INTERNATIONAL MARITIME ORGANIZATION

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SCIENTIFIC GROUP OF THE LONDON CONVENTION – 44th Meeting; and

SCIENTIFIC GROUP OF THE LONDON PROTOCOL – 15th Meeting
12 – 16 April 2021
Agenda item 16

LC/SG 44/16
29 April 2021
Original: ENGLISH
Pre-session public release: ☐

REPORT OF THE FORTY-FOURTH MEETING OF THE SCIENTIFIC GROUP OF THE LONDON CONVENTION AND THE FIFTEENTH MEETING OF THE SCIENTIFIC GROUP OF THE LONDON PROTOCOL

Table of contents

LIST OF ANNEXES

s. 22(1)(a)(ii)

3.11 The delegation of Australia noted that WG 41 had stated that there were no active marine cloud brightening proposals in development (LC/SG 44/3/Add.1); however, in December 2019, Australia had initiated a “proof of concept” study for marine cloud brightening and trials were conducted in 2020 and 2021. The delegation offered to provide more information on the study to future sessions of the Scientific Groups.

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

[1] The coordinator, Dr. s. 47F(1) (Italy), can be contacted at s. 47F(1)

MEETING:	LC/SG 44	44TH Meeting of the Scientific Group of the LC and 15th Meeting of the Scientific Group of the LP
CONTACT:		Department of Agriculture, Water and the Environment s. 22(1)(a)(ii), Director, Sea Dumping Section s. 22(1)(a)(ii) / s. 47F(1) s. 22(1)(a)(ii)@awe.gov.au cc seadumping@awe.gov.au

C2: AGENDA ITEM 3 - MARINE GEOENGINEERING

DOCUMENTS

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

SUGGESTED INTERVENTION

Thank you Chair. The GESAMP Working Group 41's Table on Marine Geoengineering techniques advises there are no active marine cloud brightening proposals to develop or trial. We would like to provide a status update. In December 2019, Australia initiated a proof-of-concept study for cloud brightening. Australia is able to provide further information on this study if requested. Thank you.

If asked -

The study was assessed as low risk to the values of the Great Barrier Reef Marine Park. The trials ran in March 2020 and March 2021.

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

Further information can be found at: https://www.gbrrestoration.org/home. This includes several methods with the same underpinning technologies as global geoengineering concepts but deployed at local scales. Meeting and maintaining appropriate regulatory approval and ensuring public support will be fundamental in deploying any viable intervention on the Reef.

s. 22(1)(a)(ii)

As part of this challenge, funding has been provided to the Sydney Institute of Marine Science for a marine cloud brightening feasibility study. This study will test mechanisms for supplying salt-based aerosols (formed by spraying micron sized seawater droplets) to the air to increase marine cloud reflectivity.

On 11 December 2019, a Marine Parks permit was granted for a proof-of-concept study for cloud brightening. The small-scale project was assessed as low risk to the values of the Great Barrier Reef Marine Park with appropriate mitigation in place. The proof-of-concept study occurred in March 2020 and March 2021, following approval of the required Sampling and Analysis Plan. The aim of initial trials is to evaluate the performance and reliability of the equipment and to quantify the characteristics and behaviour of the sea-salt plume at sea surface level under prevailing meteorological conditions. The trials occurred within two locations offshore Townsville and involved operation of the sea spray generator from a vessel for several hours with monitoring of atmospheric conditions and plume. Early reporting indicates the equipment was successful at the scale deployed.

