

Offshore Buoy Fouling in the Ligurian Sea

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Due to the scarcity of available data on Mediterranean fouling far from the coast, we believe it would be useful to report on some observations carried out on ODA5 1 buoy (Oceanographic data acquisition system), which in January 1987 was positioned about 30 nautical miles off the coast at Genoa (43° 50' 19" N, 09° 06' 24" E) and moored on a bottom at 1100 m. The buoy is a 42 m long cylinder, 80 cm in diameter, with three flanged rings along the axis and a stabilizing disk at its end. Another reason for studying this buoy was the reported presence of a large amount of mussels when the buoy was recovered at the end of 1986 because of maintenance. The study begun in the summer of 1987 using observations, samples and photographs made by scuba-divers. Despite very strong currents that made diving and sampling operations difficult to carry out, till February 1990, fifteen dives and three samplings (table 1) were effected. The fouling settled in particular at the end of 1989 is described, while other reports deals with the mussels' population development. Settlement near the surface is poor on account of breaking action of waves. There are small green algae and amphipod *Caprella andreae* Mayer; in this area limpets (*Patella caerulea* L., *Patella aspera* var. *tarentina*) Lam. and cirripeds *Lepas anatifera* L., *L. pectinata* Spengler e *L. hillii* (Leach) have been found. At the following depths Amphipoda become dominant. At 3 m Caprellids and *Jassa marmorata* Holmes cover almost all the available surface. Below 3 m some sea-urchins *Arbacia lixula* (L.) and *Paracentrotus lividus* Lamarck, and some bivalves *Hiatella rugosa* (Pennant) were found.

At 6 m depth flanged ring was covered by mussel byssus residuals and brown algae *Ectocarpus siliculosus* (Dyllwyn) Lyngbye. *M. galloprovincialis* Lam., were unfortunately removed in large numbers by unknown people in the summer of 1989. In summer in these first meters of depth the green algae *Enteromorpha compressa* (L.) Greville, *E. intestinalis* (L.) Link, *E. prolifera* (Muller) J. Agardh ssp. *prolifera* were present.

Below 6 m depth the compound ascidian *Diplosoma listerianum* (Milne-Edwards H.) became dominant in most part of the fouling community, which was composed by *Anomia ephippium* L., brown algae and Caprellid amphipod, the latter decreasing in number with depth. At -15 m the second flanged ring formed an area, which was highly settled by mussels. Hydroids (*Bougainvillia ramosa* Van Beneden and *Onchia siphonoma* L.) occurred mainly in winter; they were more abundant and larger at deeper sites.

From 15 m downwards algal cover decreased considerably, leaving space to Didemnidae, which together with serpulids *Pomatoceros triquetus* (L.), *Spirobranchus polytrema* (Philippi), *Semivermilia cribrata* (O.G. Costa) become the dominant organisms. Few well-developed mussels and some small sea-anemones were also present. At 20-25m specimens of *Echinus acutus* Lam. and *Lima lima* (L.) were sampled. Other members of the fouling community were hydroids, bryozoans like *Aetea* sp., and sea-anemones of various species and sizes. The nudibranchs of genus *Eubranchus* and the gastropod *Lamellaria perspicua* (L.) were also collected.

The ring at 30 m was still heavily settled by mussels, other members of the community were a great number of hydroids and sea-anemones of various species and sizes (which are still under study), bivalves, among which the most frequent were *A. ephippium*, *H. rugosa* and small specimens of *Chlamys*. Among the mussels sampled at this depth Decapoda Crustacean *Pilumnus hirtellus* (L.), *P. villosissimus* (Rafinesque) and *Athanas nitescens* (Leach) were found several times.

Below 30 m some particular colourful organisms were observed, including large-sized pink sea-anemones, some specimens of *Spirographis spallanzanii* Viviani and a colony of *Alcyonium palmatum*.

The stabilizing disk on the upper surface was completely covered with bivalves. In July 1988, *Aequipecten opercularis* (L.), *Clamys varia* (L.), *Chlamys bistriata* (Poli), *Pecten jacobaeus* (L.), *Falliolum incomparabile* (Risso), *Pseudamysium clavatum* (Poli) were dominant over the mussels. A year later (August 1989) the mussels had exceeded them in terms of biomass. Other bivalves *Pteria hirundo* (L.), *H. rugosa* and *Musculus subpictus* (Contraire) occurred.

In Table 1 some wet-weight values are recorded; the minimum amount of fouling occurred at 3 m, the maximum at 36 m with about 25 Kg/m².

date	depth	wet-weight	g/dm ²	dominant organisms
22.7.88	6 m	210 g	52.5	M, GA, A
	12 m	430 g	107.5	M, As, A
	25 m	360 g	90.0	M, As, A, E.
9.12.88	3 m	65 g	16.2	A, O, D
	6 m	565 g	141.2	M, A
	12 m	440 g	110.0	M, D
	30 m	845 g	211.2	M, O, As
6.8.89	36 m	1000 g	250.0	M, P, O
	6 m	spoiled	---	Byssus
	12 m	720 g	180.0	M, S, B, O
	30 m	440 g	110.0	M, S, D, B
	39 m	680 g	170.0	M, O, P, S

M = Mussels GA = Green Algae A = Amphipoda
O = Other Bivalves As = Ascidians
P = Polychaets S = Serpulids B = Bryozoans

Bellan Santini et al. (1970) described fouling settled on panels immersed up to 4 year from 47 m to 830 m depth off Nice.

