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RESEARCH ARTICLE

A taxonomic re-evaluation of *Pittosporum roimata* Gemmill & S.N. Carter (*Pittosporaceae*, *Apiales*)

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Abstract. *Pittosporum roimata* Gemmill & S.N. Carter (*Pittosporaceae*, *Apiales*) was established in 2018 as an endemic species confined to the Poor Knights Islands group, off the eastern coastline of Northland Aotearoa / New Zealand. The new species was distinguished from *P. cornifolium* A. Cunn. on the basis of vegetative characters (leaf length, width, petiole length), floral characters (pedicel length, flower colour), and numbers of fruit per stem. The new species was also reported as differing from *P. cornifolium* by a single substitution within the nrITS cistron, with that data obtained from a paper that did not provide a phylogenetic interpretation of this result, nor specify whether the cultivated plants used were derived from seed obtained from multiple individuals or from cutting grown plants from a limited wild-sourced selection. In this paper the same morphological characters used to separate *P. roimata* are examined using a much wider sampling of *P. cornifolium*, and the specimens available for *P. roimata*. There are very slight differences in leaf width and length, petiole length, and pedicel length in Poor Knights Islands *P. roimata* specimens seen also in some collections from other northern Aotearoa / New Zealand offshore islands and some mainland stations. Flower colour is not a useful character as this is variable in *P. roimata* and *P. cornifolium*, as it is also in many other Aotearoa / New Zealand *Pittosporum*. On the basis of our morphological assessment we conclude that to maintain the segregation of *P. roimata* from *P. cornifolium* at the species rank is impractical, as there is a grading of characters between both species. As plants corresponding to *P. roimata* occur throughout the range of *P. cornifolium*, already a variable species, we suggest that, in line with other treatments of Aotearoa / New Zealand *Pittosporum*, it is better to reduce *P. roimata* into synonymy of *P. cornifolium*.

Keywords: *Pittosporaceae*, *Pittosporum cornifolium*, *Pittosporum roimata*, Aotearoa / New Zealand, taxonomy

Introduction

Pittosporum Banks ex Gaertn. (*Pittosporaceae* R. Br., *Apiales* Nakai) is a genus of approximately 200 species. The genus is renowned for its morphological plasticity which has confounded taxonomists since

the genus was established by Gaertner (1788) (see comments by Gowda, 1951, Cooper, 1956 and Cayzer et al., 2023). This plasticity has been attributed to heteroblastism, which affects all life stages, notably the leaf size, shape, and inflorescences and infructescence structure (Cooper, 1956; Cayzer, 2021;

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Cayzer et al., 2023). The failure to recognise this issue has added to the complexity of species delimitation, resulting in the recognition of many minor variations at species rank rather than life stages or ecological variants (see cases discussed in Schodde, 1972; Cayzer et al., 1999; Cayzer et al., 2023).

Globally *Pittosporum* is the only genus of *Pittosporaceae* to extend its distribution outside Australasia. While the centre of diversity of *Pittosporum* is Oceania and the Pacific, the genus is also diverse in Malesia and Papuasia, with recent revisions for those regions recognising 52 species (Cayzer et al., 2023). Many of the *Pittosporum* species are island endemics, more than 11 species are confined to the islands of Hawai'i (Wagner et al., 1990; Gemmill et al., 2002), c. 45 species are endemic to New Caledonia (Schlessman et al., 2014), and 20–26 species (see below) endemic to the main islands of Aotearoa / New Zealand (hereafter Aotearoa). Much like the Hawaiian species (Gemmill et al., 2002), Aotearoa *Pittosporum* resulted from geographic isolation and rapid recent speciation. As such there is often considerable morphological overlap among species, and, frustratingly for the botanist, much variation both within and between species (Cooper, 1956; Allan, 1961). The latest full treatment of Aotearoa *Pittosporum* was by Cooper (1956), a treatment that, with some modification, was mostly adopted by Allan (1961); both authors not then appreciating the family characteristics which are essential to resolving the taxonomic confusion in this group (see comments in Cayzer et al., 2023). Cooper (1956) recognised 20 species. Later, de Lange and Rolfe (2010) and Clarkson et al. (2012) accepted 21, and Carter et al. (2018) 24 species, while Schönberger et al. (2022) accepted 26 species. Schönberger et al. (2022) accepted several species that were excluded by unpublished assessments made by A.P. Druce (e.g., Druce, 1993) whose views have often been uncritically followed by others e.g., de Lange and Rolfe (2010); they also accepted two new species described in 2015 and 2018, respectively. The first of these, *Pittosporum rangitahua* E.K. Cameron & Sykes (Cameron, Sykes, 2015), is endemic to Raoul Island, the largest of the oceanic Kermadec Islands, and as such is not considered here as truly part of the continental Aotearoa islands flora, the oceanic Kermadecs being part of Aotearoa on purely geopolitical grounds (see comments on the Kermadec biogeography by Trnski, de Lange, 2015). The second species, *P. roimata* Gemmill & S.N. Carter, is

endemic to the Poor Knight Islands, a group of volcanic islands located 50 km northeast of Whangarei (Fig. 1).

The potential taxonomic distinctiveness of *Pittosporum roimata* was initially suggested by Clarkson et al. (2012) in their study of the 'biological flora' of *P. cornifolium* A. Cunn. ex Hook. There, they noted that plants of *P. cornifolium* from the 'Poor Knights Islands had yellow flowers, and larger, thicker, more coriaceous leaves that are obovate to rhomboid (subacuminate to obtuse at apex and acute to obtuse at base), and that they also differed by a single point mutation at 583 base pairs in the nrDNA ITS cistron (see also Clarkson, 2011). Clarkson (2011) recommended that on the basis of this discovery and morphological indications of disparity a further detailed study of Poor Knights Islands plants was warranted. Perhaps stimulated by these comments, following further morphometric analysis, *Pittosporum roimata* was finally formally segregated and described by Carter et al. (2018) as an island endemic distinct from *P. cornifolium* with which it had been placed by others (Cooper, 1956; de Lange, Cameron, 1999). In that paper the authors distinguished their species from *P. cornifolium* on the basis of its larger leaves, shorter petioles, yellow flowers, larger inflorescences, the production of several terminal fruits per stem, and allopatry from *P. cornifolium* and the single nucleotide difference in the nrDNA ITS cistron noted by Clarkson (2011) and Clarkson et al. (2012).

