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Uncertainty in Law and Science: The International Legal Status of Scrubber Wash Water

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UNCERTAINTY IN LAW AND SCIENCE: THE INTERNATIONAL LEGAL STATUS OF SCRUBBER WASH WATER

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ABSTRACT

This article argues in favor of stricter regulation to the wash water resulting from the Exhaust Gas Cleaning System aboard ships. These systems are also known as scrubbers. The International Maritime Organization (IMO) has required the shipping industry to reduce the fuel oil sulfur limit to 0.5%, and in emission control areas to 0.1%. To achieve this reduction, ship owners use scrubbers to comply with this regulation, which essentially cleans the fuel. However, the current legal framework of scrubber wash water lacks certainty due to two reasons. The first reason is uncertainty in the law, because it is not clear from the IMO Guidelines whether scrubber wash water is considered as pollution by vessel operation under MARPOL or pollution by dumping under the London Convention. The second reason is uncertainty in science. It is also not clear whether the current levels of materials allowed to be discharged in scrubber wash water are harmful to the environment. This is demonstrated in contradictory scientific reports submitted to the IMO.

This article attempts to answer two interrelated questions. First, how does the law deal with legal uncertainty? Second, how does the law deal with the questions related to scientific uncertainty? Hence, this article is divided into four main parts. The first part presents the legal problems raised regarding scrubber wash water. This includes uncertainty in the law, uncertainty in science, and how they overlap. The second part tackles the solution for uncertainty in the law. It resorts to the general rules of marine pollution and argues that pollution by dumping is the applicable regime. The third part presents a solution for the uncertainty in science from the legal perspective, which includes both policy and judicial solutions. For the policy solution, this article argues in favor of adopting the precautionary principle. As for the judicial solution, this article adopts guidance from a case decided by the International Court of Justice to set the borders between law and science. This article concludes by presenting a hypothesis for addressing the uncertainty in the law and uncertainty in science surrounding the issue of scrubber wash water and whether it is harmful to the environment.

INTRODUCTION: THE CROSSROAD BETWEEN SEA AND AIR POLLUTION

This article argues in favor of stricter regulation to the wash water resulting from the Exhaust Gas Cleaning Systems onboard ships, which are also known as scrubbers. In 1997, the International Maritime Organization (hereinafter IMO) endeavored to reduce sulfur dioxide emissions from ships.[1] In 2005, the IMO reached its first agreement to decrease global shipping emissions of sulfur dioxide by reducing the maximum sulfur content for fuel to 4.5%,[2] which was later amended to be 3.5%.[3] This percentage was never meant to be the final decrease.[4] The IMO continued to decrease the sulfur content for fuel, imposing a limit of 0.5% fuel sulfur content by 2020, and 0.1% for special areas.[5]

Shipping companies have three options to reduce emissions from their ships to comply with IMO sulfur dioxide limits.[6] The first option is the use of low sulfur fuel and ultra-low sulfur fuel oil.[7] The second option is the use of alternative fuel, which includes, but is not limited to, liquefied natural gas (hereinafter LNG), electricity or shore power (for short sea shipping only), biodiesel, synthetic diesel, and methanol.[8] These fuels may

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1. *Prevention of Air Pollution from Ships*, INTERNATIONAL MARITIME ORGANIZATION, imo.org/en/OurWork/Environment/Pages/Air-Pollution.aspx [https://perma.cc/NJ93-LUTE] (last visited May 22, 2022) ; *see also* JAMES HARRISON, MAKING THE LAW OF THE SEA: A STUDY IN THE DEVELOPMENT OF INTERNATIONAL LAW 151-160 (2011).

2. Marine Environment Protection Committee (hereinafter MEPC) Res. MEPC.130(53), MEPC 53/24/Add.1, *Guidelines for On-Board Exhaust Gas-SO_x Cleaning Systems*, § 4.1 (July 22, 2005).

3. L. Kattner et al., *Monitoring Compliance with Sulfur Content Regulations of Shipping Fuel by in Situ Measurements of Ship Emissions,* 15 ATMOS. CHEM. PHYS. 10087, 10088 (2015).

4. *See* LIUDMILA OSIPOVA ET AL., INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION, GLOBAL SCRUBBER WASHWATER DISCHARGES UNDER IMO'S 2020 FUEL SULFUR LIMIT 6 (April 2021), https://theicct.org/sites/default/files/publications/scrubber-discharges-Apr2021.pdf [https://perma.cc/722E-YZNE].

5. Michael Tsimplis, *Marine Pollution from Shipping Activities, in* MARITIME LAW 461 (Yvonne Baatz ed., 5th ed. 2021).

6. DNV GL, ASSESSMENT OF SELECTED ALTERNATIVE FUELS AND TECHNOLOGIES 10 (June 2019).

7. ALEXEY BAKHTOV, HELSINKI COMMISSION, ALTERNATIVE FOR SHIPPING IN THE BALTIC SEA REGION, BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION 9 (2019).

8. Julia Hansson et al., *Alternative Marine Fuels: Prospects Based on Multi-Criteria Decision Analysis Involving Swedish Stakeholders,* 126 BIOMASS AND BIOENERGY 159, 159, 161 (2019); *see* Julia Hansson et al., *The Potential Role of Ammonia as Marine Fuel—Based on Energy Systems Modeling and Multi-Criteria Decision Analysis,* 12 SUSTAINABILITY 3265, 3272 (2020).

be able to fulfill the IMO requirements.[9] The third alternative, which is the focus of this research, is to use heavy fuel oil in combination with an exhaust gas cleaning system, or scrubber.[10] A scrubber reduces the amount of sulfur oxide,[11] and in turn assists ships in achieving the global standards that have been set.[12]

There are three types of scrubbers.[13] The first is the open loop scrubber.[14] It uses seawater for cleaning by allowing the seawater to move through the scrubber and wash it from the inside.[15] At the end of the washing process, the scrubbers release the wash water into the sea, along with the residues.[16] The second type are closed loop scrubbers, which use fresh or salt water to clean the emissions, but the wash water is recirculated as opposed to being discharged overboard.[17] The third type of scrubber is a hybrid scrubber, which is a combination of an open loop scrubber and a close loop scrubber.[18] This article focuses only on the open loop scrubbers for two reasons. First, it is the most dominant form of scrubber, as more than eighty percent of ships that use scrubbers use open loop scrubbers.[19] Second, the wash water of the open loop scrubbers allows ships to comply with the 2015 Guidelines.[20]

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9. Julia Hansson, et al., *Alternative Marine Fuels: Prospects Based on Multi-Criteria Decision Analysis Involving Swedish Stakeholders*, *supra* note 8, at 159; Julia Hansson et al., *The Potential Role of Ammonia as Marine Fuel—Based on Energy Systems Modeling and Multi-Criteria Decision Analysis*, supra note 8, at 3265.

10. BAKHTOV, *supra* note 7.

11. *Id.*

12. *See* Council Directive 2016/802, art. 7-10, annex II, 2016 O.J. (L 132) 58, 67-68, 74.

13. Sargun Sethi, *A Guide To Scrubber System On Ship*, MARINE INSIGHT, https://www.marineinsight.com/tech/scrubber-system-on-ship/ [https://perma.cc/FM3K-SWUL] (last visited March 26, 2022).

14. AMERICAN BUREAU OF SHIPPING, ADVISORY ON EXHAUST GAS SCRUBBER SYSTEM 19-23 (July 2018), https://ww2.eagle.org/content/dam/eagle/advisories-and-debriefs/exhaust-gas-scrubber-systems-advisory.pdf [https://perma.cc/4PFG-33MG].

15. *Id.*

16. *Id.* at 21.

17. *Id.* at 21.

18. *Id.* at 23.

19. OCTAVIO MARIN-ENRIQUEZ ET. AL., ENVIRONMENTAL IMPACTS OF EXHAUST GAS CLEANING SYSTEMS FOR REDUCTION OF SOX ON SHIPS – ANALYSIS OF STATUS QUO 12 (June 2021), https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021-05-28_texte_83-2021_sox-ships.pdf [https://perma.cc/ZZ95-HQEK].

20. *See id.* at 16.

A major issue with scrubbers is the released water that is produced, also known as wash water.[21] On one hand, scrubbers help the shipping industry reduce SO_x, CO_2, and NO_x from ships.[22] On the other hand, scrubber wash water includes harmful materials to the marine environment.[23] Among many other elements, scrubber wash water contains trace metals, nutrients, and is of a potentially harmful pH, all of which are currently under further scientific investigation by the IMO and the European Union (hereinafter EU).[24] The 2008[25] and 2015[26] Guidelines for Exhaust Gas Cleaning Systems present the challenge of scrubber wash water, which is the lack of scientific evidence of its harm.

Article 195 of the United Nations Convention on the Law of the Sea (hereinafter UNCLOS) has imposed a duty to refrain from transferring from one type of pollution to another.[27] This principle bans any form of pollution transfer. There are two forms of transfer.[28] The first is the transfer of pollution from one place to another, and the second from one form (such as pollution of the atmosphere) to another (such as pollution of the ocean).[29] It imposes on countries an obligation to deal with the environment as one unit, which means prevention of environmental harm in all forms from the point of origin.[30]

This article addresses two issues. The first is the uncertainty of the legal framework of scrubber wash water. This uncertainty is because the 2015 Guidelines did not address violations of scrubber wash water

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21. Sonja Endres et al., *A New Perspective at the Ship-Air- Sea- Interface: The Environmental Impacts of Exhaust Gas Scrubber Discharge,* 5 FRONTIER MARINE SCI., April 2018, at 1, 5-8.

