

APPENDIX C

Annual reports of WG 15 on Ecology of Harmful Algal Blooms (HABs) in the North Pacific

2000 Annual report

The Working Group 15 held its first formal meeting from 0900 to 1230 hours and from 1330 to 1600 on October 22, 2000. The meeting was attended by 15 members from Canada, China, Japan, Korea, Russia and U.S.A. (*Endnote 1*). The proposed agenda for the meeting (*Endnote 2*) was adopted.

Assessment of HAB problems in the coastal waters of PICES countries (Agenda Item 1)

The Working Group 15 was created to facilitate studies in harmful algal blooms (HABs) in the member countries of PICES. This need was recognized at the previous PICES Annual Meeting in Vladivostok, Russia in 1999. The WG 15's first task has been to evaluate current knowledge of the extent and severity of HABs in these countries and to that end representatives of each of the countries presented reports summarizing the nature and state of knowledge (species, location, intensity and consequences) of HABs in their regions. To put these reports in perspective, a few prefatory remarks have been made by Prof. F.J.R. (Max) Taylor.

In the past few decades the study of HABs has become a multidisciplinary field of its own, combining taxonomy, phytoplankton ecology (nearly all are caused by photosynthetic microplankton, with *Noctiluca* being a notable exception), limnology, toxicology, public health, epidemiology, economics and aquaculture. At the IX International Conference in Hobart, Tasmania, this year, there were 500 participants from 45 countries. The scope of phenomena and causative organisms has undergone a dramatic expansion, leading to a flood of reports that have caused considerable concern in most coastal countries. HABs can be broadly subdivided into two types: those that harm marine fauna and those that cause potentially fatal human health problems. HABs

can be fundamentally subdivided into those harming marine organisms and those that are hazardous to humans.

Marine fauna mortalities

Harmful algae can kill fish, seabirds and marine mammals, either through oxygen depletion, the release of toxins or through food chain transfer and accumulation. This is particularly an economic concern in aquaculture operations. For example, the pioneering, successful cultivation of yellowtail and red bream in the Seto Inland Sea of Japan was plagued by recurring blooms of raphidophyte algae, notably species of *Chattonella*. This also brought the role of eutrophication into focus since this has been known to produce an increase in HABs. In the PICES region this has been demonstrated not only in Japan but also in China and Korea. Fish killing dinoflagellates are also known from the PICES region. Major deaths of seabirds and sea lions have occurred in Monterey, California, in recent years, and elsewhere whales have died from toxins in their food, analogous to human health hazard.

Human health hazards

Humans can be affected by HABs primarily through eating contaminated seafood (shellfish or fish). Toxins produced by HAB species are accumulated by marine organisms feeding on them. The toxins are primarily neurotoxins although gastro-intestinal symptoms often precede them. The toxins act primarily on membrane permeability of sodium or calcium. For example, while saxitoxin blocks sodium channels and blocks nerve transmission ciguatoxin causes them to remain open, resulting in depolarization. The primary forms of HAB-related human intoxications in the North Pacific are:

- a. paralytic shellfish poisoning (PSP) caused by saxitoxins;
- b. diarrhetic shellfish poisoning (DSP) caused by okadaic acid, dinophysysyoxin and pectenotoxins;
- c. amnesic shellfish poisoning (ASP) caused by domoic acid; and
- d. ciguatera fish poisoning (CFP) caused by ciguatoxin, osteopsistoxin and possibly maitotoxin.

These are caused chiefly by dinoflagellates but ASP is linked to several species of the diatom genus *Pseudo-nitzschia*.

Summary of the National Reports (Agenda Item 2)

The National Reports on currents knowledge of HABs problem have been presented by all PICES member countries. These reports serve as the baseline on which WG 15 is going to build other activities. The first conclusion to be drawn is that all countries have significant HAB problems and may be worsening in some. Japan experienced costly fish kills in fish farms in the Seto Inland Sea due to chloromonad flagellate blooms, which have also been problematic to salmon farmers in British Columbia. The losses have run into the millions of dollars. Korea is plagued by dinoflagellate-related fish kills as is Hong Kong. China has experienced severe losses from HABs in its extensive shrimp farming activities. Eutrophication has been implicated in the Inland Sea, Hong Kong and Korean localities and shrimp farms are inherently eutrophic.

PSP is present in all PICES countries and particularly severe in western Canada, Alaska (extending as far south as California) and probably Russia. In Japan, PSP appears to have spread since the 1970s from the north down both the east and west coasts. In Korea toxicity has been known from the south coast since the 1970s. DSP has been recorded in Japan but there are few records elsewhere. Since the symptoms of the latter are difficult to distinguish from bacterial contamination it is only the presence of okadaic acid in shellfish that confirms DSP. In most

PICES countries this is not tested for. ASP is well established on the west coast of the United States where it has mainly affected seabirds and marine mammals. Ciguatera fish poisoning, found in tropical and subtropical reef systems is a significant problem in Hawaii, is recorded from imported fish in Hong Kong and can be expected in offshore South China Sea locations.

Some coastlines, such as the eastern Bering Sea, are evidently understudied and field monitoring and research in HABs is usually not co-ordinated between adjacent countries even though the phenomena do not respect national boundaries.

Recommendations for 2001 activities (Agenda Items 3 and 5)

During the next year, WG 15 is planning to produce a series of maps showing the location of HABs in the PICES region. The initial maps will indicate historic knowledge of all HAB events in each PICES country. Since ICES is also producing such maps for its region (including the west coast of North America) it seems logical to follow the same format so that they can be additive, eventually contributing to a global picture.

In mid-2000, a questionnaire, based on the ICES equivalent, was sent to each country to serve as the start of a PICES HABs database. The suggested historical maps should be part of the database, which can then be updated by annual event reports.

