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P. B. Heenan

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## Three newly recognised species of *Hypericum* (Clusiaceae) from New Zealand

P. B. HEENAN

Allan Herbarium  
Landcare Research  
PO Box 40  
Lincoln 7640, New Zealand

**Abstract** Phylogenetic analysis of nrDNA ITS sequence data infers that New Zealand plants previously assigned to *Hypericum japonicum* are incorrectly placed in that species. Morphological and DNA sequence data support the recognition of two endemic and one indigenous species of *Hypericum*. *Hypericum rubicundulum* and *H. minutiflorum* are newly described species endemic to New Zealand, and the DNA data infer they are sister species. These two species are distinguished from *H. pusillum* by a rhizomatous growth habit and leaves that are grey-green to olive-green and usually ruddy. In comparison to *H. rubicundulum*, *H. minutiflorum* has a more compact growth habit, much smaller leaves and flowers, and is restricted to the central North Island. *Hypericum rubicundulum* occurs in inland parts of the South Island, and is known from one collection in the North Island. *Hypericum pusillum* Choisy is a reinstated name, based on a Tasmanian type, that is applied to prostrate or decumbent, green and sinuate-leaved plants from Tasmania and New Zealand. This is the most common species in New Zealand, occurring on North, South, and Stewart Islands.

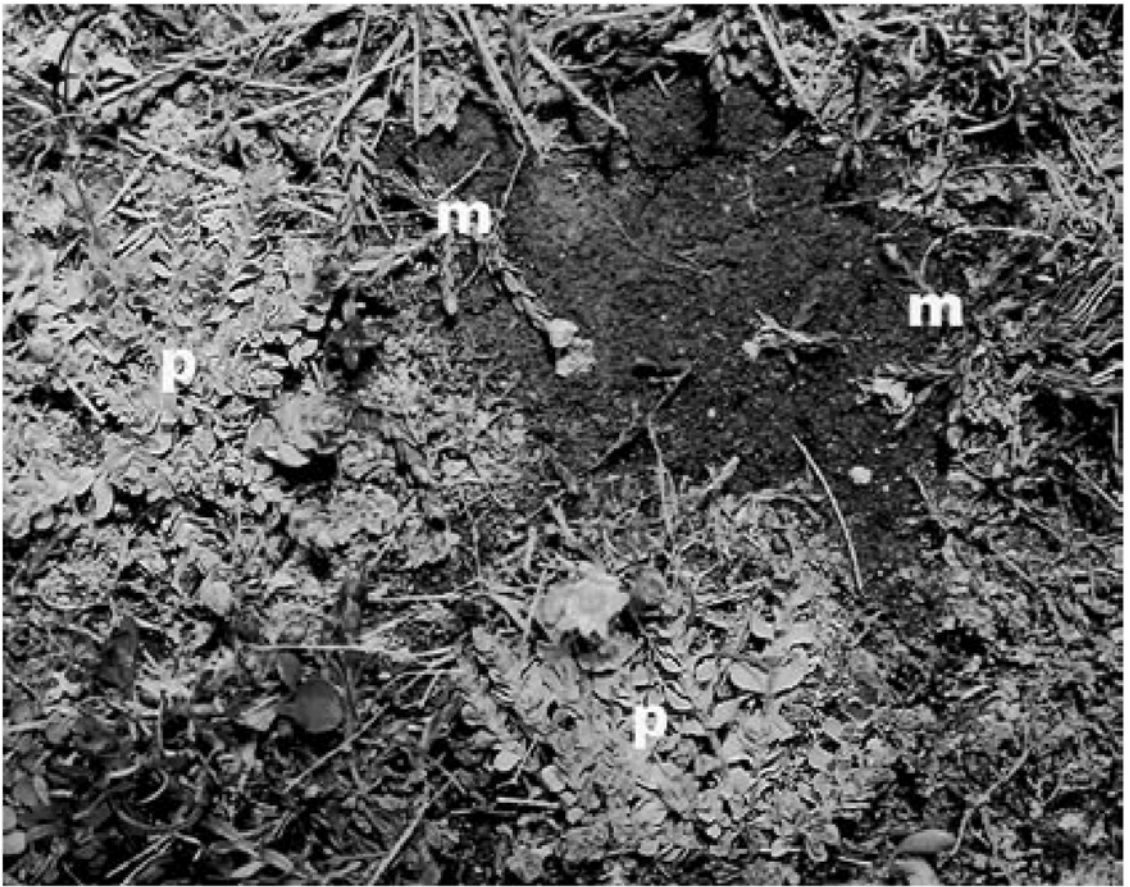
**Keywords** Clusiaceae; *Hypericum*; *H. pusillum*; *H. rubicundulum*; *H. minutiflorum*; new species; taxonomy; DNA sequence data; New Zealand flora

### INTRODUCTION

Plants from New Zealand that have been referred to *Hypericum japonicum* are decumbent or prostrate, short-lived, perennial herbs with leaves <10 mm long and usually solitary, terminal yellow flowers <12 mm in diameter. They usually grow as a minor component of coastal to montane, damp, wet habitats, such as occur around tarn and lake margins and in depressions in grassland and in open scrub. *Hypericum japonicum* is considered indigenous to New Zealand but its distribution extends to Australia and South East Asia (Robson 1972, 1990). The most recent taxonomic treatment of *H. japonicum* recognised five main variants, with one of these (variant 5) considered to occur in New Guinea, Tasmania, and New Zealand (Robson 1990). Characters emphasised in this treatment included inflorescence branching pattern, stem orientation, and sepal shape.

The name *H. japonicum* was initially applied to New Zealand plants by Hooker (1852, 1860, 1867), and this view was followed in more recent times by Cheeseman (1906, 1925), Allan (1961), Robson (1972, 1990), and Webb et al. (1988). It is noteworthy, however, that a monograph of *Hypericum* by Choisy (1821) provided the name *H. pusillum* for plants from Tasmania, and these are indistinguishable from some of the plants in New Zealand. This name has not subsequently been used, with a clear preference being taken by Robson (1972, 1990) for a very broad morphological and geographic concept of *H. japonicum*. In New Zealand, variation among plants referred to *H. japonicum* was first recognised by Druce (1993), who identified several entities and gave them informal names such as “S.I.”, “Volcanic Plateau”, “Glen Allen”, and “Howard”. The distinctiveness of some of these informal entities is such that they can be readily distinguished in the field and sometimes they grow together (Fig. 1).

In this study, nrDNA Internal Transcribed Spacer (ITS) sequence data are used to test hypotheses of the relationships of New Zealand *Hypericum* plants assigned by Robson (1990) to *H. japonicum* s.l. These hypotheses are: (1) New Zealand plants are



**Fig. 1** *Hypericum pusillum* (p) and *H. minutiflorum* (m) growing together on frost flats at Rangitaiki, central North Island (NZMS 260 U19/052462) (Photo P. N. Johnson).

correctly placed in *H. japonicum*; (2) New Zealand plants belong with the *H. japonicum* complex but should be recognised as distinct species; (3) New Zealand plants are wrongly placed in *H. japonicum*. Furthermore, morphological variation of New Zealand plants traditionally assigned to *H. japonicum* is critically examined to test suggestions (e.g., Druce 1993) that there are a number of unnamed entities in New Zealand.

