

Annex IX

Workplan of the NOWPAP WG3 (HAB) for the 2006 – 2007 biennium

Promotion of Mitigation of Red Tides for the NOWPAP Region

CEARAC would like to suggest an activity for “Promotion of Mitigation” of red tides as a main WG3 activity in 2006 and 2007 because the necessity of “Promotion of Mitigation” was cited in the Integrated Report and the WG3 workplan (See Table 1).

Through WG3 activities in the past two years, we can obtain basic information and understand the situation of HABs in the NOWPAP Region by the National Reports on HABs in the NOWPAP Region, the Integrated Report on HABs for the NOWPAP Region, HAB Reference Database, *Cochlodinium* Homepage and its pamphlet.

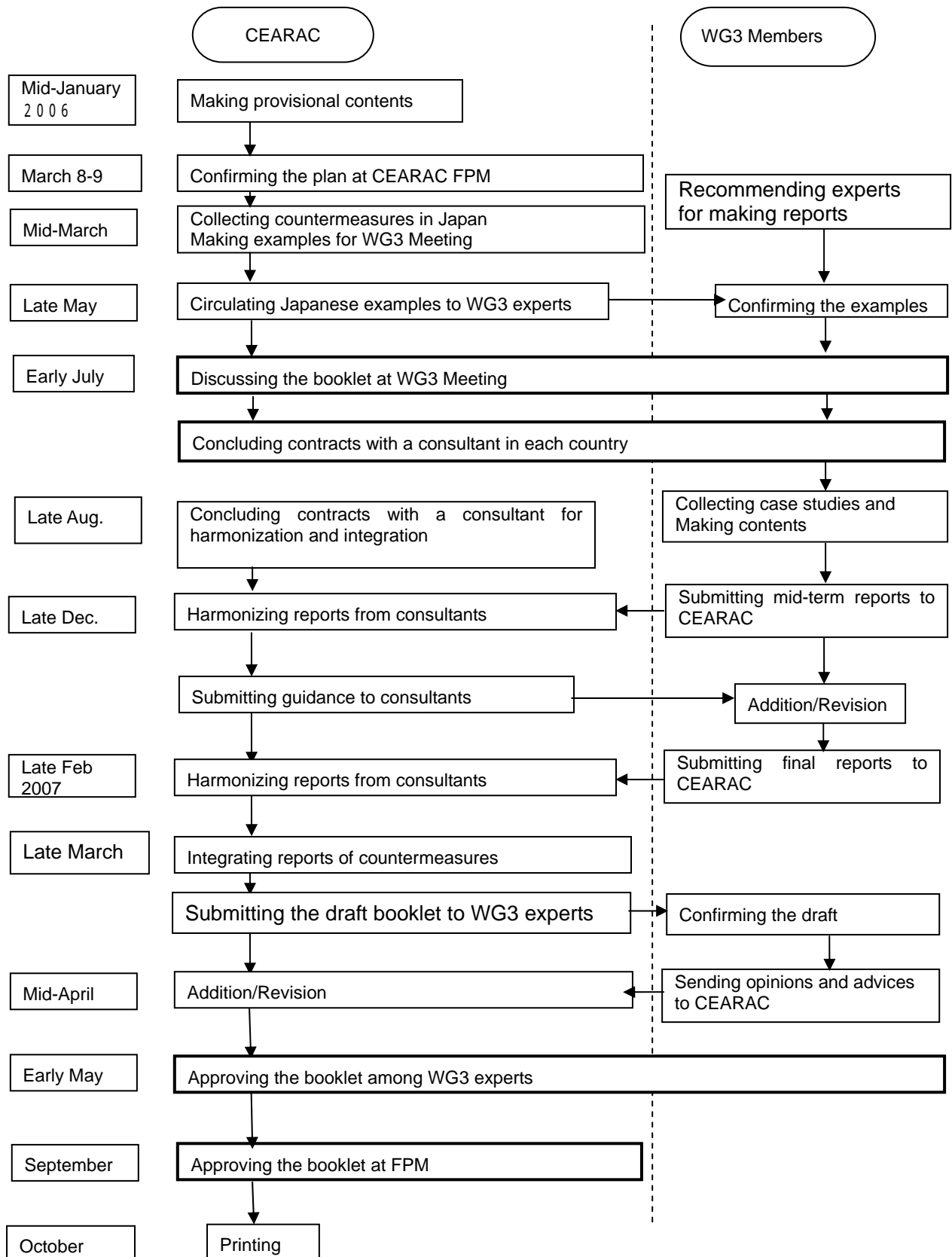
CEARAC is now ready to begin an activity for “Promotion of Mitigation.” CEARAC and WG3 shall collect information about countermeasures to terminate and mitigate red tide for the NOWPAP Region and make a booklet of countermeasures against red tides. We expect that this booklet will be used to learn advantages and disadvantages of mitigation activities and invent better methods and applications to terminate and mitigate red tides.