Despite their arguments, acceptance of *Pittosporum roimata* has been mixed. Horticulturists have long recognised that Poor Knight's *Pittosporum cornifolium* plants had larger, glossier leaves as compared to the common race of *P. cornifolium* available in the nursery trade. *Pittosporum roimata*, as *P. cornifolium* 'Poor Knights' became commonplace in cultivation since the early 1990s, based on cuttings obtained from two wild selections collected from Aorangi Island, Poor Knights Islands, by the late Graeme Platt (14 November 1941 — 1 October 2021) and Guy Bowden (Tawapou Coastal Natives: <http://www.tawapou.co.nz/about-us/tawapou-nursery>) in December 1993 while on a New Zealand Department of Conservation sanctioned field trip to those islands in which the junior author participated. This point is important, as it indicates a limited cultivated gene pool for *P. roimata* from which to test taxonomic claims for its segregation. Field botanists who have collected from the islands

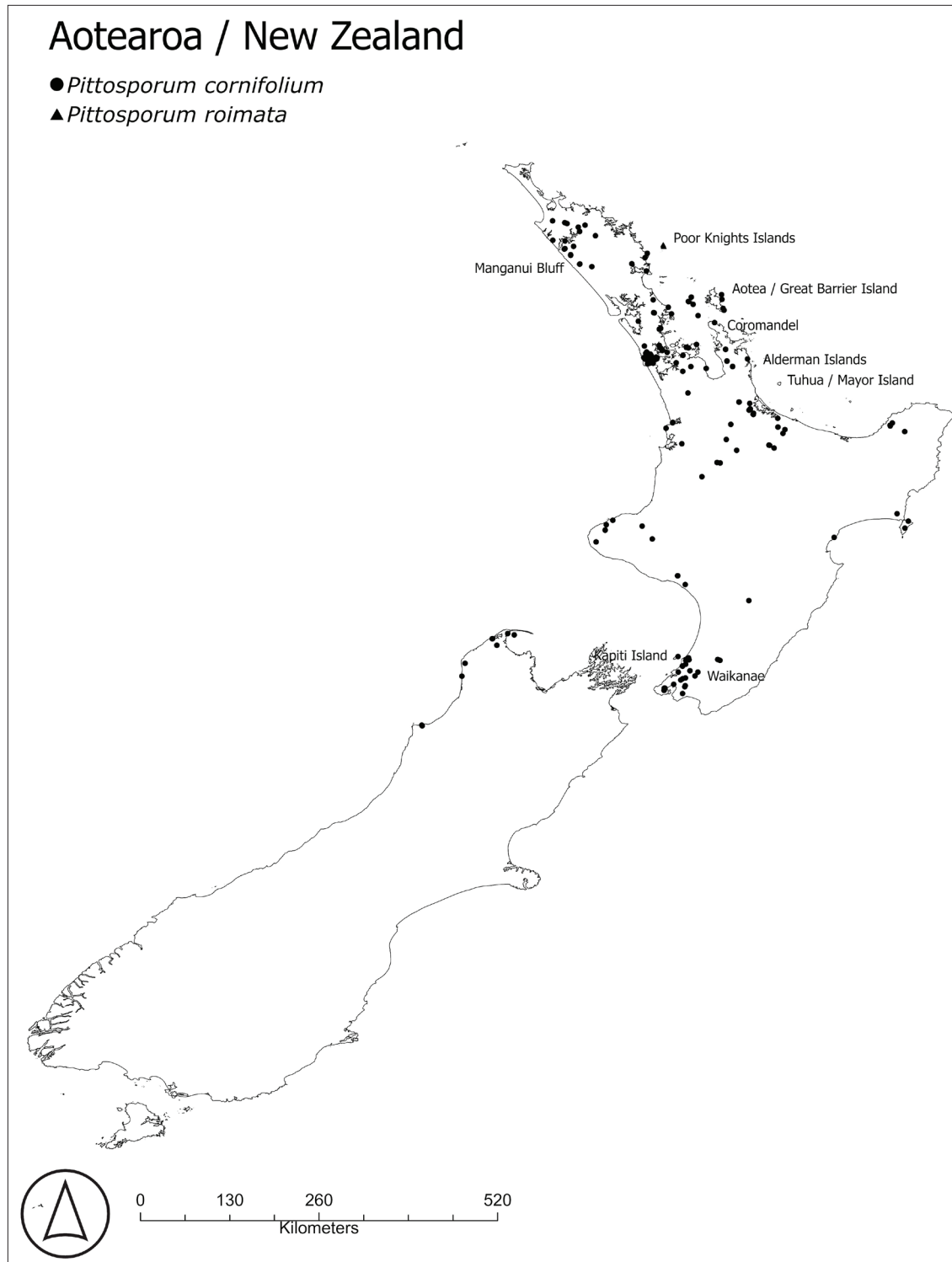


Fig. 1. Distribution of *Pittosporum cornifolium* species and *P. roimata* based on herbarium data and Citizen Science observations posted on <https://inaturalist.nz/>. Citizen Science records were vetted to remove records of cultivated plants

had also noted some of these features on herbarium labels with respect to the leaf size and flower colour, and de Lange and Cameron (1999: 455), who published an annotated listing of the vascular plants for the islands, noted that “Poor Knights plants are distinct from the usual mainland forms of this species in having much larger leaves which often have a slightly pubescent margin”. Since the formal recognition of *P. roimata*, the species has been accepted in some listings of the vascular flora of Aotearoa, e.g., Schönberger et al. (2022) (that reflect the names used by the Landcare Research Allan Herbarium (CHR)) but not by others such as the New Zealand Plant Conservation Network (www.nzpcn.org.nz) who included it within *P. cornifolium* (see <https://www.nzpcn.org.nz/flora/species/pittosporum-cornifolium/>). In the most recent threat listing of the vascular flora of Aotearoa (de Lange et al., 2024: 69) the species is listed as ‘Taxonomically unresolved’.

As uncertainty remains, we undertook to test the claim to species rank for *P. roimata* by examining the same morphological characters taken from a much wider herbarium sampling of *P. cornifolium* and those plants attributed to *P. roimata* by the naming authors.

Method

We selected 52 herbarium specimens from Auckland Museum Tamaki Paenga Hira (AK, herbarium acronyms follow Thiers, 2008—continuously updated), encompassing the geographic distribution and extremes of morphological variation expressed by the *P. cornifolium* complex. Included in this set of specimens, 37 were from mainland, 4 from offshore islands, and 11 from Poor Knights. From each specimen we measured the same leaf dimensions as those used in Carter et al. (2018); lamina length and width, and petiole length. We measured these dimensions on 10 leaves from each specimen; leaves were selected to capture the variation in leaf size present in each specimen, differing from Carter et al. (2018), who selected five leaves. For *P. cornifolium*, 410 leaves and petioles were measured, with 126 pedicel lengths recorded from each flower on 14 flowering specimens. For *P. roimata*, 120 leaves and petioles were measured, with 28 pedicels measured from 5 flowering specimens.

All data was tested for normality using the Shapiro-Wilk Test, and following this, data was tested

for homogeneity of variances using the F-Test, or for non-normal data, the Fligner-Killeen test was used. Consequently, significant differences in means of lamina length, width, petiole, and pedicel length were tested using two-sample independent t-tests, and applied Welch’s correction if data was deemed to violate the assumption of homogeneity of variances. The Wilcoxon rank-sum test was used when data was non-normally distributed. Tukey’s boxplots were produced to show the true ranges of measurements collected, outliers, and means. Finally, we used averaged measurements for each specimen and conducted a principal components analysis (PCA) using ggplot2 function (Wickham, 2016), using lamina length, width, and petiole length, and taking prior probability for each species to be equal. Pedicel length was omitted to avoid bias from few measurements for both species. Ellipses were also generated for the PCA to show 95% confidence of spread between species. Graphs and statistical analyses were completed in R (v.2023.12.1).

