New subspecies of *Banksia seminuda* and *B. occidentalis* (Proteaceae) from the south coast of Western Australia

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Abstract

Hopper, S.D. New subspecies of *Banksia seminuda* and *B. occidentalis* (Proteaceae) from the south coast of Western Australia. Nuytsia (7): 15-24(1989). *Banksia seminuda* subsp. *remanens* and *B. occidentalis* subsp. *formosa* are described and illustrated. Both have smaller leaves, are more floriferous and are smaller shrubs than their respective nominate subspecies. Both have outstanding horticultural merit. Their conservation in the wild will necessitate careful management, as both new subspecies may be killed by fire, and both have restricted geographical distributions. *B. seminuda* subsp. *remanens* and *B. occidentalis* subsp. *formosa* each have a distribution and morphological features suggesting that they are relictual taxa of Western Australian lineages that show the closest relationships to eastern Australian members of *Banksia* section *Oncostylis*.

Introduction

The genus *Banksia* L. f. has been the subject of intensive scrutiny in recent years. George's (1981) taxonomic revision constituted a significant advance in understanding variation in the genus. The revision, together with publication of colour books on banksias (Holliday & Watton 1975; George 1984), led to the selection of the genus as the subject of a three year national mapping project, The Banksia Atlas (Taylor & Hopper 1988). This resulted in the collection, collation and computer mapping of 25 000 sight records made by hundreds of volunteer contributors throughout Australia.

Banksia Atlas contributors, and a number of botanical collectors before them, drew attention to the occurrence of anomalous populations of a *Banksia* growing near granite outcrops in the Walpole-Nornalup National Park on Western Australia's south coast. A specimen of this taxon (*G. Liddelow* 778) was included by George (1981) in his list of selected collections of *B. littoralis* R. Br. var. *seminuda* A.S. George (now *B. seminuda* (A.S. George) B.L. Rye). George did not comment on this specimen as being a noteworthy variant of *B. seminuda*. In the case of

B. occidentalis, however, he did discuss a poorly collected coastal variant that was short in stature and had short broad leaves in comparison to typical populations (George 1981, p. 405). Muir (1981), in a little known publication, also mentioned this variant, extolling its horticultural merit and noting its precarious conservation status. Several members of the Albany Branch of the Western Australian Wildflower Society were also aware of a population of this variant, and had successfully grown it in gardens. Their conviction that it warranted a name as a distinct taxon was communicated to Banksia Atlas coordinating staff in 1985.

Examination of both these variants in the field and in the herbarium has convinced me that each constitutes a distinct subspecies.

Key to subspecies of *B. seminuda*

Longest leaves 4-6 cm long, 5-8 mm wide; margins recurved, entire except for 2-6 apical serrations; canopy densely floriferous; usually a shrub to 2-3 m tall ..... *B. seminuda* subsp. *remanens*

Longest leaves 7-12 cm long, 8-15 mm wide; margins not recurved, with 5-40 serrations along whole length; canopy sparsely floriferous; a tree to 20 m tall..... *B. seminuda* subsp. *seminuda*

Banksia seminuda (A.S. George) B.L. Rye subsp. **remanens** Hopper, subsp. nov. (Figures 1a-d, 2h-k, 3c).

B. seminuda (A.S. George) B.L. Rye subsp. *seminuda* foliis brevioribus dentibus non profundis apicem versus, habitu fruticoso et floridioribus differt.

Typus: Walpole-Nornalup National Park, 1 km due W of Conspicuous Beach carpark, 35° 03' 30" S, 116° 50' E, 31 July 1987, *S.D. Hopper* 5920 (holo: PERTH; iso: CANB, K, MEL, NSW, PERTH).

A *shrub* to 2 or 3 m or rarely a *tree* to 15 m, fire sensitive; trunk usually irregular and branching close to the ground, rarely straight; bark with longitudinal fissures, hard; canopy densely floriferous. *Longest leaves* linear, 4-6 cm long and 5-8 mm wide; margins recurved, often prominently, entire except for 2-6 apical serrations. *Bracts* on fruit with a dark narrowly elliptical or compressed rhomboidal glabrous patch on outer surface, to 4.5 x 1.2 mm on common bracts and 2.0 x 1.0 mm on floral bracts, with narrow interbract depressions densely hairy with a fine tomentum.