22. *Id.* at 8.

23. *Id.* at 2-3.

24. JENS PETER HANSEN & ALFA LAVAL AALBORG, DANISH MINISTRY OF THE ENV'T, ENV'T PROT. AGENCY, EXHAUST GAS SCRUBBER INSTALLED ONBOARD MV FICARIA SEAWAYS, PUBLIC TEST REPORT, ENVIRONMENTAL PROJECT NO. 1429, 21-26 (2012).

25. Int'l Mar. Org. [IMO] Marine Env't Prot. Comm [MEPC], Res. MEPC.170/57, *Guidelines for Exhaust Gas Cleaning Systems*, MEPC 57/21 (Apr. 4, 2008) [hereinafter 2008 Guidelines].

26. IMO MEPC, Res. MEPC.259(68), *2015 Guidelines for Exhaust Gas Cleaning Systems*, MEPC 68/21/Add.1 (May 15, 2015) [hereinafter 2015 Guidelines].

27. U.N. Convention on the Law of the Sea, art. 195, Dec. 10, 1982, 1833 U.N.T.S. 561 [hereinafter UNCLOS] ("In taking measures to prevent, reduce and control pollution of the marine environment, States shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another.").

28. Lakshman Guruswamy, *The Promise of the United Nations Convention on the Law of the Sea (UNCLOS): Justice in Trade and Environment Disputes,* 25 ECOLOGY L. Q. 198, 217-219 (1998-1999).

29. *Id.*

30. *Id.*

discharge. Thus, this article investigates the legal rules related to pollution of the marine environment, especially the rules related to pollution from ships and pollution by dumping. It aims to decide the applicable rule if the 2015 Guidelines are violated.

The second issue is the scientific uncertainty that surrounds the environmental harm from scrubber wash water. This article investigates the role of the precautionary principle to solve such scientific uncertainty.[31] It also studies international legal precedent of the International Court of Justice (hereinafter ICJ) from an Antarctic whaling case which could inform a solution to the legal problem as it relates to uncertainty in science.

In addressing these two issues, this article adopts two methodologies. First, it analyzes various international legal conventions. This method includes the study of the status quo as represented in several international texts: UNCLOS, the International Convention for the Prevention of Pollution from Ships (hereinafter MARPOL), two annexes of MARPOL, the London Protocol, and the London Convention. This article not only presents the rules pertaining to both dumping and discharge, but it also compares the rules amongst the different legal conventions. Second, this article employs case law methodology by studying the legal analysis of an Antarctic whaling case to provide clarification as to how the law deals with uncertainty in science. Third, this article strives to understand the general legal framework of pollution from ships, and how the framework could affect the legal status of scrubber wash water. The aim of this method is to define the legal limits to deal with uncertainty in the law. This article presents a scientific research approach that reflects the contradictory scientific opinions related to scrubber wash water on one hand, and on the other hand, investigates the legal principles and precedents that deal with uncertainty in science.

This article is divided into four main parts. The first part presents the legal problems raised regarding scrubber wash water. This includes uncertainty in the law, uncertainty in science, and how they overlap. The second part tackles the solution for uncertainty in the law and resorts to the general rules of marine pollution. It also argues that pollution by dumping should be the applicable regime for violations of scrubber wash water. The third part offers a solution for uncertainty in science from the legal perspective, which includes policy and judicial solutions. For the policy solution, the article argues in favor of adopting the precautionary

31. *See* European Commission Science Communication Unit, *Future Brief: The Precautionary Principle: Decision-Making Under Uncertainty*, 18 SCIENCE FOR ENV'T POLICY 1, 4-5 (2017).

principle. As for the judicial solution, the article adopts the judgment of the ICJ in the Antarctic whaling case as guidance to set the borders between law and science. Finally, this article concludes by considering uncertainty in the law and uncertainty in science and presents a hypothesis for regulating scrubber wash water.

I. THE LEGAL PROBLEM SURROUNDING SCRUBBER WASH WATER: UNCERTAINTY IN LAW *VERSUS* UNCERTAINTY IN SCIENCE

A. Uncertainty in Law: The Legal Status of Scrubber Wash Water

The specific legal frameworks concerned with scrubber wash water are the 2008[32] and 2015[33] Guidelines for Exhaust Gas Cleaning Systems published by the Marine Environment Protection Committee (MEPC) which set standards for both air and water pollution from ships that use scrubbers.

The first type of pollution regulated by the 2008 and 2015 Guidelines is air pollution. The fuel oil sulfur content is required to be decreased to reach 0.5% in non-control areas which entered into force in January 2020.[34] The following table shows the fuel oil sulfur content and corresponding ratio emissions.[35]

32. 2008 Guidelines, *supra* note 25.

33. 2015 Guidelines, *supra* note 26.

34. IMO MEPC, Res. MEPC.280(70), *Effective Date of Implementation of the Fuel Oil Standard in Regulation 14.1.3 of MARPOL Annex VI*, MEPC 70/18/Add/1 (Oct. 28, 2016). Annex VI distinguishes between emission control areas and non-control areas, setting a stricter limit of 0.1% fuel oil sulfur content for the emission control areas. IMO MEPC, Res. MEPC.190(60), *Amendments to the Annex of the Protocol of 1997 to Amend the International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto*, MEPC 60/22 (March 26, 2010). The emission control areas include the Baltic Sea, the North Sea, and the North American area, which is defined as the sea area located off the Pacific and Atlantic coasts of the United States and Canada, off the Atlantic coast of France, off the Gulf of Mexico coast of the United States, and off the coasts of certain Hawaiian Islands. *Id.* In the future, other coastal areas, such as the Mediterranean Sea, are considering inclusion in the emission control areas. *IMO 2020 - cutting sulphur oxide emissions*, INT'L MAR. ORG, https://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx [https://perma.cc/4F4F-DXH7] (last visited May 23, 2022). Non-control areas include all the other seas and oceans around the globe.

35. 2015 Guidelines, *supra* note 26, at 1.3

Table (1): Fuel Oil Sulphur Limits

Fuel Oil Sulphur Content (% m/m)	Ratio Emission SO2 (ppm)/CO2(%v/v)
4.50	195.0
3.50	151.7
1.50	65.0
1.00	43.3
0.50	21.7
0.10 (emission control areas)	4.3

According to the 2019 Guidelines for consistent implementation of the 0.50% sulfur limit under MARPOL Annex VI, "current ship machinery operations should be sufficiently capable of addressing the concerns regarding combustion of the new . . . limit."[36] However, because most ships operating outside emission control areas are optimized to operate on heavy fuel oil,[37] the shift presents some major challenges. These challenges include internal leakages, formation of wax sediment, engine fuel starvation, and power loss.[38]

The second type of pollution regulated is water pollution. A ship may comply with the new limits if fitted with an approved means of compliance,[39] such as a scrubber. The 2015 Guidelines adopt the following criteria regarding scrubber wash water:[40]

36. MEPC Res. MEPC.320(74), *2019 Guidelines for Consistent Implementation of the 0.50% Sulphur Limit Under MARPOL Annex VI*, § 3.0.1, MEPC 74/18/Add.1 (May 17, 2019).
37. *Id.* § 3.0.2.
38. *Id*. app. 2.
39. *Id.* § 3.0.2.
40. 2015 Guidelines, *supra* note 26, §§ 10.1.2 – 10.1.6.

Table (2): Scrubber Wash Water Criteria

Element	Criteria
pH	Less than 6.5 measured at the ship's overboard discharge
PAHs	Less than 50 μg/L above the inlet water PAH concentration
Turbidity/Suspended Particulate Matter	Less than 25 FNU (formazin nephelometric units) or 25 NTU (nephelometric turbidity units) above the inlet water turbidity
Nitrates	Treatment system should prevent the discharge of nitrates beyond that associated with a 12% removal of NOx from the exhaust, or beyond 60 mg/l normalized for wash water discharge rate of 45 tons/MWh whichever is greater.
Washwater additives and other substances	Depending on the additives and other substances, should take into account other established criteria and, if necessary, additional washwater discharge criteria should be established.

The major concern is that the 2008 Guidelines state that the criteria "should be revised in the future as more data becomes available on the contents of the discharge and its effects, taking into account any advice

given by GESAMP."[41] However, this statement was carried over to the 2015 Guidelines and no revisions were made.[42]

Finally, the problem of scrubber wash water is also applicable at the EU level. Until 2019, the EU has typically adopted IMO regulations and incorporated them within its directives to make them binding on member states. However, the paths of the IMO and the EU started to part with the adoption of the European Green Deal (hereinafter referred to as the Deal).[43] In 2019, the Deal adopted a lower emission target for both 2030 and 2050 agendas.[44] In the 2030 climate target plan, the IMO aims to reach a 40% decrease, compared to 2008 levels;[45] while the EU aims to reach a 55% decrease, compared to 1990 levels.[46] For the 2050 climate plan, the IMO aims to reach a 70 % decrease compared to 2008 levels.[47] On the other hand, the EU plans to be climate-neutral by 2050.[48]

B. Uncertainty in Science: Contradictory Scientific IMO Reports

1. The Japan Report

The Japanese government formed an expert committee to analyze scrubber wash water based on the 2015 Guidelines.[49] The report maintains

41. 2008 Guidelines, *supra* note 25, app. II. GESAMP is the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection established by the United Nations.

