INTERNATIONAL MARITIME ORGANIZATION

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THIRTIETH CONSULTATIVE MEETING
OF CONTRACTING PARTIES TO THE
LONDON CONVENTION
&
THIRD MEETING OF CONTRACTING
PARTIES TO THE LONDON PROTOCOL
27 – 31 October 2008
Agenda item 4

LC 30/INF.4
28 August 2008
ENGLISH ONLY

OCEAN FERTILIZATION

A compilation of recent international statements, agreements and recommendations regarding ocean fertilization

Submitted by the United Nations Environment Programme (UNEP)

SUMMARY

Executive summary:	In order to facilitate the further discussion on ocean fertilization at this session, UNEP has compiled some of the statements, agreements and recommendations by international fora and initiatives on this topic since April 2007.
Action to be taken:	To take note of.
Related documents:	As listed below.

Introduction

1 **Ocean Fertilization**, i.e. "the concept for ocean sequestration in which infertile waters are seeded with iron or other nutrients to enhance the growth of plankton and consequently increase the uptake of CO_2 into the ocean waters"[1], was addressed at the following meetings under the auspices of the London Convention (LC) and Protocol (LP):

[1] Definition from the Carbon Sequestration Leadership Forum (CSLF), cf. www.cslforum.org

Group	Date	Record number	Ocean fertilization reference
31st Meeting Scientific Group of the London Convention / 2nd Meeting Scientific Group of the London Protocol	19 – 23 May 2008	LC/SG 31/16	Chapter 2 and Annex 2
29th Consultative Meeting / 2nd Meeting of Contracting Parties	5 – 9 November 2007	LC 29/17* Press Release**	§§ 4.14 – 4.29, Annexes 5, 6
30th Meeting Scientific Group of the London Convention / 1st Meeting Scientific Group of the London Protocol	18 – 22 June 2007	LC/SG 30/14***	§§ 2.22 – 2.28

* available at www.imo.org/includes/blastData.asp/doc_id=8866/17.pdf
** available at www.imo.org/Newsroom/mainframe.asp?topic_id=1472&doc_id=8706
*** available at www.imo.org/includes/blastData.asp/doc_id=8447/14.pdf

2 In order to facilitate and support the further discussions on **Ocean Fertilization** to be held at the 30th Consultative Meeting and 3rd Meeting of Contracting Parties (London, 27 to 31 October 2008) the UNEP has compiled some of the statements, agreements and recommendations made/adopted by the following international bodies and institutions in their discussions about ocean fertilization. Please note that this compilation is not exhaustive:

- **UNESCO/IOC *ad hoc* Consultative Group on Ocean Fertilization**
- **CBD COP 9** (9th Meeting of the Conference of the Parties to the Convention on Biological Diversity)
- **GEOHAB** (Global Ecology and Oceanography of Harmful Algal Blooms)
- **SCOR & GESAMP** (Scientific Committee on Oceanic Research and Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection)
- **Scientific Groups (**London Convention and Protocol) [2]
- **SOLAS** (The Surface Ocean – Lower Atmosphere Study)
- **IPCC** (Intergovernmental Panel on Climate Change).

3 In order to provide a quick overview of the various statements, agreements and recommendations (cf. annexes for their full text), extracts/key citations are given below in chronological order, including an indication whether the text is primarily of a technical/scientific or political/policy nature.

4 Further information about the international institutions referred to in this document is given in a table at the end of the cover page.

[2] This statement is included because it was released after the 30th Meeting Scientific Group of the London Convention/1st Meeting Scientific Group of the London Protocol.

EXTRACTS/KEY CITATIONS

UNESCO/IOC ad hoc Consultative Group on Ocean Fertilization

Date: 14 June 2008	**Nature: Technical/Scientific**	**Annex 1**

"We do not yet have the level of understanding of the marine environment needed to develop a set of specific regulations that would safeguard the ocean environment from fertilization-type activities." --- "Manipulative experiments, including ocean fertilization, are important tools that scientists use to develop a better understanding of the marine environment." --- "The size of the activity is not the only factor to consider." --- "Experiments designed to study the impact of ocean fertilization on the lifecycles of mega-fauna, such as fish, may require spatial scales of order 200 km by 200 km."
(in response to CBD agreements) "The restriction of experiments to coastal waters appears to be a new, arbitrary, and counter-productive limitation." --- "There is no scientific basis for limiting such experiments to coastal environments." --- "A careful science-based "assessment of associated risks" depends on knowledge that could be gained by further experimentation."

