Contemporary use and seasonal abundance of indigenous edible plants (with an emphasis on geophytes) available to human foragers on the Cape south coast, South Africa

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Contemporary use and seasonal abundance of indigenous edible plants (with an emphasis on geophytes) available to human foragers on the Cape south coast, South Africa

By

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DECLARATION

I, Jan Carlo De Vynck, student no. 211267716, hereby declare that the thesis for *Magister Scientiae* is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.

Jan Carlo De Vynck
31 October, 2014

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Summary

Human subsistence within the Cape Floristic Region (Cape) dates back to our inception as a distinct species. Unique archaeological evidence found here for the defining attribute of cognitive modernity, as well as coinciding paleo-climatic challenges to survival, both highlight the Cape's potential to support the existence of pre-historic hunter-gatherers. This habitat, with its unprecedented diversity of geophytes and other plant growth forms, has not yet revealed its potential to provide carbohydrate resources for early *Homo sapiens sapiens.* In order to investigate this potential, an ethnobotanical survey of the south Cape coastal area near Still Bay was conducted. Despite 17th Century colonialism marking the onset of indigenous plant knowledge decline, the 18 people of Khoe-San descent interviewed in this survey still actively used 58 indigenous edible plant species with a variety of 69 uses. Fruit showed the highest popularity of plants used (52%) followed by nectar, with plants having underground storage organs (USOs) ranking third (34%). Among growth forms, shrubs dominated (34%) followed by geophytes and trees (both 21%). With the exception of *Prionium serratum*, which was rare in the research area, this study failed to identify species that could have formed a staple source of carbohydrate for pre-colonial Khoe-San peoples of the Cape south coast. While eight species of USOs were identified (12% of total) only *Cyphia* species emerged as an important carbohydrate source. This study indicated the importance of Thicket Biome species as a source of edible plants. The second component of the study comprised a two-year phenological survey of indigenous edible plant species in four primary vegetation types. A total of 32 USO species and 21 species with aboveground edible carbohydrates (fruiting species) were identified across all sites. Limestone Fynbos had the richest flora of edible species (21 USO species and 18 fruiting species), followed by Strandveld (15 USOs and 13 fruiting species), Renosterveld (8 and 8, respectively) and lastly Sand Fynbos (5 and 5, respectively). The season of highest apparency showed slight variation amongst the four sites over the two years, with more variation evident in the period of apparency. The first survey year had below average rainfall, while the second year received an average rainfall amount. The second year saw a dramatic increase in apparency of abundance for all sites (50 to 60% increase) except for the Sand Fynbos site, which showed little change. The other sites showed a one month increase in the period of apparency in the second survey year. Overall, late summer to autumn was the period of lowest apparency of USOs. The ripening of certain fruiting species during this time would have provided a source of carbohydrate when USO availability was at its lowest. Strandveld had the highest biomass in the peak of apparency (over 80 $kgha^{-1}$) in the first year with a nearly 20% increase for the second year. The combined biomass for the four study sites in the first survey year was roughly 150 $kgha^{-1}$ and 185 $kgha^{-1}$ for the second year. The apparency of abundance (ripe and edible phase) of fruiting species did not increase much for Renosterveld and Strandveld in the second survey year, except for Limestone Fynbos (49% increase) and Sand Fynbos (53%). A multivariate analysis showed seven phenophases for high apparency of edible USOs and ripe fruit across the four vegetation types. Given the contribution of evergreen USOs and fruiting species, there would always have been carbohydrates available for foragers to collect in the major vegetation types of the south Cape coast. However, harvesting and processing this carbohydrate resource would have posed cognitive challenges for MSA hunter-gatherers, given the interwoven taxonomic complexity of numerous toxic plant species, and the diverse phenology of edible plant species within the varied vegetation types. These challenges were undoubtedly mastered, highlighting the Cape environment as a possible catalyst to improved human cognitive maturity.

CHAPTER 1

Introduction

1.1 The rise of humans and their habitats

The African continent has been home to the systematic rise of our *Homo* lineage for the last 2.6 million years. It was on this continent that evidence of the first lithic technology, the Oldowan industry (Early Stone Age, ESA), was ascribed to *Homo habilis* (Leakey, 1961; Plummer, 2004; Toth & Schick, 2006). The ancestral base of this unique hominin lineage is diverse and dates back to approximately 4 million years ago (mya) (Wood & Harrison 2011). Evidence of our divergence from other primates and the subsequent emergence of the *Homo* lineage is provided by fossils located mainly in southern and eastern Africa (Olson, 1978; Johanson & White, 1979; Vrba, 1985; Larrick & Ciochon, 1996).

Around 1.6 mya a new set of hominin skills known as the Acheulian (also ESA), replaced the Oldowan. These skills were ascribed to *Homo erectus* (Rightmire, 1991; Begun & Walker, 1993; Dominguiz-Rodrigo *et al.*, 2001; Chazan *et al.*, 2008; Lepre *et al.*, 2011; Van Arsdale, 2013) enabling it to be the first hominin to migrate out of Africa into Eurasia (Sinclair *et al.*, 1986; Gabunia *et al.*, 2001; Antón, 2003; Antón and Swisher, 2004). *H. erectus* was also the first hominin to enter South Africa's Cape region (Keller, 1973; Klein, 1978; Klein & Cruz-Uribe, 1991; Archer & Braun, 2010). There is no evidence for the presence of Oldowan hominins in the Cape. This could be attributed to a small population size leaving little trace of habitation, but is more likely due to the difficulty of exploiting a resource base associated with predominantly infertile landscapes of the region (Marean *et al.*, 2014).

Evidence of the distinctive bifacial hand axes and choppers of *H. erectus* are widespread in the Cape, suggesting the prolonged survival of this industry, and therefore *Homo* species in the region (Klein, 1974; Deacon, 1983; Thompson, 2009;

Braun *et al.*, 2013). After roughly a million years of Acheulian dominance, Middle Stone Age (MSA) technologies gradually emerged (Herries, 2011; Kandel & Conard, 2012). These started appearing at least 200 thousand years ago (ka) (Butzer *et al.*, 1978; Kuman *et al.*, 1999; Ambrose, 2001).

There is little evidence from this time period in South and East Africa. However, it is clear that by 150 to 200 ka MSA people can be classified as *Homo sapiens* (Marean *et al*., 2007; Shea *et al.*, 2007). Climatic conditions played a role in shaping this lineage. A severe and long lasting glacial period (Marine Isotope Age 6 - MIS6; 195-123 ka) resulted in harsh environmental conditions which challenged the existence and survival of our first kin (Parkington, 1981; Fisher *et al.*, 2010; Jerardino & Marean, 2010). The southern Cape coast, which has a good representation of MSA sites, provides the earliest evidence for modern human behaviour (Henshilwood *et al.*, 2002; Marean *et al*., 2007; Brown *et al*., 2009; Marean, 2010). Here, and nowhere else, from around 160 ka, we see that people express cultural characteristics through symbolic behaviour, abstract thought and aesthetic awareness which are the hallmarks of *Homo sapiens sapiens* (Hill *et al.*, 2009; Moritz, 2012). These cultural characteristics are found in the presence of heat-treated lithic technology (Brown *et al.*, 2009), the use of marine resources (Jerardino and Marean, 2010; Marean, 2010) and the systematic processing and use of ochre pigments (Watts, 2010).

The MSA prevailed until 30 – 40 ka (Jacobs *et al.*, 2008; McCall & Thomas, 2009; D'Errico *et al.*, 2012) and was succeeded by the Later Stone Age (LSA) when the MSA's descendants, the hunter-gatherer San people, emerged. The San were associated with a further development of cognitive skills for both symbolic and subsistence purposes (Deacon, 1984).

After 2 ka the pastoral Khoe-khoen people migrated into the Cape from the north of the country (Schweitzer, 1974; Henshilwood, 1996; Sadr, 1998; Ouzman & Smith, 2004). The resultant competition between indigenous ungulate fauna and the pastoralist's livestock, together with the challenges the San faced navigating this foreign subsistence economy, was detrimental to the hunter-gatherers. This period of co-existence between the Khoe-khoen and San people resulted in the inevitable merging of subsistence strategies. The Khoe-khoen supplemented their pastoralist lifestyles with hunting and gathering from natural resources, and the San engaged, to a limited extent, in livestock ownership (Elphick & Gilliomee, 1989; De Jongh, 2012a).

When the Europeans arrived at the Cape in the mid 17th Century they noted that although the Khoe-khoen and San remained two distinct groups, cultural overlaps were apparent (Elphick, 1972, 1977; Boonzaaier *et al.*, 1996; De Jongh, 2012b). Since the onset of this historical period, the two groups became increasingly integrated as people of Khoe-San descent, with a resultant shift from subsistence to agricultural resource use (Schapera, 1930; Elphick, 1972; Viljoen, 2006; Gilliomee & Mbenga, 2007). Today, few remnants of the pre-historic hunter-gatherer existence are evident amongst the Khoe-San descendants of the southern Cape.

With regard to the actual diet of our ancestors, primates most closely related to our lineage are known to subsist mainly on plant foods (Conklin-Brittain, *et al*., 2006). Some have even been observed foraging for plants with underground storage organs (hereafter USOs) (Hernandez-Aguilar *et al*., 2007). Plants, especially those with USOs, were an integral dietary component of our oldest hominin ancestors (Hatley & Kappelman, 1980; Laden & Wrangham, 2005).

Hominin evolution is associated with dietary shifts resulting from improved technology, rendering new resources accessible and, through the use of fire for cooking, digestible (Wrangham *et al.,* 1999; Klein, 2000). The MSA also reveals some evidence for the use of USOs (Albert & Marean, 2012), however, organic material is poorly preserved and skeletal remains crucial for craniodental morphology, dental microwear and stable isotope analysis are sparse (Teaford & Ungar, 2000; Buckley *et al.*, 2014).

Research on the use and nutritional importance of plants in the diet of contemporary non-agrarian societies provides useful information on foraging strategies (Kuhn & Stiner, 2001). Unfortunately, ethnographic studies of San people are restricted to arid environments, such as the Kalahari Desert; the advent of modern ethnographic science post-dated the demise of intact hunter-gatherer communities in more mesic habitats. Nonetheless, Kalahari San forage for a wide variety of plants. Lee (1984) observed the !Kung San foraging for 63 species, with nuts from the mongongo tree (*Schinziophyton rautanenii*) ranking highest due to its abundance in that area. The Hadza of Tanzania, also a derivative of the San lineage, exist in a savanna habitat and forage for 11 plant species five of which are USOs (Berbesque and Marlowe, 2009; Marlowe and Berbesque, 2009). The Aché, hunter-gatherer people of Paraguay's warm temperate rain forests forage, for 40 plant species, and the bulk of their carbohydrate requirements is derived from palm hearts (usually *Syagrus romanzoffiana*; Arecaceae) (Hawkes *et al*., 1982; Hurtado *et al*., 1985). USOs and certain other sources of carbohydrate (e.g. palm hearts, the stem bases of certain Cyperaceae and Poaceae) provide lower nutritional returns than other higher ranked foodstuffs (Kaplan *et al*., 2000; Wrangham *et al.*, 2009). However, the low energy costs of procuring these potentially inferior nutritional options must be considered (Marlowe & Berbesque, 2009), especially as they are seen as fallback foods to be consumed when honey and meat are scarce (Marlowe and Berbesque, 2009).

As noted previously, MSA archaeological sites on the Cape south coast provide unique insights into the evolution of cognitively modern humans (Singer & Wymer, 1982; Deacon & Wurz, 2001; Henshilwood *et al*., 2002; 2004; Marean & Assefa, 2005; Marean, 2010). Evidence for the dietary use of USOs in MSA people is scarce; however analysis of phytoliths does hold some promise in this regard (Albert & Marean, 2012). In contrast, the Cape LSA, yielded concrete evidence for the use of USOs, especially in the form of Iridaceae geophyte corms preserved in archaeological sites (Deacon & Deacon, 1963; Deacon, 1976; Opperman & Hydenrych, 1990; Deacon & Deacon, 1999). Ethnographic research on the indigenous flora of South Africa provides evidence of 1002 species used as foodstuffs (Fox *et al.,* 1982). However, very little research has documented the indigenous edible plant species of the hugely diverse Cape Floristic Region (CFR). In particular, almost nothing is known about the use of geophytic USOs, despite the region having the richest geophytes flora in the world (Procheş *et al.*, 2005).

The southern Cape is home to a plethora of resources that would have potentially been available to MSA hunter-gathers. The sea shore supports a productive and diverse intertidal fauna, due to the mixing of the cold, productive Benguela and warm

Agulhas currents, and was intensively exploited in the MSA (Marean *et al*., 2007; Marean, 2010; 2011). The terrestrial fauna comprised a diverse array of plains game (including an extinct megafauna) that was largely associated with the exposed Agulhas Bank (Klein, 1974; 1978; 1983; Rector & Reed, 2010; Thompson; 2010) as well as a browsing and mixed feeder fauna associated with the contemporary, dissected coastal plain (Boshoff *et al.*, 2001). There is good evidence from MSA archaeological sites (Singer & Wymer, 1982; Klein, 1983) as well as ethnographic observations, of the exploitation of components of this fauna by Khoe-San people (Skead, *et al.,* 2011).

As noted previously, the region also supported a diverse and abundant array of carbohydrate resources, principally in the form of USOs (Procheş *et al.*, 2005; 2006). The importance of USOs to the survival of subsistence Cape hunter-gatherers is largely unknown. Foraging for this seasonally and spatially variable resource (Singels, 2013), which includes many closely related toxic and edible clusters of species (Manning *et al.*, 2002) would likely have posed cognitive challenges for early humans. Overcoming these challenges may well have contributed to changes in brain development.

This thesis seeks to fill a major gap in the literature by focussing on (i) the evidence of edible indigenous plant species use by contemporary Khoe-San descendants living on the Cape south coast, and (ii) the seasonal abundance of below-ground (USOs) and aboveground (fruits, stems, seeds, etc.) edible carbohydrate resources in four vegetation types on the Cape south coast.

1.2 Study area

1.2.1 Physiography

The study area comprises the coastal plain between the Breede and Gouritz rivers on the Cape south coast (Fig. 1). The area is transitional between the winter rainfall region to the west and the non-seasonal or bimodal rainfall region to the east.

Therefore the study area receives rain from both the winter driven circumpolar westerly systems as well as post-frontal events, when moist air is advected across the warm Indian Ocean, producing rain at any time of the year (Deacon *et al*., 1992; Cowling *et al*., 1999). The annual rainfall for the study area varies from 398 - 510 mm [supplied by South African Weather Service (Linnow, 2012 n.p)] with the driest and warmest period occurring in late summer. The area generally has a moderate climate with an annual mean temperature of around 18℃, minimum average of 6℃ and maximum average temperature not higher than 30℃. Frost is seldom recorded.

The area is underlain by Palaeozoic deposits which form the bedrock of the folded sediments of the Cape Supergroup. These are Table Mountain Group sandstones (visible on the coast) and Bokkeveld shales (visible north of the coast). Near Riversdale (about 25 km from the coast) the Palaeozoic sediments dip in an east-west fault and are filled by the Createaceous Enon Formation comprising conglomerates and mudstones (Rogers, 1984; Malan, 1987; Deacon *et al*., 1992; Henshilwood, 2005). Much of the southern (coastwards) coastal plain is mantled by Pliocene limestone of the Bredasdorp Formation. These, in turn, are covered near the coastal margin by alkaline Pliocene-Pleistocene sands of marine origin. Inland of these are patches of older aeolian sands that are leached and acidic (Rebelo *et al.*, 1991). Shale and mudstone derived soils are moderately fertile, while those associated with leached sands are infertile. The calcareous sands associated with limestone, calcrete and coastal dunes are also relatively infertile due to their high alkalinity and subsequent low levels of plant-available phosphorous (Thwaites & Cowling, 1988).

1.2.2 Vegetation

Vegetation of the Cape coastal lowlands, including the study area (Fig. 1), is under strong edaphic control (Thwaites & Cowling, 1988; Rebelo *et al*., 1991; Cowling *et al.*, 2009). Rocks yielding fine-grained and relatively fertile soils support Renosterveld, a fire-prone grassy shrubland often dominated by *Elytropappus rhinocerotis* (renosterbos) (Cowling *et al.*, 1986; Bergh *et al.*, 2007). According to Procheş *et al.* (2005; 2006), Renosterveld supports the highest diversity and abundance of USOs amongst all vegetation types in the CFR. Infertile acid sands support fynbos, a fire-prone heath-like shrubland characterised by the presence of Restionaceae, Ericaceae and Proteaceae (Goldblatt, 1978; Cowling *et al*., 1996; Goldblatt & Manning, 2002). Soils derived from limestone support a highly distinctive and endemic-rich form of fynbos. Marine sands are associated with subtropical thicket, either in its solid form (where it escapes the effects of fire) or as thicket clumps in a matrix of fynbos (Cowling *et al.*, 1996). This vegetation is colloquially known as Strandveld (Abanda *et al.* 2011). Plant compositional change – or beta diversity – between these edaphically differentiated vegetation types is extremely high. Consequently few species are shared amongst vegetation types and regional plant richness is very high (Cowling, 1990; Cowling *et al.*, 1992; Cowling and Lombard, 2002).

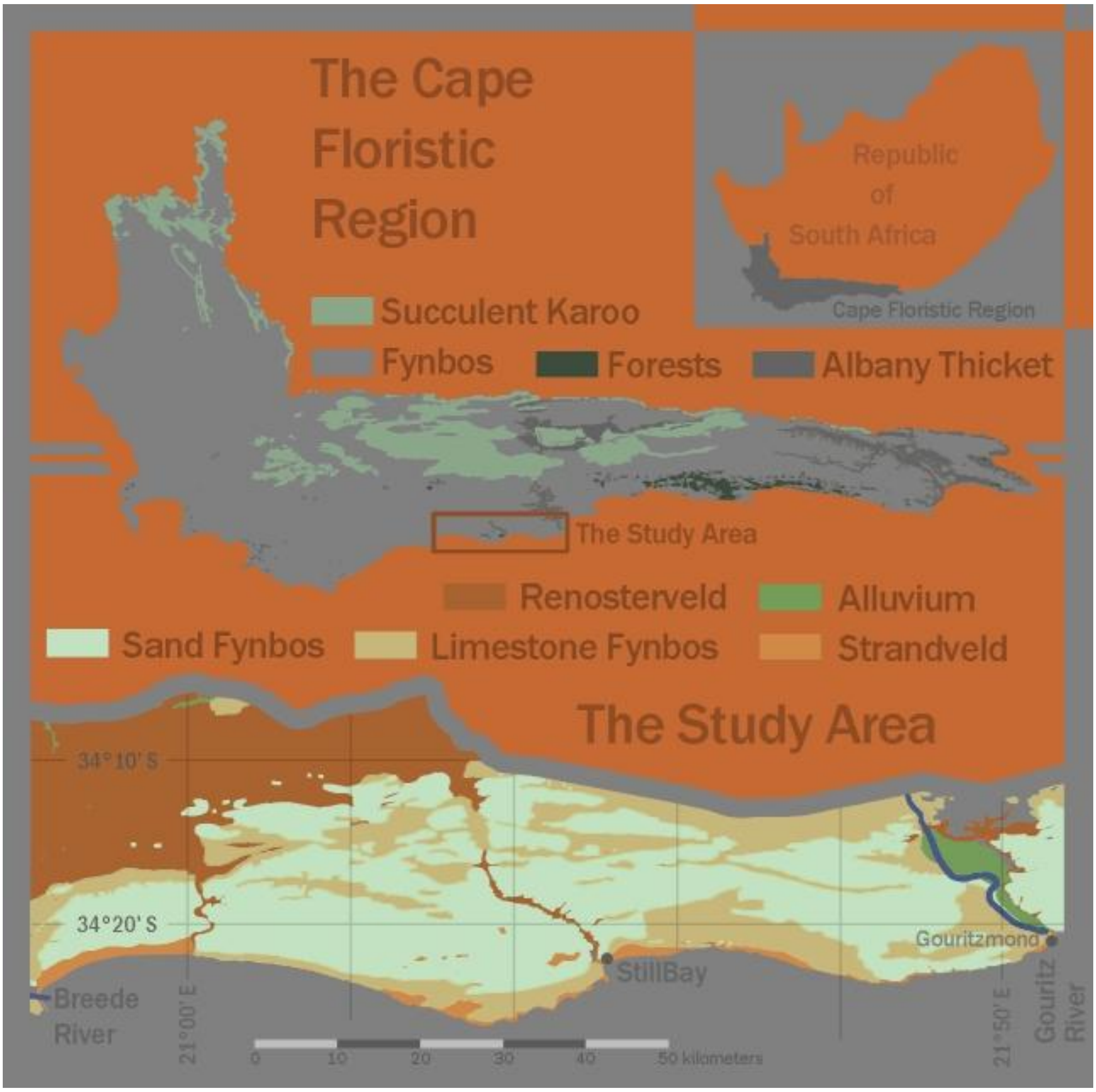


Fig. 1: The biomes of the Cape Floristic Region and the major vegetation types in the study area (adapted from Mucina and Rutherford, 2006).

1.3 Key questions

This thesis will attempt to answer two key questions. The first is ethnographic:

Question 1: to what extent do contemporary people of Khoe-San descent harvest indigenous edible plants, with an emphasis on USOs?

The second question relates to temporal resource variation:

Question 2: what is the abundance, biomass and seasonality of indigenous edible plants, with an emphasis on USOs?

1.4 Structure of thesis

The structure of this thesis is best described by the following contextualising aspects and background.

Chapters 2 and 3 comprise two substantive chapters, each addressing one of the key questions listed in Section 1.3, starting with the ethnographic chapter. Each chapter is written in the form of a research paper.

Chapter 4 discusses the extent to which the research goals were reached, what the study's shortcomings were, and poses potential future research questions.

1.4.1 Chapter 2

Indigenous edible plant use by contemporary Khoe-San descendents of South Africa's Cape south coast. Evidence from an ethnobotanical study in the Still Bay area.

An ethnobotanical survey in the Still Bay area was undertaken in order to assess the extent to which contemporary Khoe-San descendants on the Cape south coast harvest indigenous food plants. This was the first ethnobotanical survey of its kind to be conducted amongst the people of Khoe-San descent in the CFR.

The botanical focus was on edible plants, particularly USOs (including geophytes). The rationale underpinning this study was to supplement current research on recreating the resource base and patterns of resource use by MSA peoples at the time when modern humans emerged (Marean *et al.*, 2014).

The following questions were posed:

1. How many indigenous edible plant species are harvested by extant people of Khoe-San heritage and what are they used for?
2. Which species are most commonly harvested?
3. What are the growth forms and biome affinities of the harvested species?
4. What inferences can be drawn from the results regarding plant diets of early modern humans in the region?

1.4.2 Chapter 3

Seasonal abundance of under- and aboveground carbohydrate resources available to foragers on the Cape south coast, South Africa.

To date no research has been conducted on the seasonal abundance and availability of USOs for hunter-gatherers in the CFR. Most USOs are leaf-deciduous geophytes that are apparent only during the wet and cool winter months. During the dry summer, only evergreen species and those that flower after the leaves have wilted (hysteranthous species) are apparent (Pierce, 1984; Procheş *et al.*, 2006). It is likely therefore, that summer and autumn were seasons of USO scarcity. Fruit production, largely associated with tree and shrub species of the Thicket Biome, tends to peak in spring and autumn months (Pierce, 1984). Fruit could therefore be an alternative source of carbohydrates during the autumn months when USO apparency is at its lowest.

A study of the phenology over two calendar years of USOs in four vegetation habitats in the Still Bay region on the Cape south coast was conducted. The availability of fruit was also observed in order to assess whether this carbohydrate source could complement the availability of USOs.

The following questions were posed:

1. Is there an annual reliability for under- and aboveground carbohydrate resources from indigenous edible plants? And, what is the available biomass of USOs for each of the four vegetation types?
2. How does the apparency and biomass of indigenous edible USOs vary spatially (i.e. in terms of vegetation type) and temporally (i.e. in terms of season)?
3. To what extent does aboveground carbohydrates (largely fruit) availability complement the availability of edible USOs?

1.4.3 Chapter 4

Plant foraging: contemporary results in a pre-historic and future context.

The concluding chapter examines the degree to which the research findings contribute to the understanding of how the extent and availability of indigenous edible plant resources aided human subsistence and survival in the MSA along the southern Cape coast.

In addition, shortcomings of the study are identified and novel future research questions proposed.

1.5 References

Abanda, P. A., Compton, J. S. and Hannigan R. E. 2011. Soil nutrient content, above-ground biomass and litter in a semi-arid shrubland, South Africa. *Goederma* 164 (3-4): 128-137.

Albert, R. M. and Marean, C. W. 2012. The Exploitation of Plant Resources by Early *Homo sapiens*: The Phytolith Record from Pinnacle Point 13B Cave, South Africa. *Geoarchaeology* 27 (4): 363–384.

Ambrose, S. H. 2001. Paleolithic technology and human evolution. *Science* 291 (5509): 1748-1753.

Antón, S. C. 2003. Natural history of Homo erectus. *American Journal of Physical Anthropology* 122 (37): 126-170.

Antón, S. C. and Swisher, C. C. 2004. Early dispersals of Homo from Africa. *Annual review of Anthropology*: 271-296.

Archer, W. and Braun, D. R. 2010. Variability in bifacial technology at Elandsfontein, Western cape, South Africa: a geometric morphometric approach. *Journal of Archaeological Science* 37 (1): 201-209.

Begun, D. and Walker, A. 1993. The endocast. In: Leaky. R. and Walker. A, (eds.). *The Nariokotome Homo erectus Skeleton*. Harvard University Press, Massachusetts. pp. 326-358.

Berbesque, J. C. and Marlowe, F. W. 2009. Sex differences in food preferences of Hadza Hunter-Gatherers. *Evolutionary Psychology* 7 (4): 601-616.

Bergh, N. G., Hedderson T. A., Linder, H. P. and Bond, W. J. 2007. Spatial pattern of genetic variation in Elytropappus rhinocerotis (Asteraceae) from the Cape provinces of South Africa. *South African Journal of Botany* 73 (2): 279.

Boonzaaier, E., Malherbe, C., Smith, A. and Berens, P. 1996. *The Cape Herders. The history of the Khoikhoi of southern Africa.* David Philip, Cape Town. pp. 17-18.

Boshoff, A. F., Kerley, G. I. H. and Cowling, R. M. 2001. A pragmatic approach to estimating the distributions and spatial requirements of the medium- to large-sized mammals in the Cape Floristic Region. *Diversity and Distributions* 7 (1-2): 29-44.

Braun, D. R., Levin, N. E., Stynder, D., Herries, A. I., Archer, W., Forrest, F., and Fitzsimmons, K. E. 2013. Mid-Pleistocene Hominin occupation at Elandsfontein, Western Cape, South Africa. *Quaternary Science Reviews* 82: 145-166.

Brown, K. S., Marean, C. W., Herries, A .I .R., Jacobs, Z., Tribolo, C., Braun, D., Roberts, D. L., Meyer, M. C. and Bernatchez, J. 2009. Fire as an engineering tool of early modern humans. *Science* 325 (5942): 859-862.

Buckley, S., Usai, D., Jakob, T., Radini, A., and Hardy, K. 2014. Dental calculus reveals unique insights into food items, cooking and plant processing in prehistoric Central Sudan. *Public library of Science one*, 9 (7): e100808.

Butzer, K. W., Beaumont, P. B., and Vogel, J. C. 1978. Lithostratigraphy of Border Cave, KwaZulu, South Africa: a Middle Stone Age sequence beginning 195,000 bp. *Journal of Archaeological Science* 5 (4): 317-341.

Chazan, M., Ron, H., Matmon, A., Porat, N., Goldberg, P., Yates, R. and Horwitz, L. K. 2008. Radiometric dating of the Earlier Stone Age sequence in excavation I at Wonderwerk Cave, South Africa: preliminary results. *Journal of Human Evolution* 55 (1): 1-11.

Conklin-Brittain, N. L., Knott, C. D. and Wrangham, R. W. 2006. Energy intake by wild chimpanzees and orangutans: methodological considerations and a preliminary comparison. In: Hohmann, G., Robbins, M. and Boesch, C. (eds.). *Feeding ecology of primates.* Cambridge University Press, Cambridge. pp. 443-469.

Cowling, R. M. 1990. Diversity components in a species-rich area of the Cape Floristic Region. *Journal of Vegetation. Science* 1: 699–710.

Cowling, R. M., Pierce, S. M. and Moll, E. J. 1986. Conservation and utilisation of South Coast renosterveld, an endangered South African vegetation type. *Biological Conservation* 37 (4): 363-377.

Cowling, R. M., Homles, P. M. and Rebelo, A. G. 1992. Plant diversity and endemism. In: Cowling, R. M. (ed.). *The ecology of fynbos: Nutrients, fire and diversity*. Oxford University Press, Cape Town. pp 62-112.

Cowling, R.M., Rundel, P.W., Lamont, B.B., Arroyo, M.K. and Arianoutsou, M. 1996. Plant diversity in Mediterranean climate regions. *Trends in Ecology and Evolution* 11: 362–366.

Cowling, R. M., Cartwright, C. R., Parkington, J. E. and Allsopp, J. 1999. Fossil wood charcoal assemblages from Elands Bay Cave, South Africa: implications for Late Quaternary vegetation and climates in the winter-rainfall fynbos biome. *Journal of Biogeography* 26 (2): 367-378.

Cowling, R. M. and Lombard, A. T. 2002. Heterogeneity, speciation/extinction history and climate: explaining regional plant diversity patterns in the Cape Floristic Region. *Diversity and Distributions* 8: 163–179.

Cowling, R. M., Procheş, S. and Partridge, T. C. 2009. Explaining the uniqueness of the Cape flora: Incorporating geomorphic evolution as a factor for explaining its diversification. *Molecular Phylogenetics and Evolution* 51 (1): 64-74.

Deacon, H. J. 1976. *Where hunters gathered: a study of Holocene Stone Age people in the Eastern Cape*. South African Archaeological Society, Claremont, Cape Town.

Deacon, H. J. 1983. An introduction to the fynbos region, time scales and palaeoenvironments. In: Deacon, H. J., Hendey, Q. B., and Lambrechts, J. J. N. (eds.). *Fynbos Paleoecology: A preliminary synthesis*. South African National Scientific Progress Report. Council for Scientific and Industrial Research, Pretoria. pp. 1-20.

Deacon, J. 1984. Later Stone Age People and their descendants in southern Africa. In: Klein, R. G. (ed.). *Southern African prehistory and paleoenvironments*. A. A. Balkema, Rotterdam. pp. 221-328.

Deacon H.J. and Deacon, J. 1963. Scott's Cave: a late Stone Age site in the Gamtoos Valley Annals of the Cape Provincial Museums. *Natural History* 3: 96-112.

Deacon, H. J. and Deacon, J. 1999. *Human beginnings in South Africa: uncovering the secrets of the Stone Age.* David Philip Publishers (Pty) Ltd, Cape Town.

Deacon, H. J., Jury, M. R. and Ellis, F. 1992. Selective regime and time. In: Cowling, R. M. (ed.). *The ecology of fynbos: Nutrients, fire and diversity*. Oxford University Press, Cape Town. pp 6-22.

Deacon, H. J. and Wurz, S. 2001. Middle Pleistocene populations and the emergence of modern behaviour. In: Barham, L. and Brown, K. R. (eds.). *Human Roots – Africa and Asia in the Middle Pleistocene.* Western Academic & Specialist Press, Bristol. pp. 55–63.

D'Errico, F., Backwell, L., Villa, P., Degano, I., Lucejko, J. J., Bamford, M. K. and Beaumont, P. B. 2012. Early evidence of San material culture represented by organic artifacts from Border Cave, South Africa. *Proceedings of the National Academy of Sciences* 109 (33): 13214-13219.

De Jongh, M. 2012. *The southern Cape Hessequa: a forgotten first people.* University of South Africa, Pretoria. p. 11. (a)

De Jongh, M. 2012. *Roots and Routes: Karretjie People of the Great Karoo – the marginalisation of a South African First People*. Unisa Press, Pretoria. ch. 2. (b)

Dominguez-Rodrigo, M., Serrallonga, J., Juan-Tresserras, J., Alcala, L. and Luque, L. 2001. Woodworking activities by early humans: a plant residue analysis on Acheulian stone tools from Peninj (Tanzania). *Journal of Human Evolution* 40 (4): 289-299.

Elphick, R. H. 1972. *The Cape Khoi and the first phase of South African race relations*. PhD, dissertation, Yale University. pp. 293.

Elphick, R. H. 1977. *Kraal and Castle: Khoikhoi and the Founding of White South Africa.* Yale University Press, New Haven.

Elphick, R. H. and Gilliomee, H. (eds.).1989. *The shaping of South African Society, 1652-1840.* Maskew Miller, Cape Town. p. 25.

Fisher E. C., Bar-Matthews, M., Jerardino A. and Marean, C. W. 2010. Middle and Late Pleistocene paleoscape modeling along the southern coast of South Africa. *Quaternary Science Reviews* 29 (11): 1382–1398.

Fox, F. W., Young, M. M. N. and Hallowes, D. 1982. *Food from the veld: Edible wild plants of southern Africa botanically identified and described*. Delta books, Johannesburg.

Gabunia, L., Antón, S. C., Lordkipanidze, D., Vekua, A., Justus, A. and Swisher, C. C. 2001. Dmanisi and dispersal. *Evolutionary Anthropology: Issues, News, and Reviews* 10 (5): 158-170.

Gilliomee, H. and Mbenga, B. 2007. *New history of South Africa*. Tafelberg Publishers, Cape Town. pp. 52.

Goldblatt, P. 1978. An analysis of the flora of Southern Africa: its characteristics, relationships, and origins. *Annals of the Missouri Botanical Garden* 65: 369–436.

Goldblatt, P. and Manning, J.C. 2002. Plant diversity of the Cape Region of southern Africa. *Annals of the Missouri Botanical Garden* 89: 281–302.

Hatley, T. and Kappelman, J. 1980. Bears, pigs, and Plio-Pleistocene hominids: a case for the exploitation of belowground food resources. *Human Ecology* 8 (4): 371–387.

Hawkes, K., Hill, K. and O'Connell, J. F. 1982. Why hunters gather: optimal foraging and the Aché of eastern Paraguay. *American Ethnologist* 9 (2): 379-398.

Henshilwood, C. 1996. A revised chronology for pastoralism in southernmost Africa: New evidence of sheep at *ca.* 2000 B.P. from Blombos Cave, South Africa. *Antiquity* 70: 945-949.

Henshilwood, C.S. 2005. *Holocene Archaeology of the coastal Garcia State Forest, Southern Cape, South Africa*. D.Phil., Dissertation, University of Cambridge. p. 15.

Henshilwood, C.S., D'Erico, F., Yates, R., Jacobs, Z., Tribolo, C., Duller, G.A.T., Mercier, N. and Wintle, A.G. 2002. Emergence of modern human behaviour: Middle stone age engravings from South Africa. *Science* 295 (5558): 1278-1280.

Henshilwood, C.S., D'Errico, F., Vanhaeren, M., van Niekerk, K. and Jacobs, Z. 2004. Middle Stone Age shell beads from South Africa. *Science* 304 (5669): 404-404.

Hernandez-Aguilar, R. A., Moore J. and Travis, R. P. 2007. Savanna chimpanzees use tools to harvest the underground storage organs of plants. *Proceedings of the National Academy of Science USA* 104 (49): 19210–19213.

Herries, A. I. 2011. A chronological perspective on the Acheulian and its transition to the Middle Stone Age in Southern Africa: the question of the Fauresmith. *International Journal of Evolutionary Biology* 2716: 1-25.

Hill, K., Barton, M., & Hurtado, A. M. 2009. The emergence of human uniqueness: characters underlying behavioral modernity. *Evolutionary Anthropology: Issues, News, and Reviews* 18 (5): 187-200.

Hurtado, A. M., Hawkes, K., Hill, K. and Kaplan, H. 1985. Female subsistence strategies among Aché hunter-gatherers of Eastern Paraguay. *Human Ecology* 13 (1): 1-28.

Jacobs, Z., Wintle, A. G., Duller, G. A., Roberts, R. G. and Wadley, L. 2008. New ages for the post-Howiesons Poort, late and final Middle Stone Age at Sibudu, South Africa. *Journal of Archaeological Science* 35 (7): 1790-1807.

Jerardino, A. and Marean, C. W. 2010. Shellfish gathering, marine paleoecology and modern human behavior: perspectives from cave PP13B, Pinnacle Point, South Africa. *Journal of Human Evolution* 59 (3): 412-424.

Johanson, D. C. and White, T. D. 1979. A systematic assessment of early African hominids. *Science* 203 (4378): 321-330.

Kandel, A. W. and Conard, N. J. 2012. Settlement patterns during the Earlier and Middle Stone Age around Langebaan Lagoon, Western Cape (South Africa). *Quaternary International* 270: 15-29.

Kaplan, H., Hill, K., Lancaster, J. and Hurtado, A. M., 2000. A theory of human life history evolution: Diet, intelligence, and longevity. *Evolutionary Anthropology* 9 (4): 156–185.

Keller, C. M. 1973. *Montagu Cave in prehistory: a descriptive analysis*. University of California Press, Berkley.

Klein, R. G. 1974. Environment and subsistence of prehistoric man in the southern Cape Province, South Africa. *World Archaeology* 5 (3): 249-284.

Klein, R. G. 1978. The fauna and overall interpretation of the "Cutting 10" Acheulean site at Elandsfontein (Hopefield), southwestern Cape Province, South Africa. *Quaternary Research* 10 (1): 69-83.

Klein, R. G. 1978. Stone Age predation on large African bovids. *Journal of Archaeological Science* 5 (3): 195-217.

Klein, R. G. 1983. Palaeoenvironmental implications of Quaternary large mammals in the fynbos region. *Fynbos paleoecology: a preliminary synthesis. South African National Scientific Programmes Report* 75: 116-138.

Klein, R. G. 2000. Archeology and the evolution of human behavior. *Evolutionary Anthropology* 9 (1): 17–36.

Klein, R. G. and Cruz-Uribe, K. 1991. The bovids from Elandsfontein, South Africa, and their implications for the age, palaeoenvironment, and origins of the site. *African Archaeological Review* 9 (1): 21-79.

Kuhn, S. L. and Stiner, M. C. 2001. The antiquity of hunter-gatherers. In: Panter-Brick, C., Layton, R. H. and Rowley-Conwy, P. (eds.). *Hunter-gatherers: an interdisciplinary perspective.* Cambridge University Press, Cambridge. pp. 99–142.

Kuman, K., Inbar, M. and Clarke, R. J. 1999. Palaeoenvironments and cultural sequence of the Florisbad Middle Stone Age hominid site, South Africa. *Journal of Archaeological Science* 26 (12): 1409-1425.

Laden, G. and Wrangham, R. 2005. The rise of the hominids as an adaptive shift in fallback foods: plant underground storage organs (USOs) and australopith origins. *Journal of Human Evolution* 49 (4):482–498.

Larick, R. and Ciochon, R. L. 1996. The African emergence and early Asian dispersals of the genus *Homo*. *American Scientist* 84: 538-551.