Other specimens examined. Long Point, Walpole-Nornalup National Park, 1 Aug. 1987, *B. Bond* s.n. (PERTH); Mt Hopkins area, Walpole-Nornalup National Park, May 1986, *A. Danks* s.n. (PERTH); 1 km E of Mt Hopkins, 26 May 1987, *A. Danks* s.n. (PERTH); Poison Hill, 2 km E of Long Point, Walpole-Nornalup National Park, 30 July 1987, *S.D. Hopper* 5915 (AD, CANB, NSW, PERTH); Walpole-Nornalup National Park, Forest of Arms, c. 1 km due E of the summit of Mt Hopkins, 1 Aug. 1987, *S.D. Hopper* 5931, 5932 (MEL, NSW, PERTH); Crystal Springs, Long Point, 200 m from sea, 20 Aug. 1973, *G. Liddelow* 778 (PERTH); Walpole, June 1974, *G. Rogerson* s.n. (PERTH); Cliffy Head, Nornalup National Park, 24 April 1968, *R.D. Royce* 8418 (PERTH); Mt Hopkins, Walpole-Nornalup National Park, 35° 02' S, 116° 40' E, May 1978, *T. & A. Wilson* s.n. (CANB, PERTH).

Distribution. Confined to a 30 km stretch of the south coast of South West Western Australia, from Cliffy Head to Conspicuous Cliff, mainly in the Walpole-Nornalup National Park. (Figure 2).

Habitat. All known sites are within one kilometre of the coast, near or rarely on the edge of exposed sheet granite outcrops. This subspecies favours deep well-drained sand surrounding outcrops,

