

DISTRIBUTION NOTES ON TAIWAN MOTHS, 5. *UDEA STIGMATALIS* (LEPIDOPTERA: PYRALIDAE: PYRAUSTINAE)

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ABSTRACT.— Notes are provided on specimens newly recorded from Taiwan of the Japanese species, *Udea stigmatalis* (Wileman). A Taiwan subspecies is described: *Udea stigmatalis tayulingensis* n. subsp.

KEYWORDS: Asia, China, East Asia, Japan, Oriental, *Udea stigmatalis tayulingensis* n. subsp., taxonomy.

The genus *Udea* includes many species from around the world. For Taiwan, the Taiwan catalog of 1992 (Heppner and Inoue, 1992) listed 5 species then known for the island. Some nomenclatural changes will be noted for some of the species in the catalog update (Heppner, 2005). Herein, collection records from the Taiwan Lepidoptera Survey are recorded for another *Udea* species new for Taiwan, being a high altitude example of the Japanese faunal influence in Taiwan, *Udea stigmatalis* (Wileman, 1911), originally described from Japan. Thus far, all specimens in Taiwan have only been taken at 2000-2570m elevation. Inoue *et al.* (1982) illustrate the species from Japan. The species has until now not been recorded outside of Japan.

All specimens reported on below are from the Taiwan Lepidoptera Survey, currently housed at the Florida State Collection of Arthropods (FSCA), Gainesville, Florida. A new Taiwan subspecies is described for the Taiwan populations of *U. stigmatalis*.

Udea stigmatalis tayulingensis Heppner, n. subsp.

Adult similar in size (male 22-24mm wingspan, female 22-26mm) to Japanese specimens, with similar wing maculation: body and forewing coloration fuscous (abdomen paler) with pale irrorations on FW, with basal suffusion of rust-brown to mid-costal region, with 2 irregular fuscous spots about midwing on radius. HW pale translucent white with apical gray area and small subterminal line, plus a small fuscous spot midwing. Female similar but FW spots somewhat larger than in male.

Holotype male: TAIWAN.— Nantou Co.: Tayuling (2570m), 5-9 Jun 1982, J.B. Heppner. Deposited with the National Taiwan Museum, Taipei, Taiwan (on indefinite loan to the Florida State Collection of Arthropods, Gainesville, Florida).

Paratypes (33 ♂, 30 ♀): TAIWAN.— Hsinchu Co.: Kuangwu For. Sta. (2000m), 18-25 Aug 1988 (1 ♂), J. B. Heppner & H.-Y. Wang. Kaohsiung Co.: Tienchih (2210m), 24 Oct 1984 (7 ♂, 2 ♀), J. B. Heppner & H.-Y. Wang. Nantou Co.: Tayuling (2570m), 5-9 Jun 1982 (9 ♂, 7 ♀); 10-14 Jun 1982 (6 ♂, 12 ♀); 15-18 Jun 1982 (9 ♂, 8 ♀), J. B. Heppner. Meifung Hort. Sta. (2100m), 6-10 Sep 1988 (1 ♂, 1 ♀), J. B. Heppner & H.-Y. Wang. Etymology.— Named after the town of Tayuling, Taiwan. Distribution.— Japan and Taiwan.

Notes.— The species *U. stigmatalis* seems related to two European species that have some resemblance to it, *Udea prunalis* ([Denis & Schiffermüller]) and *U. inquinatalis* (Lienig & Zeller). Males of the European *U. olivialis* ([Denis & Schiffermüller]) also have some resemblance to *U. stigmatalis*. In all these cases, the European species have some markings that are similar but nonetheless are all gray in general coloration, while *U. stigmatalis* in Japan and Taiwan

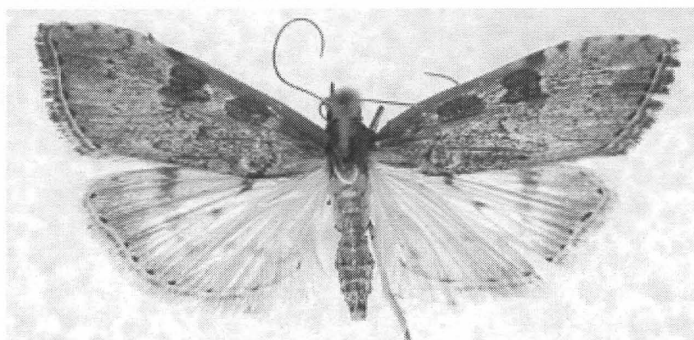


Fig. 1. Paratype female of *Udea stigmatalis tayulingensis*.

have shades of brown on the forewings. In Japan, the species is generally somewhat larger than in Taiwan and more brownish overall. The biology of the *U. stigmatalis* remains unknown. *Udea* species in general are known to be leaf-feeders on herbaceous plants, and some species also feed on various hardwood trees.

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PRIMITIVE SEDGE MOTHS FROM NEW ZEALAND AND TASMANIA: TRANSFER OF *PRODITRIX* AND RELATIVES TO ORTHOTELIINAE (LEPIDOPTERA: GLYPHIPTERIGIDAE)

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ABSTRACT.— The New Zealand genera, *Charixena* Meyrick, *Doxophytis* Meyrick, *Proditrix* Dugdale, *Protosynaema* Meyrick, and *Titanomis* Meyrick, in the past thought to be in Plutellidae or other families, are transferred to subfamily Orthoteliinae of the family Glyphipterigidae as the first non-European Orthoteliinae, a highly significant finding for elucidating the evolution of Glyphipterigidae and the superfamily Yponomeutoidea. *Orthotelia*, previously the only known member of primitive sedge moths (subfamily Orthoteliinae), shows many adult and larval characters that align it with the New Zealand *Proditrix* complex of genera and species. The Southern Hemisphere contingent of Orthoteliinae is seen as a relictual group within Glyphipterigidae, present thus far only in the ancient refugium of New Zealand, with one species in Tasmania. Adults are diurnal or crepuscular. Larvae of Orthoteliinae are borers in monocot hostplants (except for the single species in Tasmania feeding on a lower dicot plant), while most species in the subfamily Glyphipteriginae that are known biologically (95% of species in the family remain unknown biologically) are borers or leafminers, mostly also in monocot hostplants such as sedges and grasses.

KEY WORDS: *Abrenthia*, Acrolophidae, Asia, Australia, biology, Brachodidae, *Carmentina*, *Caunaca*, *Charixena*, China, Choreutidae, cocoon, Colombia, Costa Rica, *Cotaena*, Cyperaceae, *Diploschizia*, *Doxophytis*, *Drymoana*, Epacridaceae, Ericales, Europe, Japan, Glyphipteriginae, *Glyphipterix*, Gramineae, *Hierodoris*, hostplants, Immidae, Immoidea, Japan, Lacturidae, larvae, *Lepidotarphius*, morphology, *Neomachlotica*, Neotropical, Noctuidae, Noctuoidae, *Ochsenheimeria*, *Ochsenheimeriidae*, Oecophoridae, Oriental, *Orthotelia*, Pandanaceae, Palearctic, *Plutella*, Plutellidae, Praydinae, *Prays*, *Proditrix*, *Protosynaema*, Psychidae, pupae, *Sericostola*, Sesiioidea, Taiwan, Tasmania, taxonomy, Tineidae, Tineoidea, *Titanomis*, USA, Urodidae, Yponomeutidae, Yponomeutoidea, Ypsolophinae, Zygaenidae, Zygaenoidea.

When the family Glyphipterigidae was first delineated to modern taxonomic standards (Heppner, 1977, 1982a), a number of genera incongruously named or organized within the family by E. Meyrick (1914) were transferred to other families (Heppner, 1982b). Types and descriptions of 272 supposed or historically associated Glyphipterigidae genera were previously studied (Heppner, 1982b), and then transferred to 25 different families as diverse as Psychidae (Tineoidea) and Zygaenidae (Zygaenoidea), even small Noctuidae (Noctuoidae), plus large contingents to Choreutidae and Brachodidae (Sesiioidea), and many tropical genera to such families as Attevidae (Yponomeutoidea), Immidae (Immoidea), Lacturidae (Zygaenoidea), and Urodidae (Sesiioidea) (Heppner, 1981a, 1982b, 1982c, 1995, 1996; Kyrki, 1988, 1990). Genera remaining in Glyphipterigidae were a fairly homogeneous group that have retained their status (Heppner, 1982a), with the most speciose and worldwide genus being *Glyphipterix* (often misspelled as *Glyphipteryx* in older literature).

It was not until Kyrki (1984) began his studies of Yponomeutidae that this further grouping of unrelated genera was found needing re-study, and where he also had to transfer various genera to other families, although some went to what now can be considered subfamilies of Yponomeutidae, or Plutellidae (e.g., Ypsolophinae). Later, Kyrki and Itämes (1986) discovered in their study of the biology and morphology of the unusual misplaced and monobasic European genus *Orthotelia* Stephens (often misspelled as *Orthotaelia*), that this represented the most primitive sedge moth, and transferred the genus as a new glyphipterigid subfamily, Orthoteliinae. Meyrick's (1895) summary of British Lepidoptera had *Orthotelia* as a genus of Plutellidae, although his concept of this family was equivalent to half of what now are considered part of the superfamily Yponomeutoidea, plus the genera that now are in Choreutidae. Spuler (1910) already had the genus in its own subfamily, Orthoteli-

nae, but within Plutellidae. Older works, as summarized by Kyrki and Itämes (1986), had *Orthotelia* placed among other groups since Stephens first named the genus in 1829 (the single species was first described in 1794), even as disparate as Gelechiidae and Tineidae, and sometimes in its own monobasic family. None of these works, including later works by Meyrick (1895) and Spuler (1910), made any significant phylogenetic comments about the genus or offered much of a solution as to its affinities, other than a generalized phylogenetic schematic by Meyrick (1895) showing *Orthotelia* basal to lineages to what now are Yponomeutidae and Plutellidae. In his world catalog for the yponomeutid complex, Meyrick (1914) still retained the genus in Plutellidae. *Orthotelia* are larger and different in appearance from typical sedge moths of the subfamily Glyphipteriginae, but conform to the fundamental morphology of the family, as the subfamily Orthoteliinae.

In my earlier paper on generic transfers out of the older concept of Glyphipterigidae (Heppner, 1977), two Meyrick genera from New Zealand, *Charixena* and *Protosynaema*, appeared to belong best in Plutellidae and were retained or transferred to that family based on adult characters. Meyrick had described *Protosynaema* in 1886 (named in 1885) and placed it tentatively in Plutellidae (Meyrick, 1914). *Doxophytis* Meyrick (1914) was also described as Plutellidae, but Meyrick stated he thought it was related to Glyphipterigidae. It was not until a paper by Dugdale (1987a), on a new complex of strange New Zealand moths which he named in the new genus *Proditrix* and which he grouped together with some other unusual New Zealand species of related genera described by Meyrick — *Charixena*, *Doxophytis*, and *Protosynaema* — that it became evident to me that this group of New Zealand taxa actually represented the first non-European Orthoteliinae.

