

The Drosophilidae of Taiwan: Genus *Amiota*, Subgenus *Phortica*¹

Jan Máca² and Fei-Jann Lin³

Czech Institute of Nature Conservation (ČÚOP),
Žižkovo náměstí 34, České Budějovice,
Czech Republic²

and

Institute of Zoology, Academia Sinica,
Nankang, Taipei, Taiwan 115, R.O.C.³

(Accepted January 30, 1993)

Jan Máca and Fei-Jann Lin (1993) The Drosophilidae of Taiwan: genus *Amiota*, subgenus *Phortica*. Bull. Inst. Zool., Academia Sinica 32(3): 171-183. Seventeen species of genus *Amiota* Loew, subgenus *Phortica* Schiner, are given from Taiwan, including *Amiota (Phortica) speculum* Máca and Lin, n. sp., *A. (P.) perforcipata* Máca and Lin, n. sp., *A. (P.) fangae* Máca, n. sp., *A. (P.) hongae* Máca, n. sp., *A. (P.) liniae* Máca and Chen, n. sp., and *A. (P.) watanabei* Máca and Lin, n. sp. All species previously known from Taiwan, except *A. (P.) eparmata* Okada, are given from additional localities; three species are new records for Taiwan.

Key words: *Amiota*, *Phortica*, Taiwan, *Amiota (Phortica) speculum* n. sp., *A. (P.) perforcipata* n. sp., *A. (P.) fangae* n. sp., *A. (P.) hongae* n. sp., *A. (P.) liniae* n. sp., *A. (P.) watanabei* n. sp.

Species of the genus *Amiota*, subgenus *Phortica*, from Taiwan have previously been described by Hendel (1914), Duda (1923), Okada (1971, 1977) and Tsacas and Okada (1983). Specimens of some of these species were later collected in Guangdong Province of Mainland China (Peng *et al.* 1990). *Amiota (P.) maculiceps* (Duda, 1924), first described from Sumatra, has also been observed in Taiwan (Duda, 1926a). Here we identify five new species of *Amiota* which we collected during field work conducted in Taiwan in 1991. In addition, one new species — *A. (P.) watanabei* — which was previously con-

fused with *A. (P.) orientalis* — is clarified. Three other species which were hitherto known only in neighbouring countries have also been recorded from Taiwan for the first time. Finally, *A. (P.) maculiceps* (Duda, 1924) has not recently been confirmed from Taiwan, and therefore has been deleted from lists of Taiwanese fauna.

The subgenus *Phortica* is a well-defined group which is distinguishable from other groups of the subfamily Steganinae by its characteristic mesonotum and abdomen patterns, mostly banded tibiae, as well as some other characters (Okada 1971, Máca 1977, Toda and Peng 1990). The most closely

1. Paper No. 379 of the Journal Series of the Institute of Zoology, Academia Sinica.

related *Amiota*, subgenus *Sinophthalmus* Coquillett from North and Central America, has an identical appearance but differs in its bare arista. *Amiota (Phortica) pappi* Tsacas and Okada from New Guinea perhaps deserves subgeneric status; like *Sinophthalmus* it shows bare arista, but its male terminalia differ from both of the above-mentioned subgenera.

In other respects, the subgenus *Phortica* is a rather uniform group. Its range of distinguishing characters — with the exception of the male terminalia — is quite narrow. Generally, the group shows sparse morphometric distinguishing characters, but the combined coloration of frons, orbits, legs, and abdominal tergites is often species-specific. In some cases, such characters as arista branching, bristles of the 3rd femur in males, and wing indices may be accepted as reliable distinguishing characters. Propleural bristles (one or more tiny bristles near the anter-oventral corner of the anepisternum) were observed to be present in all our specimens; however, the taxonomic value of this character remains uncertain. Pteropleura shape, the posterior part of the anepisternum, and the structures around the wing base may prove to be good distinguishing characters, and it may be presumable that their shapes reflect species diversity in mating songs. Unfortunately, these structures cannot be observed properly without prior clearing in KOH solution.

Morphological terms in this paper are used according to McEvey (1990). The paired furcoid process of the epandrium is called the anterior process. All given measurements are of holotypes; extreme values are given in parentheses in cases of variability. Type specimens of the new species have been deposited in the Institute of Zoology, Academia Sinica, Taipei; some of the paratypes can be found in the collection of one of the authors (J. M.); paratypes of *A. (P.) linae* are also in the collection of the Institute

of Genetics, Fudan University, Shanghai, and in the collection of the Natural History Museum, Budapest.

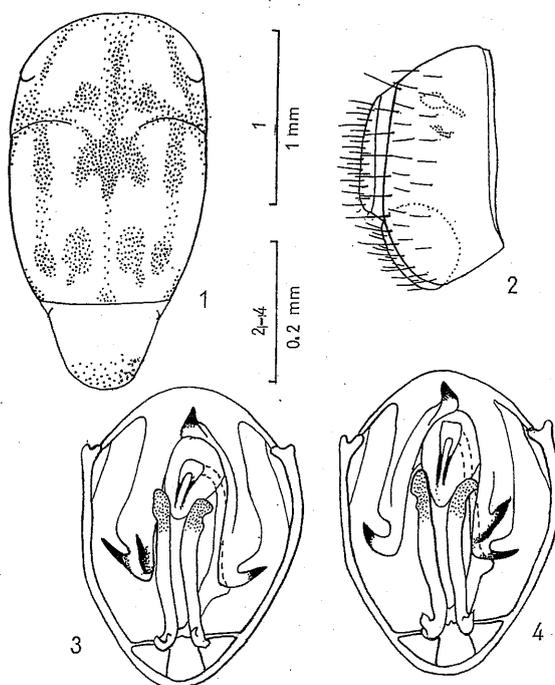
DESCRIPTION OF NEW SPECIES OF *AMIOTA (PHORTICA)* FROM TAIWAN

Amiota (Phortica) speculum Máca and Lin, sp. nov. (Figs. 1 – 4)

Specimens examined:

Holotype ♂: Chipen, Taitung County, 11 Sept. 1991 (Máca, Fang and Hong).

Paratypes: same data as holotype, 5 ♂♂; Nankang, Taipei City, 26 Oct. 1991, 1 ♂ (Máca).



Figs. 1 - 4. *Amiota (Phortica) speculum* Máca and Lin, sp. nov.

