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A Revision of *Neochoroterpes* (Ephemeroptera: Leptophlebiidae) New Status

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ABSTRACT

Neochoroterpes Allen is elevated from a subgenus of *Choroterpes* to the level of a genus, NEW STATUS. Four species are recognized: *N. oklahoma* (Traver) NEW COMB., includes *C. oklahoma* Traver (1934) and *C. (N.) mexicanus* Allen (1974), NEW SYN.; *N. nanita* (Traver) NEW COMB., includes *C. nanita* Traver (1934) and *C. (N.) crocatus* Allen (1974), NEW SYN.; *N. kossi* (Allen) NEW COMB.; and *N. orientalis*, N. SP. The imago male of *N. kossi* (Allen) is described for the first time. Keys to the imago males and larvae are provided.

INTRODUCTION

The mayfly genus *Neochoroterpes* new status, is endemic to southwestern North America. Larvae are important components of lotic habitats in this arid region (McClure and Stewart 1976, Lind 1979, Bramblett and Fausch 1991).

Three subgenera of *Choroterpes* Eaton, 1881, are currently recognized. In revisions of the eastern hemisphere Leptophlebiidae (Peters and Edmunds 1964, 1970), *Choroterpes* was divided into two subgenera, *Choroterpes* s.s. Peters and Edmunds, 1964, and *C. (Euthraulus)* (Barnard), 1932. Allen (1974) erected the subgenus *Neochoroterpes* for three North American species.

The North American species of *Choroterpes* were reviewed by Allen (1974) and Edmunds et al. (1976). Twelve species are currently recognized; seven species of *Choroterpes* s.s., three species of *C. (Neochoroterpes)*, and two species of uncertain subgeneric placement. The seven species of *Choroterpes* s.s. are known from both imagos and larvae and include four eastern species, *C. basalis* (Banks), *C. ferruginea* Traver, *C. fusca* Spieth and *C. hubbelli* Berner, and three western species, *C. inornata* Eaton, *C. albiannulata* McDunnough and *C. terratoma* Seemann. Burian's (submitted) revision of eastern North American *Choroterpes* s.s. reduces the number of eastern species from four to one. The three *Neochoroterpes* species are *C. (N.) mexicanus* Allen, *C. (N.) kossi* Allen, and *C. (N.) crocatus* Allen. *Neochoroterpes* species

are based solely on the larvae with the exception of *C.* (*N.*) *mexicanus* which is also based on subimagoes. The two species of uncertain subgeneric status, *C. nanita* Traver and *C. oklahoma* Traver, are based on imagos.

Edmunds et al. (1976) characterized the taxonomic status of *Choroterpes* in North America as follows, "It appears that the phyletic and taxonomic relationships of the species of *Choroterpes* in Mexico and north to Texas and Arizona are far from resolved but are of considerable biogeographic interest." This statement was accurate on all accounts.

This revision was undertaken to determine the number of species of *Neochoroterpes* and to provide comprehensive, illustrated descriptions and usable keys for the identification of both imagos and larvae. It is the first part of a larger study that also includes the phylogeny and zoogeography of *Neochoroterpes*.

Abbreviations.—Specimens from the following collections were studied or mentioned in the text.

CAS California Academy of Sciences, San Francisco
CU Cornell University, Ithaca
FAM Florida A&M University, Tallahassee
UTPA University of Texas - Pan American, Ediburg

KEY TO THE SPECIES OF *NEOCHOROTERPES*

MALE IMAGOS

1 Bulbous base of forceps much longer than penes (Fig. 26); all 7 ganglia usually marked with gray ..... ***kossi***
Bulbous base of forceps equal to or shorter than apex of penes (Figs. 25, 27, 28); some ganglia marked with gray but not all 7 ..... **2**

2(1) Hind wing minute (Fig.24b), costal projection with posterior margin angular and in distal half of wing; abdominal middorsal stripe wide, about 1/3 width of abdomen; femora with distinct subapical and median maculae. ..... ***orientalis***
Hind wing larger (Figs. 21a-23a), costal projection in basal half; abdominal middorsal stripe less than 1/3 width of abdomen; femora maculae variable but not as above; **3**

3(2 Apex of penes pointed; penes triangular in shape with spines angled anteriorly (Fig. 25) ..... ***nanita***
Apex of penes rounded; penes long with spines directed posteriorly (Fig. 28) ..... ***oklahoma***

LARVAE

1. Gill 1 without lateral branch (Fig. 17a) ..... ***kossi***
Gill 1 with lateral branch, branch may be very short (Figs. 18a-20a) 2

2(1) Lateral branch of gill 1 short and untracheated (Fig. 19a); abdominal color pattern similar to Fig. 31 ..... ***nanita***
Lateral branch of gill 1 long and tracheated (Figs. 18a, 20a) **3**

3(2) Maxillary and labial palps with very long setae (Figs. 10, 14); abdominal color pattern similar to Fig. 30 ..... ***oklahoma***
Maxillary and labial palps with setae of normal length (Figl2, 16); abdominal color pattern similar to Fig. 32 ..... ***orientalis***

Neochoroterpes kossi (Allen) NEW COMB.

Choroterpes (*Neochoroterpes*) *kossi* Allen 1974:168 [Material: larva (Holotype); Holotype locality: USA (Arizona); Holotype deposition: CAS] NEW COMBINATION.

Mature Larva.—Dimensions (mm): male 6-7; female 7.5-9.5. General color light brown with grey markings. Head: Light brown with grey markings. Labrum with scattered dorsal setae and anterior dorsal brush (Fig. 1). Mandibles with few widely spaced setae in basal 1/2, setae in distal 1/2 longer, not increasing in number at base of lateral incisor (Fig. 5). Maxillae as in Fig. 9. Labium as in Fig. 13. Suboesophageal ganglion dark. Thorax: Light brown, often with grey and dark markings. Legs light brown with grey markings; femora often suffused with gray and with gray subapical macula; tibia and tarsi suffused with gray; tarsal claws with 10-12 marginal denticles. Abdomen: Sternal ganglia well marked with gray. Terga brown with a pale median longitudinal strip and pale margins, terga often with pale submedian spots (Fig. 29); gill one a single filament without a lateral branch (Fig. 17a); gills 2-7 with thick heavy terminal processes (Fig. 17b). Sterna light brown, all seven ganglia well marked with gray, becoming less distinct with maturity.

