**Phytoplankton In Decline, World-wide**

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**Plankton, base of ocean food web, in big decline**

By SETH BORENSTEIN, AP Science Writer Seth Borenstein, Ap Science Writer - Wed Jul 28, 1:01 pm ET

WASHINGTON - Despite their tiny size, plant plankton found in the world's oceans are crucial to much of life on Earth. They are the foundation of the bountiful marine food web, produce half the world's oxygen and suck up harmful carbon dioxide.

And they are declining sharply.

Worldwide phytoplankton levels are down 40 percent since the 1950s, according to a study published Wednesday in the journal Nature. The likely cause is global warming, which makes it hard for the plant plankton to get vital nutrients, researchers say.

The numbers are both staggering and disturbing, say the Canadian scientists who did the study and a top U.S. government scientist.

"It's concerning because phytoplankton is the basic currency for everything going on in the ocean," said Dalhousie University biology professor Boris Worm, a study co-author. "It's almost like a recession ... that has been going on for decades."

Half a million datapoints dating to 1899 show that plant plankton levels in nearly all of the world's oceans started to drop in the 1950s. The biggest changes are in the Arctic, southern and equatorial Atlantic and equatorial Pacific oceans. Only the Indian Ocean is not showing a decline. The study's authors said it's too early to say that plant plankton is on the verge of vanishing.

Virginia Burkett, the chief climate change scientist for U.S. Geological Survey, said the plankton numbers are worrisome and show problems that can't be seen just by watching bigger more charismatic species like dolphins or whales.

"These tiny species are indicating that large-scale changes in the ocean are affecting the primary productivity of the planet," said Burkett, who wasn't involved in the study.

When plant plankton plummet - like they do during El Nino climate cycles\_ sea birds and marine mammals starve and die in huge numbers, experts said.

"Phytoplankton ultimately affects all of us in our daily lives," said lead author Daniel Boyce, also of Dalhousie University in Halifax, Nova Scotia. "Much of the oxygen in our atmosphere today was produced by phytoplankton or phytoplankton precursors over the past 2 billion years."

Plant plankton - some of it visible, some microscopic - help keep Earth cool. They take carbon dioxide - the key greenhouse gas - out of the air to keep the world from getting even warmer, Boyce said.

Worm said when the surface of the ocean gets warmer, the warm water at the top doesn't mix as easily with the cooler water below. That makes it tougher for the plant plankton which are light and often live near the ocean surface to get nutrients in deeper, cooler water. It also matches other global warming trends, with the biggest effects at the poles and around the equator.

Previous plankton research has mostly relied on satellite data that only goes back to 1978. But Worm and colleagues used a low-tech technology - disks devised by Vatican scientist Pietro Angelo Secchi, in the 19th century. These disks measure the murkiness of the ocean. The murkier the waters, the more plankton.

It's a proxy the scientific community has long accepted as legitimate, said Paul Falkowski of Rutgers University, who has used Secchi disk data for his work.

He and other independent scientists said the methods and conclusions of the new study made sense.

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**Plankton decline across oceans as waters warm**

The amount of phytoplankton - tiny marine plants - in the top layers of the oceans has declined markedly over the last century, research suggests.


Writing in the journal Nature, scientists say the decline appears to be linked to rising water temperatures.

Figure 1 Microscope picture of plankton Phytoplankton in its myriad varieties is essential for life in the oceans

They made their finding by looking at records of the transparency of sea water, which is affected by the plants.

The decline - about 1% per year - could be ecologically significant as plankton sit at the base of marine food chains.

Algal bloom off British Isles Algal blooms can be imaged from space

This is the first study to attempt a comprehensive global look at plankton changes over such a long time scale.

"What we think is happening is that the oceans are becoming more stratified as the water warms," said research leader Daniel Boyce from Dalhousie University in Halifax, Nova Scotia, Canada.

"The plants need sunlight from above and nutrients from below; and as it becomes more stratified, that limits the availability of nutrients," he told BBC News.

Phytoplankton are typically eaten by zooplankton - tiny marine animals - which themselves are prey for small fish and other animals.

Disk record

The first reliable system for measuring the transparency of sea water was developed by astronomer and Jesuit priest Pietro Angelo Secchi.

Asked by the Pope in 1865 to measure the clarity of water in the Mediterranean Sea for the Papal navy, he conceived and developed the "Secchi disk", which must be one of the simplest instruments ever deployed; it is simply lowered into the sea until its white colour disappears from view.

Various substances in the water can affect its transparency; but one of the main ones is the concentration of chlorophyll, the green pigment that is key to photosynthesis in plants at sea and on land.

The long-term but patchy record provided by Secchi disk measurements around the world has been augmented by shipboard analysis of water samples, and more recently by satellite measurements of ocean colour.

The final tally included 445,237 data points from Secchi disks spanning the period 1899-2008.

"This study took three years, and we spent lots of time going through the data checking that there wasn't any 'garbage' in there," said Mr Boyce.

"The data is good in the northern hemisphere and it gets better in recent times, but it's more patchy in the southern hemisphere - the Southern Ocean, the southern Indian Ocean, and so on."

The higher quality data available since 1950 has allowed the team to calculate that since that time, the world has seen a phytoplankton decline of about 40%.

