Environmentally hazardous shipwrecks
Swedish national programme
- work procedure, examples and lessons learnt

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Outline

- Swedish programme
- Legal framework
- Inventory
- Methodology
- Surveys
- Risk assessment
- Remediation
- Experiences
- Useful links
Swedish national programme

- SwAM is responsible for coordination of investigations and remediation of environmentally hazardous shipwrecks
- Annual budget € 2.4 M/year, 10 years
- Decision support tool – VRAKA
- RemEDIATE 2-3 wrecks annually

Frida Åberg, 2016
Swedish legal framework

• Wrecks that constitutes an environmental hazard
  • Risk of leakage of oil and other hazardous substances
  • Imminent risk of release, ~hours.

• Wrecks that constitutes an hazard in respect to navigation
  • Wrecked ship in a fairway or in an area with important commercial fishing.
  • In a public port if it hinders the usage of the port, e.g. other ships cannot enter the port.

• Wrecks that constitutes cultural heritages

• Nairobi International Convention on the Removal of Wrecks
Swedish legal framework, cont.

- **Nairobi International Convention on the Removal of Wrecks**
  - Shipowner responsible to remove hazard that occur after a wreckage
    - Wreck
    - Hazardous substance
  - State can intervene after a deadline
    - shipowner responsible for state´s costs
  - Shipowner (300gt)
    - compulsory insurance
    - other financial security to cover liability
  - EEZ, option expand to territorial waters
  - Sweden ratification 3 February 2018.
    - Expand application to Swedish territorial waters and inner waters.
  - The convention is not applicable on ships that have wrecked prior to the states ratification of the convention.
Legal considerations prior to a oil removal operation

- 1850-2018
- No owner, insurance
- Not in a fairway or public port
- Potentially polluting
- No law applicable (most likely)
- Cost for preventive removal of threat – Swedish taxpayers
Inventory
– potentially polluting ship wrecks

**Main outcomes:**

- 17 000 objects
  - >100 gt
  - After 1900
  - Oil as propulsion
- 2700
  - More thorough evaluation of the propulsion
    - Oil vs coal
- 316 potentially polluting ship wrecks
  - Oil still contained
  - ~30 hazardous ship wrecks
Risk management – prioritizing for oil removal operations

- ~30 wrecks
  - Which one constitutes the largest risk?
  - How do we use tax money most efficiently?

- Environmental risk
  - Probability of leakage
  - Volume oil inside the wreck
  - Where would the oil end up
  - Sensitivity of the nature type

- Prioritizing for oil removal operations
  - Time
  - Cost
Work procedure

- Checklist
- Documentation of project
- Methodology

Inventory
- Legal
- Check-list
- Agreement

Risk Assessment
- Data
- Survey
- VRAKA
- Site-specific modelling

Decision
- VRAKA-list
- Feasability
- Consultation with local authorities
- Cost-benefit
- Other aspects?

Operation
- Call-off
- Remediation: oil, derelict fishing gear

Documentation
- Check-list
- Evaluation
- Data sharing
Work procedure - Investigations

Step 1: Archive search
- General arrangement drawings
  - location of tanks
- Maritime Declarations
  - amount of oil on-board

Step 2: On-site surveys
- Investigations/hydrographic surveys
  - multibeam / sidescan sonar
  - film, photo - photogrammetry
- Physical surveys
  - sediment samples
  - oil samples
  - hull thickness measurements
Risk assessment - VRAKA

VRAKA

- Decision support tool
  - Prioritization of wrecks for remediation
- Risk assessment of shipwrecks
  - What can happen?
  - How likely is it?
  - What are the consequences?
- Petroleum products
  - Cargo
  - Bunker
- Chalmers University of Technology

Tool for estimation of the probability of release

Method for estimation of environmental consequences

Frida Åberg
Risk assessment - VRAKA

Part 1
Hazardous activities

- 8 different types of activities
  - Intensity
  - Probability of opening
Risk assessment - VRAKA

Part 2
Method for estimation of environmental consequences

• Three levels of Risk estimation
  • Level of detail
  • Users choice
Risk assessment - VRAKA

Tier 1

- Probability of discharge \times Volume released.
- \( P_{\text{Release}} \times \text{Expected amount of oil} = \text{Risk}_{\text{Total}} \)
### Risk assessment - VRAKA

#### Tier 2

- Probability of discharge
- Volume
- Distance to shoreline
- Sensitivity

<table>
<thead>
<tr>
<th></th>
<th>Low severity</th>
<th>Moderate severity</th>
<th>High severity</th>
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<tbody>
<tr>
<td><strong>Volume</strong></td>
<td>&lt;100 m³</td>
<td>100 – 500 m³</td>
<td>&gt;500 m³</td>
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<tr>
<td><strong>Distance to shore</strong></td>
<td>&gt;10 nm</td>
<td>1 – 10 nm</td>
<td>&lt;1 nm</td>
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<td><strong>Sensitivity</strong></td>
<td>Nearest shore is: Sand, steep cliffs or rock walls or facilities.</td>
<td>Nearest shore is: Cliff beaches, pebble, boulder or gravel beaches.</td>
<td>Nearest shore is: Reeds, meadows, fine sediment beaches, or mixed beaches</td>
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</table>
Risk assessment - VRAKA

