

## Larvae of four New Zealand species of *Psychoda* (Diptera: Psychodidae)

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### Abstract

The larvae of 4 species of the genus *Psychoda* endemic to New Zealand are described and illustrated: *P. formosa*, *P. penicillata*, *P. setistyla*, and *P. tridens*. Brief notes are given on larval ecology.

### INTRODUCTION

Although 43 species of New Zealand psychodids have been comprehensively described by Satchell (1950, 1954), based in part on the unpublished work of Tonnoir, little has been published on their larvae or habitats. This paper discusses the larvae of 4 endemic species of *Psychoda* Latreille. Even this small group permits some general comparisons to be made of the adaptations and habitats of psychodid larvae in New Zealand and Europe.

Representative specimens have been deposited with Entomology Division, DSIR, Auckland, and additional material is housed in the collections of the Entomology Department, Lincoln College, Canterbury.

### GENERAL FORM OF THE LARVA OF *PSYCHODA*

Larvae apodous, slightly tapered at both ends with varying degrees of dorso-ventral flattening; there are 11 body segments, the last bearing a sclerotized respiratory siphon; all segments subdivided into annuli, the 3 thoracic and 1st abdominal segments with 2 annuli per segment, the remainder with 3 per segment.

Each annulus may bear a sclerotized strap-like plate, with a maximum of 26 per larva; often, however, they are attenuated (e.g., *Psychoda formosa*, Fig. 1), absent (e.g., *Psychoda penicillata*, Fig 4), or confined to the posterior 2 annuli of each segment resulting in a total of 20 (e.g., *Psychoda setistyla*, Fig. 7).

Tracheal system amphipneustic; anterior spiracles are raised cylindrical structures laterally on the posterior annulus of the 1st segment; posterior spiracles at end of sclerotized tapering tubular siphon, with openings between the dorsal and ventral pair of processes; siphon divisible into 2 regions: proximal part sclerotized and sometimes with microcuticular ornamentation; distal region more transparent; with paired tracheae visible through the integument. At, or near, the junction of these regions are 2 siphonal sensillae, of unknown function but of characteristic form. The ventral pair of terminal processes is the larger; each with annulated process of up to 4 segments on a cylindrical sclerotized base. At the distal tip is a fan of radiating setae with 1 or 2 sensory processes. Openings of paired tracheae partly occluded by plugs suspended by radiating threads; there is a similar plug in anterior spiracles.

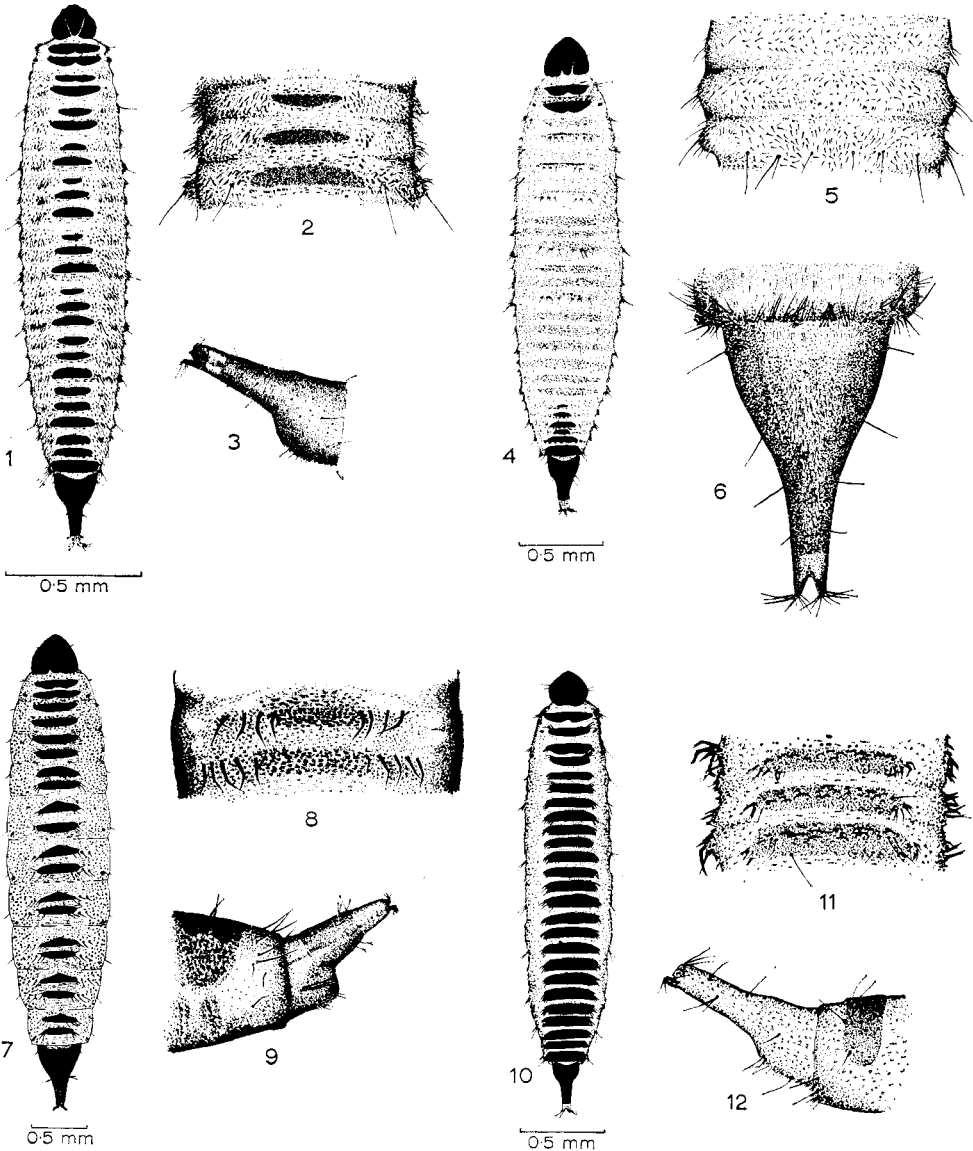
Head capsule heavily sclerotized, with a u-shaped epicranial suture. (Lateral ocelli present or absent, but valueless as a diagnostic feature as larvae with and without lateral ocelli have been reared from the same batch of eggs (Satchell 1947)).