Male Imago.—Dimensions (mm): body 5.3-7.5 (n=30), forewing 5.6-7.0 (n=30), hindwing 0.9-1.6 (n=30), fore tibia 1.2-2.6 (n=30), fore femur 0.9-1.5 (n=30). A very dark brown species with a distinctly ringed abdomen. Head: Vertex of head dark brown; nasal carina and longitudinal ridge prominent; compound eyes orange, lower portion darker; antenna brown, flagellum lighter distally; ocelli white, bases brown. Thorax: Dark brown and black, black in furrows and margins. Pleura with dark brown sclerites bordered with black, much lighter orange areas in regions of spiracles and leg bases. Mesosternum dark brown, lighter where basisterum joins furcisternum especially laterally. Metasternum lighter brown. Front wing hyaline, cloudy in stigmatic area; longitudinal veins brown; fork of MA less than 1/2 length to margin (Fig. 21a); cross veins brown in stigmatic area and anterior to R1. Hind wings hyaline; longitudinal veins yellow in anterior 1/3 (Fig. 21b-c). Legs brown; femora darkened apically; tibiae brown with a dark band at proximal end; tarsi brown. Abdomen: Terga dark olive ground color suffused with dark brown; segments 2-8 usually ringed with narrow white transverse band on posterior margin; spiracular marks on segments 3-9 black, fish hook shaped, pointed posteriorly with the shaft lateral; dorsal tracheal branches visible as lighter hair-lines; middorsal line narrow, outlined with dark brown on segments 2-7,8, faint on segment 9; dorsum of segment 10 darker than previous segments. Caudal filaments dark basally, narrowly ringed with black at joinings. Subgenital plate extends posteriorly so that approximately 1/2 of penes covered. Genitalia (Fig. 26): forceps light brown, bulbous base of segment 1 much longer than length of penes; penes long, light brown, with median dark line, 7-15 posteriorly directed stout spines,

and rounded apex with 1-2 apical spines.

Diagnosis.—Larvae of *N. kossi* can be distinguished from all other species of *Neochoroterpes* by the unforked first gill and the abdominal color pattern. Male imagos of *N. kossi* can be distinguished by the morphology of the penes and by the length of the bulbous base of the forceps which is longer than the penes.

Type Material Examined.—PARATYPES *Choroterpes* (*Neochoroterpes*) *kossi* Allen, 1974): 5 L (alcohol CAS) USA (ARIZONA) Coconino Co, Oak Creek s Flagstaff.

Other Material Examined.—USA (NEW MEXICO): 7 M, 4 L, Catron Co, San Francisco R, Luna, 27 V 1984, Henry (UTPA); 6 L, same data, 17 X 1986 (UTPA). TEXAS: 5 L, Brewster Co, Calamity Ck, Woodward Ranch, 19 VIII 1984, BC Henry, NW Henry, BR Henry (UTPA); 10 M, Culberson Co, MCKittrick Ck, Guadalupe Mts Natl Pk, 20 VIII 1984, BC Henry, BR Henry, NW Henry (UTPA); 9 L, same data 29 V 1984 (UTPA).

Distribution.—Neochoroterpes kossi is known from mountainous regions of Arizona, New Mexico, and Trans-Pecos Texas (Map 1).

Biology and Ecology.—Neochoroterpes kossi lives in cool, clear streams in Arizona, Colorado, and the Guadalupe and Del Norte Mountains of Trans-Pecos Texas. Larvae live on the underside of rocks in quiet pool areas of streams. Mating swarms occur in midmorning adjacent to streams. Imagos have been collected from McKittrick Creek in the Guadalupe Mountain National Park from March through August. In October only immature larvae were collected from the San Francisco River in western New Mexico. *N. kossi* is found together with *C.* inornata in streams of western New Mexico.

Neochoroterpes oklahoma (Traver) NEW COMB.

Choroterpes oklahoma Traver, 1934:204 [Material: male imago (Holotype); Holotype locality: USA (Oklahoma); Holotype deposition: CU, No. 1269.3] NEW COMBINATION; Traver, 1935:545.

Choroterpes (*Neochoroterpes*) *mexicanus* (in part) Allen, 1974:163 [Material: larva (Holotype) and male subimago; Holotype locality: MEXICO (Nuevo Leon); Holotype deposition: CAS], NEW SYNONYM; Edmunds, Jensen, and Berner, 1976:215.

Mature Larva.—Dimensions (mm): body males 5-6.5 (n=13); females 6-7.5 (n=17). Head: Light brown to brown with variable black markings; dorsal surface of labrum with scattered setae (Fig. x), ending at or beyond anterior margin and with anterior brush (Fig. 2). Lateral margins of mandibles with setae in distal 1/2 extending to base of lateral incisor (Fig. 6). Maxillary palpae with very long setae, especially on third segment (Fig. 10). Labial palps (Fig. 14) with similar long and curly setae. Thorax: Light brown to brown with variable black markings. Legs pale to light brown with dark markings. Femora variable, usually with brown to black variable pattern on dorsal surface. Tibiae pale with small dark spots at proximal and distal ends. Claws with 10-12 denticles, denticles enlarging apically, distal end dark. Abdomen: Terga usually with distinct middorsal light brown to yellow area, large lateral black maculae (Fig. 30). Gills on segment 1 with a distinct lateral tracheated branch (Fig. 18a), gills on segments 2-7 with three subequal terminal process (Fig. 18b), gills opaque with black trachea. Sterna pale to light brown with no distinct pattern on ganglia. Caudal filaments light brown.

