AN ANNOTATED LIST OF THE TROGLOBITIC ANCHIALINE AND FRESHWATER FAUNA OF QUINTANA ROO

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Thomas M. Iliffe

Twenty species of aquatic, troglobitic (cave-limited) organisms are presently known from cenotes and caves in the state of Quintana Roo, Mexico. These include 18 species of crustaceans from 7 orders and 2 fish species from two orders. Twelve species inhabit anchialine (coastal, brackish water) caves, while the remainder are limited to subterranean freshwaters. Nearly all are of a marine origin.

The word “cenote” is derived from a Mayan term and denotes a subterranean chamber that contains permanent water. Hall (1936) and others have categorized cenotes as follows: (1) Jug-shaped cenotes have a small surface opening. (2) Vertical-walled cenotes have a large surface opening. (3) Aguada-like cenotes consist of large cavities with sloping walls leading down to shallow pools. “Aguadas” are seasonal pools only containing water during the wet season. (4) Cave-like cenotes contain a lateral passage descending to a chamber containing water. Often, these pools are sumps with cave passages continuing underwater. Many cenotes and caves near the Caribbean coast of Quintana Roo contain anchialine pools. The term “anchialine” was coined by Holthuis (1973) to denote, “pools with no surface connection to the sea, containing salt or brackish water, which fluctuates with the tides”. Anchialine caves in Quintana Roo typically contain freshwater near the surface. However, beneath an abrupt halocline, the salinity increases to brackish or fully marine levels (14 to 35 ppt). Average salinity beneath the halocline in mainland caves is about 16 ppt (Coke, pers. comm.). The depth of the halocline and thus the thickness of the freshwater lens increases with distance inland. Most of these caves are formed by preferential dissolution of limestone at the mixing zone halocline between fresh and brackish waters (Back et al., 1986).

Due to characteristic cave development at the halocline and the orientation of cave passages along fractures, many anchialine caves extend for considerable distances. With the development of advanced cave diving methodology, it has become possible to explore and study these vast underwater labyrinths. One of Mexico’s largest underwater cave systems is the Sistema Naranjal (the Maya Blue-Najaron System) near Tulum with 15,480 m of surveyed passage (Coke, pers. comm.). Other long underwater caves on the mainland include Nohoch Nah Chich (13,380 m), Cenote Sac Actún (4,500 m), Cenote Zapote (4,500 m), Cenote Ponderosa (4,500 m) and Carwash Cenote (2,590 m). Cueva Quebrada (7,600 m) and Aerolito (6,100 m) are long anchialine caves on the island of Cozumel.

The limestone that makes up the
Yucatan Peninsula ranges in age from Miocene and Eocene in the interior to Pleistocene and Holocene deposits near the coast. Surface rocks along the east coast of Quintana Roo are composed of Pleistocene coral reef material dated at 120,000 years (Back et al., 1986).

Hall (1936) has examined the physical and chemical characteristics of the more inland cenotes of Yucatan. He found that water temperatures ranged from 21.9 to 28.5 °C with a mean of 25.4 °C. Three cenotes had marked vertical gradients with warmer water at the surface and cooler water (by as much as 5 °C) at depth. Water in several cenotes examined by Hall became anoxic and contained hydrogen sulfide at depth, although the surface waters were near saturation. Other cenotes had relatively uniform oxygen concentrations at all depths.

The first serious attempts to investigate the cave fauna of the Yucatan Peninsula were carried out in 1932 and '36 by expeditions from the Carnegie Institution of Washington (Pearse, 1936, 1938 a). A total of 306 species was collected from aquatic and terrestrial caves during this study of which 28 were considered as troglobites (Pearse, 1938 b).

Between 1973 and '75, systematic studies of the cave fauna of entire Yucatan Peninsula were carried out by biologists from Texas Tech University (Reddell, 1977). These investigations increased the total number of species reported from caves to 565 of which 11 were aquatic troglobites and 23 terrestrial.

Cave diving investigations starting in the mid 1980's have just begun to document the rich anchialine fauna inhabiting coastal caves. The remipede *Speleonecetes tulumensis*, the ostracod *Danielopolina mexicana*, the thermosbaenacean *Tulumella undens* and the amphipod *Tulaweckelia cernua* are known only from anchialine caves on the mainland near Tulum. The shrimp *Agostocaris bozanici*, *Yagerocaris cozumel*, *Somersiella sterreri* and *Janicea antiguenensis* have Mexican populations limited to caves in the island of Cozumel. Only the cirolanid isopod *Bahalana mayana* has so far been obtained from both locations.