42. 2015 Guidelines, *supra* note 26, app. 3.

43. *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions*, at 10, COM (2019) 640 Final (Nov. 12, 2019).

44. *Proposal for a Regulation of the European Parliament and of the Council establishing the framework for achieving Climate Neutrality and Amending Regulations (EU) 2018/1999 (European Climate Law)*, COM (2020) 80 final (Apr. 3, 2020).

45. *Id.*

46. *European Climate Law*, EUR. COMM'N, https://ec.europa.eu/clima/policies/eu-climate-action/law_en [https://perma.cc/KB5D-5LMR] (last visited Apr. 7, 2022).

47. *Id.*

48. *Id.*

49. JIROU KOYAMA ET AL., REPORT BY THE EXPERT BOARD FOR THE ENVIRONMENTAL IMPACT ASSESSMENT OF DISCHARGE WATER FROM SCRUBBERS (JAPAN) (July 2018), https://globalmaritimehub.com/wp-content/uploads/2019/04/Report-by-the-expert-board-for-the-environmental-impact-assessment-of-discharge-water-from-Scrubbers-Japan.pdf [https://perma.cc/4N8N-F9VN] (The report was written under the affiliation of three Japanese Ministries: The Ministry of Land, Infrastructure, Transport and Tourism; the Ministry of Environment; and the Ministry of Agriculture, Forestry and Fisheries). *Id.* at 68.

that adverse effects are unlikely if discharge standards are adhered to[50] despite the fact that the 2015 guidelines did not see any changes since the 2008 guidelines. The report took actual wash water samples and conducted wash water simulations to reach its conclusions.[51] The physical model that the report uses is based on two factors: "(1) a ship is sailing straight ahead in calm waters at a constant speed; [and] (2) this ship is releasing scrubber discharge water from her astern outlets and below the waterline at a constant discharge rate."[52] Because it was a simulation, the report ignores the effect of temperature, sea conditions, waves, and wind.

The report evaluates the environmental risk of wash water to marine aquatic organisms in short and long terms.[53] In the short term, the aim was to assess the probability that "lower pH and higher temperature of [scrubber] wash water may cause unacceptable risks to the marine aquatic organism."[54] Even though the report ultimately concludes that scrubber wash water is unlikely to reach an unacceptable level,[55] the report recognizes the potential risks due to heavy metals, NOx, and polycyclic aromatic hydrocarbons (PAHs).[56] Importantly, however, the report did not evaluate the harm of each individual substance. Rather, it evaluated the potential harm of scrubber wash water through a whole effluent toxicity test.[57] This test found that there is less probability that marine organisms may be detrimentally exposed to wash water.[58]

In the long term, the report attempts to evaluate the adverse effect of wash water on water quality in the Japanese coastal sea area.[59] The period used to calculate the accumulated concentration was ten years.[60] Though the report assumed that all ships would be fitted with scrubbers and would be in operation for ten years, the report concluded that "the additional accumulated concentration caused by wash water discharge from scrubbers would not introduce adverse effect."[61] Thus, the report concluded overall that the risks to the marine environment, or marine aquatic organisms, are in the range of acceptability.[62]

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50. *Id*. at 16.
51. *Id.* at 7-9.
52. *Id.* at 9.
53. *Id.* at 7.
54. *Id.* at 8.
55. *Id.* at 16, 39.
56. *Id.* at 7.
57. *Id.*
58. *Id.* at 43.
59. *Id.* at 49.
60. *Id.*
61. *Id.* at 64.
62. *Id.* at 67.

2. The Panama Report

Panama commissioned a report to conduct an extensive literature review on the environmental impacts of wash water.[63] The report addressed two issues. The first issue studied was the discharged water from scrubbers (scrubber wash water), and the impact of effluent on marine life and biogeochemical processes. The second issue studied was the use of scrubbers as an alternative to vessels using low sulfur fuel and whether they are truly equivalent regarding air emissions. This article focuses on the scientific findings regarding the first issue.[64]

As to pollution from wash water, the report analyzes seven governmental and independent reports regarding scrubbers.[65] After analyzing those various reports, the Panama report concludes that scrubber wash water raises a serious concern due to its acidity and the concentration of heavy metals and polyaromatic hydrocarbons.[66] The report finds the following: (1) scrubber effluent is very acidic, with a pH around three when discharged, which could have adverse health effects on marine life, and potentially affect the ability of the ocean to absorb CO2; (2) wash water contains heavy metals from the fuel and oil which can be toxic to marine life; (3) wash water contains polyaromatic hydrocarbons (PAH) which are hydrocarbon compounds with multiple aromatic rings that can have serious health effects on marine life; (4) some particulate matter present in exhaust gases ends up in wash water, which can have negative health effects; and (5) wash water contains nitrates due to nitrogen oxides present in the exhaust gasses, and if nitrate concentration in the ocean increases too much, eutrophication effects can occur. [67]

63. IMO MEPC, *Pollution Prevention and Response, Scrubber Environmental Impact Literature Review, Submitted by Panama*, MEPC 74/INF.10 (Feb. 8, 2019), https://1u594u31nvw01cjgyx4gvsr15ge-wpengine.netdna-ssl.com/wp-content/blogs.dir/1/files/2019/08/MEPC-74-INF.10-Scrubber-Environmental-Impact-Literature-Review-Panama-2019.pdf [https://perma.cc/F256-EMZF].

64. Regarding air pollution from the scrubbers, the Panama report questions the effectiveness of the scrubbers to remove the small particulates effectively. IMO MEPC *Pollution Prevention and Response, Scrubber Environmental Impact Literature Review, Submitted by Panama*, *supra* note 63, at 2.

65. *Id.* Annex at 4.

66. *Id.* Annex at 12.

67. *Id.* Annex at 3-4.

3. The Greek Report

Greece submitted a third report on the same topic.[68] The study chose five different sites to investigate the impact of wash water on the marine environment: Tokyo Bay, the Strait of Malacca, the Persian Gulf, the Strait of Gibraltar and the Panama Canal.[69] The study runs two models: near field and far field.[70] This part discusses what each model means, the assumption that the model is based on, and the findings of each model. The near field model is based on the "steady-state concentration distribution resulting from the EGCS wash water discharged by a fleet of vessels in busy open waters such as straits and canals."[71] The far field model simulates "the background buildup . . . of effluent concentration with time, specifically in the relatively enclosed geographic locations such as bays and ports where accumulation of effluent due to poor water exchange could be significant."[72]

The near field model was based on several assumptions. First, the amount of traffic and its composition was based on the current traffic data without anticipating any future levels.[73] Second, a fixed arrival time was used for all ship types, ignoring any seasonal change in traffic.[74] Third, the model only accounted for medium and large size ships (cargos, tankers, cruise ships) because EGCS are more financially attractive for larger vessels.[75] Fourth, the model assumed that the effluent consists of conservative substances, meaning "no decay or loss of suspended particles through settling into the sedimentary seafloor" was taken into account, and that "there is no background concentration of the individual effluent component."[76] The far field model is based on the same assumptions as the near-field model, though "assumes removal of effluent substances from the water column through settling and decay processes."[77]

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68. IMO MEPC, Air Pollution Prevention, Evaluation and Harmonization of Rules and Guidance on the Discharge of Liquid Effluents from EGCS into Waters, Including Conditions and Areas, Submitted by Greece, MEPC 75/INF.13 (Jan. 23, 2020), https://www.gob.mx/cms/uploads/attachment/file/546370/MEPC_75-INF.13_-_Evaluation_and_harmonization_of_rules_and_guidance_on_the_discharge_of_liquid_effluents_fr . . . __Greece_.pdf [https://perma.cc/Z6V3-7ALS].

69. *Id.* Annex at 2.

70. *Id.*

71. *Id.* Annex at 26.

72. *Id.* Annex at 30.

73. *Id.*

74. *Id.*

75. *Id.*

76. *Id.* Annex at 29.

77. *Id.* Annex at 31.

Regarding the results, the near field model finds that in the Strait of Hormuz in the Persian Gulf, Tokyo Bay, the Panama Canal, the Strait of Malacca, and the Strait of Gibraltar, wash water is unlikely to cause ecological concern.[78] As for the far field model, which examines the environmental impact of scrubber wash water as a whole, the study finds that in the Persian Gulf, the Port of Qingdao, and the port of Galveston, the wash water could cause issues for marine life due to "background accumulation (low flushing rate) and high shipping traffic activity."[79] The study finds that the higher the ship traffic in certain places, the higher the probability that the safety level will be exceeded.[80] Finally, regarding the far-field model in Tokyo Bay, the study finds that scrubber wash water could cause issues for marine life, and also responds to the Japanese Report discussed earlier.[81] The Greek Report examined the contaminates as a whole unit, rather than individually, while the Japanese report examined the contaminants (NOx or COD) singularly.[82]

C. The Relationship Between the Legal and Scientific Uncertainties

The legal and scientific uncertainties are interrelated. As for the scientific uncertainty, the problem takes two forms. The first form is the lack of scientific evidence of the environmental harm from the elements included in scrubber wash water. This is clear in the 2015 Guidelines which continued to use the standards of the 2008 Guidelines for scrubber wash water. In addition, the 2008 and 2015 Guidelines agree that the current standards need to be revised, which has not yet been done. The second form is the existence of contradictory scientific reports, which has been presented in the Japanese, Panama, and Greek Reports. Viewing the legal uncertainty in light of the scientific uncertainty, a number of conclusions can be made. If the scrubber wash water meets the 2015 Guidelines, three assumptions are possible. It could be considered to have no polluting effect, or, relating back to the scientific uncertainty, it could be considered as pollution by ship operation or pollution by dumping, two topics that are addressed in the next section. If the scrubber wash water does not meet the 2015 Guidelines, two assumptions are possible. It could be considered either pollution by ship operation or pollution by dumping, again relating back to the scientific uncertainty discussed.

