challenge the traditional species concept, according to Ekelund. “If we can find so many new species, then we must rethink whether the traditional species boxes are an appropriate way to measure protozoan diversity,” he says.

Unlike bacteria, few genomic sequences for protozoan species of Cercozoa are available for Ekelund and his collaborators to compare to the species they were analyzing. “We had to make a thorough analysis of the genome to find the most suited regions, and then construct new functioning primers,” says first author Christoffer Bugge Harder. “We used the hypervariable V4 region of 18S ribosomal DNA, [and] these primers captured all major Cercozoan groups.”

Cercozoa “are worthy of study because they are an important component of the food web, and their response to climate change will have consequences for the ecosystem,” says Bryan Griffiths at Scotland’s Rural College in Edinburgh. The sensitivity of Trinema especially stands out, since their tough silica shell should protect them from adverse changes. Although “Trinema could hide in their shell and wait out the bad times,” he says, Ekelund’s team showed that “they are particularly sensitive and, therefore, could be useful indicators for environmental change.”

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RESEARCH ADVANCES

Monocercomonoides sp. Shed Their Mitochondria Naturally

Barry E. DiGregorio

The unicellular Monocercomonoides sp. lacks traces of mitochondria even though it is considered a standard eukaryotic cell in other respects, according to Anna Karnkowska at Charles University in Prague, Czech Republic, and her collaborators from Dalhousie University in Halifax, the University of Alberta in Edmonton, and the University of British Columbia in Vancouver, all in Canada. Thus, the mitochondrial iron-sulfur cluster assembly pathway, thought to be conserved in all eukaryotic cells, is missing, and, in this case, replaced by a cytosolic sulfur mobilization system (SUF) acquired from bacteria—making Monocercomonoides sp. lineage the first known naturally amitochondriate eukaryote. Details appeared May 23, 2016 in Current Biology (doi:10.1016/j.cub.2016.03.053).

Monocercomonoides “is a micro-aerophilic organism, so we anticipated it will have reduced mitochondria,” Karnkowska continues. “We were expecting a much reduced form of mitochondrion, but the absence was a surprise.” Several other types of microorganisms, including parasites such as Giardia, Entamoeba, and Trichomonas, live in anaerobic environments and were suspected of having shed mitochondria, she adds. However, they possess “reduced mitochondria, which are much smaller and often difficult to identify under the microscope.”

“This is first case of a eukaryote which has lost the mitochondrial organelle,” Karnkowska says. “It is important to understand that this is not an ancestral stage, but a loss. Monocercomonoides and its relatives are obligate animal symbionts, and mitochondrial homologs are present in the close free-living relative of Monocercomonoides, which suggests that the absence of mitochondrion in Monocercomonoides sp. is secondary.”

Mitochondria, considered to be of bacterial origin, are energy-producing organelles in eukaryotic cells. Thus, the ongoing search continues for an ancestor of eukaryotes that lacks mitochondria because it did not acquire them through endosymbiosis, she says. “Monocercomonoides is not a primitive amitochondriate, but secondarily.” Its loss of organelles presumably arose via “reductive evolution,” a simplifying process through which organisms shed genes and gene-encoded structures. “It is important to note that Monocercomonoides in other respects is a ‘normal’ eukaryotic cell, containing other organelles and systems typical for eukaryotes,” she points out. “That means that loss of mitochondria does not correspond with the loss of other [eukaryotic] traces.”

“It is extremely interesting that the mitochondrial organelle can be lost completely when the system for aerobic respiration is no longer needed,” says Siv Andersson at Uppsala University in Uppsala, Sweden. “This is consistent with our findings that the mitochondrial genome is needed to prevent the hydrophobic proteins of the respiratory chain complexes to be targeted to the ER [endoplasmic reticulum]. When these processes are no longer required, both the mitochondrial genome and the organelle itself can be lost.”

How do petite yeast mutants, which lack mitochondria, fit in with the new findings? “When yeast grows anaerobically, they don’t need the system for aerobic respiration, and can survive even without a mitochondrial genome,” Andersson says. “The additional ‘twitch’ is that these [Monocercomonoides] cells don’t even need the organelle.”

“I don’t mind comparison with yeast, but what is important is the context of other anaerobic eukaryotes with reduced mitochondria such as Giardia and Entamoeba,” Karnkowska says. Although what Andersson says is “all true . . . the only problem is that other mitochondria-like organelles—mitosomes, hydrogenosomes—which do not contain genomes, are found in anaerobic eukaryotes.”

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NEW FROM ASM

Candida auris Shows Unique Growth Patterns

The emerging pathogen and multi-drug-resistant fungus Candida auris has at least two different growth forms, concludes a re-