16.67	1.67
Montblanc	6	1	1.48	1.48	14.78	1.48	14.78	49.76	14.78	1.48
Montblanc	6	2	2.08	2.08	20.84	2.08	20.84	47.90	2.08	2.08
Montblanc	6	3	1.61	1.61	16.11	1.61	16.11	45.24	16.11	1.61
Montblanc	6	4	5.88	5.88	5.88	5.88	5.88	58.82	5.88	5.88
Montblanc	6	5	2.17	2.17	21.65	2.17	21.65	45.87	2.17	2.17

10.2 Northeastern Africa

10.2.1 Morphometric Data

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Adi Arkay	1	1	0.23	5.43	2.58	2.08	104.4	18.5	81.9	31.1	1	0	8
Adi Arkay	1	2	0.21	5.74	2.54	2.08	100.5	18.2	80.5	27.5	4	0	9
Adi Arkay	1	3	0.19	4.65	2.62	1.93	114.7	20.3	78.6	32.8	0	0	0
Adi Arkay	1	4	0.13	4.42	2.54	1.89	119.8	19.9	81.3	33.0	0	2	8
Adi Arkay	1	5	0.19	4.65	2.54	1.85	105.6	19.7	81.5	27.8	3	0	9
Adi Arkay	1	6	0.15	4.57	2.50	1.93	106.9	18.2	79.7	28.9	4	0	9
Adi Arkay	1	7	0.19	4.34	2.54	1.89	110.2	20.2	81.9	31.9	2	0	9
Adi Arkay	1	8	0.21	4.50	2.54	1.85	108.1	17.8	85.8	40.4	0	0	0
Adi Arkay	1	9	0.23	4.81	2.54	1.96	113.7	18.1	82.4	30.1	2	0	9
Adi Arkay	1	10	0.25	4.42	2.43	1.93	102.4	24.5	90.4	27.1	0	0	1
Adi Arkay	1	11	0.17	5.81	2.54	2.00	113.4	18.2	79.8	29.9	4	0	9
Adi Arkay	1	12	0.21	4.50	2.46	1.89	105.7	22.1	80.5	40.6	4	0	9
Adi Arkay	1	13	0.21	4.57	2.58	1.85	103.5	25.9	86.5	34.3	4	0	9
Adi Arkay	1	14	0.21	4.42	2.39	2.04	111.6	17.2	79.1	32.2	5	0	9
Adi Arkay	1	15	0.17	4.50	2.50	1.93	106.2	21.1	86.5	34.5	1	0	8
Adi Arkay	1	16	0.21	4.42	2.62	1.93	113.6	21.1	87.2	31.7	0	0	5
Adi Arkay	1	17	0.19	4.57	2.66	2.00	107.5	20.6	83.9	30.4	1	0	7
Adi Arkay	1	18	0.19	4.34	2.62	1.89	112.7	19.2	79.5	33.6	2	0	9
Adi Arkay	1	19	0.17	4.34	2.50	1.89	108.5	24.0	80.6	33.4	0	0	0
Adi Arkay	1	20	0.15	4.57	2.58	1.96	104.8	19.6	82.7	26.9	4	0	9
Adi Arkay	2	1	0.21	4.42	2.58	2.16	102.7	21.2	81.6	35.4	5	0	9
Adi Arkay	2	2	0.15	4.50	2.58	1.96	108.8	19.5	76.9	33.5	5	0	9
Adi Arkay	2	3	0.17	4.65	2.62	2.04	105.1	19.8	81.7	41.4	5	0	9
Adi Arkay	2	4	0.21	4.65	2.46	2.08	111.0	13.6	71.2	33.7	5	0	9
Adi Arkay	2	5	0.19	4.65	2.50	1.89	106.5	16.2	78.2	29.7	5	0	9
Adi Arkay	2	6	0.15	5.74	2.23	2.08	109.4	21.7	79.5	36.4	0	0	0
Adi Arkay	2	7	0.21	4.50	2.62	2.00	103.7	19.2	80.2	33.5	4	0	9
Adi Arkay	2	8	0.17	4.65	2.66	2.12	98.9	20.1	84.1	37.1	5	0	0
Adi Arkay	2	9	0.19	4.65	2.50	1.96	105.5	20.4	77.9	36.9	5	0	9
Adi Arkay	2	10	0.19	4.57	2.58	2.08	99.4	18.4	81.5	34.2	5	0	9
Adi Arkay	2	11	0.17	4.73	2.70	2.12	104.7	17.0	68.8	31.4	5	0	5
Adi Arkay	2	12	0.15	4.42	2.58	1.89	104.0	20.1	79.0	36.1	6	0	9
Adi Arkay	2	13	0.21	4.42	2.50	2.00	99.4	17.6	77.4	37.0	0	0	0
Adi Arkay	2	14	0.15	4.50	2.50	2.04	104.7	15.4	73.2	26.4	5	0	9
Adi Arkay	2	15	0.13	5.97	2.66	2.00	100.5	19.3	73.2	32.9	5	0	9
Adi Arkay	2	16	0.17	4.50	2.62	1.89	101.7	21.2	82.9	34.2	0	0	0
Adi Arkay	2	17	0.17	4.65	2.62	2.00	111.1	16.0	71.3	31.6	4	0	9
Adi Arkay	2	18	0.15	5.74	2.66	2.00	108.5	19.3	77.7	36.5	5	0	9
Adi Arkay	2	19	0.21	4.42	2.54	2.08	103.2	16.8	77.8	36.4	5	0	9
Adi Arkay	2	20	0.19	4.50	2.50	1.96	102.9	17.7	74.7	35.5	0	0	0
Adi Arkay	3	1	0.15	4.34	2.54	2.08	100.9	17.3	81.7	37.4	4	0	9
Adi Arkay	3	2	0.13	4.50	2.62	2.08	104.6	13.7	79.1	33.4	1	0	9
Adi Arkay	3	3	0.17	4.65	2.62	2.00	106.5	20.1	80.4	34.6	4	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Adi Arkay	3	4	0.19	4.34	2.50	2.16	99.9	19.7	82.8	34.0	4	0	9
Adi Arkay	3	5	0.15	4.65	2.62	1.96	107.4	18.2	81.0	33.9	4	0	9
Adi Arkay	3	6	0.17	4.50	2.54	2.12	100.3	21.9	78.0	32.0	4	0	9
Adi Arkay	3	7	0.15	4.50	2.58	2.12	100.1	18.3	82.8	42.9	4	0	9
Adi Arkay	3	8	0.19	4.57	2.62	2.08	105.0	17.5	73.6	37.6	0	0	0
Adi Arkay	3	9	0.15	5.50	2.66	2.12	109.9	15.7	81.7	34.4	4	0	8
Adi Arkay	3	10	0.17	4.19	2.54	2.04	98.6	16.6	74.1	39.3	5	0	9
Adi Arkay	3	11	0.19	4.50	2.58	2.12	90.6	17.7	82.0	37.4	1	0	9
Adi Arkay	3	12	0.25	4.50	2.54	2.08	106.3	14.5	75.7	29.0	5	0	9
Adi Arkay	3	13	0.19	4.57	2.70	2.12	106.8	16.0	75.2	36.1	2	0	8
Adi Arkay	3	14	0.15	4.57	2.62	2.04	98.6	19.1	79.1	32.8	2	0	9
Adi Arkay	3	15	0.17	4.34	2.58	1.85	100.0	18.6	77.3	30.1	4	0	8
Adi Arkay	3	16	0.15	4.42	2.54	2.04	107.9	16.4	80.6	36.0	2	0	9
Adi Arkay	3	17	0.17	4.50	2.62	2.04	109.7	18.9	77.9	38.0	0	0	0
Adi Arkay	3	18	0.19	4.42	2.54	2.00	109.3	19.8	90.2	38.3	4	0	9
Adi Arkay	3	19	0.13	4.42	2.62	2.04	101.7	16.4	79.5	31.6	4	0	9
Adi Arkay	3	20	0.15	4.26	2.50	2.08	103.2	12.9	71.9	32.5	4	0	9
Adi Arkay	4	1	0.13	4.65	2.62	2.12	108.9	18.4	85.4	31.9	4	0	9
Adi Arkay	4	2	0.21	4.81	2.66	2.08	110.3	19.8	83.5	32.6	0	0	1
Adi Arkay	4	3	0.19	4.42	2.58	2.08	107.6	19.8	80.1	32.6	5	0	9
Adi Arkay	4	4	0.21	4.57	2.70	2.19	114.7	15.3	75.3	28.2	0	0	2
Adi Arkay	4	5	0.19	4.50	2.73	2.08	103.0	18.6	76.3	30.0	4	0	8
Adi Arkay	4	6	0.15	4.57	2.62	2.00	108.4	18.3	80.8	32.2	1	0	8
Adi Arkay	4	7	0.21	4.57	2.62	2.04	105.3	17.7	78.0	28.6	4	0	9
Adi Arkay	4	8	0.27	4.73	2.70	2.08	108.5	13.6	80.9	32.8	0	0	9
Adi Arkay	4	9	0.17	6.05	2.54	2.04	101.9	17.2	84.0	28.1	2	0	4
Adi Arkay	4	10	0.19	4.34	2.62	1.96	111.0	19.0	80.4	30.1	2	0	9
Adi Arkay	4	11	0.21	4.96	2.62	2.08	110.2	17.1	79.7	31.3	4	0	9
Adi Arkay	4	12	0.21	4.73	2.62	2.12	104.4	20.9	81.9	25.6	4	0	8
Adi Arkay	4	13	0.15	4.42	2.54	2.00	113.3	19.3	84.2	31.2	0	0	0
Adi Arkay	4	14	0.15	4.73	2.58	2.04	99.0	18.6	85.2	29.0	0	0	1
Adi Arkay	4	15	0.17	4.73	2.62	2.12	107.9	18.2	88.4	31.2	2	0	9
Adi Arkay	4	16	0.21	4.65	2.70	2.04	105.7	16.5	77.6	28.7	4	0	8
Adi Arkay	4	17	0.21	4.65	2.70	2.04	103.4	19.4	83.4	32.1	0	0	0
Adi Arkay	4	18	0.23	4.34	2.54	1.93	103.2	20.4	73.7	30.8	0	0	0
Adi Arkay	4	19	0.17	4.65	2.62	2.00	103.8	18.0	78.6	30.0	4	0	9
Adi Arkay	4	20	0.13	5.19	2.70	2.16	99.3	18.3	82.2	30.2	4	0	9
Adi Arkay	5	1	0.19	4.42	2.46	1.93	95.3	18.6	80.8	32.6	4	0	9
Adi Arkay	5	2	0.15	4.50	2.46	1.93	104.6	18.6	82.8	34.7	6	0	9
Adi Arkay	5	3	0.15	4.57	2.46	1.85	97.0	19.3	83.6	24.1	0	0	0
Adi Arkay	5	4	0.27	4.26	2.46	2.00	95.2	20.7	83.0	30.8	5	0	9
Adi Arkay	5	5	0.21	4.34	2.43	1.93	93.9	19.3	84.3	33.8	0	0	0
Adi Arkay	5	6	0.13	4.57	2.43	1.96	99.7	20.1	86.3	34.3	5	0	9
Adi Arkay	5	7	0.17	4.42	2.46	1.89	85.1	20.1	87.6	30.7	5	0	9
Adi Arkay	5	8	0.21	4.34	2.39	1.89	101.6	24.0	84.7	34.3	4	0	9
Adi Arkay	5	9	0.15	5.58	2.39	1.89	90.3	19.5	82.9	25.8	5	0	9
Adi Arkay	5	10	0.17	4.34	2.50	1.89	97.7	19.1	81.6	31.4	4	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Adi Arkay	5	11	0.17	4.57	2.46	1.93	101.0	20.9	84.8	31.2	5	0	9
Adi Arkay	5	12	0.17	4.50	2.50	2.04	90.8	23.0	89.2	36.4	5	0	9
Adi Arkay	5	13	0.21	4.42	2.54	2.08	93.1	24.0	85.4	29.0	5	0	9
Adi Arkay	5	14	0.13	4.57	2.50	1.77	92.1	19.7	78.2	32.4	5	0	8
Adi Arkay	5	15	0.15	4.96	2.39	1.96	91.1	20.5	85.9	32.9	5	0	9
Adi Arkay	5	16	0.19	4.88	2.46	1.89	108.5	21.0	86.3	39.7	0	1	1
Adi Arkay	5	17	0.19	4.34	2.43	1.85	112.0	21.1	86.3	29.3	0	0	0
Adi Arkay	5	18	0.15	4.34	2.50	1.96	106.6	18.7	83.9	26.6	4	0	9
Adi Arkay	5	19	0.15	4.42	2.46	1.96	90.9	21.6	86.4	35.7	5	0	9
Adi Arkay	5	20	0.21	4.42	2.46	2.08	114.7	17.1	86.3	26.7	4	0	8
Gonder	1	1	0.19	4.73	2.66	2.12	107.5	18.3	76.1	30.8	6	0	8
Gonder	1	2	0.25	4.57	2.73	2.08	104.2	18.7	80.2	29.3	5	0	8
Gonder	1	3	0.21	4.73	2.70	2.16	95.1	16.4	79.9	30.1	5	0	9
Gonder	1	4	0.21	4.65	2.73	2.12	103.6	17.7	82.9	28.8	5	0	8
Gonder	1	5	0.19	4.73	2.66	2.08	112.4	16.5	80.9	27.3	4	0	8
Gonder	1	6	0.21	4.65	2.73	2.08	96.7	18.9	78.8	30.4	6	0	7
Gonder	1	7	0.21	4.57	2.77	2.16	100.6	18.2	85.4	28.1	8	0	8
Gonder	1	8	0.19	4.73	2.70	2.23	108.6	19.1	77.5	30.6	5	0	8
Gonder	1	9	0.17	4.88	2.66	2.04	109.0	19.8	88.4	36.5	4	0	9
Gonder	1	10	0.19	4.65	2.77	2.16	111.8	15.3	73.8	28.3	8	0	9
Gonder	1	11	0.25	4.73	2.70	2.08	105.7	18.7	85.2	33.0	4	0	9
Gonder	1	12	0.17	4.73	2.62	2.08	114.3	18.8	82.1	35.8	5	0	9
Gonder	1	13	0.19	4.81	2.77	2.16	110.7	15.9	80.7	27.8	6	0	9
Gonder	1	14	0.19	4.73	2.73	2.16	111.2	20.6	86.8	35.2	5	0	8
Gonder	1	15	0.25	4.81	2.81	2.19	107.3	18.9	74.8	32.4	5	0	8
Gonder	1	16	0.19	4.96	2.77	2.19	103.3	18.9	75.8	31.8	6	0	9
Gonder	1	17	0.15	5.50	2.66	2.04	105.1	18.2	80.5	26.3	6	0	9
Gonder	1	18	0.23	4.81	2.81	2.19	99.5	17.8	80.4	32.3	4	0	9
Gonder	1	19	0.19	4.81	2.70	2.12	99.3	20.0	79.6	34.0	4	0	8
Gonder	1	20	0.19	5.04	2.81	2.19	107.7	17.1	75.4	33.8	6	0	9
Gonder	2	1	0.23	4.81	2.77	2.23	108.5	18.5	79.7	40.3	0	0	0
Gonder	2	2	0.15	4.88	2.73	2.23	96.1	22.2	82.1	37.3	2	0	9
Gonder	2	3	0.19	4.81	2.73	2.16	108.7	16.9	72.0	36.5	2	0	8
Gonder	2	4	0.17	4.65	2.70	2.08	109.6	21.4	82.3	30.4	0	0	0
Gonder	2	5	0.21	4.73	2.70	2.12	108.9	19.5	79.9	43.0	0	0	0
Gonder	2	6	0.19	4.65	2.70	2.08	104.7	18.5	75.8	33.5	0	0	0
Gonder	2	7	0.23	4.73	2.73	2.19	109.7	16.9	79.8	41.9	0	0	0
Gonder	2	8	0.21	4.81	2.58	2.08	108.8	24.1	84.4	29.2	0	0	0
Gonder	2	9	0.19	5.12	2.73	2.27	110.6	18.2	78.5	34.0	0	0	0
Gonder	2	10	0.17	4.65	2.66	2.00	94.3	21.4	83.6	30.2	0	0	0
Gonder	2	11	0.17	4.73	2.81	2.27	108.6	17.5	81.2	40.7	2	0	8
Gonder	2	12	0.17	4.88	2.70	2.12	108.8	19.1	77.2	37.8	0	0	0
Gonder	2	13	0.25	5.97	2.70	2.12	109.9	24.6	81.3	28.8	0	0	0
Gonder	2	14	0.17	5.97	2.73	2.16	108.2	19.3	80.7	36.8	0	0	0
Gonder	2	15	0.21	4.73	2.62	2.12	116.8	19.0	75.9	28.7	0	0	0
Gonder	2	16	0.19	4.57	2.73	2.19	105.6	19.6	77.9	36.3	2	0	0
Gonder	2	17	0.19	4.73	2.73	2.12	113.7	22.1	85.1	36.4	0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Gonder	2	18	0.25	5.97	2.73	2.12	109.1	16.8	73.2	31.3	1	0	0
Gonder	2	19	0.21	5.74	2.73	1.96	93.4	17.6	78.4	34.0	0	0	0
Gonder	2	20	0.21	5.66	2.70	2.19	104.9	17.5	76.0	36.9	4	0	9
Gonder	3	1	0.23	4.57	2.70	2.19	104.7	19.4	77.0	34.6	0	0	0
Gonder	3	2	0.21	4.81	2.62	2.12	108.6	17.3	75.1	33.1	0	0	0
Gonder	3	3	0.19	4.65	2.62	2.00	107.9	20.9	75.2	35.5	0	0	0
Gonder	3	4	0.25	4.65	2.70	2.12	106.9	19.2	73.3	27.7	4	0	9
Gonder	3	5	0.19	4.73	2.73	2.16	116.3	16.2	70.2	37.6	0	0	0
Gonder	3	6	0.25	4.73	2.70	2.16	115.9	17.8	78.3	32.3	0	0	0
Gonder	3	7	0.17	4.65	2.62	2.16	112.1	18.1	71.6	37.5	0	0	0
Gonder	3	8	0.25	4.57	2.66	2.04	91.0	18.8	74.3	36.4	2	0	9
Gonder	3	9	0.19	5.04	2.81	2.12	105.5	20.4	76.5	31.7	4	0	9
Gonder	3	10	0.25	4.65	2.62	2.08	106.1	17.6	72.2	36.3	6	0	9
Gonder	3	11	0.29	5.66	2.73	2.08	107.6	20.8	79.7	30.5	5	0	9
Gonder	3	12	0.25	4.42	2.62	2.04	110.1	18.8	77.4	35.9	0	0	0
Gonder	3	13	0.27	4.65	2.73	2.16	100.2	16.3	72.1	33.0	4	0	9
Gonder	3	14	0.21	4.65	2.73	2.12	107.5	15.5	73.5	33.0	0	0	0
Gonder	3	15	0.21	4.73	2.70	2.16	105.3	19.9	83.2	31.8	0	0	0
Gonder	3	16	0.21	5.35	2.70	2.12	116.8	17.9	79.6	35.8	0	0	0
Gonder	3	17	0.23	4.65	2.70	2.12	106.8	22.9	83.6	36.2	5	0	9
Gonder	3	18	0.17	4.88	2.66	2.16	101.4	20.8	77.2	34.0	5	0	9
Gonder	3	19	0.17	4.88	2.73	2.08	115.6	14.8	76.1	40.7	0	0	0
Gonder	3	20	0.19	4.73	2.62	2.00	105.9	16.7	77.4	30.5	2	0	8
Gonder	4	1	0.19	4.65	2.58	2.12	110.7	16.8	74.1	32.9	4	0	8
Gonder	4	2	0.19	4.65	2.62	2.08	103.0	17.0	71.6	35.5	0	0	0
Gonder	4	3	0.17	4.65	2.58	2.04	108.0	17.1	79.9	33.8	6	0	9
Gonder	4	4	0.17	4.73	2.66	2.00	105.8	17.8	79.7	39.7	4	0	9
Gonder	4	5	0.15	4.57	2.62	2.04	106.6	15.7	73.9	31.6	0	0	0
Gonder	4	6	0.21	4.65	2.70	2.16	112.1	18.2	82.2	32.5	4	2	8
Gonder	4	7	0.17	4.73	2.62	2.08	112.1	17.9	81.0	29.3	4	0	9
Gonder	4	8	0.25	4.81	2.54	2.08	115.4	19.5	80.8	35.3	0	0	0
Gonder	4	9	0.19	4.88	2.62	2.16	103.7	17.0	75.2	37.1	0	0	0
Gonder	4	10	0.15	4.65	2.62	2.08	104.0	18.8	81.3	33.9	0	0	0
Gonder	4	11	0.19	4.57	2.62	2.12	103.8	18.1	81.5	31.2	4	0	0
Gonder	4	12	0.19	4.57	2.54	2.04	106.2	16.9	71.0	27.5	0	0	0
Gonder	4	13	0.15	4.73	2.58	2.16	103.5	18.2	77.6	35.0	0	0	0
Gonder	4	14	0.19	4.81	2.62	2.23	115.9	18.3	89.7	29.7	0	0	0
Gonder	4	15	0.13	4.81	2.62	2.04	97.3	18.8	80.7	35.7	4	0	8
Gonder	4	16	0.17	4.57	2.73	2.16	116.2	17.5	85.5	36.8	0	0	0
Gonder	4	17	0.21	4.88	2.62	2.12	107.5	15.6	87.1	33.2	4	0	8
Gonder	4	18	0.19	5.97	2.62	2.04	107.3	17.0	79.5	32.8	4	0	8
Gonder	4	19	0.21	4.57	2.50	2.08	113.8	17.7	79.6	34.8	0	0	0
Gonder	4	20	0.21	4.65	2.66	2.12	110.1	16.3	78.1	39.2	4	0	9
Gonder	5	1	0.21	4.57	2.58	2.04	103.8	19.0	74.7	32.5	0	0	0
Gonder	5	2	0.21	4.96	2.50	2.08	101.2	20.0	80.2	35.7	0	0	0
Gonder	5	3	0.19	4.65	2.62	2.04	102.4	23.3	87.3	34.2	0	0	0
Gonder	5	4	0.17	4.81	2.58	2.00	105.9	24.6	86.1	35.7	0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Gonder	5	5	0.19	4.73	2.66	2.16	111.6	19.2	80.4	40.7	0	0	0
Gonder	5	6	0.23	4.73	2.73	2.23	108.4	20.6	87.1	34.1	0	0	0
Gonder	5	7	0.19	4.65	2.54	2.04	107.6	20.7	81.8	28.1	0	0	0
Gonder	5	8	0.21	5.04	2.70	2.12	101.9	24.5	86.2	27.6	0	0	0
Gonder	5	9	0.21	4.73	2.35	2.12	106.5	22.1	86.4	32.4	0	0	0
Gonder	5	10	0.21	4.88	2.58	2.04	114.9	21.8	86.0	29.9	0	0	0
Gonder	5	11	0.27	4.57	2.54	2.04	103.5	23.0	87.2	33.0	0	0	0
Gonder	5	12	0.19	4.73	2.70	2.16	104.3	18.6	91.7	30.9	0	0	0
Gonder	5	13	0.23	4.65	2.70	2.08	102.0	20.5	80.0	32.8	0	0	0
Gonder	5	14	0.27	4.65	2.70	2.08	107.7	21.3	83.4	34.6	2	0	8
Gonder	5	15	0.17	4.88	2.62	2.16	101.2	19.4	80.3	32.7	0	0	0
Gonder	5	16	0.23	4.81	2.70	2.19	112.8	25.1	86.2	29.0	0	0	0
Gonder	5	17	0.21	4.57	2.54	2.08	102.6	18.6	81.6	34.3	0	0	0
Gonder	5	18	0.19	4.81	2.58	2.08	113.2	23.4	84.4	32.4	0	0	0
Gonder	5	19	0.23	4.50	2.62	2.04	111.2	22.1	86.4	34.7	0	0	0
Gonder	5	20	0.27	4.81	2.70	2.12	114.8	23.1	83.2	30.6	0	0	0
Gonder	6	1	0.19	5.97	2.70	2.23	102.9	17.4	87.5	31.4	2	0	8
Gonder	6	2	0.25	4.81	2.70	2.12	106.6	17.1	83.0	37.4	2	0	8
Gonder	6	3	0.21	4.81	2.70	2.19	106.4	17.3	85.5	32.2	1	0	8
Gonder	6	4	0.23	4.88	2.81	2.23	107.2	21.3	80.2	40.5	0	0	0
Gonder	6	5	0.19	4.73	2.70	2.08	98.6	21.9	82.4	26.8	0	0	0
Gonder	6	6	0.17	4.81	2.77	2.23	108.5	19.6	84.7	35.8	0	0	0
Gonder	6	7	0.15	6.05	2.73	2.16	111.2	20.1	80.2	29.2	0	0	0
Gonder	6	8	0.17	5.97	2.66	2.16	110.2	18.3	84.4	29.2	0	0	0
Gonder	6	9	0.21	4.65	2.58	2.16	113.9	20.7	83.5	32.2	0	0	0
Gonder	6	10	0.17	4.81	2.73	2.23	105.4	22.8	87.2	36.1	2	0	9
Gonder	6	11	0.19	5.66	2.70	2.00	92.9	16.9	86.1	33.5	0	0	0
Gonder	6	12	0.13	5.89	2.66	2.08	96.6	21.1	80.6	32.1	0	0	0
Gonder	6	13	0.25	4.65	2.70	2.08	100.4	18.8	84.2	36.6	2	0	8
Gonder	6	14	0.17	5.74	2.70	2.12	91.1	18.2	79.4	26.2	0	0	1
Gonder	6	15	0.17	4.73	2.73	2.12	94.1	18.7	81.9	30.2	5	0	8
Gonder	6	16	0.27	6.12	2.77	2.19	104.2	19.5	86.6	30.2	5	0	8
Gonder	6	17	0.21	4.57	2.73	2.12	102.7	19.5	78.4	27.1	2	0	7
Gonder	6	18	0.29	4.81	2.73	2.16	112.7	14.8	74.3	33.5	0	0	0
Gonder	6	19	0.15	4.73	2.70	2.12	102.8	17.5	82.2	34.2	0	0	0
Gonder	6	20	0.17	4.81	2.85	2.19	110.1	19.1	78.8	25.5	2	0	8
Bahir Dar	1	1	0.17	4.50	2.70	2.04	105.2	18.0	84.3	40.7	2	0	8
Bahir Dar	1	2	0.23	4.50	2.58	2.04	114.0	21.9	85.2	31.6	2	0	7
Bahir Dar	1	3	0.21	4.50	2.62	2.00	103.3	18.7	85.4	40.6	2	0	8
Bahir Dar	1	4	0.17	4.57	2.62	2.04	103.9	17.4	86.8	40.0	0	0	0
Bahir Dar	1	5	0.21	4.73	2.62	2.04	98.5	19.3	81.2	35.6	0	0	0
Bahir Dar	1	6	0.27	4.65	2.54	2.19	102.3	18.9	82.7	33.2	4	0	8
Bahir Dar	1	7	0.17	4.50	2.62	1.96	109.5	18.8	84.4	38.2	0	0	0
Bahir Dar	1	8	0.21	4.65	2.43	2.08	100.9	20.9	78.2	38.5	0	0	0
Bahir Dar	1	9	0.17	4.73	2.66	2.04	112.3	20.7	84.7	37.9	0	0	0
Bahir Dar	1	10	0.27	4.50	2.54	2.04	98.7	20.4	79.5	44.5	4	0	8
Bahir Dar	1	11	0.17	4.65	2.62	2.08	107.7	19.3	80.9	41.4	0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Bahir Dar	1	12	0.21	4.73	2.66	2.08	111.8	22.5	82.1	40.7	4	0	8
Bahir Dar	1	13	0.19	4.73	2.46	2.04	110.8	17.4	86.0	34.4	4	0	8
Bahir Dar	1	14	0.21	4.57	2.54	2.04	115.9	18.1	81.4	37.2	4	0	9
Bahir Dar	1	15	0.17	4.34	2.58	2.08	105.8	24.1	83.3	38.3	0	0	0
Bahir Dar	1	16	0.17	4.50	2.54	2.04	94.8	18.6	80.7	38.8	2	0	8
Bahir Dar	1	17	0.15	4.73	2.50	2.08	104.4	20.8	84.3	32.5	0	0	0
Bahir Dar	1	18	0.17	4.81	2.66	2.04	107.4	23.5	87.6	38.2	2	0	9
Bahir Dar	1	19	0.17	4.73	2.58	2.04	109.8	18.1	84.6	40.1	4	0	8
Bahir Dar	1	20	0.17	4.50	2.66	2.00	106.4	23.2	88.1	43.9	0	0	0
Bahir Dar	2	1	0.21	4.65	2.54	2.08	95.5	22.1	84.0	34.5	0	0	4
Bahir Dar	2	2	0.13	6.12	2.43	2.04	105.2	20.4	81.3	29.6	0	0	4
Bahir Dar	2	3	0.17	4.73	2.50	2.04	100.4	16.7	80.8	36.2	0	0	4
Bahir Dar	2	4	0.17	5.81	2.50	2.04	106.4	14.8	79.6	34.3	9	0	9
Bahir Dar	2	5	0.21	4.65	2.31	1.93	98.4	18.0	81.8	34.5	6	0	9
Bahir Dar	2	6	0.15	4.57	2.50	2.00	100.0	20.6	77.4	34.0	0	0	4
Bahir Dar	2	7	0.17	4.57	2.54	2.04	105.9	17.8	83.4	27.9	0	0	4
Bahir Dar	2	8	0.23	4.42	2.50	2.08	100.2	18.8	77.9	37.3	0	0	4
Bahir Dar	2	9	0.19	4.57	2.46	1.96	108.3	15.6	83.4	36.3	0	0	4
Bahir Dar	2	10	0.21	4.50	2.35	2.00	107.0	18.5	82.9	38.9	0	0	4
Bahir Dar	2	11	0.21	4.50	2.39	2.00	105.9	15.8	76.6	37.3	0	0	4
Bahir Dar	2	12	0.19	4.81	2.54	2.00	95.5	21.1	84.9	34.9	0	0	4
Bahir Dar	2	13	0.23	4.73	2.66	2.04	97.2	23.1	84.4	39.4	0	0	0
Bahir Dar	2	14	0.19	4.65	2.62	2.08	101.6	20.2	83.1	27.5	4	0	8
Bahir Dar	2	15	0.19	4.73	2.58	2.08	96.9	18.9	81.9	39.9	0	0	4
Bahir Dar	2	16	0.21	4.73	2.43	2.04	103.0	17.3	79.1	36.9	0	0	4
Bahir Dar	2	17	0.17	4.65	2.54	2.08	99.6	16.0	81.3	34.7	0	0	4
Bahir Dar	2	18	0.17	4.88	2.46	2.04	110.7	19.2	81.9	33.0	0	0	0
Bahir Dar	2	19	0.19	4.81	2.62	2.08	98.1	18.7	84.2	30.0	0	0	0
Bahir Dar	2	20	0.19	4.73	2.46	2.04	108.1	17.3	82.9	33.5	5	0	8
Bahir Dar	3	1	0.23	4.57	2.50	2.04	107.3	18.0	77.1	35.9	5	0	8
Bahir Dar	3	2	0.23	4.65	2.50	2.00	103.7	16.9	74.8	35.5	5	0	8
Bahir Dar	3	3	0.21	4.42	2.54	2.08	96.7	16.9	84.0	35.6	0	0	0
Bahir Dar	3	4	0.19	4.81	2.50	2.00	111.6	20.0	84.8	35.5	4	0	9
Bahir Dar	3	5	0.17	4.73	2.50	2.00	96.3	17.5	78.4	35.9	2	0	8
Bahir Dar	3	6	0.21	4.65	2.46	2.04	101.0	17.3	78.1	34.4	4	0	8
Bahir Dar	3	7	0.21	4.57	2.39	2.04	107.2	15.9	80.6	35.4	5	0	9
Bahir Dar	3	8	0.19	4.57	2.50	2.04	100.2	19.0	77.8	30.5	0	0	0
Bahir Dar	3	9	0.27	4.42	2.54	2.08	96.2	17.9	87.0	36.9	0	0	0
Bahir Dar	3	10	0.30	4.57	2.62	2.16	101.2	16.4	80.0	30.0	2	0	9
Bahir Dar	3	11	0.25	4.50	2.58	2.08	107.3	18.9	78.7	37.4	5	0	8
Bahir Dar	3	12	0.17	4.65	2.54	1.96	110.0	18.9	75.6	35.8	0	0	0
Bahir Dar	3	13	0.21	4.19	2.50	2.04	100.9	20.0	82.5	34.8	5	0	8
Bahir Dar	3	14	0.23	4.42	2.43	1.93	99.6	18.6	79.2	34.4	0	0	0
Bahir Dar	3	15	0.27	4.57	2.54	2.08	103.6	15.4	80.8	27.6	0	0	0
Bahir Dar	3	16	0.15	4.57	2.50	2.00	94.6	16.5	81.6	36.9	2	0	8
Bahir Dar	3	17	0.17	4.73	2.54	2.08	106.4	14.2	75.0	30.1	5	0	8
Bahir Dar	3	18	0.19	4.65	2.46	2.00	102.6	15.9	79.4	33.0	0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Bahir Dar	3	19	0.29	5.43	2.50	2.08	97.1	18.2	83.9	35.9	0	0	0
Bahir Dar	3	20	0.23	4.26	2.46	2.00	95.1	17.9	79.7	33.1	0	0	0
Bahir Dar	4	1	0.17	4.42	2.66	2.00		19.4	77.9	38.8	0	0	0
Bahir Dar	4	2	0.19	4.50	2.35	1.93	103.8	20.2	86.9	38.6	0	0	0
Bahir Dar	4	3	0.21	4.50	2.54	2.04	114.4	14.4	75.1	26.9	0	0	0
Bahir Dar	4	4	0.21	4.42	2.54	2.04	95.2	17.4	82.3	39.3	0	0	0
Bahir Dar	4	5	0.21	4.42	2.54	2.04	110.1	20.2	85.6	33.9	0	0	0
Bahir Dar	4	6	0.19	4.42	2.39	1.96	108.9	14.9	76.6	31.1	0	0	6
Bahir Dar	4	7	0.23	4.26	2.58	2.00	101.3	20.8	88.7	36.6	2	0	8
Bahir Dar	4	8	0.19	4.42	2.50	2.08	104.5	15.7	82.0	36.1	0	0	0
Bahir Dar	4	9	0.19	4.50	2.50	1.96	109.5	21.3	83.2	29.3	0	0	0
Bahir Dar	4	10	0.19	4.50	2.58	2.12	103.9	19.9	72.2	34.5	0	0	0
Bahir Dar	4	11	0.25	4.50	2.54	2.04	111.6	18.4	84.7	36.6	0	0	0
Bahir Dar	4	12	0.25	4.50	2.50	2.04	107.3	16.9	77.7	33.6	0	0	0
Bahir Dar	4	13	0.13	4.65	2.50	2.04	100.4	15.5	73.6	33.3	0	0	0
Bahir Dar	4	14	0.19	4.65	2.46	1.96	108.8	15.5	85.4	28.5	0	0	3
Bahir Dar	4	15	0.17	4.50	2.58	2.00	99.4	16.8	70.1	38.1	0	0	7
Bahir Dar	4	16	0.19	4.57	2.50	2.04	111.7	17.9	78.6	31.1	0	0	0
Bahir Dar	4	17	0.15	4.57	2.58	2.08	110.4	18.9	76.6	28.9	0	0	2
Bahir Dar	4	18	0.17	4.65	2.46	2.00	102.8	20.4	81.2	32.2	0	0	0
Bahir Dar	4	19	0.19	4.57	2.54	2.00	108.4	21.0	85.8	37.5	0	0	0
Bahir Dar	4	20	0.17	4.57	2.62	2.12	106.9	19.4	84.9	34.5	0	0	0
Bahir Dar	5	1	0.19	4.57	2.50	2.04	107.3	17.3	78.6	30.8	0	0	0
Bahir Dar	5	2	0.15	4.42	2.46	2.08	106.9	20.4	83.1	32.9	0	0	0
Bahir Dar	5	3	0.17	4.50	2.46	2.04	104.5	15.0	79.7	39.4	0	0	0
Bahir Dar	5	4	0.19	4.65	2.50	2.08		19.0	86.4	33.6	0	0	0
Bahir Dar	5	5	0.17	4.65	2.50	2.12	111.9	16.2	76.5	35.7	0	0	0
Bahir Dar	5	6	0.19	4.73	2.46	2.08	107.8	20.1	83.9	35.4	0	0	0
Bahir Dar	5	7	0.17	4.50	2.46	2.04	105.1	18.9	79.0	34.1	0	0	0
Bahir Dar	5	8	0.17	4.50	2.54	2.08	106.0	14.6	76.9	33.0	0	0	0
Bahir Dar	5	9	0.17	4.81	2.46	2.00	108.4	17.0	81.4	32.9	0	0	0
Bahir Dar	5	10	0.17	4.50	2.43	2.00	96.8	17.4	75.1	35.9	0	0	0
Bahir Dar	5	11	0.15	4.26	2.50	2.08	106.9	19.7	81.1	37.0	0	0	0
Bahir Dar	5	12	0.19	4.57	2.54	2.08	101.1	17.9	83.8	32.2	0	0	0
Bahir Dar	5	13	0.19	4.50	2.46	2.00	102.9	18.1	88.0	32.2	5	0	9
Bahir Dar	5	14	0.19	4.50	2.46	2.00	107.0	19.6	88.8	34.5	0	0	0
Bahir Dar	5	15	0.17	5.58	2.50	2.00	115.4	15.3	86.9	38.0	4	0	9
Bahir Dar	5	16	0.17	4.50	2.39	2.00	101.0	19.0	80.1	38.0	0	0	0
Bahir Dar	5	17	0.27	4.42	2.46	1.96	97.7	19.4	80.0	25.6	0	0	0
Bahir Dar	5	18	0.19	4.73	2.54	2.12	103.4	18.9	88.7	34.5	0	0	0
Bahir Dar	5	19	0.19	5.89	2.58	2.08	110.1	17.4	84.9	36.7	0	0	0
Bahir Dar	5	20	0.17	4.65	2.46	2.00	108.2	18.6	79.2	30.3	0	0	0
D. Markos	1	1	0.21	4.88	2.85	2.35	110.2	22.1	78.5	33.9	0	0	0
D. Markos	1	2	0.30	4.57	2.81	2.16	92.4	18.6	81.4	34.6	0	0	0
D. Markos	1	3	0.23	5.12	2.81	2.19	99.9	18.5	76.4	33.8	0	1	0
D. Markos	1	4	0.29	5.12	2.73	2.19	112.5	23.5	84.6	36.1	0	0	0
D. Markos	1	5	0.21	4.96	2.66	2.12	106.1	17.1	84.5	32.5	0	1	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
D. Markos	1	6	0.27	4.81	2.66	2.12	106.5	20.0	76.9	38.4	0	0	0
D. Markos	1	7	0.21	4.57	2.66	2.16	100.4	19.1	77.1	38.4	0	0	0
D. Markos	1	8	0.17	4.96	2.66	2.08	96.4	18.7	82.5	37.8	0	0	0
D. Markos	1	9	0.21	5.12	2.73	2.39	113.4	18.6	74.5	36.8	0	0	0
D. Markos	1	10	0.19	4.73	2.70	2.16	109.9	21.3	77.6	37.5	0	0	0
D. Markos	1	11	0.25	4.96	2.62	2.08	102.6	18.1	81.0	33.5	0	0	0
D. Markos	1	12	0.29	5.27	2.73	2.27	113.4	19.8	74.3	33.1	0	0	0
D. Markos	1	13	0.19	4.81	2.66	2.16	107.4	22.0	77.2	28.7	0	0	0
D. Markos	1	14	0.19	4.65	2.54	2.00	93.1	21.8	81.6	38.3	0	0	0
D. Markos	1	15	0.23	4.81	2.70	2.12	97.5	17.7	80.8	36.8	0	0	0
D. Markos	1	16	0.25	4.73	2.73	2.16	101.3	17.9	77.4	33.1	0	0	0
D. Markos	1	17	0.25	4.81	2.73	2.16	109.3	17.3	77.5	30.2	0	0	0
D. Markos	1	18	0.17	4.81	2.62	2.16	99.7	18.9	82.1	28.0	0	0	0
D. Markos	1	19	0.19	4.73	2.73	2.23	103.5	18.6	81.9	38.4	0	0	0
D. Markos	1	20	0.19	4.57	2.66	2.12	104.9	18.5	81.2	32.3	0	0	0
D. Markos	2	1	0.25	4.57	2.70	2.23	105.5	18.0	79.9	34.6	0	0	0
D. Markos	2	2	0.27	4.65	2.58	2.16	107.7	17.0	79.7	37.8	0	0	0
D. Markos	2	3	0.21	4.81	2.70	2.27	101.6	23.1	75.6	37.3	0	0	0
D. Markos	2	4	0.17	4.65	2.77	2.23	103.3	16.8	81.4	37.5	0	0	0
D. Markos	2	5	0.23	4.73	2.73	2.23	105.2	22.4	80.9	34.3	0	0	0
D. Markos	2	6	0.21	4.65	2.70	2.19	96.8	19.9	81.5	34.6	0	0	0
D. Markos	2	7	0.25	4.73	2.62	2.19	97.2	17.2	80.0	34.3	0	0	0
D. Markos	2	8	0.29	4.73	2.66	2.19	106.5	20.6	83.8	34.3	0	0	0
D. Markos	2	9	0.27	4.65	2.66	2.12	105.3	18.9	79.7	32.3	0	0	0
D. Markos	2	10	0.17	4.65	2.66	2.23	104.3	20.5	83.1	37.8	0	0	0
D. Markos	2	11	0.17	4.96	2.70	2.23	102.3	17.2	84.0	35.8	0	0	0
D. Markos	2	12	0.21	5.04	2.70	2.27	101.9	16.5	78.1	37.9	0	0	0
D. Markos	2	13	0.19	5.04	2.73	2.27	100.9	17.1	83.5	33.7	0	0	0
D. Markos	2	14	0.27	4.65	2.58	2.12	105.1	22.1	88.2	29.2	0	0	0
D. Markos	2	15	0.23	4.88	2.58	2.19	102.8	21.7	77.4	37.9	0	0	0
D. Markos	2	16	0.23	4.96	2.73	2.16	101.3	16.1	82.6	34.5	0	0	0
D. Markos	2	17	0.27	4.65	2.70	2.23	111.1	16.7	80.4	34.0	0	0	0
D. Markos	2	18	0.25	4.96	2.73	2.23	114.4	24.6	88.3	40.7	0	0	0
D. Markos	2	19	0.19	4.73	2.66	2.23	98.9	18.2	76.5	40.8	0	0	0
D. Markos	2	20	0.25	4.88	2.66	2.19	116.6	22.5	89.7	38.3	0	0	0
D. Markos	3	1	0.21	4.42	2.58	2.12	93.1	18.5	84.9	30.5	0	0	0
D. Markos	3	2	0.21	4.81	2.73	2.08	107.6	20.7	88.6	35.4	0	0	0
D. Markos	3	3	0.21	4.81	2.66	2.12	105.8	21.6	86.2	35.3	0	0	0
D. Markos	3	4	0.17	6.12	2.58	2.04	88.9	18.0	87.8	32.7	0	0	0
D. Markos	3	5	0.25	6.05	2.73	2.19	108.2	23.8	86.7	31.9	0	0	0
D. Markos	3	6	0.17	5.97	2.66	2.16	100.1	21.1	85.4	36.5	0	0	0
D. Markos	3	7	0.25	4.73	2.70	2.19	100.7	21.6	82.6	36.1	0	0	0
D. Markos	3	8	0.15	4.96	2.66	2.27	104.3	17.5	79.2	28.1	0	0	0
D. Markos	3	9	0.23	5.81	2.62	2.12	100.2	22.6	86.3	28.6	0	0	0
D. Markos	3	10	0.29	4.65	2.66	2.08	103.5	23.6	84.0	28.9	0	0	0
D. Markos	3	11	0.25	5.74	2.66	2.12	102.6	19.9	88.3	32.4	0	0	0
D. Markos	3	12	0.19	5.74	2.73	2.16	100.6	24.5	84.5	36.7	0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
D. Markos	3	13	0.21	4.96	2.54	2.08	104.6	16.0	81.0	33.3	0	0	0
D. Markos	3	14	0.17	5.89	2.70	2.19	93.6	20.4	84.2	34.9	0	0	0
D. Markos	3	15	0.25	4.65	2.70	2.12	107.9	21.1	84.6	29.5	0	0	0
D. Markos	3	16	0.29	4.73	2.66	2.23	98.2	21.9	81.7	36.7	0	0	0
D. Markos	3	17	0.23	4.88	2.58	2.08	95.0	20.3	85.3	34.7	0	0	0
D. Markos	3	18	0.21	5.81	2.77	2.27	98.9	23.3	88.1	34.7	0	0	0
D. Markos	3	19	0.21	4.73	2.73	2.04	105.0	25.6	83.4	31.8	0	0	0
D. Markos	4	1	0.19	4.73	2.70	2.12	106.6	23.9	84.7	32.2	0	0	0
D. Markos	4	2	0.21	4.81	2.62	2.08	90.0	23.2	86.2	27.7	0	0	0
D. Markos	4	3	0.23	4.81	2.66	2.16	109.2	19.8	77.7	34.6	0	0	0
D. Markos	4	4	0.27	4.81	2.70	2.27	116.1	22.1	87.7	35.4	0	0	0
D. Markos	4	5	0.17	4.57	2.58	2.04	98.0	19.5	82.1	34.3	0	0	0
D. Markos	4	6	0.23	4.88	2.66	2.19	105.4	18.9	81.6	31.4	0	0	0
D. Markos	4	7	0.25	4.65	2.54	2.12	108.8	21.1	81.8	36.5	0	0	0
D. Markos	4	8	0.17	5.97	2.73	2.16	111.9	22.1	81.1	36.7	2	0	7
D. Markos	4	9	0.21	4.73	2.73	2.19	100.8	24.7	89.1	37.8	0	0	0
D. Markos	4	10	0.27	4.65	2.66	2.12	106.6	20.4	82.3	36.6	0	0	0
D. Markos	4	11	0.21	4.81	2.62	2.16	112.6	20.8	84.6	35.1	0	0	0
D. Markos	4	12	0.19	4.65	2.62	2.12	103.6	24.6	82.0	34.1	0	0	0
D. Markos	4	13	0.19	5.97	2.66	2.04	101.4	20.8	83.4	37.6	0	0	0
D. Markos	4	14	0.21	4.65	2.73	2.16	106.5	21.7	82.4	30.9	0	0	0
D. Markos	4	15	0.21	4.96	2.58	2.04	115.8	22.1	86.0	34.0	0	0	0
D. Markos	4	16	0.25	4.88	2.66	2.12	111.1	18.2	83.3	36.4	4	0	8
D. Markos	4	17	0.29	5.04	2.66	2.16	104.5	22.3	81.9	39.4	0	0	0
D. Markos	4	18	0.30	6.05	2.70	2.16	95.4	21.9	81.2	38.5	0	0	0
D. Markos	4	19	0.23	6.05	2.66	2.27	99.3	18.3	83.2	43.2	0	0	0
D. Markos	4	20	0.25	4.81	2.66	2.12	87.6	20.6	80.1	35.1	0	0	0
D. Markos	5	1	0.25	4.65	2.73	2.23	106.6	21.0	77.3	37.3	0	0	0
D. Markos	5	2	0.19	5.89	2.73	2.23	108.2	21.5	80.5	39.1	0	0	0
D. Markos	5	3	0.29	5.81	2.58	2.08	109.8	20.9	85.2	35.9	0	0	0
D. Markos	5	4	0.19	4.57	2.62	2.12	97.7	24.7	81.8	29.5	0	0	0
D. Markos	5	5	0.17	4.73	2.73	2.23	108.1	20.1	84.2	37.5	2	0	8
D. Markos	5	6	0.23	4.50	2.54	2.12	101.8	25.4	85.0	32.2	0	0	0
D. Markos	5	7	0.17	4.57	2.50	2.04	98.1	23.4	83.4	39.7	0	0	0
D. Markos	5	8	0.23	5.50	2.73	2.27	101.1	22.0	82.0	28.5	0	0	0
D. Markos	5	9	0.17	5.89	2.70	2.12	105.2	20.3	87.8	36.5	0	0	0
D. Markos	5	10	0.21	4.65	2.58	2.08	104.3	20.1	77.8	32.7	0	0	0
D. Markos	5	11	0.23	4.88	2.70	2.23	106.9	22.4	82.7	31.4	0	0	0
D. Markos	5	12	0.19	4.73	2.62	2.16	110.0	20.5	82.6	38.7	0	0	0
D. Markos	5	13	0.25	4.96	2.77	2.23	97.3	18.0	83.3	36.8	0	0	1
D. Markos	5	14	0.19	4.57	2.54	2.00	103.8	20.4	79.7	34.9	0	0	0
D. Markos	5	15	0.27	5.89	2.66	2.16	104.7	21.2	83.7	43.3	0	0	0
D. Markos	5	16	0.25	4.88	2.70	2.19	107.5	17.9	77.4	31.8	0	0	0
D. Markos	5	17	0.19	4.57	2.66	2.16	98.9	24.9	86.6	37.1	2	0	8
D. Markos	5	18	0.27	4.65	2.50	2.08	105.5	18.9	81.0	32.6	0	0	0
D. Markos	5	19	0.19	4.65	2.77	2.19	110.2	19.6	86.6	36.6	0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
D. Markos	5	20	0.15	5.12	2.62	2.12	115.7	22.4	84.0	37.7	0	0	0
Holeta	1	1	0.21	4.93	2.64	2.30	109.7	23.7	88.5	40.1	0	0	6
Holeta	1	2	0.21	4.78	2.61	2.16	101.0	22.8	93.6	40.7	0	0	5
Holeta	1	3	0.25	5.00	2.61	2.26	108.1	20.1	93.4	38.8	0	0	1
Holeta	1	4	0.25	4.93	2.68	2.33	97.4	21.3	91.6	39.5	0	0	1
Holeta	1	5	0.25	4.93	2.64	2.23	108.5	24.0	89.7	37.7	0	0	5
Holeta	1	6	0.30	4.86	2.64	2.26	106.3	22.0	84.6	37.4	0	0	1
Holeta	1	7	0.26	5.14	2.61	2.12	100.9	19.6	90.2	43.8	0	0	1
Holeta	1	8	0.25	4.78	2.58	2.16	109.2	22.7	85.6	40.4	0	0	5
Holeta	1	9	0.18	4.78	2.58	2.12	102.4	23.5	92.1	39.2	1	0	1
Holeta	1	10	0.21	4.93	2.68	2.26	96.2	21.9	90.6	35.7	0	0	1
Holeta	1	11	0.18	4.78	2.64	2.19	106.3	21.8	89.0	41.7	0	0	1
Holeta	1	12	0.25	4.93	2.61	2.19	102.3	22.2	85.6	36.4	0	0	1
Holeta	1	13	0.26	4.86	2.58	2.19	98.0	24.2	91.8	39.9	0	0	1
Holeta	1	14	0.19	5.00	2.68	2.23	98.1	18.2	87.2	37.4	0	0	1
Holeta	1	15	0.19	4.86	2.71	2.26	108.5	24.3	90.0	44.3	0	0	5
Holeta	1	16	0.26	4.93	2.51	2.12	97.9	21.3	87.6	42.5	0	0	1
Holeta	1	17	0.26	4.64	2.61	2.12	102.0	21.4	89.6	38.7	0	0	1
Holeta	1	18	0.26	5.36	2.61	2.19	102.8	26.0	88.0	37.7	0	0	1
Holeta	1	19	0.28	4.28	2.64	2.19	97.5	21.8	91.4	41.5	0	0	0
Holeta	1	20	0.21	5.07	2.68	2.12	105.1	24.0	90.8	41.2	0	0	1
Holeta	2	1	0.21	4.14	2.51	2.12	105.2	24.2	86.2	36.7	0	0	0
Holeta	2	2	0.26	5.21	2.61	2.09	104.4	22.2	89.1	30.1	0	0	1
Holeta	2	3	0.23	5.93	2.58	2.16	99.2	26.0	91.7	37.4	0	0	1
Holeta	2	4	0.14	5.93	2.47	2.09	99.5	23.6	89.8	44.6	0	0	0
Holeta	2	5	0.25	5.07	2.64	2.23	106.4	22.6	86.0	41.1	0	0	5
Holeta	2	6	0.19	5.93	2.58	2.16	102.2	24.9	85.6	36.8	0	0	1
Holeta	2	7	0.21	5.14	2.58	2.16	102.8	24.4	82.3	37.1	0	0	0
Holeta	2	8	0.18	4.78	2.54	2.02	105.8	20.2	80.4	32.7	0	0	1
Holeta	2	9	0.23	5.00	2.61	2.33	98.3	21.0	93.2	40.8	0	0	1
Holeta	2	10	0.18	5.00	2.54	2.12	111.7	26.4	93.2	38.1	0	0	1
Holeta	2	11	0.14	4.93	2.54	2.05	96.3	22.6	86.7	35.8	0	0	1
Holeta	2	12	0.18	5.00	2.51	2.02	98.3	21.6	85.5	34.9	0	0	1
Holeta	2	13	0.18	4.93	2.58	2.09	106.2	20.0	86.0	30.8	0	0	1
Holeta	2	14	0.28	5.07	2.64	2.09	102.6	23.1	89.6	39.4	0	0	1
Holeta	2	15	0.16	4.93	2.61	2.05	107.5	24.4	90.1	41.4	0	0	1
Holeta	2	16	0.26	5.07	2.78	2.19	105.9	20.1	87.2	38.6	0	2	9
Holeta	2	17	0.18	4.93	2.47	2.02	104.6	24.2	88.4	34.0	0	0	1
Holeta	2	18	0.19	4.93	2.68	2.26	94.5	15.6	85.4	38.5	0	0	1
Holeta	2	19	0.16	4.86	2.54	2.09	106.7	19.9	83.7	28.4	0	0	1
Holeta	2	20	0.21	5.14	2.51	2.12	104.1	25.0	89.8	37.3	0	0	1
Holeta	3	1	0.23	6.21	2.68	2.16	108.5	18.1	86.3	36.3	0	0	1
Holeta	3	2	0.25	5.00	2.71	2.26	101.3	18.8	80.5	38.1	1	0	1
Holeta	3	3	0.16	5.07	2.68	2.23	111.4	25.2	89.5	38.4	0	0	1
Holeta	3	4	0.32	5.07	2.68	2.19	102.7	17.8	85.4	33.9	0	0	1
Holeta	3	5	0.28	5.14	2.68	2.23	107.6	20.9	80.8	34.7	0	0	1
Holeta	3	6	0.21	6.07	2.68	2.26	94.8	16.9	84.3	36.4	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Holeta	3	7	0.21	5.00	2.58	2.09	103.4	26.7	83.5	36.3	0	0	0
Holeta	3	8	0.26	6.07	2.71	2.30	101.1	20.7	85.2	35.8	0	0	1
Holeta	3	9	0.30	5.21	2.64	2.19	101.0	19.6	80.7	34.4	0	0	1
Holeta	3	10	0.25	5.28	2.78	2.23	99.4	20.7	79.9	39.1	0	0	1
Holeta	3	11	0.25	5.07	2.68	2.19	93.3	16.8	78.7	30.5	0	0	1
Holeta	3	12	0.19	6.28	2.68	2.16	99.3	18.5	85.9	40.5	0	0	1
Holeta	3	13	0.18	5.07	2.71	2.19	100.1	17.5	84.6	36.0	0	0	1
Holeta	3	14	0.33	5.00	2.78	2.16	96.6	23.8	84.3	42.5	0	0	1
Holeta	3	15	0.19	5.07	2.61	2.16	106.0	18.3	89.3	35.6	0	0	1
Holeta	3	16	0.26	5.00	2.71	2.23	92.1	17.3	85.8	45.3	0	0	1
Holeta	3	17	0.28	5.14	2.58	2.09	101.5	18.3	82.8	27.7	0	0	1
Holeta	3	18	0.26	5.00	2.61	2.19	99.9	20.8	85.7	43.0	0	0	1
Holeta	3	19	0.21	5.28	2.78	2.19	104.4	21.6	81.7	35.7	0	0	0
Holeta	3	20	0.19	4.78	2.61	2.19	101.7	19.2	86.2	40.8	0	0	1
Holeta	4	1	0.26	5.00	2.61	2.19	99.7	17.7	93.2	35.5	0	0	5
Holeta	4	2	0.23	4.93	2.61	2.23	108.1	21.7	81.0	32.8	0	0	1
Holeta	4	3	0.21	5.00	2.68	2.23	108.7	20.4	82.0	36.4	0	0	1
Holeta	4	4	0.18	4.71	2.61	2.16	103.5	24.6	91.7	36.6	0	0	1
Holeta	4	5	0.21	4.93	2.68	2.37	102.5	19.9	84.9	35.6	0	0	1
Holeta	4	6	0.19	4.78	2.61	2.19	110.1	23.6	83.6	34.2	0	0	1
Holeta	4	7	0.18	5.00	2.61	2.16	109.3	21.9	84.8	36.2	0	0	1
Holeta	4	8	0.25	5.07	2.64	2.26	101.6	21.5	86.7	34.3	1	0	1
Holeta	4	9	0.19	5.07	2.68	2.30	97.7	19.6	84.0	38.4	0	0	0
Holeta	4	10	0.28	6.14	2.61	2.30	99.6	21.3	86.4	40.3	0	0	1
Holeta	4	11	0.23	5.14	2.68	2.19	110.6	17.4	77.0	30.5	0	0	1
Holeta	4	12	0.25	4.93	2.61	2.19	101.0	18.9	82.7	37.8	0	0	1
Holeta	4	13	0.21	4.86	2.61	2.19	105.5	20.8	86.2	35.8	0	0	1
Holeta	4	14	0.30	4.71	2.71	2.26	95.6	21.5	84.1	32.6	0	0	1
Holeta	4	15	0.33	5.00	2.64	2.30	106.9	21.3	86.9	34.4	0	0	1
Holeta	4	16	0.19	5.07	2.71	2.30	100.0	19.9	83.6	38.8	0	0	1
Holeta	4	17	0.19	5.14	2.75	2.26	105.2	19.5	86.4	36.7	0	0	1
Holeta	4	18	0.33	5.07	2.58	2.23	104.5	19.2	82.9	38.5	1	0	1
Holeta	4	19	0.25	4.93	2.68	2.26	106.5	18.6	77.6	30.9	0	0	1
Holeta	4	20	0.19	4.86	2.68	2.26	102.5	17.7	80.2	37.9	0	0	1
Holeta	5	1	0.23	5.00	2.58	2.12	112.8	17.8	78.8	35.4	0	0	0
Holeta	5	2	0.19	4.86	2.64	2.09	108.1	18.9	78.9	35.6	0	0	1
Holeta	5	3	0.21	4.86	2.68	2.23	105.6	19.8	82.3	35.8	0	0	1
Holeta	5	4	0.21	5.00	2.61	2.12	104.4	16.7	80.2	31.7	0	0	1
Holeta	5	5	0.23	5.14	2.64	2.33	112.4	23.6	78.7	31.9	0	0	1
Holeta	5	6	0.14	4.93	2.54	2.16	105.5	20.1	87.7	34.1	0	0	1
Holeta	5	7	0.23	4.86	2.61	2.16	104.9	19.6	88.5	33.3	0	0	1
Holeta	5	8	0.19	6.14	2.58	2.09	106.5	17.7	78.6	33.7	0	0	1
Holeta	5	9	0.19	6.07	2.54	2.12	104.9	14.3	77.4	34.1	0	0	1
Holeta	5	10	0.19	5.85	2.61	2.23	107.1	21.6	78.2	34.9	0	0	1
Holeta	5	11	0.21	5.93	2.58	2.09	108.9	18.4	81.6	36.5	0	0	1
Holeta	5	12	0.14	4.78	2.71	2.19	104.1	17.4	73.4	37.6	0	0	1
Holeta	5	13	0.21	5.78	2.61	2.19	107.3	17.5	79.6	34.2	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Holeta	5	14	0.21	4.71	2.64	2.23	102.1	18.4	79.1	30.9	0	0	0
Holeta	5	15	0.19	4.93	2.51	2.12	103.6	18.8	79.5	41.7	0	0	0
Holeta	5	16	0.18	4.86	2.64	2.12	108.3	16.5	82.7	37.4	0	0	1
Holeta	5	17	0.21	5.00	2.61	2.30	100.2	16.8	81.5	31.7	0	0	0
Holeta	5	18	0.21	5.93	2.64	2.26	104.0	20.1	83.1	37.5	0	0	1
Holeta	5	19	0.21	5.85	2.64	2.16	98.0	19.2	80.8	32.5	0	0	0
Holeta	5	20	0.23	4.86	2.58	2.09	110.2	16.7	78.1	30.3	0	0	1
Holeta	6	1	0.27	5.04	2.73	2.12	110.9	16.6	78.0	36.9	0	0	2
Holeta	6	2	0.19	4.73	2.73	2.16	104.8	17.6	82.9	29.4	0	0	1
Holeta	6	3	0.32	5.04	2.73	1.93	96.6	18.8	80.8	30.1	0	0	0
Holeta	6	4	0.21	4.81	2.62	1.93	103.1	18.1	79.2	27.0	0	0	0
Holeta	6	5	0.23	4.81	2.77	1.96	108.5	16.7	80.5	25.6	0	0	1
Holeta	6	6	0.25	4.81	2.73	2.08	105.5	17.7	85.6	24.4	0	0	0
Holeta	6	7	0.27	4.65	2.66	2.08	95.5	20.4	87.7	41.2	0	0	1
Holeta	6	8	0.25	6.05	2.70	2.27	110.6	19.9	76.7	34.5	0	0	0
Holeta	6	9	0.25	4.96	2.73	2.12	105.1	17.4	84.1	28.0	0	0	1
Holeta	6	10	0.21	4.96	2.70	2.08	110.5	18.7	80.9	31.3	0	0	0
Holeta	6	11	0.19	4.73	2.66	2.12	109.6	17.2	80.6	30.1	0	0	2
Holeta	6	12	0.23	4.88	2.73	2.04	113.6	16.8	83.7	33.6	0	0	1
Holeta	6	13	0.25	4.96	2.77	2.16	102.2	19.9	80.3	38.0	0	0	1
Holeta	6	14	0.21	4.73	2.66	2.12	97.3	17.0	75.0	26.8	0	0	1
Holeta	6	15	0.21	4.65	2.70	2.08	111.8	20.4	83.6	33.4	0	0	1
Holeta	6	16	0.23	5.97	2.66	2.16	99.2	18.1	77.9	30.9	0	0	0
Holeta	6	17	0.23	4.81	2.66	1.96	100.5	19.3	77.1	28.2	0	0	1
Holeta	6	18	0.21	4.65	2.73	2.08	102.1	17.2	85.1	31.6	0	0	0
Holeta	6	19	0.25	6.36	2.73	2.12	111.5	16.0	81.3	35.1	0	0	1
Holeta	6	20	0.23	6.05	2.62	2.04	111.9	18.0	86.3	28.3	0	0	0
Shashem	1	1	0.21	5.00	2.75	2.19	110.6	20.6	83.0	38.3	1	0	0
Shashem	1	2	0.18	4.64	2.68	2.09	91.3	22.8	81.4	33.1	0	0	0
Shashem	1	3	0.21	5.71	2.54	2.02	102.2	23.5	89.1	34.9	0	0	0
Shashem	1	4	0.14	4.71	2.51	1.98	102.4	23.2	79.9	36.8	1	0	1
Shashem	1	5	0.18	5.93	2.61	2.05	98.0	22.5	83.4	35.6	1	0	1
Shashem	1	6	0.26	6.07	2.58	2.02	94.6	21.3	80.6	36.4	1	0	1
Shashem	1	7	0.18	6.00	2.71	2.23	108.5	20.7	82.2	33.4	1	0	1
Shashem	1	8	0.12	5.93	2.64	2.16	102.5	20.1	85.1	30.3	1	0	1
Shashem	1	9	0.25	5.71	2.54	2.02	106.9	20.3	78.7	31.1	1	0	1
Shashem	1	10	0.16	6.07	2.58	2.02	100.5	17.4	84.6	38.1	1	0	1
Shashem	1	11	0.23	5.93	2.64	2.09	107.4	18.8	79.5	39.4	1	0	1
Shashem	1	12	0.19	4.93	2.61	2.02	113.3	21.0	83.2	37.9	1	0	1
Shashem	1	13	0.18	5.14	2.61	2.05	102.9	19.8	83.9	32.1	1	0	1
Shashem	1	14	0.26	5.93	2.61	2.09	106.9	22.3	81.1	38.2	1	0	1
Shashem	1	15	0.25	5.85	2.61	2.02	102.5	20.9	85.4	33.8	1	0	1
Shashem	1	16	0.18	4.86	2.61	2.09	108.3	21.7	87.7	34.7	1	0	1
Shashem	1	17	0.18	4.86	2.54	2.02	99.3	19.5	77.6	34.6	0	0	1
Shashem	1	18	0.19	6.00	2.61	2.02	113.1	19.8	85.4	31.0	1	0	1
Shashem	1	19	0.18	4.93	2.68	2.12	102.5	20.4	79.1	27.8	0	0	1
Shashem	1	20	0.19	5.93	2.64	2.12	107.6	21.1	89.5	32.7	0	0	5