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

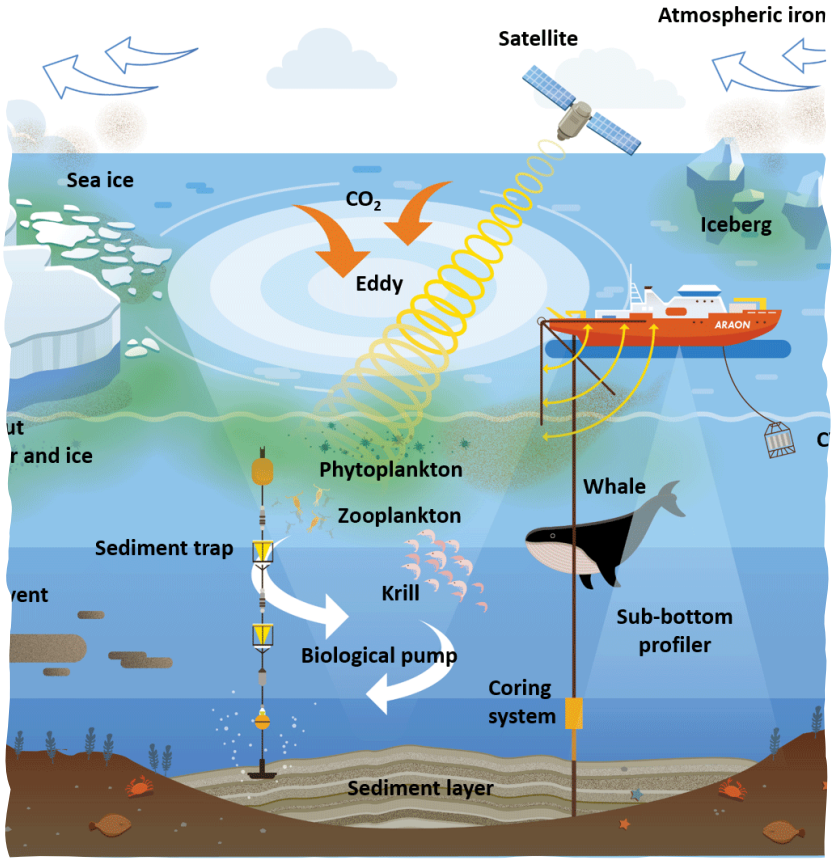
From: s. 22(1)(a)(ii)
To: s. 22(1)(a)(ii); Sea Dumping Section
Cc: Sea Dumping
Subject: RE: Upcoming meeting with GBRMPA 6 May 2021 [SEC=OFFICIAL]
Date: Monday, 3 May 2021 11:08:18 AM

s. 22(1)(a)(ii), yes. I do. But I am going to call them before your meeting. Australia has offered to provide more information about our marine cloud brightening trials that were conducted in 2020 and 2021. They must have occurred in the GBRMP as GBRMPA provided permits for this to happen. So we may raise it if we need to on Thursday. I can talk to you again before Thursday's meeting.
s. 22(1)(a)(ii)

From: s. 22(1)(a)(ii) <s. 22(1)(a)(ii) @environment.gov.au>
Sent: Monday, 3 May 2021 10:40 AM
To: Sea Dumping Section <xxxxxxxxxxxxxxxxxxx@xxxxxxxxxxx.xxx.xx>
Cc: Sea Dumping <xxxxxxxxxx@xxxxxxxxxxx.xxx.xx>
Subject: Upcoming meeting with GBRMPA 6 May 2021 [SEC=OFFICIAL]
s. 22(1)(a)(ii)

s. 22(1)(a)(ii)
Assessment Officer | Sea Dumping Section
Assessments Queensland and Sea Dumping Branch
GPO Box 787, CANBERRA ACT 2601
Phone: s. 22(1)(a)(ii)
The Department acknowledges the traditional owners of country throughout Australia and their continuing connection to land, sea and community. We pay our respects to them and their cultures and to their elders both past and present.

Marine geoengineering, including ocean fertilisation



- 2013 resolution to amend the London Protocol to regulate the placement of matter for ocean fertilization and other marine geoengineering activities.
- IMO has received only **6** instruments of acceptance of the amendment from: the UK, Finland, the Netherlands, Norway, Estonia and Germany.
  - Two thirds of the Contracting Parties that adopted the amendment need to ratify it by providing 'instruments of acceptance' **before** the amendment comes into **force**.
  - Progress is slow.
- During the 2021 Scientific Groups discussions Australia agreed to provide information on a **proof-of-concept marine cloud brightening study** conducted in the Great Barrier Reef Marine Park in 2020 and 2021.
  - This was noted by Greenpeace.
  - Australia advised we are waiting on peer review of the research before circulating - aim to provide an update prior to the next Scientific Groups meeting (28 March – 1 April 2022).

