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The Genus *Tigriopus* Norman (Copepoda: Harpacticoida) in
New Zealand with a Description of a New Species

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Abstract

THE genus *Tigriopus* (Copepoda : Harpacticoida) is recorded in New Zealand splash zone pools and a new species is described from Leigh, Northland. A key to all described species is provided.

INTRODUCTION

THE genus *Tigriopus* has been recorded from locations all over the world, but there is only one previous record from New Zealand. McGregor (1965) found *Tigriopus* in spray zone pools associated with the larvae of the mosquito *Opifex fuscus* but identified them, probably incorrectly, as the Mediterranean species *T. fulvus*.

More recently, the author has received collections of *Tigriopus* from Macquarie Island, Snares Island, Kaikoura, Island Bay (Wellington) and Leigh (Northland). These have provided further records and material for discussion of *T. angulatus* Lang as well as revealing the existence of a new species of this genus.

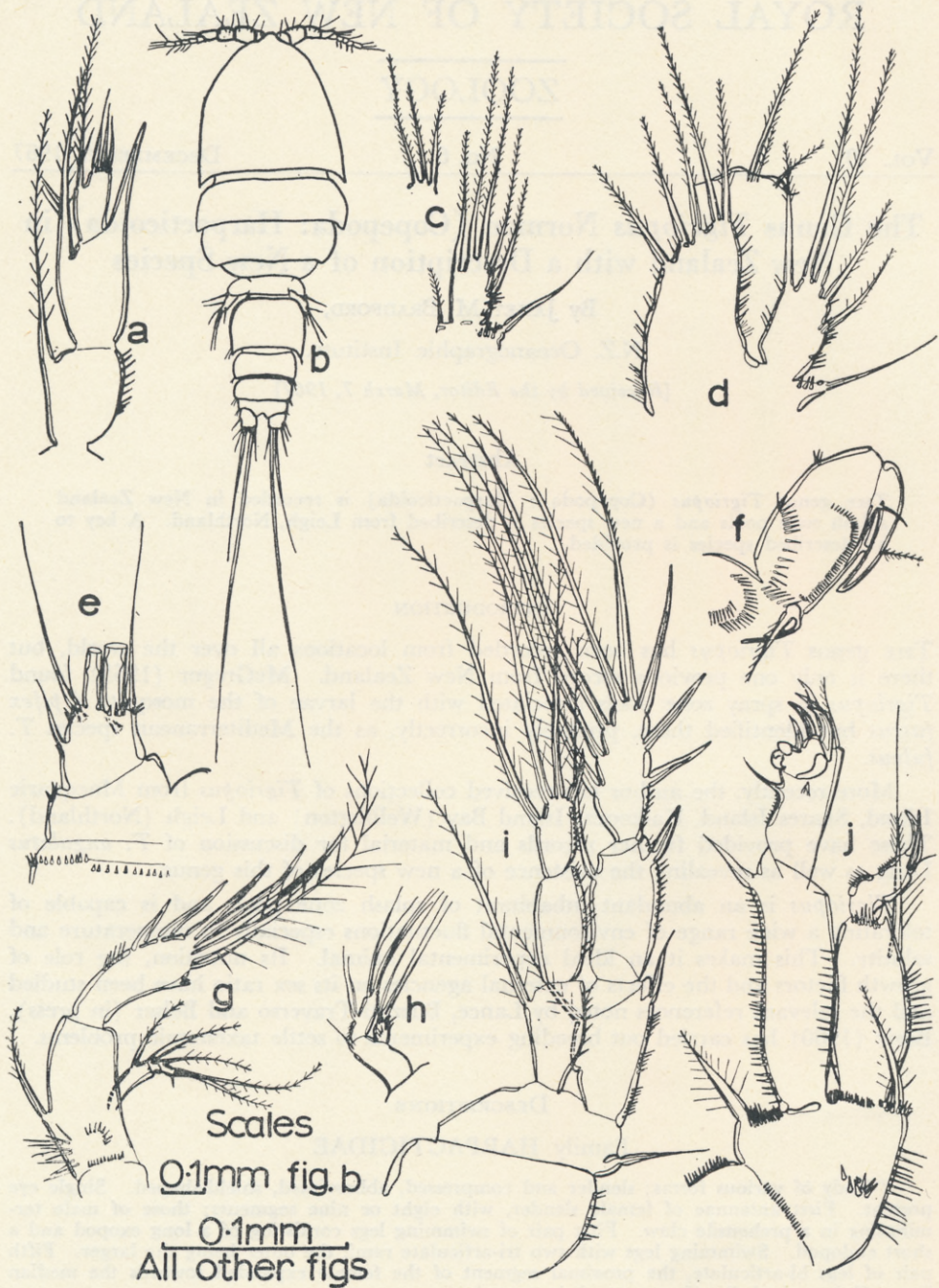
Tigriopus is an abundant inhabitant of splash zone pools and is capable of tolerating a wide range of environmental fluctuations especially in temperature and salinity. This makes it an ideal experimental animal. Its nutrition, the role of growth factors and the effects of external agencies on its sex ratio have been studied and the relevant references noted by Lance, Buzzati-Traverso and Belser (in press). Bozic (1960) has carried out breeding experiments to settle taxonomic problems.

