South African Journal of Botany 102 (2016) 60–69

Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb

Indigenous edible plant use by contemporary Khoe-San descendants of South Africa's Cape South Coast

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ARTICLE INFO

Article history:
Received 14 July 2015
Received in revised form 2 August 2015
Accepted 10 September 2015
Available online xxxx

Edited by J Van Staden

Keywords:
Cape Floristic Region
Carbohydrates
Geophytes
Growth forms
Plant use

ABSTRACT

There is evidence that hunter-gatherer societies of both the Middle and the Later Stone Ages in the Cape Floristic Region (CFR) used many plant species, particularly those with underground storage organs (USOs), as sources of carbohydrate. In the CFR, USOs – mostly monocotoledon geophytes – are particularly diverse and abundant. However, little is known about which species were targeted by hunter-gatherers. Here we use, for the first time in the CFR, ethnobotanical methods to survey the use of indigenous edible plant species amongst contemporary people of Khoe-San descent, in an attempt to gain insight on hunter-gatherer resource use. Specifically we surveyed 18 participants living in rural areas around Still Bay. They 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 that these species were 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 edible apical meristems 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 colonisation in the 1700s and the concomitant introduction of cereal crops.

1. Introduction

Very little is known about which plant resources the Khoe-San peoples of the Cape Floristic Region (hereafter Cape) of South Africa used as foodstuffs. 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* (Krishna et al., 2012; Pickrell et al., 2012; Soodyall, 2011) who have lived on the Cape south coast since about 160 000 BP (Brown et al., 2009; Marean, 2010, 2011).

The focus of this study is on the plants that sustained the carbohydrate component of lifestyles of Cape hunter-gatherers, particularly those bearing USOs (including geophytes). Evidence for plant use as foodstuffs amongst the Khoe-San people of the Cape, albeit scant, is associated with ethnographic, historical and archaeological archives (Bleek, 1956; Deacon, 1976; Deacon and Deacon, 1963, 1999; Marlowe and Berbesque, 2009; Opperman and Heydenrych, 1990; Skead et al., 2009). In particular, Later Stone Age (LSA) deposits in the Cape coastal region have yielded ample evidence of the use of geophytes and fruits, presumably as food stuffs (Deacon, 1976; Deacon and Deacon, 1963, 1999; Opperman and Heydenrych, 1990). 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.

Here we used an ethnobotanical approach to assess the extent to which contemporary Khoe-San descendants on the Cape south coast harvest indigenous food plants. Surprisingly, this was the first study of its kind in the Cape. We conducted the survey in the Still Bay area of the Cape south coast. Still Bay is located between two important Middle

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http://dx.doi.org/10.1016/j.sajb.2015.09.002
0254-6299/

Stone Age (MSA) archaeological sites, namely Blombos to the west and Pinnacle Point to the east (Fig. 1) and has numerous LSA sites. Both MSA sites have yielded some of the earliest evidence of behaviourally modern humans on record (Brown et al., 2009; Henshilwood et al., 2002; Marean et al., 2007; Marean, 2010). The rationale underpinning this study was to complement ongoing research to establish the resource base and patterns of resource use by Cape hunter-gatherer people (Marean et al., 2015).

We asked the following questions:

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 could be drawn from our results regarding plant diets of Cape hunter-gatherer people?

2. Methods

2.1. 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 about 6000 inhabitants. The residents include people of Khoe-San descent, the majority of which live in Melkhoutfontein, a settlement 4 km northeast of Still Bay (Fig. 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 Thicket (including both valley and dune forms) (Mucina and Rutherford, 2006). The combination of rural lifestyles and relatively intact indigenous plant resources increases the likelihood that some aspects of traditional foraging practices may have persisted to present times.

2.2. Participants

During the study's scoping phase, we 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 1). 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 'Study area'.

2.3. Survey methods

Following general ethnobotanical guidelines (Martin, 1995), we compiled a list of all known edible, medicinal and otherwise useful plant and animal species 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, 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, 1976; Deacon and Deacon, 1963, 1999; Fox et al., 1982; Opperman and Heydenrych, 1990; Skead et al., 2009), we categorised all species in the study area as edible.

