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Discharge of sewage and grey water from vessels in Antarctic Treaty waters

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Information paper submitted by ASOC[1]

Summary

This paper provides information on discharges of black (sewage) and grey water from vessels, expresses concerns that the current system for the management of sewage and grey water waste streams may not be sufficient to provide adequate protection for Antarctic ecosystems and wildlife, and summarises the current regulation. While the largest volumes of sewage and grey water discharges are inevitably associated with those vessels carrying the greatest numbers of people i.e. cruise vessels, the concerns are not restricted to these vessels. The paper proposes that ATPs consider further the need for more stringent management of the disposal of black (sewage) and grey water discharges from vessels and in particular considers the need for:

1. A prohibition on the discharge of untreated sewage or grey water into Antarctic Treaty waters;

2. Special Area status for the Antarctic Treaty Area under MARPOL Annex IV (in line with Special Area status already conferred with respect to MARPOL Annexes I, II and V);

3. The introduction of stringent management measures in the Polar Code to protect Antarctic waters from the impacts of sewage and grey water discharges.

Introduction

Although formal monitoring of human activities and impacts on polar environments is a standard requirement for land-based operations, there is an absence of readily available information on the extent and impact of sewage and grey water discharges from vessels in Antarctic waters. Concern exists over the vulnerability of polar marine ecosystems to the impacts of black (sewage) and grey water[2] discharges as these areas are characterized by low light (for part of the year) and especially low temperature conditions, which slow decomposition of the wastes. A paper submitted to the International Maritime Organization (IMO)[3] during discussions on the development of a Polar Code highlighted that polar waters are less tolerant to rapid changes in the nutrient status of the water column or seabed than other marine environments.

All vessels produce sewage or black water and grey water which can be either discharged in an untreated or treated form into the sea, or retained on board and discharged ashore to reception facilities. The volume of sewage waste from vessels, which are able to carry thousands of passengers and accompanying crew, is considerable. For example, a vessel carrying 3,000 passengers and crew is estimated to generate between 15,000 – 30,000 gallons (ca. 57,000 – 114,000 litres) of sewage per day, while a US Environmental Protection Agency (EPA) survey of cruise vessels reported an average sewage generation rate of 21,000 gallons (ca. 79,000 litres) per day per vessel[4]. Sewage discharges from cruise vessels have been found to contain a range of contaminants including heavy metals, volatile and semi-volatile organics, pesticides, nutrients, pathogens, and faecal coliforms[5]. The largest volumes of grey water are also produced by cruise ships. Grey water discharges on cruise ships are estimated at 90,000 – 255,000 gallons (ca. 340,000-965,000

[1] Lead author: Dr. Sian Prior.

[2] Grey water includes discharges from dishwater, shower, laundry, bath and washbasin drains, but it does not include the drainage from toilets, urinals, hospitals and animal spaces or from cargo spaces (Resolution MEPC.219(63) 2012 Guidelines for the Implementation of MARPOL Annex V).

[3] DE 54/13/8 *Additional MARPOL provisions for the Polar Code.* Submitted by FOEI, IFAW, WWF, Pacific Environment and CSC. 20 August 2010.

[4] The Ocean Conservancy, 2002. *Cruise Control, A Report on How Cruise Ships Affect the Marine Environment*. May 2002. US EPA 2008, Cruise Ship Discharge Assessment Report, United States Environmental Protection Agency, December 2008.