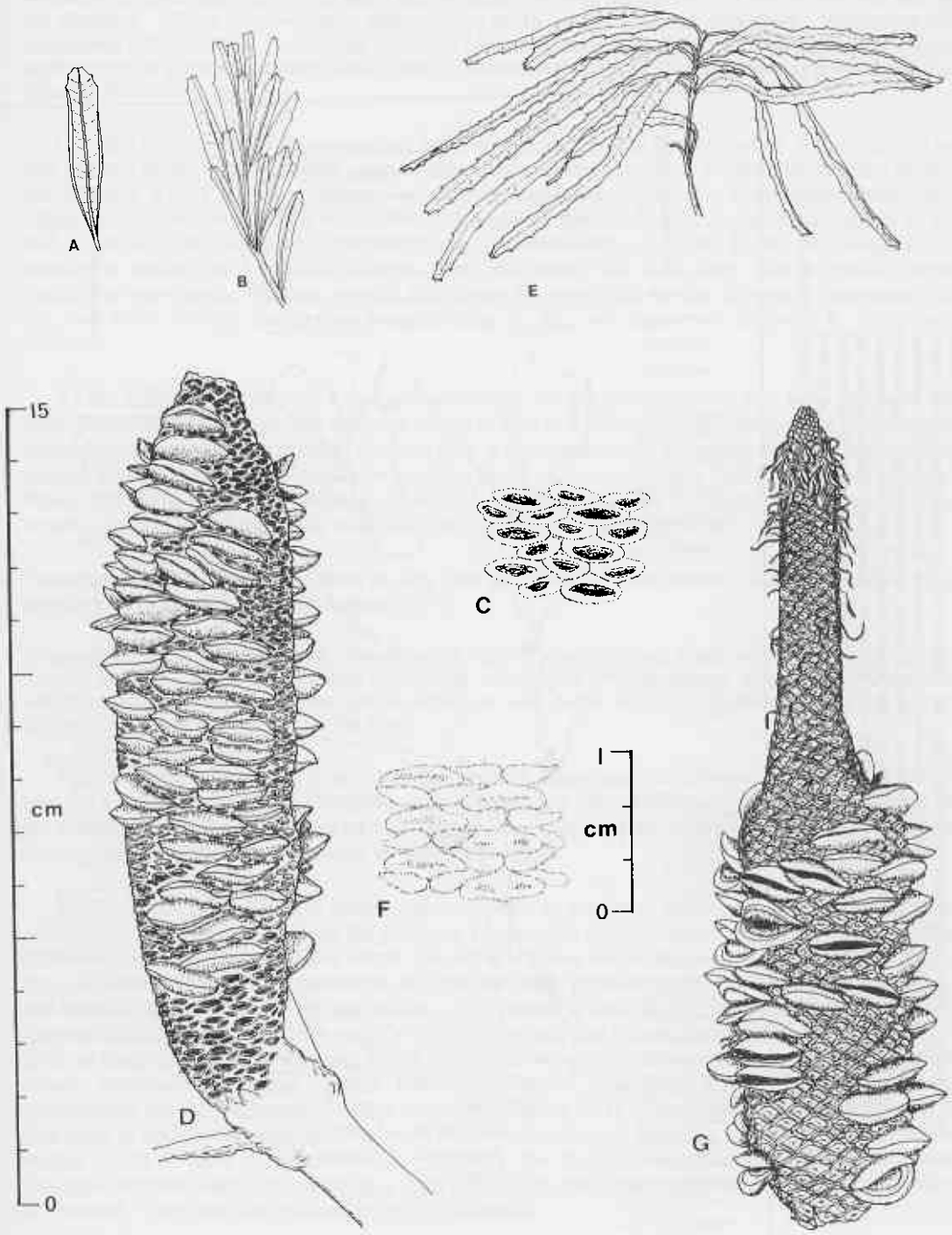

Figure 1. (A-D) *Banksia seminuda* subsp. *remanens:* (A) abaxial view of a leaf showing recurved margins; (B) sprig of leaves; (C) enlargement of bracts on infructescence; (D) infructescence. (E-G) *Banksia seminuda* subsp. *seminuda*: (E) leaves; (F) enlargement of bracts on infructescence: (G) infructescence. A-D: *A. Danks* s.n. May 1986 (PERTH). E: *A. Danks* s.n. 26 May 1987 (PERTH). F-G: *A.S. George* 11654 (PERTH) A, B, D, E, G, same scale; C, F same scale. Drawn by Susan Patrick.