1. Mesoscutum
2. Peripheralia organs
3. Phallic organs, ventral aspect, Holotype
4. Phallic organs, ventral aspect, one of paratypes, Chipen, Taitung County

Description:

Male: Antenna yellowish brown, 3rd segment (1st flagellomere) paler. Arista with two dorsal rays (length 0.8 width of 3rd antennal segment); apical expansion is much like that in *A. (P.) foliacea* Tsacas and Okada. Frons pale brown, orange medially, as long as posteriorly wide, slightly narrowed anteriorly (anterior to posterior width, 0.7). Approximately 20 coarse frontal hairs. Periorbit white, ocellar triangle dark brown, orbits yellowish brown with dark spot at base of upper orbital bristle. Palpus pale. Face pale with whitish pruinose lateral spot on each side. Gena pale and linear posteriorly above.

Mesoscutum (Fig. 1) pale brown, polinose, with ill-defined darker pattern consisting of posteriorly trilobed medial spot behind suture; two small dark spots between anterior dorsocentrals plus some additional, barely recognizable dark spots. Humerus yellow. Mesoscutellum yellowish grey, darkened apically. Pleura pale, middle of anepisternum and lower part of katepisternum darker; pteropleura mamorate. Two small propleural bristles. **Wing:** C-*i* 1.8 (1.8 – 2.1), 4v-*i* 3.2 (2.7 – 3.3), 4C-*i* 1.8 (1.5 – 1.9), 5x-*i* 1.4 (1.1 – 1.4), Ac-*i* 4.0 (4.0 – 4.1), C₃ fringe 0.7. Legs yellow. First femur anterior with brownish patch, last two tarsomeres darker on all three legs. Apical and preapical tibiae bristles barely discernible; anteroventral and posteroventral bristles of 2nd basitarsus well-developed.

First two abdominal tergites pale, 2nd tergite with small dark spot anterolaterally. Remaining tergites darkened (somewhat less so near mid-line), with narrow yellow anterior band and yellow lateral (incurved) section. Third sternite much wider than long. **Periphallic organs** (Fig. 2): Epandrium broad, rounded below. Anal cerci narrow, parallel. Surstylus sheet-like, hairy, without teeth with triangular dilated mediad. Decasternum absent. Ejaculatory apodeme small, spoon-like. **Phallic organs** (Figs. 3-4): Anterior

parameres connected to hypandrium by a bar, biarmous; upper branch long, club-shaped, lower branch with several apical hairs. Aedeagus membranous apically; membrane without discernible spines. Aedeagal apodeme higher than wide, vertical rod long, including obtuse angle to the proper aedeagus. Posterior paramere asymmetrical; dorsomedial edge connected to left-side ventrolateral spur *via* the sclerotized band, right side weakly sclerotized submedially and with two ventrolateral spurs. This arrangement was observed in four specimens, including holotype; in other three specimens, side structure is reversed — dorsomedial edge connected to right-side spur, left side with two spurs. Caudal end of posterior paramere T-shaped; two branches connected to hypandrial arms. Hypandrium narrow, with paramedial inward dilation (flap) on each side.

Diagnosis: This new species belongs to the *foliiseta* complex; it differs from other species in this complex mainly by its male genitalia shape.

Note: Prof. M. J. Toda (Sapporo) collected this species in Guangdong Province, China (personal communication).

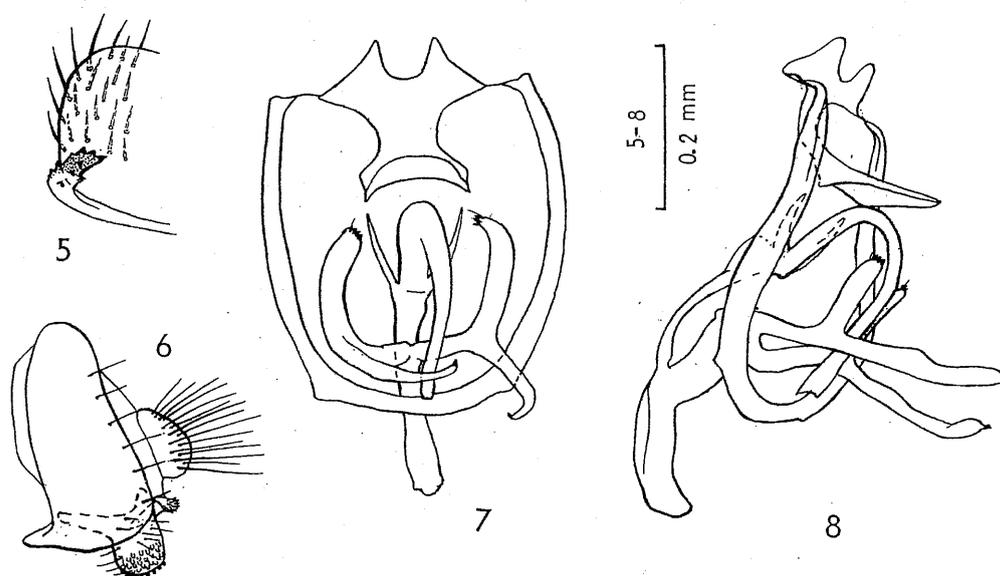
***Amiota (Phortica) perforcipata* Máca and Lin, sp. nov.**
(Figs. 5 – 8)

Specimen examined:

Holotype ♂: Kukuan, Taichung County, 18 Jan. 1975 (F. J. Lin).

Description:

Male: Antenna orange, 3rd segment paler. Arista with 6 upper rays (basal trio are longer than the width of the 3rd antennal segment) and 3 short lower rays. Middle orbital bristle length 1/3 of lower orbital bristle. Ocellar triangle dark brown, frons only little more pale, with tiny longitudinal ridge-like structures; anterolateral corners of frons orange. Periorbit white. Palpus yellowish



Figs. 5 – 8. *Amiota (Phortica) perforcipata* Máca and Lin, sp. nov.

5. Lateral margin of sixth abdominal tergite
6. Periphallallic organs
7. Phallic organs, ventral aspect
8. Phallic organs, lateral aspect

gray, darker basally. Face pale yellowish, facial keel and ventrolateral edges brown. Gena pale, darker anteriorly to buccal angle.

Mesoscutum dark brown with ill-defined pale pattern. Humerus yellowish. Mesoscutellum grey basally, medial line and apex dark brown. Pleura grey, with some indistinct dark spots; katepisternum paler. *Wing*: C-*i* 2.4, 4v-*i* 2.9, 4C-*i* 1.5, 5x-*i* 1.5, Ac-*i* 1.5, C₃ fringe 0.7. Legs yellow, femora darkened except at tips; each tibia with three dark rings, basal ring not longer than width of tibia.