Male Imago.—Dimensions (mm): body 5.0-7.4 (n=52); forewing 5.2-7.8 (n=52); hindwing 0.96-1.9 (n=52); fore tibia 1.2-2.7 (n=52); fore femur 0.8-1.4 (n=52). Head: Vertex brown with lighter area at base of ocelli. Eyes with upper portion orange, lower portion black. Antennae brown, whitish-red stain at base within antennal sclerite. Ocelli white, brown at base. Thorax: Shining brown to dark brown. Pleuron surrounding the spiracles rust colored; coxal cavity white. Legs white to light brown; femora with proximal and distal brown maculae, maculae separate, not ringed, present on anterior and posterior surfaces, sometimes extending along longitudinal carina; tibiae white to light brown with a dark brown ring on proximal end. Forewings (Fig. 22a) opaque in costal and subcostal spaces, costal, subcostal, and radius brown, other longitudinal veins and usually all cross veins hyaline to yellow. Hindwings hyaline as are all veins (Figs. 22b-c). Abdomen: Terga variable, grey, white, or brown; segments 2-8 with large pale middorsal V-shaped marks through which runs the narrow middorsal pale line conjoining them, diffuse black dots lateral to V-shaped marks, distinct black crescent shaped spiracular markings opening to posterior on segments 2-8, segments 8-9 darker with elongate submedial white or pale areas; some populations with abdominal segments 1-9 ringed narrowly with white on p,osterior margins. Sternum variable, transparent with grey, white, or brown coloration, white pigmentation often associated with nerves, especially at ganglia of segments 7 and 8, white appearing as longitudinal hairlines and narrow transverse bands on segments 1-6; sternum of segment 9 with distinct dark, horseshoe-shaped area, opening to posterior. Caudal filaments white or grey, faintly ringed at seament ioints. Genitalia (Fia. 28); forceps white, base often outlined with brown, bulbous basal area of segment 1 shorter than or equal to length of penes. Penes white, apex blunted with no apical spines, spines limited to distal 1/4 of penes, directed posteriorly, penes with undulating lateral margins.

Diagnosis.—Larvae of *N. oklahoma* can be distinguished from *N. kossi* by the presence of a forked first gill and from *N. nanita* by the length of the fork and tracheation of the first gill; the fork is one half or longer than the main gill branch from its fork to its distal end. The abundance of long setae on segments 2 and 3 of the palps of the maxillae and labium and the abdominal color pattern distinguish *N. oklahoma* from all other species of *Neochoroterpes*. The male imagos of *N. oklahoma* can be distinguished from all other species of *Neochoroterpes* by pene morphology.

Type Material Examined.—PARATYPE: male imago (alcohol CU) USA (Oklahoma), Murray Co, 20 III 1932, C Sandoz; PARATYPES: 10 larvae (alcohol CAS), USA (TEXAS), Palo Pinto Co, Brazos R, 12 IX 1970, 17 X 70, 23 III 70, B Stark (CAS);

Other Material Examined.—USA (Oklahoma): Murray Co, 1 reared M, 1 M, 1 L, Washita R, 7 IV 1984, Henry (UTPA). NEW MEXICO: 2 M, Chaves Co, Rio Penasco at U.S. 82 and 24, VIII 1982, Henry (UTPA); 4 L, Eddy Co, Sitting Bull Falls, 18 VIII 1982, Henry (UTPA); 1 L, same data, 18 X 1986. TEXAS: 14 M, 14 L, Bosque Co, N. Bosque R, 1 mi e Valley Mills, Tx Hwy 56, 22 V 1988, Henry (UTPA); 13 M, 1 F, 12 L, Concho Co, Colorado R at FM 2134, 31 III 1984, Henry (UTPA); 2 reared F, 21 L, Palo Pinto Co, Brazos R at FM 4, 7 IV 1984, Henry (UTPA); 7 M, San Saba Co, Barefoot Fishing Camp, Colorado R, 10 VI 1983, BC Henry (UTPA). MEXICO: (CHIHUAHUA) 4 L, Rio Santa Maria at Buenaventura, 24 V 1984, Henry (UTPA). DURANGO: 1 F, 5 L, Rio Nazas at Rodeo, 20 V 1984, Henry, Sweet, and Lewis (UTPA). NUEVO LEON: 7 L, Cienega de Flores, 16 III 1983, Henry (UTPA). ZACATECAS: 2 L, Rio Sain Alto, kilo post 120, Hwy 45 N. Fresnillos, 14 VI 1988, Henry and Strenth (UTPA).

Distribution.—This is the most widespread species of *Neochoroterpes* (Map 2). The imago described by Traver (1934,1935) from the Washita River system in Oklahoma and a reported population from the upper Arkansas River Basin in Colorado (Bramblett and Fausch 1991) are the only known populations of *Neochoroterpes* in the Mississippi River Drainage. The species is known from practically all of the Western Gulf Slope Drainages of Texas, including the Brazos, Colorado, Guadalupe, and Nueces River systems. Most current and former tributaries of the Rio Grande (Rio Bravo del Norte) contain *N. oklahoma*. These rivers include the Rios Conchos, Nazas, Aquanaval, and Santa Maria which originate on the eastern slopes of the Sierra Madre Occidental; the Pecos and Devils Rivers of Texas; the Rios Salado and San Juan of Mexico; and the Rios Conchos, San Fernando, and Purification which originate in the Sierra Madre Oriental and flow directly into the Gulf of Mexico.

Discussion.—*Neochoroterpes oklahoma* was first described from male imagos as *C. oklahoma* Traver (1934, 1935). The larva and subimago were later described as *C. (N.) mexicanus* Allen 1974. Comparisons between type material and specimens reared from type localities clearly indicate that *C.(N.) mexicanus* Allen is the same species as *C. oklahoma* Traver and that *C. oklahoma* Traver is a *Neochoroterpes*.

Biology and Ecology.—Larvae of *N. oklahoma* are thigmotactic and negatively phototropic. They live on the underside of rocks in moderate current of medium size streams and rivers, second order and greater. *Neochoroterpes oklahoma* populations are present in river sections between the first order streams and the coastal plain. When rocks are removed from the water and turned substrate side up, the larvae move rapidly to the underside. Subimagoes emerge in the evening and mating flights occur in mid morning along the margins of the streams. Mating swarms occur in Texas from March through November. Swarms are known during August in New Mexico. Larvae over winter and appear to be larger at emergence than summer generations.

Neochoroterpes nanita (Traver) NEW COMB.

Choroterpes nanita Traver, 1934:203 [Material: male imago (Holotype) and male subimago; Holotype locality: USA (Texas); Holotype deposition: CU no. 1268.1] NEW COMBINATION; Traver, 1935:544.