On adult characters, it could be possible to maintain *Proditrix* and relatives as Plutellidae, as Dugdale (1987a) thought (he used Plutellinae as a subfamily of Yponomeutidae), since to some extent the often plesiomorphic characters partially overlap in the families

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we are discussing, but the larval and pupal morphology, and their biologies, clearly are unknown for Plutellidae. Kyrki (1990) made further studies on possible evolutionary lineages in Yponomeutoidea, based on a cladification of the groups involved, later reviewed by Dugdale *et al.* (1999). All four of these New Zealand genera are borers in the leaf crowns of monocot hostplants (Dugdale, 1987a; Hudson, 1928), something unknown for Plutellidae, which typically are leaf skeletonizers on dicot plants (a small group are flower borers). Although it is not unusual to find strange tropical species that require us to alter the concept of Lepidoptera families, which were originally based mostly on European species, a study of the morphology of these New Zealand species demonstrates that they conform to Orthoteliinae and need a transfer to Glyphipterigidae to join *Orthotelia* as the most primitive of the sedge moths. Table 1 notes the main characters demonstrating the new assignments to Glyphipterigidae for the New Zealand species. Clearly, they represent evolutionary elements that are basal to much of the Yponomeutoidea.

Dugdale (1987a) noted a fauna of 12 species in New Zealand in the *Proditrix* group of genera, plus an undescribed species from Tasmania that he thought was possibly related to *Doxophyrtis*. Together with species Dugdale (1987a) transferred to his new genus, *Proditrix*, the check list below includes all species now transferred to Orthoteliinae, plus the one from Tasmania recently described as another species of *Proditrix* (McQuillan, 2003). Dugdale (1987a) included the New Zealand species, "*Hierodoris*" *stellata* Philpott, as the 12th member of this group; this species needs further study to confirm its generic placement. The genus *Hierodoris* Meyrick otherwise belongs in Oecophoridae (Dugdale, 1988; Heppner, 1977).

The species *Proditrix tetragona* (Hudson), was originally described in the genus *Titanomis* Meyrick and thought to belong in Tineidae, but Dugdale (1987a) verified this as belonging in his new genus *Proditrix*. The only actual known *Titanomis* species, *Titanomis sisyrota* Meyrick, previously left unclassified (Dugdale, 1988), is also a very rare species from the highlands of New Zealand. This species in the past was referred to Psychidae or even Cossioidea, due to its combination of primitive characters. The original description by Meyrick (1888) tentatively placed the genus in his concept of Anaphoridae (now Acrolophidae), and was maintained there by Dalla Torre and Strand (1929) in their catalog of Psychidae but which then included Anaphorinae. Further notes by Hudson (1928), and the known characters of *T. sisyrota*, lend credence to it also being in Orthoteliinae, and is hereby transferred to the *Proditrix* group. Dugdale (1987a) noted that *Titanomis* has 4-segmented maxillary palpi and lacks ocelli, among other characters now seen as close to *Orthotelia*. The biology and larvae are not known but the noted habitat is similar to that of the other New Zealand Orthoteliinae, namely montane wet grasslands (Hudson, 1928). It is even slightly larger than *P. tetragona* and also appears similar in wing maculation (illustrated by Hudson, 1928).

Whereas the type-species of the genera were examined for adult characters for my generic study of Glyphipterigidae (Heppner, 1977), other species were not all examined. Thus, it remains uncertain if some odd species, like *Protosynaema steropucha* Meyrick (Fig. 9) belong in the genus and in Glyphipterigidae, since the greatly thickened antennae are anomalous for the family. However, based on Dugdale's (1987a) analysis, these species are all placed correctly to genus, and can thus herein be transferred to Orthoteliinae, but perhaps individually needing further study. However, the undescribed species from Tasmania mentioned by Dugdale (1987a) as possibly related to *Doxophyrtis* from New Zealand, and now named as *Proditrix nielsenii* McQuillan (2003), feeds on an ericaceous-group tree (family Epacridaceae) and not a

monocot, so odd species sometimes do not conform to previous views. Although a few other sedge moths around the world are also known to feed on dicot plants, such as Piperaceae and Urticaceae (Diakonoff, 1986; Heppner, 1982a, in prep. a), most feed on monocots.

Most species in the family are not known biologically, so while the Holarctic and south temperate Glyphipterigidae have so far mainly been recorded on sedges, rushes and grasses, the tropical species that we know biologically thus far feed on more diverse plants, as just noted, but most species remain unknown biologically and detailed larval descriptions are even more scarce. At least for New Zealand Orthoteliinae, most appear to inhabit higher elevations with wet grasslands. The new species from Tasmania likewise occurs in a montane south temperate rainforest habitat (McQuillan, 2003).

As adults, most sedge moths are diurnally active (Heppner, 1981b, 1982a, 1985a, 2004, in prep. a). *Orthotelia* adults fly at dusk according to Kyrki and Itämes (1986). Dugdale (1987a) mentions some of the *Proditrix* species being collected at lights and also in flight traps, but it is likely most of these moths are crepuscular in adult activity. Typical Glyphipteriginae adults can be taken at lights as well, if one is near one of their resting sites at night, even though they are otherwise diurnal in activity. Hudson (1928) also notes species of what now are in the *Proditrix* complex as being taken at lights, but his text is often unclear whether any are also found during the day or at dusk. He notes diurnal activity, however, for the *Protosynaema* species. For *Doxophyrtis*, Hudson (1928) notes adults resting on hostplants during the day but is unclear if they otherwise are active diurnally or only at dusk. His notes on *Charixena* are very detailed about the larval life history, as well as the cocoon, but has no clear notes on adult activity. In Tasmania, McQuillan (2003) found the adults of the new *Proditrix* species there to be unwilling fliers, very sluggish and behaviorally adapted to death feints when disturbed among the leaves of their hostplant, and thus far not taken at lights, but no normal flight activity was recorded for this species.

One reason many of the *Proditrix* complex species seem to be rare may well be that they are active during the day or are crepuscular and are often in remote mountains, and thus not often taken at lights. Most moth collectors in general do not actively search for day-flying or crepuscular moths, if at all.

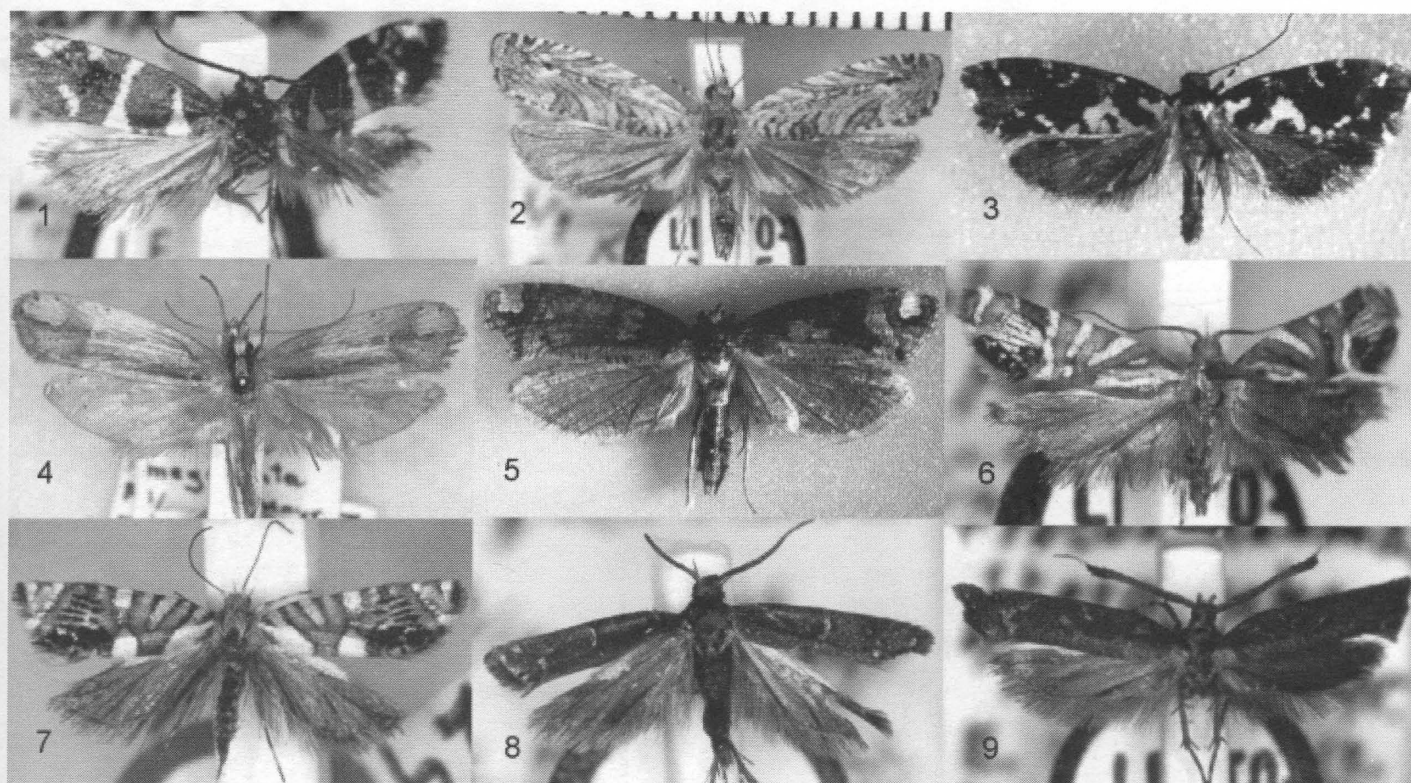


Fig. 1-9. Adults of New Zealand Orthoteliinae: 1. *Charixena iridoxa* (Meyrick), lectotype female (BMNH) (ca. 17mm). 2. *Doxophyrtis hydrocosma* Meyrick, lectotype male (BMNH) (ca. 20mm). 3. "*Hierodoris*" *stellata* Philpott, holotype male (NMNZ) (ca. 20mm). 4. *Proditrix megalynta* (Meyrick), holotype male (BMNH) (ca. 35mm). 5. *Proditrix tetragona* (Hudson), holotype female (NMNZ) (ca. 55mm). 6. *Protosynaema eratopis* Meyrick, lectotype male (BMNH) (ca. 16mm). 7. *Protosynaema hymenopis* Meyrick, holotype female (BMNH) (ca. 11mm). 8. *Protosynaema quaestuosa* Meyrick, lectotype male (BMNH) (ca. 16mm). 9. *Protosynaema steropucha* Meyrick, lectotype male (BMNH) (ca. 17mm).

