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SUSPENDED BIOFILTERS: SUCCESSION OF FOULING COMMUNITIES IMMEDIATELY ADJACENT TO A FISH CAGE AND CONTROL LOCATION

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ABSTRACT

Biofouling succession on the suspended artificial surfaces was studied in the Bay of Piran (northern Adriatic) near a fish farm and at the control location. The novel fouling community was analysed qualitatively and quantitatively. Initially, benthic Algae colonized the artificial surfaces and dominated fouling community near the fish cage; Algae, Bryozoa and Hydroidea prevailed on control site surfaces. Later succession-settlers were mostly suspension-feeders (hydroids, bivalves, polychaete worms, bryozoans, ascidians), which occupied the artificial surfaces on both sites. After five months, the surfaces were overgrown predominantly by the bryozoan Schizobrachiella sanguinea, *which was later replaced by the serpulid polychaetes (mainly* Serpula vermicularis*).*

Key words: biofouling, successions, fish farm, Adriatic Sea

BIOFILTRI SOSPESI: SUCCESSIONI DI COMUNITÀ DI FOULING IMMEDIATAMENTE ADIACENTI GABBIE DI PESCI E SITI DI CONTROLLO

SINTESI

Nella baia di Pirano (Adriatico settentrionale) sono state studiate successioni di bio-fouling su superifici artificiali sospese in prossimità di un allevamento di pesci e di un sito di controllo. Le neo-comunità di fouling sono state analizzate sia qualitativamente che quantitativamente. Durante un primo stadio alghe bentoniche hanno colonizzato le superfici artificiali e dominato la comunità del fouling prossima alla gabbia di pesci. Sulle superfici del sito di controllo sono prevalsi alghe, briozoi ed idrozoi. In fasi successive le superfici di entrambi i siti sono state colonizzate da organismi filtratori (idrozoi, bivalvi, policheti vermiformi, briozoi, ascidiacei). Dopo cinque mesi le superfici erano ricoperte in prevalenza dal briozoo Schizobrachiella sanguinea, *successivamente sostituito da policheti serpulidi (principalmente* Serpula vermicularis*).*

Parole chiave: bio-fouling, successioni, allevamento di pesci, Mare Adriatico

INTRODUCTION

As a rule, pollution originating from open water fish farming exceeds the local purifying capacity of the marine environment. Several solutions were proposed to reduce fish farm impacts and to enhance the auto-purifying capacity of the sea, such as deployment of artificial reefs (review in Spanier & Angel, 1999; Angel, 2001; Black et al., 2001; Hughes, 2001).

To provide surface for bio-fouling community that would enhance natural uptake of the fish farm wastes we deployed suspended artificial structures near fish cages in the moderately eutrophic Bay of Piran (northern Adriatic). Attached flora and fauna are assumed to utilise dissolved and particulate wastes released by farmed fish depending on the structure of the fouling community. Therefore, a study was carried out on succession of fouling communities on suspended structures in the immediate vicinity of fish cages compared to control location.

MATERIALS AND METHODS

Our study was conducted in the Bay of Piran (see figure 1 in Malačič & Forte, *this volume)* where two fish farms produce about 100 tons of European seabass *(Morone labrax)* and gilthead seabream *(Sparus auratus)* annually. The artificial structures consist of plastic mesh (2 x 2 cm openings) rolled into cylindrical bio-filters (BFs) with a total surface of 0.5 m^2, supporting the frames, floats and anchor weights (Plate I: Fig. 2). We deployed four arrays consisting of 11 BFs at each location (close to fish farm and control) (Plate I: Fig. 1) at depths ranging from 5 to 11 m. Field surveys of BF and removal for laboratory analysis were carried out 3-4 times yearly from 2001 to 2003. BFs were photographed under water and then removed for further laboratory analysis consisting of taxonomic analysis of fouling community, wet and dry mass measurements, including carbon and nitrogen contents.

RESULTS AND DISCUSSION

Artificial structures were located in the photic zone and the initial colonisation after a monthly immersion of BFs was dominated by autotrophs at both, fish cage and control site. The main taxa were algae (6 species of Chlorophyceae and Rhodophyceae) and diatoms, embedded in mucilage. Fouling fauna was represented by small bryozoan colonies (1 species), Hydroidea (3 species) and Bivalvia. On average, 38% (38.3±1.2) of BFs surface was covered by fouling organisms at fish farm site compared to significantly higher coverage (73.3±7.2) on the control site. Algal fouling prevailed on fish farm site (22.5±2.0% of total surface) compared to 8.3±3.1% on the control site, where hydroids (49.2±3.1) and bryozoans (15.8±1.2%) dominated the early colonisation (Plate I: Figs 6a, 6b).

Algae covered, on average, 29.1±6.8 and 9.5±4.4% of BFs surface at fish farm and control locations, respectively, after three months of the BFs immersion. BFs were nearly completely overgrown with fouling communities: 94.1±2.0% coverage was observed at fish farm and 95.0±1.8 on the control site. Fouling fauna was still dominated by hydroids and bryozoans, the latter covering 35.9±9.0 and 67.2±10.2% of BFs surface at fish farm and control locations, respectively.

