THE APPLICATION OF ULTRASOUND AS CAGE ANTIFOULING METHOD AND ITS IMPACT ON EUROPEAN SEA BASS, *DICENTRARCHUS LABRAX*

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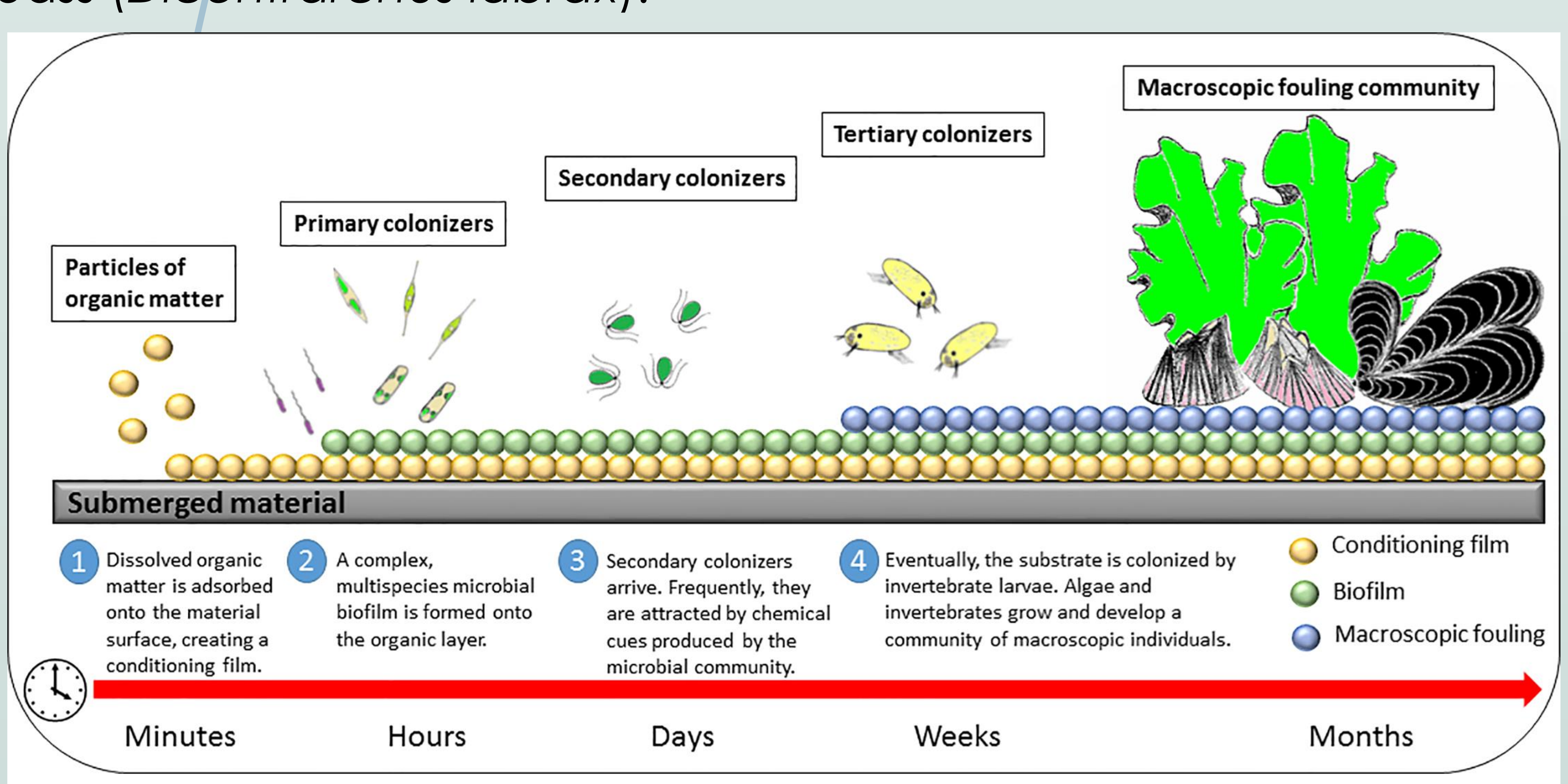
Introduction

Aquaculture faces a major issue to reach its full potential, due to biofouling, which is affecting products quality, quantity and environment- labor- equipment integrity. According to market experts, current treatment measures represents from 10 to 20% of farm exploitation costs. This study aims to prevent micro-fouling layers apparition on offshore aquaculture fish farm cage nets with ultrasonic (US) waves to increase not only the aquaculture productivity and operational efficiency but also to verify the implementation and performance in the field. Knowledge about the impact of US application on fish growth, feeding behavior and health will facilitate the adoption of this technology. In this study, we determined and defined the maximum level of power and frequency after an adequate trial period with US to get the most effective anti-fouling system without harming the commercially important European sea bass (*Dicentrarchus labrax*).