DESCRIPTIONS

Family HARPACTICIDAE

"Body of various forms; slender and compressed, abbreviated, shield-shaped. Single eye present. First antennae of female slender, with eight or nine segments; those of male terminating in a prehensile claw. First pair of swimming legs consisting of a long exopod and a short endopod. Swimming legs with two tri-articulate rami, the outer being the larger. Fifth pair of legs bi-articulate, the proximal segment of the female expanded towards the median line. Ovisac single." (Lance *et al.* in press.)

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TEXT-FIG. 1. *Tigriopus angulatus*. a, male 2nd leg endopod; b, female dorsal view; c, male 5th and 6th legs; d, female 5th and 6th legs; e, female furca ventral; f, maxilliped; g, female antenna II; h, mandibular palp; i, male 4th leg; j, female 1st leg.

Genus TIGRIOPUS Norman, 1868

“General form of body similar to *Harpacticus*. First antenna of the female with nine segments. The outer rami of the second antennae with three segments. Both rami of the first pair of swimming legs tri-articulate. Second segment of the endopod of the second pair of swimming legs of the male terminating in a strong outer spine and inner spine. Exopod of third pair of swimming legs of male similar to exopods of the second and fourth pair; not modified as in *Harpacticus*.” (Lance *et al.* in press.)

Tigriopus angulatus Lang, 1933. Text-fig. 1, a–j.

- 1902. *Harpacticus brevicornis*: Giesbrecht, P. 36–7, Plate 9 (not O. F. Muller, 1776).
- 1933. *Tigriopus angulatus* Lang, P. 1–8, Fig. 1–14.
- 1934. *T. angulatus*: Lang, P. 9–10, Fig. 10.
- 1935. *T. angulatus*: Brehm, P. 77–9, Fig. 4–6.
- 1948. *T. californicus*: Lang, P. 342, Text-fig. 154 (in part Not Baker, 1912).

LOCALITIES. Snares Island, Oceanographic Institute Station Number D 140 (collected by E. W. Dawson 13.1.64); Kaikoura and Island Bay (Wellington), New Zealand (collected by J. M. Grieve 17.7.64 and 21.6.66 respectively); Macquarie Island (collected by W. Merilees 19.2.67).

HABITAT. Marine, in splash zone pools.

SIZE. Males 1.01–1.18mm, females 1.03–1.22mm.

Tigriopus angulatus was described from Macquarie Island by Lang (1933) who later (Lang, 1934) recorded it from Tasmania and Campbell Island and considered it to be synonymous with Giesbrecht’s (1902) *Harpacticus brevicornis*. On further consideration (Lang, 1948) he equated *T. angulatus* with *T. californicus*.

