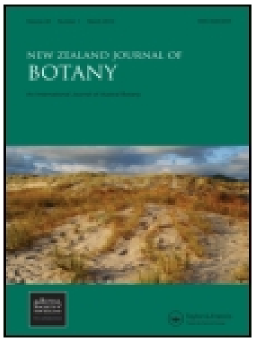

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Contributions to a chromosome atlas of the New Zealand flora – 40. Miscellaneous counts for 36 families

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Chromosome numbers are reported for 112 endemic or indigenous vascular plants from New Zealand. Ninety one of these are new and the remainder provide confirmation of previous counts. Many of the counts fill gaps in the available record of chromosome numbers of New Zealand plants and a summary table provides a list of the genera where numbers remain to be determined. With the publication of these numbers, c. 85% of the indigenous vascular flora of New Zealand now has a documented chromosome number.

Keywords: chromosome numbers; vascular plants; New Zealand flora; Lycopodiidae; Polypodiidae; Magnoliidae

Introduction

Chromosome numbers are a valuable indicator of biodiversity as well as providing characters that are of use in systematic and evolutionary studies (Stace 2000) and also help in the understanding of issues of genetic diversity in the conservation of rare and endangered species (de Lange et al. 2008; Young & Murray 2000). Following the publication of comprehensive indices of chromosome numbers of indigenous vascular plants (Dawson 2000; Dawson et al. 2000), the gaps in the records for New Zealand were greatly clarified. Subsequent papers by Dawson et al. (2007), de Lange & Murray (2002), de Lange et al. (2004) and Murray et al. (2005) have filled many of the gaps but chromosome numbers are still lacking for c. 20% of the species. Using these indices and the recent papers of new counts, the checklist of New Zealand indigenous plants (de Lange & Rolfe 2010) and this publication we estimate that chromosome numbers are now known for c. 85% of the native vascular plants of New Zealand. Nevertheless, there remain whole genera, such as *Euphrasia* and *Gahnia*, for which no chromosome numbers are known for New Zealand species and several large genera, such as *Carex*, *Dracophyllum*, *Lepidium*, *Myosotis* and *Pimelea*, for which counts are lacking for many of the species. In addition, many of the published chromosome counts have been obtained from single representatives of the species and as there are now several significant examples of intraspecific chromosome variation, for example *Raoulia australis* Hook.f. and *R. hookeri* Allan (Dawson et al. 1993) *Hebe odora* (Hook.f.) Cockayne (Dawson & Beuzenberg. 2000), *Lobelia angulata* (G.Forst.) Hook.f. (treated as *Pratia angulata*) (Murray et al. 2004) and *Crassula ruamahanga* A.P.Druce (de Lange et al. 2008), it is valuable to have counts made from several plants throughout their geographical range.

Here we report the chromosome numbers for 110 taxa from 36 families, 90 of them for the

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first time. Two counts are also provided, one for a Rarotongan (Cook Islands) plant of *Alternanthera sessilis*, a species not present in New Zealand (Heenan et al. 2009) and the other for *Plantago lanceolata*, a common naturalised plant in New Zealand.

Materials and methods

The plants used in this study are listed in Table 1. They were collected from the wild and grown either at the University of Auckland or at Oratia Native Plant Nursery, Oratia, Auckland. Voucher specimens are deposited in the herbaria of the Auckland Institute and Museum (AK), Museum of New Zealand Te Papa Tongarewa (WELT), Victoria University of Wellington (WELTU), Canterbury University (CANU) and the Allan Herbarium (CHR). Chromosomes were observed at mitotic metaphase or meiotic metaphase I using the methods described in de Lange et al. (2004a). The taxonomic treatment follows Allan (1961), the Angiosperm Phylogeny Group (APG III 2009), Cheeseman (1925) and de Lange & Rolfe (2010). Threatened and uncommon plant ratings follow de Lange et al. (2009b). Authorities for plants for which chromosome counts are presented here are given in Table 1, otherwise they are given in the text.

We have not provided an exhaustive list of all the previously reported chromosome numbers in the genera that we have studied as this would have resulted in an excessively long reference list. However, extensive background information is available at 'The Index to Plant Chromosome Numbers' (IPCN) at www.tropicos.org/Project/IPCN and for New Zealand, a comprehensive listing of chromosome numbers is available on Ngā Tipu o Aotearoa New Zealand Plants (http://nzflora.landcareresearch.co.nz).

Results and discussion

Table 1 contains a list of the chromosome numbers of all the plants studied and micrographs of the chromosomes of selected species are shown in Figs. 1–3. The following notes provide additional information about the plants that were studied. The taxonomic classes follow the recent phylogenetic classification proposed by Chase and Reveal (2009).

LYCOPODIIDAE

Lycopodiaceae

Huperzia and Lycopodium

As currently accepted (de Lange & Rolfe 2010), there are four genera of Lycopodiaceae in New Zealand, *Huperzia*, *Isoetes*, *Lycopodiella* and *Lycopodium*. Counts have previously been reported for the two species of *Isoetes* by Marsden (1979) and for one species of *Lycopodiella* (*L. lateralis* (R.Br.) B.Øllg.) and one *Lycopodium* (*L. scariosum* G.Forst.) by de Lange et al. (2004a). Here, we report new counts for New Zealand material of *Huperzia varia* (R. Br.) Trevis. ($2n=256$), (the form previously treated by Allan (1961) as *Lycopodium billardierei* Spring), and for two species of *Lycopodium*, *L. deuterodensum* ($2n=68$) and *L. fastigiatum* ($2n=60$) (Fig. 1A). *Huperzia australiana* (Herter) Holub and *Lycopodium volubile* G.Forst. remain to be counted. Published counts for *Huperzia* from elsewhwere include *H. miyoshina* (Makino) Ching ($2n=134$), *H. occidentalis* (Clue) Kartesz et Gandhi ($2n=134$) and *H. prolifera* (Blume) Trevis. $n=$c.278 (IPCN) show no obvious relationship to that of *H. varia*. However, a recent biosystematic investigation has shown that *Huperzia* is paraphyletic, and that those species widely known as the 'tassel ferns' of which *H. varia* s.l. is one, are distinct at genus level from *Huperzia* s.s. (A. Field, James Cook University, pers. comm. 2011). The count obtained for *L. fastigiatum* is the same as that obtained previously for *L. scariosum* but neither shows any obvious numerical relationship to that of *L. deuterodensum*, indicating cytological variability in the genus.

Table 1 Documented chromosome numbers of New Zealand (and Rarotongan) plants: miscellaneous genera.

Species	*n*	2*n*	Source	Voucher
LYCOPODIIDAE				
Lycopodiaceae				
Huperzia varia (R.Br.) Trevis		256	North I., North Auckland, Waitākere Ra.	AK 303460
Lycopodium deuterodensum Herter		68	North I., North Auckland, Waitākere Ra.	AK 303416
Lycopodium fastigatum R.Br.		60	North I., Wellington, Tongariro National Park	AK 303655
POLYPODIIDAE				
Blechnaceae				
Blechnum colensoi (Hook.f.) N.A.Wakef.		122	North I., South Auckland, Rangitoto Ra.	AK 297978
B. fraseri (A.Cunn.) Luerss.		56	North I., North Auckland, Waitākere Ra.	AK 303458
B. minus (R.Br.) Allan		56	North I., North Auckland, Waitākere Ra.	AK 303461
Cyatheaceae				
Cyathea cunninghamii Hook.f		138	North I., South Auckland, Awaroa Scenic Reserve	AK 331573
C. kermadecensis W.R.B.Oliv.		138	Kermadec Is., Raoul I	AK 297198
Dryopteridaceae				
Lastreopsis kermadecensis Perrie et Brownsey		164	Kermadec Is., Raoul I	AK 297199
Pteridaceae				
Adiantum viridescens Colenso		116	North I., South Auckland, Kāwhia	AK 297979
Cheilanthes distans (R.Br.) Mett.		116	North I., North Auckland, Penrose	AK 297200
MAGNOLIIDAE				
Amaranthaceae				
**Alternanthera sessilis* (L.) Roem. et Schult.		28	Cook Is., Rarotonga	AK 300435
Apiaceae				
Anisotome lyallii Hook.f.		22	South I., Southland, Nugget Point	AK 303471
Chaerophyllum colensoi var. *deliculatum* (Allan) K.F.Chung		14	South I., Otago, Ōhau Tarns	AK 285854
Daucus glochidiatus (Labill.) Fisch., C.A.Mey. et Avé-Lall		44	North I., Wellington, E. Wairarapa	AK 297601
Asteliaceae				
Astelia aff. *nervosa*		140	North I., North Auckland, Tūtāmoe Ra.	AK 290709
Asteraceae				
Leptinella conjuncta Heenan		104	South I., Otago, Manuherikia	CHR 572831
L. dispersa subsp. *rupestris* (D.G.Lloyd) D.G.Lloyd et C.J.Webb		52	North I., South Auckland, Karioitahi Gap	AK 303459
Microseris scapigera (Sol. ex A.Cunn.) Sch.Bip.		36	South I., Otago, Old Man Ra.	N.V.

Table 1 (*Continued*)

Species	*n*	2*n*	Source	Voucher
Olearia lacunosa Hook.f.		108	North I., Wellington, Tararua Ra., Mt Holdsworth	AK 315855
		108	North I., Wellington, Tararua Ra., Mt Holdsworth	AK 331195
O. rani (A.Cunn.) Druce var. *rani*		108	North I., North Auckland, Waitākere Ra.	AK 302324
O. telmatica Heenan et de Lange		108	Chatham Islands, Rangiāuria (Pitt Island)	CHR 621451
O. townsonii Cheeseman		108	North I., South Auckland, Kauaeranga Valley	AK 303516
Picris angustifolia DC. subsp. *angustifolia*		10	North I., Northland, Whangaruru Harbour	AK 252278
Senecio kermadecensis Belcher		60	Kermadec Is, Raoul I	AK 307003
S. lautus subsp. *esperensis* (Sykes) de Lange		40	Kermadec Is, L'Esperance Rock	AK 328000
S. radiolatus F.Muell. subsp. *radiolatus*		40	Chatham Is., Rēkohu (Chatham I.), Waitangi West, Zimmermans	AK 301153
S. aff. *dunedinensis*	20_{II}	40	South I., Canterbury, Mt. Cass	AK 303513
S. aff. *glomeratus*		60	Chatham Is., Rēkohu (Chatham I.), Te Whanga	AK 303644
Boraginaceae				
Myosotis laeta Cheesem.		46	South I., Marlborough, Red Hills	AK 303646
M. pygmaea Colenso	22_{II}		South I., Nelson, Mangarākau	AK 303514
M. aff. *drucei*	22_{II}		North I., Tongariro National Park, Mt Ruapehu, Upper Makatote	AK 331000
Brassicaceae				
Rorippa laciniata (F.Muell.) L.A.S.Johnson	48_{II}		North Auckland, Hikurangi Swamp	AK 307042
Convolvulaceae				
Dichondra aff. *brevifolia*		30	Chatham Is., Ohira Bay	AK 331474
Ipomoea pes-caprae subsp. brasiliensis (L.) Ooststr.		30	North I., North Auckland, Ripirō Beach, Ōmāmari	AK 313714
Coriariaceae				
Coriaria arborea var. *kermadecensis* W.R.B.Oliv.		40	Kermadec Is., Raoul I.	AK 297965
Crassulaceae				
Crassula ruamahanga A.P.Druce	47_{II}		South I., Southland, Waitutu Forest	AK 303691
Cyperaceae				
Bolboschoenus fluviatilis (Torr.) Soják		c.110	North I., South Auckland, Puhinui, Lake 'Bernie Chote'	AK 331193
Carex astonii Hamlin		c.60	North I., Wellington, Kaimanawa Ra., Moawhango	AK 303479
C. calcis K.A.Ford		c.68	South I., Nelson, Matiri Range	AK 232856
C. cremnicola K.A.Ford		c.60	South I., Nelson, Pikikiruna Ra.	AK 299654
C. edgariae Hamlin		c.60	South I., Otago, Mt Aspiring National Park	AK 303470