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Shashem	2	1	0.21	4.78	2.68	2.12	105.5	18.3	83.5	33.7	1	0	5
Shashem	2	2	0.16	4.64	2.54	2.09	104.2	20.4	87.0	31.2	0	0	1
Shashem	2	3	0.25	5.14	2.61	2.16	110.7	22.7	84.5	39.6	1	0	5
Shashem	2	4	0.23	4.71	2.64	2.16	105.3	20.4	86.2	29.2	0	0	5
Shashem	2	5	0.25	5.78	2.68	2.19	112.5	22.7	82.4	32.0	0	0	1
Shashem	2	6	0.28	4.57	2.64	2.16	114.2	28.1	88.2	39.0	0	0	1
Shashem	2	7	0.18	4.71	2.51	2.02	101.9	18.9	82.6	38.6	0	0	5
Shashem	2	8	0.23	4.78	2.58	2.09	103.2	21.7	88.3	33.8	0	0	5
Shashem	2	9	0.26	4.86	2.58	2.23	105.6	24.3	88.0	29.4	4	0	1
Shashem	2	10	0.21	5.93	2.51	2.09	108.5	22.1	88.7	34.6	1	0	1
Shashem	2	11	0.23	4.71	2.61	2.12	105.8	21.4	89.3	32.9	1	0	5
Shashem	2	12	0.21	5.00	2.61	2.09	102.9	20.0	87.4	36.0	1	0	5
Shashem	2	13	0.16	4.64	2.61	2.16	104.0	19.6	85.2	27.2	1	0	
Shashem	2	14	0.25	4.93	2.64	2.19	117.4	18.3	86.1	34.9	1	0	5
Shashem	2	15	0.26	4.86	2.68	2.16	104.5	20.0	82.4	37.7	0	0	1
Shashem	2	16	0.23	4.86	2.58	2.16	106.5	23.7	89.7	36.5	1	0	5
Shashem	2	17	0.23	5.93	2.61	2.26	111.4	25.2	88.1	34.8	1	0	5
Shashem	2	18	0.26	5.93	2.68	2.23	108.7	23.1	90.5	34.5	1	0	1
Shashem	2	19	0.23	4.64	2.58	2.16	116.9	21.4	85.9	32.1	1	0	5
Shashem	2	20	0.28	4.86	2.68	2.09	107.3	22.5	88.2	33.1	0	0	1
Shashem	3	1	0.26	5.78	2.61	2.16	100.5	25.0	95.5	37.1	0	0	1
Shashem	3	2	0.18	4.78	2.71	2.23	96.5	22.5	85.9	41.6	0	0	1
Shashem	3	3	0.28	4.57	2.71	2.23	95.3	25.6	87.5	40.1	1	0	1
Shashem	3	4	0.23	4.86	2.68	2.16	98.0	22.9	90.0	33.5	0	0	1
Shashem	3	5	0.28	4.71	2.82	2.23	97.9	21.0	85.7	40.0	0	0	1
Shashem	3	6	0.26	4.64	2.64	2.16	98.5	25.3	91.9	31.1	0	0	1
Shashem	3	7	0.25	4.86	2.58	2.16	98.0	21.7	93.4	35.6	0	0	1
Shashem	3	8	0.25	5.93	2.71	2.19	109.7	21.6	87.6	28.9	0	0	1
Shashem	3	9	0.26	5.78	2.75	2.19	101.5	21.2	89.1	44.2	0	0	1
Shashem	3	10	0.23	4.64	2.68	2.23	98.5	22.7	86.7	38.4	1	0	1
Shashem	3	11	0.21	5.78	2.64	2.19	104.0	21.9	95.1	36.4	1	0	1
Shashem	3	12	0.19	4.86	2.58	2.19	98.7	20.1	89.4	31.8	0	0	1
Shashem	3	13	0.19	4.78	2.54	2.05	93.1	22.8	90.6	39.9	0	0	1
Shashem	3	14	0.18	4.50	2.61	2.12	109.3	24.7	93.9	41.6	0	0	1
Shashem	3	15	0.19	5.57	2.71	2.26	101.7	23.8	92.3	36.8	0	0	1
Shashem	3	16	0.23	5.78	2.64	2.12	103.7	20.6	88.5	39.7	0	0	1
Shashem	3	17	0.23	4.78	2.64	2.16	110.0	20.5	88.4	36.5	0	0	1
Shashem	3	18	0.26	4.86	2.58	2.12	109.4	19.6	87.3	35.4	0	0	1
Shashem	3	19	0.26	5.85	2.68	2.16	96.1	22.1	92.6	42.5	0	0	1
Shashem	3	20	0.26	4.64	2.64	2.19	100.4	24.1	91.7	40.0	0	0	1
Shashem	4	1	0.19	4.78	2.47	2.09	96.5	19.5	88.5	38.2	0	2	8
Shashem	4	2	0.23	4.93	2.68	2.19	112.4	26.5	98.4	42.1	0	2	9
Shashem	4	3	0.18	5.00	2.61	2.16	99.2	23.4	88.2	40.4	0	2	9
Shashem	4	4	0.21	4.86	2.75	2.26	108.9	21.2	87.0	41.6	0	0	1
Shashem	4	5	0.21	4.93	2.64	2.19	107.7	24.7	91.8	40.8	0	0	1
Shashem	4	6	0.19	4.86	2.64	2.16	110.4	21.6	91.5	37.5	0	2	9
Shashem	4	7	0.18	4.78	2.68	2.16	99.0	23.7	92.0	36.0	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Shashem	4	8	0.18	4.86	2.68	2.12	104.4	25.3	90.1	40.6	0	0	1
Shashem	4	9	0.23	4.64	2.58	2.09	102.6	22.4	92.9	44.8	0	0	1
Shashem	4	10	0.23	4.28	2.54	2.16	111.0	21.1	90.2	41.7	0	0	1
Shashem	4	11	0.23	4.86	2.64	2.09	107.5	22.1	94.1	43.2	1	0	1
Shashem	4	12	0.21	4.50	2.51	2.16	98.2	23.4	92.8	36.7	0	0	1
Shashem	4	13	0.32	4.07	2.51	2.02	102.4	21.8	91.4	44.7	0	0	9
Shashem	4	14	0.19	4.43	2.51	1.98	102.0	19.8	83.1	36.1	0	2	8
Shashem	4	15	0.26	4.86	2.68	2.19	104.3	19.6	87.8	43.2	0	0	1
Shashem	4	16	0.23	4.50	2.51	2.02	101.5	23.4	88.9	41.9	0	2	8
Shashem	4	17	0.16	5.07	2.61	2.16	99.7	21.7	90.5	43.3	0	0	1
Shashem	4	18	0.21	4.93	2.68	2.16	106.7	23.2	92.0	42.2	0	2	8
Shashem	4	19	0.25	4.78	2.47	1.98	105.8	22.5	92.1	36.3	0	2	9
Shashem	4	20	0.23	4.78	2.64	2.16	91.5	23.1	93.3	40.4	0	0	1
Shashem	5	1	0.25	6.00	2.68	2.30	114.8	22.0	83.2	32.6	0	0	1
Shashem	5	2	0.19	5.71	2.58	2.26	108.7	21.6	87.1	30.7	0	0	1
Shashem	5	3	0.18	4.71	2.61	2.23	112.9	25.7	87.9	31.7	0	0	1
Shashem	5	4	0.21	5.85	2.61	2.19	104.4	25.4	89.8	29.2	0	0	1
Shashem	5	5	0.25	6.07	2.68	2.33	101.8	19.6	87.7	30.2	1	0	1
Shashem	5	6	0.26	5.93	2.68	2.30	101.9	21.3	89.9	40.0	0	0	1
Shashem	5	7	0.28	5.36	2.64	2.23	102.7	23.2	88.4	35.6	1	0	1
Shashem	5	8	0.28	5.78	2.61	2.19	103.5	21.2	84.6	33.0	0	0	1
Shashem	5	9	0.26	5.85	2.58	2.12	97.7	17.1	87.2	33.4	1	0	1
Shashem	5	10	0.26	5.78	2.61	2.26	111.1	20.0	83.7	31.6	0	0	1
Shashem	5	11	0.28	4.93	2.64	2.12	105.5	19.5	82.9	34.0	1	0	1
Shashem	5	12	0.25	4.86	2.71	2.19	108.0	19.1	84.5	27.0	0	0	1
Shashem	5	13	0.18	5.07	2.61	2.16	97.3	21.1	83.7	35.8	0	0	1
Shashem	5	14	0.18	4.86	2.68	2.19	108.5	17.4	81.2	36.8	0	0	1
Shashem	5	15	0.19	6.00	2.64	2.16	105.2	18.5	90.1	32.2	0	0	1
Shashem	5	16	0.28	5.78	2.71	2.37	106.3	21.3	86.6	36.8	0	0	1
Shashem	5	17	0.18	4.93	2.51	2.23	109.6	21.0	87.5	30.7	0	2	8
Shashem	5	18	0.19	5.07	2.61	2.16	106.6	18.0	80.9	33.2	0	0	1
Shashem	5	19	0.23	4.93	2.61	2.23	104.7	19.8	86.3	31.1	0	0	1
Shashem	5	20	0.23	5.07	2.64	2.12	101.8	17.1	77.7	30.3	0	0	1
Shashem	6	1	0.21	5.78	2.54	2.19	110.4	23.3	91.9	35.5	0	0	1
Shashem	6	2	0.26	4.93	2.68	2.19	112.5	21.6	89.1	35.4	0	0	1
Shashem	6	3	0.18	4.86	2.64	2.09	100.6	22.2	86.6	34.8	0	0	1
Shashem	6	4	0.23	5.93	2.64	2.16	100.3	19.3	84.1	33.3	0	0	1
Shashem	6	5	0.32	4.71	2.58	2.05	105.4	20.8	87.7	28.2	0	2	9
Shashem	6	6	0.23	4.86	2.54	2.12	104.0	25.5	88.7	35.0	0	0	1
Shashem	6	7	0.25	4.78	2.64	2.19	108.4	21.6	88.5	30.1	0	0	1
Shashem	6	8	0.26	4.64	2.64	2.09	109.1	21.1	87.5	38.0	0	0	1
Shashem	6	9	0.19	5.07	2.68	2.16	111.2	24.4	84.0	30.6	0	0	1
Shashem	6	10	0.23	4.78	2.58	2.02	114.8	24.3	83.5	32.6	0	0	1
Shashem	6	11	0.25	4.78	2.58	2.12	107.0	21.9	87.7	34.8	0	2	9
Shashem	6	12	0.25	4.71	2.78	2.23	104.4	24.9	88.3	32.3	0	0	1
Shashem	6	13	0.21	4.78	2.61	2.12	103.6	20.1	85.6	31.7	0	0	1
Shashem	6	14	0.21	4.57	2.61	2.16	109.9	23.9	90.9	36.2	0	0	1

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Shashem	6	15	0.23	4.78	2.58	2.05	108.5	22.6	87.2	33.3	0	0	1
Shashem	6	16	0.21	4.78	2.64	2.09	106.5	23.7	87.7	35.1	0	0	1
Shashem	6	17	0.21	4.71	2.58	2.05	103.3	21.6	89.8	34.1	0	0	1
Shashem	6	18	0.21	4.86	2.61	2.12	103.9	20.5	88.9	36.5	0	0	1
Shashem	6	19	0.23	4.86	2.64	2.09	110.9	23.0	85.3	31.0	0	0	1
A. Maryam	2	1	0.21	5.85	2.58	2.19	112.7	15.8	72.3	38.0	0	0	0
A. Maryam	2	2	0.23	4.93	2.51	2.16	109.1	19.2	76.3	31.1	0	4	9
A. Maryam	2	3	0.19	4.71	2.44	2.05	98.3	18.7	80.7	40.4	0	2	9
A. Maryam	2	4	0.21	5.57	2.51	2.02	98.4	19.6	74.9	32.5	0	2	9
A. Maryam	2	5	0.25	4.93	2.47	2.23	96.5	16.5	70.4	37.7	0	4	8
A. Maryam	2	6	0.23	4.93	2.64	2.09	107.4	17.3	79.3	35.3	0	4	9
A. Maryam	2	7	0.23	4.64	2.44	2.02	105.6	19.1	80.8	37.2	0	0	0
A. Maryam	2	8	0.23	4.64	2.51	1.98	105.9	20.6	80.5	40.1	0	2	9
A. Maryam	2	9	0.26	4.93	2.58	2.19	98.1	17.1	74.9	41.1	0	2	8
A. Maryam	2	10	0.23	4.57	2.47	2.05	99.1	22.0	82.6	35.3	0	0	0
A. Maryam	2	11	0.25	4.78	2.51	2.09	99.3	18.7	84.7	32.9	0	2	8
A. Maryam	2	12	0.21	4.86	2.61	1.98	102.7	16.3	78.7	40.1	0	0	0
A. Maryam	2	13	0.25	5.00	2.54	2.12	108.1	20.1	75.9	42.3	0	0	0
A. Maryam	2	14	0.21	5.00	2.54	2.05	96.2	18.9	85.2	34.6	0	2	9
A. Maryam	2	15	0.23	5.78	2.61	2.19	98.3	16.6	76.9	32.2	0	2	8
A. Maryam	2	16	0.23	4.93	2.54	1.95	106.9	18.3	83.0	34.9	0	0	0
A. Maryam	2	17	0.21	4.78	2.54	2.05	99.6	18.6	82.3	35.3	0	2	8
A. Maryam	2	18	0.23	4.64	2.44	1.98	106.0	20.9	79.2	32.6	4	2	8
A. Maryam	2	19	0.19	5.64	2.58	2.02	103.0	18.1	78.9	33.0	0	2	9
A. Maryam	2	20	0.23	4.93	2.61	2.26	99.4	18.1	75.7	38.6	0	0	0
A. Maryam	3	1	0.25	5.14	2.51	2.09	105.6	21.0	73.2	36.8	0	0	0
A. Maryam	3	2	0.21	5.85	2.54	2.02	101.9	18.5	76.4	34.6	0	0	0
A. Maryam	3	3	0.19	5.85	2.51	1.98	100.9	21.1	79.4	43.2	0	0	0
A. Maryam	3	4	0.23	5.85	2.51	2.05	91.6	19.2	82.4	37.7	0	0	0
A. Maryam	3	5	0.21	6.00	2.54	2.16	102.5	17.9	74.9	36.8	0	0	0
A. Maryam	3	6	0.25	5.21	2.58	2.23	99.8	18.6	80.0	32.7	0	0	0
A. Maryam	3	7	0.23	5.71	2.47	2.02	99.9	17.7	80.6	36.1	1	0	0
A. Maryam	3	8	0.25	5.21	2.61	2.16	91.1	32.6	83.9	31.3	0	0	0
A. Maryam	3	9	0.18	5.85	2.54	2.09	95.4	19.7	77.3	33.0	0	0	0
A. Maryam	3	10	0.23	4.86	2.54	1.98	108.2	22.3	77.7	36.3	0	0	0
A. Maryam	3	11	0.19	4.86	2.58	2.12	105.6	22.7	82.0	32.8	0	0	0
A. Maryam	3	12	0.23	4.86	2.51	2.05	95.5	21.7	76.0	33.9	0	0	0
A. Maryam	3	13	0.19	5.78	2.54	2.09	99.4	27.0	81.0	35.4	0	0	0
A. Maryam	3	14	0.25	5.00	2.51	2.02	99.8	21.6	82.3	28.8	0	3	8
A. Maryam	3	15	0.21	5.93	2.58	2.16	102.6	22.1	77.2	33.8	0	0	0
A. Maryam	3	16	0.26	5.00	2.54	2.19	101.8	21.1	84.8	31.6	0	0	0
A. Maryam	3	17	0.25	5.07	2.58	2.16	91.4	21.1	84.2	28.9	0	0	0
A. Maryam	3	18	0.30	5.00	2.51	2.09	97.9	22.3	81.8	32.4	0	0	0
A. Maryam	3	19	0.19	5.00	2.47	2.02	104.8	19.6	76.2	34.1	0	0	0
A. Maryam	3	20	0.19	5.00	2.54	2.05	112.8	21.4	77.9	41.4	0	0	0
A. Maryam	4	1	0.23	5.78	2.75	2.09	105.7	17.0	82.6	41.3	0	0	0
A. Maryam	4	2	0.19	5.71	2.37	1.98	108.9	19.4	86.1	34.0	1	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
A. Maryam	4	3	0.23	5.93	2.51	2.16	98.0	23.2	77.6	38.0	0	0	0
A. Maryam	4	4	0.28	5.64	2.54	2.09	104.7	22.4	84.1	36.8	1	0	0
A. Maryam	4	5	0.19	5.85	2.54	2.12	110.0	21.1	80.0	37.4	1	0	0
A. Maryam	4	6	0.21	5.71	2.58	2.09	102.7	18.5	72.2	37.6	0	0	0
A. Maryam	4	7	0.26	5.78	2.54	2.02	105.8	19.0	76.4	30.1	0	0	0
A. Maryam	4	8	0.25	5.71	2.47	2.09	102.8	21.0	75.6	35.9	0	0	0
A. Maryam	4	9	0.21	5.85	2.58	2.12	99.1	22.5	78.6	38.5	0	0	0
A. Maryam	4	10	0.28	5.85	2.51	2.23	110.3	18.8	75.3	31.3	0	0	0
A. Maryam	4	11	0.30	5.85	2.61	2.16	112.0	21.6	84.3	32.9	0	0	0
A. Maryam	4	12	0.23	5.93	2.64	2.12	108.5	22.5	85.8	35.9	0	0	0
A. Maryam	4	13	0.21	6.00	2.61	2.12	114.3	17.7	78.1	40.7	0	0	0
A. Maryam	4	14	0.23	5.36	2.58	2.05	112.6	21.2	80.2	31.9	0	0	0
A. Maryam	4	15	0.21	5.00	2.51	1.98	112.1	19.7	80.1	37.9	1	0	0
A. Maryam	4	16	0.30	5.85	2.61	2.19	113.4	17.9	80.8	40.9	0	0	0
A. Maryam	4	17	0.21	4.64	2.40	1.91	106.4	21.3	70.8	31.9	0	0	0
A. Maryam	4	18	0.23	5.85	2.54	2.16	110.7	19.9	82.4	33.8	0	0	0
A. Maryam	4	19	0.23	4.86	2.61	2.23	109.0	20.7	88.2	37.8	0	0	9
A. Maryam	4	20	0.19	5.71	2.61	2.09	104.5	23.1	79.3	44.5	0	0	0
A. Maryam	5	1	0.25	5.43	2.58	2.12	104.2	19.0	77.8	39.9	0	0	0
A. Maryam	5	2	0.21	5.71	2.64	2.30	114.1	19.5	77.8	35.5	0	0	0
A. Maryam	5	3	0.26	4.64	2.54	2.02	97.9	13.7	76.7	34.3	0	0	0
A. Maryam	5	4	0.19	5.71	2.51	2.09	114.1	17.2	73.2	36.9	0	0	0
A. Maryam	5	5	0.19	5.00	2.47	1.95	99.8	21.7	81.7	34.8	0	0	0
A. Maryam	5	6	0.21	5.85	2.61	2.12	101.5	16.5	76.3	32.7	0	0	0
A. Maryam	5	7	0.25	4.86	2.54	2.05	105.4	17.7	79.7	35.5	0	0	0
A. Maryam	5	8	0.21	5.78	2.68	2.16	103.0	18.0	71.5	29.9	0	0	0
A. Maryam	5	9	0.23	4.64	2.54	2.05	108.2	18.8	81.7	36.8	0	0	0
A. Maryam	5	10	0.23	5.57	2.47	1.95	95.6	20.6	80.6	37.4	0	0	0
A. Maryam	5	11	0.21	5.71	2.58	2.16	104.4	18.5	76.5	33.1	0	0	0
A. Maryam	5	12	0.23	5.71	2.61	2.05	116.3	19.9	80.8	30.6	0	4	8
A. Maryam	5	13	0.19	4.86	2.61	2.23	107.5	21.1	79.5	31.1	0	0	0
A. Maryam	5	14	0.19	5.36	2.61	2.23	99.0	18.2	80.6	36.6	0	0	0
A. Maryam	5	15	0.28	4.93	2.47	2.05	105.8	14.2	75.9	35.7	0	0	0
A. Maryam	5	16	0.19	5.85	2.64	2.09	117.8	18.0	80.6	30.0	0	0	0
A. Maryam	5	17	0.33	4.93	2.61	2.19	107.7	16.9	76.2	35.4	0	0	0
A. Maryam	5	18	0.19	5.50	2.47	2.09	114.4	18.2	86.0	36.3	0	0	0
A. Maryam	5	19	0.26	5.07	2.58	2.19	97.6	17.4	81.4	32.7	0	0	0
A. Maryam	5	20	0.25	4.78	2.58	2.23	98.1	19.3	88.8	37.7	0	0	0
A. Maryam	6	1	0.25	4.78	2.58	2.09	100.7	21.0	79.8	36.6	0	0	0
A. Maryam	6	2	0.19	5.93	2.61	2.37	118.4	19.1	84.2	35.5	0	0	0
A. Maryam	6	3	0.23	5.43	2.47	2.12	96.7	19.0	85.3	36.6	0	0	0
A. Maryam	6	4	0.21	5.85	2.51	2.23	109.9	21.2	82.8	33.9	0	0	0
A. Maryam	6	5	0.25	5.78	2.54	2.09	115.3	19.7	81.3	35.7	0	0	0
A. Maryam	6	6	0.23	6.00	2.54	2.23	116.5	19.6	78.8	36.8	0	0	0
A. Maryam	6	7	0.30	5.93	2.58	2.12	107.7	23.2	84.6	34.0	0	0	0
A. Maryam	6	8	0.23	5.85	2.61	2.23	114.7	19.1	77.2	34.4	0	0	0
A. Maryam	6	9	0.25	5.71	2.51	2.19	117.2	16.8	85.5	32.3	0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
A. Maryam	6	10	0.23	5.78	2.54	2.23	107.3	19.4	88.7	36.4	0	0	0
A. Maryam	6	11	0.28	5.85	2.54	2.19	116.0	18.6	79.7	32.4	0	0	0
A. Maryam	6	12	0.21	5.71	2.58	2.23	103.0	23.7	92.2	32.0	0	0	0
A. Maryam	6	13	0.30	5.64	2.47	2.12	111.0	19.0	81.8	34.9	0	0	0
A. Maryam	6	14	0.23	5.71	2.51	2.19	110.3	19.2	83.3	39.3	0	0	0
A. Maryam	6	15	0.19	5.14	2.61	2.26	103.8	22.9	86.4	42.3	0	0	0
A. Maryam	6	16	0.21	5.07	2.61	2.26	110.9	19.7	81.0	35.1	0	0	0
A. Maryam	6	17	0.26	5.07	2.54	2.16	106.2	18.2	82.1	39.9	0	0	0
A. Maryam	6	18	0.23	5.07	2.71	2.37	104.4	18.5	82.6	26.7	0	0	0
A. Maryam	6	19	0.25	4.64	2.58	2.23	112.8	19.8	80.3	32.3	0	0	0
A. Maryam	6	20	0.25	5.07	2.58	2.23	110.8	20.0	83.6	39.8	0	0	0
Mega	1	1	0.14	4.93	2.58	2.09	92.8	20.8	78.5	34.2	0	2	9
Mega	1	2	0.21	4.71	2.61	2.05	102.8	17.2	83.7	37.1	4	5	9
Mega	1	3	0.18	4.71	2.64	2.12	102.4	22.1	81.9	35.8	0	2	8
Mega	1	4	0.19	5.07	2.61	2.09	108.2	19.5	86.0	39.5	0	0	4
Mega	1	5	0.21	4.86	2.61	2.16	105.1	24.6	91.7	40.9	4	2	9
Mega	1	6	0.21	4.93	2.51	2.09	105.7	17.9	80.7	42.8	0	2	9
Mega	1	7	0.19	5.00	2.58	2.12	98.7	20.7	82.1	32.2	2	2	9
Mega	1	8	0.25	5.00	2.64	2.09	108.6	22.9	85.5	31.7	0	2	9
Mega	1	9	0.18	5.07	2.71	2.09	105.9	16.3	79.9	34.2	4	2	8
Mega	1	10	0.19	4.78	2.58	2.12	116.8	23.2	83.8	32.2	4	2	9
Mega	1	11	0.18	4.43	2.54	2.09	96.8	21.9	87.6	32.4	1	2	9
Mega	1	12	0.21	4.28	2.58	2.12	105.2	20.0	86.2	34.6	4	5	9
Mega	1	13	0.25	4.64	2.64	2.16	110.3	20.0	85.2	36.0	0	2	9
Mega	1	14	0.25	4.86	2.68	2.16	108.3	19.8	83.2	33.7	1	0	0
Mega	1	15	0.19	4.78	2.61	2.09	114.9	22.6	80.6	28.4	1	0	0
Mega	1	16	0.19	4.86	2.61	2.12	102.3	20.1	84.3	40.3	0	2	9
Mega	1	17	0.14	4.78	2.58	2.02	107.3	16.7	84.0	37.2	0	0	0
Mega	1	18	0.26	4.93	2.64	2.16	103.1	17.6	79.5	40.9	4	2	9
Mega	1	19	0.23	5.00	2.54	1.98	105.4	20.0	86.6	37.6	0	0	0
Mega	1	20	0.21	4.93	2.61	2.19	109.7	18.0	86.6	38.1	4	2	9
Mega	2	1	0.25	4.78	2.61	2.05	98.1	20.8	82.0	37.3	0	4	8
Mega	2	2	0.25	4.64	2.58	2.09	107.6	18.3	81.6	37.4	0	2	8
Mega	2	3	0.19	4.50	2.54	2.02	104.5	23.8	86.4	36.1	0	0	8
Mega	2	4	0.19	4.78	2.68	2.16	107.1	22.9	79.5	31.6	2	2	9
Mega	2	5	0.21	4.57	2.54	2.02	100.6	24.4	89.5	29.9	0	2	9
Mega	2	6	0.25	4.71	2.64	2.16	101.1	18.2	74.3	31.4	0	0	4
Mega	2	7	0.23	4.78	2.64	2.19	104.4	22.0	80.2	27.5	0	0	4
Mega	2	8	0.26	5.64	2.54	2.12	97.7	17.6	78.0	35.8	0	0	4
Mega	2	9	0.19	4.64	2.64	2.12	104.3	16.2	74.7	30.7	1	0	4
Mega	2	10	0.30	4.71	2.64	2.05	100.7	17.9	82.7	32.1	0	2	9
Mega	2	11	0.21	4.71	2.58	2.16	101.1	17.4	80.1	36.8	1	2	8
Mega	2	12	0.21	4.78	2.58	2.02	102.0	17.1	80.1	37.2	1	0	4
Mega	2	13	0.23	4.71	2.64	2.12	108.0	15.3	73.9	34.4	0	2	8
Mega	2	14	0.21	4.71	2.54	2.12	105.2	21.4	84.4	35.7	1	4	9
Mega	2	15	0.18	5.50	2.61	2.05	104.5	20.9	81.3	36.9	0	0	4
Mega	2	16	0.21	4.57	2.58	2.09	104.1	20.1	80.3	35.1	0	2	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Mega	2	17	0.30	5.78	2.68	2.19	98.6	20.8	81.7	30.9	0	2	8
Mega	2	18	0.19	4.71	2.64	2.09	107.3	23.7	85.3	35.7	1	2	9
Mega	2	19	0.23	4.86	2.61	2.16	107.6	26.1	87.4	31.5	0	2	9
Mega	2	20	0.23	4.50	2.68	2.19	103.9	16.4	80.1	33.4	0	2	9
Mega	3	1	0.28	5.00	2.61	2.26	98.3	19.6	88.5	33.9	0	2	9
Mega	3	2	0.25	4.78	2.51	2.09	93.6	21.0	78.6	33.3	0	2	9
Mega	3	3	0.19	4.57	2.54	2.16	105.7	18.4	88.1	38.0	1	0	4
Mega	3	4	0.23	5.14	2.54	2.23	96.8	21.0	88.7	38.6	0	4	8
Mega	3	5	0.25	4.64	2.51	2.05	105.3	19.2	79.6	35.2	1	4	9
Mega	3	6	0.18	5.64	2.47	2.12	102.3	20.7	86.7	35.7	4	0	4
Mega	3	7	0.19	4.86	2.58	2.05	103.0	16.5	75.8	29.3	4	4	9
Mega	3	8	0.21	4.71	2.51	2.09	97.8	23.3	83.4	38.6	0	2	8
Mega	3	9	0.18	5.78	2.54	2.23	101.1	19.5	85.3	34.5	1	2	9
Mega	3	10	0.26	4.78	2.40	2.09	88.0	19.8	84.6	33.5	1	2	8
Mega	3	11	0.23	4.71	2.54	2.05	90.9	19.9	88.9	37.1	0	2	9
Mega	3	12	0.21	4.71	2.47	2.12	112.3	17.6	80.0	39.0	4	0	4
Mega	3	13	0.18	4.78	2.51	2.05	108.3	24.1	98.5	33.8	0	2	8
Mega	3	14	0.25	4.78	2.54	1.95	100.9	19.3	78.7	36.2	0	2	8
Mega	3	15	0.26	4.78	2.54	2.16	101.9	22.0	88.0	36.1	0	2	8
Mega	3	16	0.23	5.64	2.51	2.16	99.2	20.9	79.4	33.3	1	2	8
Mega	3	17	0.18	4.93	2.47	2.02	109.0	19.3	83.0	37.2	1	0	4
Mega	3	18	0.26	4.57	2.54	2.02	98.5	20.2	79.3	34.5	1	2	9
Mega	3	19	0.21	4.93	2.47	2.05	93.9	25.5	82.1	34.6	2	2	9
Mega	3	20	0.18	4.86	2.51	2.12	98.6	18.8	86.8	39.7	4	2	8
Mega	4	1	0.21	4.64	2.44	2.12	110.1	22.6	89.0	30.7	0	0	1
Mega	4	2	0.16	4.57	2.51	2.02	115.1	23.6	85.8	38.9	4	0	1
Mega	4	3	0.23	4.43	2.44	2.05	108.9	20.9	86.6	28.5	0	0	0
Mega	4	4	0.19	4.50	2.44	2.05	109.5	19.1	80.2	36.6	4	4	9
Mega	4	5	0.19	4.64	2.51	1.98	113.1	18.2	83.4	36.1	1	0	4
Mega	4	6	0.21	4.57	2.47	2.16	105.1	22.3	81.7	29.6	0	0	1
Mega	4	7	0.23	4.86	2.51	2.12	110.0	19.8	87.4	31.5	0	0	4
Mega	4	8	0.21	4.86	2.47	2.02	107.2	20.8	84.2	34.7	4	5	9
Mega	4	9	0.18	4.71	2.58	2.19	117.0	22.0	89.5	36.0	0	0	1
Mega	4	10	0.26	4.64	2.33	2.09	110.3	23.1	77.8	25.3	0	0	1
Mega	4	11	0.23	5.64	2.40	2.09	96.1	18.2	68.1	35.6	4	0	4
Mega	4	12	0.19	4.50	2.44	2.02	118.7	22.2	86.7	32.5	0	0	4
Mega	4	13	0.23	4.71	2.51	2.05	118.5	19.3	80.7	36.9	0	0	4
Mega	4	14	0.21	4.64	2.54	2.09	116.1	20.0	77.8	35.3	0	0	1
Mega	4	15	0.19	4.64	2.40	1.98	109.1	21.2	87.6	34.4	1	0	1
Mega	4	16	0.21	5.00	2.37	2.02	117.8	23.8	84.8	28.9	0	0	4
Mega	4	17	0.25	4.71	2.44	2.09	111.1	19.6	85.4	30.2	0	0	4
Mega	4	18	0.18	4.57	2.51	2.09	112.3	23.9	83.8	29.7	0	0	4
Mega	5	1	0.23	5.57	2.54	1.95					1	2	8
Mega	5	2	0.16	5.43	2.54	2.02					4	2	9
Mega	5	3	0.14	4.71	2.54	2.05					4	5	9
Mega	5	4	0.23	4.78	2.51	2.05					4	2	9
Mega	5	5		4.86	2.58	2.02					0	0	0

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Mega	5	6	0.25	4.71	2.58	2.05					0	3	8
Mega	5	7	0.21	4.78	2.58	1.91					1	2	9
Mega	5	8	0.21	4.50	2.44	1.98					4	2	8
Mega	5	9	0.23	4.71	2.64	2.05					0	5	9
Mega	5	10	0.23	4.86	2.64	2.09					0	4	9
Mega	5	11	0.19	4.50	2.51	2.12					4	5	9
Mega	5	12	0.21	4.57	2.44	1.98					4	5	9
Mega	5	13	0.30	4.57	2.54	2.05					0	4	8
Mega	5	14	0.19	4.64	2.40	1.91					1	4	8
Mega	5	15	0.21	4.71	2.61	2.12					4	2	9
Mega	5	16	0.19	4.64	2.47	1.98					3	2	8
Mega	5	17	0.19	4.86	2.44	2.02					4	4	9
Mega	5	18	0.18	4.50	2.54	2.02					1	4	9
Mega	5	19	0.21	4.50	2.51	1.91					1	4	8
Mega	5	20	0.21	4.64		1.98					0	3	9

10.2.2 Pheromone Data

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Adi Arkay	1	1	0.64	0.64	0.64	0.64	0.64	0.64	95.54	0.64
Adi Arkay	1	2	5.29	28.73	8.31	7.93	17.50	8.05	24.08	0.10
Adi Arkay	1	3	0.08	14.00	0.08	57.13	18.33	0.08	10.20	0.08
Adi Arkay	1	4	7.84	15.66	6.73	46.93	9.33	0.09	13.33	0.09
Adi Arkay	2	1	7.12	13.58	9.74	9.69	20.56	13.47	11.66	14.17
Adi Arkay	2	2	0.42	52.04	0.42	0.42	0.42	0.42	45.43	0.42
Adi Arkay	2	3	6.14	36.99	7.48	8.33	5.15	9.39	26.43	0.10
Adi Arkay	2	4	0.41	37.81	0.41	29.41	0.41	0.41	30.71	0.41
Adi Arkay	2	5	8.32	16.12	4.90	46.81	8.99	3.78	11.01	0.07
Adi Arkay	2	6	0.10	9.54	0.10	15.29	22.33	12.91	14.80	24.93
Adi Arkay	2	7	14.95	29.83	0.14	7.34	8.78	9.80	29.02	0.14
Adi Arkay	2	8	14.00	35.06	0.11	0.11	15.67	6.66	20.22	8.17
Adi Arkay	3	1	17.17	33.24	0.11	7.24	8.38	8.64	25.11	0.11
Adi Arkay	3	2	14.25	33.31	8.40	4.76	12.95	6.47	19.77	0.09
Adi Arkay	3	3	0.07	38.28	6.73	4.73	18.86	6.13	17.01	8.17
Adi Arkay	3	4	0.07	3.75	12.02	26.67	34.77	0.07	14.67	7.98
Adi Arkay	3	5	17.28	32.67	6.75	0.13	15.15	7.11	20.77	0.13
Adi Arkay	3	6	0.18	42.67	9.61	0.18	0.18	11.15	35.86	0.18
Adi Arkay	3	7	0.08	13.02	7.83	8.94	25.30	16.57	10.54	17.73
Adi Arkay	3	8	0.32	53.96	0.32	0.32	0.32	0.32	44.10	0.32
Adi Arkay	4	1	5.32	45.09	8.64	7.45	7.77	0.09	25.55	0.09
Adi Arkay	4	2	14.98	31.83	4.26	6.04	18.23	2.53	22.09	0.05
Adi Arkay	4	3	13.89	28.02	6.29	5.89	20.06	6.61	19.16	0.07
Adi Arkay	4	4	7.40	37.79	7.75	7.46	0.14	9.75	29.57	0.14
Adi Arkay	4	5	14.64	28.70	0.23	23.75	13.75	0.23	18.47	0.23
Adi Arkay	4	6	0.23	52.40	0.23	0.23	0.23	11.58	34.88	0.23
Adi Arkay	4	7	14.81	32.93	7.76	5.47	13.15	6.68	19.13	0.07
Adi Arkay	4	8	20.32	38.31	0.10	7.37	0.10	8.30	25.39	0.10
Adi Arkay	5	1	5.09	37.92	20.51	0.06	6.66	0.06	25.20	4.50
Adi Arkay	5	2	16.22	36.78	5.22	5.43	4.02	7.70	24.55	0.08
Adi Arkay	5	3	0.24	0.24	0.24	43.94	13.24	12.16	15.92	14.01
Adi Arkay	5	4	19.72	38.52	0.15	21.17	0.15	9.84	10.29	0.15
Adi Arkay	5	5	7.34	19.85	3.00	28.41	18.52	4.98	14.56	3.33
Adi Arkay	5	6	0.02	5.33	1.11	0.02	86.30	2.13	3.25	1.85
Adi Arkay	5	7	0.09	43.05	6.20	7.23	8.75	0.09	26.73	7.86
Adi Arkay	5	8	0.09	43.00	5.52	17.72	0.09	8.15	25.34	0.09
Gonder	1	1	1.78	2.51	1.09	2.93	1.53	3.23	81.84	5.10
Gonder	1	2	24.21	15.44	1.15	2.08	1.99	1.78	45.41	7.95
Gonder	1	3	1.23	17.33	1.40	2.34	1.97	1.86	56.82	17.06
Gonder	1	4	1.07	15.50	1.13	2.49	2.83	3.24	63.73	10.01
Gonder	1	5	1.11	13.44	1.10	2.35	3.33	2.57	65.18	10.94
Gonder	1	6	1.20	4.06	1.26	4.60	1.71	1.88	78.62	6.67
Gonder	1	7	5.52	13.96	5.12	17.83	10.84	14.71	13.28	18.74
Gonder	1	8	0.85	2.46	2.07	2.71	2.94	2.56	83.61	2.80
Gonder	2	1	1.39	32.75	1.43	3.49	2.03	2.51	52.07	4.34

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Gonder	2	2	1.20	28.38	1.20	2.38	2.10	2.91	57.08	4.74
Gonder	2	3	0.89	15.55	1.12	4.12	3.72	3.15	65.13	6.33
Gonder	2	4	0.94	17.63	1.14	2.80	1.41	3.19	66.72	6.18
Gonder	2	5	1.01	25.22	1.17	1.32	1.13	3.08	61.38	5.70
Gonder	2	6	0.63	25.36	1.11	2.25	10.76	2.14	54.91	2.83
Gonder	2	7	0.90	1.63	1.07	15.40	1.56	1.39	73.95	4.11
Gonder	2	8	1.20	24.35	1.19	1.70	2.38	2.25	60.92	6.01
Gonder	3	1	0.84	43.04	0.68	0.46	1.09	1.64	49.37	2.88
Gonder	3	2	1.56	2.95	1.73	1.46	4.42	3.31	77.65	6.91
Gonder	3	3	1.03	15.62	0.87	2.40	11.48	1.85	61.20	5.55
Gonder	3	4	0.66	2.19	1.29	3.91	2.57	3.66	78.26	7.47
Gonder	3	5	0.79	38.96	0.93	1.53	1.86	1.36	51.12	3.45
Gonder	3	6	0.80	30.44	0.68	1.03	2.20	2.34	59.37	3.15
Gonder	3	7	1.16	20.50	1.09	4.13	1.26	3.23	64.54	4.09
Gonder	4	1	0.31	28.74	0.31	29.23	0.31	0.31	40.49	0.31
Gonder	4	2	8.76	16.23	5.99	11.23	26.25	8.04	23.41	0.08
Gonder	4	3	0.14	18.46	0.14	14.33	17.50	0.14	19.80	29.48
Gonder	4	4	0.06	64.52	0.06	8.01	7.24	0.06	10.39	9.65
Gonder	4	5	3.87	7.24	0.06	5.47	48.15	0.06	16.75	18.39
Gonder	4	6	5.65	23.70	6.71	7.42	8.97	9.91	30.37	7.27
Gonder	4	7	0.10	0.10	5.68	35.23	36.26	5.78	16.76	0.10
Gonder	4	8	4.20	7.88	0.06	67.16	12.14	0.06	8.44	0.06
Gonder	5	1	5.03	9.48	0.07	0.07	7.57	0.07	47.36	30.35
Gonder	5	2	0.05	3.98	31.94	30.78	3.30	0.05	6.95	22.96
Gonder	5	3	9.91	18.57	4.72	38.19	5.46	5.98	17.09	0.08
Gonder	5	4	10.48	19.76	8.23	0.13	25.71	8.35	27.20	0.13
Gonder	5	5	0.31	26.20	0.31	48.15	24.07	0.31	0.31	0.31
Gonder	5	6	0.69	0.69	0.69	0.69	0.69	0.69	95.14	0.69
Gonder	5	7	0.23	32.34	12.18	0.23	0.23	12.89	41.66	0.23
Gonder	5	8	0.06	4.03	4.56	27.38	9.82	45.30	8.78	0.06
Gonder	6	1	13.41	26.83	0.17	0.17	16.23	0.17	21.56	21.45
Gonder	6	2	1.15	69.75	1.27	1.64	6.60	2.15	6.21	11.24
Gonder	6	3	17.13	32.81	0.18	0.18	9.41	9.64	30.48	0.18
Gonder	6	4	0.26	53.01	0.26	0.26	0.26	0.26	45.44	0.26
Gonder	6	5	5.55	31.11	0.10	8.99	21.51	8.35	24.30	0.10
Gonder	6	6	0.07	0.07	4.33	16.57	26.54	21.00	11.83	19.59
Gonder	6	7	0.19	23.94	0.19	50.75	0.19	0.19	24.36	0.19
Gonder	6	8	0.67	3.25	0.01	0.83	6.29	1.02	87.12	0.81
Bahir Dar	1	1	0.72	1.15	1.27	3.96	2.01	4.58	79.74	6.56
Bahir Dar	1	2	1.05	3.83	2.36	4.75	1.61	3.65	73.39	9.37
Bahir Dar	1	3	0.29	10.97	1.21	4.97	1.69	2.24	67.42	11.20
Bahir Dar	1	4	0.25	9.11	0.95	4.37	3.20	1.12	61.89	19.10
Bahir Dar	1	5	1.54	12.42	1.50	4.94	1.80	2.27	68.78	6.75
Bahir Dar	1	6	14.52	8.85	1.04	3.56	12.05	1.61	51.53	6.84
Bahir Dar	1	7	1.53	3.63	1.56	3.58	1.53	2.38	76.04	9.75
Bahir Dar	1	8	2.59	12.80	1.23	4.56	2.51	2.21	68.04	6.07
Bahir Dar	2	1	1.60	11.71	1.40	5.30	3.77	3.51	67.20	5.50

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Bahir Dar	2	2	1.58	4.59	3.02	50.61	3.33	4.29	9.20	23.37
Bahir Dar	2	3	0.27	10.92	2.17	6.67	14.35	1.88	56.97	6.77
Bahir Dar	2	4	0.74	14.54	1.03	2.56	2.97	1.97	68.01	8.19
Bahir Dar	2	5	0.31	11.70	1.26	2.39	16.84	1.84	59.17	6.48
Bahir Dar	2	6	0.96	9.45	1.14	4.12	14.77	1.88	59.28	8.40
Bahir Dar	2	7	10.87	12.13	0.94	5.70	12.06	1.63	49.88	6.77
Bahir Dar	2	8	13.07	14.14	1.14	4.22	10.37	1.69	50.70	4.66
Bahir Dar	3	1	0.29	11.87	1.14	3.74	17.07	0.87	59.88	5.13
Bahir Dar	3	2	0.79	13.13	1.36	4.55	2.47	1.15	70.91	5.64
Bahir Dar	3	3	1.24	11.23	0.02	4.15	14.24	2.86	55.12	11.14
Bahir Dar	3	4	11.48	10.39	0.96	4.75	12.67	2.71	50.10	6.94
Bahir Dar	3	5	11.65	9.79	1.11	2.16	2.25	1.95	59.59	11.51
Bahir Dar	3	6	10.96	10.06	0.96	5.30	12.61	1.84	51.98	6.30
Bahir Dar	3	7	80.78	0.37	0.37	0.63	0.35	0.49	15.53	1.47
Bahir Dar	3	8	55.75	4.69	0.44	1.78	1.12	8.83	24.16	3.23
Bahir Dar	4	1	31.63	12.56	1.15	1.50	1.69	2.17	46.71	2.58
Bahir Dar	4	2	88.57	1.75	0.17	0.46	0.18	0.35	7.55	0.96
Bahir Dar	4	3	6.48	5.29	0.06	7.47	8.40	66.17	6.07	0.06
Bahir Dar	4	4	0.01	7.45	14.80	15.07	13.59	23.20	13.94	11.94
Bahir Dar	4	5	13.24	10.83	0.02	20.91	8.03	22.77	10.71	13.49
Bahir Dar	4	6	5.58	1.21	16.63	29.14	12.49	24.05	7.38	3.51
Bahir Dar	4	7	7.80	16.20	4.87	12.37	10.17	11.35	26.06	11.18
Bahir Dar	4	8	0.38	2.33	1.30	3.17	2.55	4.73	80.70	4.85
Bahir Dar	5	1	0.82	1.15	1.27	2.76	2.47	2.59	80.47	8.49
Bahir Dar	5	2	0.40	2.34	1.55	1.70	1.54	2.66	74.32	15.48
Bahir Dar	5	3	1.75	2.32	2.10	2.80	2.55	2.11	75.18	11.19
Bahir Dar	5	4	26.84	11.52	1.09	2.00	2.02	2.19	46.12	8.21
Bahir Dar	5	5	11.91	23.10	1.11	2.39	2.65	2.20	54.95	1.70
Bahir Dar	5	6	2.63	4.59	1.51	3.24	2.13	2.63	76.73	6.54
Bahir Dar	5	7	1.09	2.93	2.34	4.67	2.49	5.47	66.09	14.92
Bahir Dar	5	8	1.93	2.25	1.80	3.71	3.04	2.36	80.45	4.46
D. Markos	1	1	4.00	0.06	32.42	12.15	27.87	19.66	3.80	0.06
D. Markos	1	2	8.47	10.66	0.03	12.99	13.24	0.03	54.57	0.03
D. Markos	1	3	8.01	9.61	0.03	12.33	19.23	12.59	38.18	0.03
D. Markos	1	4	5.30	11.30	0.02	6.79	16.23	7.66	39.89	12.81
D. Markos	1	5	5.52	7.87	0.02	9.97	12.35	4.05	47.51	12.70
D. Markos	1	6	10.67	13.03	0.03	13.34	15.96	7.32	19.65	20.01
D. Markos	1	7	10.22	21.78	0.02	12.15	13.19	20.70	6.34	15.60
D. Markos	1	8	0.81	3.62	0.02	2.70	1.42	7.76	75.65	8.02
D. Markos	2	1	1.52	6.66	0.03	3.11	2.10	4.27	70.02	12.29
D. Markos	2	2	1.11	6.23	0.03	2.47	2.19	3.04	74.09	10.85
D. Markos	2	3	0.31	8.37	0.66	4.96	2.25	1.22	66.19	16.04
D. Markos	2	4	0.36	5.81	0.03	5.40	3.47	3.17	71.70	10.06
D. Markos	2	5	0.27	6.53	0.02	5.00	2.79	2.10	65.10	18.20
D. Markos	2	6	0.85	0.65	0.03	4.80	2.38	3.32	64.36	23.61
D. Markos	3	1	0.88	4.89	0.03	4.52	1.68	4.84	68.09	15.07
D. Markos	3	2	1.07	6.13	0.04	5.21	0.04	3.47	72.61	11.44