The specimens from Macquarie Island, Snares Island, Kaikoura and Island Bay differ from *T. californicus* (Baker, 1912) in the proportions of their limbs, especially the first leg in both sexes, and the female fifth legs and in having a total of eight spines and setae on the last segment of the fourth leg exopod instead of seven as in *T. californicus*.

Figures 1–15 of Lang (1933) and Plate 9 (Figs. 1–14) of Giesbrecht (1902) show the same differences from *T. californicus*. Lance (who has performed breeding experiments using specimens of *Tigriopus* from New Zealand) has concluded that *T. californicus* is distinct from the southwest Pacific species for which the name *angulatus* should be reinstated (pers. comm.).

Differences are noted between the New Zealand specimens and material from Macquarie Island. The basal segment of the female fifth legs of New Zealand specimens is distinctly longer than wide and extends well past the exopod whereas in Macquarie Island specimens it is wider than long and does not extend past the exopod, agreeing with Fig. 9 of Lang (1933) and Fig. 6, Plate 9, of Giesbrecht (1902). Also, the second basipod segment of the male mandible in the New Zealand specimens has only one distal seta instead of the two drawn by Giesbrecht (1902) and generally found in Macquarie Island specimens.

Lance *et al.* (in press) distinguish *T. angulatus* from *T. californicus* by this characteristic. Even if the number of setae on the second basipod of the mandible is variable there are other, more obvious, differences between the mandibular palps:

SETAE ON THE MANDIBULAR PALPS

	<i>T. californicus</i>	<i>T. angulatus</i>
Exopod		
Lateral setae	2	1 or 2
Terminal setae	3	2
Endopod		
Median setae	3	2
Terminal setae	7	5

There appears to be some variation in the spination on the anal segment. Rarely does either sex in New Zealand specimens have spinules on the ventro-distal border of the anal segment. Specimens from Snares Island differ from these in having a row of spinules in this position similar to those found on Macquarie Island specimens and figured by Lang (1933).

Brehm's (1935) record of *T. angulatus* is unusual in that the animal was found in a freshwater lake at 3,000 feet in the Andes near Santiago. Although *Tigriopus* is noted for its ability to withstand wide environmental changes especially in salinity and temperature it has elsewhere only been found in marine environments. The animal that Brehm figured and discussed in considerable detail is extraordinarily like the New Zealand specimens even to the proportions of the female fifth legs.

Records of *Tigriopus* from Kerguelen Islands as *Harpacticus fulvus* by Brady (1875, 1879) and from the Antarctic Peninsula as *H. brevicornis* by Quidor (1906) were probably *T. angulatus*. Since they did not figure their material its identity cannot be checked.

It appears that *T. angulatus* is represented by two forms: a southern form (Macquarie Island and Antarctic Peninsula) with the basal segment of the female's fifth leg scarcely extending past the exopod, generally with two setae on the second basipod segment of the mandible and spinules on the anal segment ventro-distal border; and a northern form (New Zealand and Santiago) with the basal segment of the female fifth leg extending well past the exopod, one seta on the second basipod segment of the mandible, and no spinules on the anal segment ventro-distal border.

The occurrence of the Snares Island specimens, with spines on the anal segment ventro-distal border and with female fifth legs more like New Zealand specimens than Macquarie Island specimens, suggests that there may be a cline between the northern and southern forms.

DISTRIBUTION. *Tigriopus angulatus* has been recorded from New Zealand, Macquarie Island (Lang, 1933), Tasmania and Campbell Island (Lang, 1934) and Snares Island, with likely records from the Antarctic Peninsula (Giesbrecht, 1902; Quidor, 1906), South America (Andes near Santiago) (Brehm, 1935) and possibly Kerguelen Islands (Brady, 1875, 1879) (see Fig. 4).

***Tigriopus raki** n.sp.** Text-fig. 2, a-j; 3, a-g.

FEMALE

Length: 0.60mm.

