

Marine & Environmental Law

Ocean Iron Fertilisation beyond National Jurisdiction: International Law Opportunities and Constraints

By

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INTRODUCTION

The concentration of greenhouse gases (GHG) in the atmosphere has increased substantially since the industrial revolution.¹ Unequivocal evidence of a warming climate that has been observed includes increased global average air and ocean temperatures, extensive melting of snow and ice, and rising average sea levels.² It is now generally accepted that the dominant cause of the climatic warming experienced is the increase in anthropogenic GHG emissions, most notably carbon dioxide (CO₂).³ If mankind continues to emit GHGs at the current rate, by 2050 the concentration of GHGs in the atmosphere will have doubled pre-industrial levels and will most likely result in a global temperature increase exceeding 2°C.⁴

Climate change poses a significant threat to ecosystems.⁵ If a temperature increase of 2°C is experienced an estimated 15 to 40% of species could face extinction.⁶ Marine ecosystems are also threatened by ocean acidification, a result of a rising concentration of CO₂.⁷ Climate change also poses severe impacts to human life and, using models, scientists have projected that as the climate continues to warm flood risk will increase, droughts will intensify, crop yields will decline, deaths from malnutrition and heat stress will increase world wide and vector-borne diseases will become more widespread.⁸ Furthermore it is

¹ Before the Industrial Revolution the concentration of GHGs in the atmosphere was equivalent to 280ppm CO₂, it is currently equivalent to approximately 430ppm CO₂.

² IPCC. 'Summary for Policymakers'. (2007). In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge, UK, 7-22. At 2-5.

³ Ibid.

⁴ Stern, N. 'Stern Review The Economics of Climate Change'. (2006). HM Treasury. At iii.

⁵ Ibid. At vi

⁶ Ibid.

⁷ Ibid.

⁸ IPCC. 'Summary for Policymakers'. (2007). In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge, UK, 7-22. [hereafter 'IPCC, 2007 WG II'] At 8-18.

predicted that these impacts of climate change will accelerate as GHG concentrations rise and the climate system gets warmer.⁹

Humankind is now faced with the urgent global challenge of adapting to the unavoidable impacts caused by previous emissions and stabilizing the atmospheric GHG concentration at a level that will not threaten the ability of humans to continue surviving on earth.¹⁰ According to recent models a 90% reduction in emissions will be required in order to limit climate change to an 'acceptable' level.¹¹ The reduction of CO₂ emissions from anthropogenic activities is the preferred climate change mitigation measure;¹² however, there is much evidence available indicating that, with the current emission reduction policies and practices, the global GHG emissions will continue to rise over the next few decades.¹³

As a result of the urgent need for action against climate change and the evidence of the continuing acceleration of emissions from anthropogenic activities, several alternative 'geo-engineering' mitigation measures have been proposed and discussed intensely.¹⁴ 'Geo-engineering' involves large scale manipulations of the earth's systems which would result in wide-ranging changes to the planet with uncertain consequences.¹⁵ Fertilisation of the oceans with iron as a means to enhance the production of marine phytoplankton (microscopic algae) and increase the sequestration of CO₂, thereby boosting the oceanic

⁹ Stern, N. [Note 4] At vii

¹⁰ IPCC, 2007 WG II [Note 8] At 19-20

¹¹ Matthews, H.D. and Caldeira, K. 'Stabilizing climate requires near zero emissions.' (2008). *Geophys Res Lett.* **35**, L04705.

¹² Denman, K.L. 'Climate change, ocean processes and ocean iron fertilisation'. (2008). *Marine Ecology Progress Series* **364**. 219. At 219.

¹³ IPCC. 'Summary for Policymakers'. (2007). In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge, UK, 7-22. At 4.

¹⁴ Denman, K.L. [Note 12] At 219.

¹⁵ Cullen, J.J. and Boyd, P.W. 'Predicting and verifying the intended and unintended consequences of large scale ocean iron fertilisation'. (2008). *Marine Ecology Progress Series*. **364**. 295. At 295.

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¹² Denman, K.L. 'Climate change, ocean processes and ocean iron fertilisation'. (2008). *Marine Ecology Progress Series* **364**. 219. At 219.

¹³ IPCC. 'Summary for Policymakers'. (2007). In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge, UK, 7-22. At 4.

¹⁴ Denman, K.L. [Note 12] At 219.

¹⁵ Cullen, J.J. and Boyd, P.W. 'Predicting and verifying the intended and unintended consequences of large scale ocean iron fertilisation'. (2008). *Marine Ecology Progress Series.* **364**. 295. At 295.

carbon sink, is a proposed 'geoengineering' mechanism that is surrounded by much controversy.¹⁶

For Ocean Iron Fertilisation (OIF) to be successful as a mitigation operation it must:

'...sequester CO₂ in sufficient quantity for a sufficient time period to make a sufficient reduction on the rate of increase of atmospheric CO₂ in a verifiable manner, without deleterious unintended side effects'.¹⁷

A dozen small scale iron addition experiments have been conducted in the last 15 years and several models of large scale OIF have been produced,¹⁸ however there is still a large degree of uncertainty with regards to the sequestration efficiency and side effects of OIF.¹⁹ Despite these uncertainties OIF has received much attention as a potential climate change mitigation technique which has spurred intense debates. To date only OIF research activities have been conducted, however the private sector has made plans to merge science and commercial interests and accrue financial gains through the generation of carbon credits.²⁰ The current and potential role of OIF in the carbon markets is crucial to consider so to understand to what extent OIF activities are occurring and may occur in future.

Experimental research on iron fertilisation conducted to date has occurred in international waters and the proposed large scale iron fertilisation activities would occur there too. The extra-territorial nature of OIF activities begs the question of what rights states have to conduct OIF research and commercial activities in the different maritime zones, and what compliance, enforcement and liability mechanisms are available.

¹⁶ Denman, K.L. [Note 12] At 220.

¹⁷ Ibid. At 220.

¹⁸ Ibid. At 219.

¹⁹ Buesseler, K.O. et al. 'Ocean Iron Fertilisation – Moving Forward in a Sea of Uncertainty.' (2008). *Science*. **319**. 162.

²⁰ Ibid, Climos. 'The Rational for Commercial Participation in Ocean Iron Fertilization Experiments'. Submitted to the Scientific Group of the London Convention by Climos. May 19, 2008. Available at: www.climos.com/imo/Climos/Climos_Commercial_Rationale.pdf Accessed on: 10/11/2008.

The protection of the oceans and seas biophysical and ecological characteristics is important from both an ecocentric and anthropocentric point of view as mankind is dependant on the sea as a vital source of food security and for upholding economies and the well-being of present and future generations.²¹ Given the uncertainties regarding the environmental side effects of OIF it is important to ensure that regulations and restrictions are imposed on OIF activities in international waters so to minimise detrimental environmental effects that could potentially be of global significance.

Currently there is no specific international law aimed at regulating OIF research activities and projects. The aim of this paper is to assess the efficiency of current international laws in regulating and restricting OIF activities, with a specific focus on ocean utilisation and environmental protection, and to determine whether a specific international regime for OIF is needed. The first chapter provides context in the form of an overview of the current scientific and commercial status of the OIF technique, and highlights specific areas of concern. The second chapter is an investigation of the regulation of the activity itself under the United Nations Convention of the Law of the Sea (UNCLOS) with respect to access to and use of the oceans. The international treaties, soft laws and customary laws that could potentially regulate and restrict OIF activities on the high seas are dealt with in the third chapter. The last chapter examines the weaknesses inherent in the current international laws with respect to OIF activities and the protection of the environment, and proposes a way forward.

²¹ Kirchner, A. 'International Marine Environmental Law: Editorial Introduction'. 2003. In: *International Marine Environmental Law*. At 2.

CHAPTER 1 - OCEAN IRON FERTILISATION AS A FORM OF CLIMATE CHANGE MITIGATION

1.1 - THE OCEANIC CARBON SINK

The deep waters of the oceans play an important role as one of the major reservoirs in the global carbon cycle.²² The natural cycle of carbon between the surface layers and the deep waters of the ocean is controlled by two global mechanisms; the 'solubility pump' and the 'biological pump'.²³

The Solubility Pump

The sinking of cold, dense salty water in the polar regions is the driver of the solubility pump. Any CO₂ that has dissolved in these cold dense waters will sink under the warmer layers at the Polar Regions and remain trapped under these layers until the deep water eventually warms and resurfaces.²⁴ Ocean circulation and the solubility of CO₂ in ocean water thus determine to what extent CO₂ is captured, stored and released by the solubility pump. As a result of the increased concentration of atmospheric CO₂, the solubility of CO₂ in ocean waters has increased since pre-industrial times and has consequently formed a historically-recent ocean sink for CO₂.²⁵ Techniques to manipulate and further enhance the ocean solubility pump and the associated sequestration of carbon to the deep ocean are highly unlikely to become feasible.²⁶

²² Mahli, Y. et al. 'Forests, Carbon and Global Climate'. (2002). *Phil. Transactions: Mathematical, Physical and Engineering Sciences*. **360**. 1567. At 1567, 1569.

²³ Ibid.

²⁴ Rayfuse, R. et al. 'Ocean Fertilisation and Climate Change: The Need to Regulate Emerging High Seas Uses. (2008). *The International Journal of Marine and Coastal Law* **23**. At 302.

²⁵ Lampitt, R.S. et al. 'Ocean Fertilisation: a potential means of geo-engineering?' (2008). *Philosophical Transactions of the Royal Society*. **366**. 3919-3945. At 3920-3921.

²⁶ Zhou, S. and Flynn, P. 'Geoengineering Downwelling Ocean Currents: A cost Assessment.' (2005). *Climate Change* **71**. 203.

The Biological Pump

The concentration of CO₂ in the oceans' surface layers is kept in equilibrium with the atmosphere while the deep ocean masses have been found to be oversaturated with dissolved CO₂.²⁷ The concept of the biological pump has been identified as the cause of this phenomenon.²⁸ The driver of the biological pump is the gravitational settling of organic carbon that has been fixed through the photosynthetic activity of phytoplankton at the surface.²⁹

The surface layers of the ocean take up CO₂ from the atmosphere where it is rapidly dissolved into three different inorganic carbon components. The conversion of dissolved CO₂ into organic carbon occurs by means of the photosynthetic activities of phytoplankton. During photosynthesis CO₂ is absorbed from solution thus lowering the CO₂ concentration in the surface layers resulting in an uptake of CO₂ by the ocean from the atmosphere.³⁰ The absorbed CO₂ is fixed as organic carbon in phytoplankton.³¹

Phytoplankton forms the base of the marine food web by providing a source of food to zooplankton (small drifting marine animals). After consuming the phytoplankton, zooplankton excrete dissolved organic carbon and respire dissolved inorganic carbon, most of which is cycled within surface layers on short timescales.³² Some of the dead phytoplankton and dissolved organic carbon released by zooplankton sink beneath the ocean's surface layers. Most of organic carbon that is exported out of the surface layers is remineralised in the first 500m by bacteria and, only a small fraction reaches the deep ocean sediments, where it is stored in deep ocean reservoirs as dissolved organic carbon and

²⁷ Longhurst, A.R. 'Role of the marine biosphere in the global carbon cycle'. (1991). *Limnol. Oceanogr* **36.8**. 1507-1526. At 1507

²⁸ Ibid.

²⁹ Ibid.

³⁰ Lampitt, R.S. et al. [Note 25] At 3921-3822.

³¹ Denman, K.L. [Note 12] At 221.

³² Ibid.

organic sediments.³³ Currently the world's deep ocean reservoirs hold more carbon than what exists in the atmosphere.³⁴

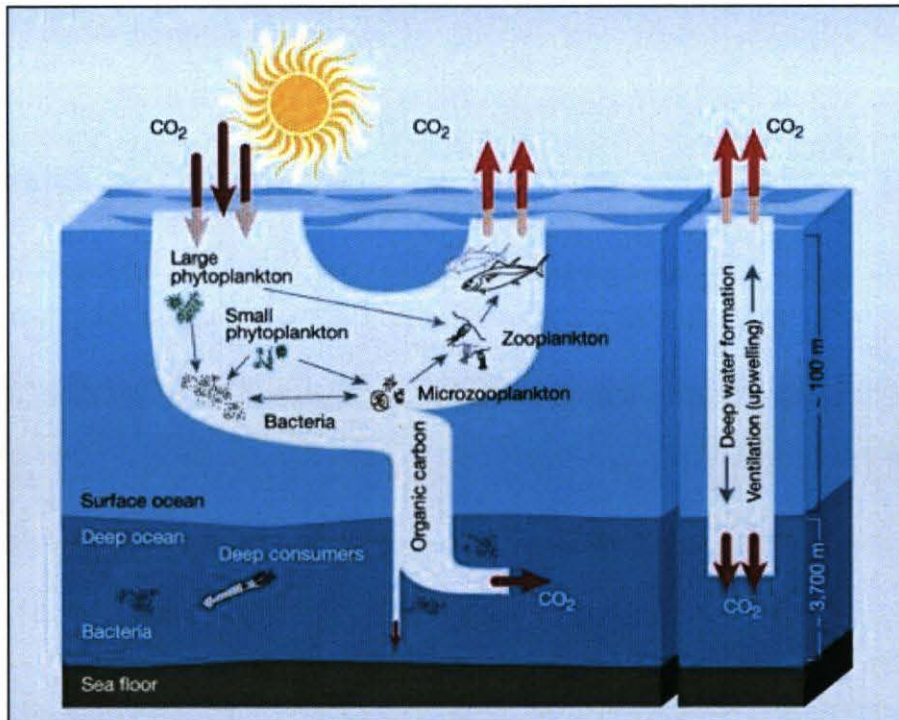


FIGURE 1: The Biological Pump

From: Christolm, S.W. 'Stirring Times in the Southern Ocean'. 2000. *Nature* (407) 685-687.

Limitations to the Photosynthetic Activity of Phytoplankton

The photosynthetic activity of phytoplankton is dependant on several factors including; light, availability of macronutrients and micronutrients, temperature, mixing and grazing. Macronutrients are nutrients that are required in relatively high concentrations and include nitrogen and phosphorus, while micronutrients such as iron and zinc are required at lower concentrations.

Phytoplankton growth in the oceans is predominantly limited by light and nutrient availability.³⁵ Nutrients are made available to the sunlit "euphotic zone"³⁶

³³ Ibid. Peterson, J.E. 'Can Algae Save a Generation? A look at Technology, Law and Policy Regarding Iron Fertilisation of the Ocean to Counteract the Greenhouse Effect.' (1995). *Colo. J. Int'l Env'tl. L. & Pol'y.* **6.61** At 69.

³⁴ Ibid.

by several mechanisms including upwelling events,³⁷ terrestrial run-off and wind-blown dust deposits.³⁸ There are regional variations in the supply of nutrients to the euphotic zone and hence the effectiveness of the biological pump varies geographically.³⁹ Consistently high concentrations of macronutrients with low levels of phytoplankton biomass (as defined by chlorophyll) are found in approximately 25% of the oceans surface area.⁴⁰ The Southern Ocean, the North Pacific and the eastern equatorial Pacific are the three major ocean areas that have been recognized as High Nutrient Low Chlorophyll (HNLC) regions and have all been characterized as having a deficiency of iron.⁴¹

The Iron Hypothesis

The oceanographer, John Martin, conducted research, in the three major HNLC regions, that led to the development of the iron hypothesis, which states that inadequate supplies of iron to HNLC regions are responsible for the lack of phytoplankton productivity.⁴² The initial experiments, conducted in bottles, indicated that a small supply of iron to HNLC waters could induce a significant bloom of phytoplankton that could metabolise up to 20 000 times its weight in CO₂.⁴³ Using these results Martin estimated that up to 3 billion tons of atmospheric carbon could be removed annually by fertilizing the Southern Ocean with 430 000 tons of iron.⁴⁴

These estimates correlated with ice-core records which indicated that iron-rich atmospheric dust deposited in the Southern Oceans during glacial times resulted

³⁵ Lampitt, R.S. et al. [Note 25] At 3920-3921.

³⁶ The surface layer of the ocean, up to 100m deep.

³⁷ Surfacing of deep ocean layers

³⁸ Lampitt, R.S. et al. [Note 25] At 3924-3925.

³⁹ Peterson, J.E. [Note 33] At 69.

⁴⁰ Lampitt, R.S. et al. [Note 25] At 3923.

⁴¹ Rayfuse, R. et al. [Note 24] At 303.

⁴² Martin, J.H. et al. 'Iron Deficiency Limits Phytoplankton growth in Northeast Pacific Subarctic.' (1988). *Nature* **331**. 341-343; Martin, J.H. et al. 'Iron Deficiency Limits Phytoplankton growth in Antarctic Waters.' (1990). *Global Biogeochemical Cycles* **4**. 5-12; Martin, J.H. et al. 'Testing the Iron Hypothesis in Ecosystems of the Equatorial Pacific Ocean.' (1994). *Nature* **371**. 123-129.

⁴³ Ibid.

⁴⁴ Martin, J.H. 'Glacial-Interglacial CO₂ Change: The Iron Hypothesis' (1990). *Paleoceanography* **5**. 1-13.

in the removal of up to 60 billion tons of carbon out of the atmosphere.⁴⁵ This led to Martin's catchy quip 'Give me half a tanker of iron, and I'll give you an ice age'.⁴⁶ Given the looming problem of global warming at the time that these discoveries were made, the potential for ocean iron fertilisation (OIF) to trigger massive phytoplankton blooms that could absorb enough CO₂ to cool the atmosphere received much attention.⁴⁷

Many objections to the iron hypothesis have been raised by scientists who have proposed several alternative explanations for the low phytoplankton productivity in HNLC waters.⁴⁸ These explanations include physical limitations and the control of phytoplankton populations by grazing zooplankton.⁴⁹ Thus, much of the criticism of the iron hypothesis was rooted in the fact that the *ex situ* bottle experiments did not provide an accurate representation of the processes occurring across entire ocean ecosystems as the phytoplankton were enclosed and isolated.⁵⁰

A series of 12 artificial iron addition experiments have been conducted in several HNLC regions⁵¹ in order to test the iron hypothesis *in situ* and assess the role of iron in a holistic manner, which involves studying the pelagic food web and assessing the interplay between ecological processes and biogeochemical signals.⁵² The results of the experiments indicated that iron additions enhanced phytoplankton blooms from polar to tropical HNLC waters, which in turn altered the biogeochemical cycles of carbon, nitrogen, sulphur and silicon.⁵³

⁴⁵ Powell, H. 'Fertilising the Ocean with Iron: Should we add iron to the sea to help reduce greenhouse gases in the air?' 2007. *Oceanus Magazine*. (4.1) 4-9. At 4

⁴⁶ Martin, J.H. [Note 44]

⁴⁷ Powell, H. [Note 45]

⁴⁸ Peterson, J.E. [Note 33] At 71.

⁴⁹ *Ibid.*

⁵⁰ Boyd, P.W. 'Iron Findings'. (2007). *Nature* **446**. 989-990.

⁵¹ Lampitt, R.S. et al. [Note 25] At 3928-3929.

⁵² Boyd, P.W et al. 'Mesoscale iron enrichment experiments 1993-2005: Synthesis and Future Directions'. (2007). *Science*. **315**. 612-617. At 612.

⁵³ *Ibid.*

In addition observations of phytoplankton blooms following natural iron fertilisation events provided support for the iron hypothesis. Large quantities of nutrients, including iron, are released into the atmosphere during volcanic eruptions, circulate the globe and are eventually deposited thus providing a mechanism for natural ocean iron fertilisation. Observations of global marine productivity following the eruption of Mount Pinatubo in June 1991 provided evidence that suggested that the Southern Ocean had experienced a spike in productivity that was consistent with the estimates of the quantities and movements of atmospheric iron,⁵⁴ thus further suggesting that iron deficiencies limit productivity in the Southern Ocean.

An alternative mechanism of natural iron fertilisation is the occurrence of enhanced vertical mixing events that supply iron to the surface waters. Despite the Southern Ocean being the largest HNLC region, natural blooms, triggered by the supply of iron through enhanced vertical mixing,⁵⁵ have been known to occur around some of the islands located within. One such natural bloom was observed by Blain *et al.* around Kerguelen Island.⁵⁶ The results of the measurements taken indicated that the efficiency of natural iron fertilisation, to enhance the uptake of carbon, was high in the nutrient rich waters.⁵⁷ Furthermore it was clearly depicted that the natural system is extremely sensitive to iron.⁵⁸

The importance of iron in carbon cycling is thus no longer in question. The potential for the relationship between iron and carbon cycles to be manipulated so to reduce atmospheric CO₂, and thereby mitigate against climate change, has created much excitement and promoted further research in oceanic bioengineering.

⁵⁴ Watson, A.J. 'Volcanic iron, CO₂, ocean productivity and climate'. (1997). *Nature*. **385**. 587-588.