Convention on Biological Diversity (CBD)

Date: 30 May 2008	**Nature: Political/Policy**	**Annex 2 a + b**

(**Decision IX/16**) "… requests Parties and urges other Governments, in accordance with the precautionary approach, to ensure that ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, including assessing associated risks, and a global, transparent and effective control and regulatory mechanism is in place for these activities; with the exception of small scale scientific research studies within coastal waters."
(**Decision IX/20**) "… requests the Executive Secretary to seek the views of Parties and other Governments and, in consultation with the International Maritime Organization, other relevant organizations, and indigenous and local communities, to compile and synthesize available scientific information on potential impacts of direct human-induced ocean fertilization on marine biodiversity …"

GEOHAB

Date: 18 April 2008	**Nature: Technical/Scientific**	**Annex 3**

"The potential for the development of harmful algal blooms, as well as hypoxia, is great, and the negative impacts may last long after urea additions have been halted [reference removed]. GEOHAB not only urges caution, but strongly suggests that such efforts not be conducted."

SCOR and GESAMP

Date: 4 March 2008	**Nature: Technical/Scientific**	**Annex 4**

"… eventual fertilization would add iron or nitrogen to large areas of the world's ocean. Proposals … on such scales suffer a major weakness: one does not know how the oceanic ecosystem will respond." --- "Ocean fertilization on any significant scale will (by design) impact the species succession and the ecosystem structure and function in the affected areas." --- "To be scientifically credible the design and implementation of large-scale nutrient addition experiments must be transparent and the results must be clearly stated and made available to the scientific community and the general public."

LC-LP Scientific Groups

Date: 13 July 2007	**Nature: Technical/Scientific**	**Annex 5**

"…knowledge about the effectiveness and potential environmental impacts of ocean iron fertilization currently was insufficient to justify large-scale operations." --- "… noted with concern the potential for large-scale ocean iron fertilization to have negative impacts on the marine environment and human health. They therefore recommended that any such operations be evaluated carefully to ensure, among other things, that such operations were not contrary to the aims of the London Convention and London Protocol [reference removed]."

SOLAS

Date: 20 June 2007	**Nature:** Technical/Scientific	**Annex 6**

"It is then critical and essential that robust and independent scientific verification is undertaken before large-scale fertilization is considered. Given our present lack of knowledge, the judgement of the SOLAS SSC is that ocean fertilization will be ineffective and potentially deleterious, and should not be used as a strategy for offsetting CO_2 emissions."

IPCC (Working Group III 4th assessment report *Mitigation of Climate Change*)

Date: April/May 2007	**Nature:** Technical/Scientific	**Annex 7**

(**Summary for Policymakers**) "Geo-engineering options, such as ocean fertilization … remain largely speculative and unproven, and with the risk of unknown side-effects."
(**Chapter 11**) "It should be noted … that iron addition will only stimulate phytoplankton growth in ~30% of the oceans (the Southern Ocean, the equatorial Pacific and the Sub-Arctic Pacific), where iron depletion prevails ... This suggests that the field-study estimates of the actual carbon sequestered per unit iron (and per dollar) are over-estimates." --- "Potential negative effects of iron fertilization include the increased production of methane and nitrous oxide, de-oxygenation of intermediate waters and changes in phytoplankton community composition that may cause toxic blooms and/or promote changes further along the food chain. None of these effects have been directly identified in experiments to date, partly due to the time and space constraints."

LIST OF INTERNATIONAL INSTITUTIONS REFERRED TO IN THIS DOCUMENT

Acronym	Full Title	What is it	Web-address
CBD	Convention on Biological Diversity	A legally binding commitment, ratified by majority of countries; to conserve biological diversity, to sustainably use its components and to share equitably the benefits arising from the use of genetic resources.	www.cbd.int
GEOHAB	Global Ecology and Oceanography of Harmful Algal Blooms	An international programme that co-ordinates and builds on related national, regional and international efforts in HAB research within an ecological and oceanographic context.	http://ioc.unesco.org/hab/GEOHAB.htm
GESAMP	Group of Experts on the Scientific Aspects of Marine Environmental Protection	An independent group of experts, formed in 1969, that advises the United Nations (UN) system on the scientific aspects of marine environmental protection.	www.gesamp.org/
LC-LP Scientific Groups	Scientific Groups of the London Convention and Protocol	Groups responsible for the provision of scientific and technical advice in relation to the London Convention and Protocol, respectively.	www.imo.org/home.asp?topic_id=1488
IPCC	Intergovernmental Panel on Climate Change	The IPCC was set up by the WMO and UNEP to provide the decision-makers and others interested in climate change with an objective source of information about climate change.	www.ipcc.ch/index.htm
SCOR	Scientific Committee on Oceanic Research	SCOR was created in 1957 by the International Council for Science.	www.scor-int.org
SOLAS	The Surface Ocean − Lower Atmosphere Study	An international research initiative that is a part of the Earth System Science Partnership (www.essp.org/).	www.solas-int.org
UNESCO/ IOC	Intergovernmental Oceanographic Commission of the UN Educational, Scientific and Cultural Organiz. (UNESCO)	IOC promotes international cooperation and coordination of programmes in research, services and capacity building in oceans and coastal areas. The IOC ad hoc Consultative Group on Ocean Fertilization is a group of scientists providing advice to IOC Council.	http://ioc-unesco.org/