Leakey, L. S. B. 1961. The progress and evolution of man in Africa. *American Anthropologist* 64 (5): 1128-1129.

Lee, R. B. 1984. *The Dobe !Kung*. Holt, Rinehart and Winston, Inc., New York. pp. 40-44.

Lepre, C. J., Roche, H., Kent, D. V., Harmand, S., Quinn, R. L., Brugal, J. P. and Feibel, C. S. 2011. An earlier origin for the Acheulian. *Nature* 477 (7362): 82-85.

Linnow, G. 2012. Client Liaison Officer: Regional Office-Western Cape. South African Weather Service. Not published.

Malan, J. A. 1987. The Bredasdorp Group in the area between Gans Bay and Mossel Bay. *South African Journal of Science* 83 (8): 506-507.

Manning, J., Goldblatt, P., Snijman, D., and Manning, J. C. 2002. *The color encyclopedia of Cape bulbs*. Timber Press, Cambridge.

Marean, C. W. 2010. Pinnacle Point Cave 13B (Western Cape Province, South Africa) in context: The Cape Floral Kingdom, shellfish, and modern human origins. *Journal of Human Evolution* 59 (3-4): 425-443.

Marean, C. W. 2011. Coastal South Africa and the coevolution of the modern human lineage and the coastal adaptation. In: Bicho, N.S, Haws, J. A. and Davis, L. G.

(eds.). *Trekking the shore. Interdisciplinary contributions to archaeology.* Springer, New York. pp. 421 – 440.

Marean, C. W. and Assefa, Z. 2005. The Middle and Upper Pleistocene African record for the biological and behavioral origins of modern humans. In: Stahl, A.B. (ed.). *African Archaeology*. Blackwell, New York. pp. 93-129.

Marean, C. W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A. I. R., Jacobs, Z., Jerardino, A., Karkanas, P., Minichillo, T., Nilssen, P. J., Thompson, E., Watts, I. and Williams H. M. 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature* 449 (7164): 905-908.

Marean, C. W., Cawthra, H. C., Cowling, R. M., Esler, K. J., Fisher, E., Milewski, A. V., de Vynck, J. C., Potts, A. G. and Singels, E. 2014. *Stone Age people in a changing Cape.* In: Allsopp, N., Colville, J. and Verboom, A. G. (eds.). Ecology and evolution of Fynbos. Megadiversity in a changing world. Oxford University Press, Oxford (in press).

Marlowe, F. W. and Berbesque, J. C. 2009. Tubers as fallback foods and their impact on Hadza Hunter-Gatherers. *American Journal of Physical Anthropology* 140 (4): 751–758.

McCall, G. S. and Thomas, J. T. 2009. Re-examining the South African Middle-to-Later Stone Age transition: Multivariate analysis of the Umhlatuzana and Rose Cottage Cave stone tool assemblages. *Azania: Archaeological Research in Africa* 44 (3): 311-330.

Moritz, J. M. 2012. Human uniqueness, the other hominids, and 'Anthropocentrism of the Gaps' in the Religion and Science dialogue. *Zygon: Journal of Religion & Science* 47 (1): 65-96.

Mucina, L. and Rutherford, M. C. (eds.). 2006. *The vegetation of South Africa, Lesotho, and Swaziland.* Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Olson, T. R. 1978. Hominid phylogenetics and the existence of *Homo* in Member I of the Swartkrans formation, South Africa. *Journal of Human Evolution* 7 (2): 159-178.

Opperman, H. and Heydenrych, B. 1990. A 22 000 year-old Middle Stone Age camp site with plant food remains from the North-Eastern Cape. *The South African Archaeological Bulletin* 45 (152): 93-99.

Ouzman, S. and Smith, B. 2004. Southern Africa's Khoekhoen herder rock art. *The Digging Stick* 21 (3): 1-4.

Parkington, J. E. 1981. The effects of environmental change on the scheduling of visits to the Elands Bay Cave, Cape Province, South Africa. *Patterns of the past: studies in honour of David Clarke*: 341: 359.

Pierce, S. M. 1984. A synthesis of plant phenology in the Fynbos Biome. South African National Scientific Programmes Report no. 88. Graphics art division of the Council for Scientific and Industrial Research, Pretoria. pp. 36.

Plummer, T. 2004. Discord after discard. Reconstructing aspects of Oldowan hominin behavior. In: Stahl, A. B. (ed.). *African archaeology. A critical introduction.* Blackwell Publishing, Oxford. pp. 55-92.

Procheş, S., Cowling, R. M. and du Preez, D. R. 2005. Patterns of geophyte diversity and storage organ size in the winter-rainfall region of southern Africa. *Diversity and Distributions* 11 (1): 101-109.

Procheş, S., Cowling, R. M., Goldblatt, P., Manning, J. C. and Snijman, D. A. 2006. An overview of the Cape geophytes. *Biological Journal of the Linnean Society* 87 (1): 27-43.

Rebelo, A. G., Cowling, R. M., Campbell, B. M. and Meadows, M. 1991. Plant communities of the Riversdale plain. *South African Journal of Botany* 57 (1): 10-28.

Rector, A. L., & Reed, K. E. 2010. Middle and late Pleistocene faunas of Pinnacle Point and their paleoecological implications. *Journal of human evolution* 59 (3): 340-357.

Rightmire, G. 1991. The dispersal of *Homo Erectus* from Africa and the emergence of more modern humans. *Journal of anthropological research* 47 (2): 177-191.

Rogers, J. 1984. *Cenozoic geology of the southern Cape coastal plain between Cape Agulhas and Mossel Bay, focussing on the area between the Kafferkuils and Gouritz rivers*. Technical report No. 15: University of Cape Town: Marine Geoscience Unit.

Sadr, K. 1998. The first herders at the Cape of Good Hope. *African Archaeological Review* 15 (2): 101-132.

Schapera, I. 1930. *The Khoisan Peoples of South Africa. Bushmen and Hottentots*. Routledge & Kegan Paul Ltd., London. pp. 47.

Schweitzer, F. R. 1974. Archaeological evidence for sheep at the Cape. *The South African Archaeological Bulletin* 29 (115-116): 75-82.

Shea, J. J., Fleagle, J. G. and Assefa, Z. 2007. Context and chronology of early Homo sapiens fossils from the Omo Kibish Formation, Ethiopia. In: Mellars, P. (ed.). *Rethinking the human revolution.* MacDonald Institute for Archaeological Research, Cambridge. pp. 153-162.

Sinclair, A. R. E., Leakey, M. D. and Norton-Griffiths, M. 1986. Migration and hominid bipedalism. *Nature* 324 (6095): 307-308.

Singels E. 2013. *Underground storage organs of plants as a food source for Pleistocene hunter-gatherers in the Southern Cape.* MSc., thesis, Stellenbosch University.

Singer, R. and Wymer, J. 1982. *The Middle Stone Age at Klasies River Mouth in South Africa.* Chicago University Press, Chicago.

Skead, C. J., Boshoff, A. F. and Kerley, G. I. H. 2011. *Historical incidence of the larger land mammals in the broader Northern and Western Cape.* In: Knight, M. (ed.). Centre for African Conservation Ecology, Nelson Mandela Metropolitan University.

Teaford, M. F. and Ungar, P. S. 2000. Diet and the evolution of the earliest human ancestors. *Proceedings of the National Academy of Science USA* 97 (13): 506-511.

Thompson, E. 2009. Acheulean artifact accumulation and early hominin land use, Garden Route Casino Road, Pinnacle Point, South Africa. *Geoarchaeology* 24 (4): 402-428.

Thompson, J. C. 2010. Taphonomic analysis of the middle stone age faunal assemblage from Pinnacle point cave 13B, Western Cape, South Africa. *Journal of Human Evolution* 59 (3): 321-339.

Thwaites, R. N. and Cowling, R. M. 1988. Soil-vegetation relationships on the Agulhas plain, South Africa. *Catena* 15 (3-4): 333-345

Toth, N. and Schick, K. D. (eds.). 2006. *The Oldowan: case studies into the earliest stone age*. Stone Age Institute Press, Gosport, Indiana. pp. ix-x.

Van Arsdale, A. P. 2013. *Homo erectus* - A Bigger, Smarter, Faster Hominin Lineage. *Nature Education Knowledge* 4 (1): 2.

Viljoen, R. 2006. *Jan Paerl, a Khoikhoi in Cape Colonial Society, 1761-1851*. Brill, Leiden. pp. 14-15.

Vrba, E. S. 1985. Early hominids in southern Africa: updated observations on chronological and ecological background. In: Tobias, P. V. (ed.). *Hominid Evolution: Past, present and future*. Alan R. Liss, New York. pp. 195-200.

Watts, I. 2010. The pigments from Pinnacle Point Cave 13B, Western Cape, South Africa. *Journal of Human Evolution* 59 (3-4): 392-411.

Wood, B. and Harrison, T. 2011. The evolutionary context of the first hominins. *Nature* 470 (7334): 347-352.

Wrangham, R. W., Jones, J. H., Laden, G., Pilbeam, D. and Conklin-Brittain, N. 1999. The raw and the stolen. Cooking and the ecology of human origins. *Current Anthropology*. 40 (5): 567–594.

Wrangham, R. W., Cheney, D., Seyfarth, R. and Sarmiento, E. 2009. Shallow-water habitats as sources of fallback foods for hominins*. American Journal of Physical Anthropology*. 140 (4): 630–642.

CHAPTER 2

Indigenous edible plant use by contemporary Khoe-San descendants of South Africa's Cape south coast. Evidence from an ethnobotanical study in the Still Bay area

2.1 Abstract

It is hypothesised that modern humans emerged on the Cape south coast of South Africa some 160 000 BP. It is not known what types of edible plants sustained them. Potential sources of carbohydrate are the underground storage organs (USOs) of the region's rich and abundant geophytic flora. This study surveyed the use of indigenous edible plant species amongst 18 people of Khoe-San descent living in rural areas around Still Bay. Participants identified 58 indigenous edible plant species (from a potential list of over 140). The identified species had 69 uses, almost half of which were for fruit and a quarter for vegetable foodstuffs. Plants bearing USOs comprised only 12% of uses. As a group, species that produced fruit had the highest popularity, followed by nectar producing species and lastly plants with USOs. The popularity of this last-mentioned group was largely underpinned by the strong preference for the tubers from two *Cyphia* species. Knowledge of edible geophytes belonging to the Iridaceae was low, despite these species being widely documented as important carbohydrate sources in the ethnographic, historical and archaeological literature. Shrubs were the most frequent growth form (34%) of edible plant species identified by the survey group. Geophytes and trees both comprised 21% of species identified. Species of Thicket Biome affinity dominated the sample (52%) followed by the Fynbos Biome (38%); wetlands contributed the remainder at 10%. The diverse array of different biomes, each with their own suite of edible plant resources, would have been important for sustaining hunter-gatherer communities on the Cape south coast. With the exception of the stems and leaf bases of palmiet (*Prionium serratum*), which occurs rarely in the study area, the survey failed to identify species

that could have formed a staple source of carbohydrate for the pre-colonial Khoe-San peoples of the Cape south coast. This is almost certainly due to the loss of hunter-gatherer lifestyles after colonization in the 1700's and the concomitant introduction of cereal crops.

2.2 Introduction

Very little is known about how the Khoe-San peoples of the Cape Floristic Region (hereafter Cape) of South Africa utilised plant resources. The Khoe-San share descendants with the Khoe-khoen, who were traditionally pastoralists, and the San, who were hunter-gatherers (Crawhall, 2006; Schlebusch, 2010). Recent research suggests that these people were the direct descendents of *Homo sapiens sapiens* (Soodyall & Trefor 1997; Soodyall, 2011; Krishna *et al*., 2012; Pickrell *et al*., 2012) who have lived on the Cape south coast since about 160 000 BP (Brown *et al.*, 2009; Marean 2010; 2011). It has been hypothesized that the persistence of a small group of hominins here – as opposed to their widespread extinction elsewhere in Africa during Marine Isotope Stage 6 (MIS6, 193 000 -125 000 BP) (Foley, 1998; Lahr and Foley, 1998; Fagundes *et al*., 2007; Basell, 2008; Masson-Delmotte *et al.*, 2010) - was a consequence of the Cape's relatively moderate climate during the largely glacial MIS6. The persistently warm Agulhas Current mediated the region's relatively warmer climate (Negre *et al*., 2010; Zahn *et al*., 2010). Marean (2010) has hypothesised that during strong glacial environments, such as those experienced in MIS6, the Cape south coast provided a unique juxtaposition of resources important for hominin persistence. These comprised diverse and abundant marine resources (Marean *et al*., 2007; Jerardino and Marean, 2010; Parkington, 2010), a diverse ungulate plains fauna, including several species of now extinct megafauna, associated with the submerged Agulhas Bank (Parkington, 2001; 2003; Matthews, *et al.*, 2009; Marean, 2010; Faith 2011), and a wealth of edible plants (cf. Van Wyk & Gericke, 2000; Van Wyk, 2002; Schwegler 2003). Plant resources included species with USOs, specifically geophytes, which globally have the highest diversity and abundance in the Cape (Goldblatt, 1997; Cowling *et al*., 1998; Myers *et al.*, 2000; Cowling and Procheş, 2005; Procheş *et al*., 2005; 2006). .

The focus of this study was on the plants that sustained the carbohydrate component of lifestyles of early modern humans, particularly those bearing USOs (including geophytes). Unfortunately, most plant remains did not persist in archaeological deposits dating back to the origin of modern humans (Albert & Marean, 2012). However, botanists and travellers in the 17th, 18th and 19th centuries recorded numerous plant uses by Khoe-San peoples in the Cape (Skead *et al.*, 2009). Also, Later Stone Age (LSA) deposits in the Cape coastal region yielded ample evidence of the use of geophytes and fruits, presumably as food stuffs (Deacon & Deacon 1963; Deacon 1976; Opperman & Heydenrych 1990; Deacon & Deacon 1999). Marean (2010) hypothesised that the high diversity and abundance of geophytes in the Cape region would have provided a reliable source of high-quality carbohydrate, contributing to the persistence of our lineage in the Cape.

In order to assess the extent to which contemporary Khoe-San descendants on the Cape south coast harvest indigenous food plants, an ethnobotanical survey in the Still Bay area was conducted. Surprisingly, this was the first study of its kind focussing on people of Khoe-San descent in the Cape.

Still Bay is located between two important Middle Stone Age (MSA) archaeological sites, namely Blombos to the west and Pinnacle Point to the east (Fig. 2.1). Both sites have yielded some of the earliest evidence of behaviourally modern humans on record (Henshilwood *et al.*, 2002; Marean *et al.,* 2007; Brown *et al*., 2009; Marean *et al.,* 2010).

The rationale underpinning this study was to complement ongoing research to recreate the resource base and patterns of resource use by MSA peoples at the time when modern humans emerged (Marean & Assefa, 2005; Fisher *et al*., 2010; Marean, 2010).

The following questions were posed:

1. How many indigenous edible plant species were harvested by extant people of Khoe-San heritage and what were they used for?
2. Which species were most commonly harvested?

3. What were the growth forms and biome affinities of the harvested species?
4. What inferences could be drawn from my results regarding plant diets of early modern humans in the region?

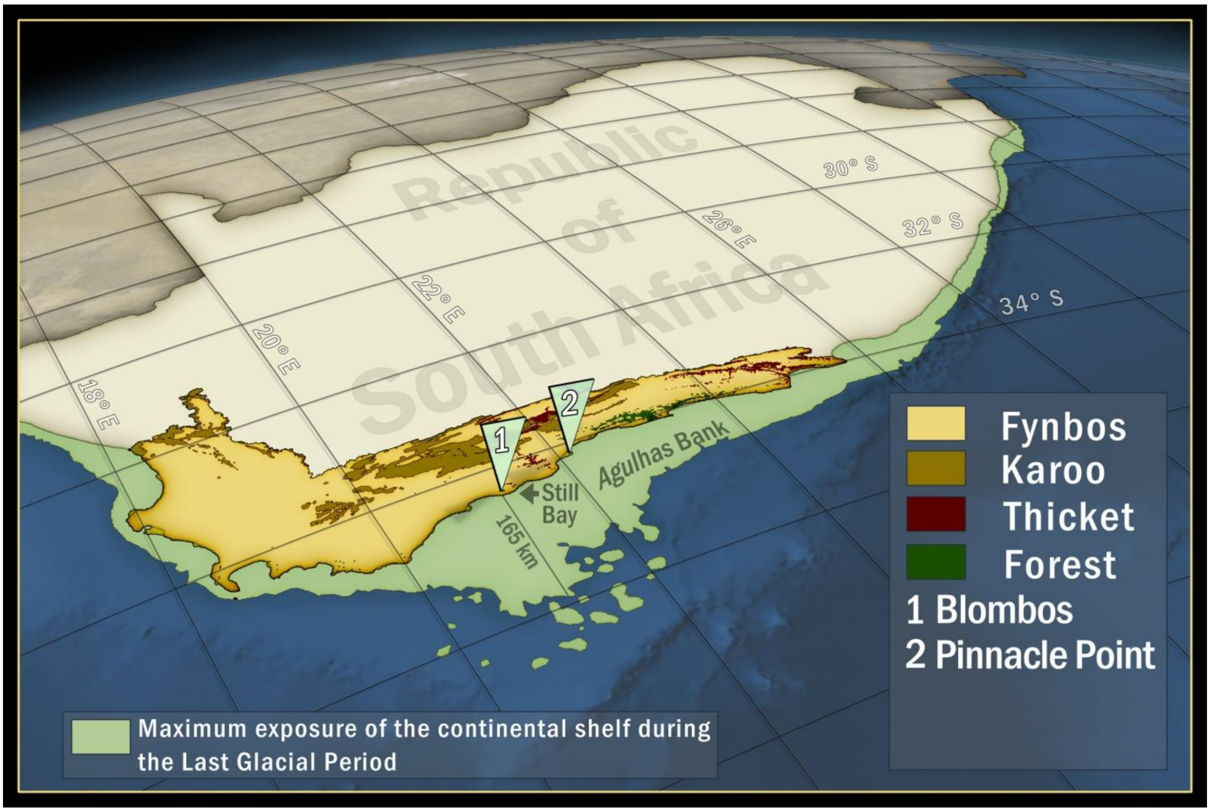


Fig. 2.1: The Cape Floristic Region showing the major biomes (Mucina & Rutherford, 2006), the major archaeological sites with MSA significance and the Agulhas Bank (continental shelf) that would have been variously exposed during the MSA (Fisher *et al*. 2010).

2.3 Methods

2.3.1 Study area

The southern Cape coast is essentially a rural area with low population densities. Still Bay is a small resort town in this region and has a permanent population of 6000 inhabitants. The residents include people of Khoe-San descent, the majority of which live in Melkhoutfontein, a settlement 4km northeast of Still Bay (Fig. 2.2). Others live in more rural contexts, such as Blikhuis, Kransfontein, Die Poort, Stonehaven and Vrye Uitsig.

These communities are still surrounded by large areas of relatively intact natural vegetation comprising Strandveld (a thicket-fynbos mosaic), Limestone Fynbos, Sand Fynbos and Valley Thicket (including both valley and dune forms) (Mucina & Rutherford, 2006). The combination of rural lifestyles and relatively intact indigenous plant resources increase the likelihood that some aspects of traditional foraging practices may have persisted to present times.

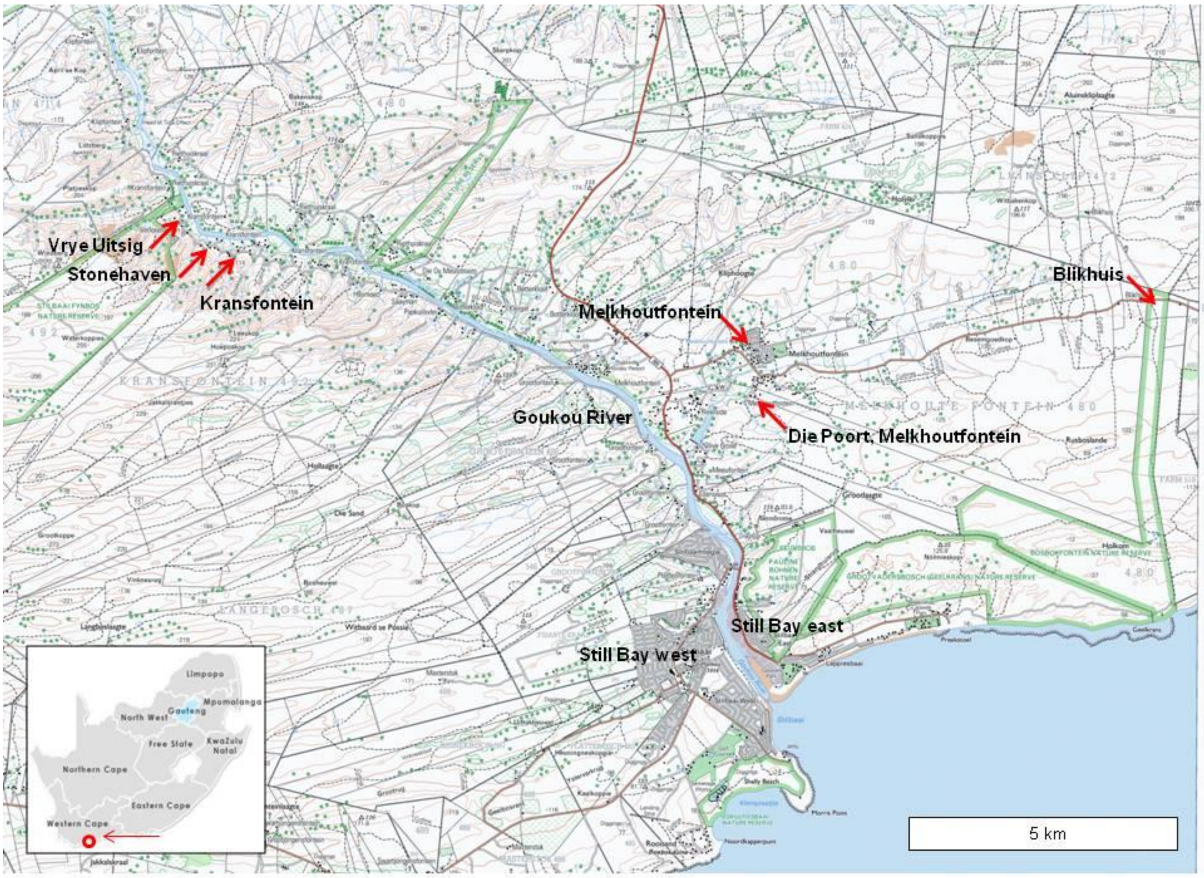


Fig. 2.2: The Still Bay area showing the different sites where participants were interviewed (adapted from National Geo-spatial Information, 2010).

2.3.2 Participants

During the study's scoping phase, I used a snowballing approach to identify a group of 18 people of Khoe-San descent who were known to have knowledge of indigenous plants and their uses (Table 2.1 and Fig. 2.3). They comprised 10 seniors over 55 years of age, six adults aged between 38 and 54 years and two teenagers of 13 and 16 years. The participants lived in areas that included all of the natural vegetation types described in Section 2.3.1)

Table 2.1: Participants in the ethnobotanical survey of indigenous edible plant uses in the Still Bay area. The abbreviations given in brackets are used in Table 2.2.

Name of participant	Age at time of survey	Geographical origin	Source of plant knowledge
Jilian Abrahams (JA)	53	Melkhoutfontein	Parents
Paulina Arendse (PA)	64	Kransfontein	Own experience
Dawid Baartman (DB)	73	Die Poort, Melkhoutfontein	Own experience, uncle
Marlin Baartman (MB)	17	Melkhoutfontein	Grandfather
Maria Busch (MBU)	50	Melkhoutfontein	Parents
Gerald Carelse (GC)	41	Melkhoutfontein	Parents, grandmother, aunt
Charlton Daniels (CD)	14	Blikhuis	Grandmother
Anna (Barbie) Daries (AD)	74	Melkhoutfontein	Grandparents
Johanna Daries (JD)	79	Melkhoutfontein	Parents
Cornelius Griffie (CG)	70	Melkhoutfontein	Parents
Charles Jakobs (CJ)	51	Melkhoutfontein	Grandmother
Marthinus (Faan) Jakobs (MJ)	56	Stonehaven	Parents, elders
Elsie (Ella) Kleinhans (EK)	73	Blikhuis	Parents
Mary Kortje (MK)	71	Melkhoutfontein	Mother
Jacobus Plaatjies (JP)	28	Vrye Uitsig	Parents, elders
Johannes Julian Riddles (JR)	43	Melkhoutfontein	Parents, grandparents
Nellie Riddles (NR)	91	Blikhuis	Parents
Anna Saayman (AS)	69	Melkhoutfontein	Mother, grandmother

Fig. 2.3: Photographs of survey participants listed in Table 2.1

2.3.3 Survey methods

Following standard ethnobotanical guidelines (Martin, 1995), a list of all known edible, medicinal and otherwise useful plant and animal species was compiled based on information gleaned from the participants as well as published sources (Fox *et al.*, 1982; Skead *et al.*, 2009). This list comprised 140 plant and seven animal species (Appendix 1), all of which were identified and photographed.

Plant specimens were collected and prepared as voucher specimens, and stored in the herbarium of the Botany Department at Nelson Mandela Metropolitan University. In the case of plant genera where all species are regarded as being edible (e.g. the corms of *Babiana* and *Watsonia*) (Deacon & Deacon 1963; Deacon 1976; Fox *et al.*, 1982; Opperman & Heydenrych 1990; Deacon & Deacon 1999; Skead *et al.*, 2009), I included all species in the study area as edible.

Then, interviews with the 18 participants were conducted following the principles embodied in the Code of Ethics of the International Society of Ethnobiology (International Society of Ethnobiology, 2006). In each interview, participants were shown voucher specimens and the photographs of each of the species listed in Appendix 1 and asked how they were used. I recorded and transcribed each interview in Afrikaans, the native language of the participants.

The matrix method devised by De Beer and Van Wyk (2011) for an ethnobotanical survey of Khoe-San descendants in the Hantam area in the Succulent Karoo biome was adopted. This method provided a quantified measure of rating knowledge. The matrix method is based on three questions that score the knowledge base of the participant and the popularity of the species displayed. The three questions are: do you know the species; do you have a name for it; and what is its use? A species popularity index (SPI) was calculated by dividing the number of participants still using a species by 18, the total number of participants. Finally, the ethnobotanical knowledge index (EKI), which is the percentage of the total tally species used by each participant, was determined. Given the focus of this chapter, only the indices for the indigenous edible plant component of the species in Appendix 2 were computed.

2.4 Results

2.4.1 Indigenous edible plant species harvested and utilised

The survey participants identified 58 indigenous edible plant species with a total of 69 uses from the list of potential species (different parts of the same plant may have different uses) (Table 2.2; Appendix 1). Almost half the uses were for fruit and a quarter for vegetable foodstuffs (Fig. 2.4). Plants bearing USOs comprised only 12% of recorded uses; nectar, herbs, seed and gum provided the remainder.

Harvested species were associated with 46 plant genera and 33 families (Table 2.2). The only family with more than four harvested species was Apocynaceae. Among the genera, only *Carpobrotus* (Aizoaceae) had more than two harvested species, while 10 genera had two species.

Table 2.2: Food utilisation of 58 indigenous plant species identified by participants of an ethnobotanical survey of the Still Bay area. See Table 2.1 for full names of participants (abbreviations in parentheses).

Species	Vernacular name(s)	Food utilisation in the Still Bay area	Evidence from literature sources
1. *Acacia karroo* Hayne (Fabaceae); PEU22993	Pendoringboom, witpendoring, doringboom	Gum eaten as a snack (PA, DB, GC, JD, CG, CJ, MJ)	Gum eaten (Observed by Barrow, 1801; Thompson, 1827. In: Skead *et al*., 2009).
2. *Annesorhiza nuda* (Aiton) B.L.Burtt (Apiaceae); PEU22948	Anyswortel, liquorice plant	Roots are eaten (MBU); chew the leaf for the liquorice taste (JA)	
3. *Aponogeton distachyos* L.f. (Aponogetonaceae); PEU22998	Waterblommetjies	Inflorescences used for stew (JA, PA, DB, MBU, GC, CG, CJ, MJ, EK, JP, JR); some leaves added (AD, JD, AS)	Flowers eaten (Observed by Burchell, 1822; Bunbury, 1848. In: Skead *et al*., 2009). Flower stems eaten (Observed by Backhouse, 1844. In: Skead *et al*., 2009). Roots eaten roasted (Observed by Thunberg, 1793; Barrow, 1801; Burchell, 1822. In: Skead *et al*., 2009).
4. *Asparagus capensis* L. (Asparagaceae); PEU22906	Katdoring, kattedoring, katbos	Children eat the berries (PA)	
5. *Astephanus triflorus* (L.f.) Schult.	Vissies	Young fruits are eaten (JA, MBU, GC, AD, JD, MJ, MK, AS, DB, CJ)	

(Apocynaceae); PEU22952			
6. *Babiana ambigua* (Roem. & Schult.) G.J. Lewis (Iridaceae); PEU23015	Bobbejaantjie	Corms eaten by children (in former times); all *Babiana spp.* with blue to purple flowers eaten in this area (JR)	
7. *Babiana patula* N.E.Br. (Iridaceae); PEU22958	Bobbejaantjie	Corms eaten by children (in former times) (JD, JR, NR)	
8. *Carissa bispinosa* (L.) Desf. ex Brenan (Apocynaceae); PEU22896	Noem-noem	Fruits are eaten (JA, PA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MK, JP, NR, AS); they give you energy (JR); when eaten in large amounts the latex accumulate in the mouth (like chewing gum) (MJ)	Fruit eaten (Observed by Barrow, 1801; Burchell, 1822. In: Skead *et al*., 2009).
9. *Carpobrotus acinaciformis* (L.) L.Bolus (Aizoaceae); PEU22900	Suurvye, vyeranke	Fruits are eaten (when soft and yellow or when dry) (JA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, MK, JR, AS, EK, NR, JP); or used to make jam (DB, MB, MBU, GC, AD, JD, CJ, JR, AS)	Fruit eaten (Observed by Thunberg, 1793. In: Skead *et al*., 2009).
10. *Carpobrotus edulis* (L.) L.Bolus (Aizoaceae); PEU22899	Ghoena	Fruits are eaten (when ripe – soft and yellow, not when dry) (JA, PA, DB, MB, MBU, GC, AD, CD, CG, CJ, MJ, MK, JR, NR); or used for jam (PA)	Fruit eaten (Observed by Thunberg, 1793; Burchell, 1822; Backhouse, 1844; Bunbury, 1848. In: Skead *et al*., 2009).
11. *Carpobrotus muirii* (L.Bolus) L.Bolus (Aizoaceae); PEU22898	Suurvye, suurvytjie, wilde suurvy	Fruits are eaten (MK, JR)	
12. Cassine peragua (L.) (Celastraceae); PEU22969	Droëlewer(bessies)	Berries eaten (JA)	
13. *Chironia baccifera* L. (Gentianaceae); PEU22916	Bitterbos, bitterbessiebos, spreeubos	Fruit is edible (JR)	

14. *Cyclopia genistoides* (L.) R.Br. (Fabaceae); PEU23002	Wildetee, teeblommetjie, duinetee	Infusion of whole herb (with flowers) used as tea (PA, CD, CJ, MJ, NR, AS)	
15. *Cynanchum obtusifolium* L.f. (Apocynaceae); PEU22894	Klimop, pôka (plant); pok-pôk, kapôke, pa-pôk, papie (fruits)	Unripe fruits eaten by children (PA, DB, MB, MBU, GC, CD, JD, CJ, MJ, EK, MK, JP, JR); or the inner part only (CG, AS); in case of old fruits (JA, MBU)	
16. *Cyperus textilis* Thunb. (Cyperaceae); PEU22957	Toue, tou	Bottom end of stem edible (sweet) (JD)	
17. *Cyphia digitata* (Thunb.) Willd. (Campanulaceae); PEU22949	Baroe, barou, bruin baroe	Raw tubers eaten by children (PA, DB, MB, GC, AD, CD, JD, CG, MJ, MK, JP, NR, JR, AS, EK, CJ, JA); it is astringent (MBU); two pebbles used as place markers in dry season because the tuber tastes better in the growing season (JD); peel skin off and eat raw (JD)	Tubers eaten (Observed by Thunberg, 1795. In: Skead *et al*., 2009).
18. *Cyphia undulata* Eckl. (Campanulaceae); PEU23016	Baroe, barou, wit baroe	Raw tubers eaten by children (JA, PA, DB, MB, GC, AD, CD, CG, MJ, MK, JP, NR, JR, AS); it is sweet (MBU)	
19. *Diospyros dichrophylla* (Grand.) De Winter (Ebenaceae); PEU22970	Jakkals(tol)bos (plant) jakkalstolle (fruits)	Fruits are eaten (PA, DB, MBU, GC, CD, CG, CJ, MJ, EK, MK, JP, NR, AS)	
20. *Emex australis* Steinh. (Polygonaceae); PEU22972	Dubbeltjie, duwweltjie	Leaves edible, used in stews (CJ, MJ)	Leaves edible (Observed by Pappe, 1862).
21. *Euclea racemosa* Murray (Ebenaceae); PEU22924	Seeghwarrie, ghwarrie	Ripe fruits are eaten (MBU, JR)	
22. *Euclea undulata* Thunb. (Ebenaceae); PEU22991	Ghwarrie	Ripe fruits are eaten (DB, CJ, NR)	Fruit eaten (Observed by Thunberg, 1793; Barrow, 1801. In: Skead *et al*., 2009).