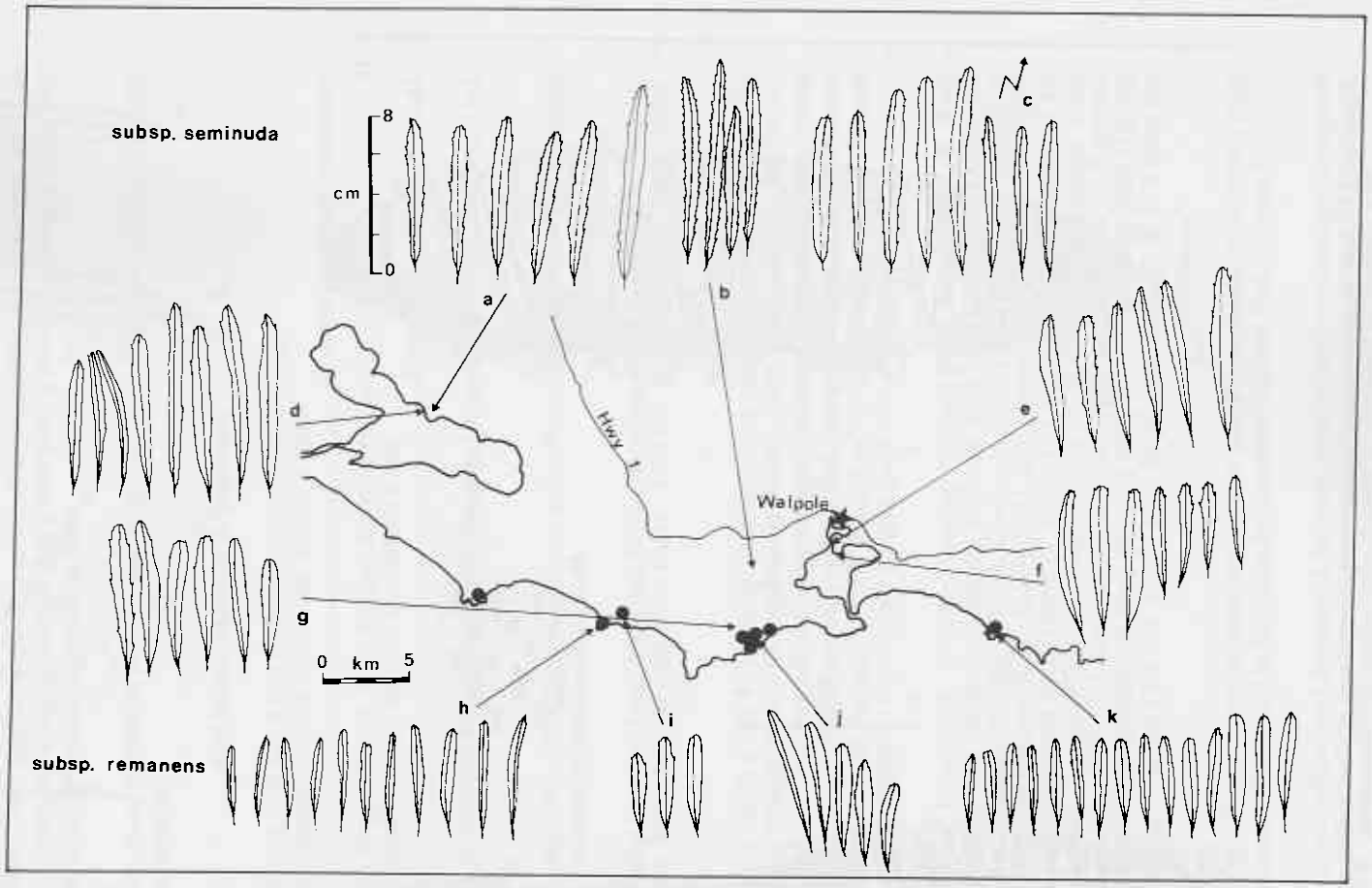

Figure 2. Known distribution of *Banksia seminuda* subsp. *remanens* (black circles) in the Walpole area of the south coast of W.A. Also illustrated is the largest mature leaf from each of a sample of plants in the following populations: *B. seminuda* subsp. *seminuda* (a) 300 m E of Broke Inlet on Broke Inlet Road; (b) tributary of the Deep River near Tinglewood Lodge; (c) Tone River bridge on Muir Highway E of Manjimup; *B. seminuda* ?subsp. *seminuda* (estuarine populations) (d) Broke Inlet settlement, (e) 400 m S of Rest Point Caravan Park, (f) Coalmine Beach Nornalup Inlet; *B. seminuda* intergrades of subsp. *remanens* and subsp. *seminuda* (g) Boggy Lake; *B. seminuda* subsp. *remanens* (h) Long Point, (i) Poison Hill, (j) Forest of Arms 1 km E of Mt Hopkins, (k) type locality 1 km W of Conspicuous Beach Road carpark. Drawn by the author.

attaining its maximum size in the steep well-watered gully of the Forest of Arms on the east side of Mt Hopkins. There it grows in a dense forest to 15 m tall with the paperbark, *Melaleuca* aff. *preissiana* Schau.; tingle *Eucalyptus jacksonii* Maiden; jarrah *E. marginata* Donn ex Smith; and an understorey of *Chorilaena quercifolia* Endl., *Chamaexeros* sp. and *Lepidosperma* spp. (including *L. effusum* Benth.).

On Mt Hopkins itself, *B. seminuda* subsp. *remanens* is a rare component of dense thickets on soil pockets adjacent to bare rock, with common associates including: *Banksia verticillata* R. Br., the Walpole Wax, *Chamelaucium* sp., *Agonis marginata* (Labill.) Schau., *A.* aff. *linearifolia* (DC.) Schau., *Gastrolobium bilobum* R. Br., *Acacia myrtifolia* (Smith) Willd., *Anthocercis viscosa* R. Br. and *Melaleuca* aff. *preissiana*. On the slopes of Poison Hill near Long Point, the subspecies is smaller in stature (to 3 m), but emerges from low heath with associates such as mallee jarrah *Eucalyptus marginata, Banksia grandis* Willd. and *B. quercifolia* R. Br. Common components of the low heath include *Dasypogon bromeliifolius* R. Br. and *Conostylis aculeata* R. Br. subsp. *aculeata*.

At the type locality west of Conspicuous Beach, the subspecies grows to 2 m in scrub on the edge of outcropping granite, but attains a height of 8 m in well-watered depressions on consolidated dunes downslope from the granite. In such sites it is conspicuously emergent from the surrounding coastal heath of *Spyridium globulosum* (Labill.) Benth., *Olearia axillaris* (DC.) F. Muell. ex Benth., *Hakea prostrata* R. Br. and *Banksia grandis*. It is sympatric with *B. littoralis* R. Br. at one site where a sloping interdunal swale runs down to a seasonally waterlogged flat.

Flowering period. Probably March to July (the last flowers of the season were observed in three populations in late July to early August 1987).

Discussion. B. seminuda subsp. *remanens* is readily distinguished from subsp. *seminuda* by its usually smaller stature, its densely floriferous canopy, its smaller leaves with recurved margins which are entire except for a few apical serrations, and in the narrowly elliptic glabrous patches on the outer surface of the bracts on the fruit.

Typical subsp. *seminuda* is an erect tree with a moderately floriferous canopy, with longer broader leaves usually serrate along the entire margin, and with smaller circular glabrous patches on the fruiting bracts. It also occurs on rich loams along watercourses, unlike the coastal consolidated dunes near granite outcrops favoured by subsp. *remanens*.

