



## Taxonomic revision of the ornate skink (*Oligosoma ornatum*; Reptilia: Scincidae) species complex from northern New Zealand

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### Abstract

Although the New Zealand skink fauna is known to be highly diverse, a substantial proportion of the recognised species remain undescribed. We completed a taxonomic revision of the ornate skink (*Oligosoma ornatum* (Gray, 1843)) as a previous molecular study indicated that it represented a species complex. As part of this work we have resolved some nomenclatural issues involving this species and a similar species, *O. aeneum* (Girard, 1857). A new skink species, *Oligosoma roimata* sp. nov., is described from the Poor Knights Islands, off the northeast coast of the North Island of New Zealand. This species is diagnosed by a range of morphological characters and genetic differentiation from *O. ornatum*. The conservation status of the new taxon appears to be of concern as it is endemic to the Poor Knights Islands and has rarely been seen over the past two decades.

**Key words:** Aorangi skink; morphology; New Zealand; North Island; *Oligosoma roimata* sp. nov.; Poor Knights Island; taxonomy, *Oligosoma ornatum*; *Oligosoma aeneum*

### Introduction

The New Zealand squamate reptile fauna is highly diverse and is comprised of two lizard families, the Scincidae (54 species) and the Diplodactylidae (42 species) (Hitchmough *et al.* 2013). Despite this recognised diversity, a substantial proportion (41%) of the lizard fauna remains undescribed (Chapple *et al.* 2009; Nielsen *et al.* 2011). A recent surge in taxonomic activity has resulted in the description of 10 new skink species since 2007 (Chapple & Patterson 2007; Bell & Patterson 2008; Chapple *et al.* 2008a,b, 2011; Patterson & Bell 2009); however, at least a further 16 skink taxa await formal description (Hitchmough *et al.* 2013). All native New Zealand skinks are placed in the genus *Oligosoma* (Girard, 1857) (Chapple *et al.* 2009). Here we complete a taxonomic revision of the ornate skink (*Oligosoma ornatum*), a taxon that a recent molecular study indicated may represent a species complex (Chapple *et al.* 2008c).

*Oligosoma ornatum* is a species that has a widespread distribution across the majority of the North Island of New Zealand, including several smaller offshore islands (Chapple *et al.* 2008c). Like many other widespread skink species in New Zealand, *O. ornatum* has had a long and confused nomenclatural history. Gray (1843) established the name *Tiliqua ornata*, and over the next decade the species was moved between six different genera. However, McCann (1955) misapplied the specific epithet *ornata* (as *Leiolopisma ornata*) to the species now identified as *Oligosoma zelandicum* (Gray, 1843). Although he correctly identified the specific epithet *aenea* (as *Leiolopisma aenea*) with the species currently known as *Oligosoma aeneum* (Girard, 1857), he used it only for populations in the southern half of their range. In addition, he introduced a new name *Sphenomorphus pseudornatus* McCann, 1955 for a compound taxon which included northern populations of *O. aeneum* plus the two species which are the focus of this paper. McCann (1955) based the name on Gray's 1843 types for *Tiliqua ornata*, therefore *Sphenomorphus pseudornatus* is an objective junior synonym of *Oligosoma ornatum*.

Gill (1976) subsequently clarified the nomenclature of *Leiolopisma zelandica* (Gray, 1843) (now placed in *Oligosoma*), and also established that the types of *Tiliqua ornata* were not conspecific with this species. Hardy (1977) believed that a specimen in the British Museum of Natural History (BMNH RR1946.8.19.39) was the holotype for *Tiliqua ornata*, but also nominated a ‘homotype’ (presumably homeotype; Te Papa Tongarewa, National Museum of New Zealand: RE002457 [ex ED S912], Manakau, Horowhenua). However, two of us (GBP, RAH), have examined both the holotype and another type specimen from the BMNH and have determined that Hardy misidentified both. Our re-examination of the *T. ornata* holotype indicates that it is conspecific with the smaller New Zealand species currently known as *O. aeneum* (copper skink). Although the colour has faded, the small size of the specimen combined with its sexual maturity and the small size of the ear opening confirm this identification. This conclusion is in agreement with Robb (1975, 1986). Attempts to use ancient DNA techniques to confirm the identity of the specimen have been unsuccessful due to the poor state of preservation. The ‘homotype’ (RE002457) is not conspecific with the holotype, but in our opinion belongs to the species that we define in the current study as *O. ornatum* sensu stricto.

Accordingly we requested that the ICZN rule in favour of:

- (1) setting aside the existing holotype of *Tiliqua ornata* Gray, 1843 and designating as neotype specimen NMNZ RE.002457 (formerly NMNZ R.1815 and EDS.912) in the National Museum of New Zealand, Wellington, collected at Manakau, Horowhenua, by A.H. Whitaker, 7 September 1971;
- (2) placing on the Official List of Specific Names in Zoology the name *ornata* Gray, 1843, as published in the binomen *Tiliqua ornata*, and as defined by the neotype designated in (1) above.

The Commission ruled in our favour in 2012. (ICZN, 2012).

Therefore the revised synonymy of *O. aeneum* is as follows:

### Synonymy of *O. aeneum*

*Tiliqua ornata*: Gray 1843:202.

*Hinulia ornata*: Gray 1845a:77.

*Hinulia ornate*: Gray 1845b:7.

*Mocoo smithi*: Gray, 1845a:82 (in part). Gray, 1867:4 (in part). Buller, 1871:6 (in part). Hutton, 1872:168 (in part).