## MATERIALS AND METHODS

The discussion that follows distinguishes three species within the New Zealand *H. japonicum* complex. For convenience and consistency throughout the paper, these are referred to as *H. pusillum*, *H. rubicundulum*, and *H. minutiflorum*. *Hypericum pusillum*

is a reinstated name and the latter two species are formally named and described later in this paper.

## Plant material and morphology

The taxonomic decisions taken in this paper are based on the study of herbarium specimens, field-collected material, and cultivated specimens of known wild origin. Field studies and collections of *Hypericum* have been made throughout New Zealand since 1995. To assess morphological variation, plants have been cultivated under similar conditions in a glasshouse at the experimental nursery, Landcare Research, Lincoln. This approach minimises the effect of environmentally induced variation. *Hypericum rubicundulum* has been grown from plants gathered at The Lakes (Hawke's Bay); Lake Ohau tarns, Cass River, and Glenmore Tarns (Canterbury); and Buller River (Nelson). *Hypericum*

*pusillum* has been cultivated from plants collected from West Dome and Three Sisters (Southland); Pisa Range, Roxburgh, and Lake Wanaka (Otago); Lake Brunner (Westland); Cameron River and Lake Ellesmere (Canterbury); Buller River (Nelson); Pelorus River and Green Bay (Marlborough); Rangitaiki River (South Auckland); and Hauturu (North Auckland). *Hypericum minutiflorum* has been grown from plants obtained from Moawhanga River (Wellington) and Matea Swamp and Waione Frost Flat from the Kaingaroa Plain (South Auckland).

#### DNA extraction, amplification, sequencing, and analyses

The *nrDNA* internal transcribed spacer region comprising ITS 1, the 5.8S gene, and ITS 2 was sequenced for nine samples of *Hypericum* from New Zealand and one from Australia (Table 1).

In addition to samples from the New Zealand *H. japonicum* complex, these new sequences included two plants of *H. gramineum*. These new sequences were included in a larger dataset of previously published sequences from *Hypericum* sect. *Trigynobrathys* and several other sections (Park & Kim 2004; Kress et al. 2005; K. M. Dlugosch & I. M. Parker unpubl.) (Table 1). *Thornea calcicola* was selected as outgroup since it has been shown to be sister to *Hypericum* (Park & Kim 2004).

Plant DNA was extracted from fresh tissue and herbarium material using the Sigma Extract-N-Amp Kit (XNAP2) or the QIAGEN DNeasy Plant Kit (69104). Temperature and cycling conditions were as described by Wright et al. (2006). For ITS amplification, the 18S (forward) primer used was CY1 (TACCGATTGAATGATCCGGTGAAG) and the 28S (reverse) primer was CY3 (CGCCGTTACTAG-

**Table 1** Species of *Hypericum* and *Thornea calcicola* (outgroup) included in the phylogenetic study.

Species	Section	Collection details and voucher or reference	GenBank accession
<i>H. aegypticum</i>	<i>Adenotrias</i>	Park & Kim 2004	AY573013
<i>H. androsaemum</i>	<i>Androseamum</i>	Park & Kim 2004	AY573012
<i>H. boreale</i>	<i>Trigynobrathys</i>	Park & Kim 2004	AY573026
<i>H. brevistylum</i>	<i>Trigynobrathys</i>	Park & Kim 2004	AY573019
<i>H. canariense</i> var. <i>floribundum</i>	<i>Webbia</i>	K. M. Dlugosch and I. M. Parker unpubl.	EF015304
<i>H. erectum</i>	<i>Hypericum</i>	Park & Kim 2004	AY572991
<i>H. formosum</i>	<i>Hypericum</i>	Park & Kim 2004	AY573018
<i>H. gramineum</i>	<i>Trigynobrathys</i>	Sydney, Australia, CHR 326439	EU352257
<i>H. gramineum</i>	<i>Trigynobrathys</i>	Lake Dunstan, Otago, New Zealand, CHR 513231	EU352256
<i>H. japonicum</i>	<i>Trigynobrathys</i>	Park & Kim 2004	AY573025
<i>H. jeonjocksanense</i>	<i>Trigynobrathys</i>	Park & Kim 2004	AY573023
<i>H. laxum</i>	<i>Trigynobrathys</i>	Park & Kim 2004	AY573024
<i>H. maculatum</i>	<i>Hypericum</i>	Park & Kim 2004	AY555842
<i>H. minutiflorum</i> A	<i>Trigynobrathys</i>	Matea, South Auckland, New Zealand, AK 300469	EU352250
<i>H. minutiflorum</i> B	<i>Trigynobrathys</i>	Matea, South Auckland, New Zealand, CHR 592397	EU352251
<i>H. minutiflorum</i> C	<i>Trigynobrathys</i>	Waione Flats, South Auckland, New Zealand, AK 289782	EU352252
<i>H. mutilum</i>	<i>Trigynobrathys</i>	Kress et al. 2005	DQ006013
<i>H. olympicum</i>	<i>Olympia</i>	Park & Kim 2004	AY573008
<i>H. pusillum</i> A	<i>Trigynobrathys</i>	Lake Brunner, Westland, New Zealand, CHR 592394	EU352253
<i>H. pusillum</i> B	<i>Trigynobrathys</i>	Three Sisters, Southland, New Zealand, CHR 527036	EU352249
<i>H. revolutum</i>	<i>Campylosporus</i>	K. M. Dlugosch and I. M. Parker unpubl.	EF638821
<i>H. rubicundulum</i> A	<i>Trigynobrathys</i>	Lake Tekapo, Canterbury, New Zealand, CHR 527037	EU352248
<i>H. rubicundulum</i> B	<i>Trigynobrathys</i>	The Lakes, Hawke's Bay, New Zealand, CHR 592395	EU352254
<i>H. rubicundulum</i> C	<i>Trigynobrathys</i>	Cass River, Canterbury, New Zealand, CHR 592396	EU352255
<i>H. scoreri</i>	<i>Hypericum</i>	Park & Kim 2004	AY573017
<i>H. setosum</i>	<i>Trigynobrathys</i>	Park & Kim 2004	AY573020
<i>H. vulcanicum</i>	<i>Hypericum</i>	Park & Kim 2004	AY573016
<i>H. yezoense</i>	<i>Hypericum</i>	Park & Kim 2004	AY573004
<i>Thornea calcicola</i>	Outgroup	Park & Kim 2004	AY573028

GGGAATCCTTGT) (J. Keeling pers. comm.). PCR products were purified using the Agencourt PCR Purification Kit (000130). Sequencing was carried out using ABI PRISM BigDye Terminator chemistry. Sequencing extension products were purified using the Agencourt CleanSeq kit (000121), and analysed on an ABI 3100 Capillary Sequencer.