Table 1 (*Continued*)

Species	*n*	2*n*	Source	Voucher
C. kirkii Petrie		c.68–70	South I., Otago, Old Man Ra., Symes Rd.	AK 304705
		c.68–70	South I., Otago, Old Man Ra., Symes Rd.	AK 330993
C. trachycarpa Cheeseman		c.66–68	South I., Nelson, Mt Mytton	AK 290522
Eleocharis acuta R.Br.		20	North I., Wellington, Rangitīkei River	AK 303478
Ficinia nodosa (Rottb.) Goetgh., Muasya et D.A.Simpson		30	North I. North Auckland, Waitākere Ra.	AK 303641
Gahnia setifolia (A.Rich.) Hook.f.		100	North I., North Auckland, Waitākere Ra.	AK 303654
Isolepis crassiuscula Hook.f.		c.64	North I., Wellington, Tongariro National Park	AK 331324
Oreobolus pectinatus Hook.f.		38	North I., South Auckland, Pureora	AK 303642
Scirpus polystachyus F.Muell.		60	South I., Westland, Lake Ianthe	AK 331190
Uncinia aff. *uncinata*		88	Chatham Is. Rēkohu (Chatham I.), Tuku-a-Tamatea Nature Reserve	CHR 596837
Droseraceae				
Drosera auriculata Backh. ex Planch.	16_{II}		North I., North Auckland, Oratia	AK 303645
D. binata Labill.	16_{II}	32	North I., North Auckland, Whangaripo Valley	N.V.
	16_{II}		North I., North Auckland, Lake Ohia	AK 331192
	16_{II}		North I., South Auckland, Opuatia	AK 331194
D. hookeri R.P.Gibson, B.J.Conn et Conran	16_{II}		North I., North Auckland, Te Paki	AK 303647
D. spatulata Labill.	16_{II}		North I., North Auckland, Ahipara	AK 331191
D. stenopetala Hook.f.		16	North I., Wellington, Rimutaka Ra., Mt Climie	AK 330896
Ericaceae				
Acrothamnus colensoi (Hook.f.) Quinn		146	North I., Wellington, Tongariro National Park	AK 303466
Dracophyllum latifolium A.Cunn.		26	North I., North Auckland, Waitākere Ra.	AK 330810
Dracophyllum strictum Hook.f.	13_{II}		North I., South Auckland, Tūhua (Mayor Island)	AK 330887
Gaultheria paniculata B.L.Burtt et A.W.Hill		22	North I., Wellington, Tongariro National Park	AK 303661
Gentianaceae				
Gentianella scopulorum Glenny		36	South I., Westland, Charleston	AK 288952
Geraniaceae				
Geranium (c) (CHR 546319; Von)		52	South I., Southland, Eyre Mts.	AK 315844
Goodeniaceae				
Selliera microphylla Colenso		56	North I., South Auckland, Matea Swamp	AK 315851
		16	South I., Central Otago, Conroys Gully	AK 331527
Haloragaceae				
Myriophyllum triphyllum Orchard		42	Chatham Is., Rēkohu (Chatham I.), Hapupu Ponds	AK 297929
M. votschii Schindl.	7_{II}		North I., North Auckland, Waitākere Ra.	AK 303656

Table 1 (*Continued*)

Species	*n*	2*n*	Source	Voucher
Juncaceae				
Juncus holoschoenus R.Br. var. *holoschoenus*		106	North I., South Auckland, Rangitāiki Frost Flat	AK 303465
J. novae-zelandiae Hook.f.		34	North I. Wellington, Mangatainoka Valley	AK 331315
Orchidaceae				
Taeniophyllum aff. *norfolkianum* D.L.Jones, B.Gray et M.A.Clem		38	North I., North Auckland, Waipū R.	AK 319087
	19_{II}		North I., North Auckland, Waipū R.	AK 319085
Oxalidaceae				
Oxalis exilis A.Cunn.		22	North I., Waiheke I. Te Whau Point	AK 315517
Oxalis thompsoniae B.J.Conn et P.G.Richards	24		North I, South Auckland, Otuataua Stonefields	AK 330791
Piperaceae				
Peperomia blanda var. *floribunda* (Miq.) et Kunth		66	Kermadec Is., Raoul I.	AK 288481
Plantaginaceae				
Parahebe jovellanoides (Garn.-Jones et de Lange) de Lange	20_{II}	40	North I., North Auckland, Ararimu	AK 301680
P. senex Garn.-Jones		42	South I., Nelson, Anatori	AK 259124
**Plantago lanceolata* L.		12	South I., Otago, Remarkables Ra.	WELTU20142
P. udicola Meudt et Garn.-Jones		96	South I., Canterbury, Lake Sarah	WELT SP089932
Poaceae				
Deschampsia pusilla Petrie		26	South I., Otago, Umbrella Mountains, Gem Lake	AK 297893
Hierochloe recurvata (Hack.) Zotov		28	North I., Wellington, Tongariro National Park	AK 303469
		28	Tongariro National Park, Mt Ruapehu, Upper Makatote	AK 330999
Lachnagrostis tenuis (Cheeseman) Edgar		56	South I., Southland, Tīwai	AK 289277
Lepturus repens (G.Forst.) R.Br.		52–54	Kermadec Is., Herald Islets, North Chanter	AK 303468
Poa celsa Edgar		28	South I., Nelson, Kahurangi National Park	AK 331472
P. intrusa Edgar		28	South I., Canterbury, Mt Somers	AK 331329
P. senex Edgar		28	South I., Otago, Old Man Ra.	AK 289207
P. subvestita (Hack.) Edgar		28	South I., Otago, Hector Ra, Wye Creek	AK 331464
P. tonsa Edgar		28	South I., Otago, Old Man Ra.	AK 331332
Puccinellia raroflorens Edgar		56	South I., Otago, Maniototo	N.V.
P. walkeri subsp. *antipoda* (Petrie) Edgar		42	Antipodes Is., Antipodes I.	AK 331478

Table 1 (*Continued*)

Species	n	2n	Source	Voucher
P. walkeri subsp. *chathamica* (Cheeseman) Edgar		28	Auckland Is., Enderby Island	AK 331463
		42	Chatham Is., Chatham (Rēkohu) I., Kaiangaroa Point	AK 331481
P. walkeri (Kirk) Allan subsp. *walkeri*		35	South I., Southland, Tīwai	AK 289228
		35	South I., Papanui Inlet, Otago Peninsula	AK 331485
Rytidosperma nudum (Hook.f.) Connor et Edgar		24	North I., Wellington, Ruahine Ra., Toka	AK 304128
Simplicia buchananii (Zotov) Zotov		28	South I., Nelson, Kahurangi National Park, near Gordons Pyramid	AK 304801
S. laxa Kirk		28	North I., Wellington, Rangitīkei, Kawhatau Valley	AK 298065
		28	South I., Otago, McCraes Flat	AK 295631
Trisetum spicatum (L.) K.Richt.		28	Chatham Is., Rēkohu (Chatham I.), Henga	AK 331461
Polygonaceae				
Persicaria prostrata (R.Br.) Soják		c.20	North I., South Auckland, Lake Okataina	AK 297996
Potamogetonaceae				
Potamogeton suboblongus Hagstr.		28	North I., South Auckland, Pureora	AK 303643
Stuckenia pectinata (L.) Börner		c.78	North I., South Auckland, Carters Beach	AK 303657
Ranunculaceae				
Myosurus minimus subsp. *novae-zelandiae* (W.R.B.Oliv.) Garn.-Jones		16	South Island, Otago, Macraes Flat	AK 331187
Restionaceae				
Apodasmia aff. *similis*		48	Chatham Is., Chatham I., Kaiangaroa	CHR 594809
Nanodeaceae				
Mida salicifolia A.Cunn.		66	North I., North Auckland, Waitākere Ra.	AK 302127
Scrophulariaceae				
Myoporum semotum Heenan et de Lange		108	Chatham Is. Rangatira (South-East I)	CHR 595021
Tetrachondraceae				
Tetrachondra hamiltonii Petrie ex. Oliv.		72	North I., Wellington, Mākirikiri Tarns	AK 290643
Thymelaeaceae				
Pimelea microphylla Colenso		36	North I., Wellington, Tongariro National Park	AK 303481
P. mimosa C.J.Burrows		72	North I., Hawkes Bay, Te Mata Peak	AK 333037
P. orthia C.J.Burrows et Thorsen subsp. *orthia*		36	North I., North Auckland, Te Paki	AK 314004
		36	North I., North Auckland, Glorit	AK 331515

Table 1 (*Continued*)

Species	*n*	2*n*	Source	Voucher
P. orthia subsp. *protea* C.J.Burrows et Thorsen		36	North I., Gisborne, Māhanga Beach	AK 331518
P. prostrata (J.R.Forst et G.Forst.) Willd. subsp. *prostrata*		36	South I., Canterbury, Mt Cass	CANU 38890
P. pseudolyallii Allan		36	South I., Canterbury, Little Mt Peel	AK 303472
P. pseudolyalli Allan hybrid	(54)		North I., Wellington, Pipinui Point	AK 303473
P. telura C.J.Burrows		36	Three Kings Is., Manawa Tawhi (Great I.)	AK 303474
P. tomentosa (J.R. et G.Forst) Druce		36	North I., North Auckland, Woodhill Forest	AK 297968
P. urvilleana subsp. *nesica* C.J.Burrows		36	North I., North Auckland, North Cape Scientific Reserve	AK 309697
P. urvilleana A.Rich. subsp. *urvilleana*		36	North I., North Auckland, North Cape Scientific Reserve	AK 309699
		36	North I., North Auckland, North Cape Scientific Reserve	AK 322634
		36	North I., North Auckland, North Cape, Titirangi Point	AK 322759
P. villosa Sol. ex Sm.		36	Chatham Is., Chatham I., Kaiangaroa	AK 303467
Winteraceae				
Pseudowintera insperata Heenan et de Lange		86	North I., North Auckland, Bream Head	AK 286205
		86	North I., North Auckland, Mt. Manaia	AK 28450

Note: * indicates exotic and/or naturalised species. N.V. = no herbarium voucher.

