GENERAL NOTES

SYSTEMATIC AND ECOLOGICAL NOTES ON *TUBIFICOIDES HETEROCHAETUS* (OLIGOCHAETA: TUBIFICIDAE) FROM THE NECHES RIVER ESTUARY, TEXAS

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Tubificoides heterochaetus (Michaelsen 1926) is an estuarine oligochaete in the Family Tubificidae that has been reported in Europe and North America. North American records include Virginia, North Carolina, Florida, Louisiana and the Sabine-Neches estuary in Texas (Wern 1980; Shirley & Loden 1982; Harrel & Hall 1991; Milligan 1996; Harrel & Smith 2002). All of the publications concerning this species, except Shirley & Loden (1982), are taxonomic, and no information is given concerning its water quality tolerance.

The taxonomic status of this species was in a state of confusion until recently. It was originally described by Michaelsen (1926) and placed in the genus *Limnodrilus* and later transferred to the genus *Peloscolex* (Lastockin 1937; Cekanovskaya 1962; Brinkhurst & Jamison 1971). Holmquist (1978) established the genus *Tubificoides* and in 1979 Brinkhurst & Baker transferred the marine and estuarine *Peloscolex* to the genus *Tubificoides*.

Descriptions of *T. heterochaetus* in the literature vary from one author to another and most were based on specific lectotypes and did not consider all of the morphological variation that occur in the species. *Tubificoides heterochaetus* was originally described by Michaelsen (1926) as possessing a cuticular penis sheath. Brinkhurst & Jamison (1971) and Brinkhurst & Baker (1979) described it as lacking a penis sheath. Baker (1981) redescribed the species to correct this. Milligan (1996) contains the only taxonomic key, known by this author, that can be used by an applied biologist for proper identification of *T. heterochaetus*. However, numbers of setae per bundle, lengths of setae, and width and length of the penis sheath vary more than the scattered literature states. Thus, an updated description of the species is given based on the literature and examination of 302 specimens collected from the Neches River estuary in Texas. The diagnostic characteristics of the

genus are based on histological genitalia structures and these are not often visible in specimens collected and prepared for ecological purposes. Thus, the description below is based on structures visible without special handling or dissection. All specimens examined were killed and preserved in formalin containing rose bengal stain, stored in 70 percent ethanol and mounted in CMC-10 media on microscope slides.

Complete specimens 5 to 9 mm long and ranged from 46 to 66 segments, but most were incomplete. Maximum width ranged from about 375 to 500 μm at segment X or XI. Anterior segments (I-XII) are non-papillate and distinctly wider than posterior papillate segments which are 70 to 160 μm wide (Figure 1). The posterior papillate segments are elongate and often constricted at their base. The prostomium is conical and shorter or equal to its base at the peristomium. Anterior segments II through XII become progressively longer. Segments II through IX have secondary annulations and have 3 to 8 (mostly 5 or 6) 38 to 50 μm long ventral and dorsal bifid setae per bundle with equal length teeth. Segment IX may have one, two or no setae. Clitellar segments X, XI and XII lack setae. A short thimble-shaped penis ranging from 36 to 37 μm wide at the base and 37 to 46 μm long with a thin cuticular sheath may be present in or just outside of segment XI. Only eight of 302 specimens examined had a visible penis sheath; two collected in February, two in May, one in August and three in November. Segment XIII decreases in width from anterior to posterior and scattered papille first appear. Segments behind XIII are covered with oblong papillae, but the posterior segments of complete specimens had very few or lacked papillae. Some post-clitellar segments possess 1, 2 or occasionally 3 apparently simple pointed setae per bundle 54 to 67 μm long. Some posterior setae are actually bifid and the upper tooth is longer and thicker than the shorter, thinner lower tooth, which is not visible unless turned just right. The posterior setae are often broken, difficult to see or absent in some segments. If all of the papillate segments of a specimen are missing it could easily be misidentified as *Limnodrilus*.

Harrel et al. (1976), Harrel & Hall (1991) and Harrel & Smith (2002) conducted three year-long surveys, with seasonal sampling of macrobenthos at the same seven collection stations in the highly industrialized, tidal, lower Neches River. A 1971-72 study (Harrel et al. 1976) was conducted before implementation of the Clean Water Act (CWA) when this section of the river was listed as the second most polluted waterway in the state with a permitted BOD (biochemical oxygen demand) waste load of 123,125 kg/day. Oxygen depletion (concentrations <2 mg/L)