First abdominal tergite pale, 2nd tergite on each side with large posterolateral dark patches, almost extending to medial line. Other following tergites with faded, medially and sublaterally dilated, posterior dark bands. Sixth tergite (Fig. 5) anterolateral with prickly elongated projection. Sixth sternite with a pair of transparent spots which are lateral with a horn-like rod attached to each side. *Periphallallic organs* (Fig. 6): Epandrium dilated

ventrally, anterolateral corner prominent and pointed. Anal cerci bulbous. Surstylus with short cuneiform bristles over apical part of inner surface. Decasternum relatively large with well-developed pubescent plate fused to it. *Phallic organs* (Figs. 7-8): Anterior parameres bilobed; longer lower branch with one sensillum, upper branch with several sensilla. Aedeagus apically truncated and arcuated, with sub-basal part flattened dorsoventrally. Posterior paramere with elongated, tongue-like mantle. Hypandrium narrow, with inconspicuous paramedial flaps.

Diagnosis: This species is closely related to *A. (P.) omega* Okada 1977 from Thailand. The new species differs according to its facial and mesoscutellum pattern, the absence of a bluish shade of pollinose; more extensive dark patches on the femora and 2nd abdominal tergite, a higher 5x-*i*, prickly projections from the 6th tergite (no such structure in *A. (P.) omega* according to personal com-

munication with Prof. T. Okada), a truncated aedeagus, and only one sensillum on the lower branch of anterior paramere.

***Amiota (Phortica) fangae* Máca, sp. nov.**
(Figs. 9 – 12)

Specimens examined:

Holotype ♂: Taipingshan, I-Lan County, 27 Aug. 1991 (Máca, Fang, and Hong).

Paratypes: Same data as holotype, 47 ♂♂. Same locality, 4 July 1988, 5 ♂♂ (F. J. Lin). Chyrduan, I-Lan County, 4 July 1991, 18 ♂♂ (Máca, Hong, and Wong). Tuchang, I-Lan County, 28 Aug. 1991, 1 ♂, 1 ♀ (Máca, Fang, and Hong). 4 July 1988, 5 ♂♂ (F. J. Lin). Paling, Taoyuan County, 3 July 1991, 12 ♂♂ and 1 ♀ (Máca, Hong, and Wong). Chitou, Nantou County, 1 Oct. 1971, 1 ♀ (F. J. Lin and Cheng). Sunlinshi, Nantou County, 13 June 1991, 10 ♂♂; 14 June 1991, 7 ♂♂ and 7 ♀♀ (Máca, Fang, and Hong).

Description:

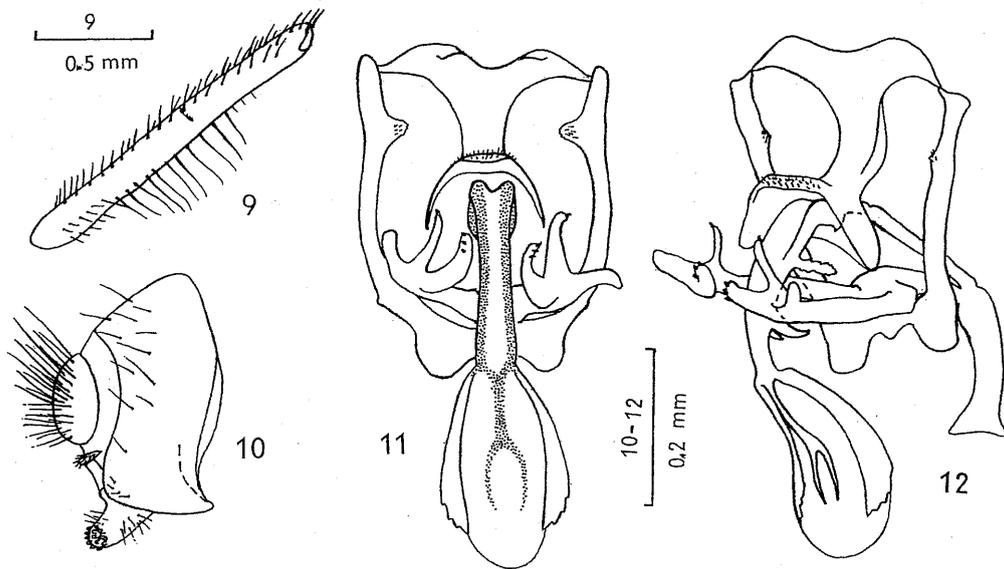
Male: Antenna yellowish brown basally, 3rd segment yellow. Arista with 4 – 5 upper and 3 lower rays; basalmost lower ray (originating approximately mid-length of arista) almost as long as width of 3rd antennal segment. Frons slightly wider than long (1.1 – 1.2 : 1), brown medially; parts of orbit and posterolateral corners whitish with ocellar triangle and anteriorly-pointed spot on the posterior part of orbit dark brown. Face yellow, keel with darker patches. Palpus dark brown, ventroapically pale brown. Gena darker below eye.

Mesonotum pale brown in ground color with usual pattern (as in *A. (P.) variegata*); humerus and sutural region yellowish. Mesoscutellum basolaterally pale and dark brown in apical one-third and along medial line. Anepisternum pale with dorsal and medial dark patches; katepisternum almost completely dark; pteropleura with dark band above katepisternal margin and with dark spot above hind coxa. *Wing*: C-*i* 2.3 (2.2 – 2.3), 4v-*i* 2.9 (2.8 – 3.3), 4C-*i* 1.6 (1.4 – 1.7), 5x-*i* 1.1 (1.0 – 1.1), Ac-*i* 4.0 (3.9 – 4.1), C₃ fringe 0.7 (0.7 – 0.8). Legs yellow, fore femur with basomedial and subapical dark spots

(basomedial spot less prominent, both spots sometimes faded); apical two-thirds of middle femur slightly darkened; each tibia with three dark rings, the apical ring of middle tibia being most conspicuous; last tarsal joint sometimes darker on all three legs. Hind femur extends medioposteriorly; contains a row of erect but apically bent bristles which are at least as long as femur width (Fig. 9).