Reddell (1977) examined distribution patterns of the troglobitic fauna in Yucatan. Four aquatic species -the mysid *Antromysis cenotensis*, the shrimp *Typhlatya mitchelli* and the two blind fish, *Ogilbia pearsei* and *Ophisternon infernale*- are widespread over the Coastal Plain. The cirolanid isopod, *Creaseriella anops*, is known from both the Coastal Plain and Sierra de Ticul, but has not been found in the Sierra de Bolonchén. The amphipod *Mayaweckelia cenoticola* occurs in both the Coastal Plain and the Sierra de Bolonchén. Two shrimp, *Typhlatya pearsei* and *Creaseria morleyi*, are found in the Coastal Plain, Sierra de Ticul and Sierra de Bolonchén. An asellid isopod, *Caecidotea* sp., is known only from the Northwestern Coastal Plain. Similarly, the amphipod *Mayaweckelia yucatanensis*, and the shrimp *Typhlatya campecheae*, are restricted to the Sierra de Bolonchén.

Reddell (1977) concludes that at this time it is not possible to speculate whether these distribution patterns
result from, “different times of invasion, a greater degree of mobility of the species, or a slower evolutionary rate”.

Wilkens (1982) plotted the distribution of the aquatic troglobites in relation to the position of Pliocene and Pleistocene shorelines in Yucatan. He supposed that the transition of marine species to freshwater caves in Yucatan was dependent on the existence of coastal (anchialine) caves. Wilkens believed that the more stable Pliocene shoreline was the primary site of cave colonization. Indeed, most caves containing the cave fish *Ogilbia pearsei* and *Ophisternon infernale* are located near the ancient Pliocene coast. The similar degree of eye and pigment reduction in distant populations of these fish, as well as in the shrimp *Creaseria morleyi*, suggested to Wilkens, a simultaneous start for cavernicole evolution of each species. Since the eye rudiments of *Ophisternon infernale* are less reduced than those of *Ogilbia pearsei* and *Creaseria morleyi*, this former species probably had a later beginning of regressive evolution. Wilkens interprets the present widespread distribution of many troglobites as a result of secondary dispersal through the subterranean water system.

The aquatic troglobitic fauna of the Yucatan Peninsula has taxonomic affinities to species inhabiting caves on various oceanic islands. At least 8 genera (*Agostocaris*, *Bahadzia*, *Bahalana*, *Danielopolina*, *Janicea*, *Typhlatya*, *Tulumella* and *Speleonectes*) are common to caves in the Yucatan and Bahamas (Holsinger, 1989). Four genera (*Janicea, Procaris, Typhlatya* and *Somersiella*) occur in both Yucatan and Bermuda, while three genera (*Danielopolina, Typhlatya* and *Ogilbia*) cohabit Yucatan and Galapagos caves.

The following list describes the known aquatic troglobites inhabiting caves in Quintana Roo. Locations of these caves are shown in Figure 1.

**Phylum CRUSTACEA**  
**Class Remipedia**  
**Order Nectiopoda**  
**Family Speleonectidae**  
*Speleonectes tulumensis* Yager, 1987  
**Characteristic features:** Elongate, slender remipede without pigment or eyes. Small cephalic shield; trunk segments increasing with age to a maximum observed number of 36 (Yager, 1987).  
**Size:** To 27.5 mm.  
**Habitat:** Anchialine.  
**Number of species in genus:** Four, all anchialine.  
**Genus range:** Bahamas (Grand Bahamas and Abaco Island), Mexico (Quintana Roo), Canary Islands, Belize (Yager, pers. comm.).  
**Species range:** Known from anchialine caves in Belize and Quintana Roo. Collection sites in Quintana Roo include Carwash and Najaron Cenotes.  
**Ecological notes:** Schram (1986:40) has noted that remipedes in general,... live below a distinct halocline in brackish layers of waters generally deep within the caves... oxygen in the remipede habitat is very low, around 0.5 parts per billion-virtually anoxic.
Yet the animals are moderately active, good swimmers. When collected and maintained in aquaria, the animals take to ceaseless, rather frenetic swimming and literally burn themselves out with a few days.

Swimming at any speed is achieved with regular metachronal beats.

The robust, prehensile to subchelate mouthparts would seem to imply a carnivorous mode of feeding. Indeed, speleonectids (have been observed to feed) on *Typhlatya garciai*, a caridean commonly associated with West Indian nectiopodans. The prey was grasped in the flexed mouthparts and pressed tightly to the mouth. When feeding was completed, an empty cuticle was set afloat.

**Life history:** According to Schram (1986: 40), nothing is currently known concerning nectiopodan breeding habits nor details of development. Several of the known species have been found in association with juveniles. In general form they resemble the adults, but they are smaller, lack gut diverticula and gonopores, and only have from 12 to 17 segments.

**Closest related species:** *S. lucayensis* from the Bahama Islands.

**Evolutionary origins:** Remipedes are the most primitive of known crustaceans. The combination of a large number of primitive characters in the animals is reminiscent of the ancestral crustacean. The nearest relative to living remipedes is a Carboniferous species, *Tesnusocaris goldichi*, known only from the fossil record (Schram, 1983, 1986; Yager, 1986).

