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NOTES ON *HIBBERTIA* (DILLENIACEAE) 2. THE *H. ASPERA* - *EMPETRIFOLIA* COMPLEX

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Abstract

The *Hibbertia aspera* group has been re-assessed and the characteristics of the hairs in particular examined in some detail. Eleven species and five subspecies are recognised, illustrated and keyed out on vegetative as well as floral characters. The following new taxa are described: *H. appressa*, *H. aspera* DC. subsp. *pilosifolia*, *H. decumbens*, *H. empetrifolia* (DC.) Hoogland subsp. *radicans* and *uncinata*, *H. hirta*, *H. hirticalyx*, *H. notabilis*, *H. rhynchocalyx* and *H. truncata*. The new combination, *H. cinerea*, is published for *Pleurandra cinerea* R. Br. ex DC. and *H. pallidiflora* Toelken is added to the flora of south-western Victoria.

Introduction

This species complex was selected to demonstrate, in the first of a number of publications planned as a revision of the species of *Hibbertia* in southern and eastern Australia, the problems encountered in the taxonomy of this genus. Although several previous attempts were made to re-assess the classification of this complex, the group shows the neglect typical of the taxonomy of *Hibbertia*, and even more clearly the lack of understanding of species in the genus. It is not clear why the taxonomy of this genus, often with such spectacular flowers, has not engendered the same great interest and popularity that collectors have shown for it. It seems the early history at least in part accounts for this lack of appreciation.

De Candolle (1817) recognised six species in this complex of which one, *Pleurandra ovata*, had been described by Labillardière (1806). Sprengel (1827) formally published Sieber's *Pleurandra astrotricha*. J.D. Hooker (1855) was the first to express concerns about the similarity of species and regarded the complex (as *P. ovata* sens. lat.) as "an extremely variable plant, whose forms I have felt repeatedly inclined to separate....however find no difference whatever in the flowers and fruit of all these varieties". He thus reduced *P. scabra* to varietal rank of *P. ovata* followed by Mueller (1862) who reduced most of the known species to his *Hibbertia billardierei*, which was to replace *Pleurandra ovata* when transferred to *Hibbertia*. While the latter only remarked that some "forms of *P. ovata* may be distinguished as varieties", Bentham (1863) described five varieties mainly based on leaf shape and tomentum.

A similar trend developed at generic level as Mueller (1862) also reduced the genera *Adrastaea* DC., *Candollea* Labill. and *Pleurandra* Labill. to synonymy of *Hibbertia*, and Bentham continued by amalgamating *Hemistemma* DC., *Ochrolasia* Turcz. and *Hemistrephus* Drummond with *Hibbertia* but retaining *Adrastaea*, *Candollea* and *Pachynema*. Finally Gilg (1893) recognised only the genera *Hibbertia* and *Pachynema* in the Dillenioidae-Hibbertiae in Australia, but some of the names were retained at infrageneric level. This status at genus and species level was maintained for almost one hundred years (Gilg & Werdermann 1925; Stebbins & Hoogland 1976, in discussion) except that Druce (1917) added to the confusion by publishing the illegitimate combination *H. ovata* (Labill.) - non *H. ovata* Steudel (1845). Domin (1928) then transferred all Bentham's varieties to this species.

Very few new taxa were described until Wakefield (1957) resuscitated, as the result of his original research and especially field observations, two species in this complex, namely *H. aspera* with stellate-tomentose undersurface of the leaves, and *H. astrotricha* for those

plants with mainly few hooked simple hairs on the undersurface. He introduced for the first time the importance of different hair types found in this group, but unfortunately he did not follow it through the whole range. Nor does he seem to have been aware of the difference in juvenile plants (cf. juvenile to adult developmental stages) at least in some species of the group. Hoogland (1974) maintained this concept but established that the oldest name of the latter species should be *H. empetrifolia*. He had consulted for the first time in about 150 years the de Candolle types but from his preliminary identifications and manuscripts (CANB but at present on loan in AD) there are no indications that he intended recognising more species in this complex. Even with Wakefield's initiative for original research, publication of species remained restricted to some obviously new taxa for local floras largely described out of context from existing species (e.g. Conn, 1990; Reynolds 1991; Toelken 1996). Even these species were largely delineated on local material.

It is extraordinary that nobody re-assessed the number of stamens, a character mentioned by Labillardière (1806) in the protologue of *P. ovata*, and used by de Candolle (1817) to separate *P. scabra* var. β from *P. ovata*, yet J.D. Hooker (1855) could "find no difference whatever in the flowers and fruit" between the various forms which he did not formally recognise. This is but one example where superficially similar plants belong to different species. Without a large number of specimens, it would seem, earlier botanists could not appreciate the range of variation of individual species and were consequently unable to discern distinguishing characters. It is also important to note in the delimitation of taxa that putative hybrids between taxa were found in field observations to be extremely rare, if at all present in some groups of *Hibbertia*, and Stebbins and Hoogland (1976, p. 150) report similar findings.

Fortunately the attractive flowers maintained a constant stream of collections over time so that the present re-evaluation is based on a broad range of material which allowed a better overview of the wide range of local variation usually found in most of the species. As a result the geographic variants can now be individually examined as well as seen as part of the variation of each species. Local variation may seem to link species but that is only part of the whole picture. For instance, the hairs on the leaves of plants of *H. empetrifolia* north of Sydney are often extremely similar to those of *H. decumbens* (cf. *H. empetrifolia* subsp. *uncinata*) but their stamen characteristics still distinguish them. It seems that previous investigators were often misled by convergent evolution of some characters. The large amount of material consulted here allowed such an overview, but also showed that much more discerning collecting is still needed to record and assess as much as possible of the local variation. The author made some field observations but in the *H. aspera* group the work was mainly restricted to South Australia and only some species in Victoria were examined in their natural habitat. One is continually overwhelmed by the variation found which has often not been recorded previously.

It is hoped that immediate publication of completed groups of species will encourage feedback and hopefully provide an incentive for more discerning collecting, observations on the still not appreciated diversity of the floral biology and general basic ecological observations, so that in the short time allotted for the presentation of a flora write-up a similar standard can be achieved to that of treatments of other plants already published in the *Flora of Australia*.

Characters

A wide range of characters is used in this re-evaluation of a group of closely related species, but only a few need further explanation. Many of these will also be applicable to other groups of species but the present discussion refers only to the *H. aspera* group.

Habit

The habit of the species of this group is plastic as in most taxa of *Hibbertia*. The plants usually produce wiry to slightly woody branches, which, when young and actively growing, produce branches of the first and second order with very much elongated internodes and usually larger leaves. Older plants have quite a different habit because of elaborate branching, some of which is di- or trichotomous (as discussed under inflorescence below) and a decrease in the size of the leaves and internodes.

Plants tend to have a decumbent habit but the cane-like branches often scramble into other vegetation. Records of plants up to 2 m or more are known for *H. cinerea*, *H. hirticalyx* and *H. truncata*. The report of 4 m high plants of *H. pallidiflora* (Toelken 1995), is an extreme case. These plants often develop a dense cover on top of others.

Although suckering is common among some *Hibbertia* species, it was only observed in *H. pallidiflora* and *H. truncata*, but the decumbent branches of *H. empetrifolia* were often found rooting at the nodes where they were touching soil. Since plants of these species often occur in groups it is likely that vegetative spread is much more common than has been previously recorded.

Juvenile developmental stages

The morphology of juvenile organs on seedlings often differing drastically from adult growth has been recorded for many plants (e.g. Lubbock 1892). In *Hibbertia* such characters are not only found in seedlings but they are sometimes retained for some time, and often intermediate forms link them to adult stages. Juvenile traits may reappear with new growth, such as, coppicing branches after burning. In the extreme case of *H. pallidiflora*, juvenile growth is in some areas maintained for a long time and/or juvenile characteristics re-appear with the first leaves of every new branch produced.

The stages in the development were found best shown in the changes of the indumentum, especially since in this study particular emphasis was placed on an understanding and subsequent use of the hairs as a tool for identification of different taxa. The full range of variation of particularly the leaves was examined and illustrated, but the general patterns found suggested that available herbarium material is incomplete and, it is hoped, that more discerning collecting will supplement knowledge before a systematic arrangement of the species is attempted. Therefore only the two extremes, the juvenile (not 'seedling' because plants examined were often more advanced but it does include intermediate stages) and adult characters are formally described, and an intermediate range can then be extrapolated from the following general patterns. Whenever intermediate stage/s were available, one was illustrated but these are not necessarily at a similar stage in different taxa. They were included to assist with an understanding of the complete range of character states found in a taxon. Reasons for a longer or shorter retention of juvenile/ intermediate characters can at present not be assessed and seem to be different for every species, and sometimes even between local forms within species.

With limited herbarium material and field studies available for the present study it was assumed here that the stages of, for instance, the hooked simple hairs to stellate hairs on the undersurface of the leaves followed similar patterns in all the species with such adult leaves, although some of these juvenile stages have not been recorded for all these species. Question marks were inserted in the illustrations to show where stages are presumed unknown, as opposed to those species where apparently these developments do not take place either because the species concerned is presumably primitive, e.g. *H. decumbens*, or, in the case of *H. empetrifolia*, seem to have retained some of their juvenile characters (cf. affinities below). The following stages are usually observed:

1. The indumentum of branches with leaves showing juvenile characters tends to be similar to that of adult branches except that it is usually more sparse and often the individual stellate hairs have fewer branches.
2. Juvenile leaves tend to be more obovate and smaller than adult leaves from fast growing branches (with long internodes), but they are generally comparable to those from older branches.
3. The indumentum of the adaxial leaf surface shows usually a range from simple hairs more or less antrosely inclined in juvenile leaves to –
usually some stellate hairs with few antrorse branches (often unequally long) usually mixed with simple hairs in the intermediate stages to –
usually more or less dense stellate hairs with about equal branches radially arranged in the adult stage. Simple hairs are commonly found in, or restricted to a strip along the flanks and the depression above the central vein.
4. The indumentum of the abaxial leaf surface (excluding the flanks and central vein) varies from usually only hooked simple hairs (in some local forms these hooked hairs are absent or almost so, in others the occasional scattered stellate hairs are found interspersed) to –
increasing numbers of stellate hairs with short similar branches in between hooked simple hairs in the intermediate stages to –
usually stellate-velutinous to -woolly with long equal branches of the stellate hairs often somewhat depressed and strongly overlapping in the adult stage. A few larger stellate hairs with pronounced tubercles are found in some species, but they are usually of the same soft texture.
5. If flowers are present on material with juvenile or intermediate characters then they are usually leaf-opposed and rarely with subwhorled leaves below the peduncle (cf. inflorescence, affinities below), except in *H. pallidiflora*, where the different stages are often not clearly separated.

In the latter species juvenile and intermediate characters occur, are maintained or recur for as yet unknown reasons (cf. Toelken 1995). Similarly, juvenile characters have often been observed on specimens of *H. hirticalyx* from Tasmania, but not one specimen from Victoria showed leaf characters other than adult. While in *H. pallidiflora* at least some of the variation seem to be ecologically induced, there are indications that those of the two forms of *H. hirticalyx* are genetically fixed, but in both cases generalisations should be avoided.

Considering the known variation of the shape and size of leaves as well as the indumentum, it is obvious that Bentham's concepts could not provide natural delimitations of the taxa. This study of the range of variation of the indumentum in each species is not only important for the delimitation and subsequent identification of these species, but also gives, when provided with a predictable range of characteristics, some indications on the affinities of the various taxa to one another (cf. affinities below). These are, however, only generalisations as a basis for further discussion in a group plants that has been neglected for a long time.

Indumentum (Vestiture)

The hairs covering various organs of the plants are at times so varied in the species of sect. *Pleurandra* that a special descriptive system has been developed to maximise the use of these characters yet allow for observed variation. The hairs are here described under the broad entry of *vestiture* for the types and shapes of hairs, their variation, distribution and

stratification. A separate indication of the denseness and texture, e.g. pilose, is provided only for young individual organs in order not to be misleading because it refers only to the visible simple hairs overtopping at first, but as they usually wear off they expose the velutinous cover of short stellate hairs on older leaves and branches of, for instance, *H. rhynchocalyx*. 'Vestiture' is used here to describe the detail in contrast to 'indumentum', which as used by Hewson (1988) also includes indications of texture and denseness, so that the two terms as used here are not interchangeable. This division of characters allowed a greater versatility to describe the large variation found in some species of *Hibbertia* without duplicating information for each organ. In a few cases some hair characters needed accentuating in connection with certain organs at the risk of an apparent inconsistency in the overall treatment. The absence of such information in other taxa should be interpreted as negative.

Each character of the vestiture is, like any other taxonomic character, only described when its range of variation (usually including its juvenile range) on a specific organ of a certain taxon has been evaluated. As a rule the vestiture of a few key organs, viz. branches, upper and lower leaf surfaces and the calyx lobes were examined and described, but there are also references to specific features of other organs. More information and especially field observations is still needed as many of these genotypic and phenotypic variations, e.g. differences of vestiture between juvenile and adult leaves as in *H. pallidiflora*, showed that these are probably affected by environmental factors causing, for instance, a prolonged retention of these juvenile characters, which in turn could result in misidentification of material.

HAIR TYPES

The basic distinction between simple and stellate hairs is sometimes not obvious, because when simple hairs form from adjoining epidermis cells the swollen basal tubercles often join so that the structure should be called a stellate hair. Similarly the branches of stellate hairs often do not seem to develop, or wear off easily and the apparent contradiction to stellate hairs with 1–3 branches is determined by comparison with the size, shape and deflection of the surrounding hairs.

The **tubercle** is an arbitrary term often used in descriptions of hibbertias for a more or less swollen base of simple and stellate hairs. In addition to the tubercle, simple and stellate hairs on the upper leaf surface of species of the *H. aspera* group are usually surrounded by **base cells**, which are somewhat bulging epidermis cells with thickened walls. These hairs are somewhat reminiscent of those found in the Boraginaceae, but in the *H. aspera* group are never coarse. The base cells together with remains of the tubercles are the paler spots usually observed on older leaves where the hairs have largely worn off. Hooked simple hairs which are occasionally found on the upper surface of leaves of some forms are usually without base cells.

The **simple hairs** are apparently always unicellular from an epidermal cell and often with a basal swelling or tubercle. They are straight or with a hooked apex, and often longer than stellate hairs, so that the frequently used terms 'pilose' or 'hirsute' refer to the visible single hairs. While straight simple hairs are more or less antorsely inclined, rarely curved, hooked simple hairs are usually erect or rarely retrorsely inclined particularly on the calyx.

Stellate hairs in *Hibbertia* are formed by a clustering of simple unicellular hairs (fig. 1A), the bases of which are more or less connate to form a longer or shorter tubercle. They are very variable and the alternatives are retained in the following sequence in all descriptions in order to remain consistently comparative in the wide range of combinations of characters as required (fig. 1B):

persisting/ wearing off except basal tubercles, erect/ multiangulate/ depressed, radial/ antrorse/ retrorse stellate hairs (with number of branches) with small/ broad/ stalked tubercle base.

A simple terminology was maintained in order to keep it self-explanatory. "Erect" and "depressed" do not replace Hewson's (1988) "porrect" (though the odd hair on plants of the *H. aspera* group may produce a straight erect central hair) and "rotate" or "peltate" (branches of hairs in this group are rarely in one plain) respectively, and some of Hewson's terms may be used in subsequent papers in this series. Basically they are multiangulate stellate hairs and "erect" refers to hairs usually with only a few branches all of them at 75 or more from the base; "depressed" to hairs with all branches less than 35 to 40 from the base. The term "stalked stellate hairs" (Toelken, 1996) was used to avoid confusing them with dendritic hairs, because their branches spread from more or less the same point and the length of the tubercle is relative to that of other stellate hairs on that specific organ. Considerable variation of stellate hairs occurs between specimens of the same species and between leaves of juvenile or adult plants.

Stellate hairs usually have similar branches, but occasionally there are distinctly unequally long ones found especially when there are larger stellate hairs over smaller ones as in *H. cinerea*. These unequal branches can reach extremes in cases where one or two branches may extend to more than twice as long as the other branches, and may on superficial investigation be confused with single hairs over stellate ones.

Although some sequences of the above terms might seem to indicate progression to more complex conditions, and this might be observed in particular examples, generalisations should be avoided as there is, for instance, evidence for increasing as well as decreasing number of branches of stellate hairs within the species of this group.

In the above descriptions the following words are added in order to provide a simple image of the three dimensional stratification of the hair cover similar to that of vegetation (cf. fig. 1B) *over/ similar/ under* together with *overlapping* (free being usual) accepting that the distribution of the different types is a random scatter unless specific accumulations are mentioned. This simplification expressed useful descriptive information of the hair cover which could otherwise only be obtained by unjustifiably cumbersome measurements.

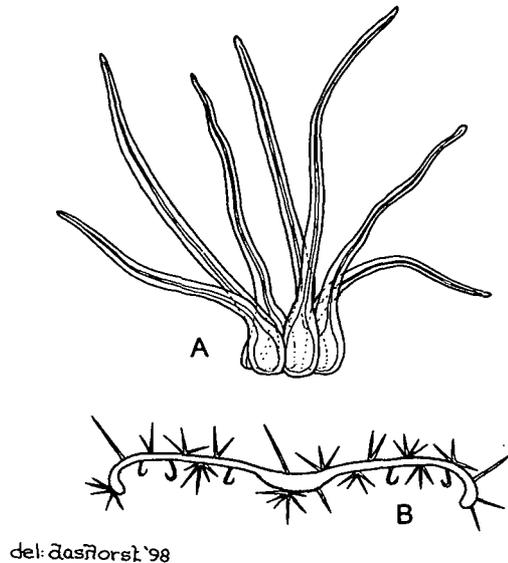


Fig. 1. Hairs. A, *H. cinerea*: stellate hairs are composed of several adjoining simple hairs $\times 50$; B, diagram of juvenile leaf of *H. aspera* subsp. *aspera* showing above few simple hairs above multiangulate antrorse stellate hairs (few often unequal branches), and below few multiangulate radial stellate hairs (many, often similar branches) rarely overlapping with hooked simple hairs $\times 20$. (A, R. Alcock 625, AD; B, C.T. White BRI 10502).

Leaves

The shape and size of the leaves often varies considerably from young to older branches but can equally vary on the same plant predominantly due to the amount the margins are recurved, which depends on the environment or techniques of drying specimens. These are therefore generally not useful characters in this group of species.

The description and illustration of juvenile and adult leaves and especially their indumentum represents extremes observed (cf. juvenile to adult developmental stages). The extent of the variation found seems to vary with environment, as particularly shading seem to have a retarding influence on the development of adult leaves, but the duration of expression of the juvenile leaves is also variable in different taxa (cf. subspecies of *H. aspera*), and may be repeated in some species, e.g. *H. pallidiflora*, with every new axis developing.

Discolourous leaves are not entirely due to their indumentum, as leaves of *H. empetrifolia*, which often has glabrescent older leaves (above and below), are usually paler below.

Inflorescence and flowers

The concept of an inflorescence has not been developed in *Hibbertia* although accumulations of flowers have been recorded in some groups of species in the genus. Flowers in *Hibbertia* are commonly single, terminal and often become leaf-opposed by sympodial growth (e.g. *H. decumbens*, fig.6A). Flowers may develop repeatedly at intervals of three or four internodes (e.g. *H. hirta*).

Two or three leaves below the peduncle of most of the species of this group are not separated by internodes so that they are here referred to as subwhorled. Sympodial growth from their axils often results in di- or trichotomous branching, and only in the latter case can one observe the terminal position (leaf-opposed) of the flower. If, however, one of the three axillary buds has not developed into a branch then the flower will appear to be axillary to that subwhorled leaf.

Some forms particularly of *H. aspera* and *H. empetrifolia* produce flowers on short shoots without fully developed leaves, sometimes in the axils of leaves along the main branches. These and normal flowering branches then produce one to three fascicled axillary branches (sympodial growth) with vestigial leaves (cf. fig. 4A), which often drop off early, so that the cluster of flowers thus formed appears to be a few-flowered inflorescence especially as the peduncle of each flower often remains intact for more than a year. They are, however not referred to as inflorescences because, unlike a raceme or cyme, or even the complex inflorescences described for some of the species of *Dillenia* (Corner 1978), there are several nodes of vegetative growth, however short, between subsequent flowers. The same applies to the dense clusters of flowers with special bract-like leaves in the *H. sericea* complex (Toelken, in preparation). Troll's definition of an inflorescence as "the shoot system which serves for the formation of flowers and which is modified accordingly" (Weberling 1987) could cover some forms of this species complex, but the concept of a single terminal flower is here preferred so that one can show the different developments within the genus more clearly.

Since the single terminal flower was accepted as the basic unit, the characteristic elongated internode between the subfloral bract and first leaf is here called "peduncle"; the internode between the bract and the flower is then referred to as "anthopodium" (Briggs & Johnson 1979), in preference to "pedicel", which has been used for so many different conditions in literature (Conn, 1995).

The characteristic subulate bracts always subtend the calyx in the *H. aspera* group. They are without recurved margins and their length relative to the calyx was found a useful

character to distinguish some of the species while in others, e.g. *H. empetrifolia*, it is variable.

The buds of most species are broadly ellipsoid but in the case of *H. empetrifolia* they are narrowly ellipsoid and the base of an open flower is not abruptly constricted but more or less stepped. This is due to a reduction of the number of ovules from four laterally attached to the placenta along the suture of the carpel to two, more or less basal ovules in the latter. In the process the position of the ovules changes from parietal (horizontal), or almost so in the case of four ovules, to basal (erect) when two ovules are produced.

Calyx and corolla

In contrast to the petals the calyx lobes are usually basally connate. In the *H. aspera* group the outer three are commonly different from the inner two in shape, indumentum and the presence of a more or less pronounced central ridge, while in many other groups it is the outer two and inner three calyx lobes that are similar.

The petals vary greatly in size, the shape of the claws, and their apices can vary from truncate, emarginate to deeply lobed, sometimes even within a population of a species. The shape of the base of the petals can, in the *H. aspera* group, be distinctive as it is cuneate (cf. fig. 7A) in the species with fewer than eight stamens and tends to be more rounded to obovate in species with ten or more stamens. It remains a character of limited use on herbarium material.

Stamens

The species of the *H. aspera* group can be divided into those with (9) 10–12 (-15) stamens and 4–8 (9) in *H. aspera* and *H. empetrifolia*. The anthers of the group with more stamens are oblong (fig. 2D) and (1-) 1.2–1.5 (-1.8) mm long while those of the latter are usually oblong-oblancheolate (fig. 2E) and (0.6-) 0.7–0.9 (-1.1) mm long in herbarium specimens. The length of the anthers in the group with many stamens does not vary as much as in the others where one or more of the central ones are usually enlarged as part of the pollination syndrome. In some species the anthers, again especially the central ones, have short pointed appendages from the connective (fig. 2D).

The filaments are usually connate for more than half their length in *H. hirticalyx*. Even in this species there is some variation but in others there is even more. As in most *Hibbertia* species with stamens in one bundle (sect. *Pleurandra*) their filaments are variously basally connate but in local forms the amount of fusion of all or bundles of them varies, and is constant in only a few species. In the *H. aspera* group it was not found to be a reliable character.

The solid filaments and the closely packed anthers are more or less curved forward (fig. 2A,B) to cover the styles so that just the stigmas protrude horizontally. This suggests a specialised pollination syndrome unique to species of the *H. aspera* group except for *H. pallidiflora* which has tubular petals (Toelken 1995). Flowers in this group are therefore more zygomorphic than in other species of sect. *Pleurandra*.

Fruit

The shape of the fruit also varies according to whether two or four seeds develop. As the ovary enlarges the original villous indumentum becomes sparser so that one can distinguish the normally stellate hairs but in *H. appressa* they are simple.

There are usually two to four ovules (rarely up to six in *H. truncata*) in each carpel and the fewer there are the more basal the placentation usually becomes. Rarely more than two

seeds per carpel mature and the position of the attachment is also often displaced at maturity, so that little importance was attached to these characters.

