Snow Algae Shade Most (Not All) Colored Snow

John Roach for National Geographic News
June 7, 2005

It may be the start of summer, but Ron Hoham and a few other scientists like him are thinking about snow, specifically coloured snow.

Where others see an excuse to snicker about yellow snow, Hoham sees other shades—and one of the most extreme and overlooked life-forms on Earth.

Hoham is a biologist at Colgate University in Hamilton, New York. He is one of a handful of people in the world who study snow algae—microscopic organisms that thrive in the chilly, acidic, sun-blasted, and nutrient-poor confines of melting snow.

"The more I study them, the more I want to know about them, and the more I learn about them, the more fascinating I find them," Hoham said.

In addition to yellow snow, coloured snow comes in greens, oranges, and reds. And though the source of yellow snow is always suspect, Hoham said the other colors are a sure sign of algae.

Why Study Snow Algae?

Bill Williams, a biologist at St. Mary's College of Maryland, said snow algae give biologists insight to the extreme conditions life on Earth has adapted to. This, in turn, provides clues to where to look for potential life on distant planets.

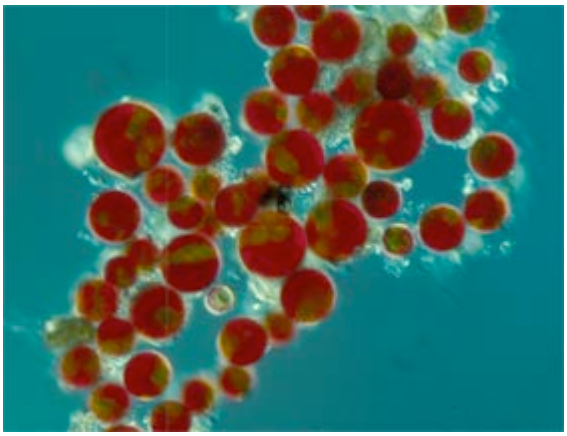
"To a plant biologist, that's the most interesting thing about snow algae," Williams said. "They manage to survive and even thrive in an environment that, for arcane reasons, is a really difficult environment to do photosynthesis in." (In photosynthesis, green plants use chlorophyll to convert sunlight into energy, mostly in the form of carbohydrates.)

The bright light, high ultraviolet radiation and cool temperatures of the snowfields where many species of snow algae are found would destroy a houseplant, according to Williams.

But photosynthetic snow algae do thrive in these harsh habitats. In a 2003 study, published in the *Proceedings of the National Academy of Sciences,* Williams and colleagues showed that snow algae absorb, via photosynthesis, carbon dioxide at about one-tenth the rate of average plants.

The finding came as a surprise to many biologists, because previous studies had shown that snowfields generally emit carbon dioxide, not absorb it, Williams said.

"Whether [snow algae] can make a given patch of snow over an entire year a CO_2 sink rather than a CO_2 source is up for grabs," Williams said. He added that to enlist snow algae in the battle against global climate change, which may be fuelled by CO_2 emissions, would be futile.



Snow algae are colourful, microscopic organisms that thrive in the chilly, acidic, sun-blasted, and nutrient-poor confines of melting snow.
Photograph: Ron Hoham

According to Hoham, the Colgate biologist, snow algae also serve as bioindicators. Such organisms can change in number, structure, or function and thus point to changes in the integrity or quality of the environment.

In particular, Hoham said snow algae's adaptability to acidity makes them good indicators for acid rain, while their resistance to ultraviolet light can flag depletion of the ozone layer, which boosts ultraviolet radiation.

But Hoham said he is mostly content with trying to figure out why and how snow algae exist at all. Even though they may not have direct relevance to humans, understanding how snow algae survive advances understanding of life in general.

Besides, conducting field studies of snow algae, Hoham added, is an ideal way to pass the workday: Snow algae are primarily found thriving in pockets of snow that linger in high alpine environments well into the summer. "I've seen some neat, beautiful areas as a result of studying these," he said.

Extreme Life Cycle

Hoham's work is beginning to unravel the mysteries of snow algae. Like all life-forms, snow algae need liquid water to thrive. As such, their most active times of the year come in the late spring and early summer, when the temperature rises sufficiently to melt winter's snow.

When the first snowmelt trickles through the snowpack to reach rock and soil below—where snow algae pass the winter in a dormant stage—the algae "wake up," germinate, and squirm up through the ice crystals toward the sunlight. These colours the snow, Hoham said.

The algae are all green algae at heart. The green comes from chlorophyll, which allows the microscopic plants to get energy from the sun. The red and orange colors of some snow algal species come from secondary pigments that screen out ultraviolet light, which can be damaging in open, high alpine snowfields.

Once a snowfield is all but melted and the snow's nutrients have been nearly depleted, the algae shift to a reproductive stage. In this they create hardy cells that will lie dormant on the ground until the next spring, when the cycle begins anew.

In his Colgate University lab, Hoham and his undergraduate students are conducting experiments with a few species of *Chloromonas* (a type of snow alga) to try and define the optimal conditions for their growth.

The researchers have found that the species, which are found in upstate New York, are optimally suited to their environment, with the exception of one parameter: day length.

"They'd do a lot better at growing and reproducing if they had more day length, which is interesting," Hoham said. "If I were reproducing, I'd want some darkness." It seems the biologist also has a sense of humour when it comes to discussing coloured snow.