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A contribution on the Middle American milliped family Rhachodesmidae (Polydesmida: Leptodesmidea: Rhachodesmoidea): description of *Tiphallus torreon* n. sp., the first species from Coahuila, Mexico; first records from Belize; and depiction of the (super)familial distribution

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Abstract. *Tiphallus torreon* n. sp., the first rhachodesmid milliped from Coahuila, Mexico, displays an iridescent turquoise pigmentation with patterned white paranotal markings and a truncated, subapical projection from the broad, non-descript gonopodal acropodite. Four genera – *Strongylodesmus* Saussure, *Mexidesmus* Loomis, and *Ceuthauxus* and *Tiphallus*, both by Chamberlin – contain forms exhibiting this general condition, but the last is the only one whose type species does. Synthetic treatments are essential to advance familial knowledge beyond the descriptive stage, and revising these four taxa would constitute a meaningful initial study. Rhachodesmidae extend from northern Nuevo León, Mexico, ca. 77 km (48 mi) from the Rio Grande, to central Costa Rica; Glomeridae (Glomerida), Platydesmidae (Platydesmida), and Stemmiulidae (Stemmiulida) show similar distributions whereas Allopocockiidae (Spirobolida) and *Rhysodesmus* Cook (Polydesmida: Xystodesmidae) traverse the river and occupy southernmost Texas. Tridontomidae, the other component of Rhachodesmoidea, occupies a small enclave in Alta Verapaz, Guatemala. Rhachodesmidae/oidea do not occur in Panama and are initially recorded from Belize; localities are needed from Honduras.

Key words: acropodite, Central America, Costa Rica, Guatemala, Nicaragua, Nuevo León, Rio Grande, Tamaulipas, Texas.

Introduction

The Mexico/Central American milliped family Rhachodesmidae (Polydesmida: Leptodesmidea: Rhachodesmoidea) is known for its anatomical diversity and striking colors; along with white, vivid hues of red, yellow, orange, blue, turquoise, and green adorn many of its species (Loomis and Hoffman 1962, Loomis 1976, Hoffman 1982). Body forms vary from subjuliform to flattened, and males lack gonopodal cannulae, the prefemoral fossas usually being enlarged and fringed with hairs. Rhachodesmidae is one of three leptodesmidean families that is endemic to the isthmus connecting North and South America; Tridontomidae, the other component of Rhachodesmoidea, and Holistophallidae are the others. Along with six spirobolidan taxa, they may have originated in what Keeton (1960), for Spirobolidae (Spirobolida), termed the “northern Mexican Highlands,” defined by Shelley and Floyd (2014) as parts or

all of Aguascalientes, Coahuila, Guanajuato, Jalisco, Nuevo León, San Luis Potosi, Tamaulipas, and Zacatecas states. A fourth regional leptodesmidean family, Sphaeriodesmidae, has spread northward into the southcentral/eastern United States (US/USA) and also inhabits Jamaica, Hispaniola, Cuba, and Guadeloupe in the Antilles (Chamberlin 1918, 1922a, b; Loomis 1936, 1937, 1968, 1975; Causey 1958; Chamberlin and Hoffman 1958; de la Torre Y Callejas 1974; Mauriès 1980; Hoffman 1980, 1999; González Oliver and Golovatch 1990; Golovatch and González Oliver 1993; Pérez-Asso and Pérez-Gelabert 2001; Shelley 2000, 2001; Pérez-Gelabert 2008; Shelley and Martínez-Torres 2013).