Tier 3

Tools for oil spill trajectory modelling and sensitivity of receptors:

1. SeaTrack Web
   - Oil spill trajectory simulation
   - Release from the sea floor

2. Digital Environmental Atlas
   - Sensitivity to oil spill
   - Ecological aspects, foremost difficulty to remediate
   - Shore types have a value 1-9
Work procedure: Prioritization - decision

- Prioritization – VRAKA
  - Input from workgroup
  - Input from in situ investigations
  - Risk value

- Feasability
  - Information i.e GA plans
  - Conditions on site

- Cost of remediation

- Input County administrative board, municipalities

Start of operation

<table>
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<tr>
<th>Vrak (namn)</th>
<th>Tier 1 Riskvärde</th>
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<td>BREMSUND</td>
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Frame agreement, requirements

- Experience of working with hazardous ship wrecks, oil removal, removal of ghosts nets
- Experience of oil removal operations
- Certifications – quality management system
  - Health, safety
  - Environment
- Economy
- Reference cases
Work Procedure: Call-off

Call-off from frame agreement

Tender documents

- Information regarding wreckage
- On-site conditions: currents, sea floor
- General arrangement plans

Oil from gooseneck piping, shipwreck Harburg. Swedish Coast Guard

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Work procedure: Oil removal

- Remotely underwater vehicle (ROV) and/or diving
- Closed loop system
  - Penetration of tanks
  - Oil pumped to surface vessel
- Remove derelict fishing gear from wreck
  - Destruction
  - Recycling
Experiences: On-site survey

**Shipwreck Bremsund**

- Side-scan sonar documentation of the wreck site (500x500m)
  - General area of the wreck site
- Detailed investigations of the wreck.
  - Video- and image documentation
  - 3D-model of the wreck, photogrammetry
  - Digital Elevation Model (DEM)
- Hull thickness measurements
  - Four relevant positions, four measurements per point
  - Starboard and larboard (if possible)
- General hydrological data of the area
  - salinity
  - temperature
  - oxygen
  - sea-floor currents (if possible)
Experiences: On-site survey

Shipwreck Bremsund

Pictures from 3D-model of the wreck, photogrammetry
Experiences: On-site survey

Shipwreck Bremsund

Pictures from 3D-model of the wreck, photogrammetry
Experiences: On-site survey

Shipwreck Skytteren

- 172m, 12000 gt, 1942, ~500 t oil
- ROV/Diving assignment
- Swedish navy - HMS Belos
  - Belos divers – wet bell
  - Clearance divers
- General investigation of the wreck, condition, deterioration
- Places of oil leakage
- Hull thickness measurements
- Other - holes, pit corrosion, fishing gear?
Experiences: *Skytteren* - results

- Strong surface (1-3 knots) and sea-floor (1-1.5 knots) current
- Investigations of the keel area, whole length of wreck

First impression - good condition, but;
- Hull thickness - 4-11 mm
- Nails more corroded than hull
- Oil leakage visible on surface
Experiences: Remediation

Shipwreck Thetis

- Oil removal – 2017
  - Test case
  - Close to shore, ROV and diving operation
  - Time of wreckage ~22 m$^3$ diesel
- Recovery ~1m$^3$
  - Filling pipes corroded
Experiences: Remediation

*Shipwreck Thetis*

- Oil removal – 2017
- Ghost net – 2018
  - Purse seine (400x100m)
  - Recovery 12-15 tons
Experiences: Remediation

Sandön & Hoheneichen

- Geographically close – economically advantageous
- Easy objects – possibility within 2018
- M/S Sandön
  - Coaster, 499 gt
  - Fire in machine room, 1975
  - Bunker 40t
- M/S Hoheneichen
  - Coaster, 499 gt
  - Storm, 1959
  - Bunker 18t
- No reports of oil leakage
Experiences: Remediation

Sandön & Hoheneichen

Prerequisites:
- Depth: 31-18 m
  - Diving operation
- Easy access: keel-side up
- No owner
- No human remains in the wreck
- Not in a shipping lane
- Limited commercial fishing activity in the area

Result: no oil!
Summary

- Swedish National Programme
- ~30 wrecks on the shortlist
- Risk assessment, VRAKA, a decision tool
- Remediation, closed loop drilling
- Be prepared for anything and everything!
Thank you!

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Further reading


VRAKA, Ph.D-thesis by Hanna Landquist (2016)
http://publications.lib.chalmers.se/records/fulltext/244266/244266.pdf

SwAM Youtube-playlists from shipwreck operations
https://www.youtube.com/playlist?list=PLr3k-vNFdXs3WyKMoJcgCWoaArRk1P62T
https://www.youtube.com/watch?v=2FWrnjLB_C4&list=PLr3k-vNFdXs0ikmAPNna4DR4M8vtHwB05
https://www.youtube.com/playlist?list=PLr3k-vNFdXs1BJfYp9fzKz3SDDEIfxOT-