[5] US EPA 2008, Cruise Ship Discharge Assessment Report, United States Environmental Protection Agency, December 2008.

litres) per day[6] while the US EPA survey reported an average generation rate for grey water of 170,000 gallons (ca. 643,000 litres) per day per vessel. Grey water has been reported to contain a wide variety of polluting substances including faecal coliform bacteria, nutrients, food waste, and medical and dental waste[7] with levels of nitrogen and phosphorus within a similar range of concentration as untreated domestic wastewater[8]. Analyses by U.S. EPA and the Alaska Department of Environmental Conservation indicated fecal coliform levels of 36,000,000 CFU/100 mL and 2,950,000 MPN/100 mL, respectively, for untreated cruise ship grey water, which is higher than, by orders of magnitude, bacteria levels identified in untreated domestic wastewater.[9] Grey water also has potential to cause harmful environmental effects due to concentrations of nutrients and other oxygen-demanding materials.[10]

Degradation of sewage and related discharges into polar waters is affected by a number of environmental factors including solar radiation, water depth, dissolved oxygen content, sea ice, algal blooms, salinity, water currents, temperature, turbidity, stratification and as a result of changes through the polar year. As the amount of sewage discharged increases, environmental factors become less significant and the effective management of sewage and related discharges becomes increasingly important[11]. Since cruise vessels tend to use the same routes, sewage and grey water discharges will be concentrated in a few regions and cumulative impacts are possible.

The risk from sewage and grey water to Antarctic waters

Nutrient balances in polar waters are likely to be particularly vulnerable to rapid changes in the nutrient status of the water column or seabed. Polar regions also have heightened vulnerability due to the presence of sensitive wildlife species in some locations. Nitrogen and phosphorus (nutrients available in sewage and grey water) are essential for the growth of plants in the marine environment, however over-enrichment can occur when nutrients are introduced as a result of human activities. Increased nutrients stimulate increased algal growth, and can lead to harmful algal blooms, loss of biodiversity, and disruption of food webs including declines in fish stocks. In cases of severe over-enrichment, hypoxic dead zones can be created[12]. Nutrients from sewage and grey water discharges are directly available for uptake by algae and enhanced levels are likely to occur along shipping routes giving rise to an increased likelihood of localised effects. Even small changes in the nutrient status can have consequences for the fluxes and flows of nutrients between the trophic levels within a food web. It is important that natural nutrient balances, which have evolved over long periods of time, are not disrupted.

Sea ice creates a specialised habitat for the nutrient-dependent phytoplankton at the base of the food web and which are consumed by krill. Krill are a central component of polar food webs and in turn support globally important populations of many of the great whales, seals, penguins and other species[13]. Alterations in the nutrient status of polar waters would result in disruption of the food web, leading to changes in wildlife populations, and could exacerbate ongoing pressure from global climate change.

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[6] The Ocean Conservancy, 2002. *Cruise Control, A Report on How Cruise Ships Affect the Marine Environment*. May 2002. US EPA 2008, Cruise Ship Discharge Assessment Report, United States Environmental Protection Agency, December 2008.

[7] Congressional Research Service Report for Congress. Cruise Ship Pollution: Background, Laws and Regulations, and Key Issues. Claudia Copeland, Updated 18, 2005. http://www.protectyourwaters.net/news/data/CRS-CruiseShipReport.pdf Accessed 19/11/12.

[8] EPA 2008. Cruise Ship Discharge Assessment Report. US Environmental Protection Agency. http://www.epa.gov/owow/oceans/cruise_ships/pdf/0812cruiseshipdischargeassess.pdf Accessed 23/11/12.

[9] U.S. Environmental Protection Agency, Cruise Ship Discharge Assessment Report 1-1 (2008), *available at* http://www.epa.gov/owow/oceans/cruise_ships/pdf/0812cruiseshipdischargeassess.pdf.

[10] Claudia Copeland, Congressional Research Service, Cruise Ship Pollution: Background, Laws and Regulations, and Key Issues 4 (last updated July 1, 2008); US Navy Naval Sea Systems Command and US EPA Office of Water. Technical Development Document: Phase I, Uniform National Discharge Standards for Vessels of the Armed Forces 5.0 (1999).

[11] Hughes, K.A., 2003. Influence of Seasonal Environmental Variables on the Distribution of Presumptive Fecal Coliforms around an Antarctic Research Station. Appl. Environ. Microbial. 69 (8), 4884 – 4891.