Results

Results showed that the lamina length for *P. cornifolium* and *P. roimata* were normally distributed with both also showing homogeneity of variances ($F = 0.778$, $d.f. = 399$, $p = 0.078$). Following this, results showed a highly significant difference in the mean lamina length between *P. cornifolium* and *P. roimata* ($t_{518} = -8.863$, $p < 0.001$). The mean lamina length of *P. cornifolium* (50.15 mm, SD = 10.44) is shorter than that of *P. roimata* (60.092 mm, SD = 11.84), although there is much overlap between the ranges of 12–88 mm compared with 32–86 mm. Two outliers for lamina length sat above 95% of the data for *P. cornifolium*. These were from two separate specimens, from Western Northland (80 mm), and a single leaf that measures above any of *P. roimata*, from Hen Island, Eastern Northland (88 mm) (Fig. 2A). *Pittosporum cornifolium* and *P. roimata* lamina width both resulted in a violation of normality although showed homogeneity of variances ($\chi^2 = 25.375$, $d.f. = 29$, $p = 0.659$). Similar to lamina length, there was highly significant difference in the means of lamina width ($W = 11038$, $p < 0.001$). The mean width in *P. cornifolium* (20.050 mm, SD = 6.85) is shorter than that in *P. roimata* (26.360 mm, SD = 6.98), although again with significant overlap in ranges 8–45 mm compared to the latter 11–44 mm. Three outliers for *P. cornifolium* lamina width

were above any other measurement for *P. roimata*, were from Western (43 and 45 mm) and Eastern Northland (44 mm) (Fig. 2B). The petiole length of *P. cornifolium* and *P. roimata* both resulted in a violation of normality, also with homogeneity of variances ($\chi^2 = 2.775$, $d.f. = 2$, $p = 0.250$). Means of petiole lengths between the two species showed a highly significant difference ($W = 40976$, $p < 0.001$). The mean petiole length for *P. cornifolium* is slightly longer (2.572 mm, $SD = 0.62$) than that for *P. roimata* (1.533 mm, $SD = 0.62$), again with major overlap of ranges: 1–5 mm compared to 1–3 mm (Fig. 2C). The pedicel lengths for both species resulted in a violation of normality and lengths did show homogeneity of variances ($\chi^2 = 14.510$, $d.f. = 13$, $p = 0.339$). There was also a highly significant difference in means for the pedicel lengths between *P. cornifolium* and *P. roimata* ($W = 686.5$, $p < 0.001$); the mean pedicel length for *P. cornifolium* (10.130 mm, $SD = 5.47$) was shorter than that for *P. roimata* (14.960 mm, $SD = 4.81$), with some overlap in ranges: 4–17 mm compared with 9–25 mm (Fig. 2D). The principal components analysis reported significant overlap between the 95% confidence ellipses, particularly between *P. cornifolium* and offshore *P. cornifolium*. The principal component analysis (PCA) of morphology for *P. cornifolium*, offshore *P. cornifolium*, and *P. roimata* showed that the first two components account for 95.6% of the total variation of the data. PC1, relating to average petiole length, represented 69.9%, PC2, relating to average lamina length represented 25.7%, and PC3, average lamina width, represented 4.4%. There is slight separation between the three groups on the x-axis (PC1), with overlapping points for each of the groups (Fig. 3). There is also slight separation on the y-axis, also with overlapping points. The ellipses also show major overlap, particularly between offshore and mainland *P. cornifolium*; however, *P. roimata* overlaps with both groups, with more overlap with offshore *P. cornifolium* (Fig. 3).

Discussion

Morphological Characters

Some authors, such as de Lange and Cameron (1999), commented that plants subsequently referred to *Pittosporum roimata* when compared with the usual range of variation in *P. cornifolium* have larger and wider leaves. These traits are not that unusual though, they are a feature of the flora of

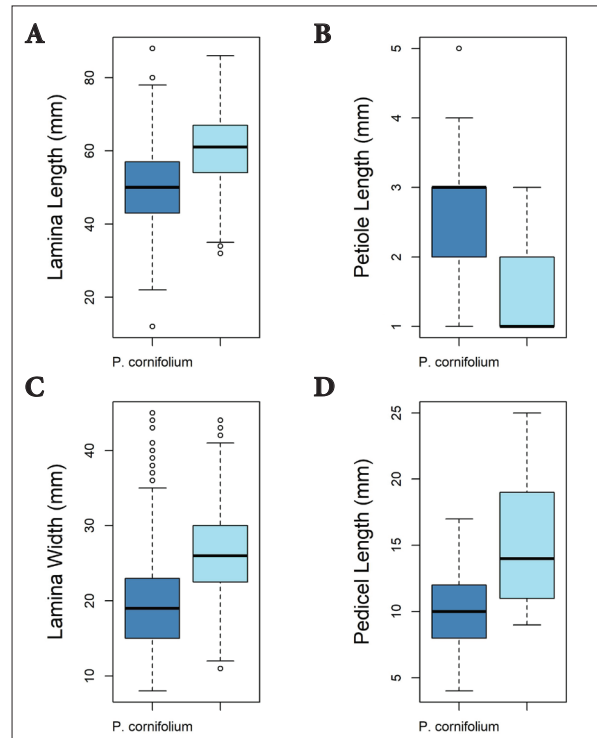


Fig. 2. Tukey's boxplots of comparison of morphological characteristics of *P. cornifolium* and *P. roimata*. A: Lamina length; B: Lamina width; C: Petiole length; D: Pedicel length

many offshore islands of Aotearoa and are collectively referred to as 'Gigantism' (Burns et al., 2011; Ciarle, Burns, 2024). Gigantism is especially evident within woody plants on offshore islands, such as the Three Kings, Poor Knights, Hen & Chickens, and Chatham Islands groups (Beever, 1986; de Lange, Cameron, 1999; de Lange et al., 1999; Burns et al., 2011; Cox, Burns, 2017), and while being regarded as an evolutionary pathway, is not necessarily justification for taxonomic segregation (Beever, 1986; de Lange, Cameron, 1999; de Lange et al., 1999).

Our statistical analyses determined significant differences in means for all measurements (leaf length, width, petiole, and pedicel length) for *P. roimata*, although with overlapping ranges in *P. cornifolium* also. The key distinctions are that *P. roimata*, compared to *P. cornifolium*, has on average leaves 10 mm longer and 6 mm wider, and petioles 1 mm shorter (Figs 2A–D). The sole consistent morphological differences found were those of pedicels, where the ranges of either species had minimal overlap (Fig 2D). However, while Carter et al. (2018) noted sexual dimorphism, stating that

Table 1. Comparison of distinguishing characteristics of subspecies of *Pittosporum pimeleoides*

Species	Shrub size, m	Lamina length, mm	Lamina width, mm	Petals, mm	Sepals, mm	Growth
<i>Pittosporum pimeleoides</i> subsp. <i>pimeleoides</i>	0.6–2.5	5–50	3–5(–10)	7–9	2.5–4 × 0.5–1	Erect to semi-erect
<i>Pittosporum pimeleoides</i> subsp. <i>majus</i>	0.1–0.6	9–30	4.5–5(–13)	11–12	4.5–5 × 0.5–1	Prostrate

female flower pedicel lengths are often shorter, directly within the range calculated for *P. cornifolium* here, they did not provide any comparative measurements for *P. cornifolium*.