McCann, 1955:97 (in part). Fawcett & Smith, 1971:135 (in part).

*Cyclodina aenea*: Girard, 1857:196. Girard, 1858:236–237, 239, pl. xxvi, fig. 9–16 (in part).

Troschel, 1859:61. Gunther, 1875:13. Robb, 1973:297.

*Hombrovia undosa*: Girard, 1857:196. Girard, 1858:240–242. Gunther, 1875:13. Boulenger, 1887:209.

*Eulamprus ornatus*: Fitzinger 1861: 403.

*Lampropholis smithii*: (Gray): Fitzinger, 1861:403. Jouan, 1869:294 (in part).

*Lampropholis (Mocoo) smithi* (Gray): Hochstetter, 1863:429 (in part). Hochstetter, 1867:163 (in part).

*Euprepes smithii* (Gray): Steindachner, 1869:47 (in part).

*Euprepes ornatus*: Steindachner 1869: 49.

*Mocoo zelandica* (Gray): Gunther, 1875:13, pl. 7, fig. 4 (in part).

*Lygosoma smithii* (Gray): Boulenger, 1887:274 (in part). Werner, 1895:21 (in part). Hutton, 1904:39 (in part).

Hutton & Drummond, 1904:351, 354, 381 (in part). Boulenger, 1906:370 (in part). McCann, 1955:75–76, 97 (in part).

*Lygosoma aeneum* (Girard): Boulenger, 1887:275. Werner, 1895:21. Werner, 1901:387. Hutton, 1904:39 (in part).

Hutton & Drummond, 1904:351, 354, 381. Boulenger, 1906:371.

Martin, 1929:164.

*Lygosoma ornatum*: Boulenger 1887: 317.

*Lygosoma (Liolepisma) micans*: Werner, 1895:21.

*Liolepisma aeneum* (Girard): Lucas & Frost, 1897:265, 278–280.

*Liolepisma smithii* (Gray): Lucas & Frost, 1897:265, 277 (in part).

*Liolepisma micans* (Werner): Lucas & Frost, 1897:279.

- Homolepida ornatum*: Lucas & Frost 1897:265, 279.  
*Homolepida ornata*: Burt & Burt 1932:536.  
*Lygosoma (Leiolopisma) aeneum* (Girard): Smith, 1937:223.  
*Lygosoma (Leiolopisma) smithi* (Gray): Smith, 1937:223 (in part).  
*Leiolopisma aenea* (Girard): Mittleman, 1952:21.  
*Leiolopisma smithii* (Gray): Mittleman, 1952:30 (in part).  
*Sphenomorphus ornatus*: Mittleman, 1952:27.  
*Lygosoma moco* Dume'ril & Bibron: Hard, 1954:145–146.  
*Leiolopisma aeneum* (Girard): McCann, 1955:76–77, 79, 102, pl. xiv, figs. 6–9. McCann, 1956:50. Barwick, 1959:331–332, 340, 346–348, 365–348, 346–348, 365–367, 376, 378. Sharell, 1966:77. Fitch, 1970:83. Porter, 1972:403. Schipper, 1972:57. Towns, 1972:95–99, 102–103. Robb, 1973:297. Greer, 1974:16. Morrison *et al.*, 1974:22. Rawlinson, 1974:94. Robb, 1974:687. Bull & Whitaker, 1975:241. Hicks *et al.*, 1975:211. Gill, 1976:143–144. Whitaker, 1976:9.  
*Leiolopisma ornatum*: McCann 1955 (in part) :76–7, 80. Robb, 1977:304–306 (in part).  
*Sphenomorphus pseudornatus*: McCann, 1955:76–77, 110–111, 125, fig. 14 (in part). Natusch, 1967:246 (in part). Whitaker, 1968:623, 628–631, 634–635, 644–646, 648–650 (in part). Whitaker, 1970:99. Forster and Forster, 1971:132 (in part). Towns, 1971:62, fig. 2. Towns, 1972:95–99, 102–104, figs. 2, 3a–c (in part). Towns and Hayward, 1973:94–95, 97. Whitaker, 1973:122–130 (in part). Robb, 1974:683, 689 (in part). Towns, 1974b:156 (in part). Towns, 1974a:217, 219, 223 (in part). Robb, 1975:447 (in part). Hicks *et al.*, 1975:210–212.  
*Sphenomorphus pseudornatum*: McCann, 1955 (in part) :79. McCann, 1956:50 (in part). Schipper, 1972:58 (in part).  
*Sphenomorphus pseudornata*: McCann, 1955:97 (in part).  
*Leiolopisma ornata*: McCann 1955 (in part) :109, 127.  
*Leiolopisma pseudornatum*: Greer 1974: 4, 14, 16–17, 35.  
*Leiolopisma pseudornatus* (McCann): Robb, 1975:483 (in part).  
*Cyclodina aenea*: Hardy, 1977:264–266, fig. 2b, c, 18, 19, 39 (in part).  
*Cyclodina aenea*: Wells and Wellington, 1985:63.  
*Oligosoma aeneum* Chapple *et al.* 2009:485.

Several previous authors have suggested that *Oligosoma ornatum* might represent a species complex. Although Hardy (1977) noted that *O. ornatum* exhibited little morphological variation throughout most of its range, he highlighted that individuals from the Three Kings Islands had very high midbody scale counts, and that animals from the Poor Knights Islands had unusually high lamellae counts compared to individuals from the remainder of the distribution. Jewell (2008) considered these morphological differences to be sufficient to warrant the recognition of both the Three Kings Islands populations and the Poor Knights Islands populations as being taxonomically distinct from *O. ornatum*. A molecular study, using mitochondrial DNA sequence data, provided support for the taxonomic distinctiveness of the Poor Knights Islands populations, but the Three Kings Islands populations were found to group within one of the three subclades identified within *O. ornatum* (Chapple *et al.* 2008c). In this study we use morphological analyses to conduct a taxonomic revision of the *O. ornatum* species complex, and describe only the Poor Knights Islands population as a new species.