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ANNEX 1

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
COMMISSION OCEANOGRAPHIQUE INTERGOUVERNEMENTALE
COMISION OCEANOGRAFICA INTERGUBERNAMENTAL

اللجنة الدولية الحكومية لعلوم المحيطات

政府间海洋学委员会

Paris, 14 June, 2008

STATEMENT OF THE IOC AD HOC CONSULTATIVE GROUP ON OCEAN FERTILIZATION [1]

I. General Comments

1. The IOC ad hoc Consultative Group on Ocean Fertilization believes it is important to open a more complete and inclusive discussion about how ocean fertilization activities might be regulated under the London Convention. Here, we offer only a few broad initial comments.

2. Our goal is to safeguard the ocean against damaging ocean fertilization activities without impeding benign fertilization activities; however the scientific community must work to clearly determine what changes are damaging and which are benign.

3. We do not yet have the level of understanding of the marine environment needed to develop a set of specific regulations that would safeguard the ocean environment from fertilization-type activities.

4. The size of the activity is not the only factor to consider. An ocean fertilization activity might be damaging even if conducted over one square kilometer (for example, over a coral reef) just as another ocean fertilization activity might be benign even though conducted over many thousands of square kilometers.

5. We should promote better scientific understanding of the ocean. Manipulative experiments, including ocean fertilization, are important tools that scientists use to develop a better understanding of the marine environment. Such scientific research should be promoted with a minimum of additional bureaucratic burden. For example, the scientists conducting the experiment should be free to decide which parameters (beyond those required to assure the detection of any significant environmental damage that might reasonably be anticipated to occur) need to be measured to address the questions motivating the experiment.

6. The IOC ad hoc Consultative Group on Ocean Fertilization is a group of scientists. We are not expert in international law or policy. Notwithstanding the lack of specific expertise, members of the ad hoc committee offered two suggestions to help safeguard the ocean against damaging ocean fertilization activities while minimizing burden on benign fertilization activities:

    a. Under one suggestion, an independent but knowledgeable committee composed of scientists as well as representatives of policy, legal, and industry would assess each proposed fertilization activity on the basis of the risk it poses to the environment. The committee would allow activities to proceed which were assessed to fall below a clearly defined threshold of environmental damage.

    b. Under another suggestion, legitimate scientific experiments (those with defensible scientific goals and public disclosure of methods and results) would proceed but ocean fertilization activities designed to generate saleable carbon credits or other monetary gain would be delayed until appropriate environmental safeguards can be developed and enacted.

1 Ken Caldeira (Chair), Carnegie Institute of Washington, Stanford, USA; Philip Boyd, National Institute of Water and Atmospheric Research, New Zealand; Ulf Reibesell, Leibniz Institute of Marine Sciences, Germany; Christopher Sabine, National Oceanic and Atmospheric Administration, USA; Andrew Watson, University of East Anglia, UK.

II. Response of the IOC ad hoc Consultative Group on Ocean Fertilization to specific questions raised by the London Convention and Protocol Scientific Group

1. Existing Scientific Literature generated by, or available at, your organization on the topic:

- The Ocean in a High CO_2 World (2005). Proceedings from the International Symposium; Special Issue of the Journal of Geophysical Research-Oceans, v. 110, 2005.
- The Ocean in a High CO_2 World Meeting Report, Oceanography Magazine, Vol. 17, No. 3, Sept. 2004 (http://www.tos.org/oceanography/issues/issue_archive/issue_pdfs/17_3/17.3_scor_ioc.pdf)
- The Ocean in a High CO_2 World, EOS, American Geophysical Union, Vol. 85, No. 37, September 2004, p351-353.
- The Ocean in a High CO_2 World Research Priorities Report (http://iodeweb3.vliz.be/oanet/Symposium2004/Symp2004Docs/Research%20Priorities%20Report-Final.pdf)
- M. Hood and S. Schneegans, A carbon sink that can no longer cope?, A World of Science, Vol. 2, No. 4, Oct-Dec 2004, p 2-5. (http://unesdoc.unesco.org/images/0013/001372/137292e.pdf)
- The Ocean Acidification Network (www.ocean-acidification.net), which includes frequently-asked-questions, document lists, and powerpoint presentations on ocean carbon sequestration science.

