

Contaminated marine sediments in the Nordic countries; review of remediation approaches

- Report from the CONSENS project to the Nordic Council of Ministers

Introduction

Contaminated sediments have been recognized as a source of contamination in aquatic food chains, and the concerns regarding ecological and human health risks of contaminated sediment continue to grow. The project CONSENS has developed a status report to the Nordic council of Ministers of relevant regulatory framework and sediment management in Norway, Sweden, Finland and Denmark, and has compiled the knowledge of remediation strategies and experience from some well-documented remediation sites within the Nordic countries.

Materials and methods

A literature review has been carried out by NIVA (Norway), Uppsala university (Sweden) and SYKE (Finland) within the CONSENS project. Information and data on regulations, contamination and remediation actions within the Nordic countries have been compiled. Typically, surveys and monitoring of remediation sites are not published in scientific peer review journals. Most of the relevant reports and official documents are written in Nordic languages and information can be spread out between many government authorities and institutes.

Results and discussion

Regulations

- Guidelines for management of coastal dredged material have been developed by the London Convention and the OSPAR Convention which have been signed by all four countries presented, and the 1992 Helsinki Convention to which all except Norway are signatories.
- The Water Framework Directive (WFD) adopted in 2000 contains far-reaching provisions intended to secure and manage water resources, and largely by implication, sediments, at the river basin scale

National strategies

The review shows inequality in national remediation strategies and prioritizing between the Nordic countries.

Norway

- 1980s: Surveillance of sediment contamination in industrialized fjords and harbors started
- 1992: An overview of 32 seriously contaminated areas, including an action plan
- 2000: > 120 areas identified as highly contaminated
- 2001: White Paper No. 12 (2001–2002) “Protecting the Riches of the Seas” presented 17 prioritized fjords, for which Regional action plans for contaminated sediments have been prepared
- National funds for soil and sediment remediation since early 2000’s

Sweden

- 1998 the Swedish Environmental Code, including 16 environmental quality objectives
- 2002: Methods of inventories of contaminated sites and overall aim of creating a completely sustainable environment by 2020
- 2016: White Paper review of main sediment contamination problems and the remediation efforts that have been performed
- 2017: Governmental funds allocated for soil and sediment remediation, taking place between 2018 and 2020

Finland

- No systematic and nationwide surveys to detect and assess sediment contamination
- 2011: preliminary national survey of contaminated sediment in inland waters, with 28 known sites and suspected sites
- 2015: A guide to support decision for handling and relocating dredged sediments as a function of their contamination levels, including concentration levels for the most common contaminants

