HAB Meeting Abstracts

PICES XIII HAB-2199 Oral

Monitoring of the shellfish-killing dinoflagellate *Heterocapsa circularisquama* in Japanese coastal sea by indirect fluorescent antibody technique

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In Japanese coastal water, *Heterocapsa circularisquama* is the most noxious dinoflagellate to shellfish aquaculture due to high density blooms causing mass mortalities of both natural and cultured bivalves such as oysters, short-necked clams, mussels and pearl oysters. The population dynamics of *H. circularisquama* has remained unclear, because of the the difficulties in monitoring this organism due to small size and the presence of other species having strong morphological similarities. To identify this species precisely and to monitor its population dynamics, a fluorescent antibody technique using monoclonal or polyclonal antibodies has been employed. We carried out the monitoring of *H. circularisquama* with an indirect fluorescent antibody technique using monoclonal antibodies. Sampling was done once a week in the summer and twice a month in other seasons at 6 locations in Ago Bay, Mie Prefecture, Japan from April 2001 to March 2003. Seawater samples were immediately fixed with formaldehyde (final concentration, 0.37%), then *H. circularisquama* cells were detected by the fluorescent antibody method. The direct counting of the cells was also done using a normal optical microscope. In 2001, *H. circularisquama* cells were detected in Ago Bay from May 14 until January 21, 2002 using the indirect fluorescent antibody technique. On the other hand, the cells were detected only in July by the conventional direct counting. Later in 2002, detection of *H. circularisquama* was from May 20 until November 11 using the fluorescent antibody technique. On the contrary, the cells could be only detected from June through October by the common direct counting. This work demonstrates that the indirect fluorescent antibody technique allows for the detection of this species even at low cell densities and is the powerful and feasible monitoring tool.

PICES XIII HAB-2201 Oral

Recent approaches for the prediction and mitigation of *Cochlodinium polykrikoides* blooms in Korean waters

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A fish killing dinoflagellate, *Cochlodinium polykirkoides*, has caused recurring widespread and persistent blooms in Korean coastal water since 1995. A comprehensive HAB monitoring program has been developed and implemented as a four-dimensional monitoring system composed of cruises, coastal waterfront patrol, aircraft surveillance, and satellite remote sensing to predict the initiation and subsequent development of the blooms. Present monitoring and prediction is based on bloom dynamics of this species. *C. polykrikoides* blooms have been initiated in the mixing frontal zone of Tsushima warm current and eutrophic coastal waters, where the optimal condition for the outbreaks of *C. polykrikoides* bloom have been triggered by heat energy from the Tsushima warm current and nutrients from eutrophic coastal waters. In early July, just before the initiation of this bloom, swimming cells were found more than 100 km offshore waters from Jeju island and *C. polykrikoides*-like benthic resting cysts were also found in the sediment of South Sea of Korea, even though excystment of this dinoflagellate species has not yet been described. To

understand where the bloom inoculum originates, NFRDI plans to track the advection of *C. polykrikoides* from the west Pacific to the south coast of Korean peninsula and neighbouring countries to undertake germination experiments with the *C. polykrikoides*-like cysts. New developments such as light microscopes equipped with self-identification programs, lectin or DNA probes, and visible light spectra highly sensitive to *C. polykrikoides* are underway. Another important approach is to develop a dependable prediction model to replace the imprecise model system that is currently being used.

PICES XIII HAB-1970 Oral
Harmful algal bloom data for the Russian east coast

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The east coast of Russia is known as an area where harmful algal blooms have occurred. HAB data for the Russian east coast mostly include data of HAB research and HAB monitoring. These data focus mostly on biological parameters: the causative organisms, occurrence and abundance. There is a great disparity in the amount of HAB data available for the Russian east coast. The most complete record of numbers and seasonal dynamics of harmful algae, as well as HAB events can be found for the coastal waters of Primorye and Kamchatka. In coastal waters of Vladivostok city there is a single sampling location which is routinely sampled by phytoplanktonologists of the Institute of Marine Biology. The increasing frequency and negative impact of HABs has promoted establishment of HAB monitoring in the area of aquaculture. Since 1990, HAB routine monitoring was established at the mollusc farms in Peter the Great Bay. There is a plankton-monitoring program, which is focused on HAB species. Data include mainly causative organisms, site of occurrence, and abundance. Potentially toxic species were found, among which *Pseudo-nitzschia*, *Alexandrium* and *Dinophysis* predominated. Toxicity of *Pseudo-nitzschia multiseries* and *Alexandrium tamarense* from Russian marine waters has recently been documented. The density of these species exceeded the reportedly harmful level throughout the summer. These data document the significant risk of shellfish contamination by toxins from HABs in Russian marine waters. There is no official HAB monitoring related to PSP and domoic acid poisoning in Russian waters. Establishment of permanent Federal program of HAB monitoring in Russian coastal waters is highly recommended.

PICES XIII HAB-2200 Oral
Preliminary proposal of a Canadian Program on the Ecology and Oceanography of Harmful Algal Blooms

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The Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Programme, initiated by the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC), is aimed at fostering and promoting international co-operative research directed toward improving the prediction of harmful algal bloom events. A group of Canadian oceanographers and specialists on harmful algae has proposed a joint research program among several institutions. The proposed research follows the science guidelines of the international program, but focuses on harmful algal species of major concern in Canadian waters and draws on the expertise within universities and government agencies (DFO and NRC) in Canada. This presentation will outline the objectives and main research activities that are being proposed and will provide information on the status of the GEOHAB-Canada proposal.