Sequence alignment was initially performed using ClustalW as implemented in MEGA version 4.0 (Tamura et al. 2007). Multiple alignment parameters were set to 12 for gap opening penalty and 6 for gap extension penalty. Minor adjustments to sequence alignments were subsequently made manually. The phylogenetic analyses were accomplished using the branch and bound search function of PAUP\* version 4.0b10 (Swofford 2001). We used the PAUP\* settings upper bound computed by stepwise, collapse option on, Multrees on, and the furthest addition sequence. The characters were unordered and equally weighted, and gaps treated as missing data. Bootstrap analysis comprised 100 000 replicates.

## RESULTS

### *Hypericum japonicum* Thunb. ex Murray

*Hypericum japonicum* as circumscribed by Robson (1990, pp. 122–130) is a highly variable species with considerable variation in habit, inflorescence architecture, and bract shape. It also occurs over a very wide geographic area, including Asia (Japan, South Korea, Philippines, China, India, and Nepal), South East Asia and Malaysia (Thailand, Malaya to New Guinea), and Australasia (Australia and New Zealand), and is an important ricefield weed. Robson's (1990) treatment of *H. japonicum* recognised five variants, with three of these named as "*japonicum pro parte*", inferring that these are most similar to the holotype specimen from Japan (Kimura 1980). The distribution of the three "*japonicum pro parte*" variants is South East Asia, including Japan, Borneo, China, Philippines, Taiwan, and Thailand. Distinguishing characteristics of these three "*japonicum pro parte*" variants include: annual herb, erect growth habit, little branched, bracts small linear to lanceolate, petals as long as the sepals, and 20–30 stamens. Other recent keys and descriptions have emphasised *H. japonicum* having stems 200–500 mm long, flowers up to 8 mm in diameter, truncate sepal apices, and the stamens grouped in three fascicles (e.g., Ohwi 1965; Park & Kim 2005). A number of these features

can be observed in illustrations of the species by Thunberg (1784) and Kimura (1980).

New Zealand plants were treated by Robson (1990) as *H. japonicum* "Variant (5), humifusum". In comparison to "*H. japonicum pro parte*", these New Zealand plants differ by their  $\pm$  prostrate growth habit, diffuse or rarely produced branches, foliar bracts, petals longer than sepals, and 5–10 stamens (Robson 1990, p. 130). Other characters of New Zealand plants include the perennial growth habit, stems being <10 cm long and only occasionally up to 20 cm long (usually shade forms), flowers up to 11 mm in diameter, sepal apices mainly subacute, and 7–10 stamens that are free with only occasionally 2 or 3 being fused near the base.

It is clear from the above discussion that Robson (1990) took a very broad view of the circumscription of *H. japonicum*, but that his recognition of five variants suggests there are some naturally recognisable groups. In this regard, recent taxonomic work has offered an alternative view of the classification of *H. japonicum* s.l. Park & Kim (2004, 2005), for example, recognised *H. laxum* at species rank, whereas Robson (1990) treated this as "variant (4) '*laxum*'". Furthermore, Park & Kim (2005) have recognised an additional new species (*H. jeongjocksanense*) that they distinguished from *H. laxum*. Although *H. japonicum*, *H. laxum*, and *H. jeongjocksanense* are morphologically distinct, a phylogenetic study of *Hypericum* species from Korea and Japan has shown that they are closely related as they belong to a monophyletic group (Park & Kim 2004) (see also Fig. 3).

### Growth habit

*Hypericum pusillum* is distinguished by numerous prostrate to decumbent main stems that originate from a central crown (Table 2, Fig. 1). Few, if any, rhizomatous stems are produced, and these usually occur within a few millimetres of the crown. The main stems are notable in that they often produce adventitious roots at their base, and as these root and stems grow the plants increase their size. The main stems are also branched and usually produce lateral stems along their length. *Hypericum rubicundulum* and *H. minutiflorum* are distinguished from *H. pusillum* by a strongly rhizomatous growth habit with the stems originating from below ground. The rhizomatous stems often spread several centimetres from the central area of the plant. These stems do not produce adventitious roots at their base but they are often branched along their length. *Hypericum rubicundulum* has decumbent, spreading or upright

stems, whereas in *H. minutiflorum* the stems are usually prostrate or decumbent.

*Hypericum pusillum*, *H. rubicundulum*, and *H. minutiflorum* are highly variable in their growth habit depending on the local environmental conditions. Plants can be small and diminutive with unbranched main stems only 30–40 mm long, or more robust and vigorous with branched main stems up to 100 mm, and sometimes 200 mm, long. Plants growing in fertile or moist sites are usually much larger and more robust than plants growing in less fertile or drier sites.

### Leaf characters

Leaf colour, size, and surface provide important differences between the three species (Table 1). *Hypericum pusillum* is readily distinguished by its light green to yellow-green colour and distinctly sinuate surface and margins (Fig. 2). The sinuate margins are particularly obvious on new or emergent leaves. In contrast, the leaves of *H. rubicundulum* and *H. minutiflorum* are grey-green to olive-green, usually ruddy, particularly on the margin and distally, and, if at all, have only slightly sinuate surfaces and margins (Fig. 2). The leaves of *H. pusillum* and *H. rubicundulum* are of similar size (e.g., (1.0–)2.5–9.0(–10.0) × 0.5–3.5(–5.5) mm), and generally much longer and wider than those of *H. minutiflorum* (e.g., 1.5–4.5 × 0.3–1.2 mm).

### Floral and fruit characters

The flowers of *H. pusillum*, *H. rubicundulum*, and *H. minutiflorum* are similar and offer few qualitative

differences. A difference is *H. pusillum* having green sepals whereas *H. rubicundulum* and *H. minutiflorum* have sepals that are grey-green to olive-green and often ruddy distally and on the margin; these colours are similar to those of the leaves for each species. The floral parts of *H. minutiflorum* are much smaller than those of *H. rubicundulum* and *H. pusillum* (Fig. 2; Table 2). For example, *H. minutiflorum* has flowers 3–6 mm in diameter and petals 2.0–3.3 mm long and 0.9–1.2 mm wide. In contrast, *H. pusillum* has flowers up to 9 mm in diameter and petals that are 2.8–4.0 mm long and 1.7–2.5 mm wide, and *H. rubicundulum* has flowers up to 11 mm in diameter and petals that are 2.8–5.8 mm long and 2.0–3.5 mm wide. When cultivated under similar conditions, the flowers of *H. rubicundulum* are always slightly larger than those of *H. pusillum* (Fig. 2).

Seed morphology also provides diagnostic characters to distinguish the species recognised here. Firstly, *H. rubicundulum* has distinct longitudinal ribs that are usually clearly evident on the seed surface (see Webb & Simpson 2001, pl. 60). In contrast, the seeds of *H. pusillum* lack these longitudinal ridges (Webb & Simpson 2001, pl. 60). *Hypericum minutiflorum* is variable in regard to the longitudinal ribs, with these being absent or only weakly developed. The seeds of *H. minutiflorum* are often oblong-obovate, in comparison to the oblong to elliptic-oblong shape of the seeds in *H. rubicundulum* and *H. pusillum*. The testa surface of all species is finely reticulate, although in *H. pusillum* this is sometimes poorly developed with the surface appearing almost smooth.