Choroterpes (Neochoroterpes) crocatus Allen, 1974:167 [Material: larvae (Holotype); Holotype locality: USA (Texas); Holotype deposition: CAS], NEW SYNONYM.

Mature Larva.—Dimensions (mm): body males 6-6.7 (n=5), females 5.7-8.3 (n= 13). General body color yellow or white with black markings. Head: Labrum with scattered dorsal setae and anterior brush (Fig. 3). Mandibles with long setae in distal half of lateral margin, setae extend to base of lateral incisor, most numerous at base of incisor, decreasing in numbers basally (Fig. 7); small setae in basal 1/3 of lateral margin only rarely. Maxillae as in Fig. 11. Labium as in Fig. 15. Thorax: Terga yellow becoming amber brown in larvae with dark wing pads. Legs yellow or white. Femora usually with variable black markings at distal end, black may be just a small, angular black mark, a small v-shaped mark, an elongate v-shaped mark with the black extending basally along the longitudinal carinae, or a large vshaped mark with the lines interrupted in the middle. Abdomen: Abdominal terga (Fig. 31) pale yellow or white with oblique black maculae on segments 1-8,9, one sublateral

and one submedial; segment 10 with only submedial maculae; pattern more distinct in females than males. Gills opaque with dark tracheal branches; gills on segment 1 single and asymmetrically forked (Fig. 19a); gills on segments 2-7 with thin delicate terminal processes, dark tracheal branching in basal portions of gills usually absent or minute except for branches to lateral terminal processes (Fig. 19b). Abdominal sterna white or yellow with no markings. Ninth sternum of females with small U-shaped indention. Caudal filaments yellow, faintly ringed at joinings of segments.

Male Imago.—Dimensions (mm): body 4.3-6.6 (n=35); forewing, 4.5-6.7 (n=35); hindwing 0.65-1.34 (n=35); fore tibia (n=35); fore femur 0.9-1.3 (n=35). Head: Brown above, paler in front. Upper portion of eyes orange becoming yellow with age in alcohol, lower portion black. Antenna brown. Ocelli white, brown at base. Thorax: Light brown or amber with a narrow middorsal pale line. Pleural sclerites amber, metasternum with a wide midventral white or pale brown area. Legs white with light brown or yellow at proximal and distal ends of femur and proximal end of tibia. Forewings with only a few of the stronger veins brown, especially vein R and its basal connection, cross veins hyaline, almost invisible even in stigmatic area (Fig. 23a). Hindwings as in Fig. 23b-c. Abdomen: Terga white to yellow with black maculae, extent of maculae variable, most complete and distinct pattern is a sinuous band on segments 2-8, lateral curve joins spiracular mark; tergum 9 darker with reduced maculae; many individuals do not have medial bend so that pattern becomes U-shaped with small curves on each end, lateral curve still joins spiracular mark laterally; middorsal pale line wider when maculae reduced. Sterna 1-6,7 white or hyaline without markings; segments 7,8-10 white; segment 10 with brown, indistinct, horseshoe-shaped area, often only sides brown. Genetalia (Fig. 27): Forceps white, bulbous portion of segment 1 shorter than or equal to length of penes. Penes broadly pointed, 3-7 stout spines, spines directed anteromedially and anterolaterally. Caudal filaments white, narrowly ringed in basal 1/3 with black, alternate segments more narrowly.

Diagnosis.—Larvae of *N. nanita* can be distinguished from all other species by the untracheated, forked first gill and the adominal color pattern. Male imagos are distinguished from all other *Neochoroterpes* species by the short, triangular penes.

Type Material.—HOLOTYPE *Choroterpes nanita* Traver, 1934: male imago (alcohol CU) USA (TEXAS) Travis Co., Austin, June 1931, H.J. Parks; HOLOTYPE *Choroterpes (Neochoroterpes)* crocatus Allen, 1974): larva, (alcohol CAS) Uvalde Co., Frio R at Cancan [Concan], Hwy 127, 1 VIII 1970.

Other Material Examined.—USA: TEXAS: 17 M, 12 L, Kerr Co, N Fork Guadalupe R, 4 mi w Hunt, 12 VI 1984, Henry (UTPA); 13 M, Medina Co, Hondo Ck, Tx Hwy 173, s Hondo, 13 V 1988, Henry (UTPA); 9 L, same data, 6 XI 1987; 12 M, Tom Green Co, Dove Ck, Knickerbocker, 19 IX 1980, Henry; 8 M, Williamson Co, San Gabriel R at US 183, 31 VIII 1980, Henry (UTPA); 7 M reared, 3 F reared, same data, 7 VI 1986.

Distribution.—The distribution of *N. nanita* is shown in Map 3.

Discussion.—*Neochoroterpes nanita* male imagos were described from Austin, Texas as *C. nanita* Traver, 1934, N. comb. The larvae of *N. nanita* were described from the Frio River, Texas as *C. (N.) crocatus* Allen, 1974, N. synonym. Reared specimens from the Frio River, the Austin area, and many other localities on and along the margins of the Edwards Plateau, Texas, clearly indicate that *C.(N.) crocatus* Allen is the junior synonym of *C. nanita* (Traver's *C. nanita*) and that the species fits the concept of *Neochoroterpes*.

Allen's (1974) key to the species of *Neochoroterpes*, and his description of *N. crocatus* both indicate that the first gill is unforked. Examination of the type specimen's first gill showed that it is forked. Additional specimens from the type locality and many other localities all have an asymmetrically forked first gill.

Biology and Ecology.—*Neochoroterpes nanita* was found in the headwater areas of streams originating from the Edwards Plateau in Texas. Larvae have been collected from stones along the margins of streams and often in quiet, backwater areas. Subimagoes emerge in the evenings, and mating flights occur in midmorning along the stream margins. Females collected from mating flights have been subimagoes and no female imagoes have been obtain by rearing. Females of this species may have no imago stage.