We conducted interviews with the 18 participants following the principles embodied in the Code of Ethics of the International Society of Ethnobiology (International Society of Ethnobiology, 2006). In each interview, we showed participants voucher specimens and the photographs of each of the potentially useful species and asked how they

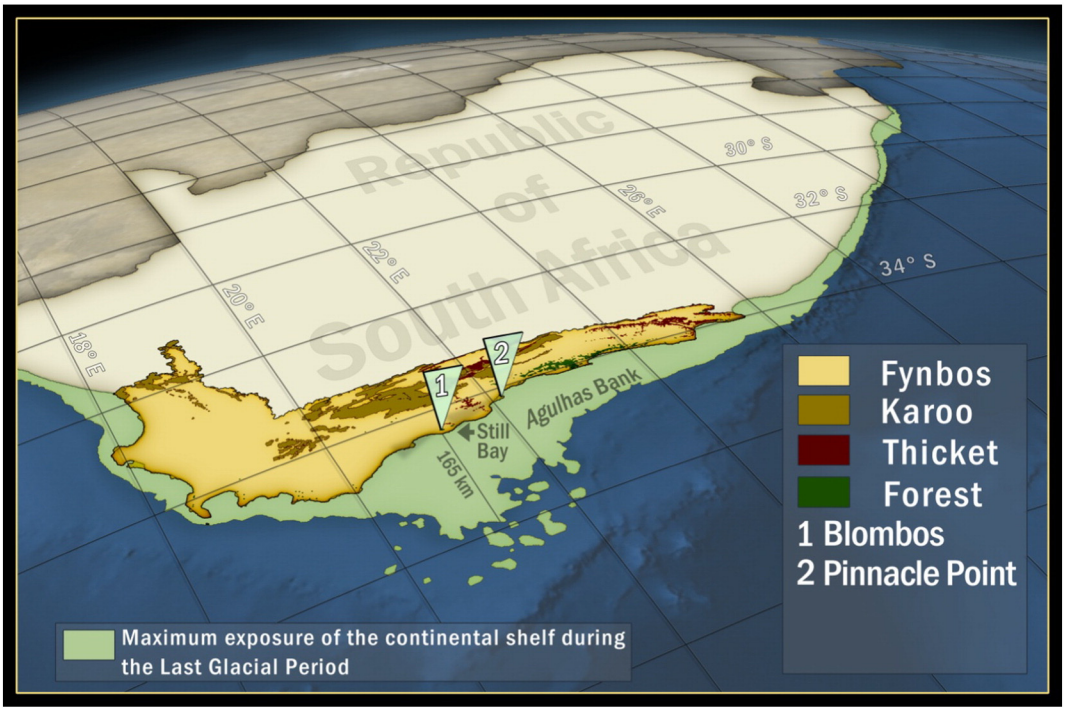

Fig. 1. The Cape Floristic Region showing the biomes (Mucina and Rutherford, 2006), major archaeological sites and the Agulhas Bank (continental shelf) that would have been variously exposed during the Pleistocene (Fisher et al., 2010).

