RAFFLES BULLETIN OF ZOOLOGY
1989 37(1 & 2): 142-159

THREE NEW SPECIES OF NYMPHULINE MOTHS FROM SINGAPORE MANGROVES PROVISIONALLY ATTRIBUTED TO *ERISTENA* WARREN (LEPIDOPTERA: PYRALIDAE)

D. H. Murphy

ABSTRACT - Three new species - *Eristena mangalis, E. thalassalis* and *E.shafferi* are described. Larvae of *E. mangalis* are aquatic and feed on the brown alga *Dictyota.* The three species are associated with *Eristena gregaria* Yoshiyasu on genitalia and secondary sexual characters, even though only the male of *E. mangalis* shows the venational character currently used to define the genus. Males also possess a mid-tibial groove and tuft considered diagnostic for *Eoophyla* Swinhoe. Taxonomic criteria for these genera and others in the *Oligostigma/Aulacodes* complex need to be re-examined.

INTRODUCTION

Adult aquatic moths of the pyralid subfamily Nymphulinae are common in Southeast Asian mangrove forest where the larval stages of at least one species feed on marine algae. Mangroves are inter-tidal forests dominated by a few species of specialised salt-tolerant trees, under which the ground surface carries a wide range of algae but very few higher plants. The nymphulines can be, in places, by far the commonest adults to be seen. These moths rest gregariously under low foliage of the trees, sometimes as many as 50 together under a single leaf. This habit was reported by Yoshiyasu (1984) for *Eristena gregaria* in Thailand.

In Singapore, three species have been recognised, all belonging to a taxon with indented hind wing, upturned palps and characterised in the male by a mid-tibial groove containing a basal hair pencil, and characteristic scale tufts on the hind femora. The male and female genitalia conform closely with those of *Eristena gregaria* but the mid-tibial organ was not mentioned by Yoshiyasu and the wing venation fails to fit accepted criteria.

The genus *Eristena* was established by Warren (1896) for his species *E. murinalis* from the Khasi hills of Assam. Little is known about the species but the genus name has been applied to others which share the feature of having veins M2 and M3 petiolate in the hind wing. Warren did not describe the legs of *murinalis* and Hampson (1896, 1897), who used leg characters extensively, did not see the species or any male attributable to *Eristena.* The Singapore species do not fulfill the criterion of petiolate M2+3. In one species only these veins are from a point or very short petiolate in the male, but clearly from the cell in the female. In the others, they are from the cell in both sexes. It is here argued that

this venational feature is trivial and cannot be used to segregate species which clearly form a coherent taxon.

Swinhoe (1900) created the genera *Eoophyla* for *Aulacodes peribocalis* Walker and *Theila* for *A. gibbosalis* Gueneé, separating them from *Aulacodes* on the basis of the mid-tibial groove and tuft. The character is difficult to verify without making slide preparation of the mid leg so that for many described species the condition is unknown. However, species with both male mid-tibial groove and with hind femoral tufts were distributed by Hampson (1894, 1896) between the genera *Oligostigma* Gueneé and *Aulacodes* Gueneé.

The type species of the genera in question, other than of *Eristena* are relatively well known. Lange (1956) described the male genitalia of *Oligostigma junceale* Gueneé (Fig. 51, p. 85) and *Aulacodes aechmialis* Gueneé (Fig. 40, p. 77). He also showed that the HW venation of *O. junceale* had the *Eristena* condition (Fig. 9, p. 69). However for neither species did he make a positive statement on the condition of the mid tibia. The male genitalia of *Theila gibbosalis* were also figured by Lange (1956, Fig.110, p. 119) and of *Eoophyla peribocalis* by Rose & Pajni (1986). Both species have three simple, acute, subapical spines from the apex of the male valva.

A feature shared by *Eristena gregaria* Yoshiyasu and the three Singapore species to be described is the presence of three highly modified subapical spines on the valva. This suggests a close affinity with *Eoophyla* though grounds for maintaining *Eristena* as a separate genus may exist in the structure of the labial palp. In view of other structural similarities however, the presence or absence of petiolation of M2 and M3 in the hind wing seems to be unacceptable as a generic character. Should they eventually be synonymised, *Eristena* has priority.

Much of Hampson's use of scaling as a major taxonomic discriminator in the higher classification of Pyralidae and other Lepidoptera is now rejected. However, this is not true for those elements described by him and other early workers which potentially act as part of the pheromone dispersal system. Here there is every likelyhood that they constitute sound homologies (used here in the sense of "synapomorphies") on which monophyletic higher taxa can be based. In both *Oligostigma* and *Aulacodes*, species have been described possessing posterior scale tufts on the male hind femora, one of which is *peribocalis*. In the three Singapore species there is a ventral apparatus with an erect tuft of narrow scales on abdominal sternite 3 which appears to be associated with these femoral tufts to form a scent dissemination apparatus. This seems grounds for treating them as a discrete taxon of generic or higher rank to which *Eoophyla peribocalis* probably belongs, as well as those provisionally treated here in *Eristena*. A serious problem still remains. In the same paper as his description of *E. gregaria*, Yoshiyasu (1984) describes a second species *E. tanongchiti* extremely close in colour pattern but lacking femoral organ and with very different male genitalia. Its features seem closer to *Oligostigma junceale* than to *E. gregaria* and raises the possibility that *Eristena murinalis* could belong with *tanongchiti* rather than with *gregaria*. It is not known whether *tanongchiti* has the mid-tibial groove and tuft of *Eoophyla*. Hampson also reported the mid-tibial groove in *Daulia*, the *Paracymoriza* section of *Parthenodes*, and in *Ercta, Botyodes, Loxoneptera, Mecyna and Udea* elswhere in Pyralidae. Such a tibial organ is of widespread occurence even outside of the Pyralidae (hind leg of many Geometridae) so that this structure alone may not indicate close relationship. The genus name *Eristena* is here used for a taxon containing *E. gregaria* Yoshiyasu and which may supercede *Eoophyla* if interpreted broadly. This

usage can only be validated by re-examination of the nominate species *E. murinalis* Warren, 1896.

Holotypes are deposited in the British Museum (Natural History), London (BMNH) together with some paratypes. Other paratypes are placed in the Zoological Reference Collection (ZRC), Department of Zoology, National University of Singapore, and in the author's private collection.

The following abbreviations have been used. FW - forewing; HW - hindwing.

Descriptions of Species

General description. - All three species have antennae more than half length of forewing, scape without process and flagellum with segments sparsely scaled dorsally. Labial palps upturned with basal joint subtending a broad fan of radiating scales, second joint broad with shaggy scaling, apical joint narrow, tapering, smooth scaled and 0.8 length of second joint. Maxillary palps long, four-jointed, erect, with spreading broad scales at apex. Chaetosemata present. Ocelli absent. Tympanal organ of crambid type (Minet, 1981, nomenclature follows Maes, 1985). Praecinctorium short, narrow, heavily scaled behind, closely overlying pons, not bilobed at apex. Conjunctiva narrow, vertical from anterior end of pons. Tympanum horizontal, at right angles to conjunctiva, the fornix rounded behind, spinula minute, saccus tympani deep in female, shallower in male. In males, the erect scale tuft of the abdominal organ lies just behind apex of the pons tympani. It arises from a domed papilla in the mid-line of sternite 3 from before which cuticular grooves diverge behind to the hind margin. (This numbering of sternites assumes that 1 and 2 are incorporated in the tympanal organ).

FW with costa straight, R1 from cell, R2 stalked with R3 and R4, all other veins from cell except 2A, 1A absent. HW truncate or clearly incised behind apex, Sc+R forking from Rs though sometimes suppressed in mature wing, M2 present (quadrifine condition), not necessarily stalked with M3. There are no patches of enlarged scales or hairs on membrane and no ciliation of veins. Legs long with 0,2,4 tibial spurs. Male mid tibia with postero-dorsal groove throughout its length and containing a basally inserted hair pencil. Mid femur with basal *av* fan of scales closely appressed to the anterior surface. Mid coxa, trochanter and base of femur with complex organ of modified scales enclosing the articulation. Hind femur with mid ventral tuft of recurved scales. Male valva with three heavily sclerotised, partly fused spines from cucullus with strongly modified apices. Coremata absent. Females without fringe of swimming hairs on mid and hind tibiae; ductus bursae with sclerotised aperture, bursa with signum consisting of 1 or 2 longitudinal bands of spinules; papillae anales fused and with dense hairs and spines, the preceding membrane densely spinulose.