**Table 2** Characters distinguishing *Hypericum pusillum*, *H. minutiflorum*, and *H. rubicundulum*.

Character	<i>H. pusillum</i>	<i>H. minutiflorum</i>	<i>H. rubicundulum</i>
Growth habit	not rhizomatous	rhizomatous	rhizomatous
Leaves	2.5–9.0 × 1.5–3.5 mm, usually strongly sinuate, light green to yellow-green	1.5–4.5 × 0.3–1.2 mm, grey green to olive-green, usually ruddy on margin and distally	(1.0–)2.5–8.0(–10.0) × 0.5–3.5(–5.5) mm, often slightly sinuate, grey-green to olive-green, often entirely ruddy, particularly on margin and distally
Leaf pellucid glands diam.	up to 0.1 mm	up to 0.05 mm	up to 0.05 mm
Flower diam.	up to 9 mm diam	up to 6 mm diam	up to 11 mm
Sepals	2.8–4.7 × 0.9–1.4 mm	1.7–2.8 × 0.6–1.0 mm	2.5–5.0 × 1.0–1.8(–2.3) mm
Petals	2.8–4.0 × 1.7–2.5 mm	2.0–3.3 × 0.9–1.2 mm	2.8–5.8 × 2.0–3.5 mm
Capsule	2.8–4.5 × 2.2–3.8 mm	2.3–2.9 × 1.5–2.5 mm	2.8–3.5 × 1.5–2.5 mm
Seeds	longitudinal ribs absent	longitudinal ribs absent or weak	longitudinal ribs usually distinct

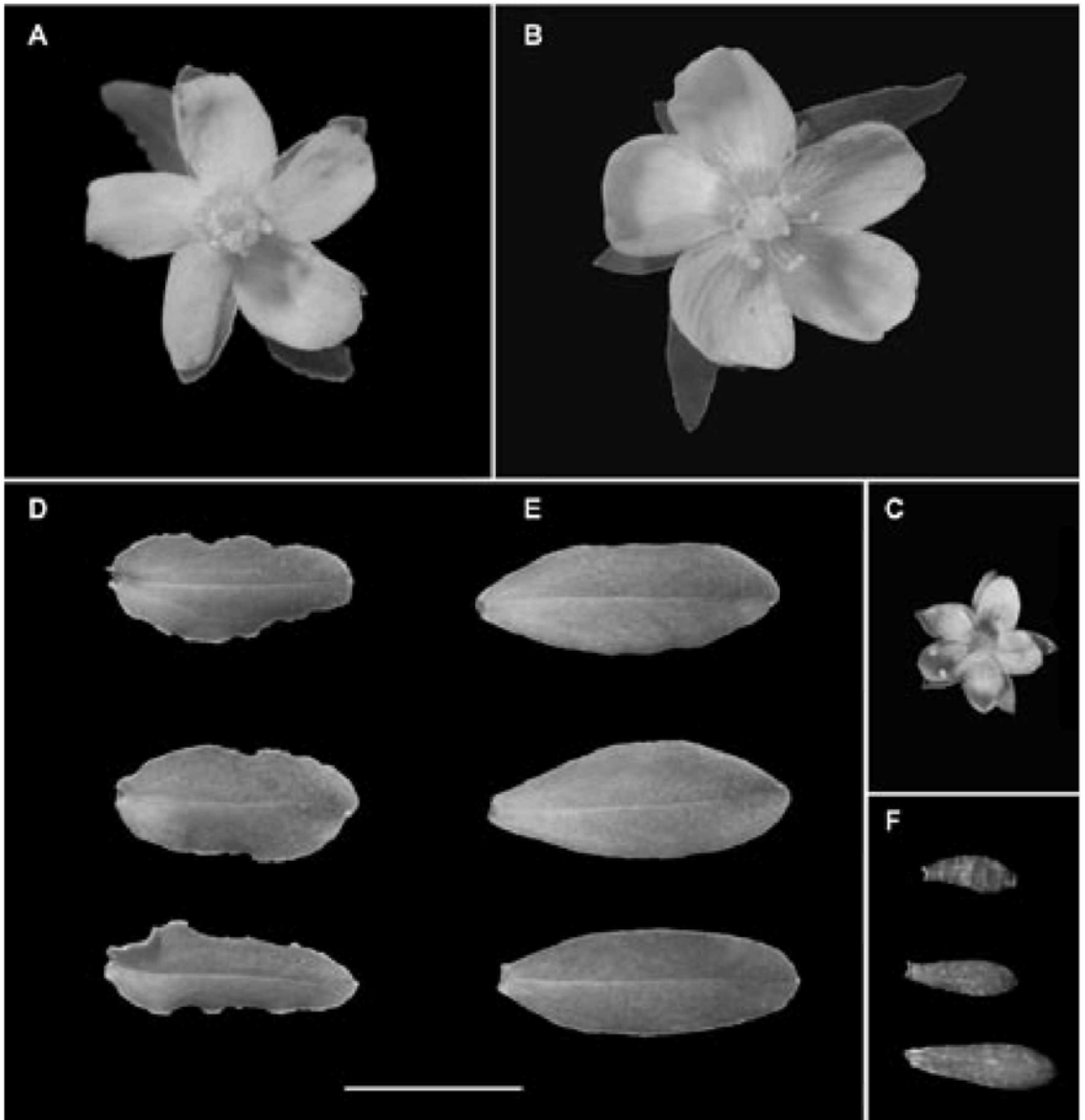


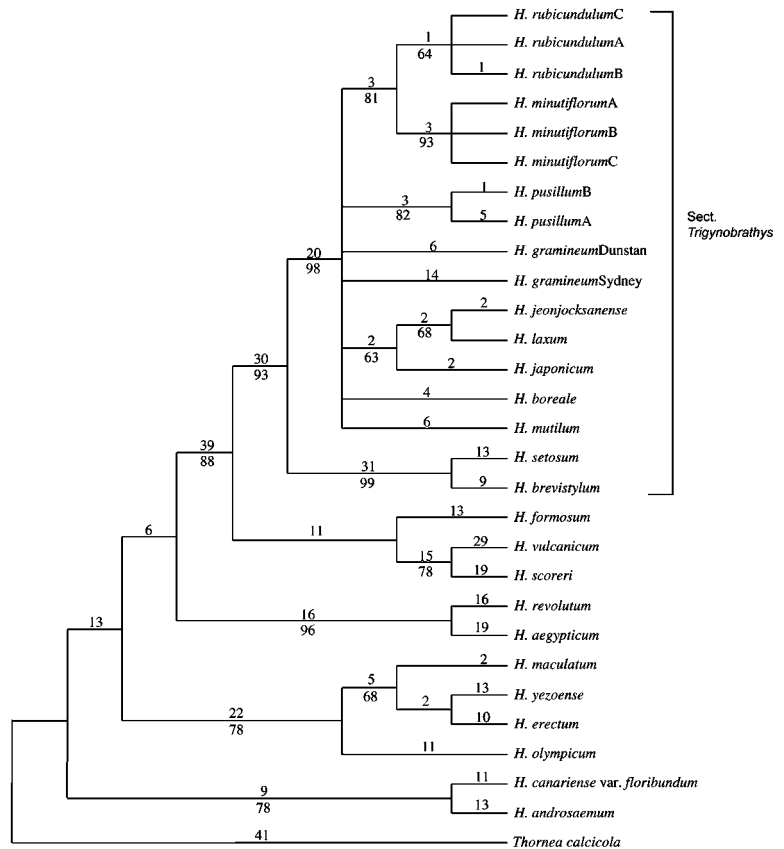
Fig. 2 *Hypericum* leaves and flowers from plants grown in cultivation: A, D, *H. pusillum*; B, E, *H. rubicundulum*; C, F, *H. minutiflorum*. Scale bar = 5 mm.