2. Specific Submission to the Scientific Groups

A. What constitutes "large scale" in the ocean?

"Large scale" is a relative term. However, in this case we can relate the experiments to ocean physics scales where large scale motions are those significantly affected by apparent Coriolis forces, typically with length scales of tens of kilometers.

There is no well-established meaning to "large scale" that would allow it to usefully distinguish between activities that would and activities that would not damage the ocean environment (see item 4 above).

B. A clear justification of the need for experiments at scales of order 200 km by 200 km

Ocean waters are continuously stirred, with currents at different depths moving at different speeds and in different directions. Both the fertilized patch and any sinking carbon will be transported along with the currents. In the small-scale experiments (tens of kilometers) so far performed, the results are strongly influenced by dilution of unfertilized water into the patch, such that it is difficult to extrapolate the results to larger scales, or to longer times. In particular, estimates of amounts of carbon sequestered to depth from extrapolations of these experiments are very uncertain.

The effects on the fertilized patch of stirring and mixing with water that has not received the fertilization treatment becomes less important near the center of the patch as patch size increases. This would provide incentive to develop experiments at scales of order 200 km by 200 km, this scale being larger than that of typical ocean eddies. For the same reason, it may be easier to assess the influence of surface manipulations on the sinking fluxes of particles when the experiments are at this scale.

Experiments designed to study the impact of ocean fertilization on the lifecycles of megafauna, such as fish, may require spatial scales of order 200 km by 200km.

C. An assessment of the impacts on oceans of experiments at such scales

It is impossible to assess the impacts of experiments through information on spatial scale alone. A host of factors, including rates, amounts, concentration, duration and composition of chemical addition, location, time of year, and so on, could all jointly be determinative of ocean impacts.

III. ADDENDUM (June 14, 2008): Response to the statement of the Conference of the Parties to the Convention on Biological Diversity on Ocean Fertilization Activities (30 May 2008)

The Intergovernmental Oceanographic Commission (IOC) *ad hoc* Consultative Group on Ocean Fertilization is concerned that the statement on ocean fertilization activities issued by the Conference of the Parties to the Convention on Biodiversity in Bonn on 30 May 2008 places unnecessary and undue restriction on legitimate scientific activities.

The statement reads, in part, "*[The Conference of the Parties of the Convention on Biodiversity (COP of the CBD)] ... urges other Governments, in accordance with the precautionary approach, to ensure that ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, including assessing associated risks, and a global transparent and effective control and regulatory mechanism is in place for these activities; with the exception of small scale research studies within coastal waters.*"

The IOC *ad hoc* Consultative Group on Ocean Fertilization notes that:

(1) The COP of the CBD recognizes "the ongoing scientific and legal analysis [of ocean fertilization] occurring under the auspices of the London Convention (1972) and the 1996 London Protocol."

(2) The CBD proposes that "ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, …with the exception of small scale scientific research studies within coastal waters." The restriction of experiments to coastal waters appears to be a new, arbitrary, and counterproductive limitation. The most useful ocean fertilization experiments to date have been performed in open ocean environments, as this is where marine productivity is most commonly limited by micronutrients. There is no scientific basis for limiting such experiments to coastal environments.

(3) There are good scientific reasons to do larger experiments, including diminishing dilution near the center of the experimental area and obtaining better data relating to vertical transport processes. "Small scale" is a relative term. A circle 200 km in diameter would cover less than one ten-thousandth of the ocean.

(4) We are concerned about the phrase in the CBD statement "global transparent and effective control and regulatory mechanism … for these activities". We assume that "these activities" refers to ocean fertilization activities for the purpose of introducing additional carbon dioxide into the ocean, as distinct from purposes such as legitimate scientific investigation. It would be helpful if this phrase were clarified to make this important distinction evident.

(5) Preservation of biodiversity in marine systems may require good scientific information from manipulative experiments in the open ocean. A careful science-based "assessment of associated risks" depends on knowledge that could be gained by further experimentation.

(6) It is essential for sound and unbiased scientific advice to be available to intergovernmental deliberations on the issue of ocean fertilization both to protect the marine environment and to ensure that marine scientific research is not unnecessarily hindered. The IOC should continue to provide scientific advice to the London Convention Scientific Group, as well as other international or intergovernmental deliberations, as requested.

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ANNEX 2 a and b

Extract of Decision IX/16 Biodiversity and climate change adopted at the 9th Meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD COP 9)

(source: www.cbd.int/doc/decisions/COP-09-dec-en.pdf, page 96)

UNEP/CBD/COP/9/29
Page 96

publications such as Convention on Biological Diversity Technical Series Nos. 10 and 25 and the UNEP/IUCN TEMATEA Issue-Based Module on Climate Change and Biodiversity when planning or implementing mutually supportive activities among the three Rio conventions with regard to biodiversity, combating desertification/land degradation and climate change at the national and international levels.