POLYPODIIDAE

Blechnaceae

Three new counts have been obtained for *Blechnum* which add to the 15 already reported for other species in New Zealand by various authors (Dawson 2000). Both *B. fraseri* and New Zealand material of *B. minus* had $2n = 56$, whereas *B. colensoi* had $2n = 122$ (Fig. 1B). Here, following advice from B.P.J. Molloy and J.D. Lovis (pers. comm.) we accept *B. minus* as present in New Zealand contrary to the treatment of Chambers & Farrant (1998). The New Zealand species of the genus appear to have two basic numbers, $x = 28$ and $x = 33$. Shepherd et al. (2007) provided a molecular phylogeny of the New Zealand Blechnaceae which showed that *B. colensoi* was sister to the morphologically similar *B. patersonii* (R.Br.) Mett. ($2n = 66$, 132 (Tindale & Roy 2002)); an interesting result given the difference in chromosome number between *B. colensoi* and *B. patersonii*. The other two numbers reported, for *B. fraseri* and *B. minus*, fit within the range of chromosome numbers previously established for the majority of the New Zealand species.

Cyatheaceae

Published counts of $n = 69$ have been recorded for *Cyathea colensoi* (Hook.f.) Domin, *C. dealbata* (G.Forst.) Sw. (for which a count of $n = 72$ has also been reported (Brownlie 1954)), *C. medullaris* (G.Forst.) Sw. and *C. smithii* Hook.f. (Dawson 2000). Here, we report counts of $2n = 138$ for two further species, the indigenous *C. cunninghamii* and the Raoul Island endemic *C. kermadecensis*.

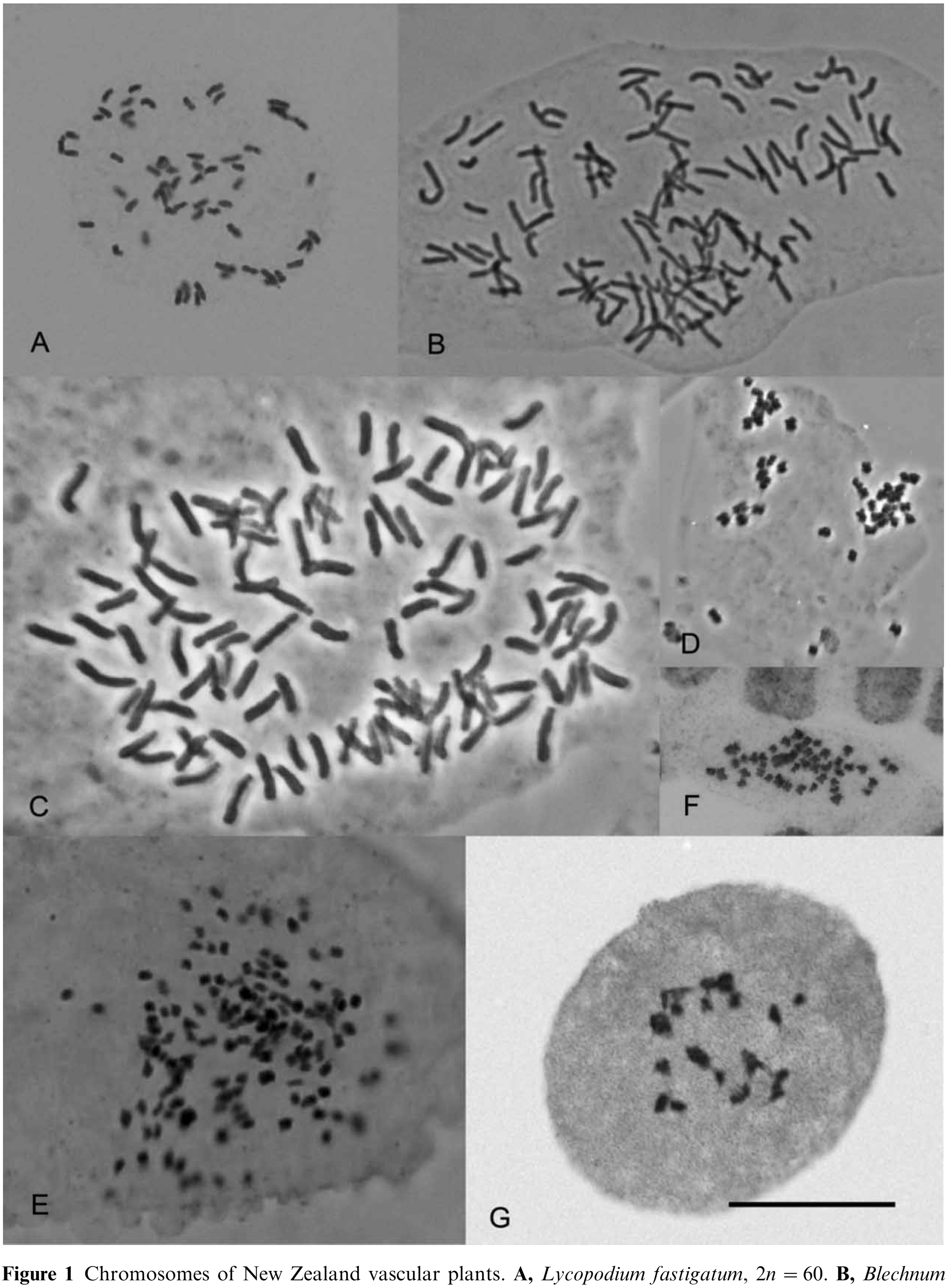

Figure 1 Chromosomes of New Zealand vascular plants. **A,** *Lycopodium fastigatum*, $2n = 60$. **B,** *Blechnum colensoi*, $2n = 122$. **C,** *Adiantum viridescens*, $2n = 116$. **D,** *Daucus glochidiatus*, $2n = 44$. **E,** *Astelia* aff. *nervosa*, $2n = 140$. **F,** *Leptinella dispersa* subsp. *rupestris*, $2n = 52$. **G,** *Senecio* aff. *dunedinensis*, $n = 20_{II}$. Scale bar = 10 μm.

Only *C. milnei* Hook.f., another Kermadec Island endemic, remains uncounted.

Dryopteridaceae

A plant of *Lastreopsis kermadecensis*, a newly described endemic species from Raoul Island (Perrie & Brownsey 2012), had $2n = 164$, equivalent to the meiotic counts reported for *L. glabella* (A. Cunn.) Tindale and *L. microsora* subsp. *pentangularis* (Colenso) Tindale. This is the tetraploid number for the genus with the other two New Zealand species *L. hispida* (Sw.) Tindale and *L. velutina* (A.Rich.) Tindale being diploid ($n = 41$) (Dawson et al. 2000).

Pteridaceae

With the count of $2n = 116$ (Fig. 1C) reported here for *Adiantum viridescens* all seven indigenous species have now been counted. Our count of $2n = 116$ for *Cheilanthes distans* is clearly different from the count of $2n = 84$ reported by Tindale & Roy (2002) for Australian plants named *C. distans*. It is, however, close to the $2n =$ c.110 reported by Quirk et al. (1983) for their Australian specimens. Brownlee (1957) also recorded $n = 87$ for New Zealand specimens of *C. sieberi* Kunze subsp. *sieberi* which is also different from the $2n = 56$ and 84 reported for Australian specimens (Tindale & Roy 2002). Chromosome numbers in this genus are variable and apomixis has also been reported (Tindale & Roy 2002).

MAGNOLIIDAE

Amaranthaceae

Rarotonga (Cook Islands) material of *Alternthera sessilis* had $2n = 28$. This is the same number as that reported for New Zealand examples of *A. denticulata* R.Br. and *A. nahui* Heenan et de Lange (treated as *A. sessilis* (L.) Roem et Schult. in de Lange et al. (2004a)). Five other species in the genus have counts of $n = 17$, $n = 20$, $2n = 96$ and $2n = 100$ (IPCN), suggesting no obvious pattern.

Apiaceae

We obtained a count of $2n = 22$ for *Anisotome lyallii*, the same number as that recorded for 10 other New Zealand species (Dawson 2000). Counts are still needed for seven taxa to complete the New Zealand representatives of the genus. We found $2n = 14$ in South Island specimens of *Chaerophyllum colensoi* var. *delicatulum*, this is the same as that recorded for *C. colensoi* (Hook.f.) K.F.Chung var. *colensoi* and for the overseas *C. temulum* L. and *C. temulentum* L., whereas all other species in the genus for which counts have been published, including the New Zealand endemic *C. ramosum* (Hook.f.) K.F.Chung, have either $n = 11$ or $2n = 22$ (IPCN). We report $2n = 44$ (Fig. 1D) for the sole indigenous species of *Daucus*, *D. glochidiatus*. This is the same number as that reported by Iovene et al. (2008) for Australian plants.

Asteliaceae

Chromosome numbers of New Zealand species of *Astelia* range from $n = 35/2n = 70$ (four species) to $2n = 140$ (one species) to $n = 105/2n = 210$ or c. 210 (two species) (Dawson 2000). Our count of $2n = 140$ (Fig. 1F) for an undescribed northern New Zealand *Astelia*, allied to *A. nervosa*, which has $2n = 210$, is the second report of a tetraploid number for the genus in New Zealand.

Asteraceae

Leptinella

We obtained a count of $2n = 104$ for the recently described *Leptinella conjuncta* (Heenan 2009) which is the same as that recorded for the allied members of the *L. pectinata* (Hook.f.) D.G.Lloyd et C.J.Webb group (Dawson 2000) from which *L. conjuncta* was segregated. We also report $2n = 52$ for *L. dispersa* subsp. *rupestris* (Fig. 1F), the same number as that recorded for subsp. *dispersa* (Dawson 2000).

Microseris

A plant of *Microseris scapigera* from the Old Man Range had $2n = 36$, the same as three previous counts for the species (Dawson 2000).

Olearia

As currently circumscribed, there are c. 41 species and varieties of *Olearia* in New Zealand (de Lange & Rolfe 2010). Six of these are uncounted (de Lange & Rolfe 2010) so here we report counts for four of them, *O. lacunosa*, *O. rani* var. *rani*, *O. telmatica* and *O. townsonii*. All have $2n = 108$, the same number as that reported for 31 other *Olearia*, polyploids with $2n = 216$, 288, 324, c. 432 and > 400 have also been reported in the genus (Dawson 2000; de Lange et al. 2004a; de Lange & Rolfe 2010). *Olearia* is now considered to be paraphyletic (Wagstaff et al. 2011) and it is interesting that the genera that cluster with it, such as *Celmisia*, *Damnamenia* and *Pachystegia*, all also have chromosome numbers based on $x = 54$ (Dawson 2000; de Lange & Rolfe 2010).

Picris

We obtained $2n = 10$ for *Picris angustifolia* subsp. *angustifolia* which is the same number as that reported from mitotic counts for *P. burbidgeae* S.Holzapfel and a meiotic count ($n = 5_{II}$) for *P. angustifolia* subsp. *merxmuelleri* Lack et S.Holzapfel by Murray & de Lange (1999).