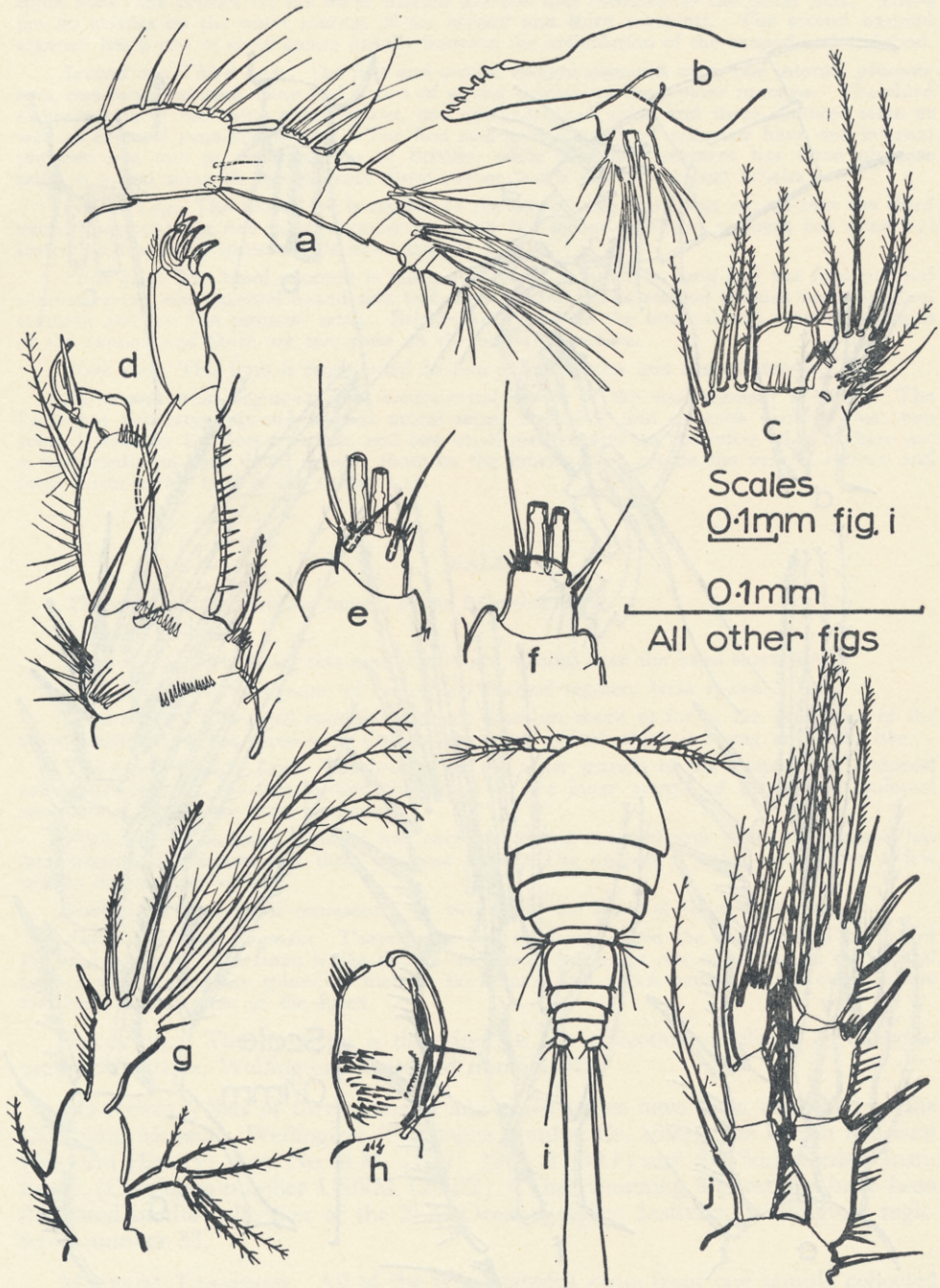
Antenna I: Nine segmented, the penultimate segment very small. The last segment has eight setae.