## Material and methods

We conducted morphological analyses on specimens from across the entire range of *O. ornatum*, including the Poor Knights Islands and the Three Kings Islands (Figure 1). Our analyses build upon the morphological measurements contained in our recently published taxonomic revisions of several closely related species (Patterson & Daugherty 1990,1994; Patterson 1997; Chapple & Patterson 2007; Bell & Patterson 2008; Chapple *et al.* 2008a,b, 2011; Patterson & Bell 2009) and the data contained in Hardy (1977). The majority of specimens examined were obtained from Te Papa Tongarewa, National Museum of New Zealand (RE codes).

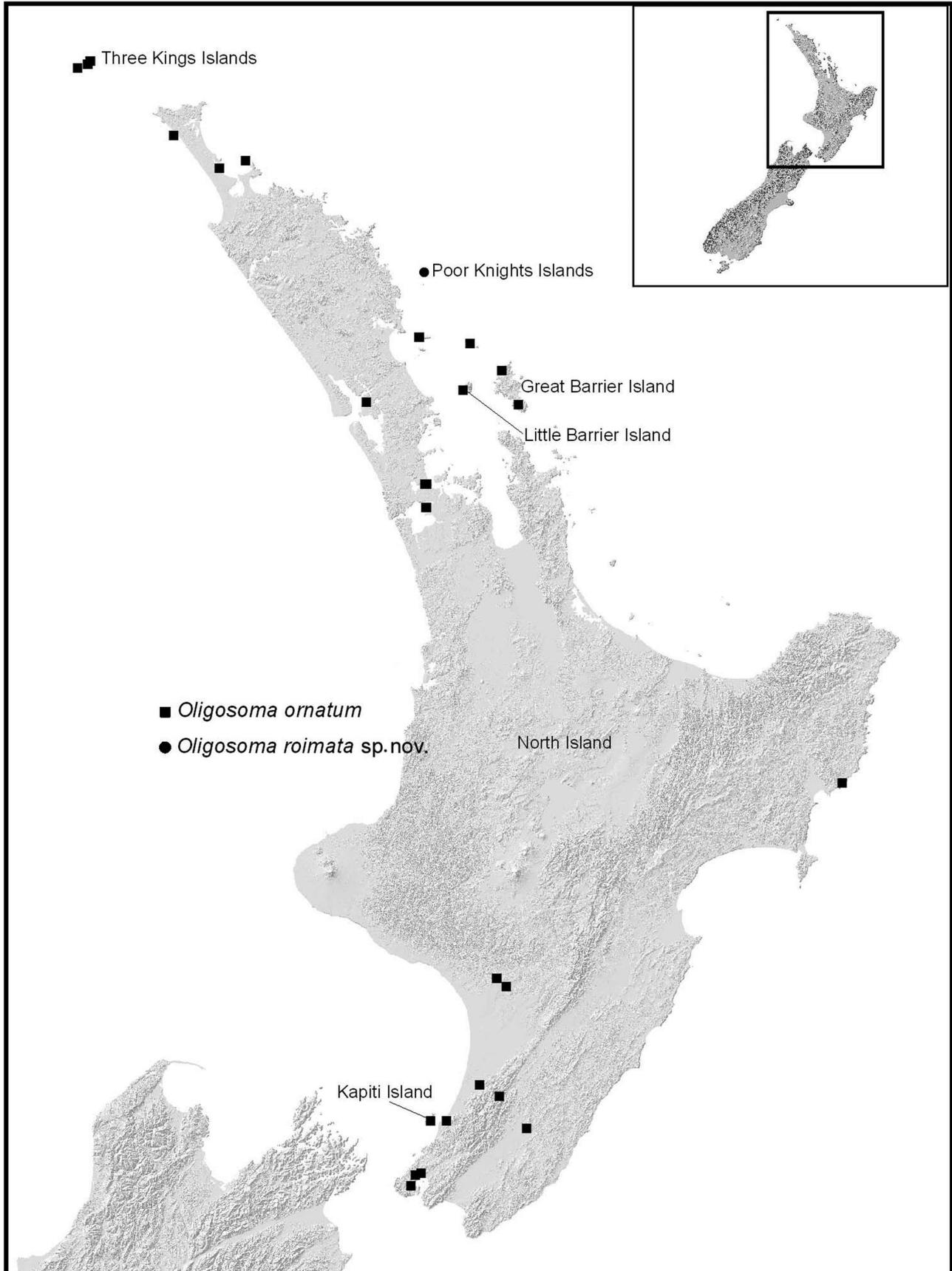


FIGURE 1. Locality map of *O. roimata* sp. nov. and *O. ornatum*.

