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A New Species of *Miliariconus* Tucker and Tenorio, 2009 (Conidae: Puncticulinae) from the Northern Red Sea

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ABSTRACT A new shallow water, coral reef-dwelling cone shell of the genus *Miliariconus* Tucker and Tenorio, 2009 is described from the Sinai Peninsula and Gulf of Aqaba (Gulf of Elat) of Egypt and Israel. The new species, *Miliariconus sinaiensis*, is most similar, especially in color pattern, to *M. fulgetrum* from Japan and the Ryukyu Islands of the northwestern Pacific, but differs in being a smaller and smoother shell with less-developed shoulder knobs, and in having a base shell color of bright pink or salmon pink. The new Red Sea cone is endemic to the southern Gulf of Suez, the coast of the Sinai Peninsula, and to the Gulf of Aqaba.

KEY WORDS Conidae, *Miliariconus*, Red Sea, Sinai Peninsula, Gulf of Aqaba, Gulf of Elat, Egypt, Israel.

INTRODUCTION

The expansion of global tourism during the early 21st Century has resulted in greatly-improved travel conditions to previously-inaccessible tropical and subtropical areas around the world. One of the most understudied of these newly-available venues is the Sinai Peninsula and Gulf of Aqaba (Gulf of Elat) of the northern Red Sea. In response to the demands of an ever-increasing population of tourists, many new resorts have been built in the cities of Sharm el-Sheikh (Egypt) and Elat (Israel) and these have acted as "base camps" for divers and exploratory conchologists. The Egyptian and Israeli beach resorts have allowed shell-collecting divers to have access to many previously-unexplored marine habitats, in particular the shallow fringing reefs that line the southern Sinai Peninsula. Within these extensive reef complexes, a large resident fauna of cone shells occurs, with at least 15 species and subspecies of the family Conidae, several of which are endemic to the area. Some of the endemic taxa, such as *Calamiconus quercinus akabensis*, *Cylinder textile neovicarius*, *Harmoniconus sharmiensis*, and *Pionoconus nigropunctatus elatensis* are eagerly sought after by shell collectors and are also considered to be of special interest to marine biogeographers and evolutionary biologists.

The Gulf of Aqaba (which is referred to as the Gulf of Elat by the Israelis) is a shallow, elongated bay that originated as an ancillary rift valley off the main Red Sea Rift System (Ben-Avraham, 1985). Having formed during the late Oligocene and early Miocene Epochs, this narrow, fjord-like body of sea water has had several episodes of altered oceanographic conditions, varying from high salinity- high productivity conditions to normal salinity-low productivity conditions (Reiss, 2012). These fluctuating water chemistries resulted from oscillating sea levels during the late Pliocene and Pleistocene Epochs (glacioeustatic fluctuations) and from tectonic uplifts of

sections of the Gulf region. In the early Pleistocene, during severe glacial build-up in the Northern Hemisphere, the surface level of the Red Sea dropped sufficiently to cause the shallow sill at the mouth of the Gulf of Aqaba to become emergent. This narrow land barrier effectively isolated the Gulf and transformed it into a large salt water lake that was cut off from the Red Sea. During this time of oceanographic sequestration, populations of cone shells trapped within the Aqaban salt water lake would have become genetically-isolated from their parent populations in the Red Sea and would have undergone rapid speciation, due primarily to the Founder Effect. The Red Sea, itself, underwent similar episodes of oceanographic sequestration during Pleistocene sea level fluctuations, leading to the evolution of the rich endemic molluscan fauna of the Recent Eritrean Molluscan Province.

As sea level rose during the late Pleistocene, the exposed land barrier at the mouth of the Gulf would have become submerged with sea water and the Gulf of Aqaba would again have reconnected to the main Red Sea Basin. Possibly due to ecological competition with congeners, many of the newly-evolved Aqaban and Sinai Peninsula endemics remained close to their center of evolution and did not disperse southward into the main body of the Red Sea. One of these is a small, shallow water cone shell that has been referred to as either the wide-ranging Indo-Pacific taxon "*Miliariconus miliaris*" or to the Japanese endemic "*Miliariconus fulgetrum*" by many workers over the past century. Close examination shows that this small cone, although similar to the true *M. miliaris* and to *M. fulgetrum*, consistently differs in many shell characters and represents a previously-overlooked species. The holotype is deposited in the molluscan type collection of the Department of Malacology, Los Angeles County Museum of Natural History, Los Angeles, California, and bears an LACM number. The new Red Sea *Miliariconus* is described here.