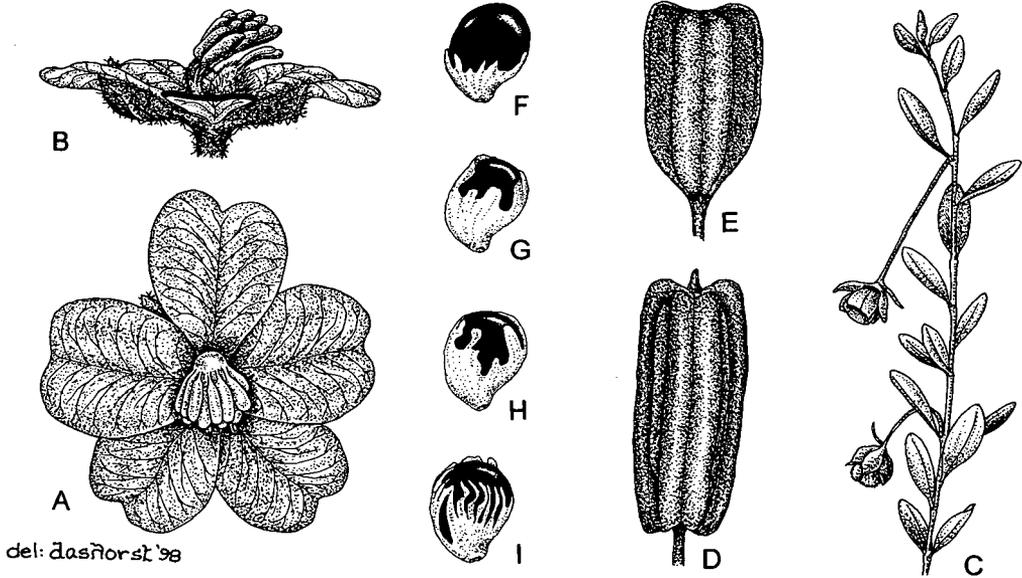


Fig. 2. Flowers and fruit. A, B, *H. truncata*: A, front view of rotate flower with stamens curved forward as commonly found in the *H. aspera* group $\times 3$; B, side view of androecium curved over the gynoecium to place apex of anthers above stigmas $\times 3$. C, *H. pallidiflora*: flowering and fruiting branch showing unique pendulous flowers with tubular petals (free petals arranged in a cylinder) shorter than calyx (one lobe removed) $\times 1.5$. D, *H. rhynchocalyx*: oblong anther with appendage terminal to connective $\times 30$. E, *H. empetrifolia* subsp. *radians*: oblong anther with flared apex $\times 30$. F–I, *H. aspera* subsp. *aspera*: the aril on seeds of the same plant varies in size and may develop broad lobes to finger-like processes $\times 6$. (A, B, H.R. Toelken 9251, AD; C, H.R. Toelken 8567, AD; D, J.B. Williams 603, NSW; E, H.R. Toelken 8681, AD; F–I, Price NSW 10293).

The seeds vary considerably in size and shape depending on the number developing in the same carpel as well as on environmental conditions as in many cases sudden heat waves etc. seem to produce premature ripening of the seeds. While most seeds are shiny black they become brown to light brown under those conditions.

The aril in this group of species develops from an upper fleshy collar of the funicle a membranous sheath of varying size and lobing (fig. 2F–I) even within the species. When four ovules develop the sheath usually does not develop well in the contact zone. The aril also seems to be smaller in prematurely ripened seeds, so that this variable character cannot be used to distinguish species within the *H. aspera* group but the well developed membranous sheath will distinguish members of this group from others in the genus.

Affinities

The species have for convenience been alphabetically arranged but the limited information available allows some speculation on the affinities of the different taxa recognised here.

The most effective characters to show progressively more complex developments are associated with the arrangement of the flowers. In *Hibbertia* the basic type is the single terminal flower, which becomes leaf-opposed by sympodial growth of the axillary bud from the subtending leaf. Mainly leaf-opposed flowers are only found in *H. decumbens*. They are also more or less frequently found, in addition to other types of flower arrangements, in many other species of the *H. aspera* group, but they are then usually associated with juvenile leaves. *H. decumbens* is unique in that it was seen to produce, in contrast to all the other species, only one flower per branch per season, and they usually remained except for a few flowers leaf-opposed in successive years. Since the limited material available did not show any sign of different stages in the leaf development, the combination of the leaf and flower characters could not be used to establish whether the rare occurrence of subwhorled leaves below flowers are a normal development in this species or are restricted to local forms.

Usually, however, the terminal flower in this group of species is subtended by two or three (up to five) subwhorled leaves, i.e. the internodes between these leaves are very much reduced. Continued axillary growth will appear di- or trichotomous etc., as usually more than one axillary bud resumes growth, but if not each axillary bud of the clustered leaves continues growth, the flower will appear to be axillary. The true terminal position of the flower can only be observed when vegetative growth is continued from the axil of each of the subtending leaves. Each of these developing branches has at times been observed to produce more flowers, but usually with a minimum of three or four vegetative nodes commonly with normal leaves in-between. This can be repeated several times in one season.

The second type of specialisation is that some or all flowering branches are further reduced to short shoots. Extreme forms with reduced to vestigial leaves are mainly observed in *H. aspera* and *H. empetrifolia*, and occasionally also in *H. appressa*, which is very similar to the latter.

The shape of the individual cells of the stellate hairs (fig.1A) suggest that they have developed from groups of adjoining simple hairs, and often some such clusters were observed among simple hairs, which sometimes obscure the difference between these two basic types of hairs (cf. indumentum). Hooked simple hairs are, however, different as they are usually found quite separate and very rare occurrences of stellate hairs with hooked branches in some forms of *H. empetrifolia* have not been observed to relate to similar clustering of hooked simple hairs. Stellate hairs formed on the undersurface of juvenile leaves between hooked simple hairs have not been observed to develop hooked branches. It is then significant that the earliest leaves of all species examined (juvenile leaves of three species have not been seen) have only hooked simple hairs, although sometimes only a few of them on their undersurface.

If *H. decumbens* is the most primitive species according to its flower arrangement, then it is interesting to note that it is also the species with the fewest stellate hairs except for a few local variants of *H. appressa* and *H. empetrifolia*, and produces like those two species hooked hairs on the undersurface of all its leaves. It is also interesting, although no conclusions could at present be drawn from the fragmentary information available, that, similar to *H. decumbens*, juvenile plants produce leaves which tend to produce less branched stellate hairs and apparently only hooked hairs on the undersurface as well as leaf-opposed flowers. In contrast to *H. decumbens*, *H. appressa* and *H. empetrifolia* have a more complex flower arrangement.

H. decumbens has 9–12 (-15) stamens suggesting that larger numbers of stamens are also a primitive character in the *H. aspera* group as Stebbins and Hoogland (1976) had suggested for the genus. The anthers of *H. decumbens* are narrowly obloid as in all other species with more than 10 stamens. The few stamens found in flowers of *H. aspera* and *H. empetrifolia*, and especially that the anthers are usually shorter and somewhat broadened at the apex particularly in the latter species indicate advanced standing. Both *H. empetrifolia*

and the very similar *H. appressa* have very few stellate hairs and hooked hairs on the undersurface of leaves, yet show apparently advanced characters in their flower arrangement as well as in the number of stamens at least in the former. Since neither in the large numbers of specimens examined of both these species nor in any populations observed in the field were any juvenile leaves found, this strongly suggests that the simple hairs and especially the commonly found hooked simple hairs on the undersurface of the leaves are a retention of a juvenile character if compared with *H. aspera*, the third very similar species in this complex. The apparently primitive *H. appressa* and *H. empetrifolia* are possibly because of this reduction more advanced than *H. aspera*.

H. appressa, *H. aspera* and *H. empetrifolia* are different from all the other species in that except for some of their subspecies they are widespread and occur in a wide range of habitats. The only character that they have in common is their more or less cuneate petals suggesting that the shape together with the reduced number of stamens may be part of a particular pollination syndrome. The different indumentum, however, suggests that *H. notabilis* – *H. aspera* and *H. appressa* – *H. empetrifolia* are convergent pairs of species.

Both *H. decumbens* and *H. hirta* are found in restricted areas on the Tablelands of central and south-central New South Wales respectively. *H. rhynchocalyx* is known only from one collection in the Gibraltar Range of northern New South Wales. *H. hirticalyx* (Wilson's Promontory, Victoria and northern Tasmania), *H. truncata* (vicinity of Port Campbell, Victoria), *H. cinerea* (vicinity of Port Lincoln, S. Australia) and *H. pallidiflora* (Kangaroo Island and adjoining mainland but extending just into Victoria) have a restricted distribution, although often locally common. All these species except *H. decumbens* share many characters and give the impression of relics of a once widespread and very variable complex. Each one has possibly further evolved in their isolation, as is, for instance, shown in the unique tubular flowers of *H. pallidiflora*. *H. decumbens*, the most primitive species according to this, shows no close affinities to any other species.

The following linear arrangement of the species based on the above arguments as well as supported by other similarities in their morphology is suggested: *H. decumbens*, *H. hirta*, *H. rhynchocalyx*, *H. hirticalyx*, *H. truncata*, *H. cinerea*, *H. pallidiflora*, *H. notabilis*, *H. aspera*, *H. appressa*, *H. empetrifolia*.

H. aspera group

This group of species was selected because members are easily distinguished from other species in the sect. *Pleurandra* by, in particular, the flat leaves with scarcely recurved to moderately revolute margins so that the undersurface is normally visible; the elongated peduncle which becomes recurved when fruiting; and the closely packed anthers which are more or less horizontally fanned forward to cover the styles with only the receptive stigmas protruding beyond their apices, except in the tubular flowers of *H. pallidiflora*, where the styles are longer.

Here the species are alphabetically arranged and not numbered so as to avoid a numbering system that cannot be maintained in the treatment of the whole genus.

The detailed localities and descriptions published by de Candolle (1817), which even include reference to the habit of the plants, must have been drawn up from the often small duplicates sent to him. The protologue based on R. Brown specimens does not agree with the collector's manuscript descriptions except for the name and locality. Authorship is maintained as 'R. Br. ex DC.' and the specimens in G-DC are regarded as holotypes. Many lectotypes were selected even for illegitimate names to clarify concepts.

Key to the species and subspecies based largely on floral characters

It was found best to describe the vestiture of the leaves in terms of 'above' and 'below' (not adaxial and abaxial surfaces), because the revolute portions of the adaxial surface are often such an important part of the leaves "below". For similar reasons the lateral sides of the leaves are called 'flanks' and the 'undersurface of leaves' here excludes the revolute margins and central vein so that it is not strictly synonymous with the abaxial leaf surface. References to the central vein always apply to the abaxial leaf surface because here it is clearly visible.

1. Corolla tubular (the free petals are arranged in a cylinder), shorter than calyx; styles clearly overtopping apex of anthers..... *H. pallidiflora*
- 1: Corolla rotate, longer than calyx; styles exposing stigmas about level with apex of anthers..... 2
2. Stamens (2-) 4-6 (-9); dried anthers obloid to obloid-obovoid, tapering towards the base, 0.5-1 (-1.2) mm long..... 3
3. Undersurface of leaves ± densely covered with stellate hairs; buds and flowers abruptly constricted into peduncle..... 4
4. Stellate hairs on upper leaf surface multiangulate, radial and with 5-15 branches, or occasionally mixed with antrorse hairs with 2-5 branches *H. aspera* subsp. *aspera*
- 4: Stellate hairs on upper leaf surface erect, radial and with 1-3 branches, if antrorse then 1-3 branches..... 5
5. Upper leaf surface with erect, radial to antrorse stellate hairs with 1-3 (4) branches; stellate hairs on the undersurface with 2-5 branches, scarcely overlapping.. *H. aspera* subsp. *pilosifolia*
- 5: Upper leaf surface mainly with spreading simple hairs or smaller antrorse ones sometimes with 2 branches; stellate hairs on undersurface with >7 branches, strongly overlapping *H. aspera* × *H. empetrifolia*
- 3: Undersurface of leaves without stellate hairs except along the flanks and the central vein; buds and base of flower constricted or stepped (cf. fig. 7F) into peduncle..... 6
6. Plants usually prostrate; some stellate hairs on the flanks of mainly the upper leaf surface radial, broad-tubercled and with 8-15 branches..... *H. empetrifolia* subsp. *radians*
- 6: Plants spreading or decumbent; stellate hairs on upper leaf surface antrorse or rarely radial, with small tubercle and 1-4 branches 7
7. Stellate hairs on branches and peduncle with (4) 5-14 branches; hooked simple hairs absent on upper leaf surfaces, or if present then not combined as below *H. empetrifolia* subsp. *empetrifolia*
- 7: Stellate hairs on branches and peduncle with 1-3(4) branches; hooked simple hairs present on upper leaf surfaces *H. empetrifolia* subsp. *uncinata*
- 2: Stamens (9) 10-12 (-15); dried anthers usually narrowly obloid, with truncate base, (1-) 1.2-1.8 (-2) mm:..... 8
8. Bract subtending flower up to half as long as calyx..... 9
9. Undersurface of leaves densely covered with stellate hairs..... 10
10. Upper leaf surface with simple and antrorse stellate hairs; southern NSW, eastern Victoria *H. notabilis*
- 10: Upper leaf surface with radial stellate hairs; south-western Victoria..... *H. truncata*
- 9: Undersurface of leaves except flanks and central vein covered with simple hooked hairs..... 11
11. Outer surface of outer calyx lobes with long appressed simple hairs over/without small stellate hairs *H. appressa*
- 11: Outer surface of outer calyx lobes with larger stellate hairs with unequal branches over small ones with similar branches and/or hooked hairs..... *H. decumbens*

- 8: Bract subtending flower two-thirds to as long as calyx 12
- 12: Outer surface of outer calyx lobes with erect to multiangulate larger stellate hairs over smaller ones..... *H. cinerea*
- 12: Outer surface of outer calyx lobes with simple over stellate hairs..... 13
- 13: Upper leaf surface and outer calyx lobes covered with simple rarely stellate hairs *H. hirta*
- 13: Upper leaf surface and outer calyx lobes with simple over stellate hairs..... 14
- 14: Anthers with a terminal appendage; simple hairs on branches, leaves and calyx 1–2 mm long *H. rhynchocalyx*
- 14: Anthers truncate or emarginate; simple hairs on branches, leaves and calyx up to 1 mm long *H. hirticalyx*

Key to the species and subspecies based largely on hair types

Examine the undersurface of at least one leaf at the apex and the base of each specimen:

- A. If both have similar hairs then use couplet 1.
 - B. If the upper leaf has a different indumentum, use only the upper adult leaves, i.e. when only stellate hairs are present on the undersurface, continue with couplet 5; if hooked simple and stellate hairs, then follow C.
 - C. If all leaves of specimen have a mixture of hooked simple hairs and stellate hairs on their undersurface, then attempt identification by the geographic distribution of species combined with matching the indumentum of intermediate leaves with illustrations for all species (see also developmental trends: juvenile to adult developmental stages). But first check carefully as sometimes adult leaves with only stellate hairs below are found at the apex of other branches on the same specimen.
- 1. Undersurface of leaves except flanks and central vein ±covered with simple hooked hairs or glabrescent 2
 - 2. Simple hairs on upper leaf surface and calyx appressed *H. appressa*
 - 2: Simple hairs on upper leaf surface and calyx spreading to erect 3
 - 3. Upper leaf surface without stellate hairs: 4
 - 4. Branches with larger stellate hairs with unequal branches over smaller ones..... *H. decumbens*
 - 4: Branches with similar stellate hairs with similar branches *H. empetrifolia* subsp. *uncinata*
 - 3: Upper leaf surface with stellate hairs 5
 - 5. Leaf flanks, central vein and petiole below with radial stellate hairs with 6–14 branches *H. empetrifolia* subsp. *radians*
 - 5: Leaves with usually antrorse stellate hairs with 1–3 (4) branches 6
 - 6. Upper leaf surface without hooked hairs, or if hooked hairs present then larger and smaller stellate hairs with (4) 5–12 branches on branches *H. empetrifolia* subsp. *empetrifolia*
 - 6: Upper leaf surface with hooked hairs; branches with uniform stellate hairs with 1–3 (4) branches *H. empetrifolia* subsp. *uncinata*
 - 1. Undersurface of leaves ±densely covered with stellate hairs (rarely mixed stellate and hooked simple hairs on juvenile leaves) 7
 - 7. Branches without simple hairs, with larger multiangulate/erect radial stellate hairs over smaller ones 8
 - 8. Adult leaves usually discolourous with distinctly fewer hairs above..... *H. truncata*
 - 8. Adult leaves with stellate hairs on both surfaces ±equally dense 9
 - 9. Shrubs to 2 m tall, with erect or spreading rigid branches; flanks of upper leaf surface with scattered larger erect stellate hairs each with 1–5 (-8) often unequal branches *H. cinerea*

- 9: Shrubs with decumbent wiry branches, usually scrambling and then up to 4 m high; flanks of upper leaf surface with scattered larger multiangulate stellate hairs each with >18 similar branches *H. pallidiflora*
- 7: Branches with simple hairs, or if without then stellate hairs about equal 10
10. Upper leaf surface with mainly simple hairs except for occasional antrorse stellate ones 11
11. Undersurface of leaves stellate-pubescent overtopped by long simple hairs from the flanks and the central vein; upper leaf surface pilose with long simple hairs *H. hirta*
- 11: Undersurface of leaves stellate-velutinous with few short simple hairs on flanks and central vein; upper leaf surface pubescent with short simple hairs and some antrorse stellate hairs *H. notabilis*
- 10: Upper leaf surface with few antrorse simple hairs over many more radial stellate hairs or sometimes mixed with few antrorse stellate hairs 12
12. Simple hairs up to 2.5 times longer than stellate ones; stamens (2-) 4-7 (-9) 13
13. Stellate hairs on upper leaf surface multiangulate, radial and with 5-15 branches, or occasionally mixed with antrorse hairs with 2-5 branches *H. aspera* subsp. *aspera*
- 13: Stellate hairs on upper leaf surface erect, radial and with 1-3 (4) branches, if antrorse then 1-3 branches 14
14. Upper leaf surface with erect, radial to antrorse stellate hairs with 1-3 (4) branches, stellate hairs on the undersurface with 2-5 branches and scarcely overlapping *H. aspera* subsp. *pilosifolia*
- 14: Upper leaf surface mainly with spreading simple hairs or smaller antrorse stellate hairs with 1 or 2 branches; stellate hairs on the undersurface with >7 branches, strongly overlapping *H. aspera* × *H. empetrifolia*
- 12: Simple hairs >3 times longer than stellate ones; stamens (9) 10-12 (-15) 15
15. Undersurface of leaves stellate-velutinous with some simple hairs on flanks and central vein; southern Victoria, Tasmania *H. hirticalyx*
- 15: Undersurface of leaves stellate-pubescent overtopped by long simple hairs from flanks and central vein; northern New South Wales *H. rhynchocalyx*

H. appressa Toelken, *sp. nov.*

Pleurandra ovata Labill., Nov. Holl. Pl. Specim. 2: 5, t. 143 (1806); Poir. in Lamarck, Encycl. Méth. Bot. 8: 444 (1808); DC., Regn. Veg. Syst. Nat. 1: 418 (1817); Prodr. 1: 72 (1824); Spreng., Syst. Veg., edn 16, 2: 463 (1825); Hook., J. Bot. (Hook.) 1: 246 (1834); Hook., Companion Bot. Mag. 1: 273 (1835); Hook.f., J. Bot. (Hook.) 2: 401 (1840); A. DC., Linnaea 25: 577 (1853); Hook.f., Fl. Tasm. 1: 16 (1855).

Type: Tasmania, *J.J.H. Labillardiere s.n.* (lecto. – selected here: right specimen on sheet Herb. Webb. No. 3936; FI; photo., AD; syn.: G-DC; for excluded specimens see *P. scabra* var. β under *H. empetrifolia* subsp. *empetrifolia*).

P. ovata Labill. var. *prostrata* Hook.f., Fl. Tasm. 1: 16 (1855), *nom. inval.*

Type: Tasmania, *R.C. Gunn 183/1836* (lecto. selected here: K).

Hibbertia billardierei F. Muell., Pl. Indig. Col. Vict. 1: 14 (1862), partly, "*Billardierii*"; Benth., Fl. Austr. 1: 28 (1863), partly, "*Billardierii*"; F. Muell., Native Pl. Vict. 1: 16 (1879), partly, *nom. illeg.*, *nom. superfl.*, "*Billardierii*".

Type: Victoria, near Snowy River, iii.1854, *F. Mueller MEL 31515* (lecto. – selected here: MEL; syntypes excl., cf. typification).

H. billardierei F. Muell. var. *ovata* Benth., Fl. Austr. 1: 28 (1863).

Type: Tasmania, *R.W. Lawrence 203* (lecto. – selected here: K).

H. billardierei F. Muell. var. *obovata* auct. non R. Br. ex Benth.: Benth., Fl. Austr. 1: 28 (1863), as for "*Hastings river, Beckler*".

H. ovata (Labill.) Druce, Rep. Botl. Soc. Exch. Club Br. Isl. 1916: 628 (1917), *nom. illeg.*; Domin, Biblioth. Bot. 89: 422 (1928), *nom. illeg.*; Ewart, Fl. Vict. 769 (1931), *nom. illeg., non* Steud. (1845).

Type: as for *P. ovata*.

H. ovata (Labill.) Druce var. *typica* Domin, Biblioth. Bot. 89: 422 (1928), *nom. inval.*

Type: as for *P. ovata*.

H. astrotricha *auctt. non* (Sieber ex Spreng.) N.A. Wakef.: N.A. Wakef., Vict. Nat. 73: 167 (1957), partly, "*asterotricha*"; J.H. Willis, Pl. Vict. 2: 391 (1973), partly, as for *P. ovata*.

H. empetrifolia *auctt. non* (DC.) Hoogland: Hoogland, Kew Bull. 29: 155 (1974), partly; W.M. Curtis & D.I. Morris, Stud. Fl. Tas. edn 2, 1: 23 (1975), partly; M. Gray et al., Fl. Melbourne 122, fig. (1993); Toelken in N.G. Walsh & Entwisle, Fl. Vict. 3: 313 (1996), partly, as for *P. ovata*.

Shrublets decumbent, 0.3–0.6 m high but with scrambling branches up to 2 m high, often sparsely branched, puberulous or glabrescent. *Vestiture* on branches and calyx persistent, with mainly long inflexed (antrorse) more or less appressed simple hairs over usually few very small multiangulate radial stellate hairs (3–6 similar or unequal branches) both with small tubercle and apparently no base cells; *leaves above* persistent or sometimes wearing off, with similar long appressed simple hairs each with distinct tubercle of one row of raised base cells; on *leaves below* with similar persistent simple hairs as above on flanks and central vein and with glabrous undersurface or rarely with few to many hooked simple hairs but soon wearing off; *juvenile* leaves apparently not different. *Leaves* sometimes with axillary tuft of hairs because of latent axillary buds; petiole (0-) 0.4–1 mm long; lamina lanceolate-elliptic, broadly ovate-elliptic or obovate-elliptic to elliptic or rarely oblong because of strongly revolute margins, (2.2-) 3.5–9 (-12.2) × (0.9-) 2.8–4.8 (-6.3) mm, acute to mucronate with excurrent central vein, gradually constricted into petiole, flanks often slightly undulate (due to raised base cells of hairs), more or less revolute exposing some of the undersurface between them and the slightly raised central vein; surfaces puberulous to glabrescent with robust appressed hairs mainly along the flanks and the raised central vein below, sometimes with few to many short hooked simple hairs, soon becoming glabrous. *Flowers* usually abruptly constricted into the peduncle or sometimes more or less stepped in southern Tasmania (buds almost spherical before opening), terminal often only on lateral branches, rarely on short shoots, subtended by 2 or 3 subwhorled leaves but not dichotomously branching, rarely leaf-opposed along branches (then minimum of 3 leaves between flowers); *peduncle* 2.1–12.6 mm long when flowering, spreading to recurved when fruiting, mainly with robust appressed simple hairs over usually few small stellate hairs; *bract* subtending calyx, linear-subulate, 1.1–2.5 mm long and usually less than half as long as calyx, glabrescent. *Calyx* pale to deep green more or less tinged red: *outer lobes* ovate to almost lanceolate, 2.3–4.5 mm long, acute to shortly acuminate, outer surface pubescent to puberulous with long simple appressed hairs over very few to no small stellate hairs, inner surface with few fine stellate hairs with usually 2 or 3 branches or glabrous towards the apex; *inner lobes* oblong-ovate, 2.4–5.1 mm long, obtuse to rounded, rarely mucronate or emarginate, puberulous mainly along the centre with appressed simple hairs and sometimes with small stellate hairs. *Petals* cuneate, 3.6–9.4 mm long, distinctly bilobed, bright yellow, papillose. *Stamens* (7-) 9–12 in one cluster; *filaments* usually ca half or less connate; *anthers* usually narrowly obloid, (0.8-) 0.9–1.1 (-1.3) mm or up to 1.6 mm long in the centre and usually with terminal appendage, dehiscing by pore and lateral slit. *Pistils* 2, each with 2 ± ventral, or 1 ventral and 1 basal ovule and with short style positioning stigmas below the apex of the central anthers, ovary pilose with straight erect, mainly simple hairs. *Seeds* brown to shiny-black, ca two-thirds covered by white membranous aril with short finger-like projections. *Flowers:* mainly Sept.–Dec., but with odd flowers throughout the year. *Common name:* Trailing Guinea-flower (M. Gray et al. 1993). Fig. 3A–F.