⁵⁵ *Ibid.*

⁵⁶ Blain, S. et al. 'Effect of natural iron fertilisation on carbon sequestration in the Southern Ocean'. (2007). *Nature*. **446**. 1070-1074.

⁵⁷ *Ibid.* At 1073.

⁵⁸ *Ibid.* At 1073.

1.2 - OCEAN IRON FERTILISATION

The OIF Strategy

The intent of the OIF strategy, proposed by Martin, was to stimulate additional phytoplankton production to absorb dissolved CO₂ from the ocean surface layers, thereby reducing its concentration and causing a drawdown of CO₂ from the atmosphere.⁵⁹ The iron added to HNLC waters would stimulate phytoplankton growth at the expense of the rich supply of macronutrients that were not in use.⁶⁰ A portion of the enhanced phytoplankton biomass would sink to the deep ocean where the carbon would be stored, unused for millennia⁶¹, thus aiding in counteracting the greenhouse effect.⁶²

The role of iron in ocean productivity is no longer contended however there are two further key enquiries that should be addressed in the assessment of OIF as a climate change mitigation strategy: is it efficient and what are the side effects? The research to date has not been aimed at addressing these two key concerns; however the results do provide little insight in both areas.

Efficiency of OIF

The efficiency of OIF as a climate change mitigation technique is dependent upon the amount of carbon uptake that occurs during the phytoplankton blooms, triggered by OIF, and the magnitude of gravitational settling of organic carbon to the deep ocean where it is sequestered. In order to assess the efficiency of OIF a combination of three approaches, namely; small scale experiments, field

⁵⁹ Fuhrman, J.H. and Capone, D.G. 'Possible biogeochemical consequences of ocean fertilisation'. (1991). *Limnol. Oceanogr.* **36.8**. 1951-1959. At 1951.

⁶⁰ Ibid.

⁶¹ Powell, H. [Note 45] At 6.

⁶² Fuhrman, J.H. and Capone, D.G. [Note 59] At 1951.

observations and controlled laboratory experiments need to be interlinked through modelling and interpretation.⁶³

Carbon Uptake by Phytoplankton Blooms

In the first field experiment 450 kilograms of iron solution, released via the propeller wash of a ship in the eastern equatorial Pacific, triggered a growth of phytoplankton biomass that was 'the equivalent of 50 redwood trees 140 feet tall in nine days'.⁶⁴ However the bloom stopped before all the macro-nutrients were removed from the water indicating that either the iron dropped out of the euphotic zone too quickly, or other factors, such as another micronutrient or light, became limiting to phytoplankton productivity once the iron deficiency was appeased.⁶⁵ Subsequent experiments and observations, in which bloom periods were varied, suggested that the productivity of phytoplankton was affected by the form of iron used, the manner and timing of its introduction, ocean temperature, vertical and horizontal mixing, and grazing.⁶⁶ There are therefore multiple variables inherent in the experimental design and the conditions of the ocean environment which determine the carbon uptake efficiency of a bloom.

Global biogeochemical models, aimed at evaluating the potential of OIF as a means of carbon sequestration, have increased in resolution and realism over the last twenty years.⁶⁷ However these models cannot accurately predict the productivity of phytoplankton blooms due to our limited understanding of the complex relationship between nutrient supply and ecosystem dynamics.⁶⁸

⁶³ de Baar, H.J.W. et al. 'Efficiency of carbon removal per added iron in ocean iron fertilisation'. (2008). *Marine Ecology Progress Series*. **364**. 269-282. At 271.

⁶⁴ Perlman, D. 'Undersea Global-Warming Experiment Disappointing'. *San Francisco Chronicle*, (Sept 8 1994). At A6, Quoting Oceanographer Kenneth Coale. Cited by Peterson, J.E. [Note 33] At 72.

⁶⁵ Peterson, J.E. [Note 33] At 73.

⁶⁶ Rayfuse, R. et al. [Note 24] At 304.

⁶⁷ Lampitt, R.S. et al. [Note 25] At 3929-3930.

⁶⁸ Ibid.

Carbon Sequestration Efficiency

For OIF to be effective as a carbon sequestration method, the carbon captured during photosynthesis in the surface layers needs to be exported from the ocean's surface layers to the depths of the ocean and remain stored.⁶⁹ A number of the iron addition experiments provided evidence of an increased export flux of organic carbon following OIF, which suggested a potential enhancement of carbon sequestration,⁷⁰ however the magnitude of carbon export measured was only a small percentage of what had been predicted.⁷¹

The observations of the naturally induced bloom at Kerguelen Island indicated that the amount of carbon export per unit of iron supplied was at least 10 times higher than previous estimates from short-term blooms induced by iron-addition experiments.⁷² However this enhanced downward flux still represented only a fraction of the downward flux estimated by Martin.⁷³ Furthermore the observed results of the bloom at Kerguelen Island do not represent the potential for human OIF experiments as the bloom was sustained by a slow and continuous supply of iron by upwelling as well as the constant replenishing of other nutrients such as nitrates and silicic acid.⁷⁴

Deep ocean waters generally surface less frequently than intermediate depth waters, and thus carbon that settles in deep waters will have a longer storage time before the water reaches the surface again and the excess carbon is exchanged as CO₂.⁷⁵ The amount of organic carbon reaching the deep ocean has not been measured in any of the iron addition experiments or field observations.⁷⁶ Predictions of the flux of organic matter to the deep ocean, based

⁶⁹ Rayfuse, R. et al. [Note 24] At 304.

⁷⁰ Lampitt, R.S. et al. [Note 25] At 3928-3929.

⁷¹ Rayfuse, R. et al. [Note 24] At 304.

⁷² Blain, S. et al. [Note 56] At 1070.

⁷³ Boyd, P.W. [Note 50]

⁷⁴ Blain, S. et al. [Note 56] At 1073.

⁷⁵ de Baar, H.J.W. et al. [Note 63] At 271.

⁷⁶ Lampitt, R.S. et al. [Note 25] At 3928-3929.

on measurements of export fluxes, indicate that the downward flux of organic matter decreases exponentially with depth due to the activities of bacteria.⁷⁷

The experiments and observations provide an inconclusive picture of the carbon sequestration efficiency of OIF and many uncertainties regarding the variables that influence carbon export remain.⁷⁸ As a result, models, based upon these experiments and observations, provide estimates of actual carbon sequestration that are of questionable reliability.⁷⁹ However there is increasing consensus among scientists that the efficiency of OIF is much lower than predicted by early simplistic models and that only a small portion of anthropogenic carbon can be removed from the atmosphere.⁸⁰ Furthermore models, which combine the concepts of export flux and nutrient cycling with ocean circulation, suggest that the Southern Ocean is the only HNLC region in which long term (more than 100 years) storage of carbon would occur.⁸¹

Supporters of OIF feel that the current estimates of OIF sequestration efficiency are sufficient for OIF to make a partial contribution to climate change mitigation and that OIF could be used as a temporary solution until more permanent solutions are developed.⁸² However the efficiency of OIF is not the only factor that needs to be considered as the technique will alter many aspects of the environment and it needs to be assessed whether the side effects are acceptable.

⁷⁷ de Baar, H.J.W. et al. [Note 63]. At 270.

⁷⁸ Rayfuse, R. et al. [Note 24] At 304.

⁷⁹ Ibid, de Baar, H.J.W. et al. [Note 63]. At 279.

⁸⁰ Lampitt, R.S. et al. [Note 25] At 3929-3930, Rayfuse, R. et al. [Note 24] At 305, Scott, K.N. 'The Day After Tomorrow: Ocean CO₂ Sequestration and the Future of Climate Change'. (2005). The Georgetown Int'l. Env'tl. Law Review. 18. 57-108. At 95.

⁸¹ Ibid.

⁸² Ibid.

Side Effects of OIF

Proponents of OIF intend to alter the pelagic ecosystem and the associated biogeochemical cycles so to enhance primary productivity.⁸³ The oceans have been subjected to much anthropogenic disturbance in the form of fishing, pollution and climate change, and are therefore not in pristine condition.⁸⁴ However, if OIF is used as a climate change mitigation strategy, large areas of the ocean will have to be fertilised for several decades, thereby altering ocean systems at large spatial and temporal scales.⁸⁵ The large scale nature of OIF warrants careful evaluation of the potential side effects.

Impacts of Individual Additions

If effective, OIF in HNLC regions would result in blooms of phytoplankton that would deplete the concentration of macronutrients in the surface layers. Some of the organic matter produced in the bloom would sink from the surface layer after having been subjected to varied degrees of food-web processes.⁸⁶ Decomposition by bacteria, involving the consumption of oxygen and release of nutrients and CO₂, and grazing by zooplankton will reduce the amount of sinking organic matter with depth so that only a small portion of the organic matter produced in the blooms reaches the deep ocean where it is sequestered.⁸⁷

Dimethylsulphide (DMS), released by blooms of certain species of phytoplankton, forms an aerosol that functions as nuclei around which cloud-condensation occurs.⁸⁸ The enhancement of the blooms of these species by OIF could result in increased cloud cover which could block incoming sunlight and aid in cooling the

⁸³ Cullen, J.J. and Boyd, P.W. [Note 15] At 297. Fuhrman, J.H. and Capone, D.G. [Note 59] At 1951.

⁸⁴ Ibid.

⁸⁵ Ibid.

⁸⁶ Ibid.

⁸⁷ Ibid.

⁸⁸ Cullen, J.J. and Boyd, P.W. [Note 15] At 297, Law, C.S. 'Predicting and Monitoring the effects of large scale ocean iron fertilisation on marine trace gas emissions'. (2008). *Marine Ecology Progress Series*. **364**. 283-288. At 286-287, Fuhrman, J.H. and Capone, D.G. [Note 59] At 1952.

climate.⁸⁹ However the full potential of this effect is disputed as not all phytoplankton species produce DMS and it is possible that a decline in DMS could result if the production of species, which do not produce DMS, is stimulated in place of species that do.⁹⁰

Predicted Cumulative Impacts

The enhanced production of phytoplankton will result in increased fixing of macronutrients in the surface layers and removal of macronutrients to the ocean depths along with carbon.⁹¹ Nutrient depletion in the surface layers of HNLC regions may significantly alter the global distribution of nutrients.⁹² Furthermore an enhanced quantity of organic matter will result in an increase in decomposition by bacteria. The high levels of decomposition will use up the oxygen in the water and create hypoxic (low oxygen) or anoxic (no oxygen) conditions in the mid-waters and the deep ocean.⁹³ Therefore sustained and widespread OIF could result in deeper waters becoming highly enriched in nutrients and carbon, and depleted in oxygen.

Predicted Indirect Side Effects

The removal of macronutrients from the surface layers in HNLC regions may diminish the productivity of other regions to which the water is circulated via currents,⁹⁴ which could in turn reduce their ability to support fisheries.⁹⁵

Oxygen depleted and nutrient enriched mid-depth waters may be the source waters for coastal upwelling events.⁹⁶ This would result in near shore hypoxia or anoxia to which the responses of marine organisms are almost entirely

⁸⁹ Peterson, J.E. [Note 33] At 77.

⁹⁰ Cullen, J.J. and Boyd, P.W. [Note 15] At 297. Fuhrman, J.H. and Capone, D.G. [Note 59] At 1952.

⁹¹ Cullen, J.J. and Boyd, P.W. [Note 15] At 298.

⁹² Lampitt, R.S. et al [Note 25] At 17.

⁹³ Ibid. At 15.

⁹⁴ Powell, H. 'What are the Possible Side Effects?: the uncertainties and unintended consequences of manipulating ecosystems'. (2008). *Oceanus*. **4.1**. At.

⁹⁵ Cullen, J.J. and Boyd, P.W. [Note 15] At 298.

⁹⁶ Ibid.

negative.⁹⁷ Mass die-offs of marine life, including fish and invertebrates, have been observed as a result of extended exposure to low levels of oxygen.⁹⁸ In addition anoxic conditions in the bottom waters near continental shelves have the potential to reduce the productivity of organisms such as fish and krill.⁹⁹

Anoxic conditions may stimulate anoxic bacterial processes that result in the release of sulphides.¹⁰⁰ "Black tides", a term given to waters that are laden with hydrogen sulphide, could cause extensive mortality of much marine life.¹⁰¹ Other gases that are released as a result of anoxic bacterial processes are nitrous oxide and methane¹⁰² which are far more potent greenhouse gases than CO₂.¹⁰³ The release of these gases could nullify a portion of the cooling effect achieved by OIF.¹⁰⁴ A problem with monitoring the impacts of OIF is that deep ocean waters circulate and resurface great distances away from, and many years after the original OIF event.¹⁰⁵ The resurfacing of the oxygen depleted, nutrient rich deep ocean waters could result in further releases of greenhouse gases.¹⁰⁶

The species composition and functioning of phytoplankton communities has been observed to change during natural and artificial blooms due to alterations in nutrient ratios.¹⁰⁷ The effects of these changes on populations of grazers and larger predators such as fish and marine mammals have not yet been researched.¹⁰⁸ It has however been speculated that the consequences, from an anthropocentric perspective, could be either positive or negative.¹⁰⁹ Fish stocks that are currently depleted may rejuvenate due to an increased food supply. The

⁹⁷ Lampitt, R.S. et al [Note 25] At 3932.

⁹⁸ Ibid.

⁹⁹ Peterson, J.E. [Note 33] At 77.

¹⁰⁰ Fuhrman, J.H. and Capone, D.G. [Note 59] At 1953.

¹⁰¹ Lampitt, R.S. et al [Note 25] At 3933.

¹⁰² Fuhrman, J.H. and Capone, D.G. [Note 59] At 1953-1954.

¹⁰³ Lampitt, R.S. et al [Note 25] At 3935.

¹⁰⁴ Law, C.S. [Note 88] At 284-285.

¹⁰⁵ Powell, H. [Note 94]

¹⁰⁶ Ibid.

¹⁰⁷ Arrigo, K.R. 'Marine microorganisms and global nutrient cycles'. (2005). *Nature*. **437**. 349-355. At 349-350.

¹⁰⁸ Ibid.

¹⁰⁹ Lampitt, R.S. et al [Note 25] At 3936.

negative alternative that could arise is that the food web could be altered in such a manner so to favour less-useful or even harmful organisms which in turn could negatively impact fish stocks and other species in the food chain.¹¹⁰

The change in the species composition of phytoplankton communities may be such that the blooms consist of algae species that are harmful to marine life, human health and economies.¹¹¹ In the 12 experiments conducted to date no harmful algal blooms have yet been stimulated, however the production of plankton species similar to those associated with harmful algal blooms has been observed.¹¹² Alterations in the species composition and characteristics of phytoplankton may also affect the export rate of organic matter from the euphotic zone and thus modify the efficiency of the biological pump.¹¹³ Such results were observed during a natural bloom in which the populations of certain forms of phytoplankton, which proved to be inefficiently exported, were increased.¹¹⁴

A driver of photosynthesis is the absorption of solar radiation by phytoplankton. Experiments and calculations have indicated that this could have a substantial warming effect on the ocean surface in the area in which OIF has been conducted¹¹⁵. Warmer surface layers would cause further warming of the atmosphere and negatively impact upon the effectiveness of OIF as warmer waters hold less dissolved CO₂ than cold waters.¹¹⁶ Increased stratification of the oceans could result due to further reductions in the density of surface waters as they become warmer and mixing with deep, dense cold waters occurs less

¹¹⁰ Ibid.

¹¹¹ Ibid. At 16.

¹¹² Powell, H. [Note 94]

¹¹³ Lampitt, R.S. et al [Note 25] At 3937.

¹¹⁴ Lucas, M. et al. 'Nitrogen uptake responses to a naturally induced Fe-fertilised phytoplankton bloom during the 2004/2005 CROZEX study'. 2007. *Deep Sea Research II* (54) 2138-2173. Cited by Lampitt, R.S. et al [Note 12] At 3937.

¹¹⁵ Lefevre, N. et al. 'Phytoplankton physiology can affect ocean surface temperatures.' (2001). *Geophys. Res. Lett.* . 28.7. 1251-1254

¹¹⁶ Powell, H. [Note 94]

readily.¹¹⁷ The clouding of the surface layers by phytoplankton blooms and the associated reduction in the penetration of light and heat could result in the oceans' top layer becoming shallower, which in turn would lead to a reduction of the total volume of water coming into contact with the atmosphere and exchanging CO₂.¹¹⁸

Conclusion

Thus the potential impacts of OIF on marine biodiversity and fish stocks may be a direct consequence of altered nutrient supplies, as well as, an indirect consequence of alterations to biogeochemical cycles and the physical characteristics of the ocean. Given that marine fish and invertebrates provide an estimated 2.6 billion people with at least 20% of their average protein intake,¹¹⁹ and the increasingly ecocentric international approach to environmental management (eg The Convention on Biological Diversity), the consideration of the potential impacts of OIF on ecosystems is crucial before any large scale commercial fertilisation is undertaken. In addition there are various possible circumstances in which OIF could result in further warming of the atmosphere. This is a highly undesirable side effect and the potential cooling effect of OIF needs to be weighed up against the potential unintended warming effect.

Given the complexity of marine ecosystems it has been argued that the ecological and biogeochemical responses to OIF are unpredictable and that the most obvious predictions of ecosystem manipulations, e.g. a bloom of phytoplankton in response to OIF, cannot be guaranteed.¹²⁰ Thus unintended impacts may not be considered or assessed before they happen.¹²¹

¹¹⁷ Ibid

¹¹⁸ Ibid

¹¹⁹ Marine and Coastal Biodiversity: Why is it important? Available at: <http://www.cbd.int/marine/important.shtml>
Accessed on: 12/12/2008.

¹²⁰ Cullen, J.J. and Boyd, P.W. [Note 15] At 300.

¹²¹ Ibid.

Future Research

To date none of the experiments have been directed at determining the sequestration efficiency of OIF. The results show that the iron hypothesis is sound in principle, but is far less efficient than initially predicted in practice. However some scientists feel that the poor efficiency of OIF, which was predicted by models that were based on the 12 artificial iron addition experiments, is due to spatial and temporal scaling issues¹²². Furthermore all of the potential ecological consequences, such as cumulative and long-term adverse consequences, of large scale OIF experiments remain unpredictable. There is clearly a need for further field research on larger spatial and temporal scales that is focused on the efficiency and verification of OIF and the side effects of OIF.¹²³

CHAPTER 1.3 – CARBON TRADING MARKETS

Despite the scientific uncertainties and difficulties facing OIF, the prospect of making substantial financial gains through the sale of carbon credits has captured the attention of entrepreneurs. Carbon credits can be traded in two different types of carbon markets; regulatory markets, which were established and are regulated under the international climate change regime, and voluntary markets. Both types of markets entice private sector involvement.

Regulatory Markets under the Climate Change Regime

For any OIF project to generate carbon credits to be used by states to meet their GHG emission reduction targets it must meet the conditions set out in the United

¹²² Blain, S. et al. [Note 56] At 1073.

¹²³ Buesseler, K.O. et al. [Note 19] At 162, Lampitt, R.S. et al [Note 12] At 27, Watson, A.J. et al. 'Designing the next generation of ocean iron fertilisation experiments'. (2008). *Marine Ecology Progress Series*. **364**. 303-309. At 300.

Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP).¹²⁴

United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC was opened for signature in 1992 at the United Nations Conference on Environment and Development in Rio,¹²⁵ and it came into force in 1994. As of November 2008 there were 192 parties representing near global membership. It was developed as an instrument that could aid in the battle against global climate change by setting an objective to achieve:

'...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' and 'within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner'.¹²⁶

The UNFCCC is a broad framework convention that sets out principles and basic commitments and forms the base off which future decisions and protocols regarding climate change can build¹²⁷. The core principles are intended to aid in the achievement of the objective by serving as a guide for parties in their implementation of the UNFCCC. The principles direct states to:

- protect the climate system so to achieve 'inter-generational equity'¹²⁸
- recognise their 'common but differentiated responsibilities' and capabilities¹²⁹
- apply the 'precautionary principle'¹³⁰
- promote sustainable development¹³¹

¹²⁴ Freestone, D. and Rayfuse, R. 'Ocean iron fertilisation and international law'. (2008). *Marine Ecology Progress Series*. **364**. 227-223. At 228.

¹²⁵ Ibid.

¹²⁶ United Nations Framework Convention on Climate Change 1992 (1994) [hereafter 'UNFCCC'] ILM 1992:851-873 at Art 2.

¹²⁷ Bettelheim, E.C. and d'Origny, G. "Carbon Sinks and Emissions Trading under the Kyoto Protocol: A Legal Analysis." (2002). *Philosophical Transactions: Mathematical, Physical and Engineering Sciences*. **360**. 1827-1851. At 1829.

¹²⁸ UNFCCC. [Note 126] Art 3.1.

¹²⁹ Ibid.

¹³⁰ Ibid. Art 3.3.

- promote an 'open international economic system' (market) that would encourage sustainable economic growth and development in all parties¹³².