[12] http://www.gpa.unep.org/gpa-pollutant-source-categories/nutrients.html; Karydis, M., 2009. Eutrophication assessment of coastal waters based on indicators: a literature review. Global NEST Journal, Vol 11, No 4, pp 373 – 390.

[13] http://www.coolantarctica.com/Antarctica%20fact%20file/wildlife/krill.htm.

Sewage and grey water discharges can also be vectors for the introduction of invasive species since these effluents routinely contain enteric bacteria and have the potential to contain parasites and viruses[14]. Treatment can reduce the levels of microorganisms present in these discharges however it is not a mandatory requirement even though the deliberate release of non-native organisms is not allowed.

The risks and impacts of sewage and grey water discharges from ships in polar regions have increased as ship traffic has expanded in these areas.[15] For example, visits by cruise ships, which have the potential to generate and discharge as much waste as a small town,[16] are increasing in both polar regions.[17,18,19]

To reduce the threat to the marine environment and to wildlife, land-based stations in Antarctica have been improving the treatment of sewage discharged by installing biological treatment plants and UV sterilisers to sterilise effluent before discharge[20], as well as incinerating food scraps and the sludge from treatment processes[21]. While the impact of discharges from research stations is not directly comparable to shipping, the volumes of wastes generated on cruise ships is high and these vessels use similar routes throughout the season. Studies of the impacts of wastes discharged from research stations have led to the conclusion that the disposal of domestic wastes deserves special consideration in polar marine environments[22]. ASOC believes that this conclusion should be applied to the management of all such wastes in Antarctic waters, including discharges from vessels.

Current regulation of sewage and grey water discharges in Antarctic waters

The International Convention for the Prevention of Pollution from Ships (or MARPOL Convention) incorporates a zero discharge aspiration through which Parties desire to achieve the complete elimination of intentional pollution of the marine environment by oil and other harmful substances[23]. Annex IV to the MARPOL Convention includes measures regulating sewage discharges, however these were not established with polar waters in mind, but more generally for discharges in temperate and tropical waters with faster decomposition rates. Further, MARPOL IV restrictions prescribe distances from shore and rates at which discharges may occur, since shorelines are appropriately viewed as vulnerable resources that these measures aim to protect. Polar shorelines and communities are equally vulnerable, but important ecological features and wildlife populations can also be found far offshore, such as ice floes, ice lines, and sensitive wildlife sites (e.g. marine mammals and seabirds), which are equally in need of protection. Therefore, restrictions based purely on proximity to shorelines are inadequate. These risks are heightened by the fact that cruise ships, with hundreds of people on board, travel to polar waters specifically to view wildlife and biodiversity hotspots.[24]

The nutrient load from ships' treated sewage is currently not regulated except in MARPOL Annex IV Special Areas – and to date only the Baltic Sea has been designated as a Special Area for the purposes of

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[14] Smith, J.J., & Riddle, M., 2009. Sewage disposal and wildlife health on Antarctica. In Kerry, Knowles & Riddle (Eds.) *Health of Antarctic Wildlife: A Challenge for Science and Policy*. Springer, Berlin Heidelberg, pp 271 – 315.
[15] DE 53/18/3 S*hipping Management Issues to be Addressed.* Submitted by FOEI, IUCN, Greenpeace, IFAW and WWF. 20 November 2009.
[16] U.S. Environmental Protection Agency, Cruise Ship Discharge Assessment Report 1-1 (2008), *available at* http://www.epa.gov/owow/oceans/cruise_ships/pdf/0812cruiseshipdischargeassess.pdf.
[17] ASOC (2008) A decade of Antarctic tourism: Status, change, and actions needed. XXXI ATCM, ASOC IP041.
[18] Arctic Council, *Arctic Marine Shipping Assessment2009 Report 5* (April 2009).
[19] http://www.miamiherald.com/2013/03/16/v-fullstory/3289437/antarctica-concerns-grow-as-tourism.html.
[20] http://www.antarctica.gov.au/living-and-working/station-life-and-activities/station-amenties-and-operations/site-services/sewage.
[21] http://www.antarctica.ac.uk/about_antarctica/environment/waste/index.php; and http://www.sciencedirect.com/science/article/pii/S0025326X04001869.
[22] Edwards, D.D., McFeters, G.A., & Venkatesan, M. I., 1998. Distribution of *Clostridium perfringens* and Fecal Sterols in a Benthic Coastal Marine Environment Influenced by the Sewage Outfall from McMurdo Station, Antarctica. Appl. Environ. Microbiol., 64 (7), 2596 – 2600.
[23] The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978.
[24] Conservation International, Cruises, http://www.biodiversityscience.org/xp/CELB/programs/travel-leisure/cruises.xml.

