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The physical impact of ice on an intertidal mussel bed.

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We show that cold winters can have major impact on intertidal mussel communities in the Wadden Sea. Observed losses are larger than those caused by wave attacks or predation. These observations were done in the context of the Mosselwad project. Mosselwad studies the stability of mussel beds in the Dutch Wadden Sea with respect to hydrodynamic forcing, predation and other biotic process. The goal is to determine contribution of each process to the destabilization of a mussel bed, which can be used to improve protection and restoration efforts. To achieve this a mussel bed is monitored using a camera system, which makes daily panoramic pictures of the mussel bed. Additionally, four times a year a detailed elevation map of the mussel bed is created using a 3D laserscanner. During first two weeks of February 2012 the monitored bed was covered with ice. After the ice was gone a large decrease in mussel cover near the camera location was revealed. Nearly 30% mussel areal was lost in 2 weeks, while during the rest of the monitoring period little variation in mussel cover was observed. Data from the monitoring campaign were used to investigate 1) the conditions under which the losses occur; 2) the spatial distribution of losses and reallocation of mussels; 3) the recovery of the mussel bed afterwards. Two mechanisms by which ice can damage mussel beds have been put forward. Firstly, drift ice pushed forward by wind ploughs through the mussel bed. Exposed to this mechanism are higher parts of the mussel bed on the wind ward side. Secondly, buoyant forces pick up ice slabs with mussels frozen into it during high-water. This mechanism requires that water puddles remain on the bed during low water and therefore requires muddy sediment.

Results show that the largest losses occurred at the higher lying areas at the wind ward side of the bed. Furthermore, large tracks starting at the front of the bed going through the bed were observed. Mussels appear to be piled up at the sides of the impact zones. These observations suggest that the main mechanism for loss is ice scour. No evidence was found on erosion to be caused by the buoyancy mechanism. Analysis of the coverage and height variation in the eight months after impact reveals that there is little recovery. There is evidence that more mussel beds in the Wadden Sea had suffered losses due to ice. In conclusion, physical disturbance by ice leads to irreversible damage to the windward side of a mussel bed. Also, it was the main cause of erosion during the monitoring period.