Despite these and other attributes, taxonomic research on Rhachodesmidae remains in the descriptive, alpha stage. No synthetic studies have been offered (Shear 1973, Hoffman 1999), and the only truly definitive account is the **redescription** of *Tancitares michoacanus* Chamberlin and discussion of its genitalia (Hoffman 2011). We concur with Shear (1973) that “only an intensive revision of all available material can hope to sort out the many species into meaningful generic categories.” Presently, the family comprises around 17 valid genera and 61 species, including the one added here, with no subfamilial or tribal groupings ever being proposed (Loomis 1968; Hoffman 1980, 1999; Bueno-Villegas et al. 2004). Synthetic treatments are thus essential because placing new forms in appropriate genera based solely on the terse existing literature is virtually impossible. Conflicting concepts of *Neoleptodesmus* Carl exist along with confusion between *Ceuthauxus* Chamberlin and *Strongylodesmus* Saussure (Shear 1973), to which we add *Tiphallus* Chamberlin and *Mexidesmus* Loomis. In 2011, AOE and MAGR discovered an undescribed, turquoise-blue rhachodesmid (Fig. 1) in southern Coahuila, where the family has never been documented despite Causey’s (1973) general citation. It possesses a short, broad, and nondescript gonopodal acropodite, and the last four genera above, all geographically plausible, accommodate these and other forms. While a complete familial revision is needed, revising these four taxa collectively would constitute an initial treatment that would significantly advance Rhachodesmidae’s level of knowledge. Such a time-consuming study is beyond our scope, so we assign the Coahuila form to *Tiphallus*, the oldest name whose type species demonstrates its general acropodital condition. Types are deposited in the Florida State Collection of Arthropods, Gainesville (FSCA), and the North Carolina State Museum of Natural Sciences, Raleigh (NCSM). We also publish rhachodesmid samples from the Field Museum of Natural History, Chicago, Illinois, USA (FMNH), and the Canadian Museum of Nature, Ottawa, Ontario, Canada (CMN).

Taxonomy

Order Polydesmida Pocock 1887

Suborder Leptodesmidea Brölemann 1916

Superfamily Rhachodesmoidea Carl 1903

Family Rhachodesmidae Carl 1903

Diagnosis (adapted from those of Shear [1973] and Hoffman [1982]). Small to moderate-size, often spectacularly colorful, Rhachodesmoidea with transversely ovoid collums; paranota varying from slight longitudinal ridges to large, subquadrate flanges, rarely slender and subspiniform. Gonopods without cannulae and prefemoral processes; prefemoral telopodital regions densely and subuniformly pilose, fossas usually large, deeply excavated, and with long marginal hairs; acropodites without superficial subdivisions.

Components. Seventeen genera are presently recognized; Hoffman (1999) listed 16 but overlooked *Tiphallus*.

Distribution. Rhachodesmidae’s distribution – northeastern Mexico to central Costa Rica – is also that of Rhachodesmoidea; Tridontomidae occupy a small enclave in Alta Verapaz Department (Dept.), Guatemala, in the heart of this area (Fig. 2). Like Glomeridae (Glomerida), Platydesmidae (Platydesmida), and Stemmiulidae (Stemmiulida) (Shelley and Golovatch 2011, Shelley et al. 2012), Rhachodesmidae extend northward along the Gulf Coast of Mexico, through the Sierra Madre Oriental, and across the Tropic of Cancer into northern Nuevo León and Tamaulipas, the northeasternmost states, and nearly to

southernmost Texas, USA (Shear 1973). The projected range spans the breadth of the Middle American isthmus from central Costa Rica to Colima, Mexico, where it angles northeastward and curves to near the Rio Grande. The northernmost locality is Bustamente, Nuevo León, but nearby Sabinas Hidalgo, where *Ceuthauxus nuevus* (Chamberlin) occurs (Chamberlin 1942, Loomis 1968, Hoffman 1999, Bueno-Villegas et al. 2004), is closer to the US, being some 77 km (48 mi) from the river above Roma, Starr County (Co.), Texas. Like the aforementioned families, Rhachodesmidae has never been encountered north of the watercourse, so the family differs from Allopocockiidae (Spirobolida), whose northernmost species, *Anelus richardsoni* (Pocock), inhabits Willacy Co., Texas, 99 km (62 mi) north of the river (Cook 1911; Chamberlin and Hoffman 1958; Hoffman 1980, 1999; Shelley and Hoffman 1995). Discounting the Chisos Mountain species in west Texas (Big Bend National Park, Brewster Co.) and the two in the Appalachians (Hoffman 1998, 1999; Shelley 1989, 1999), *Rhysodesmus* Cook (Polydesmida: Xystodesmidae) also traverses the River into southernmost Texas, as *R. texicolens* (Chamberlin) inhabits Webb, Willacy, and Cameron Cos. (Chamberlin 1938, 1943; Chamberlin and Hoffman 1958; Hoffman 1970, 1980, 1999; Shelley 1987).