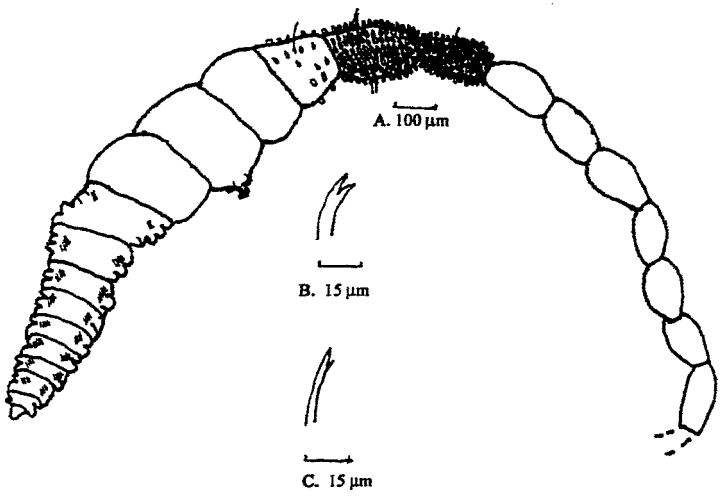

Figure 1. *Tubificoides heterochaetus*: (a) body, (b) tip of anterior and dorsal seta, and (c) tip of posterior weakly bifid seta.

occurred at all stations and toxic pollutants were present in the water and the substrate. No *T. heterochaetus* were collected during this survey and they may have been excluded by the heavy load of organic and toxic pollutants in the river.

During a 1984-85 study (Harrel & Hall 1991), after implementation of the first two phases of the CWA and a 93 percent reduction in the permitted BOD pollution load in the river to 8,717 kg/day, a total of 525 specimens of *T. heterchaetus* were collected from six of the seven sampling stations. Density at individual collection stations ranged from zero to 1196/m^2 and maximum density occurred during February. Salinity ranged from <0.5 ppt to 8.5 ppt at the stations and depths where it occurred.

During a 1999 study (Harrel & Smith 2002), after implementation of phase 3 of the CWA, but a 19 percent increase in the permitted BOD waste load in the river, 302 specimens of *T. heterochaetus* were collected at five of the seven collecting stations. Density at individual collecting stations ranged from zero to 991/m^2 and maximum density occurred in November. Salinity ranged from <0.5 ppt to 13.2 ppt.

During 1978 and 1979 Wern (1980) conducted monthly collections of macrobenthos from 12 stations in the Keith Lake system of marsh lakes located between the Sabine-Neches navigation channel, the Gulf of Mexico and the Intracoastal Waterway. She collected 1254 specimens

of *T. heterochaetus* and some specimens were collected at all 12 stations at some time during the study. Density ranged from zero to 3075/m^2 and highest densities occurred during July and August, which was attributed to a reproductive event. Salinity ranged from <0.5 to 20 ppt. Mean station bottom water dissolved oxygen concentrations ranged from 6.0 to 7.1 mg/L. No permitted effluents were released directly into this system, but some contaminants (e.g., metals, oil and grease) were present in the sediments and were probably transported in by tidal action from the Intracoastal Waterway and the Sabine-Neches Navigation channel or from oil field activity in the area. These occurred in higher concentrations at some stations than at others, but no differences in macrobenthos distribution, abundance or diversity could be attributed to pollution.

Shirley & Loden (1982) reported *T. heterochaetus* from the Calcasieu River estuary in Louisiana, which is located about 80 km east of the Neches River and Keith Lake estuaries. Specimens were collected from 10 of 27 stations sampled during 1974 to 1976. No specimens were collected at stations where oxygen depletion occurred and environmental parameters where they were collected included: (1) salinity - 2.3 to 14.1 ppt, (2) oxygen percent saturation - 68 to 112%, (3) depth - 1.0 to 5 m, and (4) substrate - clay and silt. Density rarely exceeded 100/m^2 and average density was 46.2/m^2.

Other Oligochaetes that occurred with *T. heterochaetus* in the Neches River and Keith Lake estuaries include *Limnodrilus hoffmeisteri*, *L. udekmianus*, *Ilyodrilus templetoni*, *Aulodrilus piguetti*, *A. pluriseta*, *Dero nivae*, *D. furcata*, *Slavinia appendiculata*, *Nais variabilis* and *Paranais grandis*. All of these are considered freshwater species, except *P. grandis* which has been reported only from coastal Louisiana and Texas. Polychates that were common where *T. heterochaetus* occurred were *Hobsoni grayi*, *Parandalia americana*, *Neanthes succine*, *Laeonereis culveri*, *Polydora socialis*, *Streblospio benedicti* and *Mediomastus californiensis*.

Tubificoides heterochaetus is a oligohaline to mesohaline estuarine species restricted to habitats where the salinity varies from <0.5 to 20 ppt, but was uncommon where salinity was <2 ppt or >14 ppt. It occurred in sand, silt and clay substrates and at depths to at least five meters. It is tolerant to moderate pollution and cannot tolerate oxygen depletion or severe pollution. It was not collected in the Neches River estuary until after pollution abatement occurred resulting in improved water quality when it became a common component of the benthic community.

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REPRODUCTION IN THE WESTERN HOGNOSE SNAKE, *HETERODON NASICUS* (SERPENTES: COLUBRIDAE) FROM THE SOUTHWESTERN PART OF ITS RANGE

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The western hognose snake, *Heterodon nasicus* ranges from southern Canada to San Luis Potosí, México and southeastern Arizona to central Illinois where it frequents prairies, open woodlands and floodplains of