SYSTEMATICS

Class Gastropoda
Subclass Sorbeoconcha
Order Prosobranchia
Infraorder Neogastropoda
Superfamily Conoidea
Family Conidae
Subfamily Puncticulinae
Genus *Miliariconus* Tucker and Tenorio, 2009

Miliariconus sinaiensis Petuch and Berschauer, new species (Figure 1E-H)

Description: Shell of average size for genus, inflated, stocky, vasiform, turbinate, with distinctly rounded sides; spire proportionally low, broadly subpyramidal; shoulder and spire whorls ornamented with 10-12 large, rounded knobs; body whorl smooth and shiny, ornamented with 10-12 faintly incised grooves on anterior half of some specimens (such as holotype, Plate 1E, F); anterior end and siphonal area ornamented with 6 proportionally large and conspicuous spiral cords; body whorl base color pale pink or salmon-pink, overlaid by 2 large wide bands of dark pinkish-rose or pinkish-tan, one around mid-body and one around anterior end, with color bands separated by wide white band around mid-body; body whorl color bands overlaid with numerous tan spiral lines and large obliquely-angled thin white flammules, arranged in zig-zag chevron pattern; anterior tip of shell white or pale yellow-white; large cords around anterior end marked with alternating white and tan spots; spire whorls and shoulder knobs white, with large reddish-tan elongated patch present between shoulder knobs; aperture proportionally narrow; interior of aperture white, with 2 large dark pinkish-tan patches that

correspond to dark body whorl bands; periostracum thin, adherent, dark yellow-tan.

Type Material: Holotype: length 22.1 mm, on coral rubble, 1 m depth, off Elat, Israel, Gulf of Aqaba (Gulf of Elat), Red Sea (Plate 1E, F) (LACM 3350). **Other Study Material:** length 28.2 mm, 1 m depth on exposed coral rubble, off Sharm el-Sheikh, South Sinai Governorate, southern Sinai Peninsula, Egypt, research collection of E.J. Petuch (Figure 1G, H); length 27.5 mm, on coral rubble, 1 m depth, off Elat, Israel, research collection of E.J. Petuch; length 27.8 mm, exposed at low tide, on reef flat off Hurghada, Egypt, research collection of D.P. Berschauer.

Type Locality: Northernmost Gulf of Aqaba (Gulf of Elat), Red Sea, exposed on coral rubble in 1 m depth, off Elat, Israel.

Distribution: The new species is endemic to the northern Red Sea, where it ranges from the southern Gulf of Suez, along the entire Sinai Peninsula, and throughout the entire Gulf of Aqaba (Gulf of Elat).

Ecology: *Miliariconus sinaiensis* inhabits coral rubble areas and exposed reef platforms, from the low tide mark to depths of 5 m.

Etymology: The new species is named for the Sinai Peninsula of Egypt, which is the biogeographical center of distribution for this endemic cone shell.

DISCUSSION

Of the 11 known species of *Miliariconus*, the new species most closely resembles *M. fulgetrum* (Sowerby I, 1834) from Japan and the Ryukyu Islands of the northwestern Pacific (Figure 1C, D). Both the Japanese and the Eritrean species share a color pattern of obliquely-angled chevrons that are arranged in a network of prominent zig-zags flammules. Indeed, the similar patterns of zig-zag "lightning" markings have led some cone workers and shell dealers to consider *M. fulgetrum* and *M. sinaiensis* to be conspecific, without considering that no *fulgetrum*-type cones are found anywhere in the vast area between Japan and the Red Sea. The similarity of color patterns is only superficial, as the "lightning pattern" of *M. fulgetrum* is better-defined and breaks up into numerous small flecks and dots that cover most of the body whorl. The "lightning" zig-zag flammules seen on *M. sinaiensis* are proportionally larger and more cohesive and do not break up into small dots and flecks. The Japanese *M. fulgetrum* is also a more darkly-colored shell, having a base color of dark reddish-brown and lacking any of the pink and salmon-pink colors of the new Red Sea species. *Miliariconus fulgetrum* is also a more elongated and cylindrical shell with proportionally much larger and more rounded shoulder knobs. Because there has been some confusion over the conspecificity of *M. fulgetrum* and *M. sinaiensis* and the type locality of *M. fulgetrum* (Filmer, 2012), we here designate the type locality of *M. fulgetrum* as "Tean Bay, Amami Oshima Island, northern Ryukyu Islands, Japan" (based on specimens collected in Tean Bay, in November, 1974, by the senior author; one illustrated here on Figure 1C, D). We consider *M. fulgetrum* and *M. sinaiensis* to be separate, distinct species.