Aceratophallus lamellifer Brölemann, the southernmost species, occurs at Chitaria, Cartago Province (Prov.), and Parismina, Limon Prov., Costa Rica (Chamberlin 1933, Loomis 1968, Hoffman 1999), so we project Rhachodesmidae for the Osa Peninsula to the northwest, where they have never been taken. They do not inhabit Panama (Hoffman 1999), although Loomis (1961) described *A. quadratus* and *Teinorachis tenuis* from “presumably/probably Canal Zone,” and subsequently (Loomis 1964, 1968) reported “probably Canal Zone” and “probably Panama.” According to Loomis (1971), the millipeds were with material that O. F. Cook collected in 1923 in Haiti; Loomis inquired, since the family is unknown from Hispaniola, and Cook replied that they were probably from the Canal Zone where he had also sampled that year. Because the family was known from neighboring Costa Rica, Loomis (1961) considered Cook’s response reasonable and characterized the species as “likely members of the Panamanian fauna.” Later, he (Loomis 1971) found *A. quadratus* in a sample that he had collected at Ameya (misspelled as “Amaya”), Chinandega Dept., Nicaragua (12°34’N, 87°09’W), a railroad stop between Corinto and Chinandega (city). Since they routinely collaborated, Loomis surmised that Cook had taken the specimens from the Ameya sample, examined them, and mistakenly placed them with the Haitian material, so he “corrected” their type localities to Ameya. Twenty-eight years later, Hoffman (1999) compounded the confusion by citing the wrong paper, Loomis (1964) instead of (1971), as the source of the “correction.” Confirmation with fresh material that both *A. quadratus* and *T. tenuis* do indeed occur there is desirable.

We believe that insufficient time has passed since Rhachodesmidae originated for it to spread as far southward as Panama. They are known from all countries within the projected range except Belize, which we eliminate below, and Honduras, where records are needed.

BELIZE: *Cayo District*, Xunantunich Ruins near Guatemala border, M, 7 August 1985, and M, F, 8 August 1990, M. A. Brittain (NCSM). *Toledo District*, Blue Creek Cave, M, juv., 20 February 1980, B. Martin (CMN) **New Country Records.**

Remarks. According to Causey (1973), the only polydesmidan family that is more abundant in Mexican caves than Rhachodesmidae is Pyrgodesmidae (= Stylodesmidae).

Genus *Tiphallus* Chamberlin, 1952

Tiphallus Chamberlin 1952: 566. Loomis 1968: 42. Jeekel 1971: 290. Causey 1973: 116. Hoffman 1980: 165.

Type-species. *Tiphallus aberrans* Chamberlin 1952, by original designation.

Diagnosis. Gonopodal telopodite without unequivocal separation between prefemur and acropodite, soleniferous element reduced to vestigial, basal remnant closely appressed to medial prefemoral surface and angling anteriorly from fossa; acropodite a broad, nondescript, irregularly lobate structure with few if any projections or distinctive features.

Components. Four species: *T. aberrans* Chamberlin 1952, *T. alberti* Causey 1973, *T. frivolus* Causey 1973, *T. torreon* new species.

Distribution. Four states in northeastern Mexico: Coahuila, Nuevo León, Tamaulipas, and San Luis Potosi.

Remarks. *Tiphallus* and its species were omitted from Hoffman (1999). Only two true taxonomic usages exist (Chamberlin 1952, Causey 1973), so the published literature provides little insight into the genus. Lacking a short synopsis of even one established rhachodesmid genus, we can only cite aspects of these works plus features that we consider potentially diagnostic.

***Tiphallus torreon* new species**

Fig. 1, 3–6.

Type specimens. Male holotype and one male paratype (FSCA) collected by A. O. Espino in August 2013 along Arroyo de Palos, Sierra de Jimulco, Coahuila, Mexico; one male and two female paratypes (FSCA, NCSM) taken by same collector at same locality in September 2012 and 14–16 September 2011, respectively. All types were taken at the same locality, which constitutes the **first definite records from Coahuila for Rhachodesmidae**.

Diagnosis. Distinguished from congeneric species by the truncated, subapical acropodal projection.

