

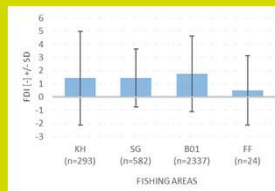
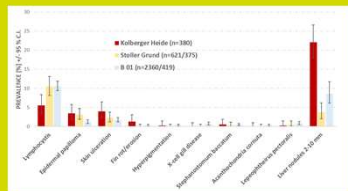
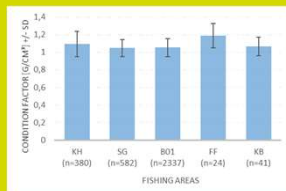
Studies on the health status of dab (*Limanda limanda*) from a dumpsite of conventional munitions in Kiel Bight, Baltic Sea

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The impact of dumped conventional and chemical munition on fish health in the Baltic Sea has been studied in the framework of the international DAIMON project (Decision Aid for Marine Munition). Studies on effects of conventional munitions dumped in the western Baltic Sea focused on dab (*Limanda limanda*), the most abundant flatfish species in the area, which has been used as a marine bioindicator species in many studies on biological effects of contaminants carried out in the Baltic Sea and North Sea.

In the present study, dab (n = 3432) were examined for fitness indicators (Fulton's condition factor, CF) and the presence of externally visible diseases and parasites and a special emphasis on macroscopic and histopathological liver lesions (n = 1253), including tumours. Methodologies applied followed standardized ICES¹ and BEQUALM² protocols. The fish disease index (FDI) includes seven externally visible viral, bacterial and parasitic diseases and is calculated considering confounded factors such as sex, length and seasons (Lang et al., 2008³). Sampling areas were the munitions dumping area Kolberger Heide (KH) (Kiel Bight), compared to Flensburg Fjord (FF), Little Belt (KB) and the reference areas Stoller Grund (SG) and B01 in Kiel Bight considered free of dumped munitions, located west and north of Kolberger Heide.

Condition factor (CF), external diseases and fish disease index (FDI)



The condition factor and the results of the fish disease index do not show a relevant difference between the munitions dumping area Kolberger Heide, Little Belt, Flensburg Fjord and reference sites (SG and B01). Significant differences between these areas were only recorded for the occurrence of liver nodules.

Macroscopic views of liver pathologies

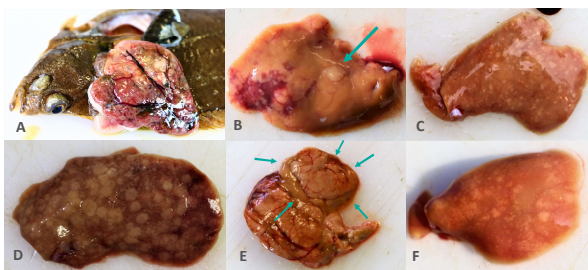


Figure: A: An overview of dab; a part of intestine and a direct view on the liver is shown. This liver is app. three times bigger than normal and without normal liver tissue structure. B: Liver with a white nodule, size 6-9 mm (arrow) and haemorrhages in liver tissue as found in peliosis hepatis; C, D and F: Liver of a dab with numerous white spots. E: Liver of a dab with a >10 mm nodule (arrows), widened blood vessels and a soft tissue structure; Aetiology of the nodules and white spots can be very different and can only be verified through histological examination.

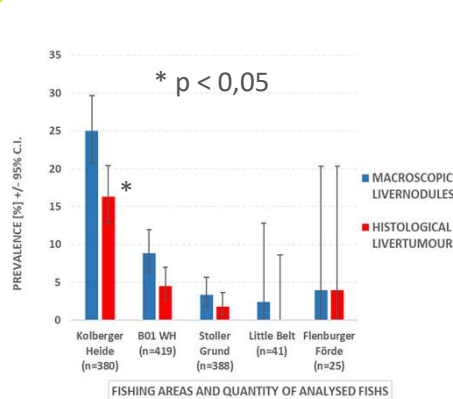
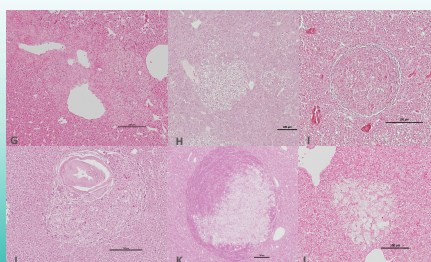


Diagram: A high and significant ($p < 0,05$) prevalence of macroscopic liver nodules and histologically confirmed liver tumours in Kolberger Heide in comparison to Little Belt, Flensburg Fjord and reference sites (SG and B01) was found. Since not all macroscopic liver nodules were diagnosed as tumours, the prevalence of liver tumours was lower.

Histological views of histopathological liver lesions, peliosis hepatis and tumours



Figures show:
- non-specific lesions: fibrosis (G) necrosis (L) and granuloma (I, J, K) due to unspecific parasites.
- pre-neoplastic lesions: clear cell foci of cellular alterations (H) (H&E staining)

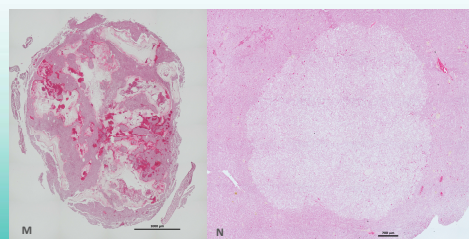


Figure M: Low power view of a liver with peliosis hepatis (a very rare disease regarded as early non-neoplastic toxicopathic lesion). It was recorded frequently in the dumpsite Kolberger Heide and was associated with carcinoma; **N:** Low power view of a clear cell hepatocellular adenoma. Clear compression of adjacent hepatocytes is evident around most of the lesion. (H&E staining)

¹ ICES. 2004. Biological effects of contaminants: Use of liver pathology of the European flatfish dab (*Limanda limanda* L.) and flounder (*Platichthys flesus* L.) monitoring; S.W. Feist, T. Lang, G.D. Stentford, A. Köhler; ICES Techniques in Marine Environmental Sciences, No. 38. 42pp.

² BEQUALM. Biological Effects Quality Assurance in Monitoring Programmes. Available from: <<http://www.bequalm.org/about.htm>>.

³ Lang, T., Wosniok, W., 2008. The Fish Disease Index: a Method to Assess Wild Fish Disease Data in the Context of Marine Environmental Monitoring. ICES CM 2008/D:01, p. 13.