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**(Insecta: Diptera)**

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**Front cover.** The insect depicted is *Dilophus nigrostigma*, male

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## ABSTRACT

The Bibionidae known from New Zealand are revised, and their taxonomic affinities are discussed. Eight extant species (three of them new) and one fossil species are recognised as valid. All are placed in *Dilophus*; the genus *Philia* is considered not to be represented in New Zealand. All extant species are endemic. Their known seasonality and geographic distribution are indicated, with maps showing locality records, and a key to their identification is given. Characters helpful in species discrimination are illustrated, and plant species with bibionid associations are listed.

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Two colleagues have persistently encouraged this study, especially by persuading me to enlarge my initial concept of writing a paper on some new species and new records of Bibionidae to a full revision of the family in New Zealand. They are B.A. Holloway of DSIR Plant Protection, Auckland, New Zealand and D. Elmo Hardy, Professor of Ento-

mology, University of Hawaii. Dr Holloway kindly gave me the notes she had organised for an initial study of the family as represented in the New Zealand Arthropod Collection, and has subsequently viewed the manuscript. Dr Hardy reviewed the manuscript at an early stage while on a visit to New Zealand, and examined specimens with a view to commenting on possible relationships between the Australian and New Zealand faunas (Hardy 1982).

I am grateful to the curators and staff of the institutions listed on p. 7, primarily for loan of appropriate specimens, including type material, and for discussions on aspects of the family.

## INTRODUCTION

Bibionid flies occur worldwide, abundantly in tropical and temperate regions. There are about seven hundred known species. They are commonly known as march flies, but this is not current usage in respect of the New Zealand species.

New Zealand representatives of the family Bibionidae are here all included in the genus *Dilophus* Meigen. In the *Catalogue of the Diptera of New Zealand* (Miller 1950), however, *Bibio imitator* Walker is listed, implying that it is part of the bibionid fauna of New Zealand. It is now generally accepted that this record of occurrence is not valid.

The genus *Bibio* was used by Walker (1848) to encompass his new species *nigrostigma*, which is endemic to New Zealand, and the first bibionid to be described from this country. Hutton (1901) recorded three species, two of which he described as new, in the genus *Dilophus*, and transferred *nigrostigma* to *Dilophus*.

There was a gap of over 50 years before the bibionids of New Zealand were again investigated. Then Hardy (1951, 1953) recorded one species of *Bibio* and six of *Philia* Meigen, four of the latter being new species. This current review recognises eight extant species, all endemic to New Zealand; three of them are newly described. A fossil species from an Eocene siltstone lens is also noted as part of New Zealand's bibionid fauna.

Within the New Zealand representatives of *Dilophus*, *nigrostigma* stands out as a large, bold species having strong spines and prominences on legs and thorax. It is also the most common.

Two species have reduced venation, but there is no reason beyond this character to consider them closely related. All other species have normal venation (i.e., no obvious reductions or absences) and appear to be within the limits of a close relationship, yet with satisfactory distinguishing characters.

Hardy (1982) has recorded information to suggest that at least five Australian species of *Dilophus* bear resemblances to New Zealand species.

## MORPHOLOGY

New Zealand examples of the subfamily Bibioninae are the main source of the following generalised morphological description of the family. Other sources are from worldwide literature on bibionids. The terminology used is standard for Diptera.

The body (Fig. 1) shows varying degrees of hairiness, and varies in length from 2.0 mm to 16.0 mm.

The head (Fig. 1 and 2) is holoptic in males. The rostrum (the portion of the head anterior to the eyes) is either well developed and produced distinctly beyond the base of the antennae or is not or scarcely developed beyond the antennal base; in length it is equal to the lower division of the eye in males, or is equal to or longer than the eye in females, or in both sexes is only half the length of the eye. The antennae have a variable number of segments – up to 16 have been recorded – with fusion of segments sometimes apparent, reducing the number of distinguishable segments beyond the pedicel; the pedicel is flattened, and its distal segment is often distinctly longer than the others. The mouthparts have labella usually as a prominent structure, and often hairy; the proboscis is never much elongated; and the palpi are 3–5-segmented. The round or reniform eyes are larger in males and sometimes divided into distinct areas of different-sized ommatidia, the smaller ones ventral. The ocelli are strong, and the ocellar triangle is distinct, and sometimes raised above the level of the eyes.

The thorax (Fig. 1 and 3) lacks sutures. The pronotum has two comb-like transverse rows of strong or fairly strong spines which are variable in number, colour, and strength. The mesonotum is bare, or bears longitudinal rows of hairs embedded in or adjacent to two longitudinal sulci and on the lateral margins. The pleurites are generally bare. The scutellum (Fig. 3) has a tuft of apical setulae.

The legs have the coxae bare or with a few hairs or minute pubescence, and the trochanters with fine hairs. The femora are elongate, sometimes enlarged towards the apex, and occasionally grooved. The fore tibiae (Fig. 9–13) have spines, varying in number and strength, at the apex and on the middle third of the posterodorsal surface. The fore tarsus and middle tibia and tarsus are normal, but the hind tibia (Fig. 14–17) may be normal or swollen, especially towards the apex, and sometimes has an apical spur; the tarsal segments are sometimes enlarged. The empodium and pulvilli (Fig. 4) are equally strong, or the empodium is absent in some species.

The wings (Fig. 18–22) have the membrane usually clear, but when not so then the shading is more prominent anteriorly, but with transverse clear areas on either side of the stigma. The anterior veins are darker than the posterior veins. A stigma is usually present at the apex of  $R_1$ . Venation is normally as in Fig. 21, but with modifications usually in the form of deletions of portions of  $M_1$  and  $M_2$  and/or loss of  $m-cu$ . There is no discal cell, and at most a single complete anal vein reaches the wing margin. The anal cell is rarely closed. The costa does not extend to the posterior margin but ends close to the wing apex. The  $R$  veins bear dorsal hairs which are either few and weak or numerous and strong; if the latter, then their length equals or exceeds the distance between them.

The abdomen is of 7–9 segments, elongate, and more or less cylindrical and hairy. The male terminalia (Fig. 5 and 23–30) have the terminal sternite supporting a pair of claspers, the hairiness and shape of which is variable, and the terminal tergite supporting a pair of cerci. The female terminalia (Fig. 6 and 7) have the posterior sternite and tergite bearing a pair of lobes and cerci respectively.

## BIOLOGY

### Adult habitats and food

Most of this information comes from my own collecting notes and from the labels of specimens examined. Adults are associated with a wide range of plant species (Table 1, p. 19) and feed on flowers, probably consuming the nectar and other exudations. Flowers of some plants are very attractive to bibionids, and during the months of peak activity (November to February) are visited by adults in swarm-like numbers. Two such flowers are those of citrus and cordyline, and there are probably others from the list of plants in Table 1 which are just as attractive.

### Pre-adult habitats and food

An account of the habitat of *D. nigrostigma* is given by Hudson (1892). He records that larvae frequently inhabit

the woody powder often found under rotting logs, that they are gregarious, and that larvae live for up to 8 months, pupating in spring. Harris (1983) records that larval *D. nigrostigma* are abundant in forest margins under fallen leaves of broad-leaved trees, both exotic and native. He cultured *D. nigrostigma* and *D. segnis* in boxes with soil and leaves, and adults emerged. Textbooks (Tillyard 1926, Colless & McAlpine 1970) generalise that Australasian bibionid larvae inhabit soil or decomposing vegetation, some feeding on plant roots, but probably on dead tissue. Larvae of New Zealand species probably all occur in decaying vegetation at soil level. None have been found in living plant tissue.

Generally, world wide, bibionid larvae are recorded as occupying the range of habitats described above. Pupae appear to be always found in the soil.

### Economic importance

The economic importance of bibionids is unclear, but larvae are not generally regarded as likely to be of great significance to crops or other plants. Hardy (1961) noted that larvae have been recorded as damaging vegetable or cereal crops.

Adults which feed on nectar may play a part in pollination.

### Seasonality

Adults have been collected from July through to April, with peak populations in the summer months, generally November to February.

## METHODS AND CONVENTIONS

### Collecting, preparation, and curation

Adults are sluggish, and are readily captured with net or tube. Preservation as dry, pinned specimens is quite adequate, but ethanol preservation is also commonly used. Preparations of terminalia may be obtained from abdomens cleared in sodium hydroxide solution. These can be examined *in situ*, or may be prepared for slide mounting by teasing or cutting through the median lateral lines.

Collections have increased moderately since the previous works on New Zealand Bibionidae were published (Hardy 1951, 1953). The very common species *D. nigrostigma* occurs in all collections in numbers, and *D. segnis* and *D. crinitus* in reasonable numbers, but only small series of other species have accumulated.

All type series specimens are pinned unless otherwise stated. All records were determined or checked by the author.

### Abbreviations

The two-letter code at the beginning of each new record or group of similar records alludes to the areas of New Zealand designated by Crosby *et al.* (1976).

Abbreviations for repositories are as follows.

- BMNH British Museum (Natural History), London, U.K.
- BPBM Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.
- CMNZ Canterbury Museum, Christchurch, New Zealand
- LCNZ Lincoln College, Canterbury, New Zealand
- NMNZ National Museum, Wellington, New Zealand
- NZAC N.Z. Arthropod Collection, DSIR, Auckland, New Zealand
- OMNZ Otago Museum, Dunedin, New Zealand
- UCNZ University of Canterbury, Christchurch, New Zealand
- UHMH University of Hawaii Museum, Honolulu, Hawaii, U.S.A.

## SYSTEMATICS

### Family BIBIONIDAE

The name Bibionidae originated from *Bibio* Geoffroy, 1762, and has subsequently remained in use unchanged.

Bibionidae can be recognised as members of the division Bibionomorpha of the suborder Nematocera. Within the Bibionomorpha are included a majority of the families of the Nematocera, and the closest family to Bibionidae has always been regarded as the Scatopsidae. In literature up to about 1940 it was common to have both families included in the Bibionidae as subfamilies. Recently, and sometimes earlier (e.g., Tillyard 1926), both have been given full family ranking. Scatopsidae can be separated from Bibionidae by the absence of apical spurs on the middle and hind tibiae and by having the antennal base near or above mid-eye level.

**Diagnostic characters. Adults:** antennae arising from near or below lower margin of eyes; ocelli present; coxae not elongate; middle and hind tibiae with 1 or 2 distinct apical spurs; empodium and pulvilli strongly and usually equally developed; discal cell absent; males holoptic, the eyes large and almost always differentiated into a larger anterodorsal section and a smaller posteroventral section; females dichoptic; small to moderate-sized flies up to 16 mm long.

**Mature larvae** terrestrial, 12-segmented, holopneustic or peripneustic; integument with conspicuous hairs or fleshy processes, usually dark and rather leathery; head

large; mouthparts well developed; metathoracic spiracles usually distinct.

**Pupae** inactive, living in smooth cavities excavated by larvae near surface of ground.

The family contains three subfamilies – Bibioninae, Pleciinae, and Hesperininae – of which the first two are the most common. Bibioninae are found predominantly in temperate regions, whereas Pleciinae are most numerous in the tropics. Only Bibioninae are known to occur in New Zealand. The subfamilies are readily separated on antennal, leg, and wing characters.

- Bibioninae: antennae robust; fore tibiae terminating in a large apical spur or having a ring of strong spines at apex and 1 or 2 sets of spines along the segment; radial sector unbranched.
- Pleciinae: antennae robust; fore tibiae without strong spines; radial sector furcate.
- Hesperininae: antennae very elongate; fore tibiae without strong spines; radial sector furcate.

### Subfamily BIBIONINAE

*Dilophus* is considered to be the sole genus in New Zealand, and is distinguished from *Bibio* – which is, like *Dilophus*, a well known worldwide genus – as follows.

- *Dilophus*: fore tibiae with a ring of apical spurs and a cluster of 1 or 2 sets of spines near middle of segment.
- *Bibio* (Fig. 8): fore tibiae bearing 1 strong apical spur and a smaller one, and lacking sets of spines on segment.

**Remarks.** As indicated in the Introduction, the record of the occurrence of *Bibio imitator* Walker in New Zealand is not considered to be valid. Examination of collections of New Zealand bibionids has failed to reveal its occurrence here. The type specimen is now apparently lost (Hardy 1956, 1982). It was recorded as bearing the locality 'New Holland', which may have influenced Miller (1950) to interpret such a label loosely as New Zealand; other such interpretations of dubious and generalised early localities in the Australasian region are known.

Hardy (1982) has examined other Australian *Bibio* species described by Walker and Macquart and bearing the label 'New Holland', and concluded that all are synonymous with *imitator* Walker, which is very common in Australia and well known to present-day entomologists. Colless & McAlpine (1970) note that *B. imitator* occurs in very large numbers in garden soil in Australia but does not attack living plants. There is always a possibility that the species may enter New Zealand in the future, probably as an assisted immigrant in imported soil or vegetable matter.

### Genus *Dilophus* Meigen

*Philia* Meigen, 1800: 20. Type species *Tipula febrilis* Linnaeus, by designation of Coquillett (1910, p. 588). Suppressed by ICZN, 1963, Opinion 687, p. 339.