PICES XIII HAB-2039 Oral

The use of remote sensing and meteorological data for monitoring HABs through ecological associations

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There are multiple ways to use remote sensing for monitoring harmful algal blooms (HABs). When the toxic species dominates or correlates to total phytoplankton biomass, ocean color is effective. Relative increases in chlorophyll as identified through chlorophyll anomalies from SeaWiFS, have successfully identified new blooms of *Karenia brevis* in the Gulf of Mexico, USA. In addition, chlorophyll anomalies are useful in tracking transport along the coast.

Toxic events often occur when the causative organism is a relatively small component of the biomass. In these cases, associations involving links to specific meteorological and oceanographic features are more useful for monitoring. The use of ocean color data for detecting *K. brevis* in the Gulf of Mexico is more effective when coupled with wind patterns, since certain wind patterns lead to *K. brevis* blooms rather than other non-toxic blooms. Along the west coast of the United States, backscatter from ocean color sensors can identify the Columbia River plume due to its high sediment loading. Preliminary evidence suggests that the Columbia River plume may prevent blooms of the diatom *Pseudo-nitzschia* spp. and associated domoic acid toxicity from moving onshore, along Washington state's southern beaches. Along the northern beaches, upwelling areas identified from sea surface temperature (SST) imagery may distinguish patterns leading to HAB development. The analysis of meteorological forcing mechanisms may also identify conditions conducive for these blooms to reach the coast.

PICES XIII HAB-2198 Oral

Ecological linkages between physical and oceanographic conditions and the seasonal growth and distribution of *Pseudo-nitzschia* blooms on the U.S. west coast

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Domoic acid has been responsible for mortalities of brown pelicans, Brandt's cormorants and sea lions along the Pacific Northwest coast. Beach and harvest closures resulting from toxic *Pseudo-nitzschia* blooms have also had a severe impact on both coastal economies and tribal communities. If the location and transport of toxic *Pseudo-nitzschia* blooms can be understood and forecast, coastal managers can then take preventative action to minimize the impact to affected coastal resources. A 5-year, multi-disciplinary, regional ECOHAB project is studying the physiology, toxicology, ecology and oceanography of toxic *Pseudo-nitzschia* species off the Pacific Northwest coast, a region in which both nutrient supply and current patterns are primarily controlled by seasonal coastal upwelling processes. Researchers are testing the hypothesis that harmful algal blooms affecting Washington State coastal communities are largely caused by *Pseudo-nitzschia* growing in the Juan de Fuca eddy (a nutrient rich environment "bioreactor" favorable for phytoplankton growth) and subsequently transported to nearshore waters by storms. The long term project goal is to develop a mechanistic basis for forecasting toxic *Pseudo-nitzschia* bloom development and transport in the Pacific Northwest, and in other similar coastal regions in Eastern Boundary upwelling systems. Results from the field and survey studies, when synthesized with predictive bio-physical models, will benefit coastal managers by providing insights into possible predictors of toxic *Pseudo-nitzschia* blooms as well as helping identify oceanic/atmospheric conditions favorable for the transport of toxic cells onshore.

PICES XIII HAB-1825 Oral
The occurrences of HAB in Chinese coastal waters in recent three years

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China is one of the countries facing serious HAB problems. There is a rapid increase of the occurrences of HAB in the coastal waters of China. Till 2003, there were 647 HAB events recorded. In the last two decades of 20 century, the number of HAB events tripled during every decade. In the last three years, 275 HAB occurred, accounting for 42% of the total HAB records.

The Bohai Sea in the north, the coastal water of Yangtze River Estuary and the Zhejiang Province in the East China Sea and coastal water along Guangdong Province in the South China Sea are the three areas with frequent HAB occurrences. In last three years, HABs in the Bohai Sea and South China Sea did not increase in frequency, however, HABs in the East China Sea did become more frequent.

In the East China Sea, blooms of *Prorocentrum* have reoccurred for 5 years over an area larger than 1,000 km^2. These blooms occur in May along the frontal area between Zhejiang coastal current and Taiwan warm current, in a water depth of between 30-50 meters. In May 2004, a *Prorocentrum* bloom extending over 10,000 km^2 was observed. In the Bohai Sea, HABs caused by new organisms, such as *Phaeocystis sp* and *Karenia sp* have recently been discovered. In the coastal water of Guangdong Province, the HABs are usually found in the Pearl River estuary in areas of dense aquaculture.

It is clear that the occurrences of HABs in China are still increasing and more efforts in research and management of HABs are needed.

PICES XIII HAB-1864 Oral
Monitoring toxic HAB in the Chinese waters during the recent three years

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A three-year HAB monitoring program as well as a study of early warning and prediction was conducted in Jiaozhou Bay in northern China beginning in 2001. The sampling sites are located in a mariculture area where the dominant product is the Manila clam *Ruditapes philippinarum*. This monitoring program includes sampling of clams and phytoplankton every month, with analysis and reporting from May to September of each year. We found that DSP is much more frequent than PSP in the north sea of China. It has been dramatically increasing in recent years. DSP toxicity detected by the mouse bioassay is higher than that by HPLC. The results of toxic algae and shellfish toxin monitoring do not always correlate well with each other, which suggested that phytoplankton monitoring serves best as a tool of early warning.

Another survey (2002~2004) of shellfish toxins has been carried out in Zhoushan islands of the East China Sea, the most serious HAB area in China during recent years. The HAB season is this area is from early May to mid June. PSP and DSP toxins were analyzed by mouse assay and HPLC. During these investigations 20 species of wild shellfish samples were collected, extracted and analyzed. Low amounts of PSP and DSP toxins were measured in a few species except for *Nassarius* sp., collected from Liuheng Island, which showed 3.84MU/g and 8.8MU/g PSP toxicity by mouse assay, yet showed no PSP toxins by HPLC. It suggested that there might be a new PSP derivative or a new neurotoxic toxin that exists in this *Nassarius* sample.