Although determined significant in statistical analyses, these measurements highlight slight differences. In comparison, the morphological differences between *Pittosporum cornifolium* and *P. roimata* are less than those seen in both subspecies of *P. pimeleoides* A. Cunn. (see Table 1). This highlights a point made earlier that the wide variability within New Zealand species of *Pittosporum* is common; hence, assigning taxonomic ranks on the basis of a few morphological characteristics such as petal colour, larger leaves, and smaller petioles would, for Aotearoa *Pittosporum*, let alone many other Aotearoa genera, necessitate the recognition of myriad new species. The principal components analysis of morphological features shows that there is slight

separation between *P. cornifolium* and *P. roimata* (Fig. 3), although offshore island *P. cornifolium* plants overlap both the two previous groups. This PCA distribution between species likely indicates a cline from smaller-leaved mainland to larger-leaved offshore island plants, thus following the well-established pattern of island ‘gigantism’ noted above. Further, the claim that *Pittosporum roimata* uniquely has yellow flowers is incorrect. Yellow flowers are occasionally seen in *P. cornifolium* (Fig. 4, 5), and evident in collections from Maunganui Bluff, Western Northland (*P.J. de Lange* 15588 & *A.J. Veale*, UNITEC 14017) and Aotea / Great Barrier Island (*T. Kirk s.n.*, Field Museum, IRN: 3470780), while *P. roimata* may have apricot, pink or pink-tinged flowers (Fig. 6). Realistically, using flower colour as a character helping to determine species rank in Aotearoa *Pittosporum* is unwise; different flower colours are well known in *P. crassifolium* Banks &

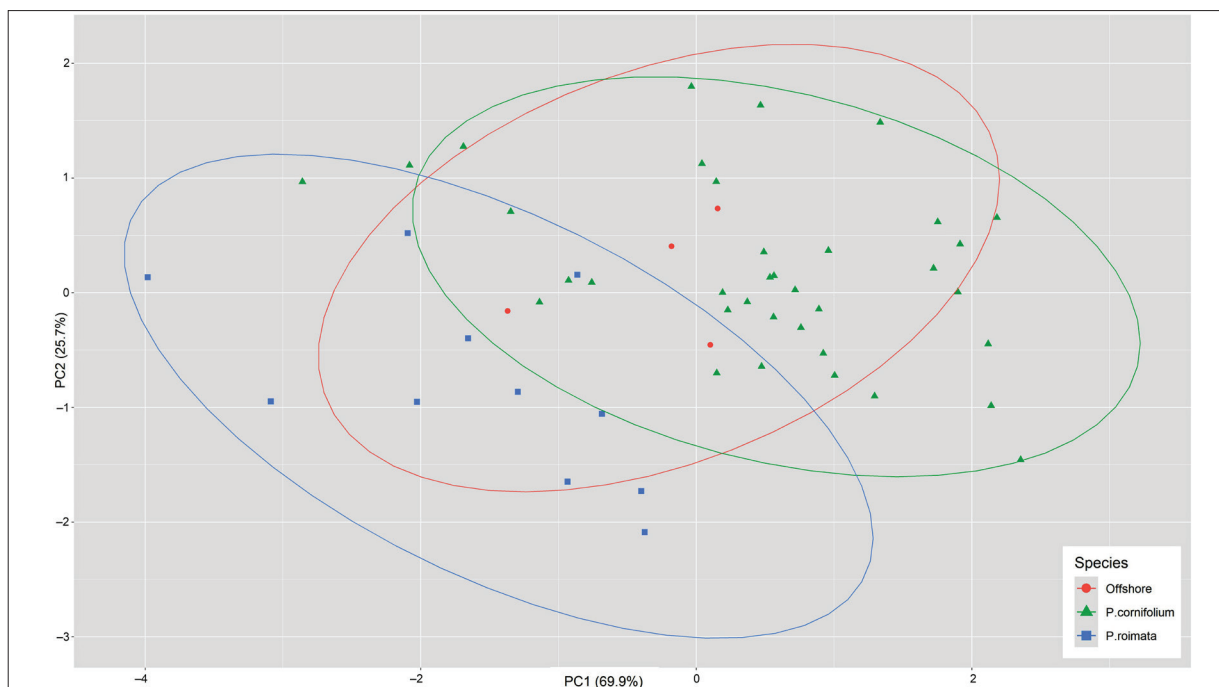


Fig. 3. Principal components analysis of morphological data from *Pittosporum cornifolium* (green triangle), offshore *P. cornifolium* (red circle), and *P. roimata* (blue square)

Sol. ex A. Cunn., *P. fairchildii* Cheeseman, *P. huttonianum* Kirk, *P. serpentinum* (de Lange) de Lange, *P. tenuifolium* Sol. ex Gaertn., *P. umbellatum* Banks et Sol. ex Gaertn., and *P. virgatum* Kirk, species which exhibit a range of colours from very dark red through orange to yellow or even white (Cooper, 1956; Metcalf, 1972; Authors, *pers. obs.*). As these colour morphs occur within syntopic populations and have a genetic basis (a fact appreciated by horticulturists who have made selections of these, such as the white-flowered *Pittosporum crassifolium* 'Osbournei': see Goulding, 1983), they should not be used to justify taxonomic segregation. The number of fruits per stem for the species was also considered significant (Carter et al., 2018, Table 1). However, in specimens with potentially bisexual *P. cornifolium* flowers (Fig. 7) fruit numbers can well exceed the 'usually 1 capsule' attributed to *P. cornifolium*, falling within the range given for *P. roimata*. Carter et al. (2018) did not examine bisexual *P. roimata* plants to see if capsule set was even greater than the range given for female plants, this would be worthy of further investigation. Collectively then, we contend that none of the characters used by Carter et al. (2018) are sufficient to warrant taxonomic segregation of *P. roimata* from *P. cornifolium*, and especially its species-rank segregation.

Distribution

Although *Pittosporum roimata* was described as a Poor Knights Islands endemic, enigmatically Carter et al. (2018, Fig. 4, p. 638) included specimens from mainland northern Aotearoa and other offshore islands as *P. cornifolium* that fall within their concept of *P. roimata*. Indeed, in our analysis of specimens held at AK (and also observations on iNaturalist NZ, <https://inaturalist.nz/>) we have noted plants that correspond to the concept of *P. roimata* ranging from western Northland (Maunganui Bluff), east to the Whangarei Heads, Hauturu-o-Toi / Little Barrier Island, Aotea / Great Barrier Island, eastern Coromandel Peninsula, Alderman Islands, Tuhua / Mayor Island, Kapiti Island and the Waikanae hills.