23. *Grewia occidentalis* L. (Malvaceae); PEU22941	Dadels, broodjie, basbessie	Ripe fruits are eaten (JA, DB, GC, CG, MJ, JP)	
24. *Juncus kraussii* Hochst. (Juncaceae); PEU23017	Krap-my-nie	Bottom end of stems edible (pull them out) (JD)	
25. *Lauridia tetragona* (L.f.) R.H.Archer (Celastraceae); PEU22909	Droëlewer(bessies)	Fruits eaten (MBU, GC, AD, JD, AS); if too many, then dries the mouth (MBU)	
26. *Leonotis leonurus* (L.) R.Br. (Lamiaceae); PEU22897	Wildedagga, vleidagga, manbossie	Nectar sucked from flowers (JP)	
27. *Leonotis ocymifolia* (Burm.f.) Iwarsson (Lamiaceae); PEU22887	Koppie(s)dagga	Nectar sucked from flowers (JP)	
28. *Mentha longifolia* (L.) Huds. (Lamiaceae); PEU22938	Makmint	Used in food (JA); added to tea (JA); used to flavour ice water (leaf added) (CG)	Dried for tea (Observed by Backhouse, 1844. In: Skead *et al*., 2009).
29. *Microloma saggitatum* (L.) R.Br. (Apocynaceae); PEU22983	Bokhoring, bokhorinkie	Young fruits are eaten (JA, PA, DB, MBU, GC, AD, CD, JD, CG, EK, JP, JR, NR, AS, CJ)	
30. *Muraltia spinosa* (L.) F. Foster & J.C. Manning (Polygalaceae); PEU22921	Skilpadbessie(bos)	Ripe berries are eaten (JA, DB, MB, MBU, GC, CD, JD, CG, MJ, MK, JP, CJ); add sugar and yeast to make a potent beer (GC, CJ)	Fruit eaten (Observed by Thunberg, 1793. In: Skead *et al*., 2009).
31. *Olea europaea* ssp. *africana* L. (Oleaceae); PEU22988	Swartolien, swartoleen, swartolienhout, wilde-olyf	Fruits are eaten (DB, MB, JP); leaves added to ginger beer (GC)	
32. *Osteospermum*	Bietou(bos)	Ripe berries are eaten (JA, PA, DB,	

moniliferum L. (Asteraceae); PEU22903		MBU, GC, AD, CD, JD, MJ, EK, MK, JP, NR, AS, JR, CJ, CG); including the seeds (considered to be nutritious) (JR); or harmful to the appendix (CG)	
33. *Osyris compressa* (P.J.Bergius) A.DC. (Santalaceae); PEU22913	Basbos, basboom, basbessie(boom), basbessiebos, bessiebos	Berries (sometimes with seeds) eaten by children (JA, DB, MB, MBU, GC, AD, CD, CG, CJ, MK, JP, JR, NR, AS, PA, JD, MJ, EK)	
34. *Oxalis pes-caprae* L. (Oxalidaceae); PEU22968	Suring	Flowers stalks are eaten (JA, PA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, EK, MK, NR, AS, JP, JR); bulbs are eaten (JA, PA, DB, MBU, GC, CJ, MJ, JR); an ingredient of *waterblommetjie* stew (AD, AS)	Flower stalks eaten (Observed by De Vries, 1627. In: Skead *et al*., 2009).
35. *Oxalis polyphylla* Jacq. J.R.J.A.M.B. (Oxalidaceae); PEU22951	Suring	Flower stalks and bulbs eaten (JR)	
36. *Pelargonium peltatum* (L.) L'Hér. (Geraniaceae); PEU22943	Wildemalva	Fresh leaf is eaten (sour taste) (JP, JR)	
37. *Polygala myrtifolia* L. (Poygalaceae); PEU22905	Septemberbossie, septemberblom	Nectar sucked from flowers (by children) (JA, DB, MB, MBU, GC, AD, CD, CG, MK, JR, AS)	
38. *Prionium serratum* (L.f.) Drège ex E.Mey (Juncaceae); PEU22955	Palmiet	Inner top part of (young) stem eaten (PA, CG, CJ, JP, JR); slices eaten on sandwiches (CJ); tastes like butter (CJ); young stems eaten when plants flower (MJ); or after flowering (CG); young inflorescence eaten (CJ); my brother used to eat *palmiet*, but details forgotten (JD)	"Root" reported to be eaten (Pappe, 1862; Watt & Breyer-Brandwijk, 1962; Fox *et al.*, 1982).
39. *Protea obtusifolia* H.Buek ex Meisn. (Proteaceae); PEU23008	Suikerkaane, protea	Nectar sucked from flowers (JA, DB, MB, MBU, GC, AD, CD, JD, CJ, MJ, EK, MK, JP, JR, NR, AS, PA, CG)	
40. *Protea repens* (L.) L. (Proteaceae); PEU23009	Suikerkaane, protea	Nectar sucked from flowers (JA, DB, MB, MBU, GC, AD, CD, JD, CJ, MJ, EK, MK, JP, JR, NR, AS, PA, CG); the preferred species	Nectar sucked from flowers (Observed by Barrow, 1801; Bunbury, 1848. In:

			Skead *et al*., 2009).
41. *Quaqua mammilaris* (L.) Bruyns (Apocynaceae); PEU22987	Horlosie, bokhoring, oumakosie	Flowers eaten, known as *horlosies* (JA, PA, DB, MBU, GC, CG, CJ, MJ, JP); fruits eaten, known as *bokhoringkies* (JA, PA, DB, MB, MBU, GC, JD, CG, MJ)	
42. *Romulea rosea* (L.) Eckl. (Iridaceae); PEU22874	Froetang(s), knikkers	Fruits are eaten by children (JA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, EK, JP, JR, NR, AS, MK)	
43. *Salvia africana-lutea* L. (Lamiaceae); PEU22885	Bergtee, wildesalie, duinesalie, teeboom, saliebos, veldsalie	Oven-dried leaves: a tasty tea (PA, AD); nectar sucked from flowers (MBU)	
44. *Searsia glauca* (Thunb.) Moffett (Anacardiaceae); PEU22911	Kraaikos, taaibos, konkeltaaibos, spreeubos	Ripe fruits are eaten (JA, PA, DB, MB, MBU, GC, AD, CD, CG, CJ, EK, MK, NR, AS, JD, MJ, JP, JR)	
45. *Searsia lucida* (L.) F.A.Barkley (Anacardiaceae); PEU22974	Taaibos, knakerbos, knakertaaibos, knakerdopbos, knakers, appelgap	Children eat the fruits (JD, CG, CJ, MJ, EK, NR, JA, MK); galls on stems eaten, after blowing out the insect inside (MBU, GC, AD, CD, JD, JP, JR, AS)	
46. *Sideroxylon inerme* L. (Sapotaceae); PEU22929	Melkhoutboom	Ripe fruits are eaten (JA, PA, GC, CD, CG, MJ, JR; NR)	
47. *Solanum africanum* Mill. (Solanaceae); PEU22876	Nasgal, nastergal	Ripe fruits are eaten (PA, JR, NR)	
48. *Solanum retroflexum* Dunal. (Solanaceae); PEU22942	Nasgal, nastergal	Ripe fruits are eaten (DB, JD, MJ, MK, JR, AS); leaf used (sparingly) when cooking with spinach for flavour (AS)	
49. *Sutherlandia frutescens* (L.) R.Br. (Fabaceae); PEU22936	Keurtjie(s), kankerbossie	Unripe seeds eaten as snack (JA, MBU, GC, CD)	

50. *Thamnochortus insignis* Mast. (Restionaceae); PEU22944	Riet, dekriet	Internodes are pulled out and the soft tips eaten (JA, MB, MBU, GC, AD, CD, JP)	
51. *Trachyandra ciliata* (L.f.) Kunth (Asphodelaceae); PEU22883	Wilde groenboon, kool, veldkool	Young inflorescences eaten as stew (JA, MBU, AD, CJ)	
52. *Trachyandra divaricata* (Jacq.) Kunth (Asphodelaceae); PEU22889	Veldkool	Young inflorescences eaten as stew (JA, MBU)	
53. *Tritonia squalida* (Aiton) Ker Gawl. (Iridaceae); PEU23018	Kalkoentjie	Corms are eaten (JR)	
54. *Tulbaghia violacea* Harv. (Alliaceae); PEU23012	Wildeknoffel, veldknoffel, bergknoffel	Used as culinary herb in meat dishes (AS); especially offal (AD)	
55. *Typha capensis* (Rohrb.) N.E.Br. (Typhaceae); PEU23013	Papkuil	Stems are eaten (PA)	
56. *Viscum capense* L.f. (Viscaceae); PEU22956	Voëlent, voëlentjie	Infusion as tasty (not medicinal) tea (MBU, JD); tasty tea prepared by chopping the stems and placing them in a bag close to the fire until they turn brown (DB); fruits are edible (AD, EK, NR)	
57. *Viscum rotundifolium* L.f. (Viscaceae); PEU22891	Voëlent, rooibessielidjiesbos	Fruits are eaten (PA, MJ)	
58. *Zygophyllum morgsana* L. (Zygophyllaceae); PEU22877	Spekbos(sie)	Seeds are eaten (JA, MBU, GC)	

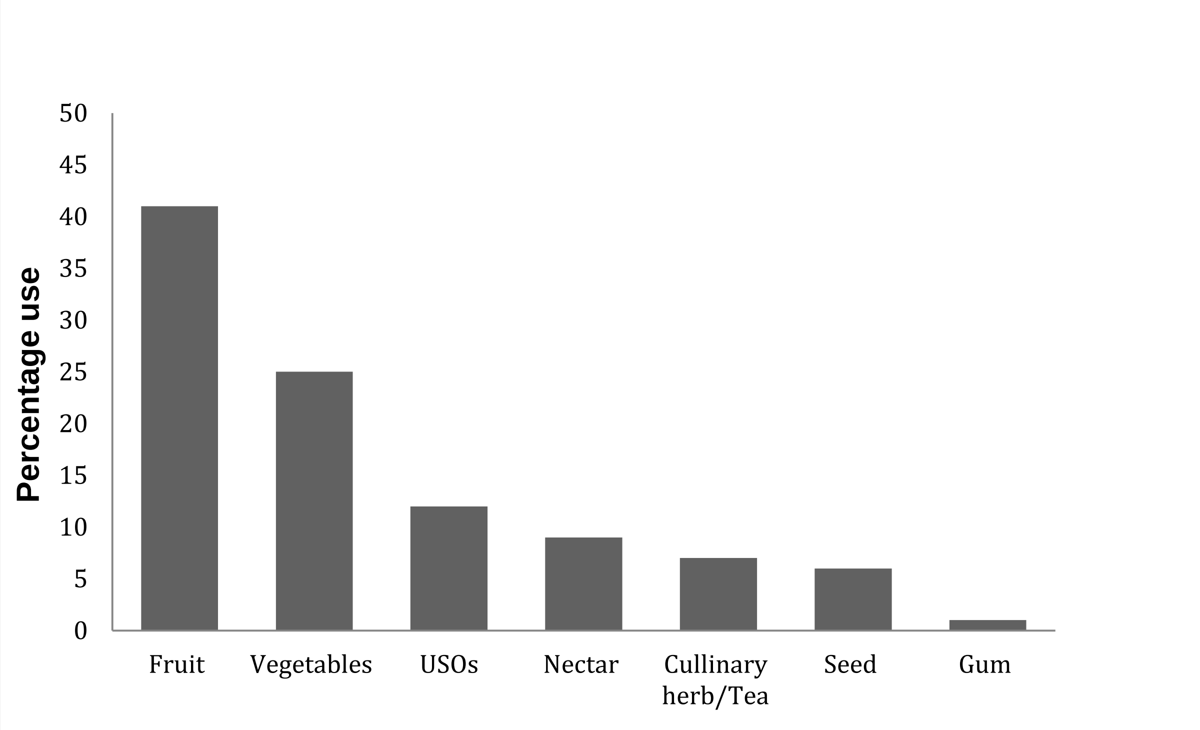


Fig. 2.4: Indigenous edible plant species use by Khoe-San descendants in the Still Bay area of the southern Cape coast.

2.4.2 Identification of most commonly harvested species

As a group, fruit-bearing species had the highest SPI (= 0.52) (Fig. 2.5; Fig. 2.6; Appendix 2). These included five species (*Carissa bispinosa, Carpobrotus edulis, Muraltia spinosa, Osyris compressa* and *Searsia glauca*) that were harvested by all participants, and another seven species (*Carpobrotus acinaciformis, Cynanchum obtusifolium, Diospyros dichrophylla, Microloma saggitatum, Ostospermum moniliferum, Romulea rosea* and *Searsia lucida*) that had SPI's greater than 0.80 (Table 2.3). Nectar producing species had the second highest SPI, largely as a consequence of all participants identifying *Protea obtusifolia* and *P. repens* as sources. Third ranked were species bearing USOs. The SPI for this group (= 0.34) was largely underpinned by the strong preference for the two *Cyphia* species. Knowledge of edible Iridaceae (*Watsonia, Babiana, Tritonia*) was low. The gum-producing *Acacia karoo* and seed-yielding species had the same popularity, the latter driven by *Osyris compressa* with a SPI of 1.00. Knowledge of species yielding vegetable food was low overall (SPI = 0.24); however, there was wide variation within categories. Commonly identified species were *Oxalis pes-caprae* (flower stalks) (SPI = 1.00) and *Aponogeton distachyos* (inflorescences) (SPI = 0.77). With the exception of *Cyclopia genistoides* (SPI = 0.33), few participants identified any of the other culinary herb/tea species.

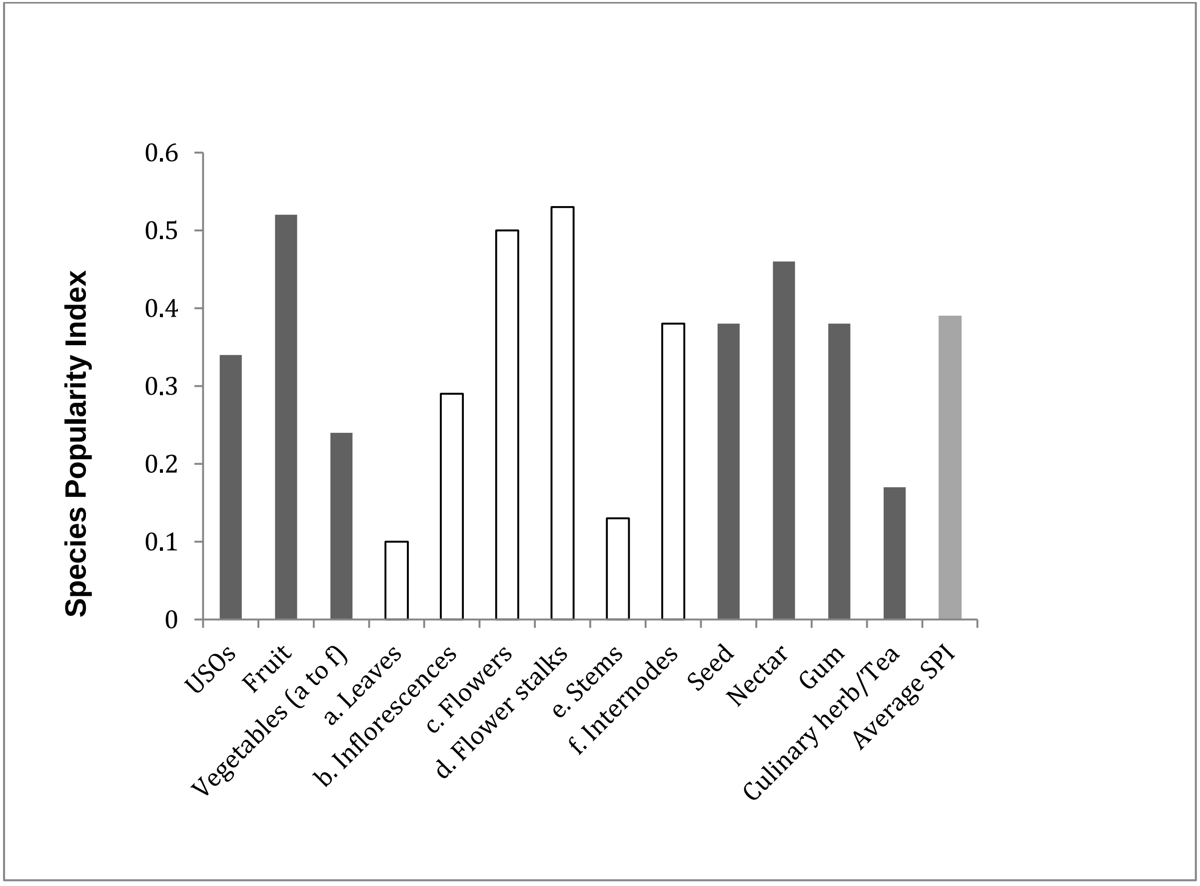
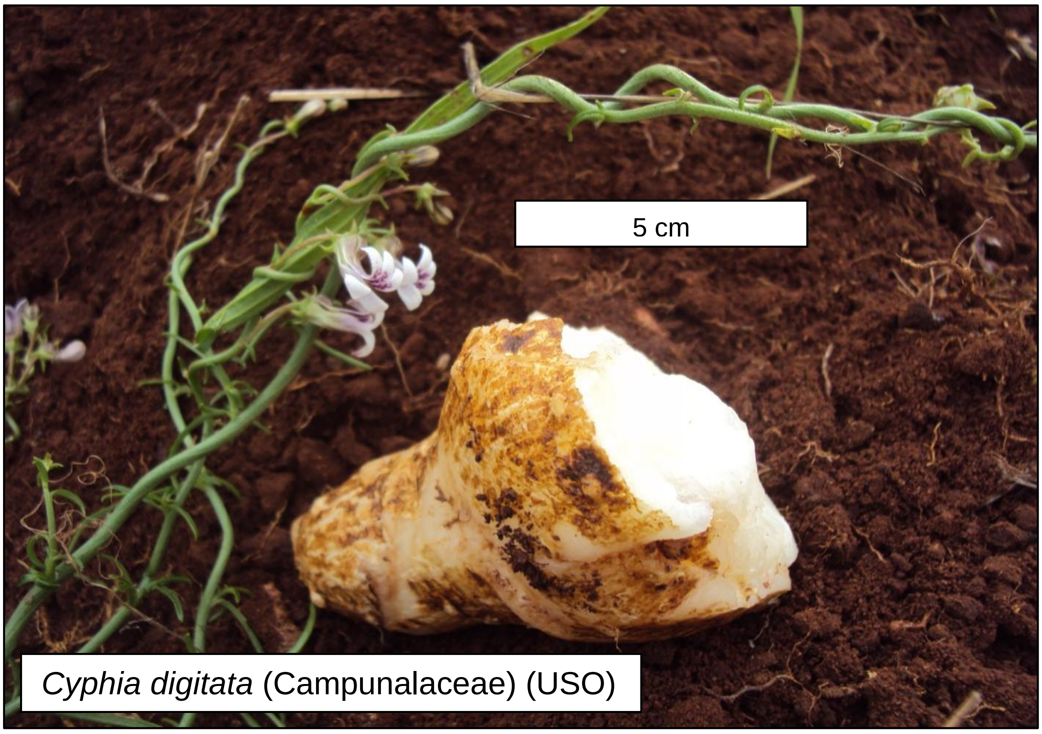


Fig. 2.5: Indigenous edible plant uses ranked by the Species Popularity Index (see Table 2.3 for detailed ranking of species uses).

Table 2.3: Indigenous edible plant species by use and rank (see Appendix 2 for ranking of all species).

Species by use	**Rank**	**SPI**
USO bearing plant		
Cyphia digitata	1	1.00
C. undulata	2	0.83
Fruit		
1. Carissa bispinosa	1	1.00
2. Carpobrotus edulis	1	1.00

3. Muraltia spinosa	1	1.00
4. Searsia glauca	1	1.00
5. Carpobrotus acinaciformis	5	0.94
6. Ostospermum moniliferum	5	0.94
7. Romulea rosea	5	0.94
8. Cynanchum obtusifolium	8	0.88
9. Diospyros dichrophylla	8	0.88
10. Microloma saggitatum	10	0.83
11. Searsia lucida	10	0.83
Vegetable		
Flower stalk		
1. Oxalis pes-caprae	1	1.00
Seed		
1. Osyris compressa	1	1.00
Nectar		
1. Protea obtusifolia	1	1.00
2. Protea repens	1	1.00



Cyphia digitata (Campunalaceae) (USO)

Carissa bispinosa (Apocynaceae) (Fruit)

Muraltia spinosa (Polygalaceae) (Fruit)

Searsia glauca (Anacardiaceae) (Fruit)

Carpobrotus acinaciformis (Aizoaceae) (Fruit)

Osteospermum moniliferum (Asteraceae) (Fruit)

Cynanchum obtusifolium (Apocynaceae) (Fruit)

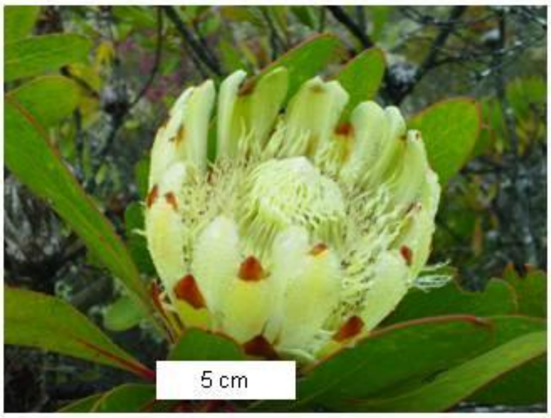
Diospyros dichrophylla (Ebenaceae) (Fruit)

Microloma saggitatum (Apocynaceae) (Friut)

Searsia lucida (Anacardiaceae) (Fruit)

Osyris compressa (Santalaceae) (Fruit)

Oxalis pes-caprae (Oxalidaceae) (Veg.)



Protea repens (Proteaceae) (Nectar)

Fig. 2.6: Photographs of the highest ranked USO, fruiting species and their uses.

2.4.3 Growth forms and biome affinities of the harvested species

Of the 58 indigenous edible plant species identified by the participants, shrubs were the most frequent growth form (34%) followed by geophytes and trees at 21% each (Fig. 2.7). Four of the geophytes were used for purposes other than the ingestion of their USOs, namely *Romulea rosea* (fruit), *Trachyandra ciliata* and *T. divaricata* (inflorescence, vegetable) and *Tulbaghia violacea* (culinary herb) (Table 2.2). Other growth forms, such as climbers, graminoids and forbs, comprised a minor component.

Species of Thicket Biome affinity dominated the sample (52%), followed by the Fynbos Biome (38%); wetlands contributed the remainder (10%).

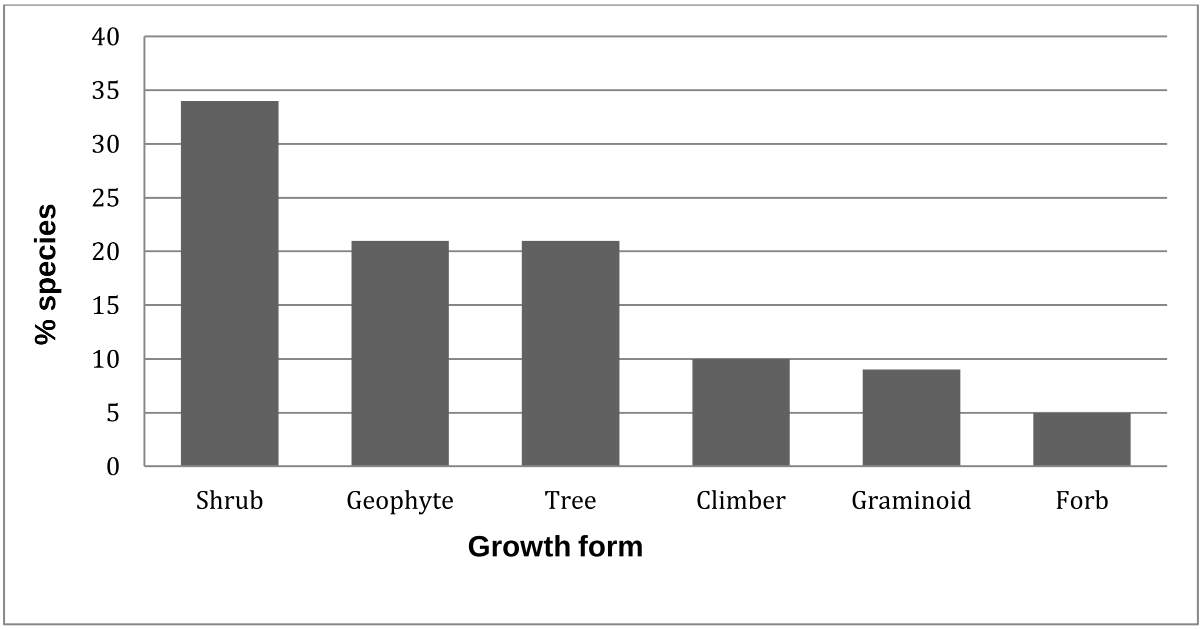


Fig. 2.7: Growth forms of 58 indigenous edible plant species of the Still Bay area.

2.5 Discussion

A total of 1002 indigenous edible plant species (Fox *et al.*, 1982), comprising 4.4% of South African flora (Van Wyk, 2011) have been documented in the past 300 years. While much of this food plant knowledge came from observations of Cape Khoe-San people (Skead *et al.*, 2009), no systematic studies were undertaken prior to their collapse as a consequence of colonial expansion. Despite this inevitable decline in knowledge the Khoe-San people of the Still Bay area still harvest 58 species, eight of which bear USOs. This is four times the recorded 14 species (two of which were USO bearing species) harvested for food by people of Khoe-San origin in the Agter-Hantam region of South Africa's Succulent Karoo Biome (De Beer & Van Wyk, 2011). Looking further afield at intact hunter-gatherer communities: Lee (1984) observed the !Kung San harvested 63 food plants in the Kalahari; Marlowe and Berbesque (2009) showed that the Hadza in Tanzania use 10 species, five of which were USO bearing; and, Hawkes *et al*. (1982) reported that the Aché of the subtropical forests of Paraguay forage for over 40 plant species with palm hearts (usually *Syagrus romanzoffiana*; Arecaceae) as their staple carbohydrate resource.

With the exception of palmiet (*Prionium serratum)*, which is rare in the study area, this study failed to identify species that could have formed a staple source of carbohydrate for pre-colonial Khoe-San peoples of the Cape south coast. *P. serratum* is locally dominant in flowing, acid waters of the Cape where it may form extensive wetlands (King, 1981) (Fig. 2.8). However, in the study area it is confined to a few patches of the Goukou River. While USO bearing plants comprised eight species (12% of total) only the *Cyphia* species emerged as important. Although *Cyphia* tubers are relatively large, (58.6 grams on average [Singels, 2013]) easy to harvest and with a very high moisture content, they had little nutritional value (Singels, 2013). As a result, they are harvested as a thirst-quenching meal mainly by children and consumed *in situ.* Indeed, most of the recorded species harvested are items consumed in the field (fruits, berries, nectar) or, in the case of vegetables, added to meals prepared primarily from commercially available foodstuffs (Coetzee & Miros, 2009).

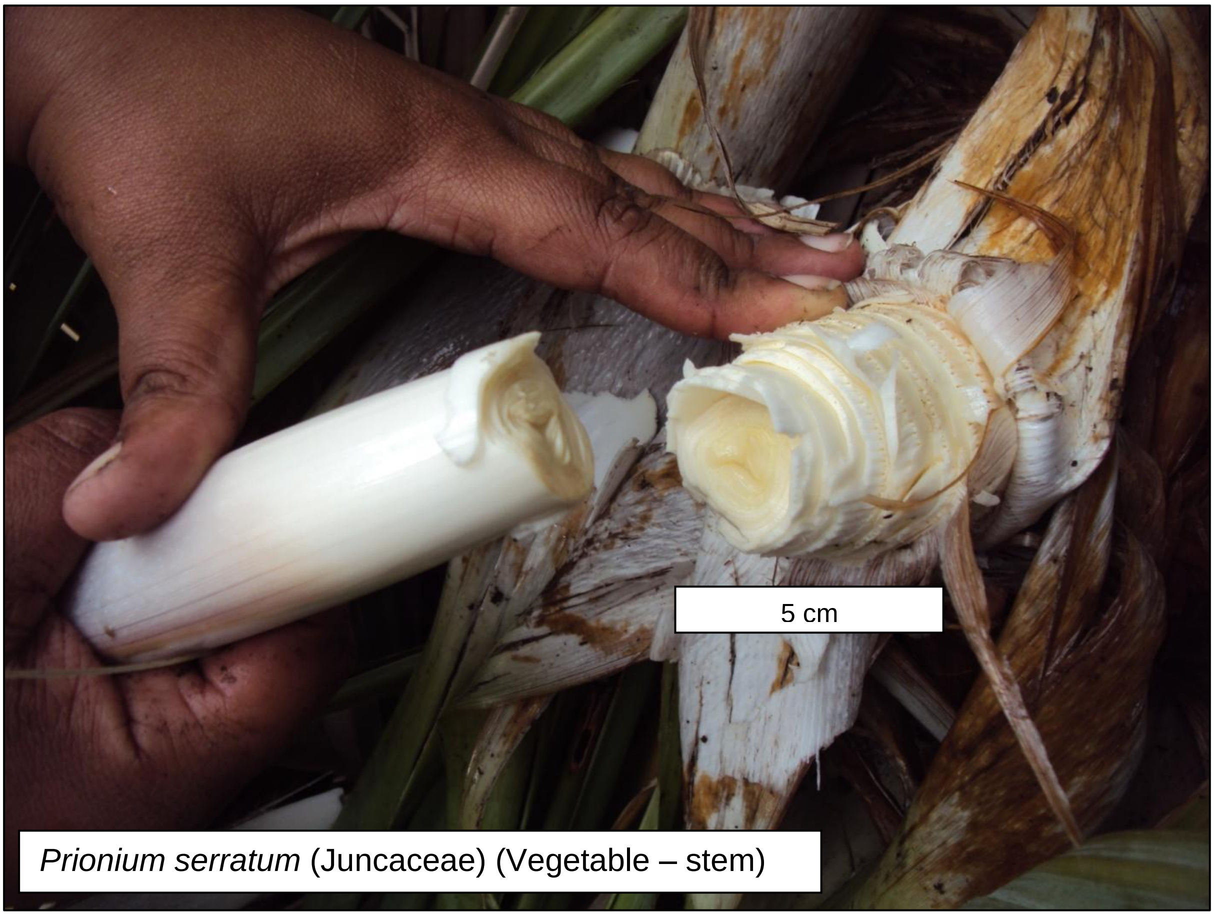


Fig. 2.8: Photograph of the inner stem or edible portion of *Prionium serratum*.

Despite archaeological, ethnographic and historical evidence for the use of plants bearing USOs (principally geophytes) as a staple carbohydrate by Khoe-San people (Bleek, 1956; Deacon & Deacon 1963; Deacon 1976; Opperman & Heydenrych 1990; Deacon & Deacon 1999; Marlowe & Berbesque, 2009; Skead *et al.*, 2009), there is little evidence today of this practice amongst the Khoe-San people of the Still Bay area. This is almost certainly due to the loss of hunter-gatherer lifestyles after colonization in the 1700's and the concomitant introduction of cereal crops. The integration of people into the cash economy, starting in the early to mid-20th Century (Viljoen, 2006; De Jongh, 2012), would have further hastened this lack of dependence on indigenous sources of carbohydrate. None of the participants in this study harvested the USO bearing plants typically associated with Khoe-San use, namely species of *Watsonia, Babiana* and certain other genera belonging to the Iridaceae family (Deacon & Deacon 1963; Deacon 1976; Opperman & Heydenrych 1990; Deacon & Deacon 1999). All the species used in this study do not require processing and are eaten raw. It is possible, therefore, that carbohydrates that require processing, such as those associated with *Watsonia* species, have been forgotten. Interestingly, certain species that can be eaten raw, namely the corms of *Babiana* species and *Moraea fugax* (Fox *et al.*, 1982; Peters, 1990; Youngblood, 2004), are unknown to the Still Bay people.

As Marlowe and Berbesque (2009) state, many varieties of USOs are low-ranked, fallback foods, specifically because they can be difficult to access and require processing. Another factor diminishing the use of USOs is that many are toxic. Even within genera, for example *Moraea,* some species are edible (.e.g. *Moraea fugax*) whilst most others are toxic (Hutchings, 1996; Van Wyk and Gericke, 2000; Van Wyk *et al.*, 2002; Kellerman *et al*., 2005). Distinguishing amongst edible and toxic species may require good taxonomic skills.

Most of the targeted species in this study were shrubs, as one would expect in a landscape dominated by species-rich fynbos shrublands. However, the relatively high incidence of shrubs associated with thicket vegetation of the coastal margin (Strandveld) and river valleys (Valley Thicket) was interesting, given that this component is the most species poor in Cape coastal environments (Cowling *et al.*, 1992). Geophytes were relatively well represented and this was to be expected given their high diversity in the Cape (Procheş *et al.*, 2005).

Among the harvested species, the Thicket Biome was best represented, despite comprising a relatively small area, followed by Fynbos, the predominant biome type in the region. Wetlands, which are generally species-poor and have limited extent, included some 10% of the species harvested. Globally, wetlands are important areas for human foragers (Wrangham *et al.*, 2009).

It is very difficult to draw inferences regarding the plant diets of early modern humans in the region as so much of the hunter-gatherer tradition has been lost. I speculate that *Prionium serratum* stems (owing to its year round availability, abundance in certain wetland habitats and ease of procurement), the USOs of some Iridaceae species, and the tubers of *Cyphia* species were the most likely sources of staple carbohydrates for hunter-gatherers on the Cape south coast. Contemporary people focussed on carbohydrate resources that were easily procured and readily eaten; carbohydrates that required cooking or other forms of processing were ignored (Pyke *et al.*, 1977; O'Connell & Hawkes, 1981). This was unlikely to be the case for hunter-gatherers, who lacked access to cereal crops during the pre-colonial years.

The study suggests the importance of Thicket Biome species that exceeds their richness and extent of this biome in the study area. In addition to providing an abundance of fruits and berries (Chapter 3), Thicket Biome species were also an important source of wood for fuel and implements, shelter (e.g. *Sideroxylon inerme* milkwood thickets), and honey (the last-mentioned was identified by many of the participants). The mosaic of thicket and fynbos ecosystems, each with their own suite of resources, was therefore probably important for sustaining hunter-gatherer communities on the Cape south coast.

2.6 References

Albert, R. M. and Marean, C. W. 2012. The exploitation of plant resources by early *Homo sapiens*: The Phytolith record from Pinnacle Point 13B Cave, South Africa. *Geoarchaeology* 27 (4): 363–384.

Barrow, J. 1801. *An account of travels into the interior of southern Africa 1797-1798.* Vol. 1. Cadell & Davies, London.

Basell, L. S. 2008. Middle Stone Age (MSA) site distributions in eastern Africa and their relationship to Quaternary environmental change, refugia and the evolution of *Homo sapiens*. *Quaternary Science Reviews* 27 (27-28): 2484-2498.

Bleek, D. F. 1956. *A Bushman dictionary.* American Oriental Society, New Haven, Connecticut.

Brown, K. S., Marean, C. W., Herries, A. I .R., Jacobs, Z., Tribolo, C., Braun, D., Roberts, D. L., Meyer, M. C. and Bernatchez, J. 2009. Fire as an engineering tool of early modern humans. *Science* 325 (5942): 859.

Coetzee, R. and Miros, V. 2009. *Koekemakranka: Khoi-Khoin-Kultuurgoed en kom-kuier-kos.* Lapa Uitgewers, Pretoria.

Cowling, R. M., Homles, P. M. and Rebelo, A. G. 1992. Plant diversity and endemism. In: Cowling, R. M. (ed.). *The ecology of fynbos: Nutrients, fire and diversity*. Oxford University Press, Cape Town. pp. 62-112.

Cowling, R. M. and Procheş, S. 2005. Patterns and evolution of plant diversity in the Cape Floristic Region. In: Friis, I. and Balslev, H. (eds.). *Plant diversity and complexity patterns: local, regional and global dimensions*. Proceedings of an International Symposium held at the Royal Danish Academy of Sciences and Letters in Copenghangen, Denmark, 25-28 May, 2003. *Biologiske Skrifter* 55: 273-288.

Cowling, R. M., Rundel, P. W., Desmet, P. G. and Esler, K. J. 1998. Extraordinary high regional scale plant diversity in southern African arid lands: subcontinental and global comparisons. *Diversity and Distributions* 4 (1): 27-36.

Crawhall, N. 2006. Languages, genetics, and archaeology: Problems and the possibilities in Africa. In: H. Soodyall (ed.). *The prehistory of Africa*. Jonathan Ball Publishers, Johannesburg & Cape Town. pp. 109-124.

Deacon, H. J. 1976. *Where hunters gathered: a study of Holocene Stone Age people in the Eastern Cape*. South African Archaeological Society, Claremont.

Deacon H. J. and Deacon, J. 1963. Scott's Cave: a late Stone Age site in the Gamtoos Valley Annals of the Cape Provincial Museums. *Natural History* 3: 96-112.

Deacon, H. J. and Deacon, J. 1999. *Human beginnings in South Africa: Uncovering the secrets of the Stone Age.* David Philip Publishers (Pty) Ltd, Cape Town.

De Beer, J. J. J. and Van Wyk, B. E. 2011. An ethnobotanical survey of the Agter-Hantam, Northern Cape Province, South Africa. *South African Journal of Botany* 77 (3): 741-754.

De Jongh, M. 2012. *Roots and routes: Karretjie people of the Great Karoo – the marginalisation of a South African First People*. Unisa Press, Pretoria. ch. 2.

Fagundes, N. J. R., Beaumont, N. M., Neuenschwander, S., Salzano, F. M., Bonatto, S. L. and Excoffier, L. 2007. Statistical evaluation of alternative models of human evolution. *Proceedings of the National Academy of Sciences* 104 (45): 17614-17619.

Faith J. T. 2011. Ungulate community richness, grazer extinctions, and human subsistence behavior in southern Africa's Cape Floral Region. *Palaeogeography, Palaeoclimatology, Palaeoecology* 306 (3): 219–227.

Fisher, E. C., Bar-Matthews, M., Jerardino, A. and Marean, C. W. 2010. Middle and Late Pleistocene paleoscape modeling along the southern coast of South Africa. *Quaternary Science Reviews* 29 (11): 1382–1398.

Foley, R. 1998. The context of human genetic evolution. *Genome Research* 8 (4): 339-347.

Fox, F. W., Young, M. M. N. and Hallowes, D. 1982. *Food from the veld: Edible wild plants of southern Africa botanically identified and described*. Delta books, Johannesburg.

Goldblatt, P. 1997. Floristic diversity in the Cape Flora of South Africa. *Biodiversity and Conservation* 6 (3): 359-377.

Hawkes, K., Hill, K. and O'Connell, J. F. 1982. Why hunters gather: optimal foraging and the Aché of eastern Paraguay. *American Ethnologist* 9 (2): 379-398.

Henshilwood, C. S., d'Errico, F., Yates, R., Jacobs, Z., Tribolo, C., Duller, G. A. T., Mercier, N., Sealy, J. C., Valadas, H., Watts, I. and Wintle, A. G. 2002. Emergence of modern human behavior: Middle Stone Age engravings from South Africa. *Science* 295 (5558): 1278-1280.

Hutchings, A. 1996. *Gladiolus dalenii* van Geel. In: *Zulu medicinal plants: An inventory.* University of Natal Press, Durban. p. 464.

International Society of Ethnobiology, 2006. *ISE Code of Ethics* (with 2008 additions) (viewed 19 June 2013) URL: www.ethnobiology.net/global_coalition/ethics.php.

Jerardino, A. and Marean, C. W. 2010. Shellfish gathering, marine paleoecology and modern human behavior: perspectives from cave PP13B, Pinnacle Point, South Africa. *Journal of Human Evolution* 59 (3): 412-424.

Kellerman, T. S., Coetzer, J. A .W., Naudé, T. W. and Botha, C. J. 2005. *Plant poisonings and mycotoxicoses of livestock in Southern Africa,* 2nd edn. Oxford University Press, Cape Town.

King, J. M. 1981. The distribution of invertebrate communities in a small South African river. *Hydrobiologia* 83 (1): 43-65.

Krishna, R., Veeramah, K. R., Wegmann, D., Woerner, A., Mendez, F. L., Watkins, J. C., Destro-Bisol G., Soodyall, H., Louie, L. and Hammer, M. F. 2012. An early divergence of KhoeSan ancestors from those of other modern humans is supported by an ABC-Based analysis of autosomal resequencing data. *Molecular Biology Evolution* 29 (2): 617-630.

Lahr, M. M. and Foley, R. A. 1998. Towards a theory of modern human origins: Geography, demography and diversity in recent human evolution. *Yearbook of Physical Anthropology* 41: 137-176.

Lee, R. B. 1984. *The Dobe !Kung*. Holt, Rinehart and Winston, Inc., New York. pp. 40-44.

Marean, C. W. 2010. Pinnacle Point Cave 13B (Western Cape Province, South Africa) in context: The Cape Floral kingdom, shellfish, and modern human origins. *Journal of Human Evolution* 59 (3-4): 425-443.

Marean, C. W. 2011. Coastal South Africa and the coevolution of the modern human lineage and the coastal adaptation. In: Bicho, N.S., Haws, J. A. and Davis, L. G. (eds.). *Trekking the shore. Interdisciplinary contributions to archaeology.* Springer, New York. pp. 421 – 440.

Marean, C. W. and Assefa, Z. 2005. The Middle and Upper Pleistocene African record for the biological and behavioral origins of modern humans. In: Stahl, A.B. (ed.). *African Archaeology.* Blackwell, New York. pp. 93-129.

Marean, C. W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A. I. R., Jacobs, Z., Jerardino, A., Karkanas, P., Minichillo, T., Nilssen, P. J., Thompson, E., Watts, I. and Williams H. M. 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature* 449 (7164): 905-908.

Marean, C. W., Bar-Matthews, M., Fisher, E., Goldberg, P., Herries, A., Panagiotis, K., Nilssen, P. J. and Thompson, E. 2010. The stratigraphy of the Middle Stone Age sediments at Pinnacle Point Cave 13B (Mossel Bay, Western Cape Province, South Africa). *Journal of Human Evolution* 59 (3-4): 234-255.

Marlowe, F. W. and Berbesque, J. C. 2009. Tubers as fallback foods and their impact on Hadza Hunter-Gatherers. *American Journal of Physical Anthropology* 140 (4): 751–758.

Martin, G. 1995. *Ethnobotany: a methods manual. A people and plant conservation manual*. WWF International, UNESCO and Royal Botanic Gardens, Kew. Chapman and Hall, London.

Masson-Delmotte, V., Stenni, B., Pol, K., Braconnot, P., Cattani, O., Falourd, S., Kageyama, M., Jouzel, J., Landais, A., Minster, B., Barnola, J. M., Chappelaz, J., Krinner, G., Johnsen, S., Röthlisberger, R., Hansen, J., Mikolajewicz, U. and Otto-Bliesner, B. 2010. EPICA Dome C record of glacial and interglacial intensities. *Quaternary Science Reviews* 29 (1): 113-128.

Matthews, T., Marean, C. W. and Nilssen, P. J. 2009. Micromammals from the Middle Stone Age (92 000 – 167 000 ka) at Cave PP13B, Pinnacle Point, south coast, South Africa. *Paleontologia Africana* 4: 112–120.

Mucina, L. and Rutherford, M. C. (eds.). 2006. *The vegetation of South Africa, Lesotho, and Swaziland.* Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403 (6772): 853-858.

National Geo-spatial Information. 2010. Department of Rural Development and Land Reform, Mowbray, Cape Town. map 3421AD.

Negre, C., Zahn, R., Thomas, A. L., Masqué, P., Henderson, G. M., Martínez-Méndez, G., Hall, I. R. and Mas, J. L. 2010. Reversed flow of Atlantic deep water during the Last Glacial Maximum. *Nature* 468 (7320): 84-88.

O'Connell, J. F. and Hawkes, K. 1981. Alyawara plant use and optimal foraging theory. In: Winterhalder, B. and Smith, E.A., (eds.). *Hunter-gatherer foraging strategies: Ethnographic and archeological analyses.* University of Chicago Press, Chicago. pp. 99-125.

Opperman, H. and Heydenrych, B. 1990. A 22 000 Year-Old Middle Stone Age camp site with plant food remains from the North-Eastern Cape. *The South African Archaeological Bulletin* 45 (152): 93-99.

