Environmental Dangerous Shipwrecks

Swedish Agency for Marine and Water Management

CHALMERS UNIVERSITY OF TECHNOLOGY

SWEDISH MARITIME ADMINISTRATION

WRECKS OF THE WORLD III CONFERENCE, GOthenbourg, 12-13 October 2015
Environmental Dangerous Shipwrecks

Content:

- Background and earlier studies
- Governmental Mission, Step 1
- Governmental Mission, Step 2
- Wreck Investigation, Standard Operational Procedures
- Field Operations
- Special investigation of sunken wrecks after WWII
- International Experiences
- Conclusions

- Risk Analysis Tool, VRAKA (presented by Hanna Landquist - Chalmers)
- Environmental Sampling and Analysis (presented by Anders Östin - FOI, Fredrik Lindgren – Chalmers, Anders Tengberg – Chalmers)
Governmental Missions

Background

2008-05-21 Report from The Swedish Agency for Public Management (Statskontoret) “Wrecks and ownerless boats”

Conclusion about wrecks as threats to the environment:
Suggested three phases: 1. Inventory, 2. Site Investigations and 3. Clean-Up operations

2009-03-17 Proposal of the maritime environment
Governmental proposal to the Swedish parliament including a mission to the Swedish Maritime Administration for realization of the phase 1 above, an inventory of risks and threats.

2009-05-20 Governmental task to Swedish Maritime Administration, Step 1
Funds was allocated to investigate the proportion, degree and possibility of threats to the maritime environment from leaking wrecks and to propose appropriate steps of measures.

2011-01-15 Swedish Maritime Administration report; ”Wrecks as an environmental risk”

2014-2015 Governmental task to Swedish Maritime Administration, Step 2
Funds was allocated to execute site investigations, assessment of possible environmental consequences and suggestion for further actions.
Earlier Studies in Sweden

Inventory of wrecks 2009-2010

Earlier inventory's
Data Collection FMIS/Fornsök
Reduction of data in 4 steps
>500 appointments with organizations/civil individuals
Risk Assessment

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Pre study 2007
Risk Assessment tool VRAKA 2009-2013,
FORMAS
Experts and advisors 2009-2010

The Importance of Solving Legal
Problems Regarding Wrecks
Risks Posed by Dangerous Wrecks in
Swedish Waters
(Katarina Kepplerus, Lunds Universitet 2010

Potential Shipwreck Pollution in the Baltic Sea
Overview of Work in the Baltic Sea States
(Eric Svensson, Göteborgs Universitet 2010)

Risk and Vulnerability Analysis
Digital Miljöatlas 2010

Corrosion Analysis, 2010

2007 NAIROBI INTERNATIONAL CONVENTION
ON THE REMOVAL OF WRECKS (Participation)
Governmental Mission, Step 1

Inventory of databases, 2009-2010

- About 17000 objects reduced to about 5000 shipwrecks

- Further reduced to 2700, considering age, position, function, type, etc.

- 2700 reduced to 316, considering propulsion, cargo, and potential environmental risks

- Reduced to 31, by complementary research such as wreckage reports, cargo manifest, etc. Those 31 wrecks are likely to contain environmentally dangerous substances.
Inventory 2009-2010