Descriptions of morphology follow the techniques described in Patterson & Daugherty (1990) and Chapple *et al.* (2008a,b, 2011). Midbody scale rows were counted at the midpoint between the fore- and hind legs. Ventral scales were counted in a line from the mental scale to the vent (including the mental and one preanal scale). The subdigital lamellae were counted on the fourth hind toe of the right foot. The number of selected head scales was counted and their arrangement described as outlined in Patterson & Daugherty (1990). Ten measurements (mm) were made on all specimens: i) axilla to groin (AG), ii) snout to axilla (SF), iii) snout to ear (SE), iv) ear to axilla (EF), head length (HL) from the posterior part of the interparietal to the tip of the snout, v) head width (HW) between the lateral edges of the left and right parietals, vi) intact tail length (TL), vii) fourth hind toe length from base of toe to tip excluding nail (FTL), viii) snout-vent length (SVL), ix) hindlimb length (HLL), measured from groin to tip of fourth toe including nail, and x) forelimb length (FLL), measured from forelimb insertion to tip of fourth finger, including nail (Patterson & Daugherty 1990, 1994; Chapple *et al.* 2008a). Numbers are given where some individuals had missing toes. Individuals were sexed by gross examination of gonads and associated reproductive tracts (testes or ovaries and/or presence of oviductal eggs) from a median incision applied to the lower abdominal region.

## Species descriptions

### Genus *Oligosoma* Girard, 1857

#### *Oligosoma ornatum* (Gray, 1843)

Figure 2

*Sphenomorphus pseudornatum*: McCann 1955 (part): 79. (?)

*Cyclodina ornata*: Hardy 1977: 261-64.

*Cyclodina pseudornata*: Robb 1986: 92, 108, 110, 112.

*Cyclodina* sp. 4: Jewell 2008: 114.

*Oligosoma ornatum*: Chapple *et al.* 2009: 472, 485.

**Neotype**: Manakau, 12 km south of Levin (40° 42'S, 175° 29'E), NMNZ RE002457 (S912) (adult male) (coll. A.H. Whitaker, September 1971). (Figure 2).

**Specimens examined (48 specimens)**. Castaway Valley, Great Island, Three Kings Islands (34° 9'S, 172° 9'E), NMNZ RE004440 (S798) (adult female) (coll. F.M. Climo, November 1971); South West Island, Three Kings Islands (34° 10'S, 172° 5'E), NMNZ RE004881 (S1244) (male) (coll. J.A. Bartle, January 1976); Track to summit, Great Island, Three Kings Islands (34° 9'S, 172° 9'E), NMNZ RE004439 (S797) (female) (coll. F.M. Climo, November 1970); Castaway Valley, Great Island, Three Kings Islands (34° 9'S, 172° 9'E), NMNZ RE004441 (S799) (male) (coll. F.M. Climo, November 1970); Tasman Valley, Great Island, Three Kings Islands (34° 9'S, 172° 9'E), NMNZ RE004946 (S1309) (male) (coll. G. Kuschel, November 1970); North East Island, Three Kings Islands (34° 8'S, 172° 10'E), NMNZ RE001598#1 (female), NMNZ RE001598#2 (male), NMNZ RE001598#3 (male), NMNZ RE001598#4 (female), NMNZ RE001598#5 (female), (coll. R. Dell and F.M. Climo, February 1974); Mt Camel, Houhora, Northland (34° 49'S, 173° 9'E), NMNZ RE004579 (S939) (male), NMNZ RE004581 (S941) (male) (coll. A.H. Whitaker, May 1972); Matapia Island, Northland (34° 36'S, 172° 47'E), NMNZ RE006121 (FT3113) (male) (coll. P. Anderson, May 1993); West Bay, Hen Island, Hen and Chickens Group (35° 53'S, 174° 42'E), NMNZ RE003863 (S221) (female), (coll. A.H. Whitaker, January 1968); Marotiri (Lady Alice) Islands, Hen and Chickens Group. (35° 53'S, 174° 42'E), NMNZ RE004492 (S851) (male), (coll. A.H. Whitaker, March 1971); Hen Island, Hen and Chickens Group (35° 53'S, 174° 42'E), NMNZ RE006124 (FT583) (male) (coll. I. McFadden, February 1989); Lady Alice Island, Hen and Chickens Group (35° 53'S, 174° 42'E), NMNZ RE006125 (FT594) (female) (coll. A. Cree, February 1989); Hen Island, Hen and Chickens Group (35° 53'S, 174° 42'E), NMNZ RE000321 (male) (coll. H. Hamilton, December 1924); Old Woman Cove, Hen Island, Hen and Chickens Group (35° 53'S, 174° 42'E), NMNZ RE003864 (S222) (male) (coll. A.H. Whitaker, January 1968); Summit Track, Little Barrier Island. (36° 13'S, 175° 03'E), NMNZ RE004834 (S1196) (male) (coll. J. Watt, March 1974); Mangere, Auckland (36° 58'S, 174° 47'E), NMNZ RE001631 (male), NMNZ RE001625#21 (female), NMNZ RE001625#22 (female), NMNZ RE001625#23 (female), NMNZ RE001625#24 (male), NMNZ