Neochoroterpes orientalis New Species

Mature Larva.—Dimensions (mm): body male 6; female 7-7.5. Head: Brown with black margins. Antennae white. Labrum with shallow angular anterior emargination; dorsal setae scattered except for dense anterior brush (Fig. 4). Mandibles with setae in outer distal margin, a few scattered setae on basal outer margin (Fig. 8); maxillae as in Fig. 12; labium as in Fig. 16. Thorax: Light yellow; legs white; femora with distinct pair of maculae on anterior surface, one macula subapical and one medial; tibiae and tarsi white. Abdomen: Terga yellow with wide middorsal stripe, sublateral U-shaped maculae on segments 2-8, distinct dark spiracular marks (Fig. 32). Gills opaque; gill 1 asymmetrically forked, fork tracheated and almost as long as main projection (Fig.20a); gills 2-7 with three subequal process (Fig. 20b). Sterna white, becoming yellow on posterior segments, no markings. Caudal filaments yellow, ringed in basal 1/4.

Male Imago.—Dimensions (mm): body 6.1 (n=2), forewing 6.0 (n=2), hindwing 0.6-0.8 (n=2), fore tibia 2.0-2.2 (n=2), fore femur 1.0-1.2 (n=2). Head: Upper portion of eyes orange, lower portion black; vertex white below ocelli; ocelli white distally, brown basally. Thorax: Terga yellow with hair lines of brown in furrows; scutellum with paired distinct white submedial areas. Pleura light brown, some sclerites outlined with black; membrane of meothoracic spiracle orange, margined with white. Forewings as in Fig. 24a; hindwings small, costal projection angular and in distal half of wing (Fig. 24b-c)). Legs white; femora with distinct subapical and medial maculae; tibia white with proximal dark band; tarsi white; sterna yellow with white at junction of sclerites. Abdomen: Terga dirty white color with wide middorsal stripe, posterior margins with minute white dots; segments 2-7 with distinct U-shaped sublateral macula; spiracular marks dark, distinct, crescent shaped, connecting with lateral arm of Ushaped maculae; distinct dark slash on posterior margin of nota 1-7, slash at base of U-shaped maculae on segments 2-7; nota 8-10 white, 8 and 9 with orange maculae, dorsum of 10 with dark brown posterior margin. Sterna pale, segments 1-5 without markings, segments 6-9 with white maculae, extent of maculae increasing posteriorly. Genitalia (Fig. 27); forceps white, bulbous base of segment 1 shorter than or equal to length of penes; penes white, tapering to a rounded apex, numerous posteriorly spines in distal 1/2, 1 apical spine, lateral margins of penes without undulations. Caudal filaments distinctly ringed with black in basal half.

Diagnosis.—Larvae of *N. orientalis* are distinguished from all other *Neochoroterpes* species by the combination of a tracheated first gill and the abdominal color

pattern. Imagos are distinguished by the minute hindwing and the shape of the penes.

Etymology.—This species is named for the Sierra Madre Oriental of Mexico.

Type Material.—HOLOTYPE: reared male imago (alcohol), MEXICO (QUERETARO) unnamed stream 5 km n Jalpan, 6-VI-1988, B Henry and N Strenth, deposited in CAS. PARATYPES: 2 L, same data as holotype (alcohol) deposited in CAS; 1 reared M, 3 L, same data as holotype, deposited in UTPA; PUEBLA, 2 M reared, 1 L, Rio Piedras Negras, Piedras Negras, Hwy 130 sw Poza Rica, kilo marker 158, 22 V 1992, Henry, deposited in UTPA.

Distribution.—The known distribution of *N. orientalis* is shown in Map 4.

Discussion.—Allen (1974) reported the presence of *Neochoroterpes* larvae from tributaries of the Rio Panuco and from two coastal streams in Veracruz, Mexico. These specimens were listed under *C.(N.) mexicanus* by Allen (1974). I have not seen these specimens but the only *Neochoroterpes* I have collected from this region is *N. orientalis*.

Biology and Ecology—Mature larvae were collected from the underside of stones in a shallow stream which a local man called "Rio". Although larvae with dark wing pads were collected, and the collection was in the morning during typical *Neochoroterpes* swarming times, no imagos were observed in the field. In addition, no subimagos were collected at an evening light trap as is typical of other *Neochoterpes* species.