List of 31 wrecks likely to contain environmentally dangerous substances

Definition according to Bergen Maritime Museum

<table>
<thead>
<tr>
<th>Namn</th>
<th>Län</th>
<th>Föríst</th>
<th>Byggd</th>
<th>Motor</th>
<th>Brutto</th>
<th>Last + bunker enligt uppgift</th>
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<tbody>
<tr>
<td>Åltnes</td>
<td>M</td>
<td>1998</td>
<td>1978</td>
<td>D</td>
<td>5995 dwt</td>
<td>Petroleoil + bunker?</td>
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<tr>
<td>Breumsund</td>
<td>H</td>
<td>1966</td>
<td>1888</td>
<td>D</td>
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<tr>
<td>Finnbirch</td>
<td>H</td>
<td>2006</td>
<td>1978</td>
<td>D</td>
<td>5752</td>
<td>Återstår cirka 80 ton bunkerolja ombord</td>
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<td>Fu Shan Hai</td>
<td>DK</td>
<td>2003</td>
<td>1985</td>
<td>D</td>
<td>71980 dwt</td>
<td>66800 ton gördning + 165 ton bunkerolja</td>
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<tr>
<td>Harburg</td>
<td>AB</td>
<td>1957</td>
<td>1919</td>
<td>D</td>
<td>850</td>
<td></td>
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<tr>
<td>Heldarstindur</td>
<td>M</td>
<td>1990</td>
<td>1976</td>
<td></td>
<td></td>
<td>10 000 liter diesel</td>
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<td>Immen</td>
<td>A</td>
<td>1977</td>
<td>1976</td>
<td>D</td>
<td>3199</td>
<td>Bunker?</td>
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<tr>
<td>Ingemar</td>
<td>K</td>
<td>1984</td>
<td>1963</td>
<td>D</td>
<td>422</td>
<td>Bunker?</td>
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<tr>
<td>Irevik</td>
<td>M</td>
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<td>1938</td>
<td>D</td>
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<td>Jan Hewelusz</td>
<td>TY</td>
<td>1993</td>
<td>1977</td>
<td>D</td>
<td>3015</td>
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<td>Koronowa</td>
<td>DK</td>
<td>1970</td>
<td>1972</td>
<td>D</td>
<td>1503</td>
<td>Bunker?</td>
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<td>Langeland</td>
<td>O</td>
<td>2009</td>
<td>1971</td>
<td>D</td>
<td>2500 dwt</td>
<td>10 ton dieselolja i bunker + 2 ton smörjolja</td>
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<td>Lindesnäs</td>
<td>D</td>
<td>1957</td>
<td>1950</td>
<td>D</td>
<td>1265</td>
<td>1732 kbm flyg fotogen + bunker?</td>
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<tr>
<td>Malmi</td>
<td>I</td>
<td>1979</td>
<td>1958</td>
<td>D</td>
<td>4962</td>
<td>Bunker?</td>
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<tr>
<td>Marina</td>
<td>E</td>
<td>2006</td>
<td>1968</td>
<td>D</td>
<td>251</td>
<td>9,6 kubik gasolja + 100 l smörjolja i bunker</td>
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<td>Martina</td>
<td>M</td>
<td>2000</td>
<td>1968</td>
<td>D</td>
<td>696</td>
<td>600 ton saltysra + bunker?</td>
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<td>Mundogas</td>
<td>X</td>
<td>1966</td>
<td>1963</td>
<td>D</td>
<td>3645</td>
<td>2000 ton flytande ammoniak + bunker?</td>
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<td>Necati Pehivan</td>
<td>AB</td>
<td>1954</td>
<td>1944</td>
<td>D</td>
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<td>Norrriank</td>
<td>H</td>
<td>1967</td>
<td>1935</td>
<td>D</td>
<td>140</td>
<td>134 kbm eldningsolja, 82 kbm brännolja + bunker?</td>
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<td>Nynäs I</td>
<td>A</td>
<td>1903</td>
<td></td>
<td>D</td>
<td>171</td>
<td>376 kbm (303 ton) smörjoljor + bunker?</td>
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<td>Nynäs IX</td>
<td>O</td>
<td>1958</td>
<td>1917</td>
<td>O</td>
<td>33</td>
<td>38000 liter eldningsolja, 14 fat fotogen + bunker?</td>
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<td>Omega</td>
<td>A</td>
<td>1960</td>
<td>1921</td>
<td>O</td>
<td>722</td>
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<td>Rone</td>
<td>I</td>
<td>1981</td>
<td>1916</td>
<td>D</td>
<td>149</td>
<td>150 ton tjockolja + bunker?</td>
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<tr>
<td>Sendon</td>
<td>M</td>
<td>1975</td>
<td>1959</td>
<td>D</td>
<td>499</td>
<td>1150 ton fosfat + bunker?</td>
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<td>Sefir</td>
<td>H</td>
<td>1980</td>
<td>1954</td>
<td>D</td>
<td>738</td>
<td>Full last av lät eldningsolja + bunker?</td>
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<tr>
<td>Skytteren</td>
<td>O</td>
<td>1042</td>
<td>1001</td>
<td>A</td>
<td>12358</td>
<td>Brännolja som last/bunker, Lackage förekommer</td>
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<td>Thetis</td>
<td>O</td>
<td>1985</td>
<td>1961</td>
<td>D</td>
<td>165</td>
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<tr>
<td>Tilia</td>
<td>H</td>
<td>1972</td>
<td>1952</td>
<td>D</td>
<td>494</td>
<td>Bunker?</td>
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<td>Villan</td>
<td>M</td>
<td>1980</td>
<td>1959</td>
<td>D</td>
<td>439</td>
<td>Bunker?</td>
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<tr>
<td>Wästanväg</td>
<td>X</td>
<td>1965</td>
<td>1955</td>
<td>D</td>
<td>499</td>
<td>625 ton salpeter i 12 500 säckar + bunker?</td>
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<td>Östanhav</td>
<td>K</td>
<td>1903</td>
<td>1948</td>
<td></td>
<td>834</td>
<td>Bunker?</td>
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</tbody>
</table>
Governmental Mission, Step 2
Environmental Dangerous Shipwrecks