78. *Id.* Annex at 36, 41-43
79. *Id.* Annex at 48, 55, 58.
80. *Id.* at 2.
81. *Id.* at 48-52.
82. *Id.*

II. SOLUTION FOR UNCERTAINTY IN LAW: DUMPING *VERSUS* DISCHARGE

A. The Governing Regimes of Scrubber Wash Water

There are several conventions that regulate pollution, including UNCLOS, the London Convention and Protocol, and MARPOL.[83] Article 1(4) of UNCLOS defines pollution of the marine environment by any introduction of substances into the marine environment, which would result in harmful consequences to the marine environment, or human health, and it includes activity that would reduce the quality for use of the seawater.[84] In regard to wash water, pollution by dumping and pollution from vessel operation are the focus of this article. According to UNCLOS, pollution by dumping does not include any pollution derived from the normal operation of the vessels.[85] Further, UNCLOS does not include a specific rule related to the prohibition of the pollution of the ship, but rather only includes an obligation on states to "minimize to the fullest possible extent, the release of toxic harmful or noxious substances."[86] UNCLOS' rules of pollution from the ship are not comprehensive, but rather act as a framework for the states and international actors including port states, coastal states, flag states, and international organizations, in this case the IMO.[87]

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83. MARTIN STOPFORD, MARITIME ECONOMICS 682 (3rd ed. 2009). Other conventions have been enacted as well, such as the Convention on the Protection of the Marine Environment of the Baltic Sea Area. *Id.*

84. UNCLOS, *supra* note 27, art. 1, § 1(4) ("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 sea, impairment of quality for use of sea water and reduction of amenities.").

85. UNCLOS, *supra* note 27, art. 1, § 1(5)(b)(i) ("the disposal of wastes or other matter incidental to, or derived from the normal operations of vessels, aircraft, platforms or other man-made structures at sea and their equipment, other than wastes or other matter transported by or to vessels, aircraft, platforms or other man-made structures at sea, operating for the purpose of disposal of such matter or derived from the treatment of such wastes or other matter on such vessels, aircraft, platforms or structures; placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of this Convention.").

86. UNCLOS, *supra* note 27, art. 207, § 5.

87. KRISTIN BARTENSTEIN, COMMENTARY ON ARTICLE 211 TO 215, IN UNITED NATIONS CONVENTION ON THE LAW OF THE SEA: A COMMENTARY 1426 (Alexander Proelss ed., 2017).

The issue of pollution by dumping was first presented in the 1958 Geneva Convention on the High Seas.[88] However, Articles 24 and 25 regulated only two issues, those being the discharge of oil, and dumping of radioactive waste.[89] In 1972, the Stockholm Declaration took a broader approach, and included the responsibility of states to prevent pollution of the seas.[90] Presently, the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (also known as the London Convention, and which entered into force in 1975) and the 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (also known as the London Protocol, which entered into force in 2006 and modernized the London Convention), are the main legal texts dealing with dumping from the ship.[91]

Pollution by vessel operation or accident is regulated by MARPOL.[92] According to MARPOL, discharge means "any release howsoever caused from a ship, and includes any escape, disposal, spilling, leaking, pumping, emitting or emptying."[93] MARPOL includes six annexes,[94] and Annex VI, Prevention of Air Pollution from Ships, "covers mandatory technical and

88. DETLEF CZYBULKA, COMMENTARY ON ARTICLE 192 TO 196, IN UNITED NATIONS CONVENTION ON THE LAW OF THE SEA: A COMMENTARY 1299 (Alexander Proelss ed., 2017).

89. Convention on the High Seas, arts. 24-25, Apr. 29, 1958, 450 U.N.T.S. 11, 82.

90. U.N. Environment Programme, *Declaration of the United Nations Conference on the Human Environment*, princ. 7 (Jun. 16, 1972) ("[s]tates shall take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.").

91. *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, INT'L MAR. ORG., https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx [https://perma.cc/CGZ8-2V57] (last visited May 25, 2022).

92. DAMIEN CREMEAN AND ERIKA TECHERA, MARINE POLLUTION LAW, IN ROUTLEDGE HANDBOOK OF INTERNATIONAL ENVIRONMENTAL LAW 285-289 (Shawkat Alam et al., eds. 2013).

93. International Convention for the Prevention of Pollution from Ships, art. 2, Nov. 2, 1973, 1340 U.N.T.S. 61.

94. International Convention for the Prevention of Pollution from Ships (MARPOL), INT'L MAR. ORG., https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx [https://perma.cc/EM2Q-58R2] (last visited May 25, 2022). The six Annexes are: Annex I Regulations for the Prevention of Pollution by Oil (entered into force Oct. 2, 1983); Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered in to force Oct. 2, 1983); Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into Force July 1, 1992); Annex IV Prevention of Pollution by Sewage from Ships (entered into force Sept. 27, 2003); Annex V Prevention of Pollution by Garbage from Ships (entered into force Dec. 31, 1988); Annex VI Prevention of Air Pollution from Ships (entered into force May 19, 2005). *Id.*

operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships."[95] While the 2008 and 2015 Guidelines set limits for the elements included in wash water, all of which are pending further scientific investigation, as discussed, the Guidelines did not clarify how violations would be handled in the instance that the elements in wash water exceed the limits indicated. Because the Guidelines did not address violations of limits, states may enact their own wash water regulations. For example, Germany has enacted a prohibition on the discharge of scrubber wash water in certain waterways based on legislation concerned with waste disposal.[96] By classifying scrubber wash water as garbage or waste, it can be concluded that some interpret scrubber wash water to fall under Annex V, Prevention of Pollution by Garbage from Ships. However, considering wash water to fall under these rules is based on an inaccurate reading of the international legal texts. Pollution by dumping is the applicable regime in the case of scrubber wash water, as discussed below.

B. The Inapplicability of Annex V

1. Scrubber Wash Water is Not Included in Annex V Definitions.

Scrubber wash water is not included in the definition of operation wastes of Annex V, Prevention of Pollution by Garbage from Ships, which adopts very specific definitions of garbage. Resolution MEPC 201(62), which revised Annex V, includes detailed definitions of each material that is regulated.[97] According to Annex V, some wash water is included in the definition of operational wastes: (1) "all solid wastes (including slurries) not covered by other Annexes that are collected on board during normal maintenance or operations of a ship, or used for cargo stowage and handling"; and (2) "cleaning agents and additives contained in cargo hold and external wash water."[98] However, operational wastes "does not include grey water, bilge water, or other similar discharges essential to the

95. *Id.* Annex VI. Such measures includes scrubbers.

96. *See* STEFAN SCHMOLKE, ET AL., ENVIRONMENTAL PROTECTION IN MARITIME TRAFFIC – SCRUBBER WASH WATER SURVEY 25 (Sept. 2020), https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_162-2020_environmental_protection_in_maritime_traffic_-_scrubber_wash_water_survey.pdf [https://perma.cc/B5NN-7HQJ].

97. IMO MEPC, Res. MEPC.201(62), *Amendments to the Annex of the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, 1973*, Regulation 1 (July 15, 2011).

98. *Id*. Regulation 1(12).

operation of a ship."[99] Hence, pursuant to Annex V, scrubber wash water is not considered an operational waste.

2. Annex V Regulates Other Types of Wash Water

Regulation 3 of Annex V prohibits discharge of garbage into the sea, except as otherwise provided in other Regulations of Annex V.[100] The following table shows the discharge rules under MARPOL Annex V.[101]

Table (3): Discharge Rules for Revised MARPOL Annex V

<table>
<tr><th rowspan="2">Garbage type[1]</th><th colspan="2">All ships except platforms[4]</th><th>Regulation 5
Offshore platforms located more than 12 nm from nearest land and ships when alongside or within 500 metres of such platforms[4]</th></tr>
<tr><th>Regulation 4
Outside special areas and Arctic waters
(Distances are from the nearest land)</th><th>Regulation 6
Within special areas and Arctic waters
(Distances are from nearest land, nearest ice-shelf or nearest fast ice)</th></tr>
<tr><td>Food waste comminuted or ground[2]</td><td>≥3 nm, en route and as far as practicable</td><td>≥12 nm, en route and as far as practicable[3]</td><td>Discharge permitted</td></tr>
<tr><td>Food waste not comminuted or ground</td><td>≥12 nm, en route and as far as practicable</td><td>Discharge prohibited</td><td>Discharge prohibited</td></tr>
<tr><td>Cargo residues[5, 6] not contained in washwater</td><td rowspan="2">≥ 12 nm, en route and as far as practicable</td><td>Discharge prohibited</td><td rowspan="2">Discharge prohibited</td></tr>
<tr><td>Cargo residues[5, 6] contained in washwater</td><td>≥ 12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2 and paragraph 5.2.1.5 of part II-A of the Polar Code)</td></tr>
<tr><td>Cleaning agents and additives[6] contained in cargo hold washwater</td><td rowspan="2">Discharge permitted</td><td>≥ 12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2 and paragraph 5.2.1.5 of part II-A of the Polar Code)</td><td rowspan="2">Discharge prohibited</td></tr>
<tr><td>Cleaning agents and additives[6] in deck and external surfaces washwater</td><td>Discharge permitted</td></tr>
<tr><td>Animal Carcasses (should be split or otherwise treated to ensure the carcasses will sink immediately)</td><td>Must be en route and as far from the nearest land as possible. Should be >100 nm and maximum water depth</td><td>Discharge prohibited</td><td>Discharge prohibited</td></tr>
<tr><td>All other garbage including plastics, synthetic ropes, fishing gear, plastic garbage bags, incinerator ashes, clinkers, cooking oil, floating dunnage, lining and packing materials, paper, rags, glass, metal, bottles, crockery and similar refuse</td><td>Discharge prohibited</td><td>Discharge prohibited</td><td>Discharge prohibited</td></tr>
</table>

99. *Id.*

100. *Id.* Regulation 3(1).