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
D. Markos	3	3	0.91	5.95	0.02	3.05	2.67	5.20	79.60	2.59
D. Markos	3	4	1.17	5.26	0.03	2.54	1.89	2.00	71.08	16.02
D. Markos	3	5	1.08	5.73	0.03	5.02	3.63	3.24	70.43	10.83
D. Markos	3	6	0.97	3.10	0.04	5.24	3.54	5.25	70.09	11.77
D. Markos	3	7	1.05	5.17	0.87	2.90	4.27	4.99	70.37	10.36
D. Markos	3	8	0.91	0.57	4.79	6.98	2.77	6.07	62.57	15.33
D. Markos	4	1	1.37	1.63	0.04	4.60	0.04	5.31	76.71	10.29
D. Markos	4	2	0.72	1.36	0.52	3.32	1.22	2.44	78.09	12.34
D. Markos	4	3	7.31	6.57	0.04	3.37	2.76	1.69	51.81	26.45
D. Markos	4	4	0.30	11.03	0.89	5.30	3.40	2.25	72.54	4.30
D. Markos	4	5	0.71	8.87	1.49	3.03	1.14	2.25	73.89	8.61
D. Markos	4	6	2.44	3.64	0.02	5.25	3.63	10.57	66.18	8.27
D. Markos	4	7	0.29	0.54	1.35	3.96	4.02	3.42	78.59	7.82
D. Markos	4	8	7.17	7.71	0.66	4.27	12.50	3.71	56.12	7.86
D. Markos	5	1	3.41	1.34	2.23	3.35	1.91	4.71	73.70	9.35
D. Markos	5	2	11.42	11.93	1.13	6.25	1.98	1.83	59.67	5.78
D. Markos	5	3	4.40	2.81	2.73	5.25	3.84	2.31	72.60	6.05
D. Markos	5	4	0.32	12.88	2.18	3.64	1.69	1.18	73.27	4.83
D. Markos	5	5	1.42	13.32	1.84	4.65	1.60	3.99	64.72	8.46
D. Markos	5	6	21.53	0.80	1.66	2.61	1.09	3.48	59.99	8.84
D. Markos	5	7	0.76	20.50	1.15	4.54	1.46	2.55	65.16	3.89
D. Markos	5	8	2.05	1.50	2.94	3.70	6.16	3.43	76.01	4.21
Holeta	1	1	2.97	0.04	17.47	9.17	7.68	4.26	44.31	14.10
Holeta	1	2	6.90	11.35	11.44	23.72	16.23	0.16	30.04	0.16
Holeta	1	3	2.36	7.12	7.74	32.46	10.51	0.08	39.64	0.08
Holeta	1	4	13.80	6.16	8.33	14.16	22.55	0.13	34.72	0.13
Holeta	1	5	10.78	9.05	11.78	24.49	12.19	0.20	31.31	0.20
Holeta	1	6	11.18	12.07	12.17	17.15	18.22	0.18	28.85	0.18
Holeta	1	7	8.42	9.72	0.17	12.97	14.95	0.17	53.43	0.17
Holeta	2	1	11.30	10.27	0.23	13.76	16.58	0.23	47.40	0.23
Holeta	2	2	3.59	10.39	10.48	11.48	36.28	9.82	17.88	0.08
Holeta	2	3	8.38	7.23	16.11	16.37	22.51	0.19	29.00	0.19
Holeta	2	4	5.77	44.57	0.13	7.58	8.09	0.13	33.59	0.13
Holeta	2	5	5.46	50.30	0.10	7.31	8.32	0.10	28.29	0.10
Holeta	2	6	4.32	33.35	0.09	15.57	16.00	7.80	22.78	0.09
Holeta	2	7	7.28	9.19	8.34	11.47	12.46	0.10	40.05	11.10
Holeta	2	8	3.89	43.10	5.27	5.37	0.05	3.55	29.46	9.31
Holeta	3	1	6.31	37.64	0.18	14.49	15.55	0.18	25.47	0.18
Holeta	3	2	11.38	11.59	0.29	0.29	17.53	0.29	58.33	0.29
Holeta	3	3	12.24	12.23	0.25	14.06	15.11	0.25	45.61	0.25
Holeta	3	4	6.11	3.35	6.90	16.18	33.73	24.65	0.05	9.03
Holeta	3	5	4.47	38.29	0.09	6.08	27.20	0.09	23.68	0.09
Holeta	3	6	4.89	39.12	0.11	14.56	7.80	8.33	25.09	0.11
Holeta	3	7	4.27	34.16	0.11	21.45	13.26	6.29	20.34	0.11
Holeta	3	8	4.46	47.00	5.83	6.78	8.32	0.06	27.49	0.06
Holeta	4	1	4.51	42.92	0.08	22.26	6.83	0.08	23.24	0.08
Holeta	4	2	10.22	19.45	17.54	0.17	12.80	0.17	39.47	0.17

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Holeta	4	3	4.85	19.19	13.46	13.12	30.18	0.15	18.91	0.15
Holeta	4	4	7.21	62.66	0.16	0.16	0.16	0.16	29.34	0.16
Holeta	4	5	6.29	52.97	0.13	8.08	0.13	0.13	32.14	0.13
Holeta	4	6	3.79	48.57	7.28	7.42	0.06	3.93	28.89	0.06
Holeta	5	1	3.03	29.32	8.96	9.58	0.05	15.14	16.59	17.33
Holeta	5	2	5.20	52.12	7.57	7.07	0.11	0.11	27.71	0.11
Holeta	5	3	5.10	10.87	12.94	0.10	38.18	32.60	0.10	0.10
Holeta	5	4	27.17	45.83	0.09	6.02	0.09	0.09	20.63	0.09
Holeta	5	5	6.25	57.14	0.15	8.74	0.15	0.15	27.28	0.15
Holeta	5	6	4.03	55.45	0.10	7.06	7.18	0.10	25.98	0.10
Holeta	6	1	4.06	45.26	6.72	6.83	0.07	0.07	26.27	10.72
Holeta	6	2	4.85	23.28	0.07	0.07	14.90	8.04	26.67	22.12
Holeta	6	3	12.70	19.00	0.06	12.13	13.79	0.06	24.02	18.24
Holeta	6	4	7.27	21.84	8.16	17.06	9.96	0.14	35.43	0.14
Holeta	6	5	11.89	0.14	0.14	16.36	35.81	14.64	20.88	0.14
Holeta	6	6	36.63	57.75	0.94	0.94	0.94	0.94	0.94	0.94
Holeta	6	7	13.06	32.64	12.05	19.42	22.11	0.24	0.24	0.24
Shashem	1	1	16.95	30.12	9.83	28.59	14.01	0.17	0.17	0.17
Shashem	1	2	7.85	22.74	45.93	9.35	13.71	0.14	0.14	0.14
Shashem	1	3	3.29	8.48	5.77	23.01	12.61	0.06	46.72	0.06
Shashem	1	4	16.81	0.27	17.29	26.57	38.27	0.27	0.27	0.27
Shashem	1	5	9.42	5.80	23.37	0.15	39.30	0.15	21.67	0.15
Shashem	1	6	16.72	48.03	16.10	18.24	0.23	0.23	0.23	0.23
Shashem	1	7	8.24	16.95	0.21	73.78	0.21	0.21	0.21	0.21
Shashem	2	1	11.07	0.15	0.15	17.01	29.41	13.53	28.53	0.15
Shashem	2	2	11.35	6.23	40.05	0.18	24.61	0.18	17.21	0.18
Shashem	2	3	15.55	41.65	0.31	17.03	24.55	0.31	0.31	0.31
Shashem	2	4	13.11	35.52	12.07	16.89	21.70	0.24	0.24	0.24
Shashem	2	5	18.53	46.86	0.43	0.43	32.45	0.43	0.43	0.43
Shashem	2	6	21.77	0.60	0.60	0.60	74.61	0.60	0.60	0.60
Shashem	2	7	45.18	0.32	0.32	0.32	52.90	0.32	0.32	0.32
Shashem	2	8	6.14	47.06	0.16	35.60	10.56	0.16	0.16	0.16
Shashem	3	1	37.06	0.87	0.87	0.87	57.74	0.87	0.87	0.87
Shashem	3	2	21.13	0.26	19.96	18.57	39.30	0.26	0.26	0.26
Shashem	3	3	22.26	15.02	0.26	0.26	42.56	19.12	0.26	0.26
Shashem	3	4	6.96	56.90	6.37	8.74	13.22	0.11	7.60	0.11
Shashem	3	5	3.42	27.28	22.03	46.90	0.09	0.09	0.09	0.09
Shashem	3	6	9.20	0.15	62.47	0.15	14.73	0.15	13.00	0.15
Shashem	3	7	8.92	67.24	0.15	8.98	14.24	0.15	0.15	0.15
Shashem	3	8	7.51	72.70	0.13	8.28	11.01	0.13	0.13	0.13
Shashem	4	1	5.63	62.37	14.37	7.27	10.11	0.08	0.08	0.08
Shashem	4	2	27.90	37.35	0.45	0.45	32.51	0.45	0.45	0.45
Shashem	4	3	20.14	6.80	26.66	0.15	24.26	12.23	9.60	0.15
Shashem	4	4	5.58	41.20	0.13	52.58	0.13	0.13	0.13	0.13
Shashem	4	5	2.66	6.48	1.39	7.14	64.82	2.02	13.00	2.48
Shashem	4	6	5.03	54.50	30.29	0.10	9.78	0.10	0.10	0.10
Shashem	4	7	4.36	54.34	10.15	6.36	9.43	0.09	15.17	0.09

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Shashem	4	8	8.18	5.49	18.59	0.17	52.69	14.54	0.17	0.17
Shashem	5	1	11.94	34.76	0.08	52.89	0.08	0.08	0.08	0.08
Shashem	5	2	5.88	72.20	0.08	0.08	11.26	0.08	10.34	0.08
Shashem	5	3	4.44	52.54	27.53	6.52	8.71	0.09	0.09	0.09
Shashem	5	4	3.83	53.30	30.66	5.83	6.19	0.06	0.06	0.06
Shashem	5	5	6.16	64.48	5.07	7.66	7.97	0.08	8.47	0.08
Shashem	5	6	5.40	7.49	24.36	0.16	30.75	12.33	19.36	0.16
Shashem	5	7	11.66	4.21	0.13	0.13	17.24	46.32	20.16	0.13
Shashem	5	8	5.92	58.27	29.29	6.21	0.08	0.08	0.08	0.08
Shashem	6	1	23.88	5.23	0.10	0.10	70.41	0.10	0.10	0.10
Shashem	6	2	6.84	21.53	2.02	60.82	8.70	0.03	0.03	0.03
Shashem	6	3	23.23	75.50	0.21	0.21	0.21	0.21	0.21	0.21
Shashem	6	4	8.74	78.76	11.48	0.20	0.20	0.20	0.20	0.20
Shashem	6	5	3.01	60.66	31.72	4.42	0.05	0.05	0.05	0.05
Shashem	6	6	3.35	58.90	26.26	4.94	6.43	0.04	0.04	0.04
Shashem	6	7	8.15	90.45	0.23	0.23	0.23	0.23	0.23	0.23
A. Maryam	1	1	6.34	2.23	67.44	0.60	0.57	19.04	3.22	0.57
A. Maryam	1	2	3.37	6.59	4.62	2.56	28.63	43.72	9.51	0.99
A. Maryam	1	3	2.56	8.89	29.49	9.20	0.16	47.58	2.00	0.13
A. Maryam	1	4	1.15	25.74	50.49	12.39	0.76	6.61	1.32	1.55
A. Maryam	1	5	4.32	10.97	29.98	7.07	17.96	22.23	4.28	3.18
A. Maryam	1	6	4.06	3.96	10.58	32.35	16.18	26.37	2.10	4.41
A. Maryam	1	7	1.02	0.54	19.76	3.95	18.40	55.69	0.50	0.15
A. Maryam	2	1	20.62	2.84	48.78	9.27	10.10	5.43	2.05	0.91
A. Maryam	2	2	13.85	4.14	1.21	16.23	28.93	32.33	2.43	0.89
A. Maryam	2	3	6.20	1.12	50.66	9.63	13.17	17.65	0.46	1.10
A. Maryam	2	4	3.27	2.60	48.47	6.06	13.38	24.57	1.22	0.44
A. Maryam	2	5	4.55	1.48	20.46	12.53	31.41	28.85	0.71	0.01
A. Maryam	2	6	15.41	4.29	1.50	1.61	34.30	38.30	2.49	2.10
A. Maryam	2	7	6.34	3.11	60.11	5.64	11.82	11.22	1.28	0.48
A. Maryam	2	8	28.00	4.88	3.66	2.66	25.92	29.00	5.15	0.74
A. Maryam	3	1	2.35	5.41	1.27	7.93	3.35	73.80	5.04	0.85
A. Maryam	3	2	3.16	4.25	26.56	4.78	35.80	22.06	2.76	0.64
A. Maryam	3	3	15.66	15.01	3.12	3.36	5.29	34.83	20.78	1.95
A. Maryam	3	4	0.20	2.41	61.25	9.37	9.62	13.62	3.17	0.36
A. Maryam	3	5	1.99	2.90	22.31	5.68	35.02	24.08	3.63	4.38
A. Maryam	3	6	11.48	6.11	12.57	12.88	12.44	41.83	2.60	0.08
A. Maryam	4	1	36.55	13.39	0.11	42.63	6.98	0.11	0.11	0.11
A. Maryam	4	2	2.38	1.20	32.67	5.59	23.96	27.37	2.49	4.34
A. Maryam	4	3	36.91	6.25	0.10	39.50	5.72	0.10	3.45	7.98
A. Maryam	4	4	43.58	19.27	0.31	35.59	0.31	0.31	0.31	0.31
A. Maryam	4	5	11.69	2.60	55.34	6.00	6.32	10.40	4.46	3.19
A. Maryam	4	6	37.70	17.00	0.16	0.16	39.91	4.74	0.16	0.16
A. Maryam	4	7	21.00	7.01	10.70	27.47	7.57	25.98	0.13	0.13
A. Maryam	5	1	0.31	2.54	50.83	7.65	19.11	16.46	0.81	2.29
A. Maryam	5	2	9.19	3.63	3.03	24.14	29.42	26.43	1.13	3.03
A. Maryam	5	3	8.79	0.77	8.25	62.09	4.48	14.58	0.48	0.55

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
A. Maryam	5	4	9.97	1.33	66.88	5.06	7.37	4.97	1.24	3.17
A. Maryam	5	5	2.78	1.14	10.34	13.74	30.33	33.93	2.38	5.36
A. Maryam	5	6	9.35	2.38	63.13	6.48	6.48	9.69	0.91	1.55
A. Maryam	5	7	6.12	1.37	34.55	8.05	18.25	28.13	0.80	2.73
A. Maryam	5	8	2.57	1.91	1.24	11.05	53.62	24.21	4.92	0.48
Mega	1	1	24.58	0.52	38.46	0.52	34.37	0.52	0.52	0.52
Mega	1	2	3.53	18.08	5.95	15.04	28.10	6.62	18.70	3.98
Mega	1	3	0.21	0.21	0.21	98.50	0.21	0.21	0.21	0.21
Mega	1	4	6.01	1.94	32.00	6.89	32.96	14.64	1.09	4.46
Mega	1	5	10.13	1.42	25.25	7.32	36.34	9.62	6.38	3.55
Mega	1	6	37.29	2.82	50.18	9.25	0.12	0.12	0.12	0.12
Mega	1	7	3.96	1.60	31.05	5.63	40.17	11.24	1.92	4.43
Mega	2	1	13.25	1.30	12.87	14.21	45.24	9.69	1.04	2.40
Mega	2	2	9.42	0.71	39.24	8.59	24.02	16.43	0.41	1.17
Mega	2	3	9.42	0.71	39.24	8.59	24.02	16.43	0.41	1.17
Mega	2	4	11.28	4.68	20.68	10.35	29.53	8.10	6.93	8.45
Mega	2	5	19.53	1.03	58.54	4.20	9.81	3.52	1.01	2.36
Mega	2	6	11.79	1.95	36.76	6.52	19.57	14.13	4.76	4.52
Mega	2	7	18.39	0.90	41.82	2.41	26.77	2.68	3.95	3.08
Mega	2	8	8.43	2.43	45.11	3.03	25.81	6.76	3.06	5.38
Mega	3	1	16.13	2.81	1.72	7.52	42.69	22.23	1.42	5.47
Mega	3	2	17.20	0.92	57.44	6.13	9.15	6.52	1.00	1.64
Mega	3	3	13.07	3.15	35.67	7.36	28.17	5.58	2.68	4.31
Mega	3	4	8.08	2.76	45.70	5.05	24.60	9.07	3.66	1.08
Mega	3	5	8.83	2.43	43.90	11.35	21.16	5.79	3.01	3.52
Mega	3	6	22.91	4.44	42.83	25.08	4.62	0.04	0.04	0.04
Mega	3	7	10.72	2.18	40.03	19.83	21.47	4.06	0.52	1.19
Mega	3	8	15.11	1.16	56.91	2.87	16.63	5.80	0.62	0.91
Mega	4	1	0.11	5.87	39.26	4.76	34.03	6.79	3.31	5.86
Mega	4	2	3.56	2.28	28.47	6.00	39.05	5.02	5.98	9.65
Mega	4	3	3.84	0.72	1.59	0.92	57.58	30.37	4.10	0.88
Mega	4	4	14.08	1.57	57.47	5.86	10.92	6.32	1.73	2.06
Mega	4	5	7.46	6.02	1.76	7.97	53.14	16.88	3.83	2.95
Mega	4	6	8.10	2.77	68.81	3.02	10.12	3.40	2.22	1.56
Mega	4	7	12.57	2.14	33.59	8.59	27.42	8.80	3.07	3.82
Mega	4	8	5.20	2.26	76.27	2.36	9.54	1.63	1.40	1.34
Mega	5	1	4.00	2.24	19.78	6.33	40.56	16.48	4.78	5.83
Mega	5	2	17.31	3.93	46.28	9.55	12.88	5.09	0.05	4.90
Mega	5	3	44.99	2.60	39.85	3.85	4.14	4.50	0.03	0.03
Mega	5	4	6.58	1.69	51.59	4.93	20.56	10.79	3.24	0.61
Mega	5	5	10.47	3.26	2.83	12.68	12.30	51.03	5.52	1.91
Mega	5	6	1.22	1.30	51.43	5.41	23.64	15.02	1.34	0.64
Mega	5	7	0.20	1.16	0.52	7.76	54.74	31.71	3.50	0.41

10.3 Westcentral Africa

10.3.1 Morphometric Data

Locality	C	S.	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Kumba	1	1	0.23	5.93	2.51	2.12	97.6	25.0	81.8	42.9	6	2	8
Kumba	1	2	0.25	5.85	2.54	2.19	104.6	25.1	86.9	36.1	6	4	8
Kumba	1	3	0.19	5.57	2.58	2.05	107.0	25.6	91.9	41.3	8	5	9
Kumba	1	4	0.25	5.57	2.47	2.12	106.0	28.4	92.5	41.5	6	6	8
Kumba	1	5	0.23	5.71	2.58	2.09	112.1	26.3	97.6	54.6	6	7	8
Kumba	1	6	0.26	5.78	2.47	2.05	110.8	25.8	96.3	52.5	9	7	8
Kumba	1	7	0.21	5.71	2.61	2.23	103.2	21.6	87.2	44.9	8	4	7
Kumba	1	8	0.21	5.85	2.54	2.16	103.0	23.9	90.9	36.6	8	4	8
Kumba	1	9	0.21	5.71	2.51	2.16	98.7	23.8	86.6	36.2	6	4	8
Kumba	1	10	0.23	5.00	2.47	2.02	110.4	27.0	92.5	49.3	8	4	7
Kumba	1	11	0.25	5.28	2.61	2.23	102.0	23.2	93.4	38.4	8	5	8
Kumba	1	12	0.19	5.00	2.54	2.09	107.9	28.9	96.5	43.1	6	7	7
Kumba	1	13	0.21	5.64	2.54	2.23	106.8	21.1	91.2	45.1	8	7	8
Kumba	1	14	0.23	5.36	2.51	2.12	106.8	20.9	91.3	45.0	6	4	8
Kumba	1	15	0.19	5.64	2.54	2.19	105.2	23.6	97.9	40.8	8	4	8
Kumba	1	16	0.23	5.78	2.47	2.09	100.0	22.3	90.6	32.3	8	5	8
Kumba	1	17	0.25	5.36	2.58	2.16	107.0	23.5	84.8	46.0	8	5	8
Kumba	1	18	0.26	5.64	2.61	2.12	102.8	22.7	92.6	48.2	8	7	8
Kumba	1	19	0.26	5.00	2.47	2.09	112.9	25.4	91.4	45.6	8	7	8
Kumba	1	20	0.21	5.00	2.51	2.02	102.7	20.4	85.3	44.6	8	7	7
Kumba	2	1	0.23	6.00	2.64	2.16	90.7	20.8	90.6	44.2	6	5	7
Kumba	2	2	0.25	5.85	2.58	2.19	107.5	22.4	96.3	42.2	8	3	8
Kumba	2	3	0.23	5.71	2.54	2.05	94.2	17.0	81.7	42.8	8	4	8
Kumba	2	4	0.21	5.36	2.64	2.19	102.6	22.7	91.5	37.2	9	8	9
Kumba	2	5	0.19	6.00	2.64	2.16	111.8	21.3	85.7	39.1	9	4	8
Kumba	2	6	0.23	5.07	2.58	2.12	109.7	24.2	92.8	42.8	8	2	8
Kumba	2	7	0.28	5.21	2.68	2.19	104.0	21.4	82.6	42.5	6	3	9
Kumba	2	8	0.23	6.00	2.61	2.05	105.6	17.3	88.8	41.1	7	6	9
Kumba	2	9	0.18	5.36	2.61	2.12	100.9	22.7	91.1	37.2	9	6	8
Kumba	2	10	0.23	5.93	2.58	2.09	110.3	23.2	89.5	43.4	9	6	8
Kumba	2	11	0.18	4.86	2.68	2.16	100.8	18.4	91.0	41.6	6	4	8
Kumba	2	12	0.23	5.21	2.58	2.19	102.5	21.7	89.7	42.5	8	4	9
Kumba	2	13	0.18	5.50	2.54	2.12	90.0	21.2	89.8	42.8	9	4	8
Kumba	2	14	0.25	5.57	2.47	2.09	96.5	17.8	89.2	38.0	8	8	8
Kumba	2	15	0.19	5.00	2.54	2.05	106.8	20.9	89.6	44.3	8	4	8
Kumba	2	16	0.25	5.85	2.58	2.16	90.0	19.1	81.9	36.5	8	4	8
Kumba	2	17	0.21	5.36	2.61	2.58	107.1	25.8	88.7	35.1	8	4	9
Kumba	2	18	0.21	5.14	2.61	2.19	106.5	20.4	84.4	41.3	8	3	8
Kumba	2	19	0.28	5.00	2.61	2.16	102.1	19.4	86.2	36.1	9	7	9
Kumba	3	1	0.21	4.86	2.54	2.12	101.7	21.4	93.0	37.8	8	7	8
Kumba	3	2	0.23	5.00	2.54	2.26	101.0	19.9	84.9	36.2	8	6	8
Kumba	3	3	0.18	5.71	2.58	2.19	108.4	18.9	83.7	36.0	8	4	9
Kumba	3	4	0.23	5.07	2.58	2.16	103.3	21.6	80.9	38.4	8	4	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Kumba	3	5	0.21	4.78	2.58	2.26	108.1	20.1	84.8	35.3	6	0	9
Kumba	3	6	0.23	5.00	2.54	2.16	99.3	20.8	84.4	35.2	8	6	8
Kumba	3	7	0.25	5.00	2.47	2.19	102.0	19.5	79.5	34.6	6	4	9
Kumba	3	8	0.21	5.07	2.64	2.26	99.5	17.7	83.3	36.2	6	1	9
Kumba	3	9	0.19	4.93	2.58	2.16	107.3	19.5	83.5	33.0	6	6	8
Kumba	3	10	0.25	4.71	2.51	2.16	97.5	17.8	85.7	35.6	6	4	8
Kumba	3	11	0.26	4.78	2.47	2.12	115.0	19.4	86.3	34.9	6	4	8
Kumba	3	12	0.21	5.00	2.54	2.23	108.3	19.6	87.1	35.7	6	4	9
Kumba	3	13	0.26	5.00	2.51	2.23	95.8	19.4	85.4	37.4	5	2	8
Kumba	3	14	0.23	4.36	2.51	2.19	111.4	20.3	85.5	40.7	6	4	7
Kumba	3	15	0.26	4.93	2.58	2.26	109.3	16.5	91.2	34.0	6	6	9
Kumba	3	16	0.21	5.36	2.54	2.30	106.9	21.5	89.8	35.9	6	4	8
Kumba	3	17	0.23	5.07	2.54	2.12	106.2	16.5	89.7	42.1	5	4	9
Kumba	3	18	0.21	5.14	2.54	2.19	92.6	20.1	83.8	35.3	6	6	8
Kumba	3	19	0.23	5.14	2.58	2.09	94.7	20.1	86.0	40.4	4	0	9
Kumba	3	20	0.21	4.93	2.47	2.19	102.3	22.3	87.9	34.2	8	4	7
Kumba	4	1	0.23	4.93	2.54	2.23	101.9	18.4	83.9	35.0	8	4	8
Kumba	4	2	0.19	4.93	2.64	2.16	112.9	18.8	91.4	36.7	5	1	7
Kumba	4	3	0.21	5.28	2.54	2.12	108.7	21.1	89.2	39.2	6	1	8
Kumba	4	4	0.18	5.21	2.58	2.16	97.2	19.6	92.3	45.0	6	6	8
Kumba	4	5	0.21	5.00	2.51	2.12	109.5	17.2	88.9	37.5	8	4	9
Kumba	4	6	0.19	4.93	2.47	2.09	106.6	20.6	92.3	40.1	6	6	8
Kumba	4	7	0.23	5.00	2.40	2.40	106.2	21.0	90.3	35.2	6	6	8
Kumba	4	8	0.16	5.28	2.58	2.09	110.6	17.7	93.3	33.5	5	1	8
Kumba	4	9	0.19	5.07	2.51	2.09	103.9	21.8	87.2	36.5	6	6	8
Kumba	4	10	0.16	5.07	2.54	2.19	110.0	17.1	87.2	38.3	6	6	8
Kumba	4	11	0.23	5.00	2.54	2.16	108.9	19.8	90.2	38.7	6	4	8
Kumba	4	12	0.23	5.00	2.54	2.12	105.6	20.8	86.4	39.8	6	4	8
Kumba	4	13	0.19	5.43	2.37	2.16	107.6	23.9	92.0	41.0	6	6	8
Kumba	4	14	0.21	5.00	2.61	2.16	104.9	20.7	88.6	37.6	9	6	8
Kumba	4	15	0.18	5.28	2.61	2.23	110.9	24.5	90.3	46.9	5	1	7
Kumba	4	16	0.21	4.78	2.51	2.09	105.0	18.7	91.8	34.9	5	1	8
Kumba	4	17	0.21	5.00	2.54	2.09	108.8	22.1	90.0	37.9	8	7	8
Kumba	4	18	0.19	5.36	2.51	2.05	105.2	21.8	90.5	38.5	5	0	8
Kumba	4	19	0.25	5.00	2.54	2.09	99.8	23.5	89.3	41.3	8	4	8
Kumba	4	20	0.18	4.78	2.54	2.02	104.3	18.8	85.7	39.9	8	6	8
Mamfe	1	1	0.25	5.00	2.58	2.12	105.9	21.7	86.1	35.4	5	0	8
Mamfe	1	2	0.26	6.00	2.58	2.09	100.8	19.3	92.4	37.7	5	0	7
Mamfe	1	3	0.21	4.86	2.61	2.23	105.7	18.6	85.2	40.3	8	4	8
Mamfe	1	4	0.23	6.07	2.64	2.12	107.2	24.3	92.0	34.6	5	0	7
Mamfe	1	5	0.18	4.93	2.58	2.12	110.2	19.8	86.2	34.0	5	0	7
Mamfe	1	6	0.25	4.86	2.61	2.09	104.4	21.2	90.7	42.1	8	1	9
Mamfe	1	7	0.21	6.00	2.54	2.09	103.7	19.8	93.1	39.1	5	2	7
Mamfe	1	8	0.18	4.78	2.54	2.16	107.0	18.1	92.8	36.7	5	0	8
Mamfe	1	9	0.21	4.78	2.54	2.23	103.5	21.6	87.9	41.5	6	2	8
Mamfe	1	10	0.25	4.93	2.61	2.16	103.9	20.8	87.5	41.1	6	2	9
Mamfe	1	11	0.21	4.86	2.54	2.19	98.5	24.7	88.4	39.9	6	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Mamfe	1	12	0.23	5.36	2.64	2.16	100.5	17.0	90.5	34.9	6	6	8
Mamfe	1	13	0.23	6.00	2.61	2.16	108.6	20.5	86.1	35.1	6	0	8
Mamfe	1	14	0.23	4.86	2.61	2.12	101.8	22.2	90.1	38.4	8	4	9
Mamfe	1	15	0.19	5.93	2.51	2.09	107.0	20.8	86.5	39.5	6	1	8
Mamfe	1	16	0.25	5.85	2.58	2.16	105.0	23.4	91.1	35.3	4	0	8
Mamfe	1	17	0.23	4.71	2.71	2.16	94.8	21.5	89.3	37.1	5	0	9
Mamfe	1	18	0.25	5.00	2.58	2.12	103.2	22.6	88.3	35.2	6	4	8
Mamfe	1	19	0.23	5.07	2.61	2.19	109.3	21.6	87.1	37.3	6	4	9
Mamfe	1	20	0.23	5.00	2.61	2.16	105.2	25.1	95.4	41.5	5	0	8
Mamfe	2	1	0.23	5.85	2.64	2.09	107.2	20.6	89.0	41.2	6	2	8
Mamfe	2	2	0.18	5.71	2.58	2.12	103.8	18.2	90.1	38.0	9	3	8
Mamfe	2	3	0.26	4.71	2.58	2.09	95.1	20.7	87.0	40.7	6	1	8
Mamfe	2	4	0.21	4.64	2.58	2.19	97.3	17.7	87.1	40.3	6	2	8
Mamfe	2	5	0.26	4.86	2.58	2.16	107.8	18.6	82.6	36.8	8	4	8
Mamfe	2	6	0.23	4.64	2.51	2.19	102.2	22.8	87.1	41.5	8	3	9
Mamfe	2	7	0.23	4.78	2.54	2.09	101.3	21.0	89.7	38.3	8	5	8
Mamfe	2	8	0.23	4.86	2.61	2.05	104.6	24.3	89.8	37.9	6	6	8
Mamfe	2	9	0.26	4.93	2.58	2.05	97.7	20.0	89.3	36.8	6	2	7
Mamfe	2	10	0.30	4.86	2.61	2.16	104.2	18.9	90.8	41.9	6	3	8
Mamfe	2	11	0.25	5.00	2.61	2.19	105.1	17.7	88.3	30.1	6	2	7
Mamfe	2	12	0.23	4.86	2.58	2.12	101.9	22.1	90.2	36.9	5	0	7
Mamfe	2	13	0.25	4.93	2.58	2.05	101.0	19.6	83.5	38.6	6	4	7
Mamfe	2	14	0.26	4.78	2.71	2.16	99.0	21.1	85.5	44.4	5	0	8
Mamfe	2	15	0.25	4.86	2.58	2.12	101.6	18.8	84.2	34.6	6	2	8
Mamfe	2	16	0.21	4.71	2.51	2.05	99.1	20.2	89.8	38.7	6	4	8
Mamfe	2	17	0.19	4.78	2.58	2.12	100.4	20.9	87.4	34.6	6	4	8
Mamfe	2	18	0.26	4.93	2.58	2.05	90.4	20.5	84.5	39.9	6	3	8
Mamfe	2	19	0.25	4.86	2.54	2.09	101.0	20.0	86.3	35.2	8	3	8
Mamfe	2	20	0.18	4.78	2.54	2.26	100.3	22.4	87.5	34.2	6	2	8
Mamfe	3	1	0.18	5.93	2.54	2.16	116.6	19.8	87.5	29.3	5	0	8
Mamfe	3	2	0.25	4.86	2.54	2.33	105.3	19.5	84.0	36.0	8	0	9
Mamfe	3	3	0.14	5.93	2.71	2.19	106.1	18.8	86.3	38.7	4	0	9
Mamfe	3	4	0.18	5.93	2.51	2.12	113.5	18.2	86.2	31.2	5	0	8
Mamfe	3	5	0.28	4.71	2.54	2.12	101.6	16.7	80.9	41.7	6	0	8
Mamfe	3	6	0.26	5.14	2.71	2.16	99.7	21.7	89.6	43.2	5	0	8
Mamfe	3	7	0.19	5.07	2.61	2.23	101.6	18.9	88.1	38.5	5	0	9
Mamfe	3	8	0.26	5.85	2.61	2.23	111.2	22.8	88.8	34.3	5	0	8
Mamfe	3	9	0.23	4.93	2.54	2.23	111.5	16.7	84.6	33.2	6	0	8
Mamfe	3	10	0.28	4.93	2.54	2.19	104.0	19.7	82.9	43.5	8	0	8
Mamfe	3	11	0.28	5.85	2.54	2.19	106.5	22.0	85.8	38.9	4	0	8
Mamfe	3	12	0.26	5.93	2.61	2.23	106.0	17.1	89.9	35.2	6	0	8
Mamfe	3	13	0.21	4.93	2.54	2.19	113.7	18.5	87.3	34.8	6	2	8
Mamfe	3	14	0.11	5.00	2.54	2.23	109.8	16.7	88.3	34.6	6	0	8
Mamfe	3	15	0.21	5.71	2.54	2.19	102.6	19.4	79.0	43.2	8	0	8
Mamfe	3	16	0.23	5.21	2.54	2.09	106.8	18.5	86.8	37.0	6	0	8
Mamfe	3	17	0.21	5.00	2.47	1.98	106.3	18.0	82.2	37.4	5	0	8
Mamfe	3	18	0.18	6.00	2.61	2.09	110.9	19.3	86.1	38.8	6	6	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Mamfe	3	19	0.26	6.07	2.51	2.16	95.1	19.1	83.4	39.1	6	0	8
Mamfe	3	20	0.21	5.07	2.44	2.05	97.3	15.8	84.5	39.4	8	2	7
Mamfe	4	1	0.28	4.86	2.51	2.09	97.1	21.9	93.1	30.3	5	0	8
Mamfe	4	2	0.21	5.00	2.51	2.05	99.7	16.7	88.2	39.3	6	2	8
Mamfe	4	3	0.21	5.21	2.54	2.09	109.8	20.1	85.6	38.9	6	0	8
Mamfe	4	4	0.12	5.00	2.54	2.23	106.7	15.8	83.4	30.8	5	0	8
Mamfe	4	5	0.18	5.07	2.58	2.19	105.4	22.1	86.6	38.7	9	7	9
Mamfe	4	6	0.25	5.36	2.58	2.12	106.4	21.5	84.0	36.8	9	7	9
Mamfe	4	7	0.25	4.86	2.61	2.09	99.9	19.5	89.5	35.2	5	0	9
Mamfe	4	8	0.21	5.14	2.58	2.12	106.6	20.9	84.4	36.2	6	1	8
Mamfe	4	9	0.23	5.14	2.61	2.09	105.8	18.7	89.0	34.5	8	0	8
Mamfe	4	10	0.23	5.00	2.51	2.16	108.8	20.4	82.4	26.2	8	2	8
Mamfe	4	11	0.23	5.14	2.54	2.16	97.9	17.3	85.3	32.2	8	4	8
Mamfe	4	12	0.23	5.50	2.61	2.23	109.7	16.9	82.6	38.5	9	6	8
Mamfe	4	13	0.23	5.21	2.58	2.16	95.5	19.3	87.0	32.1	9	4	8
Mamfe	4	14	0.37	5.93	2.64	2.19	111.8	22.4	80.4	39.6	5	0	7
Mamfe	4	15	0.18	4.78	2.64	2.23	96.6	20.0	87.2	41.3	9	4	8
Mamfe	4	16	0.23	5.07	2.54	2.19	108.2	19.6	86.1	34.5	9	4	8
Mamfe	4	17	0.21	5.14	2.64	2.23	92.6	19.7	86.5	31.3	6	2	8
Mamfe	4	18	0.25	5.07	2.61	2.19	112.9	17.5	89.2	34.0	9	6	8
Mamfe	4	19	0.21	4.86	2.68	2.16	109.0	18.0	90.1	33.3	8	2	7
Mamfe	4	20	0.25	4.78	2.58	2.16	98.1	20.0	87.5	40.5	5	0	7
Mamfe	5	1	0.18	4.78	2.51	2.05	115.8	22.1	85.6	40.8	6	1	9
Mamfe	5	2	0.19	5.14	2.47	2.05	111.5	20.3	84.9	43.6	6	2	8
Mamfe	5	3	0.25	4.78	2.58	2.12	109.1	24.5	86.5	40.6	6	4	8
Mamfe	5	4	0.28	4.86	2.51	2.05	119.2	19.1	94.5	36.4	6	0	9
Mamfe	5	5	0.21	4.93	2.61	2.12	104.6	16.3	82.7	41.6	6	2	9
Mamfe	5	6	0.18	5.21	2.54	2.05	108.8	18.3	91.0	40.5	8	1	9
Mamfe	5	7	0.18	4.86	2.51	2.12	113.6	18.9	88.1	35.8	5	1	9
Mamfe	5	8	0.26	5.93	2.54	2.12	107.8	20.5	88.7	42.0	6	0	8
Mamfe	5	9	0.23	5.78	2.58	2.09	110.2	17.3	88.1	40.9	6	4	7
Mamfe	5	10	0.21	5.07	2.51	2.05	101.4	17.7	90.8	39.0	5	0	8
Mamfe	5	11	0.21	5.78	2.44	2.05	115.0	18.5	88.2	43.8	5	0	7
Mamfe	5	12	0.21	5.00	2.58	2.05	108.9	24.8	92.4	42.0	6	0	9
Mamfe	5	13	0.23	4.78	2.47	2.12	110.3	23.4	91.7	40.4	6	2	8
Mamfe	5	14	0.18	4.86	2.51	2.12	112.3	20.4	84.5	37.0	6	4	7
Mamfe	5	15	0.25	5.00	2.58	2.12	95.6	18.1	84.0	41.3	8	1	7
Mamfe	5	16	0.21	5.85	2.51	2.05	103.6	16.4	83.4	43.8	5	4	8
Mamfe	5	17	0.26	4.86	2.47	2.12	116.3	19.4	83.0	45.7	6	1	8
Mamfe	5	18	0.19	5.85	2.51	2.09	109.1	22.2	80.7	34.7	8	2	9
Mamfe	5	19	0.25	4.78	2.54	2.02	108.8	19.8	87.0	42.7	5	0	8
Mamfe	5	20	0.23	5.21	2.54	2.05	107.7	18.9	91.9	37.7	4	6	9
Bamenda	1	1	0.28	5.07	2.68	2.19	105.6	22.6	82.8	30.1	8	6	8
Bamenda	1	2	0.28	5.00	2.61	2.19	108.7	19.7	82.6	39.8	8	4	8
Bamenda	1	3	0.30	5.07	2.54	2.16	111.1	24.7	89.1	38.2	6	4	7
Bamenda	1	4	0.32	5.07	2.61	2.12	111.6	22.5	85.1	36.7	8	2	8
Bamenda	1	5	0.23	5.00	2.61	2.16	108.3	18.6	80.7	37.4	6	2	7

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Bamenda	1	6	0.26	5.00	2.54	2.12	100.2	22.8	83.3	37.9	5	0	8
Bamenda	1	7	0.47	5.00	2.68	2.19	108.3	20.1	81.4	39.9	6	4	5
Bamenda	1	8	0.26	5.07	2.54	2.16	102.7	25.2	89.1	38.5	6	2	5
Bamenda	1	9	0.33	5.07	2.64	2.26	102.1	18.0	86.2	33.9	6	4	5
Bamenda	1	10	0.23	5.00	2.58	2.23	104.1	22.2	90.9	33.7	6	0	8
Bamenda	1	11	0.23	6.07	2.64	2.30	98.9	23.2	89.3	36.8	8	4	8
Bamenda	1	12	0.26	5.07	2.64	2.23	103.7	20.1	82.2	41.5	8	4	7
Bamenda	1	13	0.25	5.21	2.64	2.12	110.3	20.9	83.4	32.4	8	0	6
Bamenda	1	14	0.26	5.14	2.61	2.19	94.3	19.6	88.8	32.9	5	0	5
Bamenda	1	15	0.23	4.93	2.54	2.19	103.5	21.9	84.3	35.4	5	0	5
Bamenda	1	16	0.25	4.93	2.54	2.23	98.2	27.2	93.1	47.6	6	0	8
Bamenda	1	17	0.26	4.93	2.58	2.26	107.9	20.4	88.1	32.7	6	2	8
Bamenda	2	1	0.28	5.00	2.54	2.16	102.2	30.7	93.0	44.7	5	0	8
Bamenda	2	2	0.26	5.00	2.71	2.23	108.4	24.8	89.0	41.2	6	0	8
Bamenda	2	3	0.26	4.93	2.64	2.19	109.4	26.9	85.9	39.9	5	0	8
Bamenda	2	4	0.25	6.21	2.64	2.16	110.8	25.5	86.9	45.0	6	1	8
Bamenda	2	5	0.30	5.00	2.47	2.09	102.2	28.8	88.7	40.0	6	0	8
Bamenda	2	6	0.28	6.14	2.61	2.23	104.8	26.9	93.3	44.6	6	2	8
Bamenda	2	7	0.23	5.43	2.68	2.23	99.2	23.7	91.1	40.0	6	0	9
Bamenda	2	8	0.23	5.00	2.51	2.05	96.1	27.9	85.8	39.6	8	0	8
Bamenda	2	9	0.25	5.07	2.61	2.23	109.8	31.4	87.7	43.4	8	0	8
Bamenda	2	10	0.25	5.14	2.58	2.19	112.5	26.6	86.6	46.1	5	0	8
Bamenda	2	11	0.26	5.00	2.58	2.16	98.8	21.2	89.1	41.2	5	0	8
Bamenda	2	12	0.32	5.21	2.71	2.19	105.1	23.9	92.0	38.5	6	0	5
Bamenda	2	13	0.32	6.28	2.61	2.23	113.8	25.8	86.4	41.3	5	0	8
Bamenda	2	14	0.26	5.21	2.58	2.09	113.2	25.5	91.8	43.0	5	0	8
Bamenda	2	15	0.25	5.36	2.64	2.23	113.3	18.6	88.4	40.6	6	0	9
Bamenda	2	16	0.19	5.07	2.58	2.23	101.0	19.5	90.4	46.2	5	0	8
Bamenda	2	17	0.28	5.14	2.68	2.16	103.7	23.9	89.8	33.2	6	0	6
Bamenda	2	18	0.25	5.36	2.61	2.19	107.8	23.5	90.8	41.8	5	0	6
Bamenda	2	19	0.26	5.07	2.61	2.23	109.8	25.2	83.8	41.4	6	0	8
Bamenda	2	20	0.30	5.07	2.64	2.19	103.4	22.8	88.4	43.1	5	0	8
Bamenda	3	1	0.28	4.86	2.61	2.19	108.6	17.2	83.6	35.3	6	0	8
Bamenda	3	2	0.26	6.07	2.58	2.12	103.9	19.4	86.0	33.0	8	1	6
Bamenda	3	3	0.30	5.07	2.54	2.12	101.4	20.1	88.6	46.5	6	2	8
Bamenda	3	4	0.26	5.00	2.54	2.12	105.1	18.8	83.0	40.3	6	1	8
Bamenda	3	5	0.19	5.28	2.64	2.23	106.5	22.8	89.9	42.5	6	4	8
Bamenda	3	6	0.30	5.07	2.64	2.23	105.3	20.9	86.6	35.8	5	1	8
Bamenda	3	7	0.25	4.93	2.51	2.09	105.9	22.3	86.2	38.4	4	0	8
Bamenda	3	8	0.25	4.93	2.54	2.16	100.5	20.3	91.3	41.4	5	0	8
Bamenda	3	9	0.26	5.07	2.61	2.23	101.6	20.4	88.0	37.3	6	4	6
Bamenda	3	10	0.25	4.93	2.58	2.16	104.5	21.7	90.5	42.3	6	2	8
Bamenda	3	11	0.30	4.86	2.54	2.19	109.7	20.8	89.4	41.2	6	0	8
Bamenda	3	12	0.23	5.14	2.51	2.16	106.0	21.7	92.5	43.5	6	2	8
Bamenda	3	13	0.25	5.14	2.71	2.09	110.1	26.1	88.5	39.8	6	0	7
Bamenda	3	14	0.25	5.07	2.58	2.16	107.6	20.1	89.1	36.9	6	0	8
Bamenda	3	15	0.28	5.00	2.58	2.16	113.4	20.3	88.5	42.1	6	1	7

