The effect of World War 2 shipwrecks on the ecosystems of the Baltic Sea

Samuel Solanti

Hochschule Stralsund, Department of Business Studies

BMSB1200: Academic Core Competencies

Prof. Dr. Phil. Natascha Loebnitz

16.12.2022

Abstract

During World War 2, the Baltic Sea was subject to intensive actions of war, mostly between the Kriegsmarine and the Soviet Union Baltic Sea fleet. During those actions of war, a high number of ships were sunk, now lying on the seabed of the Baltic Sea. These shipwrecks as well as their cargo, weapon systems and ammunition are subject to chemical corrosion through salty sea water, and it is the goal of this work to gain an insight into how these shipwrecks and their artefacts are being affected by the sea and how they are affecting the surrounding seabed whereas they lie. This is done through review of topic related literature.

What is the issue with Shipwrecks from WW2 in the Baltic Sea

When a ship is being sunk during an active conflict of war, mostly there is neither time, nor any interest in caring for the environmental risk factors every sunken modern ship is causing to the environment. There are two types of environmental impacts which can happen when a ship is being sunk: immediate and long-term environmental impacts, depending mostly on the amount and area of damage a ship experiences when it sinks. A number of these long-term impacts and how they have evolved during the 60 post-war years, will be evaluated in the following Assignment.

Number of Wrecks in the Baltic Sea

While throughout history ships have always been endangered for sinking in action, the second World War is considered to be the period of time with the highest sinkage rate of both, civilian and military vessels. (Monfils, 2005) 60 years after the second World War, awareness of the amount and potential threat of environmental pollution due to shipwrecks has risen, leading to resounding investigations on number and integrity of the known wrecks. Unfortunately, even though several International Maritime Organizations started collecting data since 2004, the database regarding shipwrecks from World War 2 has three folded and it is still not complete. (Monfils, 2005; Rogowska et al., 2015)

Some major issues in locating and identifying shipwrecks are, that over the years, lying on the seabed, wreckages and other artifacts will be covered with sediments, which makes it difficult to detect them using optical or sonar-based systems. (Frizzell, 2020) At the same time locating methods based on magnetometry are not reliable due to the ongoing chemical reactions and structural changes of the wreck’s metal structure and thus it’s typical

behaviour, especially in terms of magnetic or acoustic matters. (Frizzell, 2020; Willa & Szpak, 2022)

Due to these problematic circumstances, it is currently not possible to locate and assess every shipwreck in an uncomplicated and economically reasonable way. It would simply be too expensive to perform a large-scale search and assessment to accomplish clearance on number and structural integrity of the shipwrecks in the Baltic Sea, originating especially from the second World War.

Effects of Salt Water on wreckage in the Baltic Sea

The Baltic Sea is renowned as a Sea with phenomenal conservation capabilities, mainly due to its relatively low salinity levels and cold temperatures. (Hjulhammar, 2015) Most of its conservation abilities base on the salinity level of about 6‰, which result in a lower activity of the shipworm and is the reason why the Baltic Sea has brought forth several well-preserved wooden shipwrecks. (Adams & Rönnby, 2013)

Similarly to wood, ships build of metals are a lot more conservable within the Baltic Sea, because of the low salinity compared with other Oceans. Yet still salt water is a highly corrosive environment for metals and in combination with the constant movement of sediments, it quickly causes heavy damage to metal shipwrecks and any weaponry or freight within. Having been exposed to sea water and its destructive elements for over 60 years since the World War 2, has in many cases lead to severe reduction of material and structural integrity of shipwrecks in the Baltic Sea. (Monfils, 2005) This severity of the corrosion process has been documented on several wrecks, including the “Stuttgart” which is lying in polish waters. (Willa & Szpak, 2022) The “Stuttgart” itself has experienced heavy damage during its sinking but during the years the hull of it has lost a lot of its integrity. Unfortunately analysis of water samples from around the wreck, especially surface sediments, have shown an increase of dissolved metal elements in the water. (Rogowska et al., 2015) That means, the shipwreck is increasingly dissolving, losing metal elements into the water, causing increasing pollution of the surrounding Sea area.