While typical populations of both subspecies differ in the above characters, some intergradation does occur. George (1981) noted the presence of estuarine populations of subsp. *seminuda* such as at Broke Inlet and Nornalup Inlet where "the habit is lower and of irregular form, similar to that of var. *littoralis*.". My field observations suggest that such populations are of irregular habit only at the water's edge, becoming upright within a few metres inland as the ground rises on rich loamy slopes. Even some plants at the water's edge may be tall and upright (e.g. near the Walpole Yacht Club at Coalmine Beach, Nornalup Inlet). However, the estuarine populations differ from typical subsp. *seminuda* in having shorter less serrate more coriaceous leaves, with some plants approaching the size of leaves of subsp. *remanens* (Figure 2d-f). There appears to be a transition in leaf form at both Broke Inlet and Coalmine Beach towards more typically serrate thin leaves inland within 5-100 m from the water's edge. Possibly, the shorter-leaved variants in these estuarine localities warrant formal treatment as a third subspecies, but further studies of population variation are needed. They are here retained in subsp. *seminuda*.

A rare population of apparent intergrades between *B. seminuda* subsp. *seminuda* and subsp. *remanens* occurs as an isolated stand on the edge of the creek running into Boggy Lake, about 600 m NW of the summit of Mt Hopkins (vouchers *S.D. Hopper* 5934, PERTH). About 20 trees