Representation of the biofouling process (Martín-Rodríguez, A.J., *et al*., PLOS ONE, 2015. **10**(4): p. e0123652)

Methods

Field trial 1: conducted in offshore mini-cages (diameter: 3 m, depth: 5 m) without fish.

Goals: 1)cost-effect analysis of US treatment; 2) evaluate biofilm formation for 1-month under full continuous ultrasound signaling and pulse/intermittent fire; 3) evaluate effectivity as anti-biofouling on cage nets.

Field trial 2: conducted in offshore cage system (diameter: 20 m, depth: 8 m, stocking density: 30.000 to 50.000 fish) with various (full-fire/intermittent fire) configurations.

Goals: 1) evaluate effectivity as anti-biofouling on cage nets, 2), assessment of impact on fish (mortality / behavior).

Field trial 3: will be conducted in operational cages (diameter: 30 m, depth: 20 m, stocking density: >50.000) with US treatment (fixed frequency and operational mode full or pulsed fire selected from previous trials.

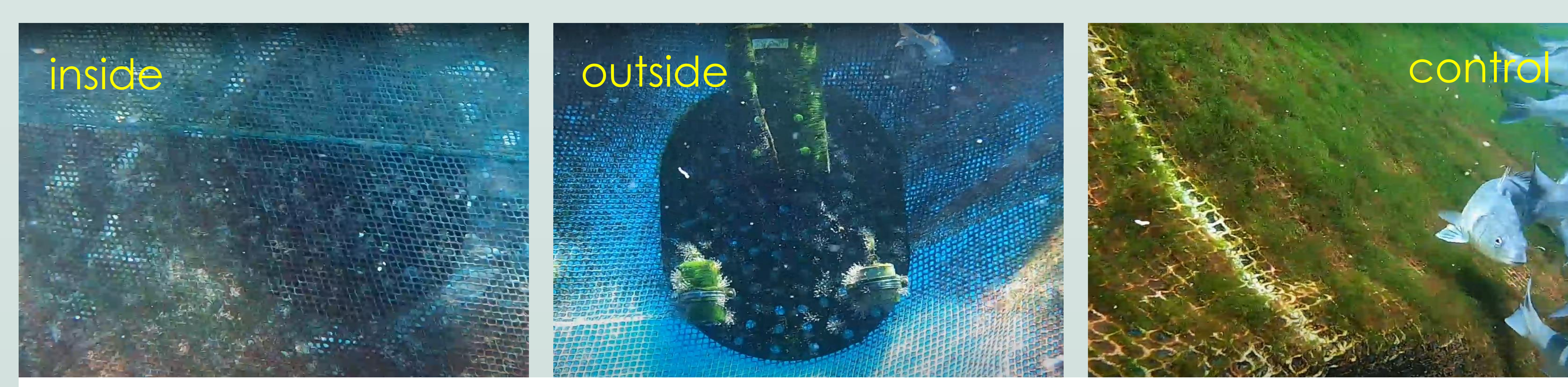
Goals: 1) impact on animal welfare with sampling at d0; before US application, and after 7, 30, 60 and 90 days of continuous application.

Results

Field trial 1: offered an initial glance on the impact of different frequencies on biofilm formation on the mini-cages and allowed improvements in terms of transducers position

Field trial (2) showed that algae do not grow near the transducers and high frequency transducers are more effective for preventing biofouling. No stress response was observed on the fish during US application. Improvements on system set up (power and performance) still required.

Expected results of Field Trial 3: Innocuity frontiers for US application being tested under commercial production conditions. Standardized US application to prevent biofouling on rearing cages of offshore farms. Background information on stress response to be extended to other commercially important species and to different size/age cohorts.



