AN APPRAISAL OF GAZORYCTRA HÜBBNEE (HEPIALIDAE) AND DESCRIPTION OF A NEW SPECIES FROM ARIZONA AND NEW MEXICO

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ABSTRACT. Gazoryctra includes 10 species from North America, and 3 from N Europe and Asia. Seven Nearctic species of Hemabae are transferred to Gazoryctra: hyperboresus Möchler, lembereti Dyar, matheut H. Edwards, notogynus Barnet & Benjamin, pulcher Grote, neumigae Neumigae & Dyar, and wrightiana Ferguson. Gazoryctra wrightiana is described based on 94 males from the White Mountains of Arizona and adjacent New Mexico. A checklist of Gazoryctra is included.

Additional key words: Gazoryctra wrightiana, Hepialus, systematic, Holartic.

Gazoryctra Hübbner are medium-sized swift moths found in high latitudes or alpine habitats of the Holartic Region. They are handsome moths, with brown, orange, or pinkish forewings and silvery white maculations. Adults of most species fly in late summer or fall. They are exceptionally strong fliers, particularly the diurnal arctic-alpine species. Many have very brief periods of diurnal activity, flying for only 20 or 30 min during evening twilight.

All previously known Gazoryctra were described in the nonmotitical genus Hepialus Fabricius (or Epiaius Lederer). North American Gazoryctra have been referred to as the "hyperboresus group" by Barnet and Benjamin (1925) and Ferguson (1957). Members of this group were incorrectly placed in Phymatopus Wallengren by Pflitzner (1912, 1937-38). Viette (1949) alone recognized that some Nearctic hepialids should be classified in Gazoryctra.

The purpose of this paper is to provide adult, pupal, and larval characters for the recognition of the genus, to clarify which elements of the Holartic hepialid fauna belong to Gazoryctra, to validate nomenclature changes for the North American species, and to describe a new species from the southwestern United States.

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Background

Hüblér (1920-1948) established three genera for the hecworthiaceous Palaeartic swift moth fauna occurring in N Europe: Gazorctra, Pharmacis, and Triodia. In his synopsis of the generic classification of European Hepialidae, Viette (1948) designated Bombyx gamma as type species of Gazorctra. He characterized Gazorctra as having a lobed valva and a toothlike trullum in stylet genus, and further noted that small apical tibial spurs were present on middle and hind legs. He transferred to Gazorctra the Palaeartic Hepialus macrostomus Everson and the Nearctic H. confusa H. Edwards and H. megasthoni H. Edwards. Later, Viette (1954) noted that Gazorctra species also had prominent earlike lobes in the interssegmental membrane between abdominal segments 8 and 9 (loci of Robmon 1977, tergal lobes of Nielsen and Kirsten in press), and added a fifth species to the genus, *H. luscusargentius* Bang-Haas.

Many lepidopterists have overlooked or ignored the generic concepts of Hüblér (1920), Wallengren (1869), Börner (1925), and Viette (1948, 1949), and have continued to treat most Holartic swift moths as members of the nominotypical genus *Hepialus* (McDunnough 1939, WEAH 1976, Ferguson 1979, Davis 1985). In North America, Hepialidae have been classified into two genera: *Hepialus* (type species: *humbalti* Linnaeus) and *Sthenopis* Packard (type species: *quadriguttatus* Packard). Most lepidopterists have recognized *Sthenopis* from the time of its proposal in 1665 (Packard 1655, Kirby 1862, Neumoegen & Dyer 1894, Wagner & Pflitzer 1911, Forbes 1923, McDunnough 1939, Davis 1985). However, our studies indicate that *Hepialus humalti* and members of *Sthenopis* (except *S. tinidale* Acemus Walker, and perhaps others) have a common ancestor not shared by most other Holartic Hepialidae. Synapomorphies for these taxa include (1) a metathalal hairpincil in males; (2) swollen metatibiae in males (members of the *Sthenopus regius* group and some *Acemus* lack hairpinci and swollen metatibiae, but these appear to be reversals within the clade); (3) triangular forewings with falcate apices; (4) forewing scales with rounded apices; and (5) absence (loss) of the epiphysis in all but *Acemus* and *Sthenopus argenteonectulatus* Harris. In addition, all members of this group are larger than most other Hepialidae and eoxipalate Lepidoptera, with forewing lengths typically exceeding 4 cm. Consequently, if *Sthenopus* is to be retained as a distinct genus, then names proposed for more distantly related taxa like Gazorctra warrant at least generic status.

