

To survive asteroid impact, algae learned to hunt

October 30 2020



K/Pg, or Cretaceous-Paleogene extinction event, refers to the aftermath of the asteroid hitting Earth 66 million years ago. Credit: Odysseus Archontikis/University of Oxford

Tiny, seemingly harmless ocean plants survived the darkness of the asteroid strike that killed the dinosaurs by learning a ghoulish behavior—eating other living creatures.

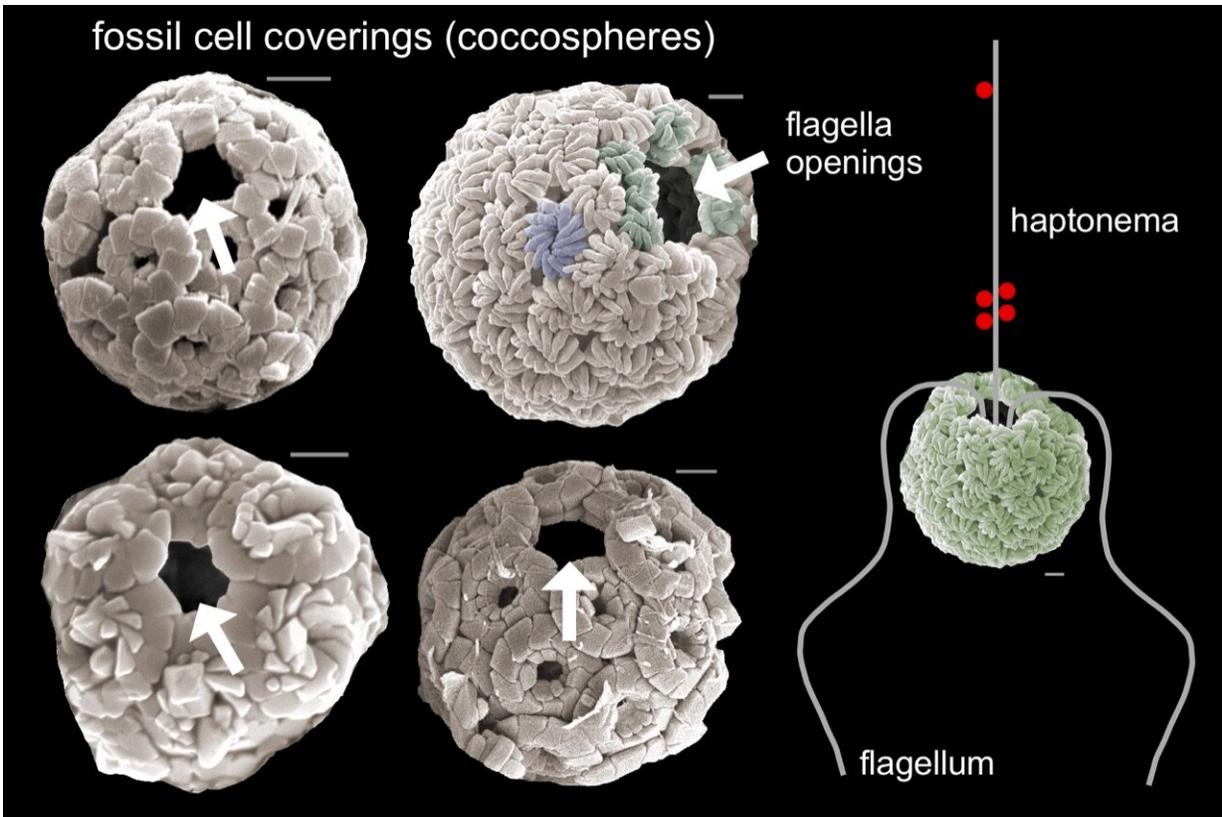
Vast amounts of debris, soot, and aerosols shot into the atmosphere when an asteroid slammed into Earth 66 million years ago, plunging the planet into darkness, cooling the climate, and acidifying the oceans. Along with the dinosaurs on the land and giant reptiles in the ocean, the dominant species of marine algae were instantly wiped out—except for one rare type.

A team of scientists, including researchers at UC Riverside, wanted to understand how these algae managed to thrive while the [mass extinction](#) rippled throughout the rest of the global food chain.