Algae coverage decreased to 13.4±4.2 and 1.2±1.5 % (fish farm and control site) after five months of immersion, while macrofauna, now consisting of 6 main sedentary groups (Hydroidea, Cirripedia, Ascidiacea, Bivalvia, Polychaeta, Bryozoa) prevailed. However, only one bryozoan species *Schizobrachiella sanguinea* covered over 80% of BFs surface at both localities. Nearly 2 years after the immersion of BFs, serpulid polychaetes, mostly *Serpula vermicularis*, dominated fouling communities at both localities.

Vagile fauna, associated with BFs, was less important and included mainly Crustacea (Amphipoda, Gammaridea, Decapoda, Anisopoda), motile Polychaeta and opistobranch molluscs.

A total of 38 sedentary taxa were identified over the experimental period (nearly 2 years) attached to BFs, of which 26 were common to both localities (Tab. 1). More taxa were registered at fish farm (36) than on control site (28) (Plate II: Figs 12, 13).

Described pattern of colonisation of BFs generally conforms to the successions on artificial substrates observed in other studies in the northern Adriatic (Bressan, 2001) and elsewhere (Cook, 2001). The only exception was the low abundance of mussels and barnacles that seemed to be unsuccessful settlers on BFs.

CONCLUSIONS

The initial 5 months after BFs deployment were characterised by macro algae (Chlorophyceae, Rhodophyceae) settlement that covered comparatively larger surfaces on bio-filters deployed near the fish cage. Hydrozoans and Bryozoa were also successful colonisers of BFs during this initial stage, particularly bryozoan *Schizobrachiella sanguinea* outcompeted other species for space. Serpulid polychaetes dominated the fouling community at both localities after over a year of immersion.

Similar taxa developed at fish farm and control localities but number of taxa recorded on bio-filters deployed on fish farm site was higher, indicating that the enriched environment enhanced the settlement of various organisms.

Tab. 1: Taxonomic structure of flora & sedentary fauna of bio-filter fouling communities at fish farm and at control site between 2001 and 2003.

Taxa	Fish farm	Control site
Algae		
Enteromorpha sp.	+	+
Cladophora sp.	+	-
Antithamnion sp.	+	+
Polysiphonia sp.	+	+
Ceramium sp.	+	+
Champia sp.	-	+
FAUNA		
Spongiaria spp.	+	-
Hydroidea		
Obelia geniculata	+	+
Campanopsis sp.	+	+
Kirchenpaueria sp.	+	+
Eudendrium sp.	+	+
Gonothyraea sp.	+	-
Bivalvia		
Chlamys multistriata	+	+
Chlamys varius	+	+
Hiatella arctica	+	+
Barbatia barbata	+	-
Mytilus galloprovincialis	+	+
Ostrea edulis	+	+
Anomia ephippium	+	+
Pericardium sp.	+	-

Tab. 1: Taksonomska struktura flore in sesilne favne v združbi obrasti na biofiltrih ob ribogojnici in na kontrolni postaji v obdobju 2001-03.

Taxa	Fish farm	Control site
Polychaeta		
Serpula vermicularis	+	+
Pomatoceros triqueter	+	+
Hydroides helmatus	+	-
Mercierella enigmatica	+	+
Spirorbis pagenstecheri	+	+
Salmacina incrustans	+	-
Polydora sp.	+	-
Cirripedia		
Balanus balanus	+	+
Bryozoa		
Adeona haeckeli	+	-
Bugula neritina	+	+
Lichenopora radiata	+	+
Schizobrachiella sanguinea	+	+
Tubulipora sp.	+	-
Ascidiacea		
Styela plicata	+	
Polycarpa pomaria	+	+
Botryllus schlosseri	+	+
Microcosmus vulgaris	+	+
Ascidiella aspersa	+	+
Phallusia sp.	-	+

SUKCESIJE ZDRUŽB OBRASTI NA LEBDEČIH BIOFILTRIH V NEPOSREDNI BLIŽINI RIBOGOJNICE IN NA KONTROLNI LOKACIJI

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POVZETEK

V obdobju 2001-2003 smo v Piranskem zalivu raziskovali sukcesije biološke obrasti na lebdečem umetnem substratu plastičnih mrež (biofiltrih) v neposredni bližini ribogojnice in na kontrolni lokaciji. Prvi naseljenci so bile bentoške alge (predvsem ob ribogojnici) in hidroidi (predvsem na kontrolni postaji). Poznejše sukcesije združb obrasti obeh lokacij je oblikovala zlasti suspenziofaga sedentarna favna školjk, polihetnih črvov, hidroidov, mahovnjakov in kozolnjakov. Po petih mesecih so prevladali mahovnjaki vrste Schizobrachiella sanguinea, *po skoraj dveh letihi pa polihetni črvi* (Serpula vermicularis).

Ključne besede: obrast, sukcesije, ribogojnica, Jadransko morje

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