Annex IV. As a result sewage discharges from vessels contribute to increased nutrient loads in the marine environment[25].

Annex IV of the Protocol on Environmental Protection to the Antarctic Treaty provides some respite from the impact of sewage discharges from vessels carrying more than 10 persons in the Antarctic Treaty Area. Untreated sewage cannot be discharged within 12 nautical miles of land or ice shelves, and beyond this distance, sewage which has been stored in a holding tank cannot be "discharged instantaneously but at a moderate rate and, where practicable, while the ship is en route at a speed of no less than 4 knots". In addition, vessels are expected to make use of sewage record books.

There is currently no global regulation of the discharge of grey water, and its regulation is not under active consideration at the IMO. Since it would inevitably take a number of years for the IMO to develop and agree a global standard and/or regulation, environmental non-governmental organisations have proposed that mitigation of the risk associated with grey water discharges should be undertaken within the context of the Polar Code in order to provide the necessary environmental protection for polar waters[26]. This has not however been accepted. Some countries have, however, introduced restrictions within their national jurisdictions. For example, discharge of grey water is not allowed in Canadian Arctic waters under the Arctic Waters Pollution Prevention Act[27], and following sampling of large cruise ships in 2000, when the Alaska Cruise Ship Initiative found that traditional marine sanitation devices on passenger ships were unable to effectively treat sewage (black water) and also that untreated shower and galley water (grey water) contained bacteria and suspended solid concentrations equal to or exceeding black water, standards were strengthened for black water and introduced for grey water in Alaskan state waters[28].

While some measure of protection is provided by the Antarctic Treaty Environment Protocol provisions, the reality is that sewage can be discharged in untreated form throughout most of the Antarctic Treaty Area, and there is no restriction on the levels of nutrients, such as nitrogen or phosphorus or on the introduction of bacteria, viruses and parasites via sewage within the Area. Untreated grey water can be legally discharged anywhere within the Antarctic Treaty Area.

Proposed measures for sewage and grey water discharge in Polar Waters

In the absence of readily available detailed data on the volumes of sewage and grey water discharged in Antarctic Treaty waters, and lack of data on impacts associated with such discharges, and in keeping with the zero discharge aspiration of the MARPOL Convention, environmental non-governmental organisations have proposed the inclusion of more stringent measures for the discharge of sewage and grey water in polar waters within the Polar Code:

In DE 57/11/14, the co-sponsors urged inclusion of the following measures within the Polar Code to regulate the discharge of sewage and of grey water which can contain faecal coliform bacteria, oil and grease, detergents, nutrients, metals and food waste:

a) No discharge of untreated sewage or untreated grey water.

b) Designate the Arctic and Antarctic Area as Special Areas for the purposes of MARPOL Annex IV, where generally the discharge of sewage will be prohibited or discharge will be in line with the provisions of an Annex IV Special Area and will meet the standards adopted for total nitrogen and phosphorous levels.

c) With respect to vessels not covered by Special Area Status in Antarctic and Arctic waters, require