Sinks are defined by the UNFCCC as 'any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere'.¹³³ The biological pump in the oceans clearly falls within this definition.

Sinks are referred to in a number of contexts within the commitments set out in the UNFCCC. All parties to the UNFCCC are required to submit national inventories of the emissions of GHGs by sources and removals of GHGs by sinks¹³⁴ and to develop national and regional programmes to mitigate against climate change, which must include measures to remove GHGs using sinks.¹³⁵ Furthermore all parties are obliged to 'promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases ... including biomass, forests and oceans'.¹³⁶ The UNFCCC urges all parties to apply a precautionary approach, which stipulates that a lack of scientific certainty should not be used as a reason for postponing climate change mitigation measures.¹³⁷ In addition it requires all parties to use appropriate methods, such as impact assessments, 'with a view to minimizing adverse effects on the... quality of the environment', of projects or measures designed to mitigate or adapt to climate change.¹³⁸

The UNFCCC thus encourages the use of sinks but does not provide specific details and rules, and instead stipulates that these, along with the methodologies

¹³¹ Ibid. Art 3.4.

¹³² Ibid. Art 3.5.

¹³³ Ibid. Art 1.8.

¹³⁴ Ibid. Art 4.1(a) and 12.1 (a).

¹³⁵ Ibid. Art 4.1(b).

¹³⁶ Ibid. Art 4.1(d).

¹³⁷ Ibid. Art 3.3.

¹³⁸ Ibid. Art 4.1 (f).

to calculate removal of GHGs by sinks, must be formulated at later sessions of Conferences of the Parties (COP).¹³⁹

In recognition of the differentiated capabilities and responsibilities of parties, the UNFCCC divided parties into Annex I and Non-Annex I Parties. Annex I comprises of parties that are developed countries and countries that are undergoing a transition to market economy. The obligation to reduce GHG emissions and protect and enhance GHG sinks and reservoirs was imposed upon Annex 1 parties.¹⁴⁰ In addition the UNFCCC set the foundation for the development of carbon markets by obliging states to promote an 'open international economic system'¹⁴¹ and permitting Annex I parties to implement policies and measures jointly with other parties.¹⁴²

The Kyoto Protocol

At the third COP to the UNFCCC, held in 1997 at Kyoto, the Kyoto Protocol (KP) was concluded¹⁴³ and adopted unanimously¹⁴⁴. The KP was the response to the 'Berlin Mandate', a result of the UNFCCC COP in 1993, which called for a protocol to be developed that would introduce binding emission reduction commitments within a specified time-frame for the post-2000 period.¹⁴⁵ The KP came into effect in 2005 and, as of 16 October 2008, 182 countries and one regional economic integration organisation (the EEC) had deposited instruments of ratification, accession, approval or acceptance.¹⁴⁶

¹³⁹ Ibid. Art 4.2(c), (d).

¹⁴⁰ Ibid. Art 4.2(a).

¹⁴¹ Ibid. Art 3.5

¹⁴² Ibid. Art 4.2 (a) (d)

¹⁴³ Cameron, P. 'From Principles to Practice: The Kyoto Protocol'. (2000). *Journal of Energy and Natural Resources Law*. 18. 1-18. At 6.

¹⁴⁴ UNFCCC. 'A Summary of the Kyoto Protocol'. Available at: unfccc.int/kyoto_protocol/background/items/2879.php Accessed on: 30/04/2008

¹⁴⁵ Larson, D.F. et al. 'Policy Research Working Paper 4761: Carbon Markets, Institutions, Policies and Research'. October 2008. The World Bank Development, Research Group, Sustainable Rural and Urban Development Team. Available at: <http://www-wds.worldbank.org>. Accessed on: 10/11/2008. At 8.

¹⁴⁶ UNFCCC. 'Kyoto Protocol: Status of Ratification'. Available at: www.unfccc.int/Kyoto_protocol/status_of_ratification/items/2613.php. Accessed on: 04/11/2008

Emissions rights, defined as the 'right to emit a certain quantity of a specified substance during a defined period of time',¹⁴⁷ are specified for developed states in Annex B of the KP on a state-specific basis.¹⁴⁸ These rights, granted to Annex B countries as 'Assigned Amounts', are binding emissions targets that are to be reached within the 2008-2012 commitment period.¹⁴⁹ The KP established three regulated market-based mechanisms, namely; Emissions Trading, Joint Implementation and the Clean Development Mechanism, to aid Annex B States in the achievement of these targets¹⁵⁰.

Under the emissions trading mechanism an Annex B party that has remained under their emission target may sell the remainder of their Assigned Amount Units (AAU) to other Annex B parties.¹⁵¹ The cap-and-trade market established by Emissions Trading does not apply to OIF as it relates to the trading of allowances and not project based activities.¹⁵²

Joint Implementation (JI) and the Clean Development Mechanism (CDM) allow countries to contribute to projects that reduce GHG emissions abroad¹⁵³. Both of these mechanisms involve the generation of tradable units by means of projects that reduce or remove GHGs, given that the reduction or removal of GHGs is additional to what would happen in the absence of project activities.¹⁵⁴

The use of JI, outlined in Article 6 of the KP,¹⁵⁵ is restricted to Annex B States.¹⁵⁶ JI allows Annex B States to contribute financially to projects conducted within the

¹⁴⁷ de Witt Wijnen, R. 'Emissions Trading under Article 17 of the Kyoto Protocol'. (2005). In: *Legal Aspects of Implementing the Kyoto Protocol Mechanisms*. At 430-404.

¹⁴⁸ Kyoto Protocol to the United Nations Framework Convention on Climate Change 1998 (2005) 37 ILM 22. [hereafter 'KP'] Art 6.

¹⁴⁹ Hirsch, H.D. 'Trading in Ecosystem Services: Carbon Sinks and the Clean Development Mechanism'.(2007). *Journal of Land Use and Environmental Law*. **22.2**. 623-639. At 627.

¹⁵⁰ Cameron, P. [Note 143] At 6-7.

¹⁵¹ KP [Note 148] Art 17.

¹⁵² Freestone, D. and Rayfuse, R. [Note 124] At 321.

¹⁵³ Larson, D.F. et al. [Note145]

¹⁵⁴ KP [Note 148] Art 6.1 (b).

¹⁵⁵ KP [Note 148] Art 6.

¹⁵⁶ Larson, D.F. et al. [Note145] At 7.

territory of other Annex B States and in return receive Emission Reduction Units (ERU), which represent one ton of CO₂ equivalent GHG reductions.¹⁵⁷

The CDM, the most radical of the three mechanisms, allows Annex B States to finance projects that reduce or remove emissions in non-Annex B States, which have no emissions limitations set, and in return receive Certified Emission Reduction Units (CERs).¹⁵⁸ The aim of the CDM was to aid in the sustainable development of developing countries while helping Annex B States to reach their Assigned Amount of greenhouse gas emissions¹⁵⁹ through the creation of CERs.¹⁶⁰

The Annex B party can only claim CERs to use to offset their emissions once an independent auditor has certified that actual reductions occurred.¹⁶¹ The KP established an Executive Board to oversee and approve CDM projects and license the auditors.¹⁶² There are criteria established in the KP that need to be met for a project to qualify as a CDM project. These criteria include: all participating countries must be parties to the convention and they must be participating voluntarily; the benefits of the project related to climate change mitigation must be real, measurable and long-term; and reductions in emissions must be additional to that which would have occurred in absence of the project.¹⁶³

Public and private entities, acting under the supervision of a KP party and subject to the guidance of the Executive Board, are permitted to become

¹⁵⁷ Streck, C. 'Joint Implementation: History, Requirements and Challenges'. (2005). In: *Legal Aspects of Implementing the Kyoto Protocol Mechanisms*. At 111-112.

¹⁵⁸ Carr, C. and Rosebuj, F. 'Flexible Mechanisms for Climate Change Compliance: Emission Offset Purchases under the Clean Development Mechanism'. (2007). *New York University Environmental Law Journal*. 16.43-61. At 46.

¹⁵⁹ Netto, M. and Schmidt, K.U.B. 'CDM Project Cycle and the Role of the UNFCCC Secretariat' (2005). In: *Legal Aspects of Implementing the Kyoto Protocol Mechanisms*. Freestone, D. and Streck, C. (Eds). Oxford University Press. Inc. New York. At 430-404.

¹⁶⁰ KP [Note 148] Art 12.

¹⁶¹ Freestone, D. and Rayfuse, R. [Note 124] At 231.

¹⁶² KP [Note 148] Art 12.

¹⁶³ *Ibid.* Art 12.5.

involved in the CDM.¹⁶⁴ The CDM allows for two types of projects to be implemented in Non-Annex I States 'source projects', which involve the reduction of emission from sources, and 'sink projects', which involved carbon capture and sequestration from the atmosphere¹⁶⁵. More than 800 CDM projects have been approved and only one of these is a sink project.¹⁶⁶ The reason for the minimal use of sink projects in the CDM is that sink projects have long been a point of contention in the negotiations of parties to the UNFCCC.¹⁶⁷

COP 7 took place in November 2001 in Marrakech and parties were able to reach agreement and produce a framework of 'guidelines, modalities and rules', enabling the regulation of market mechanisms, known as the Marrakech Accords.¹⁶⁸ According to the Marrakech Accords reforestation and afforestation are the only sink projects that may be considered under the CDM¹⁶⁹ and, in keeping with these Accords, the Executive Board has not approved of any OIF activity.¹⁷⁰ At the COP in Bali December 2007 it was decided that only avoided deforestation would be considered for a permissible sink project in the protocol following the KP.¹⁷¹

None of the KP market mechanisms allow for the trading of carbon credits generated through OIF activities as the projects are not conducted within the territory of signatory countries.¹⁷² However it is possible that in future regulatory markets may develop that allow for OIF activities.¹⁷³ The regulations and

¹⁶⁴ Freestone, D. and Rayfuse, R. [Note 124] At 231.

¹⁶⁵ Powell, H. 'Dumping Iron and Trading Carbon: Profits, pollution, and politics will all play roles in ocean iron fertilisation'. 2008. 46(1) *Oceanus Magazine*. 22-25. At 24.

¹⁶⁶ Freestone, D. and Rayfuse, R. [Note 124] At 231.

¹⁶⁷ Ibid.

¹⁶⁸ Freestone, D. 'The UN Framework Convention on Climate Change, the Kyoto Protocol, and the Kyoto Mechanisms'. 2005. In: *Legal Aspects of Implementing the Kyoto Protocol Mechanisms*. At 8-9. Freestone, D. and Rayfuse, R. [Note 124] At 231.

¹⁶⁹ Freestone, D. and Rayfuse, R. [Note 124] At 231. Rayfuse, R. [Note 24] At 300.

¹⁷⁰ Rayfuse, R. [Note 24] At 300.

¹⁷¹ Freestone, D. and Rayfuse, R. [Note 124] At 231.

¹⁷² Ibid. Leinen, M. 'Building relationships between scientists and business in ocean iron fertilisation'. (2008). *Marine Ecology Progress Series*. 364. 251-256. At 253.

¹⁷³ Powell, H. [Note 165] At 24.

standards for the CDM provide a likely model off which OIF activities may be regulated by markets in future.¹⁷⁴ Standards to which OIF activities will most likely have to measure up to include; permanence (CO₂ removed must remain out of the atmosphere for 100 years), additionality (CO₂ removal must be additional to what would have occurred in the absence of the project), free of leakage (no unintentional negative environmental consequences elsewhere), and must be amenable to monitoring of effects and verification of removals.¹⁷⁵ Currently there are no means to provide real evidence to support these requirements and therefore, if the same requirements are upheld in future commitment periods, OIF projects may never be, or may take some time to be included in regulatory markets under the climate change regime.

The inclusion of OIF projects as sinks on the national inventories of developed countries has never been considered by the UNFCCC parties and may not be for some time given the scepticism expressed by the International Panel on Climate Change regarding OIF.¹⁷⁶ However, beyond the ambit of the KP there is little restricting the ability of national authorities to offer national carbon offset schemes or the private sector to offer voluntary carbon offset schemes, as both schemes are not subject to the international climate change regime and are instead regulated by domestic laws.¹⁷⁷

Voluntary Markets

Despite the remaining uncertainties regarding the side effects of OIF and the efficiency and verification of OIF as a carbon sequestration technology¹⁷⁸, a number of companies have made plans to engage in large scale OIF activities to generate carbon offsets to be traded on voluntary markets.¹⁷⁹ Voluntary carbon

¹⁷⁴ Ibid.

¹⁷⁵ Ibid.

¹⁷⁶ Freestone, D. and Rayfuse, R. [Note 124] At 231.

¹⁷⁷ Ibid.

¹⁷⁸ Buessler, K.O. et al. [Note 19] At 162.

¹⁷⁹ Powell, H. [Note 45] At 8-9.

markets involve carbon credit trades to offset emissions where such offsets are not required by regulation and thus do not affect States' commitments under the UNFCCC and KP.¹⁸⁰ There are two types of voluntary markets; a legally binding cap-and-trade market, which works on the same principle as Emissions Trading under the Kyoto Protocol in that it is driven by an emissions cap, and a voluntary offsets market, also referred to as the voluntary Over The Counter (OTC) market, which operates without an emissions limit.¹⁸¹ Project-based offsets account for almost all of the carbon offsets purchased in the voluntary OTC market.¹⁸² It is thus under the voluntary OTC markets that carbon credits generated by OIF activities may be traded.

Buyers of voluntary carbon credits include private businesses, government, individuals and NGOs, most of which are based in the United States.¹⁸³ Customer motivations for purchasing voluntary carbon credits were identified in a survey conducted by Hamilton *et al.* in 2007. The motives included:

- 'Sustainability reporting/internal goals
- Corporate responsibility/environmental ethics
- Public relations/branding
- Sales of carbon-neutral products
- Anticipation of regulation¹⁸⁴

Currently voluntary market projects are unregulated nationally and internationally and a resulting key concern is that they are not subjected to the same strict regulation as Kyoto projects.¹⁸⁵ It is feared that this may allow for inaccurate accounting of carbon offsets and poor environmental monitoring.¹⁸⁶ The effects of inaccurate accounting may be limited by the far smaller size of

¹⁸⁰ Freestone, D. and Rayfuse, R. [Note 124] At 231.; Hamilton, K. et al. 'State of the Voluntary Carbon Markets 2007 – Picking Up Steam'. (2007). Available at: <http://www.carbon.sref.info/an-example/market-news>. Accessed on: 11/11/2008

¹⁸¹ Hamilton, K. et al [Note 180] At 15-16.

¹⁸² *Ibid.* At 16.

¹⁸³ *Ibid.* At 49

¹⁸⁴ *Ibid.*

¹⁸⁵ Powell, H. [Note 165] At 24.

¹⁸⁶ *Ibid.*

voluntary markets in relation to regulated markets.¹⁸⁷ The capacity for OIF to become a 'run away commercial success', an undesirable result in the event of poor accounting of carbon offsets, is therefore limited by this size.¹⁸⁸ Environmental impacts of projects may be kept in check in voluntary markets by the perceptions of a 'subjective buying public', which has been shown to have a strong influence on markets.¹⁸⁹ Therefore the publicity that OIF receives may influence its success in voluntary markets.

Financial Incentives for an OIF Industry

There are growing number of companies and individuals that have opted for a 'carbon neutral' image.¹⁹⁰ Large consumer-facing companies such as Dell, Google, Nike, Yahoo and Sky have elected to purchase (possibly hundreds of thousands of tons) carbon offsets in the voluntary markets.¹⁹¹ The voluntary markets showed signs of growth in the 2006/2007 period and, according to a projection of market growth (refer to figure 2), an estimated annual transaction, ranging between 380 000 and one billion tons of CO₂ equivalent, may be reached by 2012.¹⁹² Participants in the voluntary market believe that this market could become as large as the 2006 CDM market, valued at US\$4.8 billion¹⁹³, by 2012.¹⁹⁴

¹⁸⁷ Ibid.

¹⁸⁸ Ibid.

¹⁸⁹ Ibid.

¹⁹⁰ Hamilton, K. et al [Note 180] At 54.

¹⁹¹ Ibid. At 54.

¹⁹² Ibid. At 54-55.

¹⁹³ Larson, D.F. et al. [Note145] At 43.

¹⁹⁴ Hamilton, K. et al [Note 180] At 55.

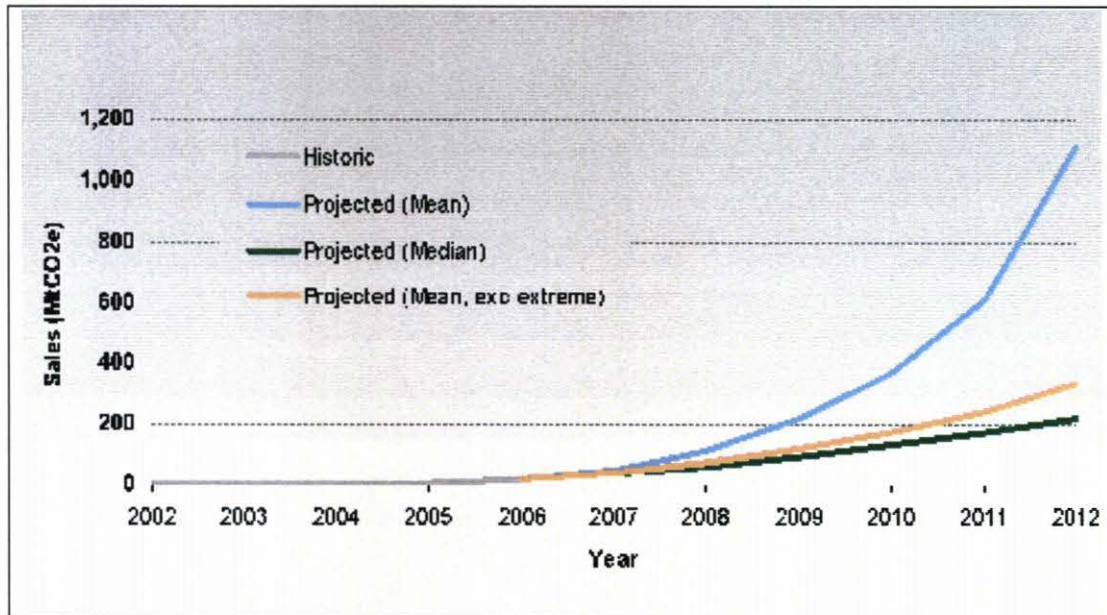


Figure 2: Future Voluntary Market Size Estimates

From: Hamilton, K. et al. 'State of the Voluntary Carbon Markets 2007 – Picking Up Steam'. 2007. Available at: <http://www.carbon.sref.info/an-example/market-news>. Accessed on: 11/11/2008.

There is thus a large financial incentive to participate in this rapidly growing market. OIF may seem like an attractive industry to develop as the costs of the fertilising material are relatively low,¹⁹⁵ due to the fact that major iron deposits occur on all the populated continents, and bulk transportation of iron to the ocean is feasible given the current capacities of tankers and supertankers.¹⁹⁶

Proponents of an OIF Industry

The large scale experiments that are required to characterise OIF as a climate change mitigation strategy and inform future policy making under the climate change regime will require substantial funding. Private companies have expressed an interest in providing funding for iron addition experiments and, in

¹⁹⁵ Lampitt, R.S. et al [Note 25] At 3930.

¹⁹⁶ Peterson, J. et al. [Note 33] At 75.

return, selling carbon credits equivalent to the carbon offsets that resulted during the experiment.¹⁹⁷

Planktos Corp. is one of the private companies that expressed an interest in OIF. In 2007 Planktos revealed that they had made plans to conduct six large scale OIF pilot projects from 2007 to 2009.¹⁹⁸ The first project involved dissolving 90 tons of an iron containing mineral over a 10'000 square-kilometre area of the high seas off the Galapagos Islands.¹⁹⁹ David Kubiak, a spokesperson for Planktos, announced that the company wished to sell any carbon credits that were based on this work, and that the company could earn a potential US\$25 million if between 2.5 million and 4.5 million tons of carbon were sequestered, and buyers could be found.²⁰⁰ After overcoming both protests from the Ecuadorian government and environmental NGOs and the denial of port entry by Spanish authorities in the Canary Islands, the project was eventually halted in February 2008 due to insufficient funding.²⁰¹ Other firms planning OIF research activities are the US-based companies Climos and GreenSea Ventures Inc.²⁰²

In addition to sources of funding the experiments require the involvement of scientists whose results must remain objective.²⁰³ Several scientists have conveyed that they are unwilling to team up with private companies to conduct research, for fear of the effects, or perceived effects, on the impartiality of their research.²⁰⁴ Furthermore a group of scientists expressed the opinion that it is premature to sell carbon credits generated in the first generation of large scale OIF experiments.²⁰⁵ In relation to OIF activities Buesseler stated that

¹⁹⁷ Leinen, M. [Note 172] At 254.

¹⁹⁸ Rayfuse, R. et al [Note 24] At 299.