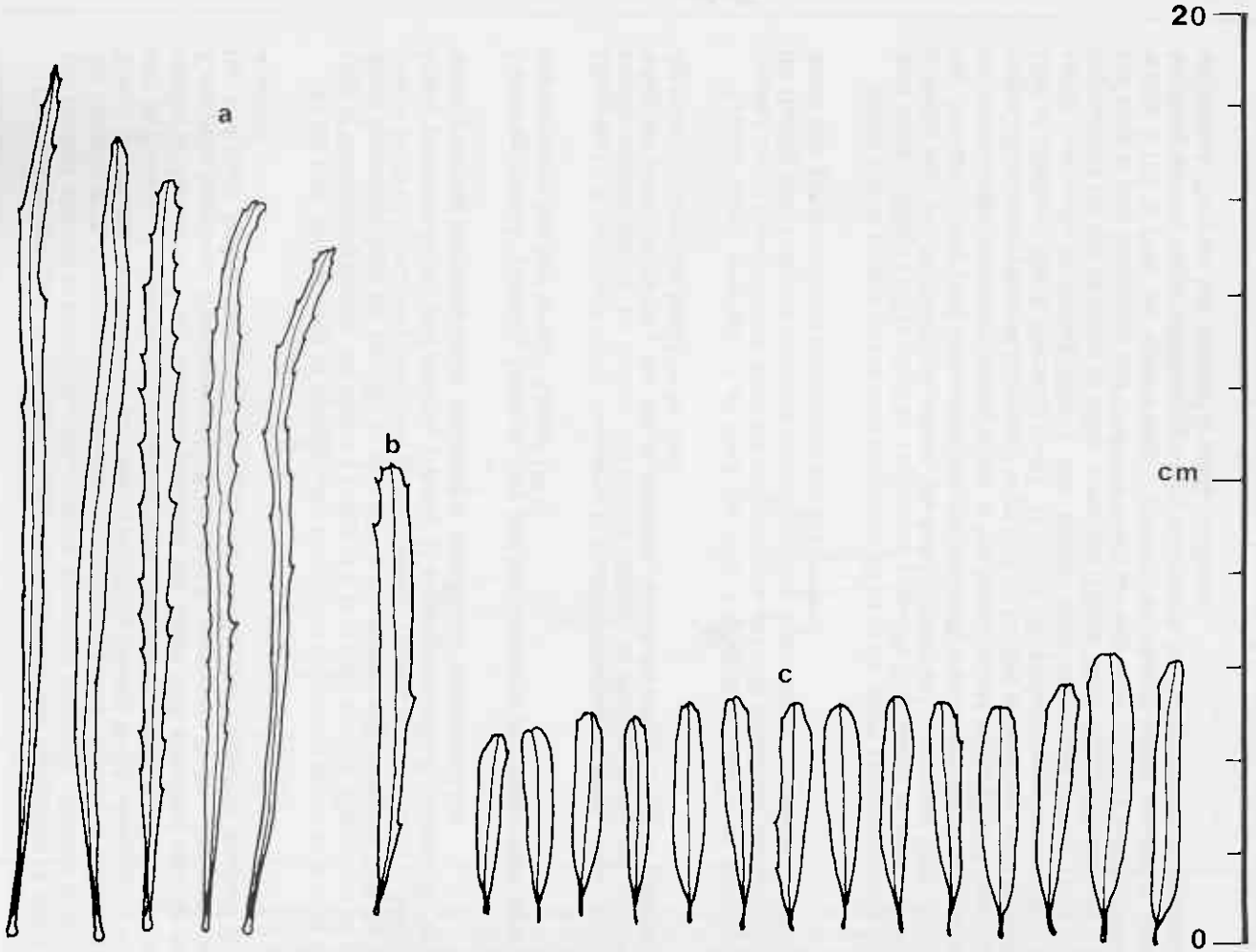

Figure 3. The largest mature leaf from each of a sample of (a) *Banksia littoralis*, (b) putative hybrid, and (c) *B. seminuda* subsp. ***remanens*** (type population) from the granite headland 1 km W of Conspicuous Beach Road carpark. Drawn by the author.

were observed in this population in 1987, some attaining a height of 17 m and a d.b.h. of 50 cm. Leaves were 6-9 cm long and 9-12 mm wide, and their margins varied from entire except for a few apical serrations through to sparsely serrate along their entire length (Figure 2g). Thus, leaves on different trees ranged from those typical for subsp. *remanens* through to those typical of subsp. *seminuda*. The population was also geographically and ecologically intermediate between the coastal slopes below granite occupied by subsp. *remanens* and the riverine forests further inland (e.g. along the Deep River) occupied by subsp. *seminuda*.

In view of the localized intergradation seen at Boggy Lake, and the similarity in leaf morphology of some of the estuarine plants of subsp. *seminuda* at Broke and Nornalup Inlets to that of some plants of subsp. *remanens*, subspecific rather than specific status is considered appropriate for the latter taxon. Throughout most of its range, subsp. *remanens* is morphologically uniform and ecologically differentiated from subsp. *seminuda*.

A single presumed hybrid of *B. seminuda* subsp. *remanens* and *B. littoralis* was located on a small granite outcrop 1 km W of Conspicuous Beach Road carpark (*S.D. Hopper* 5918, PERTH). The plant was a straggly shrub 1.5 m tall growing in an otherwise pure stand of subsp. *remanens* some 500 m from the nearest *B. littoralis*. The presumed hybrid had leaves intermediate between the parental taxa (Figure 3), and hirsute perianth limbs, a feature of *B. littoralis*.

In leaf morphology and its densely floriferous canopy, *B. seminuda* subsp. *remanens* resembles taxa in the eastern Australian *B. spinulosa* complex. The subspecies may be a relictual taxon with affinities linking western and eastern members of the hook-styled *Banksia* section *Oncostylis* Benth.

Conservation status. Geographically restricted and possibly vulnerable, but secure in Walpole-Nornalup National Park, and western populations to be included in the proposed Shannon-D'Entrecasteaux National Park. Several thousand plants occur at the type locality and near Mt Hopkins, while thousands of seedlings were observed on the slopes of Poison Hill in 1987.

Etymology. From the Latin *remanens* (remaining behind, persisting), alluding to the evolutionary history of the subspecies, which appears to be a relic of a more mesic climate persisting in the highest and most equable rainfall area of the southwest. An additional meaning intended is that the subspecies is one of the last to be identified and named as a distinct banksia after a very active phase of taxonomic research.

Key to subspecies of *B. occidentalis*

Longest leaves 4-8 cm long, 2-8 mm wide; canopy densely floriferous;
shrub to 2 m tall ..... *B. occidentalis* subsp. *formosa*

Longest leaves 9-17 cm long, 2-3 mm wide; canopy moderately floriferous;
shrub or small tree to 7 m tall ..... *B. occidentalis* subsp. *occidentalis*

Banksia occidentalis R. Br. subsp. **formosa** Hopper, subsp. nov. (Figure 4a).

B. occidentalis R. Br. subsp. *occidentalis* foliis brevioribus latioribusque (ad 8 cm x 8 mm), floridioribus et habitu fruticosa differt.

Typus: Black Point, proposed Shannon-D'Entrecasteaux National Park, 2 Aug. 1987, *S.D. Hopper* 5937 (holo: PERTH; iso: AD, CANB, K, MEL, NSW, PERTH).