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The mouthparts are withdrawn into the head capsule and are similar in most species (Satchell 1947). They are not described in this paper.

Vestiture (of considerable taxonomic importance) may appear as hairs, spines, combs, plaques, or some combination of these. Commonly, thoracic vestiture is modified, with frayed ends giving an overall pilose appearance. Overall, thoracic vestiture looks lighter than that of the abdomen, resulting in a different textural appearance between the 2 regions.



Figs 1-12. 1-3, *Psychoda formosa*: 1, larva; 2, 2nd abdominal segment; 3, lateral view of respiratory siphon. 4-6, *Psychoda penicillata*: 4, larva; 5, 2nd abdominal segment; 6, dorsal view of respiratory siphon. 7-9, *Psychoda setistyla*: 7, larva; 8, 2nd abdominal segment; 9, lateral view of respiratory siphon. 10-12, *Psychoda tridens*: 10, larva; 11, 2nd abdominal segment; 12, lateral view of respiratory siphon.

Microtrichial elements of the vestiture are simple surface elevations of the epicuticle, whereas each seta is set in its own basal ring and is associated with a nerve axon. The chaetotaxy in all species examined differs little from that described for *Psychoda alternata* Say by Feuerborn (1927). Setae show a wide range of development from species to species, being obvious in some, and reduced, hidden among microtrichia in other species.

### SPECIES DESCRIPTIONS

#### ***Psychoda formosa*** Satchell (Figs 1, 2, and 3)

Satchell, 1954, Trans. R. ent. Soc. Lond. 105: 487-8.

Full-grown larva 2 mm long, narrow, with slight dorso-ventral flattening (Fig. 1). Each annulus bears a dorsal plate, making 26 in all; plates of median segments reduced, particularly those of 1st annuli of segments 5 and 6; these about  $\frac{1}{2}$  width of plates in front (Fig. 1). Dorsally vestiture of hair-like elements, many frayed at ends; thickest and longest in areas adjacent to dorsal plates (Fig. 2). In front of each thoracic dorsal plate an area of small sclerotized plaques, each fringed with many posteriorly-directed long filamentous hairs. On abdominal segments similar fringed plaques lie behind each dorsal plate. Laterally, on last annulus of each segment, a pair of setae-bearing papillae (1 each side, Fig. 2). Ambulatory elements on ventral surface of 2nd annulus of each abdominal segment represented by elongated comb-like plaques that merge into more thorn-like forms laterally. On posterior and anterior annuli of each segment, elements similar but considerably smaller. Setae sometimes easily overlooked in hairy vestiture; under high magnification ( $\times 450$ ) they individually appear to have a shroud of very fine filamentous hairs skirting them.

Siphon with moderately broad base, narrowing rapidly into slender tapering distal portion. Paired ventral processes at its distal tip have 4 annuli each with long radiating setae at end (Figs 1 and 3). Anterior spiracles about twice as long as wide. Base of structures encircled by rows of fine hairs; distally sclerotized.