RE001625#25 (female), NMNZ RE001625#26 (female), NMNZ RE001625#27 (male) (coll. G.S. Hardy, January 1970); Devonport, Auckland. (36° 49'S, 174° 47'E), NMNZ RE006122 (FT188) (female) (coll. R. A. Hitchmough, November 1987); Great Barrier Island (36° 05'S, 175° 21'E), NMNZ RE001629#45 (female), NMNZ RE001629#46 (male) (coll. G.S. Hardy, December 1974); Tryphena, Great Barrier Island (36° 18'S, 175° 29'E), NMNZ RE002041 (male) (coll. D. Towns January 1985); 2 km N. of Leigh, Northland. (36° 18'S, 174° 18'E), NMNZ RE003865 (S223) (female) (coll. A.H. Whitaker, January 1968); Devonport, Auckland (36° 49'S, 174° 46'E), NMNZ RE003980 (S338) (female) (coll. D. Waddington, January 1969); Moturoa Islands, Northland (34° 47'S, 173° 20'E), NMNZ RE003831 (S189) (male) (coll. R. Falla, January 1968); Mt Mangere Auckland (36° 58'S, 174° 47'E), NMNZ RE004470 (S828) (male) (coll. E. Nichols, May 1970); Pouawa-Tirihau Bridge, 16 km N of Gisborne (38° 37'S, 178° 10'E), NMNZ RE004307 (S665) (male) (coll. T. Jewell, July 1970); Groper Rock, Mokohinau Islands (35° 55'S, 175° 06'E), NMNZ RE004798 (S1160) (male) (coll. A.H. Whitaker, November 1973); Kelburn, Wellington (41° 17'S, 174° 46'E), NMNZ RE003751 (S106) (male) (coll. D. Castle, January 1964); Korokoro, Lower Hutt, (41° 12'S, 174° 51'E), NMNZ RE004087 (S445) (female) (coll. G Woodward, July 1969); Mt Curl, Marton District (39° 57'S, 175° 26'E), NMNZ RE004225 (S583) (female) (coll. M. Meads, February 1969); Mt Curl, Marton District (39° 57'S, 175° 26'E), NMNZ RE004835 (S1197) (female), (coll. M. Meads, June 1972); Rata, Rangitikei (40° 00'S, 175° 31'E), NMNZ RE003647 (S2) (female) (coll. T. Brown, April 1966); Johnsonville (41° 13'S, 174° 48'E), NMNZ RE005160 (S1525) (male) (coll. J. Boyd October 1976); Mt Curl, Marton District (39° 57'S, 175° 26'E), NMNZ RE004171 (male) (coll. M. Meads December 1968); Black Rock Stn, 10 km NE Masterton, Wairarapa (40° 54'S, 175° 43'E), NMNZ RE004844 (S1206) (female) (coll. A.H. Whitaker, March 1972); Reikorangi, Waikanae (40° 52'S, 175° 03'E), NMNZ RE004528 (S887) (female) (coll. A.H. Whitaker, November 1971); Waiopahu Reserve, Levin (40° 38'S, 175° 19'E), NMNZ RE003750 (S105) (female) (coll. A.H. Whitaker, March 1967); Kapiti Island (40° 52'S, 174° 55'E), NMNZ RE004732 (female) (coll. B.D. Bell, Nov. 1972).

**Diagnosis.** *Oligosoma ornatum* can be distinguished from other *Oligosoma* species through a combination of characters. The orange iris clearly visible in living animals separates the species from all other *Oligosoma* except *O. aeneum*, *O. levidensum* (Chapple *et al.*, 2008), *O. hardyi* (Chapple *et al.*, 2008), *O. townsi* (Chapple *et al.*, 2008), *O. oliveri* (McCann, 1955), *O. macgregori* (Robb, 1975), *O. whitakeri* (Hardy, 1977), *O. striatum* (Buller, 1871), *O. homalonotum* (Boulenger, 1906), and *O. roimata* **sp. nov.**. The unbroken subocular scale row separates *O. ornatum* from *O. striatum*, *O. homalonotum* and *O. hardyi*. *Oligosoma ornatum* has a prominent teardrop marking under the eye, and a moderately large ear opening, which separates it from *O. aeneum*, *O. levidensum* and *O. hardyi* which lack this marking and have small ear openings. *Oligosoma townsi* midbody scale count of  $\geq 38$  does not overlap with *O. ornatum*.

The maximum SVL is much less than that of *O. oliveri* (105.6 mm) and the AG/SF ratios are quite different (Chapple *et al.* 2008a). There is minimal overlap between *O. ornatum* and *O. whitakeri* in midbody and ventral scale counts with *O. whitakeri* having a higher range for both indices (Hardy 1977). *O. ornatum* lacks the yellow and orange colouration of many *O. whitakeri* specimens (Hardy 1977). *O. whitakeri* generally has dark blotches on the ventral surface, whereas it is often lightly speckled in *O. ornatum*. *Oligosoma whitakeri* has a longer tail (TL/SVL: 1.32; Hardy 1977) compared to *O. ornatum* (TL/SVL: 1.14). Colour pattern distinguishes *O. ornatum* from *O. macgregori* and there is no overlap in midbody counts between these two species. The ventral colouration of *O. ornatum* which is usually flushed with orange, red, pink or yellow is different from the white venter of *O. roimata* **sp. nov.**

**Description of Neotype.** Body elongate, squarish in cross-section; limbs moderately well-developed, pentadactyl. Lower eyelid with a large, opaque central scale, bordered anteriorly and posteriorly by relatively large scales. Snout blunt. Nostril centred just below middle of nasal, not touching bottom edge of nasal. Supranasals absent. Rostral broader than deep. Frontonasal broader than long, not separated from frontal by prefrontals meeting in midline. Frontal longer than broad, similar in length to frontoparietal and interparietal together, in contact with 2 anteriormost supraoculars. Supraoculars 4, the second largest. Preoculars 2, the upper one larger. Frontoparietals distinct, larger than interparietal. A pair of parietals meeting behind interparietal and bordered posteriorly by a pair each of nuchals and temporals, also in contact with interparietal, frontoparietal, fourth supraocular and 2 postoculars. Loreals 2, posterior one the larger; anterior loreal in contact with first and second supralabial, posterior loreal, prefrontal, frontonasal and nasal; posterior loreal in contact with second and third supralabial, first subocular, upper and lower preocular, prefrontal and anterior loreal. Supralabials 7, the sixth largest. Infralabials 6,

several of them equal in size; fifth supralabial below centre of eye. Mental broader but shallower than rostral. Suboculars series continuous. Postmental larger than mental. Chinshields 3 pairs. Two primary temporals. Dorsal scales largest, weakly striate. Ventral scales smooth. Subdigital lamellae smooth. Ear opening round, moderately large, with no projecting granules. Forelimbs shorter than hindlimbs. Adpressed limbs not meeting in adult. Digits short, sub-cylindrical. Third front digit shorter than the fourth.