Pappe, K. W. L. 1862. *A description of South African forest-trees and arborescent shrubs used for technical and economical purposes by the colonists of the Cape of Good Hope*. W. Brittain, Cape Town. pp. 50-54.

Parkington, J. E. 2001. Milestones: The impact of the systematic exploitation of marine foods on human evolution. In: Tobias, P. V., Raath, M. A., Moggi-Cecci, J. and Doyle, G. A., (eds.). *Humanity from African naissance to coming millennia - colloquia in human biology and palaeoanthropology*. Firenze University Press, Firenze. pp. 327-336.

Parkington, J. E. 2003. Middens and moderns: shellfishing and the Middle Stone Age of the Western Cape, South Africa. *South African Journal of Science* 99 (5-6): 243.

Parkington, J. E. 2010. Coastal diet, encephalization, and innovative behaviors in the late Middle Stone Age of southern Africa. In: Stephen Cunnane and Kathlyn Stewart (eds.). *Human Brain Evolution: The Influence of Freshwater and Marine Food Resources.* Wiley-Blackwell, New York. pp. 189-202.

Peters, C. R. 1990. African wild plants with rootstocks reported to be eaten raw: the monocotyledons, part I. *Mitteilungen aus dem Institut für Allgemeine Botanik Hamburg* 23: 935-952.

Pickrell, J. K., Patterson, N., Barbieri, C., Berthold, F., Gerlach, L,. Güldermann, T., Kure, B., Mpoloka, S. W., Nakagawa, H., Naumann, C., Lipson, M., Loh, P., Lachance, J., Mountain, J., Bustamante, C. D., Berger, B., Tishkoff, S. A., Henn, B. M., Stoneking, M. and Reich, D. 2012. The genetic prehistory of southern Africa. *Nature Communications* 3: 1143.

Procheş, S., Cowling, R. M. and du Preez, D. R. 2005. Patterns of geophyte diversity and storage organ size in the winter-rainfall region of southern Africa. *Diversity and Distributions* 11 (1): 101-109.

Procheş, S., Cowling, R. M., Goldblatt, P., Manning, J. C. and Snijman, D. A. 2006. An overview of the Cape geophytes. *Biological Journal of the Linnean Society* 87 (1): 27-43.

Pyke, G., Pulium, R. and Charnov, E .L. 1977. Optimal foraging theory: A selective review of theory and tests. *Quarterly Review of Biology* 52: 137-154.

Schlebusch, C. 2010. Issues raised by use of ethnic-group names in genome study. *Nature* 464 (7288): 487.

Schwegler, M. 2003. *Medicinal and other uses of Southern Overberg Fynbos lants*. M. Schwegler, Cape Town.

Singels E. 2013. *Underground storage organs of plants as a food source for Pleistocene hunter-gatherers in the Southern Cape.* Masters thesis, Stellenbosch University.

Skead, C. J., Manning, J. C. and Anthony, N. C. 2009. *Historical plant incidence in southern Africa: a collection of early travel records in southern Africa*. South African National Biodiversity Institute, Pretoria.

Soodyall, H. 2011. *Report on genetic ancestry studies carried out in the Hessequa region.* University of the Witwatersrand, Johannesburg.

Soodyall, H. and Trefor, J. 1997. "Khoisan prehistory: the evidence of the genes." *Khoisan identities and cultural heritage conference, University of the Western Cape, held at the South African Museum, Cape Town*.

Van Wyk, B.-E. 2002. A review of ethnobotanical research in South Africa. *South African Journal of Botany* 68 (1): 1–13.

Van Wyk, B.-E. 2011. The potential of South African plants in the development of new food and beverage products. *South African Journal of Botany* 77 (4): 857-868.

Van Wyk, B.-E. and Gericke, N. 2000. *People's plants: A guide to useful plants of Southern Africa*. Briza Publications, Pretoria.

Van Wyk, B. E., van Heerden, F. and van Oudtshoorn, B. 2002. Poisonous plants of South Africa. Struik, Cape Town.

Viljoen, R. 2006. *Jan Paerl, a Khoikhoi in Cape Colonial Society*, *1761-1851*. Brill, Leiden.

Watt, J. M. and Breyer-Brandwijk, M. G., 1962. *The medicinal and poisonous plants of southern and eastern Africa*. E and S Livingstone Ltd, London.

Wrangham, R. W., Cheney, D., Seyfarth, R. and Sarmiento, E. 2009. Shallow-water habitats as sources of fallback foods for Hominins. *American Journal of Physical Anthropology* 140 (4): 630–642.

Youngblood, D. 2004. Identification and quantification of edible plant foods in the Upper (Nama) Karoo, South Africa. *Economic botany* 58 (1): 43-65.

Zahn, R., Lutjeharms, J., Biastoch, A., Hall, I., Knorr, G., Park, W. and Reason, C. 2010. Investigating the global impacts of the Agulhas Current. *Eos* 91 (12): 109-110.

CHAPTER 3

Seasonal abundance and apparency of under- and aboveground carbohydrate resources available to foragers on the Cape south coast, South Africa

3.1 Abstract

Modern humans lived on the Cape south coast around 160 000 years ago, surviving off a variety of resources. Plant based carbohydrates formed one aspect of their subsistence; however, the availability of these plant resources to foragers over a seasonal cycle is not known. This study investigated the phenology of edible indigenous plant species in four vegetation types on the south coastal lowlands of the Cape Floristic Region (CFR). Abundance and seasonality were recorded of aboveground carbohydrate (principally fruit-bearing species) and, plants bearing underground storage organs (USOs) over two years. In addition, biomass of USOs was determined. A total of 32 USO species and 21 species with aboveground edible carbohydrates (88% fruiting species) were identified. Limestone Fynbos had the richest flora of edible species (21 USO species and 18 fruiting species), followed by Strandveld (15 USOs and 13 fruiting species). Renosterveld produced the highest abundance (about 5000 individuals ha^{-1}), but the lowest biomass of USOs. The highest biomass in the peak of apparency was recorded for the Strandveld vegetation type (over 80kg ha^{-1}). A very dry year preceded the study's first year of observation, resulting in an overall apparency of only 73% of the second year, which in turn was preceded by an average rainfall year. A multivariate analysis showed seven phenophases for high apparency of edible USOs and ripe fruit across the four vegetation types. Overall, given the contribution of evergreen USOs and fruiting species, there were always some carbohydrates for foragers to collect in the major vegetation types of the study area. The juxtaposition of different vegetation types – and biomes – within the daily foraging range of hunter-gatherers, is likely to have

greatly increased the availability of USOs to them. However, recognising which vegetation types are most productive, identifying hotspots of productivity and distinguishing between edible and toxic USOs must have required considerable cognitive skills.

3.2 Introduction

The coast of South Africa's' Cape Floristic Region (hereafter Cape) has yielded numerous archaeological sites showing evidence for the emergence of anatomically (Rightmire & Deacon, 1991; Lam *et al*., 1996; Royer *et al*., 2009), and cognitively modern humans (Singer & Wymer, 1982; Deacon & Wurz, 1996; 2001; Henshilwood *et al.,* 2002; 2004; Marean & Assefa, 2005; Marean *et al*., 2007; Henshilwood *et al*., 2009; Brown *et al*., 2009; 2012). Additional evidence indicates that modern humans evolved from a small founder population located along the Cape south coast (Brown *et al*., 2009; Marean 2010; 2011). Key to their survival here was the availability of multiple sources of protein, derived from rich marine resources (Bustamante & Branch, 1996; Marean *et al*., 2007) and a diverse and abundant fauna of plains game (Parkington, 2001; 2003; Marean, 2010; Matthews *et al*., 2009; Faith, 2011) which was associated with the now submerged Agulhas Bank (Fisher *et al*., 2010). It has been hypothesized that carbohydrate resources were accessible from the exceptionally diverse and abundant flora of Underground Storage Organs (USOs) (Marean, 2010), characteristic of the Cape. These include geophytes, which comprise 16% of the Cape flora (Goldblatt, 1978; Goldblatt, 1997; Cowling *et al.,* 1998; Meyers *et al*., 2000; Procheş *et al*., 2005; 2006).

Although Khoe-San descendants living along the Cape south coast still use 58 indigenous edible plant species (with 69 uses; see Chapter 2), they no longer rely on USOs as a staple carbohydrate resource. The fruiting species are consumed as "on-the-go food" *in situ*. However, historical research shows that extant hunter-gatherers do rely predominately on USOs for their carbohydrate requirements (Lee, 1973; O'Connell & Hawkes, 1984; Laden & Wrangham, 2005). Hominins also relied on carbohydrates as a dominant food source (Parkington, 1972; Hatley & Kappelman, 1980; Deacon, 1984; Wrangham *et al.*, 1999). The South African archaeological record provides limited evidence for the use of USOs in the Middle Stone Age (MSA) as organic matter does not preserve well. However there is strong evidence that USOs were a component of the Later Stone Age (LSA) diet, with the corm husks of some Iridaceae genera being unearthed in a number of sites (Deacon & Deacon, 1963; Deacon, 1970; 1972; Klein, 1974; Parkington, 1977). Historically, numerous botanists and travellers (Skead *et al.*, 2009), including Bleek and Lloyd (1911), recorded the use of USOs by San people and ethno-graphic evidence shows that these descendants still rely on aspects of a past dependence on indigenous plants for their carbohydrate resources (see Chapter 2; Schapera, 1934; Lee, 1969; 1973; 1984; Barnard 1992; Van Wyk & Gericke, 2000; De Beer & Van Wyk, 2011).

To date no research has been conducted on the seasonal abundance and availability of USOs for hunter-gatherers in the Cape. Most USOs are leaf-deciduous geophytes that are apparent only during the wet and cool winter months; during the dry summer only evergreen species and those that flower after the leaves have wilted (hysteranthous species) are apparent (Boeken & Gutterman, 1991; Ruiters *et al.*, 1993a; 1993b; Ruiters, 1995). It is likely, therefore, that summer and autumn were a time of USO scarcity. Fruit production, largely associated with tree and shrub species of the Thicket Biome, tends to peak in spring and autumn months (Pierce, 1984; Pierce & Cowling, 1984); hence fruit could be an alternative source of carbohydrates during the autumn months when USO apparency is at its lowest.

During the course of two calendar years, this study investigated the phenology of USOs in four vegetation types, [Strandveld, Limestone Fynbos, Sand Fynbos and Renosterveld (Mucina and Rutherford, 2006)] in the Still Bay region on the Cape south coast. Also observed was the availability of fruit production in order to assess whether this carbohydrate source could complement the availability of USOs.

This study posed the following questions:

1. What is the seasonal apparency and biomass of edible carbohydrate resources for each of the four vegetation types?

2. To what extent does aboveground carbohydrate availability (mainly in the form of fruit) complement the availability of edible USOs?

3.3 Methods

3.3.1 Study area

The study area spanned the coastal plain between the Breede and Gouritz rivers on the Cape south coast (Fig. 3.1). The area is transitional between the winter rainfall region to the west and the non-seasonal or bimodal seasons to the east. As a result, the study area received rain from both winter driven circumpolar westerly systems as well as post-frontal events. These events were characterised by moist air advected across the warm Indian Ocean, resulting in rainfall throughout the year (Deacon *et al.*, 1992). The climate of the study area is semi-arid to subhumid with mean annual rainfall ranging from 350 to 550 mm. Temperatures are mostly mild with a mean minimum of 6˚C and a mean maximum just below 30˚C (Linnow, 2012 n.p.). Frost is seldom recorded.

The area is underlain by folded and faulted Palaeozoic deposits of the Cape Supergroup. These comprise Table Mountain Group sandstones (visible on the coast) and Bokkeveld shales (exposed on the inland margin of the study area). Near Riversdale (about 25 km from the coast) the Palaeozoic sediments dip in an east-west fault and are filled by the Createceous Enon Formation, which comprises conglomerates and mudstones (Malan, 1987; Deacon et al., 1992; Rogers, 1984). Much of the southern (coastwards) coastal plain is mantled by Pliocene limestone of the Bredasdorp Formation. These, in turn are covered near the coastal margin by alkaline Pliocene-Pleistocene sands of marine origin. Inland of these are patches of older aeolian sands, which are leached and acidic (Rebelo *et al.*, 1991; Abanda *et al.*, 2011). Shale and mudstone derived soils are moderately fertile, while those associated with leached sands are infertile. The calcareous sands associated with limestone, calcrete and coastal dunes are also relatively infertile due to their high alkalinity and subsequent low levels of plant-available phosphorus (Thwaites and Cowling, 1988).

Vegetation of the Cape coastal lowlands is under strong edaphic control (Thwaites and Cowling, 1988; Rebelo *et al.*, 1991). Rocks yielding fine-grained and relatively fertile soils support Renosterveld, a fire-prone grassy shrubland often dominated by *Elytropappus rhinocerotis* (renosterbos) (Cowling *et al.*, 1986). According to Procheş and co-workers (2005; 2006), Renosterveld supports the highest diversity and abundance of USOs amongst all vegetation types of the Cape. Infertile acid soils support Sand Fynbos, a fire-prone heath-like shrubland, characterised by the presence of Restionaceae and Proteaceae. Limestone -derived soils support Limestone Fynbos, a highly endemic-rich vegetation type (Willis *et al.*, 1996). Marine sands are associated with subtropical thicket, either in its solid form or as thicket clumps in a matrix of Fynbos. This vegetation is colloquially known as Strandveld. Plant compositional change, or beta diversity, between these edaphically differentiated vegetation types is extremely high; consequently few species are shared among these four vegetation types and regional-scale plant richness is very high (Cowling, 1990; Cowling *et al.*, 1997).

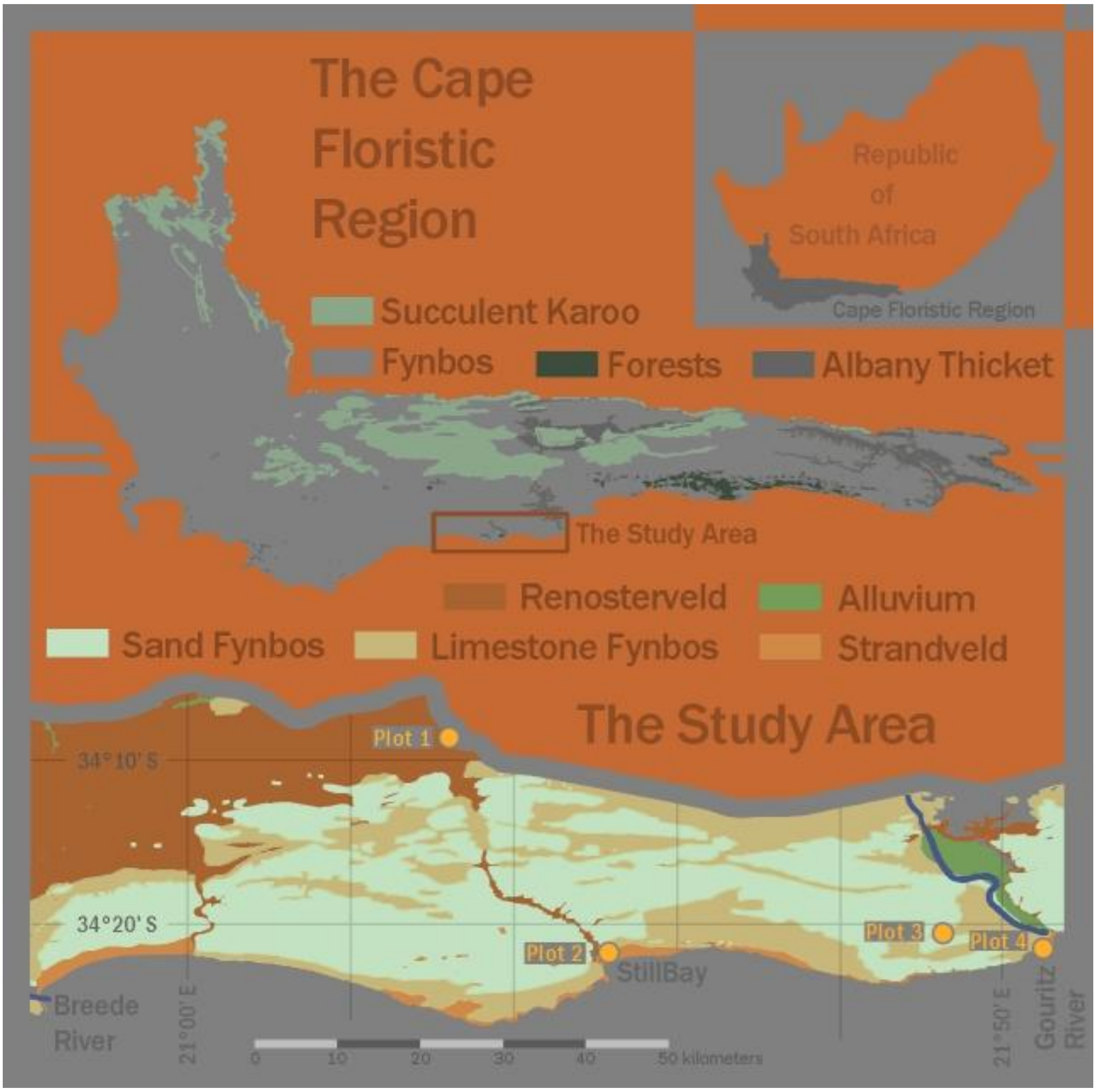


Fig. 3.1: The study sites (marked Plot 1-4; 1 = Renosterveld, 2 = Limestone Fynbos, 3 = Sand Fynbos and 4 = Strandveld) located in the four major vegetation types (depicted by the shaded rectangle) and their relation to the Cape Floristic Region and the major biomes (adapted from Mucina and Rutherford, 2006).

3.3.2 Study sites

Monitoring sites were located in representative areas of the four major vegetation types present in the lowland study area, namely, Limestone Fynbos, Renosterveld, Sand Fynbos and Strandveld (Fig. 3.2). The vegetation in each of the four sites was pristine and all plots were located within protected areas. The Limestone Fynbos site

(34° 21’55.62”S; 21° 25’26.00”E) falls within the Pauline Bohnen Local Authority Nature Reserve, the Renosterveld site (34° 06’58.25”; 21° 14’59.70”E) within the Werner Frehze Local Authority Nature Reserve, the Sand Fynbos site (34° 20’40.87”S; 21° 45’59.80”E) in the Rein’s Private Nature Reserve and the Strandveld site (34° 21’17.38”S; 21° 52’28.65”E) within the Gouritz Mouth Local Authority Nature Reserve. The Sand Fynbos site had burnt four years before sampling was initiated which would likely have enhanced the apparency of USO species, many of which flower more profusely in the early post-fire years (Le Maitre and Brown, 1992). Table 3.1 provides biophysical data for each of the study sites.

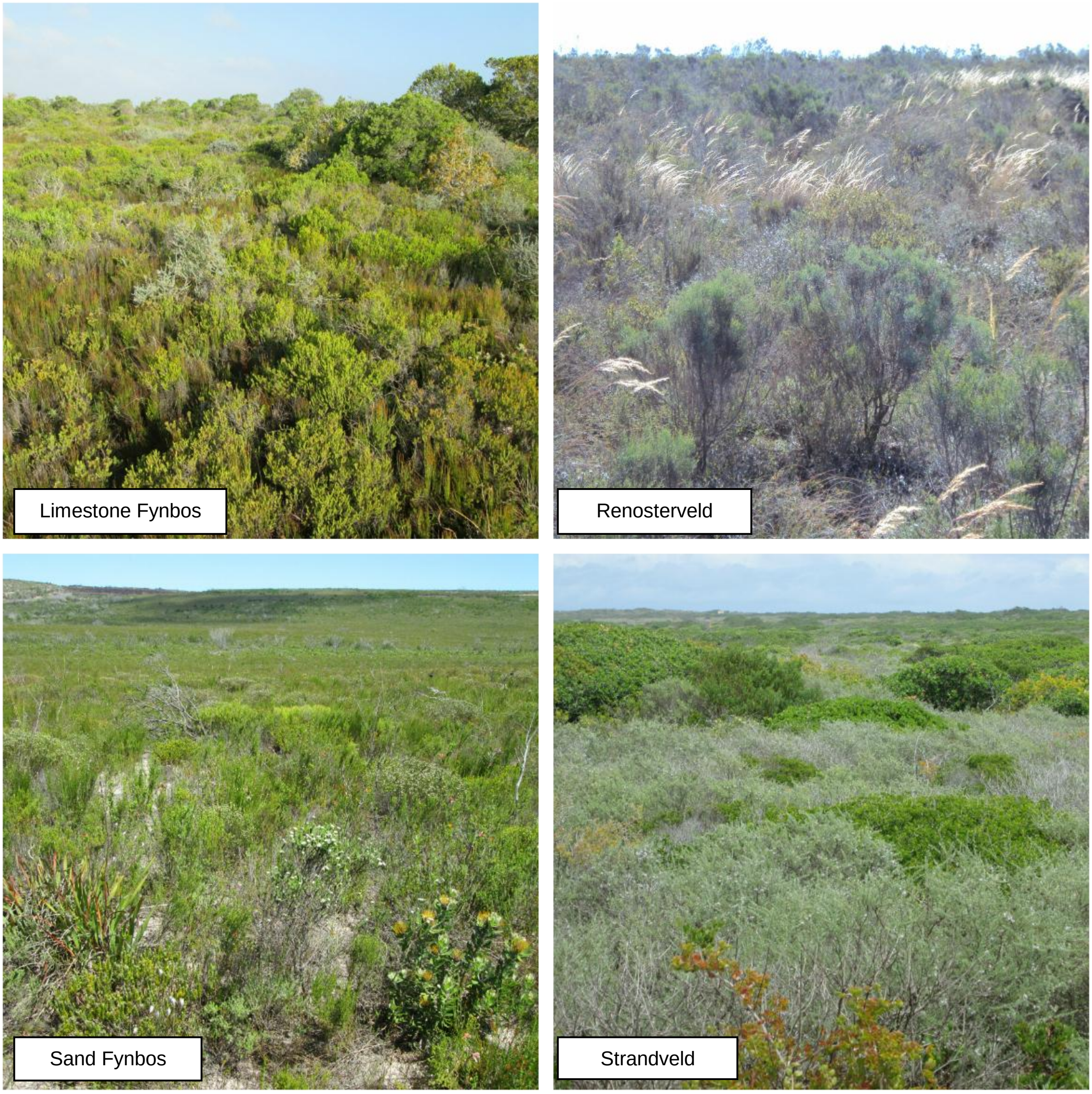


Fig. 3.2: The four study sites (see Fig. 3.1) in the four major vegetation types.

Table 3.1: Biophysical data for the four study sites.

Vegetation	Strandveld	Limestone Fynbos	Sand Fynbos	Renosterveld
Mean annual rainfall (mm)	352	510	352	378
Soil	Deep alkaline sand; moderately fertile	Shallow, alkaline sand overlying limestone; infertile	Deep, leached, acid sand: infertile	Shallow, slightly acid loam overlying clayey sub-soil; moderately fertile
Dominant species	*Cassine peragua* (Celastraceae) *Eriocephalus africanus* (Asteraceae) *Osteospermum moniliferum* (Asteraceae) *Rhoicissus digitata* (Vitaceae) *Sideroxylon inerme* (Sapotaceae) *Zygophyllum morgsana* (Zygophyllaceae)	*Erica spectabilis* (Ericaceae) *Ischyrolepis leptocladus* (Restionaceae) *Leucadendron meridianum* (Proteaceae) *Metalasia muricata* (Asteraceae) *Stoebe muirrii* (Asteraceae) *Thamnochortus muirrii* (Restionaceae)	*Erica dispar* (Ericaceae) *Leucadendron galpinii* (Proteaceae) *Leucospermum muirrii* (Proteaceae) *Protea susannae* (Proteaceae) *Thamnochortus insignis* (Restionaceae) *Watsonia fourcadei* (Iridaceae)	*Aloe ferox* (Asphodelaceae) *Elytropappus rhinocerotis* (Asteraceae) *Eriocephalus africanus* (Asteraceae) *Metalasia muricata* (Asteraceae) *Themeda triandra* (Poaceae)

3.3.3 Data collection

Each plot was divided into six 300 m x 20 m transects. In each transect, I counted 1) the abundance of USO individuals which would be apparent to a forager (i.e. in a phenophase where one or more aboveground organs were visible) and, 2) the number and type of plant species bearing ripe fruit or other edible aboveground parts (e.g. inflorescences of *Trachyandra* species) (see Chapter 2). I strived to adopt a forager's perspective, and avoided all species known to be toxic, and those plant individuals which were too small to harvest. I categorised species of unknown palatability, especially once cooked, as edible (e.g. tubers of *Rhoicissus digitata* and corms of *Chasmanthe aethiopica*) (see Chapter 2). The survey was repeated every six weeks over a two-year period and the biomass of the USOs was quantified using mean values as documented by Singels (2013).

3.3.4 Data analysis

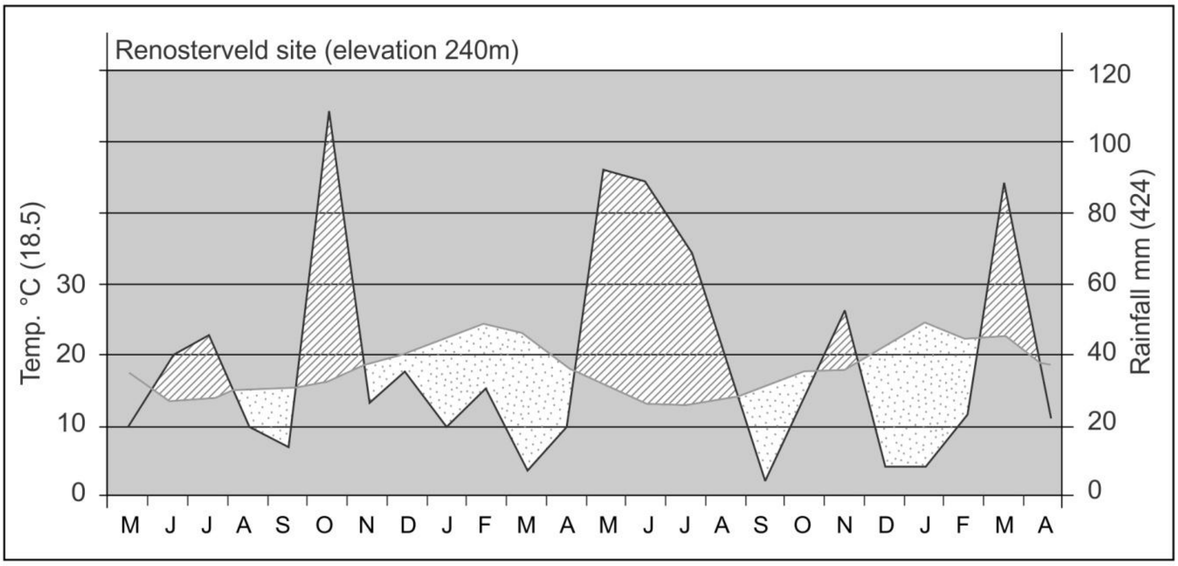
The analysis comprised Phenograms which were constructed for each edible species at each site (Appendix 4). In order to summarise the phenological data for each site, they were expressed as raw and relative counts of apparent individuals of the combined species apparent at any given observation time. The latter value was calculated as the number of individuals of a particular species at a given date divided by the maximum number of individuals for that species observed during the two-year sampling period.

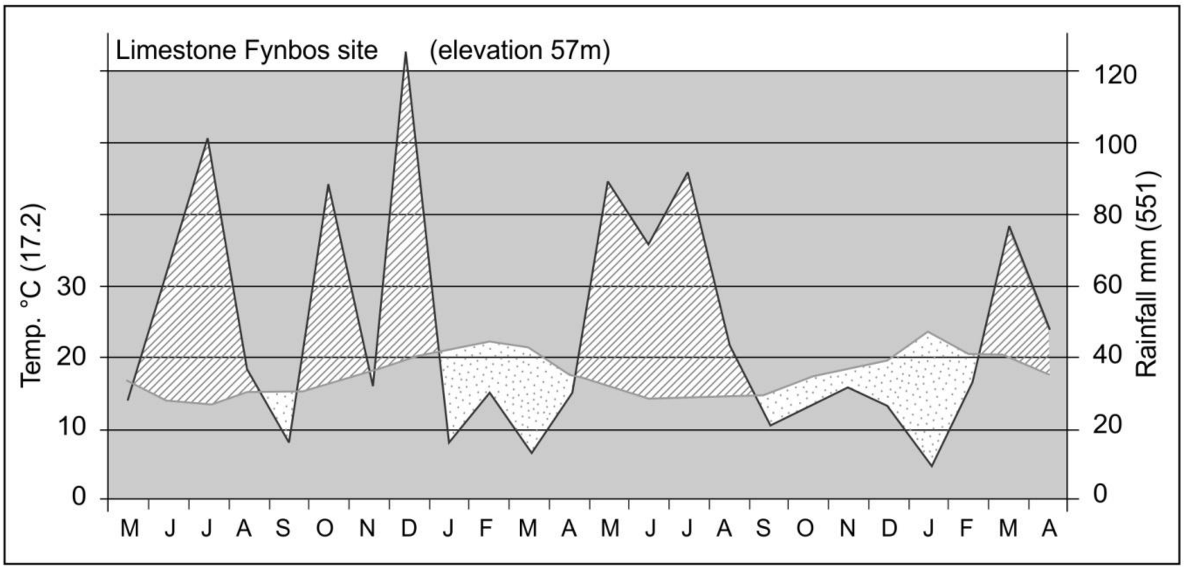
Hierarchical clustering (Anderberg, 1973) was used to investigate phase synchronicity (i.e. phenological timing) among edible USOs and fruiting species. Such clustering requires a dissimilarity matrix as the input. Dissimilarity was calculated as the sum of the absolute differences of apparency between two species (including site combinations, e.g. species 1 at site 1 versus species 1 at site 2, or species 1 at site 1 versus species 2 at site 1) for each sampling date. As the total number of individuals per species varied within and across sites, the proportion of individuals visible (USOs) or with ripe fruit relative to the total number of individuals for a given species within a site was used as the index of apparency for calculating dissimilarities. Hierarchical clustering was performed using the *hclust* function and the averaging agglomeration method in R version 2.15 [R Development Core Team (Pinheiro *et al.*, 2012)]. Defining clusters was not performed using a strict dissimilarity threshold, but rather involved intuitive exploration of the phenograms of different potential clusters while endeavouring to maintain cluster thresholds that were fairly similar.

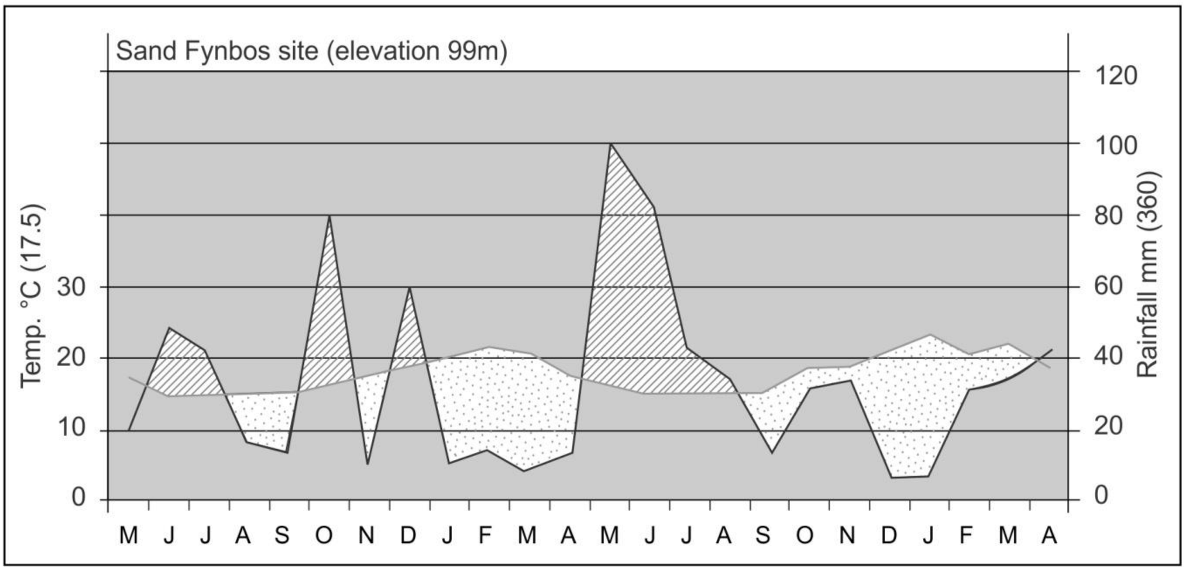
In order to test whether the USO apparency is non-seasonal, a Kruskal and Wallis (1952) rank sum test of the raw and relative counts of USOs within each vegetation type (i.e. counts irrespective of species designations) was used. These analyses were also conducted in R.

3.4 Results

In 2009, the year prior to when monitoring was initiated, lower than average rainfall was experienced at all of the study sites. Thus, the Renosterveld site experienced 68% of the mean whereas the Limestone Fynbos, Sand Fynbos and Strandveld sites experienced 72% of their means respectively. Monitoring was initiated in May, 2010 when the effects of the previously dry year were still evident. Both of the two monitoring years experienced above average rainfall (Fig. 3.3). All four sites received year round rain (the driest period from January to March), coupled with sporadic high rainfall events (e.g. February rainfall was almost double that of January and March). The wettest months were June, October and November.


Renosterveld site (elevation 240m)
Temp. °C (18.5)
Rainfall mm (424)
0 10 20 30
0 20 40 60 80 100 120
M J J A S O N D J F M A M J J A S O N D J F M A


Limestone Fynbos site (elevation 57m)
Temp. °C (17.2)
Rainfall mm (551)
0 10 20 30
0 20 40 60 80 100 120
M J J A S O N D J F M A M J J A S O N D J F M A


Sand Fynbos site (elevation 99m)
Temp. °C (17.5)
Rainfall mm (360)
0 10 20 30
0 20 40 60 80 100 120
M J J A S O N D J F M A M J J A S O N D J F M A

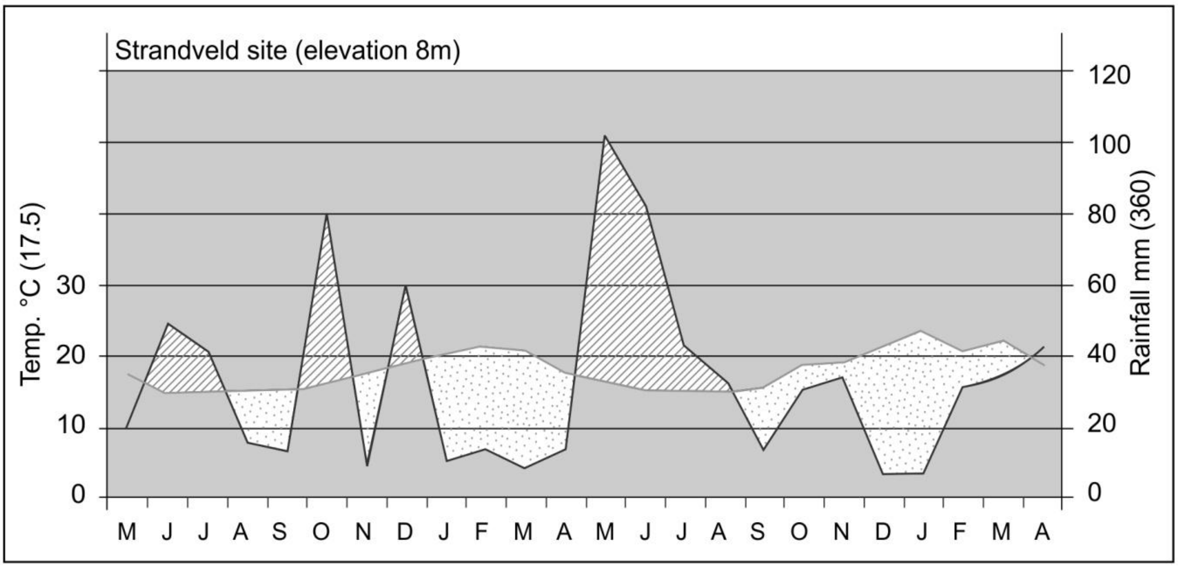


Fig. 3.3: Climate diagrams showing temperature and rainfall patterns for the study sites during the survey period (May 2010-April 2012). Mean values of temperature and rainfall are shown in parentheses.

A total of 32 USO species and 21 species with aboveground edible carbohydrates were identified throughout the study area (see Appendix 3 for full species list per vegetation type). Of the latter, 88% were fruit-bearing species and only three were vegetables (*Trachyandra ciliata, T. revoluta* and *Tetragonia decumbens).* Note that hereafter, all species with aboveground carbohydrate are referred to as fruiting species. Limestone Fynbos had the richest flora of edible species (21 USO species and 18 fruiting species), followed by Strandveld (15 USOs and 13 fruiting species), Renosterveld (8 and 8, respectively) and lastly, Sand Fynbos (5 and 5, respectively). In the first year, Renosterveld showed the highest abundance of USOs, around 5000 ha^{-1} at the height of apparency. Both Strandveld and Limestone Fynbos produced around 4000 USOs and Sand Fynbos less than 1000 edible USOs/ha^{-1} (Fig 3.4). The second year saw a dramatic increase in apparency of abundance for all sites with a recorded 50 - 60% increase, except for the Sand Fynbos site, which showed little change. The season of highest apparency showed slight variation among the four sites over the two years; more variation was evident in the period of apparency. Owing to a low diversity of edible species, Sand Fynbos showed low abundance, but a long period of apparency associated with the high abundance of the perennially apparent evergreen USO, *Watsonia fourcadei*, the only abundant species in this vegetation type. The other sites showed a one month extension into summer in the period of apparency in the second survey year. Overall, late summer to autumn was the period of lowest apparency of USOs.

Strandveld had the highest biomass in the peak of apparency (over 80kg/ha^{-1}) in the first year with a nearly 20% increase for the second year (Fig. 3.4). Due to the perennial apparency of *Rhoicissus digitata,* this vegetation type showed high biomass throughout the survey period. This was also evident in the Limestone Fynbos, but owing to the lower abundance of *Rhoicissus digitata,* the biomass for this site showed a marked decline in late summer and autumn. Renosterveld had relatively low biomass, despite high abundance, as the edible portions of the species comprised largely small USOs. Sand Fynbos had the lowest biomass, which was contributed largely by *Watsonia fourcadei*. The combined biomass for the four study sites in the first survey year was roughly 150kg/ha^{-1} and 185kg/ha^{-1} for the second year.

In the first survey year, Strandveld showed the highest abundance of fruiting species at about 690 plants/ha^{-1} (ripe and edible phase) followed by Limestone Fynbos which produced about 680 plants/ha^{-1} with Sand Fynbos (85 plants/ha^{-1}) and Renosterveld (61 plants/ha^{-1}) both considerably less. In the second year, the apparency of abundance (ripe and edible phase) of fruiting species did not increase much for Renosterveld (21% increase) and Strandveld (14% increase), but did for Limestone Fynbos (49% increase) and Sand Fynbos (53% increase) (Fig 3.5). The abundance of predominately *Carpobrotus* species which bear ripe fruits during the drier months was a key factor for the extension of fruit apparency period for Limestone Fynbos (see Fig. 3.6 for apparency and biomass of USOs throughout the four vegetation types and Appendix 4 for Phenodiagrams of all recorded species).