Table 1. Workplan for WG3 in 2006 and 2007

	2006	2007
CEARAC FPM	(Mar)	(Sep)
WG3 Meeting	(Summer)	
Development of HAB-database	• Collection of articles about countermeasures	• Collection of articles about countermeasures
Information dissemination	• Newsletter • (HAB Reference Database) • (<i>Cochlodinium</i> HP) • (<i>Cochlodinium</i> Pamphlet)	• Newsletter • (HAB Reference Database) • (<i>Cochlodinium</i> HP) • (<i>Cochlodinium</i> Pamphlet)
Identification and analysis of important scientific issue	• Collection of information about countermeasures against <i>Cochlodinium</i> red tides	T.B.D.
Promotion of Mitigation	• Survey of countermeasures to terminate or mitigation red tides	• Issue of Booklet of Countermeasures to Terminate or Mitigate Red Tides

CEARAC has made the provisional contents of the booklet (See Appendix 1) and an example of a report of a countermeasure implemented in Japan (See Appendix 2). In the 3rd WG3 Meeting to be held in summer 2006, the provisional contents and a format of reports will be discussed for improvement of the contents with advices and opinions from experts. Based on the agreement of the meeting, consultants who will be recommended by WG3 experts will start to collect information and make reports of countermeasures in their own countries with allocation of funds from CEARAC. The fund will be paid for not only gathering information about countermeasures but also collecting and categorizing reference information for HAB Reference Database. In early 2007, CEARAC will collect the reports from each NOWPAP Member. A consultant who will be hired by CEARAC will make a booklet based on the reports from each country. The booklet will be issued by the end of 2007 (See Figure 1).

Figure 1. Provisional schedule of making a booklet of countermeasures to terminate or mitigate red tides



Appendix 1 Proposal of making a booklet of countermeasures to terminate or mitigate red tides”

1. Objectives

“Booklet of case studies on countermeasures to terminate or mitigate red tides” aims to share information on countermeasures against red tides among NOWPAP Members, to contribute to establish policies and measures against red tides in stakeholders and related agencies.

2. Contents

Provisional table of contents of the booklet is in Table A-1, which tells what kinds of information are introduced in the booklet. This booklet introduces (1) countermeasures implemented in the past whether or not it was succeeded; (2) countermeasures conducted presently; (3) countermeasures under development and study. Those countermeasures conducted outside the NOWPAP Region are also to be collected.

Table A-1. Outline of a booklet of countermeasures against red tides

Chapter/Section	Contents
1. Introduction	<p>Purpose of this booklet.</p> <p>Brief explanation of measures against harmful microalgae</p> <p>Brief overview of countermeasures against red tides</p> <p>Scope of the information in this booklet.</p>
2. Countermeasures against red tides in the NOWPAP Region	
2.1 Situation of red tides in the NOWPAP Region and Necessity of development of countermeasures	<p>Explanations of the situation of red tides in the NOWPAP Region, based on the National Reports and the Integrated Report.</p> <p>Explanations of damage to aquaculture and fisheries in the NOWPAP Region referred to the National Reports, the Integrated Report and related literature.</p> <p>Necessity of countermeasures against red tides</p> <p style="padding-left: 20px;">overview of features of each countermeasure</p> <p style="padding-left: 20px;">necessity of development of countermeasures</p> <p>* This section is not including measure against toxin-producing plankton (shellfish poisoning)</p> <p>* New section can be introduced for measures against toxin-</p>