These should be part of the database, which can then be added to by annual event reports, as is the case in the ICES region. In addition a questionnaire was sent to each country to serve as the start of a PICES database.

The Working Group proposed holding (jointly with POC and BIO) a session at PICES X on "Physical, chemical and biological interactions during harmful algal blooms". Drs. F.J.R. (Max) Taylor (Canada), and Vera L. Trainer (U.S.A.) were suggested as potential convenors, and one

more convenor from Asia could be determined later, if the session approved by MEQ.

The Working Group also recommended (subject to approval by MEQ and Science Board) convening a 2-day Practical Workshop on “Taxonomy and identification of harmful algal bloom species” for experienced analysts from each country to ensure that all identifications of harmful species will be based on the same criteria. Many of the species are common to most of the participating countries. It is planned that the workshop will be held at the

University of British Columbia in Vancouver, just prior to PICES X.

WG 15 reviewed the list of organizations and programs for collaboration and identified SCOR GEOHAB, IOS/WESTPAC HAB, and ECOHAB as the highest priority programs for interaction.

Steps toward the co-ordination of research, particularly fieldwork, in adjacent waters should be encouraged and facilitated.

Appendix C Endnote 1

Participation List

Canada

Paul J. Harrison
Maurice Levasseur
F.J.R. (Max) Taylor (Co-Chairman)

Japan

Yasuwo Fukuyo
Ichiro Imai

People's Republic of China

Tian Yan

Republic of Korea

Chang-Hoon Kim

Russian Federation

Dmitry L. Aminin
Tatiana Yu. Orlova (Co-Chairman)

U.S.A.

Donald M. Anderson
William Cochlan
David Garrison
Vera L. Trainer
Mark L. Wells

Observer

Young-Shil Kang

Appendix C Endnote 2

Agenda

1. An introduction. (F.J.R. (Max) Taylor)
2. National reports on HAB events in PICES countries:
Canada (Paul J. Harrison and F.J.R. (Max) Taylor)
China (Tian Yan)
Japan (Yasuwo Fukuyo)
Korea (Young-Shil Kang)
Russia (Tatiana. Yu. Orlova)
U.S.A. (Vera L. Trainer)
3. Discussion to plan joint activities.
4. Forum on new results:
Tian Yan, Mingjiang Zhou, Meng Fu, Yunfeng Wang, Rencheng Yu, and Jun Li “Inhibition of egg hatching success and Larvae survival of the scallop, *Chlamys ferrerii*, associated with exposure to cells and cell fragments of the dinoflagellate, *Alexandrium tamarense*”
Chang-Hoon Kim “Bloom dynamics, physiology and PSP toxin production of *Alexandrium* species and *Gymnodinium catenatum* in the Korean coastal waters”

Vera L. Trainer “US West Coast Monitoring project”

Maria T. Maldonado, Eden L. Rue, and Mark L. Wells “The Role of trace elements in domoic acid production by *Pseudo-nitzschia* spp.”

Donald M. Anderson “Biogeography of the Toxic Dinoflagellate Genus *Alexandrium*”

5. General discussion and recommendations to PICES.
6. Closing remarks.

2001 Annual report

Accomplishments in 2000 – 2001

1. Accomplishments include more complete and uniform country reports from China, Japan, Korea, Russia, western U.S.A. and western Canada. Mexico would also like to contribute their report to this publication. The WG 15 requests that national reports be published in the PICES Scientific Report Series. The report will include an introduction/background (Dr. Max Taylor), country reports (these will detail types of HAB events, seasonality, earliest dates recorded, highest toxin levels, general environmental information, comprehensive literature, causative organisms, bloom reports including maps, unanswered questions, and hopes for future work), summary (Dr. Max Taylor), and appendices (to include images, scanning electron micrographs, and maps).

2. A workshop on *Taxonomy and identification of HAB species and data management* was held at the University of British Columbia, October 4-5, 2001, hosted by Dr. Max Taylor. Guest speakers included Dr. Laurie Connell from University of Maine (molecular probes) and Ms. Michelle Tomlinson from the National Ocean Data Center (HAB database). Dr. Connell presented a session on gene probes that are currently being used and/or development for automated HAB species detection. She gave a demonstration of this technique and described the pros and cons of its use. Ms. Tomlinson gave a web-based demonstration of the HAB database that is currently being developed for the entry of biological HAB data. To date, shellfish toxin data

from Washington State has been entered. Alaska and British Columbia shellfish monitoring data will be entered by December 2001. These data can be accessed on the web and maps of HAB events can be created. (This work was also presented at the TCODE Electronic Poster Session). The intent of the WG 15 is to add HAB information into this database from as many

PICES member countries as possible (also including Mexico).

3. General recommendations to MEQ
 - a. More interaction and collaboration between adjacent/contiguous countries is desired. For example, *Pseudo-nitzschia* and *Heterosigma* projects between the United States and Canada could be encouraged by PICES.
 - b. Monitoring of both shellfish and plankton is desired of all countries. There are serious limitations and problems in comparison among countries when only a single sentinel shellfish species is used for monitoring.
 - c. Information needs are identified, especially from Russia, the northern B.C. coast, and northern Alaska. Monitoring projects are required in these areas that are generally lacking in HAB data.
 - d. Mexico should be included in the database project and has expressed a desire to do so.
 - e. There is the need for a basic taxonomy class, especially for young U.S. and Canadian scientists (there are taxonomy

classes that are offered, but these are focused towards scientists from 3rd world countries). This basic taxonomy class could be sponsored by ICES and/or PICES (perhaps jointly).

- f. Convene a 2-day workshop on *Development of common standards for HAB data* prior to PICES XI. A possibility to conduct this workshop jointly with TCODE should be pursued.