¹⁹⁹ Schrope, M. 'Treaty Caution on Plankton Plans'. (2007). *Nature*. 447. 1039.

²⁰⁰ Ibid.

²⁰¹ Rayfuse, R. et al [Note 24] At 299. Courtland, R. 'Planktos dead in the water'. Published online 15 February 2008.

Nature. Available at: www.nature.com. Accessed on: 18/06/2008.

²⁰² Rayfuse, R. et al [Note 24] At 299.

²⁰³ Buesseler, K.O. et al. [Note 19] At 162.

²⁰⁴ Powell, H. [Note 45] At 9.

²⁰⁵ Buesseler, K.O. et al. [Note 19] At 162.

²⁰⁶ Powell, H. [Note 45] At 9

²⁰⁷ Leinen, M. [Note 172] At 254, Freestone, D. and Rayfuse, R. [Note 124] At 231.

²⁰⁸ Cullen, J.J. and Boyd, P.W. [Note 15] At 296.

²⁰⁹ Buesseler, K. et al. 'To Fertilize, or Not To Fertilize'. (2008). *Oceanus Magazine*. 4.1. 3; Powell, H. [Note 45] At 8-9.

"Commercial efforts are moving forward with or without scientific effort".²⁰⁶ OIF activities in the absence of impartial scientific monitoring and reporting may have disastrous consequences and it is therefore crucial that partnerships between commercial entities and scientists are encouraged.

Various concerns have been raised regarding the regulation of private companies OIF activities on the high seas, the trade in carbon credits generated by OIF projects and the various unforeseen environmental impacts of OIF. In response to these concerns Climos proposed a code of conduct, as a form of self-regulation, which addresses these areas of concern.²⁰⁷

1.4 CONCLUSION

OIF could potentially make a significant difference to atmospheric CO₂ concentrations (an estimated 0.5Gt carbon per year); however this could only be attained by the intentional alteration of the ecosystems and biogeochemical cycles of the world's oceans.²⁰⁸ Thus large scale OIF activities carry potential risks and potential benefits. At present there is much uncertainty regarding the type and magnitude of risks inherent in OIF and the efficiency of the technique in sequestering carbon for reasonable periods. A key concern is the long-term effects that OIF projects may have on the environment at a global-scale.

Arguments have been presented for and against proceeding with OIF research at a conference held by the Woods Hole Oceanographic Institute in September 2007.²⁰⁹ Andrew Watson, of the University of East Anglia, conveyed a middle ground position when he stated, "There are plenty of ways to do it wrong, but

²⁰⁶ Powell, H. [Note 45] At 9

²⁰⁷ Leinen, M. [Note 172] At 254, Freestone, D. and Rayfuse, R. [Note 124] At 231.

²⁰⁸ Cullen, J.J. and Boyd, P.W. [Note 15] At 296.

²⁰⁹ Buesseler, K. et al. 'To Fertilize, or Not To Fertilize'. (2008). *Oceanus Magazine*. 4.1. 3; Powell, H. [Note 45] At 8-9.

done right, [OIF] does actually sequester carbon for hundreds of years in the place that it would ultimately end up anyway".²¹⁰

In order to 'do it [OIF] right' clear regulations for trading the results in carbon offset markets, as well as, regulations for conducting the experiments at sea and protecting the marine environment are needed. Currently OIF falls outside the ambit of the international climate change regime and is therefore not subject to regulation under this regime. There are however other international regimes that may restrict or regulate OIF activities. The following chapter investigates the rights of States to conduct OIF for research purposes, which are currently being contemplated, and for commercial purposes, which may arise in future, under the current regime for ocean governance.

²¹⁰ Ibid.

CHAPTER 2 – OCEAN ACCESS AND USE UNDER THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA (UNCLOS)

New perspectives or cultures relating to the use of the ocean and its resources develop as technology, relating to ocean use, advance; scientific understanding of the oceans grows; and the characteristics of the oceans change. The laws regulating human activity on the oceans are an expression of this culture,²¹¹ and, accordingly, these laws have needed to evolve in order to remain efficient and relevant.

OIF, a large scale cultivation activity in the oceans, is a new technology that is fundamentally different to ocean uses contemplated under the current ocean governance regime. The proposed use of the oceans for OIF is fraught with issues, such as who should benefit from OIF, and who has the legal authority to undertake OIF and to what extent. This chapter considers OIF within the context of the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and its provisions relating to jurisdiction, with the aim of establishing the rights of States to conduct OIF as a commercial activity and for scientific research. In addition the assessment of the position of OIF under UNCLOS presents an opportunity to evaluate the efficiency of the current state of ocean governance.

2.1 THE EVOLUTION OF OCEAN MANAGEMENT

In 1609 an article entitled '*Mare Liberium*' or 'freedom of the seas' was prepared by Hugo de Grotius.²¹² Under *Mare Liberium* the status of the oceans was such

²¹¹ Orbach, M.K. 'Cultural context of ocean fertilisation'. (2008). *Marine Ecology Progress Series*. **364**. 235-242. At 235.

²¹² *Ibid.* At 237.

that no nation or group controlled the use of the oceans.²¹³ This system of ocean governance was developed in a time when much of the focus was on navigation, and living resources were believed to be unlimited.²¹⁴ In the late 1700s States started extending their jurisdiction over the ocean by declaring a 3 nautical mile (nm) territorial sea adjacent to their coastline.²¹⁵ The perception of the oceans, beyond the traditional 3nm territorial sea, as a 'commons', available to all but owned by no one, persisted.²¹⁶

This regime seemed sufficient up until the point that mankind's technological capabilities and population size increased substantially and the potential for conflict over ocean space intensified. Mankind became increasingly dependant on the oceans as a provider of food, recreational activities, sources of energy and other non-living resources as well as a highway for world trade and a dumping site for the wastes of civilisation. It became evident that ocean resources were not unlimited and that human activities were placing pressure on ocean systems. As a consequence States wished to gain more extensive control over the oceans.

In 1945 President Truman of the United States (US) claimed the resources of the continental shelf adjacent to its shores for the US, thereby establishing a 'resource control zone' beyond the traditional 3nm territorial sea.²¹⁷ Many coastal States followed suit in claiming extended resource control zones and, in addition, started to declare territorial seas larger than the traditional 3nm, over which they exercised sovereignty.²¹⁸ By 1973 4,500,000 square nm of ocean had been subjected to unilateral claims.²¹⁹ The extent of ocean enclosure and the lack of rights and regulations for navigation presented a potential for conflict over ocean

²¹³ Ibid.

²¹⁴ Juda, L. *International Law and Ocean Use Management*. (1996). At 240.

²¹⁵ Orbach, M.K. [Note 211] At 237.

²¹⁶ Juda, L. [Note 214] At 2.

²¹⁷ Orbach, M.K. [Note 211] At 237.

²¹⁸ Juda, L. [Note 214] At 192.

²¹⁹ Ibid.

use and access.²²⁰ Furthermore international political arguments such as; who should benefit from the use of ocean resources, and legal debates such as; who has jurisdiction over the ocean, arose.²²¹ It was evident that a new ocean management regime was needed.

The third United Nations Conference on the Law of the Sea aimed to establish an equitable international legal framework for ocean governance. Three committees were established to handle different subject matter; the first dealt with the seabed beyond national jurisdiction, the second dealt with maritime zones and the third dealt with protection of the marine environment and scientific research.

Following nine years of negotiations, UNCLOS was adopted and signed by 159 States and other entities in December 1982. In November 1993, a year after having received its 60th ratification, UNCLOS came into force. As at 7 November 2008 there were 157 States or entities that had ratified or acceded to UNCLOS.²²²

UNCLOS is a framework convention that addresses a broad array of issues relating to ocean uses, jurisdictional questions and obligations. It comprises of 320 Articles and nine annexes. It aims to settle all issues relating to the law of the sea holistically through mutual understanding and cooperation and to develop a legal systems that:

'will facilitate international communication and promote peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment'.²²³

²²⁰ Juda, L. [Note 214] At 193.

²²¹ Ibid. At 6.

²²² 'Status of the United Nations Law of the Sea, of the Agreement relating to the implementation of Part XI of the Convention and of the Agreement for implementation of the provisions of the Convention relating to the conservation and management of straddling stocks and highly migratory fish stocks'. Available at www.un.org/Depts/los/reference_files/status2008.pdf Accessed on: 21-11-2008.

²²³ United Nations Convention on the Law of the Sea 1982 (1994) 21 I.L.M. 1261. [hereafter 'UNCLOS'] Preamble.

UNCLOS seeks to achieve a 'just and equitable international economic order' through the realisation of its goals and recognises that the interests and needs of mankind as a whole, and in particular, that of developing countries, need to be taken into account.²²⁴ Furthermore it aims to promote the economic and social advancement of mankind by strengthening peaceful, secure and friendly international relations and by conforming to the principles of justice and equal rights.²²⁵

2.2 MARITIME ZONES

A question encountered when considering OIF is that of who has the right to conduct OIF and where. UNCLOS defines a series of maritime zones which set out criteria related to coastal State sovereignty and sovereign rights and resource exploitation. The maritime zones outlined by UNCLOS are regarded as a reflection of customary laws.²²⁶ These zones are the internal waters, the territorial sea, the exclusive economic zone and the continental shelf (Refer to Figure 3).

²²⁴ Ibid.

²²⁵ Ibid.

²²⁶ Freestone, D. 'The Conservation of Marine Ecosystems under International Law' (1996). In: *International Law and the Conservation of Biological Diversity*. At 102.

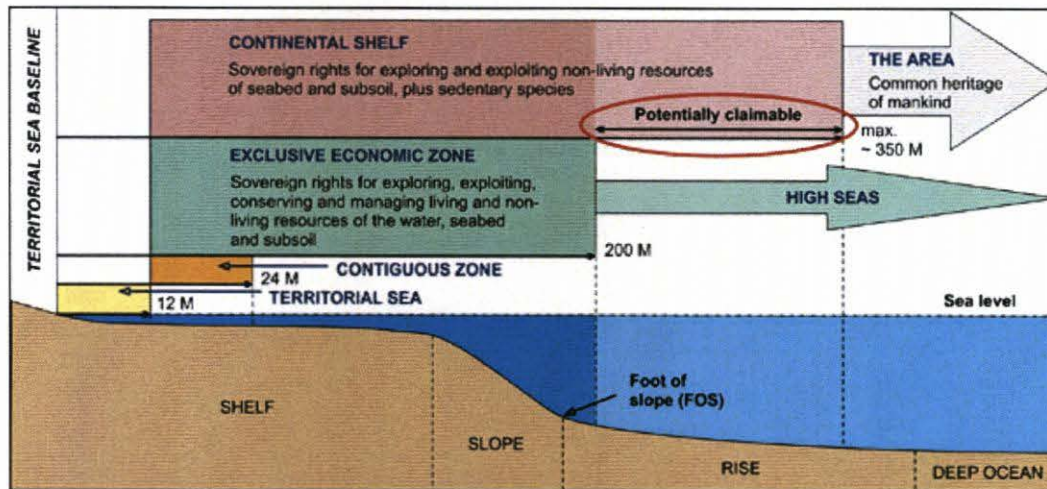


Figure 3: Diagram of the Maritime Zones under UNCLOS
From: www.bgr.bund.de

The Territorial Sea

Article 3 of UNCLOS provides coastal States the right to declare a territorial sea up to the limit of 12nm from a baseline.²²⁷ The method for establishing a baseline is set out in Articles 7 to 14. Any sea area landward of a baseline is classified as internal waters.²²⁸ The sovereignty of coastal States is extended over the internal waters and territorial sea and is applicable to the airspace over the area, its seabed and subsoil.²²⁹ Therefore any persons or activities occurring within the territorial sea are subject to the laws of the coastal State which, under UNCLOS, has been granted legislative and enforcement powers. The 12nm limit of the territorial sea and the rights within the territorial sea are widely accepted and practiced even in States which are not parties to UNCLOS.²³⁰

Ships of any nationality have been granted the right of innocent passage²³¹ through the territorial sea and through internal waters which had not previously

²²⁷ UNCLOS [Note 223] Art 3.

²²⁸ Ibid. Art 8.1.

²²⁹ Ibid. Art 2.

²³⁰ Churchill, R.R. and Lowe, A.V. *The Law of the Sea*, Third Edition. At 80.

²³¹ UNCLOS [Note 223] Art 17.

been considered as such.²³² Innocent passage is defined as passage that is not prejudicial to the peace, good order or security of the coastal State and UNCLOS expressly excludes 'the carrying out of research or survey activities', 'any act of wilful and serious pollution' and 'any other activity not having a direct bearing on passage'.²³³ Coastal States have the right to take steps to prevent passage that is not innocent²³⁴ and can therefore exclude vessels seeking to conduct OIF in its territorial sea.

Foreign ships passing innocently through another States' territorial sea must comply with the legislation enacted by the coastal State in conformity with international laws and UNCLOS provisions. Article 21 of UNCLOS permits coastal States to enact legislation for navigation, protection of cables and pipelines, conservation of marine living resources, fisheries, pollution, scientific research, and customs, fiscal, immigration and sanitary regulations, 'relating to innocent passage through the territorial sea'.²³⁵ Therefore coastal States cannot deny a vessel innocent passage through its territorial sea but they can regulate the manner in which it is conducted.

The enforcement powers of coastal States in the territorial sea under UNCLOS are essentially complete²³⁶ with the exception of jurisdiction over crimes committed before the vessel enters the territorial sea, given such vessel does not enter internal waters and merely passes through,²³⁷ and over civil proceedings where the liabilities incurred by the ship are not in connection with its voyage through the waters of the coastal State.²³⁸

²³² Ibid. Art 8.2.

²³³ Ibid. Art 19.

²³⁴ Ibid. Art 25.

²³⁵ Ibid. Art 21.

²³⁶ Churchill, R.R. and Lowe, A.V. [Note 230] At 98.

²³⁷ UNCLOS [Note 223] Art 27.

²³⁸ Ibid. Art 28.2.

UNCLOS grants States the exclusive right to conduct, regulate or authorise marine scientific research activities in its territorial sea.²³⁹ States may conduct research in another States territorial sea as long as the coastal State has provided explicit consent and the conditions set by the coastal State are upheld.²⁴⁰

OIF commercial and research activities may therefore be carried out legally in the territorial sea by a coastal State or with the consent of a coastal States given it is consistent with the coastal States' national and international obligations. However this is a highly unlikely scenario given the inappropriateness of the shallow waters of coastlines for carbon sequestration and the known negative impacts of phytoplankton blooms in close proximity to the coastline that would be of direct consequence to the coastal State.

The Exclusive Economic Zone

The Exclusive Economic Zone (EEZ) is a relatively recent concept that was introduced and supported by developing States at the third UN Conference of the Law of the Sea. Developing States, aspiring to enhance their economic development, sought greater control over the natural resources in the waters adjacent to their coastline, which in many cases had been exploited extensively by developed countries' distant water fishing fleets.²⁴¹ The approval of the EEZ at the conference represented a shift in the global culture relating to ocean governance as it codified the ability of coastal States to exercise national control over areas of the ocean that were significant in terms of the exploitation of natural resources.²⁴²

²³⁹ Ibid. Art 245.

²⁴⁰ Ibid.

²⁴¹ Churchill, R.R. and Lowe, A.V. [Note 230] At 161.

²⁴² Juda, L. [Note 214] At 225-226.

Under UNCLOS coastal States have the right to declare an EEZ with a maximum breadth of 200nm from the territorial sea baseline.²⁴³ Within the EEZ coastal States may exercise

'sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the superjacent waters to the seabed and of the seabed and its subsoil'.²⁴⁴

The enhancement of the biological pump using OIF is a complex process. If viewed in isolation, the depletion of macronutrients in surface waters, which occurs as a result of OIF, would constitute a form of exploitation of non-living resources, while the enhanced production of phytoplankton to increase CO₂ uptake would fall within the ambit of exploiting living resources. However, in OIF projects it is the interaction between non-living and living resources that is being exploited. The exploitation of the biological interactions, that are inherent in ocean ecosystems, was not contemplated specifically in this provision. However the wording of 'natural resources, whether living or non-living', suggests that the scope of the term 'natural resources' is broad and non-exclusive thereby covering all of aspects of the natural ocean system from which a use or benefit may be derived. Therefore ecosystems and the interactions therein fall within the scope of coastal States' sovereign rights under this provision.

Furthermore Article 56 provides

'sovereign rights... with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water currents and winds'.²⁴⁵

The inclusion of 'other activities' in this Article provides the coastal State with a freedom to permit and take advantage of developments in technology.²⁴⁶ OIF

²⁴³ UNCLOS [Note 223] Art 57.

²⁴⁴ Ibid. Art 56.

²⁴⁵ Ibid.

²⁴⁶ Churchill, R.R. and Lowe, A.V. [Note 230] At 167.

does fall within the jurisdiction of coastal States under this provision as an activity for the economic exploitation of the EEZ.

Article 56 grants coastal States jurisdiction 'as provided for in the relevant provisions of this Convention with regard to... marine scientific research and the protection and preservation of the marine environment in their EEZ'.²⁴⁷ The relevant provisions for marine scientific research are set out in Part XIII of UNCLOS.

Within an EEZ marine scientific research can be regulated, authorized and conducted by the coastal State and by other States subject to the consent of the coastal State.²⁴⁸ States conducting research activities in another State's EEZ are obliged to provide the coastal State with relevant information six months in advance of the proposed project; to allow coastal States to participate or be represented in the project; and to provide the results of the research to coastal States and the international community.²⁴⁹

Coastal States are obligated to establish rules to ensure that the consent to conduct research, which is 'exclusively for peaceful purposes and in order to increase scientific knowledge of the marine environment for the benefit of all mankind', is not delayed or denied unreasonably.²⁵⁰ However coastal States are permitted to withhold consent at their discretion if the project significantly impacts the exploration and exploitation of living or non-living resources.²⁵¹ Furthermore UNCLOS requires that marine scientific research activities must not unreasonably disrupt the ability of coastal States to exercise their sovereign rights in their EEZ.²⁵²

²⁴⁷ UNCLOS [Note 223] Art 56.

²⁴⁸ Ibid. Art 246.1 and 246.2.

²⁴⁹ Ibid. Art 248.

²⁵⁰ Ibid. Art 246.3.

²⁵¹ Ibid. Art 246.5 (a).

²⁵² Ibid. Art 246.8.

Therefore OIF research may be conducted in the EEZ by the coastal State or by any other State with the consent of the coastal State, providing that it is for the 'benefit of all mankind' and it does not significantly impact the coastal States ability to exercise its sovereign rights. Given that the aim of OIF is to mitigate climate change and that further research is needed, to ensure that the technique is efficient and that the side effects are acceptable, it could be argued that OIF research is to the benefit of mankind. The side effects of OIF experiments are currently unpredictable and the consequences could be such that living resources in the EEZ are negatively impacted upon, which, in turn would interfere with the activities of the coastal State in the exercise of their sovereign rights. However a coastal State may not be able to deny consent to an OIF research project in its EEZ as it may not be possible to prove, prior to the commencement of the project, that the project will have consequences that are of 'direct significance for the exploration and exploitation of natural resources'.

The Continental Shelf

The continental shelf is defined by UNCLOS as the natural prolongation of the land territory to the outer edge of the continental margin or to a minimum distance of 200nm from the baseline and not exceeding a distance of 350nm from the baseline or 100nm from the 2 500 metre isobath.²⁵³ The continental shelf in legal terms incorporates the seabed and subsoil of the continental shelf, slope and rise, and is therefore different from the geological definition.²⁵⁴

The EEZ and the continental shelf overlap up to the 200nm limit of the EEZ. The regime of the EEZ provides much greater jurisdiction to a coastal State than that of the continental shelf. Therefore the regime of the continental shelf is only significant where a state has not claimed an EEZ or where the continental shelf

²⁵³ Ibid. Art 76.

²⁵⁴ Churchill, R.R. and Lowe, A.V. [Note 230] At 148.

extends beyond 200nm. Within a continental shelf two regimes may exist, that of the EEZ applicable up to the 200nm limit (inner continental shelf) and that of the continental shelf, applicable beyond 200nm (outer continental shelf). Coastal States are not required to proclaim or occupy the continental shelf adjacent to their coastline as the rights are automatic,²⁵⁵ whereas an EEZ must be declared for the rights under UNCLOS to be conferred to the coastal State. Therefore a continental shelf may exist without an EEZ, but an EEZ cannot exist without a continental shelf.²⁵⁶

The regime of the continental shelf under UNCLOS grants coastal States the sovereign right to explore and exploit the natural resources of the continental shelf, however these resources are confined to mineral and other non-living natural resources of the seabed and subsoil together with living organisms that are sedentary.²⁵⁷ The legal status of the superjacent waters and airspace above those waters is not affected by the rights of the coastal State.²⁵⁸ Furthermore foreign states enjoy the freedom of navigation, laying of pipes and cables and fishing for non-sedentary species on the continental shelves of other states.²⁵⁹ The coastal State may not infringe upon these freedoms in the exercise of their rights on the continental shelf.²⁶⁰

Thus the control of a coastal State on the continental shelf beyond the EEZ or where there is no EEZ, is limited to the regulation of activities that interfere with the specified resources. It has been speculated that OIF activities reduce oxygen concentrations at depth. Low oxygen conditions could be detrimental to sedentary species on the continental shelf, and therefore the coastal State could take action on this line of argument and possibly hinder or put a stop to OIF

²⁵⁵ UNCLOS [Note 223] Art 77.3.

