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Climate Adaptation of Marine Microalgae

Why in News?

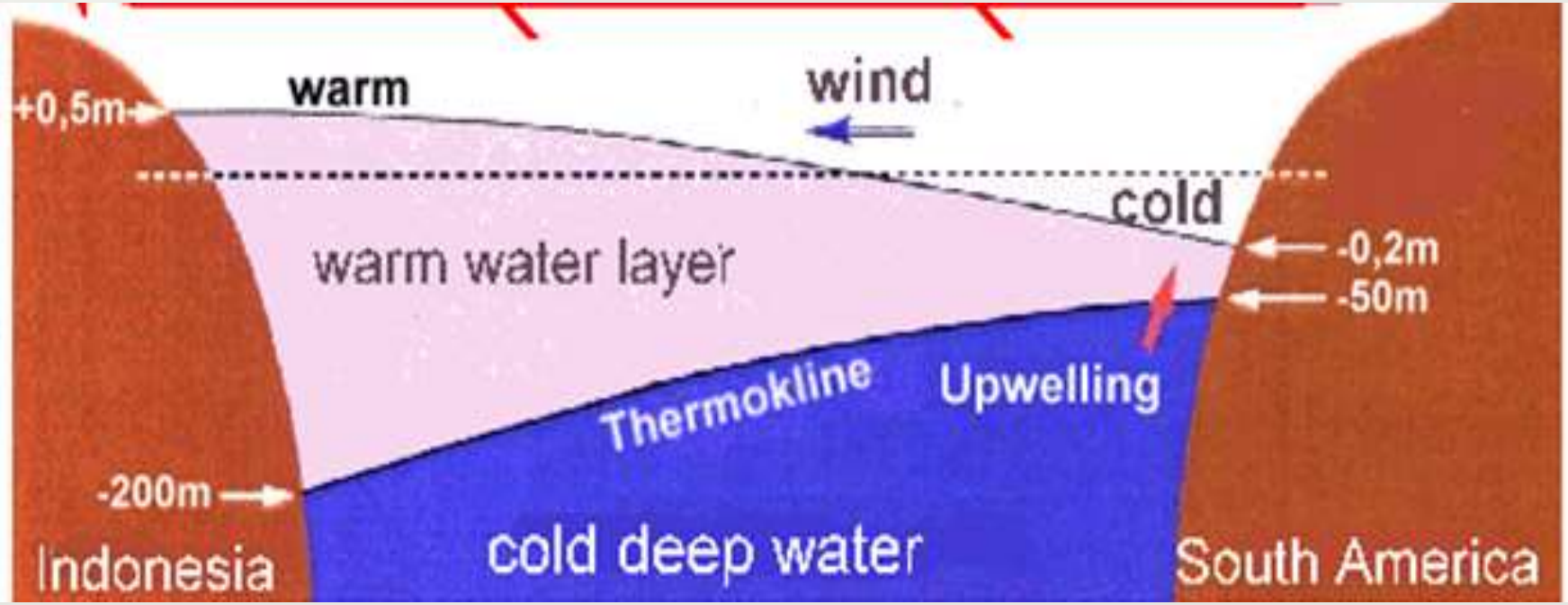
- Recently, Scientists have found that phytoplankton, also known as Microalgae, are adapting to warming climate, declining nutrient levels in seas with novel strategy
- Study finds microalgae are firing up a light-responsive protein to use sunlight for growth

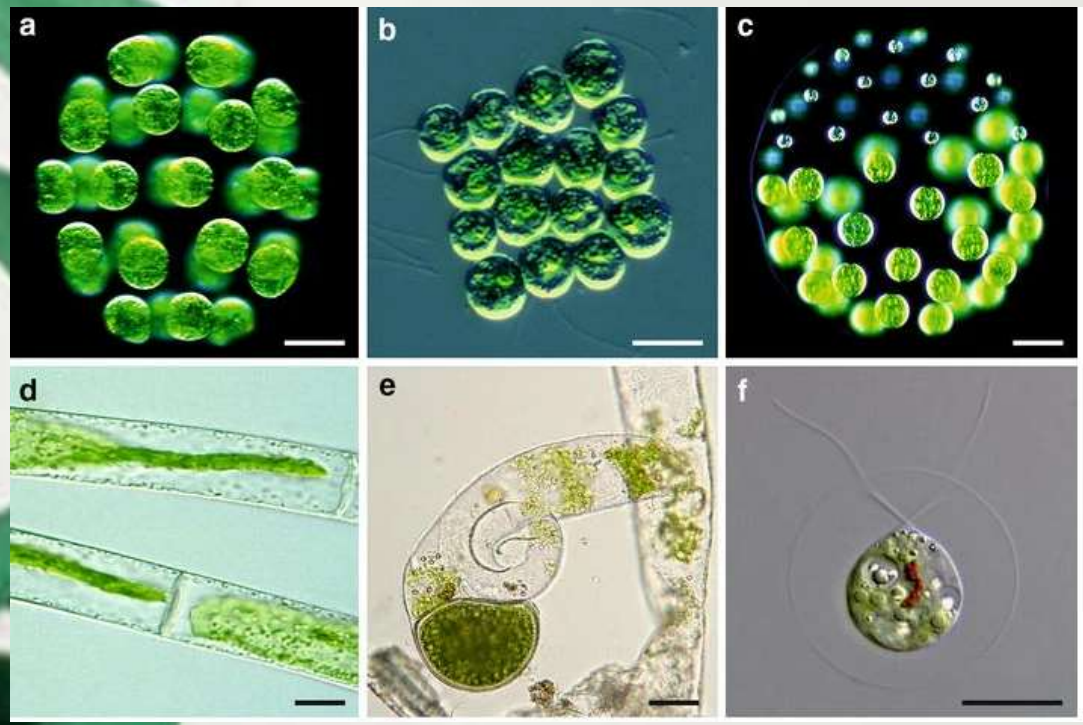
What is Marine Microalgae?