	<p>producing plankton if it is feasible and necessary, which will be discussed in the 3rd WG3 Meeting.</p>
<p>2.2 Countermeasures against red tide in the NOWPAP Region</p>	<p>Brief explanations on termination and mitigation after red tides emergence (refer to difference between preventive measures and countermeasures)</p> <p>Introduction of each countermeasure (see Appendix 2)</p> <p>2.2.1 Chemical methods (hydrogen peroxide, organic acid, surface-active agent, copper sulfate, ozone emergence, etc)</p> <p>2.2.2 Physical methods (ultrasonic waves, cavitation, etc)</p> <p>2.2.3 Biological methods (algacidal bacteria, pray on animals, etc)</p> <p>2.2.4 Others (clay spraying, communication system after emergence, avoidance of culture rafts, feed withdrawal, ballast water treatment, recovery vessel of red tides, etc)</p>
<p>2.3 Countermeasures against each red tide causative species</p>	<p>Classification of countermeasures by red tides causative species in a chart (matrix by species names and countermeasures)</p> <p>- Red Tides causative species -</p> <p>Genus <i>Chattonella</i> (<i>C. antique</i>, <i>C. marina</i>)</p> <p><i>Cochlodinium polykrikoides</i></p> <p><i>Karenia mikimotoi</i></p> <p><i>Heterocapsa circularisquama</i></p> <p><i>Heterosigma akashiwo</i></p> <p>Diatom red tides, etc</p>
<p>3. Countermeasures against red tides implemented in the world</p>	<p>Introduction of countermeasures against red tides in the world except for the NOWPAP Members. Countermeasures used in the Mediterranean and the United States could be introduced.</p> <p>* If possible, difference between methods in the world and those in the NOWPAP Region.</p>
<p>4. Summary (more countermeasures in the future)</p>	<p>Classification of features on case studies mentioned above in a chart</p> <p>Showing problems and prospects of each method as much as possible</p> <p>Proposing preferable methods which is environmental friendly and considering ecosystem</p>
<p>References</p>	

Each countermeasure could be introduced with a provided format (See Table A-2). An example is shown in the Appendix 2, which introduces “Clay Spaying.”

Table A-2. Format of information on a countermeasure

1)Name of countermeasure	Ex. Clay Spraying
2)Implementing agency(cited literature)	Ex. Kagoshima Prefectural Fisheries Technology & Development Center (Former Fisheries Experiment Station Kagoshima Pref.)
3)Target species	Ex. <i>Cochlodinium polykrikoides</i>
4)Implementing water area	Ex. Kagoshima Bay (omitted in case of developing stage)
5)Capacity of Application	* capacity of applied red tides(size, location, etc)
6)Method/Mechanism	* method in detail and mechanism concept of its effectiveness on red tides, etc.
7)Outcomes	* summary of implementation results and effects, or experiment results in case of developing stage, etc.
8)Influence to Ecosystem/Environment	* in case of on-going stage, specific influence to other marine life and environment; in case of developing stage, estimated influence brief, etc.
9)Others	* specific things such as costs, feasibility, applicability, etc. other than 1)-8) above

Appendix 2 Example of a report of countermeasure (under construction)

1. Clay Spraying (used in Yatsushiro Sea and Kagoshima Bay)

1) Method

Clay spraying for red tide termination

2) Implementing Agency (cited literature)

Implementing agency: Kagoshima Prefectural Fisheries Technology and Development
Center

(Former Fisheries Experiment Station, Kagoshima Prefecture)

Cited literature: Titles of literatures (now in Japanese)

3) Target species

Dinoflagellate: *Cochlodinium polykrikoides*, *Chattonella marina*, *Gymnodinium mikimotoi*

4) Implemented Water Areas

Kyushu Region: Yatsushiro Sea and Kagoshima Bay

5) Dates of Implementation of the methods

Around 1980

6) Application Capacity

Ex: Coastal area or (Showing area (km²))

7) Method

An applied method is spraying clay directly to where red tides occurred. Mechanism of red tides extermination by clay splaying is attributed to the following effects.