The new Red Sea cone is also similar to the wide-ranging Indo-Pacific *Miliariconus miliaris* (Hwass, 1792) (found from southeastern Africa to Polynesia; Figure 1A, B), but differs in being a smaller, stockier, and more colorful shell with proportionally smaller and less-developed shoulder knobs. Although some specimens of *M. miliaris* have a pattern of white zig-zag flammules on a pink background (as seen here

on Figure 1A, B), this "lightning" configuration is never as well-defined nor as well-developed as that seen on *M. sinaiensis*. *Miliariconus miliaris* also is a much more heavily-sculptured shell than either *M. fulgetrum* or *M. sinaiensis*, having large, prominent beaded cords running around the anterior half of the body whorl. The wide-ranging *M. miliaris*, extending from East Africa to Polynesia, is most probably the ancestor of both *M. fulgetrum* and *M. sinaiensis*. Along the Egyptian coast near Hurghada, the new species occurs sympatrically with the widespread Eritrean Molluscan Province congener *M. taeniatus* (Hwass, 1792), but appears to be less common. With the discovery of the new northern Red Sea species, the genus *Miliariconus* is now know to contain 11 species. These include:

Miliariconus abbreviatus (Reeve, 1843) (endemic to the Hawaiian Islands)
Miliariconus aristophanes (Sowerby I, 1857) Philippines, Melanesia, and Polynesia)
Miliariconus coronatus (Gmelin, 1791) (widespread Indo-Pacific)
Miliariconus encaustus (Kiener, 1845) (endemic to the Marquesas Islands)
Miliariconus fulgetrum (Sowerby I, 1834) (endemic to Japan and the Ryukyu Islands)
Miliariconus miliaris (Hwass, 1792) (southeastern Africa to Polynesia)
Miliariconus pascuensis (Rehder, 1980) (endemic to Easter Island)
Miliariconus roosevelti (Bartsch and Rehder, 1939) (endemic to Clipperton Island)
Miliariconus sinaiensis Petuch and Berschauer, new species (endemic to the northern Red Sea)
Miliariconus taeniatus (Hwass, 1792) (Red Sea and coast of Oman)
Miliariconus tiaratus (Sowerby I, 1833) (Gulf of California to the Galapagos)

It is interesting to note that, of the 11 known species, only five (*aristophanes*, *coronatus*, *miliaris*, *taeniatus*, and *tiaratus*) have wide geographical ranges. The other six congeners (*abbreviatus*, *encaustus*, *fulgetrum*, *pascuensis*, *roosevelti*, and *sinaiensis*) all are restricted to small geographical areas or isolated islands. This indicates that members of the genus can readily lose their planktotrophic larval stage and utilize direct development and low dispersibility (vagility) as a reproductive strategy. By having evolved inside the isolated Aqaban salt water lake during the Pleistocene, *Miliariconus sinaiensis* lost its ability to disperse and spread elsewhere throughout the central and southern Red Sea and it remains confined to its center of origin.