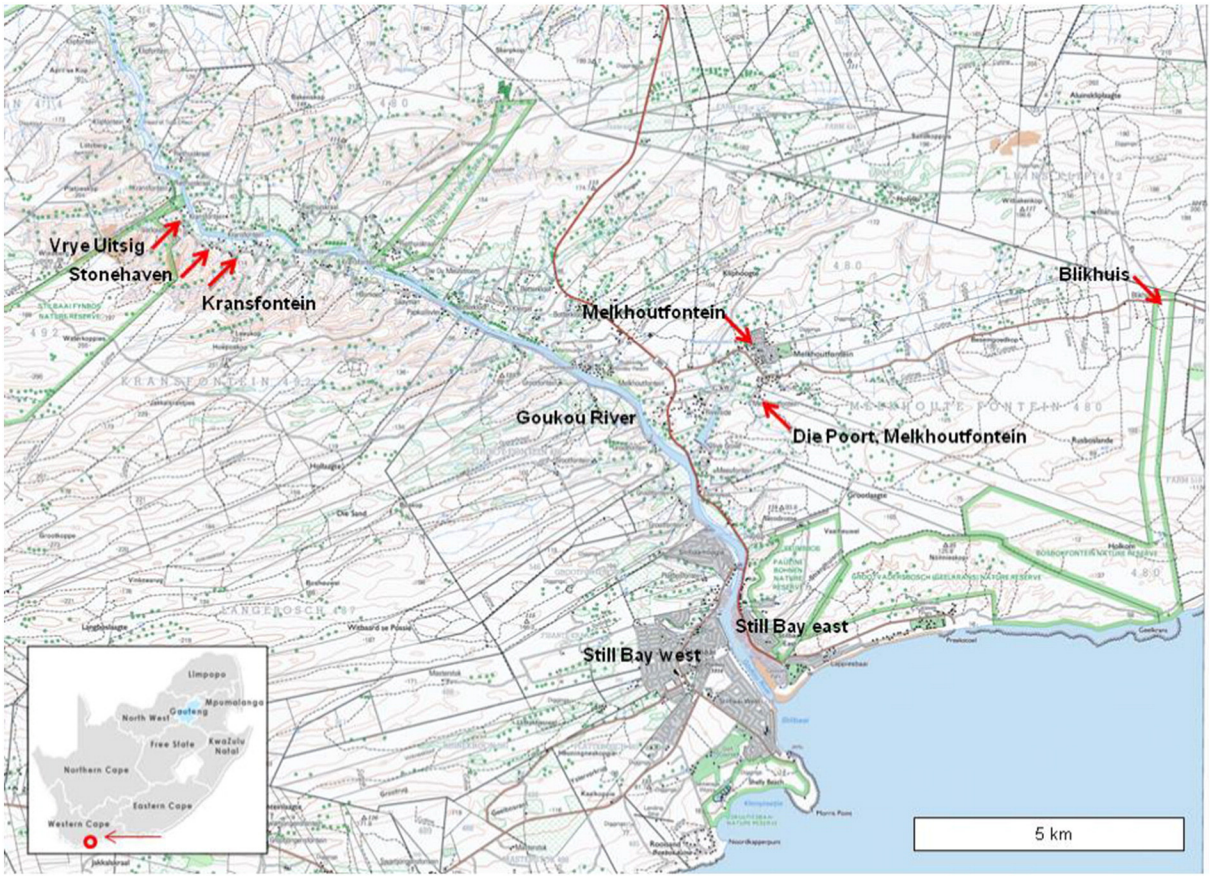

Fig. 2. The Still Bay area showing the different sites where participants were interviewed (adapted from National Geo-spatial Information, 2010).

were used. We recorded and transcribed each interview in Afrikaans, the native language of the participants.

In order to analyse the data we used 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. This method provides 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? Based on this information, we computed a species popularity index (SPI) by dividing the number of participants still using a species by 18, the total number of participants. We also calculated an ethnobotanical knowledge index (EKI), which is the percentage of the total tally of species used by each participant. Given the focus of this paper, we calculated these indices only for the indigenous edible plant component identified by the participants.

Table 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 and Appendix A.

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

Table 2
Food utilisation of 58 indigenous plant species identified by participants of an ethnobotanical survey of the Still Bay area. See Table 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. (Apocynaceae); PEU22952	Vissies	Young fruits are eaten (JA, MBU, GC, AD, JD, MJ, MK, AS, DB, CJ)	
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.	Makmint	Used in food (JA); added to tea (JA); used to flavour ice	Dried for tea (observed by Backhouse,

Table 2 (*continued*)

Species	Vernacular name(s)	Food utilisation in the Still Bay area	Evidence from literature sources
(Lamiaceae); PEU22938		water (leaf added) (CG)	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 moniliferum* L. (Asteraceae); PEU22903	Bietou(bos)	Ripe berries are eaten (JA, PA, DB, 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	Suuring	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	Suuring	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 [apical meristem] 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 and Breyer-Brandwijk, 1962; Fox et al., 1982).
39. *Protea obtusifolia* H.Buek ex Meisn. (Proteaceae); PEU23008	Suikerkanne, protea	Nectar shaken 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	Suikerkanne, protea	Nectar shaken 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)	

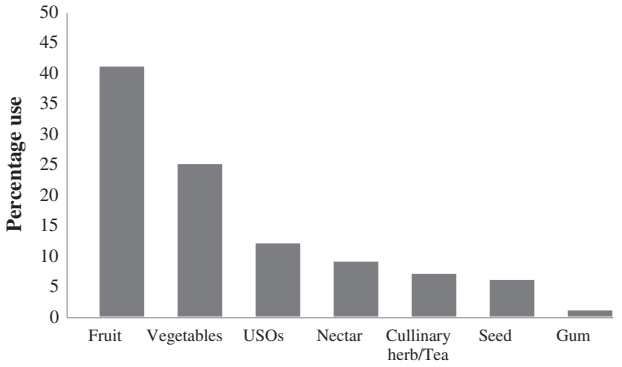

Fig. 3. Percentage use of indigenous edible plant species by Khoe-San descendants in the Still Bay area of the southern Cape coast.