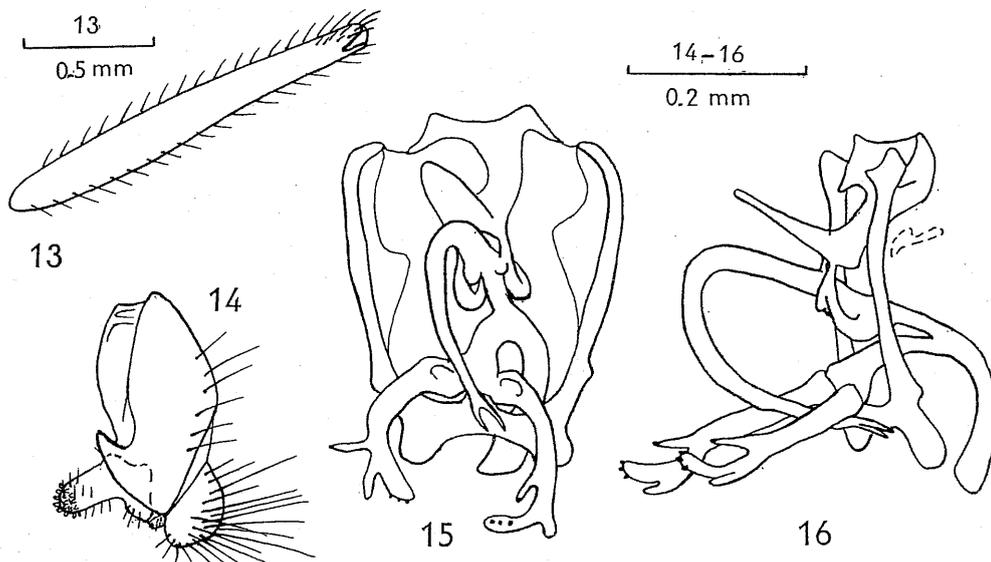
First abdominal segment yellow, second tergite on each side with large posterolateral patch extending to the anterolateral corner; posterolateral corner with a second small patch. Third segment with medially and submedially dilated posterior dark band which extend and narrow to the middle of the lateral tergite margin; posterolateral corner of tergite with a small dark patch; fourth tergite identical. Fifth tergite with medially protruding dark band, lateral margin yellow. Sixth tergite dark with pale medial line. Sixth sternite with horn-like furcoid rods extending laterally. *Peripheral organs* (Fig. 10): Epandrium with inconspicuous anterior process and pointed anteroventral corner. Anal cerci bulbous, upper bristles elongated. Surstylus elongated with cuneiform apicomedial bristles. Decasternum with strongly transversed pubescent plate. *Phallic organs* (Figs. 11-12): Anterior parameres trilobed as in *A. (P.) variegata*. Aedeagus with bilobed medial rod, lateral rods serrated; middle part with bulbous base and two pairs of ventral appendages — basal serrated, apical hook-like; apodeme triangularly dilated. Posterior paramere wide with broadly truncated mantle anteriorly. Hypandrium slightly pointed medially, with small paramedial flaps.

Diagnosis: This new species belongs to the *variegata* complex. It has medially protruding dark bands on the 3rd and 4th tergites; these bands are become narrow laterally and are directed toward the anterolateral tergal margins. Lower arista branches are long. Among species showing these characters, *A. (P.) fangae* differs in having



Figs. 9 - 12. *Amiota (Phortica) fangae* Máca, sp. nov.

- 9. Hind femur of male, caudal aspect
- 10. Periphallitic organs
- 11. Phallic organs, ventral aspect
- 12. Phallic organs, lateral aspect



Figs. 13 - 16. *Amiota (Phortica) hongae* Máca, sp. nov.

- 13. Hind femur of male, caudal aspect
- 14. Periphallitic organs
- 15. Phallic organs, ventral aspect
- 16. Phallic organs, lateral aspect

long bristles on the hind femur and serrated aedeagus appendages.

Note: Several specimens (mostly ♀♀) were infested with parasitic fungi of the order Laboulbeniales; a study of female morphology was not performed in order to preserve the fungi.

***Amiota (Phortica) hongae* Máca, sp. nov.**
(Figs. 13 – 16)

Specimens examined:

Holotype ♂: Chyrduan, I-Lan County, 4 July 1991 (Máca, Hong, and Wong).

Paratypes: Same data as holotype, 4 ♂♂

Description:

Male: Second antennal segment brown at base, third segment paler. Arista with four dorsal rays; two ventral rays as long as width of 3rd antennal segment. Frons dark brown both medially and in the area between the ocellar triangle and orbital bristles. Face pale. Palpus as in *A. (P.) fangae*. Gena pale with longitudinal ridge-like pruinose.

Mesonotum with *variegata*-like pattern. Mesoscutellum with large pale spot on each basal side, medial line and subapical parts brown, apex with small pale spot. Pleura with pruinose composed of tiny longitudinal ridges; dark except for lower third of anepisternum, upper margin of katepisternum, and broad upper margin of pteropleura. *Wing:* C-*i* 2.2 (2.0 – 2.2), 4v-*i* 3.2 (3.2 – 3.6), 4C-*i* 1.7 (1.7 – 2.0), 5x-*i* 1.0 (0.9 – 1.0), Ac-*i* 3.3 (3.3 – 4.0), C₃ fringe 0.75 (0.7 – 0.8). Costa somewhat inflated behind second break. *Legs:* Coxae yellow. First femur brown except for apex; 2nd femur slightly darkened basally and at about 2/3 of length; 3rd femur similarly dark, but with subapical darkening more extensive (from less than half the length of the femur almost to its apex). Each tibia with three dark rings. Two final tarsal segments dark in some specimens. Hind femur without conspicuous bristles (Fig. 13).

First abdominal tergite yellow. Each side

of second tergite with a large sublateral posterior dark spot and small dark spot at the posterior corner. Third to 5th tergites each with medially and laterally protruding posterior dark bands which do not reach the lateral margin of tergite; in addition, 3rd tergite with a dark spot at posterolateral corner. Sixth tergite and epandrium dark. *Periphallid organs* (Fig. 14): Epandrium with anteroventral corner directed upward. Anal cerci, surstylus, and decasternum much like those in *A. (P.) fangae*. Ejaculatory apodeme small and weakly sclerotized. *Phallic organs* (Figs. 15-16): Anterior paramere trilobed. Aedeagus strongly curved, slightly bifid apically, and connected basally to posterior paramere via a curved paired bridge; apodeme relatively short. Posterior paramere with tongue-like mantle. Hypandrium with large paramedial flaps.

Diagnosis: Dark bands on 3rd and 4th abdominal tergites are medially dilated and sublaterally interrupted; lower branches of arista are long, scutellum with dark trifold pattern. Among those species showing these characters, *A. (P.) hongae* differs in having a simple apically bifid aedeagus.