"This event came closest to wiping out all multicellular life on this planet, at least in the ocean," said UCR geologist and study co-author Andrew Ridgwell. "If you remove algae, which form the base of the food chain, everything else should die. We wanted to know how Earth's oceans avoided that fate, and how our modern marine ecosystem re-evolved after such a catastrophe."

To answer their questions, the team examined well-preserved fossils of the surviving algae and created detailed computer models to simulate the likely evolution of the algae's feeding habits over time. Their findings are now published in the journal *Science Advances*.

According to Ridgwell, scientists were a bit lucky to find the nano-sized fossils in the first place. They were located in fast accumulating and high-clay-content sediments, which helped preserved them in the same way the La Brea tar pits provide a special environment to help preserve mammoths.



High-resolution scanning electron microscope images of fossil cell coverings of nanoplankton highlighting holes that would have allowed flagella and haptonema to emerge from the cell and draw in food particles. Credit: Paul Brown/University College London

Most of the fossils had shields made of [calcium carbonate](#), as well as holes in their shields. The holes indicate the presence of flagella—thin, tail-like structures that allow tiny organisms to swim.

"The only reason you need to move is to get your prey," Ridgwell explained.

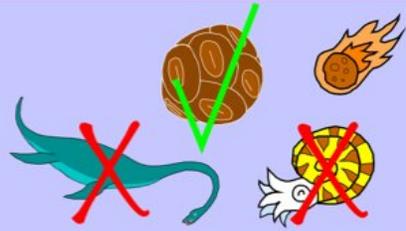
Modern relatives of the ancient algae also have chloroplasts, which enable them to use sunlight to make food from carbon dioxide and

water. This ability to survive both by feeding on other organisms and through photosynthesis is called mixotrophy. Examples of the few [land plants](#) with this ability include Venus flytraps and sundews.

Algal plankton turned to hunting to survive the K/Pg impact darkness

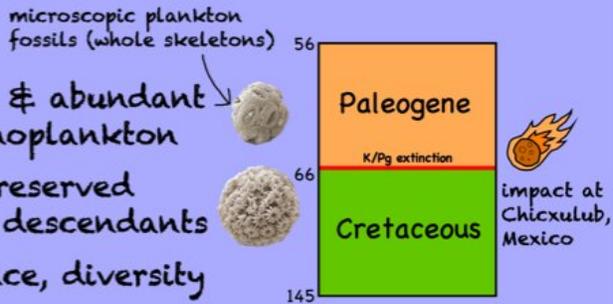
What we wanted to know...

...how did some marine organisms survive the impact event 66 million years ago and reconquer the oceans in the aftermath?



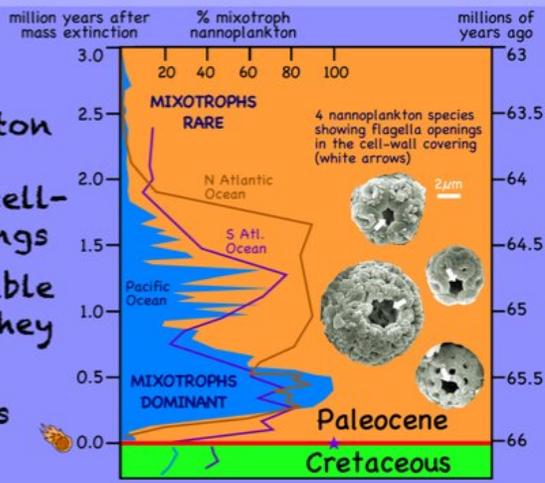
What we did...

...looked at the most continuous & abundant fossil record of ocean life: nannoplankton
 ...targeted the most exquisitely preserved fossils of extinction survivors & descendants
 ...documented plankton abundance, diversity & ecology



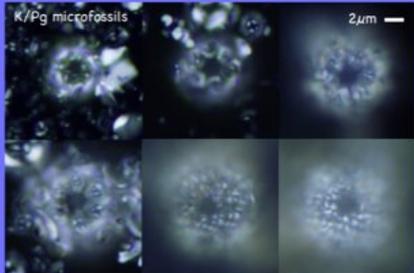
We found that...

...the survivor & recoloniser plankton show features indicative of food capture and ingestion: especially cell-wall coverings with flagella openings
 ...these cells were mixotrophs, capable of photosynthesis & feeding, and they dominated for >1 million years
 ...an eco-evolutionary model shows similar results to the fossil data



We conclude that...