A *shrub* to 2 m, fire sensitive; trunk irregular or straight, usually with widespreading branches. *Longest leaves* linear, up to 48 cm long and 38 mm wide. *Canopy* densely floriferous.

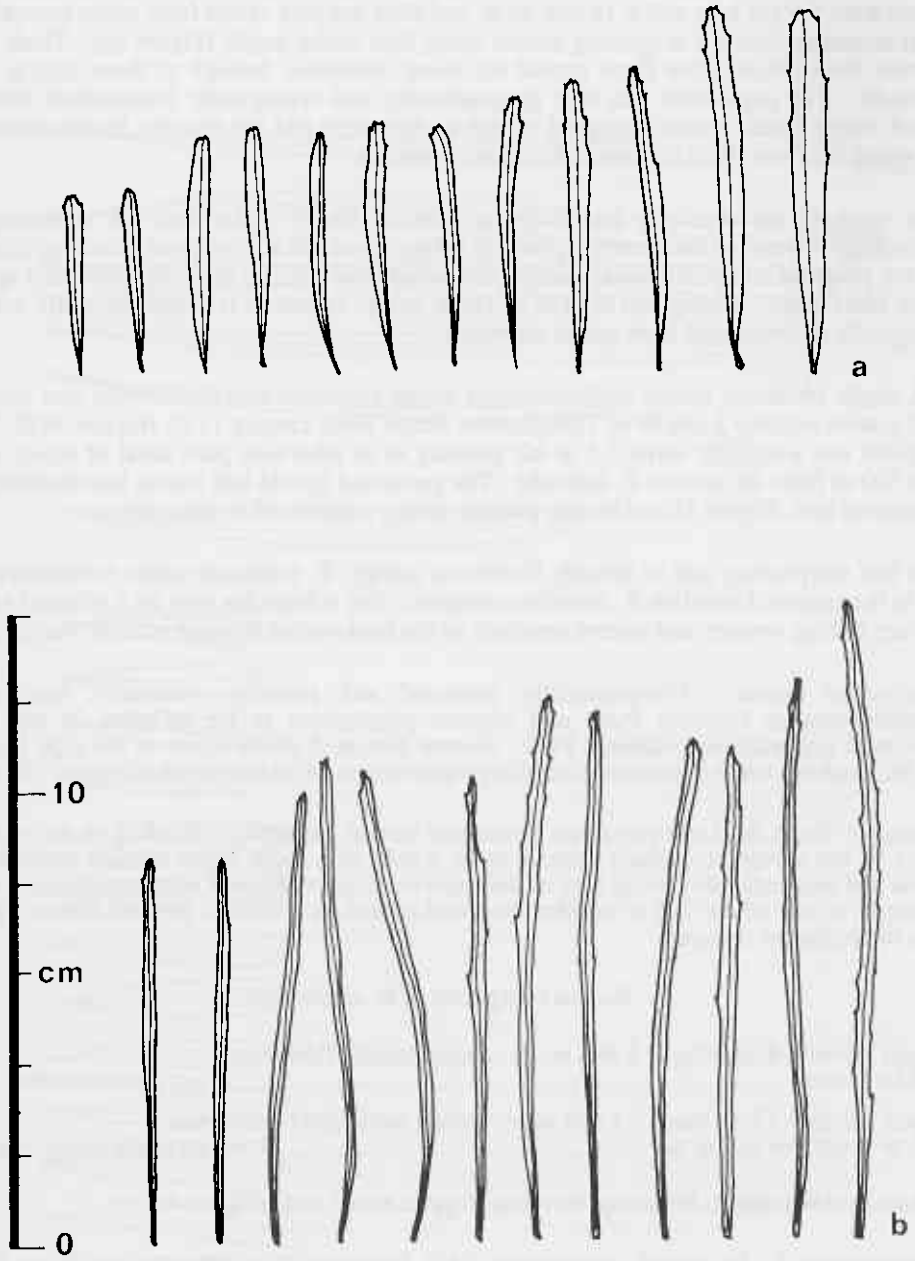

Figure 4. The largest leaf from each of a sample of (a) *Banksia occidentalis* subsp. *formosa* (type population), and (b) *B. occidentalis* subsp. *occidentalis* (Wilson's Inlet near Hay River, *S.D. Hopper* 5952, PERTH). Drawn by the author.

Other specimens examined. Black Point, near Cape Beaufort, Feb. 1978, *P. Luff* s.n. (CANB, PERTH); c. 15 km W of Albany, SE of coastal carpark on Muttonbird Road, 9 Oct. 1987, *S.D. Hopper* 6224 (PERTH).