Eristena mangalis, new species
(Colour Plate 1A, 1B; Figs. 1-5)

Description. - Male (Colour Plate 1A) wingspan 10 - 11 mm. Head white scaled, palpi banded with fuscous, antennae yellow. Thorax white with collar fuscous and weak transverse fuscous line. Abd. 1 + 2 broadly white dorsally, 3 - 7 fawn with marginal white line, 8 with narrow white scales when extended, valvae white scaled externally.

Legs white except fore femora and tibiae dark scaled in front, and mid tibia at base;

tarsi unbanded. Hind femoral tuft of sparse, weakly curved, narrow white scales; tibia with basal outer tuft but without long scale-setae on shaft. The abdominal papilla and scale tuft situated very far forward on sternite 3, almost at the margin of the segment, the cuticular grooves forming a narrow isosceles triangle (Fig. 2I).

FW upperside white to silver-grey, irrorated with pale fuscous anteriorly. A weak transverse fascia originates in a black spot at 0.5 on costa, beyond which an orange patch, then two white fascia from 0.7 and 0.9 converge to tornal angle. A marginal pale orange band with a prominent apical black spot and black marginal line entends to tornus. Underside fawn with marginal and submarginal lines and apical spot distinct.

HW upperside greyish white with discal fuscous patch, sub-basal and post-medial dark lines converge almost to anal angle; a submarginal orange fascia surrounded by white, flecked distally by black; a marginal black spot surrounded by orange at apex of M2+3 subtends a fan of black cilia, and is followed by a black marginal line, sometimes interrupted to form incipient spots, extends to 0.4 from base. Underside white with discal spot, post-medial line, marginal spot and line distinct.

Wing venation of male (Figs. 1A to D) normal for the group except that M2 and M3 in HW typically arise from a point or are very short petiolate (Fig. 1C). 5 out of 40 examined had these veins from the cell. About half the males have apex of Sc in HW suppressed, though the sensillae that mark its insertion show its presence in the pupal wing. Mediocubital lobe of HW prominent but preceding incision weak so that the wing appears truncate.

Male genitalia (Fig. 2A, 2F) with tegmen scaled, as broad as long, deeply emarginate in front, depressed and membranous medially, with strongly indicated lateral lobes; lateral fenestrulae absent. Vinculum straight in lateral view, subequal to length of tegmen, saccus an ovoid sclerotised pouch containing a few scales. Uncus 1.8 length of tegmen and height of ring, curved in side view, tapered with blunt apex in dorsal view, with a pair of strong latero-basal setae and scattered smaller setae until 2/3 its length, the apex entirely bare. Anal tube broad, papillate above, smooth and sclerotised beneath. Gnathos heavily sclerotised, the cochlear reaching to 0.72 length of uncus, its apex (Fig. 2G) deflexed clavate with a strong dorsal spine with 2 smaller denticles before it. Valva (Fig. 2H) obovate with apex bluntly produced, 2.6 as long as broad; uniformly scaled outside, inside with strong cuticular ridges, sacculus defined above by a cluster of spinelike scales, costal margin with a fringe of long, inwardly directed setae, a subapical cluster of moderately long, inwardly curved scales. The cucullus bears insertions of three massive, closely appressed spines which arch dorso-anteriorly, with apices (Fig. 2E) broadly expanded and transversely striate, the outer-most forming a broad lateral wing. Phallus stout, tubular, 3.1 height of ring, the coecum penis 0.32 its total length; vesica densely spinulose throughout, at one point these spines enlarged to form a "signum" (Figs. 2B, 2C), cornuti present but very reduced, far basal in position, usually a group of 2 or 3, occassionally only one. Juxta broadly Y-shaped, square behind and emarginate in front.

Female (Colour Plate 1B) wingspan 10 - 12 mm. Color pattern almost identical to male except abdomen without basal white band, wings slightly more irrorated with fuscous, FW more extensively orange in distal half and HW with more extensive white submarginal band.

Legs without tibial or femoral tufts. Abdomen without scale papilla or cutaneous channels on sternite 3.

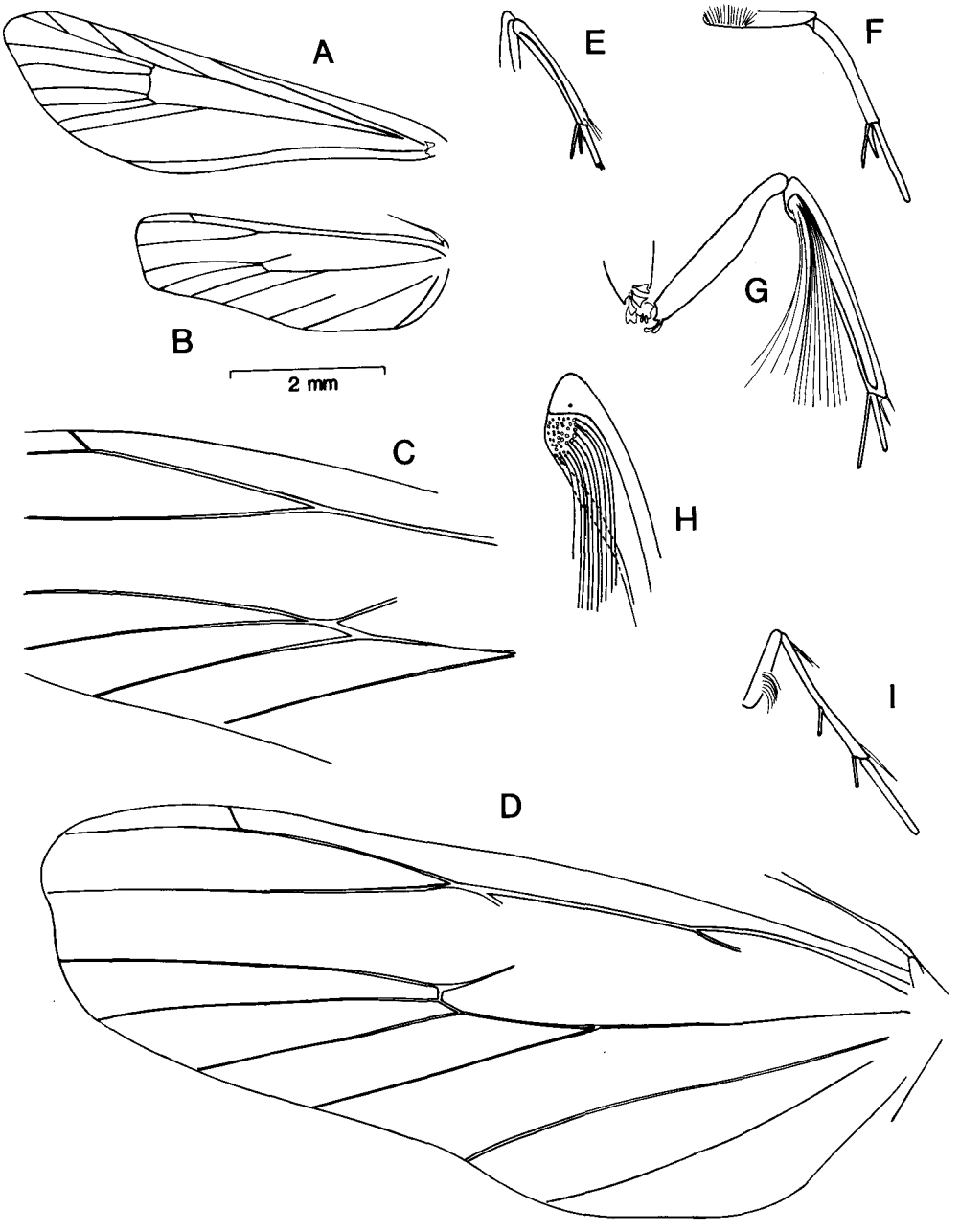

Fig. 1. *Eristena mangalis*, new species. A = Male forewing venation x1; B = male hindwing venation x1; C = detail of male hindwing venation x3.4; D = female hindwing venation x3.4; E = mid tibia, posterior view showing position of groove x1; F = mid femur and tibia, anterior view x1; G = mid leg, posterior view showing tibial hair pencil erected and trochanteral articulation x2; H = enlargment of insertion of mid-tibial hair pencil x4; I = hind femur, tibia and basitarsus, anterior view x1. (Magnifications relative to scale.)

