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TITLE: Approaches to monitoring, control and management of harmful algal blooms (HABs)

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ABSTRACT:

Virtually every coastal country in the world is affected by harmful algal blooms (HABs, commonly called 'red tides'). These phenomena are caused by blooms of microscopic algae. Some of these algae are toxic, and can lead to illness and death in humans, fish, seabirds, marine mammals, and other oceanic life, typically as a result of the transfer of toxins through the food web. Sometimes the direct release of toxic compounds can be lethal to marine animals. Non-toxic HABs cause damage to ecosystems, fisheries resources, and recreational facilities, often due to the sheer biomass of the accumulated algae. The term 'HAB' also applies to non-toxic blooms of macroalgae (seaweeds), which can cause major ecological impacts such as the displacement of indigenous species, habitat alteration and oxygen depletion in bottom waters. Globally, the nature of the HAB problem has changed considerably over the last several decades. The number of toxic blooms, the resulting economic losses, the types of resources affected, and the number of toxins and toxic species have all increased dramatically. Some of this expansion has been attributed to storms, currents and other natural phenomena, but human activities are also frequently implicated. Humans have contributed by transporting toxic species in ballast water, and by adding massive and increasing quantities of industrial, agricultural and sewage effluents to coastal waters. In many urbanized coastal regions, these inputs have altered the size and composition of the nutrient pool which has, in turn, created a more favorable nutrient environment for certain HAB species. The steady expansion in the use of fertilizers for agricultural production represents a large and worrisome source of nutrients in coastal waters that promote some HABs. The diversity in HAB species and their impacts presents a significant challenge to those responsible for the management of coastal resources. Furthermore, HABs are complex oceanographic phenomena that require multidisciplinary study ranging from molecular and cell biology to large-scale field surveys, numerical modelling, and remote sensing from space. Our understanding of these phenomena is increasing dramatically, and with this understanding comes technologies and management tools that can reduce HAB incidence and impact. Here I summarize the global HAB problem, its trends and causes, and new technologies and approaches to monitoring, control and management, highlighting molecular probes for cell detection, rapid and sensitive toxin assays, remote sensing detection and tracking of blooms, bloom control and mitigation strategies, and the use of large-scale physical/biological models to analyze past blooms and forecast future ones.

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