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# Unveiling the secrets of an adaptable, ubiquitous ocean algae

*Its DNA gives it broad range and critical importance in the current and future health of our oceans*

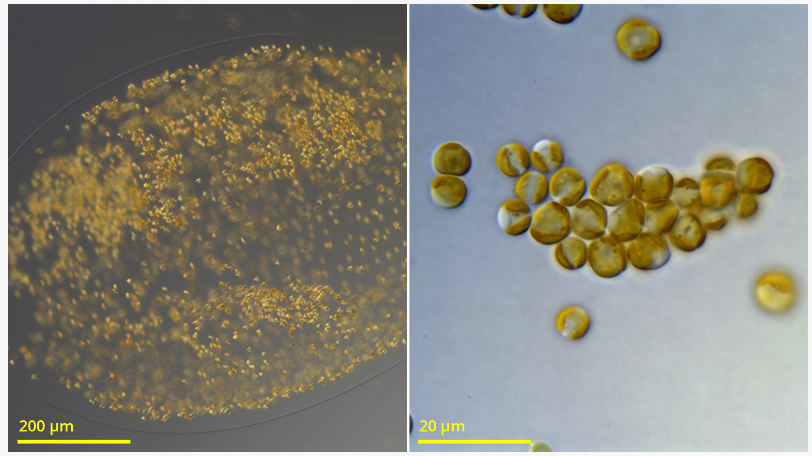
The RVIB Nathaniel B. Palmer, visible in the distance, was used to collect samples as part of the CICLOPS cruise. Here, a zodiac waits as a science crew works ashore Livingston Island as part of an earlier research effort. Image courtesy Margaret Mars Brisbin.

LA JOLLA, CA, UNITED STATES, September 30, 2025 / EINPresswire.com/ -- Phaeocystales, a group of bloom-forming marine algae, are gaining attention for their remarkable ecological roles and global reach. Found in every ocean—from the icy Southern Ocean to temperate and tropical waters—these nanoplankton may live in colonies or drift alone. When blooms form, they can aggregate into massive mats visible from space, covering hundreds of square miles, leading to both helpful and harmful effects.

Led by Andrew Allen, Ph.D., senior author and professor at the J. Craig Venter Institute (JCVI) and Scripps Institution of Oceanography, a team has now deciphered DNA from this group, mainly from the species Phaeocystis, providing new insights into its biology and environmental adaptability. Making up as much as 10% of the ocean’s plankton biomass, the algal group plays important roles in the ocean food web, climate, and even cloud formation. Results from the study are published in the journal Nature Communications.

When forming large blooms, Phaeocystis bind to each other through a stinky, sticky, mucus-like matrix that sits just below the water’s surface. A foam may also form that sits above the water, especially near coastlines. Because of their smell and the gelatinous substance, blooms can disrupt tourism in places including Western Europe, especially along the North Sea coastlines, and in Mediterranean coastal areas.

They also pose challenges to other industries. Commercial fishing struggles with nets and intake valves being clogged while the mats choke aquaculture operations. A single major harmful algal bloom (HAB) may cost tens of millions of dollars when it affects fisheries, tourism, and public health, according to the National Centers for Coastal Ocean Science.



Phaeocystis is a type of microscopic ocean organism that can change its form, which plays an important role in how energy and nutrients move through marine ecosystems. Images courtesy Ian Probert (Roscoff, France).

However, these algae aren't all bad. Because of their biological flexibility, Phaeocystis are key players in ecosystems challenged with limited light and nutrient scarcity. Their ability to thrive across a wide range of temperatures and salinities makes them resilient to environmental change and vital to marine food webs.

They are key in cycling of sulfur and carbon, playing a significant role in regulating Earth's climate. Large colonies contribute to the "biological carbon pump" by sinking rapidly and transporting carbon from the surface to deep in the ocean, helping regulate atmospheric carbon dioxide levels. They also produce a substance called dimethylsulfoniopropionate (DMSP), which breaks down into dimethyl sulfide (DMS), a compound that can influence cloud formation and climate.

The study, "Genome-resolved biogeography of Phaeocystales, cosmopolitan bloom-forming algae," provides the most comprehensive genetic insight into this algal group to date. The research team sequenced 13 strains of Phaeocystales, including high-quality reference genomes for three species. These genomes reveal the evolutionary innovations that allow Phaeocystales to adapt to diverse and often extreme environments.

Zoltán Füssy, Ph.D., study first author and research fellow at JCVI and Scripps Oceanography, remarked that the team, "faced significant challenges due to the high proportion of repetitive elements in the DNA, which complicated genome assembly and annotation."

Despite this, they succeeded in producing robust genomic resources that illuminate the group's metabolic flexibility, including mixotrophic nutrient acquisition—that is, the ability to utilize dissolved nutrients and those acquired from living prey—and adaptations to iron and vitamin B12 scarcity, especially in polar regions, where Phaeocystis is particularly dominant.

The study also uncovered signs of horizontal gene transfer and viral DNA insertions, suggesting that Phaeocystales have evolved through complex interactions with other marine organisms and viruses.

These findings not only enhance our understanding of Phaeocystales' ecological success but also highlight the importance of incorporating their diversity into global ocean models. As climate change continues to reshape marine ecosystems, understanding organisms like Phaeocystales is becoming increasingly critical.

In addition to collaborators at the US Department of Energy, Joint Genome Institute (JGI) and other US researchers, the teams included collaborators from the Czech Republic, The Netherlands, France, and Australia.

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About J. Craig Venter Institute

The J. Craig Venter Institute (JCVI) is a not-for-profit research institute in Rockville, Maryland and La Jolla, California dedicated to the advancement of the science of genomics; the understanding of its implications for society; and communication of those results to the scientific community, the public, and policymakers. Founded by J. Craig Venter, Ph.D., JCVI is home to approximately 120 scientists and staff with expertise in human and evolutionary biology, genetics, bioinformatics/informatics, information technology, high-throughput DNA sequencing, genomic and environmental policy research, and public education in science and science policy. JCVI is a 501(c)(3) organization. For additional information, please visit www.jcvi.org.

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