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Bamenda	3	16	0.21	5.14	2.58	2.12	107.3	22.6	88.2	39.2	5	0	8
Bamenda	3	17	0.32	5.14	2.61	2.09	103.7	18.7	88.1	44.6	5	0	6
Bamenda	3	18	0.30	5.07	2.61	2.23	113.4	21.8	89.2	40.8	5	0	7
Bamenda	3	19	0.25	5.07	2.54	2.12	101.6	23.8	86.2	41.7	6	0	8
Bamenda	3	20	0.28	5.07	2.58	2.16	107.7	20.1	87.0	39.1	6	2	8
Bamenda	4	1	0.30	5.00	2.54	2.05	104.7	24.4	90.0	34.9	5	0	5
Bamenda	4	2	0.23	5.14	2.54	2.19	96.0	22.9	92.5	34.5	6	0	9
Bamenda	4	3	0.25	5.00	2.64	2.19	100.1	23.3	90.8	30.0	6	4	6
Bamenda	4	4	0.23	6.00	2.64	2.16	100.6	19.9	82.5	29.3	8	4	6
Bamenda	4	5	0.26	5.00	2.68	2.12	104.8	22.6	90.3	34.2	9	6	8
Bamenda	4	6	0.26	5.21	2.33	2.02	108.7	20.5	87.8	41.7	9	4	8
Bamenda	4	7	0.25	6.00	2.47	2.33	105.2	21.1	89.1	32.7	9	4	7
Bamenda	4	8	0.32	5.14	2.51	2.09	102.4	25.3	87.8	40.2	9	4	8
Bamenda	4	9	0.21	6.07	2.58	2.16	97.9	21.2	83.2	30.3	9	4	7
Bamenda	4	10	0.21	5.14	2.44	2.05	99.8	17.4	88.3	35.4	9	4	8
Bamenda	4	11	0.35	5.28	2.58	2.19	103.5	25.7	87.2	35.7	9	4	8
Bamenda	4	12	0.25	5.21	2.54	2.16	102.4	21.1	86.2	39.9	9	4	8
Bamenda	4	13	0.37	5.55	2.37	2.05	94.5	22.1	85.5	35.8	8	3	8
Bamenda	4	14	0.33	5.14	2.51	2.12	104.2	19.8	85.5	39.5	6	4	5
Bamenda	4	15	0.30	5.00	2.47	2.12	102.4	21.2	84.9	40.1	8	4	8
Bamenda	4	16	0.25	6.00	2.58	2.19	97.1	21.7	92.6	35.3	8	3	8
Bamenda	4	17	0.19	4.86	2.47	2.16	94.6	22.4	95.2	36.1	9	5	8
Bamenda	4	18	0.25	6.07	2.58	2.12	94.8	22.3	92.7	38.1	5	1	5
Bamenda	4	19	0.19	5.93	2.51	2.12	100.4	22.0	94.7	42.9	9	4	7
Bamenda	4	20	0.25	5.14	2.58	2.12	96.2	20.8	82.6	44.0	9	5	9
Bamenda	5	1	0.19	5.14	2.61	2.12	100.1	16.7	77.2	31.6	5	0	8
Bamenda	5	2	0.28	5.07	2.61	2.19	108.9	21.7	79.6	36.6	5	0	8
Bamenda	5	3	0.26	5.00	2.51	2.05	98.8	15.8	73.3	35.0	5	0	9
Bamenda	5	4	0.30	5.00	2.54	2.16	110.1	18.3	83.5	37.2	6	0	8
Bamenda	5	5	0.28	5.07	2.61	2.23	103.9	19.7	82.0	38.2	6	0	9
Bamenda	5	6	0.26	5.36	2.58	2.09	104.5	18.1	78.3	35.9	6	0	7
Bamenda	5	7	0.23	5.07	2.47	2.19	109.0	18.0	77.1	35.3	5	0	9
Bamenda	5	8	0.26	5.28	2.51	2.05	105.7	19.1	84.0	32.4	5	0	7
Bamenda	5	9	0.35	6.14	2.61	2.23	111.1	22.1	75.7	38.4	5	0	8
Bamenda	5	10	0.30	5.36	2.51	2.16	112.8	16.9	73.0	35.3	6	0	8
Bamenda	5	11	0.25	5.07	2.64	2.12	116.4	20.8	79.5	32.7	6	4	8
Bamenda	5	12	0.21	5.07	2.58	2.19	99.2	16.4	74.5	27.6	4	0	7
Bamenda	5	13	0.23	5.21	2.61	2.23	104.6	20.1	81.8	37.2	5	0	8
Bamenda	5	14	0.26	5.07	2.68	2.12	115.9	18.8	76.4	31.2	5	0	7
Bamenda	5	15	0.23	5.36	2.61	2.26	103.8	18.3	73.5	38.7	5	0	7
Bamenda	5	16	0.25	5.00	2.54	2.23	103.2	20.7	78.6	28.3	6	0	7
Bamenda	5	17	0.30	5.00	2.58	2.05	107.1	20.2	80.0	35.5	5	0	7
Bamenda	5	18	0.28	5.07	2.54	2.16	105.9	19.2	78.2	32.8	4	0	5
Bamenda	5	19	0.32	5.21	2.51	2.12	101.4	17.3	75.2	30.5	6	1	8
Bamenda	5	20	0.23	5.14	2.58	2.16	113.9	16.9	83.2	31.5	6	0	8
Kumbo	2	1	0.25	5.43	2.58	2.19	114.8	19.1	84.6	36.0	4	0	9
Kumbo	2	2	0.21	5.50	2.58	2.23	111.9	18.9	81.4	36.4	5	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Kumbo	2	3	0.21	5.21	2.58	2.16	112.8	19.1	82.5	36.2	5	0	9
Kumbo	2	4	0.26	5.21	2.64	2.19	119.3	20.1	79.4	36.0	6	0	9
Kumbo	2	5	0.23	4.93	2.54	2.16	106.2	21.6	79.9	34.8	6	0	9
Kumbo	2	6	0.25	5.21	2.54	2.16	102.5	16.9	74.8	41.1	6	0	9
Kumbo	2	7	0.23	5.28	2.58	2.26	110.6	18.1	80.4	28.0	6	0	9
Kumbo	2	8	0.26	5.21	2.64	2.30	111.1	23.1	87.2	34.0	6	0	9
Kumbo	2	9	0.28	4.86	2.61	2.16	107.0	23.0	83.7	31.5	2	0	8
Kumbo	2	10	0.25	5.00	2.54	2.26	106.8	21.6	86.4	33.2	6	0	9
Kumbo	2	11	0.23	5.43	2.58	2.19	107.4	18.3	85.3	40.2	5	0	9
Kumbo	2	12	0.26	5.93	2.58	2.26	119.6	18.2	80.7	34.7	6	0	9
Kumbo	2	13	0.25	5.36	2.58	2.12	109.4	22.9	84.0	39.7	5	0	9
Kumbo	2	14	0.23	4.93	2.58	2.26	107.7	16.1	82.9	27.9	5	0	9
Kumbo	2	15	0.26	4.93	2.58	2.19	112.8	20.6	81.4	41.5	6	0	9
Kumbo	2	16	0.19	5.00	2.54	1.98	108.7	18.7	79.0	36.0	6	0	8
Kumbo	2	17	0.19	5.00	2.58	2.12	110.0	18.9	77.0	42.0	5	0	9
Kumbo	2	18	0.25	5.21	2.54	2.16	102.4	19.6	82.8	32.5	6	0	9
Kumbo	2	19	0.26	5.64	2.61	2.37	111.8	17.2	75.7	40.1	6	0	9
Kumbo	2	20	0.19	5.21	2.54	2.23	101.4	17.9	77.8	43.6	5	0	8
Kumbo	3	1	0.21	5.43	2.68	2.23	111.9	18.6	85.7	29.9	6	1	9
Kumbo	3	2	0.19	6.07	2.58	2.19	116.4	20.1	76.3	36.5	5	6	9
Kumbo	3	3	0.18	6.07	2.47	2.05	106.1	18.3	83.7	39.4	6	4	9
Kumbo	3	4	0.25	5.64	2.68	2.16	106.5	22.7	85.1	36.7	6	0	9
Kumbo	3	5	0.19	5.00	2.54	2.16	113.8	20.6	85.5	40.4	6	0	9
Kumbo	3	6	0.25	5.00	2.58	2.16	116.2	17.7	85.4	37.1	5	0	9
Kumbo	3	7	0.26	5.85	2.61	2.19	115.7	18.7	77.3	36.9	6	1	9
Kumbo	3	8	0.28	6.14	2.61	2.12	120.5	16.1	75.7	37.9	6	1	9
Kumbo	3	9	0.23	6.14	2.61	2.19	113.5	18.8	83.6	34.6	8	0	7
Kumbo	3	10	0.23	5.14	2.64	2.23	113.9	15.7	86.6	32.2	8	1	6
Kumbo	3	11	0.19	5.00	2.64	2.19	119.5	17.4	81.8	40.9	6	1	8
Kumbo	3	12	0.23	5.21	2.54	2.19	114.7	20.8	80.6	36.1	8	1	9
Kumbo	3	13	0.25	6.14	2.54	2.19	109.5	19.4	87.0	37.1	6	0	9
Kumbo	3	14	0.23	5.07	2.54	2.19	117.5	17.1	82.4	27.4	6	0	9
Kumbo	3	15	0.25	5.93	2.68	2.12	112.8	18.2	80.3	33.8	5	0	9
Kumbo	3	16	0.23	5.21	2.61	2.16	111.0	25.2	79.8	39.4	8	1	9
Kumbo	3	17	0.23	5.85	2.44	1.98	111.2	22.2	76.1	39.4	5	0	9
Kumbo	3	18	0.25	5.00	2.40	2.16	111.4	23.2	78.3	41.6	5	0	9
Kumbo	3	19	0.21	5.07	2.51	2.19	114.3	15.9	83.2	37.9	6	0	8
Kumbo	3	20	0.18	5.00	2.61	2.05	113.8	25.7	81.6	38.4	6	0	7
Kumbo	4	1	0.25	6.07	2.58	2.23	109.2	21.3	79.1	33.7	5	0	9
Kumbo	4	2	0.26	6.07	2.47	2.05	100.4	24.1	79.1	36.8	6	0	9
Kumbo	4	3	0.26	4.86	2.54	2.16	100.7	18.9	82.6	31.7	6	0	9
Kumbo	4	4	0.21	5.93	2.58	2.40	102.6	19.9	81.1	32.7	6	0	7
Kumbo	4	5	0.25	5.00	2.58	2.09	95.6	23.1	80.7	38.1	8	1	9
Kumbo	4	6	0.18	5.07	2.61	2.16	97.4	23.2	82.4	30.3	6	0	9
Kumbo	4	7	0.23	5.07	2.51	2.12	108.1	20.1	83.5	28.3	8	0	9
Kumbo	4	8	0.23	5.93	2.54	2.12	104.1	19.4	79.4	37.7	8	0	9
Kumbo	4	9	0.25	4.86	2.51	2.16	109.5	25.1	83.2	41.1	6	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Kumbo	4	10	0.26	6.07	2.64	2.23	106.7	19.0	77.5	29.1	7	0	7
Kumbo	4	11	0.18	5.14	2.61	2.16	107.1	21.1	83.4	35.4	8	0	8
Kumbo	4	12	0.19	5.14	2.61	2.19	98.1	27.2	86.5	37.5	8	4	9
Kumbo	4	13	0.23	5.07	2.51	2.19	106.8	23.1	84.2	34.2	9	2	7
Kumbo	4	14	0.25	5.07	2.51	2.09	104.4	19.7	84.0	34.3	8	4	9
Kumbo	4	15	0.26	5.00	2.54	2.23	102.1	23.9	84.9	39.4	8	0	8
Kumbo	4	16	0.26	6.07	2.54	2.12	103.3	20.2	80.2	29.3	6	0	8
Kumbo	4	17	0.25	4.78	2.51	2.16	104.7	16.6	77.6	31.5	8	0	9
Kumbo	4	18	0.25	5.07	2.54	2.12	97.3	23.2	82.7	40.8	4	0	9
Kumbo	4	19	0.25	5.07	2.54	2.09	108.1	21.1	78.1	36.7	6	0	7
Kumbo	4	20	0.25	5.14	2.51	2.12	113.4	20.6	83.5	29.1	6	0	9
Banyo	1	1	0.21	5.93	2.54	2.05	104.8	16.2	78.6	36.5	4	0	9
Banyo	1	2	0.21	5.64	2.44	2.05	103.4	18.4	76.1	36.2	8	0	9
Banyo	1	3	0.21	5.00	2.54	2.16	107.6	17.5	81.5	38.4	6	0	9
Banyo	1	4	0.21	5.21	2.51	2.05	101.7	20.9	81.1	34.6	6	0	9
Banyo	1	5	0.28	4.93	2.54	2.09	101.5	17.3	81.1	36.9	5	0	9
Banyo	1	6	0.18	5.78	2.51	2.12	110.2	18.6	80.6	33.7	5	1	9
Banyo	1	7	0.25	5.00	2.54	2.02	108.4	13.9	75.5	39.1	5	0	9
Banyo	1	8	0.26	5.71	2.58	2.02	98.2	17.1	75.8	40.9	5	0	9
Banyo	1	9	0.19	4.93	2.51	2.16	103.9	18.8	79.2	34.5	8	0	8
Banyo	1	10	0.26	4.64	2.64	2.09	98.3	16.7	75.8	30.2	4	0	9
Banyo	1	11	0.25	4.78	2.58	2.09	109.7	23.0	85.2	34.6	6	2	8
Banyo	1	12	0.19	5.00	2.58	2.09	106.9	16.3	82.9	27.1	8	0	8
Banyo	1	13	0.26		2.54	2.05	112.3	18.1	86.2	37.3	6	0	8
Banyo	1	14	0.23		2.58	2.05	107.6	16.3	81.8	35.6	8	1	9
Banyo	1	15	0.25		2.58	2.09	104.2	18.1	76.1	44.7	5	2	8
Banyo	1	16	0.26		2.58	2.09	103.8	20.0	78.9	34.9	6	4	8
Banyo	1	17	0.23		2.58	2.12	108.4	17.8	79.9	40.6	5	0	8
Banyo	1	18	0.23		2.58	2.12	96.7	18.3	74.6	31.0	6	2	8
Banyo	1	19	0.25		2.51	2.16	101.2	18.7	81.7	37.1	8	0	9
Banyo	1	20	0.23		2.51	2.05	110.2	14.2	75.1	35.4	6	0	9
Banyo	2	1	0.23	5.21	2.61	2.05	112.9	17.2	75.9	35.5	6	0	8
Banyo	2	2	0.23	5.07	2.54	2.19	101.7	21.9	87.0	42.9	8	0	8
Banyo	2	3	0.32	5.00	2.54	2.12	108.6	20.4	77.1	31.2	8	0	8
Banyo	2	4	0.26	6.07	2.61	2.16	108.7	21.7	80.6	33.9	8	0	9
Banyo	2	5	0.25	5.14	2.58	2.16	101.3	20.7	80.1	37.4	4	8	9
Banyo	2	6	0.30	5.14	2.58	2.23	113.2	20.4	81.7	39.2	8	1	9
Banyo	2	7	0.16	4.93	2.61	2.02	114.1	22.0	79.0	33.1	8	2	9
Banyo	2	8	0.21	5.28	2.54	2.19	103.8	16.2	83.2	40.8	8	4	8
Banyo	2	9	0.23	5.14	2.54	2.09	97.9	24.6	84.3	40.8	8	0	9
Banyo	2	10	0.25	5.28	2.61	2.19	104.9	19.1	76.2	29.7	6	0	9
Banyo	2	11	0.25	5.00	2.51	2.09	103.7	22.6	79.9	36.7	6	4	8
Banyo	2	12	0.21	5.07	2.54	2.19	107.3	19.3	74.0	33.9	8	0	5
Banyo	2	13	0.25	6.14	2.58	2.16	110.3	27.2	91.3	39.5	8	2	9
Banyo	2	14	0.19	5.07	2.54	1.98	115.4	16.0	76.2	34.7	8	4	9
Banyo	2	15	0.26	5.14	2.47	2.16	98.9	20.3	89.2	33.7	6	2	9
Banyo	2	16	0.23	5.28	2.58	2.16	109.2	18.2	81.2	40.0	6	4	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Banyo	2	17	0.19	5.07	2.51	1.98	99.3	20.7	81.6	43.8	6	0	9
Banyo	2	18	0.26	5.00	2.61	2.16	105.2	21.3	80.0	30.1	8	2	9
Banyo	2	19	0.25	5.07	2.58	2.23	108.1	19.4	80.2	34.6	6	0	9
Banyo	2	20	0.21		2.58	2.16	110.9	14.6	80.0	37.2	6	1	8
Banyo	3	1	0.23	6.21	2.68	2.19	109.9	19.2	79.9	32.8	8	0	8
Banyo	3	2	0.19	5.85	2.54	2.16	106.7	22.9	81.6	32.5	6	0	9
Banyo	3	3	0.21	5.00	2.64	2.26	106.6	20.9	83.5	28.4	5	0	9
Banyo	3	4	0.26	5.00	2.68	2.30	105.4	18.9	82.1	32.9	5	0	9
Banyo	3	5	0.21	4.78	2.58	2.02	110.2	16.8	76.6	30.3	5	0	9
Banyo	3	6	0.19	5.14	2.68	2.19	112.9	19.6	82.8	31.1	5	0	9
Banyo	3	7	0.21	5.07	2.64	2.26	107.5	20.8	82.7	33.0	6	0	7
Banyo	3	8	0.21	5.00	2.58	2.23	100.0	18.5	75.2	29.1	5	0	9
Banyo	3	9	0.19	5.28	2.64	2.23	100.4	20.6	82.6	29.6	6	0	8
Banyo	3	10	0.25	5.00	2.61	2.19	106.4	19.6	79.9	30.4	6	0	9
Banyo	3	11	0.23	5.21	2.64	2.30	104.1	20.8	77.5	30.6	8	0	9
Banyo	3	12	0.19	4.86	2.58	2.26	95.6	19.6	76.7	30.6	6	0	8
Banyo	3	13	0.23	4.78	2.58	2.19	104.1	20.3	77.0	39.6	6	0	8
Banyo	3	14	0.19	5.14	2.61	2.23	106.8	22.3	81.4	31.4	6	0	9
Banyo	3	15	0.25	5.85	2.64	2.26	107.5	18.4	74.7	33.4	5	0	9
Banyo	3	16	0.19	4.86	2.58	2.19	107.9	19.2	79.9	34.9	8	0	6
Banyo	3	17	0.23	5.93	2.68	2.12	108.9	24.2	79.9	30.7	5	0	9
Banyo	3	18	0.23				108.5	19.7	77.9	31.4	6	1	8
Banyo	3	19	0.23	5.85	2.71	2.26	99.6	18.4	80.9	34.4	8	0	9
Banyo	3	20	0.26	5.00	2.61	2.09	101.3	20.9	80.7	31.2	6	0	9
Banyo	4	1	0.21	4.93	2.61	2.09	94.7	19.5	90.2	32.7	5	0	9
Banyo	4	2	0.25	4.93	2.54	2.09	101.7	20.4	86.6	41.5	5	1	6
Banyo	4	3	0.25	4.93	2.51	2.12	94.1	20.4	82.9	27.3	8	0	9
Banyo	4	4	0.26	5.07	2.51	2.12	106.9	16.9	84.4	36.5	8	0	9
Banyo	4	5	0.23	5.93	2.54	2.12	106.9	19.7	77.4	34.5	8	0	9
Banyo	4	6	0.18	5.21	2.61	2.12	103.9	14.4	85.8	37.3	8	0	8
Banyo	4	7	0.25	6.07	2.54	2.12	97.8	20.3	82.9	37.7	8	0	9
Banyo	4	8	0.21	5.85	2.58	2.12	109.2	19.5	80.5	39.4	6	0	9
Banyo	4	9	0.21	4.93	2.61	2.12	106.9	16.0	81.7	38.1	6	0	8
Banyo	4	10	0.21	4.93	2.51	2.12	105.3	16.8	84.6	32.3	6	0	9
Banyo	4	11	0.23	5.00	2.54	2.05	97.2	18.7	81.2	31.6	6	0	6
Banyo	4	12	0.21	4.78	2.54	2.05	102.1	20.2	84.5	39.3	5	0	9
Banyo	4	13	0.18	5.00	2.54	2.09	108.3	20.0	82.7	39.2	6	0	9
Banyo	4	14	0.26	4.78	2.47	2.02	104.8	21.1	77.6	36.3	5	0	8
Banyo	4	15	0.23	4.86	2.54	2.02	104.5	19.6	82.3	44.6	8	0	9
Banyo	4	16	0.25	4.86	2.51	2.09	107.6	20.6	84.2	40.8	6	0	9
Banyo	4	17	0.19	4.93	2.64	2.05	103.1	20.7	85.9	39.1	5	0	8
Banyo	4	18	0.23	5.07	2.58	2.05	109.9	14.7	78.7	33.0	6	0	9
Banyo	4	19	0.18	4.86	2.61	2.09	97.4	16.9	89.1	33.7	5	0	9
Banyo	4	20	0.26	4.78	2.54	2.05	98.3	20.4	84.8	36.1	5	0	9
Lewa	1	1	0.21	4.93	2.51	2.19	98.9	19.4	79.2	43.9	6	0	9
Lewa	1	2	0.26	4.78	2.58	2.12	93.0	19.3	87.6	40.3	6	0	9
Lewa	1	3	0.25	5.00	2.47	2.09	103.8	21.4	83.4	31.4	6	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Lewa	1	4	0.21	5.57	2.44	1.95	94.6	19.0	82.8	35.0	6	0	9
Lewa	1	5	0.26	4.93	2.51	2.02	104.0	18.3	84.9	30.5	6	0	9
Lewa	1	6	0.26	4.93	2.47	2.02	103.6	21.4	80.0	35.6	6	1	9
Lewa	1	7	0.18	4.14	2.51	2.09	115.4	26.5	81.7	29.7	8	2	9
Lewa	1	8	0.18	4.93	2.54	2.02	106.9	18.9	84.9	38.3	6	0	9
Lewa	1	9	0.26	5.00	2.51	2.02	105.9	21.3	79.9	33.2	5	0	9
Lewa	1	10	0.25	5.00	2.58	2.19	109.5	19.4	82.6	33.5	5	0	9
Lewa	1	11	0.21	4.78	2.47	2.12	103.6	23.9	81.2	32.0	6	0	9
Lewa	1	12	0.26	4.64	2.47	2.12	105.1	20.5	79.5	34.3	5	0	9
Lewa	1	13	0.23	4.64	2.54	2.16	106.5	23.2	88.2	33.8	5	0	9
Lewa	1	14	0.26	5.00	2.44	2.12	104.4	20.5	79.7	34.6	6	4	9
Lewa	1	15	0.25	5.93	2.51	2.05	110.7	20.7	85.1	32.9	5	0	9
Lewa	1	16	0.25	5.00	2.51	2.09	110.0	19.7	88.8	28.2	6	0	9
Lewa	1	17	0.23	5.00	2.51	2.05	114.1	17.2	77.5	33.8	5	0	9
Lewa	1	18	0.19	5.14	2.47	2.09	104.3	19.1	80.7	34.5	4	0	9
Lewa	1	19	0.18	5.00	2.51	2.02		17.0	77.0	34.5	5	0	9
Lewa	1	20	0.18	4.78	2.51	2.16	103.4	20.1	81.9	30.4	5	0	9
Lewa	2	1	0.19	5.00	2.51	2.09	106.1	16.3	74.7	36.9	8	0	9
Lewa	2	2	0.25	4.86	2.47	2.02	101.9	20.0	82.3	39.5	8	0	9
Lewa	2	3	0.18	4.64	2.47	2.05	97.6	24.3	89.1	43.4	6	2	9
Lewa	2	4	0.19	4.93	2.54	2.05	108.3	17.7	75.6	38.0	5	0	9
Lewa	2	5	0.23	5.07	2.51	2.05	105.3	20.0	84.3	35.9	5	0	8
Lewa	2	6	0.19	5.93	2.54	2.12	111.6	16.8	84.6	35.6	5	0	9
Lewa	2	7	0.26	4.86	2.47	2.05	99.3	18.7	77.9	40.9	6	0	9
Lewa	2	8	0.23	4.86	2.54	2.05	104.6	16.9	77.6	32.6	9	7	8
Lewa	2	9	0.25	5.00	2.61	2.51	108.3	18.8	82.3	36.7	5	2	8
Lewa	2	10	0.19	4.86	2.54	2.12	102.3	15.7	88.3	38.9	5	0	8
Lewa	2	11	0.18	5.00	2.51	2.19	105.4	19.1	82.5	33.4	5	0	9
Lewa	2	12	0.19	5.00	2.40	1.98	109.2	22.4	89.7	42.7	8	0	9
Lewa	2	13	0.23	4.86	2.47	2.05	105.2	18.2	87.6	36.5	5	0	9
Lewa	2	14	0.23	5.64	2.51	2.19	103.9	21.2	87.9	31.5	8	1	9
Lewa	2	15	0.23	5.78	2.58	2.02	97.2	20.3	81.1	29.9	6	0	9
Lewa	2	16	0.21	4.64	2.51	2.09	106.6	15.4	80.8	30.2	5	0	9
Lewa	2	17	0.18	4.93	2.44	2.09	106.5	17.5	81.1	33.5	6	0	9
Lewa	2	18	0.21	5.14	2.54	2.09	108.6	19.4	89.6	33.2	6	0	9
Lewa	2	19	0.23	5.00	2.47	2.02	107.9	20.6	83.3	29.5	6	0	9
Lewa	2	20	0.23	5.00	2.47	2.05	105.0	18.7	85.9	36.0	8	0	9
Lewa	3	1	0.21	5.57	2.51	2.12	96.5	22.6	85.7	41.1	5	0	8
Lewa	3	2	0.26	4.93	2.54	2.16	98.9	21.4	71.5	32.2	5	0	9
Lewa	3	3	0.25	5.00	2.37	2.12	102.6	20.8	84.2	38.8	6	0	9
Lewa	3	4	0.19	5.00	2.61	2.19	109.2	15.2	75.8	38.9	6	0	9
Lewa	3	5	0.18		2.54	2.19	108.5	19.4	77.1	38.5	5	0	9
Lewa	3	6	0.16	4.86	2.54	2.16	103.4	16.9	79.5	41.9	5	0	9
Lewa	3	7	0.23	4.86	2.58	2.16	111.8	17.7	81.7	36.3	5	0	9
Lewa	3	8	0.19	4.71	2.54	2.09	105.2	17.4	80.2	39.7	5	0	9
Lewa	3	9	0.28	4.71	2.54	2.16	99.2	20.7	87.5	40.6	6	0	9
Lewa	3	10	0.21	4.93	2.47	2.02	98.7	20.9	85.9	32.5	5	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Lewa	3	11	0.25	4.78	2.51	2.02	92.6	18.4	77.4	30.0	6	0	9
Lewa	3	12	0.21	4.86	2.47	2.16	96.0	19.3	85.0	36.1	6	0	9
Lewa	3	13	0.18	4.86	2.51	2.09	94.9	20.6	90.8	44.9	8	0	8
Lewa	3	14	0.23	5.00	2.58	2.16	95.6	20.8	76.4	35.1	8	0	9
Lewa	3	15	0.18	4.86	2.47	2.05	106.9	20.7	80.3	42.7	5	0	8
Lewa	3	16	0.28	5.00	2.68	2.12	113.8	16.1	80.7	32.9	5	0	6
Lewa	3	17	0.25		2.61	2.16	108.8	20.2	84.3	38.3	6	0	9
Lewa	3	18	0.25	4.86	2.58	2.12	108.5	17.3	82.3	36.5	6	0	9
Lewa	3	19	0.25	4.93	2.61	2.16	113.1	17.0	79.1	33.5	6	0	9
Lewa	3	20	0.23	5.00	2.47	2.09	108.8	19.1	79.4	33.5	5	0	9
Lewa	4	1	0.23	5.14	2.51	2.05	105.4	19.8	83.3	28.8	8	0	9
Lewa	4	2	0.23	5.00	2.54	2.12	106.9	17.8	78.7	29.1	6	0	9
Lewa	4	3	0.30	5.21	2.51	2.12	110.6	18.4	80.2	35.6	5	0	9
Lewa	4	4	0.21	4.78	2.51	1.98	105.6	21.4	81.1	29.5	5	0	9
Lewa	4	5	0.23	5.07	2.47	2.02	104.6	16.5	81.5	29.9	5	0	9
Lewa	4	6	0.21	5.07	2.54	2.05	112.9	18.8	85.8	27.6	8	0	9
Lewa	4	7	0.18	5.28	2.51	2.09	100.1	17.7	77.2	35.1	6	0	9
Lewa	4	8	0.23	5.71	2.54	2.02	106.2	16.6	79.7	34.2	4	0	9
Lewa	4	9	0.12	4.93	2.44	2.02	99.3	20.6	87.3	33.3	5	0	9
Lewa	4	10	0.25	5.00	2.58	2.12	107.7	16.9	81.7	32.9	5	0	9
Lewa	4	11	0.25	5.14	2.54	2.16	100.9	16.9	77.7	34.4	6	0	9
Lewa	4	12	0.21	5.14	2.40	1.98	111.8	18.6	81.7	31.6	5	0	9
Lewa	4	13	0.18	5.07	2.58	2.05	107.2	15.8	74.2	30.8	8	0	9
Lewa	4	14	0.23	5.00	2.58	2.09	103.7	19.8	78.7	32.9	5	0	9
Lewa	4	15	0.19	5.07	2.40	2.05	107.5	19.5	83.6	36.9	6	0	9
Lewa	4	16	0.26	5.00	2.51	2.02	105.2	16.3	76.9	29.4	8	0	9
Lewa	4	17	0.18	5.21	2.54	2.05	102.5	21.2	87.1	31.5	4	0	9
Lewa	4	18	0.19	5.00	2.61	2.12	101.4	20.8	88.9	37.2	4	0	9
Lewa	4	19	0.30	5.07	2.54	2.09	111.2	16.7	78.6	33.8	5	0	9
Lewa	4	20	0.19	5.14	2.44	2.05	104.2	19.9	84.0	32.1	5	0	9
Gouna	1	1	0.21	5.00	2.51	2.05	95.4	17.6	83.4	34.9	6	0	9
Gouna	1	2	0.26	4.93	2.51	2.16	100.1	17.8	69.9	34.9	5	0	9
Gouna	1	3	0.21	4.86	2.16	2.05	93.0	18.4	82.5	35.2	8	0	9
Gouna	1	4	0.19	5.07	2.64	2.12	98.6	18.9	83.4	37.4	6	0	9
Gouna	1	5	0.25	5.21	2.54	2.09	106.0	18.9	77.9	37.2	5	0	9
Gouna	1	6	0.18	5.00	2.54	2.09	89.9	21.7	81.2	32.7	6	0	9
Gouna	1	7	0.23	5.00	2.54	1.98	101.1	18.3	74.4	33.9	5	0	9
Gouna	1	8	0.21	6.00	2.64	2.12	110.1	20.4	70.6	40.5	5	0	9
Gouna	1	9	0.23	4.93	2.54	2.12	105.3	21.8	74.9	37.6	5	0	9
Gouna	1	10	0.21	5.36	2.54	2.05	112.2	23.3	82.8	27.8	5	0	9
Gouna	1	11	0.25	4.93	2.47	1.98	100.8	15.2	74.8	28.2	8	0	9
Gouna	1	12	0.19	4.93	2.47	1.98	99.9	19.2	75.2	38.9	6	1	9
Gouna	1	13	0.19	5.07	2.54	2.19	106.1	19.6	81.1	33.9	8	0	9
Gouna	1	14	0.28	4.93	2.61	2.19	100.7	18.0	74.1	36.3	6	0	9
Gouna	1	15	0.25	5.85	2.51	2.09	101.9	17.5	82.0	34.6	6	0	9
Gouna	1	16	0.25	4.93	2.58	2.19	104.3	20.4	76.4	36.9	6	0	9
Gouna	1	17	0.25	4.86	2.58	2.12	112.4	20.2	76.6	32.9	6	1	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Gouna	1	18	0.23	4.93	2.47	1.95	106.2	16.9	78.7	36.9	5	0	9
Gouna	1	19	0.19	5.00	2.54	2.09	104.1	21.0	77.4	36.9	5	0	9
Gouna	1	20	0.19	5.00	2.58	2.19	110.7	19.4	77.5	37.8	5	0	9
Gouna	2	1	0.18	5.71	2.44	1.95	98.4	16.9	81.2	37.0	6	0	9
Gouna	2	2	0.23	5.00	2.54	2.02	98.7	19.7	76.9	39.6	6	0	9
Gouna	2	3	0.25	5.85	2.44	2.05	97.2	19.9	86.0	37.7	8	0	9
Gouna	2	4	0.18	5.93	2.47	1.98	98.1	17.9	79.5	32.0	5	0	9
Gouna	2	5	0.18	5.64	2.54	2.05	106.1	17.7	82.2	37.7	6	0	9
Gouna	2	6	0.18	5.07	2.58	2.09	98.9	21.5	82.6	39.2	8	0	9
Gouna	2	7	0.25	5.78	2.47	1.98	111.3	19.5	77.3	42.5	8	0	9
Gouna	2	8	0.23	4.93	2.58	2.23	105.8	17.1	78.5	41.5	6	0	9
Gouna	2	9	0.16	5.07	2.54	2.05	109.1	18.2	78.8	39.6	5	0	9
Gouna	2	10	0.18	4.86	2.51	2.19	103.3	20.4	88.6	40.7	5	0	9
Gouna	2	11	0.23	4.86	2.47	2.02	104.2	18.2	84.2	46.8	5	0	9
Gouna	2	12	0.19	4.86	2.47	2.02	95.3	19.1	83.6	47.9	6	0	9
Gouna	2	13	0.19	5.07	2.51	2.09	106.0	21.0	79.9	40.1	6	0	9
Gouna	2	14	0.25	4.93	2.51	1.98	109.8	19.3	84.9	31.7	6	0	9
Gouna	2	15	0.18	4.93	2.47	2.05	96.4	16.8	85.5	38.1	6	0	9
Gouna	2	16	0.25	5.14	2.54	2.16	110.5	18.4	84.9	37.5	6	0	9
Gouna	2	17	0.26	5.21	2.54	2.09	105.1	17.7	87.7	37.8	8	1	9
Gouna	2	18	0.19	5.07	2.51	2.02	104.3	17.4	80.8	37.9	6	0	9
Gouna	2	19	0.19	5.00	2.54	2.09	106.2	20.1	78.6	35.4	5	0	9
Gouna	2	20	0.21	5.93	2.47	2.02	108.5	19.1	75.5	43.4	8	0	9
Gouna	3	1	0.19	4.86	2.51	2.09	101.1	17.2	72.9	30.5	9	4	9
Gouna	3	2	0.19	4.78	2.44	2.02	105.6	20.3	77.0	34.9	8	4	9
Gouna	3	3	0.19	4.78	2.58	2.05	112.6	16.4	75.5	26.2	4	9	9
Gouna	3	4	0.26	4.93	2.51	2.05	114.9	16.9	77.5	30.3	9	7	9
Gouna	3	5	0.23	5.64	2.51	2.09	115.8	19.0	79.7	27.3	4	6	9
Gouna	3	6	0.25	5.71	2.47	2.05	103.1	15.6	81.1	32.6	6	6	9
Gouna	3	7	0.26	4.78	2.51	2.05	94.8	15.9	76.6	25.1	6	0	9
Gouna	3	8	0.21	4.78	2.44	2.09	90.8	19.8	89.1	34.2	4	8	9
Gouna	3	9	0.21	4.86	2.58	2.12	106.1	14.8	79.0	28.9	6	4	9
Gouna	3	10	0.30	5.93	2.47	2.09	111.3	15.4	77.2	30.9	6	9	9
Gouna	3	11	0.23	5.07	2.58	2.19	117.8	18.7	82.4	26.4	6	4	9
Gouna	3	12	0.23	4.93	2.44	2.05	114.2	15.2	83.3	30.2	9	7	9
Gouna	3	13	0.23	5.07	2.54	2.12	107.6	14.4	79.1	31.1	9	5	9
Gouna	3	14	0.25	5.00	2.54	2.05	109.2	16.9	77.9	26.1	5	1	9
Gouna	3	15	0.21	5.00	2.51	2.02	97.3	16.6	85.1	33.5	4	9	9
Gouna	3	16	0.23	5.00	2.44	2.02	106.1	17.2	81.8	30.9	7	4	9
Gouna	3	17	0.19	5.85	2.51	2.05	109.5	16.9	79.4	27.5	9	6	9
Gouna	3	18	0.19	5.78	2.51	2.05	100.8	18.1	81.4	28.4	7	9	9
Gouna	3	19	0.18	4.71	2.44	2.02	109.0	19.9	79.9	28.7	7	4	9
Gouna	3	20	0.19	5.71	2.47	2.02	98.6	15.3	71.2	30.4	8	2	9
Gouna	4	1	0.25	4.78	2.47	2.09	100.8	19.5	80.2	32.2	6	1	9
Gouna	4	2	0.23	4.93	2.47	2.02	103.6	17.0	75.2	26.4	6	1	9
Gouna	4	3	0.19	4.64	2.47	2.05	109.0	16.5	74.6	28.2	5	0	9
Gouna	4	4	0.26	4.71	2.44	1.95	101.4	16.8	78.6	27.4	9	6	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Gouna	4	5	0.28	5.00	2.47	2.09	102.0	16.8	80.5	37.2	6	1	9
Gouna	4	6	0.25	4.71	2.47	1.98	107.0	18.1	72.7	32.2	4	0	9
Gouna	4	7	0.18	4.78	2.51	1.98	103.0	14.5	70.0	29.6	6	2	9
Gouna	4	8	0.26	4.86	2.44	2.16	111.2	17.1	78.0	32.9	4	6	9
Gouna	4	9	0.19	4.93	2.44	2.05	103.3	17.5	74.0	31.7	9	4	9
Gouna	4	10	0.23	4.86	2.44	2.09	107.3	15.4	79.4	35.1	5	0	9
Gouna	4	11	0.18	5.71	2.44	2.05	112.8	19.2	76.4	28.7	6	2	9
Gouna	4	12	0.23	4.86	2.54	2.16	104.9	20.9	83.9	32.0	8	2	9
Gouna	4	13	0.23	4.71	2.54	2.09	106.3	13.6	79.9	39.1	6	1	9
Gouna	4	14	0.25	4.86	2.51	2.16	100.5	17.6	78.3	31.9	6	2	9
Gouna	4	15	0.25	4.93	2.54	2.05	105.4	15.5	81.4	32.7	6	3	9
Gouna	4	16	0.23	4.64	2.47	1.95	107.2	17.0	71.8	31.6	4	0	9
Gouna	4	17	0.23	4.86	2.44	2.02	107.6	14.4	67.2	26.0	5	0	9
Gouna	4	18	0.21	4.78	2.47	1.95	91.7	15.5	75.3	32.8	5	0	9
Gouna	4	19	0.26	5.07	2.54	2.05	105.1	15.1	76.2	27.7	9	4	9
Gouna	4	20	0.21	4.71	2.40	1.95	104.7	15.9	69.6	30.5	6	2	9
Gouna	5	1	0.21	4.93	2.68	2.12	106.9	20.8	84.3	29.5	4	6	9
Gouna	5	2	0.18	4.71	2.54	2.09	105.0	21.7	85.6	35.3	4	5	9
Gouna	5	3	0.18	4.93	2.64	2.09	107.6	15.0	78.8	35.0	3	4	9
Gouna	5	4	0.21	5.00	2.58	2.05	114.1	20.4	82.8	23.2	4	6	8
Gouna	5	5	0.18	5.93	2.58	2.05	106.9	24.3	84.3	36.0	4	5	9
Gouna	5	6	0.23	4.86	2.51	2.05	104.7	19.3	76.2	37.6	4	6	9
Gouna	5	7	0.18	5.71	2.58	2.09	103.6	22.7	85.8	35.1	4	6	9
Gouna	5	8	0.19	4.86	2.64	2.02	109.3	19.6	81.4	29.4	4	6	9
Gouna	5	9	0.18	4.71	2.51	2.12	98.3	18.6	82.6	37.3	4	6	9
Gouna	5	10	0.16	4.78	2.47	2.09	107.6	23.9	89.9	38.1	4	6	9
Gouna	5	11	0.25	5.78	2.54	2.02	106.5	18.3	90.2	38.5	4	6	9
Gouna	5	12	0.23	4.78	2.61	2.09	104.1	14.5	81.1	38.5	4	6	9
Gouna	5	13	0.18	5.78	2.58	2.12	106.5	17.7	80.5	35.2	5	8	7
Gouna	5	14	0.19	5.43	2.47	2.02	102.6	25.1	91.6	36.9	4	4	9
Gouna	5	15	0.19	5.71	2.58	2.19	106.9	19.3	78.9	33.9	3	5	9
Gouna	5	16	0.18	4.71	2.51	1.98	102.6	18.4	78.2	37.3	3	6	9
Gouna	5	17	0.21	4.71	2.54	2.16	113.8	18.4	82.0	27.3	1	6	9
Gouna	5	18	0.18	4.86	2.51	2.16	96.5	18.9	86.0	41.5	0	5	9
Gouna	5	19	0.21	5.57	2.47	2.09	109.0	32.1	84.9	36.1	3	6	9
Gouna	5	20	0.18	5.00	2.54	2.12	107.7	23.0	86.5	39.3	0	4	9
Garoua	1	1	0.21	5.00	2.54	2.02	108.0	22.0	82.0	41.0	6	4	9
Garoua	1	2	0.18	5.85	2.61	2.02	105.0	18.0	79.0	37.0	5	0	9
Garoua	1	3	0.23	4.86	2.51	1.98	117.0	19.0	77.0	39.0	6	3	9
Garoua	1	4	0.23	5.00	2.54	2.09	112.0	21.0	75.0	33.0	5	0	9
Garoua	1	5	0.25	4.78	2.51	2.05	109.0	16.0	84.0	32.0	6	4	9
Garoua	1	6	0.23	4.93	2.58	2.09	117.0	21.0	86.0	42.0	4	1	9
Garoua	1	7	0.21	4.93	2.54	2.05	102.0	17.0	82.0	41.0	8	6	9
Garoua	1	8	0.19	4.71	2.51	1.95	94.0	20.0	86.0	43.0	6	4	9
Garoua	1	9	0.16	5.14	2.61	2.12	98.0	20.0	89.0	37.0	6	1	9
Garoua	1	10	0.23	4.86	2.54	1.95	109.0	19.0	81.0	37.0	4	0	8
Garoua	1	11	0.23	4.64	2.47	1.91	98.0	20.0	79.0	39.0	6	2	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Garoua	1	12	0.25	5.14	2.51	2.05	109.0	20.0	78.0	33.0	3	8	9
Garoua	1	13	0.26	5.78	2.47	1.98	110.0	14.0	74.0	32.0	5	1	9
Garoua	1	14	0.19	5.00	2.61	2.02	104.0	23.0	86.0	35.0	4	6	9
Garoua	1	15	0.19	4.86	2.54	2.09	105.0	22.0	84.0	44.0	6	8	9
Garoua	1	16	0.19	5.07	2.51	1.91	107.0	14.0	82.0	36.0	4	5	9
Garoua	1	17	0.18	5.78	2.64	2.02	91.0	21.0	82.0	37.0	6	2	9
Garoua	1	18	0.25	4.86	2.58	2.02	90.0	26.0	90.0	41.0	5	0	9
Garoua	1	19	0.18	4.86	2.61	2.05	116.0	22.0	85.0	38.0	5	4	9
Garoua	1	20	0.19	5.00	2.58	2.02	97.0	17.0	89.0	36.0	4	6	9
Garoua	2	1	0.19	5.00	2.47	2.09	101.0	25.0	83.0	32.0	5	0	9
Garoua	2	2	0.19	4.93	2.40	2.02	94.0	24.0	87.0	34.0	8	0	9
Garoua	2	3	0.18	5.00	2.54	2.09	93.0	17.0	89.0	38.0	9	4	9
Garoua	2	4	0.23	5.00	2.54	2.09	96.0	22.0	84.0	35.0	5	1	9
Garoua	2	5	0.19	5.07	2.47	2.12	104.0	25.0	83.0	33.0	5	0	9
Garoua	2	6	0.21	4.78	2.51	2.16	108.0	22.0	83.0	33.0	0	5	9
Garoua	2	7	0.12	4.86	2.51	2.09	93.0	18.0	82.0	33.0	4	6	9
Garoua	2	8	0.16	4.86	2.44	2.05	107.0	27.0	84.0	34.0	3	9	9
Garoua	2	9	0.19	4.64	2.54	1.95	105.0	18.0	82.0	37.0	0	5	9
Garoua	2	10	0.19	5.78	2.58	1.91	108.0	19.0	80.0	36.0	0	5	9
Garoua	2	11	0.23	4.50	2.44	1.88	101.0	20.0	82.0	33.0	0	8	9
Garoua	2	12	0.18	4.50	2.47	2.05	98.0	22.0	89.0	33.0	1	5	9
Garoua	2	13	0.19	4.86	2.58	2.12	108.0	24.0	92.0	36.0	4	8	9
Garoua	2	14	0.18	4.64	2.47	2.12	99.0	22.0	84.0	32.0	1	4	9
Garoua	2	15	0.18	4.86	2.54	1.98	90.0	18.0	88.0	32.0	5	6	9
Garoua	2	16	0.23	4.57	2.47	1.91	104.0	22.0	82.0	39.0	6	8	9
Garoua	2	17	0.25	4.50	2.54	2.16	107.0	22.0	84.0	39.0	5	9	9
Garoua	2	18	0.28	4.64	2.51	2.05	106.0	23.0	85.0	40.0	1	8	9
Garoua	2	19	0.18	4.50	2.54	2.09	100.0	22.0	79.0	26.0	0	8	9
Garoua	2	20	0.25	4.57	2.47	2.05	114.0	22.0	84.0	33.0	5	8	9
Garoua	3	1	0.26	4.64	2.54	2.02	98.0	21.0	80.0	38.0	5	4	9
Garoua	3	2	0.18	4.64	2.58	2.19	108.0	20.0	80.0	32.0	4	6	9
Garoua	3	3	0.16	4.64	2.61	2.23	97.0	22.0	78.0	42.0	3	8	9
Garoua	3	4	0.19	4.86	2.54	2.02	99.0	23.0	81.0	41.0	3	8	9
Garoua	3	5	0.21	4.64	2.51	2.12	102.0	21.0	81.0	43.0	4	8	9
Garoua	3	6	0.23	4.64	2.54	2.05	90.0	20.0	78.0	38.0	3	6	9
Garoua	3	7	0.21	4.50	2.37	1.91	103.0	20.0	79.0	32.0	3	8	9
Garoua	3	8	0.25	4.50	2.44	1.88	109.0	20.0	79.0	32.0	3	6	9
Garoua	3	9	0.19	4.64	2.51	2.05	93.0	25.0	82.0	39.0	3	6	9
Garoua	3	10	0.21	4.50	2.54	1.98	104.0	20.0	84.0	35.0	5	8	9
Garoua	3	11	0.19	4.64	2.47	1.81	97.0	21.0	80.0	38.0	1	5	9
Garoua	3	12	0.16	4.86	2.54	2.12	96.0	21.0	82.0	31.0	3	5	9
Garoua	3	13	0.26	4.71	2.51	2.02	105.0	21.0	78.0	35.0	4	5	9
Garoua	3	14	0.21	4.50	2.51	2.05	104.0	20.0	77.0	36.0	5	6	9
Garoua	3	15	0.16	4.64	2.44	2.09	105.0	22.0	80.0	40.0	4	6	9
Garoua	3	16	0.16	4.78	2.44	1.95	97.0	20.0	77.0	36.0	5	8	9
Garoua	3	17	0.19	4.57	2.47	2.02	104.0	18.0	85.0	33.0	5	8	9
Garoua	3	18	0.16	4.57	2.54	1.91	101.0	18.0	87.0	33.0	5	6	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Garoua	3	19	0.18	4.78	2.44	1.91	91.0	20.0	82.0	32.0	5	6	9
Garoua	3	20	0.18	4.64	2.44	1.77	102.0	19.0	79.0	47.0	5	6	9
Garoua	4	1	0.18	5.64	2.44	1.98	106.9	20.1	77.1	33.0	4	8	9
Garoua	4	2	0.25	5.78	2.51	2.02	112.7	19.8	78.6	31.0	1	4	9
Garoua	4	3	0.18	5.57	2.47	1.98	113.4	14.7	76.3	33.7	4	6	9
Garoua	4	4	0.21	4.71	2.47	1.98	109.8	17.3	74.4	29.5	4	6	9
Garoua	4	5	0.19	4.57	2.40	1.88	110.8	19.2	72.8	35.1	4	8	9
Garoua	4	6	0.19	5.50	2.51	1.91	112.3	14.7	68.9	25.2	0	4	9
Garoua	4	7	0.18	4.71	2.47	1.91	115.2	15.8	80.2	36.6	5	6	9
Garoua	4	8	0.23	4.64	2.37	1.91	114.7	16.9	71.2	25.9	0	4	9
Garoua	4	9	0.26	4.64	2.54	2.09	109.1	18.7	76.9	28.2	0	4	9
Garoua	4	10	0.19	5.57	2.44	2.05	104.6	19.3	75.7	30.0	0	4	9
Garoua	4	11	0.18	4.50	2.47	2.02	114.6	14.9	79.0	33.9	1	5	9
Garoua	4	12	0.30	4.57	2.44	2.12	112.8	22.3	80.9	37.4	4	6	9
Garoua	4	13	0.23	4.50	2.37	1.91	111.0	16.8	81.5	28.6	3	8	9
Garoua	4	14	0.18	4.64	2.44	2.05	108.9	16.2	72.8	26.9	0	5	9
Garoua	4	15	0.19	4.64	2.47	1.84	112.4	18.2	79.5	28.9	3	7	9
Garoua	4	16	0.19	4.71	2.47	2.16	111.2	17.0	72.2	31.8	0	4	9
Garoua	4	17	0.18	4.71	2.51	2.19	106.7	18.4	74.6	32.7	5	5	9
Garoua	4	18	0.19	4.86	2.51	2.09	108.8	18.5	76.2	31.9	1	4	9
Garoua	4	19	0.14	4.78	2.47	1.81	107.5	18.1	75.0	31.8	5	5	9
Garoua	4	20	0.26	4.64	2.47	1.95	103.4	17.1	77.4	32.4	4	6	9
Garoua	5	1	0.19	4.86	2.61	2.19	116.0	16.9	75.5	35.0	0	5	9
Garoua	5	2	0.26	4.78	2.51	2.09	108.1	16.5	80.7	38.3	4	6	9
Garoua	5	3	0.19	4.78	2.37	2.09	111.2	18.9	78.6	39.3	0	4	9
Garoua	5	4	0.18	5.00	2.58	2.12	109.8	18.0	74.7	26.7	5	6	9
Garoua	5	5	0.18	4.71	2.47	2.02	105.4	19.4	71.8	28.7	0	5	9
Garoua	5	6	0.18	5.00	2.44	1.91	113.7	19.7	73.6	35.6	0	5	9
Garoua	5	7	0.21	4.71	2.51	1.88	101.1	20.3	82.3	34.9	1	3	9
Garoua	5	8	0.19	4.86	2.51	1.95	109.3	18.5	76.6	25.6	0	4	9
Garoua	5	9	0.18	4.71	2.30	1.95	106.3	18.7	78.2	41.7	0	5	9
Garoua	5	10	0.14	4.86	2.51	2.02	106.3	20.8	75.1	30.9	0	5	9
Garoua	5	11	0.16	4.64	2.61	2.19	109.7	22.3	82.9	30.0	0	5	9
Garoua	5	12	0.14	4.93	2.61	2.02	101.1	21.4	74.7	40.2	0	4	9
Garoua	5	13	0.19	5.00	2.58	1.91	106.5	18.8	77.0	32.9	4	6	9
Garoua	5	14	0.19	4.86	2.54	1.98	111.8	17.4	77.9	40.8	4	6	9
Garoua	5	15	0.18	4.78	2.47	2.05	106.9	20.9	73.0	33.3	0	5	9
Garoua	5	16	0.18	4.71	2.54	2.12	117.2	18.9	80.3	42.3	0	5	9
Garoua	5	17	0.19	4.57	2.44	1.98	111.3	21.2	79.9	36.9	1	4	9
Garoua	5	18	0.21	4.93	2.51	1.98	115.9	18.0	79.1	36.9	1	4	9
Garoua	5	19	0.21	5.00	2.61	2.16	113.4	16.6	74.7	34.7	4	6	9
Garoua	5	20	0.23	4.71	2.58	1.98	111.5	19.2	79.0	38.0	0	4	9
Maroua	1	1	0.16	4.93	2.58	1.91	109.8	23.9	87.7	40.9	3	3	8
Maroua	1	2	0.25	4.93	2.51	2.02	118.7	18.7	75.6	42.9	3	4	9
Maroua	1	3	0.16	4.64	2.51	1.98	111.6	19.9	85.5	36.4	0	4	8
Maroua	1	4	0.19	4.86	2.44	1.77	119.3	21.1	80.7	44.9	4	6	8
Maroua	1	5	0.14	4.78	2.54	2.09	116.5	19.4	80.0	38.1	3	5	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Maroua	1	6	0.18	4.78	2.40	1.98	113.6	18.4	72.7	41.6	0	5	8
Maroua	1	7	0.19	4.86	2.54	2.05	110.8	18.4	80.7	40.3	4	5	8
Maroua	1	8	0.14	4.71	2.47	1.88	100.9	17.2	84.0	35.9	3	6	9
Maroua	1	9	0.21	4.78	2.47	2.12	109.8	20.4	84.3	44.8	1	5	9
Maroua	1	10	0.14	4.86	2.47	2.05	118.7	20.4	76.0	39.2	3	5	9
Maroua	1	11	0.18	4.93	2.47	1.95	115.6	17.1	79.2	41.8	3	6	8
Maroua	1	12	0.23	4.93	2.44	1.84	102.6	18.0	82.9	40.7	4	6	8
Maroua	1	13	0.19	5.00	2.64	2.09	115.2	18.8	84.4	40.6	3	6	9
Maroua	1	14	0.28	4.93	2.47	1.95	108.4	19.2	79.8	41.5	3	8	9
Maroua	1	15	0.18	4.71	2.47	1.88	114.3	17.5	78.4	39.5	4	6	9
Maroua	1	16	0.23	4.86	2.44	1.88	119.6	20.9	76.4	37.6	4	5	9
Maroua	1	17	0.21	5.36	2.61	2.09	113.4	16.9	81.2	48.9	4	6	9
Maroua	1	18	0.21	4.64	2.40	2.02	105.6	16.2	76.0	41.2	0	5	9
Maroua	1	19	0.25	4.86	2.58	2.09	122.3	18.4	81.3	42.5	4	6	9
Maroua	1	20	0.18	4.78	2.47	2.05	114.7	19.0	82.4	33.5	4	5	9
Maroua	2	1	0.19	5.93	2.54	2.05	102.8	18.7	80.2	40.1	2	4	8
Maroua	2	2	0.19	4.78	2.51	1.91	106.0	20.0	86.7	34.8	4	6	9
Maroua	2	3	0.21	4.78	2.51	2.05	107.4	21.5	83.5	32.1	4	6	9
Maroua	2	4	0.19	4.78	2.47	2.05	108.7	17.0	84.6	35.4	4	6	9
Maroua	2	5	0.18	4.64	2.40	1.95	99.4	19.1	84.4	38.4	4	4	9
Maroua	2	6	0.26	4.64	2.51	2.05	107.0	18.6	86.3	38.5	0	5	9
Maroua	2	7	0.21	5.07	2.44	2.05	106.4	20.0	81.0	36.2	4	6	8
Maroua	2	8	0.25	4.86	2.54	2.12	100.9	16.7	79.5	36.3	0	5	8
Maroua	2	9	0.23	5.71	2.51	1.98	105.8	18.8	85.3	40.4	3	6	9
Maroua	2	10	0.19	4.64	2.51	2.23	106.5	21.7	84.6	33.6	4	6	9
Maroua	2	11	0.21	5.64	2.51	1.91	101.1	18.9	83.2	31.9	4	6	9
Maroua	2	12	0.21	4.78	2.51	2.02	106.5	18.4	80.2	31.2	4	4	9
Maroua	2	13	0.18	4.78	2.47	1.91	109.5	21.6	81.1	35.8	4	6	9
Maroua	2	14	0.18	4.78	2.47	2.02	113.2	20.6	78.1	35.4	1	6	8
Maroua	2	15	0.16	4.86	2.51	1.98	111.6	24.6	86.6	38.3	4	4	9
Maroua	2	16	0.19	5.78	2.51	1.98	109.1	22.1	84.6	35.0	3	6	9
Maroua	2	17	0.16	5.36	2.47	2.05	111.8	18.0	76.9	41.8	5	0	9
Maroua	2	18	0.14	4.71	2.51	2.16	112.8	18.6	84.6	30.7	0	5	9
Maroua	2	19	0.25	4.93	2.58	2.02	108.3	19.2	82.5	36.7	4	6	9
Maroua	2	20	0.19	4.86	2.44	1.74	100.4	19.5	85.8	40.3	0	5	8
Maroua	3	1	0.21	5.85	2.51	2.09	110.5	16.4	84.7	32.9	0	4	9
Maroua	3	2	0.16	5.57	2.54	2.05	97.4	18.5	79.5	36.6	0	4	8
Maroua	3	3	0.18	5.71	2.58	2.12	106.4	18.9	82.2	32.0	0	6	8
Maroua	3	4	0.16	5.71	2.64	2.09	101.5	21.5	83.3	36.0	0	5	9
Maroua	3	5	0.19	5.57	2.58	1.95	111.2	18.0	82.4	29.5	4	6	9
Maroua	3	6	0.19	5.57	2.58	2.02	104.8	22.7	80.4	31.7	0	5	9
Maroua	3	7	0.19	4.43	2.54	1.91	91.6	17.3	86.1	36.3	0	5	8
Maroua	3	8	0.18	5.57	2.58	2.02	97.0	20.3	83.3	35.6	0	5	9
Maroua	3	9	0.19	5.57	2.47	1.88	104.9	16.8	76.7	31.3	0	5	8
Maroua	3	10	0.16	4.78	2.51	1.98	108.2	17.6	84.8	35.4	0	6	8
Maroua	3	11	0.18	5.64	2.54	2.02	113.1	15.4	81.9	36.4	0	5	9
Maroua	3	12	0.23	4.57	2.51	2.02	109.6	17.7	74.7	38.6	0	6	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Maroua	3	13	0.18	4.64	2.64	2.05	104.3	21.8	76.3	35.8	0	6	9
Maroua	3	14	0.21	4.64	2.54	1.98	101.9	17.1	80.8	34.7	0	6	8
Maroua	3	15	0.16	4.71	2.51	1.95	92.5	18.1	88.8	28.1	0	5	9
Maroua	3	16	0.19	5.00	2.61	2.12	105.2	20.6	76.2	39.7	0	5	9
Maroua	3	17	0.18	4.50	2.58	1.95	111.2	18.6	74.7	31.6	1	5	9
Maroua	3	18	0.18	4.78	2.61	2.16	97.4	22.0	88.0	33.1	0	5	9
Maroua	3	19	0.18	4.64	2.58	1.95	100.4	19.3	77.1	31.4	4	6	9
Maroua	3	20	0.23	4.64	2.47	1.88	104.6	20.2	85.8	34.7	0	5	9
Maroua	4	1	0.18	5.78	2.51	2.19	102.0	17.1	80.6	32.2	0	6	9
Maroua	4	2	0.21	4.71	2.58	2.16	106.2	19.4	82.3	35.1	0	5	8
Maroua	4	3	0.25	4.71	2.37	1.91	108.9	15.7	78.2	32.9	4	6	9
Maroua	4	4	0.21	4.78	2.58	2.12	99.2	16.7	80.4	33.9	0	5	8
Maroua	4	5	0.19	4.71	2.47	2.05	100.5	17.9	79.8	32.2	1	5	9
Maroua	4	6	0.19	4.93	2.47	1.98	108.2	19.6	84.5	32.0	3	4	8
Maroua	4	7	0.21	5.64	2.54	2.09	104.6	18.0	80.0	35.3	4	6	9
Maroua	4	8	0.21	5.57	2.40	2.05	93.3	20.7	79.4	33.8	0	8	9
Maroua	4	9	0.19	5.71	2.47	2.12	113.9	17.3	81.8	33.4	4	5	8
Maroua	4	10	0.18	4.78	2.40	2.09	102.8	20.5	80.4	36.7	0	4	8
Maroua	4	11	0.23	4.86	2.54	2.09	103.5	18.1	85.4	31.9	0	5	9
Maroua	4	12	0.18	4.93	2.54	2.05	104.2	20.2	78.9	34.3	0	4	9
Maroua	4	13	0.16	4.64	2.47	2.09	114.0	18.5	77.8	33.9	0	4	9
Maroua	4	14	0.18	4.57	2.47	2.09	101.9	20.7	82.5	39.4	1	4	9
Maroua	4	15	0.21	4.71	2.47	2.05	101.3	19.5	69.1	33.9	4	4	9
Maroua	4	16	0.19	4.71	2.51	2.05	97.6	20.2	85.5	35.8	0	6	9
Maroua	4	17	0.18	5.57	2.44	2.05	108.7	20.3	89.3	39.5	3	9	9
Maroua	4	18	0.23	5.14	2.40	2.12	94.9	19.3	84.3	34.7	0	4	9
Maroua	4	19	0.21	5.00	2.58	2.26	113.7	18.4	74.6	27.3	2	6	8
Maroua	4	20	0.18	5.36	2.54	2.05	113.0	20.5	81.8	32.9	0	4	9
Maroua	5	1	0.19	5.71	2.40	1.88	108.4	16.9	72.9	45.1	0	6	9
Maroua	5	2	0.23	4.71	2.37	2.02	108.3	16.4	70.3	38.9	3	6	8
Maroua	5	3	0.18	5.07	2.47	2.05	111.2	20.7	89.3	31.8	4	6	9
Maroua	5	4	0.25	4.64	2.54	2.09	107.4	20.7	76.2	37.0	0	4	8
Maroua	5	5	0.18	4.78	2.37	1.91	105.9	17.7	79.9	40.3	0	5	8
Maroua	5	6	0.21	4.78	2.47	2.05	105.4	14.4	79.7	37.1	0	4	9
Maroua	5	7	0.18	4.71	2.54	2.02	98.1	14.8	72.3	29.1	0	4	8
Maroua	5	8	0.18	4.64	2.44	2.05	97.8	16.3	78.1	32.7	0	6	8
Maroua	5	9	0.14	4.64	2.44	2.05	106.9	20.2	78.4	37.1	0	6	8
Maroua	5	10	0.18	4.57	2.37	2.05	103.7	18.3	78.6	41.3	0	4	8
Maroua	5	11	0.18	4.86	2.37	2.02	106.1	18.1	75.3	33.0	0	4	9
Maroua	5	12	0.23	4.71	2.54	2.02	106.1	18.6	83.0	40.0	0	4	8
Maroua	5	13	0.23	4.64	2.37	2.05	107.1	19.6	82.0	37.1	1	4	8
Maroua	5	14	0.19	4.86	2.54	2.16	101.8	18.8	80.1	33.3	0	5	8
Maroua	5	15	0.18	4.57	2.54	2.05	107.3	16.8	80.7	30.6	0	4	8
Maroua	5	16	0.18	4.57	2.47	1.91	115.3	22.9	81.5	37.6	4	6	8
Maroua	5	17	0.25	4.57	2.47	2.12	107.2	17.0	75.7	36.6	1	5	8