Gazorctra in North America

So that we could reliably assign the hecworthiaceous described here to a genus, we prepared dissections of all the holartic hecworthiaceous types.
We also examined all North American hepialid extant primary types, and prepared genitalia and wing slides for all named Neartic and many European species, including all examined by Viette (1949).

In addition to the characters given by Viette (1949), eight others were found to be shared by Gazozycta species: (1) forewing subcosta forked (vein Sc, well developed); (2) halves of tegmen meeting dorso-anteriorial, but free over much of midline; (3) dorsal margin of teg- men bearing dense oval patch of spinules; (4) caudal portion of trul- leum not fused to tegumen; and (5) pulvilli large and setose. In the larva, (6) claw elongate, with basal tooth ending before ⅓; (7) D2 and SD setae on prothorax not grouped. In the pupa, (8) caudal band of teeth encircling abdominal segment 7 broken ventrolaterally.

Our studies indicate that Gazozycta is the largest genus of North American Hepialidae. In addition to the two Neartic species identified by Viette (1949), seven other described hepialids were found to share this list of characters and are transferred here to the genus Gazozycta.

Checklist

in what follows, subspecific names are indicated by a), and are but tentatively recognized. Author names followed by year do not neces- sarily refer to literature cited in this paper.

Gazozycta Hubner [1820]

Gazozycta Kirby [1832], misp.
g. confluens (H. Edwards 1840) (Hepialus)

fuscorubens (Bang-Haas 1827) (Hepialus)

serida (Nordstrom 1828) (Hepialus infrasubsh

ii) postmaculata (Lindin 1943) (Hepialus)
gama (Hubner 1819) (Bombyx)
arctica (Boehman 1848) (Hepialus)
redia (Deutsch 1925) (Hepialus), infra subs, confluens (Hallweger 1916) (Hepialus), infra subs, chihibana (Matsumura 1931) (Hepialus), infra subs, hyperborea (Münch 1862) (Epistocas, new combination lembariti (Dyar 1904) (Hepialus), new combination maclenata (Evermann 1931) (Hepialus)
gelda (Staudinger 1897) (Hepialus)

a) neostates (Boyd 1942) (Hepialus)


mcglauchan (H. Edwards 1887) (Hepialus)

miglachaei (Pfeiffer 1912), misp.

mortgana (Barnes & Benjamin 1920) (Hepialus), new combination novagama (Pfister 1917–18) (Hepialus), misp.

a) mackiei (Barnes & Benjamin 1920) (Hepialus)

pachta (Grote [1860]) (Hepialus), new combination reserata (Neumoegen & Dyar 1903) (Hepialus), new combination mustata (Barnes & Benjamin 1920) (Hepialus), infra subs

demota (Barnes & Benjamin 1920) (Hepialus), infra subs.
Gazoryctra wielgusi, new species

This pink and silvery moth is so far known only from a restricted area in the mountains of E. Atacama and W. New Mexico. Terminology for genital structures follows Birket-Smith (1975), Culas (1973), and Nielsen and Robinson (1980). For wing venation, Nielsen and Robinson (1980), and for scale ultrastructure, Dowsey and Alfyn (1975) and Kotta-Lazar (1976).

Main (Figs. 1-11). Forewing length 15-19 mm (N = 64). Head. Antennal with 29-32 segments (N = 10), flagellum distinctly compressed with blunt short setose sensory setae (Figs. 6, 7), yellow to orange-brown. Head vestiture better admixture of buff and darker uniform scales, dark or dark-tipped scales prominent over, labial palpus, and ventral region. Labial palpus with 2 subequal segments (Fig. 3), vom bath's organ dorso-anterior. Thorax. Pro- and meso-tergites dorsum with brown-tipped and buff piliferous scales intermixed; metathorax buff. Prosternum and pro- and mesosternum dark-scalled. Tibiae and tarsi with elongate salmon-colored lanceolate scales and contrasting dark fuscous scales (Fig. 8). Ventralia (Fig. 4): R1, branched at mid-length; hindwing vein CuP obscure in some specimens, and 2A differentiated long wing cuticle. Scales (dorsal surface over median region) (Figs. 10, 11). Broadest beyond middle, spaces 8-10 x 4-5x; secondaries rufous prominent; windows small, circular to elliptical, diameter less than 1/4 interdigitate distance, surrounded by ring of unmodified cuticle, slightly 1/2 to 3/4 transverse flights; window membrane occasionally present. Fertile with peri-peripheral secondary ribbing between adjacent flights. Forewing tan or brown to peach or salmon with pattering of darker scales heavily mottled with silvery white (mostly silvery gray) markings, these outwards edged with dark scales; submarginal spots nearly always present, occasionally fused with oblique submarginal band; white spots or streaks on tegulae along concolor and base of inner margin. Hindwing uniform brown with orange to salmon-colored scales along margin, of apex, and extending basally along veins; apex finely patterned. Signs of both wings orange or salmon. Abdomen. Dorsum of segments 3 and 4 uniformly covered with long pale piliferous scales; segments 3 to 6 with both long buff scales and lanceolate salmon-colored scales. Genitalia (Fig. 5). Tergal lobes prominent, densely setose dorso and laterally, hemisperically, with ventrolateral digitate lobe extending below margin of tegumen. Caudal margin of tegumen with 2 sets of ventrally projecting, strongly sclerotized processes, upper pair digitate and angulated ventrally, spicules with single prominent notch and several smaller denticulate teeth, lower pair gradually tapering to...
FIGS. 3-5. 