²⁵⁶ Churchill, R.R. and Lowe, A.V. [Note 230] At 145.

²⁵⁷ UNCLOS [Note 223] Art 77.

²⁵⁸ Ibid. Art 78.1.

²⁵⁹ Ibid. Arts 78 and 79.

²⁶⁰ Ibid. Art 78.2.

activities in the waters above their continental shelf, if evidence of such consequences became available.

The provisions relating to marine scientific research on the continental shelf are the same as those for the EEZ, with the exception that the coastal State may not withhold consent on the basis that the project is of direct significance to the exploration and exploitation of natural resources.²⁶¹ The use of the term 'on the continental shelf' suggests that only research conducted physically on the seabed and not in the water column above is subject to the consent of the coastal State.²⁶² This interpretation is supported by Article 257 which confers a right to all States to conduct marine scientific research in the water column beyond the EEZ. Therefore the only circumstances in which coastal States may delay or halt OIF research activities, undertaken by foreign states in the water column above the continental shelf, are those in which they can prove that the research would 'unjustifiably interfere with activities undertaken by coastal States in the exercise of their sovereign rights and jurisdiction'²⁶³ on the continental shelf. Given the current level of uncertainty regarding the side effects of OIF this may prove to be a difficult point to argue.

2.3 THE HIGH SEAS

Approximately 60% of the ocean surface falls outside the ambit of coastal State jurisdiction.²⁶⁴ OIF activities have been conducted and will most likely continue to be conducted within these deep international waters, as they are more suitable, not only in terms of the likely negative impacts on the near-shore ecosystem, but also in respect of the increased storage time of CO₂ with increasing depth. Furthermore a large proportion of the HNLC regions are

²⁶¹ Ibid. Art 246.6.

²⁶² Churchill, R.R. and Lowe, A.V. [Note 230] At 407.

²⁶³ UNCLOS [Note 223] Art 246.8.

²⁶⁴ Orbach, M.K. [Note 211] At 237.

located over these international ocean areas, known as the high seas. Part VII of UNCLOS sets out provisions applicable to the high seas but does not provide a definition for the high seas. Instead UNCLOS negatively defines the scope of application of the high seas provisions in Article 86:

'The provisions of this part apply to all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a state, or in the archipelagic waters of an archipelagic State'.²⁶⁵

The high seas regime therefore applies to the airspace and water column beyond the outer limit of the EEZ and the subsoil and seabed in that same area subject to the coastal States' sovereign rights to explore and exploit resources on the outer continental shelf and the regime of the Area for the deep sea bed (Part XI). The legal status of the high seas is such that they are open to all States and no State can subject any portion of them to its sovereignty or jurisdiction.²⁶⁶ Therefore States cannot exercise control over other States using the high seas for lawful activities, except for in a few special circumstances created mostly by treaty.²⁶⁷

Activities on the High Seas

There currently three regimes aimed managing activities on the high seas under UNCLOS. The regime of the outer continental shelf, whereby the natural resources of its seabed and subsoil, as well as the sedentary species, are subject to coastal State jurisdiction, has been discussed. The regime of the high seas in Part VII provides a list of high seas freedoms while the regime of the Area in Part XI sets out rules for the exploration and exploitation of mineral resources of the Area.

²⁶⁵ UNCLOS [Note 223] Art 86.

²⁶⁶ Ibid. Art 87, 89.

²⁶⁷ Churchill, R.R. and Lowe, A.V. [Note 230] At 205.

Freedom of the High Seas

States cannot control other States activities on the high seas and essentially States are able to do as they please except for a few restrictive rules established through treaty or by custom. Furthermore the development of ocean technology is rapid and as a result all the possible activities that could be conducted by States on the high seas cannot be predicted and listed exhaustively.²⁶⁸ Article 87 of UNCLOS provides a non-exhaustive list of high seas freedoms.²⁶⁹ There have been disputes between States as to whether certain activities, which are not listed, constitute freedoms.²⁷⁰ Activities which involve no claim to appropriation of parts of the high seas and are not excluded by a specific rule of law should in principle be admitted as high seas freedoms.²⁷¹

The listed freedoms are; navigation, overflight, the laying of submarine cables and pipelines, the construction of artificial islands and other installations, fishing and scientific research.²⁷² These freedoms are restricted by specific conditions imposed on states by UNCLOS and by other international treaties. The laying of submarine cables and pipelines, the construction of artificial islands and other installations and scientific research are all subject to the regime of the continental shelf in Part VI.²⁷³ The freedom of scientific research is also subject to Part XIII of UNCLOS which provides a regime specifically for marine scientific research.²⁷⁴ The freedom of fishing is regulated by Section 2: The Conservation and Management of Living Resources on the High Seas, of Part VII of UNCLOS.²⁷⁵

²⁶⁸ Ibid.

²⁶⁹ Oude Elferink, A.G. 'The Regime of the Area: Delineating the Scope of Application of the Common Heritage Principle and the Freedom of the High Seas'. (2007). *The International Journal of Marine and Coastal Law*. **22.1**. 143-176. At 144.

²⁷⁰ Churchill, R.R. and Lowe, A.V. [Note 230] At 206.

²⁷¹ Ibid.

²⁷² UNCLOS [Note 223] Art 87.

²⁷³ Ibid.

²⁷⁴ Ibid.

²⁷⁵ Ibid.

In addition UNCLOS imposes a general condition that the freedoms have to be exercised 'with due regard for the interests of other States in their exercise of the freedom of the high seas'²⁷⁶ and that they are to be exercised for peaceful purposes.²⁷⁷ By including the 'due regard' obligation UNCLOS recognises that the exercise of one freedom may infringe upon another freedom. If a situation should arise concerning conflicting high seas uses a balancing act between the uses and the actual interests may be required under the 'due regard' obligation, in order to determine which use is most reasonable.²⁷⁸ Thus the extent of reasonableness of an activity may determine whether that activity constitutes a high seas freedom.

There are therefore four criteria to consider when establishing whether an activity falls within the freedom of the high seas: (1) does it involve a claim to appropriation of parts of the high seas, (2) is it excluded by a specific rule of law, (3) is it exclusively for peaceful purposes and (4) does it unreasonably infringe upon other high seas freedoms.

OIF activities do not involve claims to portions of the high seas and they are conducted exclusively for peaceful purposes. Whether OIF activities are excluded by a specific rule of law will be discussed in the following chapter. If the predicted side effects of OIF on ecosystems and fisheries materialise OIF activities will certainly infringe upon the freedom of fishing and, in circumstances involving ecosystem research, may infringe upon the freedom of scientific research. As discussed above the side effects of OIF are uncertain and may be experienced long after or at a great distance from the OIF incident, and consequently the link between OIF and the particular side effect thereof may be difficult to prove with certainty. This presents a problem for determining the

²⁷⁶ Ibid. Art 87.2.

²⁷⁷ Ibid. Art 88.

²⁷⁸ Churchill, R.R. and Lowe, A.V. [Note 230] At 206-207.

reasonableness of OIF and the extent to which it may have infringed upon other freedoms as it may be difficult or even impossible to provide reliable evidence to argue for or against the conduct of OIF activities. Therefore under the UNCLOS regime OIF may be considered as a freedom of the high seas provided it is not prohibited by other international laws.²⁷⁹

Shortcomings of the Freedom of the Seas Concept

If OIF activities are conducted as a freedom on the high seas, it may result in a myriad of conflicts and problems, as there are weaknesses inherent in the concept of freedom of the high seas. The exploitation of ocean resources is driven largely by market demand. Where there is an open system, with resources considered as free and in principle shared by all, such as the freedom of the high seas system, the marketplace could produce what is known as the 'tragedy of the commons'.²⁸⁰

In a market, where the sole objective is to maximise the wealth of each individual State, the unrestricted exploitation will lead to a crash of that particular resource as each consumer is able to maximise their exploitation until the resource is depleted.²⁸¹ The consequences of an open system are apparent with regard to high seas fisheries and atmospheric pollution. Fish stocks, a common resource of the high seas, have declined dramatically in many parts of the ocean, and the atmosphere, a common resource of mankind, has accumulated large amounts of GHGs and other anthropogenic pollutants. Both high seas fisheries and air pollution are now largely regulated by international laws however they both signify the inherent problem of an open system.

²⁷⁹ Scott, K. [Note 80] At 96.

²⁸⁰ Kiss, A. and Shelton, D. *International Environmental Law*, Third Edition. 2004. At 23-24.

²⁸¹ *Ibid.*

The concept of freedom of the high seas was developed at a time when the human population was much smaller than its current size and technology to extensively exploit distant seas had not been developed. Consequently there was a perception that ocean resources were unlimited.²⁸² Despite the acceptance of the fact that the ocean resources are in fact limited, the freedom of the seas concept is still in place over approximately 60% of the oceans surface. However the current freedom of the high seas concept is somewhat different to the original system under Grotius as general and specific regulations have been enacted for several of the major uses of the ocean.

The freedom of the high seas concept without any form of restriction, a situation that may be encountered with emerging uses of the high seas, has severe practical shortcomings due to the negative implications for resource conservation and marine pollution.²⁸³ Therefore as new technologies develop which involve the exploitation of the resources of the high seas, restrictions need to be put in place to ensure a tragedy of the commons situation does not result.

Large scale OIF is one such emerging use that has the potential to become an extensive market-driven activity on the high seas. OIF differs from other uses of the oceans resources in that OIF itself is not a finite resource. However the HNLC regions, in which OIF activities are based, could be regarded as a finite resource as the chemical and physical properties of these regions, which support OIF, could potentially be altered through OIF activity to the extent that they cannot be utilised for OIF for certain periods or perhaps indefinitely. If OIF is accepted as a freedom it may lead to a classic 'tragedy of the commons' scenario whereby the cumulative effects of many OIF projects is such that the ocean environment becomes degraded to such an extent that OIF can no longer yield economic

²⁸² Juda, L. [Note 214] At 240.

²⁸³ Ibid. At 209.

benefits.²⁸⁴ It is therefore clear that OIF should be subject to international regulation.

Another shortcoming of the concept of freedom of the high seas is the potential for conflict due to its deficiencies regarding the distribution of benefits. It was expressed by R.P. Aand, at the time the third UN Conference for the Law of the Sea commenced, that:

'It [the concept of freedom of the seas] was devised and developed at a particular period of history to serve the needs and interests of the rich and powerful industrial states of Western Europe and the United States'.²⁸⁵

This signifies that inequalities will result due to fact that developed states have the capabilities to exploit ocean resources far more efficiently than developing States and, therefore developed States can acquire a disproportionate share of the total economic benefits that could potentially be derived from ocean uses.

During the negotiations that led to UNCLOS the major uses of the oceans natural resources that were considered were those of fishing, oil and gas extraction and the mining of deep seabed minerals. The EEZ concept and the jurisdiction over seabed activities on the continental shelf were established to protect the interests of developing states as these resources were found and utilised predominantly in these areas. OIF activities would be conducted in areas of the high seas that are impractical to subject to a similar system of coastal State jurisdiction and furthermore, given that OIF is a large scale manipulation of interconnected ocean ecosystems it would need to be managed for the whole ocean in a holistic manner.

²⁸⁴ Cullen, J.J. and Boyd, P.W. [Note 15] At 296.

²⁸⁵ Aand, R.P. 'Tyranny' of the Freedom-of-the-Seas Doctrine'. (1973). *International Studies* 12. 416-429. At 417. Cited by Juda, L. [Note 214] At 210.

The mining of minerals from the deep seabed presented a similar challenge during the negotiations of UNCLOS as this activity also involved the exploitation of a resource predominantly found in the high seas, which was dependent on the technological capabilities of a State. A system, which allowed for the benefits derived from the ocean to be equitably distributed, was sought by developing states. The regime of the Area, detailed in Part XI of UNCLOS, was the compromise that was reached in UNCLOS.

The Regime of the Area

The perception of ocean space and resources as the 'common heritage of mankind' was referred to repeatedly during the negotiations for UNCLOS.²⁸⁶ This concept suggested that mankind's view of the ocean and its resources differed to that of the terrestrial environment, in that the ocean and its resources were to be treated as a common pool.²⁸⁷ This notion advanced to one in which oceans should be managed for the 'benefit of all humankind' and, more particularly, that ocean resources should be managed equitably taking into consideration those humans most in need of them.²⁸⁸ This concept contradicted that of the freedom of high seas which promotes the distribution of benefits primarily to developed States.

Detailed rules for the exploration and exploitation of mineral resources for the Area are set out in Part XI of UNCLOS. The Area is defined by UNCLOS as 'the seabed and ocean floor beyond the limits of national jurisdiction'.²⁸⁹ The regime of the Area is thus applicable to the ocean floor beyond the continental shelf. The Area regime is the only part of UNCLOS that implements the 'common heritage of mankind' concept²⁹⁰ as the resources of the Area are considered by

²⁸⁶ Orbach, .M.K. [Note 211] At 238.

²⁸⁷ Ibid.

²⁸⁸ Ibid.

²⁸⁹ UNCLOS [Note 223] Art 1.1(1).

²⁹⁰ Ibid. Art 136, Orbach, .M.K. [Note 211] At 238.

UNCLOS to be one common resource entrusted to one community that is mankind as a whole.²⁹¹ Part XI of UNCLOS provides mechanisms for the transfer of technology to developing States;²⁹² the protection of the marine environment and human life with respect to activities in the Area;²⁹³ the promotion of participation by developing States in activities in the Area²⁹⁴ and the establishment of the International Sea Bed Authority (ISBA) to regulate mining and promote benefit sharing, on the behalf of mankind as a whole.²⁹⁵

The Area regime was a highly contentious issue in the negotiations of UNCLOS as States were no longer free to exploit deep sea minerals and were subjected to a number of requirements.²⁹⁶ It took 12 years after the adoption of UNCLOS for Parties to achieve an acceptable regime that accommodated the views of developing and developed States.²⁹⁷ However there is still some dissatisfaction with the regime as the US has not yet ratified UNCLOS for reasons relating to the regime of the Area.

OIF activities are conducted within the water column of the ocean and therefore the activities themselves are not under the jurisdiction of the Area regime. However the consequent enhanced settling and accumulation of particulate matter on the seabed, the extent and effects of which are uncertain, does raise an issue as the seabed itself falls within the ambit of the regime of the Area and is regarded by UNCLOS as a common heritage of mankind.²⁹⁸ Article 87.2 requires the freedoms of the high seas shall be exercised with due regard for the rights with respect to activities in the Area. The impacts of the accumulation of particulate matter on the seabed are unknown and thus presenting evidence to

²⁹¹ UNCLOS [Note 223] Art 137.2.

²⁹² Ibid. Art 144.

²⁹³ Ibid Art 145, 146.

²⁹⁴ Ibid. Art 148.

²⁹⁵ Ibid. Art 137.2.

²⁹⁶ Juda, L. [Note 214] At 234.

²⁹⁷ Ibid.

²⁹⁸ UNCLOS [Note 223] Art 136.

argue for or against the conduct of OIF may be difficult in respect to the activities of the Area.

Marine Scientific Research on the High Seas

Scientific research is listed as a freedom of the high seas,²⁹⁹ and its conduct by all States and competent international organisations is permitted in the high seas provided certain conditions, set out in Part XIII of UNCLOS, are upheld. A distinction is made between research conducted in the water column of the high seas and research conducted in the Area in that research in the Area is subject to the provisions of the regime of the Area³⁰⁰ while research in the water column is subject to the provisions of the Convention.³⁰¹

General principles for research conducted in the ocean insist that it must be conducted for exclusively peaceful purposes using appropriate scientific methods while not interfering with other legitimate uses of the sea and conforming to the provisions in UNCLOS. With respect to OIF, the interference with other legitimate uses of the sea, as discussed above, may be difficult to prove or disprove given the current levels of uncertainty inherent in OIF.

The aspects of the marine environment being studied during OIF are the biological pump mechanism and all its associated interactions between biota, biogeochemical cycles, and the ocean's physical characteristics. UNCLOS promotes research of this kind by compelling States and international organisations to cooperate through agreements, to create favourable conditions for research and to integrate the efforts of scientists studying 'phenomena and processes occurring in the marine environment and the interrelations between them'.³⁰²

²⁹⁹ Ibid. Art 87.

³⁰⁰ Ibid. Art 256.

³⁰¹ Ibid. Art 257.

³⁰² Ibid. Art 243.

Research activities are not recognised by UNCLOS as a legal basis for any claim to parts of the marine environment or its resources.³⁰³ The proposals of Climos and Planktos to sell the CO₂ offsets; which are the result of OIF experiments conducted for research, do not qualify as a claim to a resource as they are not selling the resource itself (the biological pump) but rather a side effect of the exploitation of the system which was conducted for scientific research purposes.

2.5 CONCLUSION

OIF activities conducted in close proximity to the coast or over a continental shelf are likely to have more damaging side effects from an anthropogenic perspective than if conducted in more distant and deeper regions of the ocean as the majority of the world's fish catch is within 200nm of the coast.³⁰⁴ It would therefore be favourable for coastal States to exercise full jurisdiction over OIF commercial and research activities in their coastal waters and on the continental shelf as they have an incentive to approach OIF with caution due to the fact that the consequences of OIF would affect them and their resources.

The current lack of predictability of the effects of OIF on other ocean uses leaves much uncertainty as to how legal issues, concerning the consequences of OIF conducted for commercial or research purposes, may play out in future. UNCLOS offers no limitation as to who may conduct OIF on the high seas and to what extent. This system is unsustainable if the freedoms remain unregulated, as it promotes the exhaustion of natural resources, which is to the detriment of the marine environment on which humans depend.

³⁰³ Ibid. Art 241.

³⁰⁴ Juda, L. [Note 214] At 5.

The negative impact of the exploitation of natural resources on the ocean systems has been recognised and consequently a number of international laws aim to, or contain provisions that aim to protect the marine environment. These could potentially offer additional restrictions to the conduct of OIF within coastal State jurisdiction and as a freedom on the high seas, and will be considered in the following chapter.

CHAPTER 3 - PROTECTION OF THE MARINE ENVIRONMENT: SOFT LAW, CUSTOMARY LAW AND INTERNATIONAL CONVENTIONS

The traditional uses of the oceans have intensified and diversified and have consequently placed increasing pressure on the marine environment.³⁰⁵ Anthropogenic interference with oceans and ocean resources has led the depletion of marine and coastal living resources and the degradation of ecosystems.

Mankind now has the ability to manipulate the workings of the ocean's systems, and consequently has to make decisions that involve trade-offs between the state of the worlds' biophysical ecology and the state of humans and their relationships with one another.³⁰⁶ The decision whether or not to proceed with OIF activities involves a trade-off between the achievement of higher levels of carbon sequestration to mitigate climate change, and the alteration of the ocean environment and potentially elements of the environment on which we depend.

This chapter provides an overview of international environmental laws and principles of relevance to the conduct of OIF. Furthermore it assesses the current state of the protection of the marine environment from OIF from two different perspectives; namely the prevention of pollution from dumping and the protection of the ecosystem.

³⁰⁵ Kiss, A. and Shelton, D. [Note 280] At 495.

³⁰⁶ Orbach, M.K. [Note 211] At 235.

3.1 INTERNATIONAL PRINCIPLES OF ENVIRONMENTAL LAW

International environmental law makes extensive use of principles. Principles are not binding but are useful as they function as a guide to policy making and in some cases reflect or evolve into norms, customs and binding provisions in treaties. Principles are contained in all the major non-binding normative instruments such as the Stockholm Declaration and the Rio Declaration.

Sovereign Rights and Responsibilities

Principle 21 of the Stockholm Declaration is the foundation of international environmental law. It provides that States have

'the sovereign right to exploit their natural resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or areas beyond the limits of national jurisdiction'.³⁰⁷

This principle incorporates two competing interests; States' sovereign rights over natural resources and States' duty to not cause damage to the environment. Furthermore it illustrates the trade-off that is inherent in all environmental law. Article 2 of the Rio Declaration reaffirms this principle and expands States' rights to pursue policies that are both environmental *and developmental*.

The responsibility of States to not cause damage to the environment of other States or beyond national jurisdiction reflects a general rule of international customary law that was established through the combination of custom arising out of the *Corfu Channel* case (1949) and the *Trail Smelter* arbitration (1938-41).³⁰⁸ In the *Corfu Channel* case the International Court of Justice held that each State was obligated 'not to allow knowingly its territory to be used for acts

³⁰⁷ Stockholm declaration. Available at: <http://www.unep.org>. Accessed on: 08/09/2008. Principle 21.