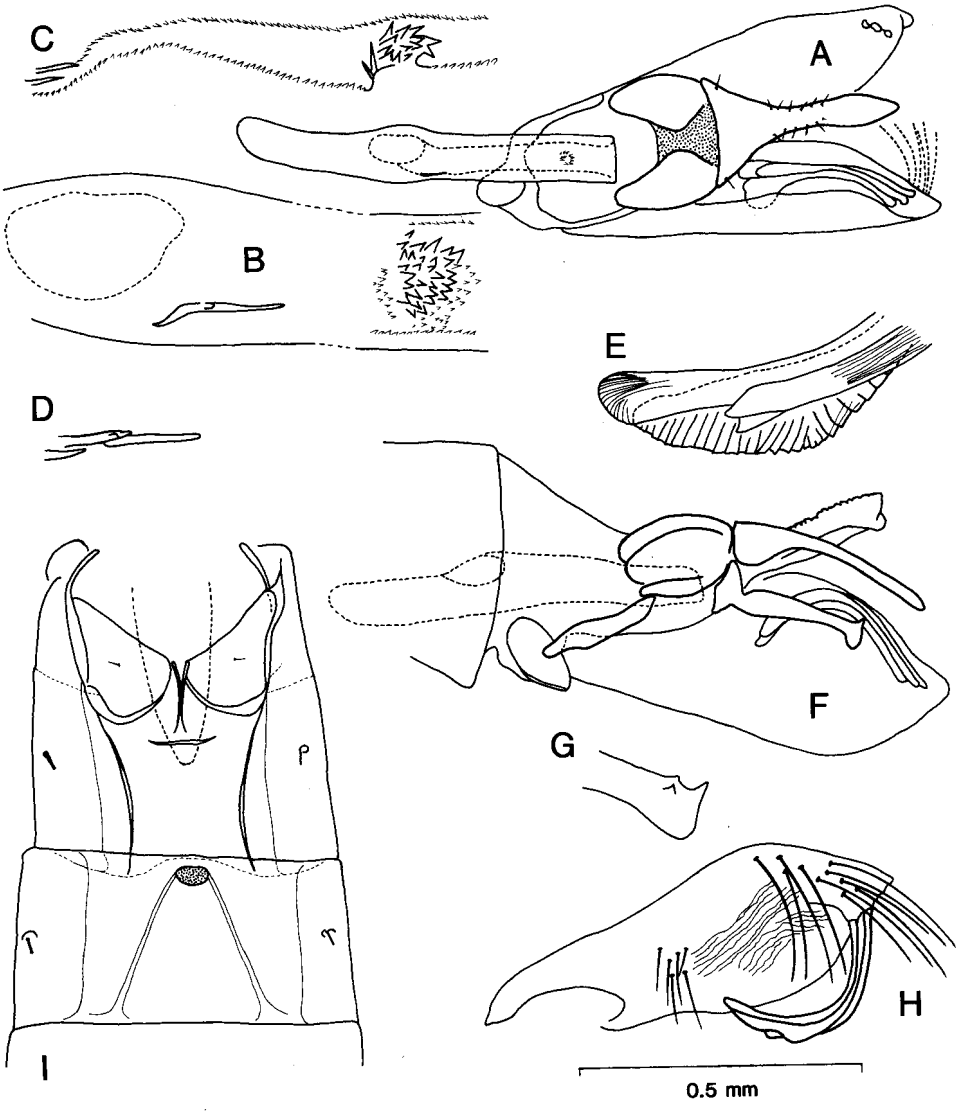

Fig. 2. *Eristena mangalis*, new species, male. A - genitalia, ventral view x1; B - vesica of specimen with 2 cornuti showing "signum" in dorsal view x3.5; C - parts of phallus, specimen with single cornutus and showing "signum" in lateral view x3.5; D - detail of specimen with 3 cornuti x3.5; F - genitalia, lateral view x1; G - apex of gnathos x3.5; H - valva, inner surface x1; I - base of abdomen, ventral view showing papilla and grooves of sternite 3 x0.7. (Magnifications relative to scale).

FW venation as male; HW differs in having M2, M3 from the cell, well separated at base (Fig.1D). 2 frenular bristles.

Female genitalia (Fig. 3): ostium bursae sclerotised, the sclerite wider than long; ductus 0.67 length of sternite 7 widening gradually into bursa which is cylindrical and slightly more (1.1) length of St. 7; its wall with widely spaced minute denticles all over except denser ventrally and enlarging there to form a signum of two longitudinal bands of strong, inwardly directed, bifid or trifid spines extending from neck to half length of sac. Spermatheca broadly tubular, 0.75 length of St.7 with a strongly spiralled duct of 9 turns. Papillae anales (Fig. 3D) fused, narrowly acute with numerous setae and spine-like setae; connecting membrane strongly denticulate; tergite 8 sclerotised, sternite 8 membraneous; apophyses anteriores 2.8, ap. posteriores 2.4 length of tergite 8.

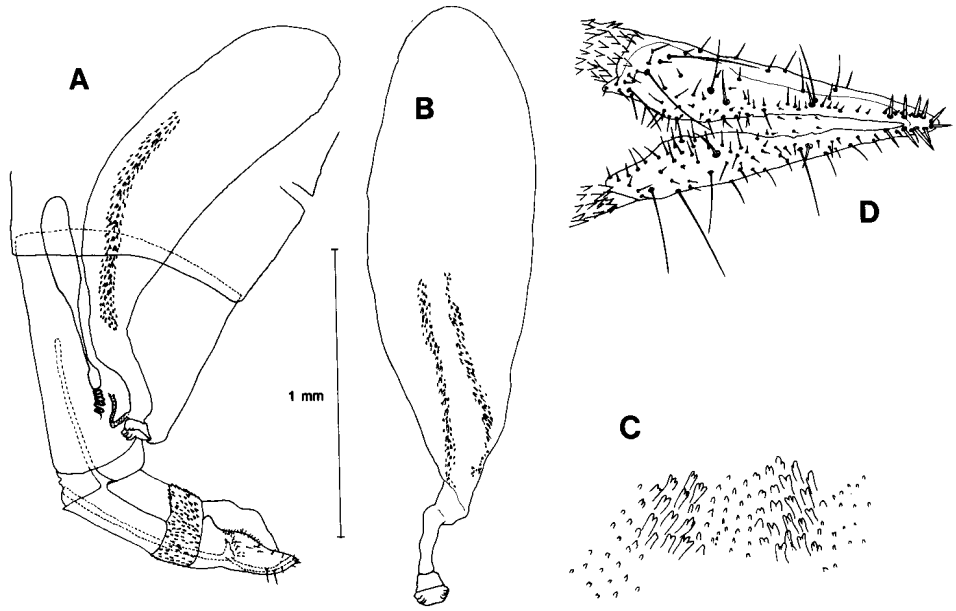

Fig. 3. *Eristena mangalis*, new species, female. A - genitalia, lateral view x1; B - bursa, dorsal view x1; C - detail of part of signum x4; D - apex of ovipositor, ventral view x4. (Magnifications relative to scale.)

Mature larva (Fig. 4): fully extended in phenol 12 mm., unextended 10 mm. Head, brown with pale frons and ocellar region. Ocelli 6 but difficult to distinguish. Prothoracic shield and leg sclerites brown, body semi-transparent in life, milky white in alcohol. Integument papillate except on prothoracic shield, pinacula absent including L group of prothorax. Setae unpigmented. Spiracles absent on prothorax, minute on abd. 1, 5 8; large and with conspicuous sclerotised internal duct on abd. 2, 3 and 4 (corresponding to tubercular spiracles of pupa). Tufts of sessile, unbranched filamentous gills on all body segments. Body chaetotaxy as Fig. 4G, chaetotaxy of abd. 10 as Figs. 4I, 4J, head chaetotaxy as Figs. 4A, 4B. Labrum deeply cleft with L3, M3 modified into broad, blade-like setae

(Fig. 4D). Mandible (Fig. 4C) with 5 teeth and setae strongly unequal, the condyle greatly enlarged, almost spherical, black and greatly complicating interpretation of ocellar chaetotaxy except on dissected material or pelts.