Antenna II: The basal segment has a large plumose seta, a three-segment exopod with five plumose setae and a patch of bristles. The end segment of the second antenna has three stout spines (the smallest outer one is naked while the other two have one toothed and one plumose edge), four large plumose setae and one small seta. There is a row of bristles along the border of this distal segment below the smallest spine.

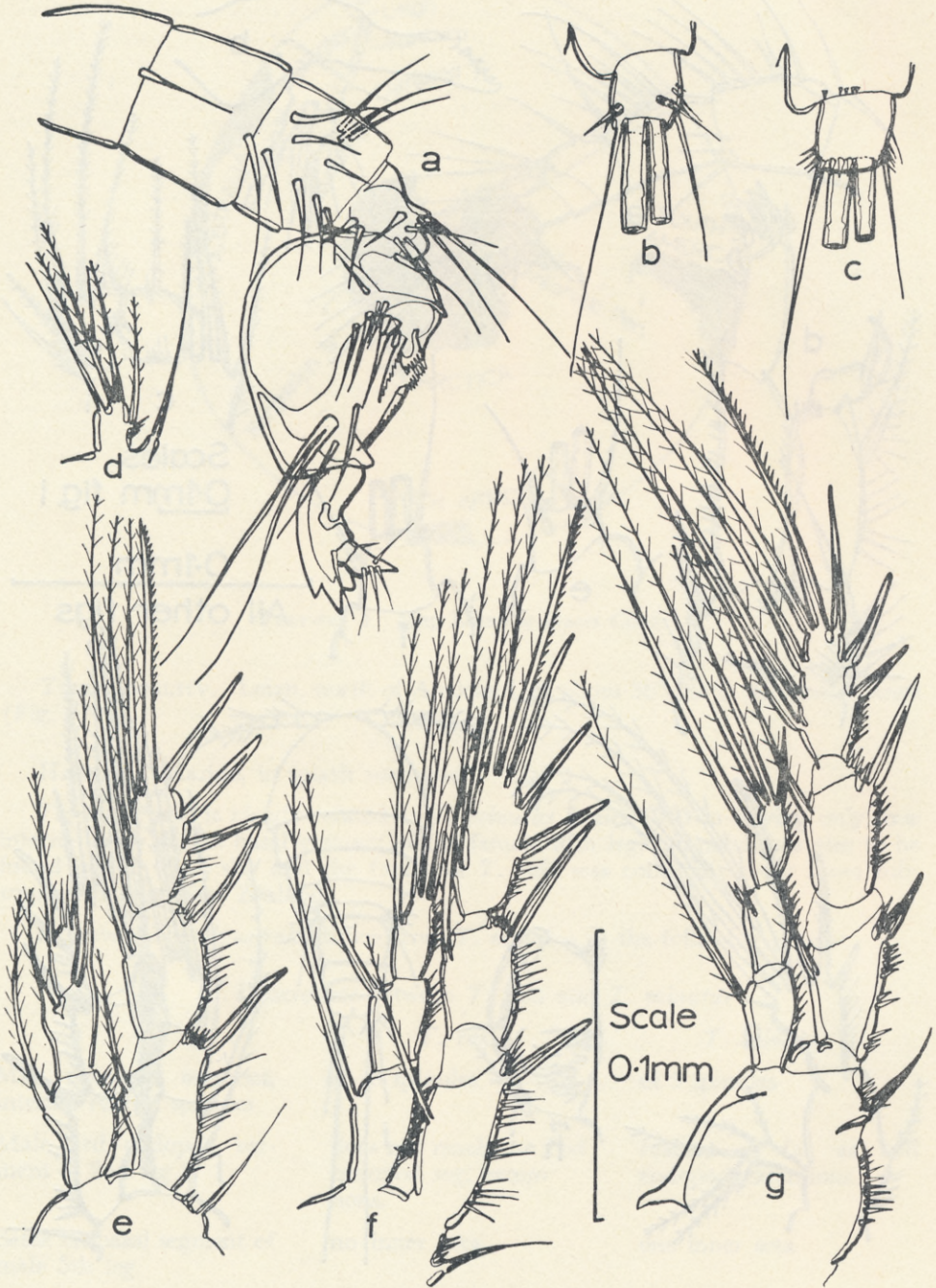
Mandible: The second basipod has one seta distally; the exopod has six setae; the endopod, three median setae and at least five apical setae.

