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# Reuniting males and females: redescriptions of *Nuisiana arboris* (Marples 1959) and *Cambridgea reinga* Forster & Wilton 1973 (Araneae: Desidae, Stiphidiidae)

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## Abstract

Two New Zealand endemic spider species, *Nuisiana arboris* (Marples 1959) (Desidae) and *Cambridgea reinga* Forster & Wilton 1973 (Stiphidiidae), are redescribed, including notes on their distribution and DNA sequences from the mitochondrial gene cytochrome *c* oxidase subunit 1. Based on morphological evidence and mitochondrial DNA sequences, *Matachia magna* Forster 1970 is a junior synonym of *Nuisiana arboris*, and *Nanocambridgea grandis* Blest & Vink 2000 is a junior synonym of *Cambridgea reinga*. Two forms of male morph in *C. reinga* are recorded.

**Key words:** cytochrome *c* oxidase subunit 1 (COI), DNA, *Matachia*, new synonymy, New Zealand, *Nanocambridgea*

## Introduction

New Zealand's spider fauna is diverse with an estimated 1990 species, of which 93% are endemic (Paquin *et al.* 2010). Most of the 1126 named species were described during the last 60 years and about 60% were described by one man, Ray Forster (Patrick *et al.* 2000). The breadth of Forster's coverage meant that many species were described on the basis of very few specimens and so it is not surprising that many species are known only from males or females. As research on New Zealand's spider fauna continues, the missing sex of some species has been identified and described (e.g., Vink 2002; Fitzgerald & Sirvid 2009). In other cases, males and females previously described as different species or in different genera have been recognised as belonging together. Here, for two species we unite males and females that had been placed in different genera.

During spider surveys in the Mercury Islands between 1995 and 2000, female *Nuisiana arboris* (Marples 1959), the type species of the monotypic genus *Nuisiana* Forster & Wilton 1973, and male *Matachia magna* Forster 1970 (both in the family Desidae) were collected from natural and artificial shelters on Korapuki Island (Green 2005). Specimens were sent to Ray Forster and he concluded (*in litt.* 23 July 1997) that the "*Matachia* is the male of *Nuisiana*" and that the two genera were still valid. Also, during fieldwork in Canterbury, a male *Matachia magna* was found with a female *Nuisiana arboris* in an artificial shelter (Bowie *et al.* 2006; Hodge *et al.* 2007)

During the identification of spiders collected recently in Te Paki Ecological District at the northern tip of Northland, it became apparent that two Stiphidiidae, *Cambridgea reinga* Forster & Wilton 1973, known only from the female, and *Nanocambridgea grandis* Blest & Vink 2000, known only from the male, may be the same species. The male and female specimens had the same colour pattern and were collected from the same localities, including a male and female collected in the same pitfall trap. The only other Stiphidiidae species collected in Te Paki Ecological District was *C. foliata* (L. Koch, 1872), which is much larger and found throughout the North Island and the north of the South Island.

To establish the synonymy of the specimens in question and to facilitate identification, we examined their morphology and a fragment of the mitochondrial gene, cytochrome *c* oxidase subunit 1 (COI).

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## Methods

Specimens were examined in 80% ethanol with a dissection microscope. In order to illustrate specimens, they were first photographed with a Nikon Coolpix 950 digital camera attached to a SMZ-U Nikon dissection microscope. The digital photos were then used to establish proportions and the illustrations were detailed and shaded by referring back to the structure under the microscope. Female internal genitalia were excised using a sharp entomological needle and cleared in lactic acid. All measurements are in millimetres and were made with a micrometer ruler fitted to the eyepiece of the microscope. The terms cephalothorax, abdomen and internal genitalia are used rather than prosoma, opisthosoma and vulva, respectively. The former terms are usual in New Zealand spider systematics (e.g., Forster 1970; Forster & Wilton 1973; Blest & Vink 2000; Vink 2002; Fitzgerald & Sirvid 2009) and are defined in Paquin *et al*. (2010). The term 'internal genitalia' refers to the spermatheca, copulatory and fertilisation ducts.

Specimens were examined from the Entomology Research Museum, Lincoln University (LUNZ), the Museum of New Zealand Te Papa Tongarewa, Wellington (MONZ) and the Auckland Museum, Auckland (AMNZ). The New Zealand region names follow Crosby *et al*. (1998).