#### DNA sequence data

The aligned ITS dataset contained 29 samples and 846 characters; 607 of these characters were constant, 239 were variable, and 162 were parsimony informative. A branch and bound search retrieved 38 most parsimonious trees and a strict consensus of these is presented (Fig. 3; CI = 0.662; RI = 0.832; RC = 0.551). *Hypericum minutiflorum*, *H. pusillum*, and *H. rubicundulum* are part of a well-supported clade

(98% bootstrap support) along with other members of *H.* sect. *Trigynobrathys*. Relationships within this clade are only partially resolved, with *H. japonicum* being sister to *H. laxum* and *H. jeonjocksanense*. Three samples assigned to *H. minutiflorum*, three assigned to *H. rubicundulum*, and two assigned to *H. pusillum* all grouped together in their respective species. *Hypericum minutiflorum* and *H. rubicundulum* appear as sister taxa. The sister group of

**Fig. 3** Strict consensus of most parsimonious trees for *Hypericum* nrDNA ITS sequences. Bootstrap values are indicated below the branches and number of changes above the branches.



*H. pusillum* is not resolved in this analysis. Another intriguing finding is that the two samples assigned to *H. gramineum* are not resolved as a clade in this analysis and they differ by 20 substitutions. This suggests that *H. gramineum* as currently circumscribed may include more than one species, and that further survey of sequence characters may be informative in addressing this issue.

### Conclusions

The phylogenetic analysis of nrDNA ITS sequence data has shown that New Zealand plants are incorrectly placed in *H. japonicum* s.l. and, furthermore, they do not belong to the clade that includes that species, *H. laxum* (treated by Robson (1990) as *H. japonicum* variant 4), and *H. jeonjocksanense*, the recently named segregate of *H. laxum* (Park & Kim 2005) (Fig. 3). Therefore, hypotheses (1) and (2) (as outlined in the Introduction), respectively, are falsified. I infer from the DNA analysis that the New Zealand plants referred to *H. japonicum* have been wrongly assigned to that species and require new

names. A feature of the ITS data is that the small number of samples assigned to *H. minutiflorum*, *H. pusillum*, and *H. rubicundulum* are each recovered as monophyletic.

Vegetative and floral morphology distinguishes three new species of *Hypericum* from New Zealand. Cultivated plants (grown for up to 13 years) all retained the growth habit, leaf, and flower characters they had when originally collected from the wild, thereby confirming that the morphological variation has a genetic basis and is not induced by the different environments the plants were growing in. Accordingly, three species of *Hypericum* are formally recognised as indigenous to New Zealand for plants that had previously been included in the broad concept of *H. japonicum*. *Hypericum rubicundulum* and *H. minutiflorum* are described as new endemic species. *Hypericum pusillum* Choisy is the available name for the indigenous species, as *Ascyrum humifusum* Labill. cannot be transferred to species rank in *Hypericum* since the new combination would be pre-occupied by *H. humifusum* L.



## TAXONOMY

*Hypericum* L., *Species Plantarum* ed. 1, 2, 783 (1753)

*Hypericum pusillum* Choisy, *Prodr. monogr. Hyperic.*, 50 (1821)

≡ *Ascyrum humifusum* Labill., *Novae Hollandiae Plantarum Specimen* 2 (2), 33, t. 175 (1806) (non *H. humifusum* L.).

≡ *Hypericum japonicum* var. *humifusum* (Labill.) Hook.f., *Flora Tasmaniae* 1, 53 (1855).

HOLOTYPE: P, Nov Holland Islands, *Labillardiere*, 1809.

DESCRIPTION (Fig. 1, 2): Herbs, perennial, not rhizomatous, glabrous. Stems usually <100 mm long, sometimes up to 200 mm long, 0.3–0.6 mm diam., usually prostrate to decumbent, sometimes erect, often with adventitious roots at base, without pellucid glands, quadrangular, usually branched below inflorescence. Leaves sessile, 2.5–9.0 × 1.5–3.5 mm, usually broadly elliptic to elliptic, usually strongly sinuate, light green to yellow-green, abaxially sometimes slightly paler; pellucid glands up to 0.1 mm diam., translucent in light, >25 glands conspicuous on upper 2/3 of abaxial surface, inconspicuous on adaxial surface; base attenuate; margin usually sinuate; apex subacute to obtuse; main lateral veins 1 to 2, basal, tertiary reticulation not visible. Inflorescence terminal, flowers solitary. Pedicels 3.7–3.8 mm long, 0.3–0.4 mm diam., green, quadrangular. Flower up to 9 mm diam.; bud cylindrical ellipsoid, apex subacute. Sepals 5, 2.8–4.7 × 0.9–1.4 mm, unequal widths, free, spreading, oblong, narrow elliptic, or elliptic-oblong, sometimes sinuate, green; margin translucent, glands absent; base free, attenuate; apex subacute to rounded, sometimes with a small apiculus. Petals 5, 2.8–4.0 × 1.7–2.5 mm, pale yellow to dark yellow, obovate to oblong; glands absent; margins entire. Stamens 9, free, c. 2.1 mm long, 0.1 mm diam., translucent, pale yellow, slightly curved, terete; anthers 0.2–0.3 mm long, yellow. Ovary c. 1.3 × 1.0–1.1 mm, ovoid, weakly trigonous in cross-section, light green; styles 3(–4), 0.3–0.5 mm long, spreading, translucent; stigma c. 0.2 mm diam. Capsule 2.8–4.5 × 2.2–3.8 mm, cylindrical to globose, shorter or longer than sepals. Seeds 0.5–0.75 × c. 0.3 mm, testa orange-brown to light yellow, aging to dark brown, oblong to elliptic-oblong, terete, semi-glossy, finely reticulate, longitudinal ribs absent.

Chromosome number  $2n = 16$  (de Lange et al. 2004).