101. IMO MEPC, *Simplified Overview of the Discharge Provisions of the Revised MARPOL Annex V Which Entered Into Force on 1 March 2018*, https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Simplified%20overview%20of%20the%20discharge%20provisions%20of%20the%20revised%20MARPOL%20Annex%20V.pdf [https://perma.cc/9U2X-TKCP].

As the table shows, discharge of garbage is regulated in three areas. Regulation four applies to discharge of garbage outside special areas and Arctic waters.[102] Regulation five applies to discharge from offshore platforms located more than twelve nautical miles from the nearest land and from ships when alongside or within 500 meters of such platforms.[103] Regulation six applies to discharge that occurs within special areas and Arctic waters, where the distance is calculated based on the nearest land, the nearest ice shelf, or the nearest fast ice.[104] A special area is an area in the sea that requires special "mandatory methods for the prevention of sea pollution by garbage."[105] The special areas include several seas with high traffic and which have special oceanographic and ecological conditions.[106]

As can be seen on the table, there are specific rules for certain types of wash water. Regulation 5 forbids any discharge of wash water in the sea.[107] Cleaning agents and additives contained in deck and external surface wash water are permitted outside and within special areas and Arctic water.[108] As to cleaning agents and additives contained in cargo hold wash water, this discharge is permitted outside special areas and Arctic Waters, and is permitted in special areas and Arctic waters if twelve or more nautical miles from land, subject to certain other regulations.[109] As to cargo residues contained in wash water, the discharge is permitted outside special areas and Arctic waters if twelve or more nautical miles from land, and is permitted in special areas and Arctic waters if twelve or more nautical miles from land, subject to certain other regulations.[110]

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102. *Id.* "Special area means a sea area where for recognized technical reasons in relation to its oceanographic and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by garbage is required." IMO MEPC, Res. MEPC.201(62), *supra* note 97, Regulation 1(14) (also providing the coordinates for these areas).

103. IMO MEPC, *Simplified Overview of the Discharge Provisions of the Revised MARPOL Annex V Which Entered into Force on 1 March 2018*, *supra* note 101.

104. *Id*.

105. IMO MEPC, *List of Special Areas, Emission Control Areas and Particularly Sensitive Sea Areas*, MEPC.1/Circ.778/Rev.2 (Apr. 6, 2017) https://www.register-iri.com/wp-content/uploads/MEPC.1-Circ.778-Rev.2.pdf [https://perma.cc/A62D-ERD3].

106. *Id.* These areas include the Mediterranean Sea, Baltic Sea, Black Sea, Red Sea, Gulfs area, North Sea, Antarctic area, Wider Caribbean region including the Gulf of Mexico and the Caribbean Sea. *Id.*

107. IMO MEPC, *Simplified Overview of the Discharge Provisions of the Revised MARPOL Annex V Which Entered into Force on 1 March 2018*, *supra* note 101.

108. *Id*.

109. *Id.*

110. *Id*.

3. Annex V Excludes Harmful Materials from the Regulation

Annex V distinguished between four types of wash water: cargo residues not contained in wash water, cargo residues contained in wash water, cleaning agents and additives contained in cargo hold wash water, and cleaning agents and additives in deck and external surfaces wash water.[111] Determining whether wash water includes harmful material to the environment or not is a pure scientific issue. If a dispute arose as to the harm resulting from wash water, courts, nationally or internationally, resort to expert opinion to determine the existence of environmental harm. Accordingly, this leads to the importance of scientific opinion regarding the issue of scrubber wash water and its effect on the environment.

C. The Applicability of Dumping Rules on Scrubber Wash Water - Pollution by Dumping Regulates the Materials Included in Scrubber Wash Water

Scrubber wash water should be regulated by the 1972 London Convention, and the 1996 London Protocol. Though the London Convention and Protocol exclude the disposal of any waste resulting from the normal operation of the ship,[112] the pollution by dumping system applies to the materials that are included in scrubber wash water. The wash water includes materials that are acids and alkalis, which include the potential of hydrogen, polycyclic aromatic hydrocarbons, nitrates and other trace materials that are harmful to the environment.[113] As will be shown, the London Convention and its Protocol regulates these materials. While UNCLOS includes the general obligation on member States to combat pollution of the marine environment by dumping,[114] Article 4.1 of the London Protocol prohibits dumping of any wastes unless it is mentioned in Annex I.[115]

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111. *Id.*

112. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, art. III, Aug. 30, 1975, 1046 U.N.T.S. 120 [hereinafter London Convention].

113. Sonja Endres et al., *supra* note 21, at 1-5.

114. KRISTIN BARTENSTEIN, COMMENTARY ON ARTICLE 211 TO 215, IN U.N. CONVENTION ON THE LAW OF THE SEA: A COMMENTARY 1412 (Alexander Proelss ed., 2017).

115. 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972., art. 4.1., (as amended in 2006), https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/PROTOCOLAmended2006.pdf [https://perma.cc/73EC-JUA5]. Annex 1 includes (1) dredged material, (2) sewage sludge, (3) fish waste, or material resulting from industrial fish processing operations, (4) vessels and platforms or other man-made structures at sea, (5) inert, inorganic geological material, (6) organic material of natural origin, (7) bulky items

The London Convention distinguishes between three types of dumping materials.[116] First, some materials are fully prohibited with no exception[117] which include: (1) organohalogen compounds, (2) mercury and mercury compounds, (3) cadmium and cadmium compounds, (4) persistent plastics and other persistent synthetic materials, (5) crude oil, fuel oil, heavy diesel oil, lubricating oils, hydraulic fluids, (6) high level radioactive wastes or matter, and (7) materials in whatever form produced for biological and chemical warfare.[118]

Second, some substances and materials require a special permit to dump in the sea.[119] These materials are (1) wastes containing a significant amount of arsenic, lead, copper, zinc, organosilicon compounds, cyanides, fluorides, or pesticides; (2) large quantities of acids and alkalis including the substances beryllium, chromium, nickel, or vanadium; (3) containers, scrap metal and other bulky wastes; and (4) radioactive waste or materials that are not included in Annex 1.[120] Third, any other material or substance that is not mentioned in the previous two requires a general permit.[121] Even though scrubber wash water may be considered dumping by normal operation of the ship, scrubber wash water contains materials that, according to other provisions of the Convention, require a permit to dump.

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primarily comprising iron, steel, concrete and similarly unharmful materials for which the concern is physical impact, . . . and (8) carbon dioxide streams from carbon dioxide capture processes for sequestration. *Id*. Annex 1, § 1(.1)-(.8). Additionally, the London Protocol states: "No provision of this Protocol shall be interpreted as preventing Contracting Parties from taking, individually or jointly, more stringent measures in accordance with international law with respect to the prevention, reduction and where practicable elimination of pollution" *Id.* art. 3, § 4.

116. London Convention, *supra* note 112, art. IV(1)(a)-(c).

117. *Id.* art. IV(1)(a).

118. *Id.* Annex I.

119. *Id.* art. VI(1)(b).

120. *Id.* Annex II.

121. *Id.* art. VI(1)(c).

III. SOLUTION FOR UNCERTAINTY IN SCIENCE: POLICY *VERSUS* LEGAL PRECEDENT

A. Policy Solution: The Precautionary Principle and Uncertainty in Science

1. The Scope of the Precautionary Principle

Scrubber wash water triggers three principles in international law: the principle of prevention of transboundary harm,[122] the principle of due diligence,[123] and the precautionary principle.[124] The first two principles are not the most relevant to scrubber wash water,[125] because the environmental harm caused by scrubber wash water is still under further scientific investigation, as was shown by conflicting scientific reports.[126] This article focuses on the precautionary principle, which addresses the uncertainty of the environmental harm and uncertainty of science.[127] The precautionary principle is a tool that offers a solution to the problem of scrubber wash water.

There is not any authoritative definition of the precautionary principle.[128] The origin of the principle comes from national law, in

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122. *See* Ario Putra Pramungkas, *Assessing the Needs for a Global Treaty on State Responsibility to Prevent Transboundary Harm and Its Obligation towards the Occurring Damages,* 2014 ASIAN J. LEGAL STUD. 5, 7 (2014-2015).