To make DNA sequence comparisons between specimens of *Matachia magna* and *Nuisiana arboris*, and between *Cambridgea reinga* and *Nanocambridgea grandis*, we used the mitochondrial gene cytochrome *c* oxidase subunit 1 (COI) as it is one of the fastest evolving mitochondrial markers and has been used to examine genetic differences between spider species and populations (e.g., Vink & Paterson 2003; Paquin & Hedin 2004; Ayoub *et al.* 2005; Vink *et al*. 2008). We sequenced COI from specimens of *Matachia magna* and *Nuisiana arboris* from near Whangarei [35°51.84'S, 174°10.15'E], Northland, New Zealand, and *Cambridgea reinga* and *Nanocambridgea grandis* from the Te Paki Ecological District, Northland, New Zealand. Specimens collected elsewhere in New Zealand had not been stored in optimal conditions for DNA preservation (Vink *et al.* 2005) and were unlikely to yield usable DNA. However, we did attempt to extract DNA from the preservative from a nine year old specimen of *Nuisiana arboris* using the methods of Shokralla *et al.* (2010), but amplification of fragments of COI was unsuccessful.

DNA was extracted non-destructively (Paquin & Vink 2009) from one to three legs using a ZR Genomic DNA™-Tissue MiniPrep kit (Zymo Research). The primers used to amplify and sequence an 844 base pair (bp) COI fragment from the Stiphidiidae specimens were C1-J-1718-spider (5'-GGNGGATTTGGAAATTGRTTRGTTCC-3') (Vink *et al.* 2005) plus C1-N-2568 (5'-GCTACAACATAATAAGTATCATG-3') (Hedin & Maddison 2001). A 1054 bp COI fragment from the Desidae specimens was amplified and sequenced using the primers LCO-1490 (5'-GGTCAACAAATCATAAAGATATTGG-3') (Folmer *et al.* 1994) plus C1-N-2568. PCR amplification was performed using *i*-StarTaq™ DNA Polymerase (iNtRON Biotechnology) in a Mastercycler® (Eppendorf) thermocycler with a cycling profile of 35 cycles of 94 ºC denaturation (30 s), 48 °C annealing (30 s), 72 ºC extension (1 min) with an initial denaturation of 3 min and a final extension of 5 min. Excess primers and salts were removed from the resulting double-stranded DNA using a DNA Clean & Concentrator™ Kit (Zymo Research). Purified PCR fragments of DNA were sequenced in both directions at either the Allan Wilson Centre Genome Service (Massey University) or Macrogen (Seoul). Sequence data were deposited in GenBank (www.ncbi.nlm.nih.gov/Genbank/). Sequences were edited and compared to each other using Sequencher 4.6 (Gene Codes Corporation). Nucleotide differences between COI sequences were expressed as a percentage and compared to intraspecific and interspecific differences observed in other spiders (Robinson *et al*. 2009).

## Taxonomy

### Family Desidae Pocock 1895

### Genus *Nuisiana* Forster & Wilton 1973

*Nuisiana* Forster & Wilton 1973: 301. Type species: *Nuisiana arboris* (Marples 1959).

***Nuisiana arboris* (Marples 1959)**
(Figs 1–6)

*Maniho arboris* Marples 1959: 352, fig. III.6 (description of female).
*Forsterina arboris* (Marples); Lehtinen 1967: 235 (transfer to *Forsterina*).
*Matachia magna* Forster 1970: 32, figs 53, 56 (description of male). **NEW SYNONYMY.**
*Nuisiana arboris* (Marples); Forster & Wilton 1973: 302, figs 1060–1062 (transfer to *Nuisiana*).

**Type specimens.** Holotype ♀, not examined, **NEW ZEALAND: Southland:** Tuatapere [46°07'S, 167°41'E], May 1956, R.R. Marples leg., Otago Museum, New Zealand.

Holotype ♂, *Matachia magna*. Not examined. **NEW ZEALAND: Coromandel:** Cuvier Island [36°26'S, 175°46'E], 22 June 1943, R.R. Forster leg., Otago Museum, New Zealand.

We did not examine the types of *Maniho arboris* and *Matachia magna*; the illustrations and descriptions in Forster (1970) and Forster & Wilton (1973) are clear enough to be sure of the species identity.