Ocean cycling

The decline is seen in most parts of the world, one marked exception being the Indian Ocean. There are also phytoplankton increases in coastal zones where fertiliser run-off from agricultural land is increasing nutrient supplies.

However, the pattern is far from steady. As well as the long-term downward trend, there are strong variations spanning a few years or a few decades.
Old photo of mariners deploying Secchi disk Father Secchi's simple disk has been used for more than 100 years

Many of these variations are correlated with natural cycles of temperature seen in the oceans, including the El Nino Southern Oscillation (ENSO), the North Atlantic Oscillation and the Arctic Oscillation.

The warmer ends of these cycles co-incide with a reduction in plankton growth, while abundance is higher in the colder phase.

Carl-Gustaf Lundin, head of the marine programme at the International Union for the Conservation of Nature (IUCN), suggested there could be other factors involved - notably the huge expansion in open-ocean fishing that has taken place over the century.

"Logically you would expect that as fishing has gone up, the amount of zooplankton would have risen - and that should have led to a decline in phytoplankton," he told BBC News.

"So there's something about fishing that hasn't been factored into this analysis."

The method of dividing oceans into grids that the Dalhousie researchers used, he said, did not permit scrutiny of areas where this might be particularly important, such as the upwelling in the Eastern Pacific that supports the Peruvian anchovy fishery - the biggest fishery on the planet.


Absorbing facts

If the trend is real, it could also act to accelerate warming, the team noted.

Photosynthesis by phytoplankton removes carbon dioxide from the air and produces oxygen.

In several parts of the world, notably the Southern Ocean, scientists have already noted that the waters appear to be absorbing less CO2 - although this is principally thought to be because of changes to wind patterns - and leaving more CO2 in the air should logically lead to greater warming.

"Phytoplankton. .. produce half of the oxygen we breathe, draw down surface CO2, and ultimately support all of our fisheries," said Boris Worm, another member of the Dalhousie team.

"An ocean with less phytoplankton will function differently."

The question is: how differently?

If the planet continues to warm in line with projections of computer models of climate, the overall decline in phytoplankton might be expected to continue.

But, said, Daniel Boyce, that was not certain.

"It's tempting to say there will be further declines, but on the other hand there could be other drivers of change, so I don't think that saying 'temperature rise brings a phytoplankton decline' is the end of the picture," he said.

The implications, noted Dr Lundin, could be significant.

"If in fact productivity is going down so much, the implication would be that less carbon capture and storage is happening in the open ocean," he said.

"So that's a service that humanity is getting for free that it will lose; and there would also be an impact on fish, with less fish in the oceans over time."

Richard.Black- INTERNET@ [bbc.co.uk](http://bbc.co.uk)

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Declining algae threatens ocean food chain: study

by Staff Writers
Paris (AFP) July 28, 2010

A century-long decline in tiny algae called phytoplankton could disrupt the global ocean food chain, including the human consumption of fish, according to a study released Wednesday.

The microscopic organisms -- which prop up the pyramid of marine animal life from shrimps to killer whales -- have been disappearing globally at a rate of one percent per year, researchers reported.

Since 1950, phytoplankon mass has dropped by about 40 percent, most likely due to the accelerating impact of global warming, they reported.

"Phytoplankton is the fuel on which marine ecosystems run," said lead author Daniel Boyce, a professor at Dalhousie University in the Canadian province of Nova Scotia.

"A decline affects everything up the food chain, including humans."

The pace of the decline -- heavist in polar and tropical regions -- matched the rate at which surface ocean temperatures have increased as a result of climate change, the study said.

Like all plants, phytoplankton need sunlight and nutrients to grow.

But warmer oceans become more stratified, creating a "dead zone" at the surface in which fewer nutrients are delivered from deeper layers.

The findings are worrying, the researchers said.

"Phytoplankton are a critical part of our planetary support system -- they produce half the oxygen we breathe, draw down surface carbon dioxide, and ultimately support all fisheries," said co-author Boris Worm.

Boyce and colleagues combined historical and high-tech data to measure the marine algae's progressive ebb.

Satellites provided the most accurate gauge, but usable images from space of Earth's ocean biosphere have only been available since the late 1990s -- too recent to show longterm trends.

To reach back further in time, Boyce and colleagues combed through logs compiled since the late 19th century using a 20-centimetre (eight-inch) white disk lowered into sea water until an observer lost sight of it.

The degree to which light penetrates the ocean's top layer, it turns out, is a good measure of the concentration of the chlorophyll found in all phytoplankton.

The study, published in Nature, "does not portend well for pelagic, or open water, ecosystems in a world that is likely to be warmer," David Siegel, a researcher at the University of California at Santa Barbara, and Bryan Franz, an ocean biologist at NASA Goddard Space Flight Center, said in a commentary.

In a separate study, also in Nature, a team of researchers led by Derek Tittensor of Dalhousie found a close tie between sea temperatures and the concentration of biodiversity in the world's oceans.

Across more than 11,000 species ranging from zooplankton to whales, the only environmental factor linked to all species groups was temperature.

"This relationship suggests that ocean warming, such as that due to climate change, may rearrange the distribution of ocean life," Tittensor said in a statement.

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