**Class Ostracoda**

**Order Halocyprida**

**Suborder Halocypridina**

**Superfamily Thaumatocypridoidea**

**Family Thaumatocyprididae**

*Danielopolina mexicana* Kornicker & Iliffe, 1989

**Characteristic features:** Halocyprid ostracod with spines on carapace.

**Size:** Length and height of carapace: 0.95 mm by 0.74 mm (A-1? female).

**Habitat:** Anchialine

**Number of species in genus:** Seven species, six of which are troglobitic and one from the deep sea.

**Genus range:** Cuba, Bahamas, Jamaica (Kornicker & Iliffe, in press), Mexico (Quintana Roo), Canary Islands, Galapagos- all anchialine; South Atlantic near the Equator at a depth of 3459 m.

**Species range:** Known only from Maya Blue Cenote, located near Tulum, Quintana Roo.

**Ecology:** Two specimens were collected from euhaline waters below the halocline at 16 m depth.

**Life history:** Not known. All instars are swimmers, probably living close to or in the substrate (Kornicker, pers. comm.).

**Closest related species:** *D. mexicana* differs from its congeners by having a carapace with abundant surface spines (Kornicker & Iliffe, 1989). *D. mexicana* shares several characters in common with *D. carolinae* and may be more closely related to this deep sea species than are any of the other cave species (Kornicker, pers. comm.). *D. mexicana* also shows relationships with *D. styx* (from the Galapagos) and with *D. elizabethae* (from Jamaica).
Danielopol (1990) concluded that *D. mexicana* is more primitive than other congeners mainly because of the presence of a Bellonci organ. **Evolutionary origins:** Of the 5 genera comprising the family Thaumatocyprididae, 2 are known only from fossils (from the Permian and Upper and Lower Jurassic), 2 known only from the deep sea, while the genus *Danielopolina* is the only member of the family inhabiting anchialine caves. While Iliffe et al. (1984) have postulated a deep sea origin for *Danielopolina*, Danielopol (1990) believes anchialine *Danielopolina* species were derived from a shallow water ancestor.

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**Class Malacostraca**
**Subclass Eumalacostraca**
**Superorder Pancarida**
**Order Thermosbaenacea**
**Family Halosbaenidae**
**Subfamily Halosbaeninae**
*Tulumella unidens* Bowman & Iliffe, 1988

**Characteristic features:** Unpigmented, blind mysid with small but non-functional eyestalks.

**Size:** Length to 3 mm.

**Habitat:** Anchialine.

**Number of species in genus:** Three, all anchialine.

**Genus range:** Bahamas (Grand Bahama, Abaco and South Andros Islands), Mexico (Quintana Roo).

**Species range:** Know from Najaron Cenote (Bowman and Iliffe, 1988), Temple of Doom Cenote and Carwash Cenote (Holsinger, 1990).

Undetermined thermosbaenaceans have been reported from Cueva Quebrada on Cozumel (Bowman, 1987).

**Ecology:** Three specimens were collected from near the halocline at -10 to -18 m depth. Salinities above and below the halocline at -14 m were 1.5 and 35 ppt, respectively.

**Life history:** Not known. The 29 specimens of the two Bahamian species reported by Yager (1987) are all females.

**Closest related species:** Both *T. unidens* and *T. grandis* from the Bahamas share a long and multi-segmented first antennae, although the latter species is considerably larger.

**Evolutionary origins:** The distribution of thermosbaenaceans with hypogean species in the West Indies, Yucatan, Texas, the Canary Islands, the Mediterranean region, Somalia and Cambodia is taken to indicate a Tethyan origin associated with the breakup of Pangea in post-Jurassic time (Schram, 1986; Cals and Monod, 1988).

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**Superorder Peracarida**
**Order Mysidacea**
**Suborder Mysida**
**Family Mysidae**
*Antromysis (Antromysis) cenotensis* Creaser, 1936

**Characteristic features:** Small, blind and unpigmented mysid.

**Size:** 3-4 mm in length from tip of rostrum to end of telson.

**Habitat:** Freshwater.

**Number of species in genus:** Nine.

**Genus range:** Four troglobitic species
from Mexico (Yucatan, Quintana Roo and Oaxaca), Cuba and Jamaica make up the subgenus Antromysis. Marine members of two other subgenera are found in the Bahamas, Puerto Rico, Caribbean coast of Colombia, Costa Rica, Surinam and the Florida Keys (Bowman, 1977).

**Species range:** Widespread in caves in Yucatan and Quintana Roo. Collection sites in Quintana Roo include Actún Ha, Cenote de San Martín, Cenote de Las Ruinas, Cenote de Santo Domingo, Cenote de Juan Coh, and Temple of Doom Cenote (Reddell, 1977; Bowman, 1977; Bowman, 1987).

**Ecology:** Enormous numbers of A. cenotensis are present swimming about in the water column of many cave pools.

**Life history:** Not known.

**Closest related species:** A. cubanica (Cuba) and A. peckorum (Jamaica).

**Evolutionary origins:** All members of the subgenus Antromysis lack eyes and inhabit caves. Their distribution in the Yucatan, Cuba and Jamaica suggests descent from a preadapted marine ancestor that colonized coastal caves in the northern Caribbean.