**Other material examined. NEW ZEALAND: Mid Canterbury:** Orton Bradley Park [43°40.22'S, 172°42.90'E], 13 June 2001, M.H. Bowie, C.J. Vink & J.C. Banks leg., 1 ♂, 1 ♀ (LUNZ). **North Canterbury:** View Hill (43°17.20'S, 172°04.53'E) 6 June 2001, M.H. Bowie & J.C. Banks leg., 1 ♀ (LUNZ). **Coromandel:** Korapuki Island [36°39.5'S, 175°51'E], 5 December 1995, C.J. Green leg., 1 ♂ (MONZ AS.001618); 4 December 1996, B.M. Fitzgerald, 1 ♀ (MONZ AS.001626); 5 December 1996, B.M. Fitzgerald leg., 1 ♀ + spiderlings (MONZ AS.001625); 5 December 1996, B.M. Fitzgerald leg., 1 ♀ (MONZ AS.001622); 5 December 1996, B.M. Fitzgerald leg., 2 immatures (MONZ AS.001624); 26–28 November 1997, C.J. Green leg., 8 ♀ (MONZ AS.001619); 26 November 1997, C.J. Green leg., 1 ♀ with spiderlings (MONZ AS.001620); 27 November 1997, B.M. Fitzgerald leg., 1 ♂, 2 ♀ (MONZ AS.001621); 25 February 1998, C.J. Green leg., 1 ♀ (MONZ AS.001627); 1 March 1998, B.M. Fitzgerald leg., 1 penultimate ♂ (MONZ AS.001628); 25 February & 2 March 1999, C.J. Green leg., 1 ♀, 1 penultimate ♂ (MONZ AS.001617); 28 November 2000, C.J. Green leg., 1 ♀, 164 eggs (MONZ AS.001639); 29 November 2000, C.J. Green leg., 1 ♀, 146 eggs (MONZ AS.001638); 30 November 2000, B.M. Fitzgerald leg., 1 ♀ (MONZ AS.001623); 30 November 2000, C.J. Green leg., 1 ♀, 135 spiderlings (MONZ AS.001637); 1 ♀, 146 eggs (MONZ AS.001636); 4 December 2000, C.J. Green leg., 1 ♀, 186 eggs (MONZ AS.001634) ; 1 ♀, egg sac (MONZ AS.001635); 1 ♀, 214 eggs (MONZ AS.001633). **Northland:** Peach Cove [35°51.4'S, 174°33.9'E], 17 October 2001, B.M. Fitzgerald leg., 1 ♀ (MONZ AS.001616). Mas Olivier [35°51.84'S, 174°10.15'E], 6 April 2010, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001597) (GenBank HM439085); 21 April 2010, O.J.-P. Ball leg., 1 ♀ (MONZ AS.001598) (GenBank HM439086); 21 April 2010, O.J.-P. Ball leg., 1 ♂, 1 subadult ♀ (MONZ AS.001599) (GenBank HM439087, HM439088).

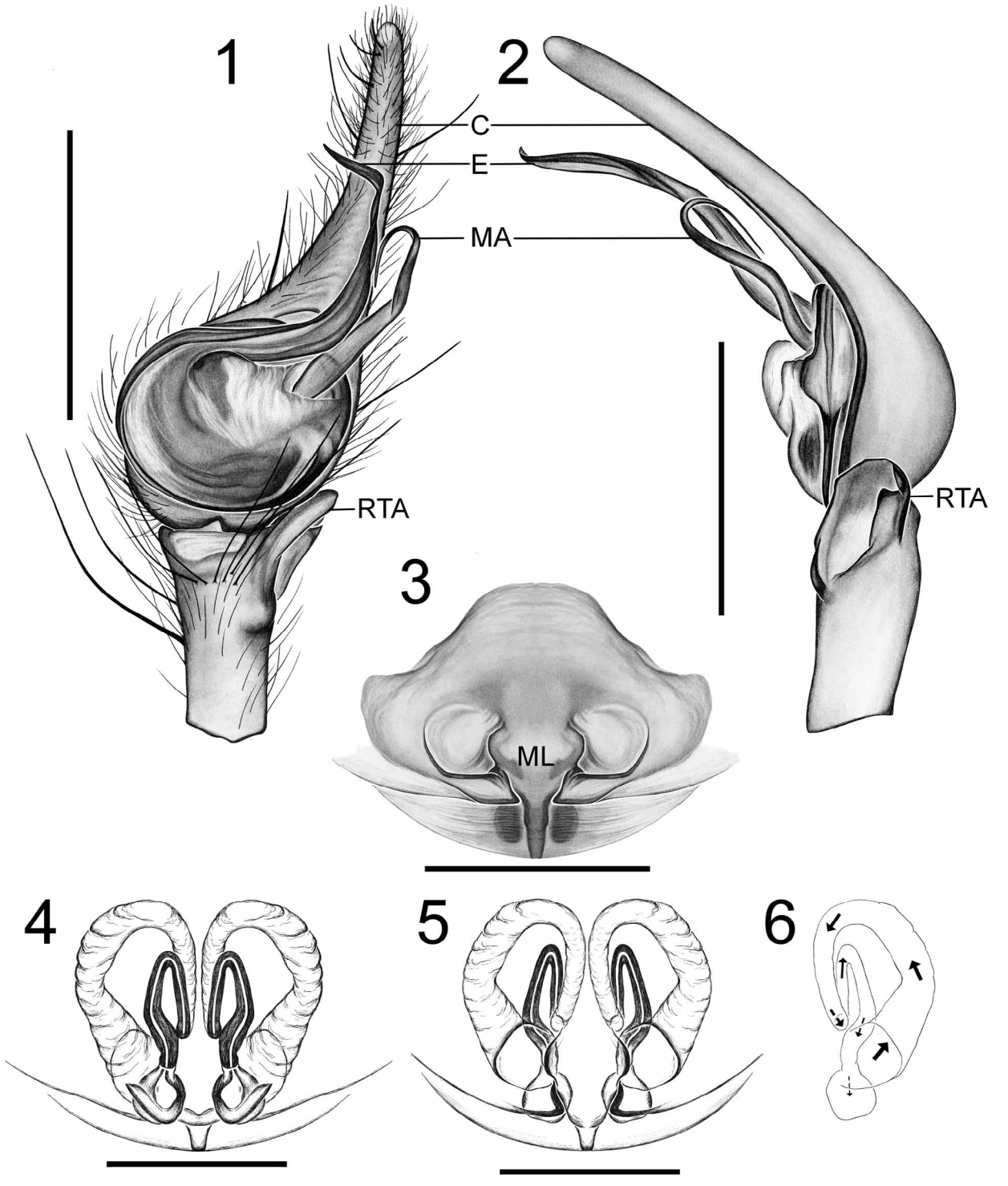
**Other locality records. NEW ZEALAND: Mid Canterbury:** Ahuriri Scenic Reserve [43°39.97'S, 172°37.44'E] (Bowie & Frampton 2004). Hoods Bush [43°28.4'S, 171°48.5'E] (Forster & Wilton 1973). **North Canterbury:** Foxs Creek [43°12'S, 172°36'E] (Forster & Wilton 1973). **Nelson:** Nelson [41°16'S, 173°18'E] (Forster & Wilton 1973). **Wairarapa:** Waituna [41°19'S, 175°10'E] (Forster & Wilton 1973). Solway [40°58'S, 175°37'E] (Forster & Wilton 1973). **Coromandel:** Little Barrier Island [36°12'S, 175°05'E] (Forster & Wilton 1973). **Auckland:** Algies Bay [36°26'S, 174°44'E] (Forster & Wilton 1973). **Northland:** Hen Island [35°57.8'S, 174°43.3'E] (Forster & Wilton 1973).