ORTHOTELIINAE

ORTHOTELIA Stephens, 1829

TS: *Depressaria venosa* Haworth, 1811

Orthotelia Stephens, 1829, redesc.

Orthotaelia Stephens, 1834, emend.

Agonipteryx Treitschke, 1835

TS: *Haemylis sparganiella* Treitschke, 1832

Caulobius Duponchel, 1838

TS: *Haemylis sparganiella* Treitschke, 1832

sparganella (Thunberg, 1788) (*Tinea*) Sweden

sparganella (Thunberg, 1794) (*Tinea*), redesc. Sweden

venosa (Haworth, 1811) (*Depressaria*) England

tostella (Hübner, [1824]) (*Tinea*) Germany

sparganiella (Treitschke, 1832) (*Haemylis*) ?Hungary

TITANOMIS Meyrick, 1888

Titanomis Dalla Torre & Strand, 1929, missp.

TS: *Titanomis sisyrota* Meyrick, 1888

sisyrota Meyrick, 1888 New Zealand

PRODITRIX Dugdale, 1987

TS: *Plutella megalynta* Meyrick, 1915

chionochloae Dugdale, 1987 New Zealand

gahniae Dugdale, 1987 New Zealand

megalynta (Meyrick, 1915) (*Plutella*) New Zealand

nielsenii McQuillan, 2003 Tasmania

tetragona (Hudson, 1918) (*Titanomis*) New Zealand

tetragma Dugdale, 1999, missp.

DOXOPHYRTIS Meyrick, 1914

TS: *Doxophyrtis hydrocosma* Meyrick, 1914

Doxophyrtis Meyrick, 1914, nom. nud.

hydrocosma Meyrick 1914 New Zealand

hydrocosma Meyrick, 1914, nom. nud.

[New genus]

Hierodoris auct.

stellata (Philpott, 1918) (*Hierodoris*) New Zealand

CHARIXENA Meyrick, 1920

TS: *Philpottia iridoxa* Meyrick, 1916

Philpottia Meyrick, 1916, preocc.

Charixena Meyrick, 1921, redesc.

Charizena [sic] Neave, 1939, missp.

iridoxa (Meyrick, 1916) (*Philpottia*) New Zealand

PROTOSYNAEMA Meyrick, 1885

Protosynaema Meyrick, 1886

TS: *Protosynaema eratopis* Meyrick, 1886

eratopis Meyrick, 1886 New Zealand

hymenopis Meyrick, 1935 New Zealand

matutina Philpott, 1928 New Zealand

quaestuosa Meyrick, 1924 New Zealand

steropucha Meyrick, 1886 New Zealand

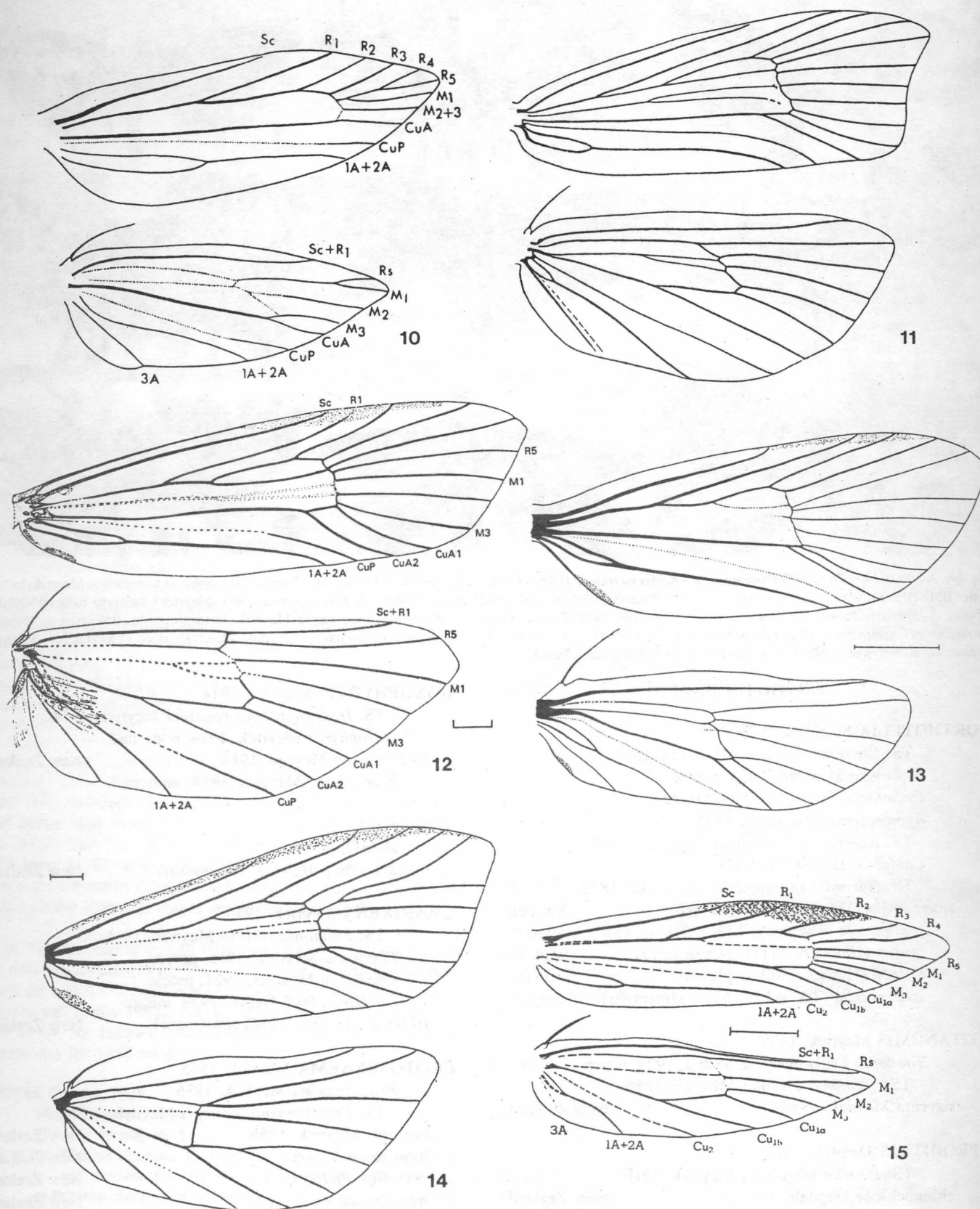


Fig. 10-15. Wing venations (Glyphipterigidae: Orthoteliinae and others as noted): 10) *Ochseneimeria vacculella* Fischer von Röslerstamm (Ochseneimeriidae), Europe (after Davis, 1975). 11) *Orthotelia spraganella*, Europe (after Spuler, 1910). 12) *Proditrix megalynta*, New Zealand (after Dugdale, 1987a). 13) *Glyphipterix quadragintapunctata* Dyar (Glyphipteriginae), USA (after Heppner, 1985). 14) *Sericostola rhodanopa* Meyrick (Glyphipteriginae), Colombia (after Heppner, 1990). 15) *Plutella xylostella* (Linnaeus) (Plutellidae), Eurasia (after Moriuti, 1977). Lines equate to 1mm for those figures with a line shown (others to various scales).

TABLE 1. Characters of Orthoteliinae in relation to Ochsenheimeriidae, Glyphipteriginae, and Plutellidae.

	Ocelli	Maxillary Palpi	Pupal Spines	Larval L-Group	Larval anal shield	Larval Prolegs	Larval Crochets	Larval A8 Spiracle	Larval Feeding	R1 spur vein
<i>Ochsenheimeria</i>	+	2	-	3	+	S	U/T1	N	B	--
<i>Orthotelia</i>	-	4	-	2	+	S	U/T2	L	B	--
<i>Titanomis</i>	-	4	?	?	?	?	?	?	?	+
<i>Proditrix</i>	+	3	-	3	+	S	U/P (C)	L	B	+
<i>Glyphipterix</i>	+	2-4	-	2(3)	+	S	U/P	L	B/LM	--
<i>Plutella</i>	+	4	-	3(2)	R	L	U/C	N	LS(FB)	--

Codes

Ocelli: present (+) or absent (-).

Maxillary palpi: number of segments.

Pupal spines: dorsal spination (some dorsal, lateral and ventral ridges may be present in some groups, like *Orthotelia* and *Proditrix*).

Larval L-group (prothoracic): number of setae.

Larval anal shield: dorsal shield present (+) or reduced (R).

Larval prolegs: short (S) or long (L).

Crochets: uniserial (U); transverse bands (T2) or in single row (T1); penellipse (P); circles (C).

A8 spiracle: normal (N) or enlarged (L).

Larval feeding: borers (B) or flower borers (FB); leafminers (LM); leaf skeletonizers (LS).

Characters distinguishing the New Zealand genera from Plutellidae while demonstrating cohesiveness with Orthoteliinae, in Glyphipterigidae, are summarized in Table 1. The table treats *Orthotelia*, *Titanomis* (adult characters only), and *Proditrix* in Orthoteliinae, *Glyphipterix* in Glyphipteriginae, plus the outgroups, *Ochsenheimeria* (Ochsenheimeriidae) and *Plutella* (Plutellidae). Information on Ochsenheimeriidae is taken mostly from Davis (1975) and Karsholt and Nielsen (1984); and notes on *Orthotelia* are from Kyrki and Itämes (1986), plus characters noted by Spuler (1910). Notes about Glyphipterigidae are taken from my works (Heppner, 1981b, 1982a, 1985a, 1990, 1998, 2004, in prep.), and from Arita and Heppner (1992) and Diakonoff (1986). Notes on Plutellidae are from Heppner (1998, 2004, in prep. a) and Dugdale *et al.* (1999). Biological data are from these references, as well as from Dugdale (1987a,b), Heppner (1987), Hudson (1928), and McQuillan (2003).