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**Order Amphipoda**

**Suborder Gammaridea**

**Family Hadziidae**

*Bahadzia* n.spp. A & B Holsinger, in press

**Characteristic features:** Amphipod lacking eyes and pigment; Characterized by second segment on outer rami of third uropod.

**Size:** Up to 10 mm.

**Habitat:** Typically anchialine.

**Number of species in genus:** Seven, all but one anchialine.

**Genus range:** Bahamas (Grand Bahama and Abaco Islands), Caicos Islands (Providenciales), Haiti and Mexico (Quintana Roo).

**Species range:** *Bahadzia* n.sp. A is known only from Xcan-ha Cenote on Cozumel, while *Bahadzia* n.sp. B inhabits one cave on the mainland of Yucatan and two on the island of Cozumel (Holsinger, in press)

**Ecology:** *Bahadzia* is usually found in mesohaline to euhaline waters below the halocline in anchialine caves.

**Life history:** Not known.

**Closest related species:** These two new species appear to be sibling taxa that evolved from a common ancestor (Holsinger, in ms.).

**Evolutionary origins:** The genus *Bahadzia* is most closely allied phylogenetically with *Mayaweckelia* and *Tuluweckelia* from the Yucatan Peninsula (Holsinger, in press). Species B is thought to be close to the putative ancestral species which independently and simultaneously colonized caves on both Cozumel and the mainland (Holsinger, in press). Species A, inhabiting an adjacent but apparently separate aquifer system on Cozumel, has diverged to a greater degree.

*Mayaweckelia cenoticola* Holsinger, 1977

**Characteristic features:** Small to medium-sized amphipod lacking eyes and pigment.

**Size:** Males to 4.0 mm; females to 6.0
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Habitat: Freshwater.

Number of species in genus: Two, both troglobitic

Genus range: Mexico (Campeche, Yucatan and Quintana Roo).

Species range: Known from 11 caves in Yucatan, Campeche and Quintana Roo (Holsinger, 1990). Collection sites in Quintana Roo include five caves - Cenote de San Martín, Cueva de Tancah, Carwash Cenote, Cenote de Las Ruinas, Cenote de Santo Domingo (Reddell, 1977; Holsinger, 1990).

Ecology: *M. cenoticola* inhabits predominantly fresh or, at most, weakly brackish cave waters. In several caves, it was found in small, partially isolated pools (Holsinger, 1977).

Life history: A strongly skewed sexual ratio favoring females may be present for this species.

Closest related species: *M. yucatanensis*, known from a single cave in the state of Campeche.

Evolutionary origins: *Mayaweckelia* has taxonomic affinities with marine forms. It inhabits caves situated between the Pliocene and Pleistocene shorelines. Holsinger (1977, 1989) concludes from this that *Mayaweckelia* originated from a marine ancestor "stranded" by retreating sea levels during the late Tertiary or early Quaternary.

*Tuluweckelia cernua* Holsinger, 1990

Characteristic features: Amphipod without eyes and pigment.

Anterior body region bent downward at a sharp angle.

Size: Males to 5.0 mm; females to 8.0 mm.

Habitat: Anchialine.

Number of species in genus: One.

Species range: Known only from six caves in Quintana Roo. Collection sites include Temple of Doom Cenote, Cueva de la Calavera, Carwash Cenote, Maya Blue Cenote, Cenote Mojarra and Najaron Cenote, all near Tulum.

Ecology: Found in fresh to weakly brackish waters of anchialine caves near the northeastern coast of Quintana Roo.

Life history: Highly disproportionate sex ratio favoring females. Of the 56 specimens reported by Holsinger (1990), 71% were female, 7% male and 21% juveniles. Some larger females had setose brood plates but none was ovigerous.

Closest related taxa: *Tuluweckelia* belongs to the weckeliid group of Hadziidae that consists of marine relict species inhabiting subterranean freshwaters of southcentral Texas, northern Mexico, Yucatan, Cuba, Puerto Rico, and Haiti (Holsinger, 1990).

Evolutionary origins: According to Holsinger (1990), the marine ancestors of *Tuluweckelia* colonized caves during a Pleistocene regression of higher sea levels. Evidence for this is its distribution in partly brackish cave waters near the coast.

Order Isopoda

Suborder Flabellifera

Family Cirolanidae

*Bahalana mayana* Bowman, 1987

Characteristic features: Medium-sized cirolanid isopod without eyes and pigment.
Size: Males to 10.0 mm; females to 8.5 mm.

**Habitat:** Anchialine.

**Number of species in genus:** Three, all anchialine

**Genus range:** Bahamas (San Salvador and Mayaguana Islands), and Mexico (Quintana Roo).

**Species range:** Known only from two caves in Quintana Roo: Cueva Quebrada on the Island of Cozumel, and Temple of Doom Cenote, near Tulum.