10.3.2 Pheromone Data

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Kumba	1	1	9.00	54.71	0.09	9.00	0.09	9.00	9.00	0.09	9.00
Kumba	1	2	6.86	23.58	8.39	0.07	11.85	25.19	12.71	0.07	11.28
Kumba	1	3	11.43	14.56	11.43	11.43	13.89	11.43	11.43	0.11	14.27
Kumba	1	4	0.09	8.50	8.50	0.09	19.04	33.02	22.18	0.09	8.50
Kumba	1	5	10.87	12.09	10.87	0.11	11.93	23.31	19.86	0.11	10.87
Kumba	2	1	2.63	0.03	0.03	2.63	10.58	45.37	20.80	15.30	2.63
Kumba	2	2	12.02	12.02	12.02	15.56	12.02	12.02	12.02	0.12	12.23
Kumba	2	3	2.90	10.97	8.78	2.90	12.03	33.26	18.19	3.90	7.08
Kumba	2	4	4.96	38.88	4.96	5.24	4.96	22.37	9.14	0.05	9.43
Kumba	2	5	19.06	41.86	19.06	0.19	0.19	19.06	0.19	0.19	0.19
Kumba	3	1	11.26	24.90	11.26	0.11	18.58	11.26	11.26	0.11	11.26
Kumba	3	2	13.38	13.38	13.38	13.38	0.13	17.67	15.13	0.13	13.38
Kumba	3	3	11.15	0.11	11.15	11.15	12.66	30.22	12.31	0.11	11.15
Kumba	4	1	8.83	15.58	15.10	23.18	0.09	0.09	8.83	8.83	19.46
Kumba	4	2	4.34	17.34	0.04	16.79	29.39	4.34	11.69	7.41	8.66
Kumba	4	3	9.70	24.73	12.67	9.70	12.56	0.10	0.10	17.89	12.56
Kumba	4	4	0.17	27.69	0.17	21.34	16.76	0.17	0.17	16.76	16.76
Kumba	4	5	1.88	28.89	2.97	0.02	31.03	1.88	8.88	7.73	16.71
Kumba	4	6	5.56	9.63	0.06	0.06	33.99	5.56	15.64	8.70	20.81
Kumba	4	7	0.94	21.01	2.43	1.34	35.92	1.79	10.62	6.94	19.01
Kumba	4	8	3.52	19.57	3.82	0.04	26.50	12.80	17.47	4.55	11.72
Mamfe	1	1	6.50	16.05	6.50	0.06	12.50	21.79	0.06	6.50	30.05
Mamfe	1	2	4.00	6.81	4.00	5.22	8.78	41.51	19.22	6.22	4.23
Mamfe	1	3	10.59	10.59	0.11	10.59	23.98	22.13	0.11	11.31	10.59
Mamfe	1	4	2.58	7.82	6.38	0.03	11.59	38.77	22.99	2.82	7.02
Mamfe	1	5	0.90	12.20	1.56	4.35	7.64	38.04	12.47	1.57	21.27
Mamfe	1	6	8.03	8.37	8.03	10.48	9.19	25.10	13.40	9.37	8.03
Mamfe	1	7	6.00	6.00	6.00	6.00	12.91	42.71	12.94	7.40	0.06
Mamfe	2	1	5.83	49.71	1.32	1.61	18.09	9.91	2.75	2.92	7.86
Mamfe	2	2	3.74	12.87	5.32	2.46	24.54	31.50	6.44	1.88	11.24
Mamfe	2	3	1.60	7.90	4.35	3.87	32.13	32.06	6.54	2.37	9.18
Mamfe	2	4	5.20	85.90	1.65	1.84	1.57	0.01	0.72	2.44	0.67
Mamfe	2	5	2.31	51.96	3.66	1.27	12.72	13.97	6.85	1.99	5.28
Mamfe	2	6	9.51	72.33	2.60	0.03	4.71	2.60	2.63	3.00	2.60
Mamfe	2	7	3.38	76.44	2.20	1.31	3.84	7.20	2.17	2.69	0.77
Mamfe	2	8	3.85	74.35	2.03	1.24	3.80	9.84	1.68	2.26	0.95
Mamfe	3	1	6.36	77.15	1.93	2.81	2.31	3.74	1.80	3.89	0.02
Mamfe	3	2	7.32	71.37	3.94	5.21	3.43	3.43	0.03	5.23	0.03
Mamfe	3	3	12.36	66.45	0.05	4.76	4.76	4.76	0.05	6.75	0.05
Mamfe	3	4	17.57	56.80	0.13	0.13	12.50	0.13	0.13	12.50	0.13
Mamfe	3	5	9.33	71.58	3.23	3.23	3.23	3.23	0.03	6.09	0.03
Mamfe	3	6	6.20	76.71	1.92	1.92	2.40	2.73	1.92	4.29	1.92
Mamfe	3	7	10.63	44.30	2.83	7.51	5.89	12.01	0.03	13.46	3.34
Mamfe	3	8	7.87	46.18	2.44	10.19	2.54	12.87	2.44	7.26	8.20
Mamfe	4	1	6.45	76.92	1.36	4.03	2.27	3.63	0.01	3.93	1.41

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Mamfe	4	2	10.31	72.80	1.68	3.54	2.93	1.72	1.68	5.32	0.02
Mamfe	4	3	17.78	47.50	2.95	10.90	3.27	2.95	3.22	3.55	7.88
Mamfe	4	4	9.14	54.83	5.13	5.21	5.34	2.06	7.28	9.13	1.87
Mamfe	4	5	4.61	86.37	2.05	1.53	1.11	0.63	1.00	2.06	0.65
Mamfe	4	6	3.74	77.70	1.41	1.07	2.42	2.01	4.48	5.20	1.97
Mamfe	4	7	5.08	85.22	0.05	0.05	4.73	4.73	0.05	0.05	0.05
Mamfe	5	1	3.80	27.87	3.80	4.44	27.12	18.03	6.32	3.80	4.81
Mamfe	5	2	2.55	10.53	7.06	4.70	22.62	33.17	11.55	3.79	4.03
Mamfe	5	3	0.05	18.35	9.68	0.05	22.26	12.40	30.29	6.85	0.05
Mamfe	5	4	1.79	14.45	7.94	3.31	26.25	27.23	7.62	3.93	7.49
Mamfe	5	5	6.42	16.42	0.06	0.06	29.63	10.78	7.91	15.07	13.64
Mamfe	5	6	0.79	4.84	7.44	6.59	17.82	36.73	21.36	2.26	2.15
Mamfe	5	7	1.80	12.76	8.69	1.80	15.18	35.03	13.65	5.62	5.48
Bamenda	1	1	3.77	14.32	5.33	5.81	19.74	20.28	15.22	3.49	12.03
Bamenda	1	2	5.67	33.70	6.32	4.58	9.15	18.60	8.81	3.26	9.92
Bamenda	1	3	4.21	24.50	7.20	2.48	34.29	9.20	10.38	2.68	5.07
Bamenda	1	4	6.53	26.31	11.50	3.04	8.80	22.33	8.17	4.57	8.76
Bamenda	1	5	6.14	39.46	6.46	2.35	5.25	20.73	13.56	5.29	0.75
Bamenda	1	6	8.44	32.41	5.72	3.17	21.48	8.99	10.02	5.98	3.80
Bamenda	2	1	1.60	13.15	2.29	3.26	19.91	14.64	32.91	4.15	8.08
Bamenda	2	2	8.01	16.75	9.55	0.04	14.70	15.84	30.98	4.09	0.04
Bamenda	2	3	11.43	27.22	4.33	1.14	9.67	22.89	18.53	2.20	2.58
Bamenda	2	4	3.67	18.34	5.93	0.01	23.56	17.80	21.68	3.73	5.27
Bamenda	2	5	5.39	9.50	4.04	4.31	14.56	29.86	24.20	3.40	4.75
Bamenda	2	6	6.93	25.54	6.06	0.03	20.28	16.14	13.20	2.64	9.17
Bamenda	2	7	5.87	20.56	5.52	4.76	15.12	15.42	20.04	3.43	9.29
Bamenda	3	1	2.42	21.78	19.61	4.31	14.86	10.26	12.88	9.86	4.02
Bamenda	3	2	1.78	13.77	18.45	2.69	6.77	19.05	30.67	4.70	2.12
Bamenda	3	3	2.91	3.17	18.31	3.77	11.29	20.61	28.45	3.49	8.01
Bamenda	3	4	4.42	7.69	33.46	7.08	4.12	14.95	20.27	4.16	3.85
Bamenda	3	5	2.03	14.57	33.98	6.99	4.31	23.56	4.35	5.54	4.67
Bamenda	3	6	7.67	29.98	13.16	4.26	18.95	8.03	10.90	2.45	4.61
Bamenda	3	7	1.13	25.55	10.49	2.70	23.03	6.49	19.55	2.14	8.90
Bamenda	4	1	5.90	28.25	8.33	5.42	13.04	8.85	11.08	4.61	14.54
Bamenda	4	2	0.70	7.51	6.60	5.99	22.31	22.48	20.69	3.03	10.69
Bamenda	4	3	11.21	13.26	27.18	20.94	2.20	11.93	6.39	5.63	1.25
Bamenda	4	4	5.37	18.49	7.59	2.98	28.24	6.32	22.00	4.79	4.22
Bamenda	4	5	8.00	14.28	13.90	7.98	13.82	11.83	17.14	2.14	10.90
Bamenda	4	6	4.44	22.25	5.54	2.66	12.95	2.10	18.95	3.49	27.62
Bamenda	5	1	6.33	18.65	10.32	6.33	15.90	14.41	15.69	0.06	12.31
Bamenda	5	2	7.16	15.73	17.03	5.06	15.81	11.74	15.60	0.05	11.83
Bamenda	5	3	6.00	21.06	6.79	6.00	28.59	7.40	10.16	0.06	13.94
Bamenda	5	4	3.79	6.73	2.19	36.28	9.07	17.56	17.21	2.20	4.98
Bamenda	5	5	4.47	5.51	5.37	57.70	9.53	4.47	4.47	0.04	8.41
Bamenda	5	6	7.55	22.87	5.44	10.14	16.80	5.04	16.99	5.04	10.14
Kumbo	1	1	8.18	7.59	21.53	3.84	5.25	28.71	17.20	3.84	3.84
Kumbo	1	2	10.67	10.81	10.67	10.67	13.83	10.67	13.64	0.11	18.91

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Kumbo	1	3	11.26	12.42	11.26	11.26	11.26	18.12	24.17	0.11	0.11
Kumbo	1	4	45.99	8.17	12.98	8.17	8.17	8.17	8.17	0.08	0.08
Kumbo	1	5	30.60	5.62	5.62	5.62	8.09	14.91	23.89	0.06	5.62
Kumbo	2	1	8.42	6.28	7.20	6.28	6.28	26.57	26.41	6.28	6.28
Kumbo	2	2	7.02	4.16	3.04	3.47	6.58	39.55	30.32	2.93	2.93
Kumbo	2	3	18.02	10.47	21.28	3.28	17.52	9.64	13.00	3.50	3.28
Kumbo	2	4	5.85	4.66	18.91	4.66	7.09	28.77	20.75	4.66	4.66
Kumbo	2	5	3.18	3.23	11.31	60.23	3.70	9.72	5.16	1.34	2.14
Kumbo	2	6	10.29	10.30	26.10	6.65	12.51	16.57	10.86	0.07	6.65
Kumbo	2	7	8.82	8.82	22.69	12.75	8.82	11.66	8.82	8.82	8.82
Kumbo	2	8	4.21	8.28	17.54	4.21	17.91	20.16	19.27	4.21	4.21
Kumbo	3	1	9.56	11.48	22.36	9.56	13.94	13.87	9.56	0.10	9.56
Kumbo	3	2	4.57	4.42	14.41	54.06	2.94	6.37	8.50	0.89	3.83
Kumbo	3	3	5.32	9.89	20.08	4.69	14.32	10.56	24.68	2.63	7.83
Kumbo	3	4	9.75	19.27	22.16	9.75	9.75	9.75	9.75	0.10	9.75
Kumbo	3	5	11.28	11.28	15.29	11.28	11.28	16.91	11.28	0.11	11.28
Kumbo	3	6	7.33	8.01	14.75	7.97	8.11	28.64	25.06	0.07	0.07
Kumbo	3	7	6.07	7.22	27.00	10.88	8.96	20.50	8.54	5.42	5.42
Kumbo	3	8	2.29	7.93	10.47	56.09	3.19	9.44	6.34	0.02	4.23
Banyo	1	1	5.72	7.64	11.50	5.72	9.48	35.84	17.89	0.06	6.15
Banyo	1	2	6.07	6.07	13.30	44.05	6.07	16.58	7.74	0.06	0.06
Banyo	1	3	5.60	5.60	8.02	5.60	6.35	33.30	24.34	5.60	5.60
Banyo	1	4	10.99	10.76	26.91	9.87	9.87	21.54	9.87	0.10	0.10
Banyo	1	5	9.36	9.36	21.48	9.36	9.36	20.50	20.40	0.09	0.09
Banyo	1	6	4.16	8.03	9.67	3.96	26.04	12.53	12.80	2.41	20.40
Banyo	2	1	36.13	3.59	3.59	3.59	13.61	14.58	16.82	3.59	4.49
Banyo	2	2	43.59	4.59	4.59	4.59	5.00	16.36	16.64	0.05	4.59
Banyo	2	3	64.54	0.06	6.00	6.00	6.00	11.30	6.00	0.06	0.06
Banyo	2	4	41.69	3.95	3.95	3.95	8.71	18.01	15.06	0.04	4.63
Banyo	2	5	13.37	12.66	26.65	7.47	10.29	14.20	8.40	0.07	6.89
Banyo	2	6	11.75	11.75	17.63	11.75	11.75	11.75	11.75	0.12	11.75
Banyo	2	7	9.56	17.36	20.51	6.39	13.23	11.72	5.68	2.81	12.74
Banyo	3	1	5.69	5.69	18.93	5.69	14.14	16.67	21.64	5.84	5.69
Banyo	3	2	4.96	11.83	12.48	4.39	13.41	12.50	6.27	1.92	32.24
Banyo	3	3	4.14	15.00	15.12	4.49	11.02	20.30	15.11	4.14	10.67
Banyo	3	4	6.38	8.17	17.38	4.72	8.85	19.20	21.48	3.59	10.23
Banyo	3	5	4.55	9.18	13.04	3.69	17.04	17.38	26.03	2.65	6.45
Banyo	3	6	7.15	7.90	19.67	7.00	7.63	10.14	29.66	0.07	10.77
Banyo	3	7	2.81	6.21	9.08	2.50	9.62	22.24	41.70	2.50	3.32
Banyo	4	1	5.66	16.51	15.22	5.06	16.37	14.65	15.37	5.06	6.10
Banyo	4	2	9.75	6.84	26.02	7.67	8.24	20.91	20.42	0.07	0.07
Banyo	4	3	9.83	21.66	8.15	7.28	7.28	21.11	10.13	7.28	7.28
Banyo	4	4	11.32	12.30	28.69	11.32	13.50	11.32	11.32	0.11	0.11
Banyo	4	5	5.34	9.36	18.66	4.47	15.00	22.41	19.01	0.04	5.71
Banyo	4	6	14.62	20.97	11.59	9.24	12.10	14.82	8.77	0.08	7.83
Banyo	4	7	5.78	9.58	9.66	5.78	13.69	17.70	26.26	5.78	5.78
Banyo	4	8	9.50	10.58	15.79	9.50	18.93	12.40	13.70	0.09	9.50

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Lewa	1	1	4.75	15.38	13.82	5.88	5.99	36.36	15.70	0.02	2.11
Lewa	1	2	10.70	10.70	10.70	10.70	25.02	10.70	10.70	0.11	10.70
Lewa	1	3	9.16	14.18	25.40	7.74	14.78	7.74	7.74	0.08	13.20
Lewa	1	4	8.36	16.13	19.78	8.36	14.73	8.36	8.36	0.08	15.83
Lewa	1	5	8.80	10.27	21.41	5.77	19.36	5.63	5.85	0.06	22.86
Lewa	1	6	7.48	14.10	5.49	2.94	17.82	24.87	16.64	2.46	8.19
Lewa	1	7	5.01	10.89	14.48	4.05	21.19	22.63	12.96	0.04	8.76
Lewa	1	8	4.61	6.16	18.56	3.84	7.80	31.64	23.51	0.04	3.84
Lewa	2	1	5.32	7.35	21.33	4.06	10.25	24.82	22.15	1.93	2.80
Lewa	2	2	3.03	4.58	10.43	3.03	9.91	45.34	17.63	3.03	3.03
Lewa	2	3	3.62	10.89	13.71	3.54	11.68	34.05	19.32	0.03	3.17
Lewa	2	4	10.64	13.92	22.10	10.64	10.64	10.64	10.64	0.11	10.64
Lewa	2	5	13.13	13.13	33.93	13.13	0.13	13.13	13.13	0.13	0.13
Lewa	2	6	4.69	11.54	14.26	4.51	24.53	18.73	17.08	0.05	4.63
Lewa	2	7	2.29	5.01	11.86	2.26	6.63	42.25	24.66	2.24	2.80
Lewa	2	8	7.64	15.00	15.69	7.64	27.88	7.64	7.64	0.08	10.81
Lewa	3	1	12.28	7.14	34.65	10.03	7.57	12.14	9.55	0.07	6.58
Lewa	3	2	5.74	3.33	16.27	4.73	3.33	49.34	13.89	0.03	3.33
Lewa	3	3	8.19	8.15	25.76	4.91	11.23	22.49	9.22	2.92	7.12
Lewa	3	4	2.93	6.57	9.24	2.31	28.13	27.65	12.03	1.80	9.33
Lewa	3	5	5.72	10.26	17.73	4.51	12.06	24.77	11.28	0.05	13.63
Lewa	3	6	8.19	8.19	17.11	8.19	8.21	36.98	12.97	0.08	0.08
Lewa	3	7	18.40	17.42	63.77	0.07	0.07	0.07	0.07	0.07	0.07
Lewa	4	1	2.56	6.71	17.10	3.13	19.16	23.60	14.16	2.32	11.27
Lewa	4	2	4.54	9.37	14.06	4.38	28.17	9.18	12.33	4.38	13.59
Lewa	4	3	7.79	9.79	19.10	7.79	16.75	13.39	17.51	0.08	7.79
Lewa	4	4	5.48	15.02	14.43	5.48	18.78	6.43	11.95	0.05	22.38
Lewa	4	5	4.97	10.56	15.15	4.83	10.64	4.83	4.83	0.05	44.14
Lewa	4	6	5.78	5.89	16.55	4.89	8.51	5.50	4.63	3.90	44.36
Lewa	4	7	5.54	9.00	16.36	4.86	18.59	15.87	15.72	0.04	14.03
Gouna	1	1	7.44	7.44	17.94	7.44	0.07	27.37	24.77	0.07	7.44
Gouna	1	2	17.05	0.17	31.13	17.05	0.17	17.05	17.05	0.17	0.17
Gouna	1	3	6.72	6.24	22.76	6.24	8.15	25.85	17.74	0.06	6.24
Gouna	1	4	10.49	10.49	26.49	10.49	10.49	10.49	10.49	0.10	10.49
Gouna	1	5	7.83	5.08	20.20	31.18	8.37	12.72	9.10	0.04	5.47
Gouna	1	6	3.52	6.33	15.94	4.58	7.72	31.48	18.77	3.36	8.30
Gouna	1	7	7.67	29.70	23.81	5.56	5.56	14.54	7.53	0.06	5.56
Gouna	2	1	16.95	5.99	35.95	10.75	7.08	5.99	11.23	5.99	0.06
Gouna	2	2	10.73	10.73	21.50	10.73	10.73	10.73	13.98	0.11	10.73
Gouna	2	3	9.45	9.27	29.68	9.27	12.48	9.27	11.23	0.09	9.27
Gouna	2	4	15.22	61.84	11.19	11.19	0.11	0.11	0.11	0.11	0.11
Gouna	2	5	7.80	7.80	29.11	29.11	7.80	10.41	7.80	0.08	0.08
Gouna	2	6	11.83	4.97	37.19	8.45	10.18	6.62	8.81	4.97	6.97
Gouna	2	7	17.52	0.18	29.22	17.52	0.18	17.52	17.52	0.18	0.18
Gouna	3	1	6.69	4.14	29.65	5.23	6.02	33.93	6.05	4.14	4.14
Gouna	3	2	10.88	10.88	21.89	10.88	10.88	12.73	10.88	0.11	10.88
Gouna	3	3	7.97	5.00	27.78	4.31	6.58	32.31	6.43	0.04	9.58

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Gouna	3	4	6.07	10.76	18.80	7.55	6.07	44.55	6.07	0.06	0.06
Gouna	3	5	9.13	5.18	31.71	8.70	5.18	26.66	8.20	0.05	5.18
Gouna	3	6	7.24	9.40	14.96	7.24	21.92	24.68	7.24	0.07	7.24
Gouna	3	7	8.07	4.78	25.73	7.05	11.45	26.64	11.45	0.05	4.78
Gouna	3	8	6.60	9.69	21.00	5.30	15.15	31.76	5.22	0.05	5.22
Gouna	4	1	9.96	7.38	31.70	7.38	7.38	28.68	7.38	0.07	0.07
Gouna	4	2	12.53	0.13	36.99	12.53	12.53	12.53	12.53	0.13	0.13
Gouna	4	3	6.34	6.34	22.65	6.34	10.41	27.70	20.09	0.06	0.06
Gouna	4	4	18.26	0.18	26.25	18.26	0.18	18.26	18.26	0.18	0.18
Gouna	4	5	13.19	6.26	45.69	6.26	6.26	7.24	8.79	6.26	0.06
Gouna	5	1	17.01	17.01	31.27	17.01	17.01	0.17	0.17	0.17	0.17
Gouna	5	2	7.34	7.34	19.59	10.71	10.20	30.06	7.34	0.07	7.34
Gouna	5	3	10.39	10.39	28.72	10.39	10.39	19.13	10.39	0.10	0.10
Gouna	5	4	13.81	13.81	16.86	13.81	13.81	13.81	0.14	0.14	13.81
Gouna	5	5	9.04	4.95	23.95	5.68	18.43	20.02	5.50	4.95	7.48
Gouna	5	6	10.93	10.93	27.38	13.84	14.84	10.93	10.93	0.11	0.11
Gouna	5	7	8.48	8.48	27.13	8.48	21.92	8.48	8.48	0.08	8.48
Gouna	5	8	10.00	10.00	23.52	10.00	10.00	16.37	10.00	0.10	10.00
Garoua	1	1	12.46	19.75	17.70	0.12	12.46	12.46	12.46	0.12	12.46
Garoua	1	2	9.73	12.18	9.73	11.55	13.20	24.04	9.73	0.10	9.73
Garoua	1	3	8.93	8.93	21.22	13.13	8.93	8.93	8.93	0.09	20.91
Garoua	1	4	5.35	7.75	18.37	2.69	17.16	36.23	7.07	2.69	2.69
Garoua	1	5	21.92	76.55	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Garoua	1	6	10.25	23.22	0.10	10.25	10.25	35.47	10.25	0.10	0.10
Garoua	1	7	11.86	5.96	34.58	8.49	5.96	21.16	5.96	0.06	5.96
Garoua	1	8	10.25	23.22	0.10	10.25	10.25	35.47	10.25	0.10	0.10
Garoua	2	1	2.03	6.37	12.71	2.03	10.14	46.60	15.75	0.02	4.35
Garoua	2	2	4.06	4.06	23.05	4.06	12.60	32.08	6.35	4.06	9.69
Garoua	2	3	7.17	26.29	17.89	5.74	6.20	18.77	9.60	3.77	4.58
Garoua	2	4	7.07	10.21	21.95	7.07	7.07	39.43	7.07	0.07	0.07
Garoua	2	5	13.03	23.88	39.60	5.84	5.84	5.84	5.84	0.06	0.06
Garoua	2	6	5.26	18.63	14.75	21.10	5.26	24.06	5.63	0.05	5.26
Garoua	3	1	6.67	6.67	15.24	6.67	20.64	26.08	7.00	0.07	10.96
Garoua	3	2	2.76	5.71	24.31	0.02	11.14	3.02	44.84	1.93	6.28
Garoua	3	3	8.27	6.46	32.66	6.46	0.06	31.27	8.28	0.06	6.46
Garoua	3	4	5.12	5.31	22.17	3.52	9.67	37.60	10.91	0.04	5.66
Garoua	3	5	9.24	3.33	22.37	7.20	26.73	19.76	4.99	2.54	3.82
Garoua	3	6	12.19	12.19	0.12	0.12	12.19	26.60	12.19	12.19	12.19
Garoua	3	7	3.76	2.64	18.56	3.63	13.85	40.43	11.04	2.64	3.44
Garoua	3	8	4.93	8.69	6.62	4.99	27.29	31.96	4.93	4.93	5.66
Garoua	4	1	6.03	25.16	31.97	5.71	3.76	17.76	3.20	3.20	3.20
Garoua	4	2	5.88	29.81	28.34	5.54	5.54	13.77	5.54	0.06	5.54
Garoua	4	3	8.01	7.72	32.34	5.60	11.34	24.21	2.76	2.16	5.86
Garoua	4	4	9.99	9.99	15.10	9.99	9.99	24.85	9.99	0.10	9.99
Garoua	4	5	4.21	29.79	23.39	5.33	0.04	27.31	5.69	0.04	4.21
Garoua	4	6	4.91	24.72	17.45	8.30	8.06	19.58	7.97	4.50	4.50
Garoua	4	7	3.48	11.40	18.72	3.68	4.90	46.40	7.91	0.03	3.48

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Garoua	4	8	7.79	4.45	33.00	5.85	11.70	20.79	6.04	3.92	6.46
Garoua	5	1	3.94	48.51	21.10	3.64	3.22	10.09	3.68	2.91	2.91
Garoua	5	2	8.52	22.15	11.99	8.52	8.52	29.76	10.36	0.09	0.09
Garoua	5	3	8.62	20.90	42.00	5.92	9.34	4.80	2.62	2.96	2.83
Garoua	5	4	3.99	43.22	20.56	4.37	10.08	6.23	7.57	0.04	3.94
Garoua	5	5	9.43	19.71	28.69	9.43	0.09	13.68	9.43	0.09	9.43
Garoua	5	6	7.75	21.35	31.75	6.34	0.06	16.61	9.47	0.06	6.60
Garoua	5	7	9.28	15.76	36.93	7.05	0.07	16.60	7.25	0.07	6.99
Garoua	5	8	7.49	23.42	28.87	18.78	6.53	8.12	6.66	0.07	0.07
Maroua	1	1	6.60	7.82	6.60	6.60	15.48	32.47	6.60	6.60	11.24
Maroua	1	2	6.36	10.04	5.58	4.76	11.90	48.23	4.89	3.21	5.03
Maroua	1	3	2.83	7.56	0.03	12.14	18.31	34.71	11.27	6.52	6.65
Maroua	1	4	6.94	3.31	25.47	4.55	6.98	33.68	14.43	2.26	2.39
Maroua	1	5	9.34	27.78	5.90	5.39	5.39	31.36	9.40	0.05	5.39
Maroua	1	7	1.98	5.66	1.98	2.17	10.43	26.22	11.20	3.35	37.01
Maroua	2	1	0.19	18.61	18.61	0.19	24.81	18.61	0.19	0.19	18.61
Maroua	2	2	6.22	18.66	0.06	0.06	13.43	34.48	10.14	6.22	10.72
Maroua	2	3	1.50	5.59	4.80	1.50	1.99	17.45	62.50	2.38	2.29
Maroua	2	4	8.87	16.02	8.87	8.87	15.09	24.43	8.87	0.09	8.87
Maroua	2	5	0.11	52.21	11.39	11.85	11.39	0.11	0.11	0.11	12.72
Maroua	2	6	10.07	10.68	13.77	0.10	10.07	35.07	10.07	0.10	10.07
Maroua	2	7	6.03	17.17	6.03	6.03	9.30	37.38	6.03	6.03	6.03
Maroua	2	8	4.87	7.12	4.87	4.87	11.02	50.28	7.25	4.87	4.87
Maroua	3	1	6.11	13.55	5.78	5.78	8.60	48.55	5.78	0.06	5.78
Maroua	3	2	7.77	9.69	7.77	0.08	9.62	46.43	10.51	0.08	8.04
Maroua	3	3	10.17	17.05	5.74	5.74	12.28	22.53	11.13	5.74	9.60
Maroua	3	4	10.47	13.67	10.47	0.10	10.47	33.75	10.47	0.10	10.47
Maroua	3	5	9.21	18.03	8.58	0.09	9.76	28.58	8.58	8.58	8.58
Maroua	3	6	7.64	11.33	7.64	7.64	17.15	31.88	7.64	0.08	9.00
Maroua	3	7	7.79	21.52	11.25	7.79	7.79	28.20	7.79	0.08	7.79
Maroua	3	8	17.96	17.96	17.96	0.18	0.18	27.44	17.96	0.18	0.18

10.4 Southwestern Africa

10.4.1 Morphometric Data

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Nababeep	1	1	0.19	5.33	2.54	2.09	103.1	23.2	87.8	33.8	5	4	8
Nababeep	1	2	0.23	5.96	2.61	2.26	107.4	22.0	85.7	38.3	5	4	8
Nababeep	1	3	0.21	5.33	2.47	2.12	94.1	21.5	84.9	39.3	5	4	9
Nababeep	1	4	0.25	4.83	2.71	2.19	107.5	24.3	85.8	39.0	4	1	8
Nababeep	1	5	0.25	5.96	2.65	2.16	112.9	22.2	86.3	39.8	5	1	8
Nababeep	1	6	0.21	6.04	2.58	2.16	108.9	22.4	85.7	37.1	6	2	8
Nababeep	1	7	0.30	5.96	2.71	2.23	106.1	20.6	86.5	37.0	5	4	8
Nababeep	1	8	0.35	4.83	2.68	2.16	104.5	24.2	88.7	40.6	4	4	8
Nababeep	1	9	0.21	5.89	2.61	2.05	92.8	22.8	90.6	40.6	9	2	8
Nababeep	1	10	0.32	5.89	2.61	2.02	100.1	21.2	84.8	37.2	5	4	8
Nababeep	1	11	0.21	5.82	2.58	2.23	103.2	20.5	83.9	41.2	5	4	8
Nababeep	1	12	0.28	5.89	2.61	2.16	105.4	24.9	84.5	42.1	6	4	8
Nababeep	1	13	0.28	5.89	2.61	2.16	104.1	23.4	87.4	39.4	5	4	8
Nababeep	1	14	0.26	5.82	2.65	2.09	109.9	19.1	84.6	35.6	3	4	8
Nababeep	1	15	0.16	5.82	2.44	1.98	112.1	18.9	85.2	33.9	9	4	8
Nababeep	1	16	0.23	5.68	2.61	2.12	105.3	18.4	88.8	38.7	6	4	8
Nababeep	1	17	0.18	5.40	2.44	1.98	111.7	23.2	87.4	33.2	6	4	8
Nababeep	1	18	0.25	5.61	2.51	1.95	96.4	22.9	84.1	43.1	5	2	8
Nababeep	1	19	0.23	5.82	2.54	2.05	96.6	24.7	86.3	45.5	2	2	8
Nababeep	1	20	0.21	5.54	2.58	1.98	100.4	19.7	87.1	38.0	6	4	8
Nababeep	2	1	0.21	5.96	2.65	2.16	107.7	22.9	84.5	39.2	1	4	8
Nababeep	2	2	0.25	5.89	2.61	2.09	95.7	16.9	79.0	38.8	6	7	9
Nababeep	2	3	0.23	5.68	2.61	2.12	106.3	19.3	77.8	32.3	5	4	8
Nababeep	2	4	0.23	5.82	2.68	2.19	99.1	18.2	88.1	38.6	6	4	8
Nababeep	2	5	0.23	5.75	2.61	2.09	101.5	16.1	75.9	34.1	6	7	8
Nababeep	2	6	0.18	5.82	2.65	2.19	96.2	22.2	81.5	36.2	6	4	8
Nababeep	2	7	0.23	5.82	2.61	2.12	99.0	22.0	84.3	36.8	4	2	8
Nababeep	2	8	0.25	5.89	2.61	2.12	106.5	20.8	82.3	34.5	4	2	8
Nababeep	2	9	0.25	5.82	2.58	2.09	101.1	19.8	83.8	40.5	6	7	8
Nababeep	2	10	0.30	5.89	2.61	2.16	102.6	17.5	86.0	43.7	7	7	8
Nababeep	2	11	0.26	5.82	2.54	2.12	92.8	22.1	87.1	36.0	6	4	8
Nababeep	2	12	0.30	5.82	2.71	2.19	99.4	23.2	83.1	37.3	9	4	9
Nababeep	2	13	0.26	5.89	2.61	2.09	111.8	23.1	93.0	40.4	6	4	8
Nababeep	2	14	0.21	6.04	2.71	2.16	111.2	22.1	89.7	39.5	2	2	8
Nababeep	2	15	0.23	5.75	2.58	2.16	98.4	21.8	85.2	36.0	6	7	8
Nababeep	2	16	0.28	5.75	2.58	2.12	104.3	20.4	88.7	30.9	5	4	8
Nababeep	2	17	0.28	5.75	2.65	2.19	111.1	19.9	87.5	37.3	5	4	8
Nababeep	2	18	0.25	5.75	2.58	2.16	105.7	21.1	84.4	39.5	2	7	8
Nababeep	2	19	0.23	5.68	2.54	2.05	104.1	20.6	81.4	35.8	6	4	8
Nababeep	2	20	0.23	5.47	2.54	1.98	98.1	20.2	80.5	29.3	9	5	8
Nababeep	3	1	0.23	6.11	2.65	2.19	101.9	15.5	85.3	36.4	6	0	8
Nababeep	3	2	0.21	5.89	2.54	2.09	118.5	20.6	86.4	36.7	7	6	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Nababeep	3	3	0.21	5.75	2.51	2.05	100.5	17.8	79.8	27.7	2	0	9
Nababeep	3	4	0.25	5.82	2.61	2.16	105.0	19.6	86.6	31.4	5	0	8
Nababeep	3	5	0.23	4.97	2.51	2.05	100.4	18.7	85.3	36.0	5	0	8
Nababeep	3	6	0.19	5.68	2.71	2.16	100.4	18.7	85.4	36.0	2	0	8
Nababeep	3	7	0.25	5.89	2.54	2.12	119.1	19.8	89.9	38.2	2	0	8
Nababeep	3	8	0.19	5.82	2.58	2.19	102.3	19.1	82.2	30.0	2	0	8
Nababeep	3	9	0.18	5.75	2.47	2.16	96.7	17.3	81.9	33.5	6	4	8
Nababeep	3	10	0.19	5.82	2.54	2.16	101.5	19.2	80.7	30.5	2	0	8
Nababeep	3	11	0.23	5.75	2.58	2.19	112.7	25.2	94.3	35.6	5	0	8
Nababeep	3	12	0.19	5.68	2.54	2.12	113.6	23.5	89.9	34.3	1	0	8
Nababeep	3	13	0.21	5.68	2.65	2.23	97.1	18.3	87.0	37.8	6	2	8
Nababeep	3	14	0.25	5.68	2.51	2.09	100.0	17.0	83.7	41.7	6	4	8
Nababeep	3	15	0.26	5.54	2.47	2.12	100.0	18.0	83.7	34.7	6	0	8
Nababeep	3	16	0.25	5.68	2.47	2.12	108.9	21.1	83.4	37.5	6	0	8
Nababeep	3	17	0.25	5.82	2.61	2.12	102.5	21.1	86.8	33.1	6	1	8
Nababeep	3	18	0.21	5.68	2.44	1.98	107.3	20.1	88.6	35.5	5	0	8
Nababeep	3	19	0.18	5.68	2.44	2.12	95.3	20.9	83.3	37.1	2	0	8
Nababeep	3	20	0.21	5.75	2.47	1.95	110.6	23.1	86.3	39.0	5	0	8
Nababeep	4	1	0.23	5.89	2.71	2.12	102.1	24.2	88.1	45.3	4	0	8
Nababeep	4	2	0.19	5.89	2.68	2.12	105.2	22.2	88.0	36.1	6	4	8
Nababeep	4	3	0.19	5.75	2.54	2.02	101.0	19.0	86.1	44.2	1	4	5
Nababeep	4	4	0.18	5.68	2.65	2.05	98.4	21.9	91.3	42.8	5	0	6
Nababeep	4	5	0.23	5.33	2.65	2.19	105.9	20.8	90.7	35.4	5	0	8
Nababeep	4	6	0.23	5.89	2.71	2.23	113.0	19.9	80.2	37.3	5	1	7
Nababeep	4	7	0.19	5.89	2.68	2.05	109.1	21.6	89.1	40.5	6	4	8
Nababeep	4	8	0.18	5.75	2.65	2.05	100.6	17.2	88.5	37.8	5	0	8
Nababeep	4	9	0.18	5.68	2.65	2.16	110.5	20.8	86.7	38.6	6	0	8
Nababeep	4	10	0.21	5.68	2.65	2.12	114.6	25.2	92.2	35.6	6	4	7
Nababeep	4	11	0.23	5.61	2.71	2.12	108.8	21.4	89.4	38.1	6	0	8
Nababeep	4	12	0.21	5.96	2.58	2.05	109.1	23.3	84.2	41.2	5	4	8
Nababeep	4	13	0.28	5.89	2.68	2.26	110.7	20.9	87.9	32.2	5	0	8
Nababeep	4	14	0.23	5.96	2.61	2.12	107.9	20.8	88.9	36.4	6	4	8
Nababeep	4	15	0.25	5.89	2.68	2.09	107.1	20.9	90.1	40.0	5	4	7
Nababeep	4	16	0.23	5.89	2.71	2.09	110.0	25.3	90.1	45.3	5	1	8
Nababeep	4	17	0.18	5.04	2.61	2.16	111.9	21.2	89.8	40.7	5	4	8
Nababeep	4	18	0.26	5.11	2.68	2.09	102.9	18.5	88.4	38.0	6	0	7
Nababeep	4	19	0.25	4.97	2.65	2.16	107.6	25.0	89.5	37.2	5	0	8
Nababeep	4	20	0.28	5.54	2.71	2.16	85.0	27.2	91.7	40.5	6	0	7
Karasburg	1	1	0.26	6.04	2.51	2.02	105.2	25.4	86.7	38.7	5	0	8
Karasburg	1	2	0.23	5.25	2.75	2.26	105.2	20.1	83.4	32.4	4	0	8
Karasburg	1	3	0.21	6.18	2.71	2.23	130.1	16.3	86.0	35.5	5	0	7
Karasburg	1	4	0.14	6.11	2.78	2.19	105.4	26.3	91.7	39.5	5	0	8
Karasburg	1	5	0.19	4.97	2.71	2.16	107.1	19.1	83.3	34.6	8	0	8
Karasburg	1	6	0.26	6.11	2.78	2.30	116.6	17.5	80.0	36.2	5	0	8
Karasburg	1	7	0.21	6.18	2.78	2.09	105.6	17.7	83.3	30.4	5	0	8
Karasburg	1	8	0.21	5.33	2.82	2.19	106.2	26.1	89.8	31.1	8	0	9
Karasburg	1	9	0.23	5.82	2.68	2.09	93.6	19.6	82.4	39.7	2	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Karasburg	1	10	0.23	6.04	2.78	2.19	97.1	19.6	84.5	35.3	5	0	8
Karasburg	1	11	0.21	6.11	2.78	2.23	105.6	21.9	85.7	35.2	8	0	8
Karasburg	1	12	0.24	6.11	2.75	2.23	103.6	17.5	83.1	31.2	8	0	7
Karasburg	1	13	0.24	6.04	2.64	2.16	99.3	22.2	90.1	38.9	6	1	9
Karasburg	1	14	0.26	5.89	2.71	2.12	100.2	18.7	85.6	37.7	5	2	8
Karasburg	1	15	0.19	6.04	2.71	2.16	111.8	18.1	80.2	36.4	5	2	8
Karasburg	1	16	0.26	6.04	2.71	2.05	103.3	23.8	85.5	41.0	8	0	8
Karasburg	1	17	0.23	5.54	2.71	2.19	100.0	21.4	80.9	31.5	6	0	7
Karasburg	1	18	0.26	6.11	2.82	2.23	104.4	24.9	88.7	36.0	5	0	7
Karasburg	1	19	0.24	6.04	2.78	2.16	100.6	20.6	86.7	32.2	5	0	8
Karasburg	1	20	0.18	5.82	2.58	2.16	103.2	20.6	83.2	34.2	4	0	8
Karasburg	2	1	0.19	5.89	2.64	2.16	98.8	18.8	81.4	34.5	4	0	7
Karasburg	2	2	0.21	5.89	2.71	2.23	112.6	18.9	82.3	37.2	5	0	8
Karasburg	2	3	0.21	6.04	2.68	2.09	105.0	18.4	78.9	37.2	5	0	8
Karasburg	2	4	0.18	5.11	2.58	2.12	109.3	19.5	84.1	40.3	6	4	8
Karasburg	2	5	0.23	5.40	2.61	2.16	113.7	20.8	84.4	39.4	5	6	8
Karasburg	2	6	0.24	5.96	2.61	2.16	114.2	21.6	84.6	31.5	6	4	8
Karasburg	2	7	0.23	5.47	2.51	2.02	103.8	19.8	91.7	39.1	6	7	8
Karasburg	2	8	0.26	6.04	2.58	2.12	111.7	18.9	88.5	42.0	5	4	8
Karasburg	2	9	0.24	6.11	2.58	2.19	104.0	20.4	82.6	41.3	5	4	8
Karasburg	2	10	0.24	5.96	2.58	2.16	107.5	20.3	89.3	33.1	5	4	8
Karasburg	2	11	0.24	6.04	2.61	2.23	112.6	21.2	85.3	39.8	6	7	8
Karasburg	2	12	0.24	6.11	2.61	2.09	113.5	18.2	85.3	38.9	6	4	8
Karasburg	2	13	0.21	5.96	2.61	2.09	110.2	22.0	85.5	38.9	6	4	8
Karasburg	2	14	0.23	4.97	2.54	2.12	116.7	22.3	88.2	40.0	4	0	8
Karasburg	2	15	0.19	5.89	2.61	2.09	109.0	22.2	86.6	37.0	6	1	8
Karasburg	2	16	0.24	6.04	2.58	2.23	104.0	21.3	84.0	39.9	6	4	8
Karasburg	2	17	0.28	5.33	2.58	2.23	102.4	21.8	91.9	36.7	6	4	8
Karasburg	2	18	0.23	4.97	2.58	2.09	101.4	17.5	82.1	40.5	6	4	8
Karasburg	2	19	0.21	6.04	2.61	2.19	118.9	24.0	87.4	35.8	6	4	8
Karasburg	2	20	0.23	6.04	2.61	2.19	105.6	22.4	87.8	43.4	6	4	8
Karasburg	3	1	0.26	5.75	2.71	2.26	104.1	18.9	82.2	35.2	4	0	7
Karasburg	3	2	0.21	4.83	2.58	2.16	110.9	20.7	80.1	31.8	4	0	8
Karasburg	3	3	0.19	5.68	2.71	2.26	112.0	17.1	79.0	34.6	5	0	7
Karasburg	3	4	0.23	5.75	2.54	2.09	102.8	19.0	81.9	34.8	5	0	8
Karasburg	3	5	0.26	5.82	2.58	2.12	105.4	22.6	86.2	38.5	5	0	8
Karasburg	3	6	0.28	5.54	2.58	2.09	102.0	16.6	85.0	36.3	5	0	7
Karasburg	3	7	0.18	5.75	2.61	2.16	108.5	19.2	79.4	34.4	1	0	8
Karasburg	3	8	0.26	5.75	2.61	2.19	108.6	23.2	84.4	39.7	5	0	8
Karasburg	3	9	0.24	5.75	2.61	2.16	107.0	21.1	87.8	35.7	5	0	8
Karasburg	3	10	0.28	4.97	2.61	2.12	102.4	18.8	84.3	36.8	5	0	8
Karasburg	3	11	0.19	5.89	2.64	2.09	107.7	19.0	83.2	35.0	4	0	8
Karasburg	3	12	0.23	5.04	2.61	2.23	109.8	23.8	88.8	39.4	5	0	8
Karasburg	3	13	0.24	5.68	2.58	2.05	102.2	19.8	85.1	36.8	9	0	8
Karasburg	3	14	0.24	5.82	2.58	2.12	108.9	22.7	80.9	42.0	4	0	8
Karasburg	3	15	0.26	4.83	2.61	2.16	92.6	19.3	84.5	40.8	4	0	8
Karasburg	3	16	0.24	5.75	2.61	2.12	110.2	17.4	83.3	30.2	6	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Karasburg	3	17	0.21	5.82	2.64	2.16	113.5	19.0	84.3	28.3	5	0	8
Karasburg	3	18	0.28	5.82	2.64	2.23	95.6	20.5	82.9	35.8	5	0	8
Karasburg	3	19	0.23	5.68	2.61	2.16	113.0	21.1	88.3	31.3	4	0	7
Karasburg	3	20	0.28	5.75	2.64	2.19	102.5	21.1	83.0	34.0	5	0	8
Karasburg	4	1	0.19	5.89	3.03	2.16	104.2	26.3	85.0	43.0	8	0	8
Karasburg	4	2	0.18	5.47	2.71	2.16	97.2	25.5	84.4	46.2	5	0	8
Karasburg	4	3	0.16	6.04	2.64	2.23	96.5	22.9	78.9	45.9	8	0	8
Karasburg	4	4	0.21	5.96	2.68	2.16	101.1	21.0	84.2	45.1	6	0	8
Karasburg	4	5	0.19	5.82	2.64	2.09	95.7	22.1	79.8	40.9	6	0	8
Karasburg	4	6	0.16	6.04	2.71	2.16	104.7	22.2	76.9	42.1	8	0	8
Karasburg	4	7	0.24	6.04	2.61	2.12	106.8	23.3	81.3	38.2	6	2	7
Karasburg	4	8	0.24	6.04	2.71	2.26	99.8	25.1	83.6	42.0	5	0	7
Karasburg	4	9	0.21	6.04	2.68	2.26	90.6	23.7	84.3	41.6	2	0	8
Karasburg	4	10	0.18	6.11	2.68	2.23	108.0	25.1	87.0	41.2	2	0	8
Karasburg	4	11	0.21	6.04	2.75	2.16	105.4	20.9	78.7	36.1	6	0	8
Karasburg	4	12	0.19	5.18	2.64	2.23	95.3	18.8	80.9	45.5	5	0	8
Karasburg	4	13	0.19	5.89	2.68	2.12	104.7	23.2	85.3	44.0	6	0	8
Karasburg	4	14	0.21	5.96	2.64	2.19	102.0	23.4	82.0	50.7	6	0	8
Karasburg	4	15	0.19	6.11	2.78	2.16	105.3	18.4	85.1	35.5	5	0	7
Karasburg	4	16	0.24	5.75	2.68	2.23	96.5	19.7	80.1	40.7	5	0	7
Karasburg	4	17	0.18	5.82	2.68	2.26	103.5	24.0	82.0	45.2	5	0	8
Karasburg	4	18	0.21	5.96	2.58	2.23	104.3	23.7	88.7	45.7	6	0	8
Karasburg	4	19	0.18	5.89	2.61	2.26	96.8	21.3	84.8	42.2	6	0	8
Karasburg	4	20	0.23	5.96	2.68	2.19	102.9	19.0	82.9	40.0	6	0	8
Keetmans	1	1	0.26	6.04	2.58	2.09	113.7	18.3	84.5	37.9	5	4	8
Keetmans	1	2	0.21	5.96	2.51	2.12	115.9	19.1	85.4	33.8	5	1	9
Keetmans	1	3	0.18	4.90	2.54	2.12	103.5	22.4	87.7	49.1	3	0	9
Keetmans	1	4	0.23	5.96	2.58	2.23	107.6	19.3	85.7	35.1	5	0	9
Keetmans	1	5	0.23	6.04	2.61	2.16	115.2	25.9	90.8	38.8	5	0	8
Keetmans	1	6	0.23	4.97	2.51	2.09	115.6	20.3	83.9	30.1	5	0	8
Keetmans	1	7	0.18	5.96	2.61	2.19	109.2	20.2	89.9	40.5	5	4	8
Keetmans	1	8	0.23	5.96	2.58	2.19	108.7	20.7	85.6	36.8	5	4	8
Keetmans	1	9	0.21	6.04	2.71	2.23	114.2	20.7	89.0	41.2	4	4	8
Keetmans	1	10	0.21	5.82	2.64	2.19	110.8	20.1	89.3	34.7	6	4	8
Keetmans	1	11	0.25	5.89	2.58	2.19	108.3	22.6	86.3	38.1	5	3	8
Keetmans	1	12	0.21	6.04	2.58	2.23	109.0	21.3	87.1	35.4	5	4	8
Keetmans	1	13	0.18	5.04	2.61	2.16	103.4	24.3	87.2	38.0	2	8	8
Keetmans	1	14	0.19	5.18	2.64	2.09	113.3	23.5	91.5	48.5	6	2	8
Keetmans	1	15	0.25	5.54	2.58	2.23	102.3	19.6	80.9	38.5	9	4	8
Keetmans	1	16	0.25	5.96	2.58	2.19	103.8	21.2	87.0	36.7	5	0	8
Keetmans	1	17	0.25	5.96	2.54	2.19	105.2	22.4	88.8	39.7	6	4	8
Keetmans	1	18	0.21	6.04	2.58	2.23	104.9	23.7	85.9	36.4	5	4	8
Keetmans	1	19	0.25	5.33	2.61	2.19	101.5	21.6	84.5	38.7	6	4	9
Keetmans	1	20	0.21	5.89	2.51	2.16	104.6	19.4	82.5	34.2	9	4	8
Keetmans	2	1	0.23	5.82	2.61	2.16	103.1	16.6	84.9	36.1	5	0	8
Keetmans	2	2	0.21	5.75	2.61	2.16	98.1	23.6	90.6	38.2	6	0	8
Keetmans	2	3	0.25	5.75	2.58	2.12	106.5	16.2	83.3	38.4	5	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Keetmans	2	4	0.21	5.82	2.58	2.19	113.2	17.4	87.0	33.3	6	0	8
Keetmans	2	5	0.19	5.96	2.68	2.19	107.1	18.5	86.3	39.4	4	0	8
Keetmans	2	6	0.23	5.82	2.54	2.09	86.0	20.3	85.5	34.3	4	0	8
Keetmans	2	7	0.21	5.96	2.61	2.19	105.1	18.4	83.1	35.0	6	0	9
Keetmans	2	8	0.19	4.69	2.61	2.09	104.0	17.4	88.0	36.3	5	0	8
Keetmans	2	9	0.26	5.82	2.47	1.98	106.4	18.6	86.3	39.1	4	0	8
Keetmans	2	10	0.18	5.40	2.64	2.19	110.4	15.8	83.2	35.0	5	0	8
Keetmans	2	11	0.26	5.25	2.58	2.16	108.2	18.1	66.7	33.1	6	0	9
Keetmans	2	12	0.23	5.04	2.61	2.19	104.2	15.6	85.6	34.7	5	0	8
Keetmans	2	13	0.25	4.69	2.58	2.19	99.8	17.1	84.8	35.7	6	0	9
Keetmans	2	14	0.12	4.76	2.61	2.16	103.0	19.0	85.1	31.8	6	0	8
Keetmans	2	15	0.23	5.82	2.54	2.02	111.4	21.1	89.0	37.3	5	0	9
Keetmans	2	16	0.16	4.97	2.51	2.09	112.5	16.1	84.2	34.0	6	0	8
Keetmans	2	17	0.25	5.54	2.61	2.19	102.8	19.3	84.2	36.6	5	0	9
Keetmans	2	18	0.21	5.04	2.61	2.16	98.6	18.8	89.0	32.3	6	0	9
Keetmans	2	19	0.18	4.83	2.64	2.19	101.8	17.3	88.3	31.3	5	0	9
Keetmans	2	20	0.19	5.89	2.71	2.16	109.1	18.7	88.4	38.0	5	0	8
Keetmans	3	1	0.32	5.82	2.64	2.19	95.6	20.0	91.3	42.8	5	0	8
Keetmans	3	2	0.19	5.82	2.58	2.16	104.9	17.2	85.6	40.1	4	0	8
Keetmans	3	3	0.19	6.04	2.58	2.19	102.7	17.1	87.3	34.2	4	0	8
Keetmans	3	4	0.19	6.11	2.64	2.16	104.9	18.7	85.5	33.3	5	0	8
Keetmans	3	5	0.25	6.04	2.64	2.16	105.4	19.0	91.4	31.8	2	0	7
Keetmans	3	6	0.33	4.90	2.68	2.19	107.3	19.6	87.8	39.7	5	0	8
Keetmans	3	7	0.23	5.75	2.68	2.23	93.8	21.3	85.2	35.2	4	0	7
Keetmans	3	8	0.25	4.90	2.64	2.19	99.8	17.4	98.3	31.5	5	0	8
Keetmans	3	9	0.19	4.97	2.71	2.19	102.1	20.3	84.8	36.0	4	0	8
Keetmans	3	10	0.28	4.97	2.54	2.26	102.1	16.8	91.1	36.5	5	1	8
Keetmans	3	11	0.23	5.18	2.64	2.30	106.6	17.1	87.2	33.9	9	0	8
Keetmans	3	12	0.28	5.18	2.71	2.19	97.5	14.8	84.3	32.9	4	0	8
Keetmans	3	13	0.33	6.04	2.71	2.30	98.9	18.6	84.0	37.2	6	0	8
Keetmans	3	14	0.25	4.90	2.58	2.19	99.8	12.9	79.5	33.0	5	0	8
Keetmans	3	15	0.19	5.11	2.47	2.09	93.4	21.6	86.0	32.9	5	0	8
Keetmans	3	16	0.21	5.33	2.61	2.16	104.9	21.8	82.5	33.4	5	0	8
Keetmans	3	17	0.32	5.25	2.78	2.23	107.7	16.7	81.0	35.8	6	0	8
Keetmans	3	18	0.23	4.83	2.64	2.16	104.3	17.3	84.0	34.0	5	0	8
Keetmans	3	19	0.23	5.18	2.54	2.23	108.0	17.9	87.3	31.6	5	0	8
Keetmans	3	20	0.25	5.61	2.54	2.23	100.1	19.1	87.9	41.1	6	1	8
Keetmans	4	1	0.18	5.11	2.16	2.58	99.9	22.2	91.3	39.1	0	2	8
Keetmans	4	2	0.21	6.04	2.23	2.64	108.8	21.2	85.7	35.8	0	2	8
Keetmans	4	3	0.19	4.62	2.58	2.23	111.6	21.4	87.1	39.7	0	2	7
Keetmans	4	4	0.32	5.82	2.58	2.09	98.8	18.4	82.6	37.7	0	2	8
Keetmans	4	5	0.21	6.04	2.68	2.23	104.9	18.0	85.2	38.1	0	2	8
Keetmans	4	6	0.19	5.96	2.58	2.16	106.5	18.7	85.6	41.3	0	2	8
Keetmans	4	7	0.23	5.96	2.68	2.23	104.0	19.1	83.3	32.6	0	6	9
Keetmans	4	8	0.18	5.89	2.68	2.23	111.7	16.7	83.0	38.7	0	6	7
Keetmans	4	9	0.21	5.96	2.61	2.19	104.2	17.6	86.1	34.9	0	2	8
Keetmans	4	10	0.21	5.68	2.54	2.19	103.1	13.6	82.9	36.0	0	6	7