Distribution and ecology

Growing in moist habitats, often on seepage areas near creeks, on forest margins or in open forest and often associated with lower slopes of mountains in widely scattered localities in southern Victoria (EG, EHL, ?MID, OTRA) and mainly the northern, eastern and southern parts of Tasmania.

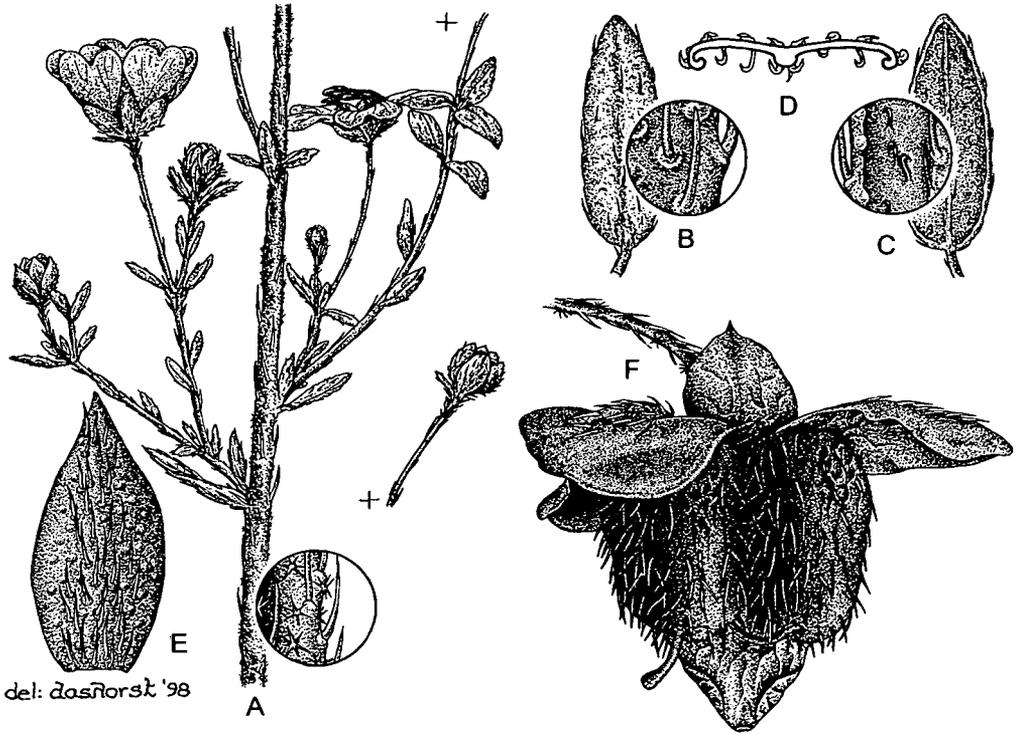


Fig. 3. *H. appressa*. A, Flowering branch showing repeated flower development $\times 1.5$; B–D, adult (and juvenile) leaf: B, above $\times 3$; C, below $\times 3$; D, transverse section $\times 9$; E, outer calyx lobe with appressed hairs $\times 9$; F, fruit showing simple hairs on follicles $\times 9$. (A–E, A.C. Beaglehole 78298, CANB; F, Blyth MEL 31467).

Conservation status: Apparently more common in Tasmania, but there and in Victoria known from a few National Parks.

Diagnostic features

The long, often robust simple hairs which are usually appressed particularly on the lower calyx immediately distinguish this species (spreading simple hairs, if at all present, are confined to the base of calyx in *H. empetrifolia*). While no stellate hairs were observed on leaves of *H. appressa*, there are some small ones on the upper surface in *H. empetrifolia* but they wear off sooner than the simple ones. Adult leaves of the latter produce a few stellate hairs on the central vein, particularly on the lower third and the petiole but not the flanges of the stem. The distinction of *H. appressa* is supported by 8–12 stamens and mainly simple hairs on the ovary, which are clearly visible on developing fruit.

Variation

Although plants are usually decumbent ground covers with branches up to 3 m long (*W.M. Curtis HO 29326*) occasional plants will scramble into adjoining shrubs or trees, as also described for *H. pallidiflora*, and a plant 2 m high in a tree has been recorded (*A.E. Orchard 5115*).

Subwhorled flowers were observed only in specimens from Tasmania. In all Victorian plants investigated scars of reduced leaves at the base of the peduncle indicated short shoots arising usually from the first node of lateral branches.

The petals are very variable on the same plant as well as on different local plants: they vary from narrow to broadly wedge-shaped, with more or less deeply bilobed apex, and from just longer than the calyx to three times that length.

The number of stamens often varies in different populations, and the filaments are fused to varying levels, although they are usually about half, rarely only a third, connate. Similarly the length of the anthers varies considerably often even in the same flower; some have shorter outer anthers in others shorter anthers are interspersed, but in southern Tasmania all the anthers tend to be shorter than 1 mm and often oblanceolate. This local variation of all these characters could not be linked with any other characters so that no infraspecific taxa are adopted here.

Typification and nomenclature

De Candolle (1817) detected in Labillardière's collection of *Pleurandra ovata* two elements and he retained the name for the specimen having 10–12 stamens (G-DC). The second specimen with fewer and often unequally long anthers he named *P. scabra* var. β , of which a specimen also exists in the general herbarium at G (cf. taxonomic notes below). The type specimen in the Labillardière herbarium (FI) contains, according to a photograph in AD, two branches. The right hand one is less branched, the leaves are somewhat ovate and some seem to have an undulate flank typical of *H. appressa* caused by the appressed hairs. The leaves of the denser left hand specimen are more elliptic and the flowers are more hidden as normally found in *H. empetrifolia* s.s. The right hand specimen is here selected as the lectotype of *P. ovata*. Labillardière's illustration which de Candolle (1817) also thought to belong to his *P. scabra* var. β (now included under *H. empetrifolia* s.s.) seems, however, judging by its more diffuse branching and exposed terminal flowers to be a poor drawing of typical *P. ovata*.

The type (*R.C. Gunn 183*) of *Pleurandra ovata* var. *prostrata* Hook.f. agrees well with the species as delineated here. The specimen *R.C. Gunn 183/1836* (K) was selected as a lectotype because this is probably the specimen J.D. Hooker examined and referred to *P. ovata* in 1840. A number of Gunn specimens with that number but collected at a later date (cf. also Buchanan, 1988) were also examined. Since J.D. Hooker (1855) quoted "P. ovata, Lab. l. c." under his "var. α . prostrata" this must become the typical variety in contrast to his and Bentham's (1863) usual format in which the species description represents at the same time the typical variety. It is not a validly published name though because it should then be an autonym (ICBN 1994: A 32.1b, A 26). This interpretation disagrees with that of Chapman (1991, p. 2325), who follows Hoogland (1974) in placing this variety under *H. empetrifolia*.

The detailed description of Mueller's *H. billardierei*, which is to replace *Pleurandra ovata* when transferred to *Hibbertia* because of the already existing *H. ovata* Steud., was based on the following specimens of six taxa (in sequence as quoted by the author in the protologue) although details are often incompletely quoted by him:

- 1 Near Rivoli Bay, x.1848, *F. Mueller* MEL 31526 — *H. pallidiflora*
- 1a Near Rivoli Bay, x.1848, *F. Mueller* MEL 31527 — *H. pallidiflora*
- 2 Near Sealer's Cove & on Mount Hunter, v.1853, *F. Mueller* MEL 31499 — *H. hirticalyx*
- 3 Near Snowy River, iii.1854, *F. Mueller* MEL 31515 — *H. appressa*
- 4 Ranges beyond Snowy & Broadribb rivers, i.1855, *F. Mueller* MEL 31509 — *H. empetrifolia*
- 5 Glasshouse Mountains, 1855, *F. Mueller* MEL 31556 — *H. aspera* subsp. *pilosifolia*
- 6 Spencer Gulf, Memory Cove, ii.1802, *R. Brown* MEL 31491(iso) — *H. cinerea*.

Although a detailed description is provided, none of the elements can be seen as the predominant one, so that *F. Mueller* MEL 31515 was selected as lectotype because it belongs to the same species as *P. ovata*, which *H. billardierei* was to replace. Mueller (1864) referred to his var. *monadelpha* (cf. *H. hirticalyx*), but in none of his subsequent publications did he cite any of Bentham's varieties.

Chapman (1991, p. 1591) followed Hoogland (1974) in placing *H. billardierei* var. *ovata* Benth. into the synonymy of *H. empetrifolia*. Its description is very general and Bentham (1863) did not cite any specimens to establish his intention. Only one collection, *C. Stuart* MEL 31471, was inscribed by him as "Hibb. Billardierii F. Muell. γ ovata", but it contains a specimen of *H. appressa* and *H. empetrifolia* subsp. *empetrifolia*, so that it does not clearly indicate his intentions. Since he obviously agreed with Mueller's name change from *P. ovata* to *H. billardierei*, one may assume that his var. *ovata* was based on *P. ovata* in order to maintain that name. Further evidence suggesting this intention is that he states this variety to be "the most common Tasmanian and N.S.Wales form". This would, however, deviate from his normal pattern that the typical variety is represented by the type description, but it would agree with the above case of J.D. Hooker's *Pleurandra ovata* var. *prostrata*, which is not represented among Bentham's varieties, although the var. *scabra* is present but without reference to him. After all Bentham himself was not conforming to this pattern when he quoted under the species, which normally would have represented the typical variety, var. *billardierei*, a number of specimens, which he also cited under different varieties below. The var. *ovata* would then, like that the var. *prostrata* (see above), be not validly published because it does not repeat the specific epithet. The following specimens (all from Tasmania) previously identified as *P. ovata* and which would fit his description of the var. *ovata*, were either initialled (MEL) by Bentham or were known to be available to him (Herb. Hook., K), but are not quoted in the *Flora Australiensis*, volume 1, p. 28, and would therefore most likely apply to this "common" taxon; they outnumber all the specimens of other taxa mentioned by Bentham.

Tasmania, 1831, *R.W. Lawrence* 203 (K) (quoted in W.J. Hooker 1834, J.D. Hooker 1840, 1855);

Tasmania, 1836, *R.C. Gunn* 183, (K) (quoted in W.J. Hooker 1835, J.D. Hooker 1840, 1855);

Port Arthur, *J. Backhouse* s.n. (K) (quoted in W.J. Hooker 1835, J.D. Hooker 1840, 1855);

W. Huon River, 30.x.1839, *R.C. Gunn* 183/1842 (K) (quoted in J.D. Hooker 1855);

Asbestos Hills, 24.x.1844, *R.C. Gunn* 183 (K) (quoted in J.D. Hooker 1855);

Recherche Bay, *R.C. Gunn* 183 (K) (quoted in J.D. Hooker 1855);

South Port, xi.1855, coll.? 1761 (MEL 31474);

River Mersey, 10.I.1849, coll.? 328 (MEL 31473);

South Esk River, 1848, coll. ? 57 (MEL 31472);

Swan Port, xi. 1849, *C. Stuart* 626 (2 elements on specimen MEL 31476).

It is therefore argued that circumstantial evidence shows overwhelmingly that Bentham (1863) intended to maintain J.D. Hooker's (1855) identifications of these specimens as var. *ovata* alluding to *Pleurandra ovata*. *C. Stuart* 626 consists of two specimens both from Swan Port and both are initialled by Bentham. These, like MEL31471 above, might explain

the abnormal distribution records into "N. S. Wales", because Bentham did not distinguish between the two taxa here called *H. appressa* and *H. empetrifolia*. The upper specimen is a glabrescent specimen of *H. empetrifolia* as it is also sometimes found in New South Wales. Some specimens of that species, which is at times very similar to *H. appressa*, were included in Bentham's circumscription because of the "oblong leaves" in the description (cf. diagnostic features and variation of *H. empetrifolia*), but the more hairy specimens of *H. empetrifolia* were included in *H. billardierei* var. *scabra*, e.g. Sieber, *Fl. Mixta* 505 (MEL 31488) is annotated by him as such.

With all specimens being equally initialled that seem to be the basis for Bentham's work, although he did not actually annotate them, the specimen *R.W. Lawrence* 203 was chosen as the lectotype of this variety in preference to *R.C. Gunn* 183, of which there exist several collections of different dates.

Notes

It is ironic that this species, which, as *Pleurandra ovata* was the first of this group to be described, is only now receiving a legitimate name in *Hibbertia* as *H. appressa*. This is particularly poignant as Labillardière (1806) did mention in the protologue its distinguishing characters, its 9–12 stamens and appressed simple hairs on the leaves. A specimen inscribed "P. ovata Labill. – Nouv. hollandia – m. Labillardiere 1808" in G-DC shows these characteristics. However, it seems Labillardière had a mixed collection because de Candolle (1817, p. 419: *P. scabra* var. β) reported a second form intermediate between his *P. scabra* and *P. ovata* with almost oval leaves, acuminate calyx and 7–8 stamens. He attributed both specimens to Labillardière and the specimen of *P. scabra* var. β in G-DC, now identified as *H. empetrifolia* s.s., was originally inscribed *P. ovata* without confirmation that it came originally from Herb. Labillardière. It was received by de Candolle from "m. Lambert 1816". A second specimen seen (G, general herbarium) annotated as "Pl. ovata Labill. n.h. t143 – Nouv. holl. – herb. Labillardier – in Herbar da Moise-Etienne Moricand – dit Stefano (1779-1854)" shows similar characteristics and must also be identified as *H. empetrifolia* s.s. De Candolle (1817) also pointed out that the illustration accompanying the protologue of *P. ovata* was presumably prepared from such a specimen as it has similar almost oval leaves. Judging, however, by its more diffuse branching and exposed terminal flowers it might also be a poor illustration of typical *P. ovata*.

A.L.P.P. de Candolle (1853) then pronounced *P. ovata* a good species separate from *P. astrotricha* Sieber ex Spreng. presumably based on observations of the one type of specimen. Since Mueller (1862) had included not only *P. ovata* in his new name *H. billardierei* but all known taxa, Bentham and subsequent botanists recognised only one species in the next almost one hundred years, and the former was never again recognised as a distinct species. Even Wakefield (1957) followed by Hoogland (1974) combined it with *H. astrotricha* or *H. empetrifolia* respectively as they did not recognise that *H. appressa* (= *P. ovata*) could be distinguished by its greater number of stamens and appressed hairs as well as simple hairs on the ovary.

When Domin (1928) published the combination *H. ovata* he enumerated all the varieties recognised by Bentham (1863), but because he changed Bentham's var. *ovata* (cf. typification above) to the var. *typica* and used it as such, this indicates clearly that he had intended these varieties to be used (ICBN, A 32) and they are thus considered validly published, although the only specimen cited as var. *typica* is actually a misidentification. The species, *H. ovata* into which they had been placed was illegitimate.

Voucher specimens (134 examined)

VICTORIA: *A.C. Beaglehole* 18851, Otway Ranges, Lavers Hill, 14.xi.1959 (AD, CANB, MEL); 78298, N.W. Glenmaggie, 10.x.1984 (AD, CANB, HO, MEL); *R.D. Hoogland* 11912, western slope of Mt Elizabeth 2, 26.xi.1970 (CANB, MEL, L, K, UC, HBG, A, G).

TASMANIA: *F.E. Davies* 1068 & *P. Ollerenshaw*, Dazzler Range, 19.I.1989 (AD, CANB, HO, MEL); *A. Moscal* 3997, Picketts Plains, 22.xi.1983 (AD, AK, H, HO, MEL, NLU); *M.E. Phillip* CBG 15034, near Simpsons Bay, South Bruny Island, 29.xi.1965 (AD, CANB).

H. aspera DC., Regn. Veg. Syst. Nat. 1: 430 (1817); N.A. Wakef., Vict. Nat. 73: 167 (1957), partly; N.C.W. Beadle et al., Vasc. Pl. Sydney edn 2: 230 (1972); J.H. Willis, Pl. Vict. 2: 391 (1973), partly; N.C.W. Beadle, Stud. Fl. NE New South Wales 3: 255 (1976), partly; N.C.W. Beadle et al., Vasc. Pl. Sydney edn 3: 228 (1982); Stanley in Stanley & E.M. Ross, Fl. South-eastern Queensl. 1: 189 (1983); G.J. Harden & J. Everett in G.J. Harden, Fl. New South Wales 1: 293 (1990), partly; Toelken in N.G. Walsh & Entwisle, Fl. Vict. 3: 312 (1996), partly.

Type: Australia, *Caley* in Herb. Lambert (holo.: G-DC).

Shrubs with erect to decumbent or scrambling branches 0.3–1 m long, more or less branched, villous to pubescent. *Vestiture* on branches and calyx persisting, with few or no antrorsely curved simple hairs over/ or usually a range of sizes of radial multiangulate stellate hairs (with (1) 2–5 (-15) often distinctly unequal, or equal branches); on *leaves above* soon wearing off, with few simple hairs, sometimes with hooked apices, or rarely stellate hairs with 1–3 unequally long branches mainly towards the base and flanks over scattered multiangulate rarely erect radial and/ or rarely slightly antrorse stellate hairs (4–12 similar branches) with small to broad tubercle surrounded by one ring of base cells; on *leaves below* persisting, including usually the central vein densely covered with overlapping, multiangulate radial stellate hairs (often with a few larger ones each with especially larger tubercle, among the main cover of smaller hairs) with numerous similar branches, all apparently without base cells; *juvenile leaves* below with hooked simple hairs interspersed (mainly along the major veins) with multiangulate radial stellate hairs with numerous similar branches mainly from small tubercles but broad tubercled ones get commoner as more stellate hairs are produced. *Leaves* without axillary tuft of hairs; *petiole* 0–0.8 mm long; *lamina* oblong-oblancheolate to obovate or rarely oblanceolate-cuneate, (2.8-) 5–13 (-18.7) × (1.8-) 2–5.5 (-7.4) mm, rounded or truncate to emarginate with incurved apex on young branches, rarely obtuse, usually gradually constricted into petiole, with velutinous to pilose, rarely pubescent undersurface exposed between more or less revolute margins and slightly raised central vein, upper surface pubescent to puberulous becoming glabrescent, more or less discoloured. *Flowers* abruptly constricted into the peduncle (buds obloid to ellipsoid), terminal and usually subtended by 3 subwhorled leaves, resulting in apparent di- or trichotomous branching or sometimes each of these branches is a short shoot with scale-like leaves and instead of one terminal flower producing a terminal cluster of up to 3 flowers, apparently not leaf-opposed on actively growing branches; *peduncle* (1.6-) 2–5 (-7.4) mm long and spreading when flowering, recurved when fruiting, pubescent to velutinous mainly with radial stellate hairs; *bract* subtending calyx, linear-subulate, 1.2–1.5 (-1.8) mm long, usually one-third to two-thirds of calyx, velutinous. *Calyx* greyish-green; *outer lobes* ovate rarely lanceolate, (2.7-) 3–3.8 (-4.1) mm long, usually shortly acuminate, outer surface pubescent to velutinous, rarely pilose (usually larger stellate hairs with unequal branches over smaller regular ones), inner surface with few fine stellate hairs each usually with 2 or 3 antrorse branches on upper third; *inner lobes* oblong-ovate, (2.9-) 3.3–4 (-4.2) mm long, more or less rounded, tomentose to velutinous, rarely pubescent. *Petals* oblanceolate to almost narrowly obtriangular, (3.1-) 3.4–5 (-6.2) mm long, bilobed, more or less papillose on inside. *Stamens* (2-) 4–6 (-9) in one cluster; *filaments* connate for half their length or more; *anthers* obloid to obloid-obovoid, (0.7-) 1–1.2 mm long, usually without terminal appendage, dehiscing by apical pore and introrse

slits. *Pistils* 2, each with 2 basal ovules, or 1 ventral and 1 basal, and with style positioning the stigmas below the apex of the central anthers; ovary shaggy with erect stellate hairs each usually with more than 3 branches. *Seeds* brown to shiny-black, usually ca two-thirds, rarely completely covered by white membranous aril ending in shorter or longer finger-like projections.

Diagnostic features

H. aspera is distinguished from most of the species in this group by its 4–7(-9) stamens, which it shares with *H. empetrifolia*, but from which it is distinguished by its usually dense stellate indumentum on the undersurface of adult leaves. Even if the stellate hairs are not dense on some local forms or on juvenile leaves they are distributed at random, while on leaves of *H. empetrifolia* stellate hairs only occur along the central vein, rarely just next to it or a few along secondary veins. Radial multiangulate stellate hairs are usually common on the upper surface of leaves of *H. aspera* while stellate hairs on lower leaf surface of *H. empetrifolia* are usually antrorsely inclined and rare if at all present. Some flowering specimens from Queensland, e.g. *R.D. Hoogland 11798*, have been included in *H. aspera* subsp. *aspera* because of these radial stellate hairs on the adaxial leaf surface in spite of just a few stellate hairs and mainly hooked ones on the undersurface, which in other specimens grade into the typical variety. These plants are interpreted as plants retaining for one or other reason their juvenile characters and more information is needed. Stellate hairs on the ovary of *H. aspera* tend to have three or more branches while there are usually only two in *H. empetrifolia*.

Leaves of the subsp. *pilosifolia* are easily distinguished from those of the typical subspecies by their erect stellate hairs usually with few unequally long branches on both surfaces of the leaves. This is particularly noticeable on the upper surface, because here the stellate hairs of subsp. *aspera* have a number of depressed equal branches.

Variation

H. aspera, like *H. empetrifolia*, shows much variation in different local populations as well as sometimes on the same plant. Basically a northern and a southern form can be recognised from about Newcastle. While the southern form seems to comprise of individuals which have foliage which changes abruptly into adult leaves with stellate-velutinous undersurface, various intermediates between the juvenile and adult forms with few to many stellate hairs on the leaf undersurface persist for longer or shorter periods in northern New South Wales and adjoining Queensland. The trend is from a dense to a sparser indumentum of particularly the stellate hairs on the undersurface of leaves, but also to fewer simple hairs on all parts of the plant. The space between individual stellate hairs also increases because the hairs tend to have shorter branches (rarely longer than 0.1 mm) although in some plants they still become velutinous on the uppermost leaves. The difference between phenotypic (the frequent retention of juvenile characters apparently due to environmental conditions), as opposed to genotypic variations (local forms), cannot be assessed from the limited herbarium material examined except for the more obvious subsp. *pilosifolia* (see below). Many records are from isolated mountain ranges. For instance, the most northern record of this subsp. *aspera*, a single specimen from the Paluma Range (*B.R. Jackes 8720*), has many hairs on the leaves and branches with unevenly long branches as in subsp. *pilosifolia*, but since they are not erect and on few leaves have at least five radial branches, as well as the presence of many hooked hairs on leaves below and sometimes even above, as it is sometimes found in some Queensland specimens, it was provisionally placed into subsp. *aspera*, but does not fit well there. The very short petals, apparently always shorter than the sepals is unique in the species (cf. *H. pallidiflora*).