Fuel leakage

As previously seen, corrosion is the major issue with all World War 2 shipwrecks in the Baltic Sea, even though rust itself does not really cause the main damage on Marine Ecosystems. The problem lies within the effects of corrosion on shipwrecks. “Iron oxide (rust) occupies a greater physical volume than iron itself, causing expansion and the forcing apart of

the already weakened fasteners, leading to oil leakage and seepage or seawater ingress" (Monfils, 2005) When corroding, initially tight sealed piping's, valves and rubber seals lose their integrity what causes further exposure to sea water and allows fuel and oil to leak out of the tanks, slowly causing oil pollution of the water.

Due to its nature, corrosion is a constant process, which cannot be stopped after it has begun. That means for each shipwreck that is still loaded with either fuel or oil tanks as cargo, that these wrecks might develop into major environmental hazards when their integrity weakens enough and there occurs a major oil leak. (Monfils, 2005) As a specific example for this threat, again in Polish waters, lies the "Franken" a German tanker from the second World War. It was sunk at the end of war and is estimated to still be loaded with 6000 tonnes of fuel and equivalent substances. Due to the wrecks state of corrosion, experts are warning it could collapse of its own weight which would cause the remaining oil to be released into the Baltic Sea causing another environmental disaster. (Willa & Szpak, 2022)

Live ammunition and explosives

Warships are in most cases equipped with weaponry and according ammunition, depending on the type and mission of them. During World War 2 most warships were equipped with both, conventional as well as chemical weapon systems and in case of being sunk, the onboard ammunition sunk as well. Additionally, after the war was over, most chemical and unnecessary conventional ammunition was dumped into the Baltic Sea due to the lack of other more suitable disposal options. (Monfils, 2005) Some of these ammunition is continuing to chemically react, getting more and more dangerous, increasing the danger of recovery attempts. (Frizzell, 2020)

Due to water flow and sediment dynamics, it is usual for parts of dumped ammunition to either not sink where intended or to float free from its original storage. This leads to occasionally toxic or dangerous materials being washed ashore or being lifted aboard fishing vessels and causing severe harm. (Monfils, 2005) Being such a large amount of ammunition and so uncontrollable, live ammunition and chemical weaponry is to be considered an omnipresent hazard throughout the whole Baltic Sea.

Effects of oil and fuel on marine sediment and Baltic Sea Ecosystems

As seen in numerous oil spills, it has been shown that even though these catastrophes happen, their impact on the shoreline isn't necessarily as fatal as the catastrophe would imply at first. A good example for this is the sinking of the Atlantic Empress in the Caribbean Sea in

1979, which released 3,5 Mio barrels of oil into the ocean. In the end of the accident and the related oil spill, the Pollution Response Team had managed to avoid any of the spilled oil to reach the closest shoreline, avoiding coastal environmental pollution. Instead the oil floated further towards the open sea and eventually disappeared. (Horn & Neal, 1981) Unfortunately the disappearance of the oil slick was only concluded visually via airplane and ship surveys but never via chemical sediment or water analysis and thus it is not clear what impact occurred to the environment around the shipwreck and the spilled oil.

Within the Baltic Sea scientists have been monitoring the effects of oil spills from the "Sleipner"-wreck, especially focusing on its impacts on effect on the surrounding water and sediments. This analysis of the Maritime Institute in Gdansk has found out that even though fuel and oil pollution at the time of the sinking of the ship were relatively high, at the current date no noticeable contamination of the sediment could be found. Due to the laboratory results the wreck of Sleipner is being considered harmless for the surrounding environment and its surrounding fauna is totally normal compared with typical shallow water sediment fauna. (Hac, 2016)

On the contrary, within the Gulf of Gdansk where the Sleipner wreck lies, the Stuttgart was sunk as well. But in proximity of the wreck of Stuttgart, the Maritime Institute Gdansk has measured greatly increased amounts of metals dissolved into the surrounding waters and especially into seabed sediments. Additionally laboratory analysis has found that synthetic fuel is still saturating the sediment. (Gałęzowska et al., 2020) Within the contaminated area of about 415.000 square meters, sedimental zones absent of any form of marine life are increasing. (Willa & Szpak, 2022) This finding has led to the theory, that synthetically created ship fuel is less dissolvent in sea water than fuel deriving from mineral oil, yet it must be subject to further research in order to be proven and if so, it could lead to more precise assessment of a wreck's risk to its environment, adding its type of fuel as a critical criterion.