Distribution. Known from the south coast of South West Western Australia on the Black Point peninsula, c. 40 km ESE of Augusta, and near Shelter Island, c. 15 km W of Albany.

Habitat. This subspecies occurs in coastal ephemeral swamps and seepages overlying massive outcrops of basalt or granite. Associates in the dense low heath at the type locality included *Banksia littoralis, Melaleuca cuticularis* Labill., *Spyridium globulosum, Olearia axillaris, Adenanthos meisneri* Lehm, *Boronia alata* Smith, *Hakea varia* R. Br., *Lepidosperma gladiatum* Labill., *Dianella revoluta* R. Br. var. *brevicaulis* Ostenf., *Jacksonia* sp., *Melaleuca* sp. (*S.D.Hopper* 5938, PERTH), and *Conostylis aculeata* R. Br. subsp. *aculeata.* Near Shelter Island, *B. occidentalis* subsp. *formosa* is a dominant emergent from dense low heath of *Lysinema ciliatum* R. Br., *Pimelea rosea* R. Br., *Dryandra sessilis* (Knight) Domin, *Banksia grandis* Willd, *Jacksonia* sp., *Acacia myrtifolia* (Smith) Willd., *Agonis flexuosa* (Sprengel) Schauer and *Adenanthos sericeus* Labill.

Flowering period. In full flower near Shelter Island in March 1985 (B. Swainson, pers. comm.). Luff's specimen collected in February has flowers, and the last flowers of the 1987 season were opening when the type was collected in early August.

Discussion. B. occidentalis subsp. *formosa* may be distinguished from subsp. *occidentalis* by its compact densely floriferous habit and its shorter broader leaves.

The new subspecies has outstanding horticultural merit as it retains its habit in cultivation (A. Taylor pers. comm.).

Like *B. seminuda* subsp. *remanens, B. occidentalis* subsp. *formosa* has a shrubby habit and short leaves similar to members of the eastern *B. spinulosa* complex of *Banksia* section *Oncostylis.* Subsp. *formosa* too may well be a persisting relic of the ancestral lineage that ranged across Southern Australia before the Miocene seas laid down the Nullarbor limestones and split the extant *Banksia* section *Oncostylis* into allopatric western and eastern groups.

Some intergradation with *B. occidentalis* subsp. *occidentalis* occurs at the Shelter Island site. A dense tall thicket of *Oxylobium lanceolatum* (Vent.) Druce on a small seepage near the foot of the coastal slopes contains about 50 trees 2.5-3 m tall of subsp. *occidentalis* (*S.D. Hopper* 6225, PERTH). Upslope in a narrow band 5 m wide are plants intermediate in leaf morphology and stature between the two subspecies. Beyond this narrow band, several hundred plants of subsp. *formosa* 1 m tall extend over the drier coastal slope.

Thus subsp. *formosa* is an ecologically differentiated race with distinctive morphological features, which intergrades with subsp. *occidentalis* rarely where habitats of the two subspecies abut. Subspecific status is considered appropriate in these circumstances.

Conservation status. Geographically restricted in two disjunct sites 200 km apart, but the subspecies has not been thoroughly surveyed and mapped. Known populations number several thousand plants, and one is secure within the proposed Shannon-D'Entrecasteaux National Park. *B. occidentalis* subsp. *occidentalis* was found by McCredie *et al.* (1985) to have high susceptibility to dieback disease, with about 60% of plants dead after 96 days following innoculation, and 95% dead after 396 days. The susceptibility of subsp. *formosa* may well be as high.

Etymology. From the Latin *formosus* (finely formed, beautiful), alluding to the beauty and horticultural potential of the subspecies.

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References

George, A.S. (1981). The genus *Banksia* L. f. (Proteaceae). Nuytsia 3: 239-474.

George, A.S. (1984). "The Banksia Book." (Kangaroo Press: Sydney.)

Holliday, I., and Watton, G. (1975). "A Field Guide to Banksias." (Rigby: Adelaide.)

McCredie T.A., Dixon, K.W., and Sivasithamparam, K. (1985). Variability in the resistance of *Banksia* L. f. species to *Phytophthora cinnamomi* Rands. Austral. J. Bot. 33: 629-637.

Muir, B.G. (1981). "D'Entrecasteaux National Park Resource Study." (National Parks Authority: Perth).

Taylor, A. & Hopper, S.D. (1988). The Banksia Atlas. Austral. Flora Fauna Ser. No. 8. (Australian Government Publishing Service: Canberra.)