FIGURE 2. Ornate skink (*O. ornatum*) neotype (RE002457).

**Measurements (in Millimeters; Neotype with the Variation Shown in the Specimens Examined in Parentheses):** SVL 65.2 (mean 62.3, range 40.0–80.5), HL 10.5 (mean 9.0, range 6.6–10.8), HW 6.8 (mean 6.4, range 4.7–7.6), AG 32.0 (mean 31.9, range 19.4–47.8), SF 26.0 (mean 23.9, range 16.4–28.8), S-E 12.3 (mean 11.5, range 8.1–13.6), EF 14.7 (mean 12.7, range 7.7–16.5), and TL unknown (not intact) (mean 65.1; N = 6).

**Scalation (Neotype with the Variation Shown in the Specimens Examined in Parentheses):** Upper ciliaries 8 (mean 7, range 5–10); lower ciliaries 11 (mean 10, range 8–13); nuchals 1 pair (mean 1 pair, range 0–2 pairs); midbody scale rows 32 (mean 32, range 28–36); ventral scale rows 74 (mean 74, range 60–88); subdigital lamellae 18 (mean 19, range 15–26); supraciliaries 7 (mean 7, range 7–8); suboculars 8 (mean 8, range 7–11). Frontonasal seldom separated from frontal by prefrontals meeting in midline. Anterior loreal in contact with first and second supralabial, occasionally in contact with second only. Posterior loreal usually in contact with second supralabial only, occasionally in contact with second and third supralabial. Supralabials 7 (usual) or 8, the sixth or seventh largest. Infralabials 5 or 6 (usual). One, occasionally two primary temporals. Third front digit usually as long as the fourth. Maximum SVL 80.5 mm. Six specimens had intact tails (TL/SVL = 1.14). Ratios for morphological measurements ( $\pm$  SD): AG/SF  $1.33 \pm 0.16$ ; SE/EF  $0.91 \pm 0.08$ ; HL/HW  $1.42 \pm 0.09$ .

**Colouration.** Dorsal surface light brown to very dark brown, with irregular dark and light flecks or blotches. Dark brown line passing from near tip of snout through upper part of eye to above and forward of ear. Posterior to ear a dark brown band of varying width extends above forelimb becoming less distinct as it proceeds towards tip of tail. This band is broken up by light blotches. Lateral surface usually lighter in colour than dorsum, lessening in intensity towards ventral surface. Usually blotched with dark and light along lateral body wall. No striping on limbs, which follow dorsal and ventral body colouring. Ventral surface red, orange, pink, yellow, white or cream, often lightly speckled with black compared with throat and chin. Fawcett (1970) interpreted the red colouration as sexual in nature; it is absent in immature animals. Throat and chin sometimes strongly mottled in appearance. A white, black-edged “tear-drop” under eye on fifth and sixth supralabial. Upper and/or lower jaws may have denticulate markings. Juvenile colouration is similar to adult except for the belly colour.

**Habitat and life history.** *Oligosoma ornatum* is known from throughout most of the North Island (BioWeb Herpetofauna database 2011), but there are no records from altitudes over 600 metres. It also occurs on several island groups off the coast of the North Island, including Little Barrier and Great Barrier Islands, the Hen and Chickens group and the Three Kings islands. It lives among leaf litter, under rocks and logs, or in dense vegetation in man-made and natural environments. One individual was recently found among the roots of a pine tree about 0.5m below the ground in Wellington. It is mostly active at dawn or dusk, seldom emerging far from cover, but will sun-bask near the entrance to its retreat. Young are born in January–February. The life-history was studied by Porter (1987) and Fawcett (1964, 1970). Fawcett found the maximum SVL for his animals was 80 mm. Females matured

after their second hibernation when about 19–20 months of age and 60–65 mm SVL; males matured when 15–16 months of age and 50–55 mm SVL. The maximum SVL recorded for this species is 84 mm and maximum weight (for the same animal) was 11.5 g (R. Romijn, pers. comm.). *Oligosoma ornatum* is currently listed in the New Zealand Threat Classification System as At Risk (Hitchmough *et al.* 2013).

### ***Oligosoma roimata* sp. nov.**

Figure 3

*Sphenomorphus pseudornatus*: McCann 1955 (in part): 76-7, 110-11, 125.

*Cyclodina ornata*: Hardy 1977 (in part): 261-64.

*Cyclodina* sp. 3: Jewell 2008: 112.

*Oligosoma ornatum*: Chapple *et al.* 2009 (in part): 472, 485.

**Holotype.** Aorangi Island, Poor Knights (35° 28'S, 174° 44'E), NMNZ RE001626#32 (adult male) (coll. G.S. Hardy, November 1973). (Figure 3).