Site Investigation, Inspection Methodology, 2014-2015

- Selection of 3-5 wrecks for close investigation.
- Wrecks to be charted, identified and investigated by suitable equipment. Multibeam echosounder, SideScanSonar, ROV filming, Diver investigation, sampling.
- Developing a Standard Operational Procedure for wreck investigation.
- Development of the risk assessment tool VRAKA, to be used in analyzing and prioritizing the wrecks.
- Assessment of possible environmental consequences from leaking substances.
- Suggestion for further actions.
- Report 31 October 2015

Project partners and Expertise
Chalmers University
Swedish Maritime Administration
National Maritime Museums in Sweden
Swedish Coastguard
Swedish Agency for Marine and Water Management
FOI, Swedish Defense Research Agency
Swerea KIMAB
Governmental Mission, Step 2
Environmental Dangerous Shipwrecks

Selection of 3-5 wrecks
From step 1, 2009-2010

Prerequisite:
- Availability, research vessel operation time, distance to go, weather
- Depth, safe diving depth for divers and ROV- equipment
- Archive information, wreckage reports, vessel drawings, cargo manifest, environmental information
Selected for closer investigation

Selected and investigated 2015
Skytteren
-Sunken 1942
-Depth 74 m

Frequent leakage several years
2005 - Swedish Coastguard ROV inspection
Leakage from hull, corroded weldings
Bunker capacity ~ 6000 cbm
Probably not full bunkered
- Fishing Vessel
- Size: 30.14 x 6.4 m
- Bunker capacity ~ 35 kbm
- Contained probably ~ 17 cbm oil

Thetis
- Sunken 1985
- Depth ~ 30 m
Altnes
Sunken 1998

-23-30 m depth
-General Cargo
-Size: 107 x 15 m
-Possibly more than 10 cbm onboard
Villon
Sunken 1986

-18-37 m depth
-General Cargo
-Size: 54.2 x 8.3 m

~ 4 cbm bunker oil remaining onboard
Standard Operational Procedure, In-situ inspection wrecks

Detailed wreck information is essential knowledge to:
- Prioritize urgent clean up operations
- Long term planning of future clean up operations
- Exclusion of wrecks posing no or small environmental threats

Some important information:
- Position and attitude of the wreck
- Hull integrity
- Condition of hull, openings and ventilation pipes (bunker and cargo tanks)
- Dangerous obstructions on the wreck, fishing nets, wires, etc.
- Steel thickness of hull plates, especially in the area of bunker, cargo tanks
- Type of sea floor and bottom topography around the wreck
- Oil leakage.
- Etc.
Standard Operational Procedure, In-situ inspection wrecks

Example of SOP checklist for divers and ROV investigations

- Type of inspection: ROV, diving, hydrography, sampling equipment
- Applied inspection equipment/measuring equipment:
- Vessel: vessel/boat name
- Weather: wind direction, wind strength, wave height
- Depth, bottom depth: xxx metres, minimal depth of the wreck/distance above the sea floor, xxx metres
- Hydrography, collection of depth data:
  - depth data and bottom topography at the wreck and in the immediate vicinity of the wreck radius of about 300 metres.
- Orientation of the wreck: Direction, upright, on the side, upside down
- Any anchoring next to the wreck or DP:
  - position, direction distance from the wreck, one/several anchors/crowfeet/tern anchors.
- Measures: Inspection, oil removal, drainage, closing of goose necks, other
- Water transparency in water column
- Structural integrity: broken apart, holes in hull, cargo hold hatches on/off, dispersed details etc.
- Wreck sunken/partially sunken in sediment;
- Hull status:
  - status of paint, corrosion, pitting, biofouling: seaweed, barnacles, sea anemone, polychaetes etc.
- Status of goose neck ventilators:
  - status of paint, corrosion, pitting, biofouling: seaweed, barnacles, sea anemone, polychaetes etc.
- Sampling and measurement of thickness on hull, tanks, goose necks etc.:
  - Cleaning with hydraulic steel brush/griding/dismania and measuring with ultrasound device designed for underwater use on an ROV or a diver.
  - Systematic investigation with positioned measuring points on the wreck, x/y distance from distinct points on the hull.
- Obstacles: transiting net, broken masts/anchors etc.
- Status of any previously applied gaskets/seals;
- Type of sea floor around the wreck: rocks, sand, clay, sediment, biofouling, etc.
- Bottom topography around the wreck: hilly, flat, etc.
- Videos, photographs/pictures of the wreck:
  - Systematic investigation with positioning stating and x/y distance from distinct points on the hull, alternatively USBL positioning.
- Leakage from hull/tanks, goose necks, other openings/holes. Positioning of leakage stating x/y distance from distinct points on the hull, alternatively, USBL positioning.
- From what portion of the wreck?
- DO/HFO/SMD/chemicals/other substances
- Continuous discharge (l/s, drops /s)
- Performed sampling
- Documentation with video, photography/pictures
INSPECTION, VILLON, SIMRISHAMN