The southern form is much more uniform except for the broad, often obovate leaves on fast growing branches in contrast to those on older ones. However, among those narrow-

leaved plants there are some with oblong ones, which have mainly longer and short simple hairs with usually very few, antrorsely inclined stellate hairs among the latter. These leaves resemble those of *H. empetrifolia* except for the stellate hairs moderately to densely covering the undersurface, but the significantly abnormal pollen indicates that these are probably hybrids (see below). These leaves are very similar to juvenile leaves (e.g. *E. Gauba* CBG 4804, *E.F. Constable* NSW 42822), as in the southern form they have simple hairs mixed with antrorsely inclined stellate on the upper leaf surface, but the lower leaf surface is always covered with more or less dense stellate hairs. The latter have, however, fewer branches, but juvenile leaves with hooked simple hairs as known from the northern form have not been observed in the south. These juvenile leaves must not be confused with what seem to be shade forms (e.g. *E. Gauba* CBG 4800, *A.C. Beauglehole* 62491) where radial and antrorsely inclined stellate hairs are mixed on the upper surface of the leaves and both types have often few, unequally long branches.

The length of the peduncle is particularly short in subsp. *pilosifolia* and flowers appear to be axillary, because they are commonly borne on such reduced short shoots, or clusters of short shoots, each with scale-like leaves in the leaf axils along the main branches. Also its flowers tend to be smaller and were sometimes identified as *H. billardierei* var. *parviflora*, but the type of that variety comes from near Sydney and is synonymous to subsp. *aspera*. Short peduncles, clustered flowers in the leaf axils and small flowers are also found in some forms of subsp. *aspera*.

Notes

Most publications since Wakefield (1957) include a number of other taxa with hairy undersurfaces of the leaves in their *H. aspera*, but it is usually not possible from the description to assess which taxa were included, as usually no specimens were annotated. Only in local floras can the range of material included be geographically evaluated. Judging by the description of the shape of the leaves and their indumentum Bailey (1899), for instance, must have had specimens of both these Queensland subspecies in his concept of *H. billardierei*. Similarly *H. aspera* of T. Stanley (1983) seems to have included specimens of two subspecies while the photograph published by S. & A. Pearson (1991) must be placed in subsp. *pilosifolia*.

Stebbins & Hoogland (1976, p.148) recorded the chromosome number $2n = 36$ "in *H. aspera* DC. from Victoria", but since they did not cite a specimen this count could refer to one of five species with densely hairy lower leaf surface, as it seems from Hoogland (1974) and some identifications that he followed Wakefield's broad concept of that species.

For key to the subspecies see key to the species, pp. 118, 120.

subsp. *aspera*.

H. aspera DC., *Regn. Veg. Syst. Nat.* 1: 430 (1817); N.A. Wakef., *Vict. Nat.* 73: 167 (1957), partly; N.C.W. Beadle *et al.*, *Vasc. Pl. Sydney* edn 2: 230 (1972); J.H. Willis, *Pl. Vict.* 2: 391 (1973), partly; N.C.W. Beadle, *Stud. Fl. NE New South Wales* 3: 255 (1976), partly; N.C.W. Beadle *et al.*, *Vasc. Pl. Sydney* edn 3: 228 (1982); G.J. Harden & J. Everett in G.J. Harden, *Fl. New South Wales* 1: 293 (1990), partly; Toelken in N.G. Walsh & Entwisle, *Fl. Vict.* 3: 312 (1996), partly.

Type: as for *H. aspera*.

Pleurandra parviflora R. Br. ex DC., *Regn. Veg. Syst. Nat.* 1: 418 (1817).

Type: New South Wales, near Port Jackson, *R. Brown* s.n. (lecto. – selected here: G-DC; syn.: *Lechenault* s.n., n.v., cf. typification).

P. cinerea auct. non R. Br. ex DC.: Sieber, *Fl. Nov. Holl.* No. 139.

Hibbertia billardierei F. Muell., Pl. Indig. Col. Vict. 1: 14 (1862), partly, as for *P. parviflora*, “*Billardieri*”; F.M. Bailey, Syn. Qld Fl. 4 (1883), partly, “*Billardieri*”; Qld Fl. 1: 13 (1899), partly, “*Billardieri*”; Comp. Cat. Qld Pl. 21 (1913), partly, “*Billardieri*”, *nom. illeg.*, *nom. superfl.*

H. billardierei F. Muell. var. *parviflora* (R. Br. ex DC.) Benth., Fl. Austr. 1: 28 (1863), partly.

Type: as for *P. parviflora*.

H. billardierei F. Muell. var. *obovata auct. non* R. Br. ex Benth.: Benth., Fl. Austr. 1: 28 (1863), as for “Hastings river, Beckler” MEL 31567 (see also *H. hirticalyx*: typification).

H. ovata (Labill.) Druce var. *parviflora* (R. Br. ex DC.) Domin, Biblioth. Bot. 89: 422 (1928); Ewart, Fl. Vict. 769 (1931), partly.

Type: as for *P. parviflora*.

Shrubs up to 0.6 m high unless scrambling, rarely with robust branches covered with more or less simple and stellate hairs usually of varying sizes but with equal branches. *Leaves* above pubescent to puberulous, becoming glabrous with ±smooth tubercles, with often depressed radial stellate hairs (5–9 equal, rarely unequal branches), with few, rarely none, much longer simple hairs mainly towards the base and the flanks; below velutinous, rarely pubescent, with usually strongly overlapping radial stellate hairs (8–many branches 0.05–0.4 (-0.6) mm long, or if surface visible between hairs then branches up to 0.2 mm long), and a few longer simple hairs on the flanks and along the central vein but frequently absent; juvenile leaves above with erect or antrorsely inclined simple and stellate hairs (1–3 often unequal branches), below pubescent, with often scarcely overlapping erect to radial stellate hairs (5–14 equal branches, usually less than 0.2 mm) and rarely with few hooked simple hairs between. *Flowers* 1, 2 (3), terminal on all branches including short shoots. *Flowers*: mainly Sept. – Dec., but occasionally until March. Figs. 1B; 2F–I; 4A–K.

Distribution and ecology

Rarely common but found in a wide range of habitats (sometimes with *H. empetrifolia*) ranging from sandstone to quartzite or sandy soils and apparently somewhat salt tolerant, in woodland or forest, often on forest margins or sclerophyll forest, mainly on the eastern or south-eastern slopes of the Great Divide in Queensland (Nk, Le, Wb, Mo), New South Wales (NC, CT, CC, ST, SC) and Victoria (EG, GPL, EHL).

Conservation status: Widespread but never common, recorded from parks in all three of the above States.

Variation

This is the most widespread subspecies and has the widest range of variation particularly the indumentum, the size and shape of leaves, the clustering of flowers and the often very short peduncle (see variation under species).

Typification

The specimen of R. Brown, who had suggested the name *Pleurandra parviflora*, was selected as the lectotype of this species. No Leschenault specimen (other syntype) could be found in de Candolle’s collection, and, since it is very unlikely that de Candolle had annotated the specimens he had seen elsewhere, it will be difficult to prove that any Leschenault specimen found in another herbarium was the specimen examined by de Candolle.

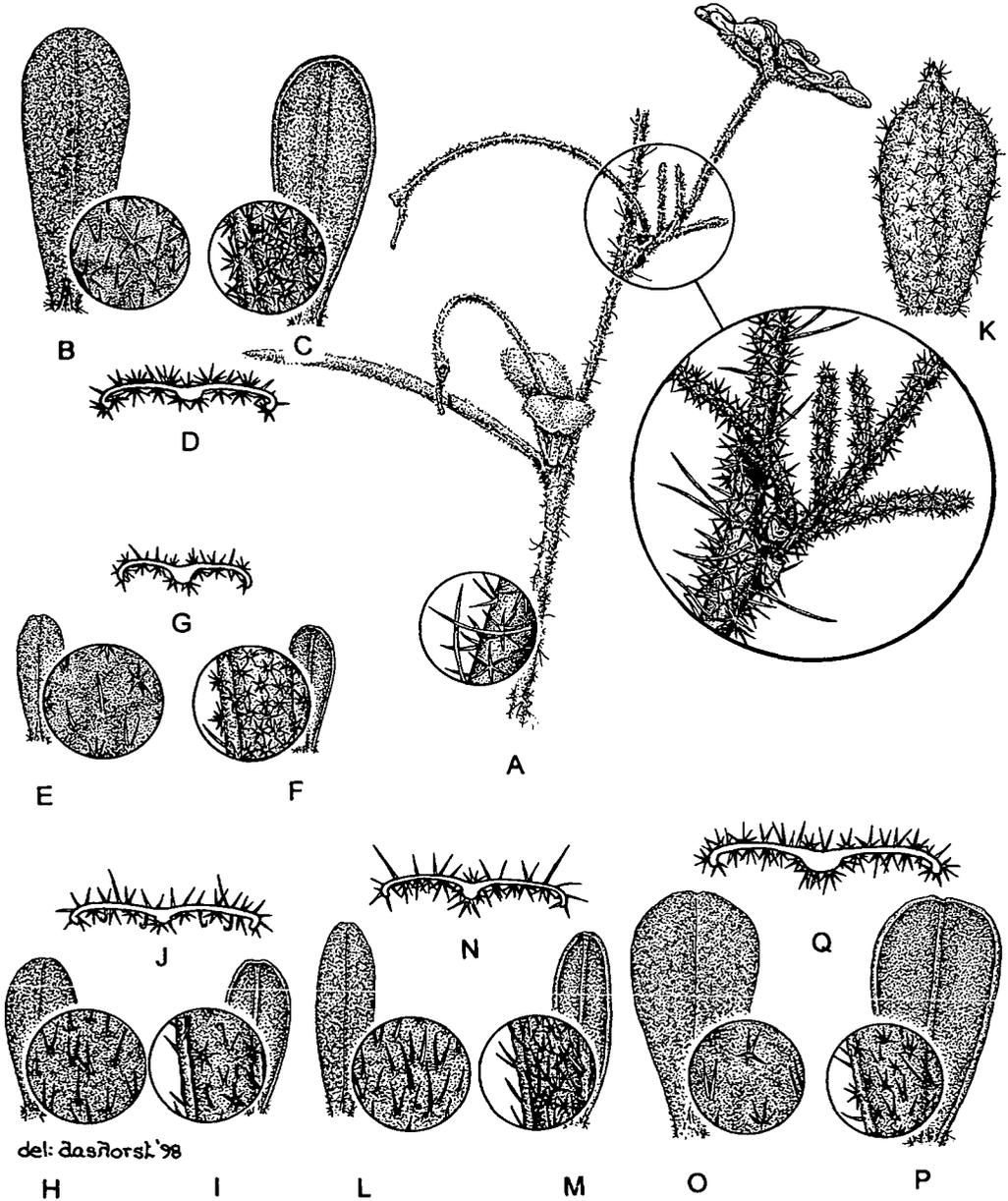


Fig. 4. *H. aspera* subsp. *aspera*. A, Branch with flowers terminal on short shoots, sometimes repeated with three reduced leaves at the base $\times 3$; B–D, adult leaf: B, above $\times 3$; C, below $\times 3$; D, transverse section $\times 5$; E–G, intermediate stage leaf: E, above $\times 3$; F, below $\times 3$; G, transverse section $\times 8$; H–J, juvenile leaf: H, above $\times 3$; I, below $\times 3$; J, transverse section $\times 8$; K, outer calyx lobe $\times 9$. *H. aspera* subsp. *aspera* \times *H. empetrifolia* subsp. *empetrifolia*. L–N, adult leaf: L, above $\times 3$; M, below $\times 3$; N, transverse section $\times 12$. *H. aspera* subsp. *pilosifolia*. O–Q, adult leaf: O, above $\times 3$; P, below $\times 3$; Q, transverse section $\times 6$. (A–D, J.L. Boorman NSW 102176; E–K, C.T. White BRI 10502; L–N, C. Tyrrel 129, CANB; O–Q, R.J. Henderson 1040, BRI).

Voucher specimens (208 examined)

QUEENSLAND: *L.H. Bird AQ 409169*, Woogaroo Creek, Goodna, 1.ix.1988 (BRI); *C.E. Hubbard 3876*, Tugun, 5-7.ix.1930 (BRI, K); *B.R. Jackes 8720*, E "Taravale", Paluma Range, 22.iii.1987 (BRI); *I.R. Telford 5515*, ca 8 km SE Amys Peak, Kroombit Tableland, 4.vi.1977 (CANB).

NEW SOUTH WALES: *B.J. Conn 3101 & A. Scott*, 2.3 km SE Silverdale, 24.v.1989 MEL, MO, NSW); *M. Evans 2485*, Kioloa State Forest, 11.x.1966 (A, BRI, CANB, K, L, MEL, NSW); *R.D. Hoogland 11772*, near Coralville, 8.ix.1970 (A, CANB, K, L, NSW).

VICTORIA: *A.C. Beauglehole 50273*, 21.5 km SSE Gormandale, 2.x.1975 (CANB, MEL); *72387*, Moondarra State Park, 6.xii.1982 (MEL); *J.H. Ross 3497*, 5 km NW Mallacoota, 21.x.1991 (AD, BRI, CANB, HO, MEL, NSW, RSA, S).

*Putative hybrids****H. aspera* subsp. *aspera* × *H. empetrifolia* subsp. *empetrifolia***

While these specimens have the dense stellate-velutinous undersurface of the leaves of *H. aspera* subsp. *aspera*, their upper surface is sparsely covered mainly with short and longer spreading simple hairs, and only occasionally are found some much shorter, antrorsely-inclined stellate hairs with 1-3 branches. Not only the hairs on the upper surface but also the oblong to oblong-oblancoelate shape of the leaves is reminiscent of those of *H. empetrifolia*. Their hybrid nature is indicated by a high percentage of abnormal pollen in most specimens except for one collection from Thirlmere, Picton Lakes (*E.J. McBarron 8762*), which unlike specimens of *H. notabilis*, has few short stamens like other specimens of *H. aspera* subsp. *aspera* from near Picton. This single collection was provisionally determined as the above hybrid for lack of other distinguishing characters. These specimens must be distinguished from presumed shade forms of *H. aspera* subsp. *aspera*, which also have at least some stellate hairs with radially arranged branches on the upper leaf surface of adult leaves. Detailed field observations are needed.

In their notes accompanying these specimens none of the collectors mentioned that they suspected hybrids or recorded plants of the other species from the area. However, M.E. Phillips made two collections along the track to Green Cape lighthouse without commenting (see below). Yet several mixed collections found in herbaria indicate that the two species often grow near one another, and, although no such specimens have been recorded from areas where these hybrids have been found, herbarium collections of both species from these general areas are cited below to show that they do occur there.

*Specimens examined****H. aspera* subsp. *aspera* × *H. empetrifolia* subsp. *empetrifolia***

NEW SOUTH WALES: *E.J. Mc Barron 8762*, Thirlmere, Picton Lakes, 27.i.1964 (NSW), 14% abnormal pollen; *M.E. Phillips CBG 4840*, track to Green Cape, approaching lighthouse, 8.x.1961 (CANB), 45% abnormal pollen; *C. Tyrrel 129*, 3.8 km NE Tanja, 28.viii.1978 (CANB), 68% abnormal pollen.

H. aspera* subsp. *aspera

NEW SOUTH WALES: *E.F. Constable NSW 30129*, Disaster Bay, near Bay Cliffs, 8.x.1954 (CANB), 0% abnormal pollen; *F.A. Rodway NSW 88039*, near Green Cape, -.xii.1920 (NSW), 3% abnormal pollen; *M. Mueller 2203*, E Bega, 17.x.1953 (NSW), 1% abnormal pollen; *G. Stewart 163 & P. Whigham*, 6.4 km E of Bega on road over Dr George Mountain, 9.x.1984 (CANB), 0% abnormal pollen.

H. empetrifolia* subsp. *empetrifolia

NEW SOUTH WALES: *M.E. Phillips CBG 4841*, track to Green Cape, 8.x.1961 (CANB), 1% abnormal pollen; *J. Pulley 426*, ca 1 km W Tathra, 20.v.1970 (CANB), 0% abnormal pollen; *493*, Green Cape, 1 km W of lighthouse, 21.v.1970 (CANB), 1% abnormal pollen; *501*, Green Cape, 7 km W of lighthouse, 21.v.1970 (CANB), 0% abnormal pollen.

subsp. *pilosifolia* Toelken, *subsp. nov.*

H. billardierei F. Muell., Pl. Indig. Col. Vict. 1: 14 (1862), partly as for syntype: Glasshouse Mountains, F. Mueller MEL 31556 (cf. typification: *H. appressa*), "*Billardierii*"; F.M. Bailey, Syn. Qld Fl. 4 (1883), partly, "*Billardieri*"; Qld. Fl. 1: 13 (1899), partly, "*Billardieri*"; Comp. Cat. Qld Pl. 21 (1913), partly, "*Billardieri*", *nom. illeg.*, *nom. superfl.*

H. aspera auctt. non DC.: Stanley in E.M. Ross & Stanley, Fl. SE Queensland 1: 189 (1983), partly; S. & A. Pearson, Pl. Central Qld 223 (1991), fig.

A subspeciebus aliis pilorum stellatorum ramis paucis erectis in foliis supra et subtus differt.

Type: Queensland, Atherton Tablelands, Wallum trig track, *J.M. Powell 680 & J. Armstrong* (holo.: NSW; iso: BRI).

Shrubs 0.6–1 m high, with spreading, often robust branches covered with similar stellate hairs with unequal branches and occasionally with simple hairs. *Leaves* above pilose-pubescent becoming glabrous with raised tubercles ('goosebumps'), with erect radial to antorsely curved stellate hairs (1–3 (4) usually unequal branches) and more or less simple hairs mainly towards the base and the flanks; below pilose to pilose-velutinous with scarcely overlapping erect radial stellate hairs (2–5 ± equal branches 0.3–0.7 mm long) and few simple hairs along the flanks and central vein; juvenile leaves or leaves around inflorescences with slender erect stellate hairs restricted to major vein and with some hooked simple hairs between them. *Flowers* 1, 2 (3), terminal mainly on short shoots. *Flowers*: mainly Aug.–Nov. Fig. 4O–Q.

Distribution and ecology

Growing usually in forests or heath and often associated with rock screes, widespread in often more temperate areas along the Great Divide of Queensland (Co, Le, Mo) from the Atherton Tablelands southwards along scattered localities into northern New South Wales (NT, NC).

Conservation status: Recorded mainly from isolated areas in mountains which are protected parks or forestry reserves.

Diagnostic features

This subspecies is easily distinguished from *H. rhynchocalyx* which is also found in the Gibraltar Ranges, by only 4–7 anthers without terminal appendages. Even vegetatively they can be recognised by relatively short erect hairs, which are more or less of the same length on the upper surface of leaves (cf. up to eight times as long in *H. rhynchocalyx*), and stellate hairs have 1–3 (4) branches in the subsp. *pilosifolia* and (4) 5–7 branches in the latter species. The tubercles of all hairs on the upper leaf surface of leaves of this subspecies are always raised so as to give the impression of 'goosebumps' on human skin, a phenomenon also visible on 'juvenile' leaves and in some plants of subsp. *aspera*.

Etymology

The epithet 'pilosifolia', Latin, 'pilose-leaved', refers to the rough appearance of the indumentum of visibly separate soft erect stellate hairs on both surfaces of the leaves. The effect of separate hairs is enhanced by usually unequally long branches and the raised tubercles of these stellate hairs.

Voucher specimens (23 examined)

QUEENSLAND: *S.T. Blake* 21344, Shipstern Range, 19.viii.1960 (CANB, BRI, NSW); *R.J. Henderson et al.* 1040, bed of Rainbow Creek ca 0.4 km from falls, Blackdown Tableland, 6.ix.1971 (BRI, NSW); *C.E. Hubbard*

4217, Springbrook, Macpherson Range, 28.ix.1930 (BRI, K); *J.M. Powell 680 & J. Armstrong*, Wallum trig track, Atherton Tablelands, 9.ix.1977 (BRI, NSW).

NEW SOUTH WALES: *H. Streimann 8163*, Chaelundi Mountain, 14.x.1978 (CANB); *C. Stuart 246, 269, 495, 559*, Sandy Creek, Timbarra, s.d. (MEL); *I.R. Telford 1340*, Mt Spirabo road, 31.viii.1969 (CANB).

H. cinerea (R. Br. ex DC.) Toelken, *comb. nov.*

Type: South Australia, Eyre Peninsula, Memory Cove, *R. Brown s.n.* (holo.: G-DC; iso: MEL, NSW).

Pleurandra cinerea R. Br. ex DC., *Regn. Veg. Syst. Nat.* 1: 417 (1817).

Pleurandra sericea Hook.f., *Fl. Tasm.* 1: 16 (1855), partly as for *P. cinerea*.

H. billardierei F. Muell., *Pl. Indig. Col. Vict.* 1: 14 (1862), partly, as for syntype: Spencer Gulf, Memory Cove, *R. Brown MEL 31491* (cf. typification: *H. appressa*), "*Billardierii*", *nom. illeg.*, *nom. superfl.*

H. densiflora (Hook.) F. Muell., *Pl. Indig. Col. Vict.* 1: 15 (1862), partly as for *Pleurandra cinerea*, *nom. illeg.*; Tate, *Proc. Trans. Roy. Soc. S. Austr.* 4: 104 (1882), "Port Lincoln".

H. billardierei F. Muell. var. *scabra* (R.Br. ex DC.) Benth., *Fl. Austr.* 1: 28 (1863), partly, as for *P. cinerea*.

Hibbertia sericea (R. Br. ex DC.) Benth., *Fl. Austr.* 1: 26 (1863), partly as for *Pleurandra cinerea*.

H. ovata (Labill.) Druce var. *scabra* (R. Br. ex DC.) Domin, *Biblioth. Bot.* 89: 422 (1928), partly, as for *P. cinerea*.

H. sericea (R. Br. ex DC.) Benth. var. *cinerea* (R. Br. ex DC.) J.M. Black, *Fl. S. Austr.* 575 (1952).

Type: as for *P. cinerea*.

H. aspera *auctt. non* DC.: N.A. Wakef., *Vict. Nat.* 73: 167 (1957); H. Eichler, *Suppl. Fl. S. Austr.* 226 (1965); Hoogland, *Kew Bull.* 29: 155 (1974); Jessop in Jessop & Toelken, *Fl. S. Austr.* 1: 355, partly, as for *P. cinerea*.