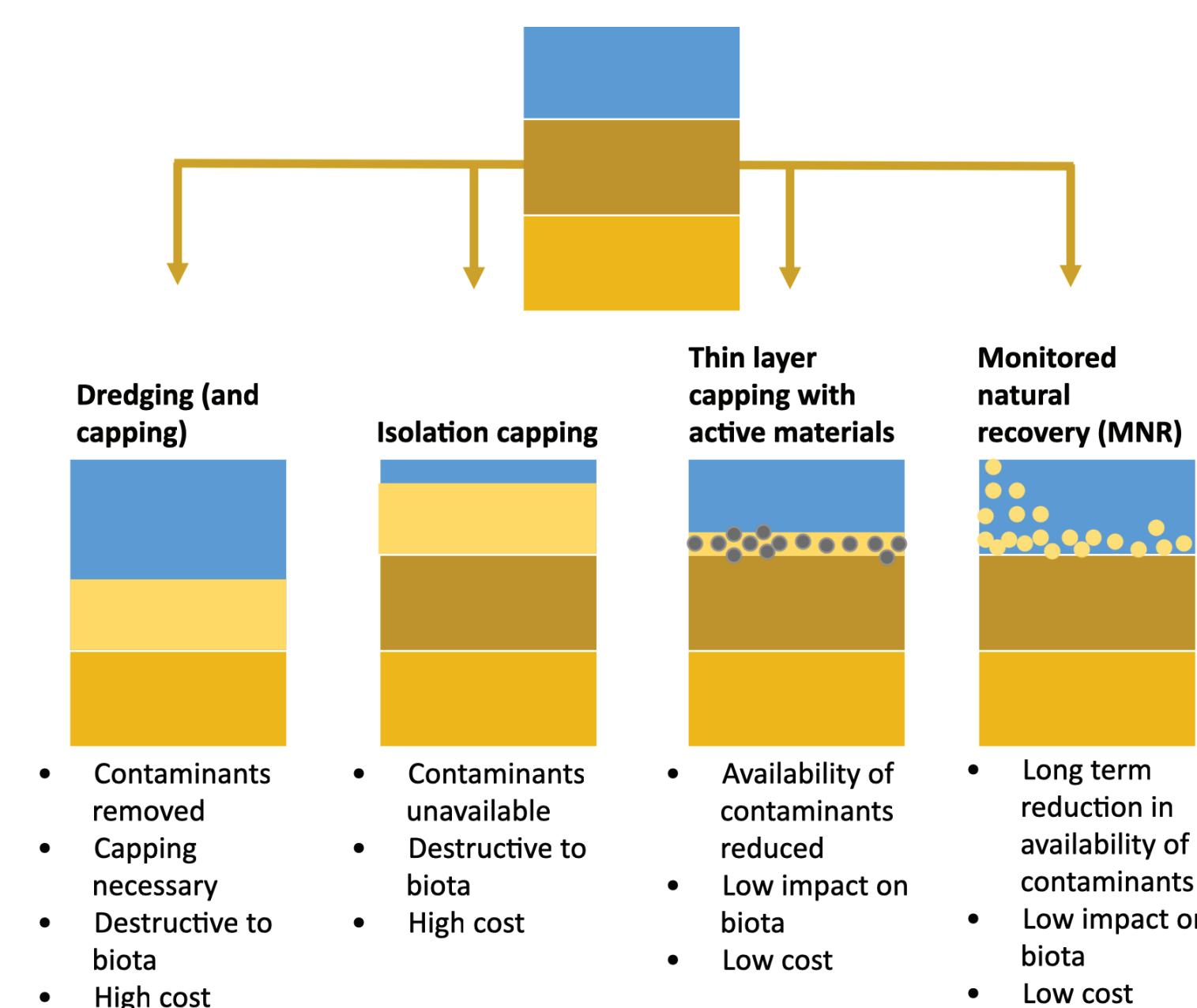
Denmark

- Monitoring of contaminants in Danish marine waters since 1998
- 2005: Guidance document for handling dredged material defining lower and upper action limit for > 20 contaminants
- 2016 Sediment data reviewed: 9 % of assessed areas have a poor chemical status
- 2017: Environmental goals for watercourses, lakes, transitional waters, coastal waters and ground water decided



17 coastal sites are prioritized for remediation in Norway. Several sites have been identified as contaminated in Sweden and Finland, though mostly inland.

Remediation approaches



- Traditionally, dredging have been extensively used for navigation purposes and to maintain sailing depths. The tradition of dredging in Finland is still very strong though the main purpose for this approach has not been clean-up actions, and in Denmark dredging is primarily a necessity to maintain sailing depths.
- Isolation capping have been conducted in a few full-scale sites in Norway, and is under consideration in Sweden.
- The use of active materials such as activated carbon is still in its infancy, though there have been promising results from field studies and laboratory scale studies carried out in Norway
- Documentation on post-remediation monitoring is very important in order to evaluate the efficiency and improve the techniques
- Decision criteria for deciding upon remediation approaches should include efficiency, adverse effects, costs and benefits of the different approaches.

Conclusions

- There is a need for comprehensive national strategies for contaminated sediments in countries that do not already have a strategy
- Actions plans and monitoring reports should be made available across the Nordic countries
- A Nordic database of clean-up projects and long term monitoring would improve the exchange of knowledge between the Nordic countries
- Results from assessments and monitoring after remediation should be encouraged to be published in Peer Review Journals.
- A risk based approach is beneficial to identify contaminated sediments, prioritize between sites and decide clean-up levels
- Research and method developments are needed for the development of risk assessment tools for multiple contaminants
- Further research (both field and laboratory) is needed for new and promising techniques
- The long term effect of low impact strategies need to be further investigated
- MNR should be given more accept as an alternative remediation strategy
- Multi-criteria analyses should be considered to decide upon remediation strategy, taking into account criteria such as adverse effects in addition to benefit, cost and efficiency