Abdominal prolegs with crochets in a complete biordinal circle, basal ring sclerite narrow, incomplete medially. Claspers with a transverse, straight biordinal row, the crochets twice as large as on ventral prolegs.

Salient features of head chaetotaxy include the very short adfrontal setae, enlarged C1 and extreme anteriorisation of major head setae, most notable being that O3 is approximated to SO3 so that the O setae form almost a right angle. This conflicts with Hasenfuss' (1960) characterisation of European Nymphulini as having them in line.

Salient features of body chaetotaxy include XD2 short, D1 shorter than D2, SD1 long but modified to a seta sensualis on A9, SD2 present on all segments except A9, L1 forming a seta sensualis on T2 -A8, but a prominent macroseta on A9, L2 and L3 short spiniform on T2 - A8, SV1 long on all segments except A1 and A8, SV2 absent on T2,T3,A1,A8 and A9.

Larval shelter (Fig. 5D): The larval gallery consists of a tough silk tube to the outside of which a tesselation of *Dictyota* fragments is firmly attached. Long occupied galleries may be several cm. long, 4-5 mm. wide and surrounded by a cm. wide zone bare of *Dictyota* outside which *Dictyota* fronds bear evident bite-marks. Galleries contain no frass. Gut contents contain *Dictyota* epithelium and some *Murrayella* together with detritus but no trace of green algae. Since the habitat contains a large component of filamentous green algae this is considered strong evidence of selective feeding.

Pupa (Fig. 5A): 5 mm. x 1.4 mm. Head seta F3 strong, P1 strong, P2 absent; prothorax without, mesothorax with one pair of setae (in line with SD1 of following segs.; metathorax with D1 and SD1; abdomen with D1 on A1-8 but no trace of D2 on any segment, SD1 present on A2-8, situated on a papilla anterior to the strong tubercular spiracles on A2-4 and internal to small spiracles of A5-7; L group 2 on A3-8, L1 fairly strong but L2 very minute; a single SV on A5-7; V present on A6 and 7. Abd. 8 projecting laterally and with a dorsal tract of spinules extending between L groups; A9+10 without setae, cremaster or projections.

Pupal shelter (Figs. 5B, 5C): Formed to the side of the larval gallery and protected with *Dictyota* fragments, behind the cocoon proper is a system of silken straps attached to the substrate (Fig. 5C).

Material examined. - Holotype male (BMNH, London) Singapore, Mandai mangroves (estuary of Sungei Mandai Besar) resting under foliage, 10 Sept 1986. 4 males, 6 females same data as holotype and part of same swarm. Numerous collections from this and other sites in Singapore. 6 larvae, 8 pupae incl. 4 reared to adult, same location as holotype, 6 Aug 1989.

Remarks. - This is the commonest species in estuarine mangrove forest. Both in behaviour and appearance it strongly resembles *E. gregaria* Yoshiyasu, especially in having a black spot on the forewing termen though there are many differences in details of pattern. The male femoral tuft is more weakly developed and the hind tibia is without the long *pd* hair-scales described for *gregaria*. Male genitalia closely resemble both *E. gregaria* and *E. thalassalis* but the strongly striate apices of the valvar spines, otherwise similar in shape, the reduction of penial stylet, weaker femoral tuft and shape of HW immediately distinguish it.

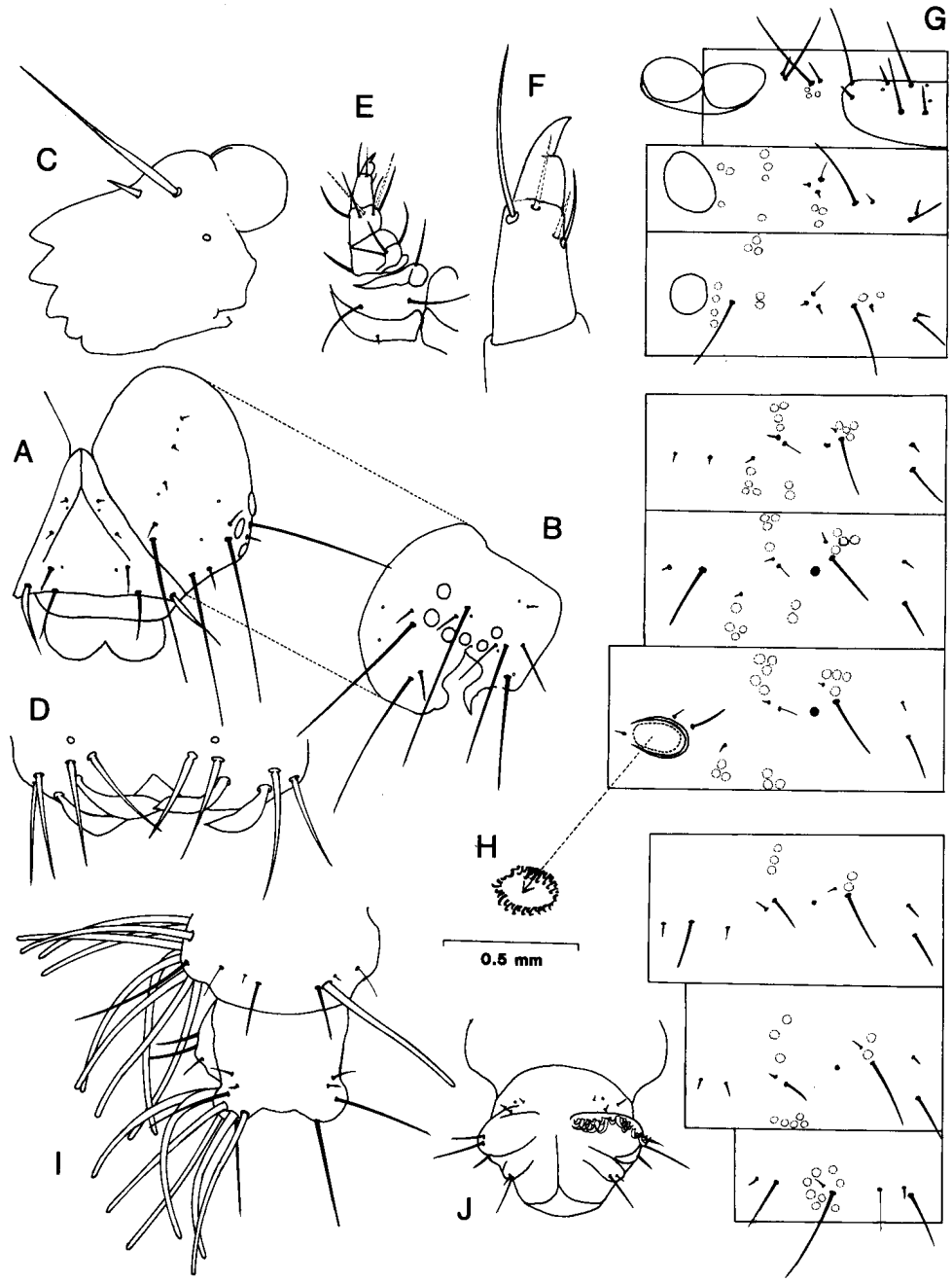

Fig. 4. *Eristena mangalis*, new species, mature larva. A - head capsule, dorsal view x1.7; B - head capsule, 3/4 anterolateral view x1.7; C - mandible, outer view x4; D - labrum, dorsal view x 4.3; E - front thoracic leg, anterior view x 1.3; F - detail of tarsal claw x 4; G - map of body chaetotaxy, approx. x1; H - crochets of abdominal proleg x1; I - abdomen 9 + 10, dorsal x1; J - abdomen 10, ventral x1. (Magnifications relative to scale.)