**Ecology:** In Cueva Quebrada, specimens were collected approximately 800 m from the entrance at a depth of about 5 m. Salinity at this point was 21 ppt and dissolved oxygen, 3.0 ppm. Specimens in Temple of Doom Cave were collected in 12 to 18 m depths, from water of 14 ppt salinity (Bowman, 1987).

**Life history:** Collected specimens include 9 males, 6 females and 1 juvenile (Bowman, 1987).

**Closest related species:** The two Bahamian species appear to be most closely related while *B. mayana* differs from both in a number of features.

**Evolutionary origins:** The members of the genus appear to be derived from a marine ancestor ranging the area from the Bahamas to the Yucatan Peninsula (Holsinger, 1989).

**Creaseriella anops** (Creaser, 1936)

**Characteristic features:** Large cirolanid isopod without eyes and pigment.

**Size:** To 21.8 mm (Creaser, 1936).

**Habitat:** Freshwater.

**Number of species in genus:** One.

**Species range:** Known from numerous cenotes and caves in the states of Yucatan and Quintana Roo. Collection sites in Quintana Roo include Temple of the Doom Cenote, Cenote de San Martin, Cueva Akin and Cenote Tos Virlool (Reddell, 1977; Wilkens, 1982; Bowman, 1987).

**Ecology:** Numerous specimens collected from freshwater cave pools using traps baited with meat (Creaser, 1936, 1938).

**Life history:** Not known.

**Closest related taxa:** Not known.

**Evolutionary origins:** Derived from marine forms in early Pleistocene times (Wilkens, 1982).

**Superorder Eucarida**

**Order Decapoda**

**Suborder Pleocyemata**

**Infraorder Caridea**

**Superfamily Procaridoidea**

**Family Procarididae**

*Procaris* n. sp. Kensley, in prep.

**Characteristic features:** Phyllobanchiate gills; maxillipeds and pereiopods with strong exopods; none of pereiopods chelate or subchelate; rostrum small and unarmed.

**Size:** Similar to other congeners where the carapace length reaches 9-10 mm.

**Habitat:** Anchialine.

**Number of species in genus:** Four, all anchialine.

**Genus range:** Bermuda, Ascension Island, Hawaii, Mexico (Quintana Roo).

**Species range:** Anchialine caves on Cozumel.

**Ecology:** Abel and Felgenhauer (1985) have studied the ecology of the Ascension species. They report that smaller individuals spend most of their
time in crevices, while larger individuals are observed swimming in open water. Examination of gut contents reveals that they feed on both plant matter and crustaceans including amphipods and atyid shrimps.

**Life history:** Little is known of either the reproductive biology or ontogeny of Procaris (Schram, 1986). A sex ratio, determined by the presence of genital apertures, of eight females to one male has been determined for the Ascension species, P. ascensionis (Felgenhauer et al., 1988). Although more than 1,000 specimens of P. ascensionis were observed in the field, no ovigerous females were seen. A single female maintained in the laboratory bore approximately 60 bright orange eggs on the endopods of pleopods. The large size of these eggs (0.83-0.93 mm) suggests the existence of a zoeal larval stage (Felgenhauer et al., 1988).

**Closest related species:** All known species of Procaris are quite similar, showing few differentiating characters (Hart and Manning, 1986).

**Evolutionary origins:** Hart and Manning (1986:416) note that the similarities between species and their highly anomalous distribution in marine caves indicate an extremely slow rate of evolution. They suggest that, "Procaris, or its predecessors, may, at one time, have been widely distributed throughout the oceans, surviving today only in cryptic habitats removed from some of the environmental pressures necessitating change."

**Superfamily Atyoidea**

**Family Atyidae**

*Typhlatya mitchelli* Hobbs & Hobbs, 1976

**Characteristic features:** Translucent to white or pigmented small shrimp. Pigment, which occurs only in individuals from some localities, appears grayish to black or brown (Hobbs, 1979). Eyes lack facets and pigment. Rostrum does not extend anteriorly beyond eyes.

**Size:** Total length to about 16 mm; carapace length of females to 4.8 mm.

**Habitat:** Freshwater.

**Number of species in genus:** Nine, all troglobitic.

**Genus range:** Ascension Island, Bermuda, West Indies (Barbuda, Caicos Islands, Cuba, Dominican Republic, Mona, Puerto Rico), Mexico (Yucatan, Campeche and Quintana Roo) and Galapagos Islands.

**Species range:** Known from 17 caves and cenotes in the states of Yucatan and Quintana Roo. Collection sites in Quintana Roo include Cueva del Fermín and Actún Ha (Hobbs, 1979).