**Diagnosis.** *Nuisiana arboris* can be distinguished from other New Zealand Desidae, particularly *Matachia* Forster 1970, by features of the male pedipalp (Figs 1, 2), especially the the shape of the retrolateral tibial apophysis. In *Matachia* the tibiae are comparatively short and bulbous (see Forster 1970: figs 55–60). The internal genitalia are less convoluted and with much broader ducts than in *Matachia* (Figs 4–6, c.f. Forster 1970: figs 61–65). The third pair of legs in female of *N. arboris* is directed rearwards, while in females of *Matachia* it is directed forwards.

**Redescription.** Colour: carapace yellow-brown, darker around eyes and cephalic region; sternum yellow-brown; abdomen light grey-brown with darker median folium on dorsal surface, widest medially; legs yellow-brown.

Chelicerae of male porrect, with two retromarginal teeth, one at mid-point, and other basal, opposite four or five promarginal teeth. Chelicerae of female not porrect, with two widely-spaced retromarginal teeth and five or six promarginal teeth. Eyes subequal in size, posterior row procurved. Cribellum present in females and males, wider than long, spinning field present in female but reduced or absent in male. Calamistrum well developed in female

but vestigial or absent in male. Male pedipalp (Figs 1, 2) with elongate retrolateral tibial apophysis with spinous lobe and distal plate forming single process (Fig. 2); cymbium tip longer than bulb and distal spinous portion of conductor extending almost to tip of cymbium; median apophysis long and bent back on itself. Epigynum with median lobe extending to epigastric furrow, flanked by pair of strong, blunt projections (Fig. 3); internal genitalia relatively simple with broad, thin-walled copulatory ducts that are sclerotised prior to spermathecae (Figs 4–6). Legs 1243; first three pairs of legs directed forwards in males but only first two pairs directed forwards in females.




**FIGURES 1–6.** *Nuisiana arboris* (Marples 1959). 1. Male pedipalp, ventral view; 2. Male pedipalp, retrolateral view; 3. Epigynum, ventral view; 4. Internal genitalia, ventral view; 5. Internal genitalia, dorsal view; 6. Schematic course of internal ducts. Scale bars for figures 1, 2 = 1.0 mm, 3–5 = 0.5 mm. Abbreviations used: C, cymbium; E, embolus; MA, median apophysis; RTA, retrolateral tibial apophysis; ML, median lobe.

**Dimensions**. Female Coromandel, Korapuki Island (MONZ AS.001621) (male Coromandel, Korapuki Island (MONZ AS.001618)): total length 9.75 (9.99); carapace length 4.18 (4.64), width 2.94 (3.41), height 2.01 (1.70); abdomen length 5.57 (5.42), width 4.03 (2.79); sternum length 2.32 (2.48), width 1.78 (1.86). Size range: female body length 9.1–11.0 (mean 10.4, n=12), male body length 8.3–11.6 (mean 10.1, n=5).