**Paratypes (4 specimens).** Aorangi Island, Poor Knights (35° 28'S, 174° 44'E), NMNZ RE003723 (S78) (male) (coll. Coll. A.H. Whitaker, December 1964); Aorangi Island, Poor Knights (35° 28'S, 174° 44'E), NMNZ RE001626#29 (female), NMNZ RE001626#30 (male), NMNZ RE001626#31 (male) (coll. G.S. Hardy, November 1973).

**Diagnosis.** *Oligosoma roimata* sp. nov. can be distinguished from other *Oligosoma* species through a combination of characters. The clearly visible orange iris separates the species from all other *Oligosoma* except *O. aeneum*, *O. levidensum*, *O. hardyi*, *O. townsi*, *O. oliveri*, *O. macgregori*, *O. whitakeri*, *O. striatum*, *O. homalonotum*, and *O. ornatum*. The unbroken subocular scale row separates *O. roimata* sp. nov. from *O. striatum*, *O. homalonotum* and *O. hardyi*. *Oligosoma roimata* sp. nov. has a prominent teardrop marking under the eye, and a moderately large ear opening, which separates it from *O. aeneum*, *O. levidensum* and *O. hardyi* which lack this marking and have small ear openings. *Oligosoma townsi* midbody scale count of  $\geq 38$  does not overlap with *O. roimata* sp. nov..

The maximum SVL of 62 mm (Whitaker 1968) is much less than that of *O. oliveri* (105.6 mm), the ear opening is smaller than in *O. oliveri* and most *O. oliveri* specimens have two primary temporals (Chapple *et al.* 2008a), whereas *O. roimata* sp. nov. always has one. There is minimal overlap between *O. roimata* sp. nov. and *O. whitakeri* in midbody and no overlap in ventral scale counts with *O. whitakeri* having a higher range for both indices (Hardy 1977). *Oligosoma roimata* sp. nov. lacks the yellow and orange colouration of many *O. whitakeri* specimens (Hardy 1977). *Oligosoma whitakeri* generally has dark blotches on the ventral surface, whereas it is unmarked or lightly marked in *O. roimata* sp. nov.. Colour pattern distinguishes *O. roimata* sp. nov. from *O. macgregori* and there is no overlap in midbody or ventral scale counts between these two species. The ear opening is slightly smaller than in *O. ornatum* and the maximum SVL is much less than *O. ornatum* (84.0 mm).

**Description of Holotype.** Body elongate, squarish in cross-section; limbs moderately well-developed, pentadactyl. Lower eyelid with a large, sometimes divided opaque central scale, bordered anteriorly and posteriorly by relatively large scales. Snout moderately blunt. Nostril centred just below middle of nasal, not touching bottom edge of nasal. Supranasals absent. Rostral broader than deep. Frontonasal broader than long, not separated from frontal by prefrontals meeting in midline. Frontal longer than broad, shorter than frontoparietal and interparietal together, in contact with 2 anteriormost supraoculars. Supraoculars 4, the second largest. Preoculars 2, the upper one larger. Frontoparietals distinct, larger than interparietal. A pair of parietals meeting behind interparietal and bordered posteriorly by a pair each of nuchals and temporals, also in contact with interparietal, frontoparietal, fourth supraocular and 2 postoculars. Loreals 2, similar size; anterior loreal in contact with first and second supralabial, posterior loreal, prefrontal, frontonasal and nasal; posterior loreal in contact with second and third supralabial, first subocular, upper and lower preocular, prefrontal and anterior loreal. Supralabials 7, the sixth largest. Infralabials 6, several of them equal in size; fifth supralabial below centre of eye. Mental broader but shallower than rostral. Suboculars series continuous. Postmental larger than mental. Chinshields 3 pairs. One primary temporal. Dorsal scales largest, weakly striate. Ventral scales smooth. Subdigital lamellae smooth.

Ear opening round, moderately large, with no projecting granules. Forelimbs shorter than hindlimbs. Adpressed limbs almost meeting in adult. Digits short, sub-cylindrical. Third front digit shorter than the fourth.



FIGURE 3. Aorangi skink (*O. roimata* sp. nov.) holotype (RE001626#32).



FIGURE 4. Aorangi skink (*O. roimata* sp. nov.) in habitat. Photograph: Colin Miskelly.

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**FIGURE 5.** *O. ornatum* displays a variety of colouration and body shape ranging from the Three Kings (A) to Wellington in the lower North Island (B). Photographs: (A) Rod Morris; (B) Richard Romijn.

**Measurements (in Millimeters; Holotype with the Variation Shown in the Type Series in Parentheses):** SVL 57.0 (mean 57.0, range 48.5–63.6), HL 8.3 (mean 8.7, range 8.1–9.2), HW 6.1 (mean 6.1, range 6.4–6.5), AG 31.0 (mean 28.3, range 21.7–33.2), SF 23.9 (mean 23.0, range 21–24.8), S-E 11.7 (mean 11.3, range 9.6–12), EF 12.9 (mean 12.1, range 10.5–13.5), and TL incomplete (no specimens with intact tails).

**Scalation (Holotype with the Variation Shown in the Type Series in Parentheses):** Upper ciliaries 7 (mean 6, range 6–7); lower ciliaries 11 (mean 10, range 10–11); nuchals 1 pair (mean 1 pair, range 1–1 pairs); midbody scale rows 34 (mean 33, range 32–34); ventral scale rows 68 (mean 69, range 65–72); subdigital lamellae 24 (mean 22, range 21–24); supraciliaries 7 (mean 7, range 7–7); suboculars 9 (mean 9, range 8–9). Frontonasal never separated from frontal by prefrontals meeting in midline. Anterior loreal in contact with first and second supralabial. Posterior loreal in contact with second and third supralabial. Supralabials 7, the sixth largest. Infralabials 6. One primary temporal. Third front digit usually shorter than the fourth. Maximum SVL 63.6 mm. Ratios for morphological measurements ( $\pm$  SD): AG/SF  $1.23 \pm 0.14$ ; SE/EF  $0.94 \pm 0.05$ ; HL/HW  $1.41 \pm 0.05$ .