*Dilophus* Meigen, 1803: 264. Type species *Tipula febrilis* Linnaeus, by designation of Latreille (1810, p. 442).

**Adults.** Fore tibiae with an apical spine and rows or clusters of spines near middle; rows of combs on anterior mesonotum; *Rs* unbranched.

**Larvae.** Characters which have been used to distinguish larvae at generic or higher levels are: the median apical lobe on the labium; the number of processes on the body; and the number of external openings on the posterior spiracle.

**Remarks.** This genus has been recognised and has been stable since it was first proposed by Meigen (1800, 1803). The apparent and repeated name changes between *Philia* and *Dilophus* are solely due to the interpretations of successive authors as to the validity of Meigen's nomenclature, and have not interfered in any way with the generic concept of a large group of species.

Now that Meigen's 1800 name has been suppressed (references to *Philia*; see above) the validity of the name *Dilophus* is confirmed for the genus.

The New Zealand fossil species *D. campbelli* Harris is known from larval exuviae only, and this fact has focused attention on larval characters of *Dilophus* and *Bibio*. The distinctions between larval forms of these two genera have been categorised by Harris (1983; after Morris 1922), who suggests that *Bibio* may be a candidate genus for the more correct placement of two extant New Zealand bibionid species which he has examined, *nigrostigma* and *segnis*.

The dilemma is a genuine one, and Harris rightly acknowledges that examination of larval forms of more species of the world fauna is required in order to have an appreciation of the extent of the variation in larval characters. This must be carried out before generic characters of adults and larvae can be confidently melded into acceptable generic concepts.

There is a universal lack of records of larval forms of Bibionidae having been collected or examined taxonomically. Of the extant New Zealand species, only two have their larval forms correctly associated with adults by rearing. Other species are not yet known to be represented in collections as larvae, or if they are in collections they are not yet recognised. The characters used for separation of adults of the various genera in the Bibionidae, especially for *Dilophus* and *Bibio* (see under 'Subfamily Bibioninae',



p. 8, col. 1), are considered to be the best available and the most universally applicable and, accordingly, New Zealand species are here retained in *Dilophus*.

The larval fossil form *D. campbelli* Harris should also remain in its designated genus.

## KEY TO SPECIES OF *DILOPHUS* KNOWN FROM NEW ZEALAND

- 1 Large species usually longer than 6.0 mm; fore tibiae with about 3 spines on a strong prominence at proximal third, and 1 spine (rarely absent) at about distal third ..... *nigrostigma*  
— Small species usually shorter than 6.0 mm; fore tibiae without a strong prominence bearing the spines ... 2
- 2(1) Cross-vein *m-cu* absent ... 3  
— Cross-vein *m-cu* present ... 4
- 3(2) Vein  $M_1$  detached in males, less distinctly so in females ..... *alpinus*  
— Veins  $M_1 + M_2$  detached ..... *tuthilli*
- 4(2) Wings with smoky dark areas in subcostal cell and other cells posterior to stigma ..... *fumipennis*  
— Wings usually clear except for brown stigma and sometimes pale brown subcostal cell ... 5
- 5(4) Veins  $R_1$  and  $R_5$  distinctly haired dorsally for their entire length, the hairs usually as close together as length of hair or closer; body generally hairy ..... *crinitus*  
— Veins  $R_1$  and  $R_5$  indistinctly haired, the hairs short and usually few or not as close together as length of hair; body not excessively hairy ... 6
- 6(5) Fore tibiae with 2 distinct and well separated clusters of strong spines, at about proximal third and distal third; legs usually brown ..... *segnis*  
— Fore tibiae with spines at middle of segment in 1 or 2 clusters or rows; legs usually dark brown ... 7
- 7(6) Fore tibiae with 3 or 4 spines all together in a row or cluster near middle of segment ..... *harrisoni*  
— Fore tibiae with spines in 2 irregular rows or clusters near middle of segment ..... *neoinsolitus*

## DESCRIPTIONS

### *Dilophus alpinus* new species

Figures 18 and 23

**Male** dark brown or shining black; wings clear. Body length about 3.5 mm; wing length about 3.0 mm.

Head black. Antennae with 13 segments. Eyes reddish brown, black on posterior sector, sparsely haired, the hairs short. Ocellar triangle distinctly raised above level of eyes. Palpi greyish-black.

Thorax. Mesonotum with hairs in longitudinal sulci, all quite short and thin. Pleurites shining black. Scutellum with an apical tuft of fine, short setulae. Legs shining dark brown. Foreleg: coxa and femur strong; tibia fairly strong, with with 2 submedial groups of spines. Middle leg normal. Hind leg: femur somewhat enlarged and swollen on distal half; tibia distinctly swollen from about proximal third to apex, where it is widest; tarsal segments swollen; basitarsal segment not as wide as apex of tibia. Wings: stigma very pale brown; anterior veins brown; posterior veins very pale; base of vein  $M_1$  and *m-cu* cross-vein missing (Fig. 18). Halteres dark brown with paler brown stalks.

Abdomen shining black, or dark brown. Terminalia pale brown.

**Female** brown to pale brown. Body length 3.5 mm; wing length 4.0 mm. As for male except as follows.

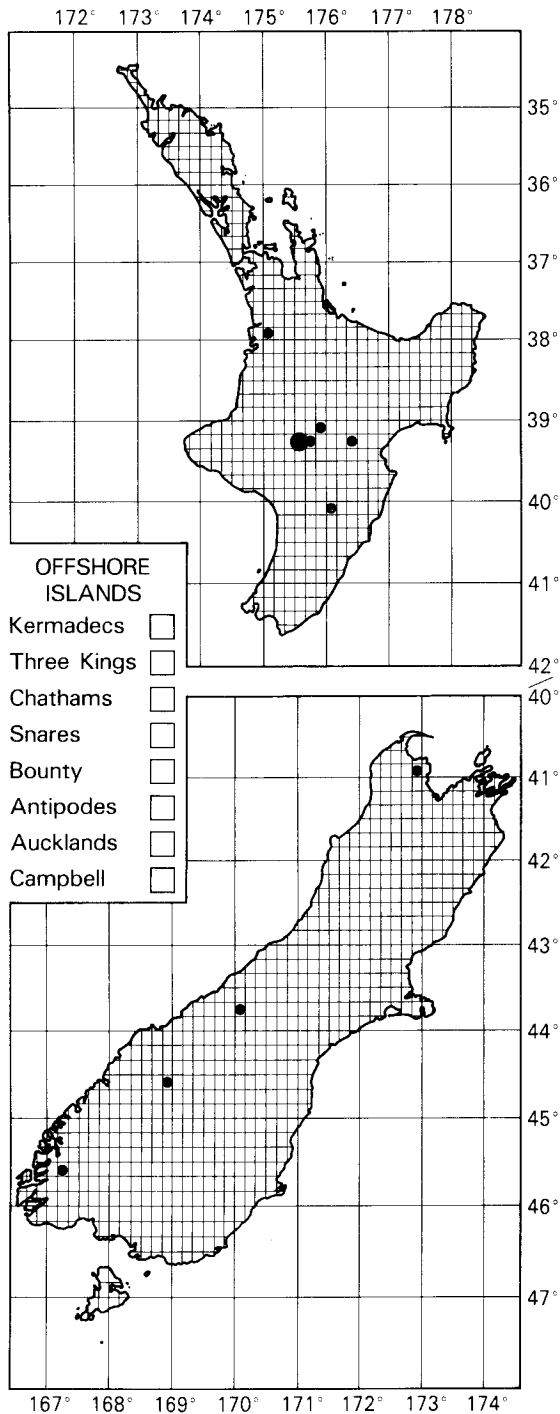
Head. Ocellar triangle distinct, shining, but not raised too much above level of front. Front between eyes at least half of head width.

Thorax. Mesonotum with 3 darker brown vittae in middle and a central, shorter vitta anteriorly between the 2 raised ridges of spines. Pleurites pale brown with some slightly darker brown irregular shading. Legs pale brown except for apical segment of tarsi, which is brown to dark brown. Foreleg: coxa and femur strong, equal in length; tibia relatively strong, with 2 submedial groups of spines. Middle leg normal. Hind leg: femur slightly enlarged in distal half; tibia only slightly enlarged towards apex; tarsal segments normal. Vein  $M_1$  faintly reaching  $M_2$ . Halteres pale brown.

Abdomen brown to pale brown. Genital plates brown.

**Type data.** Holotype male and allotype female (in copulo): TO, Mt Ruapehu, 1070 m, 8 April 1966, B.M. May (NZAC).

**Paratypes** (12 males, 7 females; NZAC, CMNZ). North I. TO: 1 male, Ruapehu, Chateau, 21 Feb 1965, G. Kuschel. HB: 3 males, Kaweka Ra., 1971, A.C. Eyles (ethanol) — 2 on *Senecio*, 24 Feb, and 1, 1000 m, Makahu Hut, on *Nothofagus*, 27 Feb. RI: 1 male, 1 female, Ruahine



• Map 1 Distribution of *Dilophus alpinus* •

Ra., 1500 m, 22 Feb 1970, G.W. Ramsay (ethanol).

South I. NN: 6 males, 2 females, Canaan Track, 2 Feb 1950, J.G. Dawber (6, 1) and A.W.P[arrott] (0, 1). OL: 1 male, 2 females, Niger Peaks, 1200–1500 m, 26 Feb 1966 - 2 females, on gentian and *Hebe hectori*, G. Kuschel, and 1 male, 1 female, on gentian, J.I. Townsend (ethanol). FD: 1 female, Wilmot Pass, 21 Jan 1970, A.C. Eyles (ethanol).

**Material examined.** Type series, plus 13 non-type examples (7 males, 6 females; NZAC, UCNZ).

WO, TO, HB, RI / NN, OL, CO, FD.

Recorded from 762–1500 m.

Collected in January (6% of total), February (82%), April (6%), and December (6%).

Plant associations: see Table 1 (p. 19).

**Remarks.** The name proposed refers to the species' association with high country.

### *Dilophus crinitus* (Hardy) new combination

Figures 9, 14, 19, and 24

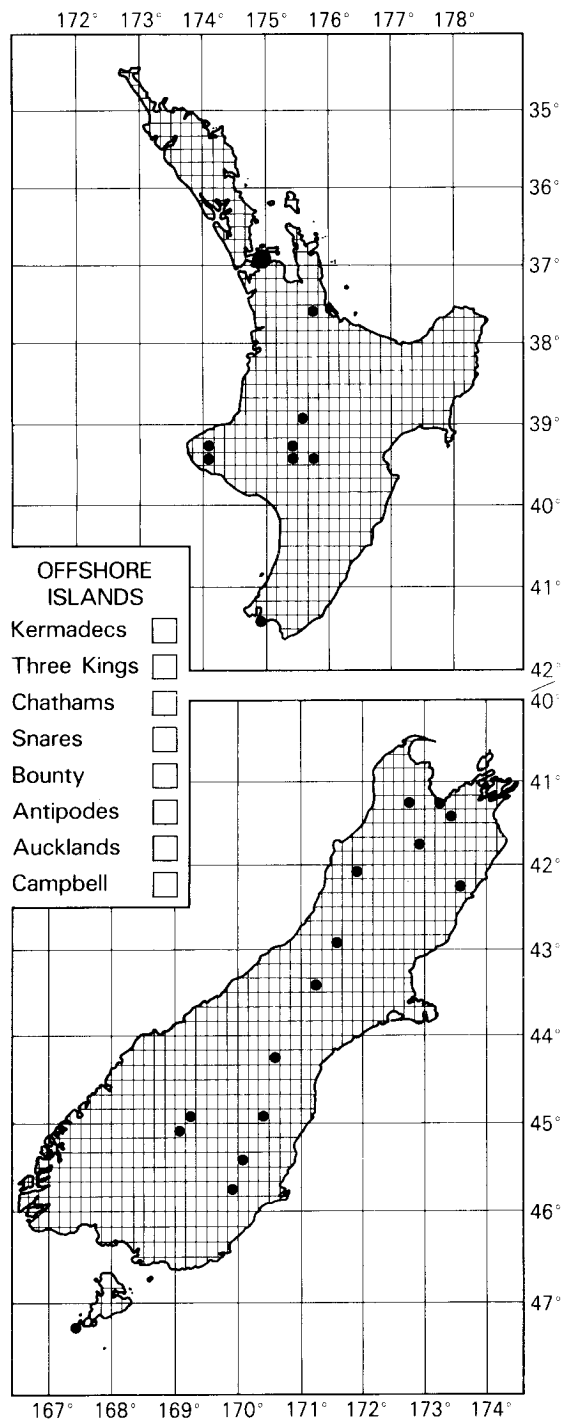
*crinita* Hardy, 1951: 262; — 1953: 514 (*Philia*).

**Male.** Generally shining black; legs showing distinct areas of pale brown; wings slightly tinged with brown. Body length about 5.0 mm; wing length about 4.5 mm.

Head shining black. Antennae dark brown, with 13 segments. Eyes brown, blackish brown on posterior sector, distinctly pilose, the hairs long. Ocellar triangle distinctly raised above level of eyes. Palpi black.