REPRESENTATIVE SPECIMENS: NORTH AUCKLAND: Kaiheriheri, *H. Carse*, 16 Nov 1902, CHR 295787; Cape Colville, *L. B. Moore*, 17 May 1933, CHR 92823; Otara, *R. O. Gardner* 2795, 25 Dec 1980, AK 151964; Puketia State Forest, *E. K. Cameron* 2788, 29 Jan 1984, AK 273003; Great Barrier Island, *E. K. Cameron* 2053, 2 Jan 1983, AK 271432; Hokianga, *A. E. Wright* 3912, 24 May 1981, AK 153912; Keri Keri falls, *R. Cooper*, 5 Jan 1950, AK 35934; Waitakere Ranges, *C. A. Mackinder*, 3 Dec 1978, AK 149043; Kaitaia, *R. H. Matthews*, 1897, WELT 25597; Wairoa, *D. Petrie*, Feb 1902, WELT 27596; Hobson's Bay, *Herb. T. Kirk*, WELT 27592. SOUTH AUCKLAND: Lake Ohinewai, *P. J. de Lange* 213, 27 Jan 1990, CHR 467324; Aotea Harbour, *P. J. de Lange*, 17 Jan 1985, AK 170425; Matata, *D. Petrie*, Mar 1896, WELT 27600; Lake Taupo, *P. N. Johnson*, 13 Jan 1981, CHR 363775; Kawerau, *E. A. Brown*, 6 Jul 1987, AK 270418; Arahaki Lagoon, *E. K. Cameron* 3207, 29 Dec 1984, AK 274483. GISBORNE: Opotiki, *M. Heginbotham*, Mar 1976, CHR 368350; Ruapani Clearing, *A. P. Druce*, Feb 1968, CHR 180603; Ruapani lakes, *P. Hynes*, 20 Feb 1970, AK 125619. TARANAKI: Pouakai Range, *A. P. Druce*, 7 Mar 1962, CHR 116534; Mt Egmont, *B. C. Aston*, Mar 1910, WELT 27611. WELLINGTON: Mt Tihia, *A. P. Druce*, Apr 1974, CHR 273206; Kaimanawa Range, *A. P. Druce*, Jan 1974, CHR 260271; Marton, *C. C. Ogle* 2503, 28 Feb 1993, CHR 481727; Wairarapa, *A. J. Healy*, 17 Mar 1853, CHR 84438; Waikanae beach, *E. Phillips Turner*, AK 102651; Paraparaumu, *B. C. A[ston]*, Jan 1912, WELT 40580. MARLBOROUGH: Green Bay, Queen Charlotte Sound, *P. B. Heenan*, 8 Jan 2004, CHR 569891; Awatere Valley, *J. H. McMahan*, Dec 1926, CHR 295950. CANTERBURY: Kaituna, *H. D. Wilson* BP541, 8 Nov 1985, CHR 496487; Travis wetland, *D. A. Banks*, 24 Jan 1996, CHR 509494; Lake Heron, *P. Hynes*, 29 Jan 1971, AK 128462. NELSON: Farewell Spit, *M. J. A. Simpson* 4546, 19 May 1965, CHR 148978; Karamea, *W. R. Sykes* 26/85, 2 Feb 1985, CHR 418024; Matiri Range, *A. P. Druce*, Mar 1979, CHR 355099; Mt Arthur, *J. A. Rattenbury*, 23 Feb 1953, AK 262511; Mangarakau, *E. K. Cameron* 13447, 9 Jan 2006, AK 295017. WESTLAND: Taramakau, *P. Wardle*, 9 Dec 1975, CHR 228228; Marsden, *A. J. Healy* 61/86, 31 Jan 1961, CHR 123147; Cascade, *P. N. Johnson*, 13 Mar 1978, CHR 311104. OTAGO: Wickliffe Bay, *P. N. Johnson*, Jun 1982, CHR 385292; Westport, *W. L. Townson*, AK 245651; Charleston, *W. R. B. Oliver*, 1 Mar 1949, WELT 7845; Lake Wanaka, *D. Petrie*, Nov 1893, WELT 27603; Dunedin, *D. Petrie*, Jan 1891, WELT 27610.

SOUTHLAND: Awarua Bay, *R. Powell*, 9 Mar 1974, CHR 103389; Stewart Island, *H. D. Wilson*, 1 Mar 1978, CHR 322469; Mason Bay, Stewart Island, *J. E. Attwood*, 15 Jan 1940, AK 49916; Freshwater Plain, Stewart Island, *E. A. Willa*, 20 Feb 1961, WELT 52137. CULTIVATED: Landcare Research experimental nursery, Lincoln, *P. B. Heenan*, 9 Nov 2007, ex Lake Brunner, Westland, New Zealand, CHR 592394.

DISTRIBUTION AND HABITATS: *Hypericum pusillum* is widespread throughout the North Island and South Island, and also occurs on Stewart Island, Great Barrier Island, and other islands of the Hauraki Gulf (Fig. 4). It grows in a range of inland and coastal habitats, with a preference for wet or damp sites. For example, it grows on river and stream banks, lake and tarn margins, swamps and bogs, open areas in forest, and damp hollows among tussocks and grasses. However, it also grows in dry sites such as volcanic lava and tephra (Rangitoto Island) and on clay banks, and it can persist among pasture grasses and along tracks.

*Hypericum pusillum* and *H. minutiflorum* are sympatric at a number of localities in the central North Island, including Waimarino Plain (e.g., CHR 295948 and CHR 471835, respectively), Mt Tihia (e.g., CHR 273206 and CHR 273235, respectively), and near Rangitaiki (e.g., CHR 534302 and CHR 534303, respectively; Fig. 1). *Hypericum pusillum* and *H. rubicundulum* have also both been collected from The Lakes ("Kaweka Lakes"), Hawke's Bay (e.g., CHR 131733 and CHR 592395, respectively).

VARIATION: *Hypericum pusillum* has a wide geographic range and grows in a number of different habitats in New Zealand. As a consequence, the morphology of *H. pusillum* is also variable as it responds to different habitats in different geographic areas. For example, plants growing in shaded scrub (e.g., CHR 286838, AK 246392) and damp ground in forest (e.g., CHR 415738) have large leaves. Some of these larger leaved forms were referred to by Druce (1993) as *H. "Glen Allen"*. *Hypericum pusillum* typically grows in open sites and has stems that are prostrate to decumbent, whereas when growing among more dense vegetation, the stems are erect.

A putative hybrid between *H. pusillum* and *H. minutiflorum* has been collected from Ngamatea East Swamp, Rangitikei River, northern Wellington (CHR 85880). This specimen has leaves that are strongly sinuate like *H. pusillum* but are ruddy coloured like *H. minutiflorum*. *Hypericum minutiflorum* has been collected from Ngamatea East Swamp (CHR

116279), and although *H. pusillum* is not known with certainty from the area, it is likely to be there as it occurs elsewhere with *H. minutiflorum* (see above).

SPECIES EPITHET: The epithet *pusillum* probably refers to the small stature of the species.

CONSERVATION STATUS: Not threatened.

***Hypericum rubicundulum* Heenan, sp. nov.**

DIAGNOSIS: Species nova *Hyperico pusillo* habitu rhizomatico, foliis cinereo-viridibus vel olivaceis saepe rubicundis marginibus non sinuatis, floribus paulo maioribus, seminibus longitudinaliter et distincte cristatis distinguenda.