Senecio

Senecio, with 30 named and widely accepted taxa (de Lange & Rolfe 2010) has been well investigated cytologically, all taxa having at least one chromosome count (Dawson 2000). Nevertheless, there are a number of informally recognised entities, two of which we report counts for here. The first of these is allied to *S. dunedinensis* Belcher from which it consistently differs by its dark maroon to brown–black, narrow leaves with deeply crenate (scalloped) margins. To date, this race is known from scattered sites in the eastern South Island from the Leatham, Marlborough, south to the Ahuriri. It usually grows on base-rich substrates such as limestone, basalt or within the apatite-rich facies of the partially metamorphosed sedimentary greywacke rocks common in the South Island. Plants of this race from Mt Cass, North Canterbury had $n = 20_{II}$ (Fig. 1G) and $2n = 40$, the same number as reported for *S. dunedinensis* s.s. (Dawson 2000). We obtained counts of $2n = 60$ (Fig. 2A), for a second informally recognised entity, *S.* aff. *glomeratus* treated as provisionally distinct and endemic to the Chatham Islands (de Lange et al. 2011a). This number is the same as that recorded for New Zealand specimens of *S. glomeratus* (Dawson 2000). The Chatham Islands race was briefly discussed and illustrated by Webb et al. (1988) and it is the race most commonly found on those islands. However, in some places there it grows with *S. glomeratus* s.s., its status is currently under investigation (P.J. de Lange, unpubl. data; Heenan et al. 2010). Aside from these two informally recognised entities, we also record counts of $2n = 40$ for another Chatham Island endemic *S. radiolatus* subsp. *radiolatus* and also for the Southern Kermadec Islands endemic *S. lautus* subsp. *esperensis*. A further confirmatory count of $2n = 60$ was obtained for Raoul Island specimens of the Kermadec endemic *S. kermadecensis*.

Boraginaceae

New Zealand representatives of the cosmopolitan genus *Myosotis* are currently under taxonomic investigation (H. Meudt, Museum of New Zealand Te Papa Tongarewa, pers. comm. 2012). Currently some 42 indigenous taxa are accepted for the genus and most lack chromosome counts (see comments by de Lange & Murray 2002). Here we report three new counts

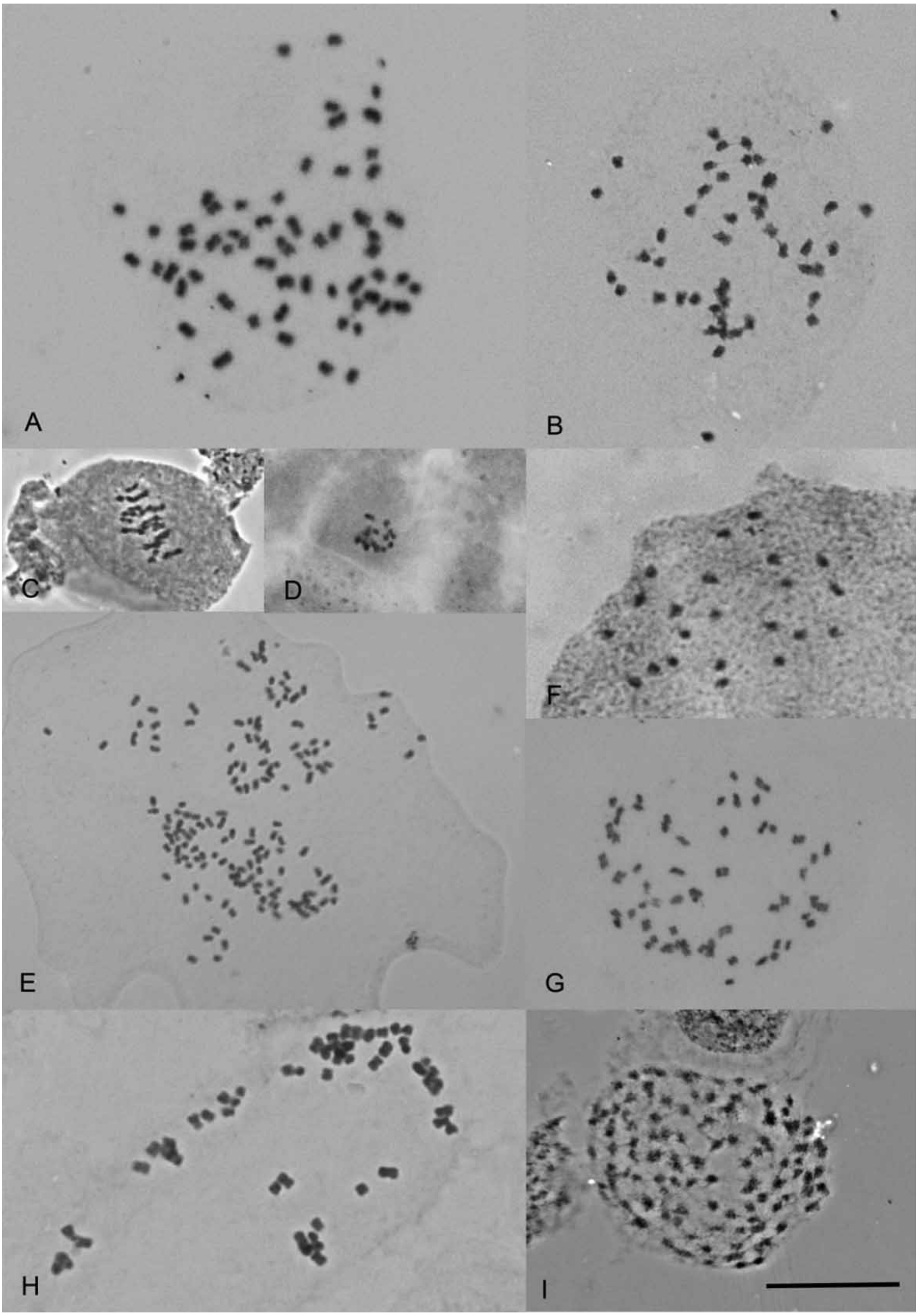

Figure 2 Chromosomes of New Zealand vascular plants. **A,** *Senecio* aff. *glomeratus*, 2*n* = 60. **B,** *Myosotis laeta*, 2*n* = 46. **C,** *Drosera hookeri*, $n = 16_{II}$. **D,** *Drosera stenopetala*, 2*n* = 16. **E,** *Acrothamnus colensoi*, 2*n* = 146. **F,** *Gaultheria paniculata*, 2*n* = 22. **G,** *Geranium* (c) (CHR 546319; Von), 2*n* = 52. **H,** *Selliera microphylla*, 2*n* = 56. **I,** *Juncus holoschoenus* var. *holoschoenus*, 2*n* = 106. Scale bar = 10 µm.

for *Myosotis laeta* ($2n = 46$) (Fig. 2B), *M.* aff. *drucei* ($n = 22_{II}$) and $n = 22_{II}$ for *M. pygmaea*. The *M.* aff. *drucei* plant matched *M. drucei* (L.B.Moore) de Lange et Barkla in flower colour, leaf pigmentation and hair distribution (see de Lange et al. 2010), but its leaves are narrower than usual for that species and further, it grew under *Chionochloa pallens* Zotov subsp. *pallens* in an alpine flush. Ecologically, this is not the usual habitat for *M. drucei* and if the leaf shape is considered significant then this gathering might be better placed with an unnamed segregate of *M. pygmaea* Colenso known as *M.* aff. *pygmaea* (Volcanic Plateau). However, our gathering differs in flower colour (cream vs. white) and leaf hair distribution from this latter plant. *Myosotis* in New Zealand is chromosomally variable (e.g., $2n = 36$, 40, 44, 46 and 48) with $2n = 44$ or 46 the most common number (de Lange & Rolfe 2010).

Brassicaceae

With the recent recognition of the Australian *Rorippa laciniata* as naturally occurring in New Zealand (de Lange et al. 2009a) there are now three indigenous New Zealand representatives of the genus. New Zealand plants of *R. laciniata* had $n = 48_{II}$ which differs from that reported for *R. palustris* (L.) Besser ($n = 16$) and the endemic *R. divaricata* (Hook.f.) Garn.-Jones et Jonsell ($2n = 48$) (Dawson 2000). Based on these results, *R. laciniata* is probably 12-ploid if we assume that the basic number for the genus is $x = 8$ (Schranz et al. 2006).

Convolvulaceae

Currently, New Zealand has two indigenous species of *Dichondra*, *D. repens* J.R.Forst et G.Forst and the endemic *D. brevifolia* Buchanan. However, it is widely accepted that there are further, as yet unnamed, entities present within the variable *D. brevifolia* (Webb et al. 1988). Here, we present a count of $2n = 30$ for a Chatham Island sample of the *D. brevifolia* agg. this is the same number as that recorded for *D. brevifolia* s.s. and *D. repens*. Two seedlings raised from seeds of *Ipomoea pes-caprae* subsp. *brasiliensis* collected in beach drift on the Ripirō Beach, North Auckland (de Lange 2012a) had $2n = 30$, the same number as that reported previously using Raoul Island material (de Lange et al. 2004a).

Coriariaceae

Examples from Raoul Island of the endemic *Coriaria arborea* var. *kermadecensis* had $2n = 40$, the same as that reported for var. *arborea*. The counts for these two varieties are the lowest chromosome number recorded for the five New Zealand species, and indeed for the genus (Dawson 2000, IPCN) that have been counted.

Crassulaceae

A plant of the recircumscribed species *Crassula ruamahanga* (de Lange et al. 2004a, 2008) from Waitutu Forest, Southland, South Island had $2n = 47_{II}$. This is the same number as that obtained from several other locations in the North and Chatham Islands (de Lange et al. 2008).

Cyperaceae

Bolboschoenus

There are no previously published chromosome counts that we know of for the three New Zealand species of *Bolboschoenus*. Here we report an approximate count of $2n =$ c. 110 for *B. fluviatilis*. This count is different from those reported for purportedly the same species from the USA (Harriman 1981; Löve & Löve 1981) where $2n =$ c. 94 and $2n = 104$ have been obtained, but it agrees with a meiotic count ($n = 55_{II}$) reported by Hicks (1928) from Canadian material. Counts are still required for *B. caldwellii* (V.J.Cook) Soják and *B. medianus* (V.J.Cook) Soják to complete the New Zealand representatives of the genus.

Carex

New counts from five indigenous *Carex* species are reported here: *C. astonii* (2*n* = c. 60), *C. calcis* (2*n* = c. 68), *C. cremnicola* (2*n* = c. 60), *C. edgariae* (2*n* = c. 60), *C. kirkii* var. *kirkii* (2*n* = 68–70) and *C. trachycarpa* (2*n* = 66–68). *Carex* chromosomes are small, poorly staining and holocentric, which we have found previously (de Lange & Murray 2002; de Lange et al. 2004a) make it difficult to obtain definitive chromosome counts. The approximate numbers that we have obtained from this sample of species are within the range now reported for the majority of the 44 indigenous carices already counted from the New Zealand flora. Counts are still required for 29 taxa to complete the indigenous representatives of the genus of New Zealand (de Lange & Rolfe 2010).