***Amiota (Phortica) liniae* Máca and
Chen, sp. nov.**
(Figs. 17 – 22)

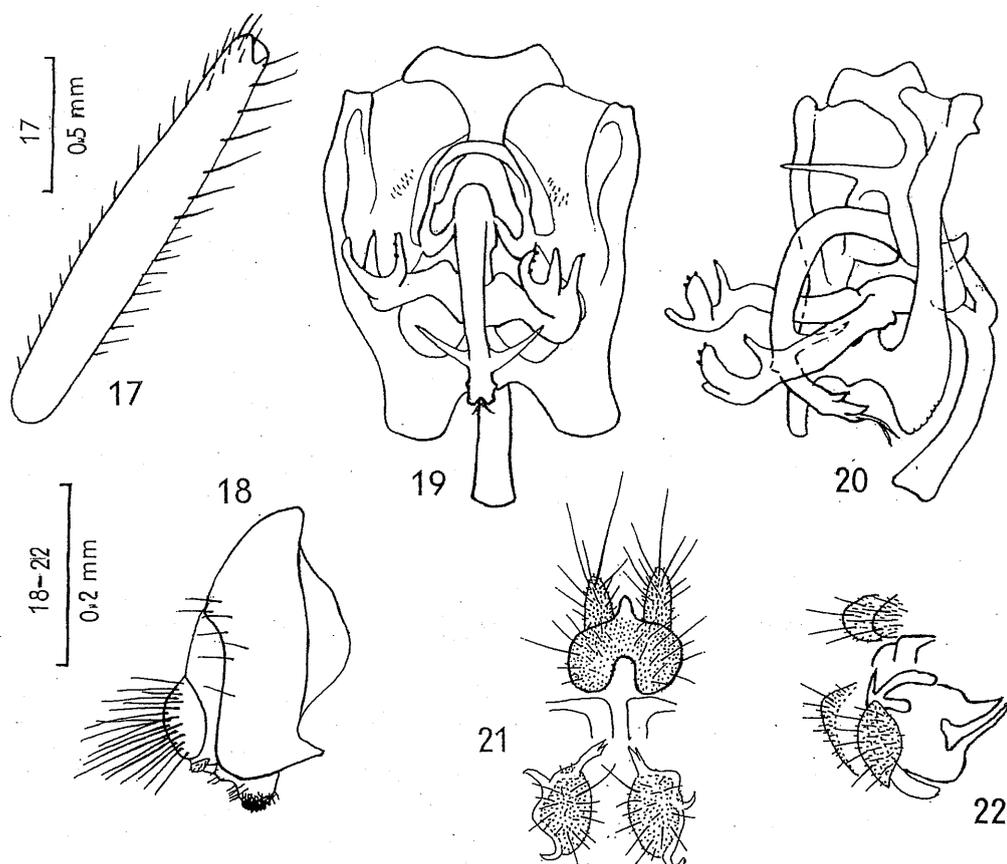
Specimens examined:

Holotype ♂: Kukuan, Taichung County, 15 Aug. 1991 (Máca, Hong, and S. F. Lin).

Paratypes: Chyrduan, I-Lan County, 4 July 1991, 6 ♂♂ (Máca, Hong, and Wong). Taipingshan, I-Lan County, 27 Aug. 1991, 3 ♂♂ (Máca, Fang, and Hong). Chitou, Nantou County, 13 Apr. 1971, 3 ♂♂ (F. J. Lin). Sunlinshi, Nantou County, 13 June 1991, 2 ♂♂; 14 June 1991, 1 ♂ (Máca, Fang, and Hong). Chip Chip (= Chichi), Nantou County, March 1909, 1 ♂ (Sauter, Coll. Mus. Nat. Hist., Budapest). Huangshan, Anhui Province, Mainland China, 29 Aug. 1991, 30 ♂♂, 7 ♀♀ (Chen and Toda).

Description:

Male: Antenna greyish yellow, pollinose, orange at base. Arista with 3-5 upper rays



Figs. 17 - 22. *Amiota (Phortica) linæ* Máca and Chen, sp. nov.

- 17. Hind femur of male, caudal aspect
- 18. Peripheral organs
- 19. Phallic organs, ventral aspect
- 20. Phallic organs, lateral aspect
- 21. Female terminalia, ventral aspect
- 22. Female terminalia, lateral aspect

(longest one approximately as long as width of 3rd antennal segment) and 3-4 lower rays (approximately 2/3-length of upper rays). Frons with large medial dark patch over ocellar triangle and entire middle part; anterior margin narrow and pale, sides broad and pale, with isolated dark spot surrounding the base of upper orbital bristle. Face pale tan. Palpus darker in basal half. Gena pale along eye margin, but mostly darker near the oral bristles.

Mesoscutum dark with ill-defined pol-

linose pattern. Humeral, notopleural, and supraalar regions pale yellowish but with dark patches near the bases of bristles. Mesoscutellum as in *A. (P.) hongae*, sometimes without apical pale spot. Anepisternum ground color pale with darker brown spots; katepisternum mostly dark, as is pteropleura. Wing: C-*i* 2.3 (2.1 - 2.4), 4v-*i* 3.0 (3.0 - 3.2), 4C-*i* 1.6 (1.5 - 1.7), 5x-*i* 0.9 (0.7 - 1.1), Ac-*i* 3.8 (3.2 - 3.9), C₃ fringe 0.7 (0.7 - 0.8). Legs yellow, fore femur dark on basal two-thirds, middle and hind femora sometimes

darker basally and subapically; each tibia with three dark rings. Apical third of hind femur with a row of about six stronger bristles (Fig. 17).

First abdominal tergite with posterior sublateral spot on each side. Each side of second tergite with large sublateral spot and darker lateral margin. Third to 5th tergites each with medially and sublaterally protruding dark bands (laterally angular and without connection to lateral margin) and narrowly darker lateral margin; later dark patch on 5th tergite not developed. Apex of abdomen dark except for medial line. *Periphallig organs* (Fig. 18): Epandrium with strong anterior process. Anal cerci bulbous. Surstylus and decasternum as in *A. (P.) fangae* and *A. (P.) hongae*. *Phallic organs* (Figs. 19-20): Anterior paramere trilobed. Aedeagus strong, curved and with expansion at base; with subapical pair of spurs and four apical hook-like projections (one hook in the lateral pair is often reduced or somewhat displaced; apical hooks with a membranous bifid line in between). Posterior paramere as in *A. (P.) hongae*. Hypandrium with very large and strong paramedial flaps.