3. Results

3.1. 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). Almost half the uses were for fruit and a quarter for vegetable foodstuffs (Fig. 3). 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). The only family with more than four harvested species was Apocynaceae. Amongst the genera, only *Carpobrotus* (Aizoaceae) had more than two harvested species, whilst 10 genera had two species.

3.2. Commonly harvested species

As a group, fruit-bearing species had the highest SPI (=0.52) (Fig. 4). 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 3). Nectar producing species had the second highest SPI, largely as a consequence of all participants identifying *Protea obtusifolia* and *Protea 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 *O. 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.

Table 3
Top ranked edible plant species for different uses (see Appendix A 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		
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

3.3. Growth forms and biome affinities of 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. 5). Four of the geophytes were used for purposes other than the ingestion of their USOs, namely *R. rosea* (fruit), *Trachyandra ciliata* and *T. divaricata* (vegetable) and *Tulbaghia violacea* (culinary herb) (Table 2). Other growth forms, such as climbers, graminoids and forbs, comprised a minor component.

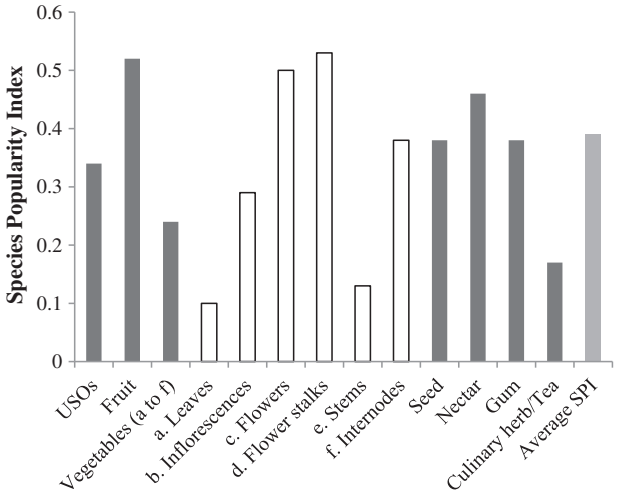

Fig. 4. Indigenous edible plant uses ranked by the Species Popularity Index (see Table 3 and Appendix A for ranking of species uses).

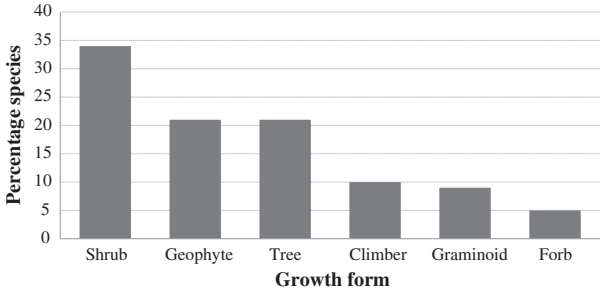

Fig. 5. Growth form associations of 58 indigenous edible plant species of the Still Bay area.

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

4. 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. Whilst 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 and Van Wyk, 2011), a region rich in geophytes (Manning and Goldblatt, 1997). Looking further afield at intact hunter-gatherer communities, Lee (1984) observed that 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 was identified by only seven participants (SPI: 0.38) and 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*, which has been recorded in a Later Stone Age site in the eastern edge of the Cape south coast (Wells, 1965), is locally dominant in flowing, acid waters of the Cape where it may form extensive wetlands (King, 1981). However, in the study area it is confined to a few patches of the Goukou River. The edible apical meristems are comparable to palm hearts (Arecaceae) utilised in other parts of the world. Whilst USO bearing plants comprised eight species (12% of total) only the *Cyphia* species emerged as important. Although *Cyphia* tubers are relatively large, (58.6 g on average), easy to harvest and with a very high moisture content, they have little nutritional value (Singels et al., in press). 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 and Miros, 2009).