- Microalgae are photosynthetic microorganisms that can be found in diverse natural environments, such as water, rocks, and soil.
- They present higher photosynthetic efficiency than terrestrial plants, and are responsible for a significant fraction of the world's oxygen production.
- Marine microalgae play a pivotal role carbon dioxide absorption.
- Examples of Microalgae: Diatoms, Dinoflagellate, Chlorella, etc.

Impact of climate change on microalgae

- global warming is causing surface ocean waters to warm, resulting in reduced nutrient availability due to less mixing between the surface waters and nutrient-rich deeper waters.
- Microalgae need sunlight and ample iron to produce food and absorb carbon dioxide, but 35% of the ocean's surface lacks sufficient iron for their growth.
- This scarcity of nutrients, including iron, impacts the primary producers like microalgae, causing them to produce less food and capture less carbon dioxide

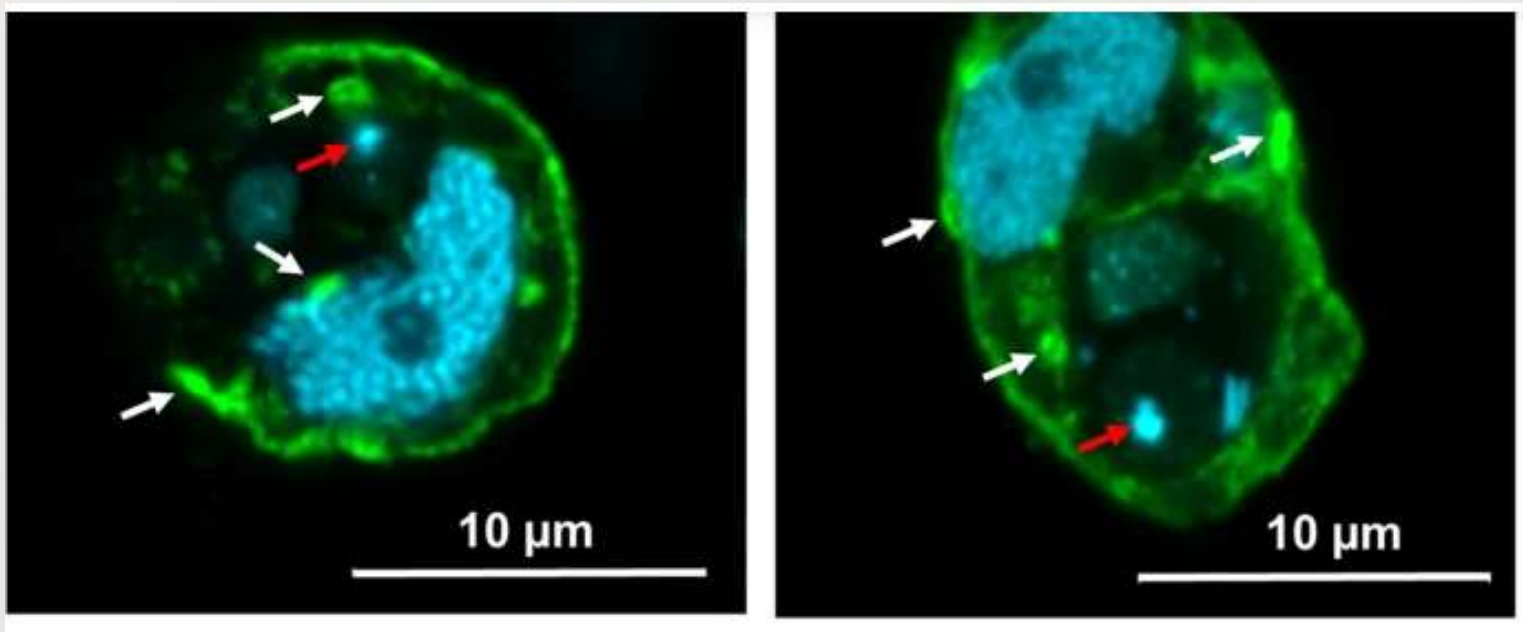




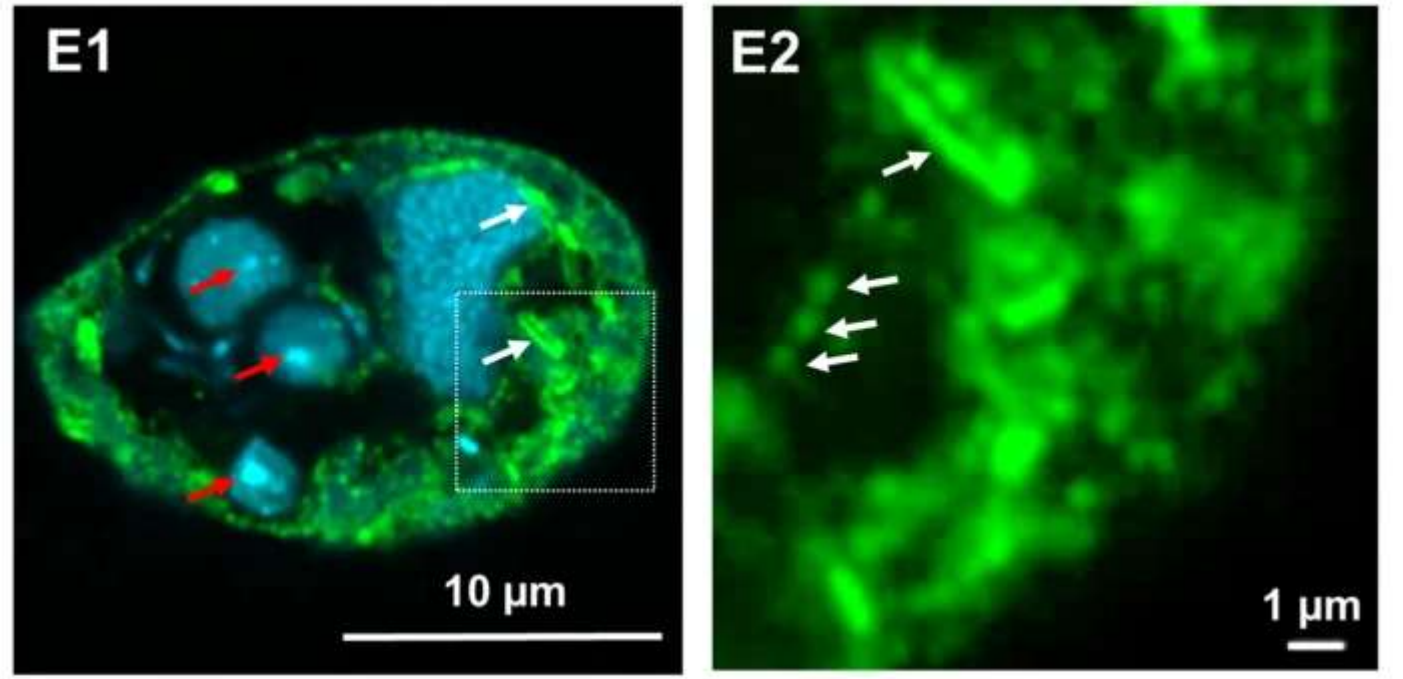
Algae Photoreceptor

- Microalgae, appear to rely on a unique strategy to cope with global warming, according to a new study.
- As climate change reduces the availability of nutrients in the sea, marine microalgae fire up a protein called Rhodopsin.
- It is related to the protein in the human eye responsible for vision in dim light.
- This light-responsive protein is helping the microalgae flourish with the help of sunlight in place of traditional chlorophyll.

- **Activation of Rhodopsin Protein**: Marine microalgae respond to changing ocean conditions by **activating rhodopsin**
- This adaptation enables these microalgae to thrive by **utilizing sunlight as an alternative energy source**, **distinct from traditional chlorophyll-based photosynthesis.**
- **This mechanism becomes** particularly **critical for their survival** in regions **with nutrient-poor surface waters** caused by ocean warming.



- Light Capture for Energy: Rhodopsin's play a pivotal role in capturing light in the ocean and are capable of absorbing as much light as chlorophyll-based photosynthesis.
- Through rhodopsin, microalgae harness light to generate energy, primarily in the form of adenosine triphosphate (ATP).
- This process allows them to produce sustenance and sequester carbon dioxide.



Implications of this Study

- Understanding the role of rhodopsin in microalgae's adaptation to changing ocean conditions can help mitigate the negative effects of ocean warming on marine ecosystems.

- This knowledge can be essential for preserving ecosystems that rely on microalgae as a food source.

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