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Keetmans	4	11	0.23	5.33	2.64	2.16	101.7	20.5	84.6	37.0	5	2	7
Keetmans	4	12	0.16	5.89	2.61	2.12	107.9	17.1	85.8	35.6	2	0	8
Keetmans	4	13	0.21	5.25	2.58	2.26	115.8	27.1	88.8	41.6	2	0	7
Keetmans	4	14	0.25	6.04	2.61	2.23	102.0	20.5	83.3	41.7	2	0	8
Keetmans	4	15	0.25	5.89	2.61	2.09	108.2	21.6	84.9	33.7	6	0	8
Keetmans	4	16	0.25	6.04	2.71	2.26	105.9	19.3	81.8	33.7	3	0	8
Keetmans	4	17	0.25	5.96	2.61	2.16	103.5	20.1	84.9	42.3	5	0	8
Keetmans	4	18	0.19	5.96	2.64	2.23	113.4	21.2	86.4	41.3	6	0	8
Keetmans	4	19	0.21	6.11	2.64	2.12	106.1	21.4	85.4	39.1	2	0	8
Keetmans	4	20	0.23	5.25	2.58	1.88	105.1	20.7	85.0	31.2	5	0	8
Mariental	1	1	0.30	4.83	2.61	2.23	102.2	21.9	89.3	37.2	6	4	9
Mariental	1	2	0.23	5.40	2.61	2.23	101.9	21.8	89.1	42.4	5	4	9
Mariental	1	3	0.28	5.82	2.61	2.23	111.1	19.5	90.0	41.2	5	4	9
Mariental	1	4	0.26	5.18	2.54	2.26	106.7	20.9	89.2	43.2	7	4	9
Mariental	1	5	0.25	5.68	2.58	2.19	106.0	20.9	89.9	39.6	0	4	8
Mariental	1	6	0.23	5.82	2.54	2.12	107.7	18.4	86.4	37.6	5	0	9
Mariental	1	7	0.28	5.04	2.61	2.23	103.6	23.0	88.9	43.4	5	0	9
Mariental	1	8	0.18	5.18	2.64	2.19	102.6	18.8	86.1	41.2	5	4	8
Mariental	1	9	0.19	4.83	2.61	2.19	100.9	19.2	88.4	42.4	6	4	8
Mariental	1	10	0.25	4.97	2.64	2.23	103.4	21.3	92.0	41.2	5	0	8
Mariental	1	11	0.18	5.40	2.58	2.23	107.0	22.0	89.6	41.4	5	0	9
Mariental	1	12	0.25	5.54	2.61	2.23	101.8	21.9	93.5	41.7	5	0	9
Mariental	1	13	0.26	5.25	2.64	2.26	103.3	22.8	93.0	43.6	5	0	9
Mariental	1	14	0.21	5.61	2.61	2.19	102.9	19.2	84.0	34.2	5	0	8
Mariental	1	15	0.18	4.97	2.64	2.12	98.0	20.9	84.3	37.5	5	0	8
Mariental	1	16	0.19	4.97	2.64	2.30	96.9	21.3	88.5	38.3	6	1	8
Mariental	1	17	0.21	5.11	2.61	2.23	101.6	22.2	87.1	44.0	5	7	9
Mariental	1	18	0.21	5.25	2.58	2.26	102.6	21.4	92.2	41.5	7	2	9
Mariental	1	19	0.23	4.83	2.64	2.30	102.8	19.9	91.0	43.1	7	3	9
Mariental	1	20	0.23	5.18	2.61	2.23	109.1	19.9	92.1	41.8	7	7	8
Mariental	2	1	0.25	5.89	2.71	2.16	107.0	19.2	85.9	35.6	9	7	8
Mariental	2	2	0.30	5.96	2.64	2.23	103.7	19.5	86.1	34.5	6	0	9
Mariental	2	3	0.26	5.82	2.54	2.02	103.0	19.3	83.4	36.9	9	4	7
Mariental	2	4	0.23	4.97	2.58	2.09	113.9	21.4	84.0	40.2	9	4	7
Mariental	2	5	0.30	6.04	2.68	2.23	109.9	18.3	82.5	40.8	6	0	9
Mariental	2	6	0.23	5.25	2.61	2.16	108.6	21.1	84.0	33.5	5	0	9
Mariental	2	7	0.30	5.96	2.68	2.26	108.1	18.8	83.3	37.4	6	4	8
Mariental	2	8	0.26	5.96	2.64	2.16	110.0	24.7	88.1	32.6	6	7	8
Mariental	2	9	0.28	4.97	2.44	2.12	101.1	20.6	86.1	41.4	8	1	9
Mariental	2	10	0.28	5.89	2.71	2.33	104.7	18.0	85.6	35.8	5	0	8
Mariental	2	11	0.26	5.89	2.68	2.23	107.6	21.6	86.8	43.4	6	7	9
Mariental	2	12	0.26	6.04	2.68	2.23	115.5	20.0	83.3	38.4	9	7	9
Mariental	2	13	0.26	5.96	2.68	2.26	103.5	16.5	80.2	36.1	6	4	8
Mariental	2	14	0.25	5.18	2.61	2.16	108.4	18.5	88.1	35.1	6	1	8
Mariental	2	15	0.25	5.82	2.61	2.23	104.0	21.6	89.4	36.2	5	0	8
Mariental	2	16	0.25	6.04	2.68	2.26	104.5	23.3	89.5	36.8	6	0	8
Mariental	2	17	0.19	5.82	2.61	2.19	111.8	22.0	85.5	42.1	6	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Mariental	2	18	0.26	5.89	2.61	2.30	106.5	18.2	87.2	36.7	5	0	9
Mariental	2	19	0.14	5.82	2.44	2.02	99.7	23.0	82.6	39.2	9	4	8
Mariental	2	20	0.23	4.83	2.54	2.12	98.7	19.3	82.6	44.3	8	0	8
Mariental	3	1	0.28	5.96	2.61	2.16	97.8	22.6	91.0	34.9	6	9	9
Mariental	3	2	0.21	4.83	2.61	2.23	112.4	23.5	93.3	36.5	4	6	9
Mariental	3	3	0.30	5.89	2.64	2.19	92.6	21.9	85.3	31.2	6	4	8
Mariental	3	4	0.25	4.76	2.61	2.19	90.3	23.3	86.7	34.5	4	1	8
Mariental	3	5	0.18	4.83	2.64	2.05	108.7	23.6	88.4	37.0	9	6	8
Mariental	3	6	0.28	5.75	2.51	2.09	94.3	22.5	82.7	37.1	9	6	8
Mariental	3	7	0.23	5.89	2.58	2.16	101.8	23.6	88.9	39.9	6	4	8
Mariental	3	8	0.21	5.89	2.58	2.16	115.4	27.7	88.6	40.4	9	4	9
Mariental	3	9	0.19	5.89	2.64	2.12	99.6	28.8	87.4	39.5	9	4	9
Mariental	3	10	0.23	5.89	2.58	2.02	90.5	24.5	86.8	38.8	9	4	8
Mariental	3	11	0.28	6.11	2.58	2.23	102.3	22.7	85.8	34.7	9	4	9
Mariental	3	12	0.18	5.89	2.58	2.16	105.7	21.5	82.8	35.6	9	7	8
Mariental	3	13	0.23	5.96	2.58	2.19	109.7	23.2	91.7	37.7	6	4	9
Mariental	3	14	0.28	5.82	2.61	2.16	90.1	22.4	91.1	35.0	6	7	9
Mariental	3	15	0.19	5.96	2.54	2.16	92.8	26.1	86.1	40.7	6	7	9
Mariental	3	16	0.21	5.82	2.61	2.19	99.6	24.6	83.6	38.0	9	4	9
Mariental	3	17	0.23	5.75	2.61	2.16	100.8	24.1	85.9	35.8	6	4	9
Mariental	3	18	0.23	5.75	2.58	2.12	103.2	21.6	84.6	37.1	6	4	9
Mariental	3	19	0.25	5.11	2.61	2.19	97.6	21.5	86.2	39.9	6	4	9
Mariental	3	20	0.21	5.89	2.64	2.16	99.4	20.3	88.2	42.0	5	4	8
Mariental	4	1	0.23	5.82	2.58	2.05	114.4	21.4	87.9	34.5	8	3	8
Mariental	4	2	0.19	5.89	2.54	2.09	99.8	19.2	85.3	35.3	6	4	8
Mariental	4	3	0.25	5.18	2.51	2.05	105.1	20.5	85.2	35.9	6	6	8
Mariental	4	4	0.25	5.82	2.51	2.09	96.5	19.5	84.8	43.1	5	4	8
Mariental	4	5	0.19	5.96	2.58	2.12	107.4	20.7	86.6	38.9	7	7	8
Mariental	4	6	0.19	5.96	2.54	2.12	94.3	22.3	85.8	40.1	8	6	8
Mariental	4	7	0.19	5.82	2.51	2.09	107.9	22.6	84.9	38.4	6	7	9
Mariental	4	8	0.21	5.75	2.54	2.09	108.7	23.7	83.2	39.7	5	1	8
Mariental	4	9	0.19	5.96	2.51	2.05	95.9	17.6	79.5	36.1	5	4	8
Mariental	4	10	0.23	5.89	2.54	2.12	104.3	19.6	87.1	36.5	6	4	8
Mariental	4	11	0.19	6.04	2.58	2.16	110.0	21.2	87.8	42.5	6	4	8
Mariental	4	12	0.23	5.89	2.61	2.16	109.2	23.2	92.2	41.2	5	7	9
Mariental	4	13	0.25	5.96	2.58	2.16	100.5	18.8	85.0	40.3	9	4	8
Mariental	4	14	0.23	5.11	2.61	2.12	104.4	20.1	84.9	37.0	4	1	8
Mariental	4	15	0.26	5.89	2.58	2.19	113.2	21.2	82.7	33.7	6	7	8
Mariental	4	16	0.18	5.96	2.54	2.12	88.8	20.0	88.3	40.2	6	0	8
Mariental	4	17	0.19	5.89	2.51	2.05	103.1	21.9	88.0	32.7	8	7	8
Mariental	4	18	0.21	5.89	2.61	2.16	96.6	20.1	82.2	42.1	6	1	8
Mariental	4	19	0.26	4.69	2.51	2.09	102.6	21.5	90.1	34.1	6	0	8
Mariental	4	20	0.23	5.75	2.47	2.09	94.9	20.8	81.8	41.2	1	7	9
Windhoek	1	1	0.18	5.82	2.58	2.12	105.3	21.9	80.7	27.5	5	4	9
Windhoek	1	2	0.21	5.75	2.58	2.02	103.7	19.7	81.0	35.1	5	4	8
Windhoek	1	3	0.19	6.04	2.64	2.23	112.4	19.6	84.0	26.5	6	4	8
Windhoek	1	4	0.21	5.89	2.61	2.16	99.2	20.5	76.5	26.4	5	4	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Windhoek	1	5	0.25	5.96	2.51	2.09	108.5	21.9	81.6	29.1	6	4	9
Windhoek	1	6	0.21	5.82	2.64	2.09	115.5	20.6	82.7	35.4	6	4	8
Windhoek	1	7	0.21	5.89	2.61	2.09	105.7	18.0	79.2	33.8	5	4	8
Windhoek	1	8	0.21	5.82	2.51	2.16	95.2	19.3	82.1	32.3	6	4	8
Windhoek	1	9	0.26	6.11	2.54	2.12	105.5	19.6	82.4	32.0	6	4	8
Windhoek	1	10	0.23	5.89	2.54	2.09	105.2	24.2	82.6	34.8	6	4	8
Windhoek	1	11	0.23	5.89	2.64	2.19	102.9	17.8	82.3	37.4	9	4	9
Windhoek	1	12	0.25	5.89	2.54	2.16	111.5	19.4	81.5	38.4	9	4	8
Windhoek	1	13	0.21	5.68	2.54	2.12	106.5	20.9	86.0	37.4	6	4	8
Windhoek	1	14	0.14	5.82	2.54	2.12	102.0	17.8	84.8	33.1	5	2	8
Windhoek	1	15	0.18	5.82	2.51	2.09	103.7	21.8	85.2	39.7	5	2	8
Windhoek	1	16	0.18	5.89	2.51	2.09	111.0	18.1	81.5	30.2	6	4	8
Windhoek	1	17	0.26	5.89	2.61	2.09	101.5	18.2	88.5	37.4	5	4	8
Windhoek	1	18	0.28	5.89	2.71	2.26	106.6	21.3	79.9	32.3	5	4	8
Windhoek	1	19	0.21	6.04	2.58	2.19	105.6	19.5	77.3	32.4	5	4	8
Windhoek	1	20	0.18	5.89	2.68	2.23	115.0	21.2	81.1	30.8	5	4	8
Windhoek	2	1	0.23	5.68	2.54	2.16	102.0	19.0	84.0	34.1	4	1	8
Windhoek	2	2	0.23	5.96	2.61	2.19	112.3	20.2	83.1	31.2	6	9	8
Windhoek	2	3	0.25	5.96	2.64	2.23	107.3	20.8	81.4	32.2	5	0	8
Windhoek	2	4	0.28	5.68	2.51	2.09	107.3	20.8	84.5	37.3	4	0	8
Windhoek	2	5	0.23	5.82	2.54	2.19	106.1	20.1	83.3	28.3	6	2	9
Windhoek	2	6	0.25	5.82	2.64	2.19	109.1	20.0	81.5	28.4	5	0	8
Windhoek	2	7	0.25	5.89	2.58	2.19	104.5	22.2	89.2	32.8	4	0	8
Windhoek	2	8	0.35	5.82	2.61	2.12	104.3	22.0	86.2	31.4	5	2	8
Windhoek	2	9	0.28	5.82	2.61	2.16	108.2	22.2	85.5	32.3	6	2	8
Windhoek	2	10	0.25	5.68	2.54	2.16	117.2	19.1	87.6	29.8	4	0	8
Windhoek	2	11	0.28	5.68	2.61	2.19	109.9	21.0	82.9	32.3	4	2	8
Windhoek	2	12	0.23	5.68	2.54	2.19	111.9	20.1	76.9	31.9	4	0	8
Windhoek	2	13	0.18	5.89	2.61	2.16	102.9	21.0	83.7	34.3	5	0	8
Windhoek	2	14	0.26	5.89	2.51	2.19	111.6	18.6	82.4	32.5	4	0	7
Windhoek	2	15	0.25	5.68	2.54	2.09	103.6	21.8	87.6	30.3	6	4	8
Windhoek	2	16	0.18	5.68	2.51	2.05	101.6	21.4	83.3	33.7	5	0	8
Windhoek	2	17	0.26	5.82	2.61	2.23	106.9	19.3	89.7	32.7	4	1	8
Windhoek	2	18	0.19	5.89	2.58	2.23	98.6	22.1	81.5	34.3	6	1	8
Windhoek	2	19	0.19	5.82	2.61	2.16	110.7	17.6	85.2	31.8	5	0	8
Windhoek	2	20	0.18	5.68	2.47	2.16	100.0	20.4	87.1	38.0	5	0	8
Windhoek	3	1	0.21	5.75	2.58	2.09	100.8	24.1	81.5	33.6	6	4	8
Windhoek	3	2	0.25	5.82	2.54	2.12	105.4	23.8	84.6	37.3	6	7	8
Windhoek	3	3	0.23	5.75	2.54	2.16	105.8	20.7	85.2	43.1	9	7	8
Windhoek	3	4	0.23	5.68	2.51	2.09	97.1	19.2	81.9	39.8	6	4	8
Windhoek	3	5	0.19	5.96	2.58	2.19	96.2	22.7	81.0	35.3	6	4	8
Windhoek	3	6	0.19	5.75	2.51	2.09	114.3	20.3	78.6	42.6	5	4	8
Windhoek	3	7	0.19	5.04	2.58	2.16	109.2	25.1	79.0	39.9	5	6	8
Windhoek	3	8	0.19	5.68	2.44	2.09	92.5	25.2	83.0	31.5	6	7	8
Windhoek	3	9	0.23	5.75	2.54	2.09	96.7	23.5	84.4	32.8	9	7	8
Windhoek	3	10	0.21	5.68	2.47	2.09	111.1	20.7	82.2	37.1	9	7	9
Windhoek	3	11	0.21	6.04	2.58	2.16	97.9	22.5	76.8	34.4	9	7	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Windhoek	3	12	0.19	5.96	2.58	2.19	105.1	22.0	84.1	35.3	6	4	8
Windhoek	3	13	0.14	5.68	2.58	2.16	102.5	22.5	83.0	39.5	5	1	8
Windhoek	3	14	0.19	5.82	2.54	2.12	108.8	23.5	85.5	32.7	6	4	8
Windhoek	3	15	0.23	5.89	2.58	2.19	106.7	22.5	82.8	34.8	6	4	8
Windhoek	3	16	0.21	5.89	2.54	2.19	104.4	20.0	81.6	34.9	6	7	8
Windhoek	3	17	0.16	6.04	2.61	2.16	96.9	24.0	87.4	34.1	6	4	8
Windhoek	3	18	0.19	5.89	2.54	2.19	103.0	20.1	77.0	36.3	5	4	8
Windhoek	3	19	0.23	5.82	2.58	2.12	101.7	19.1	83.2	39.1	6	7	8
Windhoek	3	20	0.21	5.96	2.61	2.19	109.9	22.8	83.9	33.7	6	4	8
Windhoek	4	1	0.28	5.89	2.61	2.16	96.1	23.9	83.4	43.0	8	6	8
Windhoek	4	2	0.21	5.75	2.64	2.12	97.0	25.5	87.6	39.2	6	0	7
Windhoek	4	3	0.23	5.96	2.64	2.19	99.7	23.8	83.4	44.1	8	4	8
Windhoek	4	4	0.25	5.89	2.68	2.19	93.0	22.8	88.4	43.4	6	0	8
Windhoek	4	5	0.23	5.75	2.58	2.19	97.0	23.7	85.8	36.0	6	0	7
Windhoek	4	6	0.30	5.96	2.71	2.23	104.8	23.6	90.6	38.5	6	1	9
Windhoek	4	7	0.32	6.04	2.68	2.16	92.2	24.1	84.9	40.2	6	7	8
Windhoek	4	8	0.21	5.82	2.54	2.19	95.5	20.7	86.5	33.9	5	0	8
Windhoek	4	9	0.21	4.97	2.71	2.19	95.5	20.7	86.5	33.9	5	0	7
Windhoek	4	10	0.26	5.89	2.64	2.23	92.0	22.9	88.8	39.5	4	0	6
Windhoek	4	11	0.19	4.69	2.71	2.16	98.6	21.3	88.2	41.9	6	0	7
Windhoek	4	12	0.18	4.83	2.54	2.12	96.4	20.6	79.5	36.1	6	0	9
Windhoek	4	13	0.23	5.89	2.58	2.09	96.7	25.1	86.7	38.6	6	7	9
Windhoek	4	14	0.23	4.76	2.64	2.26	93.2	18.2	84.6	34.7	6	0	7
Windhoek	4	15	0.18	5.82	2.58	2.12	102.9	24.7	85.0	39.3	6	0	8
Windhoek	4	16	0.23	5.89	2.64	2.16	101.5	22.3	81.6	38.3	9	1	8
Windhoek	4	17	0.25	4.97	2.54	2.16	92.8	23.9	86.8	34.5	8	8	8
Windhoek	4	18	0.26	5.68	2.64	2.16	87.8	23.1	86.8	44.0	6	0	8
Windhoek	4	19	0.21	5.89	2.58	2.23	89.6	20.4	88.6	45.3	6	1	8
Windhoek	4	20	0.18	5.47	2.58	2.19	101.7	22.7	86.8	34.9	6	0	8
Okahandja	1	1	0.21	6.04	2.64	2.12	107.0	21.3	84.2	37.9	4	0	8
Okahandja	1	2	0.23	5.89	2.61	2.16	109.6	18.5	83.2	36.4	5	7	8
Okahandja	1	3	0.23	5.75	2.51	2.23	104.5	21.7	85.1	37.5	4	0	9
Okahandja	1	4	0.18	6.04	2.58	2.23	107.0	18.6	85.3	39.1	6	0	8
Okahandja	1	5	0.21	5.96	2.58	2.16	98.9	19.5	82.6	34.9	6	4	8
Okahandja	1	6	0.25	5.82	2.61	2.19	103.0	21.9	78.6	38.8	6	0	8
Okahandja	1	7	0.19	5.96	2.61	2.23	111.0	23.0	83.2	35.9	4	0	9
Okahandja	1	8	0.19	6.04	2.64	2.30	101.6	19.4	82.0	34.9	5	3	8
Okahandja	1	9	0.23	5.89	2.61	2.19	103.7	19.5	82.5	34.5	4	0	8
Okahandja	1	10	0.25	5.82	2.51	2.23	104.5	24.2	87.3	40.6	5	2	8
Okahandja	1	11	0.19	5.96	2.54	2.16	102.6	18.7	83.2	35.9	9	0	8
Okahandja	1	12	0.21	5.96	2.47	2.23	106.0	22.6	85.0	38.7	6	0	8
Okahandja	1	13	0.21	6.18	2.58	2.23	108.7	20.9	82.7	39.2	6	0	7
Okahandja	1	14	0.23	6.04	2.58	2.19	108.7	23.0	79.2	40.5	6	0	9
Okahandja	1	15	0.23	6.04	2.58	2.19	108.7	23.0	79.2	40.5	6	0	9
Okahandja	1	16	0.21	5.89	2.54	2.12	113.8	20.6	78.4	41.3	4	0	9
Okahandja	1	17	0.23	5.68	2.64	2.33	103.8	18.4	80.5	39.3	6	0	8
Okahandja	1	18	0.19	5.96	2.58	2.16	108.9	21.5	84.9	34.8	6	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Okahandja	1	19	0.26	5.89	2.58	2.23	106.8	19.4	80.2	33.2	6	0	8
Okahandja	1	20	0.19	5.89	2.64	2.19	99.3	20.8	84.1	38.5	6	0	9
Okahandja	2	1	0.23	5.75	2.58	2.05	104.2	25.2	88.4	35.4	6	1	8
Okahandja	2	2	0.26	5.96	2.68	2.23	100.4	18.8	84.8	34.3	4	2	8
Okahandja	2	3	0.21	5.68	2.47	2.09	86.2	18.4	86.2	37.9	4	4	9
Okahandja	2	4	0.19	5.68	2.51	2.05	104.0	21.5	92.0	29.8	5	1	9
Okahandja	2	5	0.21	5.68	2.51	2.02	85.2	20.3	85.2	40.0	6	4	9
Okahandja	2	6	0.23	5.68	2.58	2.09	100.1	21.1	83.5	34.2	5	3	9
Okahandja	2	7	0.25	5.68	2.47	2.05	107.4	20.2	79.5	34.5	5	3	9
Okahandja	2	8	0.25	5.68	2.58	2.12	102.6	19.7	88.1	35.9	6	4	8
Okahandja	2	9	0.28	5.68	2.44	2.12	111.8	23.4	89.2	35.6	6	3	8
Okahandja	2	10	0.23	5.75	2.58	2.05	107.8	20.0	86.3	42.8	6	3	9
Okahandja	2	11	0.25	5.82	2.64	2.12	106.7	21.1	82.0	36.9	6	1	8
Okahandja	2	12	0.25	5.68	2.61	2.09	104.3	19.9	86.1	41.0	5	2	8
Okahandja	2	13	0.23	5.68	2.54	2.12	103.9	26.9	90.3	38.5	6	4	8
Okahandja	2	14	0.21	5.61	2.64	2.09	103.9	26.9	94.5	42.9	6	3	8
Okahandja	2	15	0.19	5.82	2.58	2.09	103.5	21.3	93.4	37.3	6	4	8
Okahandja	2	16	0.19	5.68	2.47	2.09	107.9	18.6	89.6	36.3	4	1	8
Okahandja	2	17	0.23	5.61	2.61	2.23	100.0	21.5	86.0	45.9	8	7	8
Okahandja	2	18	0.21	5.82	2.68	2.16	112.9	19.3	87.0	38.8	6	2	8
Okahandja	2	19	0.21	5.68	2.54	2.16	100.2	20.8	90.7	36.4	6	2	8
Okahandja	2	20	0.18	5.75	2.47	2.02	99.8	21.6	86.9	32.1	6	2	8
Okahandja	3	1	0.19	5.89	2.58	2.12	103.2	23.0	83.6	45.6	6	0	8
Okahandja	3	2	0.21	5.68	2.61	2.12	109.2	22.2	88.9	37.2	9	4	9
Okahandja	3	3	0.19	5.68	2.61	2.05	107.6	16.9	83.0	44.3	7	6	9
Okahandja	3	4	0.19	5.75	2.54	2.09	108.3	22.1	86.5	35.6	5	3	8
Okahandja	3	5	0.19	5.82	2.58	2.09	112.0	20.4	83.6	38.8	9	3	9
Okahandja	3	6	0.18	5.75	2.54	2.09	102.6	16.3	83.1	29.8	5	3	8
Okahandja	3	7	0.18	5.68	2.51	2.12	103.7	18.4	80.1	34.9	6	4	9
Okahandja	3	8	0.19	5.89	2.51	2.12	100.3	20.7	86.7	41.5	6	1	8
Okahandja	3	9	0.18	5.68	2.61	2.12	110.4	19.2	82.8	38.5	6	6	9
Okahandja	3	10	0.19	5.82	2.58	2.12	100.7	20.4	85.5	42.0	5	0	9
Okahandja	3	11	0.21	5.82	2.51	2.09	102.8	17.4	80.0	37.3	5	7	9
Okahandja	3	12	0.19	5.75	2.58	2.16	120.2	20.0	94.2	41.6	4	1	9
Okahandja	3	13	0.19	5.68	2.51	2.09	101.1	21.1	85.6	34.8	6	1	8
Okahandja	3	14	0.23	5.82	2.54	2.12	104.9	21.2	80.8	40.2	5	2	9
Okahandja	3	15	0.19	5.89	2.61	2.16	98.9	20.7	83.9	42.7	6	0	8
Okahandja	3	16	0.21	6.04	2.71	2.12	105.6	22.1	89.9	38.1	6	2	8
Okahandja	3	17	0.19	5.89	2.58	2.12	101.7	19.9	82.9	44.1	5	2	8
Okahandja	3	18	0.19	5.75	2.61	2.16	102.5	15.7	83.0	38.2	6	4	8
Okahandja	3	19	0.23	5.89	2.58	2.19	110.8	19.7	90.3	35.0	6	4	8
Okahandja	3	20	0.19	5.75	2.58	2.12	105.5	19.2	84.9	38.1	4	0	8
Okahandja	4	1	0.23	5.68	2.51	2.12	103.5	20.3	85.6	35.2	9	4	9
Okahandja	4	2	0.19	5.89	2.54	2.16	104.5	18.4	84.7	31.8	9	6	9
Okahandja	4	3	0.18	5.61	2.51	2.05	101.3	17.8	89.1	34.5	6	1	8
Okahandja	4	4	0.23	5.82	2.61	2.05	99.6	19.2	88.1	34.8	9	6	8
Okahandja	4	5	0.23	5.82	2.54	2.09	100.3	17.5	87.6	32.9	4	9	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Okahandja	4	6	0.25	5.82	2.54	2.19	98.5	18.2	80.8	29.2	5	2	8
Okahandja	4	7	0.25	5.04	2.58	2.12	107.5	17.5	80.2	35.5	9	2	8
Okahandja	4	8	0.23	5.75	2.51	2.12	109.3	17.4	84.2	31.0	6	6	9
Okahandja	4	9	0.23	5.82	2.54	2.16	106.2	22.7	80.7	34.4	5	4	8
Okahandja	4	10	0.18	5.82	2.58	2.19	96.8	17.6	85.6	32.2	9	7	9
Okahandja	4	11	0.26	5.75	2.51	2.09	92.3	16.9	83.2	28.5	8	2	8
Okahandja	4	12	0.21	5.75	2.54	2.09	110.0	22.6	85.4	32.3	9	4	8
Okahandja	4	13	0.21	5.82	2.54	2.12	99.9	22.4	89.4	32.9	9	4	8
Okahandja	4	14	0.25	5.61	2.51	2.16	108.8	21.1	80.1	35.9	9	7	8
Okahandja	4	15	0.23	5.75	2.54	2.12	102.9	19.5	87.2	27.8	9	7	8
Okahandja	4	16	0.23	5.61	2.44	2.09	79.3	17.2	85.0	31.1	5	3	8
Okahandja	4	17	0.19	5.89	2.51	2.16	100.1	17.0	79.3	29.3	5	7	9
Okahandja	4	18	0.25	5.75	2.58	2.16	103.5	21.6	84.9	32.8	5	4	8
Okahandja	4	19	0.23	5.61	2.47	2.09	99.3	20.8	85.6	32.6	5	1	8
Okahandja	4	20	0.26	5.82	2.54	2.12	105.6	20.1	85.8	41.0	6	4	9
Otjiwarong	1	1	0.26	5.89	2.61	2.12	98.4	22.8	83.9	33.0	6	4	9
Otjiwarong	1	2	0.21	5.89	2.68	2.16	105.0	22.2	85.4	33.8	6	4	9
Otjiwarong	1	3	0.19	5.82	2.54	2.12	103.0	26.1	82.4	34.8	9	4	9
Otjiwarong	1	4	0.25	5.18	2.58	2.09	102.7	23.6	87.0	34.7	9	4	9
Otjiwarong	1	5	0.23	5.82	2.64	2.09	107.3	25.4	83.1	39.2	6	4	9
Otjiwarong	1	6	0.26	5.96	2.61	2.05	107.3	22.9	90.2	42.8	6	1	9
Otjiwarong	1	7	0.23	5.82	2.61	2.12	106.1	19.7	82.1	30.9	6	4	9
Otjiwarong	1	8	0.26	5.82	2.47	2.26	93.1	23.1	81.8	40.3	9	4	9
Otjiwarong	1	9	0.26	5.82	2.61	2.09	103.7	24.1	86.2	37.7	9	4	9
Otjiwarong	1	10	0.25	5.82	2.61	2.09	108.2	21.9	84.0	36.4	5	4	8
Otjiwarong	1	11	0.21	5.89	2.68	2.09	104.2	19.4	82.6	29.5	6	1	8
Otjiwarong	1	12	0.23	5.96	2.64	2.26	108.2	23.8	87.7	34.4	6	4	8
Otjiwarong	1	13	0.25	5.89	2.51	2.12	101.2	19.5	82.4	40.2	5	0	9
Otjiwarong	1	14	0.21	5.89	2.71	2.16	101.0	19.2	80.1	34.9	4	4	9
Otjiwarong	1	15	0.23	5.89	2.51	2.16	101.0	22.4	87.4	38.4	6	4	9
Otjiwarong	1	16	0.18	5.96	2.54	2.05	106.3	20.9	86.4	37.6	9	4	8
Otjiwarong	1	17	0.18	6.04	2.61	2.09	108.2	21.0	82.9	37.8	6	4	9
Otjiwarong	1	18	0.21	5.96	2.61	2.12	104.3	25.8	85.9	34.3	5	5	9
Otjiwarong	1	19	0.26	5.96	2.51	2.09	106.9	22.0	80.1	32.9	6	4	9
Otjiwarong	1	20	0.19	5.96	2.54	2.19	98.0	20.1	80.5	31.9	9	4	8
Otjiwarong	2	1	0.21	5.68	2.47	2.12	94.9	24.0	85.0	34.5	9	6	8
Otjiwarong	2	2	0.30	5.68	2.40	2.09	107.1	22.6	81.4	33.9	9	5	8
Otjiwarong	2	3	0.18	5.82	2.58	2.19	107.4	35.6	83.4	36.9	9	7	8
Otjiwarong	2	4	0.21	5.82	2.58	2.16	97.2	22.3	84.7	33.4	9	4	8
Otjiwarong	2	5	0.25	5.68	2.40	2.02	80.0	23.0	85.0	36.2	6	4	8
Otjiwarong	2	6	0.23	5.68	2.51	2.02	107.0	24.7	86.2	35.0	9	7	9
Otjiwarong	2	7	0.25	5.89	2.61	2.12	98.4	22.8	84.3	41.1	9	4	8
Otjiwarong	2	8	0.26	5.68	2.44	2.09	109.4	19.4	76.8	30.0	9	4	8
Otjiwarong	2	9	0.21	5.89	2.58	2.05	106.8	21.4	85.8	39.6	9	4	8
Otjiwarong	2	10	0.21	5.96	2.54	2.05	110.4	21.5	83.2	33.2	9	7	7
Otjiwarong	2	11	0.23	5.82	2.58	2.16	91.3	22.8	91.6	37.7	7	4	8
Otjiwarong	2	12	0.28	5.68	2.47	1.91	111.9	19.9	86.3	38.7	6	3	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Otjiwarong	2	13	0.19	5.82	2.54	2.16	95.7	21.6	78.2	32.9	9	7	8
Otjiwarong	2	14	0.25	5.82	2.61	2.05	90.7	24.0	86.6	41.3	9	7	6
Otjiwarong	2	15	0.23	5.75	2.61	2.05	101.3	23.1	83.8	38.0	9	7	6
Otjiwarong	2	16	0.25	5.47	2.51	2.09	105.1	22.4	80.2	38.0	9	2	6
Otjiwarong	2	17	0.26	5.82	2.58	2.09	106.6	21.8	83.4	37.5	5	0	8
Otjiwarong	2	18	0.21	5.68	2.54	2.05	101.2	20.6	84.2	34.3	9	7	6
Otjiwarong	2	19	0.21	5.68	2.54	2.09	105.1	24.0	84.0	37.4	9	7	8
Otjiwarong	2	20	0.25	5.89	2.58	2.09	103.3	25.4	85.9	35.0	5	0	6
Otjiwarong	3	1	0.28	5.75	2.54	2.12	98.8	29.4	86.3	35.1	9	7	9
Otjiwarong	3	2	0.28	6.11	2.54	2.19	102.5	22.9	78.9	39.0	8	2	8
Otjiwarong	3	3	0.19	5.82	2.61	2.16	108.8	25.0	86.2	40.6	9	4	8
Otjiwarong	3	4	0.18	6.04	2.64	2.26	93.1	21.7	83.1	42.7	6	3	8
Otjiwarong	3	5	0.19	6.04	2.61	2.09	107.0	23.4	86.5	44.3	6	3	8
Otjiwarong	3	6	0.19	5.96	2.61	2.09	115.7	23.4	82.8	39.9	9	4	8
Otjiwarong	3	7	0.26	6.04	2.64	2.26	103.9	21.5	84.0	35.6	8	0	8
Otjiwarong	3	8	0.25	5.96	2.61	2.16	99.6	20.9	85.0	33.4	8	6	8
Otjiwarong	3	9	0.25	6.11	2.64	2.26	110.1	22.1	81.2	36.8	9	6	7
Otjiwarong	3	10	0.19	5.54	2.78	2.16	99.6	24.6	83.7	39.6	6	1	8
Otjiwarong	3	11	0.21	6.04	2.64	2.26	103.2	25.7	93.0	41.6	6	5	9
Otjiwarong	3	12	0.18	6.04	2.78	2.26	110.7	24.2	84.6	40.4	9	4	8
Otjiwarong	3	13	0.26	5.96	2.64	2.16	104.1	21.6	88.3	45.4	6	4	8
Otjiwarong	3	14	0.19	5.96	2.71	2.19	105.0	20.3	89.6	41.7	9	7	7
Otjiwarong	3	15	0.19	6.04	2.58	2.19	94.7	25.6	87.7	38.7	6	4	8
Otjiwarong	3	16	0.21	6.11	2.99	2.26	103.3	18.5	81.2	34.9	8	4	7
Otjiwarong	3	17	0.18	5.89	2.71	2.23	109.1	26.3	91.0	42.5	6	4	8
Otjiwarong	3	18	0.19	6.04	2.78	2.23	105.8	26.9	82.1	35.5	9	5	9
Otjiwarong	3	19	0.23	6.18	2.78	2.19	109.2	20.6	81.6	41.3	9	7	8
Otjiwarong	3	20	0.19	5.54	2.58	2.23	105.6	26.7	86.7	42.5	6	4	8
Otjiwarong	4	1	0.26	6.04	2.61	2.16	104.8	24.5	79.8	39.4	9	7	9
Otjiwarong	4	2	0.19	5.96	2.71	2.25	99.9	23.4	84.2	37.1	6	4	8
Otjiwarong	4	3	0.23	5.82	2.61	2.19	101.0	24.7	84.5	40.1	9	4	9
Otjiwarong	4	4	0.25	6.04	2.64	2.12	114.6	24.7	84.0	38.1	6	4	9
Otjiwarong	4	5	0.23	6.04	2.58	2.19	98.7	27.4	91.2	42.8	6	4	9
Otjiwarong	4	6	0.23	6.11	2.75	2.23	112.1	23.6	96.5	36.5	4	4	9
Otjiwarong	4	7	0.25	5.82	2.61	2.19	102.0	21.2	83.5	33.2	9	4	9
Otjiwarong	4	8	0.16	5.89	2.99	2.09	94.5	23.6	81.7	33.6	9	4	8
Otjiwarong	4	9	0.18	5.82	2.61	2.19	90.3	26.0	91.4	37.5	6	4	8
Otjiwarong	4	10	0.21	5.82	2.54	2.16	100.4	24.9	85.0	39.3	6	4	8
Otjiwarong	4	11	0.23	5.75	2.54	2.09	106.3	22.3	80.1	40.1	8	4	8
Otjiwarong	4	12	0.21	6.04	2.61	2.23	106.9	22.0	86.4	37.9	6	4	9
Otjiwarong	4	13	0.23	5.82	2.64	2.12	111.7	26.7	86.0	38.6	9	6	8
Otjiwarong	4	14	0.19	5.96	2.71	2.26	102.0	24.4	87.0	34.1	6	4	8
Otjiwarong	4	15	0.21	5.68	2.51	2.09	100.5	21.4	88.7	37.3	9	4	8
Otjiwarong	4	16	0.23	6.04	2.64	2.12	100.4	27.8	90.5	35.6	6	4	8
Otjiwarong	4	17	0.19	5.96	2.64	2.09	105.5	22.8	81.6	35.2	6	4	9
Otjiwarong	4	18	0.25	5.82	2.54	2.16	108.2	23.0	92.3	35.6	6	4	8
Otjiwarong	4	19	0.21	5.89	2.58	2.19	108.2	21.0	75.9	41.6	5	4	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Otjiwarong	4	20	0.19	6.04	2.64	2.09	104.1	24.3	86.3	39.4	9	4	9

10.4.2 Pheromone Data

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Nababeep	1	1	17.82	17.82	22.75	22.62	17.82	0.39	0.39	0.39
Nababeep	1	2	6.91	19.58	14.48	18.31	19.26	0.41	0.41	20.65
Nababeep	1	3	3.58	14.37	44.80	14.78	11.27	4.89	1.77	4.53
Nababeep	1	4	5.73	28.01	19.60	21.25	19.50	5.12	0.39	0.39
Nababeep	1	5	4.40	15.08	30.96	14.71	12.15	7.99	4.83	9.88
Nababeep	2	1	0.67	0.38	1.00	2.13	1.98	91.58	0.95	1.32
Nababeep	2	2	8.63	12.46	41.04	14.48	15.23	2.79	2.30	3.07
Nababeep	2	3	4.40	19.97	29.63	20.66	10.90	12.60	1.44	0.40
Nababeep	2	4	7.45	13.33	10.92	28.02	20.10	3.56	0.41	16.22
Nababeep	2	5	6.69	17.50	39.05	6.90	23.40	4.92	1.15	0.38
Nababeep	3	1	10.00	11.63	12.54	19.38	17.12	10.00	0.42	18.90
Nababeep	3	2	7.29	15.19	34.72	7.62	14.34	17.71	2.73	0.40
Nababeep	3	3	6.12	18.86	33.99	6.12	33.81	0.36	0.36	0.36
Nababeep	3	4	14.54	3.51	26.57	4.35	3.51	27.35	3.51	16.66
Nababeep	3	5	8.62	10.32	25.37	6.84	12.34	19.74	4.00	12.79
Nababeep	4	1	1.97	3.09	12.31	2.68	3.62	58.36	3.83	14.14
Nababeep	4	2	0.60	4.16	13.57	2.24	9.52	63.43	2.39	4.09
Nababeep	4	3	5.00	12.03	36.20	5.00	15.81	19.08	6.48	0.40
Nababeep	4	4	0.99	0.19	0.70	3.86	2.82	87.50	0.19	3.75
Nababeep	4	5	0.44	2.19	15.28	0.61	1.94	71.61	5.29	2.65
Nababeep	5	1	1.80	3.19	16.28	0.26	0.26	72.95	3.22	2.03
Nababeep	5	2	3.74	3.74	14.96	3.74	3.74	41.12	3.74	25.21
Nababeep	5	3	11.99	11.99	25.95	0.34	0.34	48.73	0.34	0.34
Nababeep	5	4	0.84	2.69	26.87	0.84	3.08	61.33	3.13	1.22
Nababeep	5	5	4.46	5.50	24.23	10.28	14.05	27.72	6.75	7.03
Nababeep	6	1	8.05	14.99	25.66	8.05	9.99	17.16	8.05	8.05
Nababeep	6	2	18.29	18.29	25.67	0.39	18.29	18.29	0.39	0.39
Nababeep	6	3	2.77	9.41	21.82	2.77	4.04	53.11	2.77	3.30
Nababeep	6	4	1.89	7.84	24.64	1.61	2.33	49.66	5.99	6.05
Nababeep	6	5	8.11	6.61	65.74	3.03	2.87	7.80	1.81	4.03
Karasburg	1	1	4.05	8.49	47.96	0.36	8.02	20.35	10.40	0.36
Karasburg	1	2	-0.00	-0.00	50.00	-0.00	-0.00	-0.00	50.00	-0.00
Karasburg	1	3	0.35	8.82	32.32	0.35	0.35	37.70	19.77	0.35
Karasburg	1	4	0.30	0.30	16.80	0.30	0.30	25.91	55.78	0.30
Karasburg	1	5	0.25	0.25	50.46	0.25	0.25	0.25	48.06	0.25
Karasburg	2	1	0.35	13.45	26.86	0.35	0.35	16.40	41.88	0.35
Karasburg	2	2	0.34	11.21	0.34	11.21	31.79	0.34	44.44	0.34
Karasburg	2	3	3.57	12.92	27.10	0.41	8.95	15.27	21.77	10.01
Karasburg	2	4	0.37	7.54	0.37	0.37	25.39	5.71	34.93	25.33
Karasburg	2	5	0.35	7.79	0.35	0.35	24.51	0.35	35.99	30.31
Karasburg	3	1	2.48	8.51	12.92	0.38	8.16	39.45	25.55	2.54
Karasburg	3	2	4.38	5.21	18.45	0.39	7.45	26.62	33.13	4.38
Karasburg	3	3	4.29	8.76	39.41	0.38	17.61	4.49	21.42	3.63
Karasburg	3	4	2.42	2.75	26.35	0.38	10.36	28.35	27.21	2.18
Karasburg	3	5	0.33	2.86	9.28	0.33	3.20	50.08	31.17	2.76

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Karasburg	4	1	5.75	14.66	11.49	0.38	16.26	8.36	42.72	0.38
Karasburg	4	2	3.70	10.64	24.94	0.39	6.86	23.86	29.22	0.39
Karasburg	4	3	1.18	4.76	20.71	2.94	4.70	46.02	16.66	3.03
Karasburg	4	4	4.46	8.90	71.54	0.97	7.02	5.85	0.97	0.29
Karasburg	4	5	1.52	6.83	9.74	3.73	8.09	38.38	31.33	0.37
Karasburg	5	1	0.36	7.64	6.74	0.36	32.21	12.66	39.68	0.36
Karasburg	5	2	0.34	7.35	0.34	0.34	36.00	14.60	40.70	0.34
Karasburg	5	3	0.37	7.23	5.41	0.37	26.60	28.32	31.34	0.37
Karasburg	5	4	0.38	8.12	8.05	0.38	26.53	22.09	30.84	3.60
Karasburg	5	5	0.36	7.02	7.44	0.36	19.49	43.40	21.57	0.36
Karasburg	6	1	3.07	3.47	34.80	0.37	9.67	33.01	15.24	0.37
Karasburg	6	2	3.84	6.06	10.05	4.60	17.95	30.68	22.98	3.84
Karasburg	6	3	0.37	5.54	13.49	0.37	29.64	17.19	33.02	0.37
Karasburg	6	4	1.91	6.36	10.19	0.38	15.54	42.34	21.18	2.11
Karasburg	6	5	2.63	13.90	11.67	0.41	25.11	16.31	23.67	6.29
Keetmansh	1	1	27.57	27.57	43.25	0.32	0.32	0.32	0.32	0.32
Keetmansh	1	2	18.30	18.30	61.96	0.29	0.29	0.29	0.29	0.29
Keetmansh	1	3	3.48	4.41	61.51	0.32	0.32	18.24	8.39	3.34
Keetmansh	1	4	1.67	0.20	1.67	0.20	9.09	84.84	0.20	2.14
Keetmansh	1	5	0.18	0.18	2.75	0.18	0.18	87.99	5.82	2.75
Keetmansh	2	1	2.71	2.71	3.59	0.23	0.23	82.24	5.58	2.71
Keetmansh	2	2	5.80	6.89	6.71	0.36	15.51	53.13	5.80	5.80
Keetmansh	2	3	0.30	3.26	3.86	0.30	0.30	50.43	38.28	3.26
Keetmansh	2	4	0.33	5.29	4.70	0.33	4.93	44.34	37.96	2.10
Keetmansh	2	5	0.28	7.58	5.99	0.28	0.28	71.84	7.76	5.99
Keetmansh	3	1	6.77	4.47	59.00	0.33	6.35	15.82	6.92	0.33
Keetmansh	3	2	2.32	3.27	35.16	0.98	5.48	45.79	4.88	2.11
Keetmansh	3	3	21.08	21.45	29.39	0.37	26.62	0.37	0.37	0.37
Keetmansh	3	4	1.80	2.80	15.41	5.72	4.52	58.01	10.30	1.45
Keetmansh	3	5	3.81	3.81	10.29	0.27	0.27	72.77	8.50	0.27
Keetmansh	4	1	0.30	16.70	27.75	0.30	0.30	54.03	0.30	0.30
Keetmansh	4	2	0.34	0.34	9.12	0.34	0.34	39.01	34.54	15.94
Keetmansh	4	3	0.39	28.25	18.66	0.39	0.39	22.55	14.69	14.69
Keetmansh	4	4	11.04	11.04	65.71	0.29	0.29	11.04	0.29	0.29
Keetmansh	4	5	4.28	0.31	13.30	0.31	0.31	58.32	22.87	0.31
Keetmansh	5	1	0.31	3.78	9.09	0.31	0.31	46.69	39.19	0.31
Keetmansh	5	2	7.24	7.24	17.61	0.36	0.36	39.11	27.72	0.36
Keetmansh	5	3	11.79	0.33	11.79	0.33	0.33	51.82	23.27	0.33
Keetmansh	5	4	0.29	0.29	19.34	0.29	0.29	59.86	19.34	0.29
Keetmansh	5	5	10.31	10.31	25.19	0.36	0.36	42.79	10.31	0.36
Mariental	1	1	2.53	4.45	10.54	0.33	6.20	62.59	8.50	4.87
Mariental	1	2	2.89	4.24	5.54	3.91	11.72	56.83	5.55	9.33
Mariental	1	3	7.09	8.93	32.19	0.32	50.51	0.32	0.32	0.32
Mariental	1	4	0.36	12.83	5.47	0.36	40.09	31.70	5.81	3.38
Mariental	1	5	0.31	4.53	10.76	0.31	6.12	66.50	7.71	3.77
Mariental	2	1	2.75	2.97	13.21	0.29	0.29	68.47	9.26	2.75
Mariental	2	2	5.33	26.03	32.38	5.41	24.76	5.33	0.38	0.38

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Mariental	2	3	0.37	11.87	17.23	0.37	12.55	45.46	9.59	2.55
Mariental	2	4	0.24	1.38	3.36	0.24	3.04	78.98	11.86	0.91
Mariental	2	5	4.68	14.59	36.55	0.39	19.98	16.93	6.50	0.39
Mariental	3	1	0.26	10.60	17.10	0.26	0.26	71.02	0.26	0.26
Mariental	3	2	0.36	16.91	16.72	0.36	7.32	48.64	3.89	5.81
Mariental	3	3	0.14	0.14	1.72	0.14	0.14	92.21	2.73	2.77
Mariental	3	4	3.49	54.51	19.71	0.33	17.81	3.49	0.33	0.33
Mariental	3	5	0.52	3.53	1.51	0.20	1.32	85.88	6.52	0.52
Mariental	4	1	0.31	10.73	17.18	0.31	0.31	60.11	10.73	0.31
Mariental	4	2	6.25	42.63	11.32	6.33	26.48	6.25	0.37	0.37
Mariental	4	3	0.28	61.45	25.28	0.28	11.85	0.28	0.28	0.28
Mariental	4	4	0.23	0.23	8.15	0.23	0.23	76.54	14.14	0.23
Mariental	4	5	0.29	15.36	20.74	0.29	0.29	62.47	0.29	0.29
Mariental	5	1	0.36	34.60	31.34	0.36	18.35	14.27	0.36	0.36
Mariental	5	2	4.16	14.23	43.68	0.37	18.87	13.47	4.84	0.37
Mariental	5	3	4.47	11.10	64.20	0.29	19.06	0.29	0.29	0.29
Mariental	5	4	3.09	9.60	25.13	21.56	14.91	20.47	4.85	0.41
Mariental	5	5	0.70	3.81	15.49	0.28	3.52	71.61	3.41	1.18
Mariental	6	1	1.45	1.45	8.87	0.29	4.02	69.61	10.81	3.51
Mariental	6	2	11.83	11.83	23.32	0.40	0.40	28.54	11.83	11.83
Mariental	6	3	3.64	3.56	62.41	0.32	11.55	13.39	4.82	0.32
Mariental	6	4	2.19	1.54	9.40	2.58	5.37	73.72	4.01	1.20
Mariental	6	5	1.97	3.89	18.80	0.33	8.27	58.15	6.85	1.73
Windhoek	1	1	0.21	0.21	3.22	0.21	0.21	82.62	7.19	6.12
Windhoek	1	2	6.96	6.96	44.96	0.36	0.36	26.47	6.96	6.96
Windhoek	1	3	7.24	7.24	28.17	9.47	0.35	46.83	0.35	0.35
Windhoek	1	4	0.98	5.74	9.49	0.98	0.27	75.18	4.43	2.94
Windhoek	1	5	0.43	1.21	8.34	0.91	1.25	77.21	7.98	2.68
Windhoek	2	1	6.47	6.47	43.92	0.35	0.35	32.28	9.81	0.35
Windhoek	2	2	21.38	0.30	55.72	0.30	0.30	21.38	0.30	0.30
Windhoek	2	3	4.43	4.43	30.53	0.33	0.33	48.68	10.93	0.33
Windhoek	2	4	0.13	0.13	2.99	0.13	0.13	92.52	0.13	3.82
Windhoek	2	5	0.31	0.31	11.72	0.31	0.31	60.90	11.79	14.35
Windhoek	3	1	4.22	4.22	21.10	0.29	0.29	65.27	4.32	0.29
Windhoek	3	2	6.15	6.15	50.22	0.36	13.87	12.56	10.32	0.36
Windhoek	3	3	2.00	3.37	61.42	2.36	3.84	12.13	13.09	1.79
Windhoek	3	4	2.45	3.79	15.44	0.28	4.33	70.14	3.29	0.28
Windhoek	3	5	3.32	3.32	46.62	0.36	6.14	27.80	4.75	7.70
Windhoek	4	1	0.32	5.23	49.55	0.32	0.32	33.92	10.03	0.32
Windhoek	4	2	4.59	4.69	42.34	9.78	0.34	37.59	0.34	0.34
Windhoek	4	3	3.45	8.43	42.67	18.34	11.15	10.48	5.11	0.38
Windhoek	4	4	0.39	16.37	19.46	21.72	24.90	16.37	0.39	0.39
Windhoek	4	5	3.08	13.03	44.93	2.78	27.83	2.78	2.78	2.78
Windhoek	5	1	0.37	21.23	3.22	31.75	0.37	15.64	27.03	0.37
Windhoek	5	2	4.79	6.29	28.74	0.29	0.29	59.00	0.29	0.29
Windhoek	5	3	3.34	32.20	7.21	3.34	15.47	4.35	29.70	4.37
Windhoek	5	4	4.46	3.62	15.91	10.56	28.48	28.58	7.99	0.40

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Windhoek	5	5	1.49	1.52	14.39	3.59	1.49	63.53	12.14	1.85
Windhoek	6	1	4.31	4.31	8.68	0.31	5.30	66.73	4.31	6.05
Windhoek	6	2	3.18	10.88	44.94	0.37	14.17	18.69	4.58	3.18
Windhoek	6	3	7.76	8.60	52.43	0.36	14.96	8.68	3.65	3.55
Windhoek	6	4	6.28	10.98	81.69	0.21	0.21	0.21	0.21	0.21
Windhoek	6	5	5.47	8.97	38.04	0.38	13.94	27.91	4.91	0.38
Okahandja	1	1	0.39	17.72	7.22	7.22	7.22	42.80	7.22	10.20
Okahandja	1	2	1.23	2.42	3.98	3.27	1.36	75.31	4.45	7.98
Okahandja	1	3	4.10	7.49	19.42	12.74	0.38	44.01	7.53	4.33
Okahandja	1	4	1.55	3.80	6.86	7.37	3.35	65.98	5.74	5.37
Okahandja	1	5	2.86	5.14	3.01	3.21	0.29	70.60	3.20	11.68
Okahandja	2	1	0.37	0.37	15.87	26.06	0.37	29.64	0.37	26.97
Okahandja	2	2	8.09	9.11	28.42	44.19	0.36	9.11	0.36	0.36
Okahandja	2	3	0.37	19.69	25.67	25.41	27.75	0.37	0.37	0.37
Okahandja	2	4	0.37	9.75	9.75	44.01	14.69	0.37	0.37	20.71
Okahandja	2	5	3.00	6.35	28.43	25.85	30.52	5.10	0.38	0.38
Okahandja	3	1	4.14	15.05	22.98	27.65	8.00	7.55	9.35	5.28
Okahandja	3	2	2.67	16.64	42.45	22.25	6.92	2.77	2.77	3.53
Okahandja	3	3	4.52	34.30	24.12	29.40	6.57	0.36	0.36	0.36
Okahandja	3	4	1.03	3.93	20.02	5.86	1.66	50.60	16.55	0.35
Okahandja	3	5	0.23	1.97	5.99	0.23	0.23	79.67	9.55	2.12
Okahandja	4	1	0.22	0.83	1.11	5.60	0.83	82.37	4.86	4.17
Okahandja	4	2	1.80	8.58	21.36	22.00	4.19	27.41	14.25	0.40
Okahandja	4	3	6.34	6.98	43.16	0.35	7.58	34.91	0.35	0.35
Okahandja	4	4	0.44	2.72	15.81	4.56	1.51	50.05	22.64	2.28
Okahandja	4	5	1.12	6.69	40.62	7.03	2.42	31.78	9.45	0.90
Okahandja	5	1	0.71	2.84	7.24	2.43	2.01	75.81	7.54	1.41
Okahandja	5	2	2.84	4.48	21.76	10.19	10.95	40.48	8.91	0.39
Okahandja	5	3	3.47	6.36	19.34	22.00	23.49	16.91	5.85	2.59
Okahandja	5	4	0.64	2.85	6.77	2.30	2.03	76.17	7.61	1.62
Okahandja	5	5	0.39	0.39	20.82	18.10	9.56	29.52	20.85	0.39
Otjiwarongo	1	1	1.89	5.32	55.36	5.67	4.35	15.52	10.11	1.77
Otjiwarongo	1	2	0.84	0.85	10.21	2.46	0.81	66.40	15.36	3.08
Otjiwarongo	1	3	6.41	8.37	46.06	3.54	7.16	10.98	10.15	7.31
Otjiwarongo	1	4	2.55	3.81	24.71	4.77	11.39	31.70	19.20	1.87
Otjiwarongo	1	5	1.96	1.38	14.88	4.29	3.03	55.95	13.67	4.83
Otjiwarongo	2	1	0.20	0.20	84.37	3.66	0.20	4.52	0.20	6.65
Otjiwarongo	2	2	2.65	13.50	46.88	4.02	23.67	3.86	2.06	3.36
Otjiwarongo	2	3	2.20	7.32	60.64	3.81	15.28	4.75	0.33	5.67
Otjiwarongo	2	4	2.46	6.02	73.62	3.81	8.92	4.63	0.27	0.27
Otjiwarongo	2	5	2.65	9.79	54.03	3.90	17.59	4.50	2.26	5.29
Otjiwarongo	3	1	4.65	4.65	13.11	8.64	4.77	45.75	13.78	4.65
Otjiwarongo	3	2	2.17	12.12	3.14	17.97	5.16	25.35	30.33	3.76
Otjiwarongo	3	3	2.70	10.18	58.15	2.93	8.58	2.94	9.20	5.32
Otjiwarongo	3	4	6.99	5.14	68.65	6.27	4.58	1.40	4.15	2.82
Otjiwarongo	3	5	1.20	2.90	52.73	1.74	2.93	22.21	11.71	4.58
Otjiwarongo	4	1	3.49	13.09	35.83	11.64	5.02	17.08	6.46	7.40