A comparison of abundance of USOs and fruits for all sites showed that while USO apparency was lowest in late summer–autumn, there were still considerable amounts of biomass apparent in Strandveld and Limestone Fynbos (Fig 3.6). Since the period of high fruit abundance extended well into the autumn months in Strandveld and Limestone Fynbos, fruit carbohydrate could compensate for the low availability of USO carbohydrate at that time. Hence, carbohydrate resources in the study area are available year round for hunter-gatherers, especially in the two vegetation types closest to the coast, namely Strandveld and Limestone Fynbos.

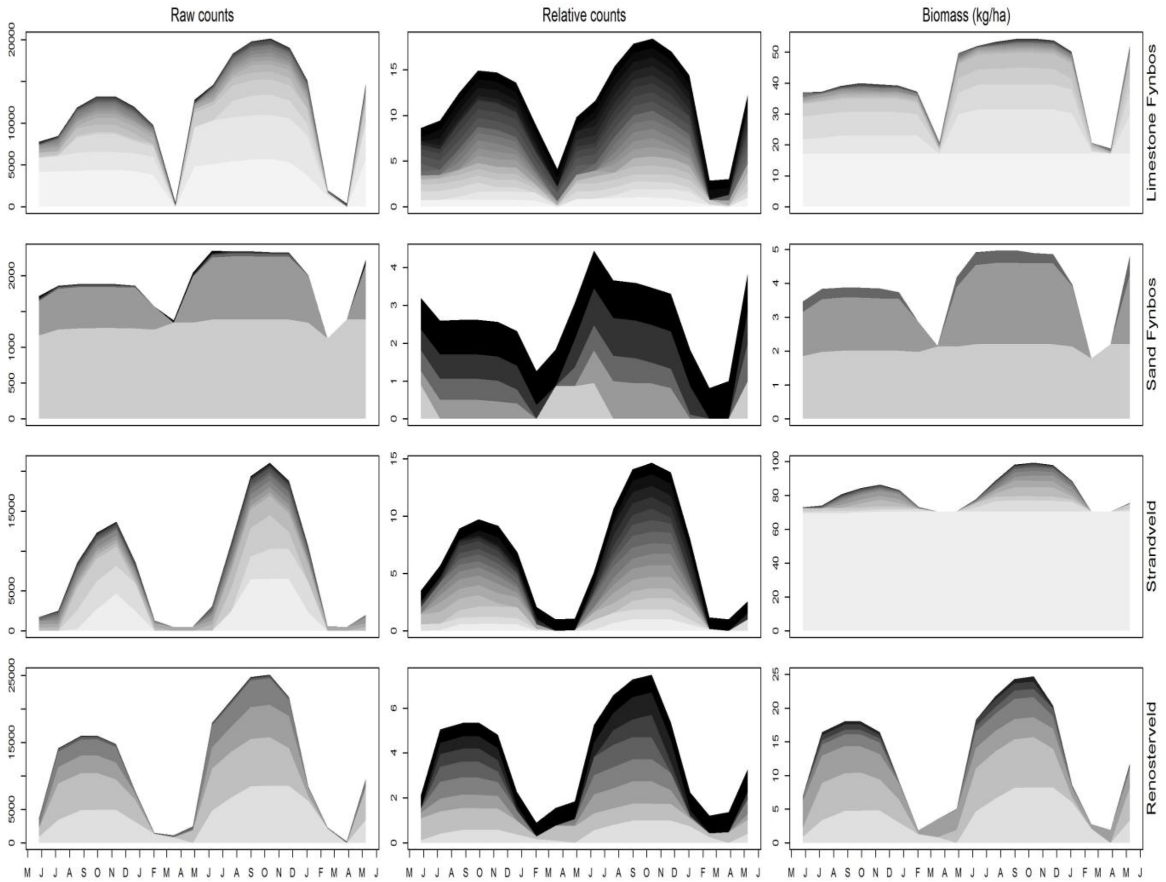


Fig. 3.4: Underground storage organ phenology (apparency) in terms of cumulative raw counts per species, cumulative relative counts (proportion of total individuals per species) and cumulative biomass (raw counts converted to biomass) in four different sites, each from a different vegetation type.

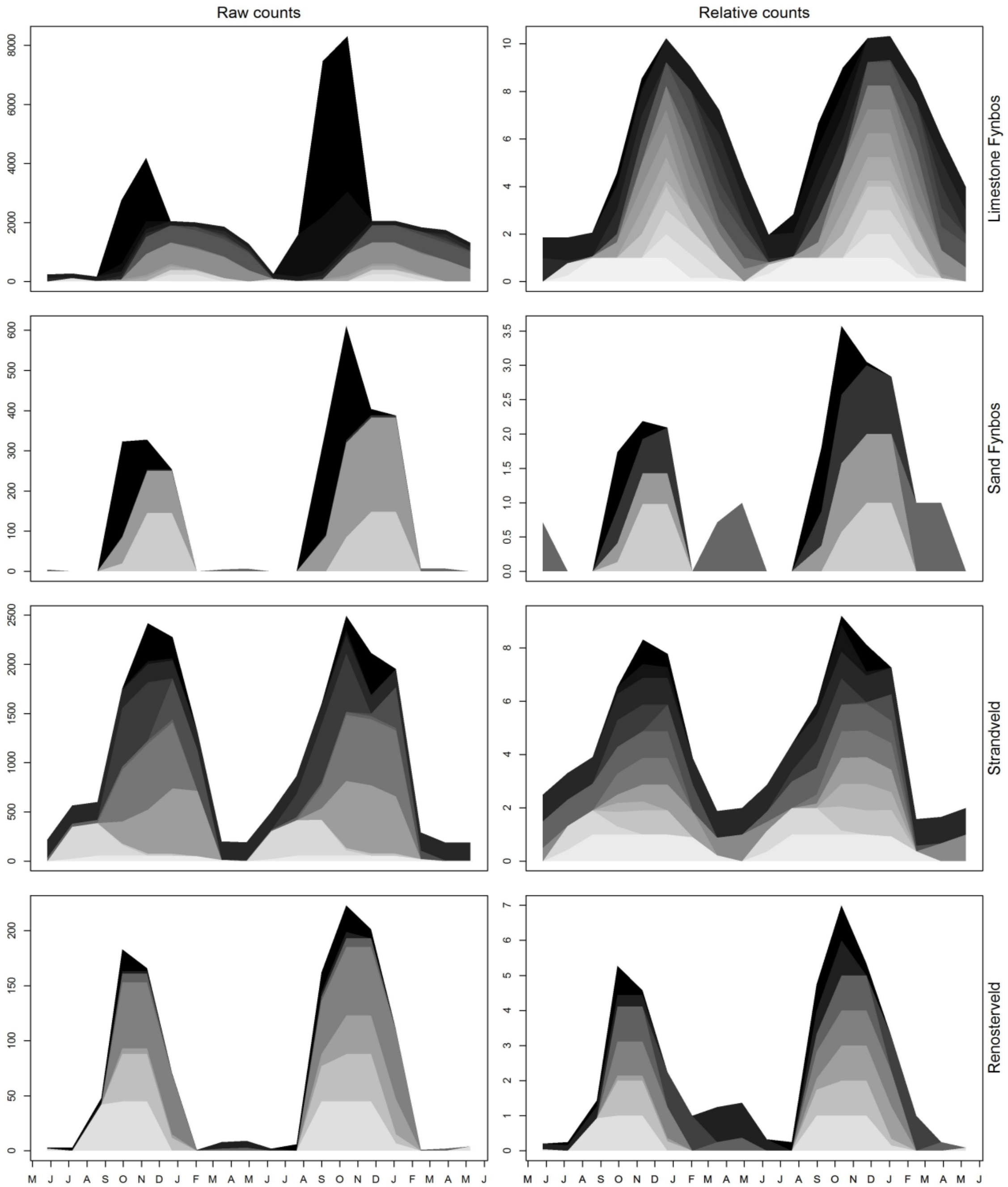


Fig. 3.5: Phenology of ripe fruits expressed as cumulative raw counts per species and cumulative relative counts (proportion of total individuals per species) in four different sites, each from a different vegetation type.

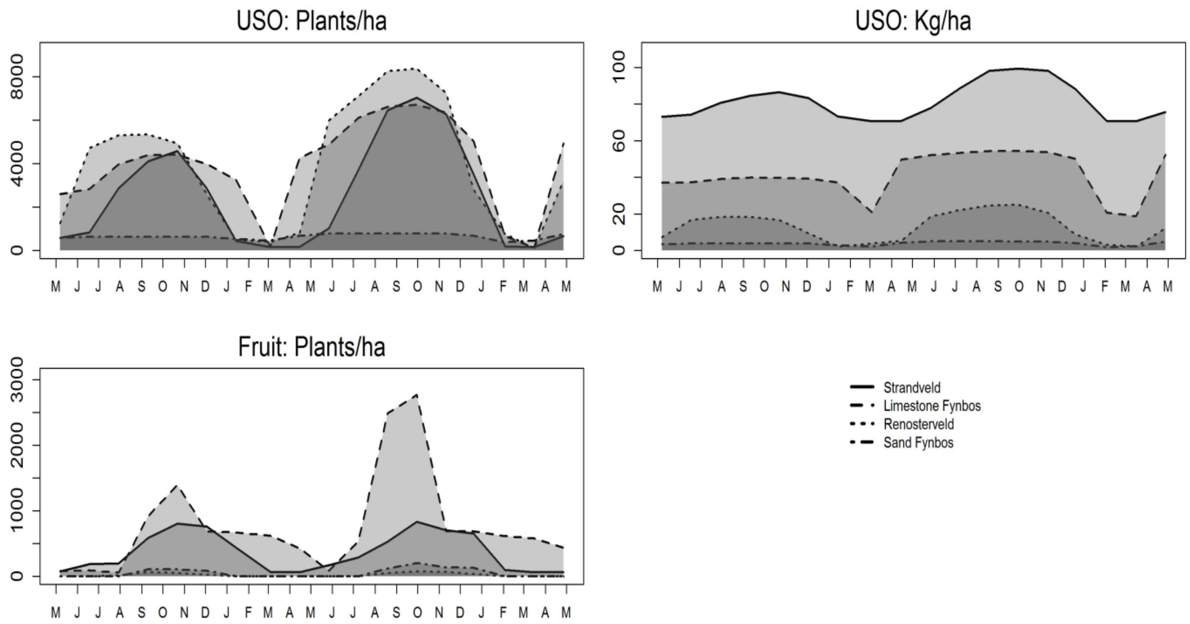


Fig. 3.6: The phenology of edible underground storage organs (USOs) and ripe fruit-bearing plants across four different vegetation types in terms of abundance and biomass (only USOs).

The multivariate analysis showed seven phenophases for high apparency of edible USOs and ripe fruit across the four vegetation types (A to G; Fig. 3.7). The bimodal pattern (A) comprised eight species (63% fruit) that were apparent in spring and autumn and largely associated with Limestone Fynbos. The out-of-season pattern (B) comprised 10 species (100% fruit), largely associated with Limestone Fynbos, which showed the highest apparency during the summer, when the apparency of USO species was low. The next four groups exhibited patterns of apparency that peaked during the cooler months (autumn/winter to spring/early summer). Groups C and D comprised species whose apparencies extended well into the warmer months. Group C comprised 19 species of predominately USOs (79%) associated mainly with Renosterveld, Limestone Fynbos and Strandveld. Group D, which had a similar pattern of apparency to Group C, comprised 11 species, all USOs, most of which were associated with Limestone Fynbos. Groups E and F recorded apparencies largely confined to the cooler months. Group E, comprised of 25 species shared equally between USOs and fruit-bearing species, showed an apparency extending into the summer months. Most of the species grew in Strandveld (44%) and Limestone Fynbos (36%). Group F, where apparency was strongly limited to the cooler months, comprised 12 species, 83% of which were fruit-bearing species. The majority of these (42%) grew in Renosterveld. The final group (Group G) comprised eight species that showed limited seasonality, 75% of which were USOs primarily growing in Limestone Fynbos.

The results of the Kruskal and Wallis (1952) test were consistent with the patterns shown in Figs. 3.4-3.7. Other than USOs in Sand Fynbos, there was no support for the hypothesis that USO and fruit apparency was non-seasonal (Table 3.2).

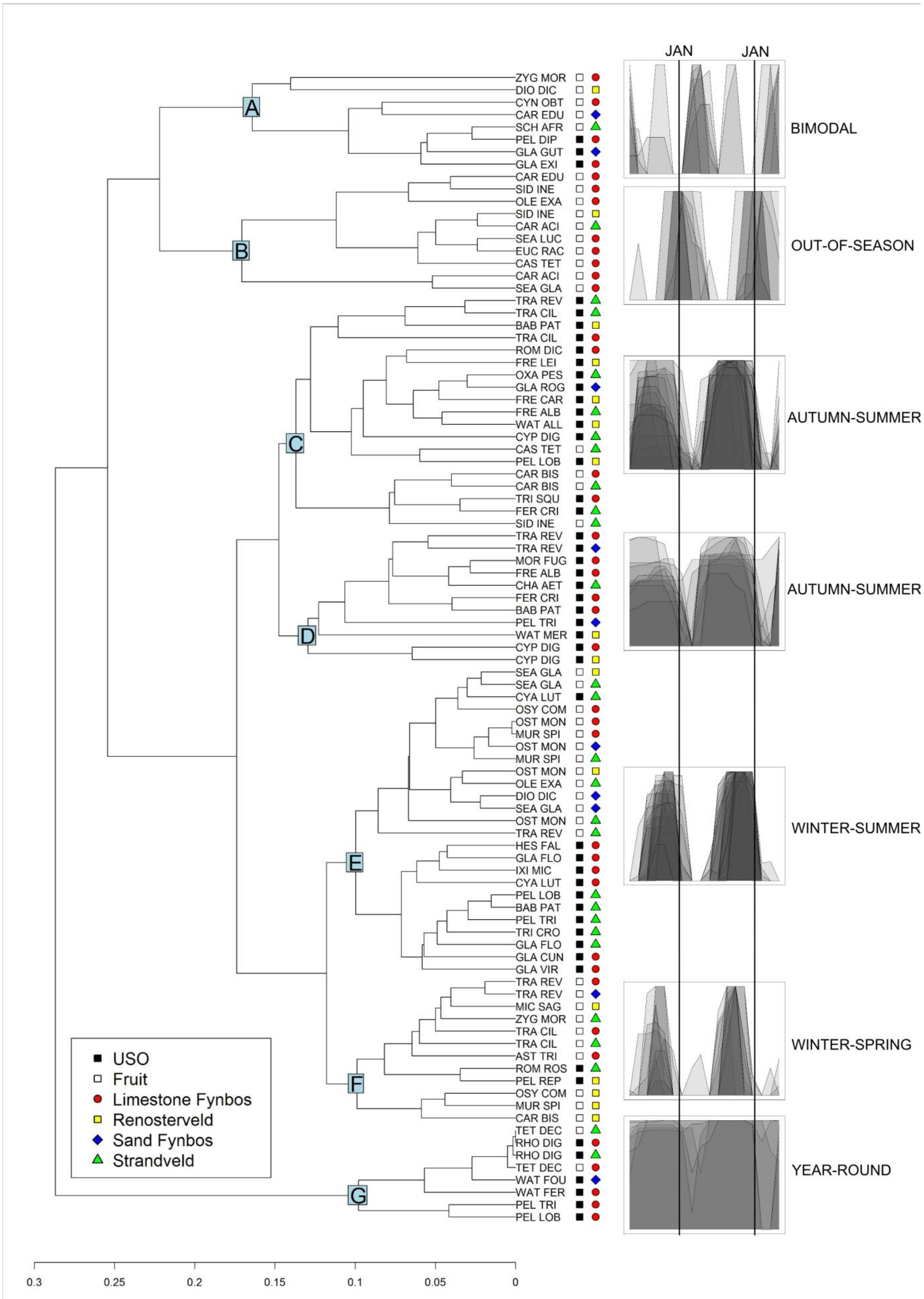


Fig. 3.7: Dendrogram showing seven phenophases in apparency of edible USOs and ripe fruits species at the four sites sampled over two years. See Appendix 3 for explanation of the species acronyms.

Table 3.2: Kruskal and Wallis (1952) rank sum test of the raw and relative counts of species apparency across four different vegetation types. The null hypothesis is that phenological phase follows a non-*seasonal* (i.e. uniform) distribution.

		Raw counts		Relative counts	
Type	Vegetation Type	X^2	Sig	X^2	Sig
USO	Limestone Fynbos	83.3	***	107.7	***
	Sand Fynbos	11.6	p=0.82	24.7	P=0.10
	Strandveld	132.6	***	153.3	***
	Renosterveld	47.1	***	75.3	***
Fruit	Limestone Fynbos	35.9	**	46.7	***
	Sand Fynbos	42.4	***	37.7	**
	Strandveld	55.9	***	50.1	***
	Renosterveld	68.2	***	61.2	***

** $p<0.01$; *** $p < 0.001$

3.5 Discussion

Substantial archaeological (Deacon & Deacon, 1963; Parkington and Poggenpoel, 1971; Deacon, 1970, 1976, 1984; Opperman & Heydenrych, 1990; Deacon & Deacon, 1999) evidence exists for the use of USOs, fruits and vegetables by LSA peoples in southern Africa and elsewhere for example, the Californian Late-Paleolithic (Heizer and Elsasser, 1980; Lightfoot and Parrish, 2009) and the LSA in Australia (O'Connell *et al.*, 1983; Latz, 1995; Smith and Ross, 2008). This evidence is substantiated by direct observations of contemporary hunter-gatherer communities in Africa (Lee, 1969, 1973, 1984; Berbesque and Marlowe, 2009; Marlowe and Berbesque, 2009). USOs in particular provide a staple source of carbohydrate. Marean (2010) has hypothesized that the diversity and abundance of USOs along the Cape coast, together with a rich source of both marine and terrestrial based protein, may have facilitated the persistence of MSA people in the region. However, very little research has been conducted on food plants potentially available to hunter-gatherers on the Cape south coast to corroborate this hypothesis. Singels' (2013) study in the same area reported a high biomass of USOs available to foragers, but a spatial pattern of occasional hotspots of biomass in a matrix of much lower biomass (Myers, 1990; Myers *et al.*, 2000). Her foraging experiments showed high within-patch return rates. In contrast, this study focussed on the temporal patterns of abundance of USOs and above-ground sources of carbohydrates in the four principal vegetation types of the Cape south coast.

3.5.1 Variation in carbohydrates sources in terms of vegetation type and season

The area spanning the lowlands to the coastal margin is characterised by a diversity of vegetation types. Each of these hosts a unique suite of plant species which are predominately driven by edaphic factors (Thwaites and Cowling, 1988; Rebelo *et al.*, 1991). This study corroborated those of Procheş *et al.* (2005, 2006) and Singels (2013), in that Renosterveld contained the highest abundance of USOs. Strandveld was found to contain the highest USO biomass in concordance with Singels (2013) who noted that Dune cordon, a type of Strandveld, as well as Renosterveld, exhibited the highest USO biomass. As opposed to Singels' (2013) results in her wide scale study, my research analysed one study plot per vegetation type and could therefore not give an accurate estimate of varying vegetation type biomass. This was due to the density variation of biomass evident within a vegetation type and throughout the different vegetation types in the study area.

The seasonality of USOs comprised mainly geophytes, many of which showed pronounced patterns of apparency. In the Cape, most geophytes are synanthous (leaves appear at the same time as flowers) with peak apparency in the winter and spring months (Pierce, 1984). It is these species that were responsible for the mid-summer to early autumn drop in the abundance of apparent USOs. Others, such as *Watsonia* species that grow in nutrient-poor fynbos vegetation, are evergreen. And yet others are hysteranthous, where leaves are apparent in the cooler months, and flowers visible in the warmer months (Dafini *et al.*, 1981). In many species, irrespective of the growth strategies, the dead remains of plants persist for a long time. These factors all contributed to the relatively low, albeit statistically significant, degree seasonal USOs apparency observed in this study.

Geophytic USO apparency was strongly determined by rainfall: low rainfall years resulted in relatively low apparency and vice versa (Boeken, 1989; 1990; Rossa and von Willert, 1999; Procheş *et al.*, 2005). This was highlighted in this study where in the first year of observation (which followed a very dry year) overall apparency was only 73% that of the second year, which was in turn preceded by an average rainfall year.

Overall, given the contribution of evergreen USOs and fruiting species, there would always have been some carbohydrates for foragers to collect in the major vegetation types of the Cape coast. This availability of USOs was further enhanced by the juxtaposition of different vegetation types and biomes within the daily foraging range of hunter-gatherers. Recognising productive vegetation types, identifying hotspots of productivity and distinguishing between edible and toxic USOs would have required considerable cognitive skills. As a result, foraging for USOs in the biologically complex coastal lowlands of the Cape may well have enhanced the development of cognitively modern MSA peoples.

3.5.2. The complementary role of fruiting and vegetable species

In the study area, fruits were associated largely with trees and shrubs of Thicket Biome affinity. While fruits did appear sporadically throughout the year, most species showed peak fruit production in spring and autumn (bimodal) or in midsummer. Fruits could therefore complement the availability of USOs. It is interesting to note that vegetable apparency peaked in the cooler months when USOs were abundant. However, the piths (similar to palm hearts) of *Prionium serratum* (Juncaceae) (Chapter 2) were not seasonally restricted (Boucher and Withers, 2004) and could have complimented periods of overall scarcity of edible plant resources. This is substantiated by previous research in hunter-gatherer communities. For example, the !Kung San value mongongo nuts (*Schinziophyton rautanenii*; Euphorbiaceae) over USOs due to palatability, high abundance and year round availability (Lee, 1984). Palm hearts of predominately *Syagrus romanzoffiana* (Arecaceae) also comprise the highest edible plant harvest composition amongst the Aché of

Paraguay (Hawkes *et al*., 1982; Hill *et al.*, 1984; Hurtado *et al*., 1985). Plant species with a high cost of procurement and low nutritional value, e.g. certain species of grass seeds, were consumed by Central Australian Aborigines due to seasonal scarcity of more preferred species (O'Connell and Hawkes, 1984; Simms, 1984).

The coastal area and its juxtaposition of predictable intertidal resources, terrestrial fauna, Strandveld, adjacent Limestone Fynbos and other vegetation types with distinct attributes were undoubtedly favourable for hunter-gatherer subsistence during challenging climatic periods. Carbohydrates in contemporary hunter-gatherer societies formed an important aspect of subsistence for energy and also, as a palatable addition to protein and fat. The vegetation types of the study area yielded a wide array of carbohydrate options both below and aboveground. In conclusion, the diversity of edible plant species, their vegetation types, the variety of annual phenophases and available biomass revealed a habitat that could undoubtedly have sustained human carbohydrate requirements at least in warm phases such as the current Holocene.

3.6 References

Abanda, P. A., Compton, J. S. and Hannigan, R. E. 2011. Soil nutrient content, above-ground biomass and litter in a semi-arid shrubland, South Africa. *Geoderma* 164 (3-4): 128-137.

Anderberg, M. R. 1973. *Cluster analysis for applications* (No. OAS-TR-73-9). Office of the Assistent for Study Support Kirtland AFB, New Mexico.

Barnard, A. 1992. *Hunters and herders of Southern Africa. A comparative ethnography of the Khoisan peoples*. No. 85. Cambridge University Press, Cambridge.

Berbesque, J. C. and Marlowe, F. W. 2009. Sex differences in food preferences of Hadza Hunter-Gatherers. *Evolutionary Psychology* 7 (4): 601-616.

Bleek, W .H .I. and Lloyd, L .C. 1911. *Specimens of Bushmen folklore*. George Alan and Company, London.

Boeken, B. 1989. Life histories of two desert species of the bulbous genus *Bellevalia*: the demographic consequences of reproductive biomass partitioning patterns. *Oecologia* 80 (2): 278-283.

Boeken, B. 1990. Life histories of two desert species of the bulbous genus Bellevalia: the relation between biomass partitioning and water availability. *Oecologia* 82 (2): 172-179.

Boeken, B. and Gutterman, Y. 1991. The effect of water on the phenology of the desert geophytes Bellevalia desertorum and B. eigii. *Israel Journal of Botany*. 40 (1): 17-31.

Boucher, C. and Withers, M. 2004. Palmiet. The unique Cape river plant Prionium Serratum. *Veld and Flora.* 90 (1): 26-28.

Brown, K. S., Marean, C. W., Herries, A .I .R., Jacobs, Z., Tribolo, C., Braun, D., Roberts, D. L., Meyer, M. C. and Bernatchez, J. 2009. Fire as an engineering tool of early modern humans. *Science* 325 (5942): 859-862.

Brown, K. S., Marean, C. W., Jacobs, Z., Schoville, B. J., Oestmo, S., Fisher, E. C., Bernatchez, J., Karkanas, P. and Matthews, T. 2012. An early and enduring advanced technology originating 71,000 years ago in South Africa. *Nature* 491 (7425): 590–593.

Bustamante, R. and Branch, G. 1996. Large scale patterns and trophic structure of southern African rocky shores: the roles of geographic variation and wave exposure. *Journal of Biogeography* 23 (3): 339-351.

Cowling, R. M. 1990. Diversity components in a species-rich area of the Cape Floristic Region. *Journal of Vegetation. Science* 1: 699–710.

Cowling, R. M., Pierce, S. M. and Moll, E. J. 1986. Conservation and utilisation of South Coast renosterveld, an endangered South African vegetation type. *Biological Conservation* 37 (4): 363-377.

Cowling, R. M., Richardson, D. M. and Mustart. P.J. 1997. Fynbos. In: Cowling, R. M., Richardson, D. M. and Pierce, S. M (eds.). *Vegetation of Southern Africa*. Cambridge University Press, Cambridge. pp. 99–130.

Cowling, R. M., Rundel, P. W., Desmet, P. G. and Esler, K. J. 1998. Extraordinary high regional scale plant diversity in southern African arid lands: subcontinental and global comparisons. *Diversity and Distributions* 4 (1): 27-36.

Dafini, A., Schmida, A. and Avishai, M. 1981. Leafless autumnal-flowering geophytes in the Mediterranean region. Photographical, ecological and evolutionary aspects. *Plant Systematics and Evolution* 173: 181-193.

Deacon, H. J. 1970. Plant remains from Melkhoutboom Cave, South Africa. *Proceedings Transkei and Ciskei Research Society* 1: 13-15.

Deacon, H.J. 1972. A reveiw of the post-Pleistocene in South Africa. *South African Archaeological Society* 1: 26-45.

Deacon, H. J. 1976. *Where hunters gathered: a study of Holocene Stone Age people in the Eastern Cape*. South African Archaeological Society, Claremont.

Deacon, J., 1984. Later Stone Age people and their descendants in southern Africa. In: Klein, R.G. (ed.). *Southern African prehistoric and paleoenvironments*. A. A. Balkema, Rotterdam/Boston. pp. 220-328.

Deacon H. J. and Deacon, J. 1963. Scott's Cave: a late Stone Age site in the Gamtoos Valley Annals of the Cape Provincial Museums. *Natural History* 3: 96-112.

Deacon, H. J., and Wurz, S. 1996. Klasies River main site, cave 2: a Howiesons Poort occurrence. In: Pwiti, G. and Soper, R. (eds.). *Aspects of African archaeology*. University of Zimbabwe Publications, Harare. Pp. 213-220.

Deacon, H. J. and Deacon, J. 1999. *Human beginnings in South Africa: Uncovering the secrets of the Stone Age.* David Philip Publishers (Pty) Ltd, Cape Town.

Deacon, H. J. and Wurz, S. 2001. Middle Pleistocene populations and the emergence of modern behaviour. In: Barham, L. and Brown, K. R. (eds.). *Human roots – Africa and Asia in the Middle Pleistocene.* Western Academic & Specialist Press, Bristol. pp. 55-63.

Deacon, H. J., Jury, M. R. and Ellis, F. 1992. Selective regime and time. In: Cowling, R. M. (ed.). *The ecology of fynbos: nutrients, fire and diversity*. Oxford University Press, Cape Town. pp. 6-22.

De Beer, J. J. J. and Van Wyk, B. -E. 2011. An ethnobotanical survey of the Agter-Hantam, Northern Cape Province, South Africa. *South African Journal of Botany* 77 (3): 741-754.

Faith, J. T. 2011. Ungulate community richness, grazer extinctions, and human subsistence behavior in southern Africa's Cape Floral Region. *Palaeogeography, Palaeoclimatology, Palaeoecology* 306 (3): 219-227

Fisher, E. C., Bar-Matthews, M. J. A. and Marean, C. W. 2010. Middle and Late Pleistocene paleoscape modeling along the southern coast of South Africa, *Quaternary Science Reviews* 29 (11): 1382-1398.

Goldblatt, P. 1978. An analysis of the flora of Southern Africa: its characteristics, relationships, and origins. *Annals of the Missouri Botanical Gardens* 65: 369-436.

Goldblatt, P. 1997. Floristic diversity in the Cape Flora of South Africa. *Biodiversity and Conservation* 6 (3): 359-377.

Hatley, T. and Kappelman, J. 1980. Bears, pigs, and plio-Pleistocene Hominids: A case for the exploitation of belowground food resources. *Human Evolution* 8: 371-387.

Hawkes, K., Hill, K. and O'Connell, J. F. 1982. Why hunters gather: optimal foraging and the Aché of eastern Paraguay. *American Ethnologist* 9 (2): 379-398.

Heizer, R. F. and Elsasser, A. B. 1980. *The natural world of the California Indians.* University of California Press, Berkley.

Henshilwood, C. S., D'Errico, F., and Watts. I. 2009. Engraved ochre from the Middle Stone Age levels at Blombos Cave, South Africa. *Journal of Human Evolution* 57 (1): 27-47.

Henshilwood, C. S., D’Erico, F., Yates, R., Jacobs, Z., Tribolo, C., Duller, G. A. T., Mercier, N. and Wintle, A. G. 2002. Emergence of modern human behaviour: Middle stone age engravings from South Africa. *Science* 295 (5558): 1278-1280.

Hill, K., Hawkes, K., Hurtado, A. and Kaplan, H. 1984. Seasonal variance in the diet of Aché Hunter-Gatherers. *Human Ecology* 12 (2): 145-180.

Hurtado, A. M., Hawkes, K., Hill, K. and Kaplan, H. 1985. Female subsistence strategies among Aché hunter-gatherers of Eastern Paraguay. *Human Ecology* 13 (1): 1-28.

Klein, R. G. 1974. Environment and subsistence of prehistoric man in the southern Cape province, South Africa. *World Archaeology* 5 (3): 249–284.

Kruskal, W. and Wallis, W. A. 1952. Use of ranks in one-criterion variance analysis. *Journal of the American Statistical Association* 47 (260): 583-621

Laden, G. and Wrangham, R. W., 2005. The rise of the hominids as an adaptive shift in fallback foods: Plant underground storage organs (USOs) and Australopith origins. *Journal of Human Evolution* 49 (4): 482-498.

Lam, Y. M., Pearson, O. M. and Smith, C. M. 1996. Chin morphology and sexual dimorphism in the fossil hominid mandible sample from Klasies River Mouth. *American Journal of Physical Anthropology* 100 (4): 545-557.

Latz, P. 1995: *Bushfires and bushtucker: Aboriginal plant use in Central Australia*. Institute for Aboriginal Development Press, Alice Springs, Australia.

Lee, R. B. 1969. !Kung Bushman subsistence: An input-output analysis. In: Vayda, A.P. (ed.). *Environment and cultural behaviour*. University of Texas Press, Austin. pp. 47-79.

Lee, R. B. 1973. Mongongo: The ethnography of a major wild food resource. *Ecology of Food and Nutrition* 2 (4): 213-307.

Lee, R. B. 1984. *The Dobe !Kung*. Holt, Rinehart and Winston, Inc., New York. pp. 40-44.

Le Maitre, D. C. and Brown, P. J. 1992. Life cycles and fire stimulated flowering in geophytes. In: van Wilgen, B. W., Richardson, D. M., Kruger, F. J. and van Hensbergen, H. J. (eds.). *Fire in South African mountain fynbos. Ecological Studies.* Springer-Verlag, Berlin, Germany. pp. 145-160.

Lightfoot, K. G. and Parrish, O. 2009. *California Indians and their environment: an introduction.* University of California Press, Berkley.

Linnow, G. 2012. Client Liaison Officer: Regional Office-Western Cape. South African Weather Service. Not published.

Malan, J. A. 1987. The Bredasdorp Group in the area between Gans Bay and Mossel Bay. *South African Journal of Science* 83 (8): 506-507.

Marean, C. W. 2010. Pinnacle Point Cave 13B (Western Cape Province, South Africa) in context: the Cape Floral kingdom, shellfish, and modern human origins. *Journal of Human Evolution* 59 (3-4): 425-443.

Marean, C. W. 2011. Coastal South Africa and the coevolution of the modern human lineage and the coastal adaptation. In: Bicho, N.S, Haws, J. A. and Davis, L. G. (eds.). *Trekking the shore. Interdisciplinary contributions to Archaeology.* Springer, New York. pp. 421-440.

Marean, C. W. and Assefa, Z. 2005. *The Middle and Upper Pleistocene African record for the biological and behavioural origins of modern humans.* In: Stahl, A.B. (ed.). African Archaeology. Blackwell, New York. pp. 93-129.

Marean, C. W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A. I. R., Jacobs, Z., Jerardino, A., Karkanas, P., Minichillo, T., Nilssen, P. J., Thompson, E., Watts, I. and Williams H. M. 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature* 449 (7164): 905-908.

Marlowe, F. W. and Berbesque, J. C. 2009. Tubers as fallback foods and their impact on Hadza Hunter-Gatherers. *American Journal of Physical Anthropology* 140 (4): 751-758.

Matthews, T.*,* Marean, C. W. *and* Nilssen, P. J. 2009*.* Micromammals from the Middle Stone Age (92 000 – 167 000 ka) at Cave PP13B, Pinnacle Point, south coast, South Africa*. Paleontologia Africana* 4: 112-120*.*

Mucina, L. and Rutherford, M. C. (eds.). 2006. *The vegetation of South Africa, Lesotho, and Swaziland.* Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Myers, N. 1990. The biodiversity challenge: expanded hotspot analysis. *Environmentalist* 10 (4): 243-256.

Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403 (6772): 853-858.

O'Connell, J. F. and Hawkes, K. 1984. Food choice and foraging sites among the Alyawara. *Journal of Anthropological Research* 40: 504-535.

O'Connell, J.F., Latz, P.K. and Barnett, P. 1983: Traditional and modern plant use among the Alyawara of Central Australia. *Economic Botany* 37 (1): 80-109.

Opperman, H. and Heydenrych, B. 1990. A 22 000 Year-Old Middle Stone Age camp site with plant food remains from the North-Eastern Cape. *The South African Archaeological Bulletin* 45 (152): 93-99.

Parkington, J. E. 1972. Seasonal mobility in the Later Stone Age. *African Studies* 31(+): 223-243.

Parkington, J. E., 1977. Soaqua: Hunter-fisher-gatherers of the Olifants River valley Western Cape. South African Archaeological Society 32: 150-157.

Parkington, J. E. 2001. Milestones: the impact of the systematic exploitation of marine foods on human evolution. In: Tobias, P. V., Raath, M. A., Moggi-Cecci, J.and Doyle, G. A. (eds.). *Humanity from African naissance to coming Millennia - colloquia in human biology and palaeoanthropology.* Firenze University Press, Firenze. pp. 327-336.

Parkington, J. 2003. Middens and moderns: shellfishing and the Middle Stone Age of the Western Cape, South Africa. *South African Journal of Science* 99 (5/6): 243.

Parkington, J. E., Poggenpoel, C., 1971. Excavations at de Hangen, 1968. *The South African Archaeological Bulletin* 26: 3-26.

Pierce, S. M. 1984. *A synthesis of plant phenology in the Fynbos Biome*. South African National Scientific Programmes Report no. 88. Graphics art division of the CSIR, Pretoria. p. 29.

Pierce, S. M. and Cowling, R. M. 1984. Phenology of Fynbos, Renosterveld and Subtropical Thicket in the south-eastern Cape. *South African Journal of Botany* 3: 1-16.

Pinheiro, J., Bates, D., DebRoy, S., and Sarkar, D. 2012. R Development Core Team. nlme: Linear and nonlinear mixed effects models, 2012. *URL http://CRAN. R-project. org/package= nlme. R package version*, 3-1.

Procheş, S., Cowling, R. M. and du Preez, D. R. 2005. Patterns of geophyte diversity and storage organ size in the winter-rainfall region of southern Africa. *Diversity and Distributions* 11 (1): 101-109.

Procheş, S., Cowling, R. M., Goldblatt, P., Manning, J. C., and Snijman, D. A. 2006. An overview of the Cape geophytes. *Biological Journal of the Linnean Society* 87 (1): 27-43.

Rebelo, A. G., Cowling, R. M., Campbell, B. M. and Meadows, M. 1991. Plant communities of the Riversdale plain. *South African Journal of Botany* 57: 10-28.

Rightmire, G. P. and Deacon, H. J. 1991. Comparative studies of Late Pleistocene human remains from Klasies River Mouth, South Africa. *Journal of Human Evolution* 20 (2): 131-156.

Rogers, J. 1984. *Cenozoic geology of the southern Cape coastal plain between Cape Agulhas and Mossel Bay, focussing on the area between the Kafferkuils and Gouritz rivers*. Technical report No. 15: University of Cape Town: Marine Geoscience Unit.

Rossa, B. and von Willert, D. J. 1999. Physiological characteristics of Geophytes in Semi-Arid Namaqualand, South Africa. *Plant Ecology* 142 (1/2): 121-132.

Royer, D. F., Lockwood, C. A., Scott, J. E. and Grine, F. E. 2009. Size variation in early human mandibles and molars from Klasies River, South Africa: Comparison with other middle and late Pleistocene assemblages and with modern humans. *American Journal of Physical Anthropology* 140 (2): 312-323.

Ruiters, C. 1995. Biomass and resource allocation patterns within the bulb of the perennial geophyte *Haemanthus pubescens* L. subsp. *pubescens*

(Amaryllidaceae) in a periodic arid environment of lowland fynbos, *South Africa, Journal of Arid Environments* 31 (3): 311-323.

Ruiters, C., McKenzie, B. and Raitt, L. M. 1993. Life history studies of the perennial bulbous geophyte species *Haemanthus pubescens* subspecies *pubescens* (Amaryllidaceae) in lowland coastal fynbos. *South Africa. International Journal of Plant Sciences* 154: 441-449. (b)

Ruiters, C., McKenzie, B., Aalbers, J. and Ram, L.M. 1993. Seasonal allocation of biomass and resources in the geophytic species *Haemanthus pubescens* subspecies *pubescens* in lowland coastal fynbos, South Africa. *South African Journal of Botany* 59: 251-258. (a)

Schapera, I. 1934. *The Khoisan peoples of South Africa.* Routledge & Kegan Paul, London.