Ecology

Carter et al. (2018, p. 639, and Table 1) placed emphasis on differences in the ecology of *Pittosporum cornifolium* and *P. roimata* to help justify their new species. As traditionally viewed, *P. cornifolium* is an epiphytic species (Clarkson et al., 2012) and *P. roimata* was stated by Carter et al (2018) to be mostly



Fig. 4. Yellow-flowered *Pittosporum cornifolium* growing on trees near Otari Visitor Centre, Wellington (image: Tim Park)



Fig. 5. Yellow-flowered *Pittosporum cornifolium* growing on trees in the foothills above Waikanae (image: Matt Ward)

terrestrial. However, *P. cornifolium* is a facultative epiphyte that is often rupestral (especially where naturalised browsing animals are excluded), very like other facultative epiphytes of dense Aotearoa forest, such as *Brachyglottis kirkii* (Kirk) C.J. Webb, *Metrosideros robusta* A. Cunn., *Griselinia lucida* (J.R. Forst. & G. Forst.) G. Forst. and *Pittosporum kirkii* Hook. f. ex Kirk, which in the absence of browsing animals will readily grow in open shrubland on porous substrates, as well as on cliff faces, rock tors and so forth (Knightbridge, Ogden, 1997; Bryan



Fig. 6. Apricot-coloured flowering *Pittosporum roimata* (male plant). This one of the two commonly grown clones found in cultivation, stemming from specimens collected from the Poor Knights Islands by the late Graeme Platt in December 1993 (image: P.J. de Lange)



Fig. 7. Bisexual flowers of *Pittosporum cornifolium* growing in coastal forest above the Ngunguru River, Ngunguru (image: Ian Skipworth)

et al., 2011; Kirby, 2014; Myron et al., 2020). Conversely, on the Poor Knights Islands *Pittosporum roimata* is not only common terrestrially on the

porous rhyolite rock of that island group but also as an epiphyte in suitable forest trees. Thus, the ecological distinction suggested by Carter et al. (2018) is not exclusive to that species, which on the naturally browsing animals free cliff girt, rocky, volcanic Poor Knights Islands, occupies both terrestrial and epiphytic habitats.

Genetic evidence

The genetic relationships within the nrDNA ITS1/2/3/4/5/6/7/8/9/10/11/12/13/14/15/16/17/18/19/20/21/22/23/24/25/26/27/28/29/30/31/32/33/34/35/36/37/38/39/40/41/42/43/44/45/46/47/48/49/50/51/52/53/54/55/56/57/58/59/60/61/62/63/64/65/66/67/68/69/70/71/72/73/74/75/76/77/78/79/80/81/82/83/84/85/86/87/88/89/90/91/92/93/94/95/96/97/98/99/100/101/102/103/104/105/106/107/108/109/110/111/112/113/114/115/116/117/118/119/120/121/122/123/124/125/126/127/128/129/130/131/132/133/134/135/136/137/138/139/140/141/142/143/144/145/146/147/148/149/150/151/152/153/154/155/156/157/158/159/160/161/162/163/164/165/166/167/168/169/170/171/172/173/174/175/176/177/178/179/180/181/182/183/184/185/186/187/188/189/190/191/192/193/194/195/196/197/198/199/200/201/202/203/204/205/206/207/208/209/210/211/212/213/214/215/216/217/218/219/220/221/222/223/224/225/226/227/228/229/230/231/232/233/234/235/236/237/238/239/240/241/242/243/244/245/246/247/248/249/250/251/252/253/254/255/256/257/258/259/260/261/262/263/264/265/266/267/268/269/270/271/272/273/274/275/276/277/278/279/280/281/282/283/284/285/286/287/288/289/290/291/292/293/294/295/296/297/298/299/300/301/302/303/304/305/306/307/308/309/310/311/312/313/314/315/316/317/318/319/320/321/322/323/324/325/326/327/328/329/330/331/332/333/334/335/336/337/338/339/340/341/342/343/344/345/346/347/348/349/350/351/352/353/354/355/356/357/358/359/360/361/362/363/364/365/366/367/368/369/370/371/372/373/374/375/376/377/378/379/380/381/382/383/384/385/386/387/388/389/390/391/392/393/394/395/396/397/398/399/400/401/402/403/404/405/406/407/408/409/410/411/412/413/414/415/416/417/418/419/420/421/422/423/424/425/426/427/428/429/430/431/432/433/434/435/436/437/438/439/440/441/442/443/444/445/446/447/448/449/450/451/452/453/454/455/456/457/458/459/460/461/462/463/464/465/466/467/468/469/470/471/472/473/474/475/476/477/478/479/480/481/482/483/484/485/486/487/488/489/490/491/492/493/494/495/496/497/498/499/500/501/502/503/504/505/506/507/508/509/510/511/512/513/514/515/516/517/518/519/520/521/522/523/524/525/526/527/528/529/530/531/532/533/534/535/536/537/538/539/540/541/542/543/544/545/546/547/548/549/550/551/552/553/554/555/556/557/558/559/560/561/562/563/564/565/566/567/568/569/570/571/572/573/574/575/576/577/578/579/580/581/582/583/584/585/586/587/588/589/590/591/592/593/594/595/596/597/598/599/600/601/602/603/604/605/606/607/608/609/610/611/612/613/614/615/616/617/618/619/620/621/622/623/624/625/626/627/628/629/630/631/632/633/634/635/636/637/638/639/640/641/642/643/644/645/646/647/648/649/650/651/652/653/654/655/656/657/658/659/660/661/662/663/664/665/666/667/668/669/670/671/672/673/674/675/676/677/678/679/680/681/682/683/684/685/686/687/688/689/690/691/692/693/694/695/696/697/698/699/700/701/702/703/704/705/706/707/708/709/710/711/712/713/714/715/716/717/718/719/720/721/722/723/724/725/726/727/728/729/730/731/732/733/734/735/736/737/738/739/740/741/742/743/744/745/746/747/748/749/750/751/752/753/754/755/756/757/758/759/760/761/762/763/764/765/766/767/768/769/770/771/772/773/774/775/776/777/778/779/780/781/782/783/784/785/786/787/788/789/790/791/792/793/794/795/796/797/798/799/800/801/802/803/804/805/806/807/808/809/810/811/812/813/814/815/816/817/818/819/820/821/822/823/824/825/826/827/828/829/830/831/832/833/834/835/836/837/838/839/840/841/842/843/844/845/846/847/848/849/850/851/852/853/854/855/856/857/858/859/860/861/862/863/864/865/866/867/868/869/870/871/872/873/874/875/876/877/878/879/880/881/882/883/884/885/886/887/888/889/890/891/892/893/894/895/896/897/898/899/900/901/902/903/904/905/906/907/908/909/910/911/912/913/914/915/916/917/918/919/920/921/922/923/924/925/926/927/928/929/930/931/932/933/934/935/936/937/938/939/940/941/942/943/944/945/946/947/948/949/950/951/952/953/954/955/956/957/958/959/960/961/962/963/964/965/966/967/968/969/970/971/972/973/974/975/976/977/978/979/980/981/982/983/984/985/986/987/988/989/990/991/992/993/994/995/996/997/998/999/1000/1001/1002/1003/1004/1005/1006/1007/1008/1009/1010/1011/1012/1013/1014/1015/1016/1017/1018/1019/1020/1021/1022/1023/1024/1025/1026/1027/1028/1029/1030/1031/1032/1033/1034/1035/1036/1037/1038/1039/1040/1041/1042/1043/1044/1045/1046/1047/1048/1049/1050/1051/1052/1053/1054/1055/1056/1057/1058/1059/1060/1061/1062/1063/1064/1065/1066/1067/1068/1069/1070/1071/1072/1073/1074/1075/1076/1077/1078/1079/1080/1081/1082/1083/1084/1085/1086/1087/1088/1089/1090/1091/1092/1093/1094/1095/1096/1097/1098/1099/1100/1101/1102/1103/1104/1105/1106/1107/1108/1109/1110/1111/1112/1113/1114/1115/1116/1117/1118/1119/1120/1121/1122/1123/1124/1125/1126/1127/1128/1129/1130/1131/1132/1133/1134/1135/1136/1137/1138/1139/1140/1141/1142/1143/1144/1145/1146/1147/1148/1149/1150/1151/1152/1153/1154/1155/1156/1157/1158/1159/1160/1161/1162/1163/1164/1165/1166/1167/1168/1169/1170/1171/1172/1173/1174/1175/1176/1177/1178/1179/1180/1181/1182/1183/1184/1185/1186/1187/1188/1189/1190/1191/1192/1193/1194/1195/1196/1197/1198/1199/1200/1201/1202/1203/1204/1205/1206/1207/1208/1209/1210/1211/1212/1213/1214/1215/1216/1217/1218/1219/1220/1221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Table 2. Comparison of characteristics of the genetically almost identical Hawaiian species of *Pittosporum* (adapted or retrieved from Wagner et al. (1990) and Wood, Kiehn (2011))