Maxilliped: The proximal segment has, on the anterior surface, a large seta, an inner row of about 13 very small spines and an outer patch of longer bristles. The distal segment is a hook with at least one basal seta. The basis is ornamented with a few small spines and one plumose seta.

* *raki* = north (Maori language).



TEXT-FIG. 2. *Tigriopus raki* n.sp. female. a, antenna I; b, mandible; c, 5th and 6th legs; d, 1st leg; e, furca dorsal; f, furca ventral; g, antenna II; h, maxilliped; i, dorsal whole animal; j, 2nd leg.



TEXT-FIG. 3. *Tigriopus raki* n.sp. male. a, antenna I; b, furca dorsal; c, furca ventral; d, 5th and 6th legs; e, 2nd leg; f, 3rd leg; g, 4th leg.

First Leg: On the first endopod segment the plumose seta does not extend much past the spine hook; the bristles on the outer margin are few and confined to the distal part. There are no bristles on the outer margin of the second and third segments. The second basipod segment has a row of small spines distally between the articulation of the exopod and endopod.

Second and Third Legs: The first and second exopod segments carry one internal plumose seta, one large external spine and a row of strong bristles on their outer margins. The third exopod segment has three naked spines, one apical toothed spine and three plumose setae as well as external proximal bristles. The first and second endopod segments have one internal plumose seta and an external row of bristles, while the third segment has three plumose setae, a naked spine on the external distal corner and a row of external bristles.

Fourth Leg: The fourth leg is similar to the second and third legs except that the third exopod segment has one more plumose seta and the second endopod segment has none but instead, a few small spines on its inner margin distally.

Fifth Leg: The basal segment is more than twice as broad as long and has four internal plumose setae, one external naked seta and some bristles. The exopod extends past the basal segment and has five plumose setae. Bristles are found on the internal and external margins of the exopod and there are two rows on the posterior surface.

Sixth Leg: This limb is represented by two plumose setae and a small bristle.

Furca and Anal Segment: The ventro-distal border of the anal segment is naked. The furca has two large, sparsely spined apical setae, a smaller seta on each distal corner, two jointed setae on the dorsal surface and one small median seta on the outer edge. There are a few bristles on each distal corner; those on the inner corner are on the ventral surface and form a row at the base of the corner seta.

MALE

The male differs from the female in the following parts:

Length: 0.62mm.

Antenna II: The strong seta and bristles are missing from the basal segment.

First Leg: The end margin of the second basipod segment lacks spines.

Second Leg: The third endopod segment does not reach as far as the extensions of the second segment; it has three setae distally, the outer one of which is strong and spine like.

Third and Fourth Legs: The bristles on the outer margin of the exopod and endopod are longer than in the female, and the spines on the inner margin of the second endopod segments of Leg 4 are more numerous.

Fifth Leg: The basal segment has only one naked external seta while the exopod has one internal naked seta and three plumose setae. The exopod is naked except for a few bristles on its outer surface.

Sixth Leg: This leg is represented by two setae; the inner of these is plumose.