**DNA sequences.** Mitochondrial COI (GenBank accession numbers HM439085–HM439088). The four sequences varied by only 0.9%, which is well within intraspecific variation observed in other spiders (Robinson *et al.* 2009). We observed nine variable nucleotide positions; eight transitions and one non-synonymous transversion.

**Biology.** *Nuisiana arboris* have been found living beneath the bark of large totara trees (*Podocarpus totara* G. Benn. ex D. Don) where they build a small web (Marples 1959). On Korapuki Island they were found under bark and in holes on large pohutukawa trees (*Metrosideros excelsa* Gaertn.). They have also been found under wooden disks on the ground (Bowie & Frampton 2004) and in tree-mounted artificial refuges designed to shelter and monitor weta (Orthoptera: Anostostomatidae and Rhaphidophoridae) (Green 2005; Bowie *et al.* 2006; Hodge *et al.* 2007). A female, with an egg sac containing 259 eggs, was found at Peach Cove, under a light web on the face of a large, undercut rock. Five egg sacs from Korapuki Island contained, on average, 171 eggs (range 146–214) and another two, 135 and 139 spiderlings. In contrast, the egg sacs of species of *Matachia* contain, on average, ten or twelve eggs (Forster & Forster 1999). Adults of *N. arboris* have been found throughout the year.

**Distribution.** Throughout New Zealand (Southland, Mid Canterbury, North Canterbury, Nelson, Wairarapa, Coromandel, Auckland, Northland).

**Remarks.** Forster & Wilton (1973) noted that it was "probable" *Matachia magna* was the male of *N. arboris*. After examining males and females from Korapuki Island, Mercury Group, Forster (*in litt.* 23 July 1997) concluded "that the Cuvier Island *Matachia* is the male of *Nuisiana*" and that the two genera were valid. Male and female specimens found together at different localities, the same colour pattern in both sexes, and COI sequences that vary by only 0.9%, lead us to conclude that *M. magna* is a junior synonym of *N. arboris*. Female *N. arboris* does not have the morphological adaptations (an elongated cephalothorax and the third pair of legs directed forward) that *Matachia* has for living in holes. However, most of our specimens were obtained from natural holes or artificial shelters, indicating that *Nuisiana* is just as much a hole-dweller, as are species of *Matachia*. There are many similarities between *N. arboris* and *Matachia* species. Forster & Wilton (1973: 301) thought that they were "very closely related" and that the rather simple genitalia of female *N. arboris* were "readily derived from those of *Matachia*". The male pedipalp of *N. arboris* is very close to that of some *Matachia* species, except for the elongate tibia of the pedipalp. Despite these similarities, we have retained the monotypic genus *Nuisiana*. A proper assessment of the validity of the genus *Nuisiana* is beyond the scope of this study, but could be resolved by a phylogenetic analysis of New Zealand Desidae that includes *Nuisiana*, *Matachia* and other similar genera (*Desis* Walckenaer 1837, *Goyenia* Forster 1970, *Helsonia* Forster 1970, *Notomatachia* Forster 1970, *Panoa* Forster 1970).

## Family Stiphidiidae Dalmas 1917

### Genus *Cambridgea* L. Koch 1872

*Cambridgea* L. Koch 1872: 358. Type species: *Cambridgea antipodiana* (White 1849).

### *Cambridgea reinga* Forster & Wilton 1973

(Figs 7–16)

*Cambridgea reinga* Forster & Wilton 1973: 151, figs 456–457 (description of female).
*Nanocambridgea grandis* Blest & Vink 2000: 21, figs 57–58 (description of male). **NEW SYNONYMY.**

**Type specimens.** Holotype ♀, not examined, **NEW ZEALAND: Northland:** Cape Reinga [34°26'S, 172°41'E], 7 January 1967, R.R. Forster leg., Otago Museum, New Zealand.

Holotype ♂, *Nanocambridgea grandis*, examined. **NEW ZEALAND: Northland:** Cape Reinga [34°26'S, 172°41'E,], 10–13 December 1995, J.W. Early & R.F. Gilbert leg., (AMNZ 5031), 2 male paratypes, same locality, date and collector (AMNZ 6568).

We did not examine the type of *Cambridgea reinga*; the illustrations and descriptions by Forster & Wilton (1973) are clear enough to be sure of the species identity.