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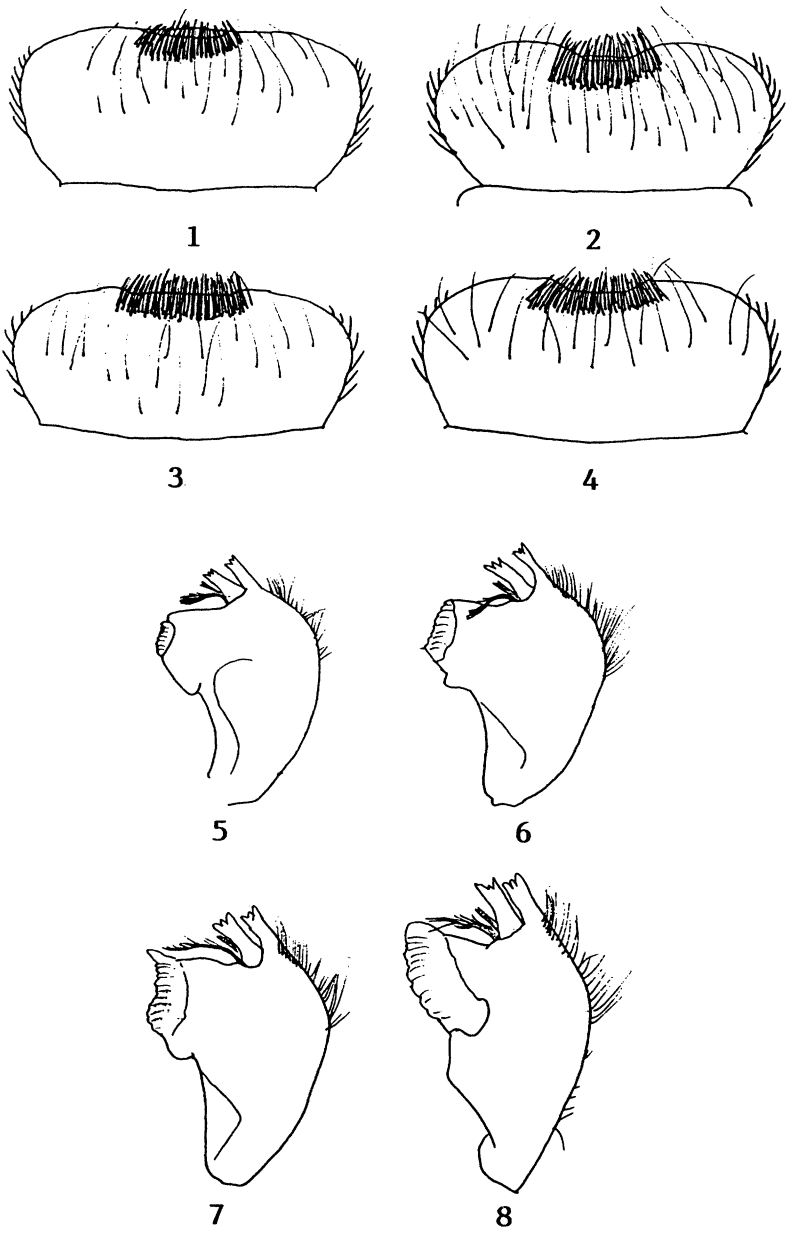
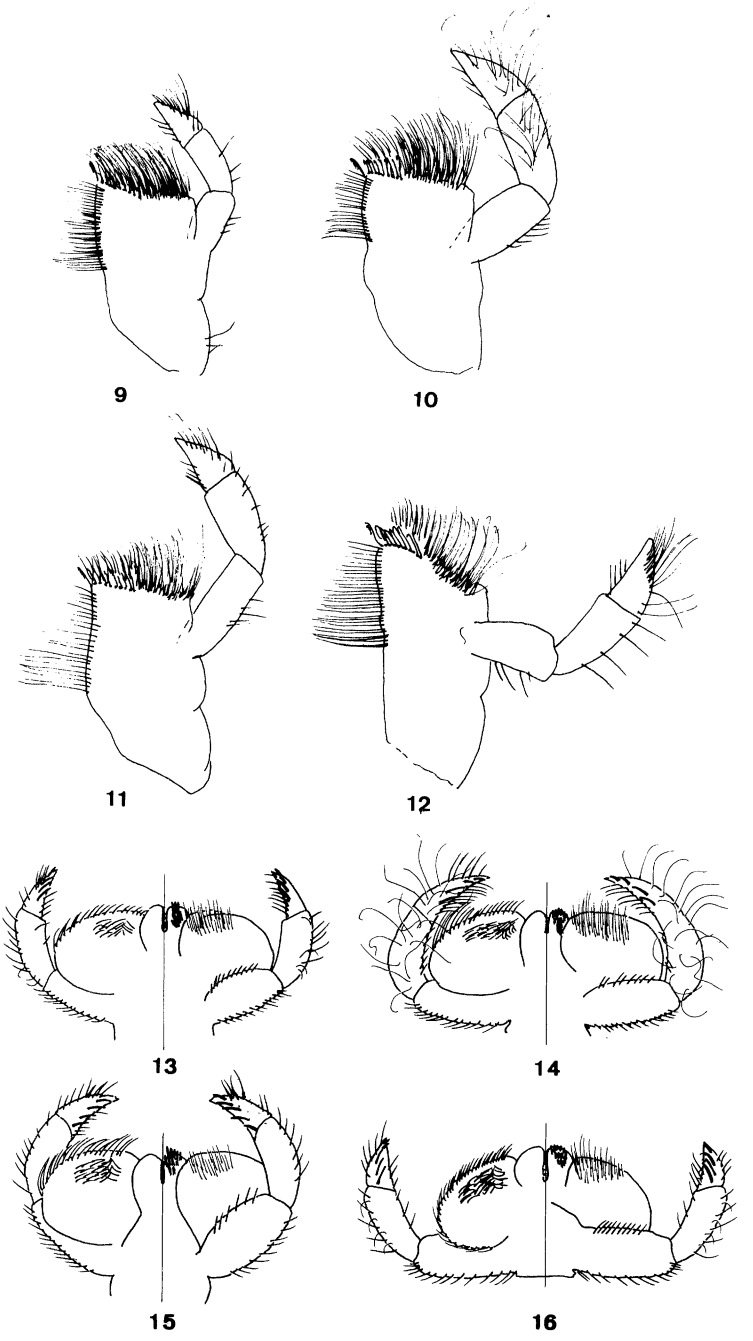
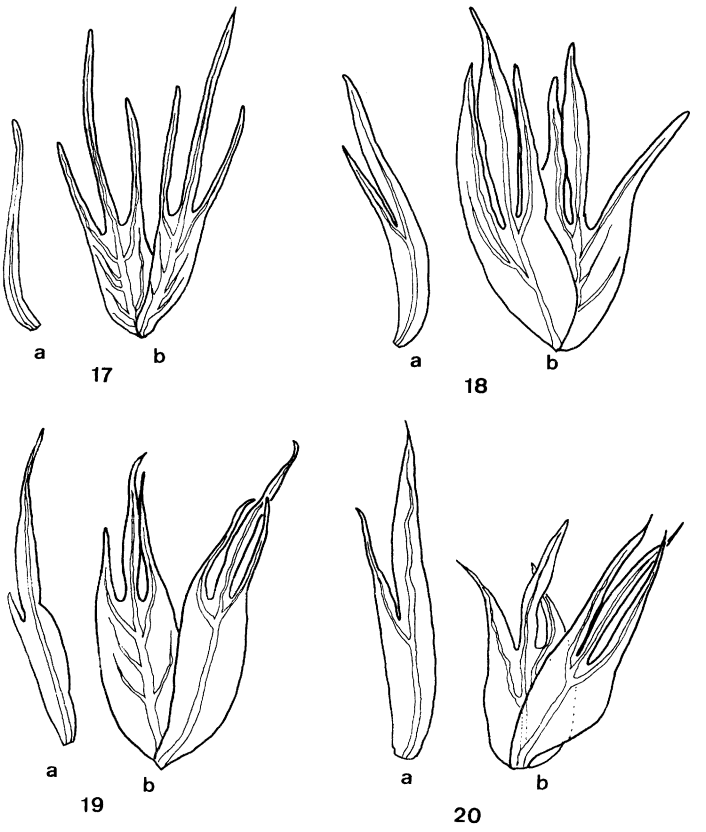


