PHYTOPLANKTON COMPOSITION IN THE AREA OF A FISH FARM: PIGMENT ANALYSIS

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Abstract
Aquaculture activity has a serious impact on the environment, e.g. the enrichment of the water column in dissolved organic and inorganic material. This may subsequently affect populations of phytoplankton differently. In this study we report on short-term changes in the water column in relation to fish feeding and differences along the transect from the centre of a fish farm towards open waters. We took samples at different sites around the fish cage. Using HPLC (High performance liquid chromatography) pigment analysis we determined the phytoplankton community structure. Comparing the pigment fingerprints in the fish farm area before and after feeding we observed only minor differences. The main phytoplankton group were diatoms. We noticed differences in the profile from the centre of the fish cage outward.
Keywords : Adriatic Sea, Aquaculture, Eutrophication, Phytoplankton, Pigments.

Introduction
Aquaculture activity has a serious impact on the environment. One of the main environmental concerns associated with fish farming is the direct discharge of suspended solids and dissolved nutrients into coastal waters and thus the enrichment of the water column by dissolved organic and inorganic material. This may subsequently affect populations of phytoplankton differently [1]. In Slovenia we have cage fish farms of sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus auratus*). The fish farm is situated in the inner part of the semi-enclosed Bay of Piran (Gulf of Trieste, Adriatic Sea). The depth beneath the fish cages is about 13 m. As a part of the EU founded project ECASA we want to identify quantitative and qualitative indicators of the effects of aquaculture on the environment and vice versa. In this study we report on short-term changes in the water column in relation to fish feeding and differences along the transect from the centre of the fish farm towards open waters.

Methods
Seawater samples were taken from 5 m depth at 6 different points of the compass around and in the centre of the fish cage (00CC), approximately 1 hour before feeding (A) and three hours after feeding (B). The first ring of sampling sites was 6 m from the centre (00N1, 0EN1, 0ES1, 00S1, 0WS1, 0WN1), and the second was 20 m away (00N2, 0EN2, 0ES2, 00S2, 0WS2, 0WN2). In addition, we sampled at sites on the profile from the centre of fish cage outwards: 00CC, 6 m (00N1), 20 m (00N2), 1166 m (ZBMA) and 6825 m (ZC0B). Using HPLC (High performance liquid chromatography) pigment analysis we determined the phytoplankton community structure. Photosynthetic pigments have proved to be useful biomarkers of the abundance, composition and physiological status of the phytoplankton biomass in the marine environment although they cannot be considered to be fully specific diagnostic markers of individual phylogenetic groups of phytoplankton.

Results
Comparing the pigment fingerprints in the fish farm area before and after feeding we observed only minor differences in pigment concentrations and the phytoplankton groups contribution to the total biomass. The main phytoplankton group were diatoms (66.3 - 77.9 %) followed by Primnesiophytes (13.7 - 21.2 %). The phytoplankton biomass in the centre of fish cage expressed in chlorophyll *a* concentration was 1.06 m μg l^{-1} before the feeding and 1.57 μg l^{-1} 3 hours after the feeding. In the area 6 m from the centre the concentration was 1.03±0.09 μg l^{-1}, and 20 m away 1.24±0.12 μg l^{-1}. But we noticed differences in the profile from the centre of the fish cage outward, most of all in the decrease in the chlorophyll *a* degradation products concentration. The highest concentration of chlorophyll *a* degradation products was measured 6 m (00N1) from the centre of the fish cage, 20 m from the centre (00N2) was a little bit lower and the decline in the direction outward from the fish cage (ZBMA, ZC0B) was nicely expressed (Fig. 1).
The main part of the concentration of chlorophyll *a* degradation products was due to concentrations of chlorophyllide *a* and pheophorbide a_1. A similar trend was also observed for pheophorbide a_2 but here the concentrations were very low. Chlorophyll *a* degradation products are good indicators of the physiological state of phytoplankton and show that fish farming influences the phytoplankton population in a negative way. Three hours after feeding we observed changes in nutrient concentrations. An increase of $PO_4{}^{3-}$ (from 0.08±0.03 mol l^{-1} to 0.14±0.04 mol l^{-1}), $NH_4{}^{+}$ (from 0.58±0.08 mol l^{-1} to 0.72±0.15 mol l^{-1}) and P_{tot} (from 0.29±0.03 mol l^{-1} to 0.35±0.01 mol l^{-1}) concentrations was measured, while the concentration of $SiO_4{}^{4-}$ decreased (from 5.55±3.02 mol l^{-1} to 2.29±1.81 mol l^{-1}).

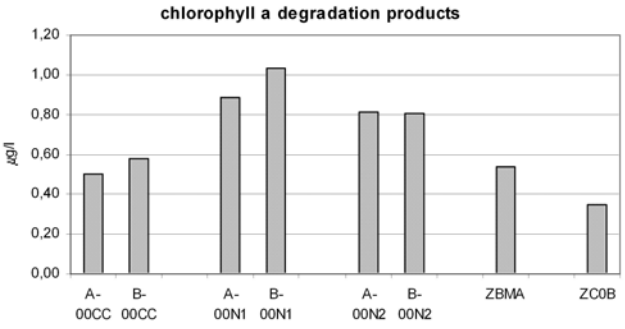

Fig. 1. The distribution of chlorophyll *a* degradation products concentration along the transect from the centre of the fish farm towards open waters.

Discussion and Conclusions
We noticed the influence of fish farming on the environment first of all from higher concentrations of chlorophyll *a* degradation products in the fish farm area. Measured values of two indicators of the trophic state, F_p ratio [2] and the trophic index TRIX [3], were higher in the fish farm area compared to the control site [4] showing again an influence of the fish farm on the environment. This was more significant during the period of a homogeneous water column [4]. Three hours are not enough to detect changes in the phytoplankton community due to the input of organic and inorganic matter. And, in addition, this is an open system with normal diurnal migrations of phytoplankton, and current influence that are possible causes of changes in phytoplankton community composition.

References

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