H. sp. A Toelken in Jessop, *List Vasc. Pl. S. Austr.* edn 4, 28 (1993).

Shrubs with erect or spreading branches, 0.3–1.2 (-2) m tall, usually densely branched, velutinous, rarely tomentose. *Vestiture* on branches, adult leaves and calyx persisting, of few to many erect radial/antrorse stellate hairs (1–5 (-8) often unequal branches) each on a small tubercle, over usually overlapping multiangulate radial stellate hairs (5–9 (-15) similar branches), each commonly on a small tubercle base but also some scattered ones with much broader tubercles especially on the upper flanks and central vein of leaves, but then often larger and with many branches more or less over or between the former, all of them with indistinct base cells; on *leaves above* and *below* similar; on *juvenile leaves* (e.g. *C.R. Alcock 625*) above with erect to forward-directed or radial stellate hairs with (1-)2–3 (-5) branches, below mainly with hooked simple hairs without tubercle bases except for stellate hairs along the central vein and on the flanks, but simple hairs becoming gradually replaced by a sparse cover of stellate hairs with few branches then a dense cover with stellate hairs each with usually more than 10 branches. *Leaves* without axillary tuft of hairs; *petiole* 0.4–1.2 mm long; *lamina* oblanceolate-elliptic, narrowly elliptic to elliptic-oblanceolate, rarely obovate, (3.2-) 6–10 (-16.3) × (1.5-) 2.5–4 (-6.6) mm, obtuse or rounded, rarely truncate or emarginate, usually gradually constricted into petiole, with more or less revolute margins but undersurface exposed between them and the more or less raised central vein, above densely pubescent to velutinous, rarely glabrescent with age, below puberulous when juvenile, becoming velutinous to densely pubescent on adult leaves, often equally densely hairy on both surfaces or rarely slightly denser below, grey-green, rarely slightly discolourous. *Flowers* abruptly constricted into the peduncle (buds obloid to broadly ellipsoid before opening), terminal on branches but apparently without short shoots, usually subtended by 3 subwhorled leaves, sometimes leading to dichotomous branching but repeating flowering in the same season not common, rarely leaf-opposed along young branches (then a minimum of 4 but usually more leaves between flowers); *peduncle* (2.5-) 3.5–6 (-7.3) mm long and spreading when flowering, recurved when fruiting, pubescent (usually larger over smaller stellate hairs); *bract* subtending calyx, linear-subulate or rarely

linear-lanceolate, 2.8–5.1 mm, usually two-thirds to as long as calyx, velutinous. *Calyx* greyish-green rarely tinged purple; *outer lobes* ovate rarely lanceolate, 3.1–5.2 mm long, shortly acuminate, outer surface villose to pubescent (often irregular larger stellate hairs over smaller regular one), inner surface with few fine antrorse stellate hairs with usually 2 or 3 branches on the upper third; *inner lobes* oblong-ovate, 3–5.3 mm long, usually rounded or outermost mucronate, tomentose to pubescent. *Petals* broadly obovate, 5.2–12 mm long, truncate, emarginate or rarely shallowly bilobed. *Stamens* 9–12 in one cluster; *filaments* usually connate up to half their length; *anthers* narrowly obloid, 1.2–1.7 mm long, with short terminal appendages sometimes on inner anthers, dehiscing mainly by introrse slits. *Pistils* 2, each with 2 ventral ovules and with terminal style positioning the stigmas near the apex of the central anthers, ovary shaggy with erect, mainly stellate hairs. *Seeds* brown to shiny-black, ca 2.3 × 2.6 mm, with lobed, rarely finger-like membranous aril covering about two-thirds of seed. *Flowers*: Aug.–Dec. Figs. 1A; 5A–K.

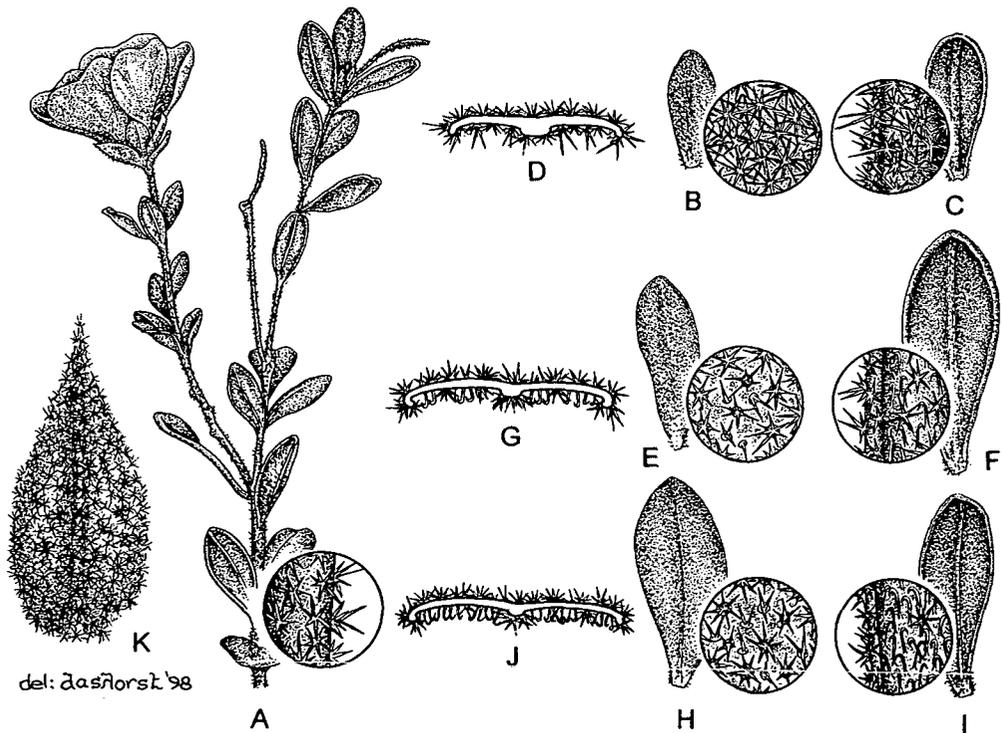


Fig. 5. *H. cinerea*. A, Flowering branch showing flower of this season and peduncle of previous one $\times 1.5$; B–D, adult leaf: B, above $\times 3$; C, below $\times 3$; D, transverse section $\times 9$; E–G, intermediate stage leaf: E, above $\times 3$; F, below $\times 3$; G, transverse section $\times 8$; H–J, juvenile leaf: H, above $\times 3$; I, below $\times 3$; J, transverse section $\times 8$; K, outer calyx lobe $\times 9$. (A–K, R. Alcock 625, AD).

Distribution and ecology

Grows usually on sandy soil often with limestone outcrops in more or less coastal scrub to low mallee vegetation on the southern point of Eyre Peninsula, South Australia.

Conservation status: Although restricted in its distribution *H. cinerea* is locally common and conserved in Lincoln National Park.

Diagnostic features

Both *H. cinerea* and *H. hirticalyx* have 9–12 stamens with oblong anthers of similar size, 1.2–1.7 mm long and without apical appendages. The bracts subtending the base of the flowers are about as long as the calyx. In both these species it seems the undersurface of the juvenile leaves are covered with more or less hooked hairs while they become covered more or less densely by stellate hairs similar to those of *H. pallidiflora*, which in turn is distinguished by its characteristic short tubular corolla and styles longer than the stamens.

H. cinerea is distinguished from *H. hirticalyx* by the smooth appearance resulting from larger stellate hairs over smaller ones while the long simple hairs over smaller stellate hairs give the latter species and in particularly the calyx a very hairy appearance. The linear bracts of the latter are rarely broader than 0.25 mm while they are broader in the former. *H. cinerea* is, like *H. pallidiflora*, usually associated with limestone while *H. hirticalyx* prefers acid soils derived from granite or sandstone.

Occasionally vegetative material of this subspecies is confused with similarly stellate-tomentose *H. incana*, which also occurs in the vicinity of Port Lincoln, but which has long fine simple hairs over stellate ones, a broad central ridge and usually grows in association with granite or quartzite outcrops, while flowering material has usually clustered, sessile flowers and fruit. This confusion between these species of different groups is shown by Black's combination *H. sericea* var. *cinerea*.

Variation

The size of the plants is usually about 1 m tall but when in competition with other shrubs it often attains a height of 2 m.

Notes

Although this species produces terminal flowers on a similar fascicled branch apex with usually three subwhorled leaves subtending it, it does not produce the two scale leaves at the base of each peduncle, nor were short shoots recorded similarly abbreviated to those found in *H. aspera*.

Voucher specimens (35 examined)

SOUTH AUSTRALIA: *J.D. Briggs 1188*, 1 km SE Winters Hill, Port Lincoln, 16.xi.1983 (AD, CANB, NSW); *1288*, ca 20 km S Port Lincoln South, 1.x.1983 (AD, CANB, MEL, NSW); *E.M. Canning 5330*, 15.4 km from Wanilla to North Shields, 2.xii.1982 (CANB, MEL); *N. Donner 11133*, Taylors Landing, 4.xi.1985 (AD, BRI, CANB, K, MEL, PERTH).

H. decumbens Toelken, *sp. nov.*

H. astrotricha auct. non (Sieber ex Spreng.) N.A. Wakef.: N.C.W. Beadle *et al.*, Vasc. Pl. Sydney edn 2: 230 (1972), partly.

H. empetrifolia auctt. non (R. Br. ex DC.) Hoogland: Hoogland, Kew Bull. 29: 155 (1974), partly; N.C.W. Beadle *et al.*, Vasc. Pl. Sydney edn 3: 229 (1982), partly; G.J. Harden & J. Everett in G.J. Harden, Fl. New South Wales 1: 302 (1990), partly.

H. empetrifoliae similis foliis subtus pilis uncatis sed 9–15 staminibus antheris linearibus 1–1.2 mm longis et foliis plerumque obovatis differt.

Type: New South Wales, near Wentworth Falls, *F.E. Davies 353* & *T. Mulcahy*, 3.xii.1987 holo.: CANB; iso.: MEL, NSW).

Shrublets with spreading to prostrate branches up to 0.4 m long, usually much branched, pubescent to puberulous. *Vestiture* on calyx outside with multiangular radial stellate hairs (2,3 (4) usually unequal branches) with fine tubercles and apparently no base cells, or

simple hairs over small stellate hairs (2,3 similar branches) and/or hooked hairs, on inside outer calyx lobes glabrous with a few fine scattered simple hairs towards the upper flanks; on branches with few larger erect to multiangulate radial stellate hairs (1–3 usually unequal branches) with small tubercles over numerous smaller multiangulate radial stellate hairs (with 2, 3 (–5) branches) with small tubercles; on *leaves above* with erect robust simple hairs with few base cells over delicate erect hooked hairs without base cells; on *leaves below* with fine erect hooked simple hairs and along central vein usually with a few robust simple hairs as above sometimes over small multiangulate radial stellate hairs (2–5 similar branches) with small tubercles especially along the central vein; *juvenile leaves* unknown. *Leaves* without axillary tuft of hairs; *petiole* (0.2–) 0.4–1 (–1.6) mm long; *lamina* obovate, broadly elliptic to almost orbicular, (2.6–) 4.2–8.5 (–10.4) × (1–) 2.5–6 (–7.6) mm, obtuse to rounded and mucronate, rarely acute, abruptly constricted into petiole, with scarcely recurved to revolute margins often more or less unequally recurved but undersurface exposed between them and the more or less raised central vein, puberulous to glabrescent, discolourous. *Flowers* abruptly constricted into peduncle (buds obovoid before opening), terminal on branches (very rarely short shoots present), leaf-opposed along main branches and apparently with single flower per branch per season, occasionally with (2) 3 subwhorled leaves; *peduncle* (3.5–) 5–10 (–12.4) mm long and spreading when flowering, not elongating and more or less recurved when fruiting, usually stellate–pubescent; *bracts* subtending calyx, linear-subulate, (0.8–) 1.1–1.5 (–1.8) × 2–3 mm, rarely up to half as long as calyx, stellate-puberulous. *Calyx* with *outer lobes* ovate, 3.3–4.2 mm long, acute to shortly acuminate, outer surface pubescent, inner surface glabrous or with a few scattered antrorse hairs with 1–3 branches on the upper third; *inner lobes* broadly oblong-ovate, 3.4–4.4 mm, rounded or outermost mucronate, pubescent. *Petals* obovate-cuneate, 3.8–7.2 mm long, more or less bilobed, bright yellow. *Stamens* 9–12 (–15) in one cluster; *filaments* connate usually at least half their length; *anthers* narrowly obloid, 1–1.2 mm long, with indistinct terminal appendages on central ones, dehiscing mainly by lateral slits. *Pistils* 2, each with 2 parietal ovules and with styles positioning the stigmas below the apex of the inner anthers, ovary tomentose to shaggy, with erect or spreading stellate hairs. *Seeds* unknown. *Flowers*: mostly Oct.–Jan., but occasionally recorded throughout the year. Fig. 6A–E.

Distribution and ecology

Grows on sandstone ledges but known only from a few localities in New South Wales (CT).

Conservation status: unknown, and few recent records.

Diagnostic features

The usually more than 10 stamens with linear anthers 1–1.2 mm long, and obovate leaves places *H. decumbens* in a complex with *H. cinerea*, *H. hirticalyx* and *H. pallidiflora*, but it is distinguished by the absence of stellate hairs on the undersurface other than on the central vein of adult leaves as well as by the hooked simple hairs on the calyx. Also its prostrate to decumbent habit is characteristic as well as its flowers being terminal mainly on main branches. The bracts are rarely up to half as long as the calyx as in *H. pallidiflora*, which is, however, distinguished by its petals being shorter than the calyx and pale yellow.

A form of *H. empetrifolia* with short and hooked simple hairs on the upper leaf surface is very similar to *H. decumbens* and also commonly grows on sandstone but usually in dry sclerophyll forest just north of Sydney. It is distinguished from the latter by its 5 or 6 stamens with short oblanceolate anthers and the base of the flowers is narrow and often stepped as is typical of that species. The similarity in these two species seems to be due to convergent evolution as the ‘dichotomous’ branching below flowers so common in *H. empetrifolia* is not found in *H. decumbens*.

Etymology

The epithet 'decumbens', Latin, refers to the low shrublets with usually decumbent to almost prostrate branches.

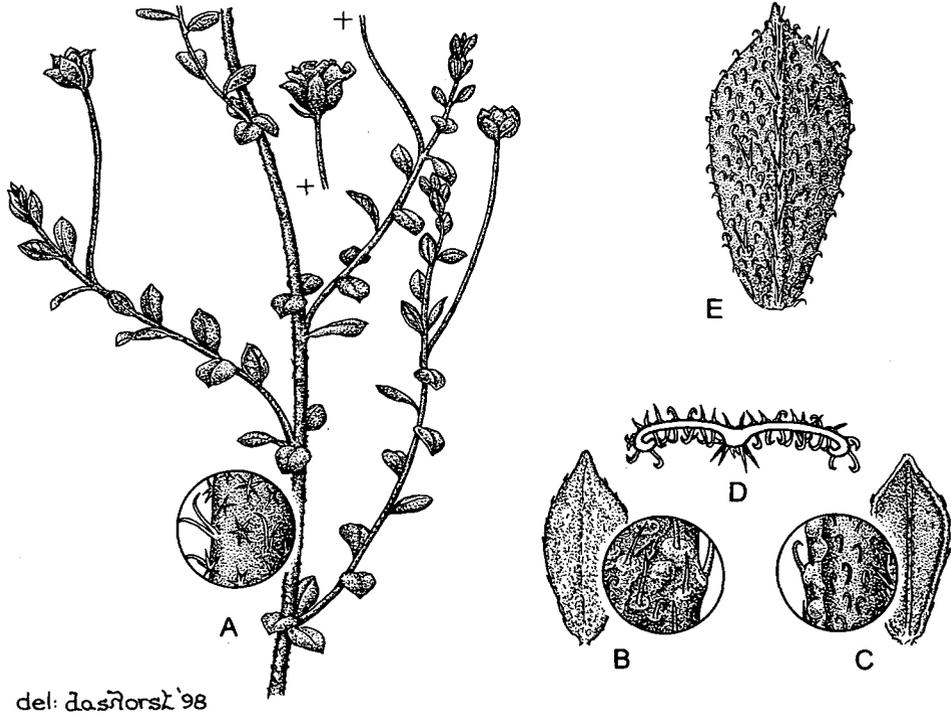


Fig. 6. *H. decumbens*. A, Flowering branch showing leaf-opposed flowers $\times 1.5$; B–D, adult (and juvenile) leaf: B, above $\times 5$; C, below $\times 5$; D, transverse section $\times 10$; E, outer calyx lobe $\times 9$. (A–E, C. Burgess CBG 36200, BRI).

Voucher specimens (14 examined)

NEW SOUTH WALES: *J.H. Maiden s.n.*, Wentworth Falls, x.1898 (NSW102231, 239376); *H.S. McKee 8985*, Woodford, 24.iii.1962 (NSW); *C.L. Wilson 493*, Castlecove, 22.iii.1957 (NSW).

H. empetrifolia (DC.) Hoogland, Kew Bull. 29: 155 (1974), partly; W.M. Curtis, Stud. Fl. Tas. edn 2: 23 (1975), partly; N.C.W. Beadle, Stud. Fl. NE New South Wales 3: 255 (1976); N.C.W. Beadle *et al.*, Vasc. Pl. Sydney edn 3: 229 (1982), partly; G.J. Harden & J. Everett in G.J. Harden, Fl. New South Wales 1: 302 (1990), partly; Toelken in N.G. Walsh & Entwisle, Fl. Vict. 3: 313 (1996), partly.

Pleurandra empetrifolia DC., Regn. Veg. Syst. Nat. 1: 420 (1817).

Type: Australia, *Herot* in Herb. Lambert (holo.: G-DC).

Shrublets with decumbent to spreading, rarely prostrate branches, up to 0.6 m high, more or less densely branched, pubescent. *Vestiture* on branches and calyx usually persisting, with antrorsely inclined, tubercled simple hairs over/rarely only the one range in size of multiangulate radial stellate hairs ((1-)2–6 branches) with small tubercle, on inside of outermost calyx lobes with few to many antrorsely appressed stellate hairs (1–3 branches); on *leaves above* often soon wearing off, like branches but stellate hairs usually very short

and/or only two rows of base cells commonly present so that it appears to have only simple hairs; on *leaves below* not persisting, few to many hooked simple hairs, except for persisting simple over stellate hairs on the flanks and central vein; of *juvenile leaves* similar to adult leaves but usually sparser and stellate hairs often with fewer branches. *Leaves* without axillary tuft of hairs; *petiole* 0–0.8 (-1.3) mm long; *lamina* narrowly oblong-elliptic, rarely oblong-oblancheolate, (2.8-) 3.6–7.5 (-16.8) × (0.6-) 1.8–3.5 (-6.4) mm, with more or less rounded apex, rarely mucronate, gradually constricted into petiole, with revolute leaf margins often covering much of the pubescent to glabrescent undersurface between them and the central vein, faintly discolourous. *Flowers* tapering or often stepped into peduncle (buds narrowly ellipsoid before opening), terminal and usually subtended by two subwhorled leaves on long and short shoots but rarely resulting in apparent dichotomous growth or more than one terminal flower on the same branch, rarely leaf-opposed; *peduncle* (1.3-) 2.4–6 (-10.4) mm long and spreading when flowering, more or less recurved when fruiting, pubescent to puberulous, with simple hairs and/or radial stellate hairs; *bracts* subtending calyx, linear-subulate, 1.3–2.4 mm long, half as long to rarely almost as long as calyx, pubescent to rarely velvety. *Calyx* often reddish-brown or sometimes pale green tinged with red to purplish; *outer lobes* ovate, 2.5–4.7 mm long, long- rarely short-acuminate, outer surface pubescent, inner surface pubescent to almost glabrous with antrorse stellate hairs each with 1–3 branches; *inner lobes* oblong to oblong-ovate, 2.9–4.1 mm long, rounded to cuspidate, usually puberulous. *Petals* narrowly obtriangular, cuneate, 3.2–6.1 mm long, bilobed, pale to bright yellow. *Stamens* (4) 5–7 (-9) in one cluster; *filaments* more or less basally connate; *anthers* obloid-obovoid, tapering towards the base, 0.6–1(-1.2) mm long, without terminal appendages, dehiscing by apical pore and introrse slits. *Pistils* 2, each with 2 basal ovules and with styles positioning the stigmas in front of the apex of the inner anthers, ovary villous with erect stellate hairs (usually 2 branches). *Seeds* shiny brown to black, 1.5–2.1 × 2.2–2.6 mm, membranous aril with finger-like lobes covering two-thirds or more of seed.

Diagnostic features

This species is very similar to *H. appressa* (cf. discussion there), but distinguished from it by usually having some stellate hairs on both leaf surfaces and especially on the lower third of the central vein; simple hairs, if present on the lower calyx, are spreading; and stellate hairs (simple hairs in *H. appressa*) are present on developing locules, and (4-) 5–7 (-9) stamens.

H. empetrifolia, although very variable, is normally characterised by its 4–7 stamens (or locally in New South Wales CC and CS rarely up to 9) with oblong-oblancheolate anthers (0.6-) 0.8–1 (-1.15) mm long; by spreading simple hairs, if present on the lower calyx; and by normally producing only short hooked simple hairs on the undersurface of leaves except for long simple hairs over/or rarely only with very short stellate hairs with few branches on the central vein and flanks.

Variation

This variable species shows a number of local variants of which only subspecies *radians* and *uncinata* could be clearly delineated. Others may be locally distinct but show ranges of intermediates nearby so that no clear delimitation of the forms could be achieved.

In central and northern New South Wales plants often have 4 or 5 stamens and a short acumen on the outer calyx lobes, which also tend to be shorter than the inner lobes. Other plants from that area have 6–8 stamens linked with a long acumen on the outer calyx lobes, which are also longer than the inner ones, but in southern New South Wales, Victoria and Tasmania these distinctions are not maintained.

All or usually some simple hairs on plants of the typical subspecies from the Central and South Coast regions of New South Wales are sometimes hooked on specimens, and in this feature resemble subsp. *uncinata* but lack the uniform, 1–3 (-4) branched stellate hairs of that subspecies. These characters are quite independent from the fact that subsp. *uncinata* is usually found associated with sandstone rocks, while the typical subspecies is only occasionally found growing in that habitat.

The flowers of *H. empetrifolia* are normally subtended by two or three subwhorled leaves and are borne terminally on all branches, but on fast-growing branches with long internodes the lateral branches are often short and/or further reduced to almost absent with variously reduced leaves. The peduncles of the latter are often very short although relatively long ones have also been observed. Throughout the wide distribution range there seem to be some plants which have their flowers apparently arranged only in the one or other way, but because a herbarium specimen rarely shows a wide range of material from the same locality which could represent the full range of variation of that plant, one cannot evaluate at this stage whether the flower arrangement could be an important characteristic in the delimitation of some local forms.

Leaf-opposed flowers are rare and apparently associated with coppicing shoots, as they are not found on all fast-growing branches with larger leaves from the base. They are often followed by flowers with subwhorled leaves on the same branch, or at least on the same plant (e.g. subsp. *empetrifolia*: *L.G. Adams & K. Paijmans 3730* (CANB); *K. Paijmans 3975* (CANB); *A.M. Buchanan 7631* (HO); subsp. *radians*: *H.R. Toelken 8681* (AD)), but in contrast to other species they were always found without a corresponding change in the indumentum of the subtending leaves. Young plants without flowers (of the subsp. *radians* on *H.R. Toelken 9205* (AD)) have already got hairs similar to those of adult plants on their youngest leaves, including some multibranched stellate hairs, typical of this subspecies. The only difference is that these young leaves have fewer hairs and each with fewer branches. It is therefore here assumed that the juvenile indumentum is retained in this species.

For key to the subspecies see key to the species, pp. 118, 119.

subsp. *empetrifolia*.

Pleurandra empetrifolia DC., Regn. Veg. Syst. Nat. 1: 420 (1817).

H. empetrifolia (DC.) Hoogland, Kew Bull. 29: 155 (1974), partly; W.M. Curtis, Stud. Fl. Tas. edn 2: 23 (1975), partly; N.C.W. Beadle, Stud. Fl. NE New South Wales 3: 255 (1976); N.C.W. Beadle *et al.*, Vasc. Pl. Sydney edn 3: 229 (1982), partly; G.J. Harden & J. Everett in G.J. Harden, Fl. New South Wales 1: 302 (1990), partly; Toelken in N.G. Walsh & Entwistle, Fl. Vict. 3: 313 (1996), partly.

Type: as for *P. empetrifolia*.

Pleurandra ovata Labill., Nov. Holl. Pl. Specim. 2: 5 (1806), partly, as for left hand specimen of type sheet, Herb. Webb. 3936 (FI); dupl. in G (type of *P. scabra* var. β : see below).

P. scabra R. Br. ex DC., Regn. Veg. Syst. Nat. 1: 418 (1817), non *H. scabra* Benth. (1863).

Type: New South Wales, Port Jackson, *R. Brown s.n.* (holo.: G-DC; iso.: K, MEL 31453, 31490).

P. scabra R. Br. ex DC., var. β DC., Regn. Veg. Syst. Nat. 1: 419 (1817).

Type: Tasmania, *J.J.H. Labillardière s.n.* (lecto. – selected here: inscribed “*P. ovata*, n. Holl., m. Lambert 1816”: G-DC; syn.: left specimen on sheet Herb. Webb. No. 3936: FI, photo. AD; G, see typification below, and notes of *P. ovata*: *H. appressa*).

P. astrotricha Sieber ex Spreng., Syst. Veg. 4, Curae Post. 191 (1827).

Type: Australia, *F.W. Sieber 149* (holo.: ?; iso.: G, K, MEL).