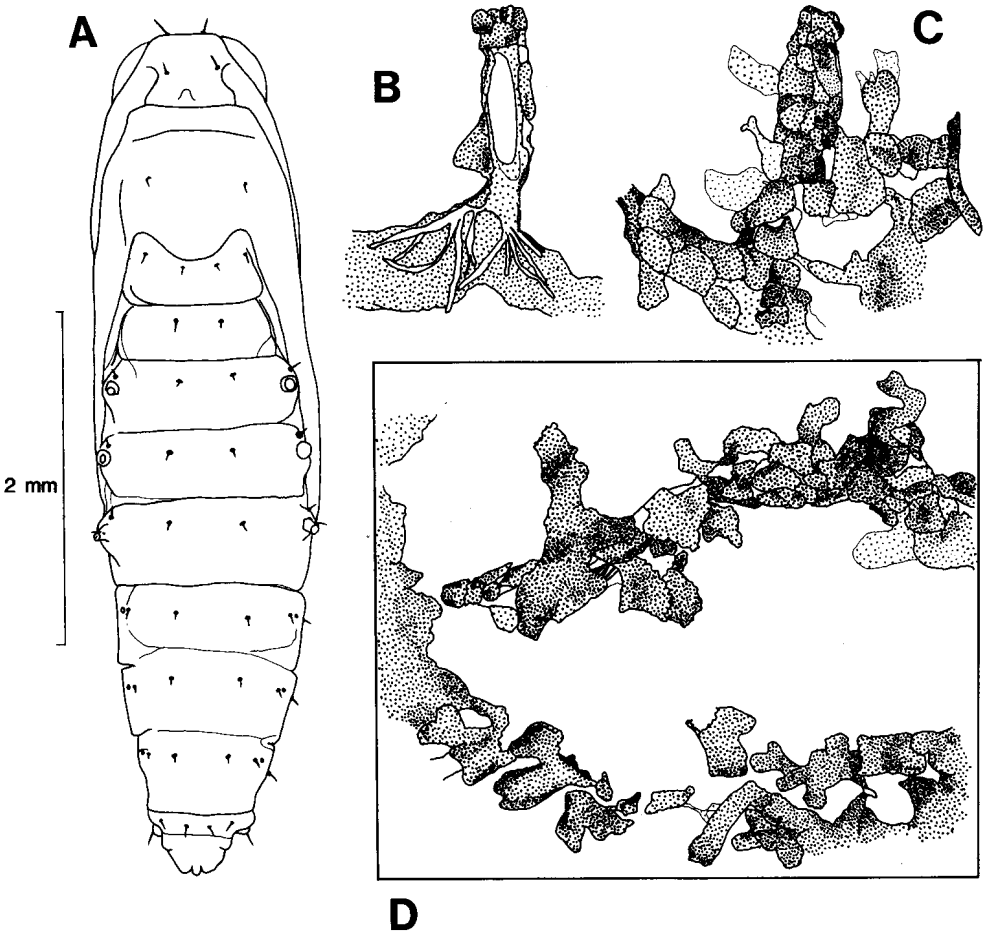

Fig. 5. *Eristena mangalis*, new species, pupa and shelter. A - pupa, dorsal view; B - pupal case, ventral view of detached case showing cocoon and silken attachment straps; C - pupal case, dorsal view; D - larval gallery on polythene film showing surrounding zone cleared of *Dictyota*. (Figs. B to D traced from photographs).

Etymology. - The name *mangalis* refers to its association with the mangal ecosystem or mangrove forest.

Eristena thalassalis, new species

(Colour Plate 1C, 1D; Figs. 6-8)

Description. - Male (plate 1C) wingspan 12 - 13 mm. Head and palps white, antennae yellow with dorsal scales on flagellar segments. Thorax white with yellow scaling behind and two transverse V-shaped fuscous fascia. Abd. 1 - 2 fuscous broadly edged with white, 3 - 6 beige narrowly edged with white, 7 - 8 wholly beige. Venter pale. Legs pale and unmarked except for dark scaling on anterior face of front femur and tibia, and inside only of hind femoral tuft. This tuft is very thick and strong, pale externally, behind with long strongly curving scales enclosing a basket-like cavity edged anteriorly by shorter, broad, pale scales (Fig. 6H).

Abdominal papilla and scale-tuft of sternite 3 (Figs. 6I, 6J) situated about 0.5, the cutaneous channels broadly arched.

FW upperside ground colour yellow to pale orange with longitudinal curving median white streak reaching to 0.5 and a curved posterior white streak from 0.2 to 0.6, both edged with fuscous. The anterior base has narrow streaks of fuscous scales on front of costa, depression of Sc, front and back of base of R and along line of Cu. Costa narrowly white in outer 2/3 with a triangular white patch at 0.5 beyond which a medial reflective fuscous fascia extends diagonally almost to tornal angle. An elongate triangular white patch from 0.7 on costa extending halfway across wing is edged proximally by fuscous. A submarginal white fascia edged on both sides with fuscous parallels the outer margin almost to tornal angle without joining the fuscous fascia. Apex pale. Behind apex a marginal black line extends to tornus. Cilia pale with a weakly defined dark line of shorter scales.

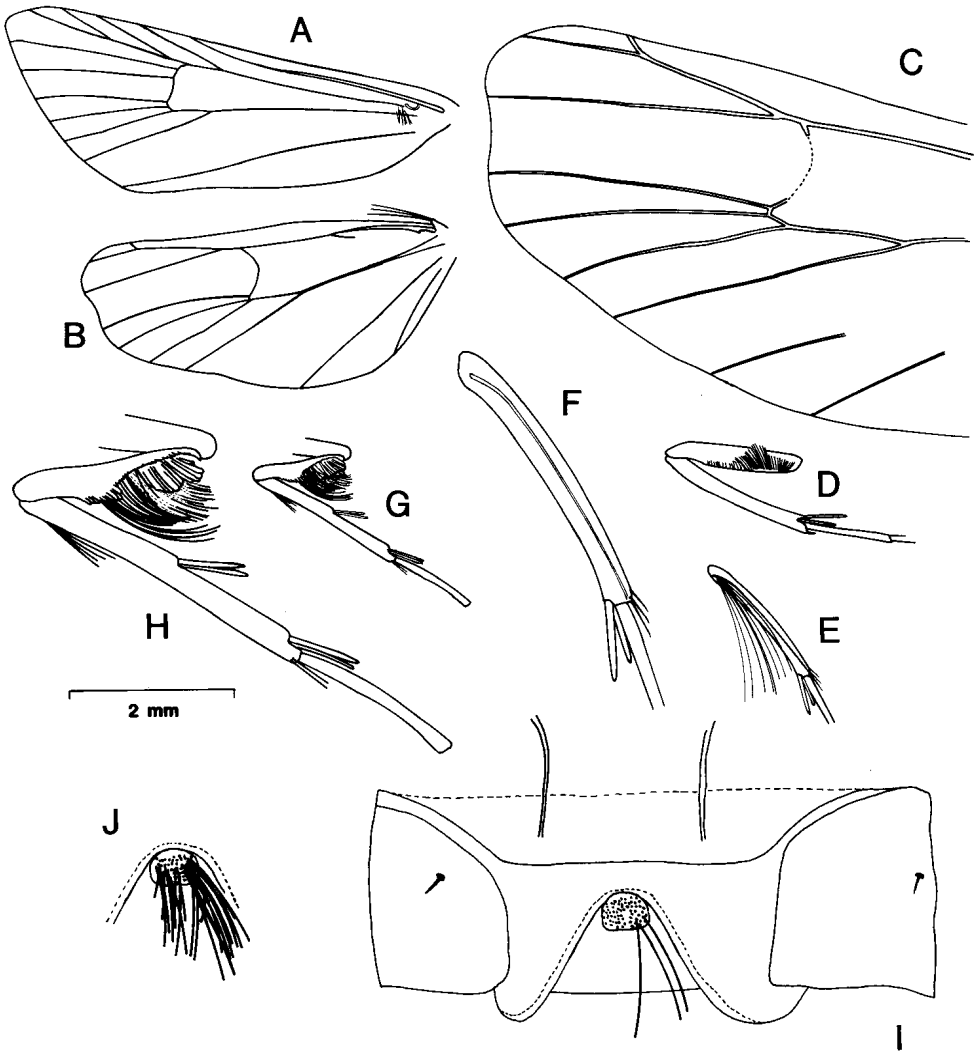

Fig. 6. *Eristena thalassalis*, new species. A - female forewing venation x1; B - female hindwing venation x1; C - male hindwing venation x2; D - mid leg, anterior view x1; E - mid tibia, posterior view x1; F - normal appearance of mid tibia, posterior view with scaling intact and hair pencil retracted x2; G - hind leg, anterior view x1; H - enlargment of hind femoral tuft x2; I - male abd. sternite 3 x2.5; J - papilla of male sternite 3 with scale tuft x 2.5. (Magnifications relative to scale.)