123. *See* Ling Chen, *Realizing the Precautionary Principle in Due Diligence,* 25 DALHOUSIE J. LEGAL STUD. 1, 2-4. (2016); *see also* Medes Malaihollo, *Due Diligence in International Environmental Law and International Human Rights Law: A Comparative Legal Study of the Nationally Determined Contributions under the Paris Agreement and Positive Obligations Under the European Convention on Human Rights*, 68 NETHERLAND INT'L L. REV. 122, 123-28 (2021).

124. *See* LESLIE-ANNE DUVIC PAOLI, PRINCIPLE OF PREVENTION, IN PRINCIPLES OF ENVIRONMENTAL LAW 161-165 (Ludwing Kramer and Emanuela Orlando eds., 2018).

125. *See* Arie Trouwborst, *Prevention, Precaution Logic and Law - The Relationship between the Precautionary Principle and the Preventative Principle in International Law and Associated Questions,* 2 ERASMUS L. REV. 105, 112 (2009).

126. *See* discussion s*upra* Section II.B.

127. *See generally* Steve Maguire and Jaye Ellis, *Redistributing the Burden of Scientific Uncertainty: Implications of the Precautionary principle for State and Nonstate Actors,* 11 GLOBAL GOVERNANCE 518 (2005); Natahsa Geiling, *Can the Precautionary principle Save the Endangered Species Act from an Uncertain Climate Future?* 47 ECOLOGY L. Q. 326 (2020); Annecoos Wiersema, *Adversaries or Partners: Science and the Precautionary Principle in International Wildlife Treaty Regimes,* 11 J. INT'L WILDLIFE L. & POL'Y 222 (2008).

128. JONATHAN WIENER, PRECAUTIONARY PRINCIPLE, IN PRINCIPLES OF ENVIRONMENTAL LAW 175 (Ludwing Kramer and Emanuela Orlando eds., 2018).

particular the German concept of *vorsorgeprinzip.*[129] In *Ethyl Corp. v. EPA*, a U.S. Federal Court of Appeals considered the Clean Air Act to be a precautionary law.[130] In *Tennessee Valley Authority v. Hill*, the U.S. Supreme Court considered the Endangered Species Act to be "institutionalized caution."[131] On the international level, the first time the precautionary principle appears in legal text was in the preamble to the Montreal Protocol on Substances that Deplete the Stratospheric Ozone Layer, in 1987.[132] The preamble states the parties to the convention are determined to "protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in scientific knowledge."[133]

The precautionary principle passes through different definitions.[134] The most relevant definitions to the problem of scrubber wash water and its scientific uncertainty are found in the United Nations Framework Convention on Climate Change of 1994 (hereinafter UNFCCC), Principle 15 of the Rio Declaration on Environment and Development of 1992 (hereinafter Rio Declaration), and the European Climate Law (hereinafter ECL). Article 3.3 of the UNFCCC sustains that where there is a threat of serious or irreversible damage, scientific uncertainty should not be used as a reason to postpone precautionary measures to anticipate, prevent or minimize the harm. [135] Principle 15 of the Rio Declaration ensures that the state applies the precautionary principle in light of their capacity to do so,

129. *Id.*

130. Ethyl Corp. v. EPA, 541 F.2d 1, 44 (D.C. Cir. 1976).

131. Tennessee Valley Auth. v. Hill, 437 U.S. 153, 194 (1978).

132. Montreal Protocol on Substances that Deplete the Stratospheric Ozone Layer, pmbl., Sept. 16, 1987, 1522 U.N.T.S. 28.

133. *Id.*

134. GEERT VAN CALSTER AND LEONIE REINS, EU ENVIRONMENTAL LAW 28 (2018).

135. U.N. Framework Convention on Climate Change, art. 3, § 3, May 9, 1992, 1771 U.N.T.S. 107 [hereinafter UNFCCC] ("The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties.").

and that a lack of full scientific certainty is not a reason to postpone addressing environmental degradation.[136]

Section 9 of the preamble to the ECL reinstates the precautionary principle as a guiding principle to the EU and its member states.[137] However, the ECL refers to the definition of the precautionary principle established in the Treaty of the Functioning of the European Union (hereinafter TFEU).[138] In Title XX of the TFEU, Article 191(2) ensures that EU environmental policies are based on two principles, which are the precautionary principle and the principle of preventive action.[139] These principles aim to offer a high level of protection to the environment. In addition, the precautionary principle on the EU level must be read considering article 37 of the Charter of Fundamental Rights of the European Union.[140] This article places special emphasis on environmental protection by mandating "environmental protection and improvement of the quality of the environment" policies for the EU and its member states.[141] These policies must be in accordance with sustainable development.[142]

2. Application of the Precautionary Principle to Scrubber Wash Water

The precautionary principle has three main elements that are applicable to scrubber wash water. These elements are "taking preventative action in the face of uncertainty; shifting the burden of proof to the proponents of an activity; and exploring a wide range of alternatives to possibly harmful actions."[143] This section applies these pillars to scrubber wash water to demonstrate the principle's applicability.

136. Rep. of the U.N. Conference on Environment and Development, Principle 15, U.N. Doc. A/CONF.151/26 (Aug. 12, 1992). ("In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. 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.").

137. Council Regulation 2021/1119, pmbl., § 9, 2021 O.J. (L 243) 64 (EU).

138. *Id.*

139. Treaty on European Union and the Treaty on the Functioning of the European Union, art. 191(2), Dec. 13, 2012, O.J. (C 326) 1.

140. Charter of Fundamental Rights of the European Union, art. 37, Oct. 26, 2012, 2012 O.J. (C 326) 2.

141. *Id.*

142. *Id.*

143. David Kriebel et al., *The Precautionary Principle in Environmental Science,* 109(9) ENV. HEALTH PERSP. 871, 871 (2001).

Scientific uncertainty shall not be a reason for continued environmental harm.[144] The problem of scientific uncertainty is a critical matter in environmental law[145] because it plays a vital role in understanding the nature of environmental harm.[146] The three previous scientific reports from Greece, Japan, and Panama have established the scientific uncertainty of the environmental harm from scrubber wash water. The international community has developed some mechanisms to overcome such uncertainty. For example, currently, there are two levels of enforcement of scientific uncertainty, one at the international level and the other at the EU level.[147] On the international level, the Intergovernmental Panel on Climate Change (IPCC) is responsible for assessing the science related to climate change. The United Nations Environmental Programme (hereinafter UNEP) and the World Meteorological Organization (hereinafter WMO) established the IPCC.[148] To avoid the problems arising from uncertainty in science, the IPCC offers an annual report with the status of climate change.[149] Scientists from all over the world contribute to the report.[150] At the EU level, one of the major objectives of EU environmental law is precaution.[151] The ECL takes some concrete steps to avoid scientific uncertainty by establishing the European Scientific

144. *See id.*

145. DANIEL BODANSKY, JUTTA BRUNNEE & LAVANYA RJAMANI, INTERNATIONAL CLIMATE CHANGE LAW, 128 (2017).

146. ANDREAS FISCHLIN, SCIENTIFIC AND POLITICAL DRIVERS FOR THE PARIS AGREEMENT, IN THE PARIS AGREEMENT ON CLIMATE CHANGE: ANALYSIS AND COMMENTARY 3-8 (Daniel Klein et al. eds., 2017); *see also,* ELIZABETH A KIRK, SCIENCE AND THE INTERNATIONAL REGULATION OF MARINE POLLUTION, IN THE OXFORD HANDBOOK OF THE LAW OF THE SEA (Donald Rothwell et al. eds., 2015).

147. ENVIRONMENT AND CLIMATE CHANGE (SUMMARIES OF EU LEGISLATION 2018) 134 (2018).

148. *About the IPCC*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, https://www.ipcc.ch/about/ [https://perma.cc/TJV5-3XGE] (last visited May 25, 2022).

149. *Id.*

150. IPCC, *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (2018) https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_Low_Res.pdf [https://perma.cc/PS8F-SEKM]; *see also* IPCC, *Climate Change 2021: The Physical Science Basis, Summary for Policymakers* (2021), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf [https://perma.cc/XD5U-MKH6].

151. *See* PAUL STOOKES, A PRACTICAL APPROACH TO ENVIRONMENTAL LAW 28-29 (2d ed. 2009); *see also* ELISA MORGERA, EUROPEAN ENV'T LAW, IN ROUTLEDGE HANDBOOK OF INT'L ENV'T LAW 438 (Shawkat Alam et al. eds., 2013).

Advisory Board on Climate Change (hereinafter Advisory Board).[152] Section 24 of the preamble to the ECL states that "scientific expertise and the best available, up-to-date evidence, together with information on climate change that is both factual and transparent, are imperative."[153] The Advisory Board complements the work of the European Environmental Agency (hereinafter EEA), though its functions are fully independent from the EEA. [154]

It is also necessary to explore alternatives to the substance or material harming the environment. For example, an alternative to scrubbers would mean the mandatory usage of an alternative fuel instead of high sulfur fuel, a type of fuel that results in high emissions. Section 14 of the preamble to the ECL maintains that net zero targets of the greenhouse gas emissions shall be achieved "through a socially fair and cost-efficient transition."[155] Article 2 of the ECL mandates Union institutions and Member States to take all necessary measures to achieve climate neutrality.[156] As a result, and in light of these regulations, the future of scrubbers is not certain, especially without considering alternatives.