From: David Mead <D.Mead@aims.gov.au>
Sent: Monday, 7 March 2022 6:14 PM
To: s. 22(1)(a)(ii) <s. 22(1)(a)(ii) @environment.gov.au>
Subject: Followup

HI,

Sorry I forgot to send this, and due to the delay I may have not remembered if I agreed to send any other information. If that's the case please let me know.

Thanks David

Two general comments that are possibly not needed yet, but provided for background:

- s. 22(1)(a)(ii)

- Previously it has been discussed that R&D may need to be controlled even if it is occurring for a non-geoengineering use, but it has the potential to be used in that way. There are clearly areas where we do need to be prudent, but the discussion and any rules needs to be more nuanced than this. By way of example RRAP is undertaking R&D to deploy marine cloud brightening at the GBR scale and technically this same technology could be used to deploy at a global scale. However, global deployment would require 10's of thousands (if not more) deployment barges spread over the planets oceans and the associated marine jurisdictions. It's not a method that a rouge actor could deploy on behalf of the planet, it would require a global commitment. So at some stage the concept of how it could be deployed needs to be factored into regulation.

Some technical points on the R&D occurring within RRAP. The program is split into two areas:

- The shading techniques that are about light reduction, and do not impact water temperature. We believe (this is still being tested) about a 30% light reduction compared to a very bright day is required to have an impact on bleaching if the water is not being cooled. Currently only one method is being explored (other discounted as too expensive/difficult) that of fogging using seawater. Misting is discussed in the notes for the meeting, we are not investigating that at this time (it's similar to fogging, but mists something other than seawater). Fogging likely to only ever be at scales of a 100's m2 to a few km2 (technical and cost challenges), and so has no impact on water temperatures.

- Marine Cloud Brightening (MCB) is the other method and it uses a very small level of light reduction to impact water temperatures over long time period. In our usage it is about preventing water from warming up, as opposed to cooling it down. In effect it is seeking to prevent elevated temperature periods that are now occurring for periods of weeks to months warming up the water. The level of light reduction is 5% to 10%, levels that will be difficult to distinguish by the naked eye, and targets avoid temperature increases of 0.5 and 1.0 degrees during bleaching events (if that much can be achieved). This is less than the current annual variations in both light and water temperature. In contrast to fogging, the

MCB effect is very small and so only works at larger scales. You need to apply this effect to the water for a period of a few weeks, and so the MCB area needs to be larger than how far water moves over several weeks. As such the likely the smallest area would be 1/3 to ½ of the GBR, noting this is an active R&D area and so is an educated guess.

- Both fogging and MCB distribute seawater droplets, the difference is in the size of the droplets. Ultimately the salt in the water returns to the ocean, so the salt is not added and neither should not be considered as "constituting a deposit of wastes or other matter" – Section 32. This is replicating how existing sea fogs and sea clouds are formed, just enhancing the process.

- Neither method is seeking to "cool the ocean".

R&D to date / occurring:

- To determine of MCB is a viable technique there are three areas of investigation, all three areas are progressing well, however we would not expect to have an "investable proposition" for 5 to 10 years. The three areas are:
  1. Are the atmospheric conditions during bleaching events suitable for MCB to work
  2. Can aerosols (salt droplets created from seawater) be generated and dispersed at sea level, that spread out in the required way, and change the levels of reflectance in low level clouds.
  3. Can the aerosols be generated in required volumes, and can this occur at a reasonable cost (energy consumption is the major issue)

- R&D into fogging is less progressed, however the concept is far simpler. Currently we are assessing if seawater droplets can be generated of the right size distribution to create a fog in a cost/energy efficient manner, and assessing the logistics of how to maintain a fog over a target area during bleaching events. Both areas are still to be proven and will take 2 to 3 years further R&D to understand.