**Ecology:** According to Hobbs (1979:622), in all localities shrimps were living in lentic situations varying from very small shallow (less than 0.3 m depth) pools to extensive underground lakes (greater than 2.0 m depth). Generally the pools were in total darkness, but T. mitchelli occurs in entrance areas that receive direct light from the surface. Substrates of the pools consisted of guano, silt, organic debris, rocks and combinations thereof. Shrimp were found on the substrate, "hanging" from submerged walls along the edges of
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lakes, free-swimming, and among dense, branched root systems hanging down from the roof of cenotes.

**Life history:** Males and ovigerous females are as yet unknown (Hobbs & Hobbs, 1976).

**Closest related species:** *T. mitchelli* is intermediate, both in morphology and in geographic position, between the Caribbean species with a short rostrum (from Cuba and Mona) and the seemingly disjunct species from the Galapagos (Hobbs & Hobbs, 1976).

**Evolutionary origins:** Of the nine species in the genus, four (from the Galapagos Islands, Bermuda, Ascension Island and the Caicos Islands) inhabit brackish or marine waters, while the remainder are found in freshwater habitats. According to Iliffe (1986:7), “species within the genus appear to have evolved from an open water marine ancestor in the Atlantic which spread westward through the Caribbean into the Pacific with prevailing currents before the closure of the Panama land bridge.” Iliffe *et al.* (1983) suggested an origin of the genus on submerged and emergent seamounts associated with the Mid-Atlantic Ridge during the separation of the American and African continental masses.

*Typhlatya pearsei* Creaser, 1936

**Characteristic features:** Small, light, whitish shrimp, somewhat opaque but not transparent; eyes lack facets and pigment.

Rostrum extends anteriorly well beyond eyes.

**Size:** To about 17 mm in total length. Carapace length of males to 3.8 mm; of females to 5.2 mm (Hobbs and Hobbs, 1976).

**Habitat:** Freshwater.

**Species range:** Known from 21 caves and cenotes in the states of Yucatan, Campeche and Quintana Roo. Collection sites in Quintana Roo include Cueva del Fermín, Pozo de San Martín, Cenote de Juan Coh, Cenote de Santo Domingo, Cenote Tos Virlol and Cenote Coop (Hobbs, 1979).

**Ecology:** According to Hobbs (1979), this species is found in lentic habitats ranging from small pools (less than 0.5 m in depth) to deep lakes (greater than 8 m). These bodies of water are generally floored with silt or bat guano... *Typhlatya pearsei* is generally found in total darkness but occasionally individuals are seen in entrance areas where pools receive either direct or indirect light from the surface.

Dissolved oxygen levels in pools containing this shrimp are as low as 0.78 mg l⁻¹ or about 10% saturation (Hall, 1936).

**Life history:** Of the 230 specimens examined by Hobbs (1979), 88% were females, 5% males and 6% juveniles.

**Closest related species:** *T. pearsei* belongs to a group in which the rostrum extends beyond the eyes. This group includes *Typhlatya* species from Bermuda, Ascension Island, Cuba and Campeche (Mexico).

**Evolutionary origins:** Both *T. pearsei* and *T. mitchelli* show identical degrees of eye reduction suggesting that they started the cavernicolous evolution at the same time (Wilkens, 1982).
Superfamily Rhynchocinetoeida
Family Agostocarididae
Agostocaris bozanici Kensley, 1988
Characteristic features: Small, unpigmented shrimp with eyes not differentiated into cornea and stalk. Integument with sparse scattering of tiny black chromatophores (Kensley, 1988).
Size: Carapace length to 8.0 mm
Habitat: Anchialine.
Number of species in genus: Two, both anchialine.
Genus range: Bahamas (Grand Bahama Island), Turks and Caicos Islands (Providenciales), Mexico (Quintana Roo)
Species range: Known only from Xcan-ha Cenote on the island of Cozumel, Quintana Roo.
Ecology: Specimens were collected in euhaline waters (salinity 34 ppt) at 18 to 41 m depths. The foregut of two specimens were packed with the filaments of the benthic cyanobacterium Oscillatoria corallinae.
Life history: Of the 9 specimens collected, 4 were females and 5 were immature. None of the females were ovigerous (Kensley, 1988).
Closest related species: A. williamsi from Grand Bahama Island and Providenciales.
Evolutionary origins: Affinities for this family, which contains only two species, are unclear. The genus shares some features with the Bresiliidae, a family of shrimp inhabiting deep sea hydrothermal vents (Hart & Manning, 1986; Kensley, 1988).