Location based issues of the Baltic Sea – and what it means to it

The Baltic Sea is very limited in its ability to remove contaminants, due to its location between landmasses and having only one relatively small connection to an Ocean. Being so limited in movement of water masses and water exchange, naturally any pollution that gets into the Baltic Sea is likely to remain within it, which could lead to the Baltic Sea becoming one of the most polluted sea in the world. (Willa & Szpak, 2022)

Especially in the Gulf of Gdansk where the wrecks of "Stuttgart" and "Franken" lie, whose are both considered to be ecologically high-risk wrecks, it is in a region of high

urbanization and industrialization, which means that industrial wastewater is being led into the Baltic Sea, polluting the region even more. (Rogowska et al., 2015; Willa & Szpak, 2022)

Shipwrecks treated as war tombs and remaining under military possession

In most cases of World War 2 warships sinking, many sailors lost their lives due to the according actions of war. Due to it mostly being quite chaotic and dangerous during the sinking of a vessel, casualties as well as private belongings of the people onboard stay in or within the ship. This leads to a moral issue with the respect of the dead: they need to be treated with human dignity and be protected from any further harm that could occur towards the dead as well as their relatives. (Petrig, 2009) Because of this demand of protecting the casualties within officially declared war tombs, for example sunken warships, there evolves a conflict of interests.

The United Nations have issued a Convention on the Law of the Sea, it is neither binding, nor clearly stating legal actions or requirements and forming more of a leeway for member states. In order to its obligations to be fulfilled, member states are required to implement their own measures according to the UNCLS suggestions. (Willa & Szpak, 2022) One of the most important directives for this work is Article 208 of UNCLS, which declares duty of the country to protect the waters under its jurisdiction from pollution of any form.

This requires every Coastal State to remove any potentially pollutive structures from their territory, which in case of shipwrecks would mean to either disassemble the wrecks in total or to remove any potentially environmentally harmful substances from them. As previously stated, if a wreck is being declared as a war tomb, it is ethically not possible for any other state to remove it or parts of it because that would severely violate against the demand to respect the dead.

As if the conflict were not complicated enough, members of the UNCLS have agreed on the responsibility of its member states for any dealt damage from warships to territorial sea areas. (UNCLS Article 31) This agreement demands every state to remove its sunk warships from foreign sea territory, which again violates against the requirement of Coastal State responsibility to protect its territory from any pollution and mostly this conflict is being seen as an ongoing discussion regarding the share of costs of the removal.

Usage of shipwrecks as artificial coral reefs

In recent years it has become subject to public and research that worldwide the coral reefs are declining dramatically, mostly due to overall pollution of oceans and due to global warming and warming of sea water temperature because of it. (McDonald et al., 2019)

Coral reefs are mainly known to be residual to warm water areas, and only in recent years it has become a bit more public, that even in cold waters coral reefs exist. Even though due to their low publicity, no major research has been conducted on them regarding their declination rate and it cannot surely be said whether they are similarly threatened like the Great Barrier Reef. Nevertheless researchers have found out, that cold water coral reefs have similarly important roles in local ecosystems, as warm water corals. (Titschack et al., 2015)

The knowledge of the importance of cold-water coral reefs and their existence, it gets interesting whether shipwrecks in the Baltic Sea could be transferred to act as artificial coral reefs, changing them from environmental pollution into environment protective artifacts. Shipwrecks could form basis of artificial coral reefs, providing protective structures for marine life, supplying the local ecosystem with more nutrients and thus increasing the ecosystem quality. (Frizzell, 2020) This possibility has been observed on several World War 2 shipwrecks in the Caribbean Ocean, where as an example the wreck of the “Gulfpenn” lies. Over the years the surface of the wreck has been covered to 12 – 15% by local coral colonies, including the wreck as part of the ecosystem. (Church et al., 2009)

Summary and possible future actions

This work attempts to show the impacts of shipwrecks from World War 2 to ecosystems of the Baltic Sea, regarding both, negative and positive impacts, and possible future impacts. It was shown that it cannot be generally assessed whether wrecks are polluting their surrounding seabed, and this is basing on many criteria, including the cargo, amount of damage received during sinkage, possible carriage of chemical weapons and materials used in the construction of the ship. Hereby it was revealed, that many World War 2 ships were equipped with chemical weapons which are nowadays endangering shorelines due to washing ashore as well as fishermen by entanglement of chemical ammunition to fishing nets. Additionally, it was found that the origin of the wrecks fuel has significant effect to its polluting effect and toxicity to the surrounding ecosystem. It is being assumed that German synthetic fuel is highly more toxic than mineral oil-based fuel, but this needs to be subject to further analysis to be proven.