David Mead
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	Agenda Items for the upcoming Meeting of the Contracting Parties
10min (11:05-11:15) s. 22(1)(a)(ii)	s. 22(1)(a)(ii) **Talking Points** • The 'Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection' (GESAMP) Working Group 41 (WG41) has suggested seven techniques that should be considered for listing in the new annex 4 of the Protocol: ○ fertilization for fish stock enhancement ○ macroalgae cultivation for sequestration including artificial upwelling ○ microbubbles/reflective particles/material ○ marine cloud brightening ○ alkalinization of the ocean by adding alkaline material directly to the ocean or by electrochemistry ○ mineralization of CO_2 in rocks under the seabed ○ extraction of CO_2 from seawater. s. 22(1)(a)(ii) s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

- Australia provided an update on trials by the Sydney Institute of Marine Science, conducted in 2020 and 2021 which were "proof of concept" studies for marine cloud brightening, noting:
    - The trials were small scale utilising ‘Sea Salt Spray Generation by Effervescent Nozzle Technology’ at two locations offshore from Townsville. Larger scale marine cloud brightening trials are expected to be undertaken in 2022.
    - These studies are in their infancy, with no quantitative data currently available.
- s. 22(1)(a)(ii)

INTERNATIONAL MARITIME ORGANIZATION

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SCIENTIFIC GROUP OF THE LONDON CONVENTION – 45th Meeting; and

SCIENTIFIC GROUP OF THE LONDON PROTOCOL – 16th Meeting
28 March to 1 April 2022
Agenda item 3

LC/SG 45/3
7 January 2022
ENGLISH ONLY
Pre-session public release: ☒

MARINE GEOENGINEERING

Updated advice from GESAMP Working Group 41 to the London Protocol Parties to assist them in identifying marine geoengineering techniques that it might be prudent to consider for listing in the new annex 4 of the Protocol

Note by the Secretariat

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

Marine Cloud Brightening

31 The technique of Marine Cloud Brightening was reviewed in GESAMP (2019) but at that time no field experiments had been carried out or were planned. However, the Australian Government's AUS$ 150 million Reef Restoration and Adaptation Program (https://gbrrestoration.org/) has a 'Cooling and Shading' sub-program (https://gbrrestoration.org/program/cooling-and-shading/) that includes a marine cloud brightening project (https://gbrrestoration.org/program/cooling-by-cloud-brightening/ and https://www.youtube.com/watch?v=lylzQsZUZnk). To date the project has carried out two initial experiments, in March 2020 and August 2021 in waters of the Great Barrier Reef (see https://www.nature.com/articles/d41586-021-02290-3 and two short videos of the 2021 test https://www.youtube.com/watch?v=_LmV94WSkmc, https://www.youtube.com/watch?v=0DgB88_BtUY).

s. 22(1)(a)(ii)

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DEPARTMENT OF AGRICULTURE, WATER AND THE ENVIRONMENT

SCIENTIFIC GROUP OF THE LONDON CONVENTION – 45th Meeting and SCIENTIFIC GROUP OF THE LONDON PROTOCOL – 16th Meeting

(Virtual meeting: 28 March to 1 April 2022)

AGENDA ITEM 3 – MARINE GEOENGINEERING

DOCUMENTS

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

If asked about provision of the Australian research on a proof-of-concept marine cloud brightening study conducted in the Great Barrier Reef Marine Park in 2020 and 2021

- Thank you Chair. At the London Convention/London Protocol (LC/LP) meeting of Contracting Parties in October 2021, the Australian delegation noted we would endeavour to bring forward an update on the proof-of-concept studies for marine cloud brightening that were conducted in 2020/21. Research programs into marine cloud brightening in the Australian jurisdiction are in their infancy, with no quantitative data currently available. Australia will provide a further update in due course.

s. 22(1)(a)(ii)

Contact: s. 22(1)(a)(ii)
Director - Sea Dumping Section
Ph: s. 47F(1)
s. 22(1)(a)(ii)@awe.gov.au cc admin.seadumping@awe.gov.au