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, 1976; Deacon and Deacon, 1963, 1999; Wells, 1965; Marlowe and Berbesque, 2009; Opperman and Heydenrych, 1990; 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 colonisation in the 1700s and the concomitant introduction of cereal crops. The integration of people into the cash economy, starting in the early to mid-20th Century (De Jongh, 2012; Viljoen, 2006), 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, 1976; Deacon and Deacon, 1963, 1999; Wells, 1965; Opperman and Heydenrych, 1990). All the species identified in this study do not require processing and are eaten raw. It is possible, therefore, that carbohydrates which 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, USOs are mostly low-ranked, fallback foods for hunter-gatherers, 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; Kellerman et al., 2005; Van Wyk and Gericke, 2000; Van Wyk et al., 2002). 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).

Amongst 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, are the habitat of 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 hunter-gatherer people in the region as so much of the hunter-gatherer tradition has been lost. We speculate that *P. 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 (O'Connell and Hawkes, 1981; Pyke et al., 1977). 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, 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). Based on faunal fossil data, thicket remained a significant component of the regional vegetation of the southern Cape throughout the Pleistocene (Klein, 1980). 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. However, the extant people of Khoe-San descent provide limited support for this hypothesis.

Acknowledgements

For funding, we thank Nelson Mandela Metropolitan University, the National Research Foundation of South Africa, the Oppenheimer Memorial Trust, the Institute of Human Origins at Arizona State University and the University of Johannesburg. We are grateful for the enthusiastic participation of the Khoe-San descendants (listed in Table 1), the landowners in the study area who granted us access, Dr. Erich Fisher for GIS and Kristen Ellis for herbarium assistance at the Department of Botany, Nelson Mandela Metropolitan University. Dr. Curtis Marean's support and guidance from the inception of this study is much appreciated.

Appendix A

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. See Table 2 for explanation of participant's abbreviations.