P. parviflora auct. non R. Br. ex DC.: Sieber, Fl. Nov: Holl. No. 144; Fl. Mixta No. 504.

P. ovata Labill. var. *scabra* (R. Br. ex DC.) Hook. f., Fl. Tas. 1: 16 (1860), partly, excl. ?specimen from Flinders Island.

Type: as for *P. scabra*.

Hibbertia billardierei F. Muell., Pl. Indig. Col. Vict.: 1: 14 (1862), partly, as for *P. scabra*; syntype: ranges beyond Snowy & Broadribb rivers, F. Mueller MEL 31509 (cf. typification: *H. appressa*); "*Billardierii*", *nom. illeg., nom. superfl.*;

H. billardierei F. Muell. var. *scabra* (R. Br. ex DC.) Benth., Fl. Austr. 1: 28 (1863), partly.

Type: as for *P. scabra*.

H. billardierei F. Muell. var. *parviflora* (R. Br. ex DC.) Benth., Fl. Austr. 1: 28 (1863), partly, as for *F.W. Sieber 144*.

H. billardierei F. Muell. var. *obovata auct. non* R. Br. ex Benth.: Benth., Fl. Austr. 1: 28 (1863), as for "Hastings river, Beckler" MEL 31477 (see also *H. hirticalyx*: typification).

H. ovata (Labill.) Druce var. *scabra* (R. Br. ex DC.) Domin, Biblioth. Bot. 89: 422 (1928), partly.

Type: as for *P. scabra*.

H. astrotricha (Sieber ex Spreng.) N.A. Wakef., Vict. Nat. 73: 167 (1957), partly, "*asterotricha*"; N.C.W. Beadle *et al.*, Vasc. Pl. Sydney edn 2: 230 (1972), partly; J.H. Willis, Handb. Pl. Vict. 2: 391 (1973), partly.

Type: as for *P. astrotricha*.

Shrublets with spreading or decumbent branches up to 0.5 m long. Vestiture of more or less spreading, usually long simple hairs over small radiating to antrorsely inclined multiangulate stellate hairs (1–5 branches) on branches, calyx and especially the upper surface of leaves where it develops a broad disc of base cells, rarely interspersed with small unicellular hooked hairs on upper leaf surface and calyx. *Flowers:* (Aug.) Sept.–Feb. (March) and occasional records throughout the year. Fig. 7A–F.

Distribution and ecology

Growing usually as a ground cover or scrambling over other vegetation in woodland or sclerophyll forest in New South Wales (NC, CC, CT, SC, ST), Victoria (EG, GPL, PROM) and Tasmania.

Conservation status: Common and widespread species.

Diagnostic features

Since the long simple hairs particularly on the branches often soon wear off or are in some forms smaller, it was found useful to distinguish this subspecies by the absence of broad-tuberclad radiating stellate hairs on the abaxial petiole and/or along the central vein as is usually found in the subsp. *radians*, which occurs only in South Australia.

Variation (see under species)

Typification

The only sheet in Herb. DC. inscribed "*P.[leurandra] scabra* β " contains two specimens:

1. a fragment of "*Pl. astrotricha* Sieber in herb. DC. 20"
2. two twigs labelled "*P. ovata?* – n. Holl. – m. Lambert 1816"

Since there was some doubt as to the identification of *P. ovata* it seems likely that the latter specimen is a fragment from Labillardière's collection of *P. ovata* although it is not actually stated but agrees with the other specimen (left specimen of *P. ovata*, Herb. Webb. No 3936) of that collection examined. Since this is according to all evidence the only specimen that seems to have been seen by de Candolle (1817), it was selected as lectotype of his *P. scabra* var. β (see also *H. appressa*: typification).

The holotype of *Pleurandra astrotricha* could not be located as Sprengel's herbarium was sold in many different parts (Stafleu & Cowan 1985), but as it is not known to have been destroyed, no neotype was selected from the two isotypes examined.

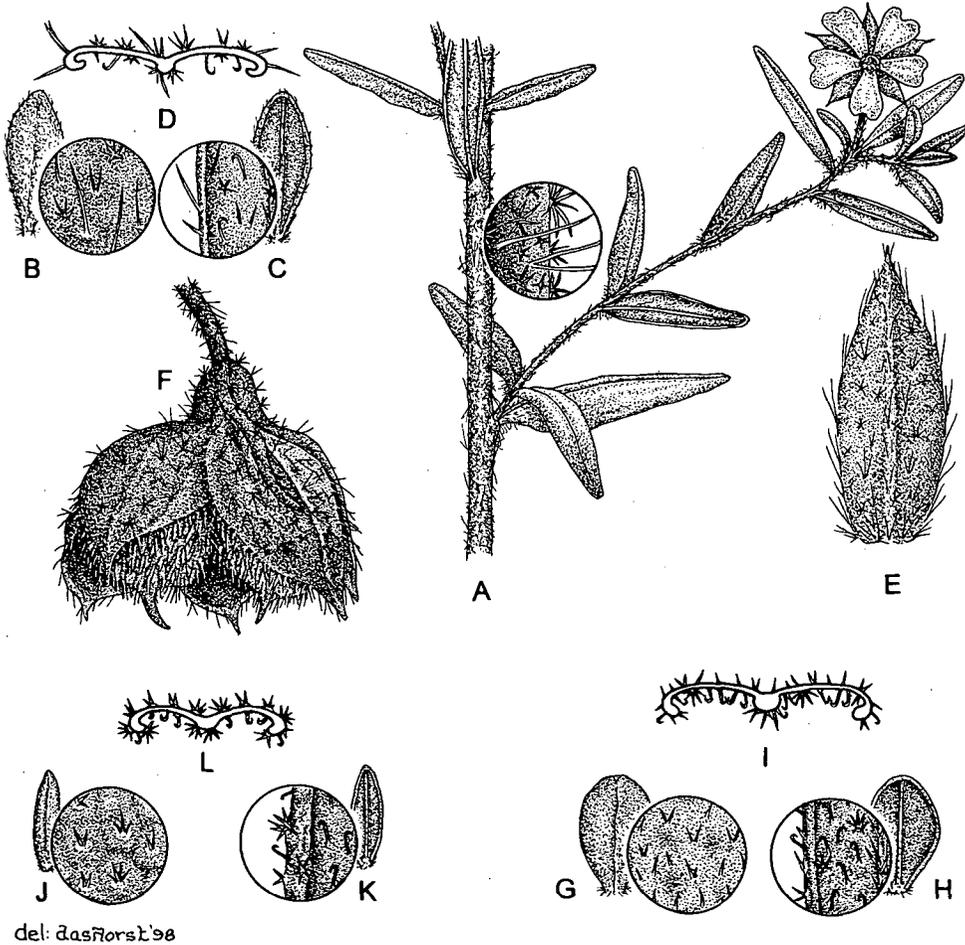


Fig. 7. *H. empetrifolia* subsp. *empetrifolia*. A, Flowering branch with two subwhorled leaves below flower $\times 3$; B-D, adult leaf: B, above $\times 3$; C, below $\times 3$; D, transverse section $\times 12$; E, outer calyx lobe $\times 10$; F, fruit with stellate hairs with two branches on the follicles $\times 8$. -subsp. *uncinata*. G-I, adult leaf: G, above $\times 3$; H, below $\times 3$; I, transverse section $\times 9$. -subsp. *radians*. J-L, adult leaf: J, above $\times 3$; K, below $\times 3$; L, transverse section $\times 15$. (A-E, J. Pulley CBG 44234, CANB; F, H.R. Toelken 9253, AD; G-I, W.F. Blakeley CANB 220908; J-L, D.N. Kraehenbuehl 211, AD).

Voucher specimens (292 examined)

NEW SOUTH WALES: R.D. Hoogland 11779, near Arakoon, 9.x.1970 (CANB, K, MEL, NSW); R.D. Hoogland 12465, "The Elbow" on Georges River, c. 2.5 km SE Campelltown, 7.x.1974 (CANB, HBG, L, NSW, UC); R. Pullen 4123, c. 1.5 mls NW Mt Budawang, 6.xii.1965 (A, AD, BH, BRI, K, L, MEL, NSW); M.J. Taylor 323 & R.G. Coveny, Govetts Leap, Blackheath, 23.x.1984 (CANB, MEL, NSW, PERTH).

VICTORIA: J.W. Audas & P.R.H. St John MEL 31512, Tidal River, Wilsons Promontory, 14.xi.1908 (MEL); A.C. Beaglehole 50272, 21.5 km SSE Gormandale P.O., 2.x.1975 (CANB, MEL, NSW); J.H. Ross 3499, 5 km NW Mallacoota, 21.x.1991 (AD, CANB, BRI, HO, MEL, NSW, RSA, S);

TASMANIA: *A. Moscal* 2470, St Marys Pass State Reserve, 2.vi.1983 (AD, HO, MEL); *A. Moscal* 2670, Reeves Creek, Picnic Rocks, 13.ix.1983 (AD, AK, HO, MEL); *M.E. Phillips CBG* 24005, near St Helens, 16.xi.1960 (CANB, NSW).

Putative hybrid

H. aspera subsp. *aspera* × *H. empetrifolia* subsp. *empetrifolia* see *H. aspera* subsp. *aspera*.

subsp. **uncinata** Toelken, *subsp. nov.*

A subspeciebus aliis combinatione pilorum stellatorum 1–3 (4) ramis in pedunculis ramisque et pilorum uncinatorum in foliis adaxilaribus calicibusque differt.

Type: New South Wales, 4 mls SW Mangrove Mountain, *R.D. Hoogland* 12243 (holo.: sheet 2, CANB 226041; iso.: sheet 1, CANB 226040, K *n.v.*, L. *n.v.*, NSW).

Shrublets with spreading to decumbent branches rarely more than 0.6 m long. *Vestiture* of branches and peduncle more or less spreading simple hairs over/or fine radiating to erect multiangulate stellate hairs (1–3 (4) branches); on upper leaf surface and outer calyx lobes sometimes with spreading simple hairs over/and usually antrorsely inclined multiangulate stellate hairs (1–3 branches) and/or more or less hooked simple hairs. *Flowers*: Sept.–April, variable. Fig. 7G–I.

Distribution and ecology

Usually growing on sandstone varying from drier to moist habitats in sclerophyll woodland north of Sydney (CC).

Conservation status: there are no recent collections available to assess present status.

Diagnostic features

Distinguished from the other two subspecies by the combination of hooked simple hairs on adaxial leaf surfaces as well as calyx lobes, and stellate hairs with 1–3(4) branches ((4) 5–12 branches in other subspecies) on the branches, peduncle and outer calyx lobes, and the hooked hairs throughout the whole or towards the flanks of the upper surface. The stellate hairs on the central vein are usually frequent, which is not commonly found in the species, and these hairs have four or more branches.

Unlike the very similar *H. decumbens* this subspecies usually has 5 or 6 stamens with short oblong-oblancoolate anthers, and the base of the flower is narrow and usually stepped (see also notes below).

Variation

It is sometimes difficult to recognise this subspecies because in section along the same branch the hairs become so dense that one can only discern the characteristic few branches on each stellate hair with difficulty. Since the hooked hairs on the upper surfaces of leaves also wear off in some plants more quickly than in others they are often only visible on the flanks. This feature is occasionally also found on leaves of plants of local forms of the other subspecies. It is therefore important to check in the identification of this subspecies the combination of the above two characteristics.

While a range of simple hairs and/or stellate hairs can be observed on the undersurface, this is usually associated with a change on every new branch from only hooked simple hairs to more or less stellate hairs (ultimately with up to 6 branches) along the central vein and occasionally also along the secondary veins. On some branches this change is rapid while on others of the same plant it does not complete the range. Since it is unknown what induces

this variation it cannot be evaluated from herbarium material whether incomplete ranges shown by some specimens should be attributed to a genetical or ecological basis.

Notes

This taxon is insufficiently understood. As the above diagnostic features indicate this taxon is very close to *H. decumbens*. It is included within *H. empetrifolia* because of its similar stamens and its similar acuminate calyx lobes as well as the fact that all the flowers investigated were produced from two or three subwhorled leaves. Hooked simple hairs are also found on the upper leaf surface and on the calyx of some plants of subsp. *empetrifolia* from the adjoining botanical divisions of Central and Southern Coast, but they are then usually sparse and not combined with the few branches of the stellate hairs on branches and the peduncle. Throughout the range of the typical subspecies there are also odd local forms which have stellate hairs with few branches on the branches and peduncle but they do not produce hooked simple hairs on the upper leaf surface. The hooked hairs on the upper leaf surface as well as the development of stellate hairs with sometimes a larger number of branches are reminiscent of subsp. *radians* (endemic in South Australia).

Etymology

The epithet 'uncinata', Latin, 'hooked' refers to the common hooked simple hairs on the leaves and calyx, which together with the little-branched stellate hairs on the branches and peduncle are a characteristic feature of this taxon.

Voucher specimens (14 examined)

NEW SOUTH WALES: *E.F. Constable NSW 45582*, Kariony, Upper Woy Woy Road, 17.ii.1958 (NSW); *L.A.S. Johnson NSW 102262*, c. 3 mls S Sampsons Pass, c. 7 mls w Kulnura, 17.x.1965 (NSW); *C.T. White 10262*, Kulnura, 5.xii.1935 (BRI).

subsp. *radians* Toelken, *subsp. nov.*

H. billardierei auctt. non F. Muell.: Tate, Trans. Proc. Rep. Roy. Soc. S. Australia 6: 149 (1883), "*Billardieri*"; Trans. Proc. Rep. Roy. Soc. S. Australia 12: 65 (1889), "*Billardieri*"; Handb. Fl. S. Australia pp. 14, 205 (1890), "*Billardieri*", partly.

H. billardierei F. Muell. var. *parviflora* auct. non (R. Br. ex DC.) Benth.: J.M. Black, Fl. S. Austr. edn 2, 3: 576 (1952).

H. aspera auctt. non DC.: H. Eichler, Suppl. Fl. S. Austr. 227 (1965); Jessop in Jessop & Toelken, Fl. S. Austr. edn 4, 1: 355 (1986), partly.

H. sp. B. Toelken in Jessop, List Vasc. Pl. S. Austr. edn 4, 28 (1993).

A subsp. *empetrifoliae* presentia pilorum stellatorum (inter pilos alios) basis latis ramisque multis (6–14) praecipue in vena centrali petioloque infra folios differt.

Type: South Australia, 4 km SSW Parawa, *H.R. Toelken 8681*, 28.ix.1997 (holo.: AD; iso.: K, MO, NSW, PERTH).

Shrublets with prostrate, rarely decumbent slightly woody branches to 35 cm long. *Vestiture* of more or less larger broad-tubercled multiangulate radiating stellate hairs (6–14 branches) between/over smaller antrorse or erect stellate hairs (1–4 branches) on branches, upper leaf surface, the lower petiole, the lower central vein and calyx all with a broad disc of base cells, sometimes interspersed with very small unicellular hooked hairs without tubercle base on upper leaf surface and calyx. Long simple hairs on branches and calyx (or only a few on the terminal beak of outer calyx lobes) are absent. *Flowers*: mainly Aug.–Dec. Figs. 2E; 7J–L.

Distribution and ecology

Growing usually on shallow lateritic soil often with ironstone, rarely recorded from sandy or swampy soils, and locally common in woodland or mallee but also often in scrub or disturbed vegetation; restricted to South Australia (SL, KI).

Conservation status: Although it has a restricted distribution it is locally common and represented in several conservation parks.

Diagnostic features

Although the broad-tubercled stellate hairs were found on all specimens examined they are sometimes not common so that it was found useful to search for them on the lower petiole and central vein. Simple hooked hairs on the upper leaf surface as found in subsp. *radians* are occasionally also found on specimens of subsp. *empetrifolia* north of Sydney, but the latter do not have broad-tubercled stellate hairs as found in subsp. *radians*.

Variation: Juvenile and ecological forms as recorded for the species.

Etymology

The epithet 'radians', Latin, 'radiating' refers to the characteristic broad-tubercled radiating stellate hairs on leaves of this subspecies.

Notes

The subsp. *radians* is restricted to lateritic soils. It is geographically isolated from typical *H. empetrifolia*, which extends to south-east Victoria. This subspecies is more than just one of the many local forms of this species.

The first specimens of this taxon were collected by Tate on Kangaroo Island in 1881 (*R. Tate AD 97620417* – see Tate 1883) and 1883 (*R. Tate AD 97620414*) followed by several of J.G.O. Tepper (MEL, AD) in 1886/7, but they were all identified as *H. billardierei* without further reference to a variety as distinguished by Bentham (1863).

The petals of plants examined in the field often remained erect and more or less tubular as in *H. pallidiflora* for several hours in the morning before they recurve to the fully open, rotate flowers commonly found in *Hibbertia* species.

Voucher specimens (76 examined)

SOUTH AUSTRALIA: *M. Fagg 783*, Deep Creek, 16.viii.1970 (AD, CANB, L); *P. Mariensz 325*, roadside, Kangaroo Island, 3.x.1970 (AD, CANB, K, L, MEL); *R. Schodde 1136*, Deep Creek, 29.viii.1959 (AD, CANB).

H. hirta Toelken, *sp. nov.*

H. hirticalyci et *H. rhynchocalyci* similis 10–12 staminibus antheribus linearibus et 1.3–1.5 mm longis sed foliis tectis apprimè subtus præcipue pilis simplicibus differt.

Type: New South Wales, Budawang Range, *J. Pulley & I. Telford BR 204*, 5.x.1971 (holo.: CANB; iso.: MEL, NSW).

Shrubs up to 0.5 m high, with ±rigid erect branches, villous. *Vestiture* on branches and calyx persisting, with few long antrorsely curved simple hairs with pronounced tubercle over/grading into a wide range of sizes of erect radial stellate hairs (1–5 similar or unequal branches) with pronounced tubercle but apparently no base cells; on *leaves above* persisting, with mainly long simple hairs with a ring of a few raised base cells forming pronounced tubercled bases, over often few shorter erect radial stellate hairs (1–3 similar or unequal branches) similar to those on branches; on *leaves below* persisting, as above but

finer (especially the tubercles except for similarly coarse hairs on the flanks and the central vein and which often overtop the others); *juvenile leaves* (insufficiently known cf. variation below) with straight simple hairs, which are finer on both surfaces but particularly so on the undersurface. *Leaves* without axillary tuft of hairs; *petiole* 0.6–1.2 mm long; *lamina* linear-oblongate rarely-elliptic, (6-) 7.5–10 (-13.8) × 1.3–2.2 (-2.6) mm, obtuse to rounded, rarely acute when young, gradually tapering into petiole, villous above and below, pale green?; margins revolute but undersurface exposed between them and the more or less raised central vein. *Flowers* abruptly constricted into peduncle (buds obovoid before opening), terminal on all branches (apparently without short shoots) subtended by (3) 4 (5) subwhorled leaves but usually only one axis continues growth, not leaf-opposed along branches; *peduncle* (2.7-) 3.5–6 (-8.4) mm long and spreading when flowering, recurved when fruiting, stellate-villous; *bract* subtending calyx, linear-subulate, 4.2–6.3 mm, usually two-thirds to almost as long as the calyx, stellate-villous. *Calyx* green: *outer lobes* lanceolate to ovate, 6.1–6.5 mm long, long-acuminate (acumen often almost as long as lanceolate base), outer surface villous, inner surface with scattered long antrorse simple hairs; *inner lobes* oblong-ovate, 5.8–6.1, acuminate to mucronate, villous to pubescent. *Petals* broadly obovate, 4.1–5.6 mm long, truncate and emarginate to more or less bilobed, papillose mainly towards the centre, yellow. *Stamens* 11, 12 in one cluster; *filaments* basally connate; *anthers* narrowly obloid, 1.3–1.5 mm long, without terminal appendages, dehiscing mainly by introrse slits. *Pistils* 2, each with 2 ventral ovules and with short terminal styles positioning the stigmas near the apex of the central anthers, ovary villous, with erect mainly stellate hairs. *Seeds* not seen. *Flowers*: Mainly Oct., but also one record in mid-June. Fig. 8A–H.

Distribution and ecology

Grows in association with sandstone or conglomerate cliffs on the Budawang Range, New South Wales (SC).

Conservation status: Known only from a very restricted area in Morton National Park.

Diagnostic features

The long spreading, mainly simple hairs on the leaves and calyx, long bracts and 10–12 linear anthers suggests a similarity with *H. hirticalyx* and *H. rhynchocalyx*, but in contrast to those species *H. hirta* has long simple hairs on the undersurface of the narrow leaves. The base cells of the erect hairs on the upper leaf surface are characteristically raised, so that they look like goosebumps on human skin.

Variation

The indumentum of the leaves shows considerable variation in the density of the hairs and the relative numbers of simple and stellate hairs. Leaves with mainly straight simple hairs on their undersurfaces do occur usually towards the base of branches (e.g. *J. Pulley* CBG 44273). The fact that this plant was not flowering as compared with the second specimen collected that day (*J. Pulley* CBG 44272) could indicate that it is young but not quite juvenile any more, because it has already quite woody branches. Until a wider range of material and especially coppicing or known juvenile material can be examined, leaves with straight simple hairs on their undersurface are interpreted as an intermediate stage between juvenile and adult leaves, as it is possible that extreme juvenile leaves do show the commonly found hooked simple hairs. In fig. 8E this variation is recorded.

Etymology

The epithet 'hirta', Latin, villous refers to the fine spreading hairs covering most parts of the plant.

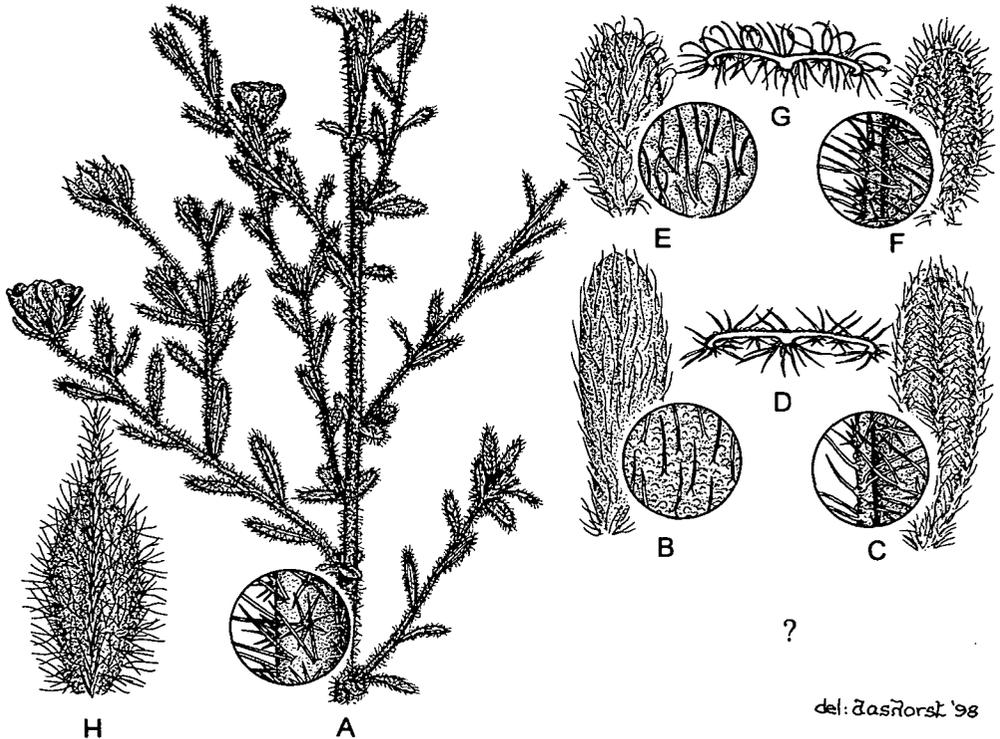


Fig. 8. *H. hirta*. A, Flowering branch $\times 1.5$; B–D, adult leaf: B, above $\times 4$; C, below $\times 4$; D, transverse section $\times 8$; E–G, ?intermediate stage leaf: E, above $\times 4$; F, below $\times 4$; G, transverse section $\times 8$; ? = juvenile leaf unknown; H, outer calyx lobe $\times 9$. (A–D, H, *J. Pulley CBG 44272*, CANB; E–G, *J. Pulley CBG 44273*, CANB).