C. Ocean Fertilization

The Conference of the Parties,

Notes the work of the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) and the 1996 London Protocol, *welcomes* the decision of the twenty-ninth Consultative Meeting of the Contracting Parties held from 5 to 9 November 2007, which: (i) endorsed the June 2007 "Statement of Concern regarding iron fertilization of the oceans to sequester CO_2" of their Scientific Groups, (ii) urged States to use the utmost caution when considering proposals for large-scale ocean fertilization operations and (iii) took the view that, given the present state of knowledge regarding ocean fertilization, large-scale operations were currently not justified:

1. *Requests* the Executive Secretary to bring the issue of ocean fertilization to the attention of the Joint Liaison Group;

2. *Urges* Parties and other Governments to act in accordance with the decision of the London Convention;

3. *Recognizes* the current absence of reliable data covering all relevant aspects of ocean fertilization, without which there is an inadequate basis on which to assess their potential risks;

4. *Bearing in mind* the ongoing scientific and legal analysis occurring under the auspices of the London Convention (1972) and the 1996 London Protocol, *requests* Parties and *urges* other Governments, in accordance with the precautionary approach, to ensure that ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, including assessing associated risks, and a global, transparent and effective control and regulatory mechanism is in place for these activities; with the exception of small scale scientific research studies within coastal waters. Such studies should only be authorized if justified by the need to gather specific scientific data, and should also be subject to a thorough prior assessment of the potential impacts of the research studies on the marine environment, and be strictly controlled, and not be used for generating and selling carbon offsets or any other commercial purposes;

5. *Requests* the Executive Secretary to disseminate the results of the ongoing scientific and legal analysis under the London Convention and London Protocol, and any other relevant scientific and technical information, to the fourteenth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice.

Extract of Decision IX/20 Marine and coastal biodiversity adopted at the 9th Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 9)

(source: www.cbd.int/doc/decisions/COP-09-dec-en.pdf, page 113)

3. *Taking into account* the role of the International Maritime Organization, *requests* the Executive Secretary to seek the views of Parties and other Governments, and, in consultation with the International Maritime Organization, other relevant organizations, and indigenous and local communities, to compile and synthesize available scientific information on potential impacts of direct human-induced ocean fertilization on marine biodiversity and make such information available for consideration at a future meeting of the Subsidiary Body on Scientific, Technical and Technological Advice prior to the tenth meeting of the Conference of the Parties;

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ANNEX 3

(source: www.obsvlfr.fr/LOV/OMT/GEOHAB/images/stories/Advisory_Bulletin_of_the_GEOHAB_SSC_on_Urea_Fertilization.pdf)

GEOHAB
Global Ecology and Oceanography of Harmful Algal Blooms

Advisory Bulletin of the GEOHAB SSC on Urea Fertilization

18 April 2008

GEOHAB[1], in agreement with the position of SCOR, GESAMP[2], and the IOC ad hoc Consultative Group on Ocean Fertilization[3] on the deliberate nutrient additions to the oceans, expresses its concern about plans to fertilize the ocean with urea for the purpose of carbon sequestration and enhanced fish production. Such proposals raise important questions about the fate of massive quantities of nitrogen added to the ocean. The potential for the development of harmful algal blooms, as well as hypoxia, is great, and the negative impacts may last long after urea additions have been halted[4]. GEOHAB not only urges caution, but strongly suggests that such efforts not be conducted.

[1] The Global Oceanography and Ecology of Harmful Algal Blooms Programme (IOC-SCOR)

[2] http://www.scor-int.org/SCOR-GESAMP.pdf

[3] Statement of the IOC ad hoc Consultative Group on Ocean Fertilization to the IMO London Convention Scientific Group Meeting on Ocean Fertilization

[4] Glibert et al., 2008. Ocean urea fertilization for carbon credits poses high ecological risks. Marine Pollution Bulletin, doi :10.1016/j.marpolbul.2008.03.010

The GEOHAB scientific Steering Committee: Robin Raine (Ireland) Chair, Raphael Kudela (USA) Vice-chair, Icarus Allan (UK), Marcel Babin, (France), Elisa Berdalet (Spain), Stewart Bernard (South Africa), Liam Fernand (UK), Ken Furuya (Japan), Leonardo Guzman (Chile), Dennis McGillicuddy (USA), Susanne Roy (Canada), Ming-Jiang Zhou (China). www.geohab.info

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ANNEX 4

(source: www.scor-int.org/SCOR-GESAMP.pdf)

International Council for Science
Scientific Committee on Oceanic Research

GESAMP
Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection

PRESS RELEASE

4 March 2008

Position of SCOR[1] and GESAMP[2] on Deliberate Nutrient Additions to the Ocean

Deliberate fertilization of the ocean, until recently a subject of mostly scientific interest, has caught the attention of the commercial sector because of its potential to sequester carbon and to increase the production of living marine resources. To be effective for either of these purposes, eventual fertilization would add iron or nitrogen to large areas of the world's ocean. Proposals to realize the potential of ocean fertilization on such scales suffer a major weakness: one does not know how the oceanic ecosystem will respond. Current understanding of how the ocean operates is increasing rapidly, but is still not sufficient to predict the effects of large-scale nutrient manipulations.