HW upperside orange distally, pale yellow on costal lobe and basal third beyond which is a broad white fascia edged all round with fuscous, extending from 2/3 on costa almost to anal lobe. Outer half broadly orange, divided by a narrow, silver fascia edged with fuscous, whose outer dark edge forms a dentate line defining a submarginal orange band containing three conspicuous, isolated black spots on medial lobe behind which a further spot is continuous with a marginal black line.

Underside of both wings beige with indications of upperside markings.

Wing venation (Fig. 6C) typical of *Eoophyla* without trace of petiolation of HW veins M2 and M3. All veins fully expressed.

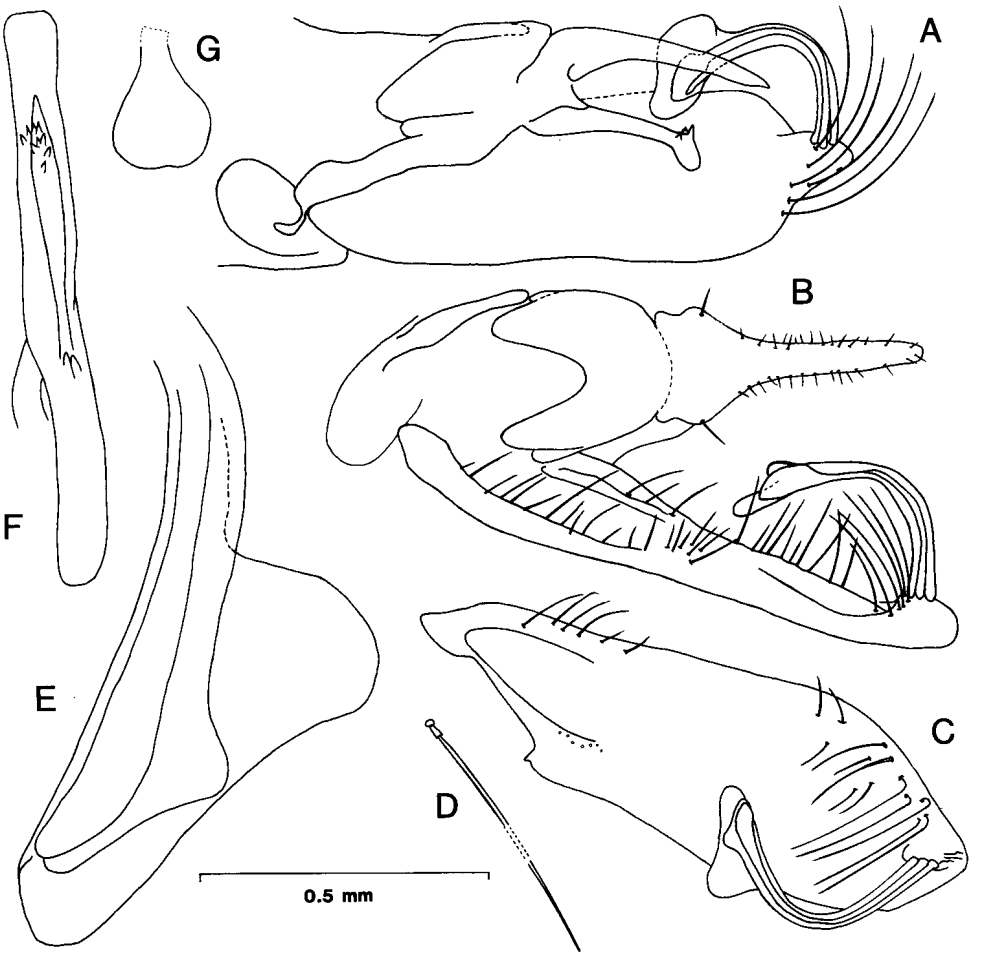

Fig. 7. *Eristena thalassalis*, new species, male. A - genitalia, lateral view x1; B - genitalia, ventral view x1; C - valva, inner surface x1; D - inner costal seta of valva x3; E - apex of valvar spines x5; F - phallus x1; G - juxta x1.

Male genitalia (Figs. 7A, 7B) similar to *mangalis* except uncus parallel-sided behind and with setulae almost to apex; gnathos with the major dorsal spines often paired, side by side; valva very similar including the internal cuticular sculpture (not figured), the three fused subapical spines similar in shape except the outer more strongly winged at apex and

without transverse striae (Fig. 7E). Phallus (Fig. 7F) with vesica more weakly spinulose except at "signum" and bearing a very strong, single, basally inserted cornutus 0.5 length of phallus. Juxta pear-shaped (Fig. 7G).

Female (Colour Plate 1D) wingspan 13 - 15 mm. Colour pattern as male. Antennae more slender, legs without tufts, abdomen without sternal organ. FW and HW venation (Figs. 6A, 6B) as male; HW with 3 frenular bristles.

Female genitalia (Fig. 8): ostium sclerotised, tubular, 3 times longer than wide with an internal longitudinal flange in inner third; ductus with a ventral sclerite as long as ostial, then widening gradually to turbinate bursa 1.2 length of sternite 7, its wall with widely spaced minute denticles enlarging dorsally to form a signum of a single, longitudinal band of simple spines extending more than 2/3 its length (Figs. 8B to D). Spermatheca ovoid, 0.4 length of sternite 7 with spiral duct. Papillae anales (Fig. 8E) fused, rather blunt; otherwise the ovipositor similar to *mangalis* (the apparent differences may be exaggerated by preparation).

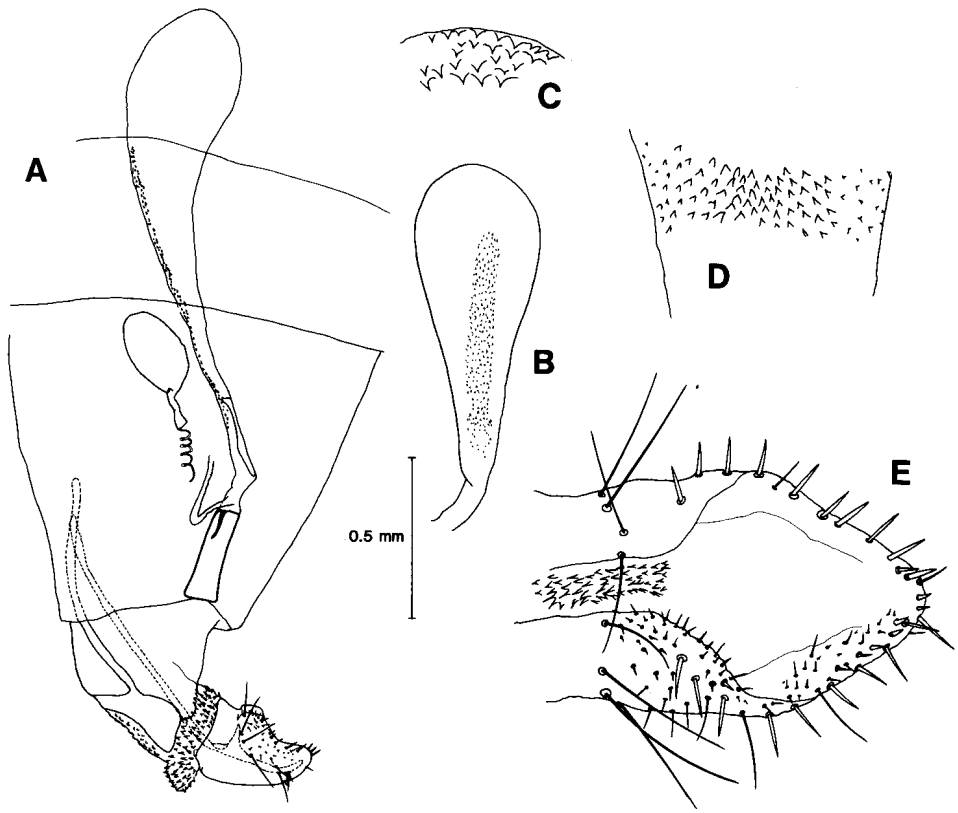

Fig. 8. *Eristena thalassalis*, new species, female. A - genitalia, lateral view x1; B - bursa, dorsal view x 1; C - detail of bursa wall, apical region, in contracted condition x4; D - detail of signum x4; E - apex of ovipositor, ventral view x4. (Magnifications relative to scale.)

Immature stages unknown.