Color in life (Fig. 1). Dorsum and sides iridescent turquoise, lateral margins of collum and caudal paranotal corners on segments 2–18 with whitish areas varying from the tips and slight extensions along caudal margins on segments 6, 11, and 14, to large splotches covering caudal 2/3 to 3/4 of paranota on segments 5, 7, 9–10, 12–13, and 15–16. Epicranium medium turquoise, fading in interantennal and genal regions then darkening again on frons; labrum white. Pregonopodal sterna and prozonae dark to medium turquoise, fading on 7th sternum between 9th legs and only faintly blue thereafter. Legs



Figure 1. *Tiphallus torreon*, habitus photo showing *in vivo* dorsal coloration.

1–4 subuniformly dark turquoise, fading on legs 5–6 and only faintly blue thereafter. Hypoproct dark turquoise, paraprocts lighter.

Holotype. Length 27.6 mm, maximal width 4.6 mm, W/L ratio 16.7%. Head lightly rugulose. Epicranial suture strong, distinct, terminating in interantennal region. Genae extending laterad well beyond epicranial margins, ends narrowly rounded. Facial setae as follows: epicranial 2–2; supra-antennal 1–1; interantennal comprising two series of 1–1; subantennal 1–1; frontal comprising five series of 1–1; genal about 8–8 irregularly scattered over both surfaces; clypeal about 10–10; labral about 13–13, merging with clypeal series and continuing for about 1/3 of genal margins. Antennae reaching back to, or slightly beyond, caudal margin of 4th tergite; 1st antennomere subglobose, 2–6 clavate, covered with moderate vestiture beginning at midlength of 2nd article and becoming progressively denser distad, 7th short and truncate with four short, broad apical cones.

Metazonae lightly granular, prozonae more so; anterior margins of collum and metaterga 2–5 with short, inconspicuous, and irregularly spaced setae. Paranota flat, subplanar, extending directly laterad or angling slightly upwards/dorsad, dorsal surfaces essentially flush with those of metaterga; anterior corners rounded except for a short but distinct tooth on those of segments 3–11, teeth becoming progressively shorter, broader, and less distinct on 12th–16th paranota and absent thereafter; caudal corners rounded, margins subcontinuous with those of metaterga on segments 2–8, slightly emarginate on 9–16, angling progressively more caudad and becoming subacuminate on 17–19. Peritremata narrow, present on 2nd–19th paranota; ozopores present on segments 5, 7, 9–10, 12–13, and 15–19, located caudal to midlengths in peritrematal swellings, opening subdorsad. Epiproct moderately long, configuration subtriangular, projecting directly caudad from 19th segment, overhanging and extending well beyond caudal paraproctal margins, apically blunt, with one long basal seta per side and four long spinneret hairs (sub)apically.

Sides of metazonae smooth to lightly granular, with only slight grooves or impressions. Strictures strong, distinct. Spiracles small, rounded, located adjacent to coxal condyles. Sternum of segment 4