³⁰⁸ Churchill, R.R. and Lowe, A.V. [Note 230] At 332.

contrary to the rights of other States' and in the *Trail Smelter* arbitration the arbitral tribunal affirmed that 'no State has the right use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another State'.³⁰⁹ This responsibility, as a general rule of customary law is binding on all States.³¹⁰ Furthermore this Principle is codified in a number of treaties such as the 1992 Biodiversity Convention³¹¹ and the 1992 UNFCCC.³¹²

The use of the word 'jurisdiction' apposed to 'territory' in Principle 21/ Principle 2 indicates that this customary law not only applies to activities within a State's territory but also to activities under a State's authority, such as vessels on the high seas, and even nationals.³¹³ Therefore States may be internationally responsible if OIF activities, conducted within the State's maritime zones or by its nationals on the high seas, cause damage to the environment of other States or the high seas.³¹⁴ However this customary law does not provide explicit detail as to what constitutes environmental damage, what level of damage is prohibited, what the consequences are and what the extent of liability is.

Preventative Principle

The preventative principle is incorporated in almost all international environmental instruments in the form of an objective to prevent environmental deterioration. This principle seeks to avoid significant harm to the environment due to the fact that it is often impossible or more costly to reverse environmental degradation. The duty of prevention is closely related to the Principle 21/ Principle 2 obligation of States not to cause significant damage to the environment in areas beyond their jurisdiction, however it is distinctive from Principle 21/ Principle 2 as it applies to States within their own jurisdiction in

³⁰⁹ Ibid.

³¹⁰ Churchill, R.R. and Lowe, A.V. [Note 230] At 332.

³¹¹ Convention on Biological Diversity, June 5, 1992, 31 I.L.M. (1992). [hereafter 'CBD'] Art 3.

³¹² UNFCCC. [Note 126] Preamble.

³¹³ Freestone, D. [Note 226] At 105, Freestone, D. and Rayfuse, R. [Note 124] At 232.

³¹⁴ Freestone, D. and Rayfuse, R. [Note 124] At 232.

addition to areas beyond their jurisdiction. Preventative measures necessitate prior assessment of a particular activity or technology

Precautionary Principle

The precautionary principle was formulated in the late 1980's and since then it has been included in almost all international environmental instruments. Principle 15 of the Rio Declaration provides a commonly quoted definition for the precautionary principle:³¹⁵

'Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation'.

This principle is essentially a guide to utilizing scientific evidence in decision-making.³¹⁶ In essence the principle directs States to take measures to prepare for potential or even hypothetical threats, even when there is no irrefutable scientific evidence that such threats will materialise.³¹⁷ It contains many ambiguities such as; what constitutes 'serious and irreversible damage' and what minimum level of scientific certainty, of such damage, is required to warrant the conduct of preventative measures.³¹⁸ These ambiguities leave much room for the subjective interpretation and varied application of the principle.

The controversies surrounding the application of the principle are that of the burden of proof and standard of proof that it imposes. Environmentalists, support the notion that the implementation of new technology can be halted if there is even the slightest indication that it may cause harm to the environment.³¹⁹ This view essentially shifts the burden of proof to the companies

³¹⁵ Fabra, A. and Gascon, V. 'The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) and the Ecosystem Approach'. (2008). *The International Journal of Marine and Coastal Law*. 23. 567-598. At 570.

³¹⁶ Cranor, C.F. 'Learning from the Law to Address Uncertainty in the Precautionary Principle'. (2001). *Science and Engineering Ethics*. 7. 313-326. At 314.

³¹⁷ Kiss, A. and Shelton, D. [Note 280] At 212.

³¹⁸ Van Den Belt, H. and Gremmen, B. 'Between the Precautionary Principle and "Sound Science": Distributing the Burdens of Proof.' (2002). *Journal of Agriculture and Environmental Ethics*. 15. 103-122. At 105.

³¹⁹ Ibid.

developing technology to provide proof with no scientific uncertainty that these technologies will not harm the environment.³²⁰ This standard of proof is impossible to achieve as there is always a level of scientific uncertainty in relation to new technologies and the health of the environment.³²¹ Furthermore the potential benefits of the technology, which may in fact outweigh the costs, are not considered when the principle is applied in this manner. Therefore the precautionary principle may hinder the development and application of new and innovative technologies that may in fact solve more problems than it creates.

The problem with the rigid and absolute application of the precautionary principle, which makes no room for trade-offs or the balancing of interests, becomes evident where preventative measures themselves present possibilities of environmental harm. The stalemate that would result could be illustrated using OIF as an example where the precautionary principle could be used as an argument for or against the conduct of OIF.

The UNFCCC expresses an obligation on States to take precautionary measures to mitigate climate change and includes the use and development of sinks in these mitigation measures.³²² Evidence indicates that climate change will cause serious and irreversible damage thus warranting preventative measures. Thus the implementation of OIF as a preventative measure for climate change is supported by the precautionary principle. However there is increasing consensus among scientists that OIF itself poses threats of serious and irreversible damage to the environment. Thus, in accordance with the rigid application of the precautionary principle, OIF should be halted.

³²⁰ Ibid. At 107.

³²¹ Cranor, C.F.. [Note 316] At 317.

³²² UNFCCC [Note 126] Art 3.

The scientific interpretation of uncertainty, based on inductive and deductive reasoning, and the resultant scientific advice, should rather be used to guide decisions as apposed to the mere presence of uncertainty, as uncertainty is inherent in all forms of science (as seen with OIF on both sides of an argument). The problem with basing decisions on scientific interpretation is that science does not produce value-free, objective truths and thus consensus is not always achievable.³²³ In a situation where no consensus can be achieved among scientists the best approach would be to balance the effects of the potential costs and benefits associated with an activity or technology. The precautionary approach requires that this decision, based on the balancing of costs and benefits, is made in the interests of safety and caution.³²⁴ Therefore a decision for or against the conduct of OIF will require an analysis and balancing of the potential side effects and benefits of OIF to determine which is the most cautious approach: to halt all OIF, and potentially lose a method that could aid in the mitigation of climate change, or to proceed with OIF, and alter the marine system such that it may potentially be to our detriment.

The current situation with regard to OIF is such that there a substantial level of uncertainty regarding the side effects and benefits of the technique and therefore much research is required. OIF research does have the potential to cause damage to the environment, but the benefit of gaining knowledge, which could be used to develop a technique that mitigates climate change, or put a halt to the extensive commercial use of an ineffective and dangerous technique, has been recognized too. Several scientists have supported the idea of carefully conducted larger experiments.³²⁵

³²³ Heazle, M. 'Scientific Uncertainty and the International Whaling Commission: an alternative perspective on the use of science in policy making'. (2004). *Marine Policy*. **28**. 361-374. At 362-363.

³²⁴ Kiss, A. and Shelton, D. [Note 280] At 105.

³²⁵ Powell, H. [Note 45] At 9.

There is however increasing consensus among scientists that it is premature to sell carbon credits generated by OIF as they cannot be verified reliably at this point in time,³²⁶ and could potentially cause damage if the carbon credits, which are sold and offset against emission limits, are not a true representation of reality. Thus it seems that the most beneficial and perhaps precautionary approach to follow would be to conduct further OIF research and to halt the sale of carbon credits generated by OIF.

3.2 PREVENTION OF MARINE POLLUTION BY DUMPING

UNCLOS

All States are required by UNCLOS to protect and preserve the marine environment.³²⁷ UNCLOS gives content to the international responsibility of States to ensure that activities under their jurisdiction or control do not cause damage to the environment of other States or to areas beyond national jurisdiction.³²⁸ It transforms this responsibility into a duty of States to take measures to ensure that activities under their jurisdiction or control are conducted so to prevent damage by pollution to other States or in areas beyond their jurisdiction.³²⁹ States are obliged to take, individually or jointly, all measures necessary to prevent, reduce and control pollution of the marine environment from any source,³³⁰ to prohibit the transfer, either directly or indirectly, of damage or hazards from one area to another; and to prohibit the transformation of one type of pollution to another.³³¹ These duties are applicable to all areas of the ocean including those under national jurisdiction.³³²

³²⁶ Buessler, K.O. et al. [Note 19] At 162.

³²⁷ Ibid. Art 192.

³²⁸ Rayfuse, R. et al. [Note 24] At 307.

³²⁹ UNCLOS [Note 223] Art 194.2.

³³⁰ Ibid. Art 194.1

³³¹ Ibid. Art 195.

³³² Rayfuse, R. et al. [Note 24] At 308.

Article 1.4 of UNCLOS defines pollution as: `

`the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the seas, impairment of quality for use of sea water and reduction of amenities`

Under this definition it is not the introduction of a substance that qualifies as pollution but rather the introduction of a substance that is likely to have deleterious effects, therefore it is the effects of a substance that are of import and not the inherent properties. Furthermore `pollution` encompasses the direct and indirect introduction of substances with deleterious effects

Article 194.3 requires States to take measures to minimise, to the fullest extent possible, the release of toxic, harmful or noxious substances from land-based sources through the atmosphere or by dumping; operational and emergency discharges from vessels and pollution from installations. Furthermore States are required to take measures to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction.³³³

Dumping is defined in Article 1.5 as

`any deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other manmade structures at sea`,

and it does not include the

`placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of the Convention`.

Dumping can only be conducted with the permission of the competent authorities of States and, if conducted within the territorial sea, EEZ or

³³³ UNCLOS [Note 223] Art 196.

continental shelf, with the express prior approval of coastal States.³³⁴ All states are required to adopt national laws to prevent and regulate dumping that must be no less effective than internationally agreed global rules and standards.³³⁵

The London Convention and London Protocol

The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, the London Convention (LC) for short, and its 1996 London Protocol (LP) are the most important internationally agreed rules and standards for dumping.³³⁶ The LC was the first global treaty concerning the dumping at sea and it came into force in 1975.³³⁷ As at 31 October 2008 it had 84 parties representing 67% of the world shipping tonnage.³³⁸ The objective of the LC is to promote the effective control of all sources of marine pollution and to prevent pollution of the sea by dumping of waste or other matter that could create hazards to human health, harm living resources and marine life, damage amenities or interfere with other legitimate uses of the sea.³³⁹ The definition for dumping under the LDC was adopted word for word by UNCLOS.

The LC provides a list of substances (the 'black list') that may not be dumped in Annex I and a list of substances (the 'grey list') that may only be dumped with a special prior permit in Annex II.³⁴⁰ The dumping of all non-listed wastes and other matter requires a prior general permit that is issued after careful consideration of all the factors listed in Annex III.³⁴¹

³³⁴ Ibid. Art 210.5.

³³⁵ Ibid. Art 210.6.

³³⁶ Rayfuse, R. [Note 24] At 309.

³³⁷ Kiss, A. and Shelton, D. [Note 280] At 528-529.

³³⁸ IMO. Summary of Status of Conventions. Available at: www.imo.org/home.asp?topic_id=1488. Accessed on: 17/11/2008.

³³⁹ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Nov 13, 1972, 11 I.L.M. [hereafter LC] Art 1

³⁴⁰ Ibid. Art IV.

³⁴¹ Ibid. Art VI (3),

Parties to the LC are required to enact legislation to regulate dumping in accordance with the above system, and impose it upon vessels and aircraft that are registered to its territory or flying its flag, that are loading the material for dumping in its territory, or that are under its jurisdiction and believed to be dumping.³⁴²

In 1996 a Protocol (LP) to the LC was developed to update and eventually replace the LC.³⁴³ The LP came into force in 2006 and as at 31 October 2008 had 36 parties.³⁴⁴ The LP adopted a precautionary approach³⁴⁵ by providing a reversed listing procedure in which all dumping is prohibited except for wastes and other matter specified in Annex 1.³⁴⁶ Furthermore Annex 1 substances may only be dumped if the stringent assessment, permitting and monitoring requirements, set out in Annex 2, are upheld.³⁴⁷ The list of substances in Annex 1 include: dredged material; sewerage sludge; fish wastes; vessels and platforms; inert, organic geological material; organic material of natural origin; bulky items primarily comprising iron, steel and concrete; and CO₂ streams from CO₂ capture processes for sequestration.

Implications for OIF

OIF as pollution

The current state of knowledge regarding the potential environmental impacts of OIF is insufficient, however models, based on the evidence collected to date, indicate that the large algal blooms stimulated by OIF have the potential to cause harm to the marine environment and impair other legitimate uses of the sea. No negative side effects directly resulting from increased concentrations of

³⁴² Ibid. Art VII.

³⁴³ IMO. 'The London Convention and Protocol: Their Role and Contribution to the Protection of the Marine Environment'. Available at: www.imo.org Accessed on: 18/11/2008.

³⁴⁴ IMO. Summary of Status of Conventions. [Note 335]

³⁴⁵ Churchill, R.R. and Lowe, A.V. [Note 230] At 366.

³⁴⁶ Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Nov 8, 1996, 36 I.L.M. [hereafter 'LP']. Art 4.1 (1).

³⁴⁷ Ibid. Art 4.1 (2)

iron itself have been predicted, however a causal link between the negative ecosystem impacts of phytoplankton blooms and iron introductions could be established.³⁴⁸ Considering that it is the potential deleterious effects of a substance that qualifies the introduction of that substance as 'pollution', it is evident that the introduction of iron could constitute pollution of the ocean under the UNCLOS and the LP.

OIF as dumping

The interpretation of the definition of dumping provided for under the UNCLOS, LC and LP will determine whether OIF is subject to the international dumping regime. 'Disposal' is not defined in any of the instruments but its ordinary definition suggests that it is the discard of a substance for the purpose of abandonment.³⁴⁹ Iron is introduced to the ocean during OIF with no intention of retrieval and thus it may be considered disposed of. Iron itself, even if not considered as waste, does fall within the ambit of 'other substance'. *Prima facie*, the introduction of iron into the ocean does constitute a form of dumping.³⁵⁰

However all instruments exclude 'the placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of' the UNCLOS, LC or LP, from the definition of dumping. Iron is introduced into the marine environment for the purpose of fertilisation and the enhancement of CO₂ absorption from the atmosphere, and not for the 'mere disposal thereof'.³⁵¹ Therefore, by virtue of this 'placement' exclusion, the introduction of iron into the water column should not constitute dumping, however the phrase 'provided that such placement is not contrary to the aims of' the UNCLOS, LC and LP respectively, supersedes this exception. This

³⁴⁸ Scott, K. [Note 80] At 98.

³⁴⁹ Rayfuse, R. [Note 24] At 312.

³⁵⁰ *Ibid.*

³⁵¹ Freestone, D. and Rayfuse, R. [Note 124] At 229.

necessitates the assessment of OIF in relation the aims of the UNCLOS, LC and LP.

The UNCLOS, LC and LP all aim to protect the marine environment and prevent, reduce and control pollution that is liable to cause harm to marine ecosystems and hazards to human health and interfere with other legitimate uses of the sea. Considering the range of predicted consequences of OIF on the marine environment and uses thereof, it may be argued that OIF is contrary to the aims of the UNCLOS, LC and LP. Therefore the introduction of iron into the marine environment could constitute dumping despite the fact iron is not introduced into the sea for merely the purpose of disposal.

The intention OIF is to manipulate the ocean system to stimulate phytoplankton blooms to draw down and sequester a higher percentage of atmospheric CO₂ into the ocean, than would occur naturally. Anthropogenic CO₂ is a waste product of civilisation that has accumulated in the atmosphere. The sequestration of CO₂ into the ocean is essentially the disposal of a waste. Excess CO₂ is thus indirectly introduced and disposed of deliberately through the process of OIF.³⁵² However it is difficult, if not impossible, to determine the quantity of CO₂ sequestered in the deep ocean by the biological pump apposed to the solubility pump, and by OIF induced phytoplankton blooms apposed to naturally occurring phytoplankton blooms. Thus it may be unfeasible to regulate the sequestration of CO₂ as a form of dumping when the quantity of the substance being dumped is uncertain.

OIF for UNCLOS Parties

OIF research and commercial activities will be subject to the duty imposed on States to take measures to prevent, reduce or control pollution of the marine

³⁵² Rayfuse, R. [Note 24] At 314, Freestone, D. and Rayfuse, R. [Note 124] At 229.

environment and to ensure that activities under their jurisdiction do not cause damage by pollution to other States. Iron additions and the consequent environmental impacts could be considered a form of pollution. Therefore UNCLOS parties, which intend to conduct OIF, need to enact legislation and take all measures necessary to prevent, reduce and control pollution resulting from the use of technologies within their jurisdiction and to prevent, reduce and control the introduction of alien or new species which may cause significant harmful changes to the environment.³⁵³

If the addition of the iron fertiliser and the storage of CO₂ do constitute dumping, States wishing to conduct OIF will be required to enact legislation and take measures to ensure OIF is regulated and authorized by the competent authorities so to prevent, reduce and control pollution of the marine environment by dumping.³⁵⁴ It could be argued that all States that are parties to UNCLOS are subject to the provisions in the LC due to the requirement of UNCLOS parties to adopt national laws that are no less effective than the global rules and standards for dumping.³⁵⁵

States are required to take measures to ensure that pollution is not directly or indirectly transferred or transformed.³⁵⁶ OIF is the enhancement of a natural system that transfers atmospheric CO₂ into the ocean. The high concentration of atmospheric CO₂, caused predominantly by anthropogenic activities, has negative consequences for the earth's systems to which humans belong and depend, and thus anthropogenic CO₂ is considered a form of pollution. The transfer of anthropogenic CO₂ from the atmosphere to the deep ocean may be considered a form of pollution transfer or transformation if the storage of CO₂ in the oceans constitutes pollution. Indirect negative side effects of the consequent storage of

³⁵³ UNCLOS [Note 223] Art 196.

³⁵⁴ Ibid. Art 210.

³⁵⁵ Freestone, D. and Rayfuse, R. [Note 124] At 230.

³⁵⁶ UNCLOS [Note 223] Art 195.

CO₂ in the deep sea have been speculated, but no evidence is yet available to support such speculations. Concerns were raised at the thirtieth meeting of the consultative groups to the LC and the third meeting of the consultative parties to the LP in terms of the obligation not to transfer damage from one part of the environment in respect of removing CO₂ from the atmosphere and transferring it to the marine environment.

OIF for LC Parties

If OIF is considered as a form of dumping and exempted from the 'placement' exclusion, parties to the LC will need to assess whether it is prohibited under Annex I, whether it requires a special permit under Annex II, or whether a prior general permit will suffice. Annex I does not apply to substances which are rapidly rendered harmless by physical, chemical or biological processes in the sea with the exception of materials that make edible marine organisms unpalatable or endanger human health or that of domestic animals.³⁵⁷ One of the potential side effects discussed was the stimulation of harmful algal blooms. Such blooms could result in a particular edible marine organism being rendered unpalatable and may even endanger human health, however these effects have not been proven and remain unpredictable. Therefore under the LC it seems unlikely that OIF activities will be prohibited.

Annex II requires that a special permit be granted for substances containing significant amounts of the matters given in a list.³⁵⁸ Therefore the chemical composition of the iron fertiliser to be introduced could determine whether a special permit is required for the conduct of OIF. Furthermore Annex II includes materials, which are non-toxic in nature, but become harmful or liable to seriously reduce amenities when dumped in certain quantities.³⁵⁹ OIF will result

³⁵⁷ LC [Note 339] Annex I.

³⁵⁸ Ibid. Art IV.1 (b).

³⁵⁹ Ibid. Annex II D.

in the alteration of marine systems and, when conducted at large scales, it could indirectly cause harm and seriously reduce amenities. If evidence of such effects became available a special permit would be required for OIF.

Currently no evidence is available to allow for the characterization of OIF within Annex I or Annex II, therefore OIF would be subject to the general permitting requirements of Annex III. These requirements include the characterisation of the matter being dumped and the dumping site; the assessment of the possible effects on amenities, marine life and other uses of the sea; and the consideration of alternative land-based methods of disposal or elimination.³⁶⁰ Ongoing monitoring of OIF with respect to these criteria would be required to ensure that the conditions are met and that the initial assessment was accurate and sufficient for the protection of the marine environment.³⁶¹

OIF for LP Parties

Assuming OIF is considered as dumping and not exempted by any of the exclusions in Article 1.4.2 ; parties to the LP would only be permitted to conduct OIF if it fell within the ambit of the categories of substances permitted for dumping in Annex 1. There are eight categories of substances listed in Annex 1, and two possible categories under which iron and CO₂ may be eligible to be considered for dumping subject to permitting requirements. These categories of substances are; inert, inorganic geological material, or organic material of natural origin. OIF may thus be exempted from the prohibition on dumping if it can be argued that the iron fertiliser and the sequestered CO₂ are either inert, inorganic geological material, or organic material of natural origin.

³⁶⁰ Ibid. Annex III.

³⁶¹ Rayfuse, R. [Note 24] At 313.