Eleocharis

New Zealand has five species of *Eleocharis*, only one of which, *E. neozelandica* Kirk is endemic (de Lange & Rolfe 2010). Here, we report a further confirmatory count for *E. acuta* R.Br. of 2*n* = 20, the same number as that recorded for *E. acuta* and *A. gracilis* R.Br. The other New Zealand species have either 2*n* = 30 (*E. neozelandica*, *E. pusilla* R.Br.) or 2*n* = 100 (*E. sphacelata* R.Br.) (de Lange et al. 2004a).

Ficinia

Currently, New Zealand has two species of *Ficinia*, *F. nodosa* and *F. spiralis* (A.Rich.) Muasya et de Lange. However, as the only distinction between *Ficinia* and closely related *Isolepis* is the presence of a gynophore, and as a few *Isolepis* are known to possess a gynophore (Muasya & de Lange 2010) it is likely that *Ficinia* will at some stage be merged with *Isolepis* (M. Muasya, pers. comm.). Here we report 2*n* = 30 in *F. nodosa* the same number as that recorded for *F. spiralis* (de Lange et al. 2004a). This number shows no obvious relationship to the numbers obtained for New Zealand species of *Isolepis* (Dawson 2000 and below) and there do not appear to be any other published counts of *Ficinia* that the New Zealand chromosome numbers can be compared with.

Gahnia

A count of 2*n* = 100 was obtained for *Gahnia setifolia*. This is the first count for a New Zealand species of the genus with a further five New Zealand species left to be counted (de Lange & Rolfe 2010). *Gahnia beecheyi* H.Mann from Hawaii has a published count of 2*n* = c. 96 (Skottsberg 1955).

Isolepis

Of the 15 *Isolepis* taxa indigenous to New Zealand published counts are available for two species. *Isolepis aucklandica* Hook.f. has *n* = 21/2*n* = 42 and there are counts of 2*n* = 24, 30, 48 and 60 for non-New Zealand plants of *I. cernua* (Vahl) Roem. et Schult. var. *cernua* (Dawson 2000). Here, we present a new count of 2*n* = c.64 for *I. crassiuscula*. As in *Carex* (above), *Isolepis* chromosomes are difficult to study but from the existing counts the genus would appear to be chromosomally variable.

Oreobolus

New Zealand has three indigenous species of *Oreobolus* none of which have previously published counts. Here we report a count of 2*n* = 38 for *O. pectinatus*, probably the most - common and widespread of the three New Zealand species. One other species, the Hawaiian *O. furcatus* H.Mann has 2*n* = 42 (Seberg 1988).

Scirpus

Following several revisions of *Scirpus*, New Zealand now has only the one indigenous species *Scirpus polystachyus* (de Lange & Rolfe 2010) which appears to be a relatively recent natural trans-Tasman coloniser (P.D. Champion, pers. comm., 2012; de Lange 2012b; de Lange et al. 2004b, 2009b) to the west coast of the South Island. Healy & Edgar (1980) treat it as naturalised. A plant of this species from Lake Ianthe had $2n = 60$. As the overseas chromosome literature does not appear to have caught up entirely with the taxonomic changes in *Scirpus* it is impractical for us to relate this count to chromosome numbers available in overseas literature.

Uncinia

Counts for all the named indigenous *Uncinia* in New Zealand are complete (Dawson 2000; de Lange & Rolfe 2010). However, there are still a number of potentially new and as yet undescribed *Uncinia* plants awaiting formal description. Here we report a count of $2n = 88$ for one these, a race of *Uncinia uncinata* (L.f.) Kük. seemingly endemic to the Chatham Islands (de Lange et al. 2011a). This count is the same as that obtained for *U. uncinata*, and for 30 of the 34 accepted species in New Zealand though species with $2n = 94$ and $2n = 132$ also occur (Beuzenberg 1970; Heenan & de Lange 2001).

Droseraceae

New Zealand has seven indigenous species of *Drosera*, one species, *D. stenopetala* is endemic and the other six are shared with Australia (de Lange & Rolfe 2010; Gibson et al. 2010; Salmon 2001). One of these indigenous species is now known as *D. hookeri*, having previously been confused with the Australian endemic *D. peltata* (Gibson et al. 2010). Previously counts of $n = 10$ and $2n = 20$ had been published for only one New Zealand species *D. spatulata* (Dawson 2000). Here we present new counts of $n = 16_{II}$ for *D. auriculata*, *D. binata*, *D. hookeri* (Fig. 2C) and *D. spatulata* and $2n = 16$ for *D. stenopetala* (Fig. 2D). The count obtained for *D. spatulata* is different from those reported previously from New Zealand ($n = 10$, $2n = 20$) (Dawson 2000). However, as Salmon (2001) notes, this species is very variable in New Zealand and our count suggests that there may be a genetic basis to this variation worthy of further investigation. If $x = 8$ is taken as the basic number, then *D. stenopetala*, the only New Zealand endemic is diploid, whereas the other, indigenous species are tetraploid, but as other *Drosera* species have numbers as low as $2n = 10$ (Sheikh & Kondo 1995) and the chromosomes of the genus are holocentric, assumptions about ploidy levels need careful evaluation.

Ericaceae

Following the merging of the Epacridaceae with the Ericaceae (Kron et al. 2002), New Zealand now has 63 taxa spread through 11 genera, only one *Androstoma* of which is endemic (de Lange & Rolfe 2010; Quinn et al. 2005). Counts are available for some species in all genera except *Sprengelia*. However, there are only a few counts in some genera, most notably *Dracophyllum*, which with 35 named taxa (de Lange & Rolfe 2010; Venter 2009) is the largest indigenous genus of the family in New Zealand and for which there are still only 16 species counted (Dawson 2000; de Lange et al. 2004a; de Lange & Rolfe 2010). Here, we present four further counts for New Zealand Ericaceae in *Acrothamnus* (one new count), *Dracophyllum* (one new count, one confirmatory) and *Gaultheria* (one new count). The sole New Zealand representative of *Acrothamnus*, *A. colensoi* had $2n = 146$ (Fig. 2E), this is about the same number as the $2n =$ c. 140 count published by Dawson (2000) as *Leucopogon colensoi* Hook.f. Of the two counts obtained for *Dracophyllum*, the count of $2n = 26$ for *D. latifolium* is new for that species, whereas that of $n = 13_{II}$ accords with the published mitotic count for *D. strictum* (de Lange et al. 2004a). Currently, the counts published for *Dracophyllum* suggest that despite the wide morphological diversity (Wagstaff et al. 2010), chromosomally the genus is rather uniform. A count of $2n = 22$ was obtained for the previously uncounted *Gaultheria paniculata* (Fig. 2F), the same number as that reported for five other New Zealand *Gaultheria* (Dawson 2000).

Gentianaceae

Published chromosome counts are available for 24 of the 38 New Zealand taxa of *Gentianella* (Dawson 2000; Glenny 2004). Here we add a further count of $2n = 36$ for the north Westland endemic *G. scopulorum*. With one exception of a plant of uncertain status with $2n = 18$ (Dawson & Beuzenberg 2000), this is the same number as that reported for the other published New Zealand counts for the genus.

Geraniaceae

Chromosome counts are now published for all eight indigenous *Geranium* species (Dawson 2000; de Lange et al. 2004a; de Lange & Rolfe 2010). However, it has long been recognised that there are a number of undescribed informally recognised entities some of which probably warrant formal recognition (Mitchell et al. 2009). Here we provide a count for one of these, a *Geranium* of uncertain affinity so far known only from cultivated material said to have arisen from within a clod of soil collected from the Von Valley, Eyre Range by the late A.P. Druce (R. Smith, Wellington Regional Council, pers. comm. 2010). To date, despite intensive field surveys, no further examples of this plant have been seen in the wild, however, material derived from the original Druce garden plant is now reasonably widespread in cultivation and this is currently the subject of an on-going taxonomic investigation (P.B. Heenan, pers. comm.). We report a count of $2n = 52$ for this plant (Fig. 2G), the same number as that recorded for the majority of the New Zealand species.

Goodeniaceae

New Zealand has two well-defined species of *Selliera*, *S. radicans* Cav. and *S. rotundifolia* Heenan, however, a third species, *S. microphylla* is also accepted by some botanists (de Lange & Rolfe 2010). The circumscription of this third species has always been problematic (Allan 1961; Colenso 1890) resulting in the traditional view that *S. microphylla* is a montane to alpine upland species distinguished primarily by its smaller vegetative and floral parts. This view is perhaps a little naïve because even with the segregation of *S. rotundifolia* (Heenan 1997), *S. radicans* remains a notoriously variable species with respect to size, stature and habitats, such that plants referred to as *S. microphylla* could be regarded as simply a reduced mountain race of *S. radicans*. Nevertheless, we counted the chromosomes of two samples, one from the North Island and the other from the South Island that in the field matched the description of *S. microphylla*. Both of these plants had, over time in cultivation, greatly increased in size and stature such that they were indistinguishable from the majority of the range of forms currently attributed to *S. radicans*. We found two chromosome numbers, with the North Island gathering of *S. microphylla* having $2n = 56$ (Fig. 2H) chromosomes and the South Island plant having $2n = 16$ chromosomes. Published counts for the other two *Selliera* species are also $2n = 16$ (Dawson 2000). Thus, while no direct taxonomic conclusion can be made from this result it does suggest that *Selliera* would repay further systematic and cytological study.

Haloragaceae

We obtained a count of $2n = 42$ for *Myrioyllum triphyllum* which now completes the counts for the indigenous representatives of the genus in New Zealand. Based on previous New Zealand counts (de Lange & Murray 2002; de Lange et al. 2004a) where it was proposed that $x = 7$, *M. triphyllum* is hexaploid. In addition, we present here a new count of $n = 7_{II}$ for *M. votschii* (Fig. 3A) which is different from the $2n = 21$ that we reported previously (de Lange & Murray 2002).