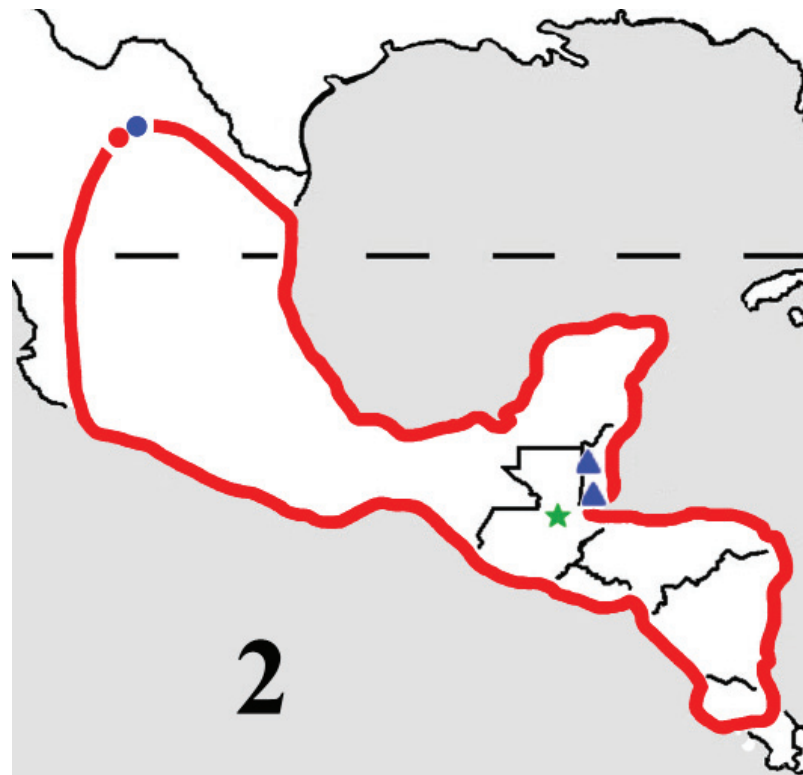


Figure 2. Known and projected distribution of Rhachodesmoidea. Red line, Rhachodesmidae; green star, area of Tridontomidae in Alta Verapaz Dept., Guatemala (Loomis and Hoffman 1962, Shear 1977). Red dot, type locality of *Tiphallus torreon*; blue dot, provisional locality in the Sierra Las Delicias. Blue triangles, rhachodesmid localities in Belize detailed in the text.

with distinct, conical lobes subtending coxae of 3rd legs; 5th sternum with shallow central depression, 6th strongly depressed between both leg pairs to accommodate distal halves of gonopodal telopodites. Postgonopodal sterna smooth, glabrous, with distinct bicruciform impressions on segments 8–18, caudal margins becoming progressively more concave on 7th–16th sterna. 1st and 2nd legs short, slightly crassate, with light pilosity beginning on femora; gonapophyses short, blunt, and stubby. Coxae of 3rd legs densely pilose with moderately long, anteriorly directed lobes contacting lateral surfaces of gonapophyses when segments compressed or curled, prefemora and femora markedly less hirsute than coxae, pilosity increasing on distal articles; 4th–7th legs densely pilose, without structural modifications. Pregonopodal claws falcate on legs 1–2, relatively straight and curved slightly apically on 3–7. Postgonopodal podomeres densely pilose, with distoventral prefemoral trichome on legs 8–24, claws gently curved and relatively blunt. Paraprocts with strongly elevated marginal rims and long lateral setae; hypoproct smoothly semilunar with four submarginal setae.

Gonopodal aperture large, subquadrate, located entirely in metazona, compressing stricture and prozona, 1.4 mm wide and 1.8 mm long at midpoints, anterior margin flat, sides elevating progressively caudad then lowering to flat caudal margin. Gonopods *in situ* with coxae closely appressed together, virtually contiguous, telopodites lying subparallel to each other, overhanging anterior margin of aperture and sternum of segment 6, terminating between 6th legs. Gonopod structure (Fig. 3–5) as follows:

