Catastrophic Darkness: How Life Survives an Asteroid Impact

September 10 2009, by Jeremy Hsu

A large asteroid impact can throw particles into the atmosphere, creating huge dust clouds that block the sun. Massive forest fires sparked by the impact can send up dark smoke, darkening the skies even more. Image Credit: NOAA

A dinosaur-killing asteroid may have wiped out much of life on Earth 65 million years ago, but now scientists have discovered how smaller organisms might have survived in the darkness following such a catastrophic impact.

Survival may have depended upon jack-of-all-trades organisms called mixotrophs that can consume organic matter in the absence of sunlight. That would have proved crucial during the long months of dust and debris blotting out the sun, when plenty of dead or dying organic matter filled the Earth's oceans and lakes.

"Mixotrophs are very good at stabilizing situations by using whatever resources are there, and can often provide what resources there aren't," said Harriet Jones, a biologist at the University of East Anglia in the UK. "They're very good at coping in extreme environments, and enabling other organisms to live."

Jones and her colleagues tested the limits of mixotrophs by subjecting them to six months of low light or complete darkness. The mixotrophs not only thrived, but also surprised researchers by helping sunlight-dependent organisms also survive pitch black conditions.

Simulating catastrophe

Scientists have long debated the overall impact of the K-T extinction that may have heralded the end of the dinosaurs, but most researchers agree that such an event would have thrown up enough dust and debris to darken Earth's skies for about six months. A lack of sunlight would have killed off a majority of plants, eliminating the food supply for animals higher up the food chain.

Many scientists assumed that even smaller organisms would struggle just to stay alive during months of almost complete darkness. Some previous studies even looked at how some organisms such as mixotrophs can survive low light and low food conditions. But no one had tried to test how well mixotrophs would survive the catastrophic environment following something such as the K-T event, Jones said.

"The literature was always saying in that biological production would cease in a post-catastrophic environment," Jones noted. "We felt that because of what mixotrophy algae could do, that wasn't always the case."

Jones joined forces with Charles Cockell, a microbiologist at the Open University based in the UK who specializes in catastrophic environments, as well as other researchers. They tested both freshwater and ocean mixotrophs under conditions ranging from low light to complete darkness for six months, and added food sources during short-term experiments to simulate decaying organic matter.

However, Jones and her colleagues also wanted to see how mixotrophs fared when living together with phototrophs, or light-dependent organisms. They tested mixotrophs and phototrophs separately and together under the different light conditions.

Live together or die alone

Turns out that the mixotrophs survived all the experiments, and some even grew under the low light conditions. Their ability to consume other organisms or organic matter helped them rebound quickly after low light returned, perhaps similar to the clouds of dust and debris finally beginning to clear.

But the real shock came from how well light-dependent organisms did when living with the mixotrophs. No photosynthesis could take place under the complete darkness, but the phototrophs mostly managed to survive based on nutrients cycled by the active mixotrophs.

"We were extremely surprised at how well phototrophs did during six months darkness, when they can't eat at all," Jones said. Such findings may cause researchers to rethink how well certain life forms survived the catastrophic impacts that dot Earth's geological record.

Furthermore, the mixotroph activity allowed the phototroph populations to rebound quickly back to normal within a month. And in the end, both mixotrophs and phototrophs tended to fare better when living together.

"So long as mixotrophs are cycling nutrients, [phototroph] algae can take off quickly and get the life cycle going," Jones explained.

Life lessons for survival

Only one low light condition saw phototrophs fail to survive while living with mixotrophs. The phototrophs may have used too much energy trying to do photosynthesis in the weak light, or perhaps the hungry mixotrophs simply fed on their fellow organisms.

"You can only do so much in a flask, and obviously the mix of species would be much greater in a natural environment," Jones pointed out.

Still, the overall results suggest how mixotrophs provide a cushion against catastrophe for certain ecosystems, and may even prevent huge population crashes. The research is further detailed in the July/August issue of the journal Astrobiology.

Jones and her colleagues plan to conduct more studies with greater mixes of species, in an environment that would more closely resemble the natural world. They also want to shorten experiments to three months rather than six.

That looks all well and good for the smaller organisms. But humans, who would have a much harder time feeding themselves if the skies went dark, may want to plan on how to prevent such catastrophic asteroid impacts in the future.

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