Field experiments, carried out in various parts of the world ocean to study the role of iron in ocean ecosystems, have not been able to demonstrate a significant net increase in carbon export to the deep ocean on short or long time scales. These experiments have also raised important and, as yet, unanswered questions about changes in community structure. Ocean fertilization on any significant scale will (by design) impact the species succession and the ecosystem structure and function in the affected areas. Furthermore, the impacts of fertilization are unlikely to be confined to the specific region that receives the fertilizer. Ocean currents mix and move water continuously and so can transport nutrients, the resulting biomass, and decomposition products beyond the target areas, with unknown consequences. Inadvertent anthropogenic additions of nutrients to the coastal ocean are presently causing significant problems such as hypoxia, anoxia and harmful algal blooms. At the present, the long-term consequences of ecosystem alterations from nutrient additions are unforeseeable and may be harmful. The effects of deliberate large-scale nutrient addition may therefore range from the desired and positive to the unintended and negative.

The Scientific Committee on Oceanic Research (SCOR) of the International Council for Science and the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) of the United Nations agree that any deliberate large-scale addition of nutrients to the ocean must be conducted in such a way that the outcomes of these experiments are statistically quantified and independently verified with respect to but not limited to:

- Changes in new primary production and total community respiration rates at the fertilization site and "downstream" of the site;
- Assimilative capacity of selected ocean regions;

[1] SCOR is an international nongovernmental organization created in 1957 by the International Council for Science to promote international cooperation in all areas of ocean science (see www.scor-int.org).
[2] GESAMP is an independent group of experts, formed in 1969, that advises the United Nations (UN) system on the scientific aspects of marine environmental protection. It is sponsored by eight UN organizations with responsibilities for the marine environment and provides a mechanism for coordination and collaboration among them (see www.gesamp.org).

- Changes in the drawdown of carbon dioxide from the overlying atmosphere, and carbon dioxide and essential macro-nutrients (P, N, and Si) from the surface waters;
- Changes in the production of carbon dioxide and other gases relevant to climate change (e.g., nitrous oxide, methane, and dimethyl sulfide) in surface and mesopelagic waters;
- Changes in denitrification rates within the oxygen minimum zone;
- Changes in the production of toxins that might be detrimental to other organisms, for example, by harmful algal blooms;
- Changes in the export of carbon to a depth where sequestration for at least 100 years is likely;
- Changes in pH and oxygen concentrations in the water column;
- Changes in biomass, composition, and biodiversity of phytoplankton, bacteria, and zooplankton, and recruitment of fish and shellfish; and
- Changes in food web structure.

To be scientifically credible the design and implementation of large-scale nutrient addition experiments must be transparent and the results must be clearly stated and made available to the scientific community and the general public. Transparency is essential, because any appearance of lack of independence from vested interests lowers the credibility of the results among ocean scientists, environmental organizations, policymakers, and potential investors in carbon credits. Carbon credits for fertilization should not be allowed unless and until reliable methods have been developed to estimate and verify the amount of carbon actually sequestered, and side effects have been properly understood and taken into account. We commend efforts by some commercial ventures to create codes of conduct and obtain outside reviews. It is essential that each stage of these experiments is reviewed by well-qualified experts free of vested interests. The goal of any new experiment on the effects of nutrient addition should be to increase our understanding of ocean processes at adequate spatial and temporal resolution; experiments should build on the lessons and the insights of previous experiments.

For further information please contact:

General Questions about the Scientific Committee on Oceanic Research (SCOR) and SCOR's interests in this topic: Prof. Bjorn Sundby, SCOR President (Canada)—Can be reached at +1 514 398-4883.

General Questions about the Joint Group of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP) and GESAMP's interests in this topic: Dr. Michael E. Huber, Chairman of GESAMP(Australia)— Can be reached at +61 7 3244 7336.

Questions about the effects of iron in ocean ecosystems:
Dr. Ken Buesseler, Senior Scientist, Woods Hole Oceanographic Institution (USA, but on sabbatical in New Zealand) — Can be reached at +64 2 1056 0521 between 9 a.m. and 5 p.m. (New Zealand time).

Questions about iron chemistry in the ocean: Prof. Tim Jickels, School of Environmental Sciences, University of East Anglia (United Kingdom)—Can be reached at +441603 593117.