ORTHOTELIINAE

Adult: small to large (11-65mm wingspan); usually winged (rarely with slight female brachyptery). **Head:** vestiture somewhat rough-scaled; ocelli present or absent; chaetosema absent; eyes normal proportion; antenna filiform, sometimes thickened (rarely greatly thickened with scaling); labial palpi generally upcurved, with 2nd segment often tufted and apical segment smoother-scaled and upright; maxillary palpi 3- to 4-segmented and relatively prominent; haustellum present, naked. **Forewing:** elongated with typically oblique termen and tornal angle relatively abrupt; apex acute to rounded; costal margin with pterostigma or vestigial; venation complete and mostly evenly spaced veins, chorda developed and large; discal cell with forked median vein usually evident; venation with R1-R3 to costal margin, R4 to costa or at termen angle, and R5 to termen; median veins unbranched and M3 separate from CuA1, although may be very close at end of discal cell; cubital veins separate; CuP present at wing margin; anal veins present as A1+2 and A3; fringes moderate along termen. **Hindwing:** elongated with relatively acute apex, or somewhat blunted, and rounded tornal angle; venation similar to FW, with all veins present are rather evenly separated; discal cell with weak forked median vein evident; R5 to near apex or at apex, and usually straight from discal cell (rarely offset with R1 midwing spur

connection to Sc); median veins separate; M3 separate from CuA1; cubital veins distant at discal cell; CuP present at wing margin; anal veins as A1+2 and A3; fringes moderate but sometimes somewhat longer in some genera. **Abdomen:** dorsal spining absent; normal shape, without prominent sexual scaling or prominent choremata except small tufts at male pleural lobes; genitalia with male having pleural lobes configured with termen of abdomen, and female normal.

Larva: typically elongated and slender, with short prolegs; head usually somewhat prognathous; head setae with A1 close to A2, with A3 distant; P1 and P2 about subequal in separation as are A1 and A3; ocelli normal; prothorax with shield developed, L-group setae usually 2-segmented but some are 3-segmented, and SV setae on same pinaculum; abdomen with prolegs reduced or very short, crochets uniserial in transverse bands or small penellipse (rarely somewhat circular), SD1 setae above spiracle, SD2 usually very small, L1 and L2 setae separate and usually more distant from L3, spiracles enlarged on segment A8 and somewhat higher than remainder of spiracle line along abdomen, D1 setae usually somewhat closer together than D2 or about equidistant. Anal end of abdomen with prominent dorsal shield, often with strongly armed spurs or spines, and A8 with D1 setae more separated than D2 setae, and L1 distant from L2.

Pupa: head often with raspy process or horn-like structures; appendages all evident; spiracles usually somewhat protruded or on small cones; abdomen often roughened but not spined, but sometimes with prominent ridges (both dorsally and ventrally); cremaster with strong spines. Pupa not generally protruded from cocoon at eclosion but sometimes somewhat projected part-way from cocoon (*Orthotelia*).

Cocoon: flattened silken case with ends slit for emergence, or simple tubular silken structure within host stem and with pre-constructed emergence hole.

ADULT CHARACTERS

Among the genera treated, the head includes useful characters like the ocelli and maxillary palpi. All groups in Table 1 have ocelli present except *Orthotelia* and *Titanomis*. For maxillary palpi, the Glyphipterigidae have a range of 2-4 segments, while Ochsenheimeriidae have 2-segmented maxillary palpi and Plutellidae have 4 segments. As in archaic moths, the greater number of maxillary palpal segments is considered to be the primitive state, even though some otherwise ancestral groups can have developed reductions, as has Ochsenheimeriidae (2 segments) among the Yponomeutoidea.

In Glyphipterigidae, the genera vary in the number of segments

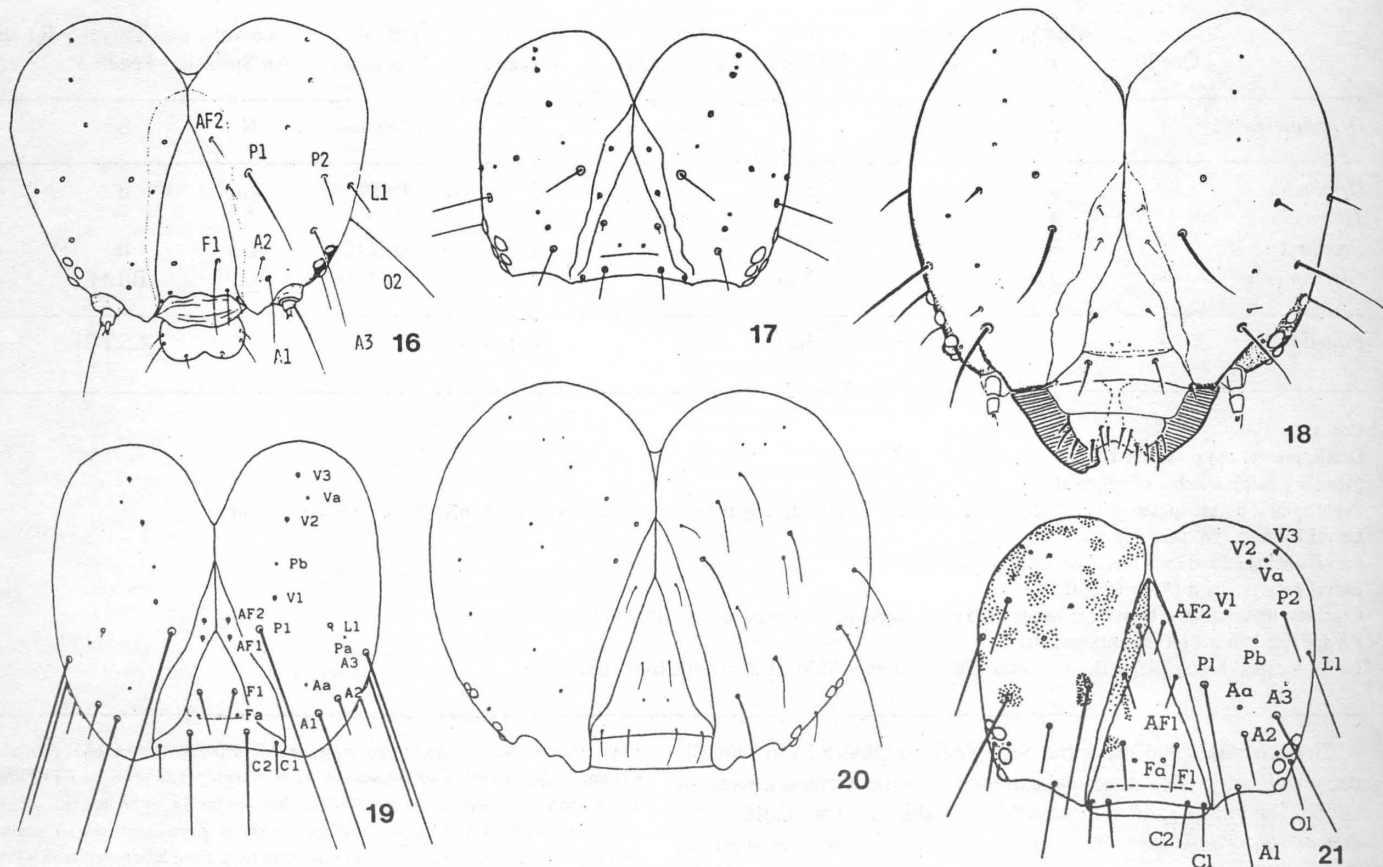


Fig. 16-21. Larval head chaetotaxy (Glyphipterigidae except as noted): 16) *Ochseneimeria* (Ochseneimeriidae), Europe (after Davis, 1975). 17) *Orthotelia* (Orthoteliinae), Europe (after Kyrki and Itämes, 1986). 18) *Proditrix megalynta* (Orthoteliinae), New Zealand (after Dugdale, 1987a). 19) *Glyphipterix scirpi* Arita (Glyphipteriginae), Thailand (after Arita, 1995). 20) *Glyphipterix semiflaviana* Issiki (Glyphipteriginae), Japan (after Moriuti, 1960). 21) *Plutella xylostella* (Plutellidae), Europe (after Moriuti, 1977). Fig. 19 and 21 with stylized setae as drawn.

in the maxillary palpi from 2 to 4 segments: for example, *Orthotelia* (4), *Titanomis* (4), *Proditrix* (3), *Abrenthia* (3), *Neomachlotica* (3), *Drymoana* (4), *Lepidotarphius* (2), *Carmentina* (2, vestigial), *Sericostola* (2), *Glyphipterix* (2-4), and *Diploschizia* (2). The genus *Orthotelia* is European, *Lepidotarphius* is East Asian (northern China and Japan), *Carmentina* is tropical Oriental, *Proditrix* and relatives are from New Zealand and Tasmania, and *Sericostola* is from Colombia and Costa Rica, while the remainder are Nearctic except for the worldwide genus *Glyphipterix* (Diakonoff, 1986; Heppner, 1981b, 1982a, 1985a, 1990, 1998, 2003, in prep. a,b; Spuler, 1910).

Wing venation of the *Proditrix* group (Dugdale, 1987a) conforms very well with the venation found in *Orthotelia* (Spuler, 1910). The only significant difference is that in *Proditrix* the hindwing Rs (or R5) vein is offset mid-wing by an R1 spur connection (Fig. 12), which is a straight vein in *Orthotelia* (Fig. 11). The radial veins are the same in both wings, while in *Plutella* in the hindwing the first 2 radial veins are typically fused as M1+M2 at the discal cell and split near the termen (Fig. 15); both being separate in Orthoteliinae. The wing venation among Glyphipteriginae genera is more and more specialized in the smaller or more narrow-winged species, while the larger species are less so (Fig. 13-14). Females of *Proditrix megalynta* (Meyrick) are somewhat brachypterous, with shortened and pointed wings (Dugdale, 1987a), which is not evident elsewhere in the Glyphipterigidae.

The R1 hindwing spur vein connection to Sc is a very primitive character in Lepidoptera. Evidently, an ancient character that has been modified in most lepidopterans. One finds this still among some homoneurous archaic moths and also in various isolated genera among higher lepidopterans, as in Tineidae (*Ardiosteres* from Australia), Psychidae (*Homera* from Australia, *Thyridopteryx* from the New World, *Pseudarbela* from Southeast Asia, and many others), many Pyralidae, Urodidae (*Urodus* from the New World), many Zygaenidae, Ratardidae (*Ratarda* from Southeast Asia), and Lasiocampidae (*Heteropacha* from the USA). Otherwise, besides those groups with reduced venation, instead of a mid-wing R1 spur vein some other lepidopterans have retained a basal connection or part of the radius is merged with the Sc vein, as in Prodoxidae (*Tegeticula* from North America), Cecidosidae (*Cecidoses* from Argentina), Oecophoridae (*Thyrocopa* from Hawaii), many Gelechiidae, Attevidae (*Atteva* from the New World), Thyrididae (*Thyris* from Europe), many Pyralidae, Somabrachyidae (*Somabrachys* from North Africa), Megalopygidae (*Megalopyge* from the New World), many Tortricidae, many Geometridae, many Papilionidae, many Drepanidae, Bombycidae (*Bombyx* from Asia), and other Bombycoidea, as well as most Noctuoidea.

Genitalia characters of the *Proditrix* complex are not distinctive in being either Plutellidae or Glyphipterigidae, and certainly can be included in Orthoteliinae without any problem based on genitalia. Even the so-called pleural lobes in males, thought to be an apomor-

phic character for Yponomeutoidea (Kyrki, 1984), are also found in some Pyralidae (Heppner, 1998), although it remains unknown whether these are independently derived in the latter family.