**MATERIAL EXAMINED.** 4 larvae, upper Leith Stream, Dunedin; collected 24.iii.1973, 11.iv.1973, 25.iv.1973, and 24.v.1973.

**REMARKS.** *Psychoda formosa* was found in the decaying leaves along the sides of the Leith Stream, Dunedin, but they were comparatively rare, 1 being found for about every 40 *Psychoda tridens*. They were easily reared on filter paper kept moist with stream water.

#### ***Psychoda penicillata*** Satchell (Figs 4, 5, and 6)

Satchell, 1950, Trans. R. ent. Soc. Lond. 101: 176-7.

Full-grown larva 2.9 mm long. Body with moderate dorso-ventral flattening, more extensible than larvae of *P. tridens*, *P. formosa*, or *P. setistyla*. Vestiture is scraggy coat of pointed hair-like elements (Fig. 4); longest and most numerous on dorsal surface of annuli of abdominal segments; under high magnification ( $\times 450$ ) many hairs appear forked or to have their bases very close together, these features much more common on 1st 2 annuli of each abdominal segment. On thorax vestiture smaller and more filamentous, grouped into small, laterally-elongated clusters in areas normally occupied by dorsal plates. Lateral margins fringed with hairs; last annulus of each segment with a pair of mamillate protrusions, each of which bears basal elements of large and small setae (Fig. 5).

Ambulatory areas largely confined to 2 annuli of each abdominal segment, consist of 1-3 flame-like spines set on quadrate bases. Dorsal surface of each abdominal segment with only 4 setae obvious, smaller ones easily confused with vestiture. Setae slender, lacking fine filaments often found on setae of other species. Siphon about 1.6 times as long as wide, with moderately expanded base merging gently with tapering distal portion (Fig. 6). Sclerotized proximal part has

microcuticular ornamentation of slender, elongated spines similar to those of vestiture (Fig. 6). Each paired ventral process bears 4 annuli ending in fan of long setae. Anterior spiracles sclerotized distally with skirt of very fine hairs about base.

**MATERIAL EXAMINED.** 3 larvae Trotter's Gorge, Dunedin; collected 16.iii.1973, 28.iii.1973, and 14.iv.1973.

**REMARKS.** The examples of this species were collected from Trotter's Gorge, North Otago. They were mostly found in the decaying debris under over-hanging bushes at the stream's edge, and tended to be aggregated in the cracks and hollows of the rocks at the stream's edge where they were subjected to occasional flooding. Nine specimens of this species were collected, but being much more mobile than other species of *Psychoda* examined, several escaped.

### ***Psychoda setistyla* Satchell (Figs 7, 8, and 9)**

Satchell, 1950, Trans. R. ent. Soc. Lond. 101: 169-70.

Full-grown larva 4.2 mm long, with marked dorso-ventral flattening. All dorsal plates present on 3 thoracic and 1st abdominal segments; on segments 5-10 1st plate of each set missing, with plates confined to posterior 2 annuli of each segment results in total of 20 plates. 6 thoracic plates distinctive, with relatively large, round, clear spaces in them.

Vestiture of lightly sclerotized plaques, central part elevated and usually slanted posteriorly. Elevated portions of plaques on latero-ventral surfaces less spiny but more heavily sclerotized than elsewhere. Ventrally plaques reduced giving way to ambulatory areas. On dorsal plates and areas immediately adjacent to them elevated portions flattened and almost spatulate. Between dorsal plates of thorax, sclerotized plaques laterally elongated with fringe of posteriorly directed hairs, most obvious in space between head and 1st plate. Between more posterior annuli, hairs fringing elongated plaques become thicker and less numerous, so that by 1st abdominal annulus they are evident as small, thorn-like spines.

Ventral surface of abdomen with 2 areas of ambulatory elements in each segment; anterior area consisting of single row of sclerotized plaques fringed with fine hairs; of this row, lateral elements most obvious. Other area consists of similar ambulatory elements, smaller and lying in 3 tiers that become less prominent anteriorly.

Setae characteristically short with broad base and much tapered sides (Fig. 8); those on respiratory siphon often short, sometimes only slightly longer than wide (Fig. 9), typically with swollen base and short conical distal portion. Ventral process has 4 annuli with short setae radiating from last. Anterior spiracles tall and tapering, about twice as high as wide at distal tip. Proximal region made up of sclerotized plaques similar to those of rest of vestiture.