A new species distinguished from *Hypericum pusillum* by a rhizomatous growth habit, leaves that are grey-green to olive-green and usually ruddy and without sinuate margins, slightly larger flowers, and seeds with distinct longitudinal ridges.

HOLOTYPE: Mt Hay Station, Lake Tekapo, margin of tarn, *A. J. Healy* 58/131, 12 Feb 1958, CHR 122480.

DESCRIPTION (Fig. 2): Herbs, perennial, rhizomatous, glabrous. Stems usually <60 mm long, occasionally longer, 0.3–0.4 mm diam., usually prostrate to decumbent, sometimes shortly upright, grey-green to olive-green and usually ruddy, adventitious roots absent, without pellucid glands, quadrangular, branched below inflorescence. Leaves sessile, (1.0–)2.5–8.0(–10.0) × 0.5–3.5(–5.5) mm, obovate, broadly elliptic, to oblong, often slightly sinuate, grey-green to olive-green, often entirely ruddy, particularly on margin and distally, abaxially sometimes slightly paler; pellucid glands up to 0.05 mm diam., translucent in light, 8–15 glands, barely conspicuous on upper 2/3 of abaxial surface, usually inconspicuous on adaxial surface; base attenuate; margin planar to slightly sinuate; apex subacute to obtuse; main lateral veins 1 to 2, basal, tertiary reticulation not visible. Inflorescence terminal, flowers 1(–3). Pedicels 0.4–0.5 mm long, 0.3–0.4 mm diam., grey-green to olive-green and usually ruddy, quadrangular. Flowers up to 11 mm diam.; bud cylindrical ellipsoid, apex subacute. Sepals 5(–6), 2.5–5.0 × 1.0–1.8(–2.3) mm, unequal widths, free, spreading, oblong, narrow elliptic or elliptic-oblong, sometimes slightly sinuate, grey-green to olive-green, often ruddy distally; margin translucent, usually ruddy, glands absent; base attenuate; apex subacute, sometimes with a small apiculus. Petals 5(–6), 2.8–5.8 × 2.0–3.5 mm, yellow, obovate to oblong, glands absent; margins entire. Stamens 9, free, 1.6–2.5 mm long, c. 0.1 mm diam.,

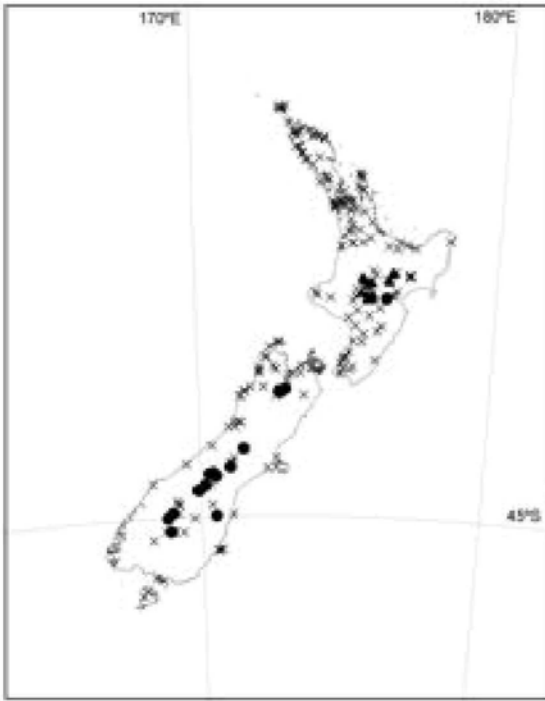


Fig. 4 Distribution of *Hypericum minutiflorum* (▲), *H. pusillum* (×), and *H. rubicundulum* (●).

translucent, pale yellow, usually slightly curved, terete, occ. fused at base; anthers 0.2–0.4 mm long, yellow. Ovary 1.3–1.9 × 1.0–1.6 mm, ovoid, often weakly trigonous in cross-section, light green; styles (2–)3(–4), 0.3–0.5 mm long, spreading, translucent, sometimes with purple-brown blotch at base; stigma 0.2–0.3 mm diam. Capsule 2.8–3.5 × 1.5–2.5 mm, cylindric to globose, usually slightly shorter than sepals. Seeds 0.6–0.7 × c. 0.3 mm, testa orange-brown to light yellow, aging to dark brown, oblong to elliptic-oblong, terete, semi-glossy, finely reticulate, longitudinal ribs usually distinct.

Chromosome number  $n = 8$ ,  $2n = 16$  (Hair & Beuzenberg 1959; de Lange et al. 2004).

REPRESENTATIVE SPECIMENS: NELSON: Buller River, *R. Mason & N. T. Moar* 4997, 26 Feb 1957, CHR 95874; Buller River, *M. J. A. Simpson* 4930, 25 Jan 1966, CHR 171439; Lake Rotoiti, *R. Melville* 6085, 18 Jan 1962, CHR 141991; Lake Rotoiti, *H. T[albot]*, 24 Jan 1963, CHR 268816; Howard River, *M. J. A. Simpson* 2917, 17 Mar 1961, CHR 120609. CANTERBURY: Pukaki, *H. E. Connor*, 2 Feb 1947, CHR 85620; Irishman Creek,

Lake Pukaki, *B. H. Macmillan & A. R. Mitchell*, 3 Mar 1970, CHR 206758; Swan Lagoon, Lake Ohau, *P. N. Johnson*, 28 Nov 1977, CHR 320203; Lake Ohau Road, Ohau Tarns, 18 Mar 2004, *P. J. de Lange* 5946, AK 285857; Swan Lagoon, *A. E. Wright* 13184, 8 Jan 2004, AK 293981; Ohau Tarns, *P. B. Heenan*, 6 Dec 2006, CHR 505497; Lake Tekapo, *D. Scott*, 9 Feb 1986, CHR 421014; “Ida kettle”, Coleridge, *D. Glenny*, 25 Nov 1984, CHR 567362; Peel Range, *A. P. Druce*, Mar 1986, CHR 401858. OTAGO: Shotover Valley, *A. P. Druce*, Jan 1992, CHR 471976; Dansey Pass, *J. B. Irwin*, 19 Dec 1971, CHR 323385; Crown Range, *A. P. Druce*, Jan 1992, CHR 471977. CULTIVATED: Landcare Research experimental nursery, Lincoln, *P. B. Heenan*, 9 Nov 2007, ex The Lakes, Hawke’s Bay, New Zealand, CHR 592395; Landcare Research experimental nursery, Lincoln, *P. B. Heenan*, 9 Nov 2007, ex Cass River, Lake Tekapo, Canterbury, New Zealand, CHR 592396.

DISTRIBUTION AND HABITATS: *Hypericum rubicundulum* occurs in inland parts of the South Island in Nelson, Canterbury, Otago, and Southland, and in the North Island it is known from one locality in Hawke’s Bay (The Lakes) (Fig. 4). It grows mainly on the margins of lakes and tarns and other wet depressions and seepages in drought-prone and dry-climate areas of inland South Island (e.g., Johnson & Rogers 2003). In these sites, *H. rubicundulum* usually occurs in the uppermost zones that experience the most brief or erratic periods of ponding. It has also been collected from grassland and tussockland.