Among Glyphipterigidae in general, the European *Orthotelia sparganella* (Thunberg) is a large species (18-28mm in wingspan) and is very different in appearance from most sedge moths (Kyrki and Itämies, 1986). However, the very large New Zealand species, *Proditrix megalynta* (29-38mm), is rather similar in superficial appearance to *Orthotelia*. The genus *Sericostola* (ca. 34mm), with two species from Colombia and Costa Rica, includes the largest known sedge moths from the New World in the subfamily Glyphipteriginae (Heppner, 1990), although the Neotropical genus *Cotaena* has very heavy-bodied, colorful species that average about 26mm in wingspan (in prep. c), and an undescribed sedge moth (genus uncertain) from Venezuela is about 22mm in wingspan. The largest species in Europe is *Glyphipterix loricatella* (Treitschke), with a wing expanse of 17-21 mm (Diakonoff, 1986; Kun and Szabóky, 2000). *Lepidotarphius perornatella* (Walker), an exceedingly colorful orange and green species from China and Japan (probably introduced to Taiwan with its garden hostplant), averages 13-19mm, and is the largest sedge moth from East Asia (Arita and Heppner, 1992; Diakonoff, 1986; Kodama, 1961).

The newly transferred New Zealand species in Orthoteliinae now are among the largest of all sedge moths, with *Proditrix* species being among the largest known: *P. megalynta* at 29-38mm in wingspan and *P. tetragona* (Hudson) at 44-55mm wingspan (Dugdale, 1987a). The latter species was described by Hudson (1918) and is one of the largest microlepidopterans in New Zealand outside of the Hepialidae. Its long-thought sister species, *Titanomis sisyrota*, is likewise a rare higher altitude (ca. 1000m) moth, known only by a few specimens, and the females are up to 65mm in wingspan, making it the largest known glyphipterigid. The new species from Tasmania, *Proditrix nielsenii*, is about the same size, at about 64mm in wingspan (McQuillan, 2003).

Most typical sedge moths, mainly in the genus *Glyphipterix*, average only about 8-10mm in wingspan (Diakonoff, 1986; Heppner, 1982a, 1985a, in prep.). Among the smallest species are *Diploschizia minimella* Heppner, from Florida (ca. 4.5-6mm) (Heppner, 1981b, 1985a), and the Taiwan species *Glyphipterix tona* Arita & Heppner (ca. 5-6mm) (Arita and Heppner, 1992).

LARVAL CHARACTERS

The primitive condition in the larvae appears to be 3 lateral (L-group) setae on the prothorax, as in Ochsenheimeriidae: this is 2 in *Orthotelia*, 3 in *Proditrix*, and 2 in other Glyphipterigidae where larvae are known. One New Zealand species of *Glyphipterix*, however, also has 3 L-group prothoracic setae, according to Dugdale (1987b). Plutellidae have 3 lateral prothoracic setae, but a few have only 2 (Praydinae). The bisetose L-group configuration has been thought typical for Glyphipterigidae, but the New Zealand species noted by Dugdale (1987b) as having a vestigial 3rd seta is a key indication that more species in the family may have this character state. We know at most 5% of the species of Glyphipterigidae biologically, and far fewer where the larvae have been described, and most of these are from the Holarctic region, not the tropics where more of the stranger species occur, like *Sericostola* in South America. Thus, having 3 prothoracic L-group setae is likely the ancestral larval state, as evidenced also in the *Proditrix* complex of Orthoteliinae from New Zealand. Unfortunately, as is often the case hindering phylogenetic analyses among the more obscure lepidopter-

ans in the world, the larvae of *Titanomis* remain unknown. Previously, we only had detailed larval chaetotaxy for *Orthotelia* and some Glyphipteriginae (Heppner, 1981b, 1985a, 1987; Kodama, 1961; Kyrki and Itämies, 1986; Moriuti, 1977; Werner, 1958).

Head chaetotaxy among the New Zealand species conform well to *Orthotelia* (Fig. 17-18), while *Glyphipterix* have the setae more varied (Fig. 19-20). However, few species have the larvae known or described, so overall generalities for the family still remain speculative to some extent.

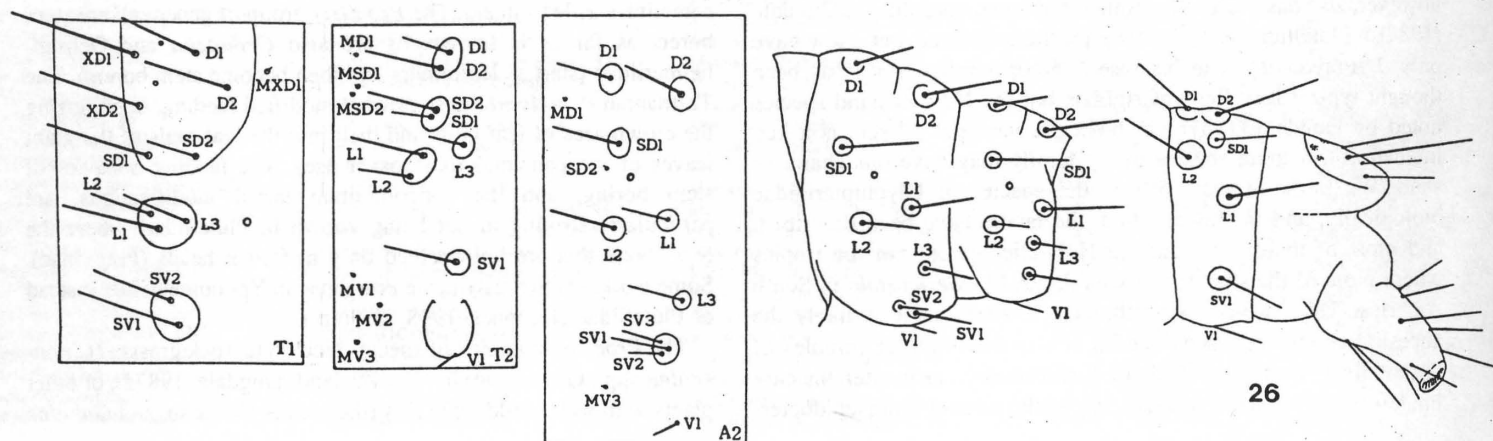
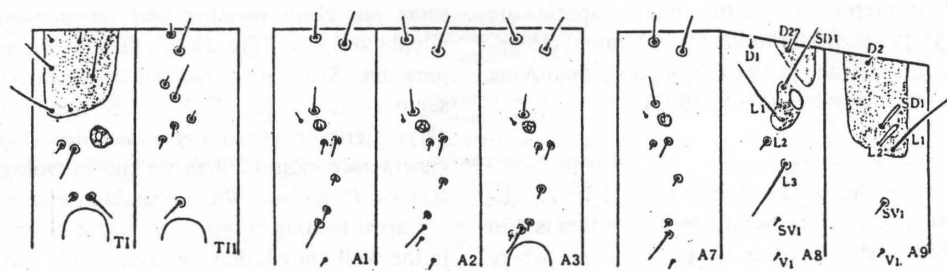
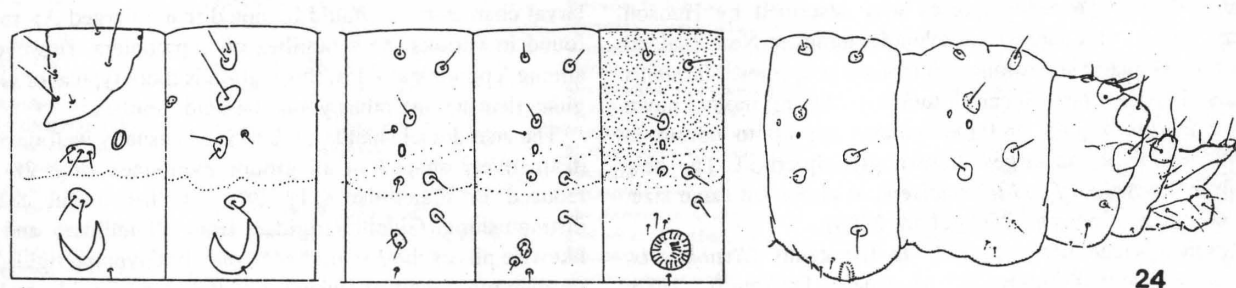
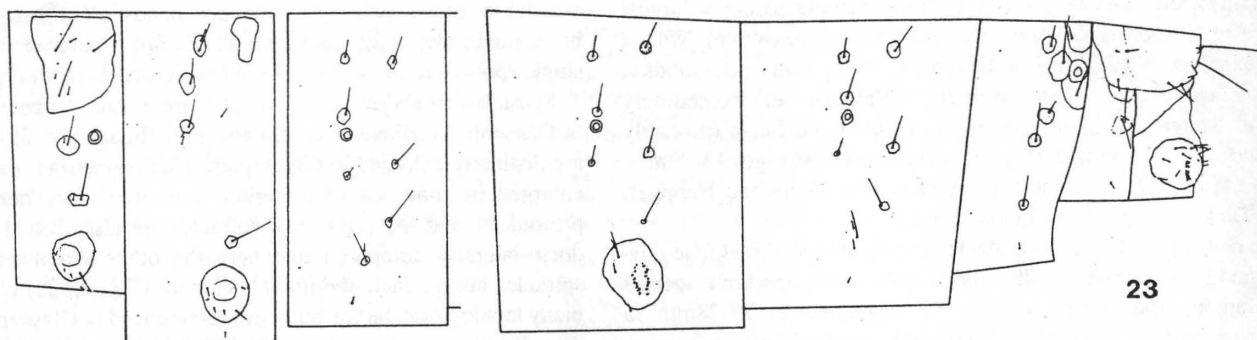
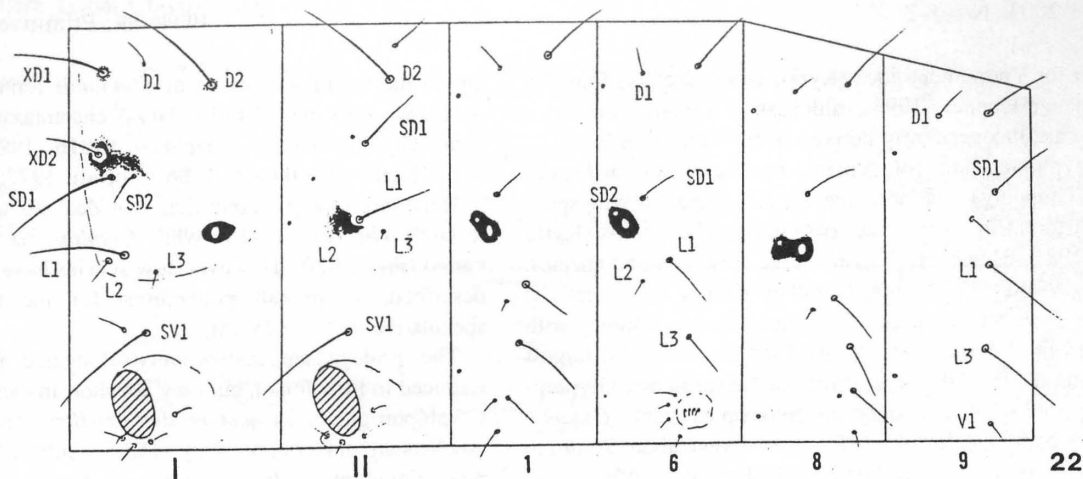
The prolegs are distinctively elongated in most Plutellidae (reduced in Praydinae), but they are short in Ochsenheimeriidae and Glyphipterigidae, as also in the *Proditrix* group of genera. The crochets are uniserial but vary in their configuration: a penellipse in most Glyphipterigidae, likewise in *Proditrix* but slightly more circular in some species, yet transverse bands in *Orthotelia*. Ochsenheimeriidae also have transverse bands but a reduced form with a single row of crochets. Plutellidae have crochets in uniserial circles.