**MATERIAL EXAMINED.** 10 larvae, from cow dung in field adjacent Waitati Valley Road, Dunedin; collected 10.iv.1973, 12.iv.1973 and others 14.iv.1973.

**REMARKS.** The larvae of this species were collected in very large numbers from specimens of cow dung taken from a field adjacent to the Waitati Valley Road, Dunedin and stored in the laboratory. Occasionally the adults were also seen on the mud beside a stream from which the cattle drank.

### ***Psychoda tridens* Satchell (Figs 10, 11, and 12)**

Satchell, 1954, Trans. R. ent. Soc. Lond. 105: 489-90.

Full-grown larva about 2.7 mm long, with moderate dorso-ventral flattening. 26 annuli each with large, heavily-sclerotized dorsal plate (Fig. 10), thus species easy to identify with low magnification and sometimes even with naked eye.

Dorsal vestiture of abdominal segments composed of blunt thorn-like projections; near outer posterior and lateral edges of 2 most anterior dorsal plates of each segment the projections become greatly elongated and often frayed at ends (Fig. 11). Between dorsal plates of thorax are small closely-packed, laterally-elongated plaques, each with fringe of hairs; typical thorn-like elements found on more posterior segments. Lateral surface with long, randomly-orientated hairs as found near edges of dorsal plates; often frayed at ends (Fig. 11). Ambulatory areas largely confined to central surface of 1st 2 annuli of each abdominal segment with smaller elements, similar to those of ventral surface of thorax.

Setae long and slender; with fringe of very fine hairs (magnification  $\times 450$ ), somewhat like a rat's tail. Siphon tapering 2-3 times as long as wide (Fig. 12). Paired ventral processes each have 3 annuli with long radiating setae at end. Anterior spiracles about  $\frac{1}{2}$  as wide as high at sclerotized distal extreme. Surrounded basally by plaques fringed with fine hairs.

**MATERIAL EXAMINED.** 11 larvae, upper Leith Stream, Dunedin; many specimens collected between 7.ii.1973 and 23.iii.1973.

**REMARKS.** The larvae were most common amongst the leafy detritus close to the stream's edge.

### DISCUSSION

The larvae of New Zealand *Psychoda* species described above were collected from the rotting vegetation found in the cracks and hollows of the rocks often encountered in New Zealand bush streams. This habitat is very similar to that of many British species of *Pericoma* Walker, and it is noteworthy that similar modifications are seen in both genera.

Like most British *Pericoma*, the larvae of New Zealand *Psychoda* seem well equipped to withstand the abrasion encountered in streams. For example, *Psychoda tridens* (Fig. 10) has a fully developed set of sclerotized plates which must surely protect the dorsal surface. Some species of New Zealand *Psychoda* larvae have greatly reduced dorsal plates (e.g. *Psychoda penicillata*, Figs 4 and 5); these species have a hairy vestiture, which also may provide some mechanical protection. Satchell (1949) pointed out that this hairy vestiture is absent in *Pericoma*, perhaps because they retain their total number of sclerotized plates with no reduction in size.

Several European species of *Psychoda* are known to pass their larval and pupal life in pats of cow dung. For many orders of insects these provide an ideal habitat; Oldroyd (1964) pointed out that dung conceals and protects the early stages from strong light and enemies. It also buffers the effects of heat and frost, and shields them from the drying effects of wind. Dung provides a richer source of protein than decaying vegetation because the cells have been crushed and broken; the proteins are predigested and much unwanted water has already been eliminated. The disadvantage of this medium is that it is temporary, and only those groups with sufficiently short larval and pupal stages can grow to maturity in it. This is no handicap to species of *Psychoda*, as their larval and pupal stages are sufficiently short. The species of the related genus *Pericoma* are larger and have a correspondingly longer period as larvae and pupae; this excludes them from using dung as a habitat, and they have remained in what is regarded as the more primitive environment for the family, that of decaying vegetation found bordering woodland streams and waterfalls.

It is important to note that the "cow pat" represents a type of habitat quite unlike that provided by any wild ruminants, which void firm, pelleted faeces. No doubt this difference is the result of animal husbandry. From this it can be seen that the colonization of cow dung by *Psychoda* has occurred comparatively recently. Presumably, before cow dung became widely available, the larvae of

many species were uncommon and lived in such habitats as richly organic mud – a habitat from which they are still occasionally collected (Satchell 1947).

The possibility that species of European *Psychoda* have adopted a life in cow dung as a preferred, or alternative habitat to their original one in decaying vegetation is reflected in the habits of *Psychoda setistyla*. Here an undoubtedly endemic New Zealand species has taken to an alien habitat within the last 140 years.

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