Thorax. Mesonotum distinctly shining black, generously covered with long, fine hairs arising mostly in 2 distinct longitudinal lines and on lateral margins. Scutellum with an apical tuft of many long setulae. Pleurites duller black, relatively bare. Legs: middle and hind femora paler brown on proximal half. Middle and hind tibiae pale brown, apically brown. Hind tarsal segments brown, slightly darker towards apex. Foreleg: coxa and femur fairly strong, about equal in length; tibia with 1 or 2 (rarely up to 5) small but distinct submedial spines; tibia and tarsal segments weak, fairly generously coated with long, fine hairs. Middle coxa small; remainder of leg normal. Hind leg: coxa small; femur and tibia slightly swollen towards apex; tarsal segments somewhat swollen. Wings: costal cell darker than membrane; stigma brown; venation normal; vein *R* with many strong, distinct hairs. Halteres brown with pale brown stalks.

Abdomen distinctly pilose, with long, fine hairs longer than on thorax. Terminalia blackish brown.



• Map 2 Distribution of *Dilophus crinitus* •

**Female.** Pale brown to pale reddish brown, with thorax particularly shining, and abdomen dull; wings slightly shaded brown. Body length about 6.0–7.0 mm; wing length 6.0 mm. As for male except as follows.

**Head.** Front between eyes about half width of head.

**Thorax.** Mesonotum haired, with fairly fine, short hairs arising from longitudinal grooves. Scutellum duller brown with darker margins. Pleurites pale reddish brown. Legs pale yellowish brown; tarsi with apical segments slightly darker. Fore coxa and femur about equal in length, relatively strong. Wings with subcostal cell not shaded; venation normal.

**Abdomen** with distinct darker brown patches on tergites. Terminalia pale brown.

**Type data.** **Holotype:** male, AK, Auckland, Mt Wellington, 10 December 1916, C.E. Cole (USNM).

**Paratypes:** 3 males, NC–WD, Arthurs Pass–Otira, 20 Nov – 11 Dec 1919 (USNM, BPBM).

**Material examined.** Holotype and 2 paratypes, plus 146 non-type examples (117 males, 28 females, 1 unsexed; NZAC, LCNZ, UCNZ, USNM).

AK, BP, TO, TK, RI, WN/NN, BR, KA, NC, MC, SC, DN, CO / SI.

Recorded from sea level to 3500 m.

Collected September (2% of total), October (38%), and November (60%).

Plant associations: see Table 1 (p. 19).

**Remarks.** The key character of haired veins is important in distinguishing *D. crinitus* from the other species with full normal venation.

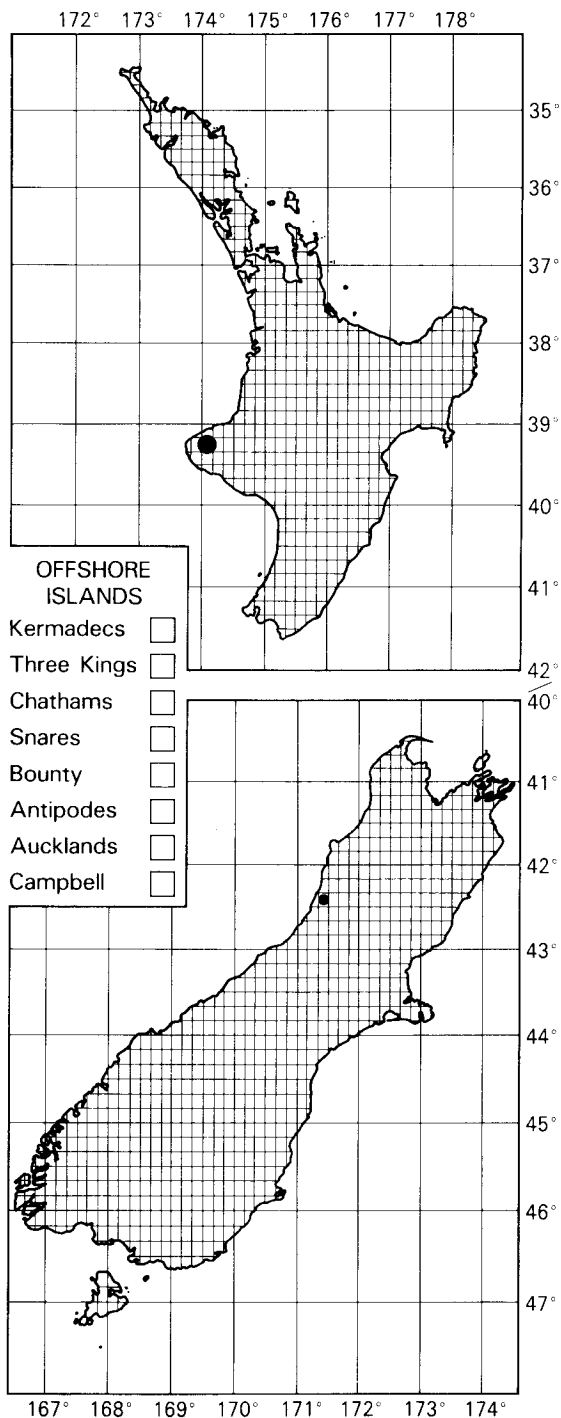
### *Dilophus fumipennis* new species

Figures 20 and 25

**Male.** Jet black, shining; wing with distinct brown or pale brown shading on several areas. Body length about 5.0 mm; wing length about 4.5 mm.

**Head** black. Antennae dull blackish brown, with 13 segments. Eyes dull reddish brown, dark brown in posterior sector, distinctly pilose, the hairs long. Ocellar triangle small, distinctly raised above level of eyes. Palpi black.

**Thorax.** Mesonotum fairly strongly haired along the 2 longitudinal sulci and on lateral margins; transverse ridges well haired. Scutellum with an apical tuft of short setulae. **Legs:** most segments glossy. Foreleg: coxa about 0.8x as long as femur, both swollen; tibia strong and somewhat swollen, with a group of about 4 posterodorsal spines in a



• **Map 3** Distribution of *Dilophus fumipennis* •

submedial cluster. Middle leg normal. Hind leg: coxa dull black; femur swollen in distal half; tibia clavate, gradually swelling towards apex; tarsal segments distinctly swollen, but basitarsus not quite as broad as apex of hind tibia. Wings shaded with pale brown, but with darker brown areas in subcostal cell extending towards posterior margin of wing. Another similar-coloured area behind the dark brown stigma extending to cross-vein, and yet another similar though paler-coloured area in apical portion of wing.  $R_1$  and  $R_2$  bearing short, fine, well separated hairs.  $M_1$  faint on proximal curve to  $m-cu$ ; base of  $M_1$  coinciding with  $m-cu$  or distad of  $m-cu$ . Halteres blackish brown, with stalk paler.

Abdomen shining jet black. Terminalia dark brown.

**Female unknown.**

**Type data.** **Holotype:** male, TK, North Egmont [950 m], Holly Hut, 29 November 1975, sweeping and beating, A.K. Walker (NZAC).

**Paratypes:** 17 males, same data as holotype (NZAC, CMNZ, USNM).

**Material examined.** Type series, plus a non-type male from TK.

**Remarks.** The name proposed alludes to the shaded wings.

### *Dilophus harrisoni* (Hardy) new combination

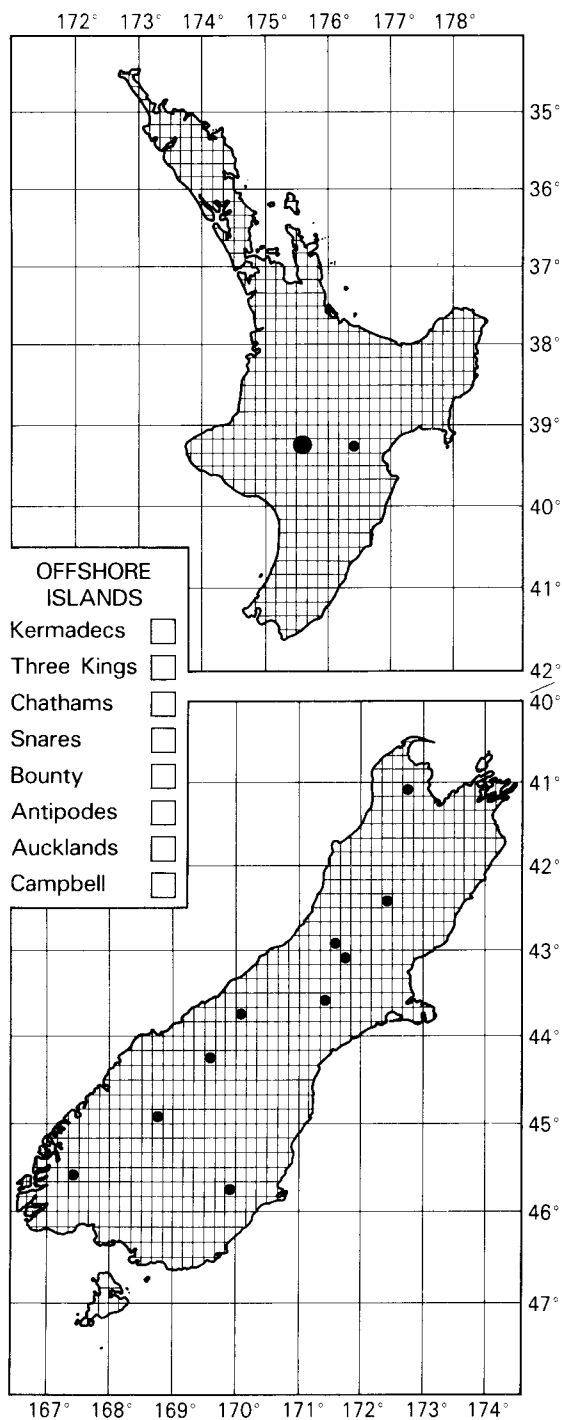
Figures 10, 15, and 26

*harrisoni* Hardy, 1953: 515 (*Philia*).

**Male.** Small, shining brown to black; wings clear. Body length about 3.0–4.0 mm; wing length about 3.0–4.0 mm.

Head dark blackish brown. Antennae greyish brown, with 13 segments. Eyes blackish brown, darker in posterior sector, fairly densely pilose, the hairs long, thins. Ocellar triangle very prominent; ocelli strong. Palpi dark brown.

Thorax. Anterior transverse rows of spines strong. Mesonotum with distinct long hairs, especially arising from the 2 longitudinal sulci and on lateral margins. Scutellum with an apical tuft of long, fine setulae. Pleurites glossy dark brown. Legs usually dark chocolate brown. Coxae and femora slightly darker than other segments. Foreleg strong from coxa to tibia; tibia with a medial group of 3 postero-dorsal spines; tarsus normal. Middle leg normal. Hind leg: femur distinctly swollen on distal half or two-thirds; tibia also swollen distad, but noticeably so only on distal third; tarsal segments distinctly swollen; basitarsus only just narrower than apex of tibia. Wings clear; stigma pale



• Map 4 Distribution of *Dilophus harrisoni* •

brown; venation normal (as in Fig. 21). Halteres brown to greyish brown.

Abdomen shining black. Terminalia brown to dark brown.

**Female.** Glossy brown to yellowish brown; head black. Body length 6.0 mm; wing length 5.0 mm. As for male except as follows.

Thorax. Hind femur and tibia only slightly swollen distad; all tibiae somewhat darker brown at apex.

Abdomen brown dorsally, pale brown ventrally.

**Type data.** **Holotype:** male, TO, National Park, Chateau track, 27 February 1949, R.A. Harrison (NZAC).

**Paratypes:** 8 males, TO, National Park, Chateau track (1), Mangatepopo (1), and above Mangatepopo Hut (6), 26–27 Feb 1949, R.A. Harrison (NZAC, BMNH, USNM, BPBM, UHMH).

**Material examined.** Holotype, 5 paratypes, and 32 non-type examples (NZAC, UCNZ, LCNZ).

TO, HB / NN, BR, NC–WD, MC, FD.

Recorded from 500–1700 m.

Collected January (29% of total), February (51%), March (5%), April (7%), November (5%), and December (3%).

Plant associations: see Table 1 (p. 19).