Female: Differs by having somewhat lower 4v-i (3.0) and 4C-i (1.5), although this has not been proven statistically. Female terminalia have a conspicuous shape (Figs. 21-22).

Diagnosis: Like *A. (P.) hongae*, *A. (P.) linae* belongs to the cluster of species which is similar to *A. (P.) orientalis*. It differs in having long bristles from the apex of the male's hind femur, almost completely dark frons, and a characteristic shape of genitalia.

***Amiota (Phortica) watanabei* Máca and Lin, sp. nov.**

Amiota (Phortica) orientalis Hendel: Okada, 1977.

Specimen examined:

Holotype ♂: Szutsutou, Nantou County, 11 Aug. 1971 (Z. I. Ting).

Description:

The one male specimen we studied agrees completely with the description and illustrations given by Okada (1977) for *A. (P.) orientalis*, which is, however, a distinct species (see list of Taiwanese species given below). Therefore, specimens collected at Pasenshan and Wulai, which were recognized by Okada (1977) as *A. (P.) orientalis* Hendel, are now considered to be conspecific with *A. (P.) watanabei* sp. nov.

AMIOTA (SUBG. PHORTICA) SPECIES FROM TAIWAN

Information is presented in the following paragraph format:

- A. Previously published records from Taiwan, including descriptions given in this paper. References to relevant papers are included.
- B. Previously unpublished material from Taiwan (if not stated otherwise, deposited in the Institute of Zoology, Academia Sinica, Taipei, Taiwan).
- C. Summary of species distribution; except for those given in paragraphs A and B, data are from: original descriptions; from Okada (1988), Peng *et al.* (1990), and Tsacas and Okada (1983); and from personal communication with Prof. M. J. Toda (Sapporo).

Other abbreviations:

- D. Reference to original description.
- Co. County (Hsien).

cardua Okada, 1977

- A. Wulai (Taipei Co.; D).
- B. Chyrduan (I-Lan Co., 4 July 1991, 1 ♂ Máca, Hong, and Wong). Chip Chip (= Chichi, Nantou Co., March 1909, 2 ♂♂, Sauter, Coll. Mus. Nat. Hist. Budapest).
- C. Taiwan and Yunnan Province.

eparmata Okada, 1977

- A. Wulai (Taipei Co.; D).
- B. None.
- C. Taiwan.

fangae Máca, sp. nov.

- A. Taipingshan, Chyrduan and Tuchang (I-Lan Co.), Paling (Tao-yuan Co.), Chitou and Sunlinshi (Nantou Co.), all D.
- B. None.
- C. Taiwan.

flexuosa Zhang and Gan, 1986

- A. None.
- B. Kukuan (Taichung Co., 15 Aug. 1991, 1 ♂, Máca, Hong and S. F. Lin).
- C. Taiwan and Yunnan Province.

foliacea Tsacas and Okada, 1983

- A. Chip Chip (= Chichi, Nantou Co.; D).
- B. Taipingshan (I-Lan Co., 27 July 1991, 2 ♂♂, Máca, Fang, and Hong), Chyrduan (I-Lan Co., 4 July 1991, 1 ♂, Máca, Hong, and Wong), Chitou (Nantou Co., 22 June 1988, 3 ♂♂ F. J. Lin; 1 Oct. 1978, 1 ♂, F. J. Lin and Chang; 13 Apr. 1972, 2 ♂♂, F. J. Lin), Tongpu (Nantou Co., 15 April 1972, 2 ♂♂ F. J. Lin).
- C. Taiwan.

foliiseta (Duda, 1923)*Phortica foliiseta* Duda, 1923

- A. Chip Chip (= Chichi, Nantou Co.; D), Mt. Hoozan (= Fongfangshan, Nantou Co.; D), Kankau (= Hengchun, Pintung Co.; D), Wulai (Taipei Co.; Tsacas and Okada 1983), Rhosan (= Lushan, Nantou Co.; Tsacas and Okada 1983).
- B. Szutsutou (Nantou Co., 11 Aug. 1971, 1 ♂, Z. I. Ting), Miaoli (Miaoli Co., 1 Sept. 1991, 4 ♂♂, Hong), Tienhsiang (Hualien Co., 10 Sept. 1991, 2 ♂♂, Máca, Fang, and Hong), Kukuan (Taichung Co., 15 Aug. 1991, 4 ♂♂, Máca, Hong, and S. F. Lin), Chipen (Taitung Co., 11 Sept. 1991, 6 ♂♂, Máca, Fang, and Hong),

Tuchang (I-Lan Co., 28 July 1991, 1 ♂, Máca, Fang, and Hong), Taipingshan (I-Lan Co., 27 Aug. 1991, 1 ♂, Máca, Fang, and Hong).

- C. Taiwan, Guangdong Province, and Thailand.

gigas Okada, 1977

- A. Alishan (Chia-I Co.; D).
- B. Wuling (Taichung Co., 14 Aug. 1991, 1 ♂, Máca, Hong, and S. F. Lin), Kukuan (Taichung Co., 18 Aug. 1975, 4 ♂♂, F. J. Lin; 15 Aug. 1991, 1 ♂, Máca, Hong, and S. F. Lin), Chitou (Nantou Co., 12 Feb. 1971, 1 ♂; 13 Apr. 1971, 2 ♂♂, all F. J. Lin).
- C. Taiwan.

hongae Máca, sp. nov.

- A. Chyrduan (I-Lan Co.; D).
- B. None.
- C. Taiwan.

lambda Toda and Peng, 1990

- A. None.
- B. Tuchang (I-Lan Co., 28 Aug. 1991, 1 ♂, Máca, Fang, and Hong).
- C. Taiwan and Guangdong Province.

linae Máca and Chen, sp. nov.

- A. Kukuan (Taichung Co.), Chyrduan and Taipingshan (I-Lan Co.), Chitou, Chichi, and Sunlinshi (Nantou Co.); all D.
- B. None.
- C. Taiwan and Anhui Province.

magna Okada, 1960

- A. None.
- B. Wuling (Taichung Co., 14 Aug. 1991, 3 ♂♂, Máca, Hong, and S. F. Lin), Taipingshan (I-Lan Co., 27 Aug. 1991, 3 ♂♂, Máca, Fang, and Hong), Chitou (Nantou Co., 13 Apr. 1971, 3 ♂♂, F. J. Lin), Tzu-En, Jiyuetan (Nantou Co., 16 Nov. 1991, 3 ♂♂, Máca and Mácová), Sunlinshi (Nantou Co., 14 June 1991, 1

♂, Máca, Fang, and Hong), Szutsutou (Nantou Co., 11 Aug. 1971, 1 ♂, Z. I. Ting).