	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	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–	–	–	–	0.11
2. Babiana ambigua	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	0.05
3. Babiana patulla	–	–	–	✓	–	–	–	–	✓	–	–	–	–	–	–	✓	–	–	0.17
4. Cyphia digitata	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
5. Cyphia undulata	✓	✓	✓	–	✓	✓	–	✓	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	0.83
6. Oxalis pes–caprae	✓	✓	–	–	–	✓	–	–	–	–	✓	✓	✓	✓	–	✓	–	–	0.44
7. Oxalis polyphylla	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	0.05
8. Tritonia squalida	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	0.05
Average USO SPI																			0.34
Fruit																			
1. Asparagus capensis	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.05
2. Astephanus triflorus	–	✓	✓	✓	–	✓	–	✓	–	✓	✓	✓	✓	✓	–	–	–	–	0.55
3. Carissa bispinosa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
4. Carpobrotus acinaciformis	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	0.94
5. Carpobrotus edulis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
6. Carpobrotus muirii	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	✓	–	–	0.11
7. Cassine perugua	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	0.05
8. Cassine tetragona	–	–	✓	✓	–	–	–	–	–	✓	–	✓	✓	–	–	–	–	–	0.27
9. Chironia baccifera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	0.05
10. Cynanchum obtusifolium	✓	✓	–	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	0.88
11. Diospyros dichrophylla	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	✓	✓	✓	–	✓	0.88
12. Euclea racemosa	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	✓	–	–	0.11
13. Euclea undulata	–	✓	–	–	–	–	–	–	✓	–	–	–	–	✓	–	–	–	–	0.17
14. Grewia occidentalis	–	✓	–	–	✓	✓	–	–	–	–	✓	–	✓	–	✓	–	–	–	0.33
15. Microloma saggitatum	✓	✓	✓	✓	✓	–	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	0.83
16. Muraltia spinosa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
17. Olea europaea ssp. *africana*	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	✓	–	0.17
18. Osteospermum moniliferum	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	0.94
19. Osyris compressa	–	✓	✓	–	✓	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	0.77
20. Quaqua mammilaris	✓	✓	–	✓	✓	✓	–	–	–	✓	✓	✓	–	–	–	–	✓	–	0.50
21. Romulea rosea	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	0.94
22. Searsia glauca	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
23. Searsia lucida	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	0.83
24. Sideroxylon inerme	✓	–	–	–	✓	✓	–	–	✓	–	✓	–	✓	–	–	✓	–	✓	0.44
25. Solanum africanum	✓	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	✓	–	–	0.17
26. Solanum retroflexum	–	✓	–	✓	–	✓	–	✓	–	✓	–	–	–	–	–	✓	–	–	0.33
27. Viscum capense	–	–	✓	–	–	–	✓	–	✓	–	–	–	–	–	–	–	–	–	0.17
28. Viscum rotundifolium	✓	–	–	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	0.11
Average Fruit SPI																			0.52
Vegetable																			
a. leaf																			
1. Annesorhiza nuda	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	0.05
2. Aponogeton distachyos	–	–	✓	✓	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	0.17
3. Emex australis	–	–	–	–	–	✓	–	–	–	–	–	–	–	✓	–	–	–	–	0.11
4. Pelargonium peltatum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	0.11
5. Solanum retroflexum	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	0.05
b. Inflorescence																			
1. Aponogeton distachyos	✓	✓	✓	✓	✓	✓	✓	–	–	✓	✓	✓	✓	✓	✓	✓	–	–	0.77
2. Prionium serratum	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	0.05
3. Trachyandra ciliata	–	–	✓	–	–	–	–	–	–	–	✓	✓	–	✓	–	–	–	–	0.22
4. Trachyandra divaricata	–	–	–	–	–	–	–	–	–	–	✓	✓	–	–	–	–	–	–	0.11
c. Flower																			
1. Quaqua mammiliaris	✓	✓	–	–	✓	✓	–	–	–	–	✓	✓	✓	✓	✓	–	–	–	0.50
d. Flower stalk																			
1. Oxalis pes–caprae	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
2. Oxalis polyphylla	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	0.05
e. Stem																			
1. Cyperus textilis	–	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.05
2. Juncus cf. *kraussii*	–	–	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.05
3. Prionium serratum	✓	–	–	✓	✓	✓	–	–	–	–	–	–	–	✓	✓	✓	–	–	0.38
4. Typha capensis	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.05
f. Internode																			
1. Thamnochortus insignis	–	–	✓	–	–	–	–	–	–	–	✓	✓	✓	–	✓	–	✓	✓	0.38

Appendix A (*continued*)

	Participants																		
Species by use	PA	DB	AD	JD	CG	MJ	EK	MK	NR	AS	JA	MBU	GC	CJ	JP	JR	MB	CD	SPI
Average Vegetable SPI																			0.24
Seed																			
1. Osteospermum moniliferum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	0.05
2. Osyris compressa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
3. Sutherlandia frutescens	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	–	–	–	–	✓	0.22
4. Zygophyllum morgsana	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	–	–	–	–	–	0.17
Average Seed SPI																			0.36
Nectar																			
1 Leonitus leonorus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	0.05
2. Leonitus ocymifolia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	0.05
3. Polygala myrtifolia	–	✓	✓	–	✓	–	–	✓	–	✓	✓	✓	✓	–	–	✓	✓	✓	0.61
4. Protea obtusifolia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
5. Protea repens	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1.00
6. Salvia africana–lutea	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	0.05
Average Nectar SPI																			0.46
Gum																			
1. *Accacia karroo*	✓	✓	–	✓	✓	✓	–	–	–	–	–	–	✓	✓	–	–	–	–	0.38
Culinary herb/Tea																			
1. Cyclopia genestoides	✓	–	–	–	–	✓	–	–	✓	✓	–	–	–	✓	–	–	–	✓	0.33
2. Mentha longifolia	–	–	–	–	✓	–	–	–	–	–	✓		–	–	–	–	–	–	0.11
3. Salvia africana–lutea	✓	–	✓	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.11
4. Tulbagia violacea	–	–	✓	–	–	–	–	–	–	✓	–	–	–	–	–	–	–	–	0.11
5. Viscum capense	–	✓	–	✓	–	–	–	–	–	–	–	✓	–	–	–	–	–	–	0.17
Average Culinary herb/Tea SPI																			0.17
Average overall 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	

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