...the extinction of photosynthesizers & survival of mixotrophs points to an impact-darkness kill mechanism
 ...mixotrophy remained advantageous because of abundant small prey cells (bacteria) & absence of larger grazers
 ...the rapid blackout and shutdown of food chains, distinguishes the K/Pg event from all other mass extinctions

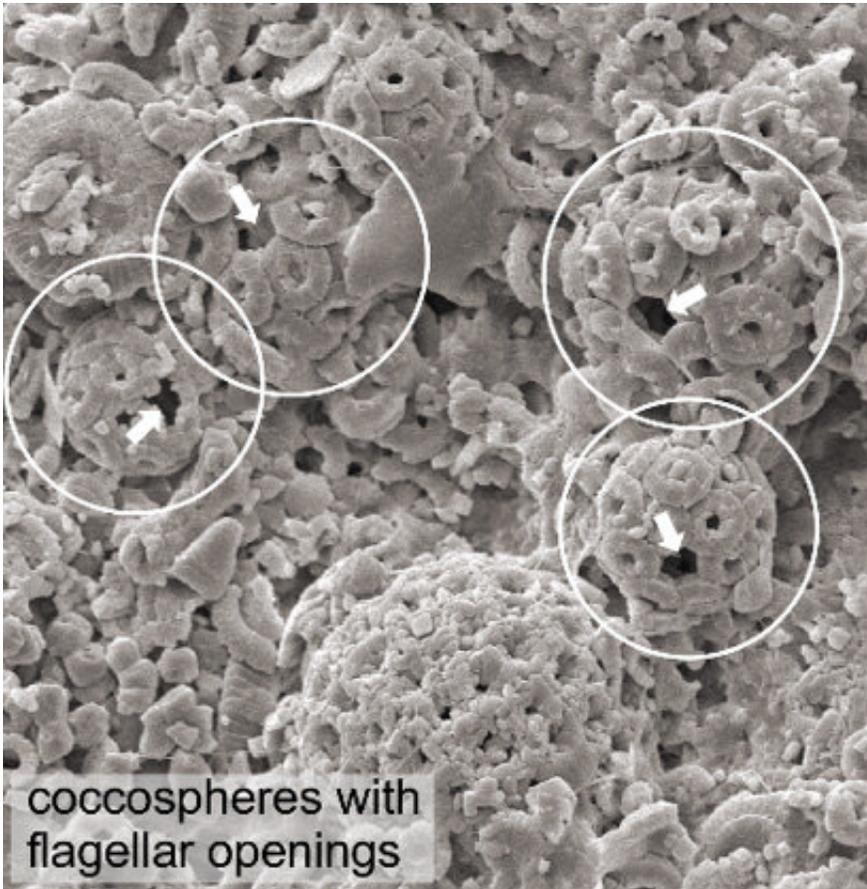


more at...
 Gibbs and others, Oct 2020
 Science Advances 6 : eabc 9123

Graphic explaining the research method and findings. Credit: Gibbs et al

Researchers found that once the post-asteroid darkness cleared, these mixotrophic algae expanded from coastal shelf areas into the open ocean where they became a dominant life form for the next million years, helping to quickly rebuild the food chain. It also helped that larger creatures who would normally feed on these algae were initially absent in the post-extinction oceans.

"The results illustrate both the extreme adaptability of ocean plankton and their capacity to rapidly evolve, yet also, for plants with a generation time of just a single day, that you are always only a year of darkness away from extinction," Ridgwell said.



A SEM view of a seafloor after the extinction showing the abundance of these cells with flagellar openings. These cells are around 7 microns in diameter (7/1000ths of a millimetre) with the scale bars next to each image showing the size of a micron (1/1000th mm). Credit: Paul Bown

Only much later did the algae evolve, losing the ability to eat other creatures and re-establishing themselves to become one of the dominant species of [algae](#) in today's [ocean](#).

"Mixotrophy was both the means of initial survival and then an advantage after the post-asteroid darkness lifted because of the abundant small pretty cells, likely survivor cyanobacteria," Ridgwell said. "It is the ultimate Halloween story—when the lights go out, everyone starts eating

each other."

More information: "Algal plankton turn to hunting to survive and recover from end-Cretaceous impact darkness" *Science Advances* (2020). [advances.sciencemag.org/lookup1126/sciadv.abc9123](https://advances.sciencemag.org/lookup...1126/sciadv.abc9123)

Provided by University of California - Riverside

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