Locality	C	S	P1	P2	P3	P4	P5	P6	P7	P8
Otjiwarongo	4	2	0.82	2.44	23.62	2.53	1.59	51.84	13.41	3.77
Otjiwarongo	4	3	7.55	17.84	17.09	24.09	25.08	7.55	0.40	0.40
Otjiwarongo	4	4	4.25	12.73	46.24	5.05	22.35	3.94	5.08	0.37
Otjiwarongo	4	5	0.76	1.56	6.88	1.89	1.68	64.79	16.63	5.81
Otjiwarongo	5	1	3.43	15.18	29.56	19.27	23.73	2.06	0.40	6.38
Otjiwarongo	5	2	3.31	7.01	65.94	7.40	6.13	2.29	5.73	2.21
Otjiwarongo	5	3	0.67	6.63	41.04	4.46	3.64	29.67	12.55	1.34
Otjiwarongo	5	4	4.43	2.77	26.69	6.24	2.72	37.85	15.89	3.42
Otjiwarongo	5	5	13.61	4.22	19.63	7.79	16.85	20.55	7.70	9.65
Otjiwarongo	6	1	9.52	4.75	27.82	4.88	14.80	24.89	4.50	8.83
Otjiwarongo	6	2	4.44	4.44	12.15	5.38	8.18	37.12	7.91	20.38
Otjiwarongo	6	3	1.61	5.00	34.90	4.19	3.48	38.14	10.47	2.21
Otjiwarongo	6	4	2.80	18.90	32.56	19.50	10.38	7.63	5.96	2.28
Otjiwarongo	6	5	3.58	21.38	31.12	15.72	9.17	5.91	10.16	2.96

10.5 Southeastern Africa

10.5.1 Morphometric Data

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Beira	1	1	0.25	5.71	2.47	1.81	105.0	22.0	83.0	33.0	5	0	8
Beira	1	2	0.21	5.93	2.64	1.88	106.0	24.0	80.0	37.0	5	0	8
Beira	1	3	0.19	5.43	2.40	1.98	105.0	18.0	72.0	32.0	6	0	8
Beira	1	4	0.23	5.78	2.64	2.02	99.0	21.0	73.0	31.0	6	0	9
Beira	1	5	0.25	5.86	2.51	1.88	109.0	21.0	82.0	38.0	5	0	8
Beira	1	6	0.23	5.93	2.61	2.02	103.0	20.0	82.0	36.0	6	2	9
Beira	1	7	0.19	5.14	2.51	1.91	89.0	16.0	80.0	39.0	6	2	8
Beira	1	8	0.21	5.50	2.54	2.12	113.0	20.0	82.0	33.0	4	1	8
Beira	1	9	0.23	5.36	2.75	1.98	105.0	15.0	82.0	36.0	6	1	8
Beira	1	10	0.25	5.21	2.61	1.88	108.0	25.0	77.0	32.0	4	0	9
Beira	1	11	0.21	5.64	2.51	1.84	95.0	23.0	78.0	31.0	4	0	9
Beira	1	12	0.19	5.07	2.54	1.81	111.0	18.0	75.0	28.0	5	0	9
Beira	1	13	0.23	5.21	2.44	1.91	110.0	19.0	75.0	36.0	5	0	8
Beira	1	14	0.19	5.43	2.61	1.91	109.0	17.0	71.0	26.0	5	0	8
Beira	1	15	0.21	4.93	2.54	1.98	106.0	18.0	78.0	36.0	5	0	9
Beira	1	16	0.25	5.28	2.47	1.95	107.0	22.0	78.0	31.0	5	0	9
Beira	1	17	0.21	5.78	2.54	1.98	106.0	16.0	72.0	29.0	5	0	9
Beira	1	18	0.19	5.36	2.64	2.12	109.0	20.0	75.0	33.0	4	2	9
Beira	1	19	0.19	5.14	2.58	2.02	110.0	19.0	76.0	37.0	3	0	8
Beira	1	20	0.23	5.93	2.64	2.02	107.0	21.0	83.0	31.0	4	1	8
Beira	2	1	0.23	5.86	2.54	1.98	106.0	21.0	78.0	29.0	5	1	9
Beira	2	2	0.21	5.07	2.58	1.95	107.0	16.0	77.0	32.0	7	0	8
Beira	2	3	0.21	4.93	2.47	2.12	98.0	19.0	78.0	33.0	4	1	9
Beira	2	4	0.23	5.28	2.47	2.02	106.0	20.0	83.0	40.0	5	0	9
Beira	2	5	0.21	5.21	2.37	2.02	104.0	19.0	76.0	29.0	5	2	8
Beira	2	6	0.23	5.07	2.51	2.05	110.0	20.0	74.0	37.0	6	0	9
Beira	2	7	0.19	5.00	2.58	2.09	107.0	20.0	78.0	36.0	5	0	9
Beira	2	8	0.16	5.78	2.44	1.95	97.0	17.0	76.0	33.0	5	1	9
Beira	2	9	0.23	5.78	2.51	2.02	97.0	16.0	76.0	36.0	6	1	9
Beira	2	10	0.19	5.78	2.44	1.98	100.0	16.0	71.0	33.0	8	2	9
Beira	2	11	0.16	5.28	2.37	2.02	105.0	17.0	74.0	29.0	9	2	9
Beira	2	12	0.19	5.28	2.51	1.95	107.0	21.0	77.0	35.0	8	0	8
Beira	2	13	0.23	4.93	2.54	2.05	101.0	20.0	79.0	39.0	5	0	9
Beira	2	14	0.19	5.07	2.44	1.98	109.0	20.0	74.0	41.0	8	2	9
Beira	2	15	0.21	5.78	2.51	2.02	119.0	17.0	88.0	39.0	6	0	8
Beira	2	16	0.23	5.07	2.44	1.95	97.0	15.0	80.0	35.0	5	5	8
Beira	2	17	0.19	5.00	2.51	1.98	102.0	19.0	75.0	37.0	5	4	8
Beira	2	18	0.21	5.28	2.51	1.98	96.0	18.0	78.0	32.0	4	0	8
Beira	2	19	0.21	4.93	2.47	2.02	93.0	17.0	86.0	38.0	4	0	9
Beira	2	20	0.19	5.64	2.47	2.02	96.0	19.0	81.0	34.0	6	0	8
Beira	3	1	0.26	5.86	2.40	2.02	112.0	16.0	83.0	41.0	5	0	9
Beira	3	2	0.26	5.00	2.51	1.98	109.0	19.0	76.0	36.0	5	1	9
Beira	3	3	0.19	5.21	2.51	2.05	106.0	20.0	86.0	37.0	6	4	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Beira	3	4	0.19	4.86	2.54	2.09	104.0	19.0	81.0	38.0	8	4	8
Beira	3	5	0.3	5.64	2.51	2.05	110.0	21.0	82.0	40.0	8	2	9
Beira	3	6	0.28	5.71	2.51	2.05	112.0	17.0	76.0	35.0	8	1	9
Beira	3	7	0.21	5.07	2.51	2.02	108.0	18.0	78.0	36.0	6	2	9
Beira	3	8	0.21	5.36	2.54	2.02	107.0	19.0	76.0	33.0	4	0	9
Beira	3	9	0.21	5.64	2.44	1.98	112.0	18.0	84.0	38.0	8	4	9
Beira	3	10	0.23	5.71	2.51	2.05	112.0	20.0	81.0	38.0	8	0	9
Beira	3	11	0.21	5.57	2.51	2.02	117.0	17.0	78.0	37.0	4	0	9
Beira	3	12	0.19	5.71	2.47	1.98	104.0	15.0	82.0	37.0	6	2	9
Beira	3	13	0.21	5.64	2.54	2.02	102.0	17.0	80.0	39.0	6	1	9
Beira	3	14	0.21	5.78	2.51	1.98	114.0	20.0	82.0	38.0	5	0	9
Beira	3	15	0.19	5.64	2.51	1.98	97.0	17.0	86.0	42.0	5	0	9
Beira	3	16	0.23	5.78	2.54	2.02	108.0	18.0	72.0	33.0	8	4	9
Beira	3	17	0.25	5.21	2.51	1.98	109.0	16.0	79.0	32.0	5	1	8
Beira	3	18	0.23	5.21	2.54	1.98	92.0	18.0	80.0	40.0	5	0	9
Beira	3	19	0.23	5.14	2.40	1.91	110.0	21.0	85.0	33.0	5	5	9
Beira	3	20	0.21	4.93	2.47	1.98	112.0	22.0	86.0	36.0	5	0	9
Mutare	1	1	0.32	5.78	2.47	1.98	114.0	18.0	81.0	36.0	4	2	9
Mutare	1	2	0.3	6.07	2.58	2.12	112.0	22.0	84.0	36.0	7	5	9
Mutare	1	3	0.3	5.86	2.51	2.09	113.0	20.0	83.0	36.0	8	4	9
Mutare	1	4	0.25	5.86	2.51	2.05	115.0	16.0	72.0	34.0	5	2	9
Mutare	1	5	0.19	6.07	2.61	2.16	110.0	14.0	69.0	35.0	8	2	9
Mutare	1	6	0.26	5.28	2.61	2.09	108.0	17.0	74.0	40.0	4	1	9
Mutare	1	7	0.25	6.07	2.54	2.09	111.0	17.0	80.0	45.0	8	1	9
Mutare	1	8	0.23	6.07	2.51	2.09	110.0	18.0	81.0	31.0	8	4	9
Mutare	1	9	0.25	5.93	2.47	2.09	104.0	17.0	80.0	29.0	5	3	9
Mutare	1	10	0.25	5.78	2.44	2.02	113.0	14.0	83.0	36.0	4	2	7
Mutare	1	11	0.21	5.57	2.54	2.19	104.0	19.0	83.0	35.0	6	2	9
Mutare	1	12	0.26	5.21	2.40	2.02	108.0	18.0	82.0	35.0	6	0	8
Mutare	1	13	0.21	5.28	2.47	1.98	112.0	18.0	81.0	35.0	8	4	9
Mutare	1	14	0.25	5.43	2.61	2.02	101.0	15.0	73.0	34.0	8	0	8
Mutare	1	15	0.23	6.00	2.47	2.02	112.0	18.0	80.0	34.0	8	1	8
Mutare	1	16	0.25	5.28	2.54	2.09	104.0	15.0	81.0	41.0	5	2	8
Mutare	1	17	0.21	5.28	2.51	2.09	105.0	18.0	79.0	30.0	6	4	9
Mutare	1	18	0.26	6.00	2.54	2.05	102.0	17.0	77.0	31.0	8	1	9
Mutare	1	19	0.21	5.86	2.54	2.09	112.0	20.0	82.0	42.0	9	1	9
Mutare	1	20	0.23	5.93	2.54	2.09	103.0	17.0	77.0	36.0	8	1	9
Mutare	2	1	0.21	5.93	2.54	2.12	109.0	15.0	79.0	34.0	6	2	8
Mutare	2	2	0.26	5.86	2.54	2.16	113.0	21.0	77.0	31.0	0	1	0
Mutare	2	3	0.25	6.14	2.61	2.19	109.0	21.0	74.0	36.0	5	2	8
Mutare	2	4	0.23	6.14	2.61	2.19	117.0	18.0	82.0	33.0	6	3	8
Mutare	2	5	0.25	5.64	2.58	2.23	114.0	20.0	83.0	37.0	4	1	8
Mutare	2	6	0.25	6.00	2.61	2.23	110.0	20.0	79.0	39.0	4	2	9
Mutare	2	7	0.23	5.86	2.54	2.16	110.0	19.0	77.0	38.0	4	1	8
Mutare	2	8	0.25	6.07	2.51	2.16	105.0	23.0	81.0	36.0	4	2	8
Mutare	2	9	0.19	6.07	2.54	2.09	114.0	19.0	76.0	38.0	3	1	8
Mutare	2	10	0.26	6.14	2.47	2.16	108.0	20.0	80.0	37.0	6	2	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Mutare	2	11	0.25	6.00	2.54	2.12	109.0	21.0	82.0	33.0	9	2	8
Mutare	2	12	0.23	6.21	2.58	2.12	112.0	25.0	79.0	33.0	8	1	8
Mutare	2	13	0.23	6.00	2.51	2.09	108.0	19.0	79.0	36.0	5	2	8
Mutare	2	14	0.21	6.07	2.54	2.12	109.0	17.0	84.0	36.0	4	2	8
Mutare	2	15	0.28	6.00	2.51	2.12	116.0	24.0	78.0	35.0	6	1	8
Mutare	2	16	0.26	6.14	2.51	2.09	118.0	23.0	79.0	40.0	0	1	2
Mutare	2	17	0.28	6.14	2.58	2.23	112.0	25.0	79.0	40.0	5	1	9
Mutare	2	18	0.25	5.93	2.47	2.09	107.0	20.0	80.0	38.0	6	1	9
Mutare	2	19	0.25	5.78	2.58	2.19	114.0	21.0	74.0	34.0	4	1	9
Mutare	2	20	0.25	6.14	2.58	2.19	111.0	21.0	74.0	38.0	3	1	8
Mutare	3	1	0.19	6.14	2.54	1.98	105.0	20.0	81.0	44.0	8	4	8
Mutare	3	2	0.23	6.07	2.51	2.16	110.0	20.0	82.0	37.0	6	2	9
Mutare	3	3	0.23	6.07	2.64	2.12	108.0	19.0	77.0	38.0	5	5	9
Mutare	3	4	0.19	5.93	2.68	2.23	112.0	19.0	78.0	34.0	6	1	9
Mutare	3	5	0.21	5.86	2.61	2.12	113.0	17.0	82.0	41.0	6	2	8
Mutare	3	6	0.23	6.07	2.61	2.09	112.0	18.0	79.0	44.0	6	1	8
Mutare	3	7	0.21	5.86	2.68	2.09	110.0	18.0	84.0	46.0	5	2	9
Mutare	3	8	0.23	6.07	2.61	2.16	98.0	17.0	82.0	40.0	6	0	9
Mutare	3	9	0.25	6.14	2.54	2.09	117.0	16.0	77.0	41.0	4	1	9
Mutare	3	10	0.19	6.14	2.61	2.16	98.0	22.0	83.0	35.0	6	1	8
Mutare	3	11	0.25	5.93	2.61	2.16	108.0	18.0	77.0	37.0	5	1	9
Mutare	3	12	0.25	6.07	2.64	2.12	113.0	13.0	76.0	42.0	5	5	9
Mutare	3	13	0.25	6.14	2.61	2.12	112.0	17.0	77.0	38.0	6	2	9
Mutare	3	14	0.21	5.93	2.54	2.09	115.0	20.0	83.0	42.0	6	1	8
Mutare	3	15	0.26	6.07	2.61	2.16	112.0	18.0	79.0	38.0	6	2	9
Mutare	3	16	0.18	6.07	2.61	2.23	105.0	22.0	82.0	34.0	5	1	9
Mutare	3	17	0.25	5.93	2.54	2.09	116.0	20.0	75.0	41.0	4	1	9
Mutare	3	18	0.28	6.14	2.58	2.09	117.0	15.0	77.0	42.0	6	2	9
Mutare	3	19	0.26	6.00	2.61	2.16	119.0	16.0	73.0	36.0	4	2	8
Mutare	3	20	0.21	6.00	2.71	2.26	106.0	20.0	80.0	39.0	5	1	8
Mutare	4	1	0.21	6.14	2.58	2.16	104.0	16.0	76.0	39.0	6	2	9
Mutare	4	2	0.26	5.93	2.54	2.19	104.0	20.0	82.0	33.0	6	2	9
Mutare	4	3	0.21	6.14	2.61	2.12	113.0	19.0	74.0	28.0	6	2	8
Mutare	4	4	0.3	6.21	2.54	2.09	105.0	20.0	86.0	40.0	5	2	7
Mutare	4	5	0.23	6.07	2.51	2.12	95.0	24.0	87.0	35.0	5	1	8
Mutare	4	6	0.23	6.14	2.68	2.09	102.0	22.0	81.0	34.0	6	1	8
Mutare	4	7	0.21	6.07	2.61	2.40	95.0	19.0	77.0	32.0	6	2	8
Mutare	4	8	0.26	6.21	2.61	2.09	92.0	21.0	82.0	38.0	6	2	8
Mutare	4	9	0.21	6.14	2.61	2.16	106.0	21.0	85.0	34.0	6	1	8
Mutare	4	10	0.25	6.14	2.54	2.05	105.0	23.0	78.0	29.0	6	1	9
Mutare	4	11	0.26	6.21	2.61	2.19	110.0	20.0	84.0	36.0	2	1	5
Mutare	4	12	0.19	6.28	2.54	2.09	112.0	22.0	81.0	33.0	6	2	9
Mutare	4	13	0.26	6.21	2.54	2.19	109.0	23.0	86.0	33.0	6	2	8
Mutare	4	14	0.23	6.21	2.58	2.09	102.0	21.0	82.0	36.0	4	1	7
Mutare	4	15	0.28	6.07	2.58	2.12	114.0	23.0	88.0	37.0	6	1	9
Mutare	4	16	0.28	6.21	2.58	2.12	101.0	20.0	86.0	35.0	5	1	8
Mutare	4	17	0.23	6.00	2.54	2.09	110.0	18.0	81.0	35.0	5	1	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Mutare	4	18	0.26	5.93	2.51	2.05	102.0	21.0	84.0	33.0	5	2	8
Mutare	4	19	0.32	6.00	2.51	2.19	113.0	21.0	81.0	40.0	5	1	8
Mutare	4	20	0.23	6.07	2.58	2.16	104.0	20.0	78.0	32.0	6	2	8
Mutare	5	1	0.21	6.00	2.58	2.19	106.0	23.0	81.0	37.0	5	2	8
Mutare	5	2	0.23	6.14	2.61	2.12	98.0	22.0	85.0	33.0	5	0	8
Mutare	5	3	0.21	6.14	2.61	2.19	105.0	19.0	78.0	37.0	6	2	8
Mutare	5	4	0.23	6.00	2.47	2.12	109.0	20.0	77.0	33.0	6	1	9
Mutare	5	5	0.21	5.93	2.54	2.19	111.0	20.0	76.0	38.0	9	4	9
Mutare	5	6	0.26	6.07	2.61	2.16	99.0	20.0	76.0	36.0	4	1	8
Mutare	5	7	0.19	6.07	2.54	2.23	109.0	27.0	79.0	40.0	8	3	9
Mutare	5	8	0.21	5.93	2.54	2.16	109.0	21.0	75.0	38.0	9	4	9
Mutare	5	9	0.19	5.93	2.51	2.09	107.0	24.0	82.0	35.0	2	1	8
Mutare	5	10	0.26	6.00	2.54	2.16	107.0	18.0	77.0	33.0	4	1	8
Mutare	5	11	0.25	5.86	2.54	2.16	111.0	20.0	86.0	31.0	4	2	8
Mutare	5	12	0.23	6.00	2.58	2.23	101.0	23.0	82.0	35.0	4	5	8
Mutare	5	13	0.21	6.07	2.61	2.23	106.0	23.0	81.0	38.0	5	1	8
Mutare	5	14	0.26	6.07	2.40	2.09	98.0	19.0	78.0	37.0	4	1	8
Mutare	5	15	0.25	6.07	2.40	2.05	112.0	21.0	75.0	39.0	9	4	9
Mutare	5	16	0.25	5.93	2.40	2.02	110.0	19.0	78.0	44.0	9	4	9
Mutare	5	17	0.21	6.00	2.51	2.12	104.0	19.0	82.0	31.0	5	1	8
Mutare	5	18	0.23	5.93	2.40	2.12	110.0	22.0	78.0	43.0	9	4	8
Mutare	5	19	0.23	6.00	2.44	2.12	103.0	21.0	81.0	43.0	4	2	8
Mutare	5	20	0.23	6.00	2.47	2.16	105.0	24.0	81.0	39.0	5	4	8
Mutare	6	1	0.28	5.86	2.64	2.30	110.0	16.0	74.0	32.0	5	5	9
Mutare	6	2	0.32	5.78	2.54	2.09	102.0	18.0	71.0	29.0	5	1	8
Mutare	6	3	0.23	5.64	2.51	2.12	102.0	17.0	76.0	32.0	6	2	9
Mutare	6	4	0.23	6.07	2.71	2.30	119.0	18.0	77.0	34.0	3	1	8
Mutare	6	5	0.28	5.86	2.44	2.16	102.0	19.0	72.0	28.0	5	1	9
Mutare	6	6	0.23	6.07	2.51	2.12	104.0	24.0	81.0	33.0	6	1	8
Mutare	6	7	0.23	5.93	2.58	2.09	106.0	20.0	77.0	34.0	6	2	8
Mutare	6	8	0.25	5.93	2.47	2.05	113.0	16.0	71.0	27.0	5	2	8
Mutare	6	9	0.23	5.86	2.51	2.12	103.0	22.0	81.0	30.0	9	0	8
Mutare	6	10	0.25	5.93	2.61	2.19	110.0	17.0	80.0	28.0	5	0	8
Mutare	6	11	0.25	5.93	2.89	2.19	105.0	23.0	82.0	33.0	7	2	9
Mutare	6	12	0.28	5.78	2.68	2.16	107.0	18.0	77.0	30.0	1	1	7
Mutare	6	13	0.28	5.93	2.64	2.23	98.0	18.0	79.0	34.0	7	2	9
Mutare	6	14	0.25	5.78	2.64	2.19	104.0	17.0	74.0	28.0	4	1	8
Mutare	6	15	0.18	6.07	2.71	2.19	103.0	19.0	74.0	31.0	6	0	8
Mutare	6	16	0.28	5.86	2.61	2.19	103.0	19.0	72.0	30.0	6	1	9
Mutare	6	17	0.21	5.86	2.68	2.33	106.0	22.0	75.0	31.0	5	0	9
Mutare	6	18	0.25	5.93	2.58	2.19	115.0	23.0	80.0	36.0	4	1	8
Mutare	6	19	0.25	6.07	2.64	2.19	106.0	22.0	85.0	40.0	5	0	8
Mutare	6	20	0.3	6.07	2.58	2.19	113.0	19.0	78.0	32.0	8	2	9
Harare	1	1	0.19	6.00	2.58	2.16	109.0	18.0	72.0	31.0	4	2	8
Harare	1	2	0.23	6.07	2.58	2.19	116.0	20.0	76.0	37.0	8	0	9
Harare	1	3	0.23	5.71	2.33	1.95	93.0	20.0	77.0	43.0	6	0	9
Harare	1	4	0.26	5.93	2.51	2.02	102.0	17.0	68.0	33.0	5	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Harare	1	5	0.23	6.14	2.54	2.16	112.0	22.0	74.0	34.0	5	1	8
Harare	1	6	0.26	5.93	2.40	2.02	113.0	20.0	71.0	39.0	5	0	9
Harare	1	7	0.21	5.93	2.51	2.19	106.0	19.0	84.0	37.0	4	0	9
Harare	1	8	0.25	5.86	2.33	1.98	107.0	19.0	76.0	40.0	6	0	8
Harare	1	9	0.28	5.86	2.47	2.19	98.0	21.0	87.0	35.0	5	1	8
Harare	1	10	0.35	6.07	2.54	2.12	112.0	21.0	72.0	39.0	9	0	8
Harare	1	11	0.25	6.14	2.54	2.16	109.0	23.0	78.0	38.0	5	2	9
Harare	1	12	0.23	6.07	2.68	2.26	110.0	21.0	78.0	36.0	6	5	9
Harare	1	13	0.19	5.93	2.54	2.12	107.0	20.0	78.0	34.0	6	2	8
Harare	1	14	0.3	6.14	2.64	2.16	110.0	23.0	79.0	37.0	6	1	9
Harare	1	15	0.3	5.93	2.47	2.16	106.0	20.0	83.0	41.0	9	6	9
Harare	1	16	0.33	5.93	2.58	2.12	110.0	20.0	73.0	37.0	6	1	8
Harare	1	17	0.23	5.86	2.51	2.05	108.0	15.0	68.0	33.0	6	0	9
Harare	1	18	0.23	6.00	2.58	2.09	108.0	18.0	82.0	32.0	9	0	8
Harare	1	19	0.25	6.21	2.61	2.16	106.0	20.0	78.0	37.0	6	5	8
Harare	1	20	0.21	6.00	2.58	2.12	110.0	17.0	79.0	36.0	5	1	8
Harare	2	1	0.26	5.93	2.54	2.19	99.0	20.0	83.0	32.0	0	0	7
Harare	2	2	0.25	5.93	2.58	2.19	103.0	19.0	81.0	34.0	3	2	8
Harare	2	3	0.23	5.93	2.58	2.26	99.0	21.0	78.0	37.0	6	2	8
Harare	2	4	0.26	5.93	2.58	2.19	101.0	19.0	76.0	35.0	4	0	9
Harare	2	5	0.25	6.00	2.54	2.16	102.0	17.0	77.0	37.0	3	0	4
Harare	2	6	0.23	6.00	2.58	2.23	104.0	15.0	79.0	37.0	4	0	9
Harare	2	7	0.26	6.00	2.64	2.26	106.0	20.0	79.0	35.0	4	1	8
Harare	2	8	0.32	5.93	2.51	2.16	104.0	19.0	71.0	33.0	4	1	8
Harare	2	9	0.23	6.00	2.64	2.23	114.0	22.0	79.0	36.0	4	2	8
Harare	2	10	0.26	6.14	2.58	2.16	100.0	18.0	77.0	33.0	4	1	9
Harare	2	11	0.25	5.86	2.47	2.09	102.0	17.0	79.0	36.0	6	1	8
Harare	2	12	0.26	5.93	2.71	2.26	89.0	18.0	82.0	36.0	2	1	8
Harare	2	13	0.25	6.00	2.58	2.12	99.0	22.0	82.0	39.0	6	1	9
Harare	2	14	0.25	5.86	2.47	2.12	102.0	20.0	76.0	37.0	8	1	9
Harare	2	15	0.35	5.86	2.47	2.16	95.0	22.0	82.0	38.0	5	1	8
Harare	2	16	0.23	6.00	2.58	2.23	104.0	17.0	80.0	37.0	4	1	8
Harare	2	17	0.21	6.07	2.58	2.12	101.0	20.0	78.0	37.0	4	1	9
Harare	2	18	0.32	5.93	2.47	2.09	103.0	21.0	77.0	34.0	6	2	9
Harare	2	19	0.23	6.07	2.68	2.16	97.0	21.0	82.0	35.0	4	1	8
Harare	2	20	0.23	5.78	2.51	2.16	100.0	22.0	82.0	34.0	4	2	8
Harare	3	1	0.26	6.00	2.54	2.16	114.0	20.0	77.0	29.0	4	1	9
Harare	3	2	0.28	6.07	2.58	2.23	109.0	19.0	73.0	33.0	4	1	9
Harare	3	3	0.26	6.00	2.58	2.12	103.0	22.0	79.0	39.0	5	0	9
Harare	3	4	0.23	6.00	2.47	2.02	111.0	21.0	78.0	37.0	5	4	8
Harare	3	5	0.25	6.07	2.44	2.09	109.0	24.0	86.0	31.0	5	1	9
Harare	3	6	0.26	6.00	2.54	2.12	110.0	17.0	76.0	29.0	5	1	9
Harare	3	7	0.23	6.07	2.58	2.16	101.0	19.0	81.0	41.0	6	2	9
Harare	3	8	0.25	6.00	2.47	2.09	112.0	20.0	80.0	33.0	5	2	9
Harare	3	9	0.23	6.14	2.47	2.09	110.0	22.0	76.0	33.0	4	2	9
Harare	3	10	0.26	5.93	2.58	2.12	106.0	17.0	75.0	34.0	5	2	8
Harare	3	11	0.23	6.14	2.54	2.09	114.0	23.0	75.0	37.0	4	1	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Harare	3	12	0.21	5.93	2.44	2.05	111.0	16.0	78.0	33.0	5	1	9
Harare	3	13	0.21	6.07	2.51	2.12	101.0	20.0	82.0	37.0	4	2	9
Harare	3	14	0.23	6.07	2.54	2.16	111.0	27.0	82.0	33.0	5	2	9
Harare	3	15	0.26	5.93	2.47	2.09	110.0	17.0	76.0	34.0	5	2	8
Harare	3	16	0.23	6.00	2.54	2.16	107.0	20.0	80.0	28.0	5	1	9
Harare	3	17	0.23	5.78	2.47	2.05	104.0	22.0	75.0	34.0	5	2	9
Harare	3	18	0.25	5.93	2.54	2.12	104.0	18.0	80.0	34.0	5	0	9
Harare	3	19	0.23	5.93	2.54	2.16	103.0	22.0	82.0	31.0	4	1	9
Harare	3	20	0.23	5.86	2.64	2.23	113.0	20.0	77.0	35.0	4	1	8
Harare	4	1	0.23	6.14	2.51	2.09	106.0	20.0	70.0	33.0	4	2	8
Harare	4	2	0.25	6.07	2.61	2.16	98.0	21.0	73.0	32.0	9	6	8
Harare	4	3	0.23	5.93	2.64	2.16	102.0	20.0	85.0	37.0	9	5	8
Harare	4	4	0.26	5.93	2.54	2.23	93.0	19.0	85.0	44.0	4	2	8
Harare	4	5	0.28	6.00	2.58	2.12	105.0	20.0	80.0	32.0	5	1	9
Harare	4	6	0.23	6.00	2.51	2.30	102.0	23.0	81.0	42.0	4	2	8
Harare	4	7	0.25	5.93	2.44	2.09	103.0	16.0	81.0	26.0	9	7	8
Harare	4	8	0.33	6.00	2.58	2.19	102.0	18.0	80.0	37.0	9	4	9
Harare	4	9	0.23	6.00	2.47	2.19	106.0	19.0	78.0	32.0	9	6	8
Harare	4	10	0.23	6.14	2.58	2.12	108.0	22.0	79.0	36.0	6	2	9
Harare	4	11	0.32	5.86	2.47	2.09	110.0	22.0	87.0	38.0	9	6	8
Harare	4	12	0.23	5.86	2.54	2.09	101.0	18.0	73.0	30.0	9	7	8
Harare	4	13	0.26	6.07	2.51	2.16	99.0	21.0	85.0	32.0	9	2	9
Harare	4	14	0.21	5.93	2.47	2.12	101.0	18.0	79.0	31.0	6	2	8
Harare	4	15	0.25	5.93	2.58	2.23	100.0	23.0	79.0	41.0	4	1	8
Harare	4	16	0.23	6.07	2.58	2.23	97.0	22.0	82.0	40.0	9	5	9
Harare	4	17	0.26	6.00	2.64	2.16	105.0	16.0	83.0	33.0	4	1	7
Harare	4	18	0.25	5.93	2.47	2.16	96.0	24.0	86.0	37.0	9	5	9
Harare	4	19	0.21	5.93	2.58	2.16	94.0	20.0	80.0	37.0	6	2	9
Harare	4	20	0.21	5.86	2.37	2.02	102.0	20.0	88.0	35.0	6	2	9
Harare	5	1	0.23	5.93	2.51	2.16	99.0	18.0	74.0	35.0	4	2	8
Harare	5	2	0.21	6.00	2.54	2.16	103.0	18.0	73.0	37.0	0	0	8
Harare	5	3	0.25	5.93	2.51	2.12	92.0	15.0	76.0	38.0	5	1	9
Harare	5	4	0.25	6.00	2.64	2.19	100.0	18.0	89.0	37.0	6	1	9
Harare	5	5	0.25	5.86	2.51	2.16	106.0	20.0	84.0	37.0	5	1	9
Harare	5	6	0.23	5.93	2.51	2.09	98.0	17.0	73.0	37.0	5	1	8
Harare	5	7	0.25	5.86	2.44	2.19	95.0	18.0	76.0	41.0	4	2	9
Harare	5	8	0.23	5.71	2.51	2.12	93.0	17.0	81.0	36.0	5	1	9
Harare	5	9	0.21	5.78	2.58	2.12	102.0	20.0	79.0	39.0	5	1	9
Harare	5	10	0.23	6.00	2.58	2.16	103.0	17.0	77.0	38.0	6	5	9
Harare	5	11	0.26	5.93	2.58	2.16	100.0	16.0	75.0	35.0	5	1	8
Harare	5	12	0.28	5.93	2.68	2.19	92.0	20.0	83.0	38.0	4	0	8
Harare	5	13	0.25	5.78	2.51	2.16	102.0	19.0	75.0	34.0	4	1	8
Harare	5	14	0.21	5.64	2.37	2.02	90.0	17.0	72.0	36.0	4	2	8
Harare	5	15	0.28	5.86	2.58	2.09	91.0	21.0	83.0	33.0	4	1	8
Harare	5	16	0.21	5.78	2.47	2.09	99.0	19.0	82.0	35.0	4	1	9
Harare	5	17	0.21	5.78	2.51	2.09	98.0	16.0	74.0	34.0	5	1	9
Harare	5	18	0.25	5.86	2.44	2.16	100.0	19.0	81.0	34.0	4	2	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Harare	5	19	0.21	5.86	2.51	2.09	94.0	19.0	79.0	40.0	4	2	9
Harare	5	20	0.21	5.93	2.51	2.09	102.0	17.0	76.0	34.0	4	2	9
Harare	6	1	0.21	6.00	2.51	2.09	74.0	20.0	81.0	32.0	6	2	8
Harare	6	2	0.23	6.00	2.61	2.19	103.0	20.0	81.0	34.0	5	2	9
Harare	6	3	0.26	6.14	2.61	2.16	108.0	18.0	76.0	36.0	6	2	9
Harare	6	4	0.25	6.00	2.51	2.26	97.0	17.0	85.0	34.0	5	2	3
Harare	6	5	0.25	6.07	2.51	2.16	108.0	14.0	80.0	32.0	6	4	8
Harare	6	6	0.23	6.07	2.54	2.19	114.0	14.0	72.0	32.0	6	4	9
Harare	6	7	0.23	6.07	2.58	2.16	112.0	17.0	82.0	32.0	6	4	9
Harare	6	8	0.21	6.00	2.54	2.26	103.0	20.0	77.0	33.0	6	2	8
Harare	6	9	0.3	6.07	2.58	2.23	105.0	17.0	79.0	37.0	6	2	9
Harare	6	10	0.26	6.00	2.51	2.19	101.0	15.0	77.0	37.0	6	2	9
Harare	6	11	0.18	6.00	2.58	2.30	105.0	14.0	74.0	30.0	8	2	9
Harare	6	12	0.21	6.00	2.54	2.23	104.0	17.0	81.0	37.0	6	2	9
Harare	6	13	0.23	6.07	2.58	2.26	103.0	15.0	79.0	37.0	6	2	9
Harare	6	14	0.26	6.00	2.51	2.16	108.0	17.0	84.0	32.0	6	2	9
Harare	6	15	0.26	6.14	2.54	2.19	110.0	23.0	82.0	30.0	6	2	9
Harare	6	16	0.26	6.14	2.58	2.26	106.0	16.0	73.0	34.0	5	2	9
Harare	6	17	0.25	6.07	2.58	2.23	108.0	19.0	74.0	37.0	6	2	9
Harare	6	18	0.23	6.00	2.58	2.16	107.0	16.0	73.0	37.0	6	2	9
Harare	6	19	0.25	6.21	2.64	2.26	113.0	16.0	82.0	36.0	6	2	8
Harare	6	20	0.25	6.14	2.54	2.23	107.0	13.0	79.0	30.0	6	2	9
Karoi	1	1	0.21	6.07	2.61	2.02	97.0	16.0	74.0	34.0	5	0	9
Karoi	1	2	0.23	6.00	2.51	2.02	105.0	14.0	72.0	35.0	6	2	8
Karoi	1	3	0.3	6.00	2.64	2.23	100.0	13.0	70.0	38.0	4	1	8
Karoi	1	4	0.3	6.00	2.58	2.05	106.0	18.0	76.0	35.0	6	0	9
Karoi	1	5	0.26	5.93	2.54	2.09	100.0	14.0	71.0	39.0	4	0	9
Karoi	1	6	0.26	6.14	2.68	2.12	103.0	14.0	80.0	40.0	3	0	8
Karoi	1	7	0.32	6.14	2.54	2.19	103.0	13.0	77.0	40.0	5	2	9
Karoi	1	8	0.23	6.07	2.54	2.09	105.0	21.0	79.0	37.0	4	0	8
Karoi	1	9	0.21	6.07	2.54	2.09	105.0	18.0	72.0	34.0	6	0	8
Karoi	1	10	0.25	5.93	2.51	2.02	103.0	16.0	72.0	37.0	6	2	8
Karoi	1	11	0.28	5.93	2.44	2.09	94.0	18.0	76.0	37.0	5	1	9
Karoi	1	12	0.25	5.93	2.44	2.05	104.0	14.0	73.0	40.0	1	2	7
Karoi	1	13	0.3	5.93	2.44	2.05	103.0	17.0	82.0	40.0	5	1	9
Karoi	1	14	0.23	6.00	2.61	2.12	107.0	17.0	76.0	46.0	4	2	8
Karoi	1	15	0.23	5.93	2.54	2.12	104.0	15.0	77.0	35.0	5	5	9
Karoi	1	16	0.25	6.07	2.54	2.05	107.0	17.0	75.0	30.0	6	1	8
Karoi	1	17	0.28	6.14	2.54	2.12	106.0	18.0	71.0	40.0	4	0	9
Karoi	1	18	0.28	5.93	2.37	2.05	105.0	21.0	88.0	39.0	4	1	9
Karoi	1	19	0.21	6.07	2.58	2.12	109.0	22.0	77.0	38.0	2	1	7
Karoi	1	20	0.26	5.93	2.54	2.12	105.2	14.0	72.0	36.0	4	2	8
Karoi	2	1	0.28	6.00	2.51	2.12	94.0	19.0	82.0	31.0	4	2	9
Karoi	2	2	0.25	5.86	2.44	2.12	100.0	16.0	77.0	36.0	5	2	9
Karoi	2	3	0.25	5.93	2.44	2.02	103.0	18.0	79.0	32.0	5	1	9
Karoi	2	4	0.21	6.00	2.40	2.05	97.0	17.0	80.0	40.0	3	1	8
Karoi	2	5	0.28	5.93	2.51	2.09	102.0	19.0	76.0	36.0	5	2	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Karoi	2	6	0.23	6.00	2.51	2.09	98.0	16.0	71.0	30.0	6	1	8
Karoi	2	7	0.25	5.86	2.40	2.12	109.0	20.0	75.0	32.0	1	1	8
Karoi	2	8	0.23	5.78	2.51	2.16	96.0	20.0	77.0	33.0	4	2	9
Karoi	2	9	0.28	5.93	2.44	2.09	94.0	23.0	83.0	33.0	5	2	8
Karoi	2	10	0.25	5.71	2.44	2.12	107.0	17.0	80.0	33.0	4	2	8
Karoi	2	11	0.26	5.78	2.47	2.09	94.0	15.0	73.0	35.0	5	4	8
Karoi	2	12	0.28	5.86	2.51	2.05	102.0	21.0	80.0	34.0	5	2	8
Karoi	2	13	0.28	6.00	2.40	2.09	118.0	16.0	69.0	37.0	5	2	8
Karoi	2	14	0.26	5.93	2.44	2.02	106.0	17.0	84.0	30.0	5	1	9
Karoi	2	15	0.26	5.93	2.51	2.16	96.0	17.0	81.0	29.0	6	2	9
Karoi	2	16	0.26	5.64	2.40	1.95	112.0	19.0	78.0	37.0	4	1	8
Karoi	2	17	0.28	5.86	2.47	2.09	100.0	18.0	76.0	31.0	4	1	8
Karoi	2	18	0.26	5.71	2.37	2.02	114.0	19.0	81.0	30.0	3	1	8
Karoi	2	19	0.26	5.78	2.47	2.16	105.0	18.0	81.0	35.0	5	2	8
Karoi	2	20	0.28	5.86	2.51	2.12	105.0	21.0	78.0	31.0	6	2	8
Karoi	3	1	0.23	5.86	2.54	2.09	106.0	20.0	73.0	29.0	5	2	8
Karoi	3	2	0.26	5.78	2.51	2.16	108.0	18.0	75.0	30.0	4	1	8
Karoi	3	3	0.26	5.71	2.51	2.12	105.0	19.0	76.0	33.0	6	1	8
Karoi	3	4	0.23	5.93	2.47	2.05	100.0	19.0	80.0	27.0	6	2	8
Karoi	3	5	0.25	5.78	2.37	2.16	101.0	19.0	76.0	25.0	5	1	7
Karoi	3	6	0.23	5.86	2.54	2.09	107.0	19.0	75.0	33.0	9	2	9
Karoi	3	7	0.23	5.86	2.54	2.05	98.0	18.0	75.0	33.0	5	2	9
Karoi	3	8	0.19	5.78	2.37	1.98	112.0	19.0	74.0	30.0	5	2	9
Karoi	3	9	0.23	5.86	2.54	2.09	97.0	17.0	76.0	36.0	5	2	8
Karoi	3	10	0.23	5.78	2.47	2.05	109.0	15.0	78.0	31.0	3	1	8
Karoi	3	11	0.23	5.78	2.51	2.09	100.0	16.0	72.0	38.0	5	0	8
Karoi	3	12	0.21	5.78	2.54	2.09	103.0	18.0	75.0	31.0	6	1	8
Karoi	3	13	0.23	5.78	2.47	2.12	105.0	19.0	76.0	36.0	5	2	8
Karoi	3	14	0.23	5.71	2.44	2.09	105.0	17.0	77.0	29.0	5	2	8
Karoi	3	15	0.23	5.86	2.37	2.09	103.0	19.0	76.0	33.0	6	2	9
Karoi	3	16	0.21	5.86	2.58	2.16	105.0	15.0	70.0	30.0	5	1	8
Karoi	3	17	0.21	5.86	2.47	2.02	106.0	19.0	77.0	36.0	9	5	9
Karoi	3	18	0.23	5.86	2.44	2.05	111.0	19.0	72.0	32.0	8	1	9
Karoi	3	19	0.23	5.64	2.47	2.05	108.0	19.0	75.0	32.0	4	2	8
Karoi	3	20	0.21	5.86	2.47	2.09	104.0	20.0	73.0	28.0	5	1	8
Karoi	4	1	0.25	6.00	2.54	2.16	115.0	19.0	83.0	42.0	7	4	9
Karoi	4	2	0.3	6.07	2.58	2.16	96.0	22.0	82.0	40.0	6	4	9
Karoi	4	3	0.32	6.00	2.54	2.12	98.0	20.0	78.0	47.0	5	2	8
Karoi	4	4	0.3	5.93	2.54	2.16	98.0	18.0	83.0	44.0	5	2	8
Karoi	4	5	0.23	5.93	2.58	2.16	100.0	21.0	83.0	34.0	5	1	8
Karoi	4	6	0.23	6.00	2.58	2.16	103.0	24.0	79.0	33.0	6	0	8
Karoi	4	7	0.21	6.00	2.47	2.16	98.0	22.0	85.0	34.0	5	0	9
Karoi	4	8	0.3	5.93	2.61	2.30	99.0	23.0	83.0	52.0	6	4	9
Karoi	4	9	0.25	6.00	2.51	2.12	97.0	18.0	84.0	41.0	5	4	9
Karoi	4	10	0.26	5.86	2.51	2.16	100.0	20.0	82.0	32.0	4	4	8
Karoi	4	11	0.23	6.07	2.54	2.16	110.0	22.0	85.0	35.0	5	4	9
Karoi	4	12	0.23	5.93	2.58	2.09	99.0	18.0	81.0	35.0	3	2	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Karoi	4	13	0.3	6.07	2.51	2.16	105.0	20.0	81.0	41.0	6	1	9
Karoi	4	14	0.21	5.86	2.51	2.12	104.0	18.0	78.0	37.0	6	2	9
Karoi	4	15	0.21	5.86	2.51	2.12	108.0	17.0	77.0	40.0	6	4	8
Karoi	4	16	0.23	5.93	2.44	2.12	97.0	21.0	81.0	38.0	5	1	8
Karoi	4	17	0.21	5.86	2.44	2.12	102.0	18.0	79.0	44.0	6	4	9
Karoi	4	18	0.23	5.78	2.54	2.19	106.0	22.0	86.0	42.0	5	2	9
Karoi	4	19	0.28	5.93	2.47	2.12	99.0	19.0	84.0	42.0	5	0	8
Karoi	4	20	0.25	5.78	2.54	2.12	95.0	20.0	78.0	34.0	4	0	9
Karoi	5	1	0.25	6.07	2.58	2.12	104.0	21.0	83.0	32.0	5	1	8
Karoi	5	2	0.26	5.86	2.58	2.12	112.0	13.0	73.0	36.0	6	0	9
Karoi	5	3	0.23	6.07	2.61	2.19	105.0	21.0	81.0	35.0	0	1	4
Karoi	5	4	0.3	6.00	2.47	2.09	99.0	19.0	80.0	37.0	6	4	9
Karoi	5	5	0.26	6.00	2.54	2.23	104.0	19.0	80.0	35.0	5	1	9
Karoi	5	6	0.23	5.78	2.58	2.16	87.0	17.0	77.0	41.0	6	4	8
Karoi	5	7	0.26	5.86	2.58	2.12	109.0	14.0	74.0	39.0	2	1	7
Karoi	5	8	0.25	6.14	2.58	2.12	101.0	17.0	78.0	34.0	4	1	9
Karoi	5	9	0.26	6.14	2.58	2.16	97.0	18.0	81.0	37.0	6	4	9
Karoi	5	10	0.23	6.00	2.64	2.12	101.0	21.0	82.0	31.0	4	0	9
Karoi	5	11	0.26	6.00	2.58	2.12	102.0	14.0	78.0	35.0	2	4	8
Karoi	5	12	0.26	6.07	2.54	2.12	105.0	16.0	79.0	39.0	5	4	9
Karoi	5	13	0.25	5.93	2.61	2.19	103.0	18.0	81.0	34.0	4	1	6
Karoi	5	14	0.25	5.93	2.51	2.12	100.0	14.0	78.0	35.0	5	4	8
Karoi	5	15	0.26	6.07	2.54	2.12	113.0	16.0	82.0	31.0	6	4	8
Karoi	5	16	0.23	6.00	2.54	2.16	107.0	17.0	80.0	38.0	5	4	9
Karoi	5	17	0.26	5.93	2.54	2.12	102.0	15.0	72.0	32.0	4	1	7
Karoi	5	18	0.23	5.93	2.58	2.12	101.0	20.0	85.0	34.0	6	1	8
Karoi	5	19	0.25	5.93	2.54	2.12	96.0	17.0	76.0	27.0	6	2	9
Karoi	5	20	0.23	6.00	2.64	2.16	102.0	15.0	79.0	34.0	4	2	9
Karoi	6	1	0.3	5.86	2.40	1.98	101.0	19.0	81.0	38.0	8	5	9
Karoi	6	2	0.21	6.00	2.68	2.26	103.0	19.0	80.0	33.0	4	1	9
Karoi	6	3	0.26	6.21	2.64	2.19	107.0	23.0	85.0	29.0	5	1	8
Karoi	6	4	0.23	6.07	2.68	2.16	96.0	17.0	84.0	28.0	4	1	9
Karoi	6	5	0.21	6.14	2.44	2.09	91.0	18.0	85.0	30.0	5	2	8
Karoi	6	6	0.25	6.14	2.58	2.05	95.0	23.0	86.0	36.0	6	4	8
Karoi	6	7	0.25	6.00	2.54	2.12	100.0	19.0	80.0	33.0	7	1	8
Karoi	6	8	0.23	6.00	2.44	2.12	106.0	15.0	75.0	32.0	6	0	9
Karoi	6	9	0.23	6.07	2.51	2.16	97.0	23.0	84.0	33.0	6	0	8
Karoi	6	10	0.26	5.93	2.40	2.05	105.0	21.0	89.0	33.0	5	1	8
Karoi	6	11	0.28	5.93	2.58	2.12	99.0	18.0	84.0	33.0	5	0	9
Karoi	6	12	0.21	5.86	2.71	2.05	100.0	22.0	86.0	34.0	6	0	9
Karoi	6	13	0.21	6.07	2.51	2.16	99.0	23.0	86.0	33.0	0	0	9
Karoi	6	14	0.23	6.00	2.58	2.26	96.0	21.0	84.0	31.0	1	2	9
Karoi	6	15	0.23	6.00	2.44	2.09	101.0	28.0	83.0	33.0	7	1	9
Karoi	6	16	0.19	5.93	2.51	2.12	98.0	18.0	80.0	40.0	5	1	8
Karoi	6	17	0.23	6.07	2.51	2.12	97.0	23.0	89.0	34.0	6	1	8
Karoi	6	18	0.28	6.00	2.54	2.12	97.0	19.0	82.0	38.0	4	4	9
Karoi	6	19	0.23	6.07	2.58	2.16	103.0	21.0	74.0	35.0	1	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Karoi	6	20	0.25	6.07	2.44	2.09	99.0	20.0	86.0	38.0	5	2	9
Lusaka	1	1	0.19	5.86	2.40	2.05	107.0	22.0	85.0	32.0	4	2	9
Lusaka	1	2	0.25	6.07	2.51	2.09	110.0	23.0	83.0	30.0	6	1	8
Lusaka	1	3	0.25	5.93	2.61	2.12	105.0	21.0	76.0	39.0	4	1	8
Lusaka	1	4	0.21	5.93	2.51	2.16	91.0	18.0	79.0	41.0	8	4	9
Lusaka	1	5	0.18	6.07	2.54	2.09	99.0	22.0	85.0	35.0	3	2	8
Lusaka	1	6	0.19	5.86	2.58	2.09	100.0	22.0	89.0	31.0	4	2	8
Lusaka	1	7	0.25	5.93	2.68	2.23	90.0	20.0	82.0	35.0	6	1	9
Lusaka	1	8	0.26	6.07	2.71	2.23	106.0	21.0	80.0	39.0	6	4	8
Lusaka	1	9	0.21	5.78	2.47	2.09	104.0	20.0	79.0	29.0	8	4	9
Lusaka	1	10	0.26	5.93	2.58	2.16	103.0	18.0	76.0	36.0	4	1	8
Lusaka	1	11	0.25	6.14	2.54	2.19					3	4	9
Lusaka	1	12	0.25	6.14	2.64	2.12					2	0	9
Lusaka	1	13	0.23	6.00	2.47	2.12	103.0	13.0	73.0	32.0	2	1	8
Lusaka	1	14	0.19	5.93	2.58	2.12	102.0	16.0	85.0	43.0	7	4	8
Lusaka	1	15	0.23	6.00	2.54	2.12	99.0	19.0	79.0	36.0	5	0	7
Lusaka	1	16	0.19	5.86	2.64	2.12	97.0	19.0	77.0	29.0	4	1	8
Lusaka	1	17	0.21	6.00	2.51	2.09	95.0	25.0	80.0	34.0	6	4	9
Lusaka	1	18	0.26	6.21	2.64	2.16	100.0	22.0	85.0	38.0	3	2	8
Lusaka	1	19	0.25	5.93	2.64	2.16	108.0	18.0	83.0	28.0	4	1	9
Lusaka	1	20	0.25	6.07	2.58	2.12	101.0	16.0	75.0	33.0	5	1	8
Lusaka	2	1	0.19	5.86	2.51	2.09	99.0	20.9	81.4	28.9	2	0	9
Lusaka	2	2	0.19	6.00	2.54	2.19	108.0	18.8	82.2	37.1	5	0	8
Lusaka	2	3	0.21	5.93	2.44	2.09	109.8	24.1	85.3	35.6	5	0	8
Lusaka	2	4	0.23	6.00	2.58	2.23	99.9	17.7	85.9	40.1	4	0	8
Lusaka	2	5	0.26	6.07	2.61	2.19	105.4	20.7	87.8	38.5	5	0	9
Lusaka	2	6	0.21	6.07	2.54	2.23	104.9	21.0	88.3	34.1	4	1	8
Lusaka	2	7	0.19	6.07	2.64	2.23	112.8	20.1	85.2	29.4	5	1	8
Lusaka	2	8	0.23	6.14	2.64	2.23	104.3	20.6	85.0	41.9	5	0	8
Lusaka	2	9	0.23	6.00	2.58	2.12	106.9	22.3	87.3	37.9	6	0	8
Lusaka	2	10	0.25	6.00	2.61	2.16	106.1	18.5	85.8	35.4	5	0	9
Lusaka	2	11	0.19	6.14	2.58	2.16	116.4	18.1	89.6	39.0	5	0	8
Lusaka	2	12	0.25	6.00	2.51	2.09	111.9	20.2	92.1	40.6	6	1	9
Lusaka	2	13	0.18	6.28	2.61	2.23	105.6	22.8	79.9	36.5	5	0	8
Lusaka	2	14	0.19	6.07	2.54	2.09	98.3	22.8	86.2	39.8	5	0	9
Lusaka	2	15	0.19	5.93	2.54	2.12	105.3	17.4	86.9	41.3	2	0	9
Lusaka	2	16	0.28	6.00	2.54	2.16	102.5	19.3	83.4	40.9	5	1	8
Lusaka	2	17	0.19	6.00	2.58	2.12	103.8	19.7	86.4	41.2	6	0	8
Lusaka	2	18	0.19	5.86	2.58	2.12	105.6	20.7	81.6	38.0	9	0	8
Lusaka	2	19	0.21	6.21	2.58	2.23	108.5	22.0	87.0	37.0	5	1	9
Lusaka	2	20	0.25	6.00	2.54	2.12	92.2	23.3	87.1	37.6	8	0	8
Lusaka	3	1	0.21	6.07	2.58	2.05	107.8	19.7	87.6	38.5	9	0	8
Lusaka	3	2	0.21	6.00	2.58	2.12	99.7	20.0	84.2	42.7	5	1	9
Lusaka	3	3	0.21	6.14	2.51	2.09	106.9	24.6	85.6	32.3	6	2	8
Lusaka	3	4	0.19	6.07	2.61	2.16	103.4	20.0	84.3	38.5	9	0	8
Lusaka	3	5	0.19	6.00	2.54	2.09	100.2	22.1	81.6	38.6	0	0	8
Lusaka	3	6	0.19	5.78	2.51	2.12	97.7	22.0	82.6	38.1	4	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Lusaka	3	7	0.19	6.00	2.44	2.05	93.4	18.4	85.6	38.1	7	0	8
Lusaka	3	8	0.19	6.00	2.58	2.16	101.0	24.3	89.3	38.0	6	0	9
Lusaka	3	9	0.18	6.00	2.58	2.02	100.8	19.5	85.5	35.5	8	0	9
Lusaka	3	10	0.19	6.00	2.47	2.09	101.0	20.0	81.2	40.2	4	0	9
Lusaka	3	11	0.23	6.07	2.54	2.09	98.8	20.2	81.6	42.2	7	0	8
Lusaka	3	12	0.19	5.93	2.40	2.09	101.8	20.3	83.7	40.1	6	0	8
Lusaka	3	13	0.25	6.00	2.51	2.19	101.3	22.4	84.3	38.0	5	0	8
Lusaka	3	14	0.25	6.00	2.54	2.12	102.7	19.4	81.8	40.5	6	0	8
Lusaka	3	15	0.25	5.93	2.54	2.09	104.1	17.1	84.4	40.0	6	0	8
Lusaka	3	16	0.19	5.78	2.44	2.12	102.4	20.4	84.0	41.2	4	0	8
Lusaka	3	17	0.18	5.93	2.58	2.12	111.0	23.3	83.7	35.9	6	0	9
Lusaka	3	18	0.21	6.07	2.40	2.02	102.3	21.6	87.8	39.6	9	0	9
Lusaka	3	19	0.23	6.00	2.51	2.09	97.4	18.6	79.3	30.2	4	4	9
Lusaka	3	20	0.19	5.93	2.54	2.09	100.1	20.9	81.7	43.3	6	0	9
Kitwe	1	1	0.21	5.93	2.51	2.12	96.0	16.4	71.3	36.1	4	4	8
Kitwe	1	2	0.25	5.64	2.44	2.02	97.6	18.7	78.1	39.6	4	0	8
Kitwe	1	3	0.23	5.86	2.44	2.12	96.5	18.2	75.5	36.6	5	2	8
Kitwe	1	4	0.25	5.86	2.54	2.12	107.2	18.4	68.4	38.1	4	4	9
Kitwe	1	5	0.23	5.86	2.44	2.23	104.0	20.7	72.6	36.1	5	4	9
Kitwe	1	6	0.23	5.86	2.47	2.09	106.8	18.9	78.3	35.2	0	4	7
Kitwe	1	7	0.25	5.86	2.47	2.16	105.0	20.5	77.5	37.3	5	4	8
Kitwe	1	8	0.26	5.93	2.54	2.12	91.0	17.6	70.3	35.3	4	4	7
Kitwe	1	9	0.26	5.86	2.47	2.12	103.2	18.6	73.8	34.1	5	4	9
Kitwe	1	10	0.23	6.00	2.54	2.09	110.4	18.2	77.2	37.1	0	4	8
Kitwe	1	11	0.23	5.86	2.51	2.09	96.2	20.8	81.0	38.5	5	4	9
Kitwe	1	12	0.25	5.64	2.44	2.12	98.8	18.6	81.1	40.4	4	1	8
Kitwe	1	13	0.21	5.86	2.37	1.98	108.6	18.2	72.0	34.6	4	4	8
Kitwe	1	14	0.25	6.00	2.51	2.09	90.7	16.2	79.5	35.1	7	4	8
Kitwe	1	15	0.25	5.78	2.47	2.09	97.5	22.0	70.6	34.8	0	1	8
Kitwe	1	16	0.21	6.14	2.51	2.16	99.5	16.8	74.2	41.2	5	2	9
Kitwe	1	17	0.23	5.64	2.44	2.09	88.7	18.9	74.5	35.4	6	1	8
Kitwe	1	18	0.21	6.00	2.51	2.09	97.4	17.4	72.9	38.0	4	4	9
Kitwe	1	19	0.25	5.93	2.47	2.09	98.8	16.8	79.1	39.8	5	4	9
Kitwe	1	20	0.21	5.78	2.51	2.09	97.1	16.8	79.6	39.0	5	1	8
Kitwe	2	1	0.25	6.00	2.54	2.16	102.0	24.0	88.0	39.0	6	4	9
Kitwe	2	2	0.25	6.00	2.54	2.19	105.0	23.0	85.0	39.0	1	4	5
Kitwe	2	3	0.25	6.07	2.58	2.16	110.0	20.0	~~81.0~~	~~34.0~~	~~6~~	~~4~~	~~8~~
Kitwe	2	4	0.23	6.00	2.40	2.05	103.0	23.0	85.0	31.0	7	1	8
Kitwe	2	5	0.25	6.07	2.51	2.12	103.0	27.0	86.0	41.0	6	4	9
Kitwe	2	6	0.23	5.86	2.58	2.16	107.0	18.0	80.0	35.0	8	4	8
Kitwe	2	7	0.23	5.93	2.51	2.16	105.0	25.0	84.0	40.0	7	0	9
Kitwe	2	8	0.26	5.86	2.54	2.12	106.0	19.0	79.0	36.0	0	4	8
Kitwe	2	9	0.25	5.86	2.51	2.12	106.0	22.0	80.0	22.0	6	4	8
Kitwe	2	10	0.19	5.93	2.58	2.16	98.0	26.0	84.0	38.0	8	4	8
Kitwe	2	11	0.28	5.93	2.58	2.02	99.0	22.0	81.0	39.0	1	4	8
Kitwe	2	12	0.26	5.93	2.51	2.09	95.0	25.0	86.0	56.0	6	2	8
Kitwe	2	13	0.25	6.00	2.54	2.16	108.0	17.0	75.0	41.0	7	4	7