**Other material examined. NEW ZEALAND: Northland:** Shenstone Block [34°31.540'S, 172°46.674'E], 17 July–15 August 2008, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001607) (GenBank HQ316174); 1 ♀ (MONZ AS.001608) (GenBank HQ332444); 22 October–21 November 2008, O.J.-P. Ball leg., 1 ♀ (MONZ AS.001604); 9 April–7 May 2009, O.J.-P. Ball leg., 1 ♀ (MONZ AS.001605) (GenBank HM439089). Spirits Bay [34°28.657'S, 172°52.715'E], 12 January–12 February 2007, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001590). Kerr Point [34°27.726'S, 172°52.962'E], 12 January–12 February 2007, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001609). Taputaputa Site B [34°26.732'S, 172°43.359'E], 17 July–15 August 2008, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001614); 1 ♂ (MONZ AS.001615); 22 October–21 November 2008, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001612); 1 ♂ (MONZ AS.001611); 1 ♂ (MONZ AS.001613). Taputaputa Site A [34°26.527'S, 172°42.162'E], 17 July–15 August 2008, O.J.-P. Ball leg., 1 ♀ (MONZ AS.001632); 22 October–21 November 2008, O.J.-P. Ball leg., 1 ♀ (MONZ AS.001631); 15 January–13 February 2009, O.J.-P. Ball leg., 2 ♂ (MONZ AS.001640). Unuwhao Site A [34°26.139'S, 172°53.279'E], 12 January–12 February 2007, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001610); 1 immature (MONZ AS.001629). Cape Reinga [34°26'S, 172°41'E], 10–13 December 1995, J.W. Early & R.F. Gilbert leg., 2 ♂ (AMNZ 6568). North Cape [34°24.947'S, 173°01.446'E], 22 October–21 November 2008, O.J.-P. Ball leg., 1 ♀ (MONZ AS.001630); 1 ♂ (MONZ AS.001605) (GenBank HQ316173); 15 January–13 February 2009, O.J.-P. Ball leg., 1 ♂ (MONZ AS.001606); 1 ♂ (MONZ AS.001601) (GenBank HM439090); 1 ♂ (MONZ AS.001603) (GenBank HM439091). Kohuronaki B [34°29.922'S, 172°50.586'E], 22 October–21 November 2008, O.J.-P. Ball leg., 1 ♂, 1 ♀ (MONZ AS. 001600); 15 January–13 February 2009, O.J.-P. Ball leg., 1 ♀ (MONZ AS.001856) (GenBank HQ316175).

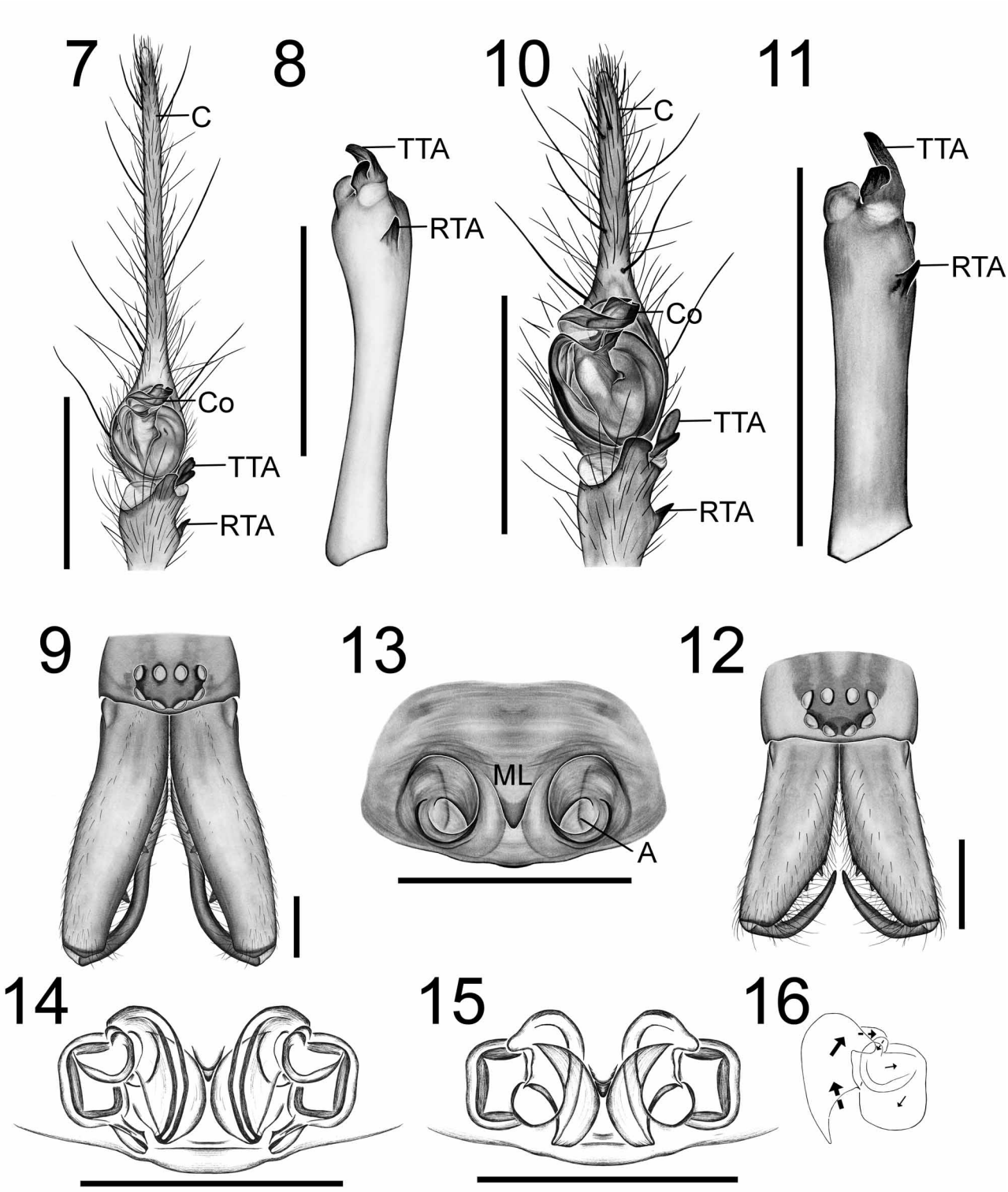
**Diagnosis.** *Cambridgea reinga* can be distinguished from other *Cambridgea* species by the arrangement of the male pedipalp (Figs 7, 8, 10, 11), particularly the terminal tibial apophysis (Figs 8, 11), which is well sclerotised (weak and foliate in most other *Cambridgea* species), and the epigynum of the female (Figs 13–16), which has large, paired atria and a median lobe about half way down the median furrow. The legs (relative to the carapace length) are longer than other *Cambridgea* species.