Superfamily Palaemonoidea
Family Palaemonidae
Creaseria morleyi (Creaser, 1936)
Characteristic features: Larger, translucent to white shrimp. Eyes somewhat bullet-shaped but lacking pigment. Carapace with two spines along anterior lateral margin.
Size: To approximately 70 mm in total length; carapace length in males to 20.3 mm, in females to 29.0 mm (Hobbs, 1979).
Habitat: Freshwater.
Number of species in genus: One.
Species range: Widely distributed in at least 32 caves and cenotes in Yucatan, Campeche and Quintana Roo (Hobbs, 1979).
Collection sites in Quintana Roo include Cueva del Fermín, Pozo de San Martín, Cenote de Juan Coh, Cenote de Las Ruinas, Cenote de Santo Domingo, Cenote de Tos Virlol, Cenote Ajín and Cueva Coop.
Ecology: According to Hobbs (1979:630), Creaseria morleyi occurs in quiet water habitats ranging from small, shallow pools (less than 0.5 m deep) and natural well (5 m deep) to large, deep lakes (greater than 3 m in depth). These bodies of water are floored by guano deposits, rich organic silt, debris, and rocks. Shrimp were found in total darkness as well as in entrance areas receiving direct and indirect light. Creaser (1936) observed these shrimp crawling over the bottom, as well as swimming in the water column. He states that they are extremely sensitive to vibrations in the water. Specimens were collected in a wire trap baited with meat. Examination of stomach...
contents indicates that the species is cannibalistic (Creaser, 1938). Holthuis (1977:187) states that, “these animals are very aggressive, if two or more are placed together in a smallish container they will attack and mutilate each other.”

**Life history:** Of the 92 specimens examined by Hobbs (1979), 70% were females, 27% males and 3% juveniles.

**Closest related taxa:** No known close relatives.

**Evolutionary origins:** This shrimp is believed to be derived from a marine ancestor stranded by sea level regressions in the early Pleistocene (Wilkens, 1982).

**Superfamily Alpheoidea**

**Family Hippolytidae**

*Janicea antiquensis* (Chace, 1972)

**Characteristic features:** Medium-sized, red shrimp with pigmented eyes and multiarticulate walking legs.

**Size:** Carapace length to 10.0 mm.

**Habitat:** Anchialine.

**Number of species in genus:** One.

**Species range:** Antigua (from seawall), Bermuda (from reef cave in 15 m depth), Grand Bahama Island (Bahamas) and Cozumel (Quintana Roo) (both latter locations from anchialine caves).

The only Mexican record for this species is from Cueva Quebrada (Kensley, 1988).

**Ecology:** Collected from marine waters of an extensive anchialine cave connecting directly with the sea.

**Life history:** Numerous very small eggs on the ovigerous females from Cozumel indicate an extended planktonic larval life that would help to explain its wide distribution (Kensley, 1988).

**Closest related taxa:** Closest affinities are to *Somersiella sterreri* (Hart and Manning, 1981).

**Evolutionary origins:** Considering the open, nonanchialine nature of the type locality - a seawall in Antigua, planktonic larval dispersal by ocean currents may explain its widespread distribution (Kensley, 1988).

*Somersiella sterreri* Hart & Manning, 1981

**Characteristic features:** Large, uniformly reddish shrimp with three prominent white spots dorsally, 1 middorsally on the sixth abdominal somite and one on each exopod of the uropods. The cornea is black, while the antennae are reddish basally, becoming white for most of their length. The walking legs and the body are red (Hart and Manning, 1981).

**Size:** Carapace length to 16.1 mm.

**Habitat:** Anchialine.

**Number of species in genus:** One.

**Species range:** Anchialine caves in Bermuda and Quintana Roo. Cueva Quebrada on Cozumel is the only Mexican cave where this species has been found.

**Ecology:** Cueva Quebrada, which is more than 2700 m long, connects with the sea through entrances on the west coast of Cozumel. Maximum depth in the cave is only 12 m, while the salinity is 21 ppt (Bowman, 1987).

**Life history:** An ovigerous female from Cozumel carried an estimated 2,000 tiny eggs. The small size of the
eggs suggests an extended existence in
the plankton and may explain its
presence at Bermuda (Kensley, 1988).

Closest related taxa: Closest affinities
are to Janicea antiguensis (Hart and

Evolutionary origins: Iliffe et al.
(1983) suggested that S. sterreri is a
Tethyan relict. The presence of
numerous small eggs may imply
planktonic dispersal by ocean currents.

Yagerocaris cozumel Kensley, 1988

Characteristic features: Small shrimp
with weakly pigmented eyes. Carapace
with strong pterygostomian spine.

Size: Carapace length to 7.2 mm.

Habitat: Anchialine.

Number of species in genus: One.

Species range: Known only from Aeo-
rolito Cenote and Cueva Quebrada on
the island of Cozumel, Quintana Roo.

Ecology: Specimens were collected
from eurihaline waters (marine salinity)
at 9 to 12 m depths. The foregut of
dissected specimen contained an
unidentifiable brown finely macerated
mush (Kensley, 1988).

Life history: Individual shrimp show
a combination of both male and female
characteristics, possibly indicating
protandrous hermaphroditism. Five of
nine specimens collected were
ovigerous. Protandrous
hermaphroditism in cave species has a
primary advantage correlated with
larger size of breeding females.
Secondarily, considering the somewhat
restricted gene pool within caves, it
would enhance opportunity for gamete
exchange if two individuals
encountering one another were both
hermaphroditic and in the appropriate
reproductive phase (Kensley, 1988).