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Kitwe	2	14	0.3	5.93	2.51	2.09	103.0	23.0	81.0	39.0	6	4	9
Kitwe	2	15	0.23	5.86	2.51	2.09	107.0	20.0	80.0	43.0	9	4	4
Kitwe	2	16	0.25	6.00	2.58	2.12	109.0	21.0	86.0	43.0	7	4	7
Kitwe	2	17	0.25	5.86	2.51	2.09	108.0	22.0	83.0	41.0	0	4	5
Kitwe	2	18	0.23	5.57	2.58	2.19	104.0	22.0	86.0	28.0	6	4	9
Kitwe	2	19	0.23	5.86	2.44	2.09	105.0	26.0	87.0	39.0	9	4	8
Kitwe	2	20	0.28	5.93	2.47	2.02	103.0	20.0	83.0	35.0	4	0	8
Kitwe	3	1	0.26	5.93	2.58	2.19	114.6	23.8	85.1	33.9	6	1	9
Kitwe	3	2	0.21	6.00	2.54	2.05	112.4	22.3	75.8	37.9	6	0	9
Kitwe	3	3	0.21	6.00	2.58	2.12	102.7	23.9	85.8	38.8	6	1	8
Kitwe	3	4	0.25	6.07	2.47	2.12	104.7	20.7	80.2	32.6	4	4	8
Kitwe	3	5	0.21	6.00	2.54	2.09	110.1	16.7	76.4	32.9	6	0	8
Kitwe	3	6	0.16	5.93	2.54	2.12	101.9	21.5	84.5	38.2	6	1	9
Kitwe	3	7	0.25	5.00	2.54	2.16	108.4	20.5	82.4	37.6	6	2	8
Kitwe	3	8	0.23	5.14	2.51	2.09	105.5	17.1	77.3	34.3	4	4	9
Kitwe	3	9	0.25	5.07	2.51	2.12	104.7	19.1	79.1	37.7	6	0	8
Kitwe	3	10	0.21	5.00	2.64	2.19	103.3	20.7	83.7	38.2	5	1	9
Kitwe	3	11	0.21	5.14	2.58	2.12	109.6	22.1	86.6	40.3	5	0	9
Kitwe	3	12	0.19	5.07	2.54	2.09	102.6	19.0	79.5	35.3	6	0	8
Kitwe	3	13	0.28	4.78	2.58	2.09	96.1	21.7	83.7	36.0	7	0	9
Kitwe	3	14	0.23	5.00	2.51	2.09	102.4	22.8	75.3	39.8	6	2	9
Kitwe	3	15	0.19	5.21	2.47	2.16	105.6	20.2	85.2	28.3	5	1	8
Kitwe	3	16	0.25	4.86	2.54	2.12	105.7	27.5	83.1	38.9	6	5	9
Kitwe	3	17	0.25	4.78	2.47	2.05	108.6	22.2	80.0	40.4	6	2	9
Kitwe	3	18	0.23	4.78	2.54	2.16	103.3	20.4	82.1	35.5	6	0	8
Kitwe	3	19	0.26	4.86	2.44	2.09	106.9	22.6	77.7	42.4	5	1	9
Kitwe	3	20	0.26	5.14	2.58	2.09	103.5	21.0	80.5	37.4	6	1	8
Kitwe	4	1	0.25	5.93	2.64	2.19	104.4	17.9	72.7	33.3	6	2	9
Kitwe	4	2	0.26	6.00	2.64	2.19	104.5	17.1	86.4	37.4	6	2	9
Kitwe	4	3	0.28	5.86	2.47	2.16	103.8	21.1	78.2	35.0	6	0	9
Kitwe	4	4	0.23	5.93	2.47	2.05	104.1	25.0	87.5	35.0	4	2	9
Kitwe	4	5	0.21	6.07	2.64	2.16	108.9	22.2	84.1	32.9	4	0	9
Kitwe	4	6	0.25	5.93	2.40	2.09	101.1	23.8	85.9	31.5	6	2	9
Kitwe	4	7	0.21	5.86	2.40	2.09	73.0	21.4	80.5	42.5	3	2	9
Kitwe	4	8	0.23	5.93	2.44	2.12	97.5	23.2	78.5	34.5	6	4	9
Kitwe	4	9	0.28	5.93	2.54	2.09	92.1	23.9	84.1	43.2	0	2	8
Kitwe	4	10	0.26	5.86	2.54	2.09	96.7	20.8	82.0	36.3	6	4	8
Kitwe	4	11	0.25	6.00	2.58	2.09	108.9	22.2	80.2	35.7	7	1	9
Kitwe	4	12	0.19	5.93	2.51	2.09	106.4	21.5	85.7	37.7	6	0	8
Kitwe	4	13	0.21	5.71	2.47	2.05	103.8	26.1	85.2	33.7	6	2	8
Kitwe	4	14	0.26	6.00	2.47	2.12	96.2	18.8	85.9	36.7	3	0	5
Kitwe	4	15	0.26	5.93	2.54	2.12	101.1	18.8	86.7	43.9	6	4	8
Kitwe	4	16	0.23	6.00	2.51	2.05	105.6	21.7	87.1	41.1	6	1	8
Kitwe	4	17	0.21	5.93	2.51	2.09	103.4	20.5	81.1	38.8	6	1	8
Kitwe	4	18	0.18	6.00	2.47	2.09	103.5	22.7	85.3	41.0	6	4	8
Kitwe	4	19	0.25	5.93	2.44	2.09	109.4	18.9	80.3	39.8	4	2	8
Kitwe	4	20	0.21	6.00	2.64	2.19	95.9	22.2	82.5	44.4	7	2	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Kitwe	5	1	0.23	5.93	2.47	2.02	105.7	21.7	83.9	40.8	4	2	8
Kitwe	5	2	0.26	6.00	2.44	2.09	103.6	21.5	77.9	28.2	7	4	9
Kitwe	5	3	0.23	6.00	2.68	2.26	102.8	20.4	84.2	39.5	5	0	9
Kitwe	5	4	0.19	5.93	2.44	2.09	108.1	15.6	75.7	35.5	7	4	8
Kitwe	5	5	0.25	5.93	2.51	2.09	88.3	27.7	85.2	34.8	4	4	9
Kitwe	5	6	0.21	6.00	2.58	2.12	101.5	24.3	83.7	38.6	8	4	9
Kitwe	5	7	0.23	5.78	2.47	2.09	106.7	24.6	81.2	29.8	4	4	9
Kitwe	5	8	0.23	6.00	2.51	2.09	108.8	18.8	80.2	39.9	6	1	8
Kitwe	5	9	0.26	6.00	2.47	2.05	111.2	19.4	81.3	39.7	4	1	8
Kitwe	5	10	0.26	5.86	2.37	1.98	99.5	18.2	79.2	32.4	5	0	8
Kitwe	5	11	0.19	5.93	2.51	2.12	105.5	19.8	85.0	45.0	6	4	9
Kitwe	5	12	0.26	6.00	2.61	2.16	104.7	24.6	86.4	36.1	6	2	9
Kitwe	5	13	0.21	5.93	2.51	2.12	103.7	21.8	86.4	42.5	7	2	9
Kitwe	5	14	0.23	6.00	2.51	2.09	100.6	20.8	82.4	36.5	6	1	8
Kitwe	5	15	0.23	5.86	2.47	2.09	94.4	22.4	88.3	45.1	7	2	8
Kitwe	5	16	0.23	5.78	2.54	2.09	102.6	19.4	82.4	40.4	6	2	9
Kitwe	5	17	0.21	5.93	2.51	2.05	101.2	20.1	83.9	35.2	9	4	9
Kitwe	5	18	0.23	6.00	2.47	2.12	104.3	18.0	86.1	35.3	5	0	8
Kitwe	5	19	0.19	5.93	2.47	2.09	101.8	18.7	86.1	39.0	9	4	9
Kitwe	5	20	0.21	6.07	2.61	2.19	105.1	19.3	79.2	35.6	9	4	8
Kitwe	6	1	0.23	5.86	2.54	2.09	115.2	22.1	81.3	40.0	5	4	8
Kitwe	6	2	0.21	5.86	2.58	2.16	101.8	22.5	86.6	35.6	6	1	9
Kitwe	6	3	0.21	5.86	2.54	2.09	106.5	24.7	83.5	31.5	7	0	9
Kitwe	6	4	0.21	5.93	2.51	2.12	110.4	20.3	81.5	40.8	4	1	9
Kitwe	6	5	0.19	6.00	2.54	2.16	97.1	22.3	84.7	34.5	4	1	8
Kitwe	6	6	0.19	6.07	2.51	2.05	104.8	20.5	81.4	36.9	4	0	9
Kitwe	6	7	0.26	5.86	2.54	2.09	104.2	22.7	84.7	39.3	6	4	9
Kitwe	6	8	0.21	5.86	2.44	2.09	106.2	16.1	80.5	39.2	7	4	8
Kitwe	6	9	0.25	5.71	2.54	2.09	104.7	21.9	81.6	36.4	5	0	9
Kitwe	6	10	0.21	5.93	2.54	2.12	110.1	20.5	81.4	40.2	5	2	8
Kitwe	6	11	0.21	5.86	2.58	2.16	104.2	23.5	79.3	37.4	6	1	9
Kitwe	6	12	0.19	5.93	2.47	2.05	106.4	22.1	84.0	38.1	6	0	9
Kitwe	6	13	0.21	6.00	2.51	2.09	91.3	19.9	84.1	40.6	7	1	8
Kitwe	6	14	0.21	6.07	2.58	2.12	102.3	20.3	79.5	39.9	5	0	8
Kitwe	6	15	0.21	5.93	2.47	2.05	106.9	25.2	76.7	39.8	6	1	8
Kitwe	6	16	0.21	5.93	2.54	2.09	101.1	21.0	83.8	32.7	6	1	9
Kitwe	6	17	0.21	6.00	2.47	2.09	102.7	24.1	83.2	39.3	4	0	9
Kitwe	6	18	0.19	6.00	2.51	2.09	108.0	23.4	87.3	36.5	7	0	8
Kitwe	6	19	0.19	5.86	2.47	2.09	98.8	24.0	86.5	35.2	7	0	8
Kitwe	6	20	0.21	5.93	2.61	2.16	107.2	19.6	83.1	36.7	5	0	8
Solwezi	1	1	0.18	5.86	2.54	2.09	97.1	21.2	79.1	33.8	6	4	9
Solwezi	1	2	0.23	6.07	2.44	2.12	103.9	19.4	80.2	35.8	6	1	9
Solwezi	1	3	0.26	6.00	2.44	2.12	105.8	22.3	80.1	34.6	3	4	9
Solwezi	1	4	0.23	6.00	2.51	2.02	108.3	18.6	81.9	35.2	9	4	9
Solwezi	1	5	0.28	5.86	2.47	2.05	99.2	17.0	84.8	36.9	4	4	9
Solwezi	1	6	0.28	6.07	2.47	2.19	112.5	17.7	84.0	34.6	4	4	9
Solwezi	1	7	0.23	5.93	2.51	2.12	104.2	16.8	85.2	37.9	6	4	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Solwezi	1	8	0.19	5.86	2.47	2.05	97.3	20.7	82.2	33.6	5	0	9
Solwezi	1	9	0.23	5.78	2.40	2.02	98.1	21.0	82.5	37.0	6	4	9
Solwezi	1	10	0.23	6.00	2.47	2.09	105.4	20.7	83.0	37.1	3	4	8
Solwezi	1	11	0.26	5.93	2.58	2.12	100.8	19.9	84.7	35.5	6	1	9
Solwezi	1	12	0.21	5.86	2.51	2.09	107.2	19.1	87.2	38.8	5	0	9
Solwezi	1	13	0.23	5.93	2.54	2.12	101.7	20.6	78.2	37.8	4	4	9
Solwezi	1	14	0.21	6.00	2.58	2.16	96.1	17.6	77.1	36.1	4	4	9
Solwezi	1	15	0.25	5.86	2.47	2.09	105.0	17.0	75.2	32.5	2	4	9
Solwezi	1	16	0.23	5.93	2.54	2.09	102.7	19.5	84.5	29.6	7	4	8
Solwezi	1	17	0.21	5.78	2.47	2.09	102.0	17.9	80.7	38.3	4	4	8
Solwezi	1	18	0.23	6.07	2.47	2.05	97.7	20.2	84.6	31.9	9	4	9
Solwezi	1	19	0.23	5.93	2.54	2.09	100.5	19.4	76.5	39.2	4	1	8
Solwezi	1	20	0.19	6.00	2.61	2.16	109.9	20.8	77.7	34.4	0	2	0
Solwezi	2	1	0.35	5.93	2.58	2.19	102.9	22.5	84.3	37.6	4	0	9
Solwezi	2	2	0.19	5.86	2.58	2.23	112.8	20.1	81.5	36.3	1	0	8
Solwezi	2	3	0.21	5.86	2.51	2.12	96.8	19.2	84.6	36.6	4	0	8
Solwezi	2	4	0.23	5.93	2.51	2.16	96.4	19.6	80.6	30.9	4	0	8
Solwezi	2	5	0.3	5.78	2.51	2.19	109.6	18.8	78.5	36.9	4	0	9
Solwezi	2	6	0.25	5.78	2.58	2.19	105.5	19.6	83.8	39.0	3	0	8
Solwezi	2	7	0.25	5.71	2.51	2.12	92.8	25.6	81.6	40.8	3	0	8
Solwezi	2	8	0.32	5.86	2.51	2.16	98.7	20.2	85.3	32.7	5	0	7
Solwezi	2	9	0.26	6.00	2.51	2.12	105.3	20.2	73.9	26.5	6	0	8
Solwezi	2	10	0.19	5.86	2.44	2.12	104.0	23.3	80.6	31.0	2	0	9
Solwezi	2	11	0.26	6.00	2.61	2.16	100.4	18.1	79.2	30.7	4	0	8
Solwezi	2	12	0.3	5.86	2.47	2.05	113.9	22.4	78.2	36.5	5	0	9
Solwezi	2	13	0.28	5.93	2.54	2.09	103.3	19.3	85.1	37.1	4	0	8
Solwezi	2	14	0.25	6.00	2.64	2.16	105.3	20.2	84.0	36.5	2	0	9
Solwezi	2	15	0.21	5.86	2.51	2.09	96.6	20.3	82.4	35.7	6	0	9
Solwezi	2	16	0.23	6.07	2.61	2.12	104.5	22.9	83.9	32.9	7	0	8
Solwezi	2	17	0.3	5.78	2.44	2.05	107.2	21.2	77.1	38.3	5	0	8
Solwezi	2	18	0.23	5.93	2.51	2.09	95.8	20.1	81.2	36.6	4	0	8
Solwezi	2	19	0.25	5.93	2.51	2.09	100.9	19.0	83.1	39.1	0	0	7
Solwezi	2	20	0.3	5.86	2.51	2.12	103.5	19.6	80.5	33.7	2	0	8
Solwezi	3	1	0.23	5.93	2.64	2.16	105.1	22.2	87.2	32.4	6	0	9
Solwezi	3	2	0.19	5.21	2.61	2.05	108.0	21.0	88.2	33.1	0	2	8
Solwezi	3	3	0.26	6.21	2.64	2.33	113.0	17.3	82.1	30.4	9	0	8
Solwezi	3	4	0.28	5.86	2.47	2.16	103.9	21.4	86.3	37.5	6	0	8
Solwezi	3	5	0.19	5.93	2.54	2.16	95.1	23.0	88.5	35.7	6	0	7
Solwezi	3	6	0.25	6.00	2.58	2.12	106.3	20.4	87.9	33.3	7	0	8
Solwezi	3	7	0.21	5.86	2.61	2.12	96.4	23.5	86.4	35.0	4	0	9
Solwezi	3	8	0.26	6.00	2.58	2.09	109.0	22.7	86.6	41.3	5	0	8
Solwezi	3	9	0.23	5.86	2.51	2.12	97.3	27.2	90.7	37.4	2	0	7
Solwezi	3	10	0.21	5.86	2.58	2.16	96.2	20.9	87.3	35.7	5	0	9
Solwezi	3	11	0.23	5.93	2.58	2.12	100.9	22.8	87.9	38.6	6	0	9
Solwezi	3	12	0.19	5.93	2.54	2.09	100.1	21.8	88.2	39.8	4	0	8
Solwezi	3	13	0.25	5.86	2.47	2.09	107.4	22.3	84.2	38.4	6	0	9
Solwezi	3	14	0.25	6.00	2.54	2.12	104.2	24.5	82.7	32.8	5	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Solwezi	3	15	0.26	5.86	2.75	2.16	107.3	20.3	88.6	31.9	4	0	8
Solwezi	3	16	0.26	5.93	2.58	2.12	95.5	23.5	85.9	31.5	5	0	8
Solwezi	3	17	0.21	5.93	2.51	2.09	104.4	20.2	84.3	27.4	6	0	9
Solwezi	3	18	0.21	5.93	2.54	2.12	107.6	18.2	86.8	30.4	0	0	8
Solwezi	3	19	0.25	6.00	2.64	2.16	111.8	20.7	86.9	34.8	5	0	9
Solwezi	3	20	0.23	6.00	2.61	2.12	100.1	20.3	83.4	28.2	5	0	9
Ikelenge	1	1	0.25	5.93	2.51	2.09	108.3	20.6	75.1	35.2	7	0	9
Ikelenge	1	2	0.23	5.86	2.47	2.09	91.4	21.0	76.3	37.9	9	0	8
Ikelenge	1	3	0.21	5.86	2.47	2.09	106.3	27.0	84.3	32.3	4	0	8
Ikelenge	1	4	0.19	5.93	2.47	2.19	95.5	25.6	80.1	35.4	6	0	9
Ikelenge	1	5	0.26	5.86	2.54	2.12	96.1	19.9	74.1	33.0	6	0	8
Ikelenge	1	6	0.25	5.78	2.40	2.09	104.3	21.3	82.4	32.9	6	0	8
Ikelenge	1	7	0.32	5.93	2.40	2.09	102.9	24.5	83.3	36.3	6	0	9
Ikelenge	1	8	0.23	5.78	2.44	2.12	97.7	28.8	81.8	37.9	2	0	9
Ikelenge	1	9	0.25	5.86	2.54	2.12	109.1	24.0	81.6	38.4	6	0	9
Ikelenge	1	10	0.21	5.86	2.44	2.05	103.5	19.9	77.3	39.5	6	0	8
Ikelenge	1	11	0.19	5.78	2.44	2.05	96.5	31.9	82.5	40.8	4	0	9
Ikelenge	1	12	0.32	5.86	2.47	2.16	111.3	23.6	80.6	31.6	2	0	8
Ikelenge	1	13	0.28	5.93	2.44	2.09	97.5	22.0	84.6	33.8	6	0	9
Ikelenge	1	14	0.21	5.86	2.44	2.12	106.0	25.1	84.4	37.9	2	0	8
Ikelenge	1	15	0.23	5.78	2.44	2.12	110.5	24.0	77.0	34.1	2	0	8
Ikelenge	1	16	0.21	5.78	2.37	1.98	90.8	25.8	81.5	27.1	6	0	9
Ikelenge	1	17	0.26	5.86	2.47	2.12		26.4	81.4	34.4	4	0	9
Ikelenge	1	18	0.25	5.93	2.47	2.12	99.4	22.4	79.8	32.1	5	0	8
Ikelenge	1	19	0.21	5.86	2.44	2.09	105.3	23.2	82.7	36.5	6	0	8
Ikelenge	1	20	0.23	5.78	2.47	2.09	111.9	21.8	84.2	34.2	5	0	7
Ikelenge	2	1	0.23	6.00	2.40	2.09	95.3	20.9	77.9	35.5	9	0	8
Ikelenge	2	2	0.21	6.07	2.54	2.23	106.3	20.1	81.3	42.3	1	0	8
Ikelenge	2	3	0.35	6.00	2.47	2.19	92.9	19.6	83.4	37.2	6	0	8
Ikelenge	2	4	0.21	5.93	2.51	2.05	108.4	19.3	84.6	38.6	6	0	9
Ikelenge	2	5	0.23	6.00	2.44	2.09	107.1	16.8	81.8	40.5	2	0	7
Ikelenge	2	6	0.23	4.78	2.54	2.05	102.6	16.7	83.6	45.1	8	0	8
Ikelenge	2	7	0.23	6.00	2.47	2.09	100.7	20.2	79.4	37.0	9	0	8
Ikelenge	2	8	0.21	5.78	2.47	2.12	96.7	19.0	86.7	37.2	6	0	8
Ikelenge	2	9	0.25	6.00	2.47	2.12	103.4	19.1	81.9	35.2	6	0	9
Ikelenge	2	10	0.28	6.07	2.47	2.05	96.8	18.4	81.1	34.4	6	0	8
Ikelenge	2	11	0.28	5.50	2.26	1.84	94.1	21.5	83.0	35.5	5	0	8
Ikelenge	2	12	0.21	5.93	2.51	2.12	104.8	22.2	88.9	39.5	6	0	8
Ikelenge	2	13	0.21	5.93	2.51	2.12	104.8	22.2	88.9	39.5	6	0	8
Ikelenge	2	14	0.3	5.86	2.47	2.12	96.9	20.2	88.7	35.3	9	5	8
Ikelenge	2	15	0.21	6.00	2.47	2.09	102.2	21.7	82.2	43.0	4	0	8
Ikelenge	2	16	0.23	5.86	2.58	2.12	96.6	21.6	89.3	36.4	5	0	8
Ikelenge	2	17	0.23	5.86	2.44	2.05	100.6	23.5	83.4	39.7	9	0	9
Ikelenge	2	18	0.25	6.00	2.54	2.16	97.4	22.5	85.5	41.4	9	0	8
Ikelenge	2	19	0.26	5.86	2.51	2.19	113.6	19.8	84.4	30.6	0	0	0
Ikelenge	2	20	0.26	5.93	2.51	2.09	90.3	23.4	88.6	36.7	4	0	8

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Ikelenge	3	1	0.25	5.93	2.47	2.09	97.3	22.0	85.4	38.0	4	0	9
Ikelenge	3	2	0.25	5.93	2.51	2.09	101.0	19.9	83.6	32.3	5	1	9
Ikelenge	3	3	0.25	6.07	2.47	2.09	96.2	19.2	91.1	32.1	4	2	9
Ikelenge	3	4	0.23	5.86	2.54	2.09	95.2	21.2	82.1	38.4	6	0	8
Ikelenge	3	5	0.25	6.00	2.47	2.16	104.0	19.1	87.4	32.3	5	0	9
Ikelenge	3	6	0.25	5.93	2.47	2.09	94.8	19.6	87.3	35.3	6	0	9
Ikelenge	3	7	0.23	6.00	2.51	2.09	89.8	29.2	85.6	42.3	4	1	8
Ikelenge	3	8	0.19	5.93	2.51	2.02	105.2	19.0	81.9	42.4	5	0	9
Ikelenge	3	9	0.25	5.93	2.51	2.09	104.0	22.2	88.8	36.6	6	0	8
Ikelenge	3	10	0.25	5.93	2.61	2.12	98.8	24.7	86.6	36.8	4	1	9
Ikelenge	3	11	0.19	6.00	2.51	2.12	100.7	22.3	85.9	34.0	9	1	9
Ikelenge	3	12	0.21	5.93	2.58	2.09	98.5	21.3	87.2	36.9	7	0	9
Ikelenge	3	13	0.21	5.78	2.44	2.02	94.8	22.5	84.7	33.9	7	0	9
Ikelenge	3	14	0.19	5.78	2.54	2.09	89.1	27.5	89.4	35.0	9	0	9
Ikelenge	3	15	0.18	6.00	2.51	2.09	106.6	21.4	87.0	39.2	7	4	9
Ikelenge	3	16	0.21	5.93	2.54	2.09	101.7	23.2	85.9	34.1	7	0	9
Ikelenge	3	17	0.26	5.86	2.47	2.09	105.2	19.8	85.6	31.9	6	2	9
Ikelenge	3	18	0.21	6.00	2.47	2.05	93.4	24.4	89.2	37.5	9	0	8
Ikelenge	3	19	0.28	5.71	2.47	2.09	97.5	19.3	89.2	36.0	4	1	8
Ikelenge	3	20	0.21	5.93	2.47	2.12	101.0	20.1	80.9	37.2	7	2	9
Ikelenge	4	1	0.19	5.86	2.51	2.12	99.4	16.2	80.3	36.7	2	0	8
Ikelenge	4	2	0.3	6.07	2.47	2.05	99.8	18.8	82.3	36.4	6	1	9
Ikelenge	4	3	0.25	5.93	2.47	2.09	95.1	20.3	77.0	39.9	6	0	8
Ikelenge	4	4	0.21	6.07	2.61	2.16	107.4	19.9	83.7	31.6	2	0	9
Ikelenge	4	5	0.19	5.93	2.47	2.09	103.0	19.4	82.7	35.1	5	0	8
Ikelenge	4	6	0.23	5.93	2.51	2.12	100.3	17.5	84.2	38.2	6	0	9
Ikelenge	4	7	0.26	5.86	2.40	1.98	105.9	17.4	82.0	39.2	6	1	9
Ikelenge	4	8	0.21	5.86	2.47	2.09	101.0	19.1	88.3	31.7	2	0	8
Ikelenge	4	9	0.3	5.86	2.47	2.05	100.1	17.1	82.6	34.1	6	0	8
Ikelenge	4	10	0.3	5.93	2.47	2.12	92.8	19.3	76.2	26.6	5	0	8
Ikelenge	4	11	0.21	5.86	2.54	2.12	97.7	16.9	83.9	40.9	5	0	8
Ikelenge	4	12	0.3	5.86	2.51	2.09	96.0	17.2	84.0	38.0	4	1	8
Ikelenge	4	13	0.23	5.93	2.64	2.16	92.3	19.5	83.7	34.7	0	0	8
Ikelenge	4	14	0.21	5.86	2.51	2.09	101.2	16.4	78.9	33.7	3	1	8
Ikelenge	4	15	0.23	5.93	2.51	2.09	97.1	18.3	85.3	35.6	1	0	8
Ikelenge	4	16	0.23	5.93	2.58	2.09	96.2	20.2	81.6	35.7	7	0	8
Ikelenge	4	17	0.19	5.86	2.47	2.09	96.5	17.1	80.6	39.2	6	1	8
Ikelenge	4	18	0.23	5.93	2.47	2.05	103.5	20.2	81.4	30.8	6	0	8
Ikelenge	4	19	0.21	6.00	2.54	2.09	107.4	18.1	80.7	31.4	7	0	8
Ikelenge	4	20	0.19	6.00	2.58	2.12	98.0	18.0	82.4	31.6	6	0	8
Ikelenge	5	1	0.26	5.93	2.51	2.09	96.3	21.6	85.6	30.3	5	0	9
Ikelenge	5	2	0.25	5.93	2.51	2.09	100.2	20.4	83.3	38.7	9	0	8
Ikelenge	5	3	0.21	5.93	2.44	2.09	100.8	22.7	86.4	41.9	9	0	9
Ikelenge	5	4	0.23	5.71	2.37	2.05	82.5	20.2	81.8	38.7	9	0	9
Ikelenge	5	5	0.21	5.86	2.47	2.16	94.9	20.5	84.2	41.2	9	0	9
Ikelenge	5	6	0.32	5.86	2.44	2.16	96.9	24.4	86.1	35.0	7	1	9
Ikelenge	5	7	0.23	5.86	2.47	2.05	106.7	22.8	87.3	37.3	9	0	9

Locality	C	S	(1)	(4)	(11)	(13)	(22)	MJI	(30)	(31)	(35)	(36)	(32)
Ikelenge	5	8	0.28	5.86	2.51	2.09	101.8	20.4	83.1	39.7	4	0	9
Ikelenge	5	9	0.28	5.78	2.44	2.05	104.1	20.5	86.2	36.3	8	0	9
Ikelenge	5	10	0.26	5.78	2.40	2.05	92.6	16.1	84.9	36.2	6	0	9
Ikelenge	5	11	0.19	5.93	2.51	2.09	111.4	21.1	92.1	34.8	9	0	8
Ikelenge	5	12	0.21	6.00	2.61	2.12	100.7	20.7	81.3	41.5	4	1	8
Ikelenge	5	13	0.26	5.78	2.47	2.05	101.0	20.8	89.0	24.2	9	0	9
Ikelenge	5	14	0.19	5.93	2.51	2.12	106.2	21.4	79.4	31.0	9	0	9
Ikelenge	5	15	0.19	6.00	2.54	2.12	106.4	21.9	86.5	33.5	9	0	8
Ikelenge	5	16	0.26	6.00	2.58	2.16	98.7	23.0	86.2	45.0	7	0	8
Ikelenge	5	17	0.21	5.93	2.47	2.09	110.6	21.0	82.7	43.3	5	0	9
Ikelenge	5	18	0.21	5.78	2.44	2.02	102.2	25.3	84.4	39.4	3	0	9
Ikelenge	5	19	0.25	5.93	2.58	2.12	87.4	22.2	85.4	37.8	4	0	9
Ikelenge	5	20	0.25	5.86	2.54	2.12	94.1	24.0	87.3	33.1	5	0	8

10.5.2 Pheromone Data

	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Beira	1	1	0.48	8.07	2.54	2.07	34.37	4.21	7.84	6.67	33.75
Beira	1	2	0.82	31.25	2.32	3.33	18.29	5.16	9.57	3.18	26.06
Beira	1	3	2.68	8.56	4.78	6.99	10.56	7.04	45.89	6.37	7.14
Beira	1	4	1.15	11.50	1.15	1.15	33.56	1.15	1.15	48.04	1.15
Beira	1	5	1.45	13.52	1.82	2.90	53.63	4.07	5.42	7.40	9.79
Beira	2	1	0.45	26.85	4.51	0.45	17.22	20.77	9.91	4.51	15.33
Beira	2	2	0.71	22.44	0.71	0.71	23.81	12.42	7.24	7.26	24.71
Beira	2	3	0.37	9.88	0.37	0.37	32.57	23.57	13.88	3.67	15.33
Beira	2	4	12.06	13.12	1.21	1.21	27.45	12.06	1.21	18.17	13.53
Beira	2	5	1.30	20.03	2.42	2.50	19.15	30.08	7.41	4.79	12.31
Beira	3	1	0.61	21.88	11.65	0.61	17.02	7.18	0.61	6.23	34.19
Beira	3	2	1.81	17.35	4.38	2.69	17.49	8.95	4.48	5.66	37.19
Beira	3	3	1.37	19.56	4.33	15.05	16.49	14.33	7.49	8.73	12.65
Beira	4	1	6.86	22.05	0.69	0.69	29.63	0.69	8.27	16.94	14.20
Beira	4	2	1.03	8.87	2.31	1.03	25.08	16.28	23.41	6.90	15.09
Beira	4	3	1.25	29.89	1.25	1.25	12.54	17.52	1.25	12.54	22.49
Beira	4	4	1.58	15.85	1.58	1.58	35.54	1.58	1.58	15.85	24.84
Beira	4	5	0.43	23.04	4.26	0.43	27.69	10.27	0.43	4.37	29.08
Beira	5	1	3.57	19.50	11.24	0.36	6.12	21.38	5.90	8.48	23.46
Beira	5	2	4.09	14.67	14.57	12.81	15.55	10.57	7.45	12.69	7.60
Beira	5	3	2.97	20.03	2.97	0.30	35.33	16.25	7.52	6.27	8.36
Beira	5	4	0.96	9.94	6.49	1.17	9.52	48.90	12.52	3.31	7.21
Beira	5	5	1.70	7.15	8.47	1.70	16.64	42.02	13.00	4.20	5.12
Mutare	1	1	4.92	8.42	5.47	8.86	36.04	7.43	12.57	12.05	4.26
Mutare	1	2	11.45	3.50	25.67	9.98	7.12	15.23	13.85	12.96	0.25
Mutare	1	3	0.68	0.68	0.68	0.68	13.34	12.70	20.89	29.23	21.13
Mutare	1	4	0.26	0.26	0.26	0.26	25.20	31.77	35.39	6.31	0.26
Mutare	1	5	4.37	10.58	7.01	5.95	18.97	43.39	2.19	5.04	2.51
Mutare	2	1	3.47	8.48	13.41	7.33	12.86	30.39	12.98	3.65	7.43
Mutare	2	2	3.52	4.15	3.78	5.40	15.53	41.14	18.31	3.35	4.82
Mutare	2	3	6.50	8.24	20.04	10.32	4.43	0.25	36.28	5.90	8.04
Mutare	2	4	2.43	16.84	3.96	3.78	26.79	18.80	13.65	3.16	10.59
Mutare	2	5	2.54	10.80	5.91	3.69	21.30	32.10	15.61	4.91	3.14
Mutare	3	1	3.56	7.46	12.38	6.38	18.06	8.93	35.51	7.42	0.31
Mutare	3	2	3.22	11.49	15.36	6.09	11.55	23.78	17.97	4.44	6.10
Mutare	3	3	4.64	7.41	8.54	8.23	7.31	25.71	25.15	5.12	7.88
Mutare	3	4	2.42	11.23	4.26	3.57	6.29	44.25	17.49	3.68	6.81
Mutare	3	5	5.78	11.65	9.31	5.27	18.85	17.98	17.77	5.51	7.89
Mutare	4	1	3.94	0.83	6.77	5.40	3.25	60.85	11.66	5.71	1.58
Mutare	4	2	3.49	6.20	6.93	6.47	14.76	34.55	22.35	2.75	2.49
Mutare	4	3	2.79	3.37	4.61	4.78	8.05	52.38	18.48	5.45	0.10
Mutare	4	4	5.18	2.83	5.10	6.96	6.16	47.35	17.11	6.37	2.93
Mutare	4	5	4.27	2.09	5.00	9.67	3.96	45.81	18.73	6.03	4.43
Mutare	5	1	3.86	6.30	8.83	4.84	8.38	42.44	16.46	3.00	5.90

	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Mutare	5	2	2.30	2.30	4.73	4.50	10.75	46.36	18.39	4.30	6.36
Mutare	5	3	6.98	11.09	12.30	10.69	11.60	10.07	17.06	9.34	10.86
Mutare	5	4	3.13	13.09	7.14	4.98	6.86	33.52	21.28	2.54	7.46
Mutare	5	5	6.76	13.50	11.94	7.07	25.75	13.31	11.29	5.33	5.04
Mutare	6	1	2.42	9.56	6.68	5.86	44.33	9.04	11.57	3.46	7.09
Mutare	6	2	3.20	5.32	3.67	6.05	17.27	34.43	17.83	6.66	5.57
Mutare	6	3	6.29	6.27	11.95	5.54	4.47	41.43	15.82	3.09	5.14
Mutare	6	4	6.95	11.74	8.79	5.87	23.48	13.14	4.96	2.46	22.61
Mutare	6	5	2.98	1.64	4.85	5.34	29.54	25.40	17.97	2.01	10.27
Harare	1	1	3.53	7.41	4.61	4.28	17.28	38.80	16.66	3.13	4.28
Harare	1	2	10.77	11.69	13.56	13.25	11.08	13.87	16.90	8.33	0.55
Harare	1	3	4.00	31.59	2.55	4.38	38.69	4.38	4.56	2.38	7.46
Harare	1	4	6.26	27.09	4.01	7.30	33.50	7.10	10.52	3.88	0.34
Harare	1	5	2.19	8.06	6.76	2.84	8.34	52.16	15.27	1.81	2.58
Harare	2	1	3.41	9.32	13.06	3.36	12.55	28.16	18.08	2.55	9.50
Harare	2	2	7.61	19.04	7.23	8.45	20.00	10.05	18.54	6.02	3.07
Harare	2	3	5.16	9.03	4.74	7.82	16.74	17.73	31.04	4.96	2.77
Harare	2	4	3.41	13.49	2.95	3.51	39.08	14.08	17.85	2.49	3.15
Harare	2	5	2.65	20.44	3.40	3.06	27.50	18.16	13.40	2.02	9.36
Harare	3	1	6.65	2.35	4.08	7.71	3.72	65.34	4.79	5.12	0.24
Harare	3	2	3.35	21.26	2.12	3.86	28.10	14.64	16.23	2.57	7.88
Harare	3	3	8.68	12.05	5.28	14.32	7.66	9.33	23.60	11.36	7.72
Harare	3	4	4.83	10.56	7.91	9.76	10.02	25.30	18.57	3.54	9.50
Harare	3	5	10.53	16.28	9.27	9.80	21.64	4.49	12.51	5.82	9.67
Harare	4	1	4.67	11.80	2.94	5.12	31.38	18.77	12.34	3.27	9.72
Harare	4	2	3.98	4.84	5.13	4.85	5.36	50.99	19.58	2.88	2.38
Harare	4	3	5.57	8.16	6.04	6.49	18.15	28.58	16.26	5.88	4.86
Harare	4	4	9.74	24.31	8.29	9.82	0.59	8.43	19.98	5.90	12.94
Harare	4	5	10.29	7.69	6.43	12.21	13.54	13.19	18.26	8.82	9.57
Harare	5	1	13.12	14.68	8.24	8.75	17.56	11.04	12.05	5.09	9.47
Harare	5	2	3.34	5.43	6.47	3.62	18.90	42.17	14.74	2.75	2.59
Harare	5	3	5.37	10.51	3.67	6.19	15.91	33.19	10.47	4.51	10.18
Harare	5	4	4.13	7.04	8.63	4.23	6.59	50.68	12.03	2.79	3.89
Harare	5	5	6.31	4.77	9.76	6.28	8.72	42.60	13.06	3.58	4.92
Harare	6	1	14.99	0.56	5.60	0.56	18.30	5.60	0.56	53.26	0.56
Harare	6	2	3.26	14.37	10.82	0.97	21.31	28.83	10.79	4.48	5.17
Harare	6	3	2.53	4.90	23.60	2.38	8.32	38.94	10.84	7.35	1.13
Harare	6	4	2.61	2.43	12.21	3.38	8.04	56.35	9.87	2.11	3.01
Harare	6	5	3.64	14.92	7.99	4.33	27.98	23.57	10.00	2.54	5.04
Karoi	1	1	2.90	1.75	7.18	2.60	2.30	49.73	31.16	2.20	0.18
Karoi	1	2	3.54	1.83	11.04	4.98	5.99	47.38	19.25	3.07	2.94
Karoi	1	3	3.49	6.47	7.90	4.08	15.78	44.27	13.35	3.05	1.60
Karoi	1	4	4.84	3.33	10.71	5.47	19.63	31.31	15.10	4.87	4.74
Karoi	1	5	5.93	3.95	13.09	6.54	6.28	36.18	17.23	5.27	5.53
Karoi	2	1	2.19	2.66	3.55	3.45	10.82	49.96	23.43	3.76	0.18
Karoi	2	2	2.18	4.04	4.32	2.89	7.71	54.98	20.45	2.01	1.42

	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Karoi	2	3	2.89	2.84	2.87	2.51	14.58	50.57	21.19	2.41	0.14
Karoi	2	4	3.66	4.28	3.22	3.68	6.42	54.35	19.73	3.19	1.46
Karoi	2	5	0.66	0.66	0.66	0.66	10.11	46.69	19.99	19.89	0.66
Karoi	3	1	5.35	2.16	9.14	6.11	4.10	44.98	20.96	5.74	1.47
Karoi	3	2	3.63	2.42	7.40	4.61	3.82	53.63	18.81	4.20	1.47
Karoi	3	3	24.98	4.74	10.92	3.80	16.83	12.10	8.65	5.46	12.53
Karoi	3	4	6.83	10.01	5.73	9.26	11.46	19.62	16.69	7.63	12.76
Karoi	3	5	0.34	0.34	0.34	0.34	38.96	29.59	8.31	11.47	10.31
Karoi	4	1	6.08	14.11	4.88	7.17	23.15	12.71	12.55	7.76	11.61
Karoi	4	2	8.43	5.25	13.28	10.60	20.07	11.42	17.67	8.45	4.83
Karoi	4	3	3.42	3.74	13.22	3.88	11.65	38.66	20.16	3.60	1.67
Karoi	4	4	4.09	5.39	6.50	4.34	16.92	41.29	14.51	3.67	3.30
Karoi	4	5	4.67	2.54	9.44	4.59	7.52	50.16	16.87	4.04	0.17
Karoi	5	1	1.12	0.97	3.95	2.38	7.07	49.92	30.27	3.06	1.26
Karoi	5	2	2.93	5.03	8.47	3.19	12.69	49.61	12.44	3.01	2.64
Karoi	5	3	6.59	8.93	5.27	6.63	18.12	27.86	13.29	5.27	8.04
Karoi	5	4	7.22	5.33	4.88	4.90	23.03	17.16	13.56	19.01	4.91
Karoi	5	5	6.60	1.76	22.65	7.47	5.01	26.37	20.29	6.58	3.25
Karoi	6	1	6.44	6.43	18.86	6.90	11.14	33.73	11.72	4.61	0.17
Karoi	6	2	3.50	2.80	9.12	5.20	14.59	23.15	36.31	3.97	1.35
Karoi	6	3	4.78	8.72	12.35	4.36	9.66	21.45	34.12	2.86	1.69
Karoi	6	4	4.63	5.33	12.14	3.37	10.70	37.70	22.88	3.08	0.18
Karoi	6	5	5.84	8.46	9.88	7.17	11.88	28.88	17.22	6.25	4.43
Lusaka	1	1	1.93	6.81	9.89	2.59	12.19	41.67	18.26	2.48	4.18
Lusaka	1	2	1.04	1.04	1.04	1.04	48.06	18.25	10.38	18.13	1.04
Lusaka	1	3	1.41	1.41	1.41	1.41	26.00	28.29	14.15	24.49	1.41
Lusaka	1	4	10.15	6.83	33.58	10.05	6.86	4.20	11.41	8.29	8.63
Lusaka	1	5	2.86	0.80	21.70	3.61	28.04	14.71	17.42	3.90	6.95
Lusaka	2	1	30.30	0.38	9.49	23.72	0.38	11.78	12.51	11.05	0.38
Lusaka	2	2	3.93	2.79	9.62	4.28	7.29	25.55	39.91	4.80	1.84
Lusaka	2	3	8.43	3.47	17.35	5.64	5.03	26.86	26.12	5.13	1.97
Lusaka	3	1	3.17	3.54	7.95	4.95	6.99	32.38	32.15	4.50	4.37
Lusaka	3	2	4.21	4.30	22.94	5.96	10.11	13.95	28.40	6.27	3.85
Lusaka	3	4	2.15	23.92	2.15	2.15	2.15	2.15	2.15	61.01	2.15
Lusaka	3	5	5.81	5.05	15.98	3.13	14.10	17.39	33.03	3.16	2.37
Kitwe	1	1	5.88	5.53	12.49	4.65	13.37	37.06	11.93	3.56	5.54
Kitwe	1	2	4.94	7.63	15.21	5.04	3.00	37.13	21.49	3.82	1.74
Kitwe	1	3	4.49	9.79	15.37	3.61	20.40	25.97	14.56	2.29	3.52
Kitwe	1	4	5.09	11.27	8.74	4.42	19.97	25.49	16.03	3.80	5.18
Kitwe	1	5	3.11	2.32	11.06	2.89	16.50	42.81	13.16	2.74	5.42
Kitwe	2	1	3.82	16.74	6.74	5.41	47.41	1.32	9.47	3.71	5.38
Kitwe	2	2	7.26	5.22	21.22	7.27	19.15	12.54	18.68	5.30	3.35
Kitwe	2	3	7.44	16.40	10.44	6.53	27.66	7.04	19.20	4.93	0.36
Kitwe	2	4	5.80	8.25	15.55	6.09	9.92	29.37	17.56	4.61	2.84
Kitwe	2	5	3.58	1.28	9.92	3.34	4.52	46.96	27.74	2.54	0.13
Kitwe	3	1	3.16	3.88	11.08	4.90	8.97	27.83	25.92	4.41	9.85

	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Kitwe	3	1	3.16	3.88	11.08	4.90	8.97	27.83	25.92	4.41	9.85
Kitwe	3	2	6.46	4.62	10.55	5.80	10.30	25.88	24.10	4.62	7.68
Kitwe	3	3	4.98	2.27	7.58	5.70	25.20	27.99	18.65	2.85	4.77
Kitwe	3	4	3.23	6.21	9.29	2.75	28.08	25.19	16.87	2.12	6.26
Kitwe	3	5	3.75	14.44	8.43	3.55	20.39	26.92	15.99	4.05	2.48
Kitwe	4	1	5.71	10.40	9.82	3.68	18.74	20.18	18.61	3.06	9.81
Kitwe	4	2	12.51	6.36	16.55	8.50	5.79	15.60	19.98	5.79	8.92
Kitwe	4	3	4.91	4.37	10.67	3.87	11.87	34.61	23.18	3.36	3.17
Kitwe	4	4	6.96	4.06	13.00	4.06	4.06	27.03	36.36	4.06	0.41
Kitwe	4	5	3.23	3.12	10.54	3.16	8.28	43.30	22.02	4.57	1.78
Kitwe	5	1	14.63	4.85	20.01	0.49	19.78	14.60	19.72	5.44	0.49
Kitwe	5	2	14.64	5.48	18.83	0.55	16.88	16.74	20.68	5.64	0.55
Kitwe	5	3	11.08	7.11	27.85	4.75	21.33	4.97	17.53	4.90	0.48
Kitwe	5	4	4.65	4.11	3.74	16.38	10.05	23.81	34.31	0.27	2.67
Kitwe	5	5	3.28	57.13	2.31	4.38	13.39	3.86	5.68	8.65	1.32
Solwezi	1	1	4.05	1.26	9.16	3.84	4.93	40.44	31.73	2.23	2.35
Solwezi	1	2	4.98	9.28	15.28	1.60	6.49	35.94	14.84	3.95	7.63
Solwezi	1	3	4.07	3.80	11.49	2.37	7.36	50.05	14.92	2.14	3.79
Solwezi	1	4	7.09	4.38	8.52	3.18	6.51	47.38	14.21	2.25	6.48
Solwezi	2	1	21.05	7.76	13.13	5.53	10.09	13.52	13.86	9.08	5.99
Solwezi	2	2	5.66	3.23	12.18	7.10	8.54	26.36	27.28	4.34	5.31
Solwezi	2	3	6.45	4.05	17.53	3.66	4.87	31.65	26.07	3.01	2.72
Solwezi	2	4	3.94	3.18	13.13	3.91	5.60	35.49	30.48	2.95	1.32
Solwezi	2	5	5.99	8.30	4.82	6.92	10.83	24.55	30.50	5.56	2.54
Solwezi	3	1	2.75	5.56	15.23	3.18	8.05	45.30	14.97	3.32	1.62
Solwezi	3	2	10.23	3.06	6.39	3.73	10.49	45.29	13.53	3.41	3.86
Solwezi	3	3	4.26	18.40	6.36	3.85	15.85	30.36	12.50	5.33	3.08
Solwezi	3	4	5.35	9.23	11.24	3.81	12.23	36.45	12.45	2.80	6.45
Solwezi	3	5	3.26	2.66	6.08	4.00	10.82	37.82	31.27	2.79	1.30
Ikelenge	1	1	3.35	12.95	9.83	1.05	15.84	27.41	23.87	3.24	2.45
Ikelenge	1	2	4.31	4.98	10.43	5.71	5.59	44.32	19.56	3.66	1.44
Ikelenge	1	3	4.28	5.19	11.52	5.13	12.45	23.68	30.87	3.29	3.60
Ikelenge	1	4	4.37	9.40	8.06	7.73	11.07	22.79	21.69	4.07	10.83
Ikelenge	1	5	15.54	5.93	9.19	12.71	10.38	0.50	33.03	12.24	0.50
Ikelenge	2	1	2.90	66.19	2.24	2.28	7.98	5.01	5.79	5.92	1.68
Ikelenge	2	2	3.65	4.93	9.60	4.86	6.10	44.83	20.44	4.33	1.27
Ikelenge	2	3	3.78	5.38	11.01	4.74	12.87	23.63	31.44	3.63	3.52
Ikelenge	2	4	4.26	5.02	13.27	7.82	7.14	21.30	30.59	5.01	5.58
Ikelenge	2	5	4.79	7.24	7.11	4.07	21.17	18.40	28.82	4.73	3.67
Ikelenge	3	1	1.80	3.50	7.86	3.61	4.04	36.92	38.31	1.45	2.51
Ikelenge	3	2	4.86	8.50	14.85	7.81	14.20	5.44	26.41	3.97	13.96
Ikelenge	3	3	6.07	12.48	19.62	3.81	4.50	16.53	33.39	3.41	0.19
Ikelenge	3	4	11.98	9.22	10.47	6.88	8.19	7.27	22.99	4.64	18.36
Ikelenge	3	5	2.83	6.61	6.81	4.64	5.75	23.78	44.23	3.15	2.19
Ikelenge	4	1	5.09	10.67	9.54	8.56	11.74	20.43	21.20	4.81	7.95
Ikelenge	4	2	3.17	2.35	6.07	4.81	8.89	29.19	38.79	3.75	2.99

	C	S	P1	P2	P3	P4	P5	P6	P7	P8	P9
Ikelenge	4	3	6.05	5.53	8.16	6.57	8.20	31.54	24.27	5.95	3.73
Ikelenge	4	4	3.01	15.45	10.02	5.50	10.12	16.44	19.85	4.48	15.12
Ikelenge	4	5	7.25	6.02	6.39	6.39	5.88	24.64	30.53	5.60	7.29