**Redescription.** Colour: carapace orange-brown with contrasting broad, blackish lateral bands and median band divided on midline by a narrow pale stripe; sternum orange-brown; abdomen pale yellow-brown, darker laterally and posteriorly; legs yellow-brown with weak annulations on leg 4.

Two male forms known (see Biology below). Chelicerae of larger male specimens are porrect, those of smaller males and females are not; chelicerae with four promarginal teeth and two retromarginal teeth. Ratio of AME.ALE.PME.PLE = 14.20.15.16; viewed dorsally, anterior eye row recurved, posterior eye row slightly procurved. Colulus large, wider than long, with many hairs. Male pedipalp (Figs 7, 8, 10, 11) tibia with retrolateral apophysis and tapering terminal apophysis; cymbium extending well beyond bulb (at least twice length of bulb), embolus extending up prolateral margin and across top of bulb, conductor large and curled around embolus; median apophysis absent. Epigynum with large, paired atria, median lobe about half way down median furrow (Fig. 13); internal genitalia receptaculate with short ducts (Figs 14–16).

**Dimensions**. Female Northland, Taputaputa Site A (MONZ AS.001631) (male Northland, Taputaputa Site B (MONZ AS.001611)): total length 9.13 (10.06); carapace length 3.87 (4.64), width 2.94 (3.25), height 1.70 (1.55); abdomen length 4.95 (5.73), width 3.10 (2.94); sternum length 2.01 (2.63), width 1.78 (2.01). Size range: female body length 5.9–9.3 (mean 8.1, n=6), male body length 6.0–11.3 (mean 8.8, n=16). Porrect male body length 6.9–11.3 (mean 9.7, n=13). Non-porrect male body length 6.0–6.8 (mean 6.5, n=3).

**DNA sequences.** Mitochondrial COI (GenBank accession numbers HM439089–HM439091, HQ316173–HQ316175, HQ332444). The seven sequences varied by only 2%, which is well within intraspecific variation observed in other spiders (Robinson *et al.* 2009), and a female and two males from Shenstone Block (GenBank HM439089, HQ316174, HQ332444) and a male from North Cape (GenBank HM439091) had identical COI sequences. We observed 26 variable nucleotide positions; 25 transitions, one transversion and all were synonymous substitutions. The COI fragment between the primers C1-J-1718-spider and C1-N-2568 is usually 850 bp in other spiders (e.g., Vink *et al.* 2009; Vink & Dupérré 2010), but for *Cambridgea reinga* it was only 844 bp. Two sequential codons are absent at 268 bp into the fragment we sequenced in *C. reinga*; these codons are present in *Stiphidion facetum* Simon 1902 (Spagna & Gillespie 2008), the type species of the family Stiphidiidae. We do not believe we had amplified a pseudogene as there were no stop codons in the sequence.




**FIGURES 7–16.** *Cambridgea reinga* Forster & Wilton 1973. 7. Male pedipalp of larger male (including the distal end of the tibia), ventral view; 8. Tibia of the larger male pedipalp, retrolateral view; 9. Chelicerae of the larger male; 10. Male pedipalp of smaller male (including the distal end of the tibia), ventral view; 11. Tibia of the smaller male pedipalp, retrolateral view; 12. Chelicerae of the smaller male; 13. Epigynum, ventral view; 14. Internal genitalia, ventral view; 15. Internal genitalia, dorsal view; 16. Schematic course of internal ducts. Scale bars for figures 7–12 = 1.0 mm, 13–15 = 0.5 mm. Abbreviations used: C, cymbium; TTA, terminal tibial apophysis; Co, conductor; RTA, retrolateral tibial apophysis; ML, median lobe; A, atrium.