Simms, S. R. 1984. Aboriginal great basin foraging strategies: an evolutionary analysis. Ph.D dissertation, Department of Anthropology, University of Utah.

Singels E. 2013. *Underground storage organs of plants as a food source for Pleistocene hunter-gatherers in the Southern Cape.* MSc. thesis, Stellenbosch University.

Singer, R. and Wymer, J. 1982. *The Middle Stone Age at Klasies River Mouth in South Africa.* Chicago University Press, Chicago.

Skead, C. J., Manning, J. C. and Anthony, N. C. 2009. *Historical plant incidence in southern Africa: a collection of early travel records in southern Africa*. South African National Biodiversity Institute, Pretoria.

Smith, M. and Ross, J. 2008. What happened at 1500-1000 cal. BP in Central Australia? Timing, impact and archaeological signatures. *The Holocene* 18 (3): 379-388.

Thwaites, R. N. and Cowling, R. M. 1988. Soil-vegetation relationships on the Agulhas plain, South Africa. *Catena* 15 (3): 33345.

Van Wyk, B.-E. and Gericke, N. 2000. *People's plants: a guide to useful plants of southern Africa*. Briza Publications, Johannesburg.

Willis, C. K., Lombard, A. T., Cowling, R. M., Heydenrych, B. J., & Burgers, C. J. 1996. Reserve systems for limestone endemic flora of the Cape lowland fynbos: iterative versus linear programming. *Biological Conservation* 77 (1): 53-62.

Wrangham, R. W., Jones, J. H., Laden, G., Pilbeam, D. and Conklin-Brittain, N. L. 1999. The raw and the stolen: cooking and the ecology of human origins. *Current Anthropology* 40 (5): 567–594.

CHAPTER 4

Plant foraging: contemporary results in a pre-historic and future context

4.1 Contemporary use

The southern Cape people of Khoe-San descent no longer rely on plants bearing underground storage organs (USOs) for their primary carbohydrate resource. When the pastoralist Khoe-khoen arrived in the southern Cape around 2000 years ago (Steyn, 1990; Henshilwood, 1996; Boonzaaier *et al.*, 1996), they met with San hunter-gatherers who had for millennia honed their subsistence skills to utilise a variety of local plant resources. The Khoe-khoen and San exchanged economies, which aided the dissemination of edible resource knowledge. However, Colonial influence from the 17th century onwards, and the subsequent introduction of cereal crops, saw a gradual demise in this wisdom. This study highlighted several factors that contributed to this loss of plant utilisation behaviour.

For example, indigenous plant genera, especially USOs, have numerous toxic species similar in appearance to those that are edible (Hutchings, 1996; Van Wyk and Gericke, 2000; Van Wyk *et al.*, 2002; Kellerman *et al*., 2005). A slight decline in knowledge sharing (adults to children) would have led to high risk foraging, serious illness and possible death. All indigenous species that were foraged for in this study were easily identified as edible, such as *Cyphia* species*.* The USOs of *Cyphia* species were foraged for predominately as a thirst quencher by the Khoe-San participants (see Chapter 2). These plants contained high moisture, but low nutritional value (Singels, 2013). The high ranking of numerous fruiting species also indicated a similar foraging incentive. As one participant stated: “We forage for thirst and then for hunger”.

Foraging and processing indigenous plant species has a higher cost in both time and energy than functioning primarily in an agrarian subsistence economy (Chamberlain, 2006). Once the Khoe-San replaced their nomadic existences with sedentary lifestyles, the natural resources within a practical periphery from their permanent dwellings were depleted, with a concurrent reduction in USO foraging. ‘Hot spots’ of USO abundance (Singels, 2013; Chapter 3) require a mobile approach to ensure an adequate harvest in a practical daily foraging radius. In addition, the cost of processing carbohydrate resources in order to render them edible is often outweighed by resources with lower processing costs (Hawkes *et al.*, 1982). This was confirmed here, in that only those plant species which could be eaten raw and unprocessed were harvested (Chapter 2).

Palatability too, could have further prompted the transition from dependence on foraging for carbohydrates to reliance on agriculturally produced cereals. When one elderly participant was asked why she no longer foraged for USOs, she replied that their palatability was inferior to that of introduced cereal crops. Considering the above, the active use of 58 indigenous edible plant species with a variety of 69 uses (12% of which were USOs) found in this study, is impressive.

Coinciding with the introduction of sedentary lifestyles was a growing dependence on the cash economy. It was observed that the further participants lived from a town, the poorer they were, and the more they depended on indigenous edible plants. This too was evident in the diverse and active use of medicinal plant species (see Appendix 1 for list of 140 plant species and seven animal species) due to the high cost of western medicine and a lack of trust in their healing properties (stated by numerous participants). Also, of all useful plant species, numerous species were exotic. These uses indicated a rapid acquisition of knowledge on useful plants. Contemporary use of indigenous edible plants is therefore driven by ongoing dependence on the environment to alleviate the pressure from the high monetary cost of required resources as well as, a desire to preserve a diminishing cultural heritage.

4.2 Abundance and seasonality

4.2.1 Abundance and composition

Edaphic factors, through their influence on the distribution of vegetation, were a primary determinant of the abundance of edible plants. Secondly, precipitation had a strong influence on abundance: a below normal rainfall year elicited a lower abundance of edible plants than a regular rainfall year.

4.2.2 Seasonality

The Cape Floristic Region (hereafter Cape) is characterised by a diversity of vegetation types (Mucina and Rutherford, 2006; Vlok and De Villiers, 2007). Each type exhibits a unique set of species as well as a portion of certain species from other vegetation types (Cowling, 1990). This variation is influenced by edaphic factors (Thwaites and Cowling, 1988; Rebelo *et al.*, 1991). The Cape's diversity is favourable for human foraging as abundant edible plant resource availability or seasonality creates an almost year round apparency. When some USOs were in their dormant seasons, and their edible portion hidden underground and unable to be detected for procurement, other species were available in their active season. Along with the extended period of apparency due to dry, wilted leaf visibility, the human forager was faced with a relatively short period of non-apparency of USOs from late Summer to early Autumn (less than 60 days; Chapter 3). During this period, the ripening of some fruits, especially *Carpobrotus* species, provided some reprieve from the lack of carbohydrate availability. This phenological study did not include the surface water zone of perennial streams (Vlok and De Villiers, 2007), which is dominated by *Prionium serratum*. This species has a year round apparency (Boucher and Withers, 2004) and therefore potential availability for the human forager. The Khoe-San actively procured this particular resource (see Chapter 2). The combination of ripening of fruiting species and presence of *Prionium serratum* could well have formed a sustainable period of carbohydrate resources during the dormant phase of all edible USOs during late Summer and early Autumn. Therefore, the juxtaposition of seasonal apparency of all edible plant resources could have provided year round availability of carbohydrates for human foragers.

4.3 Pre-historic context

An impressive array of indigenous edible plant species were utilised by the Khoe-San descendants of the southern Cape coastal area. Although much knowledge has been lost, contemporary understanding of the complex aspects of this environment points to a wide range of options that would have been available to and perceived by pre-historic foragers. Our understanding of this broader pre-historic knowledge base is seated in archaeological, historic and certain other ethnographic observations. Corm-husk remains from the Iridaceae family found at numerous archaeological sites within the Cape, strengthen the potential of this habitat as an area rich in carbohydrate resources (Deacon & Deacon, 1963; Parkington and Poggenpoel, 1971; Deacon, 1970; 1976; 1984).

As mentioned previously, harvesting Iridaceae species entailed certain risks due to the interwoven taxonomic complexity of numerous toxic species. This was illustrated by top-ranking participants [see Appendix 2, Ethnobotanical Knowledge Index (EKI), for ranking of participants) in my ethno-botanical survey who barely recalled certain edible species (*Babiana patula, B. ambigua, Tritonia squalida*) (Chapter 2). However, archaeological and historical data provide evidence that this complex taxonomic hurdle was mastered by pre-historic foragers (Deacon, 1970; Skead *et al.*, 2009). The process of discerning toxic from edible and also the associated processing technology (cooking, leaching) which rendered certain species edible, must have posed specific cognitive challenges. Changing environments over timescales ranging from months to thousands of years could have influenced carbohydrate resource availability on the Cape coast. In response, MSA foragers were likely forced to improve their taxonomic and technological skills to ensure access to sustainable carbohydrate resources. This newfound challenge could have contributed to the emergence of costly wired brains, and the sculpting of a species, the cognitively modern *Homo sapiens sapiens*.

In addition to taxonomic challenges, the complex phenology of edible plant species within the taxing diversity of vegetation types (coinciding to form annual carbohydrate dependability), would have posed further cognitive challenges for MSA hunter-gatherers. This study focused on the four primary vegetation types of the coastal lowlands of the Cape and revealed seven phenophases of apparency for all indigenous edible plant species. In addition, the biomass of edible plant resources varied significantly between the different vegetation types, with coastal vegetation (Strandveld and Limestone Fynbos) being most productive. Renosterveld, with a high diversity, but low biomass, of species, and Sand Fynbos, with year-round apparency of *Watsonia fourcadei,* both contributed to a favourable habitat for hunter-gatherers and their carbohydrate requirements.

The association of varying habitats on the Cape coast, whether for protein, carbohydrates or other subsistence requirements, and their juxtaposition of seasonal availability, could have sustained hunter-gatherers in crisis or survival periods. The associated pressure on varying resources, and on people living off these resources, could well have instigated the ideal conditions for a cognitive revolution for the *Homo* genus, resulting in the defining attributes of our species today.

4.4 Future context

This study raised a number of questions/areas which could be improved and future studies should be instigated, focussing on:
1) Ethnography
2) Abundance and Seasonality

4.4.1 Ethnography

This study of contemporary use of indigenous edible plants (medicinal and other uses included) was restricted to the coastal lowlands of the southern Cape. It focussed on communities surrounding Still Bay and their existing knowledge. Due to long term sedentary lifestyles (in addition to other reasons discussed earlier), the

Khoe-San descendants of South Africa have become specialised on vegetation types that are within a practical foraging radius of their permanent dwellings. In order to record all possible surviving ethno-botanical knowledge amongst the Khoe-San, a systematic approach of potential communities and vegetation types, together with their biomes, is urgent. This precious knowledge is being lost due to many factors, one of which is a lack of interest amongst the youth. Aspects of Khoe-San subsistence strategies, other than ethno-botanical, were still evident and active. These aspects included the procurement of marine and terrestrial fauna. A broader ethnographic study should be instigated in order to sufficiently document all remaining knowledge. If they can be found, people who actively forage for indigenous edible plants, especially USOs, should be recruited for foraging experiments to correctly document return rates. This is particularly important with respect to processing edible plants, as this dramatically influences return rates, toxicity and nutrient content. Processing observations will indicate that a comparative analyses of raw vs. cooked and the resultant nutritional implications is required. These recommendations will provide a more thorough estimate of the value of indigenous plants for pre-historic hunter-gatherers.

4.4.2 Abundance and seasonality

The phenological survey of the four primary vegetation types included 4 plots of 100m x 300m size. These respective plots were visited at six weekly intervals and vegetation counts and growth statuses recorded. It is possible that these plots could have excluded dense ‘patches’ of USOs [“Hot spots”; (Singels, 2013)] and numerous other unrecorded species due to the non-uniform distribution of USOs, the majority of which were geophytes. Future studies should also calculate the biomass of species with aboveground carbohydrates. In this regard, *Prionium serratum*, showed tremendous potential due to its abundance and availability. Net foraging return rates and nutrient analyses would clarify the role that these species played in supplementing annual carbohydrate requirements for human foragers. Further research is also required on the nutritional value and palatability of edible carbohydrates.

As mentioned, edaphic factors mainly controlled the distribution and abundance of edible plant species. The unripe seedpods of *Astephanus triflorus* known as 'vissies' or small fish to the Khoe-San in the study area, were seen as a tasty vegetable and readily consumed by many. It was found surrounding Melkhoutfontein in Limestone Fynbos creeping up Proteaceae and some other shrubs. In South Africa it has a wide distribution, but Limestone Fynbos is its only alkaline foothold throughout its distribution. It is a known toxic plant, but is edible in Limestone Fynbos. A study of the influence of alkalinity on potentially edible plants could reveal the effect of pH on toxicity and highlight potential species found in alkaline soils.

4.4.3 Humans within ecology

In pre-history, the tale of human interaction with all living organisms has emerged as a synergy of co-existence. Humans were elements within an ecosystem and not its determining factor. Hunter-gatherers were completely dependent on their resources for their daily subsistence and in certain critical periods, for their survival as a species. Although their impact on resources would have been relatively insignificant due to low population densities, a sense of respect and awareness of sustainability is most probably what they felt for the habitat that nurtured them. The almost unparalleled biodiversity of their habitat, their specialisation in sustaining themselves within this complexity of life and the resulting process which gave rise to Earth's apex predator should signal a strong message to us all today.

4.5 References

Boonzaaier, E., Malherbe, C., Smith, A. and Berens, P. 1996. *The Cape Herders. The history of the Khoikhoi of southern Africa.* David Philip, Cape Town. pp. 17-18.

Boucher, C. and Withers, M. 2004. Palmiet. the unique Cape river plant Prionium Serratum. *Veld and Flora.* 90 (1): 26-28.

Chamberlain, A. T. 2006. *Demography in archaeology: Cambridge manuals in archaeology*. Cambridge University Press, Cambridge.

Cowling, R. M. 1990. Diversity components in a species-rich area of the Cape Floristic Region. *Journal of Vegetation. Science* 1: 699–710.

Deacon, H. J. 1970. Plant remains from Melkhoutboom Cave, South Africa. *Proceedings Transkei and Ciskei Research Society* 1: 13–15.

Deacon, H. J. 1976. *Where hunters gathered: a study of Holocene Stone Age people in the Eastern Cape*. South African Archaeological Society, Claremont.

Deacon, J., 1984. Later Stone Age people and their descendants in southern Africa. In: Klein, R.G. (ed.). *Southern African prehistoric and paleoenvironments*. A. A. Balkema, Rotterdam/Boston. pp. 220–328.

Deacon H. J. and Deacon, J. 1963. Scott's Cave: a late Stone Age site in the Gamtoos Valley Annals of the Cape Provincial Museums. *Natural History* 3: 96-112.

Hawkes, K., Hill, K. and O'Connell, J. F. 1982. Why hunters gather: optimal foraging and the Aché of eastern Paraguay. *American Ethnologist* 9 (2): 379-398.

Henshilwood, C. 1996. A revised chronology for pastoralism in southernmost Africa: New evidence of sheep at *ca.* 2000 B.P. from Blombos Cave, South Africa. *Antiquity* 70: 945-949.

Hutchings, A. 1996. *Gladiolus dalenii* van Geel. In: *Zulu Medicinal Plants: An Inventory.* University of Natal Press, Durban. p. 464.

Kellerman, T. S., Coetzer, J. A .W., Naudé, T. W. and Botha, C. J. 2005. *Plant poisonings and mycotoxicoses of livestock in Southern Africa,* 2nd edition. Oxford University Press, Cape Town.

Mucina, L. and Rutherford, M. C. (eds.) 2006. *The vegetation of South Africa, Lesotho, and Swaziland.* Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Parkington, J. E., Poggenpoel, C., 1971. Excavations at de Hangen, 1968. *The South African Archaeological Bulletin* 26: 3–26.

Rebelo, A. G., Cowling, R. M., Campbell, B. M. and Meadows, M. 1991. Plant communities of the Riversdale plain. *South African Journal of Botany* 57: 10-28.

Singels E. 2013. *Underground storage organs of plants as a food source for Pleistocene hunter-gatherers in the Southern Cape.* MSc. thesis, Stellenbosch University.

Skead, C. J., Manning, J. C. and Anthony, N. C. 2009. *Historical plant incidence in southern Africa: a collection of early travel records in southern Africa*. South African National Biodiversity Institute, Pretoria.

Steyn, H. P. 1990. *Vanished lifestyles: The early Cape Khoi and San*. Unibook Publishers, Hatfield, Pretoria.

Thwaites, R. N. and Cowling, R. M. 1988. Soil-vegetation relationships on the Agulhas plain, South Africa. *Catena* 15 (3): 33345.

Van Wyk, B.-E. and Gericke, N. 2000. *People's Plants: A Guide to Useful Plants of Southern Africa*. Briza Publications, Pretoria.

Van Wyk, B. E., van Heerden, F. and van Oudtshoorn, B. 2002. Poisonous plants of South Africa. Struik, Cape Town.

Vlok, J. H. J. and de Villiers, M. E. 2007. *Vegetation map for the Riversdale domain.* Unpublished 1:50 000 maps and report supported by CAPE FSP task team and Cape Nature.

Appendix 1.1:

Participants in the ethnobotanical survey in the Still Bay area, southern Cape. The abbreviations given in brackets are used in the checklist (Appendix 1.2).

Name of participant	Age at time of survey	Geographical origin	Source of plant knowledge
Jilian Abrahams **(JA)**	53	Melkhoutfontein	Parents
Paulina Arendse **(PA)**	64	Kransfontein	Own experience
Dawid Baartman **(DB)**	73	Die Poort, Melkhoutfontein	Own experience, uncle
Marlin Baartman **(MB)**	17	Melkhoutfontein	Grandfather
Maria Busch **(MBU)**	50	Melkhoutfontein	Parents
Gerald Carelse **(GC)**	41	Melkhoutfontein	Parents, grandmother, aunt
Charlton Daniels **(CD)**	14	Blikhuis	Grandmother
Anna (Barbie) Daries **(AD)**	74	Melkhoutfontein	Grandparents
Johanna Daries **(JD)**	79	Melkhoutfontein	Parents
Cornelius Griffie **(CG)**	70	Melkhoutfontein	Parents
Charles Jakobs **(CJ)**	51	Melkhoutfontein	Grandmother
Marthinus (Faan) Jakobs **(MJ)**	56	Stonehaven	Parents, elders
Elsie (Ella) Kleinhans **(EK)**	73	Blikhuis	Parents
Mary Kortje **(MK)**	71	Melkhoutfontein	Mother
Jacobus Plaatjies **(JP)**	28	Vrye Uitsig	Parents, elders
Johannes Julian Riddles **(JR)**	43	Melkhoutfontein	Parents, grandparents
Nellie Riddles **(NR)**	91	Blikhuis	Parents
Anna Saayman **(AS)**	69	Melkhoutfontein	Mother, grandmother

Appendix 1.2

Checklist of 140 useful (edible, medicinal, and otherwise useful; indigenous and exotic) plants (and seven animal species) of the Still Bay area.

Species	Vernacular name(s)	Uses in the Still Bay area
1. *Acacia karroo* Hayne (Fabaceae) PEU22993	pendoringboom, witpendoring, doringboom	bark infusion: stomach ailments (PA), inflammation (JD), gargled for sore throat (AS), gargled for inflamed tonsils (AD); leaf infusion: fever (JA); gum eaten as a snack (PA, DB, GC, JD, CG, CJ, MJ) and also used as glue (PA); bark used to make whips (DB)
2. *Acorus calamus* Linn. (Acoraceae) PEU22990	kalmoes	infusion of dried rhizome: stomach ailments (PA, DB, GC, CJ, MJ, EK, JR, NR, AS), inflammation (JD), back problems (CJ), a general medicine and to treat a hangover (PA), kidneys (diuretic) and blood purification (JP), constipation (AD); small piece chewed to alleviate stomach pain and cramps (MBU); taken by pregnant women (JD); used as sit bath after labour (JD); uses forgotten (mother used it) (CG)
3. *Agathosma dielsiana* Schltr ex. Dümmer (Rutaceae) PEU22964	vleiboegoe, boegoe	leaf infusion used for influenza (PA); branches spread on floor for their pleasant odour (JA); fresh leaves rubbed in armpits as deodorant (JR)
4. *Agathosma muirii* E. Phillips (Rutaceae) PEU22963	anysboegoe, boegoe	leaf infusion used for influenza (PA); branches spread on floor for their pleasant odour (JA); fresh leaves rubbed in armpits as deodorant (JR)
5. *Agathosma serpyllacea* Licht. ex Roem. & Schult. (Rutacea) PEU22962	anysboegoe, boegoe	leaf infusion used for influenza (PA); branches spread on floor for their pleasant odour (JA); fresh leaves rubbed in armpits as deodorant (JR)
3. *Agathosma serratifolia* Curtis. Spreeth (Rutaceae) PEU22994	bergboegoe, boegoe	leaf infusion: stomach trouble and many ailments (MK, AS), stomach cramps (JD), influenza (JD, NR), blood purification, kidney and bladder purification (women) (AD, JP, AS), arthritis (taken with rooibos tea) (MBU); soak leaves in vinegar and apply to sprained ankle (JA, DB, AD, MK), a stretched muscle (CJ), head to treat headache (MJ) or any painful part (MBU, JD, AS); leaf tincture for many ailments (PA, CJ), asthma, high blood pressure and stress (DB, JR), applied to rashes and pimples (GC)
7. *Albuca maxima* Burm. f. (Hyacinthaceae) PEU22995	slangbol, koppie-en-piering	bulb applied as poultice to remove thorns (PA); leaves applied to insect stings (JA)
8. *Aloe ferox* Mill.	aalwyn, tapaalwyn, bitteraalwee	leaf sap: purgative to treat constipation (MK), with some castor oil added (JD); blood purification

(Asphodelaceae) PEU22996		(MBU, NR); small pills made with leaf sap and flour: blood purification (as laxative) (JA, PA, DB, MB, GC, AD, CJ, MJ), constipation – taken once every eight days (JD, CG, AS), high blood pressure (CJ), diabetes (mixed with *wildeals*) (MB); diabetes (tincture of sap) (AD); sap applied to burns (EK), ringworm (MBU); infusion of dry leaves: stomach ailments (EK); leaf sap applied to hair to repel lice (JP); leaf sap applied to cats and dogs to repel fleas (JP); leaf sap added to dog food to give them appetite (MB); sliced leaves added to drinking water to cure chicken ailments (*hoendergriep*) (JP); leaf sap used as vermifuge for dogs (MB)
9. *Aloe maculata* All. (Asphodelaceae) PEU22997	bontaalwyn	heated leaf, cut open and applied to wounds, sores and burns (JA, MBU, JD, EK, NR) as well as boils (PA, DB, GC, AD, AS) or as poultice (blister-plaster) to extract a thorn (EK, AS); sap applied to remove lice in children (EK); crystals used for blood purification and tonsillitis (JR);
10. *Annesorhiza nuda* (Aiton) B.L.Burtt (Apiaceae) PEU22948	anyswortel, liquorice plant	roots are eaten (MBU); chew the leaf for the liquorice taste (JA)
11. *Aponogeton distachyos* L.f. (Aponogetonaceae) PEU22998	waterblommetjies	inflorescences used for stew (JA, PA, DB, MBU, GC, CG, CJ, MJ, EK, JP, JR), some leaves added (AD, JD, AS)
12. *Artemisia absinthium* Linn. (Asteraceae) PEU22939	groenamara, amara, maagbossie	leaf infusion: stomach pain (MBU, GC, AD, CD, EK, MK, AS), stomach medicine (NR), stomach cramps (JA, MBU), diarrhoea (JA, MBU), diabetes (MB, AS), high blood pressure (AS); leaf infusion taken or fresh leaves eaten: stomach ailments (including pain, flatulence) and stomach ulcers (JR) or upset stomach (JD); medicine (details forgotten) (CG)
13. *Artemisia afra* Jacq. ex Wild. (Asteraceae) PEU22934	wildeals	leaf infusion: high blood pressure (CJ, MK), sometimes mixed with *perdepis* (DB, MK) and *wynruit* (DB), colds (DB, MB, GC, CD, CJ, JR), influenza (DB, MB, GC, CD, CJ, JR), diabetes (AD, JD), allergies (also by steaming) (JR), fever (CG), menstrual pains (MB), colds (mixed with *koppiesdagga* and *perdepis*) (JA); cold water infusion (left overnight) for high blood pressure (EK), colds and chest complaints (MB, AD, MJ, JP, JR, NR, AS), blood purification (JP); chew a leaf to alleviate heartburn (JD); leaves eaten or infusion taken: upset stomach (PA, AD); dried leaves taken as snuff to treat colds and headache; leaves boiled with sugar: cough syrup (JA, PA, MB, JD, CJ, MJ, EK, AS) and asthma (AD, JR, AS); raw yellow of egg added to syrup (PA); vinegar, garlic and a clove added (MB); small cushions stuffed with fresh leaves ("*wildeals-sakkies*") tied to chest and back: slimy chest in infants (AD, JD, CJ, MJ, AS), formerly mixed with *bakbos* and *perdepis* (JP) or garlic (MB); cushion only on back as 'sickness' must come out the front through lungs (JD)
14. *Aspalathus sanguinea* ssp.	molbossie, molbos, veebossie	freshly picked branches used as brooms (JA, DB, MB, MBU, GC, AD, CD, JD, CG, MJ, EK, JR, AS)

foliosa R. Dahlgren (Fabaceae) PEU22920		
15. *Asparagus capensis* L. (Aparagaceae) PEU22906	katdoring, kattedoring, katbos	infusion of roots: tuberculosis (CJ), kidney ailments (NR) and perhaps diabetes (PA); stem and leaf decoction: tuberculosis (JR); fleshy roots eaten as "*uintjies*" (JD, JR); children eat the berries (PA)
16. *Astephanus triflorus* (L.f.) Schult. (Apocynaceae) PEU22952	vissies	young fruits are eaten (JA, MBU, GC, AD, JD, MJ, MK, AS)
17. *Babiana ambigua* (Roem. & Schult.) G.J. Lewis (Iridaceae) PEU23015	bobbejaantjie	corms eaten by children (in former times) (JR)
18. *Babiana patula* N.E.Br. (Iridaceae) PEU22958	bobbejaantjie	corms eaten by children (in former times) (JD, NR)
19. *Ballota africana* (L.) Benth. (Lamiaceae) PEU22878	kattekruie	leaf infusion: taken for colds (MK, JR, NR), fever (JR), sore throat (JD), cough (mixed with *wildeals*) (DB), back pain (JD), stomach problems (AD); haemorrhoids (AD, AS), high blood pressure (AS), diabetes (AS), cancer (JA), for all ailments, bladder (PA), medicine (details forgotten) (MBU, CD); as body wash for sores and pimples (JD, MJ), applied to wounds and sores (JD, EK); fresh leaf as ear plug to treat earache (JP); burn to ward off ghosts/spirits; against fleas and other pests (PA)
20. *Boophane disticha* (L.f.) Herb. (Amaryllidaceae) PEU22999	gifbol	leaves applied to sores as inflammation plaster (MJ, JP, JR, NR); bulb scales applied to head to alleviate headache (also applied to other painful parts) (PA), muscle pains (CJ), applied to a boil to ripen it (JA, MBU, AD, CG, AS), as blister plaster to remove a thorn (CJ), as plaster to heal a wound or sore and to reduce pain (DB, GC, JD, CJ)
21. *Bulbine frutescens* (L.) Willd. (Xanthorrhoeaceae) PEU22961	geneesbossie, kankerbossie, geel katstert	leaf juice applied to burns (as first aid treatment, to prevent reddening or blistering) (JA, JD), insect stings (JA), small sores and wounds (DB, GC, AD, MK), ringworm and pimples (JR), acne (AD, JP), skin cancer (MBU); applied to bed sores, skin ailments and itches (sometimes mixed with *Chenopodium album* and nastergal leaves) (AS)
22. *Bulbine lagopus* (Thunb.) N.E.Br. (Xanthorrhoeaceae) PEU22954	katstert	leaf juice applied to small sores (MK), ringworm and pimples (JR), acne (JP), burns and insect stings (JA)
23. *Bulbine latifolia* (L.f.)Schult. & J.H.Schult. (Xanthorrhoeaceae) PEU23019	rooiwortel	root infusion: general medicine (obtained from elsewhere) (JR)
24. *Canna* spp. L. (Cannaceae)	kenna, kanna	Red leaf preferred over green leaf: poultice of bruised leaves, for any pain; leaves dry as pain is drawn out (CJ, MJ, JR)

PEU23020		
25. *Cannabis sativa* L. (Cannabaceae) PEU23000	makdagga, ganja	leaf infusion: headache and general blood purification (MK), asthma (CG, MJ, JR), stroke (AD, JP, JR), high blood pressure (JA, DB, MB, MBU, GC, AD, JD, JP, JR, AS), diabetes (DB, MB, GC, CJ, JP), colds, stress, cancer (JP); unspecified ailments (CD, NR); to strengthen the heart, taken after a heart attack (with a pinch of powder sea bean added) (PA); ash applied to acne (JR); leaves smoked to treat asthma (MJ)
26. *Carissa bispinosa* (L.) Desf. ex Brenan (Apocynaceae) PEU22896	noem-noem	fruits are eaten (JA, PA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MK, JP, NR, AS), they give you energy (JR); when eaten in large amounts the latex accumulate in the mouth (like chewing gum) (MJ)
27. *Carpobrotus acinaciformis* (L.) L.Bolus (Aizoaceae) PEU22900	suurvye, vyeranke	fruits are eaten (when soft and yellow or when dry) (JA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, MK, JR, AS) or used to make jam (DB, MB, MBU, GC, AD, JD, CJ, JR, AS); fruits have a laxative action (AD, CJ, JP, JR); leaf sap used to treat oral thrush in children (JD, CJ); leaf juice gargled (morning and evening) for sore throat (JD)
28. *Carpobrotus edulis* (L.) L.Bolus (Aizoaceae) PEU22899	ghoena	fruits are eaten (when ripe – soft and yellow, not when dry) (JA, PA, DB, MB, MBU, GC, AD, CD, CG, CJ, MJ, MK, JR, NR) or used for jam (PA); fruits have a laxative action (CJ, JP, JR); leaf sap: oral thrush in children (JA, PA, MBU, AD, CD, JD, CG, CJ, MJ, EK, MK, JP, JR, NR) and adults (AS), sore throat (MJ, JR, AS), gargle morning and evening (JD), tonsillitis (JR); sap with a little *nasgal* (*Solanum retroflexum*) added: acid in infants (EK); leaf eaten for sore throat (PA) or stomach pain (MBU)
29. *Carpobrotus muirii* (L.Bolus) L.Bolus (Aizoaceae) PEU22898	suurvye, suurvytjie, wilde suurvy	fruits are eaten (MK, JR)
30. *Cassine peragua* (L.) (Celastraceae) PEU22969	droëlewer(bessies)	Berries eaten (JA)
31. *Cassytha ciliolata* Nees (Casythaceae) PEU22904	geelrankie, oumenshare	crushed herb in Vaseline or goat fat (as an ointment): skin irritations and rashes, especially in the neck, groin and under arms (JD); decoction in bath, as wash to treat skin rashes in children and sometimes adults (JD); decoction used to wash and rinse hair – to stimulate hair growth and to make hair strong (PA)
32. *Centella stenophylla* Adamson (Apiaceae) PEU22978	klipdagga	used as medicine (MJ)
33. *Chenopodium murale* L. (Amaranthaceae) PEU22945	misbredie	leaves decoction: rashes (“small pimples”) in infants and adults (MK) and a small amount for colic in infants (PA); leaf infusion is good for the bladder (JR); leaves: to remove acid in 1–2-month-old babies (place leaves in small cloth, add *lidjiesgras*, *hondebossie* and *ghoena* leaf, bruise and place in

		water for the juices to extract, add a little sugar and give to drink (JD), ditto, but on its own (JA, MBU), as laxative for infants (MBU); healthy food (MK, NR), a spinach (PA, AD, CJ, MJ, JR, AS), cooked with some *nasgal* leaves (JD)
34. *Chironia baccifera* L. (Gentianaceae) PEU22916	bitterbos, bitterbessiebos, spreeubos	decoction of whole herb: wash hair to remove dandruff (put some aside and drink later) (MBU, AD, GC, JD), wash children's hair to treat ringworm (JA, EK, MK, JR), remove head lice (JP), wash skin to treat rashes, itches (JA, PA, AD, NR, AS), eczema (JR) and sores (JD), all skin ailments and sores (MBU); used for steaming, to treat skin ailments (and take infusion orally at the same time) (JA); drink for blood purification ("it works from the inside and the outside") (MBU, JR, NR); leaf infusion taken for colds (EK); fruit is edible (JR)
35. *Cissampelos capensis* L.f. (Menispermaceae) PEU22946	dawidjiewortel, dawidjie	infusion of rhizome: constipation and colic in infants (AD, JR), stomach problems (DB, GC, AD, AS), stomach pain and acid (JA, MBU), blood purification and pimples (DB, GC), various ailments, can be mixed with other herbs (JR); rhizome is cut in a downward direction for downward action (i.e. stomach and urinary ailments) or upwards (for an emetic action) (JA, MBU, JR); infusion of rhizome: epilepsy or spasms in children and infants (cut downwards for male child, upwards for female) (JD); leafy twigs used as fan to repel midgets (JP)
36. *Clausena anisata* (Willd) Hook.f. ex Benth. (Rutaceae) PEU22925	pêrepis, perdepis, pêrebossie (euphemism)	leaf infusion (alone or with other herbs): high blood pressure (JA, MBU, AD, CG, EK, MK), but *wildeals* is better (JD), colds (DB, MB, GC, AD, MJ, JP, JR, NR, AS), influenza and many other ailments (JA, DB, MB, MBU, GC, AD, JP, CJ, NR, AS), kidney, back, bladder and genital ailments, especially in elderly men (often with klipdagga) (PA), kidney and bladder ailments (JD, JP, JR), inflammation (JD), headache (AS), backache (EK), stomach ailments (MJ), tuberculosis (JP), blood purification (JP), diabetes (MBU, AD), medicine (details not known) (CD); leaves applied (with potato slices and vinegar) to sores on the head (children and adults) (JR); added to *wildeals* bags to treat chest ailments in infants (JP); mixed with *keurtjie* and *koppiesdagga* for diabetes, high blood pressure, colds and all ailments (MBU); narrow-leaved female form (*wyfie*) is used by men and broad-leaved male form (*mannetjie*) is used by women (otherwise it makes you ill) (CJ); use in moderation (JA)
37. *Conyza scabrida* DC. (Asteraceae) PEU22947	bakbos, bakbossie	leaf infusion: inflammation (topical and oral), also taken for cough – a good medicine (AD, NR), inflammation in lungs (AS), colds (JA, MBU, JR), back pain (JD), chest pain (JD), kidneys (JD), stomach ailments (JA, AD), chilblained feet, cracked skin and women's ailments: post-natal, clean vaginal area, prevent infection (PA), sores (as wash, can mix with *kattekruie*) (MJ), taken as post-natal medicine and also as sit bath (JD), taken to regain and/or improve voice (CJ); cold infusion of leaves (left overnight) for cough (EK); leaves applied to stomach (with a little salt): dysentery (MBU); bruised leaves, with vinegar, applied to

		stomach for stomach pain in children (JA, AD, CG, AS) and adults (JD) or to head for headache (AS); leaf infusion: wash legs to straighten them (DB), wash legs in case of sore feet (MBU); wash hair (GC); medicine (details not known) (CD)
38. *Cotyledon orbiculata* L. (Crassulaceae) PEU23001	plakkie	fresh leaf: eaten for sore or dry throat (PA); fresh (heated) leaf applied as blister plaster to boils (AD, AS); leaf juice on cloth: oral thrush in children (inside of mouth is washed) (CJ); juice from heated leaf dripped into ear to treat earache (MBU, JD), ear infections (JA) and toothache (JD)
39. *Cyclopia genistoides* (L.) R.Br. (Fabaceae) PEU23002	wildetee, teeblommetjie, duinetee	infusion of whole herb (with flowers) used as tea (PA, CD, CJ, MJ, NR, AS)
40. *Cynanchum obtusifolium* L.f. (Apocynaceae) PEU22894	klimop, pôka (plant); pok-pôk, kapôke, pa-pôk, papie (fruits)	unripe fruits eaten by children (PA, DB, MB, MBU, GC, CD, JD, CJ, MJ, EK, MK, JP, JR) or the inner part only (CG, AS), in case of old fruits (JA, MBU)
41*. Cyperus esculentus* L. (Cyperaceae) PEU23021	uintjie	corms are edible (JP)
42. *Cyperus textilis* Thunb. (Cyperaceae) PEU22957	toue, tou	bottom end of stem edible (sweet) (JD); stems twisted and beaten/bruised (on a flat rock or log, using a *klopper*) and then dried to use as rope (for tying *dekriet* bundles or sheaths of oats) and for making whips (JA, PA, DB, MBU, GC, AD, CD, JD, CG, CJ, MJ, EK, MK, JR, AS); used for making mats (PA, JP)
43. *Cyphia digitata* (Thunb.) Willd. (Campanulaceae) PEU22949	baroe, barou, bruin baroe	raw bulbs: eaten by children (PA, DB, MB, GC, AD, CD, JD, CG, MJ, MK, JP, NR, JR, AS), it is astringent (MBU); two pebbles used as place markers in dry season because the bulb tastes better in the growing season (JD); peel skin off and eat raw (JD)
44. *Cyphia undulata* Eckl. (Campanulaceae) PEU23016	baroe, barou, wit baroe	raw bulbs: eaten by children (JA, PA, DB, MB, GC, AD, CD, CG, MJ, MK, JP, NR, JR, AS); it is sweet (MBU)
45. *Datura stramonium* Linn. (Solanaceae) PEU23003	olieblaar, stinkolieblaar, olieplant, mannetjie olieblare,olieboom	heated leaves used as compress on painful parts of the body (PA, JD, CJ), backache and boils (JR), headache (JA, DB, GC, AD, CD, JD, CJ), haemorrhoids (CJ), painful legs (leaf applied with *soetolie*, sun side on the skin) (MBU); seeds or leaves are smoked: asthma (AD) or drug use (PA, CJ, MJ); seven seeds eaten (over a long period) to prevent boils (AS)
46*. Diospyros dichrophylla* (Grand.) De Winter (Ebenaceae) PEU22970	jakkals(tol)bos (plant) jakkalstolle (fruits)	fruits are eaten (PA, DB, MBU, GC, CD, CG, CJ, MJ, EK, MK, JP, NR, AS)
47. *Dodonaea angustifolia* L.f. (Sapindaceae)	ysterhout(toppe), ysterbossie	leaf infusion taken for all ailments (PA), coughs (EK), muscle pains and cramps (JD), as stimulant and energy booster (JR), high blood pressure (AD), diabetes (AD), backache (MBU, AD); leaves used