Voucher specimens (8 examined)

NEW SOUTH WALES: Budawang Range: *P. Gilmour 5275*, 3.x.1985 (CANB); *J. Pulley BR 62*, 17.vi.1971 (CANB); *T. & S. Whaitte 3110*, 2.x.1966 (NSW).

H. hirticalyx Toelken, *sp. nov.*

Pleurandra astrotricha auct. non Sieb. ex Spreng.: Hook., *J. Bot.* (Hook.) 2: 402 (1840), as for *R.C. Gunn 893/1837*, Flinders Island, 26.i.1838.

P. ovata var. *scabra* Hook.f., *Fl. Tasmania* 16 (1855), partly as for *R.C. Gunn 893*.

H. billardierei F. Muell., *Pl. Indig. Col. Vict.* 1: 14 (1862), partly, as for syntype: near Sealers Cove & on Mount Hunter, *F. Mueller MEL 31499* (cf. typification: *H. appressa*), "*Billardierii*", *nom. illeg., nom. superfl.*

H. billardierei F. Muell. var. *monadelphica* F. Muell. ex Benth., *Fl. Austr.* 1: 28 (1863); *F. Muell., Fragm.* 4: 116 (1864); *Rodway, Tasm. Fl.* 4 (1903); *W.M. Curtis, Stud. Fl. Tasm.* edn 1, 1: 22 (1956).

Type: Victoria, mountains near Sealers Cove, *F. Mueller MEL 31499*, v.1853 (lecto. – selected here: MEL; iso.: AD; syn.: Tasmania, Flinders Island, *R.C. Gunn [893/1837]*, K, NSW 112231 – cf. typification below).

H. billardierei var. *obovata* R. Br. ex Benth., Fl. Austr. 1: 28 (1863).

Type: Tasmania, Port Dalrymple, *R. Brown s. n.* (lecto. – selected here: BM (left specimen); iso.: BM (right specimen), K; syn.: Hastings River, Beckler MEL 31567 (see *H. aspera* subsp. aff. *aspera*); Beckler MEL 31477 (see *H. empetrifolia* subsp. *empetrifolia*); ?West Head, *R.C. Gunn* [893] n.v. – cf. typification below).

H. ovata (Labill.) Druce var. *monadelpha* (F. Muell. ex Benth.) Domin, Biblioth. Bot. 89: 422 (1928); Ewart, Fl. Vict. 769 (1931).

Type: as for *H. billardierei* var. *monadelpha*.

H. ovata (Labill.) Druce var. *obovata* (R. Br. ex Benth.) Domin, Biblioth. Bot. 89: 422(1928).

Type: as for *H. billardierei* var. *obovata*.

H. aspera auctt. non DC.: N.A. Wakef., Vict. Nat. 73: 167 (1957), partly; J.R. Garnet, Wildflow. Wilsons Prom. 152, t. 577 (1971), partly; J.H. Willis, Pl. Vict. 2: 391 (1973), partly; Hoogland, Kew Bull. 29: 155 (1974); W.M. Curtis, Stud. Fl. Tas. 1, edn 2: 23 (1975); Toelken in N.G. Walsh & Entwisle, Fl. Vict. : 312 (1996), partly.

H. cinereae similis sed foliis plus minusve tectis pilis simplicibus et calycis lobis exterioribus costatis rostratisque differt; a *H. aspera* 10–15 staminibus et foliorum paginis abaxialibus glabrescentibus differt.

Type: Tasmania, Tamar Creek, 2 km NE Gladstone, *A.E. Orchard* 5860, 7.xi.1983 (holo.: HO; iso.: AD, AK, CANB, MEL).

Shrubs with erect, spreading or decumbent branches, 0.3–1 (–3) m tall, usually densely branched, pubescent. *Vestiture* on branches persisting, with long antrorse simple hairs, each with a small tubercle, over larger and smaller erect, rarely multiangulate radial stellate hairs with 3–5 similar/unequal branches; on calyx with long spreading tubercle-based simple hairs over short usually multiangulate antrorse/radial tubercle-based stellate hairs (usually 2,3 unequal, or 3–6 similar branches); *on leaves above* wearing off but base cells remain prominent, with long, rarely short simple hairs with pronounced base cells sometimes tuberculate, over short multiangulate radial (3–6 similar branches) and/or antrorse (1–3 often unequal branches) stellate hairs; *on leaves below* persisting, with few scattered simple hairs on the flanks and central vein over multiangulate/depressed radial stellate hairs (5–12 similar, rarely unequal branches) rarely overlapping, with distinct tubercles, sometimes some stellate hairs overtopping others; *on juvenile leaves* below with short hooked simple hairs replaced progressively by multiangulate stellate hairs. *Leaves* without axillary tuft of hairs; *petiole* 0.4–1.4 mm long; *lamina* elliptic-oblongate, elliptic, rarely elliptic-obovate, (5.6–) 8–17 (–25.6) × 2–8 (–10.2) mm, obtuse to rounded, rarely truncate, often mucronate with central vein more or less protruding, with cuneate base, above pubescent to glabrescent, below puberulous to glabrescent when juvenile, pubescent or rarely tomentose on adult leaves, ±discolourous; margins recurved to revolute and undersurface more or less exposed between them and the slightly raised central vein. *Flowers* abruptly constricted but with stepped base when fruiting into the peduncle (buds oblong-obovoid before opening), terminal on all branches and sometimes on short shoots (including ones with reduced leaves), subtended by 2 (3) subwhorled leaves rarely leading to dichotomous growth, rarely leaf-opposed along main branches (then no flowers in succession observed); *peduncle* 1.8–8 mm long or up to 14 mm when fruiting, with scattered spreading simple hairs over stellate-pubescence; *bracts* subtending calyx, linear-subulate, 3–4.4 mm long, usually two-thirds to as long as calyx, few spreading simple hairs over stellate-pubescence. *Calyx* pale green sometimes tinged purple: *outer lobes* lanceolate, 3.2–6.3 mm long, usually long-acuminate, outer surface with scattered long spreading simple hairs over stellate-pubescent, inner surface with scattered fine antrorse stellate hairs with usually 2, 3 branches; *inner lobes* oblong-ovate, 3.2–6.2 mm long, acuminate or obtuse and mucronate, pubescent to puberulous and rarely only with stellate hairs. *Petals* broad-cuneate, rarely cuneate-spathulate, 6–9.6 mm long, usually bilobed, bright yellow. *Stamens* (7) 8–12 in one cluster; filament usually at least half connate; *anthers* narrowly obloid, (1.1–) 1.2–1.7 mm long, with central ones often with short appendage or acute, dehiscing mainly by lateral slits. *Pistils* 2; each with (2–) 4 ventral ovules and with style positioning stigmas below the apex of the central anthers, and ovary shaggy with erect stellate hairs. *Seeds* brown to shiny-black, 1.8–

2 × 2 mm, up to two-thirds covered with lobed membranous aril. *Flowers*: Sept.–Nov. Fig. 9A–K.

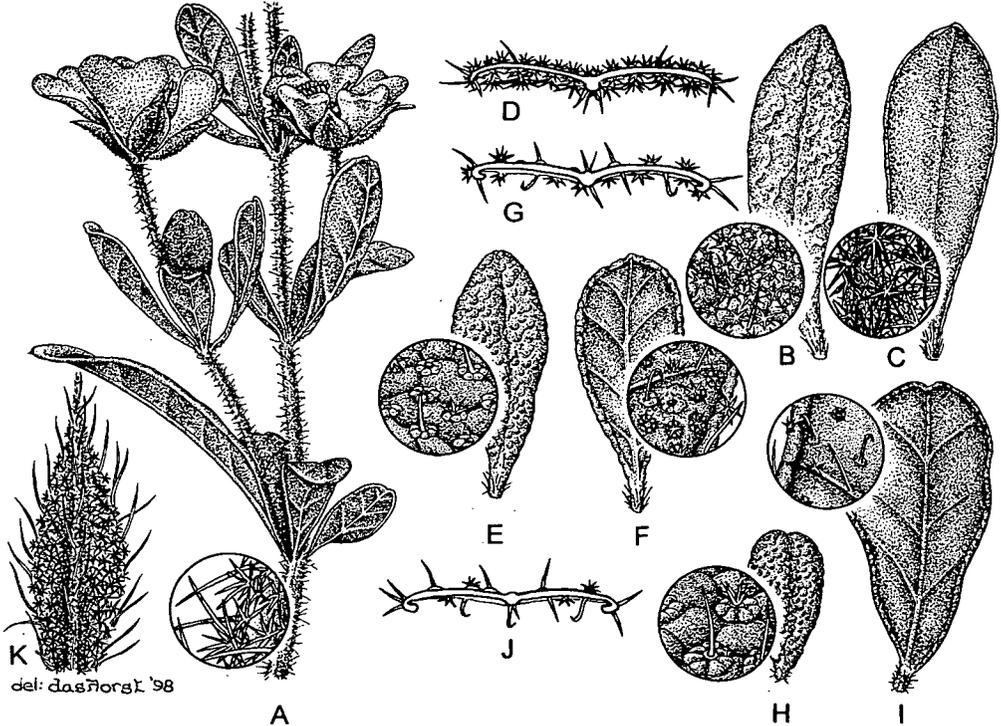


Fig. 9. *H. hirticalyx*. A, Flowering branch with terminal flowers on branches and short shoots ×2; B–D, adult leaf: B, above ×3; C, below ×3; transverse section ×6; E–G, intermediate stage leaf: E, above ×3; F, below ×3; G, transverse section ×6; H–J, juvenile leaf: H, above ×3; I, below ×3; J, transverse section ×6; K, outer calyx lobe ×8. (A–D, K, J.W. Audas & P.R.H. St John MEL 649413; A. Moscal 2531, HO).

Distribution and ecology

Growing in sandy soil usually associated with granite, on wet seepage areas on Wilsons Promontory in Victoria (PROM) as well as northern Tasmania including some of the islands in the Bass Strait.

Conservation status: Locally common and conserved in parks.

Diagnostic features

This species is mainly distinguished from the very similar *H. cinerea* by its spreading simple hairs over a more or less uniform tomentum of stellate hairs, which give particularly the calyx but also the petiole and the central vein of leaves a hairy appearance. The distinctly ridged outer three calyx lobes are terminated in a long beak up to one-third of their length while these are very short in *H. cinerea*. The latter species is usually associated with limestone whereas *H. hirticalyx* shows a preference for acid soils.

Variation

Being an extremely variable species, much more material is needed to understand the variation, particularly the vestiture shown on plants within often widely separated populations. Specimens from Wilsons Promontory are much more hairy (denser and with often longer simple hairs) than most of the Tasmanian collections seen. No juvenile form with only few hooked hairs on the undersurface of the leaves has been observed from Victorian collections as has commonly been recorded in Tasmanian material. The stellate hairs on the upper surface of the leaves of the former also tend to be small and with 4–6 radiating branches while those from Tasmania are larger and with 2,3 (4) antrorse branches. Some leaves have only simple hairs above but they grade into others with antrorse stellate hairs (*A. Moscal 2531*). The significance of the two types of stellate hairs sometimes on different leaves and sometimes on the same but with widely varying distribution patterns on leaves from apparently different populations, can at present only be tentatively explained as developmental stages, and are probably determined by local genetic and/or ecological factors. Until the full range of variation from juvenile to adult leaves and/or ecological variation is recorded for many of the different populations the phenomenon cannot be evaluated adequately. It seems that, for instance, shading is an important factor as the more glabrous plants and those with simple hairs are often described as understory plants. In *H. pallidiflora* shading seems to contribute towards the retention of juvenile characteristics, or hold development at an intermediate stage between the extremes.

Leaf-opposed flowers in this species are also associated with juvenile leaves on Tasmanian plants and at times they grade into the stage with usually two subwhorled leaves subtending the peduncle. However, unlike intermediate stages in *H. pallidiflora* the base of the peduncle is always associated with one or more leaves. On Tasmanian plants, flowers are usually borne terminally on all branches while most of the flowers on Victorian plants are produced on short shoots often with reduced leaves.

The habit is also described from Wilsons Promontory and Flinders Island as shrubs up to 3 m tall, while in at least one record from Tasmania is described as a “dominant ground cover”.

Typification

Bentham's protologue of *H. billardierei* var. *obovata* states: ‘Leaves and flowers of a [var. *monadelphica*], but ovules only 2’ and then quotes three collections. The first of these ‘*Pleurandra obovata*, R. Br. Herb., from Port Dalrymple’ (now identified as *H. hirticalyx*) shows that Bentham had consulted the R. Brown collection as there is an annotation (“*Hibbertia Billardieri* F. Muell. var. *obovata* (cf. ovules 2 only)”) on the sheet in the BM. There are two branches on this herbarium sheet but it cannot be ascertained whether Bentham's comment applies to the left specimen below which the comment is now mounted or refers to the whole collection before duplicates were sent out (cf. W.T. Stearn (1960), pp. xxvi-xxviii of Introduction to facsimile edition of R. Brown's Prodrum). There is no description of this species in Brown's manuscript (microfilm :AD). The name is only mentioned in the index to *Pleurandra* but with a note ‘4 sp[er]mae’ unlike the two ovules mentioned by Bentham. The R. Brown specimen at K was only presented to this herbarium in 1880, so that Bentham could not have consulted it.

Two collections of the second specimen quoted and initialled by Bentham ‘Hastings river, *Beckler*’ were also found to be compatible with the brief protologue. MEL 31567 is now identified as *H. aspera* subsp. aff. *aspera* and MEL 31477 as *H. empetrifolia* subsp. *empetrifolia*.

The third specimen referred to by Bentham ‘West Head, Tasmania, *Gunn [893]*’ is also likely to have been one of *H. hirticalyx*. However, no specimen of this collection annotated

by Bentham could be traced in K or MEL, although several specimens with that 'species number' but from other localities or from later dates exist.

Since the R. Brown collection explains the choice of the epithet and the sheet in BM bears an annotation by Bentham stating the name and diagnostic feature, the left specimens, being similar to the right one, was chosen as the lectotype.

The specimen *F. Mueller* MEL 31499 from Sealers Cove was selected as the lectotype of *H. billardierei* var. *monadelpha* as it is annotated in Mueller's hand as *Pleurandra monadelpha* and Bentham annotated it as "*Hibbertia Billardieri* α *monadelpha*" in contrast to the second collection quoted by Bentham but not annotated by him, *Gunn* 893 from Flinders Island (K, with details of several collections of this species). Since the two collections are similar the former was preferred.

Etymology

The epithet 'hirticalyx', Latin (but 'calyx' originally from Greek), 'calyx with long distinct hairs', referring to the long soft simple hairs over stellate hairs covering the calyx.

Voucher specimens (61 examined)

VICTORIA: *R.D. Hoogland* 11904, Mount Oberon, 25.xi.1970 (CANB, MEL, K).

TASMANIA: *R.C. Gunn* 893, West Head, Georgetown, 21.x.1844 (NSW 102163); *A. Moscal* 2693, Reeves Creek-Picnic Corner, 14.ix.1983 (AD, HO, MEL); *J.S. Whinray* 2452, Mount Killiecrankie, Flinders Island, 1.x.1978 (HO).

H. notabilis Toelken, *sp. nov.*

H. asperae persimilis sed 10–12 antheris quoque 1–1.4 mm longis, foliorum paginis adaxialibus praecipue pilis simplicibus; *H. hirticalyci* bracteis brevibus, calycis loborum extimorum rostratis brevissimis, foliorum paginis abaxialibus dense velutinis differt.

Type: New South Wales, Nadgee Nature Reserve, *D.E. Albrecht* 1037, 28.ix.1984 (holo.: MEL 673624).

Shrubs up to 0.8 m tall, more or less densely branched, densely pubescent to villous. *Vestiture* on branches persisting, with long antrorsely curved simple hairs with small tubercle over larger and smaller erect or rarely multiangulate radial stellate hairs with 3–6 similar/unequal branches; on calyx with long spreading tubercle-based simple hairs over short multiangulate radial, rarely antrorse tubercle-based stellate hairs (usually 3–5 similar, rarely unequal branches); on leaves above wearing off except for base cells remaining prominent, with short simple hairs with pronounced base cells sometimes tuberculate over/grading into erect, usually antrorse stellate hairs (1–4 \pm similar branches) often restricted to the base, the central groove and the flanks; on leaves below persisting, with few scattered simple hairs on the flanks and on the central vein over multiangulate radial stellate hairs (5–13 similar, rarely unequal branches densely overlapping and with small tubercles; juvenile leaves not seen. Leaves without axillary tuft of hairs; petiole 0.3–0.8 mm long; lamina obovate to oblanceolate, rarely elliptic-oblanceolate, 4.1–9.2 \times 1.4–4.8 mm, truncate and \pm emarginate, rarely rounded, with cuneate base, above pubescent to glabrescent, below villous to velutinous, discolourous; margins \pm revolute and undersurface well exposed between them and the scarcely raised central vein. Flowers abruptly constricted into peduncle (buds broadly oblong-obovoid before opening), terminal on all branches and often on short shoots, usually subtended by 3 subwhorled leaves leading to dichotomous or trichotomous branching but often immediately ending again in flowers, leaf-opposed flowers not seen; peduncle 2.5–6.1 mm long and up to 9.2 mm when fruiting, villous to pubescent like branches; bracts subtending calyx, linear-subulate, 1.6–2.1 mm long, usually less than half as long as the calyx, villous like pedicel. Calyx pale green; outer lobes lanceolate to ovate, 4.1–4.3 mm long, shortly acuminate to acute, outer surface with

scattered long simple hairs mainly along the pronounced central ridge and the flanks over multiangulate radial stellate hairs with 4–8 often unequal branches, inner surface antrorse stellate-puberulous towards the apex; *inner lobes* oblong-ovate, 4.2–4.5 mm long, rounded, rarely acute, puberulous and often with stellate hairs only. *Petals* broadly obovate-cuneate, 5–8.6 mm long, distinctly bilobed, papillose, yellow. *Stamens* 10–12 in one cluster; *filaments* usually about half connate; *anthers* narrowly obloid, 1–1.4 mm long, with short blunt appendages (almost rounded), dehiscing mainly by lateral slit. *Pistils* 2, each with 4 almost basal ovules and with style positioning stigmas below the apex of the anthers, and ovary short-shaggy with erect stellate hairs. *Seeds* not seen. *Flowers*: Sept.–Oct. Fig. 10A–E.

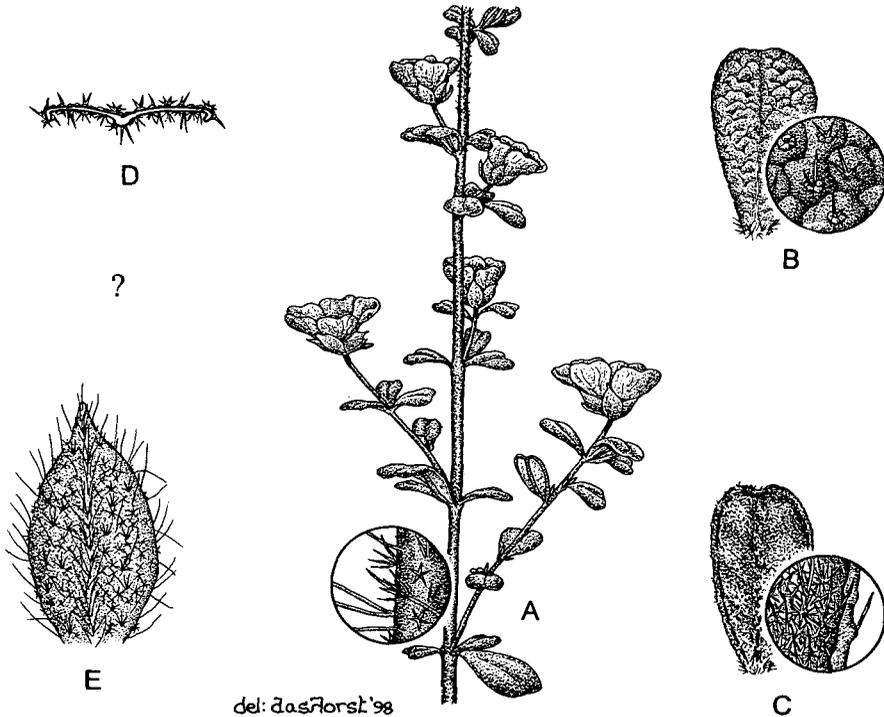


Fig. 10. *H. notabilis*. A, Flowering branch showing flowers terminal on branches and short shoots $\times 1.5$; B–D, adult leaf. B, above $\times 3$; C, below $\times 3$; D, transverse section $\times 5$; ? = juvenile and/or intermediate stage leaf unknown; E, outer calyx lobe $\times 9$. (A–E, D.E. Albrecht 1037, MEL).

Distribution and ecology

Found in open forest of *Eucalyptus sieberi* and *Angophora floribunda* on the coastal ranges on either side of the border between New South Wales (SC) and Victoria (EG).

Conservation status: Known only from two specimens both from within conservation parks.

Diagnostic features

H. notabilis is superficially very similar to *H. aspera* by its discolourous obovate leaves with rarely rounded apex, flowers on short shoots, bracts shorter than half the outer calyx lobes, and shortly acuminate outer calyx lobes, all characters by which it can be distinguished from the one or other form of *H. hirticalyx*, which occurs further south and west in Victoria and Tasmania. It is, however, characterised by its 10–12 stamens with oblong anthers 1–1.4 mm long and consistently 4 ovules per carpel unlike in *H. aspera*. The

tomentum of the upper surface of the leaves of the latter usually shows a predominance of multiangulate radial (rarely slightly antrorse in and around that locality) stellate hairs with 3–8 branches, while *H. notabilis*, similar to forms of *H. hirticalyx* from northern Tasmania and here probably its true affinities should be sought, has mainly simple hairs interspersed with a few erect antrorse stellate hairs with 1–3 branches. *H. hirta* in contrast has mainly simple hairs on the leaves.

Too little is known about the variation of this taxon to evaluate its full affinities. Subspecific rank may seem more appropriate for this extremely localised taxon, but it was made a full species because of its remarkably intermediate characteristics between *H. aspera* and *H. hirticalyx*.

Etymology

The epithet 'notabilis', Latin, remarkable or noteworthy, referring to the noteworthy importance of the number of stamens in this group of hibbertias as shown by this species in spite of its superficial resemblance to *H. aspera*.

Specimens examined

NEW SOUTH WALES: *D.E. Albrecht 1037*, Nadgee Nature Reserve, 28.ix.1984 (MEL).

VICTORIA: *J.H. Willis MEL 695404*, Howe Ranges, 24.x.1948 (MEL).

H. pallidiflora Toelken, J. Adelaide Bot. Gard. 16: 68 (1995).

Type: South Australia, southern Yorke Peninsula, along Hillock Road, *H.R. Toelken 8567*, 2.x.1994 (holo.: AD; iso.: B, CANB, G, K, MEL, MO, NSW, NY, S).

H. billardierei F. Muell., Pl. Indig. Col. Vict. 1: 14 (1862), partly; Second Syst. Cens. 1 (1889), partly, as for syntype: near Rivoli Bay, *F. Mueller MEL 31526, 31527* (cf. typification: *H. appressa*), "*Billardieri*", *nom. illeg., nom. superfl.*

H. billardierei *auctt. non* F. Muell.: Tate, Trans. Proc. Rep. Roy. Soc. S. Australia 3: 50 (1880), "*Billardieri*"; Trans. Proc. Rep. Roy. Soc. S. Australia 12: 70 (1889), partly, "*Billardieri*"; Fl. Extratrop. S. Austr. 14 (1890), partly, "*Billardieri*"; Trans. Proc. Rep. Roy. Soc. S. Australia 13: 116 (1890), "*Billardieri*"; J.M. Black, Fl. S. Austr. edn 1, 3: 387 (1926), "*Billardieri*"; edn 2, 3: 576 (1952), "*Billardieri*".

H. aspera *auctt. non* DC.: H. Eichler, Suppl. Fl. S. Austr. 227 (1965); Jessop in Jessop & Toelken, Fl. S. Austr. edn 4, 1: 355 (1986), partly.