Spiracles on abdominal segment 8 are normal (subequal in size) in Ochsenheimeriidae (Fig. 22) and Plutellidae (Fig. 26). Spiracles are distinctly enlarged in Glyphipterigidae (sometimes only slightly enlarged in some Glyphipterigidae but often very much so and protruded), and the segment 8 spiracles are also shifted somewhat dorso-laterally compared to where the other abdominal segment spiracles are on each abdominal segment (Fig. 23-25) (common to many lepidopteran larvae but more pronounced in Glyphipterigidae). The *Proditrix* group of genera likewise have these apomorphic larval characters. It should be noted that enlarged A8 spiracles are found in various other families of Lepidoptera. However, at least among Yponomeutoidea, this feature is more typical of Glyphipterigidae than for the other yponomeutoid families.

The anal dorsal shield of the larvae is usually well-developed and distinctively shaped in all groups mentioned (Fig. 28-33), while reduced in Plutellidae (Fig. 34). Another useful character for distinguishing Glyphipterigidae from Plutellidae, and one that likewise places the *Proditrix*-complex in Glyphipterigidae, is on the 9th abdominal segment, where in Plutellidae (Fig. 34) the D1 and D2 setae are close together and on merged pinacula, whereas in Glyphipterigidae (Fig. 28-33) they are more separate and on distinct pinacula. Spatulate setae, as in *Proditrix* on the 9th abdominal segment (Fig. 24, 29-30) are also known in larvae of the glyphipterigine genus *Lepidotarphius* (Fig. 25) and likely other genera once more of them are known biologically. In the Tasmanian species, *P. nielsenii*, these spatulate setae are missing, however.

Larval feeding is typically as leaf skeletonizers in Plutellidae, as in the well-known diamondback moth, *Plutella xylostella* (Linnaeus), but most Glyphipterigidae are stem borers or borers in seeds, sometimes as leafminers. The *Proditrix* group of genera all are stem borers as far as is known, as are also *Orthotelia* and Ochsenheimeriidae (start as leafminers and then become stem borers). The Tasmanian *P. nielsenii* has somewhat modified feeding, in preferring the crown area of leaf buds and then into the leaf axils of the giant leaves of the pandanus-like host it uses. The feeding behavior of stem boring, and the concomitant larval modifications, are particularly striking in not being known in Plutellidae, where the few borers that are known feed only in flower heads (Praydinae). Some works erroneously place Praydinae in Yponomeutidae, instead of Plutellidae (Heppner, 1998, in prep.).

The *Proditrix* complex of species feed on tussock grasses (*Chionochloa* spp.; Gramineae) in New Zealand (Dugdale, 1987a), or other plants with water-holding leaves (the sedges *Carex* sp. and *Gahnia*



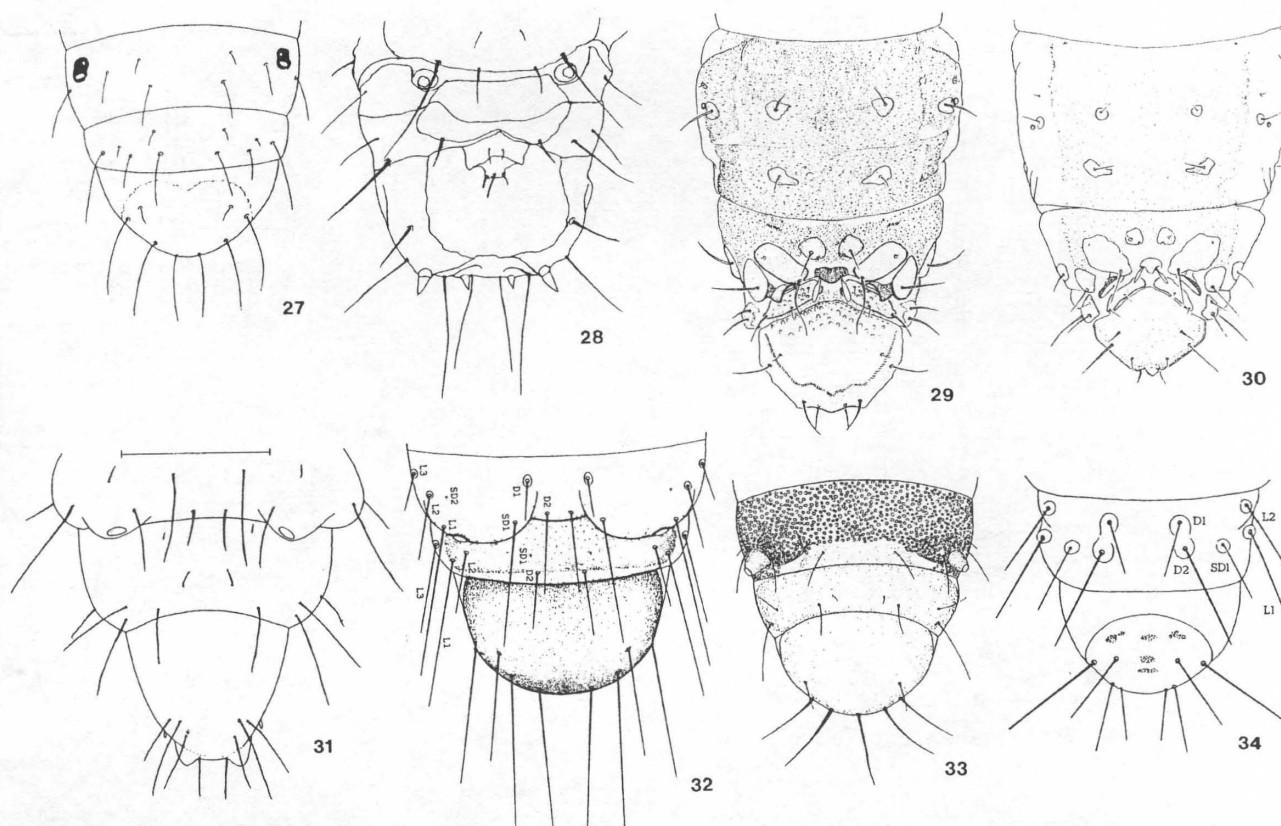


Fig. 27-34. Posterior ends of larvae, segments 8-10 (dorsal view) (Glyphipterigidae except as noted): 27) *Ochsenheimeria* (Ochsenheimeriidae), Europe (after Davis, 1975). 28) *Orthotelia* (Orthoteliinae), Europe (drawn after Kyrki and Itämes, 1986). 29) *Proditrix tetragona* (Orthoteliinae), New Zealand (after Dugdale, 1987a). 30) *Proditrix megalynta* (Orthoteliinae), New Zealand (after Dugdale, 1987a). 31) *Glyphipterix semiflavana* (Glyphipteriginae), Japan (after Moriuti, 1960). 32) *Glyphipterix scirpi* (Glyphipteriginae), Thailand (after Arita, 1995). 33) *Diploschizia habecki* Heppner (Glyphipteriginae), USA (after Heppner, 1981). 34) *Plutella xylostella* (Plutellidae), Europe (after Moriuti, 1977). Fig. 32 and 34 with stylized setae as drawn; Fig. 27 and 31-34 with stylized segmental forms as drawn.

setifolia, in Cyperaceae, the lilies *Astelia cockaynei* and *Collospermum hastatum* in Liliaceae, and *Freycinetia banksii* in Pandanaceae). The Tasmanian species feeds on foliage of a small pandanus-like tree, *Richea pandanifolia* (Epacridaceae), which is an ericaceous-related (Ericales) dicot plant (Dugdale, 1987a; McQuillan, 2003). Some other glyphipterigids around the world also feed on various dicot plants, although most are on sedges and rushes, or grasses. The use of mostly tussock grasses, or other monocots, as hostplants, however, conforms to the hosts of typical New Zealand glyphipterigid moths (genus *Glyphipterix*), which in New Zealand are called tussock moths, or cocksfoot moths, rather than sedge moths. At least some of the species do enough feeding on pasture and range grasses in New Zealand to be considered pests (White, 2002). Hudson (1928) presented most of the known biologies for the species, later elaborated on by Dugdale (1987a) for some of them.

PUPAL CHARACTERS

All genera discussed lack dorsal pupal spines, as is typical for Yponomeutoidea. The large pupae of *Orthotelia* and *Proditrix* do have some abdominal ridges (Fig. 35-36), both dorsally and laterally and even ventrally, but not spines as in Tortricidae and other primitive Microlepidoptera. However, all have the spiracles raised out from the pupal body, even in Plutellidae, but they are reduced in Orthoteliinae and Ochsenheimeriidae (Fig. 35-41). Some Ypono-

meutidae have this feature of the spiracles even more pronounced.

The few Glyphipteriginae pupae known show advanced characters, such as having the labial palpi exposed away from the labrum (Fig. 37-39), while in Orthoteliinae (Fig. 35) as also in Plutellidae (Fig. 40-41), the labial palpi touch the labrum, but the configuration among the more primitive Glyphipteriginae (e.g., the genera *Carmentina* and *Cotaena*, among others) is not known.