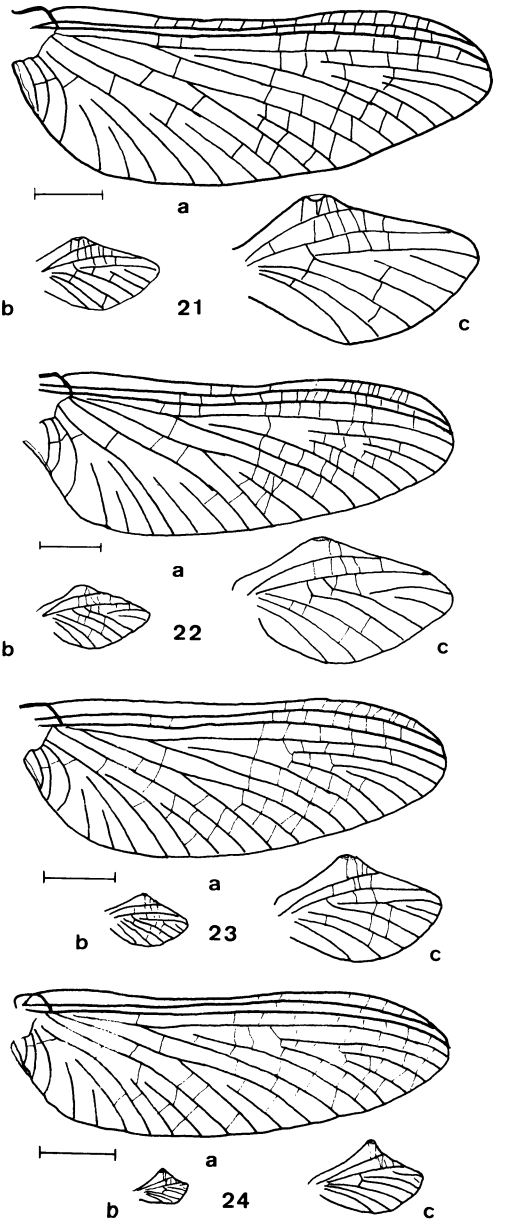
Figs. 1-8. 1-4: Larval labrum, dorsal. 1, *N. kossi*; 2, *N. oklahoma*; 3, *N. nanita*; 4, *N. orientalis*. 5-8: larval mandible. 5, *N. kossi*; 6, *N. oklahoma*; 7, *N. nanita*; 8, *N. orientalis*.



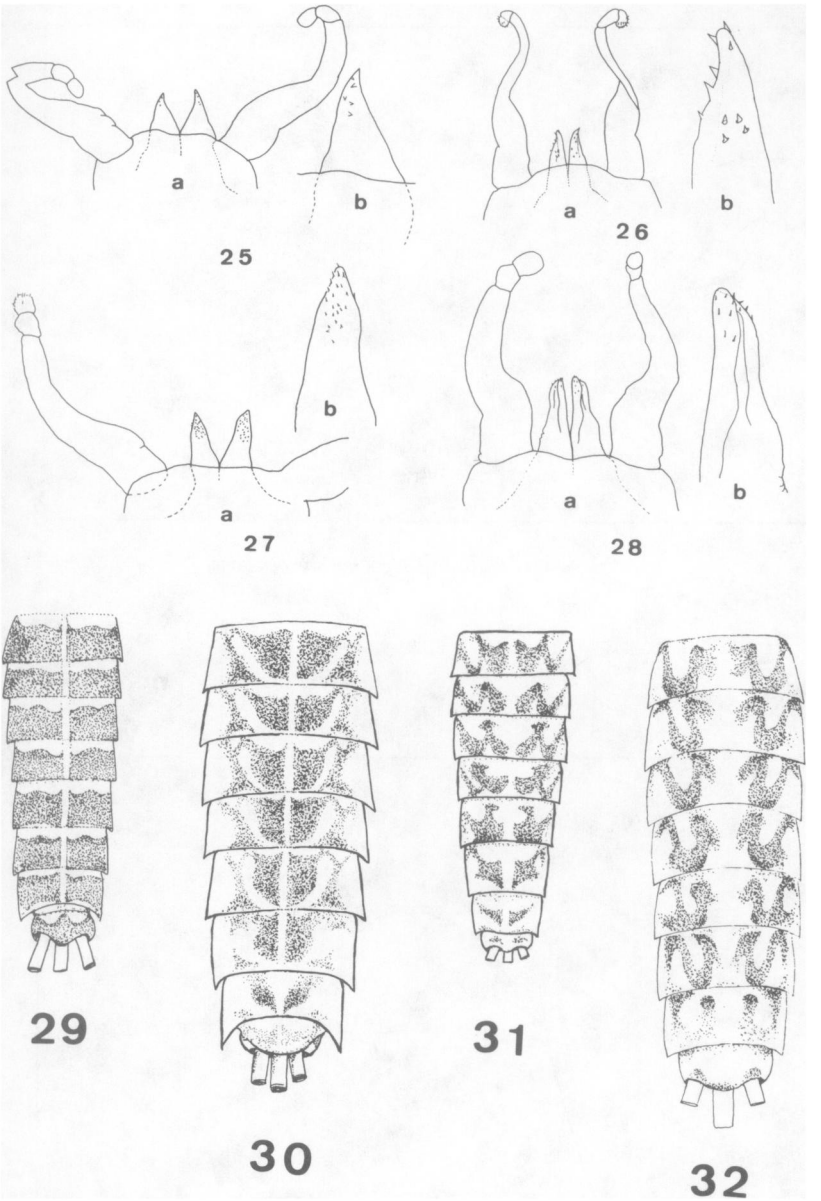
Figs. 9-16. 9-12: Larval maxillae. 9, *N. kossi*; 10, *N. oklahoma*; 11, *N. nanita*; 12, *N. orientalis*. 13-16: larval labia, dorsal left, ventral right. 13, *N. kossi*; 14, *N. oklahoma*; 15, *N. nanita*; 16, *N. orientalis*.