**Colouration.** Dorsal surface light brown to very dark brown, with irregular dark and light flecks or blotches, shading into white ventral surface (Figure 4). A white, black-edged “tear-drop” under eye, although this may be indistinct in some animals. Well marked pale dorsolateral stripe from near tip of snout to near midpoint of body, thereafter broken up by brown patches. Throat, chin and belly lightly speckled. There do not appear to be sexually dimorphic colour patterns. Juvenile colouration is unknown.

**Etymology.** From the Maori “roimata” = “tears”, referring to the teardrop marking under the eyes. The suggested common name is the Aorangi skink.

**Habitat and life history.** *Oligosoma roimata* **sp. nov.** is known only from the Poor Knights Islands, which are an island chain just over 20 km NE of the northern North Island. They consist of two large islands (larger than 1 km<sup>2</sup>) and several smaller islands and rock stacks. In total, the group is approximately 2.8 km<sup>2</sup> in area. The Poor Knights Islands are administered by the Department of Conservation as a Nature Reserve.

The islands are unique in that they have never been invaded by introduced mammalian predators. The exception is Aorangi Island, onto which Maori introduced feral pigs from stock obtained from European ships toward the end of the eighteenth century. The pigs were extirpated in 1936. Consequently, the Poor Knights Islands support a diverse range of reptile species, which can attain extremely high densities compared to mainland populations. The islands are now known to have three endemic lizard species; *Oligosoma roimata* **sp. nov.**, the Poor Knights gecko (*Dactylocnemis* sp.) and Hardy’s skink (*O. hardyi*). They also support populations of marbled skink (*O. oliveri*) which have a highly distinctive morphology, egg-laying skink (*O. suteri* (Boulenger, 1906)), moko skink (*O. moco* (Dumeril & Bibron, 1839)), shore skink (*O. smithi* (Gray, 1845)) and Duvaucel’s gecko (*Hoplodactylus duvaucelii* (Dumeril & Bibron, 1836)).

*Oligosoma roimata* **sp. nov.** is most abundant in flax and scrub on the fringes of the islands. It appears to favour dense ground cover. It is most active at dawn and dusk and appears to be mainly insectivorous (Whitaker 1968). The species is currently listed in the New Zealand Threat Classification System as Naturally Uncommon (Hitchmough *et al.* 2013); however, since population densities appear to be sparse and several recent surveys have failed to detect any animals (Trent Bell, pers. comm.; R. Parrish, pers. comm.), the species may warrant an enhanced conservation status.

## Discussion

Although our study has increased the number of described skink species in New Zealand to 39, numerous species remain to be described (Chapple *et al.* 2009). The apparent decoupling of morphological and molecular evolution in New Zealand skinks has contributed to the difficulties in identifying the true diversity of the group. Chapple *et al.* 2011 discussed the evolutionary and taxonomic implications of cryptic and ‘anti-cryptic’ species within the cryptic skink (*O. inconspicuum*) species complex. These same characteristics can be seen in the *O. ornatum* complex. ‘Anti-cryptic’ refers to a situation where a population has distinctive morphology, but there is no corresponding genetic differentiation (i.e. the opposite of a cryptic species where there is genetic differentiation, but no morphological differentiation).

A phylogeographic study of *O. ornatum* (Chapple *et al.* 2008c) identified four clades, three corresponding to *O. ornatum* sensu stricto and one divergent clade which we describe here as *O. roimata* **sp. nov.** Morphologically

the Three Kings animals are very distinctive compared to their mainland counterparts (Figure 5), with a more elongate body and higher scale counts, particularly the midbody and ventral scales. The Three Kings Islands populations are not genetically distinct from those found on the neighbouring Aupori Peninsula region of Northland in the far north of the North Island. Some populations on other northern islands such as Moturoa Island also morphologically resemble the Three Kings population, and genetically form part of the same clade. However, close examination of the mainland animals shows a gradual morphological cline on this peninsula from more elongate forms in the far north to more stocky animals in the south. For example, although all of the Three Kings animals have three scale rows between the anterior side of the ear opening and the secondary temporal, this is reduced to two scale rows in the mainland animals. The skull is noticeably longer and lower in the Three Kings animals than in mainland animals, and the relative limb length is significantly greater. We consider this variation to be consistent with a broad zone of intergradation following secondary contact of the far northern and more southern clades. An additional problem with recognising the far northern clade as a distinct taxon is the other two clades within *O. ornatum* sensu stricto are morphologically indistinguishable and are paraphyletic with respect to the far northern clade. For these reasons we recognise only the most genetically distinct of the four clades recovered by Chapple *et al.* 2008c as a distinct species, *O. roimata* sp. nov., and regard the other three clades as geographic variants within the species *O. ornatum* sensu stricto.

*O. roimata* sp. nov. is genetically divergent from *O. ornatum* sensu stricto (8.7–9.8% sequence divergence, ~6.2–7 mya), using the ND2 mitochondrial gene (Chapple *et al.* 2008c). Thus, a similar ‘anti-cryptic’ pattern to those discussed above is observed in the two species in the *O. ornatum* complex.

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