Further, the precautionary principle shifts the burden of proof to the polluter of the environment.[157] As it stands today, the Greek and Panamanian governments, referenced in Section I(B), are the bodies with the burden to prove that using scrubbers is harmful to the environment. However, the precautionary principle would shift the burden of proof from the party advocating in favor of the environment to the party that wishes to continue polluting it.[158] This could be read to mean that the precautionary principle favors the environment. In the case of scrubber wash water, this burden shifting would require the party using the scrubbers to prove that such activity is not harmful to the environment, to continue the use of such activity.

A dilemma faces the precautionary principle, however, in the face of contradicting scientific reports.[159] The Japanese government provides scientific evidence that there is no harm to the marine environment, while the Panamanian and the Greek governments offer contradictory

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152. *Id.*

153. Council Regulation 2021/1119, note 137, pmbl., § 24.

154. *Id.*

155. Council Regulation 2021/1119, note 137, pmbl., § 14.

156. *Id.* art. 2.

157. *See* SVITLANA KRAVCHENKO ET AL., PRINCIPLES OF INT'L ENV'T LAW, IN ROUTLEDGE HANDBOOK OF INT'L ENV'T LAW 46-48 (Shawkat Alam et al. eds., 2013).

158. ALAN BOYLE & CATHERINE REDGWELL, BIRNIE, BOYLE AND REDGWELL'S INT'L LAW AND THE ENV'T, 176-77 (4th ed. 2021).

159. *See* discussion s*upra* Section II.B.

evidence.[160] Because the Japanese argue that they have proof that scrubber wash water is not harmful to the environment, does it then follow that they fulfill the precautionary principle's burden of proof? The solution to the question may be accomplished by resorting to a neutral third party.[161] This party could be either a neutral scientific body, such as the IPCC, or a judicial body.[162]

The cost-benefit analysis of the harm and the credibility of scientific reports must be completed by independent bodies.[163] There are different bodies from the national level to the international level that could be used. For example, the International Tribunal for the Law of the Sea (hereinafter ITLOS) has considered the precautionary principle as part of international customary law,[164] the Seabed Disputes Chamber assesses the principle in the light of its recurrence in several international documents,[165] and in the MOX Plant Case, the ITLOS makes a connection between the precautionary principle and the duty to cooperate among states.[166]

At the EU level, the European Court of Justice (hereinafter ECJ) has dealt with the precautionary principle on two occasions.[167] One occasion is a case that dealt with mad cow disease, in which the court found "[w]here there is uncertainty as to the existence or extent of risks to human health, the institution may take protective measures without having to wait until the reality and seriousness of those risks become fully apparent."[168] However, the ECJ has two requirements to apply the precautionary principle.[169] First, there must be identification of the harm, because a mere hypothesis of the harm is not enough to trigger this principle.[170] Second,

160. *Id.*

161. See JACQUELINE PEEL & HARI M. OSOFSKY, CLIMATE CHANGE LITIGATION 55-65 (2017).

162. *Id.*

163. JASON SCOTT JOHNSTON, CLIMATE RATIONALITY 57-58 (2021).

164. ALEXANDER PROELSS, ENVIRONMENTAL PRINCIPLES AND ITLOS, IN PRINCIPLES OF ENVIRONMENTAL LAW 571 (Ludwing Kramer and Emanuela Orlando eds., 2018).

165. Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Advisory Opinion, ITLOS Rep. 10, 135 (Feb. 1, 2011).

166. MOX Plant Case (Ir. v. U. K.), Case No. 10, Provisional Measures Order of Dec. 3, 2001, ITLOS Rep. 95.

167. LUDWIG KRAMER, ENVIRONMENTAL PRINCIPLES AND THE EU COURT OF JUSTICE, IN PRINCIPLES OF ENVIRONMENTAL LAW 589-90 (Ludwing Kramer & Emanuela Orlando eds., 2018).

168. Case C-180/96, U.K. v. Comm'n, 1998 E.C.R. I-2269, ¶ 99.

169. Kramer, *supra* note 167.

170. *Id.*

there must be a comprehensive assessment that relies on the scientific data available.[171]

B. Legal Solution: Legal Limits to Reviewing Uncertainty in Science

1. Relevant Facts in the Whaling Case Related to Uncertainty in Science

The relationship between law and science is very sensitive. In order to define this relationship, this article analyzes ICJ case law to understand its limits. The Whaling Case[172] is a leading case in defining the relationship between the law and scientific uncertainty. This case is relevant to the issue of scrubber wash water because it looks at what can be considered a scientific outcome in the context of the law. The International Convention for the Regulation of Whaling (hereinafter ICRW) aims to protect whale stocks from endangerment.[173] However, the ICRW allows whaling for scientific research purposes.[174] Between 1987 and 2005, Japan commenced its Joint Aquatic Resource Permit Application (hereinafter JARPA I and II) for the purpose of scientific research within the meaning of Article VIII of the ICRW.[175] JARPA I's two original research objectives were to conduct research on the Southern Hemisphere minke whale and the role of whales in the Antarctic marine ecosystem.[176] In 2005, Japan initiated a unilateral conference to review the scientific results of the first phase, and submitted a research plan for a second phase of the project (JARPA II) which added three whale species to the permit: Antarctic minke whales, fin whales and humpback whales. [177] The new permit

171. *Id.*

172. Whaling in the Antarctic (Australia v. Japan: New Zealand intervening), Judgment, 2014 I.C.J. 226, ¶ 48 (March 31), https://www.icj-cij.org/public/files/case-related/148/148-20140331-JUD-01-00-EN.pdf [https://perma.cc/XXL9-XYUA] [hereinafter Whaling in the Antarctic Case].

173. International Convention for the Regulation of Whaling, pmbl., Dec. 2, 1946, 161 U.N.T.S. 72.

174. *Id.* art. VIII(1).

175. Institute of Cetacean Research, *Report of the Intersessional Workshop to Review Data and Results from Special Permit Research on Minke Whales in the Antarctic*, SC/59/Rep1, at 412 (Dec. 4-8, 2006), https://www.icrwhale.org/pdf/SC59Rep1.pdf [https://perma.cc/85RF-2A6W].

176. *Id.*

177. Institute of Cetacean Research, *Plan for the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II) – Monitoring of the Antarctic Ecosystem and Development of New Management Objective for Whale Resources*, SC/57/O1, at 1 https://www.icrwhale.org/pdf/SC57O1.pdf [https://perma.cc/A4EJ-DXPJ].

objectives are to "1) Monitor[] the Antarctic ecosystem, 2) Model[] competition among whale species and develop[] future management objectives, (3) Elucidat[e] temporal and spatial changes in stock structure and (4) Improv[e] the management procedure for the Antarctic minke whale stocks."[178]

Australia argues that the JARPA program is a cover for commercial whaling under the guise of scientific research. Australia claims, on one hand, JARPA II is not for scientific research. It bases its claims that Japan fails to comply with its conventional obligation on two issues: "(1) the obligation to respect the moratorium setting zero catch limits for killing of whales from all stocks for commercial purposes, [and] . . . (2) the obligation not to undertake commercial whaling of fin whales in the Southern Ocean Sanctuary."[179] On the other hand, Japan disagrees, refuting Australia's claim based on the scientific nature of JARPA II.[180]

2. The ICJ Ruling on Legal Limits and Its Application to Scrubber Wash Water

The ICJ investigated several questions related to scientific research, programme objectives, and methods used to achieve those objectives.[181] However, this part only focuses on the role of expert opinion and the role of the court to assess this opinion. The ICJ clarified that the conclusions of the expert scientists "must be distinguished from the interpretation of the Convention, which is the task of [the] Court."[182] This should not necessarily be seen as a cautious approach, but rather a prudent one, affording the ICJ the opportunity to survey a wide array of scientific opinions before deciding on the legal issues. Thus, the ICJ deals with several questions that need expert opinion, of which three are relevant to the issue of scientific uncertainty.

