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Marine plastic litter as an artificial hard bottom fouling ground

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ABSTRACT: 20 fouling organisms were observed on plastic litter dredged from the Elbe estuary during July 1990; 60 % of the species were typical sessile hard bottom organisms. Most individuals found on this artificial hard bottom were barnacles *(Balanus crenatus, Elminius modestus)*, the mussel *Mytilus edulis* and the polychaete *Lanice conchilega*. All individuals were juveniles which had settled only recently on the plastics. The earliest settlers were not much older than 4–8 weeks.

INTRODUCTION

In the past thirty years, the use of plastics and other synthetic materials has expanded at a rapid pace. Pollution by plastics in the marine environment is well documented (Carpenter & Smith, 1972; Carpenter et al., 1972; Colton et al., 1974; Shiber, 1979; Shaw & Maps, 1979; Morris, 1980; Horsman, 1982; Dixon & Dixon, 1983). Plastics constituted 75 % of the items found during a survey of the garbage on Helgoland beaches (Vauk & Schrey, 1987). This accumulation of plastic debris poses increasingly significant threats to marine mammals, seabirds, turtles, fish and crustaceans (Anonymous, 1975; Laist, 1987). The influence of garbage on the biocenoses in coastal areas and the sea-bottom has been evaluated only by Klausewitz (1984). No information is available on the enhancement of sessile hard bottom organisms in the soft bottom environment due to these new fouling grounds.

MATERIALS AND METHODS

During a benthic survey in the Elbe estuary (German Bight, North Sea) in July 1990, plastic material was dredged by accident. These items – 8 plastic sheets and two plastic beakers – were collected, and the fouling community on a 200 cm^2 area was analysed alive under a dissecting microscope. Size measurements (barnacles: length of base along the rostro-carinal axis; mussel: length axis) were performed by a calibrated ocular micrometer.

RESULTS

A total of 20 species was found on the plastic material (Table 1). No major differences were found between the different plastic foils and the two plastic cups. The species found were all juveniles; therefore, some could not be determined to species level. The most common species were barnacles (*Balanus crenatus* and *Elminius modestus*), the mollusc

Table 1. Species and number of individuals (numbers in brackets: dead individuals; * 1–10, ** 11–50 colonies) settling on 200 cm^2 of different plastic materials: A–E (A: aluminium covered plastic; B_{1-2}: white plastic foils; C_{1-4}: transparent plastic foils; D: transparent but muddy plastic foil; E_{1-2}: white plastic cups)

Species	No. of individuals on different plastics									
	A	B_1	B_2	C_1	C_2	C_3	C_4	D	E_1	E_2
Mytilus edulis	3	3	5	10	2	9	3		1	3
Balanus crenatus	31 (7)		3	29 (5)	13	24 (6)	3	2 (2)	1	37 (3)
Elminius modestus	7		4	13	12	7	3	50		8
Lanice conchilega	3		1	8	1	3	7	1		
Polydora hermaphroditica	3									
Polydora giardi	3									
Polydora sp.	1					1				
Autolytus sp.	2									
Anaitides maculata				1		4				
indeterminable Spionidae						1				
indeterminable Eusyllinae							2			
Elektra pilosa					*		*			
Membranipora membranacea						**	*			
Bowerbankia sp.					*					
Perigonius repens					*			*		
Tubularia larynx									2	
Laomedea flexuosa						*				
juvenile Anthozoa					4			1		
Corophium insidosum		9	15							
brown crustose algae								*		
green crustose algae							*			

Mytilus edulis and the polychaete *Lanice conchilega*. All other species occurred only occasionally and in low numbers on some of the samples. The size distribution, as sum of all measured individuals, is given in Figure 1 for the two barnacle species as well as for *M. edulis*. *B. crenatus* and *E. modestus* reached a maximum size of 6 and 5 mm, respectively. Most individuals had settled only recently, having sizes of 1.0 and 0.5 mm, respectively. *M. edulis* had a maximum size of 3 mm, but most individuals were between 0.5–1.5 mm in size.

DISCUSSION

Apart from the fact that plastic objects are spoiling beaches in an aesthetic sense (Dixon & Cooke, 1977), they also constitute a hazard to man and wildlife (Anonymous, 1975; Laist, 1987). This preliminary survey shows that plastic foils are also, apparently, an acceptable settling ground for a variety of marine benthic organisms. 60 % of the species found on the plastic material are known to be typical sessile hard bottom species. The most common settlers were barnacles and *Mytilus edulis*, but also Bryozoa and Hydrozoa had settled successfully on the plastic foils. The size distribution of the three dominant species gives evidence that the plastics had been mainly settled during the past few weeks. Recently settled juveniles of the barnacle species are normally between 1–1.5 and 0.5–1.0 mm in size, respectively (Pyefinch, 1948; Barnes & Barnes, 1962; Harms, 1982).