The cocoons in Glyphipterigidae and Plutellidae have rather distinctive filigreed or mesh-work form in an elongated shape. These cocoons are rather delicate silken construction in most sedge moths, but in some genera, like the Neotropical *Cotaena*, the large cocoons are very strongly constructed, yet with an open mesh-work form nonetheless. The only other families that also have such cocoons among the Microlepidoptera are Urodidae, in Sesiioidea, and Lacturidae, in Zygaenoidea (some Saturniidae, for example, make unusual filigreed cocoons, among the macro moths). There also are some similar cocoon examples among Acrolepiidae and in the tineoid family Schreckensteiniidae. In Ochsenheimeriidae, the cocoon is a simple silken case but few of the species are known biologically. In the New Zealand *Proditrix* complex, the cocoon is a flattened silken case, open at both ends as small slits in the webbing. The cocoon of *Orthotelia* is a simple form within the host stem, with an external silken flap over a pre-constructed emergence hole.

Fig. 22-26. Larval chaetotaxy (Glyphipterigidae except as noted): 22) *Ochsenheimeria* (Ochsenheimeriidae), Europe (after Davis, 1975). 23) *Orthotelia* (Orthoteliinae), Europe (after Kyrki and Itämes, 1986). 24) *Proditrix tetragona* (Orthoteliinae), New Zealand (after Dugdale, 1987a). 25) *Lepidotarphius perornatella* (Walker) (Glyphipteriginae), Japan (after Kodama, 1961). 26) *Plutella xylostella* (Plutellidae), Europe (after Moriuti, 1977). Fig. 26 with stylized setae as drawn.

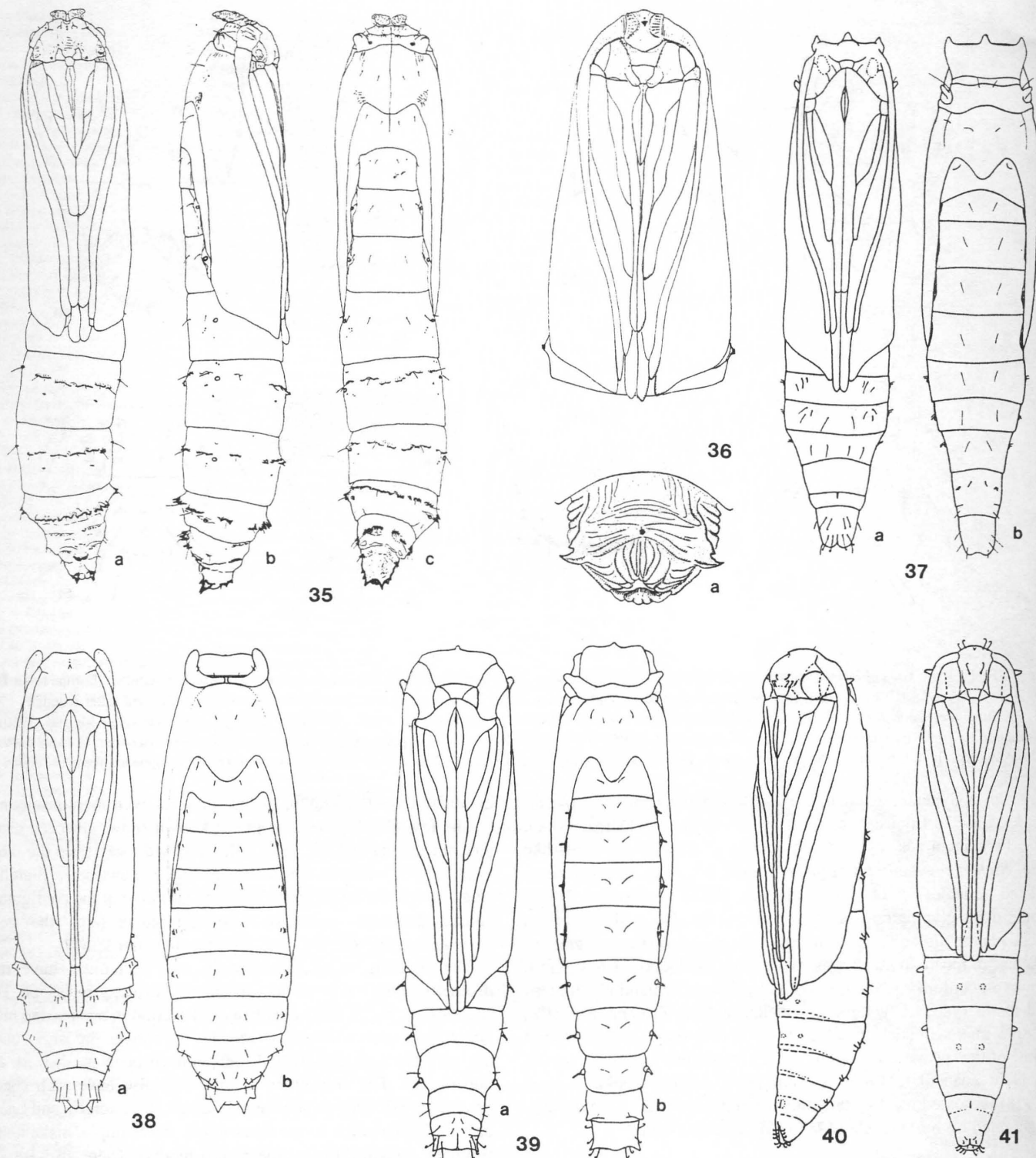


Fig. 35-41. Pupae (Glyphipterigidae except as noted): 35) *Orthotelia* (Orthoteliinae), Europe (after Kyrki and Itämies, 1986) (a, ventral view; b, lateral; c, dorsal). 36) *Proditrix gahniae* (Orthoteliinae), New Zealand (after Dugdale, 1987a) (a, cremaster detail). 37) *Glyphipterix semiflavana* (Glyphipteriginae), Japan (after Moriuti, 1960) (a, ventral; b, dorsal). 38) *Glyphipterix scirpi* (Glyphipteriginae), Thailand (after Arita, 1995) (a, ventral; b, dorsal). 39) *Diploschizia habecki* (Glyphipteriginae), USA (after Heppner, 1981) (a, ventral; b, dorsal). 40) *Plutella xylostella* (Plutellidae), Europe (after Moriuti, 1977) (ventro-lateral view). 41) *Caunaca sera* (Meyrick) (Plutellidae), New Zealand (after Moriuti, 1977) (ventral view).

CONCLUSIONS

As noted above, the range of characters demonstrates that the New Zealand group of genera that Dugdale (1987a) thought to be very odd Plutellidae (or Yponomeutidae), are in fact primitive Glyphipterigidae and conform well to the European subfamily

Orthoteliinae, previously a monobasic group with a single odd genus. The south temperate genera related to *Proditrix*, as noted earlier, could be placed in Plutellidae on adult characters, since superficially they look like odd and very large plutellids, but the wealth of characters of the immature stages and the feeding habits clearly show the relationships to orthoteliine Glyphipterigidae. Thus,

they represent the first Southern Hemisphere members of this unusual subfamily, rather than being odd Plutellidae as noted by Dugdale (1987a).

The addition of so many New Zealand species to Orthoteliinae, plus one from Tasmania, is highly significant for the world phylogeny of Glyphipterigidae and Yponomeutoidea, demonstrating that there was a larger ancient fauna of this progenitor group than first thought, and with possibly their last remnants are most prevalent in the isolated faunal refugium that is New Zealand, as also Tasmania, rather than in Europe. The plate showing adults (Fig. 1-9) illustrates most of the New Zealand *Proditrix* complex of species; others are illustrated in Dugdale (1987a) and Hudson (1928).

No species related to the *Proditrix* complex are thus far known for Australia, other than the single species from Tasmania (Dugdale (1987a; McQuillan, 2003), but more may be found in such places as New Caledonia, or even in the high mountains of New Guinea. One can speculate that perhaps more Orthoteliinae also await discovery in remote regions of the Himalayas, in Nepal or south-western China. None are known from the Himalayan-originating fauna of the high mountains of Taiwan. Survey studies over the past 25 years, as in Nepal and Borneo, have all concentrated on macro-moths, so the Microlepidoptera are still relatively unknown for these areas. Thus far, none have been discovered in austral South America (Heppner, in prep. b). The status of some of the other New Zealand Plutellidae need to be re-examined to be certain they are all true Plutellidae, or possibly also members of Orthoteliinae in Glyphipterigidae, or even Glyphipteriginae.

Other Glyphipterigidae may also still remain hidden among the conglomeration of genera and odd species already described in Yponomeutidae and Plutellidae today in most regions of the world. One need only look among the genera and species illustrated by Clarke (1955) of Meyrick types at the Natural History Museum (BMNH), London, to see what appear to be misplaced genera and species, and with some belonging in such families as Lacturidae and Urodidae, but a few even likely candidates for Gelechioidea, and still a few that may also belong in Glyphipterigidae. As noted earlier, my original generic study of what Meyrick had placed in Glyphipterigidae (Heppner, 1977) only treated genera and what species they then included. Thus, Plutellidae and Yponomeutidae were not systematically studied at that time to find odd species or genera that should be in Glyphipterigidae or other families. Even so, since then a few others have been identified and culled out of Yponomeutidae, as for example my placement of *Sericostola* to Glyphipterigidae (Heppner, 1990) and the transfer of the genus *Telosphrantis* to Choreutidae (Heppner, 1985b). Suffice it to say, that all Yponomeutidae and Plutellidae taxa throughout the world require re-checking to verify their family placement, other than those, of course, that are clearly typical for the families such as the type-genera for each family. The significant finding that the odd *Proditrix*-complex, thought to be Plutellidae, is actually part of orthoteliine Glyphipterigidae, demonstrates what may be hidden among all the other odd tropical genera of Yponomeutidae and Plutellidae, and which have important implications on the evolution of the group that should spur on such searches by other interested researchers.

New Zealand harbors an exceedingly rich fauna of Glyphipterigidae, given the size of its landmass, with some 47 species now identified in the family, although most are in the worldwide genus *Glyphipterix* (33 sp. in New Zealand). Likewise, Tasmania has about

7 endemic *Glyphipterix* species (Heppner, 1982a) for its small size, plus the single species of *Proditrix*. Both of these south temperate regions could reasonably have even more species of Glyphipterigidae, once more intensively investigated for the less-collected day-flying moths. This compares with Taiwan, which is more tropical yet has a sedge moth fauna of only 29 species (Arita and Heppner, 1992). Austral South America, previously without any recorded species of Glyphipterigidae, has about 16 species awaiting description (Heppner, in prep. b), the species about equally divided between Chile and Argentina: these are all typical sedge moths in Glyphipteriginae, and no Orthoteliinae have thus far been discovered. The entire continental region of North America, north of Mexico, has only 44 species (Heppner, 1981, 1985a, 1997a,b). All regions of the world need to be investigated more to determine if any further Orthoteliinae are hidden among odd Plutellidae that have not been studied much, as already noted, particularly in Africa, Asia, and possibly even in South America (especially austral South America and in the Andes).