Closest related taxa: Bears a superfi-
cial resemblance to the genus Calliasmata represented by one species
in the Red Sea area and one from the
Dominican Republic.

Evolutionary origins: Pterygostomian
spine and configuration of telson have
no equivalents among the hippolytid
genera.

Ogilbia pearsei (Hubbs, 1938)

Phylum CHORDATA
Class Teleostomi
Order Ophidiiformes
Suborder Bythitoidei
Family Bythitidae
Subfamily Bythitinae
Tribbe Dinematicichthyini

Characteristic features: Clear white
brotulid becoming pinkish along the
posterior margins. Total lack of eyes;
large and well developed sensory
cavities on head.

Size: To 90.5 mm.

Habitat: Freshwater.

Number of species in genus: Six, plus
numerous undescribed ones (Cohen &
Nielsen, 1978).

Genus range: From tropical American
reefs, freshwater caves in the Yucatan
and brackish waters in the Galapagos.
Probably occurring in the Indo-Pacific
as well (Cohen & Nielsen, 1978).

Species range: Yucatan and Quintana
O. pearsei from four locations within
Quintana Roo.

Ecology: Although in Yucatan this fish
has been reported from small wells or
freshwater pools, in Quintana Roo it
occurs in larger and more diverse caves and cenotes (Navarro-Mendoza, 1988). In these caves, it occurs with such predators as the American eel *Anguilla rostrata* and the catfish *Rhamdia guatemalensis*. Wilkens (1982) reported that in Yucatan *O. pearsei* is usually found associated with the eel *Ophisternon infernale*.

**Life history:** The species is viviparous with a reproductive period occurring during the months of December to February (Navarro-Mendoza, 1988). The young, which range in size from 22 to 34.5 mm, are independent and actively swimming from the moment of birth. The number of young ranges from 2 to 11, depending upon the size of the mother.

**Closest related species:** Congeners inhabiting coral reefs in the Atlantic.

**Evolutionary origins:** Derived from marine forms (Wilkens, 1982).

**Order Synbranchiformes**  
*Ophisternon infernale* (Hubbs, 1938)

**Characteristic features:** Synbranchid eel with total lack of external eyes, degenerate brown pigmentation and enhanced development of dermal sense organs on the head (Hubbs, 1938).

**Size:** To 60 cm.

**Habitat:** Freshwater.

**Number of species in genus:** Six (Rosen & Greenwood, 1976).

**Genus range:** India, Ceylon, Philippines, Northern Australia, Western Australia, Portuguese Guinea, South America, Guatemala, Cuba and Mexico (Campeche, Tabasco, Chiapas, Oaxaca, Veracruz, Yucatan and Quintana Roo).

**Species range:** Known from five caves in Yucatan. Blind eels probably belonging to this species have been seen in Actún Ha and Cenote de Santo Domingo, Quintana Roo (Reddell, 1977). Coke (pers. comm.) has observed large eels of this species to 60 cm in length from Carwash Cenote. He has also noticed specimens in Sac Actun, Najaron, and Maya Blue.

**Ecology.** *O. infernale* inhabits lightless waters containing organic rich sediments where it constructs mucus-lined burrows (Navarro-Mendoza, 1988). Although blind and inhabiting a totally dark environment, this eel shows a circadian cycle with maximal feeding activity occurring during the night. Laboratory experiments suggest a diminished photoreception capacity in that specimens held in aquaria avoid light (Navarro-Mendoza, 1988). When dissolved oxygen levels fall below 1.3 mg/liter, these eels may stick their heads out of water and take in atmospheric air.

**Life history:** The reproductive biology of this species is under study by Navarro-Mendoza.

**Closest related species:** *O. aenigmaticum*, a secondary freshwater fish living in Mexico and Cuba (Rosen & Greenwood, 1976).

**Evolutionary origins:** *O. infernale* appears to be clustered in caves located along the old Pliocene shoreline (Wilkens, 1982). Although other cavernicolous species have secondarily spread over northern Yucatan through channels in the subterranean aquifer, both *O.infernale* and *Ogilbia pearsei* seem to be primarily restricted to caves and cenotes near their original sites.
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Fig. 1: Map of Quintana Roo showing locations of caves where aquatic troglobites have been reported.

1) Cenote de Santo Domingo;
2) Cenote de Las Ruinas;
3) Cenote de Juan Coh;
4) Cenote Tos Virlol;
5) Cenote Naharon;
6) Maya Blue Cenote;
7) Carwash Cenote;
8) Cueva de Tancah;
9) Temple of Doom Cenote;
10) Cenote Sac Actún;
11) Actún Ha;
12) Cenote Mojara;
13) Cenote Ponderosa;
14) Cenote de San Martín and Pozo de San Martín;
15) Cueva del Fermín;
16) Cenote Ajín;
17) Cenote Coop;
18) Cueva Quebrada;
19) Xcan-ha Cenote;
20) Aereolito (Modified from Reddell, 1977).