General questions about GESAMP: Fredrik Haag, GESAMP Officer, International Maritime Organization (United Kingdom), Can be reached at +44 20 7463 4139, or through gesamp@gesamp.org.

This statement contains views expressed or endorsed by members of SCOR and GESAMP who act in their individual capacities; their views may not correspond with those of their sponsoring organizations or Governments.

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ANNEX 5

(source: www.imo.org/includes/blastDataOnly.asp/data_id%3D19264/14.pdf)

INTERNATIONAL MARITIME ORGANIZATION

IMO

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Ref. T5/5.01

LC-LP.1/Circ.14
13 July 2007

CONVENTION ON THE PREVENTION OF MARINE POLLUTION BY DUMPING OF WASTES AND OTHER MATTER, 1972 AND ITS 1996 PROTOCOL

Statement of concern regarding iron fertilization of the oceans to sequester CO_2

Introduction

1 At the 30th meeting of the Scientific Group under the London Convention, convened in conjunction with the 1st meeting of the Scientific Group under the London Protocol, (Santiago de Compostela, Spain: 18 to 22 June 2007), a number of documents were considered concerning large-scale ocean iron fertilization: (LC/SG 30/12 (IUCN); LC/SG 30/12/1 (Greenpeace International); and (LC/SG 30/INF.28 (United States)). In light of these submissions, the Scientific Groups developed the following "statement of concern":

Statement of Concern

"Large-scale fertilization of ocean waters using micro-nutrients such as iron to stimulate phytoplankton growth in order to sequester carbon dioxide is the subject of recent commercial interest. The Scientific Groups of the London Convention and the London Protocol took the view that knowledge about the effectiveness and potential environmental impacts of ocean iron fertilization currently was insufficient to justify large-scale operations.

According to the Intergovernmental Panel on Climate Change (IPCC), iron fertilization of the oceans may offer a potential strategy for removing carbon dioxide from the atmosphere by stimulating the growth of phytoplankton and thereby sequestering the carbon dioxide in the form of particulate organic carbon. However, the IPCC also stated that ocean iron fertilization remains largely speculative, and many of the environmental side effects have yet to be assessed.

The Scientific Groups noted with concern the potential for large-scale ocean iron fertilization to have negative impacts on the marine environment and human health. They therefore recommended that any such operations be evaluated carefully to ensure, among other things, that such operations were not contrary to the aims of the London Convention and London Protocol[1]."

[1] This is an extract of the summary report of the joint meeting of the Scientific Groups. The full report will become available in due course as document LC/SG 30/14.

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2 The Scientific Groups agreed that the evaluation referred to in the above statement should include, among other things, consideration of:

.1 the estimated amounts and potential impacts of iron and other materials that may be released with the iron;

.2 the potential impacts of gases that may be produced by the expected phytoplankton blooms or by bacteria decomposing the dead phytoplankton;

.3 the estimated extent and potential impacts of bacterial decay of the expected phytoplankton blooms, including reduced oxygen concentrations;

.4 the types of phytoplankton that are expected to bloom and the potential impacts of any harmful algal blooms that may develop;

.5 the nature and extent of potential impacts on the marine ecosystem including naturally occurring marine species and communities;

.6 the estimated amounts and timescales of carbon sequestration, taking account of partitioning between sediments and water; and

.7 the estimated carbon mass balance for the operation.

Action requested

3 The Scientific Groups requested the 29th Consultative Meeting of Contracting Parties to the London Convention and the 2nd Meeting of Contracting Parties to the London Protocol (5 to 9 November 2007) to consider the issue of large-scale ocean iron fertilization operations with a view to ensuring adequate regulation of such operations. In particular, the Scientific Groups requested that the following issues be addressed by the Contracting Parties:

.1 the purposes and circumstances of proposed large-scale ocean iron fertilization operations and whether these are compatible with the aims of the Convention and the Protocol;

.2 the need, and potential mechanisms, for regulation of such operations; and

.3 the desirability of bringing to the attention of other international instruments and institutions proposals for such operations.

4 Contracting Parties to the London Convention and the London Protocol are invited to:

.1 take into account the above-mentioned statement of concern when considering experimental or large-scale ocean iron fertilization to sequester CO_2; and

.2 provide further information relating to proposed large-scale ocean iron fertilization operations to the Secretariat and to the Scientific Groups as and when such information becomes available.

5 Background information and reports on the discussions in the last two years under the London Convention and Protocol about CO_2 sequestration in sub-seabed geological formations can be found at http://www.imo.org/dynamic/mainframe.asp?topic_id=1615, while general information about the London Convention and Protocol can be accessed at http://londonconvention.org.