Material examined. - Holotype male (BMNH, London) Singapore, Pasir Ris mangroves, resting under foliage of *Avicennia alba* along seaward margin, 7 Feb 1978. 11 males, 5 females same data as holotype; 1 male - Singapore, Mandai mangroves, in flight, 10 Sept 87; 2 males - Singapore, Pulau Kukor flying over off-shore coral flat, 17 Apr 88.

Remarks. - This species was compared with material of *Oligostigma parvalis* Moore in BMNH by Mr. M. Shaffer who considered the species close but not identical. The male of *parvalis* is not known but it could be a member of the group. Of the three Singapore species, *thalassalis* has the most strongly developed hind femoral organ, as strong as that described for *E. gregaria* by Yoshiyasu (1984) and *Oligostigma bifurcale* Pryer by Hampson (1896: 212). The wing pattern conforms quite closely to *bifurcale* but without the white centre to the HW marginal spot 1 and overall size is much smaller. *E. thalassalis* is clearly not confined to mangroves and is potentially widespread because two males were taken flying over exposed coral flats remote from land and the nearest mangroves. The main mangrove locality was a seaward facing fringe with abundant *Ulva* beds beyond it.

Structural differences between *E. thalassalis* and *E. mangalis* are most pronounced in the strong cornutus of the male phallus and the probably functionally correlated sclerites of the female ostium and ductus.

Etymology.- The name *thalassalis* refers to its maritime habitat, the greek form being adopted to avoid confusion with *murinalis* Warren.

Eristena shafferi, new species

(Colour Plate 1E; Figs. 9, 10)

Description. - Male (Colour Plate 1E): wingspan 17 mm. Head, body and appendages similarly patterned to *E. thalassalis* except as follows. Legs with tarsal segments narrowly banded with black at apex. FW upperside bright orange, medial fascia short and linking at apex with post-medial costal patch, leaving a discrete tornal reflective patch. HW upperside with similar transverse fascia beyond which broadly orange with white spots behind apex and behind Cu2. No submarginal silver fascia or dentate line. 3 marginal black spots on lobe followed by marginal line which is not expanded distally. Mid tibia with groove and tuft. The male hind femoral tuft of wholly pale, relatively sparse, moderately strongly curved narrow scales. Hind tibia without long scale-setae on shaft.

Wing venation (Figs. 9A, 9B) typical of *Eoophyla*, with HW Sc forking to margin at 0.7, M2 and M3 from cell, well separated at origin.

Male genitalia (Fig. 10A) basically as in other species except uncus behind tapering, with setulae in basal 2/3; gnathos (Fig. l0C) with the deflexed apex much produced, laterally compressed and blade-like at apex, with a single major subapical spine but two before it strong, and with several small denticles associated; valva (Fig. 10D) relatively broad, with similar internal cuticular ridging to *mangalis* (not figured). The three fused subapical spines have strongly contorted, bladder-like apices (Fig. 10E), the usual ventro-internal subapical long setae are here replaced by a dense cluster of narrow, strap-like, blunt scales (Fig. 10J). Phallus (Fig. 10F) with coecum penis 0.5 its length, vesica weakly spinulose with strong "signum" and a single, basally inserted, very strong cornutus 0.6 length of entire phallus.

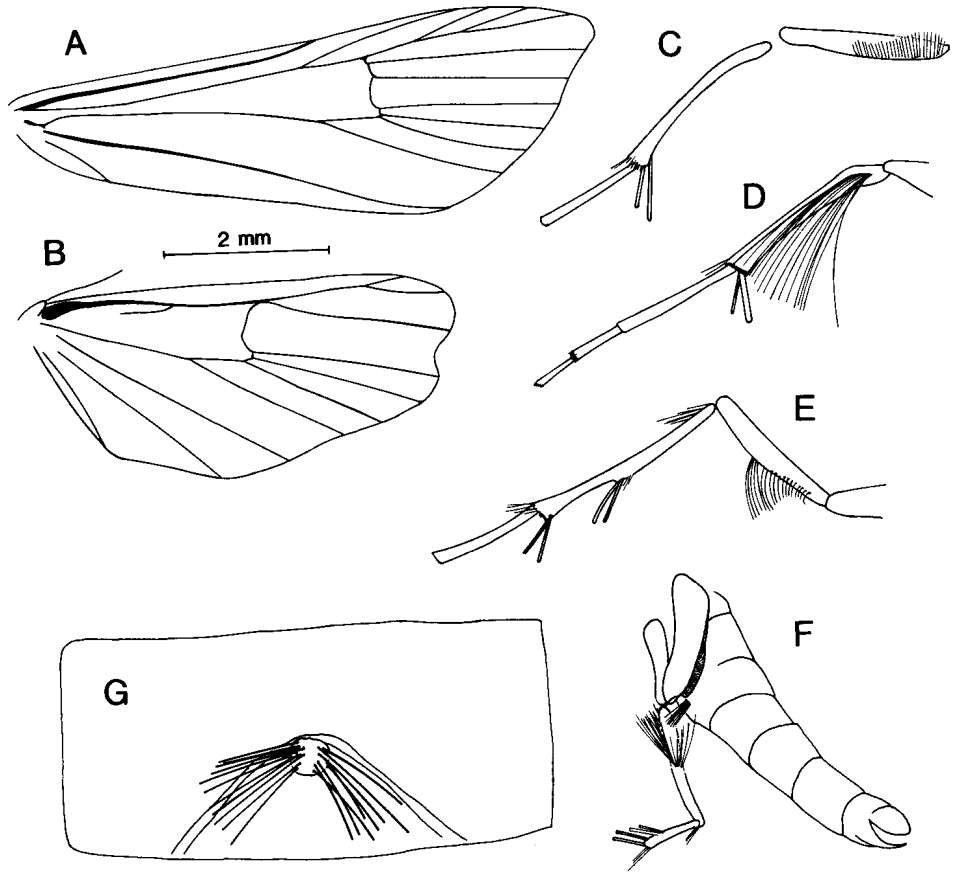

Fig. 9. *Eristena shafferi*, new species, male. A - Forewing venation x1; hindwing venation x1; C - mid femur and tibia, anterior view x1; D - mid tibia, posterior view showing groove and erected hair pencil x1; E - hind femur and tibia, anterior view x1; F - abdomen and hind leg in 3/4 ventral view showing relationship between abdominal and femoral tufts x1; G - abdominal sternite 3, ventral view x 2.5. (Magnifications relative to scale.)

Female not seen in Singapore, but alcohol material probably of this species has been taken at light in southern Thailand (Khlong Nhau mangroves near Ranong). In the absence of associated males, this material is excluded from the type series and not described. The wing pattern conforms closely to the described males and the female genitalia closely resemble those of *E. thalassalis*.

Material examined. - Holotype male (BMNH London), Singapore, Mandai mangroves, resting on foliage, 22 July 1976. 3 male paratypes, same locality but dated 5 Nov 86, 8 Feb 88, 24 May 88.

Remarks. - An uncommon species but apparently confined to mangroves, this is the largest and most brightly coloured of the three. General appearance is close to *thalassalis* which it also resembles in possessing a large penial cornutus but differs in details of pattern. The acute and slightly projecting termen of FW resembles *gregaria*. The complex