SPECIES EPITHET: The epithet *rubicundulum* refers to the stems, leaves, and sepals which are usually ruddy.

CONSERVATION STATUS: *Hypericum rubicundulum* is considered to be Naturally Uncommon (Townsend et al. 2008) as most populations, if not all, are naturally small and scattered throughout its distributional range. Furthermore, it is also confined mainly to the specific habitat of tarn and lake margins. However, the qualifier “data poor” is appended since better estimates of the total number of populations and plants and the area of occupancy are required.

#### *Hypericum minutiflorum* Heenan, sp. nov.

DIAGNOSIS: Species nova *Hyperico pusillo* habitu rhizomatico compactoque, floribus diametro minore quam 6 mm et foliis valde minoribus, cinereo-olivaceis saepe rubicundis marginibus non sinuatis distinguenda.

A new species distinguished from *Hypericum pusillum* by a rhizomatous and compact growth

habit, flowers less than 6 mm in diameter, and leaves that are much smaller, grey-green to olive-green and usually ruddy, and without sinuate margins.

HOLOTYPE: Mt Tihia, c. 3400', tussockland, *A. P. Druce*, Feb 1967, CHR 165898.

DESCRIPTION (Fig. 1, 2): Herbs, perennial, rhizomatous, glabrous. Stems up to 50 mm long, 0.2–0.3 mm diam., usually prostrate, without pellucid glands, quadrangular, branched below inflorescence. Leaves sessile, 1.5–4.5 × 0.3–1.2 mm, narrowly elliptic, oblong, or lanceolate, planar to slightly sinuate, grey-green to olive-green, usually ruddy on margin and distally, abaxially sometimes slightly paler; pellucid glands up to 0.05 mm diam., translucent in light, scattered over lamina and margin, usually inconspicuous on adaxial surface; base attenuate; margin planar to slightly sinuate; apex acute to subacute; main lateral veins and tertiary reticulation not visible. Inflorescence terminal, occ. axillary, flowers 1(–3). Pedicels 0.7–1.8 mm long, 0.2–0.3 mm diam., dark green to olive-green, often ruddy, quadrangular. Flowers 3–6 mm diam.; bud cylindrical ellipsoid, apex subacute to obtuse. Sepals 4–5, 1.7–2.8 × 0.6–1.0 mm, free, spreading, oblong to elliptic, dark green to olive-green, usually ruddy margin and distally, width unequal; lamina and marginal pellucid glands minute, scattered; base attenuate; apex subacute, often with apiculus c. 0.1 mm long. Petals 5, 2.0–3.3 × 0.9–1.2 mm, yellow, elliptic, lamina and marginal pellucid glands absent; base attenuate; margins entire; apex subacute to obtuse. Stamens 7–8, free, 1.2–2.0 mm long, 0.05–0.75 mm diam., translucent, pale yellow, slightly curved, terete; anthers c. 0.2 mm long, yellow. Ovary 1.4–2.0 × 1.0–1.4 mm, ovoid to broadly ovoid, light green; styles 3(–4), 0.3–0.4 mm long, spreading; stigma 0.15–0.2 mm diam. Capsule 2.3–2.9 × 1.5–2.5 mm, cylindrical to globose, style persistent; valves 3–4, 1.8–2.7 × 0.9–1.5 mm, light brown, usually similar length or slightly longer than sepals. Seeds 0.5–0.6 × 0.2–0.3 mm, orange-brown to light yellow, aging to dark brown, oblong-obovate or oblong, terete, semi-glossy, smooth to finely reticulate, longitudinal ribs absent or weak.

Chromosome number  $2n = 16$  (de Lange et al. 2004).

REPRESENTATIVE SPECIMENS: SOUTH AUCKLAND: Kaingaroa Plains, *A. P. Druce*, Oct 1975, CHR 285675; Hauhungaroa Range, *A. P. Druce*, Apr 1985, CHR 471658; Moerangi, Kuratau R., *A. P. Druce*, Oct 1975, CHR 285679; Rangitaiki River headwaters, *P. N. Johnson*, 20 Jan 2000, CHR 534303; Waione

Frost Flat, *P. J. de Lange* 6436 & *P. B. Cashmore*, 12 Apr 2005, AK 289782; Kaingaroa Plain, Matea Road swamp, *P. J. de Lange* 7018 & *P. B. Cashmore*, 14 Mar 2006, AK 300469; Waione Frost Flat, *P. J. de Lange* 6436 & *P. B. Cashmore*, 12 Apr 2005, AK 289782. WELLINGTON: Ngamatea, Kaimanawa Mts, *A. P. Druce*, Jan 1949, CHR 116279; Mangaio Stream, Kaimanawa Mts, *A. P. Druce* & *B. G. Hamlin*, 10 Mar 1953, CHR 79542; Mt Tihia, *A. P. Druce*, Apr 1974, CHR 273235; Waimarino Plain, *H. Carse*, Dec 1920, CHR 471835; Ngawakakuae Stream, Kaimanawa Mts, *A. P. Druce*, Jan 1974, CHR 252489; Kaimaikuku Stream, Kaimanawa Mts, *A. P. Druce*, Jan 1974, CHR 260222.

DISTRIBUTION AND HABITATS: *Hypericum minutiflorum* is restricted to the central North Island Volcanic Plateau and adjoining main axial ranges (southern South Auckland and northern Wellington) (Fig. 4). It generally grows in depressions, hollows, or wet ground within frost flat vegetation, poorly drained tussockland and shrubland, and more rarely on river terraces, tarn or wetland margins.

The vegetation of a turf hollow in an extensive “frost flat” in the upper Rangitaiki River catchment has been described by Johnson & Rogers (2003). At this site (Fig. 1), *H. minutiflorum* comprises 5% of the cover in a 4 m wide zone of turf at the margins of the hollow, an area that becomes very dry during periods when there is little or no water in the turf hollow. The most common associates at this site are the indigenous *Carex rubicunda* and *Lepidosperma australe* and the introduced *Leontodon taraxacoides* and *Prunella vulgaris* (Johnson & Rogers 2003). In this area it is also associated with *Gratiola sexdentata* and *Lythrum portula* (*P. J. de Lange* pers. comm.).

SPECIES EPITHET: The epithet *minutiflorum* refers to this species having the smallest flowers of the New Zealand species.

CONSERVATION STATUS: *Hypericum minutiflorum* occupies a small geographic area wherein it is was formerly known from a small number of widely scattered populations. However, much of its favoured habitat has now been converted to farmland and plantation forestry, and most of the remaining lower altitude wetlands are now overrun by pasture grasses and other introduced weeds such as *Hieracium* and heather (*Calluna vulgaris*). Although the total number of populations and plants is unknown, the total area of occupancy is now estimated to be <1 ha, while at all known sites ongoing declines are estimated in excess of 50% over the next decade.

Therefore, *H. minutiflorum* is considered to be Nationally Critical (Townsend et al. 2008). The qualifier "data poor" is appended since better estimates of the total number of populations and plants are required.

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