Species	Leaf texture	Leaf lower surface	Capsule size	Capsule apex	Capsule surface	Location
<i>P. argentifolium</i> Sherff	Sub-coriaceous to coriaceous	Densely whitish to pale brown flocculose-strigose	13–30	Rounded to truncate or occasionally subcordate	Densely pale brown to whitish tomentose when immature, sparsely at maturity	Moloka'i, Maui
<i>P. confertifolium</i> A. Gray	Sub-coriaceous to coriaceous, moderately rugose	Densely or moderately pale brown to reddish brown tomentose, rarely whitish	20–30	Rounded to obtuse	Densely brown to reddish brown tomentose when immature, sparsely at maturity.	O'ahu, Lana'i, Maui, and Hawai'i
<i>P. flocculosum</i> (Hillebr.) Sherff	Chartaceous	Sparsely to moderately whitish flocculose-strigose	20–32	Rounded to obtuse	Sparsely whitish tomentose at maturity	O'ahu
<i>P. gayanum</i> Rock	Strongly and coarsely rugose	Densely woolly tomentose	18–25	Broadly acute	Glabrate at maturity	Kaua'i
<i>P. glabrum</i> Hook. & Arn.	Chartaceous, coriaceous, moderately to strongly and coarsely rugose	Glabrate	12–35	Obtuse, rounded, sometimes acute	Glabrous to scattered tomentum	Kaua'i, O'ahu, Moloka'i, Lana'i, Maui
<i>P. halophilum</i> Rock	Coriaceous, rugose	Tan to golden yellow tomentum	20–35	Obtuse to truncate	Tan to golden tomentose	Moloka'i
<i>P. hawaiiense</i> Hillebr.	Chartaceous to subcoriaceous	Brown to reddish brown tomentose	24–38	Rounded to emarginate	Glabrate	Hawai'i
<i>P. hosmeri</i> Rock	Subcoriaceous	Densely pale brown or rarely whitish tomentose, sometimes glabrate	(28–)30–80	Submarginate to emarginate	Usually brown tomentose, eventually glabrate	Hawai'i
<i>P. kauaiense</i> Hillebr.	Chartaceous, coriaceous, rugose	Sparsely whitish flocculose-strigose when young, soon glabrate	9–20	Rounded to obtuse	Brown or pale brown tomentose when young, soon glabrate	Kaua'i
<i>P. terminalioides</i> Planch. ex Gray	Coriaceous to thick and chartaceous	Densely reddish brown tomentose when young, soon glabrate	19–25(–30)	Emarginate to rounded	Usually densely brown tomentose, eventually glabrate	Lana'I, Maui, Kilauea

obovate to elliptic), petal, sepal, capsule and seed sizes (Cooper, 1956). Thus, genetic differences derived from a single DNA marker taken from a sampling of two cultivated plants (which may or may not be cutting grown), while of interest, needs to be tempered with better evidence than citing an unpublished relationship derived from Hathaway (2001) and Clarkson (2011). Even more critically, Hathaway (2001: 111) noted in their unpublished phylogenetic study of Aotearoa *Pittosporum* that the ITS region lacked sufficient variation to fully resolve relationships for all species. Therefore, when applied to *Pittosporum*, preference should now be given to DNA studies that use multiple markers or techniques that sample the whole genome, in conjunction with comprehensive morphological analyses.

Synthesis

In conclusion, we contend that the characteristics supporting the recognition of *P. roimata* by Carter et al. (2018) have been taken in isolation from the known nationwide variation within *P. cornifolium*, and inconsistent to the approach taken by others for such morphologically variable Aotearoa species as *Pittosporum divaricatum* Cockayne, *P. ellipticum* Kirk, *P. kirkii*, *P. obcordatum* Raoul, *P. tenuifolium* Sol. ex Gaertn. and *P. virgatum* Kirk (Cooper, 1956; Allan, 1961). As noted above, the larger values of certain morphological features of *P. roimata* (leaves, pedicels, flowers) are features seen in many island populations of Aotearoa plants, such as *Alectryon excelsus* Gaertn., *Geniostoma ligustrifolium* A. Cunn., *Hedycarya arborea* J.R. Forst. & G. Forst., *Meliccytus ramiflorus* J.R. Forst. & G. Forst., *Myoporum laetum* G. Forst., *Rhopalostylis sapida* H. Wendl. & Drude and *Rhabdothamnus solandri* A. Cunn., that are accepted as part of their normal variation (Beever, 1986; Stalker, 1998; de Lange, Cameron, 1999; de Lange et al., 1999; de Lange et al., 2005; Salter, Delmiglio, 2005; Chinnock, 2007; Burns et al., 2011). Furthermore, the claim of a uniquely defining flower colour (yellow) for *P. roimata* is not only inconsistently seen in that species but is well known from a range of Aotearoa *Pittosporum* that exhibit fixed flower colour variation so it should not be used to delimit species in that genus. Genetically, the claims of distinctiveness based on an apparent singleton using one DNA marker (ITS) that Hathaway (2001) pointed out lacks sufficient variation to fully inform a phylogenetic interpretation of *Pittosporum* and needs further testing using

other DNA markers and whole genome sampling techniques. Finally, any claim of morphological disparity requires a comprehensive analysis of the full range of variation within the parent taxon, which was not done.

In our view, the distinctions offered by Carter et al. (2018) to separate *P. roimata* from *P. cornifolium* are less than the variation exhibited by many other widespread Aotearoa *Pittosporum* species (Cooper, 1956; Allan, 1961), leaving the claim to species rank untenable. This leaves subspecies, variety or forma as potential ranks. Of these subspecies rank, as that rank is defined in New Zealand, for minor, fixed allopatric variation (see for example de Lange et al., 1999; Glenny, 2004) is inappropriate due to the sympatric occurrence of plants that exhibit *P. roimata* characters within the northern range of *P. cornifolium*. Beyond subspecies, there is the choice of recognising varieties within *P. cornifolium* to accommodate *P. roimata*; however, that rank seems to have a confused definition (Davis, Heywood, 1963) that overlaps with that commonly employed in Australasia for subspecies, such that this rank is now little used in Aotearoa (Allan, 1961; c.f. Schönberger et al., 2022). This leaves the rank of forma as an option if the distribution of the current allopatric concept of *P. roimata* is widened to include those plants with the same characters found outside the Poor Knights Islands. However, we feel little purpose would be served by this shift in rank, especially as it would be inconsistent with the treatment meted out for other variable Aotearoa *Pittosporum* (see above). Therefore, we conclude that *Pittosporum roimata* Gemmill & S.M. Carter is better relegated into synonymy within *Pittosporum cornifolium* A. Cunn. with a new circumscription offered here for that species to accommodate the slightly larger leaves, and pedicels seen in some populations of that species (as *P. roimata*) in Northland and on the Poor Knights. This action is taken below.