H. sp. C. Toelken in Jessop, List Vasc. Pl. S. Austr. edn 4, 28 (1993).

Usually dense shrubs with scrambling branches often up to 1.5 m long or rarely up to 4 m high, becoming more or less branched, pubescent to tomentose. *Vestiture* on branches and calyx persisting, with few larger multiangulate radial stellate hairs (>18 similar branches) with broader span than of smaller stellate hairs, often with raised tubercle over a range of smaller multiangulate radial stellate hairs (4–12 similar branches) with small tubercles; on *leaves above* like branches but larger hairs mainly towards the flanks, all without obvious base cells; on *leaves below* like branches except for larger hairs mainly on the flanks and central vein but occasionally also on the undersurface; *juvenile leaves* above with fewer multiangulate, often antrorse stellate hairs (with 1–3 longer similar branches) under/with few larger multiangulate radial hairs (6–12 similar branches) along the flanks while on leaves below only hooked simple hairs are present on the undersurface (few small and larger multiangulate radial stellate hairs restricted to flanks and central vein) become gradually replaced by more stellate hairs as the plant matures. *Leaves* without axillary tuft of hairs; *petiole* 0.2–0.9 (–1.6) mm long; *lamina* obovate to oblanceolate or elliptic oblanceolate, (1.8–) 2.3–10.4 (–13.1) × 0.9–6.5 (–7.2) mm, rounded, rarely obtuse, with apex of central vein sometimes mucronate, more or less abruptly tapering into petiole, pubescent, puberulous to glabrescent, usually pale green or discolourous when young; margins more or

less recurved. *Flowers* abruptly constricted into peduncle (buds oblong-obovoid before opening), terminal on all branches (short shoots rarely present), usually with 2 or 3 subwhorled leaves but on main branches peduncle often more or less connate to the developing axillary branch (concaulescence, see variation below) so that flowers appear not connected to any node with leaf (see fig. 11A), rarely leaf-opposed on young branches and not seen repeated; *peduncle* (0.8–) 2.2–9.5 (–14) mm long and recurved when flowering, then spreading and ultimately ±recurved when fruiting, stellate-pubescent; *bracts* subtending calyx, linear-subulate, 1.2–2.2 × 1.5–2.5 mm, about half as long, rarely just longer than half as long as calyx, stellate-puberulous. *Calyx* pale green: *outer sepals* ovate to lanceolate, 2.1–3.9 mm long, acuminate to long-acuminate, outer surface pubescent to tomentose, inner surface minutely antrorse stellate-pubescent towards the apex; *inner lobes* ovate to broadly oblong-ovate, 2.1–3.5 mm long, acuminate to rounded with subterminal mucro, pubescent. *Petals* oblong-obovate to almost depressed obovate, 1.3–2.5 mm long, rounded to more or less bilobed, smooth, cream to pale yellow turning rusty-orange when dry. *Stamens* (6–) 8–13 in one cluster; *filaments* basally connate; *anthers* narrowly obloid, 0.5–0.8 mm long, with incurved terminal appendages, dehiscent mainly by introrse slits. *Pistils* 2, each with 2 (3) ±ventral ovules and with terminal styles elongating so that the stigmas are positioned beyond the apex of the anthers towards the mouth of the petal tube, ovary tomentose, with erect stellate hairs. *Seeds* shiny chestnut to pale brown, with membranous white aril more or less lobed on the lower third. *Flowers*: Aug.–Nov. (Dec.). Figs. 2C; 11A–K.



Fig. 11. *H. pallidiflora*. A, Fruiting branch with second subwhorled leaf and peduncle shifted ×3; B–D, adult leaf: B, above ×3; C, below ×3; D, transverse section ×8; E–G, intermediate stage leaf: B, above ×3; F, below ×3; G, transverse section ×8; H–J, juvenile leaf: H, above ×3; I, below ×3; J, transverse section ×8; K, outer calyx lobe ×9. (A–D, K, B. Copley 4302, AD; E–J, P. Martensz 276, AD).

Distribution and ecology

Grows usually on moist sandy to gravelly soils, sometimes close to temporarily flooded areas, commonly associated with limestone mainly in scrub of coastal heath or mallee vegetation in south-western Victoria (WAN) and South Australia (YP, SL, KI, SE).

Conservation status: Conserved in a number of parks in Victoria and South Australia, but herbarium material does not give an indication on how common the species is, as it is not often collected because of its small recurved flowers.

Diagnostic features

Among the species with usually 10–12 oblong anthers, *H. pallidiflora* is easily distinguished by its pale yellow petals being shorter than the calyx and remaining tubular (not opening widely), as well as by its long styles placing the stigmas well above the anthers at the mouth of the petal tube. Vegetatively it is distinguished from *H. cinerea*, the only other species in that group that has larger stellate hairs over smaller ones (without simple hairs) on the calyx and by its scrambling habit.

Variation

An extremely variable species in its vegetative characteristics, from a small shrublet up to 30 cm tall to scramblers to 1.2 m or in one record up to 4 m high, or leaves varying from 1.8–14 mm long, but most variable is the vestiture on the leaves.

In the case of *H. pallidiflora* the stellate hairs on the leaves are extremely variable. On top of small leaves usually of depauperate plants (with leaves 2–4.5 mm long) the stellate hairs are usually small and with 5,6 (7) branches each of which is scarcely longer (0.05 mm long: *B.M. Overton 166*) than the basal tubercle, while in the other extreme in plants from sheltered conditions leaves are up to 13.8 mm long, the 1–3 branches are up to 12 times the length of the tubercle (to 5.2 mm: *R.J. Bates 7620*).

Flowers are as in most other species subtended by two or three subwhorled leaves, i.e. predominantly three leaves on specimens from Kangaroo Island and often only two on plants from the mainland. When flowers are terminal on growing main branches (with long internodes) particularly on plants from the southern Yorke Peninsula they do not appear to be associated with any leaves, but when one examines young flower buds they are like those on short branches on the same plant subtended by usually 2 subwhorled leaves. As the flowers mature or particularly when the axillary branches develop, the internodes elongate, so that the whole branch system is distorted. The petiole of the one leaf and even sometimes the stalk of the flower is partly connate to the developing branch (concaulescence: Weberling 1989, p. 217) as shown by the elongate flanges or ridges. True leaf-opposed flowers are rare and remain in that position even in fruiting material, but are normally associated to very young branches with extreme juvenile leaves. No apparent reason could be found why only very few young branches produce leaf-opposed flowers, but some are also distorted as described above.

Notes

The first specimen of *H. pallidiflora* was collected in October 1848 by F. Mueller “towards Rivoli Bay” and was used as a syntype for his *H. billardierei* (cf. typification: *H. appressa*). Tate (1890) also probably referred to this record under that species name when he marked it present from the “Mount Gambier district”, but his record from the “Adelaide district” cannot be explained in terms of specimens seen during the present study. Both these records were probably communicated to him by F. Mueller as mentioned in Tate (1880), because the earliest specimen from the Fleurieu Peninsula, from where both species have now been recorded, dates from 1929 (*J.B. Cleland AD 97044051*).

The record of *H. billardierei* from Kangaroo Island in Tate (1889, 1890) probably referred to his own collections of *H. empetrifolia* subsp. *radians* (cf. Tate 1883, 1889a). It is unlikely that he had seen Tepper's specimens of both, the latter species and *H. pallidiflora* collected in 1886/7 on Kangaroo Island (MEL). However, Tate did name a specimen of *H. pallidiflora* he collected in 1889 on the southern Yorke Peninsula *H. billardierei* (Tate 1890a) without further reference to any varieties distinguished by Bentham (1863).

The first collection of *H. pallidiflora* from Victoria was made at the "entrance of the Glenelg River" in 1891 by L. Eckert (MEL 31539), but only few specimens have been collected since from this south-western corner of this State.

Voucher specimens (88 specimens examined)

VICTORIA: *A.C. Beaglehole* 8245, Bats Ridges, Portland 29.x.1960 (CANB, MEL); *M.E. Phillips* CBG 12248, Mount Richmond National Park (CANB).

SOUTH AUSTRALIA: *P. Gibbons* 600, 20 km NW Millicent, 18.x.1986 (AD, BRI, HO, MEL, MO, NSW, PERTH); *P. Martensz* 276, Kangaroo Island, 1.x.1970 (CANB, AD, MEL, L); *M.E. Phillips* CBG 54707, 6 miles NW Karatta, 30.ix.1965 (AD, CANB, NSW).

H. rhynchocalyx Toelken, *sp. nov.*

H. hirticalyci persimilis sed pilis simplicibus longis densis in ramis calycibusque, pilis stellatis perdensis in paginis abaxialibus foliorum et antheris mucronatis differt.

Type: New South Wales, Gibraltar Range, *J.B. Williams* 603 & *K. Winterhalder* (holo.: NSW; iso.: CANB; NE, n.v.).

Low shrubs with spreading branches moderately branched, pilose to velutinous. *Vestiture* on branches and calyx persisting, with usually many long more or less spreading simple hairs (rarely with 2 branches and up to 2 mm long) over larger and smaller erect/multiangulate radial stellate hairs (3–7 often unequal branches) with small tubercle and some base cells; on *leaves above* some wearing off, with scattered long simple hairs and large erect radial/antrorse stellate hairs (2–6 often unequal branches) with small tubercles and some base cells over/between scattered short multiangulate radial or rarely antrorse stellate hairs (2–7 similar branches) with small tubercle and few distinct base cells; on *leaves below* persisting, with few scattered (but particularly on the central vein) longer erect to multiangulate, radial fine stellate hairs (1–6 usually unequal branches) often with broader tubercle over overlapping multiangulate radial stellate hairs (5–12 similar branches) with small tubercle, and apparently no base cells; *juvenile leaves* unknown. *Leaves* with axillary tuft of long hairs because of latent axillary bud; *petiole* 0.5–2 mm long; *lamina* oblong-elliptic to oblong-lanceolate, 7–22.4 × 2.7–7.2 mm, truncate and more or less emarginate, gradually tapering into petiole, hirsute to glabrescent above, often discolourous; with margins recurved to recoiled with velutinous undersurface exposed between them and the often villous central vein. *Flowers* abruptly constricted into peduncle (buds oblong-obovoid before opening), terminal mainly on short lateral branches (no short shoots) subtended by 2 or 3 subwhorled leaves sometimes leading to dichotomous branching, apparently not leaf-opposed; *peduncle* 3.2–6.4 mm long and spreading, hirsute; bracts subtending calyx, linear-subulate, 4.4–5.1 mm, two-thirds to almost as long as the calyx, hirsute. *Calyx* pale green: *outer lobes* lanceolate to ovate, 4.8–6.1 mm long, long-acuminate, outer surface usually villous, inner surface sericeous with long soft simple hairs over mainly forward-directed stellate hairs; *inner lobes* broadly oblong to oblong-obovate, 4.7–5.2 mm long, usually rounded with subterminal mucro, villous to pubescent. *Petals* obovate-spathulate with cuneate base, 4.5–6.6 mm long, more or less bilobed, yellow. *Stamens* 12 in one cluster; *filaments* connate for most of their length; *anthers* narrowly obloid, 1.2–1.4 mm long, each with terminal appendage, dehiscing by introrse slits. *Pistils* 2, each with 2 ventral ovules, and with short terminal styles positioning the stigmas just

below the apex of the central anthers, ovary tomentose to villous with erect stellate hairs. *Seeds* not seen. *Flowers*: Oct. Figs. 2D; 12A–E.

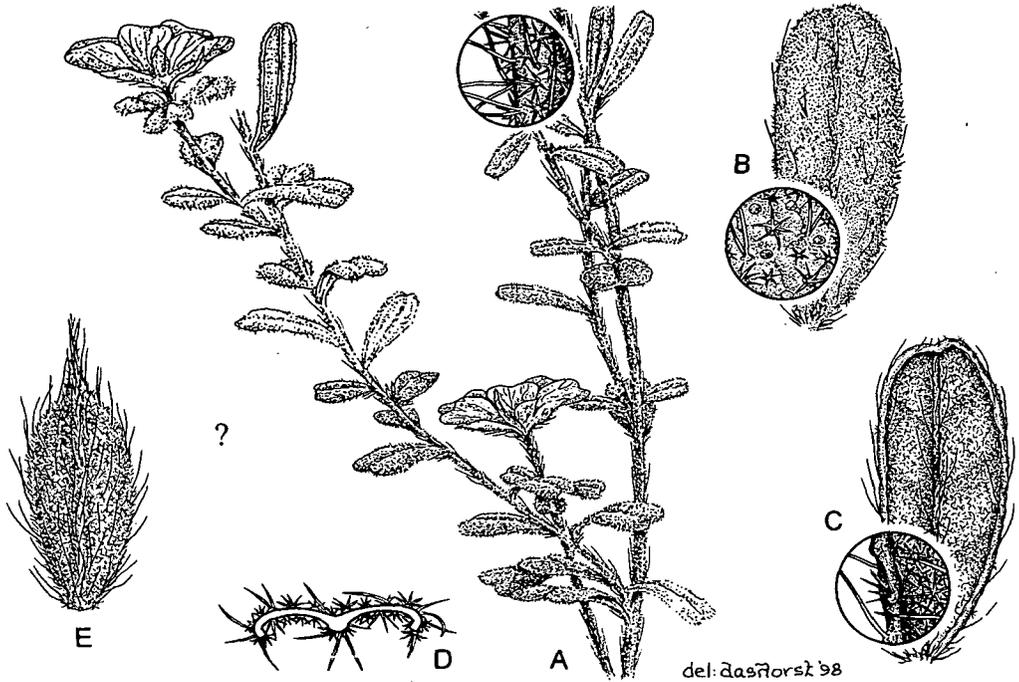


Fig. 12. *H. rhynchocalyx*. A, Flowering branch $\times 1$; B–D, adult leaf: B, above $\times 3$; C, below $\times 3$; D, transverse section $\times 3.5$; ? = juvenile and/or intermediate stage leaf unknown; E, outer calyx lobe $\times 10$. (A–E, J.B. Williams 603, NSW).

Distribution and ecology

Grows on sandy soil on granite in sheltered places on east facing slopes in dry sclerophyll forest of mainly *Eucalyptus resinifera* on the Gibraltar Range (New South Wales, NC).

Conservation status: Known only from one collection.

Diagnostic features

Shows a very close similarity to *H. hirticalyx*, even to the extent that both species are usually found in association with granite, but *H. rhynchocalyx* is distinguished by its very dense hair cover on branches, calyx with rather long and stiff simple hairs (hispidotomentose), and stellate-velutinous (hairs strongly overlapping) undersurface of the leaves, as well as the distinct appendage terminal to the connective of each anther. Unlike *H. hirta*, which has only long spreading simple hairs covering both sides of the leaves, *H. rhynchocalyx* has at least some stellate hairs above and below. The leaves are superficially similar to forms of *H. aspera*, because they are discolourous with a stellate-velutinous undersurface and the hairs are often more or less erect-stellate with a raised tubercle as in subsp. *pilosifolia*, but *H. rhynchocalyx* has terminal flowers (no short shoots) with long simple hairs on the calyx, and twelve stamens each with a distinct terminal appendage.

Etymology

The epithet is derived from Greek, 'rhynchos', beak and 'calyx', 'the covering of a flower' or calyx, and refers to the beaked outer calyx lobes accentuated by the long hairs on them.

Voucher specimens: Known only from the type collection.

H. truncata Toelken, *sp. nov.*

H. aspera auctt. non DC.: N.A. Wakef., Vict. Nat. 73: 167 (1957), partly; J.H. Willis, Pl. Vict. 2: 391 (1973), partly; Hoogland, Kew Bull. 29: 155 (1974), partly; Toelken in N.G. Walsh & Entwisle, Fl. Vict. 3: 312 (1996), partly.

H. asperae similis sed duodecim staminibus et absentia piliorum simplicissimorum in foliis; a *H. cinerea* pilis parvulis dispersis in paginis superis foliorum, foliis plerumque truncatis fructicibusque decumbentibus differt.

Type: Victoria, Port Campbell, *R.J. Adair 1134*, 10.iii.1980 (holo.: MEL; iso: CANB).

Shrublets with decumbent to prostrate branches up 0.4 m high, more or less densely branched, pubescent to tomentose. *Vestiture* on branches and calyx persisting, with few larger multiangulate radial stellate hairs (> 20 similar branches) with broader and raised tubercle over/between often a range of smaller multiangulate radial (rarely somewhat antrorse at the base of leaves) stellate hairs (5–15 similar branches) with small tubercle-base and few base cells; on *leaves above* like branches but larger hairs only towards the flanks; on *leaves below* like branches but denser, overlapping, and with larger hairs restricted to flanks and central vein; on *leaves of coppicing branches* (*H.R. Toelken 9251*) above with few widely spaced stellate hairs (often 1–5 branches except for few multi-branched ones on the flanks) and soon wearing off, below with few stellate hairs mainly along the flanks and central vein but also very few on the undersurface between many hooked simple hairs on first leaves, but rapidly increasing on subsequent leaves. *Leaves* without axillary tuft of hairs; *petiole* 0.4–1.2 mm long; *lamina* broadly obovate, 3.5–16 (-19.4) × 2–12 (-16.2) mm, with apex truncate, often apiculate, rarely emarginate or rounded, ± abruptly tapering into petiole, above pubescent to puberulous or rarely glabrescent with age, below velvety, discolourous; margins usually scarcely recurved exposing undersurface and scarcely raised central vein often projected into an apiculum. *Flowers* abruptly constricted into peduncle (buds broadly ellipsoid before opening), often terminal on short shoots and usually subtended by 2 or 3 subwhorled leaves leading to dichotomous branching and/or more than one flower from the same area, apparently not leaf-opposed along actively growing shoots; *peduncle* 3–16 (-22) mm long and erect when flowering, recurved when fruiting, more or less densely pubescent with usually larger and smaller stellate hairs; *bracts* subtending calyx, linear-subulate, 1.3–1.5 (-1.8) mm, usually half the length of calyx or less, velvety. *Calyx* with *outer lobes* ovate, 3.6–5 mm long, acute, rarely short-acuminate, outer surface tomentose to pubescent, inner surface coarse pubescent with multiangulate radial stellate hairs; *inner lobes* broadly elliptic, rarely ovate, 3.8–4.8 mm long, rounded to truncate and apiculate, tomentose to pubescent. *Petals* usually obovate, 6–10.6 mm, bilobed, slightly papillose, yellow. *Stamens* 10–12 in one cluster; *filaments* usually connate less than half their length; *anthers* narrowly obloid, 1.1–1.3 mm long, with incurved terminal appendage, dehiscing mainly by introrse slits. *Pistils* 2, each with (4) 5, 6 ventral ovules, with terminal style positioning stigmas near the apex of the central anthers, ovary shaggy with erect, mainly stellate hairs. *Seeds* not seen. *Flowers*: Sept.–Nov. Figs. 2A,B; 13A–K.

Distribution and ecology

Growing on sandy soil or sometimes sand dunes, often locally common, usually associated with limestone in coastal heath, rarely more inland; recorded only from a few

localities in the vicinity of Peterborough and Port Campbell, Victoria (OTPL). In the latter area it is one of the dominant plants of the local coastal vegetation.

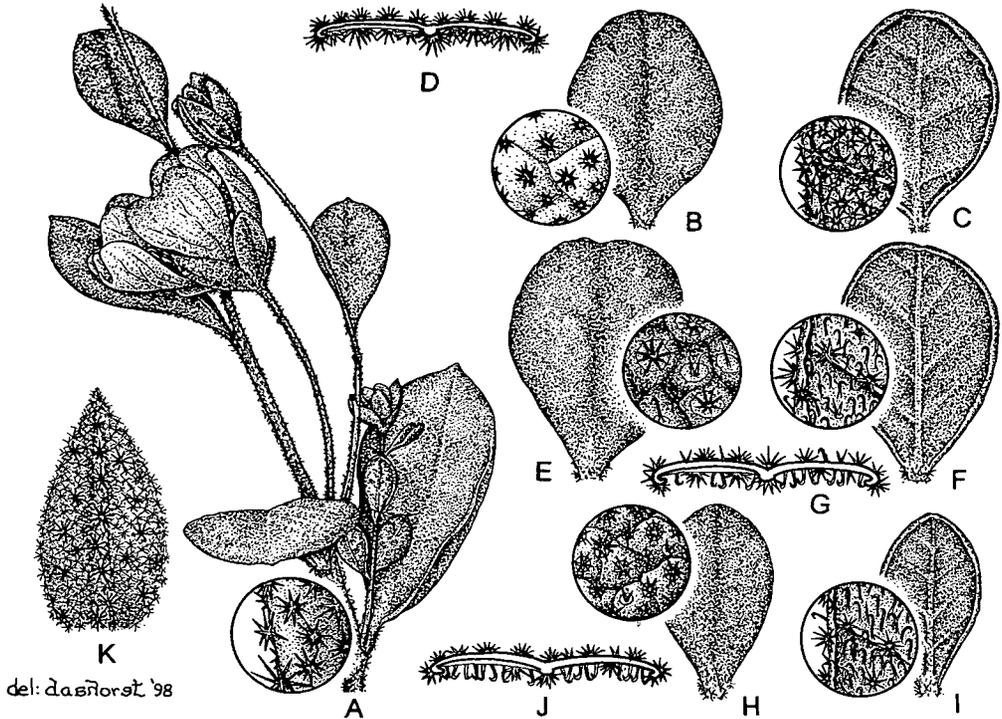


Fig. 13. *H. truncata*. A, Flowering branch with terminal flowers on branches and short shoots $\times 3$; B–D, adult leaf: B, above $\times 3$; C, below $\times 3$; D, transverse section $\times 4$; E–G, intermediate stage leaf: E, above $\times 3$; F, below $\times 3$; G, transverse section $\times 4$; H–J, juvenile leaf: H, above $\times 4$; I, below $\times 4$; J, transverse section $\times 8$; K, outer calyx lobe $\times 9$. (A–D, K, B.G. Briggs 2954, NSW; E–J, H.R. Toelken 9251, AD).

Conservation status: Locally common and conserved in Port Campbell National Park.

Diagnostic features

Superficially similar to *H. aspera* because of the combination of sparse radial multiangulate stellate hairs above and dense overlapping stellate hairs below, but is distinguished by usually producing 12 stamens as well as by the absence of simple hairs on adult plants mainly towards the base of leaves but also on the flanks and along the central vein. It is distinguished from *H. cinerea*, which also has a similar larger numbers of stamens and no simple hairs, by its small scattered hairs on the upper leaf surface and which often wear off to retain only the broad basal tubercles. The broadly obovate leaves with a truncate or emarginate apex are characteristic of the species.

Variation

The species shows an enormous range of variation in one population (H.R. Toelken 9252) in the size of the whole plant (decumbent shrublets scarcely 0.3 cm high to scramblers with branches up to 2.2 m long), the broadly obovate leaves (from 4.4×2.3 mm at the apex of senescing branches to 21.1×14.4 mm on actively growing branches or 32.4×18.1 mm (H.R. Toelken 9251) on coppice shoots), and the flowers with petals 4.6 – 11.3 mm long.

The vestiture is, however, remarkably constant except for the first few leaves (apparently rarely more than six leaves and which are usually lost soon) on coppicing branches and presumably also on the juvenile leaves. The first of these leaves has mainly hooked simple hairs and only a few stellate hairs on the flanks and central vein, but the number of stellate hairs rapidly increases on subsequent leaves and soon replace the simple hairs completely. Simple hairs were, however, not observed on coppicing branches, which were more sparsely covered with small and larger stellate hairs than is usual on adult plants.

Notes

The epithet 'truncata', Latin, refers to truncated or abruptly ending leaf apices accentuated in this species by the usually rather broad-obovate leaves.

Although J.H. Willis had annotated in 1944 a herbarium specimen of this taxon as *H. billardierei* var. *latifolia* var. nov., Wakefield (1957) seems to have included this form in his wider concept of *H. aspera*.

Voucher specimens (14 specimens examined)

VICTORIA: *A.C. Beauglehole* 21026 & *E.W. Fink*, Port Campbell National Park, 5.ix.1966 (MEL); *B.G. Briggs* 2954, near Port Campbell, 23.x.1969 (NSW); *H.B. Williamson s.n.*, Port Campbell, -x.1917 (MEL).

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