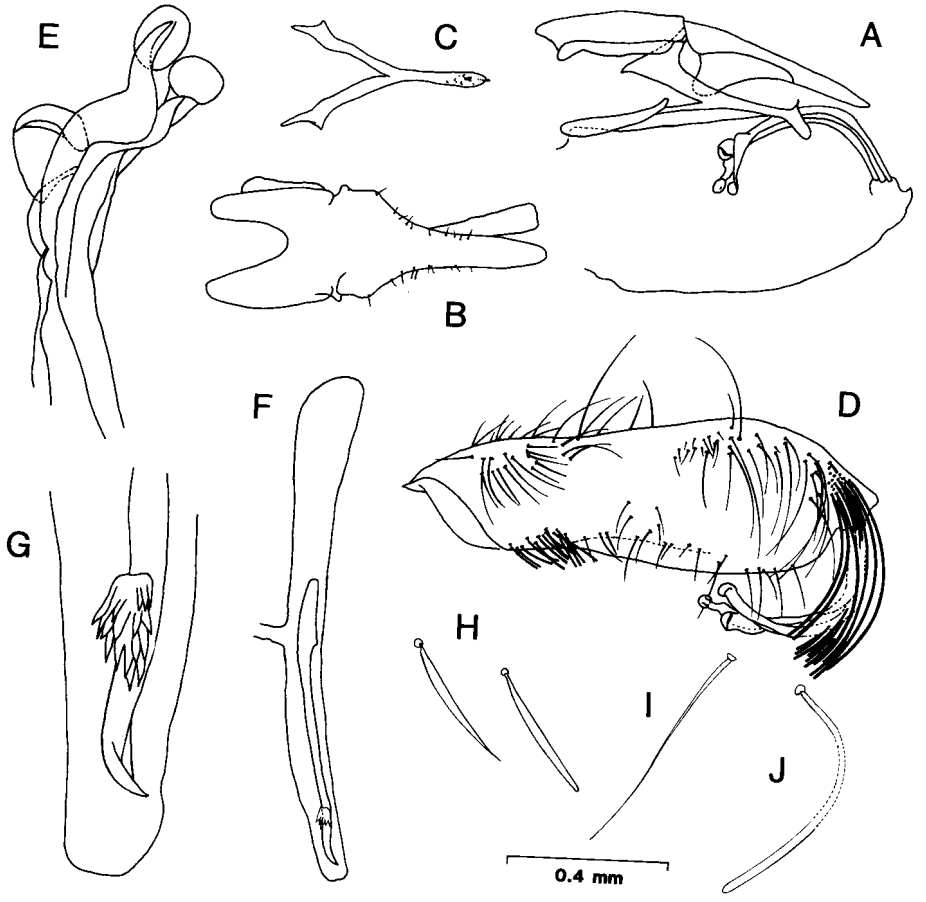

Fig. 10. *Eristena shafferi*, new species, male. A - genitalia, lateral view x1; B - tegmen and uncus, ventral view x1; C - gnathos, ventral view x1; D - valva, inner surface x1; E - apex of valvar spines x 4; F - phallus, lateral view x1; G -detail of "signum" and apex of cornutus x4; H - basal inner scales of valva x4; I - inner costal seta of valva x4; J - inner subapical scale of valva x4. (Magnifications relative to scale.)

apex of the valvar spines is very distinctive. It has not been seen to form gregarious swarms.

Etymology. - The specific epithet dedicates the species to Mr. M. Shaffer (BMNH, London) who has been generous with his time on my many problems with Pyralidae.

DISCUSSION

The old literature recognised several species that probably belong in the *Eristena/ Eoophyla* complex as understood here. Hampson reports hind femoral tufts for *ornatum* Moore, *tripletale* Hampson, *bifurcale* Pryer, *araeale* Hampson in *Oligostigma* and at least *endosaris, parapomasalis, hamalis, melanops, sinensis, saturalis, dominalis,* and *gibbosalis* in *Aulacodes* as he understood these genera. Because of the nature of his grouping it is not always clear whether some other species possess them and there is a substantial

group with mid-femoral tufts or other ventral structures that may have a functional relationship. For several species, only females are known and Hampson sometimes seems to have credited them to male-based groups on doubtful grounds. In later work such as his (1917) description of many Papuan *Aulacodes* he assigns species by number to this section of the genus without explanation. Thus the limits and integrity of *Eristena* in this sense must still remain obscure.

The long segment 3 of labial palp is significantly different from typical members of *Eoophyla* and *Theila* and although the femoral tufts are believed to define a monophyletic taxon, this may be divisible into more than one genus. Supporting this view is the attribution to *Eoophyla peribocalis* by Pruthi (1928) of a larva with simple labral setae and pedicellate gills. It is quite likely that a new genus will be needed for the species here treated as *Eristena* if *E. murinalis* proves to lack the femoral and abdominal tufts.

For comparative purposes, local material of *Nymphula manilensis*, *Nymphicula peribocalis*, *Oligostigma ?bilinealis* and *Parapoynx* aff. *stagnalis* have been examined and males are confirmed to lack mid-tibial groove, femoral tufts and abdominal gland. This supplements the work of Agassiz (1978) and Yoshiyasu (1980). Understandably, few workers describe negative characters that do not apply in their local fauna. Thus neither Lange (1956) nor Monroe (1972) use male tibial grooves or femoral tufts in their classification though Lange mentions that *Oligostigma junceale* has "tibiae of all legs in male with specialised tufts of hair" (p. 86). It is not clear whether Hampson and Swinhoe were justified in assuming that all Nearctic and Neotropical forms lacked these features.

Acknowledgments. - I am grateful to Mr. M. Shaffer (BMNH, London) for comparing material with the British Museum's collection, and to Miss C.S.C. Lee for technical assistance and help with art-work. This work was financed under Research Grant RP880352 from the National University of Singapore.

LITERATURE CITED

Agassiz, D., 1978. Five introduced species, including one new to science, of China Mark moths (Lepidoptera: Pyralidae) new to Britain. *Entomologist's Gazette*, **29**: 117-127.

Agassiz, D., 1982. Further introduced China Mark moths (Lepidoptera: Pyralidae) new to Britain. *Entomologist's Gazette*, **32**: 21-26.

Hampson, G. F., 1896. *The Fauna of British India, including Ceylon and Burma. Moths - Vol. IV.* Taylor and Francis, London. xxviii + 594 pp.

Hampson, G. F., 1897. On the classification of two subfamilies of Moths of the family Pyralidae: the Hydrocampinae and Scoparianae. *Trans. ento. Soc. London*, **1897**: 127-240.

Hampson, G. F., 1917. Descriptions of new Pyralidae of the subfamilies Hydrocampinae, Scoparianae &c. *Ann. Mag. nat. Hist.*, (8)**20**: 201-216.

Hasenfuss, I., 1960. Die Larvalsystematik der Zünsler (Pyralidae). *Abhandlungen Larvalsystematik der Insekten*, **5**: 1-263. Akademie-Verlag, Berlin.

Hering, E., 1903. Uebersicht der Sumatra-Pyralidae III. *Stettiner entomologische Zeitung*, **64**: 38-97, Pl. 1.

Lange, W. H., 1956. A generic revision of the aquatic moths of North America (Lepidoptera: Pyralidae, Nymphulinae). *The Wasmann J. Biol.*, **14**(1): 59-144.

Lieftinck, M. A., 1932. Remarks upon the early stages of *Aulacodes crassicornalis* (Guen.) and its parasite *Rhachioplex javanicus* Ferriere. *Treubia*, **14**: 131-136.

Maes, K., 1985. A comparative study of the abdominal tympanal organs in Pyralidae (Lepidoptera) I. Description, terminology, preparation technique. *Nota lepid.*, 8(4): 341 - 350.

Minet, J., 1981. Les Pyraloidea et leurs principales divisions systématiques. *Bull. Soc. ent. France*, **86**: 262 - 280.

Pruthi, H. S., 1928. Observations on the biology and morphology of the immature stages of *Aulacodes peribocalis* Wlk. (Hydrocampinae, Lepidoptera). *Rec. Ind. Mus.*, **30**: 353-356, Pl. XI.

Rose, H. S. & H. R. Pajni, 1986. Studies on the external genitalia of some species of subfamily Nymphulinae (Lepidoptera: Pyraustidae). *Research Bulletin (Science) of the Panjab University*, **37**(3-4): 1-10.

Shibuya, J., 1928. The systematic study of the Formosan Pyralidae. *Journal Faculty Agriculture, Hokkaido Imperial University, Sapporo*, **22**(1): 1-300, Pls. 1-9.

Swinhoe, C., 1900. *Catalogue of Eastern and Australian Lepidoptera Heterocera in the collection of the Oxford University Museum. - Part II: Noctuina, Geometrina and Pyralidina*. Pp. 1-540, Pls. 1-8; London.

Warren, W., 1896. New genera and species of Pyralidae, Thyrididae and Epiblemidae (part). *Ann. Mag. nat. Hist.*, (6)**17**: 131-150.

Yoshiyasu, Y., 1980, A systematic study of the genus *Nymphicula* Snellen (Lepidoptera: Pyralidae) from Japan. *Tyô to Ga*, **31** (1, 2): 1-28.

Yoshiyasu, Y., 1984, A study of Thailand Nymphulinae (Lepidoptera, Pyralidae) (3) Two new species of *Eristena* Warren. *Tyô to Ga*, **35**(1): 1-9.

Address: DHM - Department of Zoology, National University of Singapore, Kent Ridge, Singapore 0511