Agenda Item 3: GESAMP report identifying marine geoengineering techniques that it might be prudent to consider for listing in the new annex 4 of the Protocol i.e., as part of the 2013 marine geoengineering amendment to the LP

Refer - LC/SG 45/3

References to Australian marine geoengineering initiatives:

- Table 1: Marine geoengineering techniques that the London Protocol Parties might wish to consider for listing in the new annex 4 of the Protocol or take other actions. Under technique Groupings: Increasing ocean albedo/reflectivity:
  s. 22(1)(a)(ii)

  2. Marine Could Brightening - there have been 2 initial trials of this technique in waters of the Great Barrier Reef, Australia.

- s. 22(1)(a)(ii)

- s. 22(1)(a)(ii)

- s. 22(1)(a)(ii)

- s. 22(1)(a)(ii)

- Heading: **Marine Cloud Brightening** - Paragraphs 31 and 32: The technique of Marine Cloud Brightening was reviewed in GESAMP (2019) but at that time no field experiments had been carried out or were planned. However, the Australian Government's AUS$ 150 million Reef Restoration and Adaptation Program (https://gbrrestoration.org/) has a 'Cooling and Shading' sub-program (https://gbrrestoration.org/program/cooling-and-shading/) that includes a marine cloud brightening project (https://gbrrestoration.org/program/cooling-by-cloud-brightening/ and https://www.youtube.com/watch?v=lylzQsZUZnk). To date the project has carried out two initial experiments, in March 2020 and August 2021 in waters of the Great Barrier Reef (see https://www.nature.com/articles/d41586-021-02290-3 and two short videos of the 2021 test https://www.youtube.com/watch?v=_LmV94WSkmc, https://www.youtube.com/watch?v=0DgB88_BtUY). Noting that para 32 states: The LP Parties may wish to consider whether marine cloud brightening (MCB) should be regulated by the LP under the 2013 amendments due to the effect of MCB on the ocean (see section 5.16 of GESAMP, 2019) including deposition of salt particles on the ocean surface from the activity potentially constituting a deposit of 'wastes or other matter' under the LP. There is a precedent for such regulation as the London Convention (and also the Oslo Convention 1972) regulated incineration at sea that took place from the late 1960s to early 1990s due to the deposition of the products of combustion on the sea surface.

- Heading: **Priorities** - Subject to any new information about developing projects, it is suggested that the following techniques would be the highest priorities techniques to be considered for listing in the new annex 4 of the Protocol:
  - s. 22(1)(a)(ii)
  - Marine Cloud Brightening;
  - s. 22(1)(a)(ii)

- s. 22(1)(a)(ii)

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DEPARTMENT OF CLIMATE CHANGE, ENERGY, THE ENVIRONMENT AND WATER

s. 22(1)(a)(ii)

45th meeting of the Scientific Group under the London Convention and the 16th meeting of the Scientific Group under the London Protocol, 28 March – 1 April 2022

s. 22(1)(a)(ii)

Marine Cloud Brightening

Australia brought forward an update on the proof-of-concept studies for marine cloud brightening, conducted in 2020 to 2021. Trials included the utilisation of small scale 'Sea Salt Spray Generation by Effervescent Nozzle Technology' at two locations offshore from Townsville, with larger scale trials proposed in the future. Australia agreed to provide a further update in due course.

s. 22(1)(a)(ii)

43rd Consultative Meeting of Contracting Parties to the London Convention and 16th Meeting of Contracting Parties to the London Protocol (25 – 29 October 2021)

s. 22(1)(a)(ii)

Marine Cloud Brightening

Greenpeace International reminded the Meetings that the Scientific Groups had highlighted advances with the geoengineering technique of marine cloud brightening and requested the Correspondence Group also consider this technique.

The delegation of Australia informed the Meetings that they would endeavour to bring more information on marine cloud brightening to the Scientific Groups meeting in 2022 (LC 43/17).

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Assistant Director - Sea Dumping Section
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