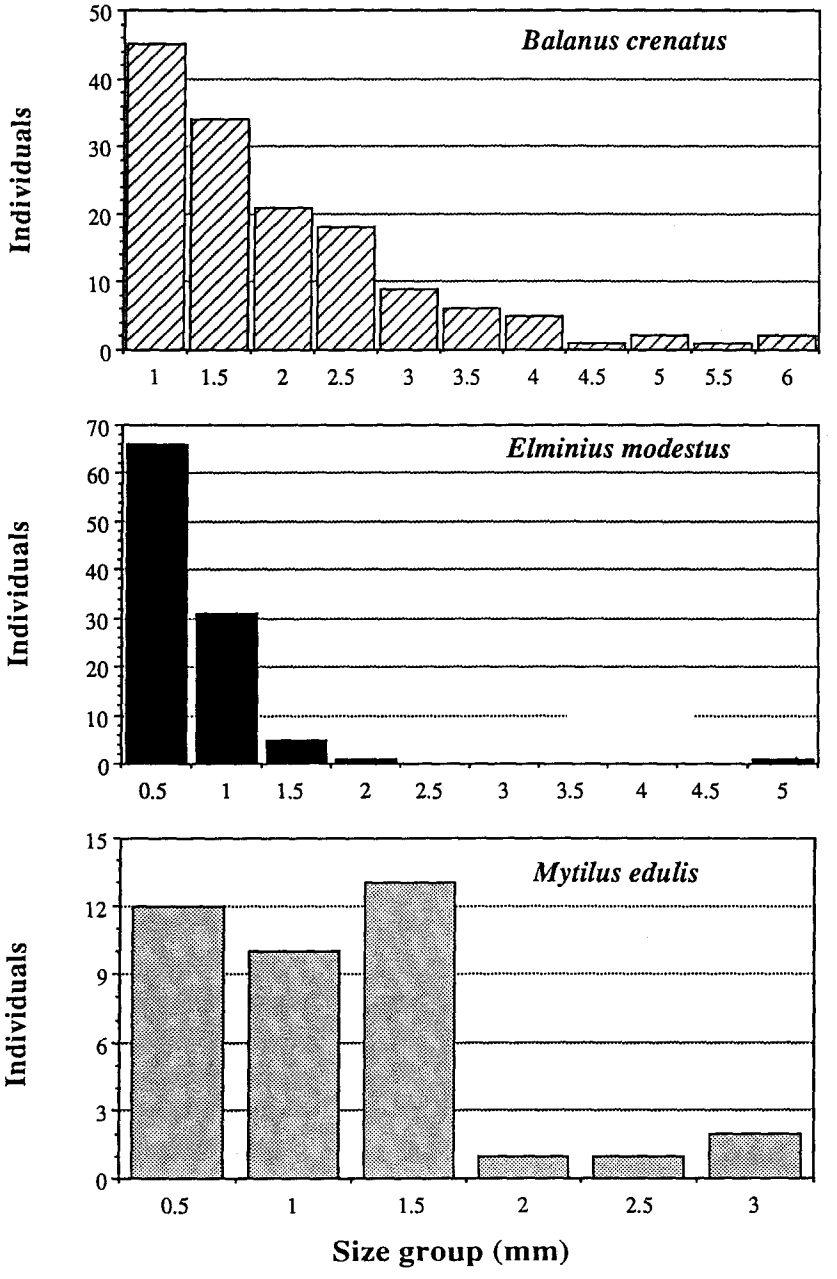

Fig. 1. Size distribution, expressed as the sum of all measured individuals, of *Balanus crenatus*, *Elminius modestus* and *Mytilus edulis* settling on the examined marine plastic litter

The few larger barnacles show that settlement must have started some weeks before. Pyefinch (1948) suggests that *Balanus crenatus* reached a size of 5–6 mm after about 3 months, whereas Harms (1982) reported this size for *B. crenatus* on 8 week-old fouling plates. *Elminius modestus* grows to a length of 5 mm after ca 4 weeks (Anger, 1978; Harms, 1982). Most individuals of *M. edulis* belong to the size group of spat fall (0.5–1.0 mm), so that their colonisation must have taken place only recently (Chalmer, 1982). No information is available on the stability of the fouling communities on these plastic foils that drift on the bottom. To evaluate the importance of these artificial hard bottom substrates, future work should focus on the reproductive success of such fouling organisms.

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