**Remarks.** *D. harrisoni* is apparently related to *D. tricuspoidatus* Hardy, an Australian species (Hardy 1982).

### *Dilophus neinsolitus* new species

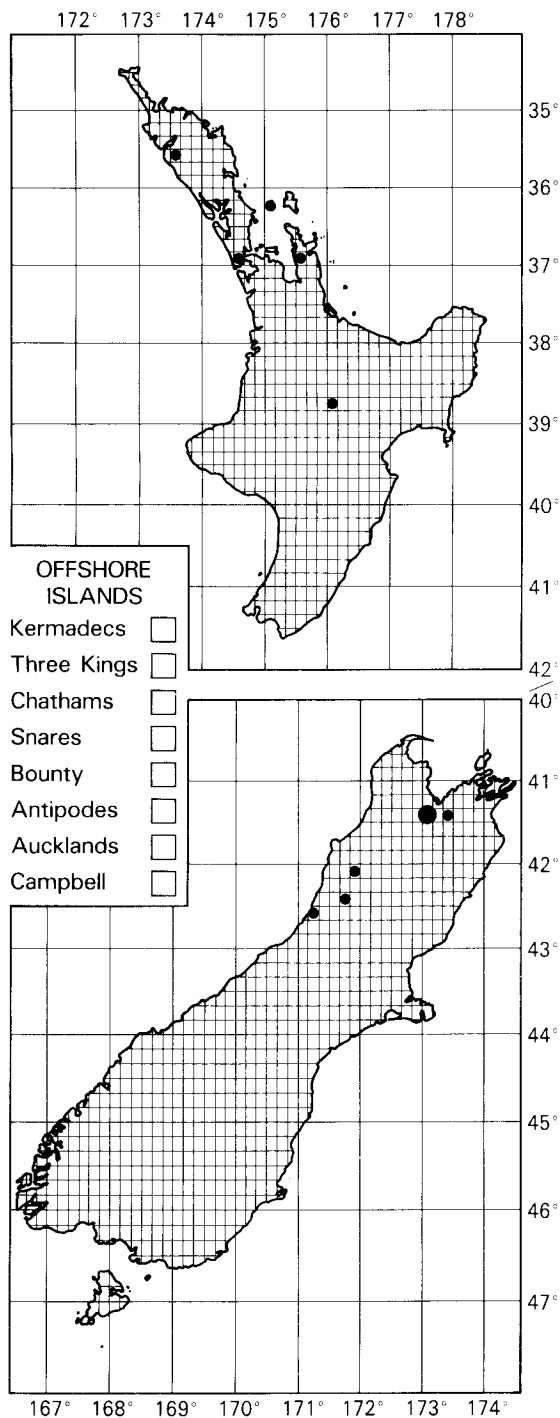
Figures 11, 16, 21, and 27

*insolita* in the sense of Hardy, 1951: 264; — 1953: 516 (*Philia*); not *insolitus* Hutton, 1901.

**Male.** Dark chocolate brown, not particularly glossy; wings slightly brown, with veins distinct. Body length about 4.0–4.5 mm; wing length about 4.0 mm.

Head black. Mouthparts brown. Antennae dark brown, with 13 segments. Eyes reddish brown, black on posterior sector, distinctly pilose, the hairs fairly dense, short. Ocellar triangle and ocelli distinct. Palpi brown.

Thorax. Anterior transverse rows of spines not strong. Mesonotum black, not excessively haired, the hairs relatively short. Scutellum with a tuft of short, strong setulae. Pleurites dark chocolate brown. Legs dark chocolate brown, more shining than other parts of body; femora sometimes paler. Foreleg: coxa and femur strong; tibia not excessively strong, with a medial cluster of spines arranged haphaz-



• Map 5 Distribution of *Dilophus neoinsolitus* •

ardly or in 2 irregular rows. Middle leg normal; tibia with a small, black median spine. Hind leg: femur distinctly enlarged in distal half; tibia clavate, increasing in width from about proximal third; tarsus enlarged, but basal segment not as broad as apex of hind tibia. Wings: venation normal; stigma brown; anterior veins brown; *R* vein with very few, very short, fine hairs. Halteres with knob brown, stalk pale brown.

Abdomen and terminalia dark brown.

**Female.** Brown to reddish brown on head and thorax; abdomen pale brown; legs yellowish brown. Body length 5.0–6.0 mm; wing length 5.5–6.0 mm. As for male except as follows.

Head. Eyes dull brown. Hind legs without the characteristic swollen segments, but femur and tibia slightly swollen towards apex.

**Type data.** **Holotype:** male, NN, Wakefield, rotten beech [*Nothofagus* sp.], 30 August 1967, J.S. Dugdale (NZAC).

**Paratypes** (20 males, 7 females; NZAC, CMNZ, USNM). North I. ND: 1 male, Waipoua State Forest, 17 Oct 1967, beating *Geniostoma ligustrifolium* and *Cyathodes fasciculatus*, J.C. Watt (ethanol). CL: 1 male, Little Barrier I., Thumb track and Summit track, 23 Nov 1951, R.A. Harrison; 1 male, Tapu, 14 Nov 1937, J.S. Armstrong. TO: 1 male, Taupo, Tauhara, 19 Nov 1933, J.S. Armstrong.

South I. NN: 8 males, 7 females, same data as holotype; 1 male, type locality, on *Fomes aplanatus*, emerged 28 Sep 1967, J.S. Dugdale; 1 male, Dun Mtn, 650 m, 16 Nov 1920, A. Philpott. BR: 2 males, Caplestone, Boatmans Creek, 8 Nov 1971, beating and to light, J.S. Dugdale; 1 male, Hochstetter State Forest, Flagstaff Reserve, 7 Nov 1972, J.S. Dugdale. BR–WD: 3 males, Kumara, 12–14 Dec 1929, J.W. Campbell.

**Material examined.** Type series, plus 3 non-type examples (NMNZ).

ND, AK, CL, TO / NN, BR, WD.

Recorded from sea level to 650 m.

Collected August (53% of total), September (2%), October (2%), November (23%), and December (10%).

Plant association: see Table 1 (p. 19).

**Remarks.** *D. neoinsolitus* is distinguished from other species by the presence of two irregular clusters or rows of spines rather than one medially on the fore tibia.

The relationship of this species to *Philia insolita* as described by Hardy (1951, 1953) is discussed under Remarks to *D. segnis*.

## *Dilophus nigrostigma* (Walker)

Figures 12 and 28

*nigrostigma* Walker, 1848: 121 (*Bibio*). Kirby, 1884: 272 (*Dilophus*). Hudson, 1892: 95 (*Dilophus*). Hutton, 1901: 193 (*Dilophus*). Hardy, 1951: 268; — 1953: 517; 1956: 87 (*Philia*).

*spectabilis* Nowicki, 1875: 10 (*Dilophus*).

*zealandicus* Walker, 1858: 235 (*Bibio*).

**Male.** Shining black; wings almost clear; stigma black. Body length about 8.0 mm; wing length about 7.5 mm.

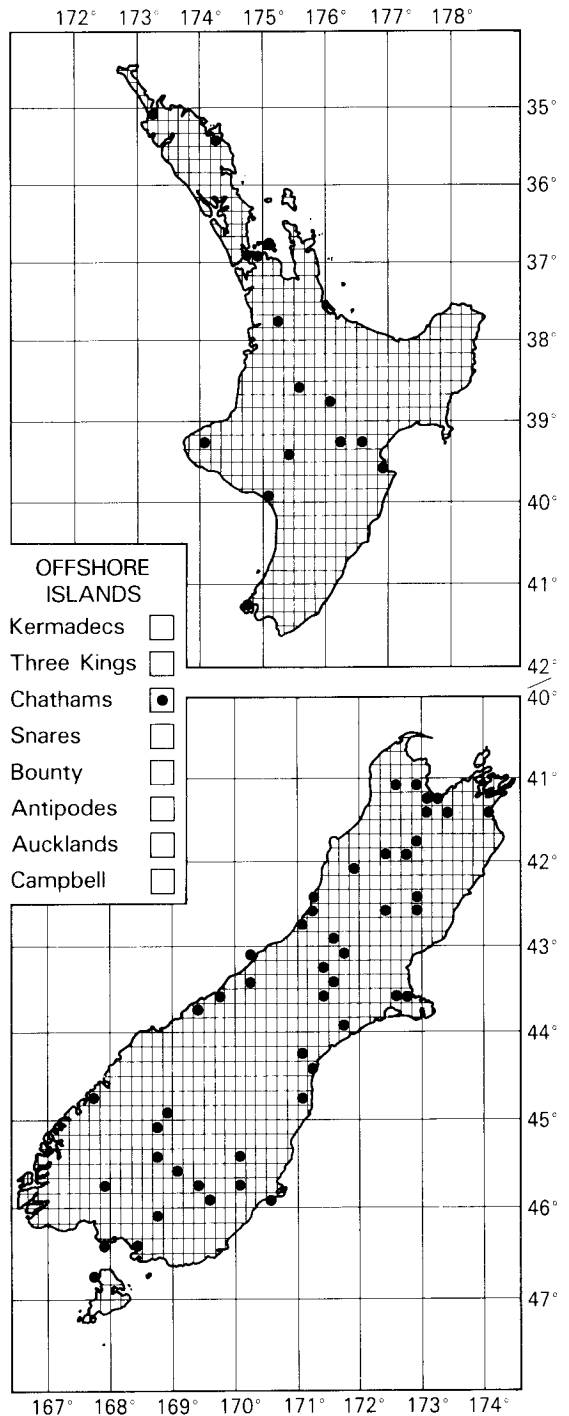
Head black. Antennae dark reddish black, with 13 segments. Eyes reddish brown, dark brown on posterior sector, thickly pilose. Front consisting of a small ocellar triangle raised distinctly above level of eyes. Palpi dark brown.

Thorax. Anterior transverse rows of spines fairly prominent. Scutellum with an apical tuft of short, fine, upcurved setulae. Mesonotum with 2 distinct longitudinal rows of hairs, embedded in and around relatively well defined longitudinal sulci; hairs also thick on lateral margins; pleurites generally bare. Legs shining black except for blackish-brown tarsi. Foreleg: coxa just shorter than femur, both fairly strong; tibia with 3 distinct spines on a posterodorsal callosity just before middle of segment, and a small spine at distal third; distal spines relatively strong, the anteroventral distal spur longer than the spines. Fore and middle tarsal segments normal, relatively thin. Middle leg: coxa small, just longer than trochanter and about one-quarter as long as femur; tibia normal. Hind leg: coxa about twice as long as trochanter and about one-third as long as femur; femur swollen somewhat towards apex, widest at about distal quarter; tibia about as long as femur, likewise swollen towards apex and broadest distally; tarsus more swollen than middle and fore tarsi. Wings: venation normal (as in Fig. 21); anterior veins dark brown; posterior veins paler brown; stigma almost black; subcostal cell shaded brown except near base; veins *RI* and *Rs* without hairs. Halteres with a dark brown bulb and dark greyish-brown stalk.

Abdomen shining black, fairly well covered with long, thin hairs. Terminalia black.

**Female.** Pale brown or pale reddish brown with darker brown abdomen, trochanters, tibiae, and tarsi. Body length 7.0–8.0 mm; wing length 7.0–8.0 mm. Similar to male except as follows.

Head dark shining brown. Eyes sparsely pilose, the hairs short. Ocellar triangle prominent, raised above level of front. Front between eyes at narrowest part half width of head. Palpi small, dark brown.



• Map 6 Distribution of *Dilophus nigrostigma* •

Thorax shining pale reddish brown, darker brown on anterior of mesonotum, on scutellum, and on proximal half or two-thirds of sternopleuron. Mesonotum with longitudinal sulci bearing short hairs, these not as profuse as in male. Legs: coxae and femora pale reddish brown; trochanters, tibiae, and tarsi brown to dark brown; hind leg not unduly swollen in tibia and tarsal segments. Stigma of wings brown to dark brown.

Abdomen not excessively haired. Genital plates dark blackish brown.

**Type data.** Syntypes: 1 male, 1 female, New Zealand (BMNH).

**Material examined.** 620 non-type examples (NZAC, LCNZ, UCNZ, USNM).

ND–SL (except CL / KA, MC) / SI / Chatham Is.

Recorded from sea level to 2440 m.

Collected in January (10% of total), February (0.2%), March (0.5%), October (0.7%), November (29%), and December (60%).

Plant associations: see Table 1 (p. 19).

**Remarks.** *D. nigrostigma* is separated from all other New Zealand species by its large size.

### *Dilophus segnis* Hutton

Figures 13, 17, and 29

*segnis* Hutton, 1901: 194 (*Dilophus*). Hardy, 1951: 272; — 1953: 516 (*Philia*).

*insolitus* Hutton, 1901: 193 (*Dilophus*) **new synonymy**.

**Male.** Shining black with brown legs. Body length about 3.5–4.0 mm; wing length about 3.5 mm.

Head black. Antennae blackish brown, with 13 segments. Eyes brown, dark brown on posterior sector, sparsely pilose, the hairs fine, long. Ocellar triangle small, raised above level of eyes. Palpi brown.

Thorax not strongly pilose, but hairs present in longitudinal sulci. Scutellum with an apical tuft of few very short setulae. Pleurites dark brown rather than black, distinctly shining. Legs brown. Foreleg: coxa blackish brown, fairly strong, about equal to femur; tibia thickened, with 2 groups of spines, one each at about proximal third and distal third; apical tibial spurs fairly strong, and apical spine often distinctly longer and black; tarsal segments normal. Middle leg normal; tibia with a single medial anterodorsal spine, this often weak. Hind leg: coxa black, about one-quarter as long as femur, which is distinctly swollen on distal half; tibia clavate, with a gradual thickening to apex; tarsal

segments distinctly swollen, the basal segment as broad as apex of tibia. Wings very faintly shaded brown; stigma brown; venation normal (as in Fig. 21); anterior veins brown; *R* vein with a few short hairs. Halteres brown, with stalks pale brown.

Abdomen black. Terminalia dark brown.

**Female.** As for male except as follows. General colour paler brown; legs darker only on distal tarsal segments.

Thorax. Foreleg with tibial spines in 2 groups closer together than in males, often at middle and proximal third of segment. Hind leg with swollen femur and tibia not as pronounced, and tarsal segments normal. Wings very faintly shaded with pale brown; stigma brown.