Juncaceae

Of the 16 *Juncus* accepted as indigenous to New Zealand (de Lange & Rolfe 2010) chromosome

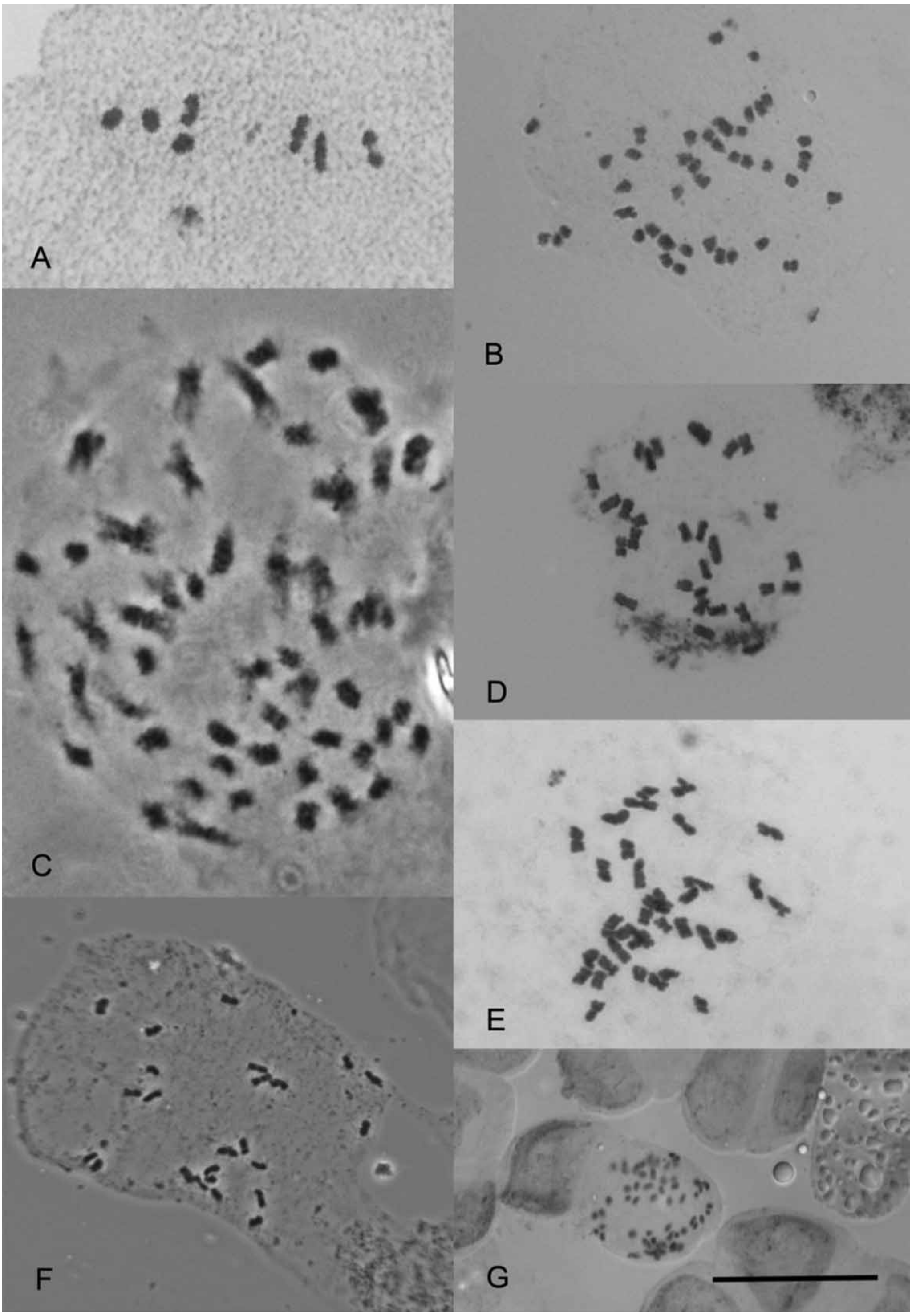

Figure 3 Chromosomes of New Zealand vascular plants. **A,** *Myriophyllum votschii,* $n = 7_{\mathrm{II}}$. **B,** *Parahebe jovellanoides*, $2n = 40$. **C,** *Lepturus repens*, $2n = 52$–54. **D,** *Puccinellia walkeri* subsp. *chathamica*, $2n = 28$. **E,** *Puccinellia walkeri* subsp. *walkeri*, $2n = 35$. **F,** *Rytidosperma nudum*, $2n = 24$. **G,** *Mida salicifolia*, $2n = 66$. Scale bar = 10 μm.

counts of $2n = 40$ have been published for three species, *J. edgariae* L.A.S.Johnson et K.L. Wilson (Sect. Genuini), *J. novae-zelandiae* (Sect. Septati) and *J. scheuchzerioides* Gaudich. (Sect. Septati). Here we present new counts of $2n = 106$ (Fig. 2I) for *J. holoschoenus* var. *holoschoenus* and $2n = 34$ for *J. novae-zelandiae*. This latter count differs from the previous published count of $2n = 40$ (Dawson 2000).

Nanodeaceae

The Nanodeaceae is a new family proposed as part of the re-circumscription of the Santalaceae (Nickrent et al. 2010). The new family comprises two genera: the Southern American and Falkland Islands monotypic *Nanodea* (*N. muscosa* C.F.Gaertn.) and New Zealand monotypic *Mida* (de Lange 2011b; Nickrent et al. 2010). Here we report $2n = 66$ for *Mida salicifolia* (Fig. 3G), which is the first count for this endemic plant and also completes counts for the sole indigenous New Zealand representative of the family. As far as we are aware there are not published counts for *Nanodea muscosa*.

Orchidaceae

The recent discovery of a species of *Taeniophyllum* indigenous to northern New Zealand was documented by Renner & Beadel (2011). In that paper, one of our mitotic counts of $2n = 38$ was published. Here in addition to that count we present a further meiotic count of $n = 19_{II}$. Although Renner & Beadel (2011) treated the *Taeniophyllum* as *T. norfolkianum* D.L.Jones, B.Gray et M.A.Clem., the relationship of the New Zealand plant to that Norfolk Island endemic and indeed the Australia *T. muelleri* Benth. and *T. wilkianum* T.E.Hunt needs further critical evaluation (M.A.M. Renner, Sydney University, pers. comm.). *Taeniophyllum scaberulum* Hook. f. has $2n = 36$ (Chatterji 1978) but no other species appear to have been counted.

Oxalidaceae

New Zealand has four indigenous species of *Oxalis* (de Lange & Rolfe 2010) and at least one unnamed plant that may warrant species rank (Murray & de Lange 1999 as *Oxalis* aff. *rubens*). For New Zealand, currently published counts are available for *O. magellanica* G.Forst. ($n = 10$) and *O.* aff. *rubens* ($2n = 24$) (Dawson 2000). Here we present new counts of $2n = 22$ for *O. exilis* and $2n = 24$ for *O. thompsoniae*.

Piperaceae

Three species of *Peperomia* are accepted as indigenous to the New Zealand Botanical Region as defined by Allan (1961). Counts of $2n = 44$ have been published for *P. tetraphylla* (G.Forst.) Hook. et Arn. and *P. urvilleana* A.Rich. (Dawson 2000; Murray & de Lange 1999) leaving *P. blanda* var. *floribunda* (Miq.) H.Huber uncounted. Within the New Zealand Botanical Region, *P. blanda* var. *floribunda* is known only from the Kermadec Islands where it is locally common on Raoul Island. Our plants of this species from Raoul Island had $2n = 66$ but Samuel & Morawetz (1989) found $2n = 22$ in plants of this species, but did not report on the origin of their plant.

Plantaginaceae

Notwithstanding the nomenclatural tumult that indigenous New Zealand representatives of this family have received over the last decade, we favour retention of the New Zealand genera merged by some into an expanded *Veronica* (Garnock-Jones et al. 2007). Thus we present here two counts for *Parahebe*, in *P. jovellanoides* we found $n = 20_{II}$, $2n = 40$ (Fig. 3B) these were published previously (with permission) as *Veronica jovellanoides* Garn.-Jones et de Lange by Davidson et al. (2009). This number is unusual for *Parahebe* being shared only with the distantly related *P. decora* Ashwin (Davidson et al. 2009). By contrast, *P. senex* ($2n = 42$) has the same basic number as all other *Parahebe* for which counts have been published (Dawson 2000).

New Zealand indigenous representatives of *Plantago* have recently been revised by Meudt (2012) and a new species *P. udicola* was described. That species has $2n = 96$ chromosomes and is regarded as 16-ploid based on $x = 6$ (Murray et al. 2010). Meudt (2012) made reference to our previously unpublished count of $2n = 96$ from Lake Sarah, Canterbury; that number is published here. We have also counted the chromosomes of *P. lanceolata*, a commonly naturalised species in New Zealand, obtaining $2n = 12$, confirming it as diploid though there are a few reports of tetraploid plants of this species (Brullo et al. 1985; Murín 1997).

Poaceae

Previously we have undertaken a major survey of the chromosomes of the indigenous New Zealand Poaceae (de Lange & Murray 2002; Murray et al. 2003, 2005). Counts are now available for 94% of the New Zealand indigenous grass flora (Edgar & Connor 2010). Here we document several counts that are either new or were published with our permission in Edgar & Connor (2010).

Deschampsia

New Zealand has six species of *Deschampsia*, five of these are indigenous, *D. flexuosa* (L.) Trin. is naturalised. Counts have previously been published for four of the five indigenous taxa (Murray et al. 2005) which left only the high alpine Central Otago endemic *D. pusilla* uncounted. Here we report a count of $2n = 26$ for that species, the same number as that recorded for the other four indigenous species.

Hierochloe

The latest publication on *Hierochloe* leaves the genus with seven indigenous species (Edgar & Connor 2010). Counts are available for five of these (Murray et al. 2005) leaving *H. cuprea* Zotov and *H. recurvata* uncounted. Here we report $2n = 28$ for *H. recurvata*. Assuming a basic number of $x = 7$, this species is tetraploid as is the allied *H. novae-zelandiae* Gand. (Murray et al. 2005), the three other species (*H. brunonis* Hook.f., *H. fusca* Zotov and *H. redolens* (Vahl) Roem. et Schult.) with $2n = 84$ are 12-ploid, and *H. equiseta* Zotov is hexaploid ($2n = 42$).

Lachnagrostis

Here we report a count of $2n = 56$ for a specimen of *Lachnagrostis tenuis*. Previously our count had been cited as *L. glabra* in Edgar & Connor (2010). However, the voucher specimen for the count has since been redetermined as *L. tenuis* by *Lachnagrostis* expert A. Brown (University of South Australia, pers. comm. 2010).

Lepturus

The tropical grass *Lepturus repens* reaches its southern limit on the remote Herald Islets off the north-eastern coastline of Raoul Island (de Lange 2011a). Plants collected from North Chanter in 2005 had a chromosome number in the range $2n = 52$–54 (Fig. 3C) which is within the range reported for this species from Sri Lanka (Tateoka 1958). Currently the New Zealand examples of this widespread tropical grass are referred to var. *cinereus* (Burcham) Fosberg (Edgar & Connor 2010) because of its 'semi-prostrate habit' (Sykes & West 1996). However, this condition is (at least for the Kermadec plants) environmentally induced by the extremely exposed situation from where Sykes collected his plants, material which, notably, he did not cultivate back in New Zealand. Our cultivated plant of this grass from North Chanter rapidly developed an erect bunched growth habit typical of *L. repens* var. *repens* plants we have seen growing in sheltered situations elsewhere in the Pacific, and further, the same growth habit was also seen in wild plants observed by one of us (PdL) in May 2011 while visiting other better vegetated islets within the Herald Islets (de Lange 2011a). On this basis, we think that the Kermadec Islands plants are better referred to *L. repens* sensu lato rather than continuing to recognise them as var. *cinereus* or indeed recognising any of the other named varieties in this variable species. This opinion accords with the views of other botanists who have studied and/or collected *L. repens* from the wider Pacific and who regard it as an extremely plastic and variable tropical grass species (R.O. Gardner & W. A. Whistler, pers. comm. 2011).

Poa

Chromosome numbers were previously known from all but six (*Poa aucklandica* ssp. *rakiura* Edgar, *P. celsa* Edgar, *P. cookii* (Hook.f.) Hook.f., *P. maia* Edgar, *P. senex* Edgar and *P. tonsa* Edgar) of the 39 indigenous *Poa* species (Dawson 2000; Murray et al. 2005). Here we report new counts of $2n = 28$ for *P. celsa*, *P. senex* and *P. tonsa*, and confirmatory counts of $2n = 28$ for *P. intrusa* and *P. subvestita*.