Aluminum eluted from clay atrophies cells of red tide species and breaks them.

Aggregation of clay makes flocculants.

Flocculants sink with the broken cells to the sea bottom.

Clay used in this method is montmorillonite from Iriki-cho, Satsuma-Gun, Kagoshima Prefecture. Sprayed clay is evened out in a large area by outboard. Thorough agitation of the clay is necessary for long detention period.

There are 2 main ways of clay spraying.

Clay is dissolved by sprinkler on board and it is flowed through a drain outlet of a ship.
Clay is dissolved with sea water in a preserve on a fishing boat, and it is sprayed.

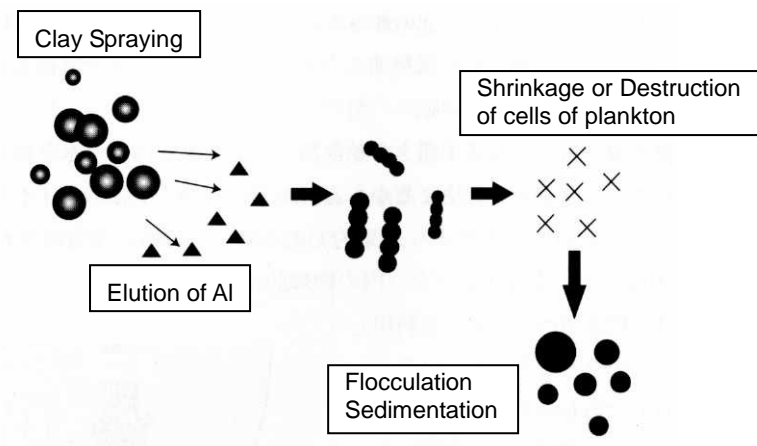


Figure A-1. Mechanism of termination of red tide by clay spraying

Other ways are spraying in hand or spraying with feeding pelletter. However, these approaches are being less used because of their inefficiency and low durability of equipments.

8) Effectiveness

Since this method was effective against *Cochlodinium* red tides in Yatsushiro Sea in 1979, wide-scale spraying was conducted as a countermeasure against *Chatternella* red tides several times in Kagoshima Bay and a countermeasure against *Cochlodinium polykrikoides*, *Chattonella marina*, or *Karenia mikimotoi* red tides more than ten times in Yatsushiro Sea. Effectiveness on HAB termination by clay spraying varies in target species (See Table A-3). The fullest effect was shown to *Cochlodinium polykrikoides* and *Chattonella marina*, and the effect on *Kerenia mikimotoi* was high.

Table A-3. Minimum concentration of clay for termination of plankton

Name of plankton	Minimum concentration of clay for termination (mg/l)
<i>Cochlodinium polykrikoides</i>	200 - 1,000
<i>Chattonella marina</i>	1,000 - 2,000
<i>Karenia mikimotoi</i>	2,000 - 4,000
<i>Chattonella antiqua</i>	3,000 - 8,000
<i>Heterosigma akashiwo</i>	5,000 - 6,000
<i>Cochlodinium convoltum</i>	5,000 - 6,000

8) Influence to the environment

(1) Influence to fish and shellfish

Influence to yellow tails and cultured tiger shrimps by clay spraying has already been reported by former Fisheries Experiment Station in Kagoshima Prefecture.

(to be continued)

(2) Influence to the environment and ecosystem

Influences to the environment and ecosystem by clay spraying could be recognized by:

Change in water quality(pH · DO)

Change in composition of nutrient in soils at sea bottoms

However, only a few incidents of those influences were reported, and it was concluded that adverse effects of clay spraying are not crucial on water quality and bottom soils.

(to be continued)

9) Others

* Cost, Feasibility, Applicability, etc.