Harmful algal blooms and climate change: Preparing to forecast the future

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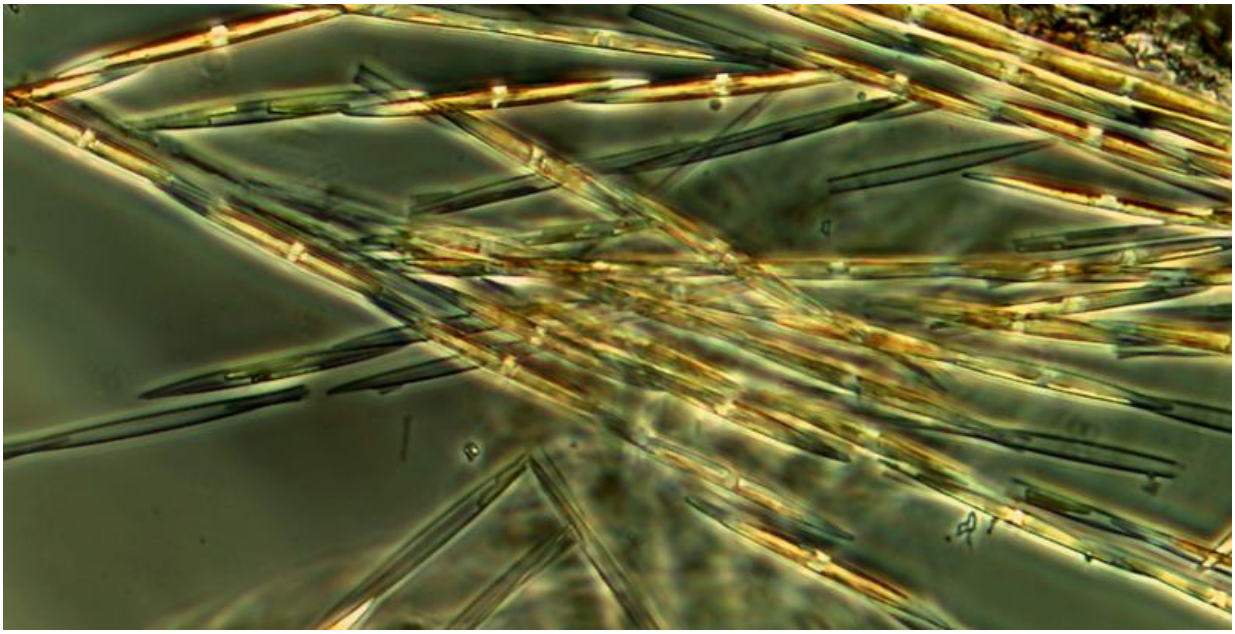

Dense cells of the harmful algae *Pseudo-nitzchia* during a bloom off the West Coast last summer. The bloom forced the closure of numerous shellfish and crab fisheries. Credit: NOAA/NWFSC

Marine scientists attending an international workshop warned that the future may bring more harmful algal blooms (HABs) that threaten wildlife and the economy, and called for changes in research priorities to better forecast these long-term trends.

The findings of the international workshop on HABs and climate Change were published Friday in the journal *Harmful Algae*. The workshop was organized under the auspices of the North Pacific Marine Science Organization (PICES) and the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) and endorsed by the International Council for the Exploration of the Sea (ICES). The central findings were that while there are reasons to expect HABs to increase with climate change, poor scientific understanding seriously limits forecasts, and current research strategies will not likely improve this capacity.

Empirical observations suggest cause for grave concern. Northward expansion of phytoplankton species, wider seasonal windows for HAB development, and an increasing prevalence of HABs worldwide all indicate a future with greater problems.

The impacts of algal blooms are extensive. Although phytoplankton blooms normally fuel productive ecosystems, some blooms create very low oxygen concentrations in bottom waters, killing or driving out marine fish or benthic organisms. Others produce potent neurotoxins that threaten ecosystems and human health.

Anthony Odell of the Olympic Region Harmful Algal Bloom Monitoring Partnership examines samples aboard a NOAA research ship last summer. Scientists mobilized throughout the summer to assess the bloom and its impacts. Credit: Olympic Region Harmful Algal Bloom Monitoring Partnership

Evidence suggests that these destructive blooms, called red tides in the past but more properly "harmful" algal blooms, are increasing in frequency and severity, possibly from human causes. "There is growing concern among scientists that climate change may exacerbate this trend," said Prof. Mark Wells, University of Maine and organizer of the workshop. "We are frustrated by the inadequate national research focus to determine the likelihood of these worst-case scenarios."

The combined effects of increasing temperature and atmospheric CO_2 are affecting ocean surface temperatures, nutrients, light, and ocean

water acidity, all of which affect marine ecosystems. These factors influence not just the intensity of algal blooms but also their composition. The question is whether climate change will enable harmful species to outcompete other phytoplankton. "It is critically important that we learn as much as possible, as precisely as possible, to fill the critical gap in knowledge between the current and the future phytoplankton community structure," says Professor Charles Trick, Western University, Canada.

The challenge is that the mechanisms driving the development of most HABs are only partially understood. "We need to build on and link our patchwork knowledge of HABs to the forecast patterns of climate change if we are to better prepare society for future HAB scenarios," said Wells.

The intense toxic phytoplankton blooms off the west coast of North America this summer appear to be associated with unusual warming-related conditions. "Does this large scale harmful algal bloom provide a window into the future?" said Dr. Vera Trainer of NOAA Fisheries' Northwest Fisheries Science Center. "While it still is unclear, there is reason for substantial concern."

The workshop participants developed several urgent recommendations on research priorities. These include re-orientating research to study how harmful species interact in planktonic communities, focus more intensive study on key organisms, emphasize developing ecological and forecast models, and strengthen linkages among global, national and regional observation programs.

"Past research has brought great understanding of individual HAB organisms; future work must concentrate on how these harmful species fit into their ecosystems. It is the most significant coastal challenge facing society today," said Trick.

Although workshop participants were optimistic, they urged fundamental shifts in HAB research so that science can better inform public debate over climate change effects on the oceans, rather than just seeking to explain destructive patterns after they develop.

Provided by NOAA Headquarters