Taxonomy

***Pittosporum cornifolium* A. Cunn. ex Hook.**,
Bot. Mag., 59: t. 3161 (1832)

Type Locality: ‘Obligingly forwarded from the Royal Gardens of Kew where it was introduced by Allan Cunningham Esq., who has most kindly communicated to me his notes, made on the place of growth in the year 1826 when he met with it in dark humid woods by the rivers in New Zealand...’ (Hooker, 1832). Allan (1961) gives additional

information, probably from Cunningham (1839), that the type locality was ‘in humid woods on the banks of the Kanakana [Kawakawa] and other rivers, Bay of Islands’.

Lectotype: Cooper (1956, p. 162–163) lectotypified the name by his full and direct reference to a specimen in K, namely ‘T.: *A. Cunningham* 616 !’. This specimen is one of several mounted on a single sheet (K 00591688). Of that specimen Cooper (1956, p. 163) noted that ‘The species was described by W.J. Hooker from material grown at the Royal Botanic Gardens, Kew, and from Allan Cunningham’s specimens and notes made by him in New Zealand in 1826. Two “type” sheets in the herbarium of the Royal Botanic Gardens, Kew, bear five labels, two sterile specimens, a fruiting specimen and fragments of flowers. One label is dated 1826, one 1833, two 1838, and one is undated. As the species was described in 1832 only part of the material can have been available to W.J. Hooker’ and it was that specimen which Cooper designated lectotype. Later, Allan (1961, p. 316) somewhat confusingly typified the name citing a specimen held in BM collected by Cunningham in 1826. This we assume is an isolectotype of the lectotype selected by Cooper. The remaining specimens on the sheets in K or labelled with collection No. 616, are listed with later collection dates so excluded from the original material as per comments in Cooper (1956).

Because the sheet K 00591688 is a mixed sheet of multiple specimens of wild and cultivated plants, with different dates of collection, a further typification is probably needed to unambiguously exclude those specimens not part of the original material used by Hooker (1832). As we are aware of a publication in advanced preparation that deals with the typification of this and other Aotearoa *Pittosporum* (L.W. Cayzer, pers. comm. June 2024) we have left the matter for that publication to resolve.

urn:lsid:ipni.org:names:684423-1

= *Pittosporoides verticillata* A.Cunn. *Ann. Nat. Hist.*, 4: 107 (1839), *nom. nud.*

≡ *Pittosporum roimata* Gemmill & S.N.Carter in Carter et al., *Syst. Bot.*, 43: 636 (2018)

Type: —NEW ZEALAND. North Island, Poor Knights Islands, Tawhiti Rahi, *A.E. Wright* 3951, 9 Sept 1980, Beneath pōhutukawa forest on summit plateau. Terrestrial, flowers yellow (*holotype*, AK 155344!).

urn:lsid:ipni.org:names:77194912-1

Growth habit — terrestrial or epiphytic, sparingly branched, 1–4 m tall shrubs. **Leaves** — in whorls of 5–6 at nodes. **Lamina** — elliptic, narrowly elliptic-rhomboid, obovate, oblanceolate, obovate-oblanceolate to rhombic 12–88 × 8–45 mm, almost sessile, petioles 1–3 mm long and wide; margins flat, apices acute, rounded, obtuse or acuminate, base cuneate to obtuse. **Inflorescences** — pseudo-terminal, 3–6-flowered umbels (male) or 1–5-flowered (female), pedicels from 2 mm (female)–25 mm long (male); subtended by foliose bracts in a basal involucre; buds bicoloured: mauve, apricot, orange or yellow, pointed and furled in distal third. **Sepals** — cream-green, narrowly deltoid, sometimes acuminate, 4–7 mm long, cohering basally then free; subulate with sparse hairs on margins only. **Petals** — ± bicoloured: outer surface mauve, pink, apricot, orange or yellow, inner surface cream-yellow, darkening with age and often with contrasting stripes and blotches also becoming more prominent with age; 8–12 mm long, apically acuminate, cohering in a tube at anthesis then recurving by half, almost fully exposing anthers in male flowers. Flowers functionally unisexual, but never absolutely so: **Male flowers** — with anthers oblong, slightly apiculate; pistil rudimentary, rarely ± functional ovules. **Female flowers** — usually with staminodes not beyond the turgid ovary, or with staminodes at three different heights, some occasionally with pollen, viability unknown; style slender about the same length as the ovary, stigma lobed or capitate. **Fruits** — capsules: orange-brown, mainly bi- or less frequently tri-valved; ovoid, 15–17 mm × 12–15 mm wide; valves 1–2 mm thick, coriaceous, finely silky hairy, becoming slightly rugulose with transverse ridging, reflexing totally; inner chambers bright orange-red, rugulose, viscum dark orange. **Seeds** — 4–6(–10); 3.0–6.5 mm diameter or long; dorsal surface rounded, sometimes ridged or bearing tubercles, angular; testa glossy black, or brown.

Distribution (Fig. 1): Endemic to Aotearoa / New Zealand where it is known from the Three Kings Islands, Te Ika a Maui / North Island and the northern portion of Te Waipounamu / South Island (Marlborough Sounds, Northwest Nelson south to the Paparoa Range) (Clarkson et al., 2012).