3. Habitus: scale = 0.2 mm (DLW Slide 86-63); 4. Wing venation: scale = 0.5 cm (DLW Slide 86-62); 5. Male genitalia: scale = 0.5 mm.

points, apices approximate over midline. Trulleum long, narrow, tapering to strongly melanized spine. Valva densely setose, boot-shaped; lower lobe rounded, curving medial; inner margin notched above basal articulation. Juxta elongate, constricted in middle; roughly pentagonal. Vinculum often emarginate ventrolaterad.

Female. Unknown.

Diagnosis. A heavily maculated species with silvery white streaks and spots along base of inner margin, subcosta, and termen between medial veins. It can be readily separated from other strongly marked Geometrae—confusa, hyperborea, pauldeni, and rosteicapit—by its dark brown hind wings with contrasting orange or salmon-colored fringes. The oblique submarginal band is continuous, never broken into separate spots as it often is in other members of the genus. It is the only salmon-colored Geometrae in the S Rocky Mountains. Male genitalia characters distinguishing wielgasti from at least some other members of the genus follow: telgal lobes nearly as high as broad, valva boot-shaped, vinculum ventrolaterally emarginate, trulleum very elongate.

Distribution. White Mountains of E Arizona and adjacent ranges in New Mexico between 2400 and 2800 m elev.


The three specimens of *C. wielgos* in the USNM bearing the data "CALIFORNIA;
Gazoterina Co., Hatman MDW, April 12, 1975. A. Menke* are siiled as there is no G. gazoterina xiolo. Moreover, all Gazoterina species are snister or full-grown. Preliminary, Xylote captured the moths in Hamagisu Meadow during a collecting trip to the Southland in August 1975 (A. Menke pers. commun.).

Paratypes are deposited in Arizona State University, Tempe; Australian National Insect Collection, Canberra; British Museum (Natural History), London; California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; Los Angeles County Museum, California; South Australian Museum, Adelaide; United States National Museum, Washington, D.C.; University of California, Berkeley; and Davis Zoologische Staatsammlung, Munich.

Biology: Gazoterina xiiol cast a very brief period of xiiib activity. All specimens have been captured in early evening just after onset of darkness. In late July, the main flight occurs between 1945 and 2000 h MST (N = 5); by mid-August flight starts as early as 1900 h MST (N = 7). All specimens (males) were collected at light, typically they are the first moths to arrive at sheets. Adults are most numerous after afternoon rains and may xiiy fly during strong rains (R. S. Wieglitz pers. com).x


g records are from xiiie areas in xiiie forests. The locality at Dixie Camp is an open ponderosa pine forest with abundant groves in open areas and nearby clearings. Higher-elevation localities have more understory shrubbery. Species is dominant at the two sites in New Mexico. Nothing is known of the early stages: The larvae presumably are p.xx

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Discussion

Gazoterina xiiolo is confined to the Holarctic Region; 10 Nearctic and 3 Palearctic species are recognized. No member is recognized from both
fams, although the markings of both genus and maculenta approach those of Hyperborea from North America.

Gazorecta appears to represent one of the most primitive genera of Hepialidae. No synapomorphies have been identified that link Gazo-
recta to other hepiidals. In the past, the absence of abdominal spurs has been used to define Hepialidae (Borror & White 1970, Kristensen 1978, Nielsen & Robinson, 1983). Yet members of Gazorecta possess a pair of small abdominal spurs (Fig. 8, Vriette 1949, Wagner 1985). In addition, the trulium is free from the tegumental callus in Gazorecta, but fused in more derived Hepialidae (Nielsen & Scole 1987).

Both adults and immature stages of Gazorecta are rare in collections. Only three new hepiidals have been described from North America since the turn of the century, and all belong to Gazorecta. Moreover, no specimens of scrophanes and wielgusi were known before 25 years ago. The biology is not known in detail for any species.

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