Iron introduced as a fertiliser has to be in a form that is readily available to be taken up and used by organisms.³⁶² It may be difficult to argue that iron in this biologically available form is an inert material.³⁶³ Furthermore, according to the Scientific Groups of the LC and LP OIF should not be considered as an inert, organic geological material.³⁶⁴

Even if iron could be classified as an inert material, OIF will only be permitted for dumping subject to ongoing assessments according to the permitting conditions set out in Annex 2, if the matter introduced falls within the definition of any of the items in Annex 1.³⁶⁵ The conditions of Annex 2 include a waste prevention audit; the consideration of alternative waste management options; the characterisation of wastes according to the chemical, physical and biological properties; dumping site selection; the assessment of the potential effects of OIF; the development of an action list; and permit conditions.³⁶⁶

OIF for Non-parties

States, which are not parties to the UNCLOS, LC or LP, that are intending to conduct OIF for commercial or research purposes are bound by principles of customary law, many of which are reflected in UNCLOS. The customary obligation of States' to ensure that activities under a their jurisdiction or control do not cause damage to other States' territories or in areas beyond national jurisdiction, is of importance with regard to the international regulation of pollution and most certainly OIF.

³⁶² Ibid. At 312.

³⁶³ Ibid.

³⁶⁴ IMO. Thirtieth Consultative Meeting of Contracting Parties to the London Convention and Third Meeting of Contracting Parties to the London Protocol. Agenda Item 4: Ocean Fertilisation. Report of the Legal and Intersessional Correspondence Group on Ocean Fertilisation. July 2008. LC30/4. Available at: www.imo.org. Accessed on : 15/11/2008.

³⁶⁵ LP [Note 346] Art. 4.1(2).

³⁶⁶ Ibid. Annex 2.

3.3. THE PROTECTION OF MARINE BIODIVERSITY

There is an increasing recognition of the key role that oceans and the biodiversity of the oceans play in sustaining life on earth.³⁶⁷ Biological diversity or biodiversity is defined in the Convention on Biological Diversity 1992 (CBD) as:

'the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'.

The term biodiversity is thus a unifying principle that signifies all living organisms and their intricate interdependencies.³⁶⁸ Marine biodiversity is valued from an anthropogenic perspective as an important food resource, a basis for tourism and as a source of a multitude of substances which may be of significance to the medical and chemical industry.³⁶⁹ In addition marine biodiversity is valued for the important ecosystem services it provides such as a sink for greenhouse gases and for the role it plays in the control of global chemical processes and cycles that may affect climate change.³⁷⁰

Pollution from land-based and other sources, over exploitation, the introduction of alien species, coastal development, and global climate change and ozone depletion threaten marine biodiversity.³⁷¹ There is increasing evidence of the degradation of ocean ecosystems³⁷² and the global loss of biodiversity, which is currently occurring at a disturbing, if not unprecedented rate.³⁷³ OIF may present a further threat to biodiversity as it will result in alterations to marine systems

³⁶⁷ United Nations General Assembly. Sixty-third session. Oceans and the Law of the Sea. Available at: www.un.org. Accessed on: 12/11/2008. At 3.

³⁶⁸ Kiss, A. and Shelton, D. [Note 280] At 352.

³⁶⁹ Freestone, D. [Note 226] At 89-90

³⁷⁰ *Ibid.*

³⁷¹ Kiss, A. and Shelton, D. [Note 280] At 399.

³⁷² United Nations General Assembly. [Note 367]. At 3.

³⁷³ Molenaar, E.J. 'Managing Biodiversity in Areas beyond National Jurisdiction'. (2007). *International Journal of Marine and Coastal Law*. 22. 89-124. At 89.

that could potentially have negative consequences for biodiversity and the marine living resources on which mankind depend.

Intergovernmental fora are now placing the concern for the potential and actual loss of marine biodiversity, higher on their agendas.³⁷⁴ Furthermore the urgent need to address the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction has been recognised.³⁷⁵

UNCLOS

The UNCLOS contains a number of provisions relating to the protection of marine ecosystems and the conservation of marine living resources.³⁷⁶ Coastal States have been granted sovereign rights, in the maritime zones up to 200nm from their baselines, to explore and exploit, conserve and manage the natural resources.³⁷⁷ They also have the duty to ensure, through proper conservation and management, that the living resources are not endangered by over-exploitation.³⁷⁸

As a result of the use of the freedom of the high seas governance approach and the ensuing lack of jurisdictional control on the high seas, UNCLOS has obliged all States to take measures applicable to their nationals, for the conservation of the living resources of the high seas, and to cooperate with each other in this regard.³⁷⁹ Article 192 recognises a general obligation to 'protect and preserve the marine environment' that is applicable to all areas of the ocean including the high seas.³⁸⁰ Furthermore Article 194.5 requires that the necessary measures be

³⁷⁴ Molenaar, E.J. [Note 373] At 91.

³⁷⁵ United Nations General Assembly. [Note 367] At 3.

³⁷⁶ Scott, K. [Note 80] At 104, Kiss, A. and Shelton, D. [Note 277] At 400.

³⁷⁷ Kiss, A. and Shelton, D. [Note 280] At 400, UNCLOS [Note 223] Art. 56.1.

³⁷⁸ Kiss, A. and Shelton, D. [Note 280] At 400, UNCLOS [Note 223] Art. 61.2

³⁷⁹ Kiss, A. and Shelton, D. [Note 280] At 402, UNCLOS [Note 223] Arts. 117 and 118.

³⁸⁰ UNCLOS [Note 223] Art 192.

taken to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life'.³⁸¹

The provisions in UNCLOS that relate to the protection of the marine environment are less precise than those relating to pollution control³⁸² and only establish a basis for the development of more detailed regimes for the preservation and protection of the marine environment.

An Integrated Ecosystem Approach

Given that all issues relating to the oceans are interconnected, the conservation and protection of marine biodiversity requires a multidisciplinary, integrated and comprehensive management approach.³⁸³ Global guidelines on environmental impact assessment need to be developed to monitor and assess the health of ecosystems. These guidelines must include the identification of vulnerable ecosystems and the prevention of significant effects thereon, the regulation of activities that are currently unregulated and the assessment of the cumulative impacts of human activities across regions and sectors.³⁸⁴

Agenda 21

Agenda 21 is a commitment of States to cooperate in taking action which was approved at the 1992 United Nations Conference on the Environment and Development.³⁸⁵ Chapter 17 of Agenda 21 reflects and builds on the customary principles for ocean governance set out in UNCLOS, and attempts to establish an integrated approach to ocean governance that encompasses management of the sea itself, the coastal areas and living resources.³⁸⁶ It recognises that oceans, seas and coastal areas and aspects thereof are all interconnected and 'form an

³⁸¹ Ibid. Art 194.5.

³⁸² Kiss, A. and Shelton, D. [Note 280] At 402.

³⁸³ United Nations General Assembly. [367] At 5.

³⁸⁴ Ibid.

³⁸⁵ Freestone, D. [Note 226] At 94.

³⁸⁶ Kiss, A. and Shelton, D. [Note 280] At 501.

integrated whole that is an essential component of the global life-support system'.³⁸⁷ Furthermore it acknowledges that the protection of this interconnected system requires new management and development approaches at global levels that are integrated and precautionary.³⁸⁸ It calls for the commitment of States to conserve and sustainably use marine living resources, to maintain biological diversity and productivity, to cooperate on information exchange and data requirements, and to provide support to developing countries.³⁸⁹

Convention on Biological Diversity

A key agreement adopted at the United Nations Conference on the Environment and Development was the Convention on Biological Diversity 1992 (CBD).³⁹⁰ It came into force in 1993 and now has 191 parties.³⁹¹ The CBD recognises the conservation of biodiversity as a common concern for humankind for the first time in a global treaty.³⁹² It reaffirms the precautionary principle and the sovereign rights of States over their natural resources.³⁹³ Sustainable use of biodiversity is a major part of the CBD and it is defined as 'the use of components of biological diversity in a way and at a rate that does not lead to the long term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations'.³⁹⁴

The CBD has three broad objectives; the conservation of biological diversity, the sustainable use of its components and fair and equitable sharing of benefits arising from the use of genetic resources and access to genetic resources and

³⁸⁷ Agenda 21. Available at: <http://www.un.org/esa/sustdev/documents/agenda21/index.htm> Accessed on: 12/11/2008.

³⁸⁸ Ibid.

³⁸⁹ Kiss, A. and Shelton, D. [Note 280] At 399.

³⁹⁰ Scott, K. [Note 80] At 104.

³⁹¹ CBD. List of Parties. Available at: <http://www.cbd.int/convention/parties/list/> Accessed on: 21/12/2008.

³⁹² CBD. [Note 311] Preamble. Kiss, A. and Shelton, D. [Note 277] At 359.

³⁹³ CBD. [Note 311] Preamble.

³⁹⁴ Ibid. Art. 2. Kiss, A. and Shelton, D. [Note 280] At 360.

technology including biotechnology.³⁹⁵ It recognises that the use of biodiversity in a sustainable manner is the key to maintaining this diversity.

The CBD seeks to conserve biodiversity through the integration of biodiversity concerns and the development of programmes and policies such as those designed for climate change mitigation.³⁹⁶ Furthermore it aims to establish a system of protected areas and promote the use of environmental impact assessments (EIA) for proposed projects likely to have significant effects on biodiversity.³⁹⁷ Binding commitments relating to: *in situ* and *ex situ* conservation of biodiversity; incentives for sustainable use of biodiversity; research and training; environmental impact assessment; public awareness and education, access to genetic resources and technology; and the provision of financial resources, are contained in Articles 6 to 20.³⁹⁸

The primary focus of the CBD is concerned with the national rights and responsibilities of States and the obligation of States to enact national legislation to prevent the destruction of species habitats and ecosystems.³⁹⁹ Article 22 requires States to apply the CBD to the marine environment consistently with the provisions under the UNCLOS.⁴⁰⁰ Furthermore the definition of biological diversity does incorporate that of the oceans and therefore the CBD does have jurisdiction over the high seas but is not specifically designed for this.⁴⁰¹

The Jakarta Mandate, established by the second COP to the CBD, represents a global recognition of the importance of marine biological diversity.⁴⁰² It calls for

³⁹⁵ CBD. [Note 311] Art. 1.

³⁹⁶ Scott, K. [Note 80] At 105.

³⁹⁷ CBD. [Note 311] Arts. 8 (a) and 14.1 (a), Scott, K. [Note 80] At 105.

³⁹⁸ CBD. [Note 311] Arts 6-20.

³⁹⁹ Kiss, A. and Shelton, D. [Note280] At 358.

⁴⁰⁰ CBD. [Note 311] Art 22.2.

⁴⁰¹ Scott, K. [Note 80] At 105.

⁴⁰² Implementation of the Jakarta Mandate on Marine and Coastal Biological Diversity, including the CBD multi-year programme of work on marine and coastal biological diversity. Available at: http://www.un.org/Depts/los/general_assembly/contributions2004/CBD2004.pdf Accessed on: 12/12/2008.

the establishment and support of an integrated management regime for marine and coastal ecosystems.⁴⁰³ In 1998, at the fourth COP, a global work plan for the conservation and sustainable use of marine biodiversity, which specifically recommended the use of the precautionary approach to guide all activities, was approved.⁴⁰⁴ There has been much emphasis placed on the need for of a system of representative marine protected areas beyond national jurisdiction in which extractive uses of the sea are excluded and other significant human pressures are removed.⁴⁰⁵ Such a system would be required to maintain consistency with international law and be based on scientific information relating to areas of seamounts, hydrothermal vents, cold water corals and the open ocean.⁴⁰⁶ Parties to the CBD have been urged to explore mechanisms for the development of such a system beyond national jurisdiction, particularly for the protection of vulnerable ecosystems.⁴⁰⁷

At the seventh COP to the CBD an integrated ecosystem approach was accepted as the fundamental paradigm for the CBD to ensure the conservation and sustainable use of biodiversity resources.⁴⁰⁸ The ecosystem approach was described as 'a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way'.⁴⁰⁹ This approach entails the holistic management of resources, and requires transparency and the consideration of all relevant factors in the decision-making process.⁴¹⁰ Thus, in accordance with the CBD, the management regime for the protection of the marine environment on the high seas should follow a holistic and precautionary approach.

⁴⁰³ Kiss, A. and Shelton, D. [Note 280] At 361.

⁴⁰⁴ Ibid. At 361.

⁴⁰⁵ Scott, K. [Note 80] At 105.

⁴⁰⁶ Implementation of the Jakarta Mandate on Marine and Coastal Biological Diversity, including the CBD multi-year programme of work on marine and coastal biological diversity. [Note 402].

⁴⁰⁷ Scott, K. [Note 80] At 105.

⁴⁰⁸ Handbook of the Convention on Biological Diversity'. 3rd Edition. Available at: www.cbd.int/doc/handbook/cbd-hb-all-en.pdf. Accessed on: 28/11/2008.

⁴⁰⁹ Fabra, A. and Gascon, V. [Note 315] At 568.

⁴¹⁰ 'Handbook of the Convention on Biological Diversity'. [Note 408]

The practical implementation of the ecosystem approach in ocean management requires a shift from the fragmented, sectoral approach, currently in use, to one that is all-inclusive. This will have far reaching effects for science, as it necessitates the development of techniques to assess and monitor cumulative effects of human activities on ecosystems, and for institutions, as the different sectors and activities affecting the ecosystem can not be handled in isolation.⁴¹¹

Protection of Biodiversity and OIF

The CBD, in respect of the conservation of marine biodiversity, is essentially a framework convention as it only sets out general obligations and no specific regime is provided. However, the establishment of a system of marine protected areas may restrict OIF activities in future.⁴¹² Furthermore the requirements for EIA may hinder OIF activities, due to the level of uncertainty still inherent in the technology, however there are currently no legally binding global international standards that could be applied to the marine system holistically.⁴¹³

The most important and most globally accepted agreement for the conservation of biodiversity, the CBD, recognises that the cumulative effects of human activities in the ocean need to be assessed, monitored and taken into consideration during decision making. The interconnectivity of the oceans and the nature and the potential wide-ranging side effects of OIF necessitate the use of a holistic management regime such as the one endorsed by the CBD. There is therefore the potential to regulate OIF activities through global instruments designed to protect biodiversity.⁴¹⁴

⁴¹¹ Fabra, A. and Gascon, V. [Note 135] At 571.

⁴¹² Scott, K. [Note 80] At 105.

⁴¹³ Rayfuse, R. and Warner, R. 'Securing a Sustainable Future for the Oceans beyond National Jurisdiction: The Legal Basis for an Integrated Cross-Sectoral Regime for High Seas Governance for the 21st Century'. (2008). *The International Journal of Marine and Coastal Law*. **23**. 399-421. At 403.

⁴¹⁴ Scott, K. [Note 80] At 106.

3.4 RECENT LEGAL DEVELOPMENTS FOR OIF

Recently concerns have been expressed with regard to the implementation and regulation of OIF. On the 13th of June 2007 at the 30th meeting of the Scientific Group under the LC and the first meeting of the Scientific Group under the LP, a statement of concern regarding ocean fertilisation of the oceans to sequester CO₂ was issued.⁴¹⁵ The Scientific Groups expressed the view that large scale OIF was not justified owing to the fact that there was still significant uncertainty regarding the effectiveness and the potential environmental impacts of OIF.⁴¹⁶ They recognised that large scale OIF has potential negative impacts on the marine environment and human health and recommended that careful evaluation of OIF be conducted.⁴¹⁷ Furthermore they requested Parties to take into account the statement of concern when considering experimental or large scale OIF to sequester CO₂, submit any information relating to OIF to the Secretariat and the Scientific Groups, and to address a number of issues such as; the need and potential mechanisms for OIF regulation and the compatibility of OIF with the aims of the LC and LP.⁴¹⁸

At the 29th Consultative Meeting of the Contracting Parties to the LC and LP, held in November 2007 in London, this 'Statement of Concern' was endorsed, it was agreed OIF activities fell within the scope of the work of the LP and LC and States were urged to consider OIF projects on a case-by-case basis under the LC and LP while exercising caution.⁴¹⁹ Furthermore it was agreed that legal and scientific issues needed to be addressed during the intersessional period so that an informed decision could be made in 2008.⁴²⁰

⁴¹⁵ Statement of Concern Regarding Iron Fertilisation of the Oceans to Sequester CO₂. 13 July 2007. LC-LP.1/Circ. 14. Available at: www.imo.org. Accessed on: 18/09/2008.

⁴¹⁶ Ibid.

⁴¹⁷ Ibid.

⁴¹⁸ Ibid.

⁴¹⁹ Main results of the 29th Consultative Meeting and 2nd Meeting of Contracting Parties. LC-LP.1/Circ.18 9 January 2008. Available at: www.imo.org. Accessed on: 18/11/2008.

⁴²⁰ Ibid.

The Legal and Intersessional Correspondence Group on Ocean Fertilisation was established to summarize the legal views of Parties regarding the application of the legal framework of the LC and LP to ocean fertilisation. OIF was presented as one of three ocean fertilisation scenarios. Diverging views as to whether OIF constituted dumping and pollution were expressed. Furthermore several of the respondents expressed concern that

'though the Convention and its Protocol were the most appropriate legal instruments to regulate this activity [OIF], it was not suited to this at this point and amendment would be required to achieve the regulation of the activity necessary'.⁴²¹

At the ninth COP to the CBD in May 2008 decision IX/16 expressed the need for further scientific and legal analysis concerning OIF was reaffirmed and recognised that this analysis was occurring under the auspices of the LC and LP.⁴²² Furthermore Parties were requested and other Governments were urged:

'in accordance with precautionary principle, to ensure that ocean fertilisation 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 within coastal waters'.⁴²³

The scope of the term 'ocean fertilisation activities' is not clearly defined, but, when considered within the phrase, 'ocean fertilisation activities...; with the exception of small scale research within coastal waters' it is apparent that this ambiguous term is to be applied broadly to all commercial and research activities

⁴²¹ Report of the Legal and Intersessional Correspondence Group on Ocean Fertilisation (LICG). Submitted by the United Kingdom. LC 30/4. 25 July 2008. Available at: www.imo.org. Accessed on: 18/11/2008.

⁴²² COP 9. Decision IX/16. C. Ocean Fertilisation. Available at: <http://www.cbd.int/decisions/cop9/?m=COP-09&id=11659&lg=0>. Accessed on: 18/11/2008.

⁴²³ Ibid.

The Parties resolved to assess scientific research proposals on a case-by-case basis according to an assessment framework, which includes tools for determining whether the proposal is contrary to the aims of the LC and LP, to be developed by the Scientific Groups under the LC and LP.⁴²⁶ Parties are urged to evaluate scientific research proposals cautiously and using the 'best available guidance' until specific criteria are available.⁴²⁷ Only those proposals that have been found acceptable under the assessment framework can be deemed as 'legitimate scientific research'.⁴²⁸

Therefore, under the LC and LP, scientific research involving large scale OIF over the deep ocean has not been banned outright but instead has been made subject to an assessment procedure yet to be developed. This conflicts with the decision taken by the CBD to only allow for small scale research in coastal waters. However the CBD recognised the work conducted by the LC and LP on ocean fertilisation, requested Parties to act in accordance with a previous decision under the LC and prepared the decision to restrict ocean fertilisation activities while 'bearing in mind the ongoing scientific and legal analysis occurring under the auspices of the LC (1972) and the 1996 LP'. This suggests that the CBD recognises that the LC and LP are taking the lead in the development of regulations for ocean fertilisation and that the decision made by the COP of the CBD was temporary due to the fact that scientific and legal analysis under the LC and LP was underway and no clear restrictions had been placed on ocean fertilisation activities. From this perspective it would appear that the decision of the LC and LP regarding ocean fertilisation trumps that of the CBD, however no clear statement regarding the relationship between these instruments is provided.

⁴²⁶ Ibid. At: Annex 6: Resolution LC-LP.1 (2008) on the Regulation of Ocean Fertilisation. Para. 4-5.

⁴²⁷ Ibid. At: Annex 6: Resolution LC-LP.1 (2008) on the Regulation of Ocean Fertilisation. Para. 6.

⁴²⁸ Ibid. At: Annex 6: Resolution LC-LP.1 (2008) on the Regulation of Ocean Fertilisation. Para. 7.