First, the ICJ addressed what constitutes scientific research. Australia offered expert opinion regarding scientific research.[183] The expert maintains that there are four elements of any scientific research: (1) the objective of the scientific research that aims to contribute to knowledge, (2) the methodology of the scientific research, (3) the peer review of the outcome of the research, and (4) the ability to avoid any adverse effects of

178. *Id.*
179. Whaling in the Antarctic Case, *supra* note 172, ¶ 48.
180. *Id.* at ¶ 49.
181. *Id.* at ¶ 67.
182. *Id.* at ¶ 82.
183. *Id.* ¶ 74.

the research.[184] Japan did not offer any expert opinion regarding the definition of scientific research, arguing instead that experts cannot "determine the interpretation of a treaty provision."[185] As for the ICJ, it tackled the question related to the definition of scientific research and its purposes from a legal perspective. The ICJ finds that it is not necessary to meet the four criteria adopted by Australia to constitute scientific research.[186] Because the ICJ did not find it necessary to define what scientific research is, and adopted a broad definition to the term, the ICJ identifies that the Japanese activities can be categorized under this broad definition of scientific research.[187]

Second, the ICJ evaluates the scientific methodology that is used to reach the claimed results. In this case, the parties disagree on the usage of lethal methods of whaling. The Japanese government argues that lethal methods are necessary to achieve the research objective, considering it "indispensable" for the purpose of JARPA II.[188] However, the Australian government argues that lethal methods must be used under two conditions only: (1) when it is essential to the program objectives, and (2) no other means are available.[189] In order to prove its claim, the Australian government offers counter expert evidence to the contrary of the Japanese claim.[190] The Australian expert states that the Japanese research program does not demonstrate the necessity to use lethal methods and that there are a variety of non-lethal research methods that could be used, for example, satellite tagging or biopsy sampling.[191]

The ICJ scrutinizes the validity of using lethal methods by investigating three issues.[192] As to whether non-lethal methods are feasible to obtain relevant data, the ICJ finds that both Japan and Australia agree that "non-lethal methods are not a feasible means to examine internal organs and stomach contents."[193] As to whether the data collected from lethal methods is reliable, the ICJ hears two conflicting expert opinions on this issue and finds that their disagreement is a matter of scientific opinion.[194] However, the ICJ states there is no basis to conclude that "the

184. *Id*.
185. *Id.* ¶ 75.
186. *Id.* ¶ 86.
187. *Id*. ¶ 88
188. *Id.* ¶ 129.
189. *Id*. ¶ 131.
190. *Id.* ¶ 130.
191. *Id.*
192. *Id.* ¶ 132.
193. *Id.* ¶ 133.
194. *Id.* ¶ 134.

use of lethal methods is per se unreasonable in the context of JARPA II."[195] As to whether Japan considered the use of lethal methods before launching its research program, the ICJ analyzed the JARPA II Research Plan and other reports.[196] The ICJ makes two findings: (1) the reports "reveal little analysis of the feasibility of using non-lethal methods to achieve the JARPA II research objective" and (2) the reports "suggest a preference for lethal sampling because it provides a source of funding to offset the cost of the research."[197]

Third, the ICJ heard contradictory evidence related to "a coherent scientific rationale" for the JARPA II sample sizes."[198] The Australian expert argues it is difficult to "understand the statistical basis for setting the level of lethal take."[199] The reason for the incoherent statistics, in their view, is that Japan is using a "retro-fitted individual sample size to justify the overall sample size."[200] The Japanese expert argues that the numbers "seemed to be of the right magnitude."[201] The ICJ aims to answer one question related to the sample size aside from the scientific disagreements about its scientific value. This question is "whether the evidence supports a conclusion that the sample sizes are reasonable in relation to achieving JARPA II stated objectives."[202] The ICJ reiterates that it does not seek to judge the scientific merits of the Japanese research objectives, which the ICJ believes to fall under the definition of scientific research, and it does not determine the relationship between the sample size and the scientific advantage of each size. The ICJ concludes that the sample size was "set for non-scientific reasons."[203]

The three questions answered by the court are helpful in analyzing any dispute that arises regarding the environmental harm from scrubber wash water. A future international court can use the same framework to investigate those three issues. First, in defining the scientific nature of any report, it shall adopt a wide definition as to what it is. Second, in evaluating the validity of the scientific methodology that is used to reach the results of a report, the court is limited to evaluating those methodologies only. Third, in hearing contradictory scientific evidence, a court shall not judge

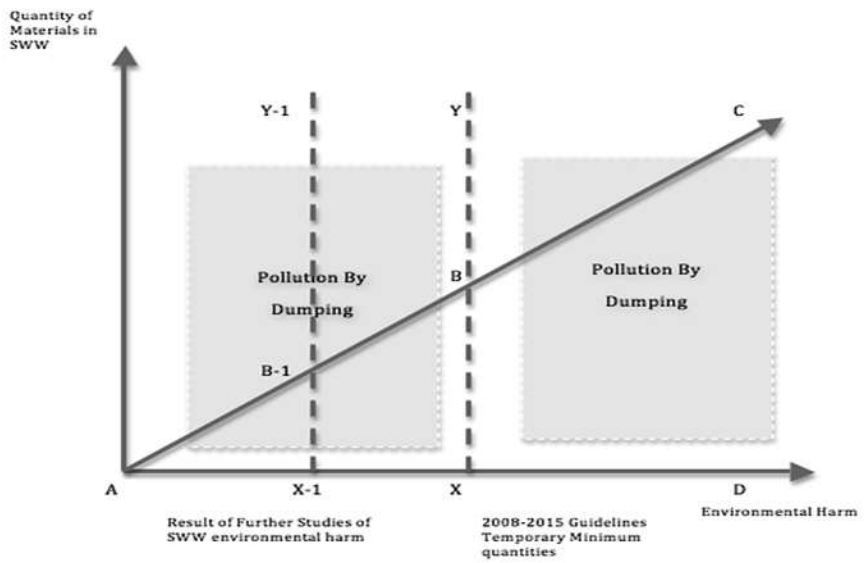
195. *Id.* ¶ 135.
196. *Id.* ¶ 136, 138.
197. *Id.* ¶ 144.
198. *Id.* ¶ 158.
199. *Id.*
200. *Id.*
201. *Id.* ¶ 159.
202. *Id.* ¶ 172.
203. *Id.* ¶ 209.

the merits of the research objectives but must evaluate the coherence of the scientific rationale.

IV. HYPOTHESIS FOR THE UNCERTAINTY OF LAW AND UNCERTAINTY IN SCIENCE

To solve the problem of scrubber wash water, two phases must occur. In the first phase, the benefit of the doubt is given to the environment, according to the precautionary principle, and for scrubber wash water that exceeds the 2015 Guidelines, the scrubber wash water should be considered pollution by dumping. Pollution by dumping is not only the most relevant rule, as shown, but it also offers the best protection to the environment. In the second phase, for scrubber wash water that does not exceed the 2015 Guidelines, pollution by dumping is nonetheless applicable on a temporary basis until the IMO reviews the environmental harm. Pollution by dumping offers the environment maximum protection against any potential environmental damage to the marine environment. Graph (1) represents the legal status of scrubber wash water during the first phase. The XY line represents the 2015 Guidelines' threshold, which has been questioned, as shown earlier. The (X-1)(Y-1) line represents the potential decrease in this threshold by the IMO.

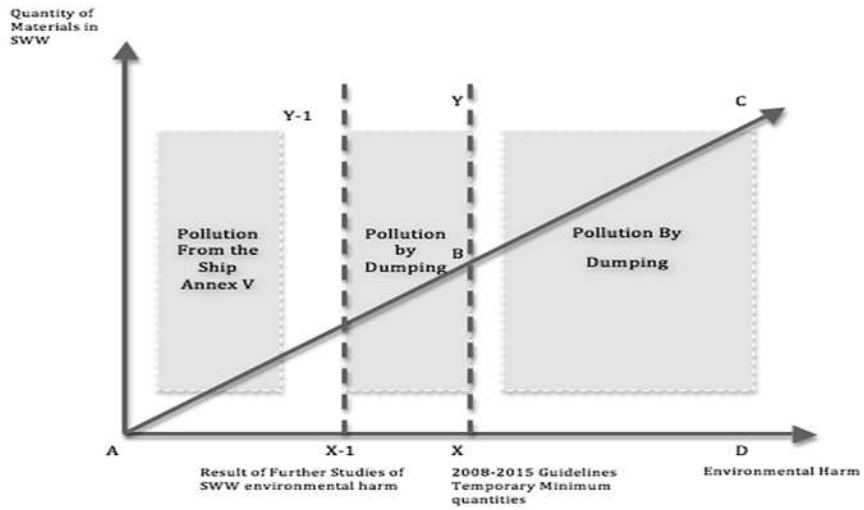
Graph (1):



If the IMO reviews the environmental harm of scrubber wash water, and determines that the acceptable levels must be decreased, there are two potential outcomes. First, the IMO may find that scrubber wash water is harmful to the environment in any state. Based on that finding, the IMO may introduce a stricter standard. Second, the IMO may conclude that scrubber wash water is not harmful to the environment. Hence, Graph (1) should be the governing relation to the future of scrubber wash water.

Once a determination is made in the second phase, the applicable rule for scrubber wash water should be pollution from ship operation (Annex VI) as long as the release water complies with the determined standard. Pollution by dumping will continue to apply to scrubber wash water that exceeds the Guidelines' threshold. Graph (2) represents the legal status of scrubber wash water during the second phase. The release between points X and (X-1) would be considered pollution by dumping. The only change in legal status applies to the release water that falls between points A and (X-1).

Graph (2):



CONCLUSION

Scrubber wash water triggers two problems: uncertainty in law and uncertainty in science. Scientific uncertainty of the environmental harm of scrubber wash water contributes to uncertainty in the law. If scrubber wash water did not include any environmental harm, the applicable rule would be pollution from ship operation (annex VI). If scrubber wash water does cause environmental harm, the applicable rule should be pollution by dumping.

The solution to legal uncertainty is to adopt pollution by dumping rules for scrubber wash water for two main reasons. First, scrubber wash water is excluded from the Annex V definitions, as it regulates other types of wash water. Second, the materials included in scrubber wash water are materials that are regulated under the London Convention and Protocol.

The solution to scientific uncertainty is to resort to the precautionary principle and judicial precedent. As to the precautionary principle, scientific uncertainty shall not be a reason for continuing the environmental harm, alternatives to the harmful substance or material must be explored, and the burden of proof should be shifted. As to legal precedent, the whaling case offers a comprehensive assessment of the limits of the international judicial system in dealing with scientific questions.