PEU22933		as medicine (CD, MJ, JP, AS); used as vermifuge for calves (DB)
48. *Drimia capensis* (Burm.f.) Wijnands (Hyacinthaceae) PEU23004	jukbol, jukui, maerman, maer-maer, slangkop	infusion of bulb scales (mixed with *keurtjie* and *bakbossie*) taken as diaphoretic to treat gout (JD); bulb added to bath water: to alleviate the itch of a rash ("*melaatsuitslag*") (JR); emetic to treat poisoning (JR)
49. *Elytropappus rhinocerotis* (L.f.) Less. (Asteraceae) PEU22953	anosterbos, renosterbos	twigs and leaves used as medicine (JA, CG, JR); infusion used to treat tuberculosis (JD) and syphilis (grandfather diagnosed the disease by the way people walk; they had to wash in it and also drink it three times) (JD); tips (*toppe*) applied to sore breast (with some *duiwelsdrek* – asafoetida – added) (JD); used to repel fleas (also as stuffing for a mattress) (DB, MJ); formerly used as brooms (JP); used for fire-making (gives pleasant smell) (DB, AD, JD, CJ, AS), adds flavour to *roosterbrood* (traditional fire-baked bread) (JD)
50. *Emex australis* Steinh. (Polygonaceae) PEU22972	dubbeltjie, duwweltjie	leaf inserted in ear to alleviate toothache (JR) and earache (CJ); leaves applied to sores, pimples and boils as compress and blister plaster (JA, MBU, AD, JD, MJ, AS); leaves edible, used in stews (CJ, MJ); leaves are used (details forgotten) (CG)
51. *Entada gigas* L. Fawc. & Rendle (Fabaceae) PEU23022	seeboontjie	seed (picked up on the beach) used for teething children (MBU)
52. *Euclea racemosa* Murray (Ebenaceae) PEU22924	seeghwarrie, ghwarrie	leaves chewed and juice swallowed: stomach pain (MBU); ripe fruits are eaten (JR)
53. *Euclea undulata* Thunb. (Ebenaceae) PEU22991	ghwarrie	leaf infusion: stomach ailments (AD); ripe fruits are eaten (DB, CJ, NR); wood used for fire-making (DB)
54. *Euphorbia burmannii* E.Mey ex Boiss. (Euphorbiaceae) PEU22902	melktou, melkbossie	latex applied to (bruised) warts to remove them (PA, CD, JD, MJ, NR)
55. *Exomis microphylla* (Thunb.) Aellen (Chenopodiaceae) PEU22932	hondebossie	strong infusion of whole herb: cancer ("internal ailments") but only effective in early stages (MK), Alzheimer disease (AS), blood pressure (JD), strengthens the heart (AD), applied to rashes (JA, PA), rinse for pink eyes (PA); infusion: sit-bath to treat haemorrhoids (JR); infusion with *nastergal* and *ghoena* leaf sap (in small amounts to purify a young (2–3 day old) baby's stomach (AS) or with *misbredie* and *lidjiesgras* to remove acid in young babies (JD); fresh herb placed under mattress to repel fleas (JD); decoction of bruised stems given to dogs to treat *hondesiekte* (EK)
56. *Falkia repens* Thunb. (Convolvulaceae) PEU22927	perdevoetjies	leaf infusion: bruised in cloth, then infused, as general cure, purgative medicine (PO)
57. *Ficinia praemorsa* Nees (Cyperaceae)	hoesgras	cough (AD, EK, MBU, JR)

PEU22979		
58. *Foeniculum vulgare* Mill. (Apiaceae) PEU22928	vinkel	infusion of whole herb: taken for kidney and bladder ailments (as diuretic) (JA, MBU, AD, JD, CJ, MK, JP, JR, AS), heart ailments (JD, NR), diabetes (MBU, JD), stomach ailments (PA), high blood pressure (EK), haemorrhoids (JD); infusion of fruits or roots (taken in large quantities, like drinking water): inflamed kidneys (MBU); fruits ripe fruits ("seeds") used as a spice when baking buns (JD, MJ), bread or rusks (JD, CJ); stem and leaves chewed for the pleasant taste (JA, MB, MBU, CD, GC)
59. *Geranium incanum* Burm.f. (Geraniaceae) PEU22976	oumeid-op-die-werf, vrouebossie, vrouetee	infusion of whole herb (sometimes mixed with other plants): taken for women's ailments (AD, CJ, EK, MK, NR, AS), bladder infections (MBU), bladder and kidneys (AS), colds (NR), taken to improve fertility by preparing female parts for conception (PA), taken if unable to conceive, to increase fertility (JA, JD); post-natal medicine (JA, PA, MBU, AD, EK, AS), post-natal steaming (MBU); infusion (with lichens from trees): irregular menstruation, to purify female parts and to promote fertility (JR); infusion used as sit bath (with *kruisement* added) by midwives (AD, JD); infusion drunk for high blood pressure (JD)
60. *Gethyllis villosa* (Thunb.) Thunb. (Amarillidaceae) PEU23005	koekemakranka	infusion of bulb: to treat stomach cancer – not as a cure, but to make people eat and drink (JD)
61. *Glycyrrhiza glabra* L. (Fabaceae) PEU23023	soethoutjie	rhizome used medicinally (JR)
62. *Gomphocarpus fruticosus* (L.) Aiton f. (Apocynaceae) PEU22965	melkbos, klapperbos	children play with fruits (pop, like crackers, when stepped on) (JA, AS)
63. *Grewia occidentalis* L. (Malvaceae) PEU22941	dadels, broodjie, basbessie	ripe fruits eaten (JA, DB, GC, CG, MJ, JP)
64. *Haemanthus coccineus* L. (Amarillidaceae) PEU23006	gifblom, veldskoenblaar, maskabaan	bulbs scales used as poultice (PA); infusion of bulb used as both emetic and purgative depending on which side the bulb (upper or lower) is cut ("*die kant wat jy hom slag, dis die kant wat jy kan verwag*") (JR); pollen can damage eyes (PA); leaves used as poultice(JD, EK, NR): bruise leaves and place on abscess or boil to draw(JD), to draw pain(EK)
65. *Helichrysum odoratissimum* (L.) Sweet (Ateraceae) PEU22895	kooigoedbos(sie), kooigoed	infusion of whole herb: diabetes (MK), colds (NR), kidney and bladder ailments (JD, NR, AS), back problems (AS), leg pains (JD), post-natal medicine (MBU, AD, AS), "mother said it brings the uterus back to its place after birth" (MBU), many different ailments (JA); fumes inhaled to treat blocked nose (JP), sinusitis and headache (JR); medicine (details not known) (CD); infusion for strengthening the heart (AD); infusion used in bath for tired and weary

		pelvis (PA); bundles of whole herb placed in house to repel flies and under bed to repel fleas (JA, MBU, JD, CJ); decoction of whole herb sprinkled on floor to repel insects (CJ); whole herb burnt to drive pests (fleas, lice) from a house (PA, MJ, JP, NR), to expel spirits from a house (PA, MBU, JP, EK), as incense in the church (for spiritual purposes) (JA, JP, JR); whole herb inserted in shoes when walking long distances (JR); decoction: used as wash to get rid of flies (*sandvlooie*) in cats;decoction against pests on plants (PA); whole herb burnt to smoke out bees (and to prevent them from swarming) (JR)
66**.** *Lauridia tetragona* (L.f.) R.H.Archer (Celastraceae) PEU22909	droëlewer(bessies)	leaves eaten to alleviate sudden pain and earache – chew a few leaves and swallow the juice (JD); fruits are eaten (MBU, GC, AD, JD, AS), if too many, then it dries the mouth (MBU)
67. *Lavendula dentata* L. (Lamiaceae) PEU23024	laventel	leaves used in a mixture to treat diabetes (JD) – see *Sutherlandia*
68*. Leonotis leonurus* (L.) R.Br. (Lamiaceae) PEU22897	wildedagga, vleidagga, manbossie	infusion of whole herb: inflammation, cancer, high blood pressure (but *L. ocymifolia* is more potent) (JR), kidney ailments, as diuretic, used by men only (MBU); high blood pressure (JP); used medicinally in the same way as *koppiesdagga* (AS); nectar sucked from flowers (JP); no medicinal uses; some men mix it with tobacco for smoking (JD)
69. *Leonotis ocymifolia* (Burm.f.) Iwarsson (Lamiaceae) PEU22887	koppie(s)dagga	infusion of whole herb (sometimes mixed with others): high blood pressure (AD, CG, EK, MK, JP, JR, NR, AS), bladder ailments and pain (PA, CJ), colds and any ailments (MBU), diabetes (AD, AS), backache (EK), inflammation and cancer (JR), cancer (mixed with garlic and keurtjies) (MBU); infusion of herb (not mixed with others): chest ailments, diabetes and nausea (JD), colds and influenza (GC), washing of sores (DB), medicinal uses forgotten (JA, CD); fresh herb applied as compress for pain (PA, MJ); tincture used as general medicine (MJ); nectar sucked from flowers (JP)
70. *Malva parviflora* L. (Malvaceae) PEU22930	kiesieblaar, pampoenbossie (plant), botterbroodjies (fruit)	crushed leaves mixed with flour applied to treat lumps in the breast (EK, NR) and infected wounds (EK, AS) or a lodged thorn (JD); leaf inserted into the ear to alleviate earache (DB, MB, GC, CG, CJ, JP, JR) and toothache (DB, MB, MBU, GC, CJ); fruits are eaten (PA, JD, CJ, MJ, JP); leaves are edible (CG)
71*. Marrubium vulgare* L. (Lamiaceae) PEU22926	kattekruie	leaf infusion: colds (NR), chest ailments (CJ), to wash wounds (CJ); add to bath water: severe influenza (diaphoretic effect) (CJ); used in the same way as *Ballota africana* (EK, JR)
72. *Melianthus major* L. (Melianthaceae) PEU22919	kruidjie-roer-my-nie	leaves used as poultice on wounds and sores (AS), on weeping corms on toes (AD), to remove corms (MBU); infusion used to wash wounds and sores (MBU, DB); leaf infusion taken orally as general medicine (MBU)
73. *Mentha aquatica*	vleimint	leaf infusion: bladder infection, menstrual pains

L. (Lamiaceae) PEU22923		(MBU)
74. *Mentha longifolia* (L.) Huds. (Lamiaceae) PEU22938	makmint	leaf infusion: bladder ailments (PA, AS), kidney problems (AS); stomach ulcers (CJ, AS), chest ailments (CJ); used with *keurtjie* for ulcers and cancer (CJ); headache (JR); fresh herb: deodorant in toilet (JR); chew fresh leaves (and rub hands) to hide smell after smoking (MBU); used in food (JA); added to tea (JA); used to flavour ice water (leaf added) (CG)
75. *Mentha spicata* L. (Lamiaceae) PEU22935	kruisement, kreisemint, kruisemunt, makmint	used as medicine (NR), nausea (JP); leaf infusion: bladder ailments, back problems, colds (PA), tension, helps you to sleep (AD), women's ailments (AD), to induce labour (JD), stomach ulcers (CJ, AS), chest ailments (as syrup) (AD, CJ); used with *keurtjie* for ulcers and cancer (CJ); leaf infusion: headache (JR), stomach pain (AS); twigs spread under bed to repel fleas (EK); fresh herb: deodorant in toilet (JR); used in food (JA, AD); added to tea (JA)
76. *Microloma saggitatum* L. R.Br. (Asclepiadaceae) PEU22983	bokhoring, bokhorinkie	young fruits are eaten (JA, PA, DB, MBU, GC, AD, CD, JD, CG, EK, JP, JR, NR, AS, CJ)
77. *Muraltia spinosa* (L.) F. Foster & J.C. Manning (Polygalaceae) PEU22921	skilpadbessie(bos)	infusion of twigs taken for pains (AD); ripe berries are eaten (JA, DB, MB, MBU, GC, CD, JD, CG, MJ, MK, JP), to suppress thirst (JA, PA, DB, AD, JR, AS), good for chest ailments (AD), to loosen phlegm in the chest (AS); add sugar and yeast to make a potent beer (GC, CJ)
78. *Nasturtium officinale* W.T. Aiton (Brassicaceae) PEU22981	bronkors	leaves and branches are eaten (PA)
79. *Notobubon laevigatum* (Aiton) A.R. Magee (Apiaceae) PEU22918	vinkel, wildeanys	infusion of whole herb: diabetes (NR), kidney and bladder (CJ, JR); people used it, but details forgotten (CG)
80. *Olea europaea* ssp. *africana* L. (Oleaceae) PEU22988	swartolien, swartoleen, swartolienhout, wilde-olyf	infusion of whole herb (including ripe berries): jaundice (MK); leaf infusion: to treat both high (MJ, PA) and low blood pressure (PA), general medicine (CJ, AS), good for tuberculosis (MBU); infusion of 10 leaves in a cup to treat back pain and cancer (real olive leaf is just as good) (CJ); leaf decoction: stomach pain (AD); fruits are eaten (DB, MB, JP); leaves added to ginger beer (GC); wood used for axe and pick handles (AD, MJ, EK, JP, JR); firewood (CD)
81. *Opuntia ficus-indica* (L.) Mill. (Cactaceae) PEU23025	turksvy	warm leaf (cut open) applied to abscess (JR); infusion: burn thorns off leaf and peel skin off, cook with water and drink for high blood pressure. Leaves could be helpful for T.B. and AIDS (PA); fruits eaten (all participants)
82. *Osteospermum moniliferum* L.	bietou(bos)	ripe berries are eaten (JA, PA, DB, MBU, GC, AD, CD, JD, MJ, EK, MK, JP, NR, AS), including the seeds (considered to be nutritious) (JR) or harmful

(Asteraceae) PEU22903		to the appendix (CG)
83. *Osyris compressa* (P.J.Bergius) A.DC. (Santalaceae) PEU22913	basbos, basboom, basbessie(boom), basbessiebos, bessiebos	berries (sometimes with seeds) eaten by children (JA, DB, MB, MBU, GC, AD, CD, CG, CJ, MK, JP, JR, NR, AS); leaf infusion: diarrhoea (NR); infusion of bark: to stop diarrhoea (PA), stomach pain (JP); bark (and/ or branches) used to tan leather (JD, EK, NR); good firewood (AD)
84. *Oxalis pes-caprae* L. (Oxalidaceae) PEU22968	suring	flowers stalks are eaten (JA, PA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, EK, MK, NR, AS); bulbs are eaten (JA, PA, DB, MBU, GC, CJ, MJ); an ingredient of *waterblommetjie* stew (AD, AS)
85. *O. polyphylla* Jacq. J.R.J.A.M.B. (Oxalidaceae) PEU22951	suring	Flower stalks and bulbs eaten (JR)
86. *Parmelia* spp. L. (Parmeliaceae) PEU23026	klipblom	infusion: to promote conception or pregnancy (PA); women’s ailments (JR); stomach pain (DB)
87. *Passerina ericoides* L. (Thymelaeaceae) PEU22917	gonnabos, veebossie, gonna, gonnatoue	bark used as rope (*gonnatoue*) (JA, PR) for tying a tent and for shoelaces (JR), used as fishing line (JP); used as broom (MBU)
88. *Passerina rigida* Wikstr. (Thymelaeaceae) PEU22931	gonnabos, gonnatoue	bark used as strong rope called *gonnatou* (JA, CJ, MK, JR, AS), to make whips (JA, DB, MB, MBU, AD, CD, JD, CJ, MJ, JP, JR, AS), tie firewood bundles and use as shoelaces (JR)
89. *Pelargonium capitatum* (L.) L’Hér. (Geraniaceae) PEU22971	malva	fresh leaves inserted into the ear: earache (PA, EK, MK) and toothache (PA, CD, EK, MK)
90. *Pelargonium caucalifolium* Jacq. subsp. *convolvulifolium* (Schltr. ex Knuth) J.J.A.v.d.Walt (Geraniaceae) PEU22914	vaalrabas	infusion of tips (with those of *Sideroxylon inerme* and *Cassine tetragona* or *Searsia lucida*) to stop diarrhoea (AD, AS)
91. *Pelargonium grossularioides* (L.) L’Hér. (Geraniaceae) PEU22910	rooilidjiesbos, rooirabas	used with *Geranium incanum* as post natal medicine (PA); not familiar with its medicinal uses (JR); children pay with fruits (*horlosies*) (JP)
92. *Pelargonium peltatum* (L.) L’Hér. (Geraniaceae) PEU22943	wildemalva	fresh leaf is eaten (sour taste) (JP, JR)
93. *Pelargonium triste* (L.) L’Hér. (Geraniaceae) PEU23007	kaneelbol, vanillabol	infusion of bulb: as sit-bath to treat haemorrhoids (JR), taken orally by women for purification of female parts (MBU)
94. *Pelargonium zonale*	malva, gewone malva	fresh leaves inserted into ear: both earache (DB, MB, GC, AD, JD, CJ, MJ, EK, AS) and toothache

(L.) L'Hér. (Geraniaceae) PEU22901		(JA, DB, MB, MBU, GC, AD, CD, CJ, MJ, EK, AS), tonsils (CJ); leaf sap dropped in ear: earache (JD)
95. Physalis peruviana L. (Solanaceae) PEU23024	appeliefie	Berries are eaten (all participants)
96. *Polygala myrtifolia* L. (Poygalaceae) PEU22905	septemberbossie, septemberblom	nectar sucked from flowers (by children) (JA, DB, MB, MBU, GC, AD, CD, CG, MK, JR, AS); leaf infusion taken for stomach ulcers (*rou sere*) (CG); leaves apparently used for medicine (unspecified) (PA)
97. *Polygonum aviculare* L. (Poygonaceae) PEU22922	litjiesgras	infusion of bruised leaves (with *misbredie*): stomach acid in infants (MBU)
98. *Portulaca oleracea* L. (Portulaceae) PEU22912	rooilidjies, rooimislyn, postelyn	leafy stems edible, used in stews (PA, AS – not traditional); good fodder for pigs (JR), chickens (JP)
99. *Prionium serratum* (L.f.) Drège ex E.Mey (Juncaceae) PEU22955	palmiet	inner top part of (young) stem eaten (PA, CG, CJ, JP, JR), slices eaten on sandwiches (CJ), tastes like butter (CJ); young stems eaten when plants flower (MJ) or after flowering (CG); young inflorescence eaten (CJ); my brother used to eat *palmiet*, but details forgotten (JD)
100. *Protea obtusifolia* H.Buek ex Meisn. (Proteaceae) PEU23008	suikerkaane, protea	nectar sucked from flowers (JA, DB, MB, MBU, GC, AD, CD, JD, CJ, MJ, EK, MK, JP, JR, NR)
101. *Protea repens* (L.) L. (Proteaceae) PEU23009	suikerkaane, protea	nectar sucked from flowers (JA, DB, MB, MBU, GC, AD, CD, JD, CJ, MJ, EK, MK, JP, JR, NR); the preferred species
102. *Punica granatum* L. (Punicaceae) PEU23010	granaat	ripe fruit (seeds) eaten (JA, PA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, MK, JP, JR, NR, AS); bark infusion: stomach pain (CJ, PA), chest ailments (CJ) and backache (PA); infusion of dried fruit rind used as vermifuge for children and adults (MBU), as unspecified medicine (JA, MJ, EK); infusion of five or six pieces of fruit rind: taken to relieve the symptoms of cancer, or as mouth rinse in case of sores in the mouth (JD); root infusion: vermifuge (children) (AD); root used as medicine (JP)
103. *Quaqua mammilaris* (L.) Bruyns (Apocynaceae) PEU22987	horlosie, bokhoring, oumakosie	flowers eaten, known as *horlosies* (JA, PA, DB, MBU, GC, CG, CJ, MJ, JP); fruits eaten, known as *bokhoringkies* (JA, PA, DB, MB, MBU, GC, JD, CG, MJ)
104. *Rhoicissus digitata* (L.f.) Gilg & M.Brandt (Vitaceae) PEU22892	bobbejaantou, bitteraartappel, bitterpatat	infusion of large fleshy tubers (sliced and dried): tuberculosis and cancer (JR); dried and pulverised tuber: kidney ailments (JP); formerly used as medicine (details forgotten) (AD); used to make whips (AD); children swing in it (MBU)
105. *Ricinus*	kasterolie, olieblaar,	warmed leaf applied to painful parts (MBU), boils

communis L. (Euphorbiaceae) PEU22984	olieboom, stinkolie, stinkolieblaar, wyfie olieblare	(JR), applied to head: headache (JA, DB, MB, AD, CD, JD, MJ), applied to genital area to treat syphilis (JD); same uses as *stinkblaar*, this is the female (JD, CJ) and is used by men (CJ)
106. *Romulea rosea* (L.) Eckl. (Iridaceae) PEU22874	froetang(s), knikkers	fruits are eaten by children (JA, PA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, EK, JP, JR, NR, AS)
107. *Rosmarinus officinalis* L. (Lamiaceae) PEU23028	roosmaryn	leaves roasted in fat: applied to hair to stimulate growth (MBU); branches placed under the bed to repel fleas (MBU)
108. *Rubia petiolaris* DC. (Rubiaceae) PEU22893	kleef-my-vas, hou-my-vas, krappertjie, gryp-my	children play with it (AD, DB, MB, GC, JD, EK, JR); secretly attached to someone's back in the hope that they will soon return (JD)
109. *Ruta graveolens* L. (Rutaceae) PEU22937	wynruit, wynruik	leaf infusion: high blood pressure (AD, MK, AS), fever – as infusion or compress (PA, AD, NR, AS), stomach pain (AS), general malaise ("*as jy nie lekker voel nie*") (JA), many ailments, including fever, pains, influenza, measles (EK), colds and influenza (DB, MB, GC), women's ailments and bladder problems (CJ), taken after a stroke to improve paralysis (JD), bruise plant and place compress on sore knee (JD); fever in small children (JR); poultice of leaves on stomach: dysentery ("*kiem in die maag*") (MBU); poultice made with flour (applied in linen bag to wrists, stomach or back) to reduce fever in infants and small children (AD); leaf infusion in bath: epilepsy in children (in former times) (MJ); used with *wildeals* and *perdepis* in "wildeals bag" to treat chest ailments in infants (JP); used as medicine (details forgotten) (CD, CG); keeps snakes away (PA)
110. *Salvia africana-lutea* L. (Lamiaceae) PEU22885	bergtee, wildesalie, duinesalie, teeboom, saliebos, veldsalie	oven-dried leaves: a tasty tea (PA, AD); leaf infusion: kidney stones (JR); infusion: wash hair for dandruff and general health (PA); infusion (tea) but uses no longer remembered (AS); nectar sucked from flowers (MBU)
111. *Salvia officinale* L. (Lamiaceae) PEU23029	maksalie	infusion used as tea (JA); used in food (JA)
112. *Salvia rutilans* Carr. (Lamiaceae) PEU23030	maksalie	infusion gargled for sore throat (AS)
113. *Searsia glauca* (Thunb.) Moffett (Anacardiaceae) PEU22911	kraaikos, taaibos, konkeltaaibos, spreeubos	ripe fruits are eaten (JA, PA, DB, MB, MBU, GC, AD, CD, CG, CJ, EK, MK, NR, AS); leaf infusion for stomach pain (DB) and diarrhoea (AD)
114. *Searsia lucida* (L.) F.A.Barkley (Anacardiaceae) PEU22974	taaibos, knakerbos, knakertaaibos, knakerdopbos, knakers, appelgap	leaf infusion: stomach ailments (AD); children eat the fruits (JD, CG, CJ, MJ, EK, NR); fruit-like galls ("*knakers*")on leaves eaten, after blowing out the insect inside (MBU, GC, AD, CD, JD, JP, JR, AS)
115. *Sideroxylon inerme* L.	melkhoutboom	ripe fruits are eaten (JA, PA, GC, CD, CG, MJ, JR; NR); bark decoction: diarrhoea and stomach pain (CJ, MJ); leaves (tips) mixed with those of

(Sapotaceae) PEU22929		*vaalrabas* and *droëlewer* to stop diarrhoea (AS); warts were "grafted" in the bark (at full moon) to make them disappear (JA, MBU); in former times wood was used for fence posts (CG); leaf used as whistle (GC)
116. *Solanum africanum* Mill. (Solanaceae) PEU22876	nasgal, nastergal	ripe fruits are eaten (PA, JR, NR); leaf juice with a little sugar: slime on the chest of infants (NR)
117. *Solanum retroflexum* Dunal. (Solanaceae) PEU22942	nasgal, nastergal	leaf infusion for chest ailments in infants (AD, MK), used topically (CJ); leaf infusion (with juice of *Carpobrotus edulis*) for acid in infants (EK); leaf sap: sedative for small babies (bruised leaves tied in a small bag with bruised *misbredie* and a little sugar added, soak in hot water), give a few drops (JD), ditto, but specific use forgotten (JA); juice of green fruits applied to ringworm (in a circle around the ringworm to contain it) (AD); ripe fruits are eaten (DB, JD, MJ, MK, JR, AS); leaf used (sparingly) in spinach (AS)
118. *Solanum sodomeum* L. (Solanaceae) PEU22879	bitterappel(tjie), bitterappeliepie, ghorra-appel, dorrelappel	fruit is burnt and the smoke inhaled to treat toothache ("the small worms causing toothache are expelled") (JA, PA, DB, MB, MBU, GC, AD, CD, JD, CG, CJ, MJ, EK, JP, JR, NR, AS); juice from fruit applied to ringworm (MBU); root infusion: tuberculosis and AIDS (PA)
119. *Sonchus oleraceus* L. (Asteraceae) PEU22966	sydissel	leaves are edible (AD, AS); fodder for chickens and pigs (MBU, CJ)
120. *Stachys aethiopica* L. (Lamiaceae) PEU22977	hydrie, fynkruie	infusion: sedative (*laat jou ontspan*) (AD); used with voëlent (*Viscum capense*) to treat high blood pressure (EK); infusion to treat chest ailments (AS); formerly used as medicine (unspecified, details forgotten) (JD, EK)
121. *Sutherlandia frutescens* (L.) R.Br. (Fabaceae) PEU22936	keurtjie(s), kankerbossie	infusion of whole herb used for all ailments (also for cancer) (JA, PA, MBU, CJ, EK, MK, JR), cancer (JA, MBU, AD, CJ, AS), cancer prophylaxis ("*voorbehoedmiddel vir kanker*") (PA), a preventative medicine ("*hy keer vir alles*") and blood purifier (CJ), diabetes (DB, MB, GC, AD, AS), high blood pressure (DB, MB, GC, AD, AS), colds and any ailments (MBU, NR), stomach ailments, colds and sore throat (a good medicine) (MJ), tuberculosis (JP); leaves eaten: all ailments (JA); used as medicine (details forgotten) (CD, CG); infusion of leaves, with *laventel* and *wildeals* added, taken for diabetes (JD); unripe seeds eaten as snack (JA, MBU, GC, CD)
122. *Sutherlandia tomentosa* Eckl. & Z euh. (Fabaceae) PEU22989	keurtjie(s), kankerbossie	used in the same way as *S. frutescens* (but the latter is generally preferred)
123. *Tarchonanthus camphoratus* L. (Asteraceae)	salieboom, saliebos, vaalolien	used as medicine in former times (EK); straight branches used for walking sticks (DB, CJ)

PEU22908		
124. *Thamnochortus insignis* Mast. (Restionaceae) PEU22944	riet, dekriet	used for thatching (JA, PA, AD, CD, CG, MJ, MK, AS); internodes are pulled out and the soft tips eaten (JA, MB, MBU, GC, AD, CD, JP); stems used as knitting needles (after smoothing the nodes on a stone) (MBU); bees nest in old tufts (called a "*hangnes*") (DB, AD, JD, CG, JR); dry tuft (on stick, bound with *gonnabos* rope) formerly used as torch (JA, DB, MB, MBU, GC, CG, CJ); dry tuft used to smoke out bees (CG) and to start a fire (CJ)
125. *Trachyandra ciliata* (L.f.) Kunth (Asphodelaceae) PEU22883	wilde groenboon, kool, veldkool	young inflorescences eaten as stew (JA, MBU, AD, CD)
126. *Trachyandra divaricata* (Jacq.) Kunth (Asphodelaceae) PEU22889	veldkool	young inflorescences eaten as stew (JA)
127. *Tritonia squalida* (Aiton) Ker Gawl. (Iridaceae) PEU23018	kalkoentjie	bulbs are eaten (JR)
128. *Tropaeolum majus* L. (Tropaeolaceae) PEU23011	kappertjie, makkappertjie	insert leaf into ear to alleviate earache and toothache (MBU, CG, EK, MK), toothache (CJ, JR); two fruits are eaten to cure a bad hangover (PA, MJ) or to prevent a hangover (CJ); fruit eaten to treat a cold (JR), fruit eaten as antibiotic treatment (MBU); infusion of leaf (or leaf simply eaten) to treat women's ailments and a sore neck (JD), leaf infusion gargled for sore throat (AD); leaf used as medicine (details forgotten) (JA); leaves and seeds (and flowers) used in food and salads (JA, MBU, CG, EK, AS); leaves edible (GC, JR), used in salads (JP)
129. *Tulbaghia capensis* L. (Alliaceae) PEU23031	wildeknoffel	bulb infusion: antibiotic (JR)
130. *Tulbaghia violacea* Harv. (Alliaceae) PEU23012	wildeknoffel, veldknoffel, bergknoffel	infusion of bulb (stems): fever and colds and influenza (can also use normal garlic) (JA, PA, MBU, MK, AS), cough, chest ailments and colds in winter (AD, EK, NR), as antibiotic (mix with other herbs) (JR), high blood pressure (JP); backache, stomachache, muscle pains and painful knees (JD); used as culinary herb in meat dishes (AS), especially offal (AD)
131. *Typha capensis* (Rohrb.) N.E.Br. (Typhaceae) PEU23013	papkuil	stems are eaten (PA); seed fluff used to stuff pillows (AD, AS); fan made from leaf (children's game) (DB)
132. *Urtica urens* L. (Urticaceae) PEU22880	brandnetel, brandneukel(s), brandnekel	leaf infusion: cancer (JA, DB, MB, GC, AD, JR, AS), stomach cancer (drink in large quantities, as drinking water) (MBU), mild stroke (JR), high blood pressure ("it may even cure you") (AD, MBU, JD, CJ), diabetes (JD), chicken pox (CD); leaf infusion with garlic: colds and other ailments (MK); leaf

		infusion with *Exomis*: cancer (MK); leaf and stem infusion: all ailments (JA, PA), measles (DB, MB, GC, EK), measles in children (MBU); used as spinach (JP, AS); added to drink water of sick chickens (GC)
133. *Usnea barbata* (L.) Weber ex F.H.Wigg. (Parmeiaceae) PEU22940	bokbaard, bokkiebaard	children smoke it like tobacco (a childhood prank) (JA, DB, MB, MBU, GC, AD, CD, JD, AS)
134. *Viscum capense* L.f. (Viscaceae) PEU22956	voëlent, voëlentjie	infusion of the herb: high blood pressure (AD, EK, JR, AS), diabetes (MK, NR, AS), rheumatism (EK, NR); mixed with *perdepis* or *kankerbos* to treat colds, back problems and leg pains (CJ); poultice on slow-healing wounds (PA); infusion taken by women who are unable to conceive ("to regulate hormones") (JA); medicine (unspecified) (MJ); infusion: wash hair to remove dandruff (JD); infusion as tasty (not medicinal) tea (MBU, JD), tasty tea prepared by chopping the stems and placing them in a bag close to the fire until they turn brown (DB); fruits are edible (AD, EK, NR)
135. *Viscum rotundifolium* L.f. (Viscaceae) PEU22891	voëlent, rooibessielidjiesbos	fruits are eaten (PA)
136. *Watsonia* spp. Miller (Iridaceae) PEU23032	pypie	flower used as whistle (JP)
137. *Zingiber officinale* Roscoe (Zingiberaceae) PEU23014	gemmer	infusion of rhizome: severe colds (PA, MB, MBU, AD, JD, NR), stomach ailments (PA, AD, CJ, EK, JR), influenza (PA, EK, JR), stomach pain (AD, AS), nausea (MBU, AD, AS), shortness of breath (AD, AS), menstrual pains (young girls) (JA), medicine (details unknown (CD); used to make ginger beer (JP)
138. *Zygophyllum flexuosum* Euckl. & Zeuh. (Zygophyllaceae) PEU22915	spekbossie	leaves roasted in Vaseline (formerly goat fat) to make an ointment (*spekbossiesalf*): dry skin, ringworm, persistent rashes (wash skin with *bitterbessiebos* decoction before application) (AD)
139. *Zygophyllum morgsana* L. (Zygophyllaceae) PEU22877	spekbos(sie)	seeds are eaten (JA, MBU, GC)
140. Unidentified; decumbent, highly aromatic plant (rare)	*vuilsiekbossie*	infusion: syphilis (taken orally and added to bath; drink one mug and then bath until the water is cold; do not dry yourself) (CJ – grandmother's recipe); plant could not be located
animal products:		
141. *hyraceum* (solidified excretions of rock rabbits) *Procavia capensis* Pallas (Procaviidae)	*dassiepis*	infusion: used by midwives (*vroedvroue*) to promote conception or pregnancy (PA); in former times used as medicine (JA, DB, AD, MJ, AS); important medicine for kidneys (MBU, JP) and high blood pressure (JP), post-natal medicine (JP); used for many ailments, including syphilis (CJ)
142. *klipsweet*	*klipsweet*	used as medicine but details forgotten (DB, AS)

(excretion of midgets found on roofs of shallow caves)		
143. dried porcupine stomach (with content) *Hystrix africaeaustralis* Peters (Hystricidae)	*ystervarkmaag*	used as medicine, including liver ailments (CJ) and diabetes (MBU); used as medicine but details forgotten (PA, DB, JR)
144. burnt goat horn	*mak bokke se horing*	infusion of burnt horn (“black scraped off”): headache, pain of inflammation (AD), inflammation in the stomach (MBU)
145. cobwebs with black soot	*spinnerak met roet*	apply to slow-healing wounds (JR)
146. burnt tortoise shell	*skilpaddop*	infusion of burnt shell (“black scraped off”): burn wounds (MBU)
147. burnt hare faeces	*haasmis*	infusion of burnt, powdered droppings: burn wounds (MBU)

Appendix 2.1:

Participants in the ethnobotanical survey of indigenous edible plant species in the Still Bay area, southern Cape. The abbreviations given in brackets are used in the ranking matrix (Appendix 2.2).

Name of participant	Age at time of survey	Geographical origin	Source of plant knowledge
Jilian Abrahams **(JA)**	53	Melkhoutfontein	Parents
Paulina Arendse **(PA)**	64	Kransfontein	Own experience
Dawid Baartman **(DB)**	73	Die Poort, Melkhoutfontein	Own experience, uncle
Marlin Baartman **(MB)**	17	Melkhoutfontein	Grandfather
Maria Busch **(MBU)**	50	Melkhoutfontein	Parents
Gerald Carelse **(GC)**	41	Melkhoutfontein	Parents, grandmother, aunt
Charlton Daniels **(CD)**	14	Blikhuis	Grandmother
Anna (Barbie) Daries **(AD)**	74	Melkhoutfontein	Grandparents
Johanna Daries **(JD)**	79	Melkhoutfontein	Parents
Cornelius Griffie **(CG)**	70	Melkhoutfontein	Parents
Charles Jakobs **(CJ)**	51	Melkhoutfontein	Grandmother
Marthinus (Faan) Jakobs **(MJ)**	56	Stonehaven	Parents, elders
Elsie (Ella) Kleinhans **(EK)**	73	Blikhuis	Parents
Mary Kortje **(MK)**	71	Melkhoutfontein	Mother
Jacobus Plaatjies **(JP)**	28	Vrye Uitsig	Parents, elders
Johannes Julian Riddles **(JR)**	43	Melkhoutfontein	Parents, grandparents
Nellie Riddles **(NR)**	91	Blikhuis	Parents
Anna Saayman **(AS)**	69	Melkhoutfontein	Mother, grandmother

Appendix 2.2:

Ranking matrix of 58 indigenous edible plant species with 69 uses (Species Popularity Index; SPI) and of 18 survey participants (Ethnobotanical Knowledge Index; EKI).
SPI - percentage use of 18 participants on each plant species (listed at right).
EKI - percentage use of each participant on 58 plant species (listed below).
Participants were only scored if they still used the plant in question.

	Participants																		
Species by use	PA	DB	AD	JD	CG	MJ	EK	MK	NR	AS	JA	MBU	GC	CJ	JP	JR	MB	CD	SPI
Geophyte																			
1. Annesorhiza nuda	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	0.11
2. Babiana ambigua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.05
3. Babiana patulla	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	-	-	0.17
4. Cyphia digitata	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
5. Cyphia undulata	1	1	1	-	1	1	-	1	1	1	1	1	1	-	1	1	1	1	0.83
6. Oxalis pes-caprae	1	1	-	-	-	1	-	-	-	-	1	1	1	1	-	1	-	-	0.44
7. Oxalis polyphylla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.05
8. Tritonia squalida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.05
Average USO SPI																			**0.34**
Fruit																			
1. Asparagus capensis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
2. Astephanus triflorus	-	1	1	1	-	1	-	1	-	1	1	1	1	1	-	-	-	-	0.55
3. Carissa bispinosa	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
4. Carpobrotus acinaciformis	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.94
5. Carpobrotus edulis	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00

6. Carpobrotus muirii	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	0.11
7. Cassine perugua	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	0.05
8. Cassine tetragona	-	-	1	1	-	-	-	-	-	1	-	1	1	-	-	-	-	-	0.27
9. Chironia baccifera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.05
10. Cynanchum obtusifolium	1	1	-	1	1	1	1	1	-	1	1	1	1	1	1	1	1	1	0.88
11. Diospyros dichrophylla	1	1	1	1	1	1	1	1	1	1	-	1	1	1	1	1	-	1	0.88
12. Euclea racemosa	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	0.11
13. Euclea undulata	-	1	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	0.17
14. Grewia occidentalis	-	1	-	-	1	1	-	-	-	-	1	-	1	-	1	-	-	-	0.33
15. Microloma saggitatum	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	-	1	0.83
16. Muraltia spinosa	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
17. Olea europaea ssp. africana	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	0.17
18. Osteospermum moniliferum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	0.94
19. Osyris compressa	-	1	1	-	1	-	-	1	1	1	1	1	1	1	1	1	1	1	0.77
20. Quaqua mammilaris	1	1	-	1	1	1	-	-	-	1	1	1	-	-	-	-	1	-	0.50
21. Romulea rosea	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.94
22. Searsia glauca	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
23. Searsia lucida	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	0.83
24. Sideroxylon inerme	1	-	-	-	1	1	-	-	1	-	1	-	1	-	-	1	-	1	0.44
25. Solanum africanum	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	0.17
26. Solanum retroflexum	-	1	-	1	-	1	-	1	-	1	-	-	-	-	-	1	-	-	0.33
27. Viscum capense	-	-	1	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	0.17
28. Viscum rotundifolium	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	0.11
Average Fruit																			**0.52**

SPI																			
Vegetable																			
a. leaf																			
1. Annesorhiza nuda	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	0.05
2. Aponogeton distachyos	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	0.17
3. Emex australis	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	0.11
4. Pelargonium peltatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	0.11
5. Solanum retroflexum	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	0.05
b. Inflorescence																			
1. Aponogeton distachyos	1	1	1	1	1	1	1	-	-	1	1	1	1	1	1	1	-	-	0.77
2. Prionium serratum	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	0.05
3. Trachyandra ciliata	-	-	1	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	0.22
4. Trachyandra divaricata	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	0.11
c. Flower																			
1. Quaqua mammiliaris	1	1	-	-	1	1	-	-	-	-	1	1	1	1	1	-	-	-	0.50
d. Flower stalk																			
1. Oxalis pes-caprae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
2. Oxalis polyphylla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.05
e. Stem																			
1. Cyperus textilis	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
2. Juncus cf. kraussii	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
3. Prionium serratum	1	-	-	1	1	1	-	-	-	-	-	-	-	1	1	1	-	-	0.38
4. Typha capensis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
f. Internode																			
1. Thamnochortus insignis	-	-	1	-	-	-	-	-	-	-	1	1	1	-	1	-	1	1	0.38
Average Vegetable																			**0.24**

SPI																			
Seed																			
1. Osteospermum moniliferum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	0.05
2. Osyris compressa	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
3. Sutherlandia frutescens	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	1	0.22
4. Zygophyllum morgsana	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	0.17
Average Seed SPI																			**0.36**
Nectar																			
1 Leonitus leonorus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	0.05
2. Leonitus ocymifolia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	0.05
3. Polygala myrtifolia	-	1	1	-	1	-	-	1	-	1	1	1	1	-	-	1	1	1	0.61
4. Protea obtusifolia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
5. Protea repens	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
6. Salvia africana-lutea	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	0.05
Average Nectar SPI																			**0.46**
Gum																			
1. Accacia karroo	1	1	-	1	1	1	-	-	-	-	-	-	1	1	-	-	-	-	0.38
Culinary herb/Tea																			
1. Cyclopia genestoides	1	-	-	-	-	1	-	-	1	1	-	-	-	1	-	-	-	1	0.33
2. Mentha longifolia	-	-	-	-	1	-	-	-	-	-	1		-	-	-	-	-	-	0.11
3. Salvia africana-lutea	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11
4. Tulbagia violacea	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	0.11
5. Viscum capense	-	1	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	0.17
Average Culinary herb/Tea SPI																			**0.17**
Average SPI																			**0.39**

EKI	0.38	0.42	0.38	0.41	0.39	0.42	0.25	0.30	0.32	0.39	0.49	0.49	0.43	0.41	0.39	0.49	0.26	0.33	
Average EKI										0.37						0.45		0.30	

Appendix 3.1:

Species list of USOs (on left) and fruiting species (aboveground carbohydrate resources) (on right) and their acronyms encountered in the Phenology survey of the four basic vegetation types of the southern Cape lowlands to coastal margin (Chapter 3).