- C. Taiwan, Guangdong and Yunnan Provinces, Ryukyus and Japan.

orientalis Hendel, 1914

Amiota (Phortica) antheria Okada, 1977, syn. nov.

- A. Kankau (= Hengchun, Pintung Co., D), Koyo-Onsen (= Honyie, Hualien Co.; Okada 1977).
 B. Nankang (Taipei City, 6 June 1991, 3 ♂♂; 10 June 1991, 2 ♂♂; 12 July 1991, 1 ♂; 13 July 1991, 2 ♂♂, 1 ♀; all Máca), Kukuan (Taichung Co., 15 Aug. 1991, 1 ♂, Máca, Hong and S. F. Lin).
 C. Taiwan and Guangdong Province.

Note: The type series of *A. (P.) orientalis* Hendel has previously been studied by one of the authors (J. M.) at the Natural History Museum, Vienna; this collection consists of five specimens, four of them female. Only the first specimen in this line (♀) bears Hendel's determination label. The single male, collected on 22 June, 1912, is in good condition; it is readily identifiable according to its terminalia (even without preparation) as being conspecific with *A. (P.) antheria* Okada; this specimen is designated thereby designated a Lectotype of *A. (P.) orientalis* Hendel. The female specimens (hereby designated as Paralectotypes of *A. (P.) orientalis* Hendel) agree with the Lectotype in all characters except terminalia.

paramagna Okada, 1971

- A. Hokuko-Kaminoshima Onsen (= Husan Spring, Miaoli Co.; D), Fenchiu (Chia-I Co.; D).
 B. Wuling (Taichung Co., 14 Aug. 1991, 11 ♂♂, Máca, Hong, and S. F. Lin), Kukuan

(Taichung Co., 18 Jan. 1975, 1 ♂, F. J. Lin), Kweiwu (Hsinchu Co., 6 Oct., 1991, 1 ♂, Tseng), Chitou (Nantou Co., 13 Apr. 1971, 25 ♂♂; 17 Apr. 1972, 1 ♂, F. J. Lin), Tongpu (Nantou Co., 15 Apr. 1972, 7 ♂♂, F. J. Lin), Sunlinshi (Nantou Co., 13 June 1991, 14 ♂♂; 14 June 1991, 2 ♂♂, all by Máca, Fang, and Hong), Szutsutou (Nantou Co., 11 Aug. 1971, 1 ♀, Z. I. Ting), Taipingshan (I-Lan Co., 27 Aug. 1991, 2 ♂♂, Máca, Fang, and Hong), Chushuipo (Taitung Co., 21 Nov. 1971, 1 ♂, F. J. Lin and Tseng).

- C. Taiwan.

perforcipata Máca and Lin, sp. nov.

- A. Kukuan (Taichung Co.; D).
 B. None.
 C. Taiwan.

speculum Máca and Lin, sp. nov.

- A. Chipen (Taitung Co.; D), Nankang (Taipei City; D).
 B. None.
 C. Taiwan and Guangdong Province.

subradiata Okada, 1977

Amiota (Phortica) orientalis Hendel: Okada, 1971, misidentified.

- A. Yunshui (Chia-I Co.; Okada 1971), Taroko (Hualien Co.; D), Wulai (Taipei Co.; D).
 B. Yunshui (Chia-I Co., 11 Aug. 1971, 1 ♂, F. J. Lin and Wu; 4 Oct. 1971, 1 ♂, F. J. Lin and Cheng), Nankang (Taipei City, 20 June 1991, 1 ♂, Máca), Wulai (Taipei Co., 10 Aug. 1971, 2 ♂♂, F. J. Lin and Wu), Miaoli (Miaoli Co., 1 Sept. 1991, 1 ♂, Hong), Chushuipo (Taitung Co., 21 Nov. 1971, 5 ♂♂, F. J. Lin and Tseng), Chipen (Taitung Co., 11 Sept. 1991, 33 ♂♂, 1 ♂, Máca, Fang, and Hong), Taroko (Hualien Co., 10 Sept. 1991, 6 ♂♂, Máca, Fang, and Hong).
 C. Taiwan.

watanabei Máca and Lin, sp. nov.

Amiota (Phortica) orientalis Hendel: Okada, 1977, misidentified.

- A. Szutsutou (Nantou Co.; D), Hassenzan (=Pasenshan, Taichung Co.; Okada 1977), Wulai (Taipei Co.; Okada 1977).
- B. None.
- C. Taiwan.

Species excluded from this list:

The record from Taiwan (Duda 1926a, 1926b) of *A. (P.) maculiceps* (Duda, 1924) is probably erroneous. No documentary material from the collection site, Kosempo (= Chiasien, Kaohsiung County), was preserved in the Natural History Museum, Budapest (Dr. L. Papp, personal communication). It does not seem probable that specimens of one species could be collected in such distant localities (Sumatra and Taiwan), thereby indicating a wide distribution, yet never be recaptured afterwards. Morphological differences between specimens from the two localities were mentioned by Duda, but the lack of information on terminalia does not allow for a clear taxonomic decision. It therefore seems probable that the Sumatran and Taiwanese findings represent two distinct allopatric species; the Taiwanese species must then be considered either conspecific with some of the species on our above list, or undescribed. Specimens from Chip Chip (= Chichi), that were preserved in the Natural History Museum, Budapest, and which were determined by Duda to be *maculiceps* actually belong to *A. (P.) cardua* and *A. (P.) liniae* (see above). According to Máca (unpublished), none of these are conspecific with the type material of *A. (P.) maculiceps*.

Acknowledgments: Financial support from the National Science Council of the Republic of China (Grant No. NSC-81-0211-B001-21) is gratefully acknowledged. Our sincere thanks are due to Prof. T. Okada (Tokyo) and Prof. M. J. Toda (Sapporo); both provided un-

published information on the distribution and some taxonomic characters of the species reported on here. Prof. H. Z. Chen (Shanghai) participated in the study of one species and figured out the female characters of *A. (P.) liniae*. Dr. R. Contreras (Vienna) and Dr. L. Papp (Budapest) helped J. M. to study materials from natural history museums. Finally, we want to thank the research workers of the Institute of Zoology, Academia Sinica, Taipei, for helping us collect materials for this study.