View of the inducers from the inside and outside of the ultrasound treated nets compared to control (pictures by Murat Arıkut)

Commercial offshore cage nets used for the trial (pictures by Murat Arıkut)

View of the controlling device for the inducers and the AWI Team during sampling (pictures by Murat Arıkut)

Acknowledgements

Authors would like to thank the immense support of Luisa Buße, Pinar Akdurak, Jakiul Islam, and the staff of the Fish Farm AKVATEK and Ege University, Faculty of Fisheries. This study is part of the project "Smart System for the Prevention of Biofouling on Aquaculture NETs by Ultrasonic Wave Technology" (NetWave), and it has received funding from the European Union's H2020-EIC-FTI-2018-2020 program under grant agreement no. 958776

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Introduction

Aquaculture faces a major issue to reach its full potential, due to biofouling, which is affecting products quality, quantity and environment- labour- equipment integrity. According to market experts, current treatment measures represents from 10 to 20% of farm exploitation costs (costs of chemicals, nets cleaning and repair, and fish escapees). Therefore, this study aims to prevent micro-fouling layers apparition on offshore aquaculture fish farm cage nets with ultrasonic (US) waves to increase not only the aquaculture productivity and operational efficiency but also to verify the implementation and performance in the field. However, there is a lack of knowledge about the effects of applying US on fish growth, feeding behavior and health. Therefore, in order to facilitate the adoption of the system, the innocuity of the technology on fish's welfare and health has to be evaluated. In this study, we determined and defined the maximum level of power and frequency after an adequate trial period with US to get the most effective anti-fouling system without harming the commercially important European sea bass (*Dicentrarchus labrax*).

Material and Methods

Field trial (1) was conducted in an offshore mini-cage system (one test and one control cage; diameter: 3 m, depth: 5 m) without fish and the effectivity of US treatment was measured by video recording of the cages to evaluate biofilm formation for 1-month. Full (continuous ultrasound signaling) and pulse/intermittent fire were tested in order to observe the power consumption and its effectivity on the algal accumulation on cage nets. Both cages were installed nearby the Barge at the offshore fish farm.

Field trial (2) was conducted in an offshore cage system (one test and one control cage; diameter: 20 m, depth: 8 m, stocking density: 30.000 to 50.000 fish) with various (full-fire/intermittent fire) configurations. The effectivity of US treatment was measured by video recording of the cages to evaluate and compare biofilm formation after 1-month. In addition, fish mortality and behaviour (feed intake, swimming behaviour) as stress marker were observed in order to select the best frequencies and power.

Field trial (3) will be conducted in operational cages (two test and two control cages; diameter: 30 m, depth: 20 m, stocking density: >50.000) with US treatment (fixed frequency and operational mode full or pulsed fire will selected after analysing the Field trial (2) assay). In order to evaluate the effect of a specific power/treatment configuration on full or pulse fire on feed intake, growth and health of European sea bass, five sampling will be performed at the offshore fish farm. These are initial sampling (d0; before US application, d2: two days after US application, d32, d62, d92: one-month interval between sampling). For the impact on feed intake and growth: weight, length, FCR, feeding behavior; for the impact on health and stress response: histological studies on skin, liver and gills, Cortisol level, LDH, Glucose, Na+, K+, Cl- ions in blood, and additionally skin mucus, blood smears, haematocrit levels and gene expression in skin, liver and gills will be analysed.

Results and Discussion

Results from the preliminary Field trial (1) offer an initial glance on the impact of different levels of frequencies on the accumulation of algae on mini-cage nets. Hereby, enhancing the wave density with close proximity positioning of the transducers exhibits clearly the highest impact area thus confirming that the placement and combination of transducers induced the most effective during 1-month of trial. Field trial (2) showed that algae do not grow near the transducers and high frequency transducers have more impact for preventing the anti-fouling on the cages compare to low frequency transducers. However, the system set up needs to improve power and performance to reduce algae growth on the whole area of the cages. Nevertheless, no stress response was observed on fish feeding and behavior during the US application.

Final results are pending! However, we expect that the US application being tested for preventing of anti-fouling will be new to the aquaculture industry, and can be implemented as a standardized application in offshore fish farms. However, as stress response can be observed in different levels in different fish species, the end product should be tested in other commercially important species as well in order to proof the safeness of system and tune fine it for each species and condition.

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