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ANNEX 6

(source: http://solas-int.org/aboutsolas/organisationaandstructure/sciencesteercomm/sscmins/positionstatement.pdf

SOLAS SSC Position statement on large-scale ocean fertilization

Large-scale fertilization of the ocean is being actively promoted by various commercial organizations as a strategy to reduce atmospheric CO_2. However, the current scientific evidence indicates that this will not significantly increase carbon transfer into the deep ocean or lower atmospheric CO_2. Furthermore there may be negative impacts of iron fertilization including dissolved oxygen depletion, altered trace gas emissions that affect climate and air quality, changes in biodiversity, and decreased productivity in other oceanic regions. It is then critical and essential that robust and independent scientific verification is undertaken before large-scale fertilization is considered. Given our present lack of knowledge, the judgement of the SOLAS SCC is that ocean fertilization will be ineffective and potentially deleterious, and should not be used as a strategy for offsetting CO_2 emissions.

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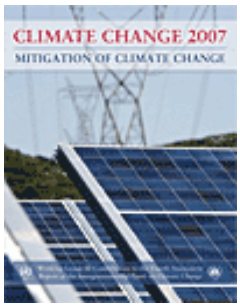
ANNEX 7

Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change



Extracts from the report "MITIGATION OF CLIMATE CHANGE"

(source: http://www.ipcc.ch/ipccreports/ar4-wg3.htm)

Summary for Policymakers
(page 15)

17. Geo-engineering options, such as ocean fertilization to remove CO_2 directly from the atmosphere, or blocking sunlight by bringing material into the upper atmosphere, remain largely speculative and unproven, and with the risk of unknown side-effects. Reliable cost estimates for these options have not been published (medium agreement, limited evidence) [11.2].

Technical Summary
(pages 78-79)

Apart from the mitigation options mentioned in the sectoral Chapters 4–10, geo-engineering solutions to the enhanced greenhouse effect have been proposed. However, options to remove CO_2 directly from the air, for example, by iron fertilization of the oceans, or to block sunlight, remain largely speculative and may have a risk of unknown side effects. Blocking sunlight does not affect the expected escalation in atmospheric CO_2 levels, but could reduce or eliminate the associated warming. This disconnection of the link between CO_2 concentration and global temperature could have beneficial consequences, for example, in increasing the productivity of agriculture and forestry (in as far as CO_2 fertilization is effective), but they do not mitigate or address other impacts such as further acidification of the oceans. Detailed cost estimates for these options have not been published and they are without a clear institutional framework for implementation (medium agreement, limited evidence) [11.2.2].

Table SPM.E.1: *Qualitative definition of uncertainty*

Level of agreement (on a particular finding) ↑ / Amount of evidence[33] (number and quality of independent sources) →			
	High agreement, limited evidence	High agreement, medium evidence	High agreement, much evidence
	Medium agreement, limited evidence	Medium agreement, medium evidence	Medium agreement, much evidence
	Low agreement, limited evidence	Low agreement, medium evidence	Low agreement, much evidence

Chapter 11 Mitigation from a cross-sectoral perspective
(pages 624-625)

11.2.2.1 Iron and nitrogen fertilization of the oceans

Iron fertilization of the oceans may be a strategy for removing CO_2 from the atmosphere. The idea is that it stimulates the growth of phytoplankton and therefore sequesters CO_2 in the form of particulate organic carbon (POC). There have been eleven field studies in different ocean regions with the primary aim of examining the impact of iron as a limiting nutrient for phytoplankton by the addition of small quantities (1–10 tonnes) of iron sulphate to the surface ocean. In addition, commercial tests are being pursued with the combined (and conflicting) aims of increasing ocean carbon sequestration and productivity. It should be noted, however, that iron addition will only stimulate phytoplankton growth in ~30% of the oceans (the Southern Ocean, the equatorial Pacific and the Sub-Arctic Pacific), where iron depletion prevails. Only two experiments to date (Buesseler and Boyd, 2003) have reported on the second phase, the sinking and vertical transport of the increased phytoplankton biomass to depths below the main thermocline (>120 m). The efficiency of sequestration of the phytoplankton carbon is low (<10%), with the biomass being largely recycled back to CO_2 in the upper water column (Boyd *et al*., 2004). This suggests that the field-study estimates of the actual carbon sequestered per unit iron (and per dollar) are over-estimates. The cost of large-scale and long-term fertilization will also be offset by CO_2 release/emission during the acquisition, transportation and release of large volumes of iron in remote oceanic regions. Potential negative effects of iron fertilization include the increased production of methane and nitrous oxide, de-oxygenation of intermediate waters and changes in phytoplankton community composition that may cause toxic blooms and/or promote changes further along the food chain. None of these effects have been directly identified in experiments to date, partly due to the time and space constraints.

Nitrogen fertilization is another option (Jones, 2004) with similar problems and consequences.