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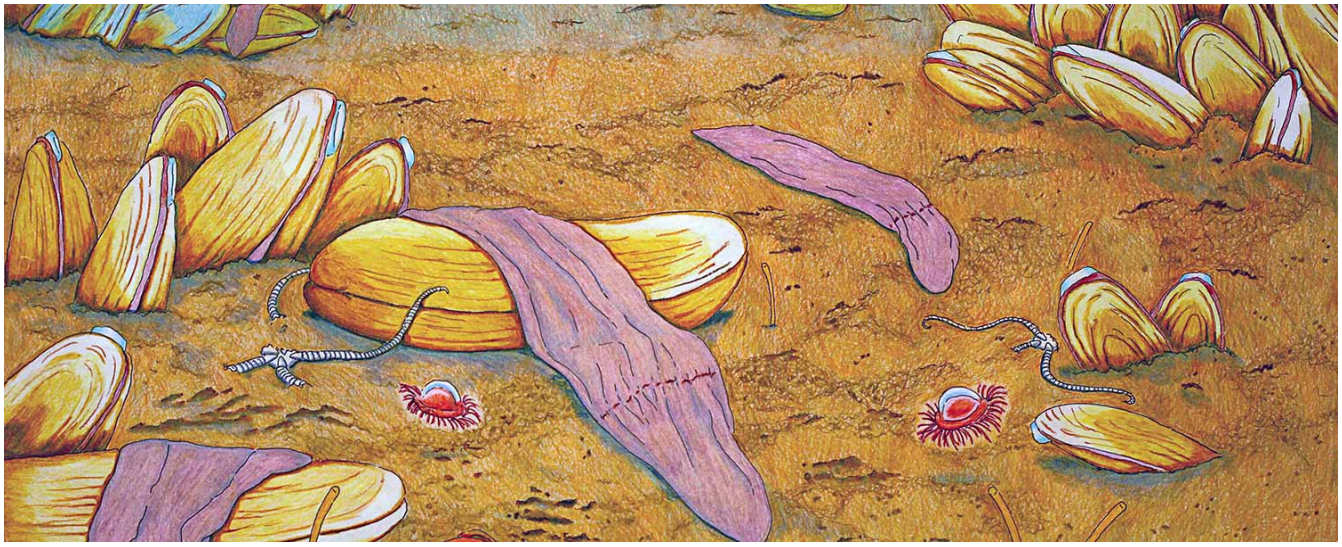
February 04, 2016 | By Annie Reisewitz

Scripps-Led Team Discovers Four New Deep-Sea Worm Species

Genetic analysis by Scripps team correctly pinpoints species on the tree of life



A pastel painting of one of four new species, Xenoturbella monstrosa, discovered by researchers. Artwork by John Meszaros

A pink flatworm-like animal known by a single species found in waters off Sweden has puzzled biologists for nearly six decades. New discoveries half a world away by a team of scientists from Scripps Institution of Oceanography at UC San Diego, the Western Australian Museum, and the Monterey Bay Aquarium Research Institute (MBARI) have helped properly identify these elusive creatures through genetic analysis.

In the Feb. 4 issue of the journal *Nature*, the researchers describe four newly discovered species living near deep-sea cold seeps, hydrothermal vents, and whale carcasses off the coasts of California and Mexico. The new discoveries have allowed the scientists to finally stabilize the placement of the five species, all in the genus *Xenoturbella*, on the animal tree of life.

The 10-centimeter (4-inch) long *Xenoturbella churro*, named for its resemblance to the popular fried-dough pastry, is one of four species recently discovered that lie near the base of the evolutionary tree of animals. It was found in a 1,700-meter (5,577-foot)-deep cold seep in the Gulf of California.

“The findings have implications for how we understand animal evolution,” said Scripps marine biologist Greg Rouse, the lead author of the study. “By placing *Xenoturbella* properly in the tree of life we can better understand early animal evolution.”

The animal’s shifting position on the tree of life began when the first species, named *Xenoturbella bocki*, was found off the coast of Sweden in 1950. It was classified as a flatworm, then, in the 1990s as a simplified mollusk. In recent years, *Xenoturbella* has been regarded as either close to vertebrates and echinoderms, or as a more distant relative on its own branch further away. Knowing where *Xenoturbella* belongs is important to understand the evolution of organ systems, such as guts, brains and kidneys, in animals.

“When Greg first spotted the worms gliding through a clam field in Monterey Bay, we jokingly called them purple socks,” said MBARI scientist Robert Vrijenhoek, a co-author of the study who led the deep-sea expeditions using remotely operated vehicles.

For the next 12 years, the researchers were on a deep-sea hunt to find more. By 2015, they had found four new species and collected specimens for anatomical and genetic analysis.

The team analyzed nearly 1,200 of the animal’s genes to conclusively identify them as evolutionarily simple members near the base of the evolutionary tree of bilaterally symmetrical animals, which are distinguished by having matching halves through a line down the center. *Xenoturbella* have only one body opening¾the mouth. They have no brain, gills, eyes, kidneys or anus, and now appear to be evolutionarily simple rather than having lost these features over time.

This discovery greatly expands the diversity of the known species from one to five. The largest of the new species, *Xenoturbella monstrosa*, was found in Monterey Bay and the Gulf of California, and measured 20-centimeters (8-inches) long. The smallest, *Xenoturbella hollandorum*, found in Monterey Bay was just 2.5-centimeters (1-inch) long, and named in honor of Scripps biologists Linda and Nick Holland for their contributions to evolutionary biology. The deepest of the species, *Xenoturbella profunda*, was discovered in a 3,700-meter (12,139-foot)-deep hydrothermal vent in the Gulf of California. All four species are thought to be associated with deep-sea cold seeps and vents to satisfy their appetite for clams and other bivalve mollusks.

“I have a feeling this is the beginning of a lot more discoveries of these animals around the world,” said Rouse.

Specimens of the four new *Xenoturbella* species have a new home in the Scripps Benthic Invertebrate Collection.

The research study, which also included researchers Nerida Wilson of the Western Australian Museum and Jose Carvajal of Scripps Oceanography, was supported by a grant from the David and Lucile Packard Foundation to the Monterey Bay Aquarium Research Institute and Scripps Institution of Oceanography, and the National Science Foundation’s Assembling the Tree of Life program.

MEDIA CONTACT

Mario Aguilera, 858-822-5148, maguilera@ucsd.edu
Robert Monroe, 858-534-3624, scrippsnews@ucsd.edu