Abdomen dull brown. Genital plates pale brown and dark brown.

**Type data.** **Holotype** of *segnis*: male, MC, Christchurch, F.W. Hutton (CMNZ). **Paratypes**: 2 females, same data as holotype (CMNZ).

**Holotype** of *insolitus*: male, MC, Christchurch, F.W. Hutton (CMNZ). **Paratypes**: 1 male, 2 females, same data as holotype (CMNZ).

**Material examined.** Type series, plus 158 non-type examples (64 males, 94 females; NZAC, CMNZ, USNM, LCNZ, UCNZ).

ND, AK, CL, TO, GB, HB, RI, WN/NN, SD, BR, KA, MC, WD, MK, OL / SI.

Recorded from sea level to 1000 m.

Collected February (1% of total), March (1%), July (1%), September (1%), October (14%), November (39%), and December (43%).

Plant associations: see Table 1 (p. 19).

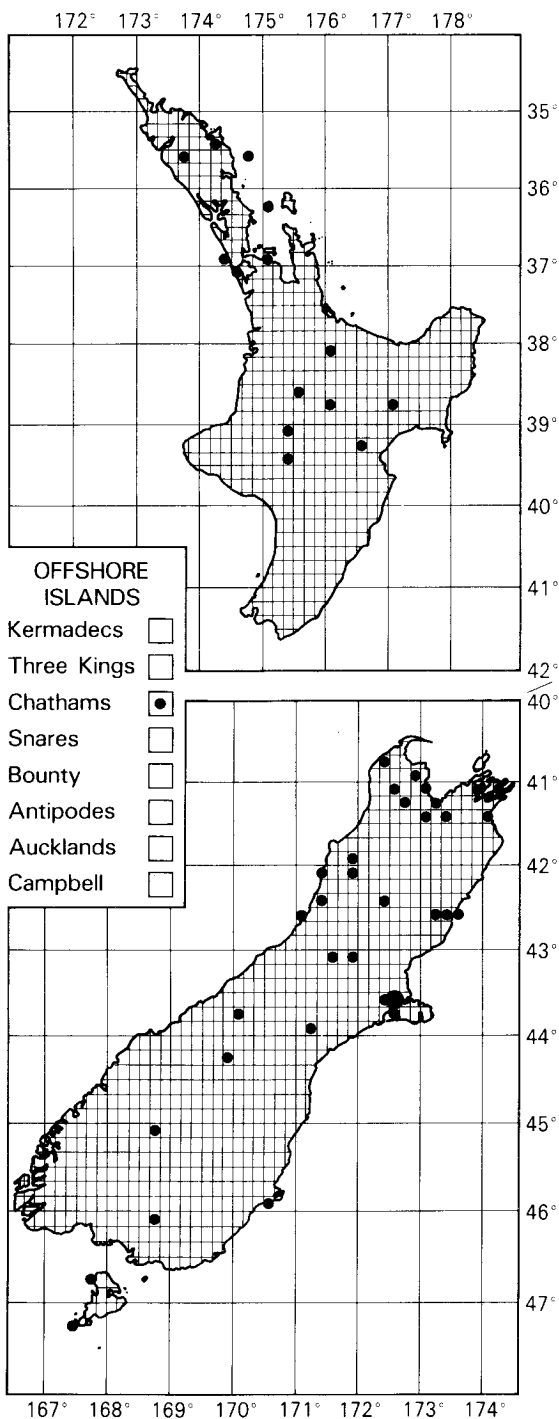
**Remarks.** The male terminalia have been prepared for both *segnis* Hutton and *insolitus* Hutton. All characters examined indicate that the type series of both nominal species are identical.

As Hardy did not have access to the type series, he probably erred in his use of the names *segnis* and *insolitus* (Hardy 1951, 1953) as being equivalent to Hutton's species.

His descriptions under these names indicate distinctness, and the species described in this revision as *D. neoinsolitus* n.sp. is probably that which Hardy took to be *insolitus* in some instances.

This conclusion is reinforced by the fact that paratypes designated here for *neoinsolitus* were taken at Kumara (BR–WD) by Campbell, and are thus from the same series that was examined by Hardy and recorded by him in 1951 as *insolita*.





• Map 7 Distribution of *Dilophus segnis* •

Some earlier determined specimens may have to be re-examined in the light of this conclusion.

The name *segnis* has been chosen to be retained because it has been used more frequently than *insolitus*, and will not disturb the terminology used by Hardy; *insolitus* is thus reduced to synonymy.

### *Dilophus tuthilli* (Hardy) new combination

Figures 22 and 30

*tuthilli* Hardy, 1953: 518 (*Philia*).

**Male.** Small, dark brown, mostly glossy; wings clear. Body length about 2.5 mm; wing length about 2.5 mm.

Head almost black. Antennae dark brown, with 13 segments. Eyes dull reddish brown, darker on posterior sector. Ocellar triangle quite distinct; ocelli strong, raised above level of eyes. Palpi dark brown.

Thorax. Anterior transverse rows of spines quite strong. Mesonotum sparsely pilose, the hairs relatively long and thin, arising from longitudinal sulci. Scutellum with an apical tuft of short, strong setulae. Legs brown to dark brown; coxae and femora often darker than other segments. Foreleg: coxa and femur relatively strong, approximately equal; tibia relatively strong, with a cluster of strong spines in 1 or 2 groups near middle; tarsus normal. Middle leg normal. Hind leg: femur swollen on distal half, but not excessively so; tibia likewise tending to be swollen towards apex; tarsal segments normal. Wings clear; stigma pale brown; venation characterised by absence of veins  $M_1$  and  $M_{1+2}$  basally and of cross-vein  $m-cu$  (Fig. 22). Halteres brown.

Abdomen shining brown to dark brown. Terminalia pale brown.

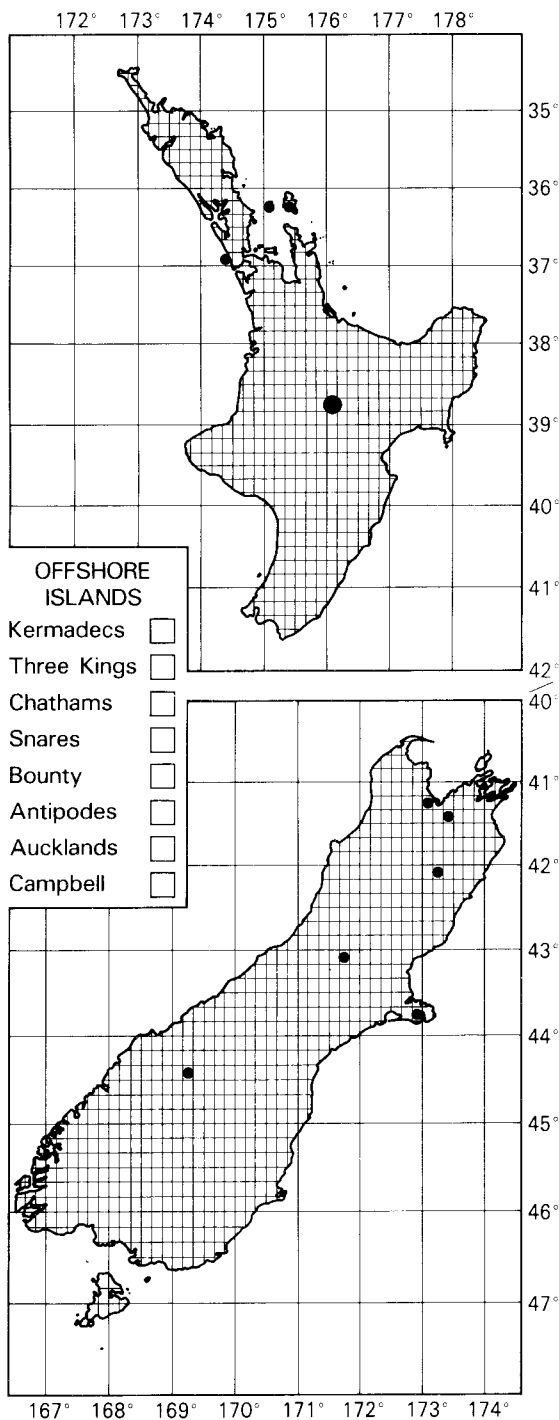
**Female.** Shining reddish to dark reddish brown on head, thorax, and legs; abdomen dull reddish brown. Body length 2.5 mm; wing length 2.5 mm. As for male except as follows.

Fore coxa paler than fore femur. Middle and hind femora and tibiae often paler brown on proximal half. Hind legs without any swollen or slightly swollen regions.

**Type data.** Holotype male and allotype female: TO, Lake Taupo, 20–22 February 1950, L.D. Tuthill (NZAC).

**Paratypes:** 10 males, 10 females, same data as holotype (NZAC, BMNH, USNM, BPBM, UHMH).

**Material examined.** 5 paratypes (2 males, 3 females) plus 17 non-type examples (16 males, 1 female, 1 unsexed; UCNZ, NZAC).



• Map 8 Distribution of *Dilophus tuthilli* •

AK, CL, TO / NN, KA, NC, MC, OL.

Recorded from sea level to 950 m.

Collected January (13% of total), February (74%), and November (13%).

Plant associations: see Table 1 (p. 19).