At the same time a shipwreck that is not polluting the local environment can be naturally included to the local ecosystem, providing a base for artificial coral reefs and protective structures for local marine life.

It was also found that legally the coastal states have the responsibility of removing potentially harmful substances and structures from the sea within its territory but simultaneously the flag states of warships have the obligation to cover any damage caused by their ships, forming a financial discussion between states, and thus slowing down progress in environmental protection tasks.

A solution to this conflict of interests could be an increase of the need of environmental protection, especially of the highly vulnerable Baltic Sea, what would result to an increased need of cooperation and cost-sharing between involved countries. In addition to that further research needs to be done to identify polluting and non-polluting wrecks more precisely to eliminate the possible dangers to the environment. This could be done through thorough surveillance of the surrounding sea sediments of the wrecks.

References

Adams, J., & Rönnby, J. (2013). *Interpreting shipwrecks: Maritime archaeological approaches*. Highfield Press.

Church, R. A., Warren, D. J., & Irion, J. B. (2009). Analysis of Deepwater Shipwrecks in the Gulf of Mexico: Artificial Reef Effect of Six World War Ii Shipwrecks. *Oceanography*, *22*(2), 50–63.

Frizzell, T., J. (2020). *IN-SITU PRESERVATION OF DEEP-SEA SHIPWRECKS: UNDERSTANDING BIOLOGICAL INTERACTIONS AND ENVIRONMENTAL IMPACTS* [Master of Science-Thesis, Texas A&M University]. https://oaktrust.library.tamu.edu/bitstream/handle/1969.1/191635/FRIZZELL-THESIS-2020.pdf?sequence=1&isAllowed=y

Gałęzowska, G., Rogowska, J., Olkowska, E., Ratajczyk, W., & Wolska, L. (2020). Environmental Risk Assessment Resulting from Sediment Contamination with Perfluoroalkyl Substances. *Molecules*, *26*(1), 116. https://doi.org/10.3390/molecules26010116

Hac, B. (2016). *Monitoring of the wreck m/s SLEIPNER - possible sources of contamination of the seabed in Polish marine areas*. *31*, 101–109. https://doi.org/10.5604/12307424.1214127

Hjulhammar, M. (2015). Sea survey and its impact on maritime archaeological research in the Baltic Sea during the last 30 years. *Tekniikan Waiheita*, *33*(2), Article 2.

Horn, S. A., & Neal, C. P. (1981). THE ATLANTIC EMPRESS SINKING—A LARGE SPILL WITHOUT ENVIRONMENTAL DISASTER. *International Oil Spill Conference Proceedings*, *1981*(1), 429–435. https://doi.org/10.7901/2169-3358-1981-1-429

McDonald, J., McGee, J., Brent, K., & Burns, W. (2019). *Governin geoengineering research for the Great Barrier Reef*. 13. https://doi.org/10.1080/14693062.2019.1592742

Monfils, R. (2005). THE GLOBAL RISK OF MARINE POLLUTION FROM WWII SHIPWRECKS: EXAMPLES FROM THE SEVEN SEAS. *International Oil Spill Conference Proceedings*, *2005*(1), 1049–1054. https://doi.org/10.7901/2169-3358-2005-1-1049

Petrig, A. (2009). The war dead and their gravesites. *International Review of the Red Cross*, *91*(874), 341–369. https://doi.org/10.1017/S1816383109990270

Rogowska, J., Kudłak, B., Tsakovski, S., Gałuszka, A., Bajger-Nowak, G., Simeonov, V., Konieczka, P., Wolska, L., & Namieśnik, J. (2015). Surface sediments pollution due to shipwreck s/s "Stuttgart": A multidisciplinary approach. *Stochastic Environmental Research and Risk Assessment*, *29*(7), 1797–1807. https://doi.org/10.1007/s00477-015-1054-0

Titschack, J., Baum, D., De Pol-Holz, R., López Correa, M., Forster, N., Flögel, S., Hebbeln, D., & Freiwald, A. (2015). Aggradation and carbonate accumulation of Holocene Norwegian cold-water coral reefs. *Sedimentology*, *62*. https://doi.org/10.1111/sed.12206

Willa, R., & Szpak, A. (2022). *Toxic Ticking Time-Bomb in the Baltic Sea and Threats to Poland's Security*. https://doi.org/10.15804/ppsy202233