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MANAGING RISK



Dumped ammunition - an environmental problem for sediment management?



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Introduction

- In many countries dumping of ammunition in aquatic environments was widespread in the period from WWII and until the 1970s.



- Ammunition contains toxic compounds which can contaminate the sediments and harm the environment.
- Should the dumped ammunition be taken up (risk for explosion) or left in place (risk for contamination)?
- Two cases of dumped ammunition are presented; the lake of Mjøsa, Norway and the lake of Thun, Switzerland.



Source: Waterkant,
Heft 4, 2006

Dumped ammunition in the lake of Mjøsa

- Ammunition was dumped from the early 1940s until 1971.
- The ammunition was dumped in three different areas of the lake at great depths varying from 160 m to 400 m.
- Mjøsa is Norway's largest lake and an important drinking water source for the surrounding Lillehammer region.



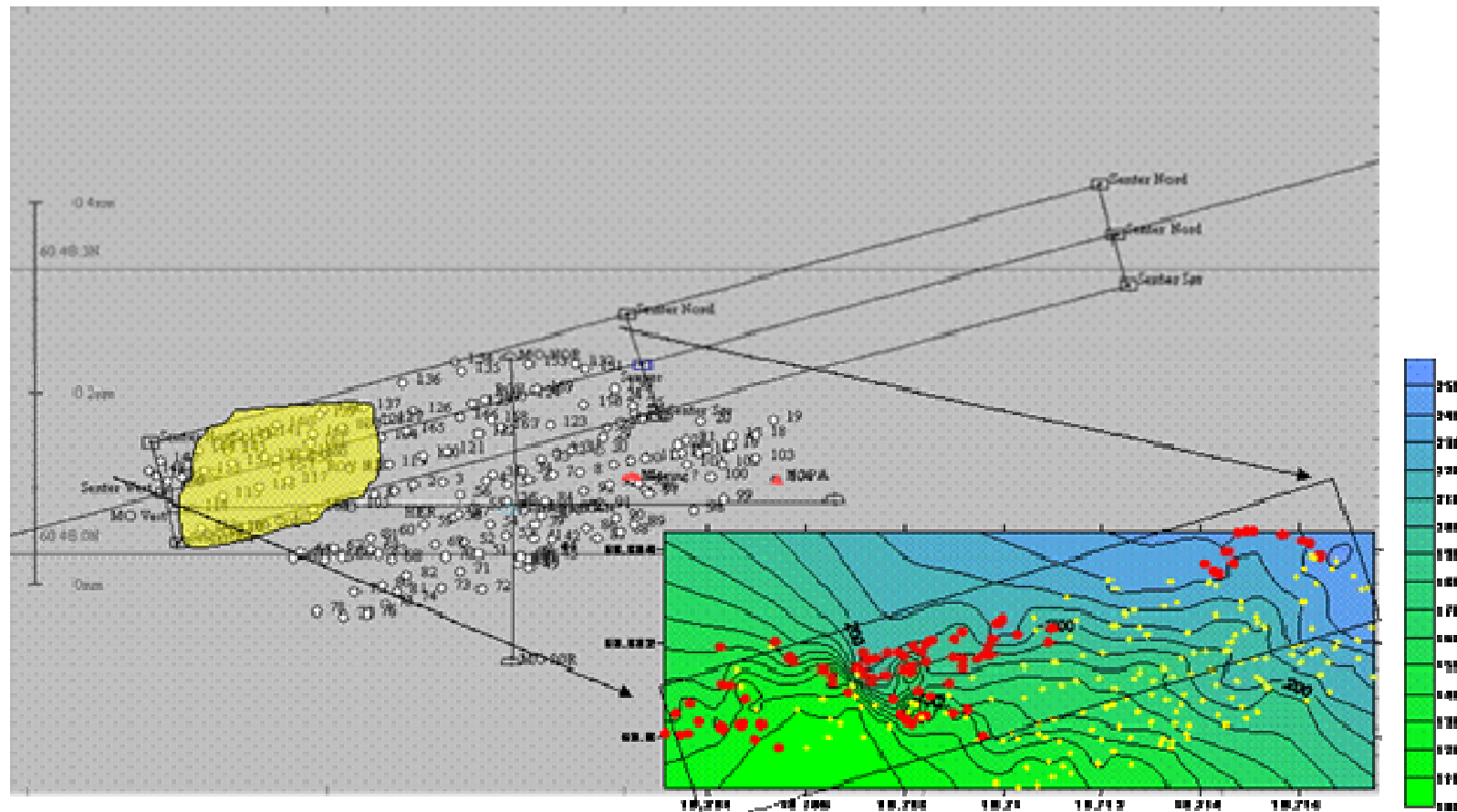
Shell (grenade) cap



Ammunition box

Dumped ammunition in the lake of Mjøsa

- 2001: Detailed survey with ROV (remotely operated vehicle)
 - Influence on drinking water quality



Red points: ammunition findings

Yellow points: no findings

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Dumped ammunition in the lake of Mjøsa

- The survey showed that none of the components in the explosives could be found in the sediments or in the water.
 - 2,4,6 trinitrophenol (picric acid)
 - 2,4,6 trinitrotoluene (TNT)
 - 1,3,5-trinitrobenzene (TNB)
 - 2-amino-4,6-dinitrotoluene
 - 4-amino-2,6-dinitrotoluene
 - 2,4-dinitrotoluene (2,4 DNT)

Dumped ammunition in the lake of Mjøsa

- An assessment was also done for the state of the explosives in the future when they would be in direct contact with water due to corrosion of the protective casing (after several hundred years):
 - The explosives will be fully or partly degraded.
 - The explosives will be covered by sediment due to sedimentation.
 - A large part of the explosives will be bound to the sediments.
 - Explosives that are spread to the water column will be relatively limited.

Dumped ammunition in the lake of Mjøsa

- The recommendation from the Norwegian Defence Authorities was to leave the ammunition in place.
- This was accepted by the Norwegian Pollution Control Authority, but they ordered the Norwegian Defence to monitor the dumping areas
- Monitoring showed remnants of picric acid in 2004 (just above the detection level) in the pore water, while in 2007 there was no picric acid in the pore water.
- This indicates that small amounts of explosives are in the sediments which can result in concentrations above the detection limit in sporadic cases.

Dumped ammunition in the lake of Thun

- Ammunition has been dumped from 1945 until 1964.
- The lake is frequently used by hobby fishermen
- Deformities were found on fish caught from the lake – could it have been caused by the dumped ammunition?



Lake of Thun. Source: www.producting.ch

Dumped ammunition in the lake of Thun

- A thorough investigation was done in 2005 to find out if there was a connection between the dumped ammunition and the deformities on the fish.
- Laboratory tests combined with modelling showed that the sedimentation in the lake was going much faster than the spreading of the buried explosives towards the sediment surface.



Dumped ammunition in the lake of Thun

- The investigation concluded that there was not going to be any (or very limited) spreading of explosives to the water column and thus no impact on the fish population.
- Later investigations have instead been looking at other possibilities for the deformities on the fish, among these are the brominated flame retardants.
- The Swiss authorities have decided that the explosives should be left in place because this poses fewer risks than taking them up.

Conclusions

- The cases from Norway and Switzerland show that dumped ammunition causes very limited or no impact on the aquatic environment.
- Even in the future when the protective casings have corroded and the explosives are in direct contact with the water, the impact on the aquatic environment is expected to be low.

Thank you for your attention!



Water sampling for analyses of explosives (Lake of Thun)



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