**Remarks.** *D. tuthilli* is distinguished from its New Zealand congeners by characters of the venation.

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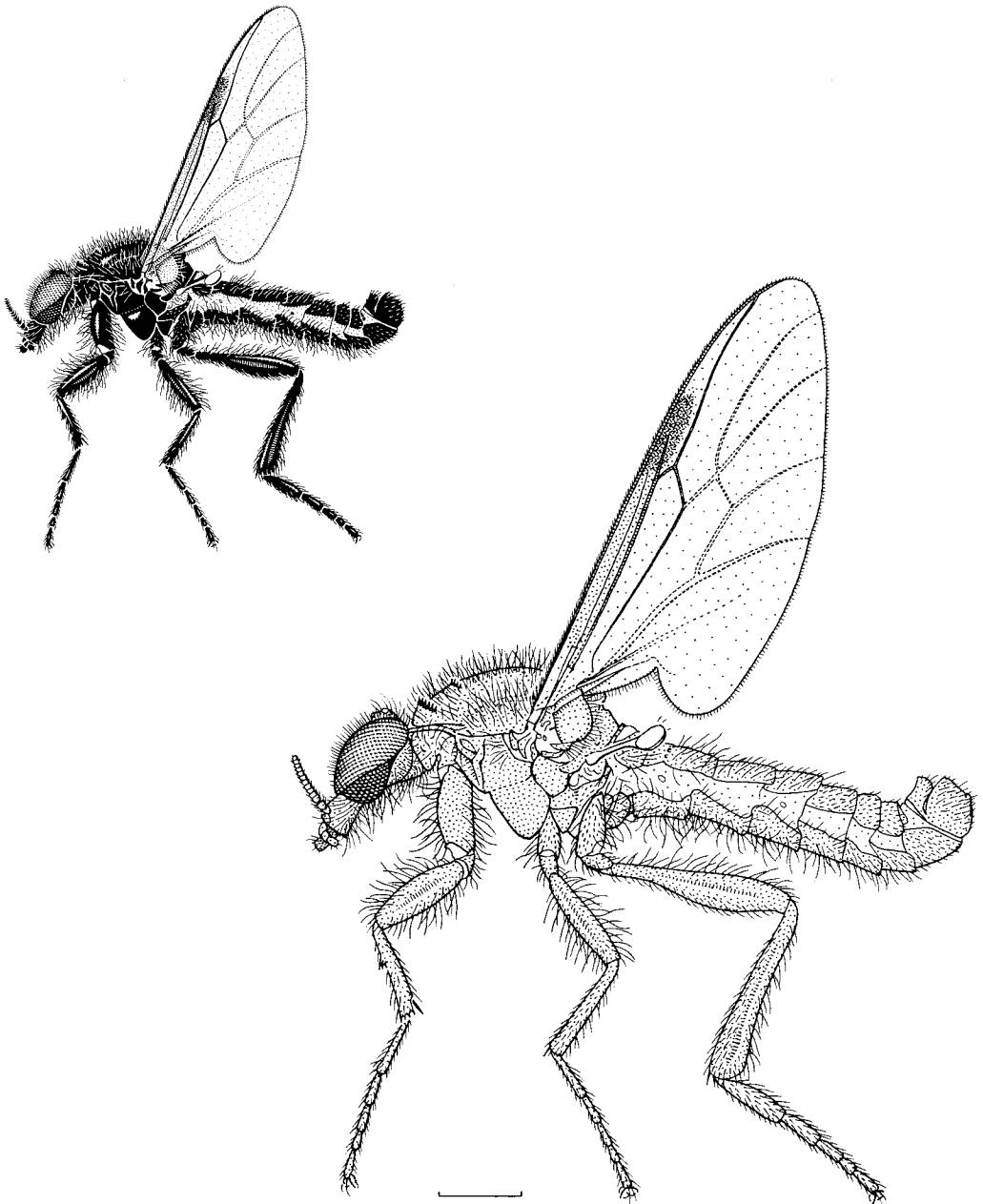
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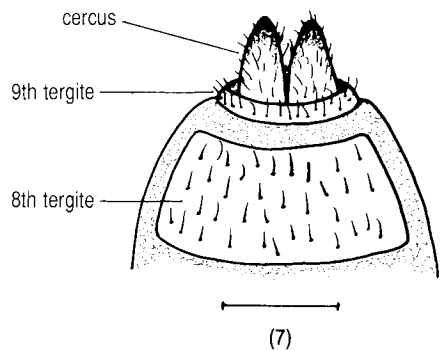
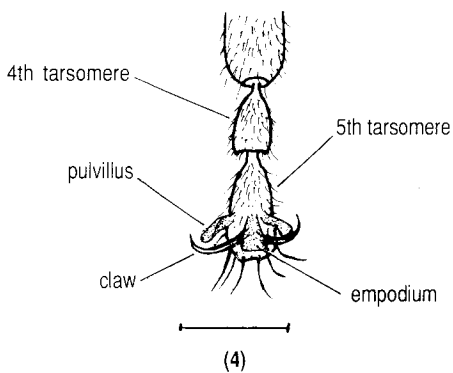
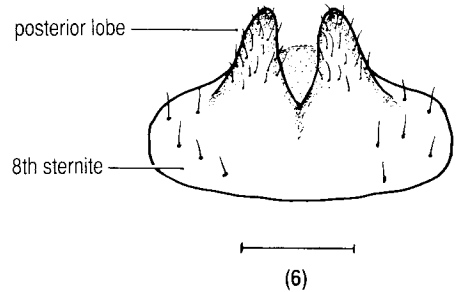
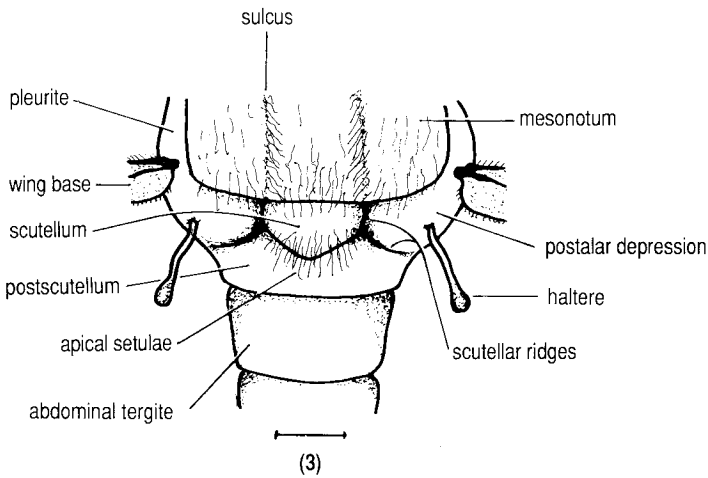
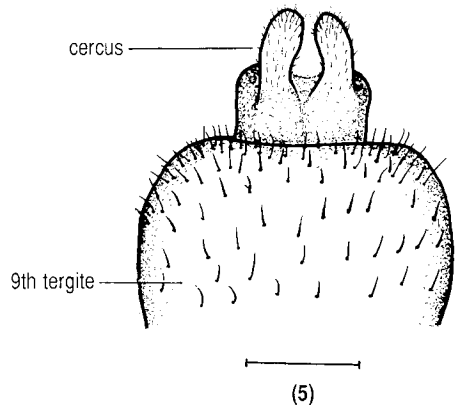
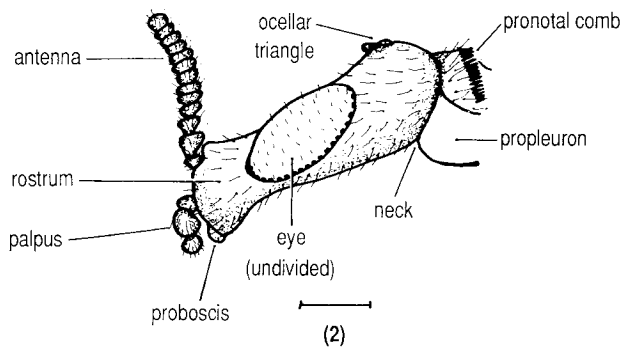
**Table 1** List of plants having bibionid associations, their family affiliation, and the species of Bibionidae recorded on each.

<i>Carduus nutans</i>	Asteraceae	<i>nigrostigma</i>
<i>Carmichaelia</i> sp.	Papilionaceae	<i>segnis</i>
<i>Carpodetus serratus</i>	Escalloniaceae	<i>nigrostigma</i>
<i>Cassinia</i> sp.	Asteraceae	<i>alpinus, nigrostigma, segnis</i>
<i>Citrus</i> sp.	Rutaceae	<i>nigrostigma</i>
<i>Coprosma</i> sp.	Rubiaceae	<i>nigrostigma, segnis, tuthilli</i>
<i>Cordyline australis</i>	Agavaceae	<i>nigrostigma</i>
<i>Cyathodes fasciculatus</i>	Epacridaceae	<i>neoinsolitus</i>
<i>Danthonia</i> sp.	Poaceae	<i>segnis</i>
<i>Discaria toumatou</i>	Rhamnaceae	<i>segnis</i>
<i>Dracophyllum arboreum</i>	Epacridaceae	<i>nigrostigma</i>
<i>Epilobium</i> sp.	Onagraceae	<i>nigrostigma</i>
<i>Galium propinquum</i>	Rubiaceae	<i>nigrostigma</i>
<i>Ganoderma applanatum</i>	Ganodermataceae	<i>neoinsolitus</i>
<i>Geniostoma ligustrifolium</i>	Loganiaceae	<i>neoinsolitus, tuthilli</i>
Gentian flowers	Gentianaceae	<i>alpinus</i>
<i>Griselinia littoralis</i>	Cornaceae	<i>segnis</i>
<i>Halocarpus bidwillii</i>	Podocarpaceae	<i>crinitus</i>
<i>Hebe</i> sp.	Scrophulariaceae	<i>alpinus, nigrostigma, tuthilli</i>
<i>Kunzea ericoides</i>	Myrtaceae	<i>nigrostigma</i>
<i>Leptospermum</i> sp.	Myrtaceae	<i>nigrostigma, segnis, tuthilli</i>
<i>Muehlenbeckia</i> sp.	Polygonaceae	<i>tuthilli</i>
<i>Nothofagus</i> sp.	Fagaceae	<i>alpinus, crinitus, nigrostigma, tuthilli</i>
<i>Olearia virgata</i>	Asteraceae	<i>crinitus, nigrostigma</i>
<i>Phyllocladus</i> sp.	Podocarpaceae	<i>harrisoni</i>
<i>Pittosporum</i> sp.	Pittosporaceae	<i>tuthilli</i>
<i>Poa colensoi</i>	Poaceae	<i>harrisoni</i>
<i>Rhopalostylis sapida</i>	Palmae	<i>segnis</i>
<i>Rosa</i> sp.	Rosaceae	<i>nigrostigma</i>
<i>Senecio</i> sp.	Asteraceae	<i>alpinus</i>
Stock ( <i>Matthiola incarna</i> )	Brassicaceae	<i>nigrostigma</i>
Tussock grasses	Poaceae	<i>crinitus</i>
<i>Weinmannia</i> sp.	Cunoniaceae	<i>alpinus, nigrostigma</i>

## ILLUSTRATIONS



**Fig. 1** *Dilophus nigrostigma* male, habitus, lateral, showing features characteristic of Bibionidae. Note divided eye (cf. female, Fig. 2). Scale line = 1.0 mm. Artist: *Des Helmore*.



**Fig. 2–7** Morphological details of Bibionidae, based on *Dilophus* species: (2) head, female, lateral; (3) mid-dorsal region; (4) tarsus, ventral; (5–7) terminalia – male, dorsal, and female, ventral and dorsal. Scale lines = 0.25 mm.