USOs per study site/vegetation type	Acronym	**Fruiting species** per study site/vegetation type	Acronym
Strandveld		**Strandveld**	
Babiana patulla	BAB PAT	*Carissa bispinosa* (fruit)	CAR BIS
Chasmanthe aetiopica	CHA AET	*Carpobrotus acinaciformis* (fruit)	CAR ACI
Cyanella lutea	CYA LUT	*Cassine tetragona* (fruit)	CAS TET
Cyphia digitata	CYP DIG	*Muraltia spinosa* (fruit)	MUR SPI
Ferraria crispa	FER CRI	*Olea exasperata* (fruit)	OLE EXA
Freesia alba	FRE ALB	*Osteospermum moniliferum (*fruit)	OST MON
Gladiolus floribundus	GLA FLO	*Schotia afra* (seed)	SCH AFR
Oxalis pes-caprae	OXA PES	*Searsia glauca* (fruit)	SEA GLA
Pelargonium lobatum	PEL LOB	*Sideroxylon inerme* (fruit)	SID INE
Pelargonium triste	PEL TRI	*Tetragonia decumbens* (veg.)	TET DEC
Rhoicissus digitata	RHO DIG	*Trachyandra ciliata* (veg.)	TRA CIL
Romulea rosea	ROM ROS	*Trachyandra revoluta* (veg.)	TRA REV
Trachyandra ciliata	TRA CIL	*Zygophyllum morgsana* (seed)	ZYG MOR
Trachyandra revoluta	TRA REV		
Tritonia crocata	TRI CRO		
Limestone Fynbos		**Limestone Fynbos**	
Babiana patulla	BAB PAT	*Astephanus triflorus* (veg.)	AST TRI
Cyanella lutea	CYA LUT	*Carissa bispinosa* (fruit)	CAR BIS
Cyphia digitata	CYP DIG	*Carpobrotus acinaciformis* (fruit)	CAR ACI
Ferraria crispa	FER CRI	*Carpobrotus edulis* (fruit)	CAR EDU
Freesia alba	FRE ALB	*Cassine tetragona* (fruit)	CAS TET
Gladiolus cunonius	GLA CUN	*Cynanchum obtusifolium* (fruit)	CYN OBT
Gladiolus exilis	GLA EXI	*Euclea racemosa* (fruit)	EUC RAC
Gladiolus floribundus	GLA FLO	*Muraltia spinosa* (fruit)	MUR SPI
Gladiolus virescens	GLA VIR	*Olea exasperata* (fruit)	OLE EXA
Hesperantha falcata	HES FAL	*Osteospernum moniliferum* (fruit)	OST MON
Ixia micandra	IXI MIC	*Osyris compressa* (fruit, seed)	OSY COM
Moraea fugax	MOR FUG	*Searsia glauca* (fruit)	SEA GLA
Pelargonium dipetalum	PEL DIP	*Searsia lucida* (fruit)	SEA LUC
Pelargonium lobatum	PEL LOB	*Sideroxylon inerme* (fruit)	SID INE
Pelargonium triste	PEL TRI	*Tetragonia decumbens* (veg.)	TET DEC
Rhoicissus digitata	RHO DIG	*Trachyandra ciliata* (veg.)	TRA CIL
Romulea rosea	ROM ROS	*Trachyandra revoluta* (veg.)	TRA REV
Trachyandra ciliata	TRA CIL	*Zygophyllum morgsana* (seed)	ZYG MOR
Trachyandra revoluta	TRA REV		
Tritonia squalida	TRI SQU		
Watsonia fergusoniae	WAT FER		
Renosterveld		**Renosterveld**	
Babiana patulla	BAB PAT	*Carissa bispinosa* (fruit)	CAR BIS

Cyphia digitata	CYP DIG	*Diospyros dichrophylla* (fruit)	DIO DIC
Freesia caryophyllacea	FRE CAR	*Microloma saggitatum* (veg.)	MIC SAG
Freesia leichtlinii	FRE LEI	*Muraltia spinosa* (fruit)	MUR SPI
Pelargonium lobatum	PEL LOB	*Osteospermum moniliferum* (fruit)	OST MON
Pelargonium repaceum	PEL REP	*Osyris compressa* (fruit)	OSY COM
Watsonia alletroides	WAT ALL	*Searsia glauca* (fruit)	SEA GLA
Watsonia meriana	WAT MER	*Sideroxylon inerme* (fruit)	SID INE
Sand Fynbos		**Sand Fynbos**	
Gladiolus guthriei	GLA GUT	*Carpobrotus edulis* (fruit)	CAR EDU
Gladiolus rogersii	GLA ROG	*Diospyros dichrophylla* (fruit)	DIO DIC
Pelargonium triste	PEL TRI	*Osteospernum moniliferum* (fruit)	OST MON
Trachyandra revoluta	TRA REV	*Searsia glauca* (fruit)	SEA GLA
Watsonia fourcadei	WAT FOU	*Trachyandra revoluta* (veg.)	TRA REV

Appendix 3.2:

Species list summary of USOs (on left) and fruiting species (aboveground carbohydrate resources) (on right) and their acronyms encountered in the Phenology survey of the four basic vegetation types of the southern Cape lowlands to coastal margin (Chapter 3).

Species summary USOs		**Species summary fruiting**	
Babiana patulla	BAB PAT	*Astephanus triflorus* (fruit)	AST TRI
Chasmanthe aetiopica	CHA AET	*Carissa bispinosa* (fruit)	CAR BIS
Cyanella lutea	CYA LUT	*Carpobrotus acinaciformis* (fruit)	CAR ACI
Cyphia digitata	CYP DIG	*Carpobrotus edulis* (fruit)	CAR EDU
Ferraria crispa	FER CRI	*Cassine tetragona* (fruit)	CAS TET
Freesia alba	FRE ALB	*Cynanchum obtusifolium* (fruit)	CYN OBT
Freesia caryophyllacea	FRE CAR	*Diospyros dichrophylla* (fruit)	DIO DIC
Freesia leichtlinii	FRE LEI	*Euclea racemosa* (fruit)	EUC RAC
Gladiolus cunonius	GLA CUN	*Microloma saggitatum* (fruit)	MIC SAG
Gladiolus exilis	GLA EXI	*Muraltia spinosa* (fruit)	MUR SPI
Gladiolus floribundus	GLA FLO	*Olea exasperata* (fruit)	OLE EXA
Gladiolus guthriei	GLA GUT	*Osteospernum moniliferum* (fruit)	OST MON
Gladiolus rogersii	GLA ROG	*Osyris compressa* (fruit, seed)	OSY COM
Gladiolus virescens	GLA VIR	*Schotia afra* (seed)	SCH AFR
Hesperantha falcata	HES FAL	*Searsia glauca* (fruit)	SEA GLA
Ixia micandra	IXI MIC	*Searsia lucida* (fruit)	SEA LUC
Moraea fugax	MOR FUG	*Sideroxylon inerme* (fruit)	SID INE
Oxalis pes-caprae	OXA PES	*Tetragonia decumbens* (veg.)	TET DEC
Pelargonium dipetalum	PEL DIP	*Trachyandra ciliata* (veg.)	TRA CIL
Pelargonium lobatum	PEL LOB	*Trachyandra revoluta* (veg.)	TRA REV
Pelargonium repaceum	PEL REP	*Zygophyllum morgsana* (seed)	ZYG MOR
Pelargonium triste	PEL TRI		
Rhoicissus digitata	RHO DIG		
Romulea rosea	ROM ROS		

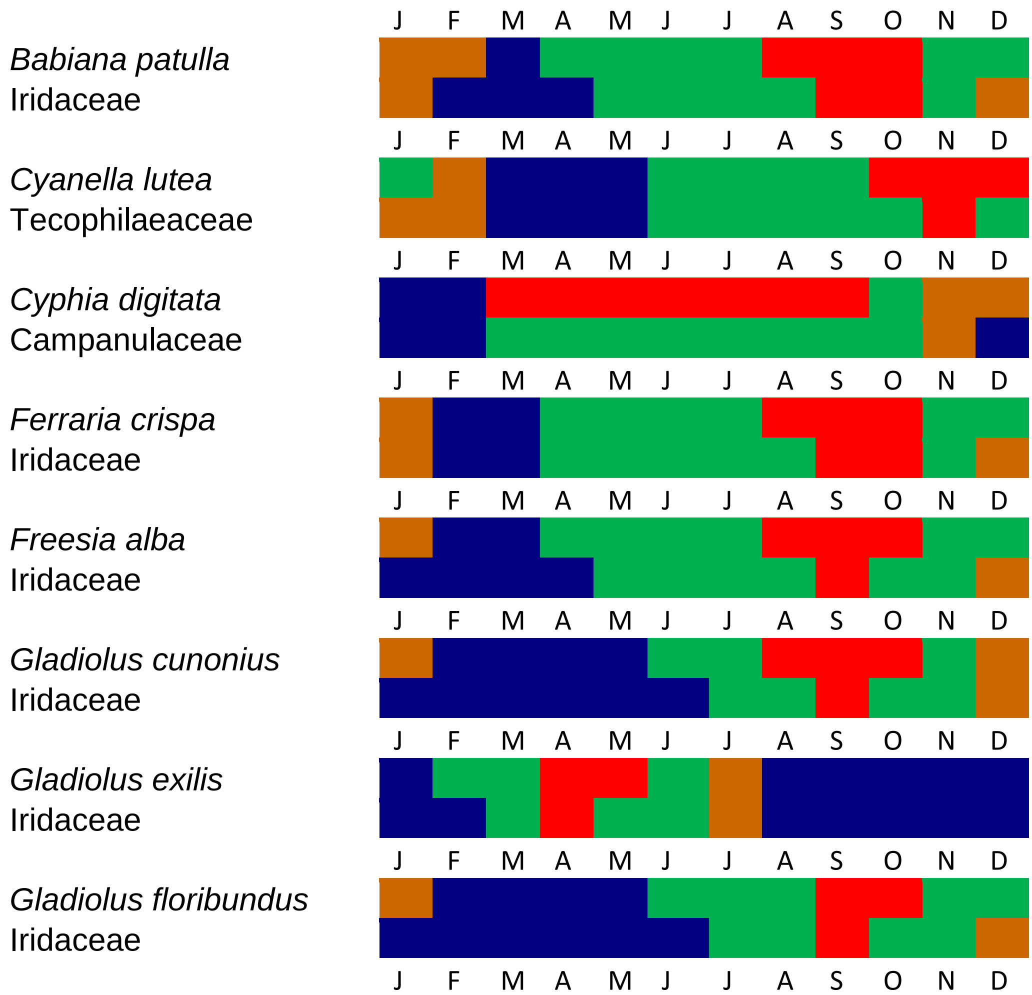
Trachyandra ciliata	TRA CIL		
Trachyandra revoluta	TRA REV		
Tritonia crocata	TRI CRO		
Tritonia squalida	TRI SQU		
Watsonia alletroides	WAT ALL		
Watsonia fergusoniae	WAT FER		
Watsonia fourcadei	WAT FOU		
Watsonia meriana	WAT MER		

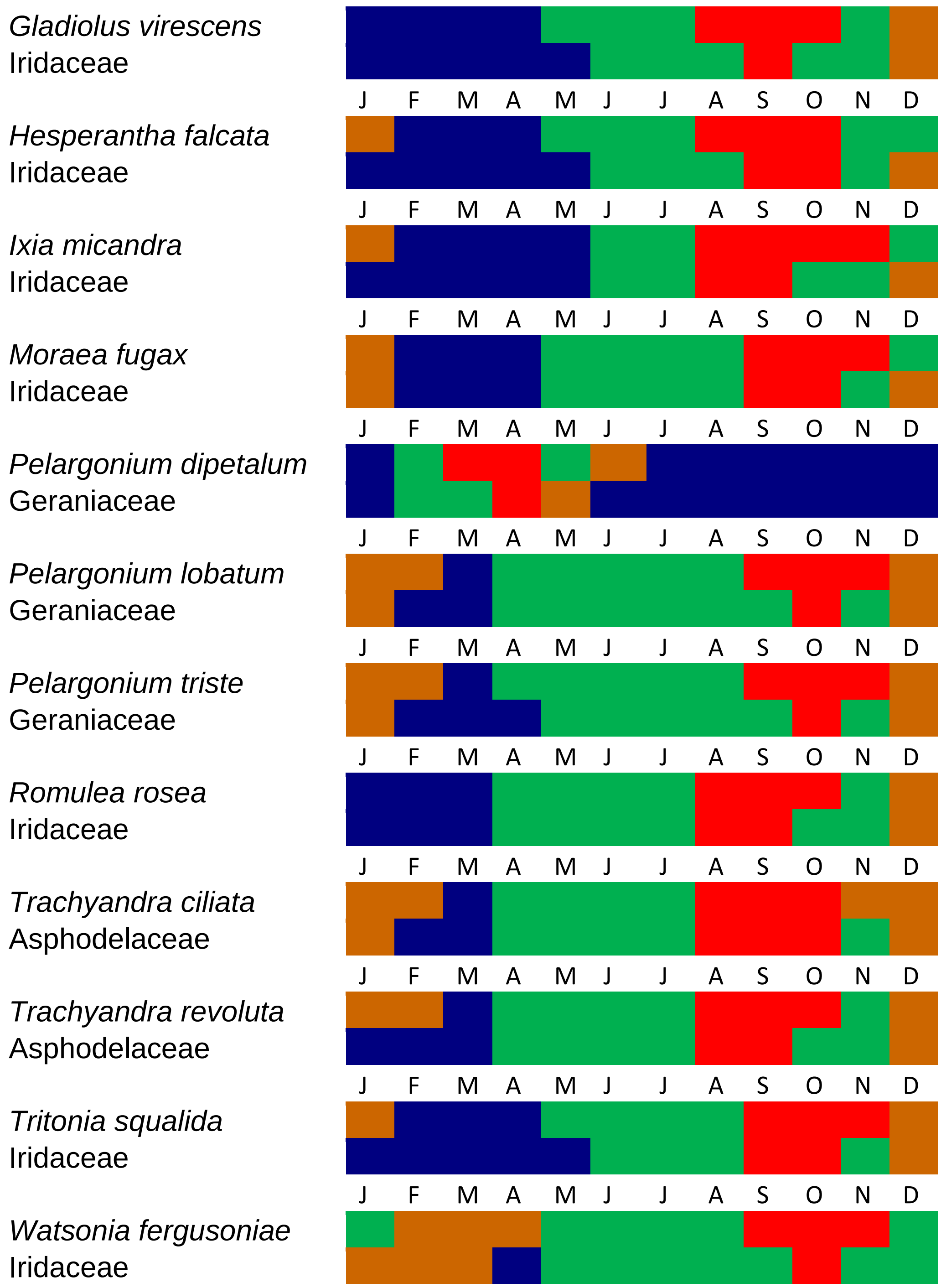
Appendix 4:

Phenodiagrams of USOs and fruiting species (aboveground carbohydrate resources) encountered in the Phenology survey of the four primary vegetation types of the southern Cape lowlands to coastal margin (Chapter 3).

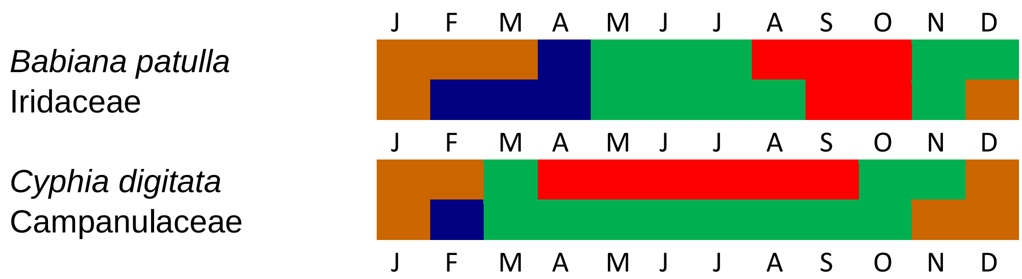
USOs

Limestone Fynbos



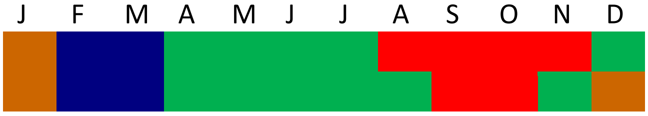


Renosterveld

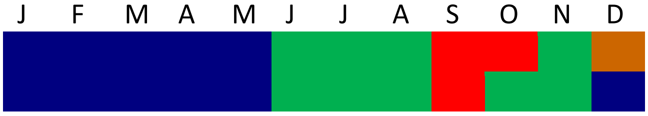


Freesia caryophyllacea
Iridaceae

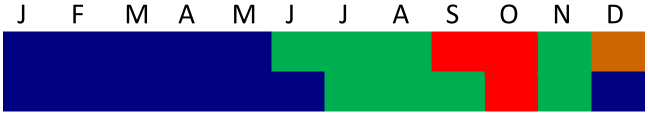
Freesia leichtlinii
Iridaceae



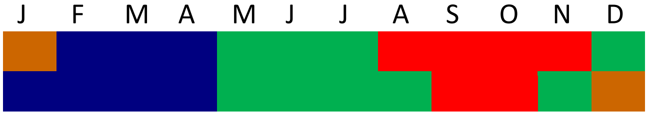
Pelargonium lobatum
Geraniaceae



Pelargonium repaceum
Geraniaceae



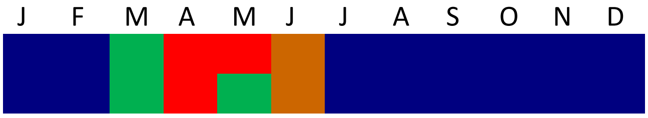
Watsonia alletroides
Iridaceae



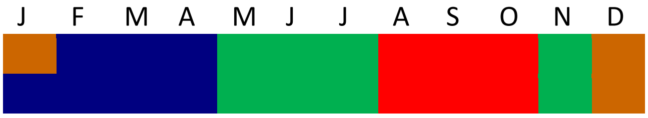
Watsonia meriana
Iridaceae

Sand fynbos

Gladiolus guthriei
Iridaceae

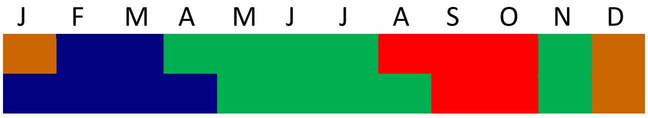


Gladiolus rogersii
Iridaceae



Pelargonium triste
Geraniaceae

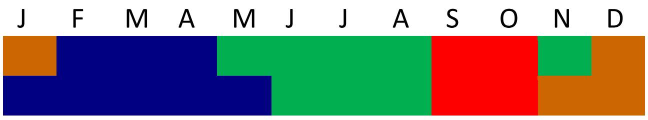
Trachyandra revoluta
Asphodelaceae



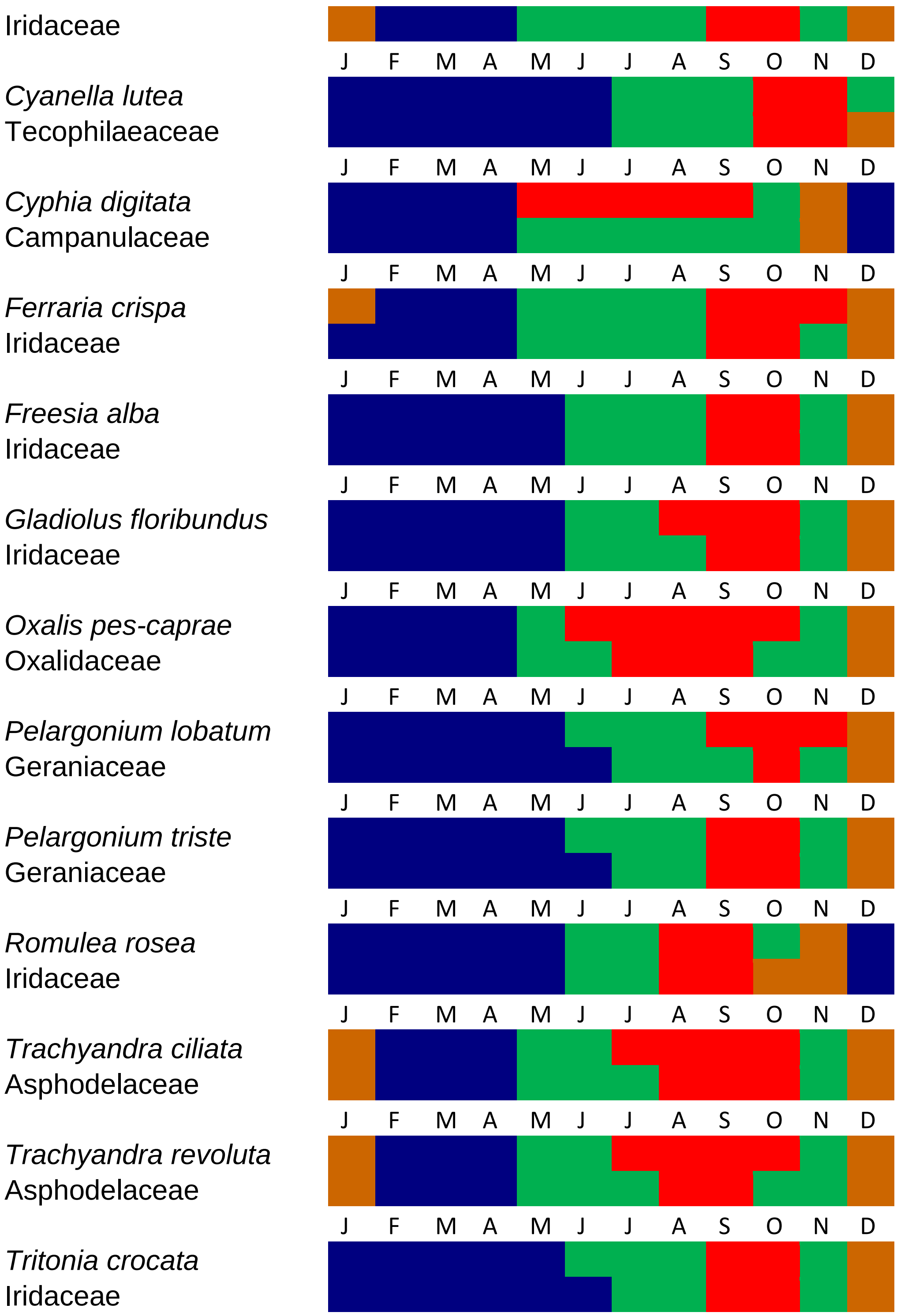
Watsonia fourcadei
Iridaceae

Strandveld

Babiana patulla
Iridaceae

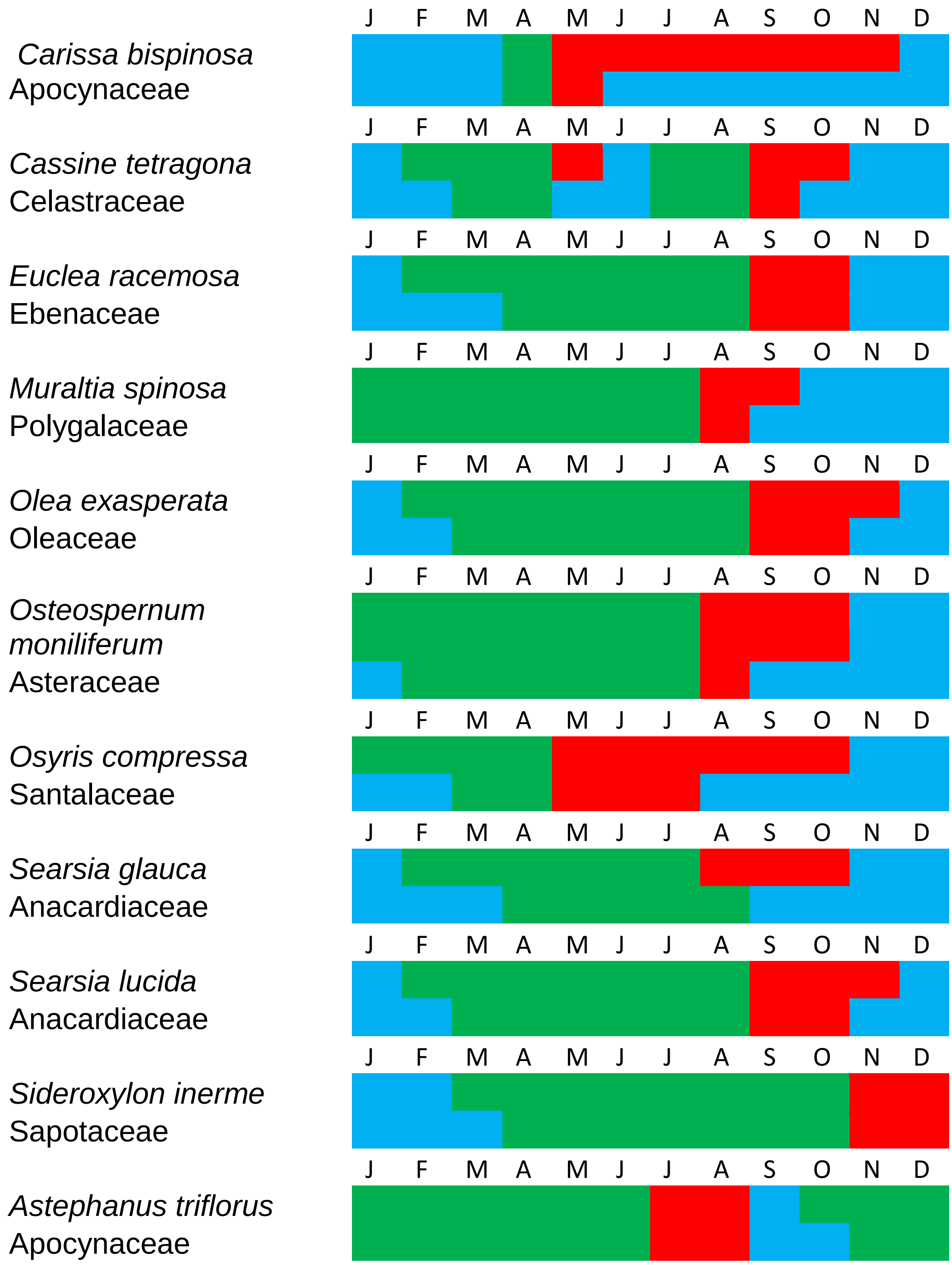


Chasmanthe aethiopica


Iridaceae
J F M A M J J A S O N D
Cyanella lutea
Tecophilaeaceae
J F M A M J J A S O N D
Cyphia digitata
Campanulaceae
J F M A M J J A S O N D
Ferraria crispa
Iridaceae
J F M A M J J A S O N D
Freesia alba
Iridaceae
J F M A M J J A S O N D
Gladiolus floribundus
Iridaceae
J F M A M J J A S O N D
Oxalis pes-caprae
Oxalidaceae
J F M A M J J A S O N D
Pelargonium lobatum
Geraniaceae
J F M A M J J A S O N D
Pelargonium triste
Geraniaceae
J F M A M J J A S O N D
Romulea rosea
Iridaceae
J F M A M J J A S O N D
Trachyandra ciliata
Asphodelaceae
J F M A M J J A S O N D
Trachyandra revoluta
Asphodelaceae
J F M A M J J A S O N D
Tritonia crocata
Iridaceae

Fruiting species

Limestone Fynbos

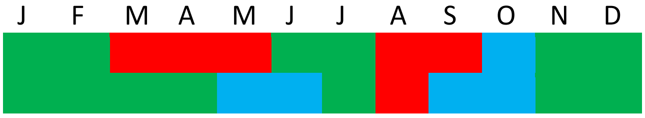


Carpobrotus acinaciformis
Aizoaceae

C. edulis
Aizoaceae

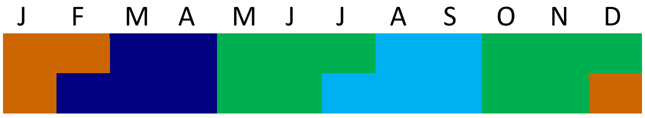
Cynanchum obtusifolium
Apocynaceae

Zygophyllum morgsana
Zygophyllaceae



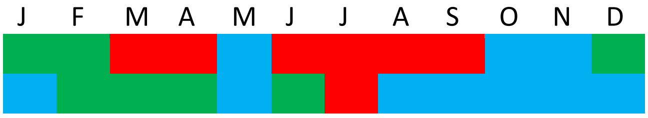
Tetragonia decumbens
Aizoaceae

Trachyandra ciliata
Asphodelaceae

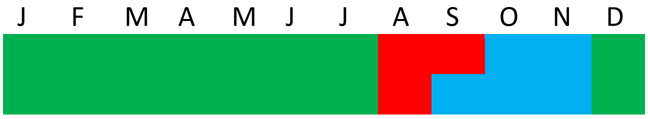


Renosterveld

Carissa bispinosa
Apocynaceae

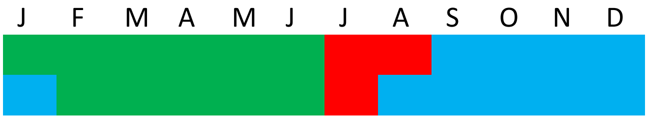


Muraltia spinosa
Polygalaceae

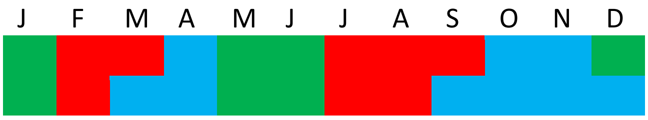


Osteospermum moniliferum
Asteraceae

Searsia glauca
Anacardiaceae

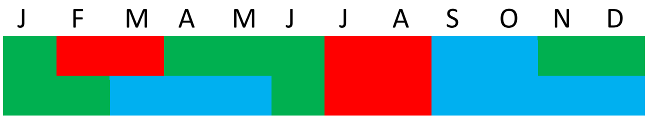


Osyris compressa
Santalaceae

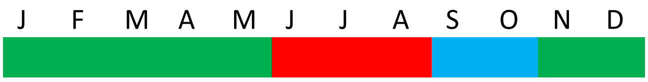


Sideroxylon inerme
Sapotaceae

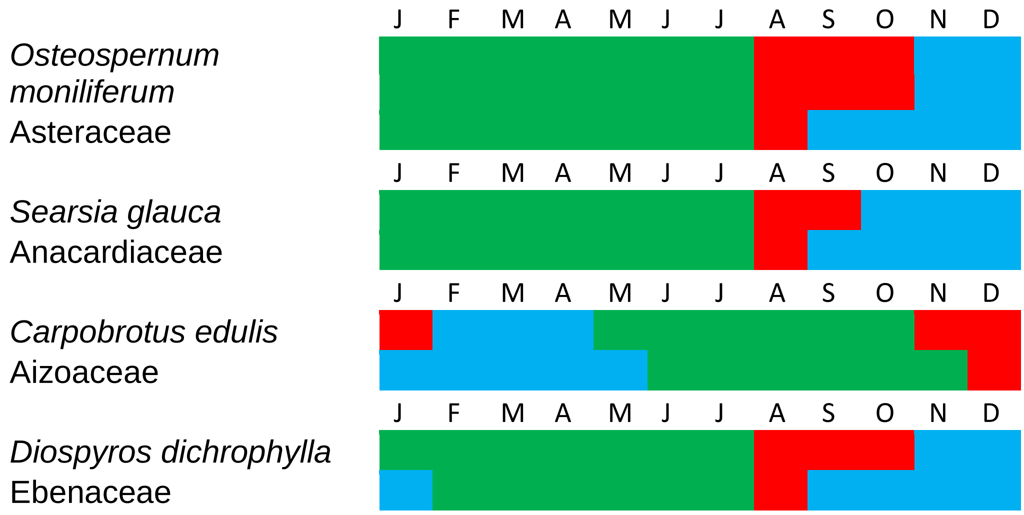
Diospyros dichrophylla
Ebenaceae



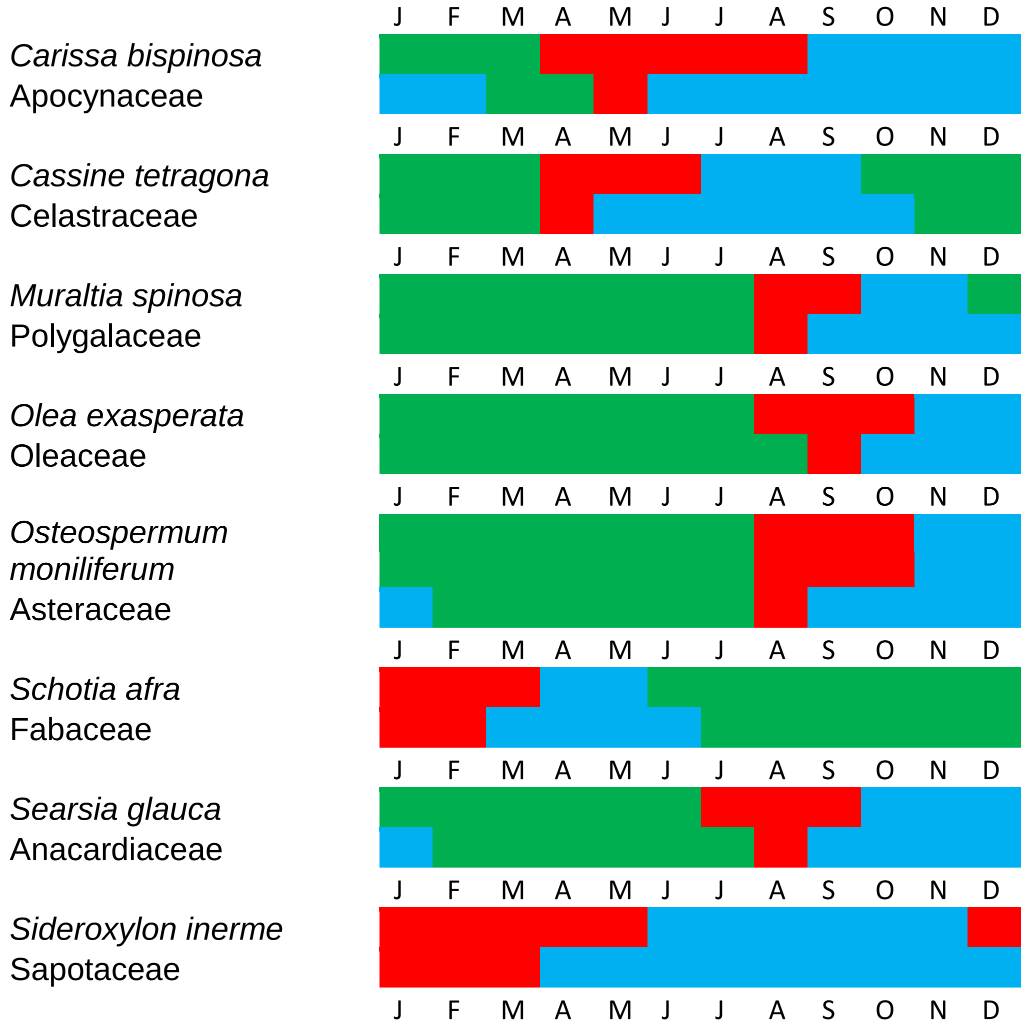
Microloma saggitatum

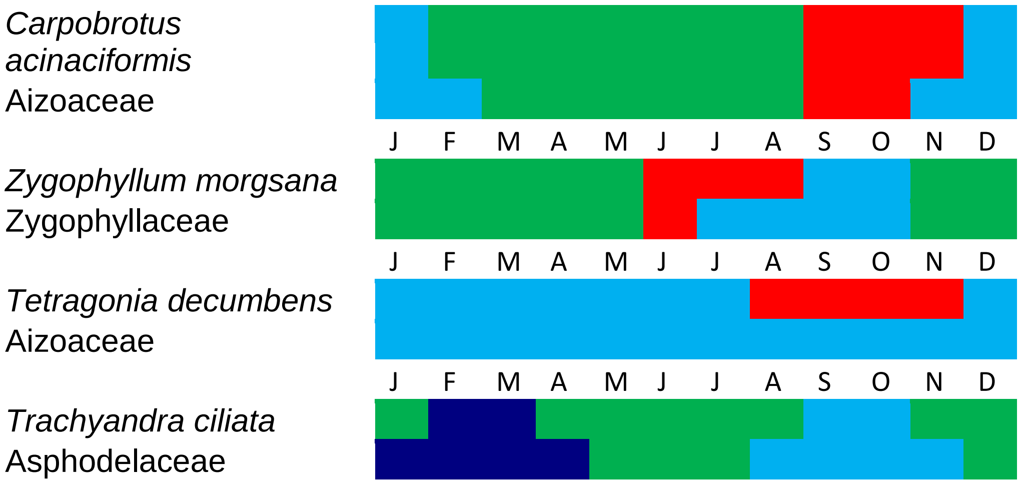


Sand Fynbos



Strandveld

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