With the presence of at least one New Zealand species in the main glyphipterigid genus *Glyphipterix* having 3 lateral prothoracic setae in the larvae (Dugdale, 1987b), and this being the character state in the *Proditrix* complex, one can see that New Zealand harbors an ancient refugium for the family where many Orthoteliinae are present as a relictual group from the lineage to Glyphipteriginae. Elsewhere, only the single European species of *Orthotelia* remains of this ancient group of species. The isolated southern land of New Zealand is well known as a Gondwanaland distribution refugium for other ancient groups of plants and animals, as are Tasmania, Australia, South Africa, and Chile, all likely places to search for more Orthoteliinae species, possibly hidden among unstudied Plutellidae genera there, or awaiting discovery.

My view is that there is an evolutionary relationship from ancestral Ochsenheimeriidae to the primitive Glyphipterigidae, which is now more evident in this enlarged Orthoteliinae subfamily, as evident in the larval and other characters outlined above. Plutellidae are likely developments from Orthoteliinae ancestors, as are the Glyphipteriginae. One would say that Ochsenheimeriidae and Glyphipterigidae are sister groups in cladistic terms, possibly with this combination being a sister group to Plutellidae and higher Yponomeutoidea. Cladologists may find this paraphyletic, but in a phylogenetic classification (rather than a cladification) this can occur.

ACKNOWLEDGMENTS

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ADDITIONS TO THE BIBLIOGRAPHY OF BUTTERFLIES, IN THE ATLAS OF NEOTROPICAL LEPIDOPTERA No. VI. COMPRISING MOSTLY WORKS PUBLISHED IN 2001

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The fifth set of *Additions* to the annotated *Bibliography of Butterflies* (Lamas, Robbins, and Field, 1995) in the series *Atlas of Neotropical Lepidoptera*, Vol. 124, was published recently (Lamas, 2002, *Lepidoptera News* 2002(1/2): 49-64). The 316 additional references included herein comprise mostly works published in 2001, such as were recorded until December 31st, 2002.

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NEUROBATHRA LEAFMINER RECORDS ON *JATROPHA* NEW TO FLORIDA (LEPIDOPTERA: GRACILLARIIDAE)

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The leafminer moth, *Neurobathra curcassi* Busck, was originally described from Cuba (Busck, [1934]) from specimens reared on leaves of psychic nut, *Jatropha curcas* (Euphorbiaceae), a somewhat medicinal plant from Mexico and northern South America, and grown throughout the Caribbean. For a number of years (records are from as early as 1975), and possibly longer, a leafminer has been known on *Jatropha* in southern Florida (tentatively noted as "*Caloptilia* sp.") but had not been identified with certainty. Recent studies of available specimens, plus the fact that the Cuban species also mines the leaves of *Jatropha* plants, indicated that the Florida species could be *N. curcassi*. Don Davis (pers. comm.) (Smithsonian Institution, Washington, DC), who is revising the Gracillariidae for North America, notes that two new species of the genus are now known for southern Florida, one of which was reared from *Jatropha* plants, but that *N. curcassi* has not yet been confirmed to be among these new records.

The genus *Neurobathra* contains 3 described species, with two previously being found in the USA, and one of these also in Florida: *N. strigifinitella* (Clemens), a leafminer on oaks. Additionally, we have the two new species already mentioned above. It should be noted that it is conceivable that some of the records below may refer to another species (or that part of the records are mixed), since *N. curcassi* could also be in southernmost Florida, but thus far it has not been confirmed. Thus, the records below most likely are for the new species on *Jatropha* in Florida being described by Davis. While these records cannot be absolutely confirmed as the new species, it may be of interest to note the available DPI records for the leafminer on *Jatropha*. Most of these records refer only to the leafmine, and available specimens of adults lack abdomens, so species confirmation cannot be obtained for these records. Appearances of the adults are similar to *N. curcassi* but genitalic examination is required to determine the exact species.

The exact date of appearance for the species in Florida is not known but likely it is a native species. Rearings from two *Jatropha* species in 1983 were from Pompano Beach (Broward Co.) and Hialeah (Dade Co.); and the earliest records available are from North Miami (1975), Ft. Myers (1976), and Naples (1977, 1979). Inasmuch as these Florida records are so widespread (Miami to Ft. Myers), it is likely that the moth has been in Florida for many years previous to 1975 and is not a recent import from the Caribbean. However, all *Jatropha* species in Florida are naturalized from tropical America. There are about 180 species of *Jatropha* known in tropical America, and three of these occur as far north as southern and western Texas, and may also host *Neurobathra* species as leafminers. The *jatropha* leafminer from Cuba, *N. curcassi*, has been recorded on 4 or 5 species of *Jatropha*; thus, it may even feed on a number of additional species of the plant genus.

The Florida records are from along both coasts of Florida, from Key Largo to Ft. Pierce (St. Lucie Co.) on the Atlantic Coast, and to Palmetto (Manatee Co.) on the Gulf Coast. This distribution is typical of other moths and tropical plants of the Caribbean that can survive along the Florida coasts as far north to where occasional winter frosts are too se-

vere (the latitude of Tampa Bay) for them to survive, although some tropical species in Florida can go further north on the Atlantic coast as far as Cape Canaveral.

Records of the Florida *jatropha* leafminer include the following (DPI = Division of Plant Industry records; FSAC = Florida State Collection of Arthropods); all are larval records (DPI), except the FSAC records (from Pompano Beach):

Broward Co.

Ft. Lauderdale, 21 Nov 1991, ex *Jatropha* sp., L. Ooms (DPI)
Plantation, 2 Aug 1994, ex *Jatropha integerrima*, K. Vanyo (DPI)
Pompano Beach, 30 Sep 1983, ex *Jatropha curcas*, D. Leone (DPI/FSAC)

Collier Co.

Naples, 8 Jun 1979, ex *Jatropha* sp., K. Delate (DPI)
11 Aug 1993, ex *Jatropha integerrima*, M. Brodie & R. Buchholz (DPI)
18 Nov 1977, ex *Jatropha multifida*, G. Gwin (DPI)

Dade Co.

Hialeah, 8 Mar 1984, ex *Jatropha integerrima*, L. Chang & L. Davis (DPI)
19 Aug 1983, ex *Jatropha curcas*, M. Thurmond (DPI)
Miami, 14 Mar 1988, ex *Jatropha integerrima*, D. Storch (DPI)
23 Mar 1984, ex *Jatropha* sp., P. Perun (DPI)
24 Oct 1985, ex *Jatropha curcas*, R. Burns & A. Hamon (DPI)
North Miami, 9 Jan 1975, ex *Jatropha hastata*, D. E. Sager (DPI)
North Miami Beach, 23 Sep 1983, ex *Jatropha* sp., P. Perun (DPI)

Lee Co.

Ft. Myers, 23 Jul 1976, ex *Jatropha* sp., W. T. Walsh (DPI)
26 Aug 1987, ex *Jatropha integerrima*, D. L. Warkentin (DPI)

Manatee Co.

Palmetto, 6 Jul 1995, ex *Jatropha curcas*, J. gossypifolia, M. Runnals (DPI)

Monroe Co.

Key Largo, 17 May 1978, ex *Jatropha multifida*, P. Chobrd & W. E. Wyles (DPI)

Palm Beach Co.

Boynton Beach, 27 May 1994, ex *Jatropha integerrima*, S. Cook (DPI)
Palm Beach Gardens, 6 Jan 1983, ex *Jatropha integerrima*, P. Wright-Koll (DPI)

St. Lucie Co.

Ft. Pierce, 17 Sep 1983, ex *Jatropha* sp., K. Hibbard (DPI)
Ft. Pierce, 1 Dec 1983, ex *Jatropha* sp., K. Hibbard (DPI)

Sarasota Co.

Sarasota, 11 Apr 1980, ex *Jatropha hastata*, J. McFarlin (DPI)

Biology.—Recorded hosts above include *Jatropha* sp., *J. curcas*, *J. gossypifolia*, *J. integerrima*, *J. multifida* (Euphorbiaceae) (*J. hastata* = *J. integerrima*). Larvae mine the leaves.

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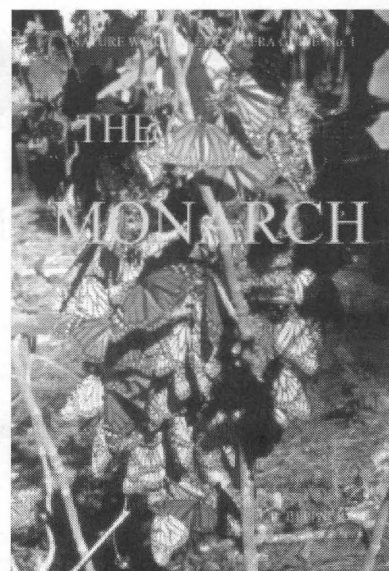
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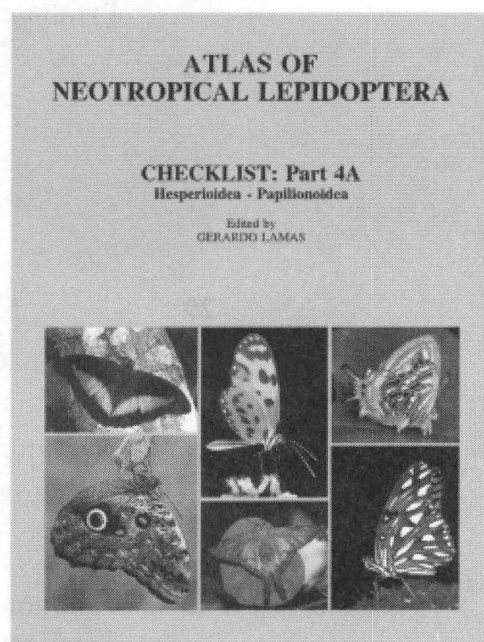
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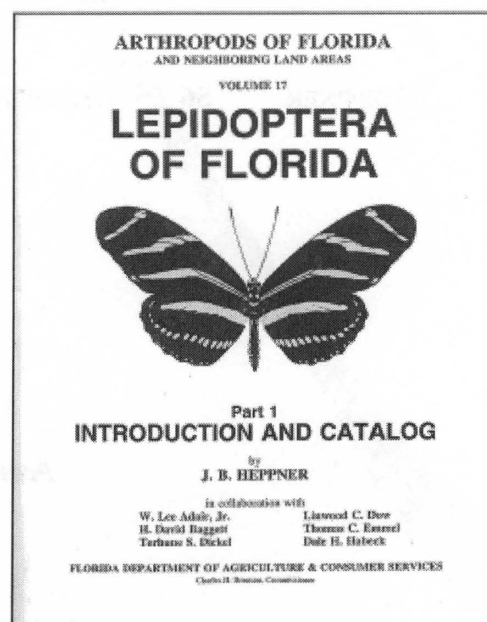
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