The Parties to the LC and LP reaffirmed part of the decision taken by the CBD by resolving to put a stop to any commercial use of OIF in the statement:

'given the present state of knowledge, ocean fertilisation activities other than legitimate scientific research should not be allowed'⁴²⁹

Furthermore OIF conducted for commercial purposes was regarded by the Parties as contrary to the aims of the LC and LP and it currently does not qualify for any exemption from the definition of dumping under the LC and LP.⁴³⁰

It was agreed by the Ocean Fertilisation Working Group that further consideration of a legally binding resolution or amendment to the LC and LP would be made at the next meeting in 2009.⁴³¹ Moreover it was recognised that preparatory work regarding OIF technical/scientific issues and legal/administrative issues was required during the intersessional period.⁴³² Provisions were made for the co-operation between the Scientific Group and relevant international organizations as well as the exchange and distribution of information related to ocean fertilisation.⁴³³

3.5 CONCLUSION

The main global regimes for the protection of the marine environment, which are of relevance to OIF, directs decision makers to adopt a precautionary approach and, in so doing, to consider the cumulative impacts of the process. None of the regimes were drafted to deal with OIF and none, in their original form, make any specific reference to activities of a similar nature to OIF. The international regime for the protection and preservation of the marine environment is thus

⁴²⁹ Ibid. At: Annex 6: Resolution LC-LP.1 (2008) on the Regulation of Ocean Fertilisation. Para. 8.

⁴³⁰ Ibid.

⁴³¹ Ibid. At: Outcome of the Ocean Fertilisation Working Group (LC 30/WP.6). Para. 4.14.

⁴³² Ibid. At: Outcome of the Ocean Fertilisation Working Group (LC 30/WP.6). Para. 4.15.

⁴³³ Ibid. At: Outcome of the Ocean Fertilisation Working Group (LC 30/WP.6). Para. 4.16-4.18.

fragmented and has its gaps with regard to the regulation of some emerging activities on the oceans.

It is clear that the international regulation of OIF currently falls within one of these gaps. The potential risks involved with large scale commercial OIF and the need for the modification of several legal instruments has been recognised. The lack of clarity with regard to the relationships between instruments, the distinction between commercial and research activities and the application of the precautionary principle may lead to much confusion and disorder.

Therefore it is not only the scientific knowledge, with regard to OIF, that is lacking, but also the legal expertise. Just as further scientific research is required to ensure OIF does inflict more damage to the environment than what is prevented, further legal development is needed.

CHAPTER 4 – NAVIGATING THROUGH MURKY WATERS: THE FUTURE OF OCEAN GOVERNANCE AND OIF

The perceptions of mankind relating to the environment and the sustainable use thereof have been forced to undergo a shift as human impacts on the environment have intensified and the consequences thereof have become global. These perceptions need to be reflected and upheld by the legal system that governs the use of the environment. The consideration of the legal realities for OIF at an international scale not only reveals that there is a need for the development of regulations for this emerging use of the oceans, but also highlights the deficiencies in the current legal regime with respect to the use and protection of the marine environment.

The aim of this chapter is to assess the legal challenges that inhibit the development of effective regulations for emerging uses of the oceans, such as OIF, to consider the legal challenges OIF itself presents, and to propose a way forward for OIF regulation and ocean governance as a whole.

4.1 LEGAL CHALLENGES

A Fragmented and Incomprehensive System

The oceans are characterised by a series of interconnected and interdependent natural systems. In order to effectively protect the marine environment and ensure the use of its resources is sustainable, an understanding of all the aspects of the marine environment and the cumulative impacts of all forms of exploitation or disturbance is required. The interconnected nature of the marine

environment requires that the ocean governance regime be structured in an integrated manner so to protect the interests of individual users and the international community as a whole.⁴³⁴

The current international regime for the protection of the marine environment and the sustainable use of its resources is not set out in a single comprehensive treaty; instead it is comprised of several legally binding and non-binding instruments.⁴³⁵ The UNCLOS provides a basic legal framework of general principles for the protection and preservation of the marine environment, in areas under the sovereignty of States and on the high seas, which are a reflection of customary international law.⁴³⁶ Furthermore specific provisions are made in UNCLOS for the protection of the environment in relation to fishing and mineral development in the Area. The other instruments, that are global, regional or bilateral, are applicable to various aspects of ocean uses, such as dumping, fishing, discharge of marine pollution by shipping and safety of navigation. Thus the current ocean governance regime is fragmented both sectorally and geographically.⁴³⁷ Furthermore there is no formal mechanism which enables co-ordination between the different instruments.⁴³⁸

The fragmented state of the legal system for the protection and preservation of the marine environment gives rise to two significant difficulties for the regulation of OIF. Firstly the current regime does not allow for the management of the marine environment using an integrated, interconnected, ecosystems-based approach. Given that the consequences of OIF are large scale and could be encountered at great distances from and several years after the OIF experiment it is essential that the oceans are managed as one interconnected system and

⁴³⁴ Rayfuse, R. and Warner, R. [Note 413] At 402.

⁴³⁵ Molenaar, E.J. [Note 373] At 95.

⁴³⁶ Freestone, D. and Rayfuse, R. [Note 124] At 229.

⁴³⁷ Rayfuse, R. and Warner, R. [Note 413] At 402.

⁴³⁸ Freestone, D. and Rayfuse, R. [Note 124] At 232.

that the cumulative impacts are accounted for. Secondly the fragmented approach of ocean governance has left gaps in the regime and it is generally accepted that the high seas regime is far from comprehensive.⁴³⁹ Emerging technologies and uses of the oceans, could pose threats to the marine environment. The current regime does not provide basic regulatory rules that cover a number of existing and emerging high seas uses and, in addition, there are no global rules for EIA that could be applied.⁴⁴⁰

Challenges for the Development of International Rules and Standards

Freedom of the High Seas v. Common Heritage of Mankind

Given the gaps in the current ocean governance regime it has been widely acknowledged that an international regime for the regulation of OIF is required. Developing legally binding international rules, which are globally accepted, for emerging ocean uses is challenging due to the current stalemate brought on by the conflicting interests and opposing ideologies of developed and developing nations.

The freedom of the high seas regime does not engender the use of a holistic ecosystems-based management approach, which is required by OIF, as it allows for the ocean system and its resources to be divided amongst nations with the means to exploit it, and to be managed disjointedly by many instruments. Furthermore it is an unsustainable system as it allows for the unrestricted exploitation of a resource, which, due to the open nature of the system, will be maximised by each consumer until the resource is depleted. It is therefore clear that the ocean governance regime is in need of a revolution to one that is sustainable.

⁴³⁹ Rayfuse, R. and Warner, R. [Note 413] At 400.

⁴⁴⁰ Ibid. At 403.

An alternative approach to ocean governance already discussed, is that of the common heritage and benefit of all mankind principle employed by the regime of the Area within UNCLOS. This approach recognises the ocean system holistically and takes into consideration the activities and interests of all of mankind. In respect of the protection, preservation and sustainable management of ocean systems and resources, this approach is more appropriate than that of the freedom of the high seas as it allows for the implementation of an integrated ecosystems-based management approach. However this is a controversial approach due to the fact that the common heritage and benefit of all mankind principle calls for the equitable sharing of benefits among mankind as a whole.

There is no international rule-making structure and instead instruments signed by independent sovereign States acting in their own interest and not that of the international community.⁴⁴¹ Therefore controversial approaches, which are aimed at the benefit of mankind as a whole and not individual States, are highly unlikely to come into force and gain enough international acceptance to ensure that they are effective, as States are able to opt not to join certain international instruments or to opt out of certain measures that are particularly onerous.

Thus the international community is at a stalemate, the freedom of the high seas approach is unsustainable, but is however favoured by the developed nations, while the common heritage and benefit of all mankind approach, which allows for a more sustainable, holistic management regime, may prove too controversial to gain international acceptance. The development of international rules and standards for OIF that are widely accepted may be hindered by this stalemate.

⁴⁴¹ Ibid. At 402.

Science and the Law

Protection of the environment can only be achieved once mankind has a sufficient understanding of how the ecosystems function, interconnect and respond to human interference. Furthermore solving the environmental problems that we are currently faced with and ensuring that the planet remains in a state suitable for human habitation, will require insight into the environment's feedback systems and possibly the manipulation of these systems. The continuation of scientific enquiry is thus essential at this point in time when mankind is faced with its toughest environmental challenge yet, climate change.

Decision making requires a balancing of costs and benefits. The costs and benefits inherent in OIF must be understood so to ensure the most beneficial decision, with regard to the environment and mankind as a whole, is made. Further scientific research related to the functioning of ocean system, the side effects of OIF and the efficiency of OIF is required before this technique should be ruled out completely. In essence the continuation of scientific research involving OIF, which aims to identify and quantify the potential risks involved with not only OIF itself but also modifications to the functioning of the marine system as a whole, is risk assessment.

The use of scientific considerations in decision making is guided by the precautionary principle. The precautionary principle differs to risk assessment in that it aims to anticipate risk and not identify or quantify risk.⁴⁴² Furthermore, in relation to decision making involving the environment, the precautionary principle requires less certain evidence of environmental degradation than risk assessment to hinder an activity.⁴⁴³ The precautionary principle may therefore hinder further scientific enquiry that may prove to be to the benefit of mankind on the basis that the research itself is a risk to the environment despite the lack

⁴⁴² Cranor, C.F. [Note 316] At 315-316.

⁴⁴³ Ibid.

of scientific evidence for this risk. Such a situation has been encountered in the decision taken by the CBD in relation to ocean fertilisation, one form of which is OIF.

OIF is a tool that can be used by scientists to gain a deeper understanding of one of the most important CO₂ cycling mechanisms, the oceans. At this point in time there is no reliable means to scientifically assess the risks of OIF research itself other than to slowly scale up the experiments conducted. The Intergovernmental Oceanographic Commission (IOC) issued a statement regarding OIF and the ban of OIF activities under the CBD in June 2008.⁴⁴⁴ The IOC expressed the view that the development of regulations to protect the marine environment from activities such as OIF, require an understanding of the environment which we currently do not have.⁴⁴⁵ Furthermore scientific understanding of OIF and the oceans is required to develop reliable assessment procedures.

OIF research, conducted on scales in the order of 200km by 200km over areas of the deep ocean, was viewed by the IOC as an important tool to aid scientists in the development of a better understanding of the marine environment.⁴⁴⁶ The CBD effectively banned large scale OIF in international waters and required that a prior assessment of the environmental impacts be conducted before small scale OIF research is permitted. Thus the CBD is essentially banning the use of a tool, OIF research, which is required to develop the assessment procedures that it demands. Furthermore the IOC felt that the restriction of research activities to coastal waters 'appears to be a new, arbitrary, and counter-productive limitation'

⁴⁴⁴ UNESCO/IOC ad hoc Consultative Group on Ocean Fertilisation Available at: http://ioc3.unesco.org/oanet/OAdocs/IOC_LCSGStatement.pdf Accessed on: 18-11-2008.

⁴⁴⁵ Ibid.

⁴⁴⁶ Ibid.

and that 'there is no scientific basis for limiting such experiments to coastal environments.⁴⁴⁷

The decision taken by the CBD has detrimental consequences for the progression of scientific understanding of ocean systems and of OIF as a potential climate change mitigation technique. This situation has been brought on by the fear that the temptation of financial benefits that could potentially be accrued through the conduct of OIF experiments may bias or be falsely viewed to have biased the conclusions made by scientists. Given that OIF involves the large scale manipulations of a highly complex and important ecosystem it is crucial that the results of these experiments remain impartial as a set of biased results may have devastating consequences.

Compliance and Enforcement on the High Seas

There is no international body that is empowered to enforce international laws, instead States' compliance is voluntary.⁴⁴⁸ The effectiveness of international marine environmental laws therefore depends on the extent to which States comply with and enforce the provisions of instruments. The UNCLOS allocates three types of jurisdictional competencies to States for the protection of the marine environment. These are coastal State control, flag State control and port State control.

Coastal States have been granted jurisdiction by Article 220 of UNCLOS to enforce laws that are aimed at combating the pollution of the marine environment in their territorial seas and EEZs.⁴⁴⁹ Therefore the jurisdiction to enforce provisions to ensure the protection of the marine environment of the territorial sea and EEZ lies with the coastal State.

⁴⁴⁷ Ibid.

⁴⁴⁸ Peterson, J.E. [Note 33] At 97.

⁴⁴⁹ UNCLOS [Note 233] Art 220.

According to the provision of Article 217, States must ensure that vessels under their jurisdiction comply with applicable international rules and standards and with the flag States' laws and regulations adopted in accordance with UNCLOS for the prevention, reduction and control of pollution of the marine environment.⁴⁵⁰ The jurisdiction to regulate and enforce activities on the high seas therefore rests primarily with the flag States.

Port States have been granted the jurisdiction to investigate, where the evidence warrants, and institute proceedings against a vessel, which voluntarily entered its port or off-shore terminal, in respect of discharges that are in violation of international rules and standards in international waters.⁴⁵¹ Furthermore port States have the jurisdiction to enforce the loading of wastes or matter in their ports or offshore terminals that is to be dumped.⁴⁵²

This system of compliance and enforcement is flawed in that coastal, port and flag States may be unwilling or unable to adopt, implement and enforce international regulations and standards and consequently the laws established to protect and preserve the marine environment may become ineffective. The regulation of high seas uses relies on flag State and port State control and may be weakened by the use of flags of convenience and ports of convenience. Despite the efforts made by the LC, LP and CBD to restrict OIF activities on the high seas, proponents of OIF may undermine their authority by registering their vessels with non-party States, incorporating their companies in non-party States and using the ports of non-party States to load the iron fertiliser.

⁴⁵⁰ Ibid. Art 217(1).

⁴⁵¹ Ibid. Art

⁴⁵² Freestone, D. and Rayfuse, R. [Note 124] At 230.

4.2 THE NEXT STEP

At present international regulation of OIF is lacking due to the fragmented state of international marine environmental law. The development of international rules and standards may become hampered by the opposing views, interests and approaches to ocean governance of nations, and the hindrance of further scientific research, while the implementation of any rules and standards may be undermined by flags and ports of convenience.

The outdated freedom of the high seas approach has led to much environmental degradation and the creation of a fragmented legal system for the protection of the marine environment. A revolution in ocean governance is required. A middle-ground approach between the freedom of the high seas concept and the common heritage and benefit of all mankind concepts is required. This middle-ground approach must reflect the perception of the oceans as one interconnected system and must allow for the holistic management of all activities and their cumulative impacts so that the common interests and concerns of mankind, with regard to the protection of the environment, are protected. Rayfuse and Warner proposed, in an article in 2008, that the concept of 'public trusteeship' conveys a common ground position for ocean governance.⁴⁵³

Under a regime based on the concept of a public trust States would continue to enjoy open access to the high seas but would do so subject to rules for sustainable management.⁴⁵⁴ Revenues and benefits generated through uses of the high seas would not need to be distributed among States to with as they please, but would instead be invested in the trust to be used for management

⁴⁵³ Rayfuse, R. and Warner, R. [Note 413] At 410.

⁴⁵⁴ Ibid. At 411.

purposes, for the rehabilitation of damaged trust property or for the capacity building of individual States so that they can uphold the provisions of the trust.⁴⁵⁵ Currently all States have the duty to protect and preserve the marine environment and cooperate to ensure its resources are used sustainably and thus the international community as a whole is the trustee for the protection of the marine environment.⁴⁵⁶ The role of trusteeship may be delegated to regional and sectoral agreements however stronger links between these agreements will need to be developed.⁴⁵⁷

International marine environmental law is lacking a legally binding, integrated comprehensive and holistic convention that regulates all activities on the high seas in the interest of all mankind. There is a need for the development of an instrument that follows the proposed public trustee concept and that provides for the following:

- Coordination between existing instruments, which include provisions for the protection of the marine environment;
- Cooperation between international and regional marine environmental organisations;
- Collaboration with other instruments that govern other aspects of the environment that may directly or indirectly impact upon the marine ecosystems, such as the climate change regime;
- A default mechanism for emerging uses of the oceans so that such uses would not be assumed freedoms but rather subject to prior assessment;
- A system of management for high seas activities based on an ecosystems-approach guided by the best available scientific knowledge;
- Collaboration between scientists and policy makers;
- Support of necessary, legitimate scientific research.

⁴⁵⁵ Ibid.

⁴⁵⁶ Ibid. At 412.

⁴⁵⁷ Ibid. At 413.

purposes, for the rehabilitation of damaged trust property or for the capacity building of individual States so that they can uphold the provisions of the trust.⁴⁵⁵ Currently all States have the duty to protect and preserve the marine environment and cooperate to ensure its resources are used sustainably and thus the international community as a whole is the trustee for the protection of the marine environment.⁴⁵⁶ The role of trusteeship may be delegated to regional and sectoral agreements however stronger links between these agreements will need to be developed.⁴⁵⁷

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⁴⁵⁵ Ibid.

⁴⁵⁶ Ibid. At 412.

⁴⁵⁷ Ibid. At 413.

The current state of scientific understanding of ocean systems and OIF is not at the level that should permit commercial OIF and that allows for the drafting of efficient regulations for commercial OIF. It is thus advisable that the ban on commercial OIF activities remains intact and be recognised and enforced by other international and regional instruments of relevance, so to promote a global ban and dispel the use of flags and ports of convenience.

With regard to OIF and the fears that research quality may be compromised by financial incentives, it is advisable that research be conducted independently from any form of commercial activity. Similar fears have been faced in the whaling industry in that some scientific research relating to whales and whaling has been funded by the sale of products from whales killed for research purposes.⁴⁵⁸ There should therefore be an international code for scientific research that prohibits the generation of funds through experimental activities, such as OIF and whaling. Furthermore given that OIF is to be conducted in international waters and that different States may have opposing interests in the matters it is recommended that an international body of scientists should be established under the proposed international instrument to oversee research activities and assist in decision making.

⁴⁵⁸ Kasuya, T. 'Japanese Whaling and Other Cetacean Fisheries.' (2007). *Env. Sci. Pollut. Res.* 14.1. 39-48. At 47.

CONCLUSION

Currently CO₂ emissions are exceeding the IPCC'S most pessimistic 'business as usual' scenario.⁴⁵⁹ The models that predict the response of the earths' systems to climate change may therefore be too conservative.⁴⁶⁰ It is clear that the climate change mitigation efforts made to date are insufficient, and the most likely result is that the climate system is going to be forced into a state that is unfavourable to the survival of mankind and the majority of species on earth. The earth, as the habitat and support system for mankind, should therefore be considered as in a state of emergency. The urgent need for the reduction of atmospheric CO₂ concentrations and the lack of effective emission reductions necessitates the consideration of alternative measures that remove CO₂ from the atmosphere.

It must be noted that these alternative measures, such as OIF and carbon capture and storage, should be considered as supplementary to emission reduction efforts, as the only means for mankind to solve the problem for good is at the source. Essentially these measures should be viewed as a means to buy mankind some time to alter its lifestyle and not as an alternative to allow for an extension of time for mankind to spend in the 'comfort zone' of consumerism and under the fallacy of infinite economic development on a planet with finite resources.

At present there is an insufficient understanding of OIF and ocean sinks for OIF to be used as a climate change mitigation technique. Further scientific research is required to fully understand the consequences and potential mitigation efficiency of OIF.

⁴⁵⁹ Spratt, D. and Sutton, P. 'Climate 'code red': The case for a sustainability emergency'. (2008). At 22-23.

⁴⁶⁰ Ibid.

The precautionary approach requires that, where there is uncertainty, decisions be made in the interest of safety and caution. The precautionary principle could therefore be utilised to put a stop to commercial OIF until such time that mankind has gained a sufficient understanding of its mitigation efficiency and side-effects. However the lack of clarity regarding the interpretation of the precautionary principle may hinder the conduct of the necessary scientific research. A clear definitive interpretation of the precautionary principle and its relation to scientific research should thus be sought.

Several legal instruments have acknowledged that further scientific understanding is required before OIF should be utilised for commercial purposes, and have consequently banned the use of commercial OIF and advised that research involving large scale OIF be subject to prior assessment. However there are weaknesses in the approach to ocean governance currently in use, which may allow for the unregulated utilisation of emerging technologies with devastating consequences.

Mankind's perception of the oceans has developed into one in which the oceans are one interconnected system. However the international laws governing the use of the oceans divide it sectorally and geographically and thus do not reflect modern ideologies. The law is thus lagging behind and the consequences for the environment and ultimately mankind will be severe. It is crucial that international marine environmental law undergoes a shift so to become comprehensive, integrated and holistic, so that emerging technologies involving large scale manipulations of marine ecosystems, such as OIF, do not remain unregulated.

Glossary

- AAU – Assigned Amount Units
- CBD – Convention on Biological Diversity
- CER – Certified Emission Reduction Unit
- CO₂ – Carbon Dioxide
- CDM – Clean Development Mechanism
- COP – Conference of the Parties
- DMS – Dimethylsulphide
- EEC – European Economic Community
- EEZ – Exclusive Economic Zone
- EIA – Environmental Impact Assessment
- ERU – Emission Reduction Unit
- GHG – Green House Gas
- HNLC – High Nutrient Low Chlorophyll
- IPCC – International Panel on Climate Change
- JI – Joint Implementation
- KP – Kyoto Protocol
- LC – London Convention
- LP – London Protocol
- nm – Nautical Miles
- OIF – Ocean Iron Fertilisation
- OTC – Over the Counter
- UNCLOS – United Nations Convention on the Law of the Sea
- UNFCCC – United Nations Framework Convention on Climate Change

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