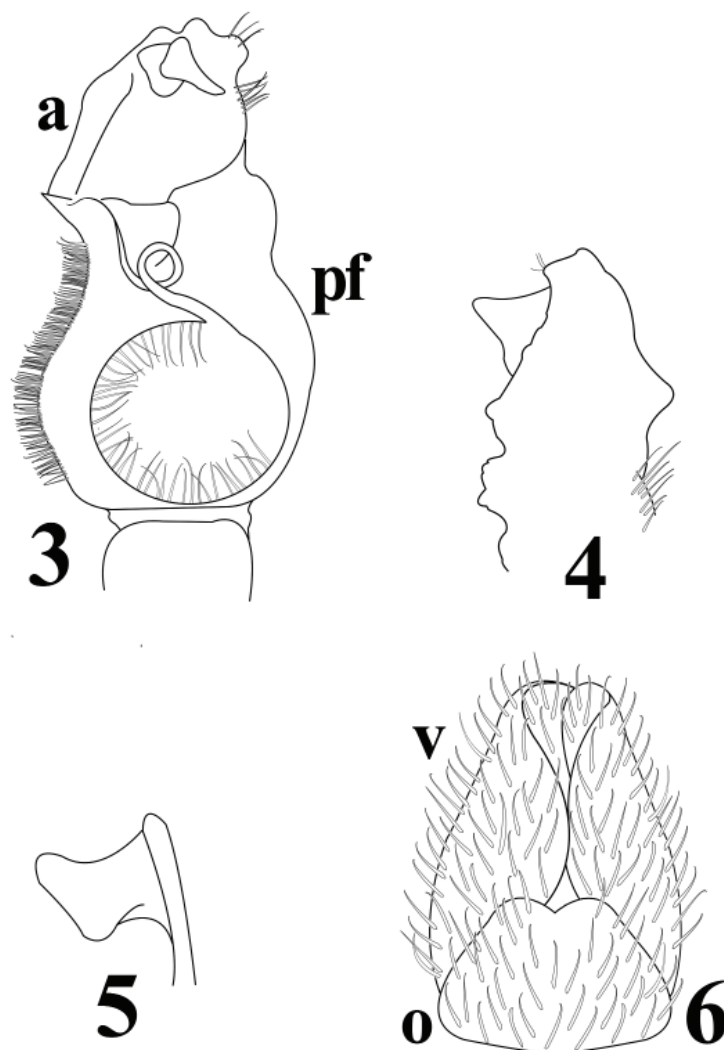


Figure 3–6. *Tiphallus torreon*. 3) Left gonopod of holotype, medial view. 4) Acropodite of the same, lateral view. 5) Distal acropodital extremity of the same showing the profile of the rhomboid subapical projection, subventral view. 6) Left cyphopod of female paratype, lateral view. a, acropodite; o, operculum; pf, prefemur; v, valve.

Apodeme short; coxa small, inconspicuous, less than half as wide as telopodite, positioned directly beneath (dorsal to) latter. Prefemoral region of telopodite more than twice as wide as coxa, expanding at midlength in anterior/posterior axis then narrowing to juncture with acropodite; anterior, lateral, and caudal surfaces covered with dense vestiture; fossa large, rounded, located caudobasally and comprising >71% of medial surface, with long, flexible hairs internally along proximal, anterior, and distal margins; efferent duct/prostatic groove arising caudally from distal margin of fossa, angling anteroventrad, looping at midlength, and tapering to slender filament running along, or close to, continuation of medial prefemoral surface; latter overhanging base of acropodite, divided at midlength into two flaps, anterior overlying caudal but both flaps lying beneath loop of duct/groove. Acropodite arising at impression near telopodital midlength, medial surface terminating just beyond prefemoral flaps, lateral surface with irregular folds and grooves, anterior and caudal margins irregularly scalloped, latter with short, lightly setose, rhomboid, subapical projection proximal to two lobed terminations; inner/medial side of lateral surface with short, broad, truncated subapical projection tapering to gently curved, narrowly rounded, caudomedially directed tip.

Male paratypes. The male paratypes agree closely with the holotype in all particulars.

Female paratypes. Fragmented and unmeasurable; somatic features agreeing generally with those of holotype. Cyphopodal aperture broad, extending laterally beyond basal podomeres of 2nd legs and encircling latter, sides and caudal margin elevated, latter with broad medial lobe extending into and constricting opening. Cyphopods tubular, oriented dorsoventrally *in situ* in center of opening, valvular apices slightly protruding. Valves (Fig. 6) long, cupped around medial and lateral sides of oviduct opening, surfaces covered with uniformly dense vestitures, marginal hairs longer. Receptacle absent. Operculum large, located dorsolaterally, semilunar but with distomedial indentation, surface with subuniformly dense vestiture and longer marginal hairs except around indentation.

Ecology. *Tiphallus torreon* was found exclusively in association with rodent holes (probably excavated by the pocket gopher, *Thomomys bottae*) in the high elevation forest zone between 2,400–3,000 m (7,872–9,840 ft) in the Sierra de Jimulco. It was not encountered in association with detritus or near flowing water but seems to be sensitive to rain; more individuals emerge from the holes and stay on the surface longer with more rain. In the initial sighting, AOE, MAGR, and associates were digging in a hole when the millipeds emerged unexpectedly.

Etymology. The specific name, a noun in apposition, references the municipality containing the type locality. Its seat, Torreón (city) some 40 km (25 mi) to the north, is the center of the ninth largest metropolitan area in Mexico, which also contains communities in neighboring Durango.

Distribution (Fig. 2, dots). Known definitely only from the type locality (red dot) in the southwestern corner of Coahuila near the border with Durango, and we provisionally assign *T. torreon* to the following specimen collected ~128 km (80 mi) to the north-northeast (blue dot):

MEXICO: *Coahuila*, Sierra Las Delicias, F, 18 August 1946, R. G. Schmidt (FMNH).

Remarks. Although the milliped looks blue in the photo (Fig. 1), the pigmentation appears more on the order of turquoise under a stereomicroscope.

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