ROV (yellow cube) investigating Villon.

Measurement of hull thickness by ultrasound

Bottom Depth about 36,5m. Depth of top of masts about 17,5 m. Vessel size 54 x 9,5 m. No visual damages on the hull but missing the cargo hatches.
Villon scene fil, IV4Dview

Villon_Average_1m_Fartyg_points_Matere140625.scene
ALTAES, FALKENBERG

Depth 36-37 meter, clay and sand. Anchoring using 2 anchors, 50 kilo, about 90 meter anchor rope/chain

Important ship drawings
ROV film, showing growth, condition of bottom paint and welding's. Bottom paint seems to be intact, less growth in the deeper areas with less light from the surface. In general no heave corrosion on the visible parts of the hull.

Significant increasing of growth on the parts that are above 30 meters depth.

Rudder and propeller with entangled trawl-net.
Ship drawings shows position of bunker tanks
THETIS, KUNGSHAMN

Growth and corroded hull at port bow close to the seafloor. No remaining paint on the hull are visible.

Wheelhouse are missing on the bridge deck.

Cover on the sounding pipe to bunker tank, portside at cargo hold.

Port railing at cargo hold.

SB cargo hold.
SKYTTEREN

2 knots current. A mooring buoy was deployed nearby the wreck and used by the investigating vessel.

70 meter depth. Not possible to use divers. ("light-weight divers")

ADCP equipment
SKYTTEREN

Bow

Rust from the vessel are located on the seafloor nearby the wreck.

Propeller blade

ROV operations was difficult due to strong currents.

Fishing lines and fishing nets at the portside reeling.
"Måseskärsvraken", Swedish Westcoast
Said to be loaded with chemical weapons and dumped after WWII.
"Måseskärsvraken", Swedish Westcoast, about 12 wrecks are located in the area marked “Warning for bottom activities”. Other wrecks closer to the coast are also suspicious and may have been part of the sunken wrecks after WWII.
The wreck on the right could be the Swabenland.
After a fishing vessel had caught the current profiler, AIS tracks was extracted in the area. Several hundreds trawling tracks could be visualized.
Trawling tracks plotted in the area with shipwrecks
Trawling tracks corresponds to the scars found in the SideScanSonar data. Almost no scars close to the shipwreck.
ROV inspection
Objects and wrecks caught by trawling net
ROV inspection

ROV-film inside cargo hold of wreck and outside on the seabed. Some cylindrical containers with unknown content.
International Experiences and Networking

The complexity of the questions related to shipwrecks requires national and international networking with knowledge exchange in several fields.

The international work with wrecks has been an important input to the Swedish project.
Example:
- In the Baltic Finland has important experience of clean up and salvage operations at sea.
- Norway has performed a number of wreck investigations including removal of oil from leaking shipwrecks.

Conferences as Wrecks of the World are also an important international forum for exchange of knowledge and experiences.
Conclusions:
- Consequent inspection methods, like SOP, will increase a successful risk assessment.
- It is still very difficult to determine remaining oil in a shipwreck. The most efficient way to determine amount of oil in a shipwreck may be to drill a hole and measure content.
- Cooperation and interaction between the governmental and university institutions has proven to be very fruitful. The inspection operations by Swedish Coastguard and Swedish Maritime Administration was integrated within their ordinary tasks.
- The most important achievement are the standard wreck inspections and the following risk analysis in VRAKA.
- It seems that the project could suggest a national strategy w.r.t. handling of shipwreck.
- Report will be finalized 31 October 2015.