Puccinellia

Counts for all the indigenous New Zealand *Puccinellia*, except *P. walkeri* subsp. *antipoda* and *P. walkeri* subsp. *walkeri* were reported by de Lange & Murray (2002). Here we report new counts of $2n = 42$ for the Antipodes Island endemic *P. walkeri* subsp. *antipoda* and $2n =$ 35 for *P. walkeri* subsp. *walkeri* from plants from coastal Otago and Southland. *Puccinellia walkeri* is chromosomally variable with *P. walkeri* subsp. *antipoda* being hexaploid, whereas plants of subsp. *chathamica* comprises hexaploids from the Chatham and tetraploids (reported here, Fig. 3D) and hexaploids from the Auckland Islands (Murray et al. 2005). *Puccinelia walkeri* subsp. *walkeri* is pentaploid (Fig. 3E). This chromosome variation suggests that their treatment as subspecies by Edgar (1996) may need re-evaluation and that perhaps they may be better treated again as species (de Lange & Rolfe 2010). Populations of subsp. *chathamica* from the Auckland Islands clearly warrant further investigation as does the origin of the pentaploid subsp. *walkeri*. We also obtained a further count of $2n = 56$ for *P. raroflorens* confirming a previous report by de Lange & Murray (2002).

Rytidosperma

If one accepts the merger of *Pyrrhanthera exigua* (Kirk) Zotov into *Rytidosperma* (Linder & Verboom 1996; Linder et al. 2010) and rejects *R. tenue* (Petrie) Connor et Edgar as a sterile hybrid (see below) then New Zealand has 20 indigenous species of *Rytidosperma*. Counts have been obtained from all but two species of the genus, *R. merum* Connor et Edgar and *R. nudum* (Dawson 2000; de Lange & Murray 2002; Murray et al. 2005). Here we report a count of $2n = 24$ for *R. nudum* (Fig. 3F). This grass had erroneously been treated as a sterile hybrid (de Lange et al. 2009a, de Lange & Rolfe 2010) but it has now been found in sufficient quantity and over such a wide part of the main axial ranges of the North Island that, despite the fact that viable seeds have never been found, it is unlikely to be a hybrid. This is in marked contrast to *R. tenue* apparently also sterile, and known only from the type and two other gatherings, and which appears to be a naturally occurring uncommon hybrid between *R. buchananii* (Hook.f.) Connor et Edgar and *R. gracile* (Hook.f.) Connor et Edgar (B.P.J. Molloy, pers. comm. 2009; see also de Lange et al. 2009a, de Lange & Rolfe 2010).

Simplicia

The chromosome numbers of the endemic ditypic genus *Simplicia* have been well documented (Dawson 2000; de Lange & Murray 2002; Murray et al. 2005). The genus is, as first noted by Zotov (1971), most closely related to the south-east Asian genus *Aniselytron* Merr. (R. Soreng, Smithsonian Instution, pers. comm. 2011). Here we correct one count reported previously by de Lange & Murray (2002, p. 8) as *Simplicia buchananii*. The specimen on which that count was based (AK 252968) is in fact an unusual westerly outlier of *S. laxa* (Smissen et al. 2011). However, we obtained a count of $2n = 28$ for plants of *S. buchananii* from near Gordons Pyramid, Kahurangi National Park and the same number was also obtained for North Island (upper Rangitīkei Valley) material of *S. laxa*. Smissen et al. (2011) note that North Island populations of *S. laxa* are genetically distinct from South Island *S. laxa* and that this may warrant further taxonomic investigation.

Trisetum

Edgar (1998) in her treatment of *Trisetum spicatum* documented its worldwide variation noting that there are diploid, tetraploid and hexaploid cytotypes, and further that there was considerable taxonomic disagreement over the number of subspecies and varieties. As such, she accepted the one variable species and advised (Edgar 1998) that 'it would be unwise to distinguish any infraspecific taxa in the New Zealand Botanical Region without an extensive biosystematic and cytological investigation as well as comparison with European and North and South American material'. Here we report $2n = 28$ (tetraploid based on $x = 7$) for a Rēkohu (Chatham Island) example of *T. spicatum*. Some Chatham Islands plants of *T. spicatum* differ from the usual South Island race by their larger stature and glabrous rather than pubescent or villous culms. However, our voucher specimen when collected had glabrous culms but after two years of cultivation the culms became villous, as described for South Island plants (Edgar 1998). Murray et al. (2005) obtained a C-value for a Campbell Island plant of *T. spicatum* which suggested a chromosome number of $2n = 56$ (octoploid). However, that plant died before a chromosome count could be obtained. Irrespective, we agree with Edgar (1998) that further study of *T. spicatum* is still necessary, and as the species is easily grown it would be an ideal candidate for a thorough cytological investigation.

Polygonaceae

New Zealand has 15 species of *Persicaria*, one of these, *P. decipiens* (R.Br.) K.L.Wilson is accepted as indigenous, while a second *P. prostrata* is either treated as naturalised (Webb et al. 1988) or as indigenous (P.D. Champion, pers. comm. 2012; de Lange et al. 2004a, 2009b; de Lange & Rolfe 2010). In New Zealand *P. prostrata* is a scarce species of lake turf habitats recorded mostly from the Rotorua Lakes District and Te Urewera in the North Island and from several stations along the West Coast of the South Island. These sites accord with the known trans-Tasman movement of grey teal (*Anas gracilis*) which are known vectors of wetland plant propagules (de Lange et al. 2011b) such that inferring an indigenous status for a plant with a known indigenous avian disperser and which has been recorded from New Zealand since at least 1882 (Webb et al. 1988) seems reasonable. Irrespective of its biostatus, plants of *P. prostrata* from Lake Okataina had $2n =$ c. 20. *Persicaria decipiens* has previously been counted with $n = 20$ (Dawson 2000; as *Polygonum decipiens*).

Potamogetonaceae

New Zealand has six indigenous representatives of the Potamogetonaceae in four genera, *Lepilaena* (*L. bilocularis* Kirk), *Potamogeton* (*P. cheesemanii* A.Benn., *P. ochreatus* Raoul, *P. suboblongus*), *Stuckenia* (*S. pectinata*) and *Zannichellia* (*Z. –palustris* L.) (de Lange & Rolfe 2010). Counts have previously been published for these New Zealand species; *Lepilaena* ($2n = 12$), *Zannichellia* ($2n = 24$) and one species of *Potamogeton* (*P. cheesemanii*, $2n =$ c. 28) (Dawson 2000; de Lange et al. 2004a). Here we report a new count of $2n = 28$ for the endemic *P. suboblongus*, the same number as that reported by de Lange et al. (2004a) for the indigenous *P. cheesemanii*. We also obtained counts of 2*n* = c. 78 for New Zealand material of *Stuckenia pectinata* which is the same number that has been reported from most of its range overseas (Holub 1997; Les & Haynes 1996).

Ranunculaceae

New Zealand has the one indigenous mousetail, *Myosurus minimus* subsp. *novae-zelandiae* (Garnock-Jones 1986) for which a single count of 2*n* = 16 has been published previously (Dawson 2000). Here we provide a confirmatory count of 2*n* = 16.

Restionaceae

New Zealand has five indigenous Restionaceae in three genera (*Apodasmia*, *Empodisma* and *Sporadanthus*) and counts have been published for all of these (Dawson 2000; Wagstaff & Clarkson 2012). Here we present a new count of 2*n* = 48 for a Rēkohu (Chatham Island) plant allied to *Apodasmia similis* (Edgar) Briggs et L.A.S.Johnson and discussed by Heenan et al. (2010) and de Lange et al. (2011a) on the basis of its larger stature and subtle differences in details of the inflorescence morphology (P.B. Heenan, Landcare Research, pers. comm. 2012). The count we obtained is the same as that recorded from South Island (Fiordland) plants of *A. similis* (Dawson 2000).

Scrophulariaceae

New Zealand has three indigenous *Myoporum*, *M. laetum* G.Forst., *M. rapense* subsp. *kermadecense* (W.R.Sykes) Chinnock and the newly described *M. semotum* (Heenan & de Lange 2011). A plant of *M. semotum* from Rangatira (South East Island) in the Chatham Islands group had 2*n* = 108, the same number as that obtained for the other two species (Dawson 2000; de Lange et al. 2004a).

Tetrachondraceae

The Tetrachondraceae is monogeneric with type species, the New Zealand endemic *Tetrachondra hamiltonii* and South American *T. patagonica* Skottsb. (Wagstaff et al. 2000). Plants of *T. hamiltonii*, from the Mākirikiri Tarns, Ruahine Ranges, North Island had 2*n* = 72.

Thymeleaeaceae

Since 2008 there have been a series of papers revising New Zealand *Pimelea* (Burrows 2008, 2009a, 2009b, 2011a, 2011b) and in the process some 53 taxa have been recognised, many of which are new to the New Zealand flora. Chromosome numbers are known for only nine of these taxa (Burrows 2009a; Dawson 2000; de Lange & Rolfe 2010). Here we report 12 counts, nine new, from ten taxa and one putative wild hybrid.

The count of 2*n* = 36 we obtained for a plant identified by C.J. Burrows as *Pimelea prostrata* subsp. *prostrata* matches one of the three published counts reported for *P. prostrata* s.l. (*n* = 18, 36, 2*n* = 36, 90) (Beuzenberg & Hair 1983; Burrows 2009a; Dawson 2000; Dawson & Beuzenberg 2000). The current treatment of *P. prostrata* recognises five subspecies and counts have been published for three of these (subsp. *prostrata*, subsp. *seismica* C.J.Burrows and subsp. *vulcanica* C.J.Burrows). Both *P. prostrata* subsp. *seismica* and subsp. *vulcanica* have counts of 2*n* = 36 (see discussion in Burrows 2009a). Burrows (2009a) suggests that *P. prostrata* subsp. *prostrata* may comprise a polyploid series and that this needs further investigation. To that we would add the comment that the treatment offered by Burrows (2009a) for *P. prostrata* is still far from satisfactory resulting in confusion as subspecies are often sympatic and/or syntopic and their defining characters often merge across all named subspecies. Burrows (2009a) suggests that *P. prostrata* is a species complex and has been subjected to repeated past and on-going introgression. While this may account for some of the problems we have had with using his treatment we feel that this species complex warrants further critical investigation using modern molecular and cytological techniques to not only test the taxa erected by Burrows (2009a) but also the claims of widespread introgression between them.

A similar situation arises for *P. urvilleana*, where two subspecies, subsp. *nesica* C.J. Burrows and subsp. *urvilleana* were distinguished by Burrows (2009a) with past introgression being suggested for the merging of distinguishing characters across parts of the subspecies' range. We obtained new counts of $2n = 36$ for both *P. urvilleana* subsp. *nesica* and subsp. *urvilleana* (as defined by Burrows 2009a) from North Cape.

A count of $2n = 72$ was also obtained for the newly described, endemic *P. mimosa* (Burrows 2011b). Of those counted from New Zealand only *P. oreophila* (probably subsp. *oreophila* as circumscribed by Burrows 2011a) has been reported to have the same number (Dawson & Beuzenberg 2000).