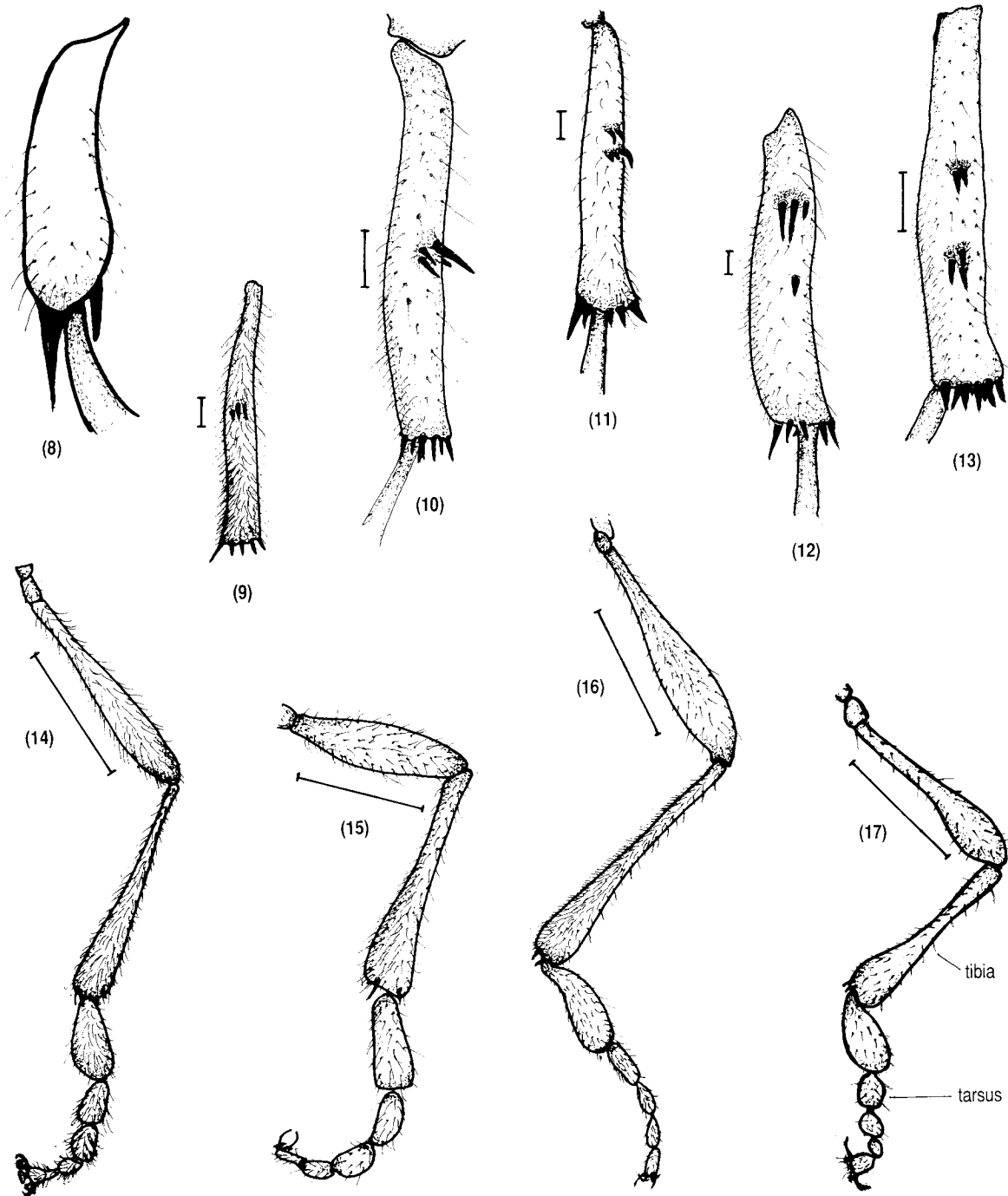
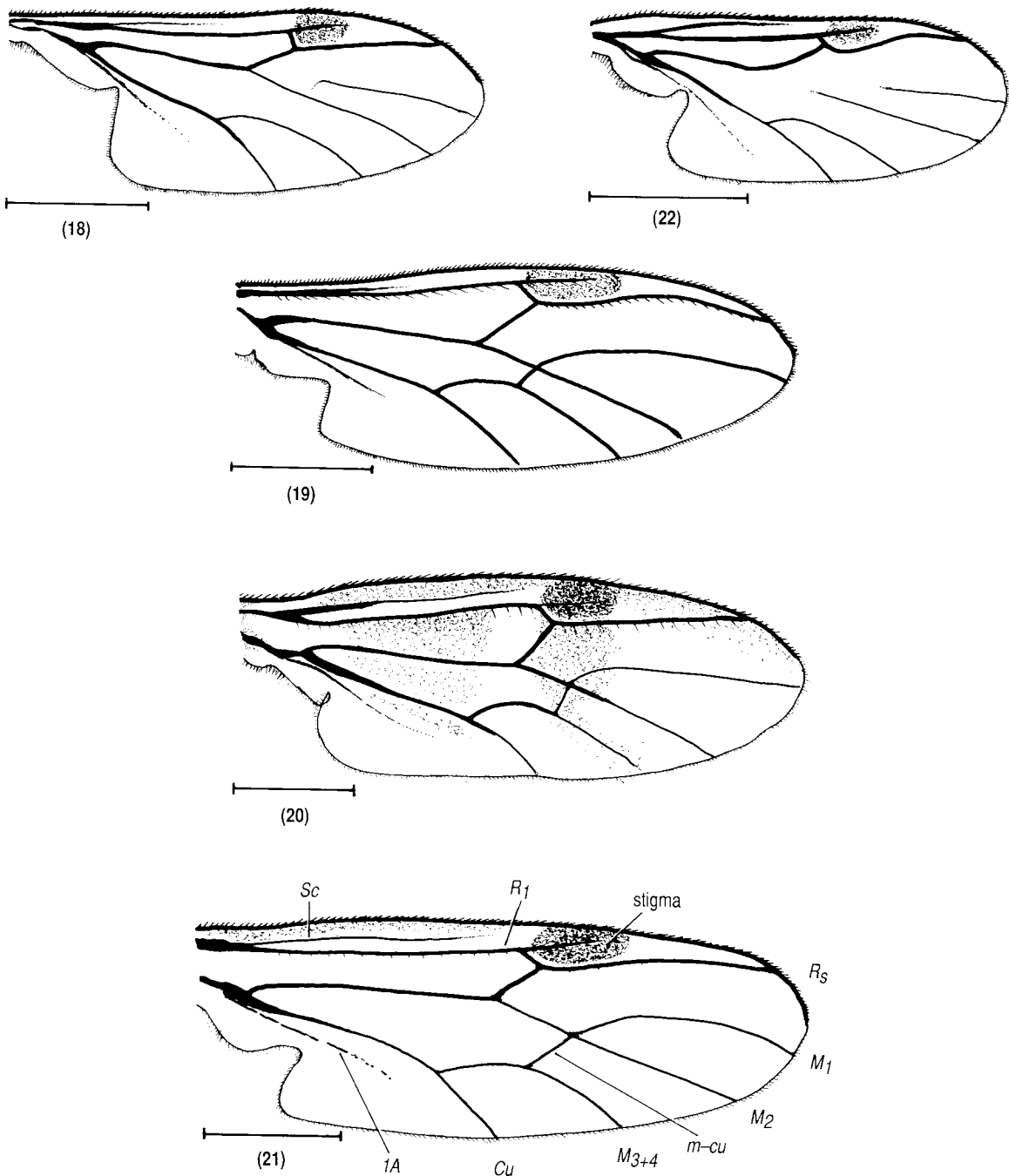
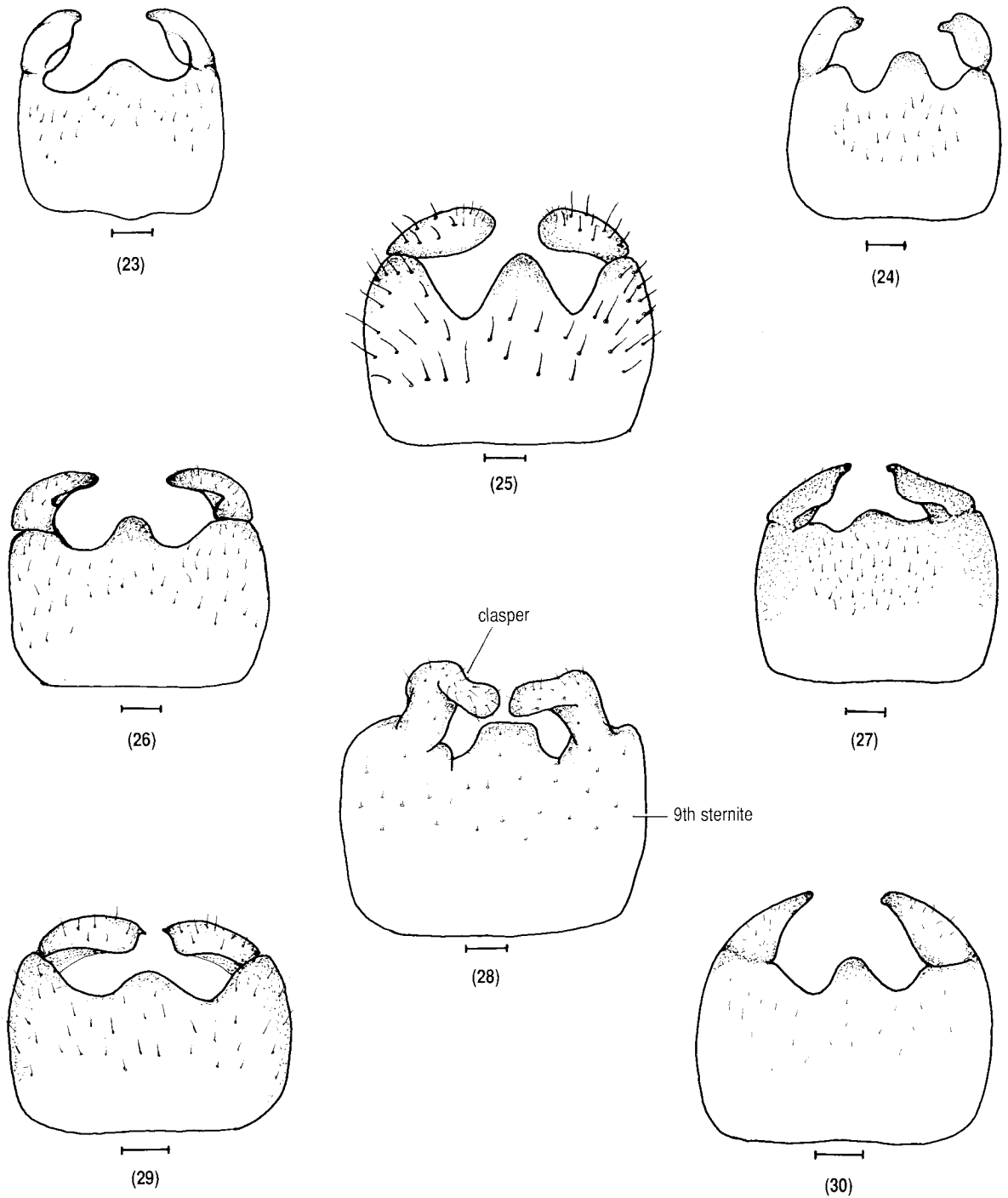


Fig. 8–13 Fore tibia, male, of: (8) *Bibio imitator* (after Hardy 1982); (9) *Dilophus crinitus*; (10) *D. harrisoni*; (11) *D. neoinsolitus*; (12) *D. nigrostigma*; (13) *D. segnis*. Scale lines = 0.1 mm.

Fig. 14–17 Hind leg, male, of *Dilophus* species: (14) *crinitus*; (15) *harrisoni*; (16) *neoinsolitus*; (17) *segnis*. Scale lines = 1.0 mm.



**Fig. 18–22** Wings of *Dilophus* species: (18) *alpinus*; (19) *crinitus*; (20) *fumipennis*; (21) *neosolitus*; (22) *tuthilli*. Scale lines = 1.0 mm.



**Fig. 23–30** Terminalia, male, ventral, of *Dilophus* species: (23) *alpinus*; (24) *crinitus*; (25) *fumipennis*; (26) *harisoni*; (27) *neoin solitus*; (28) *nigrostigma*; (29) *segnis*; (30) *tuthilli*. Scale lines = 0.1 mm.



## TAXONOMIC INDEX

All nominal taxa covered in the text are indexed, regardless of their status in taxonomy. The suffix 'k' denotes the page on which a species is keyed. Page numbers in bold type indicate the start of major descriptive sections. Numbers in italic type indicate pages on which a taxon is figured.

*alpinus*, *Dilophus* 9k, 19, 23, 24  
*Bibio* 5, 7, 8

BIBIONIDAE 7

BIBIONINAE 6, 8

*campbelli*, *Dilophus* 8, 9

*crinita*, *Philia* 10

*crinitus*, *Dilophus* 7, 9k, 10, 19, 22–24

*Dilophus* 5, 6, 8, 9

*febrilis*, *Tipula* 8

*fumipennis*, *Dilophus* 9k, 11, 23, 24

*harrisoni*, *Dilophus* 9k, 12, 19, 22, 24

*Philia* 12

HESPERININAE 8

*imitator*, *Bibio* 5, 8, 22

*insolita*, *Philia* 13, 14, 16

*insolitus*, *Dilophus* 13, 16, 17

*neoinsolitus*, *Dilophus* 9k, 13, 16, 19, 22–24

*nigrostigma*, *Bibio* 5, 15

*Dilophus* 5–8, 9k, 15, 19, 20, 21, 22, 24

*Philia* 15

*Philia* 5, 8

PLECINAE 8

SCATOPSIDAE 7

*segnis*, *Dilophus* 7, 8, 9k, 14, 16, 19, 22, 24

*Philia* 16

*spectabilis*, *Dilophus* 15

*tricuspidatus*, *Dilophus* 13

*tuthilli*, *Dilophus* 9k, 17, 19, 23, 24

*Philia* 17

*zealandicus*, *Bibio* 15

**DSIR****DSIR PLANT  
PROTECTION**

# Beetles in a suburban environment: a New Zealand case study

## The identity and status of Coleoptera in the natural and modified habitats of Lynfield, Auckland (1974–1989)

by G. Kuschel

*The importance of local biotic surveys cannot be over-emphasised at a time when management decisions affecting the future of natural environments are being made at an all too rapid rate. The effects of replacing native bush with agricultural crops, imported plantations, or exotic gardens cannot begin to be estimated without a detailed knowledge of the native flora and fauna. Although it is not uncommon for survey information on higher plants and vertebrates to be available, similar data for terrestrial invertebrates is almost impossible to find. This is one of several reasons why Dr Kuschel's 15-year survey of the Coleoptera of the Lynfield area is an unique and important contribution.*

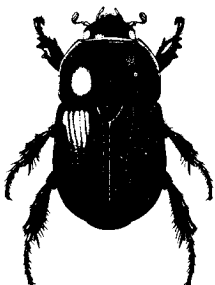
*The study was conducted in a suburban environment in New Zealand, a country where numerous exotic plants and animals, principally from the Northern Hemisphere, have been introduced and established over the past 200 years. This feature adds an additional dimension to the work, in that it provides an insight into the possible interactions between native and exotic species and differences in their habitat preferences. The survey involves almost 1000 species of beetles, three-fourths of which are endemic to New Zealand.*

*For every species recorded, the relative abundance and habitat preferences are given, as well as information on flight capability and, for exotic forms, the country of origin and, if known, the earliest New Zealand record.*

*Dr Kuschel has combined his own general knowledge of the Coleoptera and expertise in weevil taxonomy with the talents of a number of overseas specialists to provide species names for the majority of the taxa and to place almost all of them in a known genus; he has also described several new species and made other taxonomic changes. Each family is accompanied by at least one illustration, and sections on habitat types and collecting methods are included. An appendix by A.E. Esler includes a vegetation analysis and a list of higher plant species found in the area.*

*This important contribution will prove to be of immense value to entomologists, ecologists, natural historians, and conservationists, not only in New Zealand but in other countries interested in understanding and conserving their natural environment.*

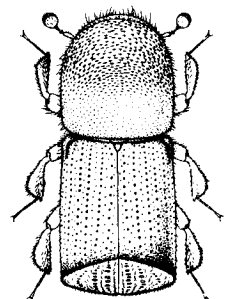
—Dr John F. Lawrence  
CSIRO Division of Entomology