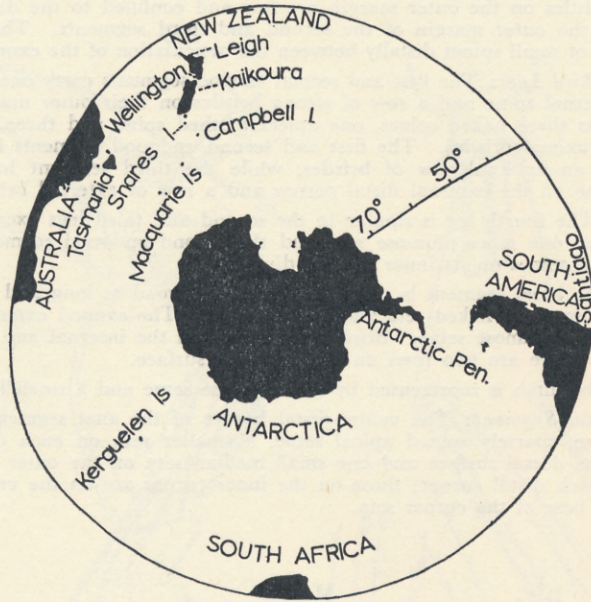
Furca and Anal Segment: There are a few small spines on the ventro-distal border of the anal segment. The furca is like that in the female but has a row of bristles on the ventral surface which are more spine-like than in the female and which extend to the outer of the two large apical setae of the furca.

HOLOTYPE. The holotype is deposited in the collection of the N.Z. Oceanographic Institute, Wellington, registered number 36.

PARATYPES. Sets of three females and three males have been deposited at the Dominion Museum, Wellington (Catalogue number Cr. 1690); the British Museum (Natural History) Reg. No. B.M. (NH) 1966. 11.30.1; and the Smithsonian Institution (Catalogue number USNM 120022). The remaining 8 paratypes have been deposited in the collection of the N.Z. Oceanographic Institute, Wellington, registered number 33.

MATERIAL EXAMINED. All of the type material came from one sample collected by Miss P. Luckens. Description and drawings were made from dissections of three male and three female paratype specimens.

Fifteen specimens of each sex were examined in detail. The average length of 27 females was 0.61mm and of 27 males, 0.64mm.



TEXT-FIG. 4. Map Locating Places Cited.

TYPE LOCALITY. Leigh, north of Auckland, at about $36^{\circ} 30' S$ on the east coast (Fig. 4).

HABITAT. Marine, in splash zone pool.

Tigriopus raki is clearly related to *T. minutus* Bozic, 1960 in having only four internal setae on the basal segment of the female fifth leg. Parallels are also to be found in the small size and the fact that *T. raki* was collected in the more sub-tropical part of New Zealand.

However, *Tigriopus raki* differs from *T. minutus* in the following points:

Differences between *T. raki* and *T. minutus*

	<i>T. raki</i>	<i>T. minutus</i>
Mxp proximal segment, internal row of spinules	of 13 spinules	of 5 spinules
Male 3rd endopod segment of 2nd leg	does not reach the 2nd endopod seg. extensions.	reaches as far as 2nd endopod extensions.
Setae on basal segment of male 5th leg.	no inner seta	one inner seta
Female 5th leg exopod	extends past the undeveloped basal seg. lobe	extends almost as far as basal seg. lobe
Male 6th leg	2 well-developed setae	3 well-developed setae

KEY TO THE KNOWN SPECIES OF *Tigriopus*

1. Exopod of 5th leg has 5 setae in both male and female	2
Exopod of 5th leg has 5 setae in female and 4 setae in male	3
2. 3rd exopod segment of 4th leg with 7 spines and setae	<i>T. californicus</i> and <i>T. japonicus</i> *
3rd exopod segment of 4th leg with 8 spines and setae	<i>T. angulatus</i>
3. Basal segment female 5th leg with 4 inner setae. Both sexes less than 1.0mm long	4
Basal segment female 5th leg with 5 inner setae. Both sexes greater than 1.0mm long	5
4. Inner seta on male 5th leg present	<i>T. minutus</i>
Inner seta on male 5th leg absent	<i>T. raki</i>
5. 5th legs with spines and bristles only on the borders	<i>T. brevicornis</i>
5th legs with bristles also on the surface	<i>T. fulvus</i>

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* See Lance *et al.* (in press).