REFERENCES

- Duda O. 1923. Die orientalischen und australischen Drosophiliden-Arten des Ung. Nat.-Museums zu Budapest. Ann. Hist. Nat. Mus. Nat. Hung. **20**: 24-59.
- Duda O. 1924. Beitrag zur Systematik der Drosophiliden unter besonderer Berücksichtigung der paläarktischen u. orientalischen Arten (Dipteren). Arch. Naturg. **90A(3)**: 172-234.
- Duda O. 1926a. Die orientalischen und australischen Drosophiliden-Arten (Dipteren) des ungarischen National-Museums zu Budapest Nachtrag. Ann. Hist. Nat. Mus. Nat. Hung. **23**: 241-250.
- Duda O. 1926b. Fauna sumatrensis. Drosophilidae (Dipt.). Suppl. Entomol. **14**: 42-116.
- Hendel F. 1914. Acalyptrate Musciden (Dipt.), 3. Suppl. Entomol. **3**: 90-117.
- Máca J. 1977. Revision of Palaearctic species of *Amiota* subg. *Phortica* (Diptera, Drosophilidae). Acta ent. bohemoslov. **74**: 115-130.
- McEvey SF. 1990. New species of *Scaptomyza* from Madagascar and Mauritius with a note on terminology (Diptera: Drosophilidae). Annls Soc. Entomol. Fr. **26(1)**: 51-64.
- Okada T. 1960. On the Japanese species of the genus *Amiota* Loew (Diptera: Drosophilidae). Mushi **34(3)**: 89-102.
- Okada T. 1971. A revision and taxometric analysis of the genus *Amiota* Loew of Japan and adjacent countries (Diptera, Drosophilidae). Kontyû **39(1)**: 82-98.
- Okada T. 1977. The subgenus *Phortica* Schiner of the genus *Amiota* Loew of Japan and the Oriental Region, with reference to anti-Burla's rule (Diptera, Drosophilidae). Bull. Biogeog. Soc. Japan **32(3)**: 17-31.
- Okada T. 1988. Taxonomic studies of the family

- Drosophilidae of Japan. *In* Selected papers by Dr. Toyohi Okada. Dept. Biol., Toyama Univ., Japan. pp 1-87.
- Peng T, L Xie, MJ Toda. 1990. Drosophilidae of Dinghu Shan: I. A list of Drosophilidae (Diptera) of Dinghu Shan. *Trop. Subtrop. Forest Ecosyst.* **6**: 55-59. (in Chinese)
- Toda MJ, T Peng. 1990. Eight new species of the subgenus *Phortica* (Diptera: Drosophilidae, *Amiota*) from Guangdong Province, Southern China. *Entomotaxonomia* **12(1)**: 41-55.
- Tsacas L, T Okada. 1983. On the Oriental and New Guinean species of the genus *Amiota* Loew originally described by Duda as *Phortica foliiseta*, with descriptions of three new species (Diptera, Drosophilidae). *Kontyû* **51(2)**: 228-237.
- Zhang W, Y Gang. 1986. Descriptions of eight new species of drosophilid flies from Kunming (Diptera: Drosophilidae). *Zool. Res. (Chungking)* **7(4)**: 351-365. (in Chinese with English summary)

台灣的果蠅科昆蟲：繞眼果蠅屬，眼高果蠅亞屬

Jan Máca 林飛棧

本文報告十七種台灣產的繞眼果蠅屬，眼高果蠅亞屬的昆蟲，包括：偵測繞眼果蠅(*Amiota (Phortica) speculum* Máca and Lin)，暗黑繞眼果蠅(*A. (P.) perforcipata* Máca and Lin)，方氏繞眼果蠅(*A. (P.) fangae* Máca)，洪氏繞眼果蠅(*A. (P.) hongae* Máca)，黃山繞眼果蠅(*A. (P.) linae* Máca and Chen)，和渡邊氏繞眼果蠅(*A. (P.) watanabei* Máca and Lin)。除了肥繞眼果蠅(*A. (P.) eparamata* Okada)外，台灣所發現種類的產地，曾在許多不同的地方採集到。*A. (P.) flexuosa* Zhang and Gan, *A. (P.) lambda* Toda and Peng 和 *A. (P.) magna* Okada 為新記錄種。

Substrate Partitioning among Non-territorial Damselfishes during Spawning in Northern Taiwan¹

Rong-Quen Jan² and Kun-Hsiung Chang

Institute of Zoology, Academia Sinica,
Nankang, Taipei, Taiwan 115, R.O.C.

(Accepted February 17, 1993)

Rong-Quen Jan and Kun-Hsiung Chang (1993) Substrate partitioning among non-territorial damselfishes during spawning in northern Taiwan. *Bull. Inst. Zool., Academia Sinica* 32(3): 184-193. We assess the significance of substrate utilization and partitioning during spawning to the mechanism underlying the structure of reef-fish assemblage. Underwater observations of damselfish were made in the subtidal waters at Kueihoe, on the northern coast of Taiwan, between the months of April and October in both 1986 and 1990-91. Over 5,000 nests were observed for six non-territorial damselfish species, including *Abudefduf bengalensis*, *Abudefduf coelestinus*, *Abudefduf vaigiensis*, *Chromis fumea*, *Neopomacentrus taeniurus* and *Pomacentrus coelestis*. The data collected from these observations were used in an analysis of the overlapping of resource utilization. Our results show that the distribution of overlap indices was positively skewed, thereby indicating specific damselfish preference in spawning substrate utilization. In other words, the spawning substrate of non-territorial damselfishes in the observed reef environment was finely partitioned. This finding supports that section of the resource partitioning hypothesis concerning the mechanisms which account for the coexistence of these damselfish species.

Key words: Community structure, Nesting substrate, Overlap index, Resource partitioning, Spawning site, Substrate.

Resource partitioning is a central issue regarding the coexistence of fishes in diverse coral reef fish communities (Smith and Tyler 1972, Sale 1978 1980, Gladfelter and Gladfelter 1978, Smith 1978, Den Boer 1986, Mapstone and Fowler 1988). It has recently been suggested that the community structure of coral reef fish is orderly and predictable if spatial and temporal scales are large. That is, it is probable that deterministic selec-

tion coefficients will be produced in a fish population (Clarke 1977 1988, Ogden 1986, Roberts 1986). However, those deterministic factors underlying succession of a community are still unclear. Resource partitioning is a factor worthy of further attention, since specialization in resource utilization is one of the ways by which order is created within a fish community.

Space and food are the resources that have attracted most attention in attempts to

1. Paper No. 380 of the Journal Series of the Institute of Zoology, Academia Sinica.
2. To whom reprint requests should be sent.