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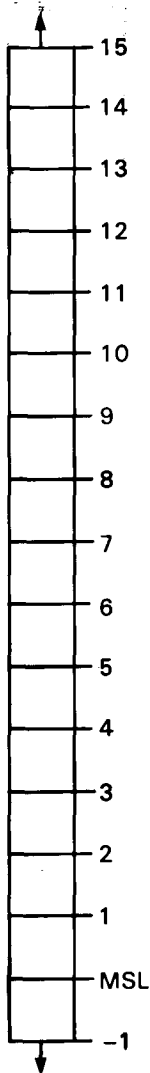
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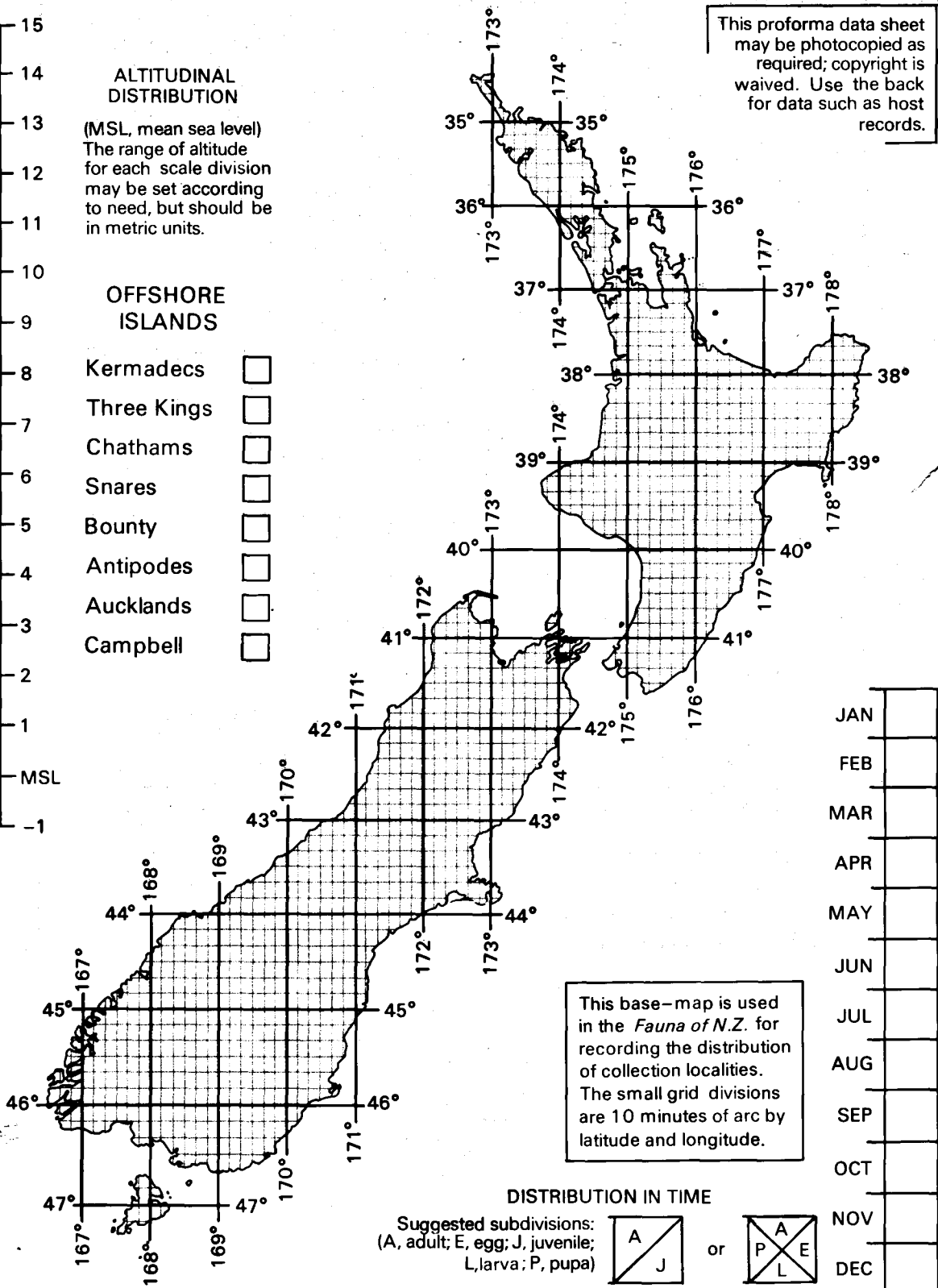


**ALTITUDINAL DISTRIBUTION**

(MSL, mean sea level)  
The range of altitude for each scale division may be set according to need, but should be in metric units.

**OFFSHORE ISLANDS**

- Kermadecs
- Three Kings
- Chathams
- Snares
- Bounty
- Antipodes
- Aucklands
- Campbell



This base-map is used in the *Fauna of N.Z.* for recording the distribution of collection localities. The small grid divisions are 10 minutes of arc by latitude and longitude.

JAN	
FEB	
MAR	
APR	
MAY	
JUN	
JUL	
AUG	
SEP	
OCT	
NOV	
DEC	

**DISTRIBUTION IN TIME**

Suggested subdivisions:  
(A, adult; E, egg; J, juvenile;  
L, larva; P, pupa)



or



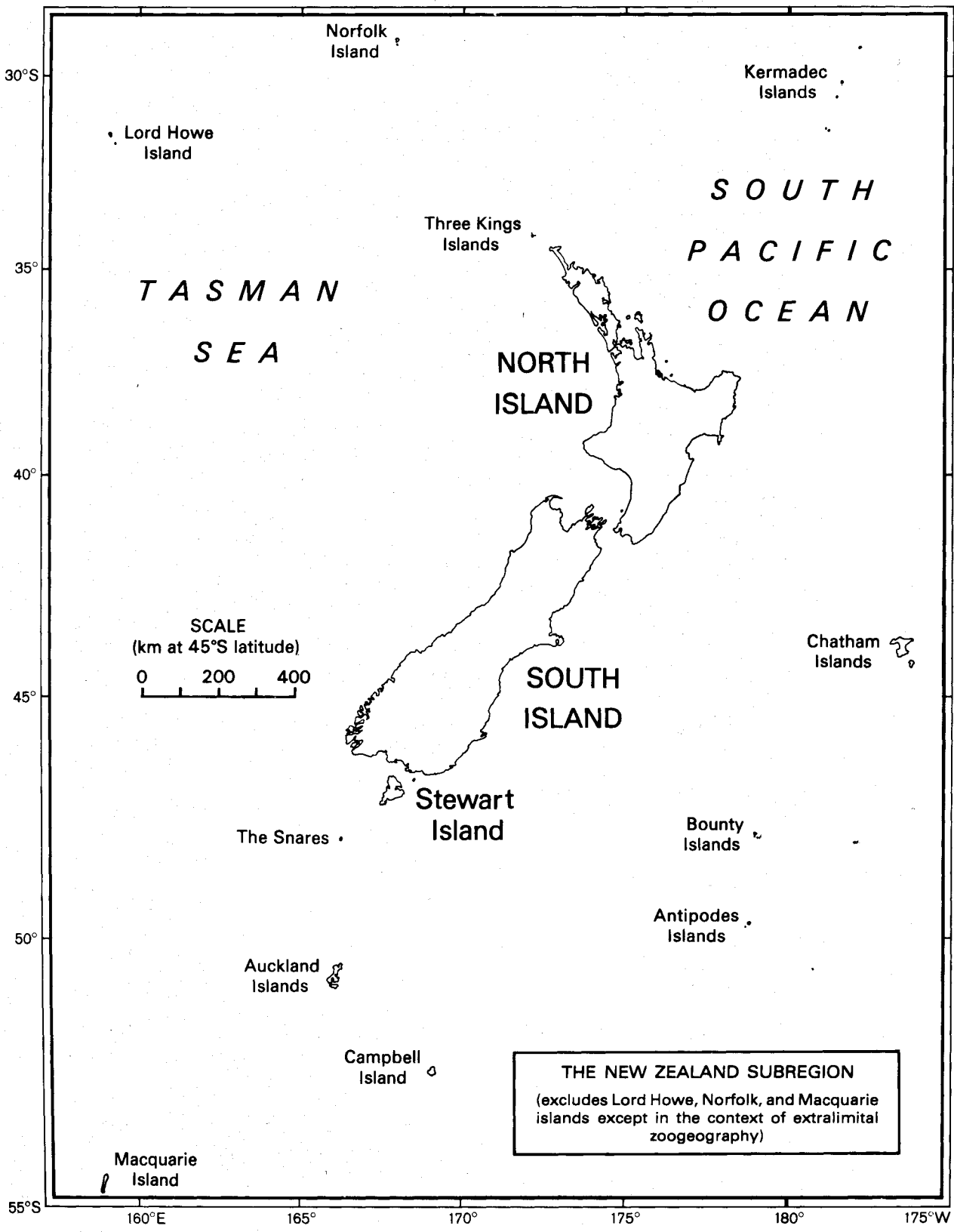
# Fauna of New Zealand



Number 20

**Bibionidae**  
(Insecta: Diptera)

Roy A. Harrison



Norfolk Island

Kermadec Islands

Lord Howe Island

SOUTH  
PACIFIC  
OCEAN

Three Kings Islands

TASMAN  
SEA

NORTH  
ISLAND

Chatham Islands

SCALE  
(km at 45°S latitude)  
0 200 400

SOUTH  
ISLAND

Stewart Island

The Snares

Bounty Islands

Antipodes Islands

Auckland Islands

Campbell Island

THE NEW ZEALAND SUBREGION  
(excludes Lord Howe, Norfolk, and Macquarie islands except in the context of extralimital zoogeography)

Macquarie Island

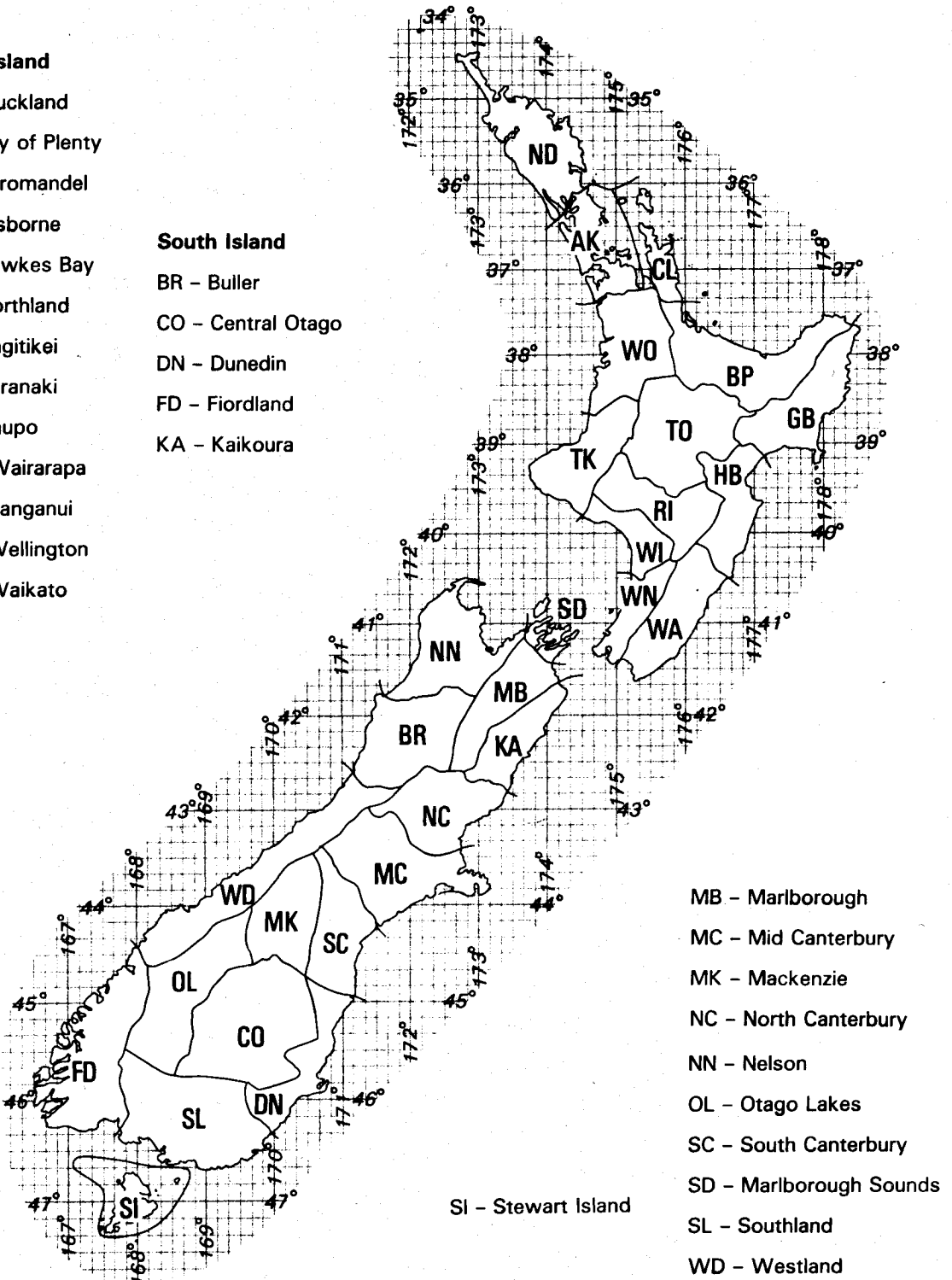
30°S 35° 40° 45° 50° 55°S  
160°E 165° 170° 175° 180° 175°W

**North Island**

- AK - Auckland
- BP - Bay of Plenty
- CL - Coromandel
- GB - Gisborne
- HB - Hawkes Bay
- ND - Northland
- RI - Rangitikei
- TK - Taranaki
- TO - Taupo
- WA - Wairarapa
- WI - Wanganui
- WN - Wellington
- WO - Waikato

**South Island**

- BR - Buller
- CO - Central Otago
- DN - Dunedin
- FD - Fiordland
- KA - Kaikoura



- MB - Marlborough
- MC - Mid Canterbury
- MK - Mackenzie
- NC - North Canterbury
- NN - Nelson
- OL - Otago Lakes
- SC - South Canterbury
- SD - Marlborough Sounds
- SL - Southland
- WD - Westland

SI - Stewart Island

Area codes and boundaries proposed by Crosby *et al.* (1976)  
for use with specimen locality data

# Fauna of New Zealand

This series of refereed occasional publications has been established with two major objectives: to encourage those with expert knowledge of elements in the New Zealand fauna to publish concise yet comprehensive accounts; and to provide a means of identification accessible to the non-specialist. It will deal with non-marine invertebrates only, since the vertebrates are well documented, and marine forms are covered by the series 'Marine Fauna of New Zealand'.

Contributors should discuss their intentions with an appropriate member of the Fauna Advisory Group or with the Series Editor before commencing work (for names and addresses, see page ii). All necessary guidance will be given.

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INTRODUCTION

KEY TO TAXA

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