We also investigated the two subspecies of *P. orthia*, finding $2n = 36$ in both subsp. *orthia* and subsp. *protea*. Again we feel that further taxonomic investigation into the status of *P. orthia* subsp. *protea* is warranted. The plants we have grown from the type locality (collected for us by one of naming authors M.J. Thorsen) have little in common with *P. orthia* subsp. *orthia* resembling rather a semi-erect to erect state of *P. urvilleana* s.l.

The other five counts of $2n = 36$ for *P. microphylla*, *P. pseudolyallii*, *P. telura*, *P. tomentosa* and *P. villosa* are all new. The count reported here for *P. villosa* is from a Rēkohu (Chatham Island) plant. Burrows (2009b) treated *P. villosa* as comprising two subspecies, subsp. *villosa* and subsp. *arenaria* (A.Cunn.) C.J.Burrows. Burrows (2009b) stated that both subspecies were present on the Chatham Islands. However, our observations on the Chatham Islands suggest that there is only one taxon on the islands that corresponds to his *P. villosa* subsp. *villosa* (de Lange et al. 2011a) and Burrow's examples of hybrids including ones collected by one of us (PdL) are merely shade forms of this. Resolution of this is beyond the scope of this paper and we recommend further taxonomic investigation. Until then, we prefer to recognise one species *P. villosa* and within it a potentially distinct race *P.* aff. *villosa* for which the name *P. dasyantha* Colenso probably applies (M.J. Thorsen, pers. comm. 2010).

The last count comes from a cultivated plant collected from Pipinui Point, on the coast west of Wellington. These plants have been treated by botanists as an unnamed race of *P. aridula* Cheeseman but they were treated as a northerly outlier of *P. pseudolyallii* by Burrows (2011a). The plant we examined was pollen sterile and had a chromosome number of $2n = 54$, a markedly different number to that we obtained from a *P. pseudolyallii* plant from Little Peel, Canterbury ($2n = 36$). The Pipinui race of *P. pseudolyallii* probably warrants further study, it seems unlikely that all plants of that race are hybrids, indeed plants raised by cuttings from that site and held at Percy Reserve, Petone, Wellington between 1991 and 1997 produced viable seed that was successfully germinated, the seedlings of which showed no divergence from the parent plants (P.J. de Lange, unpubl. data). However, we were unable to examine those plants as they are no longer extant. Other *Pimelea* recorded from the Pipinui site include members of the *P. prostrata* complex (plants mostly matching *P. prostrata* subsp. *seismica* ($2n = 36$)) and *P. cryptica* C.J. Burrows et Enright which remains uncounted. If *P. pseudolyallii* plants are all uniformly $2n = 36$ then hybrids between it and *P. prostrata* subsp. *seismica* are unlikely to have $2n = 54$ chromosomes. Possibly our plant is a hybrid involving *P. cryptica*. Further study into this northerly population of *P. pseudolyallii* is needed to resolve the apparent chromosome variation and taxonomic status of that population.

Counts are now available for about one third of New Zealand's *Pimelea* taxa and although many taxa remain to be counted, some patterns are emerging. It would seem that $2n = 36$ is the most common number, and that *P*. *prostrata* s.l. might be chromosomally variable. A similar situation was also described for *P*. *oreophila* which was reported to have diploid and polyploid races (Rattenbury 1957, Burrows 1958, Dawson & Beuzenberg 2000). However, these comments will need to be reviewed in light of the recent treatment of *P*. *oreophila* and its allies offered by Burrows (2011a).

Winteraceae

Two plants of the Northland endemic *Pseudowintera insperata* as reported by Heenan & de Lange (2006) had $2n = 86$, the same number as that recorded for the other three species in the genus (Dawson 2000).

Conclusions and future work

With the publication of this, the 40th in the series of chromosome 'Contributions' it is pertinent to reflect on what more needs to be done. We now have at least one count for c. 85% of the angiosperm flora, which means that there are c. 350 species or subspecies that remain to be examined. The majority of these are in the Magnoliidae with 17 of 188 Polypodiidae and 5 of 13 Lycopodiidae uncounted. In Table 2 we have attempted to compile a list of the families and genera where these gaps occur and it is clear that the distribution of 'missing' numbers is not random. In the great majority of families there are just one or two genera each with just a few species where counts are missing but the Cyperaceae, Asteraceae,

Table 2 Summary of the families and genera that contain species and subspecies that have not had their chromosomes counted.

LYCOPODIIDAE Lycopodiaceae: *Huperzia* 1, *Lycopodiella* 2, *Lycopodium* 1, *Phylloglossum* 1
POLYPODIIDAE Cyatheaceae: *Cyathea* 1
Gleicheniaceae: *Gleichenia* 1, *Sticherus* 1
Grammitidaceae: *Grammitis* 3
Hymenophyllaceae: *Abrodictyum* 3, *Crepidomanes* 1, *Hymenophyllum* 3, *Polyphlebium* 1
Ophioglossaceae: *Botrychium* 1, *Ophioglossum* 1
MAGNOLIIDAE Amaranthaceae: *Atriplex* 1, *Chenopodium* 1
Aizoaceae: *Carpobrotus* 1, *Chenopodium* 1
Apiaceae: *Aciphylla* 13, *Actinotus* 1, *Anisotome* 5, *Azorella* 1, *Chaerophyllum* 1, *Lilaeopsis* 1, *Stilbocarpa* 2
Asteliaceae: *Astelia* 5
Asteraceae: *Abrotanella* 1, *Craspedia* 2, *Haastia* 1, *Helichrysum* 1, *Leptinella* 1, *Olearia* 2, *Pleurophyllum* 3, *Raoulia* 1
Balanophoraceae: *Dactylanthus* 1
Boraginaceae: *Myosotis* c. 26
Brassicaceae: *Cardamine* 4, *Lepidium* 8, *Pachycladon* 5
Burmaniaceae: *Thismia* 1
Caryophyllaceae: *Colobanthus* 11, *Stellaria* 2
Centrolepidaceae: *Centrolepis* 4, *Gaimardia* 1
Convolvulaceae: *Convolvulus* 1, *Wilsonia* 1
Coriaiaceae: *Coriaria* 2
Crassulaceae: *Crassula* 4
Cyperaceae: *Bolboschoenus* 2, *Carex* 25, *Carpha* 1, *Cyperus* 1, *Fimbristylis* 1, *Gahnia* 5, *Isolepis* 12, *Lepidosperma* 3, *Machaerina* 5, *Oreobolus* 2, *Schoenoplectus* 1
Droseraceae: *Drosera* 2
Ericaceae: *Archeria* 1, *Dracophyllum* 17, *Gaultheria* 4, *Sprengelia* 1
Fabaceae: *Carmichaelia* 2
Gentianaceae: *Gentianella* 14

Table 2 (*Continued*)

Juncaceae: *Juncus* 12, *Marsippospermum* 1
Lauraceae: *Cassytha* 1
Lentibulariaceae: *Utricularia* 3
Loganiaceae: *Mitrasacme* 2
Menyanthaceae: *Liparophyllum* 1
Montiaceae: *Montia* 3
Nothofagaceae: *Nothofagus* 1
Onagraceae: *Epilobium* 2
Orchidaceae: *Diplodium* 1, *Myrmechilia* 1, *Nematoceras* 6, *Petalochilus* 4, *Pterostylis* 2, *Stegostyla* 1, *Sullivania* 1, *Thelymitra* 1
Orobranchaceae: *Euphrasia* 16
Oxalidaceae: *Oxalis* 1
Pittosporaceae: *Pittosporum* 1
Plantaginaceae: *Gratiola* 1, *Hebe* 1, *Parahebe* 2, *Plantago* 1, *Veronica* 1
Poaceae: *Agrostis* 2, *Hierochloe* 1, *Lachnagrostis* 1, *Poa* 3, *Rytidosperma* 1, *Zotovia* 1
Polygonaceae: *Polygonum* 1
Potamogetonaceae: *Potamogeton* 1
Ranunculaceae: *Ceratocephala* 1, *Caltha* 1, *Ranunculus* 5
Rosaceae: *Geum* 1
Rubiaceae: *Galium* 1
Santalaceae: *Exocarpos* 1
Stylidiaceae: *Donatia* 1, *Forstera* 3, *Phyllachne* 3
Thymelaeaceae: *Pimelea* 25

Note: Numbers after each genus = number of New Zealand species and subspecies that remain to be counted.

Orchidaceae and Poaceae stand out as the families where most work remains to be done. To some extent this reflects the contribution that these families make to the total number of species in the New Zealand flora although some families make a disproportionate contribution. The most obvious of these is the Cyperaceae, which has the greatest number of uncounted species, 58 of a total of c. 177 (de Lange & Rolfe 2010) which contrasts with the Asteraceae with more than twice as many species but only 12 uncounted. The Apiaceae also contains a large number of uncounted species, 29 of 131, with, for example, 13 species of *Aciphylla* still to be counted. The reasons for the gaps are various. In some taxa, small chromosome size coupled with a large number of chromosomes make counting particularly difficult. We have also found that the mitotic chromosomes of many members of the Cyperaceae and Juncaceae do not stain readily with standard methods so observations on meiosis may prove to be a better source of chromosome numbers for these plants. However, these species often do not flower when grown out of their natural range so this is a further impediment to meiotic analysis. Many of the other gaps are for plants from remote and or poorly accessible habitats so obtaining seed or living material is often difficult. There is also the problem that some groups are taxonomically 'difficult' and may for that reason be under represented in the current chromosome record.

Chromosome studies of New Zealand plants are now entering the end of the alpha stage with information available for the great majority of native plants. However, despite pioneering studies on chromosome evolution in genera such as *Hebe* (Frankel & Hair 1937), the development of molecular methods of chromosome analysis using *in situ* hybridisation with specific gene or sequence probes or whole genomes have not been widely used even though they offer the potential to unravel the evolution of polyploid complexes that are so prevalent in the New Zealand flora. A recent example of this is the work of Wong (2011) on *Plantago* where the alloploid ancestry of several hexaploids and the 16-ploid *P. udicola* has been clearly demonstrated using whole genomic probes of putative diploid progenitors to 'paint' the chromosomes of the polyploids. Chromosome painting can also be useful to identify interspecific hybrids as demonstrated in the naturally occurring hybrids between *Lobelia angulata* (as *Pratia angulata*) and *L. perpusilla* Hook.f. (Murray et al. 2004) and, to some extent, in species within the *Kunzea* species complex (de Lange et al. 2005).

Chromosome surveys have also provided useful insights into the population structure of both rare and common plants. Several surveys (Dawson & Beuzenberg 2000; Dawson et al. 1993; de Lange et al. 2008; Murray et al. 2010) have found that more extensive sampling has in some cases revealed quite extensive intraspecific chromosome number variation. An extreme example of this is *Crassula ruamahanga* where plants from 16 localities spanning much of the range of the species had 11 different chromosome numbers that ranged from $2n = 42$ to $2n = 100$ (de Lange et al. 2008). This sort of variation has implications for both practical conservation and in systematic and evolutionary studies.

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