

EFFECTS OF SEWAGE DISCHARGES ON COASTAL FISH ASSEMBLAGES IN MALTA, STRAIT OF SICILY, MEDITERRANEAN SEA

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Abstract

This paper presents the preliminary results of the effects of sewage pollution on a shallow fish community along the NW coasts of Malta (Sicily strait, Mediterranean sea). Clear differences in the abundance, structure and composition of fish assemblages were highlighted by means of univariate and multivariate analyses. At the sewage outfalls, the decline in species richness testified the severity of the impact, moreover the great increase of two benthic fishes gave evidence of enduring alteration in the fish community.

Keywords : Fishes, Sewage Pollution, Sicilian Channel.

Introduction

Sewage discharges are known to have profound effects on diversity, abundance and structure of Mediterranean coastal fish communities [1,2]. To assess these effects, "BACI" designs (Before-after control-impact) are the ideal tools but often the "before impact" data are missing and "after" study are the only way to detect some aspects of disturbance. Our purposes were to assess the effects of two sewage outfalls on the rocky-reef fish community along the NW coast of Malta.

Materials and Methods

Underwater visual censuses were performed, between 5 and 8m of depth, at fixed point of a standard surface of 25m²[2]. This technique was chosen among the available visual methods as the most appropriate in highly heterogeneous substrata. Surveys were carried out at four locations on the NW Maltese coasts: two putatively disturbed locations (where the outfalls directly discharge waste waters on the coastline) and two controls. At each location, four sites were randomly selected and four repeated censuses were performed. Abundance data were analyzed by means of univariate (one-way ANOVA) and multivariate (nMDS, PERMANOVA and SIMPER) procedures. Based on the null-hypothesis that there are no differences between disturbed and control areas, a PERMANOVA design was created on two factors (Disturb, fixed with two levels and Site, random nested in Disturb with four levels).

Results

Overall 41 fish taxa were identified. The nMDS plot (Fig. 1) showed a good separation (Stress = 0.18) between fish counts at disturbed (D) and control (C) sites. A symmetrical PERMANOVA (Table 1) provided evidences for significant differences both for factor Disturb and for Location.

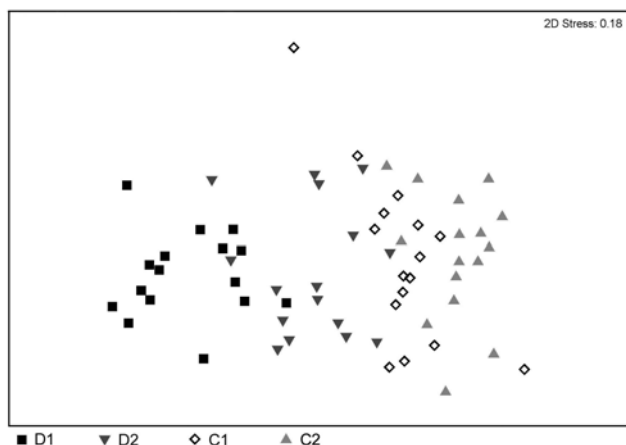


Fig. 1. Non-metric Multidimensional Scaling (nMDS) ordination plot comparing fish assemblages from sewage-disturbed locations (D1 and D2) and control (C1 and C2) locations. Centroids of single sites are represented.

According to SIMPER procedure, the average dissimilarity between the two groups was 78%. *Gobius bucchichi* and *Parablennius rouxi* were the most typifying species in disturbed locations, whilst *Oblada melanura* and *Symphodus roissali* contributed mostly to the similarity of the controls. One-way ANOVA detected significant differences in species richness and total abundance between the two groups. Total abundance resulted higher in D than at C whilst species richness showed the opposite pattern. Significant differences also occurred among single locations.

Tab. 1. PERMANOVA based on the Bray-Curtis dissimilarities of log (x+1) transformed data (41 taxa).

Source	df	SS	MS	Pseudo-F	P(perm)	perms
Disturb	1	40553	40553	4.1845	0.027	999
Location (Disturb)	2	19383	9691.3	6.7969	0.001	999
Res	60	85526	1425.4			
Total	63	1.4546E5				

Discussion

The present study provided evidence that the two sewage outfalls affect assemblage structure and fish abundances. According to the few studies which dealt with the sewage impact on Mediterranean fish communities [1,2], these changes may be mostly ascribable to the increase of nutrients and particulate organic matter due to the outfalls. At moderate levels, this enrichment can influence the fish assemblage by attracting gregarious and planktivorous fishes and our results showed a small but significant increase of the abundances of these species (e.g. *Chromis chromis* and *O. melanura*). However, the most striking differences were related to the decline in species richness which usually reflects a severe impact on fish community [1]. Fishes such as the labrids *Symphodus spp.*, *Thalassoma pavo* and the scarid *Sparisoma cretense* resulted to be particularly affected by the sewage. Some ecological requirements of these species were probably not satisfied in the polluted areas, e.g. food availability and nesting grounds.

At the disturbed locations, the high abundance of *G. bucchichi* and *P. rouxi* resulted to be remarkable. In fact, the mobility of these benthic fishes is minimal and they are reliable indicators of the effect of different levels of sewage impact [1]. To conclude our results highlighted profound alterations to the marine environment caused by the sewage outfalls. Given the reasonable inconceivability of these sources of pollutions with the need of environmental protection and tourist activities, appropriate measures should be taken, in accordance with the current guidelines.

References

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