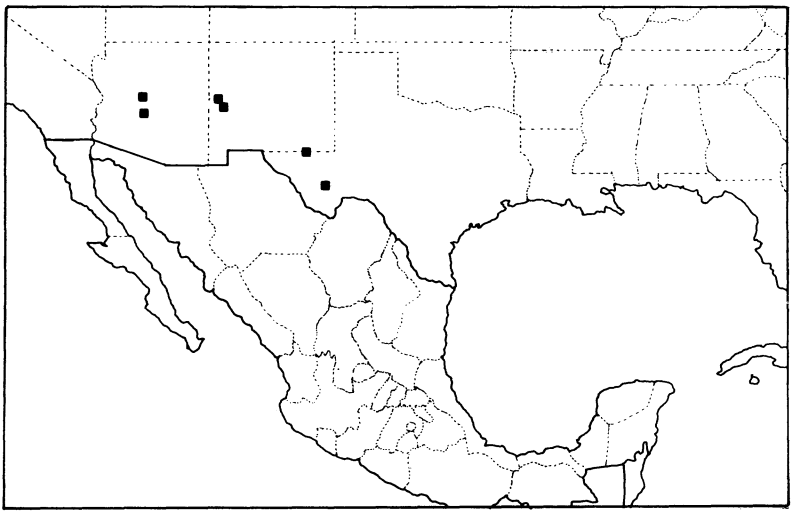
Figs. 17-20. Larval gills, a, gill 1; b, gill 4. 17, *N. kossi*; 18, *N. oklahoma*; 19, *N. nanita*; 20, *N. orientalis*.



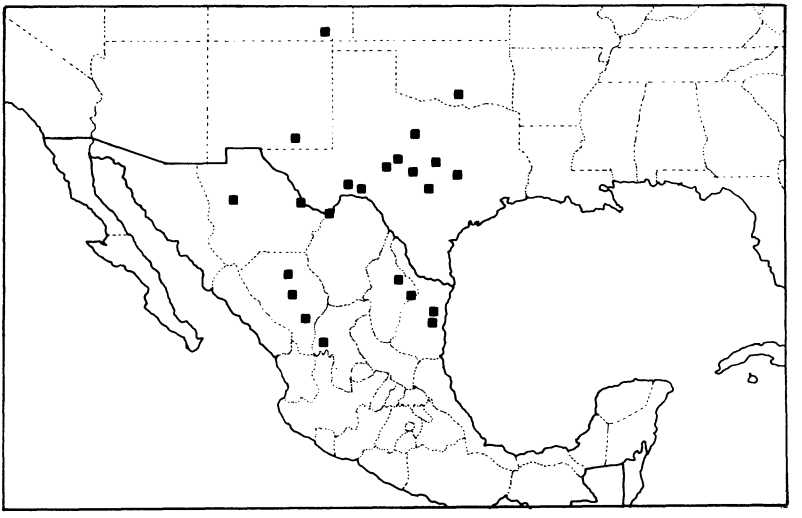
Figs. 21-24. Front wings, a; hind wings b, c; hind wing enlarged C. 21, *N. kossi*; 22; *N. oklahomae*; 23, *N. nanita*; 24, *N. orientalis*.



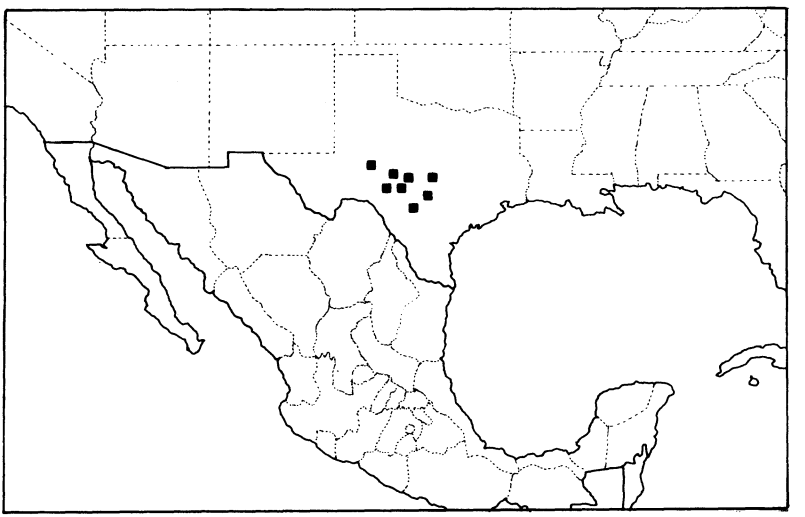
Figs. 25-32. 25-28: Genitalia a; pene enlarged, b. 25, *N. nanita*; 26, *N. kossi*; 27, *N. orientalis*; 28, *N. oklahoma*. 29-32: abdominal color pattern, larvae. 29, *N. kossi*; 30, *N. oklahoma*; 31, *N. nanita*; 32, *N. orientalis*.



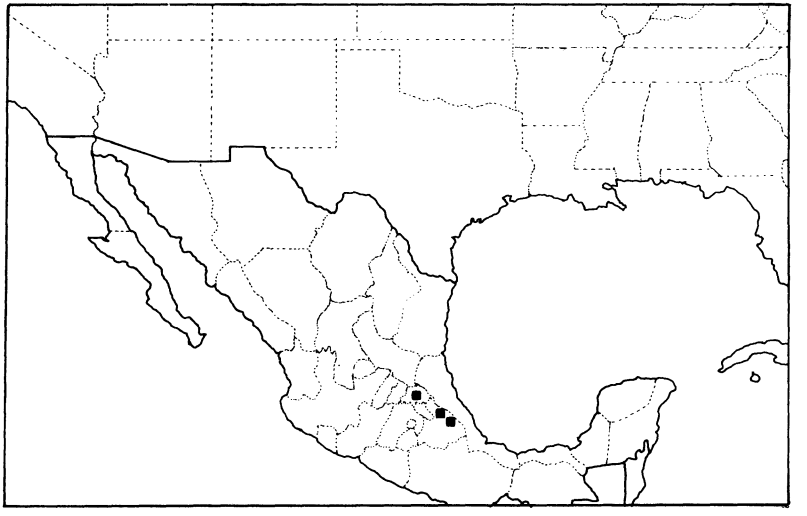
MAP 1. Distribution of *Neochoroterpes kossi*.



MAP 2. Distribution of *Neochoroterpes oklahoma*.



MAP 3. Distribution of *Neochoroterpes nanita*.



MAP 4. Distribution of *Neochoroterpes orientalis*.