[25] http://www.cep.unep.org/publications-and-resources/marine-and-coastal-issues-links/nutrients
[26] DE 57/11/4 *Measures to prevent pollution of polar waters by sewage and grey water.* Submitted by Friends of the Earth International (FOEI), the World Wide Fund for Nature (WWF) and Pacific Environment. 25 January 2013.
[27] http://www.tc.gc.ca/eng/marinesafety/debs-arctic-environment-discharges-355.htm
[28] Eley, W.D., Morehouse, C.H., 2003. Oceans Conference Record (IEEE) 2, p748 – 753; Assessment of Cruise Ship and Ferry Wastewater Impacts in Alaska, 2004. Alaska Department of Environmental Conservation. Commercial Passenger Vessel Environmental Compliance Program. February 9, 2004.

the discharge of treated sewage to be beyond a precautionary 25 nm from the nearest land, ice shelf, land fast ice or areas of ice concentration exceeding 10% ice cover, with no discharge allowed in identified marine protected areas.

d) Discharge of treated grey water should only take place over a precautionary 25 nm from nearest land, ice shelf, land fast ice or areas of ice concentration exceeding 10% ice cover for cruise vessels, with no discharge in identified marine protected areas.

e) Discharge of treated sewage or treated grey water which meets total nitrogen and phosphorus level standards would be allowed over 12 nm from the nearest land, ice shelf, land fast ice or areas of ice concentration exceeding 10% ice cover.

f) Vessels must contain sufficient holding tank capacity for retention of sewage and associated wastes and grey water until an appropriate discharge solution (to shore facilities or beyond 25 nm from nearest land, etc.) is available.

Conclusion

ASOC urges that further consideration is given to necessary controls on sewage and grey water discharges as a matter of priority. This should take into account unique polar environmental conditions, risks and vulnerabilities, to provide adequate protection for sensitive polar ecosystems. A precautionary approach would be to eliminate all discharges of sewage and grey water into polar waters, with wastes ideally returned to shore for proper disposal[29]. However, adoption of stringent management measures could still leave open the possibility of discharge of these wastes following treatment in polar waters.

ASOC calls on the ATCM to consider the following elements as a matter of priority:

1. A prohibition on the discharge of untreated sewage or grey water into Antarctic Treaty waters.

2. Special Area status for the Antarctic Treaty Area under MARPOL Annex IV (in line with Special Area status already conferred with respect to MARPOL Annexes I, II and V).

3. The introduction of stringent management measures in the Polar Code to protect Antarctic waters from the impacts of sewage and grey water discharges.

Another important consideration should be seeking to amend Annex IV of the Environmental Protocol to strengthen the management of the discharge of sewage wastes and grey water from vessels operating in the Antarctic Treaty area. For example, the discharge of treated sewage[30] and treated grey water could be required to be beyond a precautionary 25 nm from the nearest land, ice shelf, land fast ice or areas of ice concentration exceeding 10% ice cover, with no discharge of sewage or grey water wastes permitted in CCAMLR-designated marine protected areas and Antarctic Specially Protected Areas (ASPAs). The distance could be reduced if agreed total nitrogen and phosphorus level standards are met following appropriate treatment[31]. Furthermore it would be important that vessels have sufficient holding tank capacity for retention of sewage and associated wastes and grey water until an appropriate discharge solution is available. Finally, in order to better assess the risks to Antarctic ecosystems and to wildlife, it would be valuable to require that concentrations and volumes of black and grey water discharges in Antarctic Treaty waters are reported, and that the dispersion and impacts of black and grey water discharges be monitored.

[29] *See* DE 56/10/11 *Incineration in polar waters*. Submitted by Friends of the Earth International (FOEI), the Clean Ship Coalition (CSC), the International Fund for Animal Welfare (IFAW), the World Wide Fund for Nature (WWF) and Pacific Environment. 24 December 2011.

[30] This would only be applicable to non-cruise vessels should Special Area Status under MARPOL Annex IV be conferred on the Antarctic Treaty Area,

[31] Total nitrogen and phosphorus standards could be in line with those adopted under MARPOL Annex IV.