**Biology.** Three of the male *C. reinga* examined (MONZ AS.001590, AS.001605, AS.001607, AS.001608) were smaller (6.0–6.8 mm body length), had smaller non-porrect chelicerae in which the fangs barely met (Fig. 12), the distal portion of the cymbium (relative to the bulb) was much shorter (Fig. 10) and the palpal tibia was shorter

relative to its width (Fig. 11). However, the palpal sclerites (Figs 7, 10) and tibial apophyses (Figs 8, 11) are the same shape, position and relative size to one another, and the colour patterns are the same in both forms of the male. The COI sequences of smaller *C. reinga* specimens (GenBank HQ316173, HQ316174, HQ332444) matched those of larger specimens (GenBank HM439090–HM439091) and were identical for three specimens (GenBank HM439091, HQ316174, HQ332444). Two forms of male have been noted in other *Cambridgea* species. In *C. antipodiana* (White 1849), the chelicerae are large and porrect in one form of male, while the chelicerae in the other form are similar to those of the female (Forster & Wilton 1973). In *C. annulata* Dalmas 1917, males are either large and the distal portion of the cymbium is relatively elongated, or males are small and have a shorter distal portion of the cymbium (Sirvid, personal observation). The differences in male *Cambridgea* forms could be due to food availability, which is known to affect size and morphology in some spider species (Jakob & Dingle 1990).

All specimens collected were from pitfall traps or pan traps in native forest, exotic pine forest (*Pinus* spp.), or dense scrub with flax (*Phormium* spp.), manuka (*Leptospermum scoparium* J.R. Forst. & G. Forst.) and kanuka (*Kunzea ericoides* (A. Rich.) Joy Thomps.). From this we can assume that *C. reinga* probably live close to the ground. It is unknown whether this species builds sheet webs typical of other *Cambridgea* species (Forster & Wilton 1973; Blest & Taylor 1995). Adults have been found throughout the year.

**Distribution.** *Cambridgea reinga* is known only from Te Paki Ecological District at the northern tip of Northland, New Zealand, and is likely to be endemic to that region, which is an area of high endemism (e.g., de Lange *et al.* 2003; Larochelle & Larivière 2005; Marshall & Barker 2007; Chapple *et al.* 2008; Buckley & Bradler 2010).

**Remarks.** The collection of male and female specimens from the same area, the same colour pattern of both sexes and COI sequences that vary by only 2%, lead us to conclude that *N. grandis* is a junior synonym of *C. reinga*. We have retained *C. reinga* in *Cambridgea* because it has the blackish median and lateral stripes on the carapace that are typical of species of *Cambridgea*; this colour pattern is lacking in *Nanocambridgea gracilipes*, which is the type species of the genus *Nanocambridgea* Forster & Wilton 1973. Also, the tibial apophyses of *C. reinga* are more like those of other *Cambridgea* and not reduced as they are in *N. gracilipes*. Forster & Wilton (1973) distinguished *Nanocambridgea* from *Cambridgea* by the presence in *Nanocambridgea* of plumose hairs on the legs, four teeth on the promargin of the chelicerae and a ventral stridulating organ on the pedicel and abdomen of males. Blest & Vink (2000) added to these characters the greater ratio of length of leg 1 to carapace (> 7.0) in male *Nanocambridgea*. However, all of these characters except the ventral stridulating organ prove not to be diagnostic. Plumose hairs are present on the legs of some species of *Cambridgea* (Blest & Vink 2000), leg 1/carapace ratio of male *Cambridgea reinga* is greater, not less, than in *Nanocambridgea gracilipes*, and both genera have four teeth on the promargin and two teeth on the retromargin. Forster and Wilton (1973), in their generic description of *Cambridgea*, had incorrectly reported two teeth on the promargin and three to five teeth on the retromargin, but in their species descriptions they correctly listed two teeth on the retromargin and between three and five teeth on the promargin. This leaves only the ventral stridulation organ of *Nanocambridgea* versus the dorsal stridulation organ of *Cambridgea* as separating the two genera; however, proper assessment of the validity of the genus *Nanocambridgea* is beyond the scope of this study, but could be resolved by a phylogenetic analysis of New Zealand Stiphidiidae (*Cambridgea*, *Nanocambridgea* and *Ischalea* L. Koch 1872) and other similar genera, such as the Australian *Procambridgea* Forster & Wilton 1973, to see if *N. gracilipes* falls within *Cambridgea*.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