List of specimens examined

Pittosporum cornifolium

AOTEAROA / NEW ZEALAND, TE IKA A MAUI / NORTH ISLAND: Radar Bush, Pandora

Track, Te Pahi, *P. J. de Lange & A. Townsend*, 14 Apr 2015, AK357256; Okahu, Kaitaia, Northland, *H. B. Matthews*, 17 Aug 1920, AK102386; Fairburn, Kaitaia, Northland, *H. Carse*, Sep 1905, AK246968; Warawara Forest, Western Northland, *C. Morse*, 22 Nov 2016, AK363867; Tapuwae Scenic Reserve, Hokianga, Northland, *J. G. Beachman*, 18 Aug 1989, AK185535; Otangaroa State Forest, Maungataniwha, Northland, *L. Forester*, 10 Sep 1986, AK176690; Puketi Forest, Maungataniwha, Northland, *P. J. Bellingham*, 25 Jul 1984, AK168132; AK291209; Okahu, Kaitaia, Northland, *H. B. Matthews*, 17 Aug 1920, AK102385; Kaitaia, Northland, *H. B. Matthews*, Sep 1912, AK102387; Kaitaia, Northland, *H. B. Matthews*, 11 Aug 1920, AK102383; Waipoua Forest Sanctuary, Tutamoe, Western Northland, *P. J. Bellingham*, 6 Sep 1984, AK168925; Waipoua, Western Northland, *R. C. Cooper*, 15 Sep 1967, AK224829; Waipoua, Tutamoe, Western Northland, *R. C. Cooper*, 15 Sep 1967, AK127366; Russell, Bay of Islands, Northland, *J. L. Edward*, May 1953, AK31866; Whangaroa Harbour, Eastern Northland, *A. E. Wright*, 24 Sep 1990, AK226136; Whangaruru North, Eastern Northland, *R. C. Cooper*, 28 Aug 1967, AK224833; Taranga (Hen) Island, Eastern Northland, *A. E. Wright*, 1 Jan 1991, AK201207; Mt Manaia, Whangarei Heads, Eastern Northland, *A. Townsend*, 27 Feb 2008, AK306751; Opua, Eastern Northland, *N. Mackie*, 23 Sep 1933, AK102384; Pipiwai, Whangarei, Eastern Northland, *L. Forester*, 12 Nov 2007, AK307021; Houtu, Western Northland, *I. Barton*, 9 Sep 1959, AK211995; Whangaruru North, Eastern Northland, *R. C. Cooper*, 28 Aug 1967, AK127317; Whangarei Heads, Eastern Northland, *W. R. Woodhead*, Aug 1935, AK151880; Waikare Road, Eastern Northland, *R. C. Cooper*, 19 Oct 1965, AK224831; Kawakawa-Russell Road, Eastern Northland, *R. C. Cooper*, 8 Apr 1966, AK109318; Russel, Bay of Islands, Northland, *R. Bieleski*, 20 Aug 1950, AK262350; Waikare Road, Eastern Northland, *R. C. Cooper*, 19 Oct 1965, AK126158; Taranga (Hen) Island, Eastern Northland, *L. Moore & L. Cranwell*, 17 Nov 1933, AK102376; Taranga (Hen) Island, Eastern Northland, *L. Moore & L. Cranwell*, 17 Nov 1933, AK224832; Taranga (Hen) Island, Eastern Northland, *L. Moore & L. Cranwell*, 17 Nov 1933, AK102377; Waiheke Island, Auckland, *P. J. de Lange*, 16 Feb 2010, AK310100; Kawau Island, Auckland, *H. B. Matthews*, 15 Jun 1920, AK102382; Kawau Island, Auckland, *H. B. Matthews*, 16 Jun 1920, AK102369; Kawau Island,

Auckland, *H. B. Matthews*, 16 Jun 1920, AK102381; Pollock, Awhitu, Auckland, *T. Aspin*, 22 Oct 2003, AK288872; East Tamaki, Auckland, *R. O. Gardner*, 5 Aug 2004, AK340005; Stevenson's Quarry, Drury, Manukau, Auckland, *R. O. Gardner*, May 2000, AK251628; Oram's Road, Hunua Ranges, Auckland, *I. Barton*, 10 Jan 1970, AK211482; Kawakawa-Orere Point Road, Hunua Ranges, Auckland, *R. C. Cooper*, 10 Mar 1965, AK122374.

Pittosporum roimata (initially identified as)

AOTEAROA / NEW ZEALAND, TE IKA A MAUI / NORTH ISLAND: Tawhiti Rahi Island, Poor Knights Islands, Eastern Northland, *A. E. Wright*, 26 Apr 1991, AK201814; Tawhiti Rahi Island, Poor Knights Islands, Eastern Northland, *P. J. de Lange*, 17 Mar 1994, AK214230; Southern (Aorangi Island), Poor Knights Islands, Eastern Northland, *L. Cranwell*, 13 Feb 1937, AK102364; Tawhiti Rahi Island, Poor Knights Islands, Northland, *A. E. Wright*, 9 Sep 1980, AK155344; Tawhiti Rahi Island, Poor Knights Islands, Northland, *A. E. Wright*, 9 Sep 1980, AK155343; Tawhiti Rahi Island, Poor Knights Islands, Northland, *A. E. Wright*, 9 Sep 1980, AK155369; Tawhiti Rahi Island, Poor Knights Islands, Northland, *A. E. Wright*, 26 Apr 1991, AK201736; Southern (Aorangi Island), Poor Knights Islands, Eastern Northland, *E. K. Cameron*, 27 Oct 1998, AK208662; Tawhiti Rahi Island, Poor Knights Islands, Northland, *L. Cranwell*, Feb 1937, AK102379; Tawhiti Rahi Island, Poor Knights Islands, Northland, *L. Moore & L. Cranwell*, Feb 1937, AK102375; Tunnel (Aorangaia) Island, Poor Knights Islands, Northland, *L. Moore & L. Cranwell*, 19 Nov 1933 AK102365; Tunnel (Aorangaia) Island, Poor Knights Islands, Northland, *L. Moore & L. Cranwell*, 19 Nov 1933, AK102367.

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ETHICS DECLARATION

The authors declare no conflict of interest.

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Перегляд таксономічного статусу***Pittosporum roimata* Gemmill & S.N. Carter (*Pittosporaceae*, *Apiales*)**

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Реферат. *Pittosporum roimata* Gemmill & S.N. Carter (*Pittosporaceae*, *Apiales*) був описаний у 2018 році як ендемічний вид для групи островів Пур-Найтс (Бідних Лицарів) біля східного узбережжя регіону Нортленд Аотеароа / Нової Зеландії. Новий вид було виділено з *P. cornifolium* A. Cunn. на основі вегетативних ознак (довжина і ширина листка, довжина черешка), ознак квітки (довжина квітконіжки, колір квітки) і кількості плодів на стеблі. Повідомлення про те, що новий вид відрізняється від *P. cornifolium* однією заміною в цистроні nrITS ядерної ДНК, походить зі статті, в якій не наведено філогенетичної інтерпретації отриманих даних, а також не вказано, чи використовували культурні рослини, вирощені з насіння кількох особин, чи рослини, що були вирощені з живців, зрізаних з небагатых дикорослих особин. Наша стаття містить результати досліджень тих самих морфологічних ознак, на основі яких було відокремлено *P. roimata*, з використанням значно більшої кількості зразків *P. cornifolium* і наявних зразків *P. roimata*. Дуже незначні відмінності в ширині та довжині листка, довжині черешка та довжині квітконіжки, які спостерігались у зразків *P. roimata* з островів Пур-Найтс, були також відмічені в деяких гербарних зборах з інших північних островів Нової Зеландії та з деяких материкових територій. Забарвлення квітки не є надійною ознакою, оскільки ця ознака є варіабельною у *P. roimata* та *P. cornifolium*, як і в багатьох інших видів роду *Pittosporum* у Новій Зеландії. На основі нашої оцінки морфологічних ознак ми робимо висновок, що відокремлення *P. roimata* від *P. cornifolium* у ранзі виду є недоцільним через наявність градації ознак між обома видами. Оскільки рослини, що відповідають ознакам *P. roimata*, трапляються в межах усього ареалу *P. cornifolium*, який і сам є варіабельним видом, ми пропонуємо, що краще розглядати *P. roimata* як синонім виду *P. cornifolium*, що відповідає таксономічним опрацюванням інших видів роду *Pittosporum* Нової Зеландії.

Ключові слова: *Pittosporaceae*, *Pittosporum cornifolium*, *Pittosporum roimata*, Аотеароа / Нова Зеландія, таксономія