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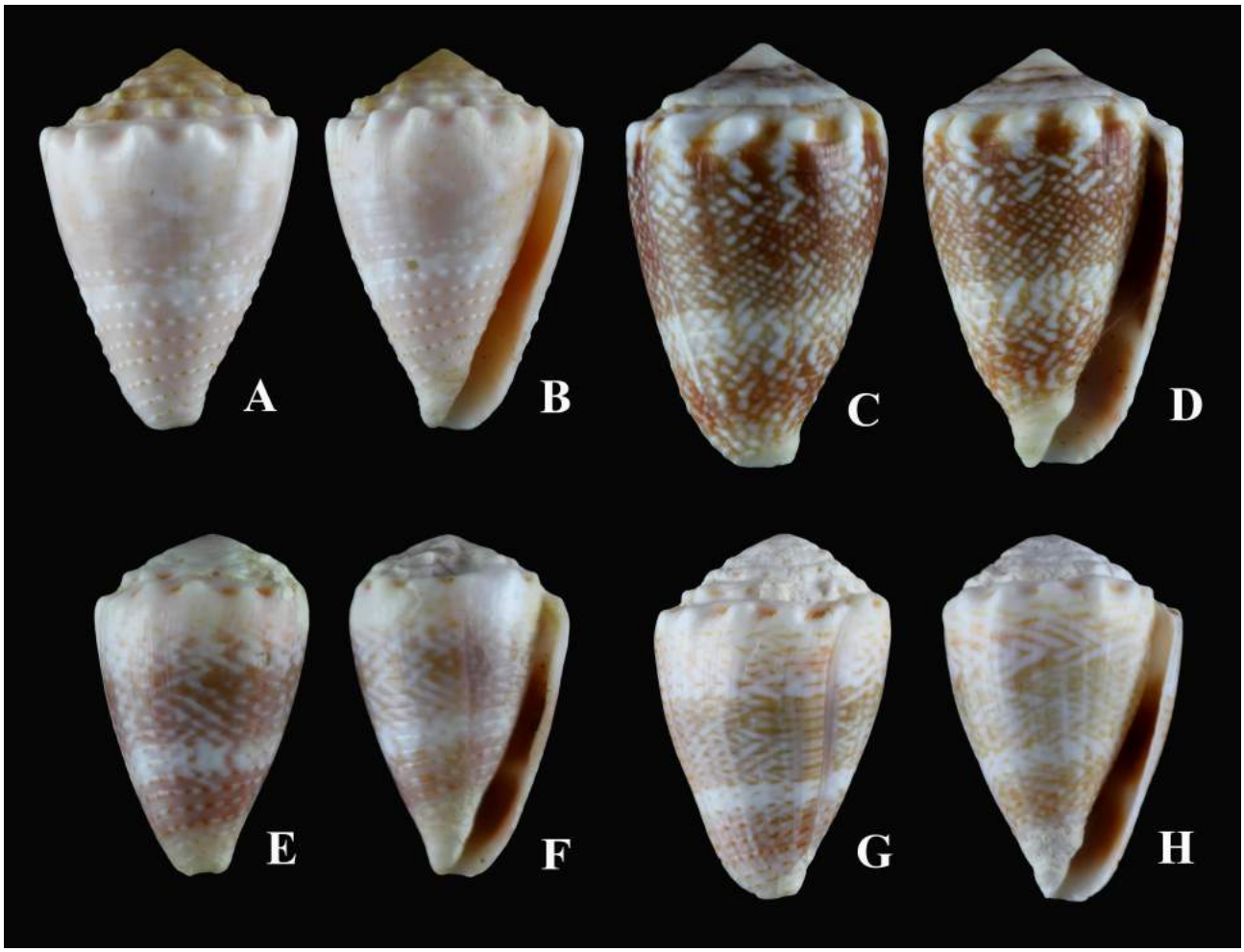

Figure 1. Species of *Miliariconus* Tucker and Tenorio, 2009 from the South Pacific, Japan, and the Red Sea. Images: A, B= *Miliariconus miliaris* (Hwass, 1792) (Type of the genus *Miliariconus*). Length 29.4 mm, found in coral rubble, 1 m depth off Chapman Island, Great Barrier Reef, northern Queensland, Australia. In the research collection of E.J. Petuch. **C, D=** *Miliariconus fulgetrum* (Sowerby I, 1834). Length 32.3 mm. Found in sand and coral rubble, 1 m depth on main reef off Tean Bay, Amami Oshima Island, northern Ryukyu Islands, Japan. In the research collection of E.J. Petuch. **E, F=** *Miliariconus sinaiensis* Petuch and Berschauer, new species. Holotype, length 22.1 mm, LACM 3350. In coral rubble, 1 m depth off Elat, Israel, Gulf of Aqaba, Red Sea. **G, H=** *Miliariconus sinaiensis* Petuch and Berschauer, new species. Length 28.2 mm, found on exposed coral rubble bottom, in 1 m depth, off Sharm el-Sheikh, South Sinai Governorate, southern Sinai Peninsula, Egypt. In the research collection of E.J. Petuch.