Talxon-Lukalna et al. (1977) have described some Cirripeds on buoy and different floating materials immersed in the Sicily Channel only during 23 days. Because of so different experimental conditions of the above works it is impossible a comparison with our data.

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Molluscs in Offshore Fouling at Ravenna and Crotona

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Fouling of some offshore platforms situated in the North Adriatic (Ravenna 0-20 m) and Ionian Sea (Crotona 0-65 m) was investigated several years ago by direct observations, sampling, and panels immersed for periods of 1 to 12 months. The immersion technique and the characteristics of fouling at two localities have been reported previously (RELINI et al., 1976).

The list of Bivalve Molluscs found on the AGO A and PCWA platforms at Ravenna and the LUNA A platform at Crotona is recorded in Table 1. Among ten species, seven were found at both the localities, two species indicated with * in Table 1 were not found on the panels but on platform structures. Among Gasteropods *Hinia reticulata* (L.) was common at Ravenna while some Nudibranch *Facelina* sp. and *Flabellina* sp. were recorded at both sites.

Table 1 - Presence of Molluscs on 19 panels examined at each site during one year

BIVALVE MOLLUSCS	RAVENNA				CROTONE					
	AGO A		PCW A		LUNA A					
	0	-9m	-20m	0	-5m	-11m	0	-14m	-20m	-65m
<i>Mytilus galloprovincialis</i> Lamarck	5	5	3	5	5	4	5	4	2	-
<i>Ostrea edulis</i> L.	+	2	1	+	+	1	+	+	+	+
<i>Anomia ephippium</i> L.	+	1	2	+	+	+	+	1	+	-
<i>Hiatella arctica</i> (L.)	2	3	4	+	2	+	2	4	3	-
<i>Musculus subpictus</i> (Contraire)	+	2	+	+	+	+	1	1	1	-
<i>Aequipecten opercularis</i> L.	-	1	+	-	+	+	+	+	+	-
<i>Nodiolus barbatus</i> L.	+	1	+	+	-	-	-	+	+	-
<i>Neopycnodonte cochlear</i> (Poli)	-	-	-	-	-	-	+	1	+	4
<i>Lima inflata</i> Link	-	-	-	-	-	-	-	*	-	-
<i>Pteria hirundo</i> (L.)	-	-	-	-	-	-	-	-	-	*

* species collected on platform structures
+ < 5 individuals/19 dm² 3 50-100 individuals/19 dm²
1 5-10 " " 4 100-500 " "
2 10-50 " " 5 > 500 " "

The data collected showed the undisputed role of mussels not only among molluscs but also in the formation of fouling on the offshore structures examined in the two Italian seas (RELINI and MONTANARI 1988), at least in the first 10 m of depth, where they represent 80 to 95% of total wet weight of fouling. Nevertheless, their importance assumed a different character in relation to the eutrophic state of the waters (Table 2). In the Adriatic, mussels form the largest biomass (up to 96.6 kg/m²) and show a more rapid growth. The harvesting of this large amount of mussels has been suggested (RELINI 1977). Other species of Molluscs (Table 1), with the exception of *Hiatella arctica*, a species of small size and no economic value, are scarce.

At Ravenna, mussels show two periods of settlement over the year; the first and by far the more important is in the spring-summer period, reaching a maximum in June, and the second in autumn with a peak in November-December. The mussels prove to be dominant after three or four months on the panels immersed in May and after six months on those immersed in October. As the length of exposure increases, there is a corresponding increase in the accumulation of fouling and in particular of mussels and thus of the weight of the biomass. In general, one can say that the weight of mussels as a percentage of the total weight of fouling relates directly to the immersion time and inversely to the depth, with a maximum at about 1 meter.

At Crotona the period of settlement and of greatest growth is the spring and dominance is reached after 6-8 months, depending on the season in which the substrata are immersed.

An appreciable settlement of mussels was recorded only after one year at the surface with 379 individuals/dm², with a maximum length of 35 mm and a biomass of 4.1 Kg/m². At 14 m there were 93/dm² and at 20 m 25/dm². At 65 m the panel was completely covered with *Neopycnodonte cochlear*, some of which reached a size of 40 mm in diameter. On the whole, the largest development of Molluscs was found at the surface with seven species, providing a total of 596 individuals/dm², of which about 90% in number were *Mytilus galloprovincialis*. At 14 m there were nine species of Molluscs, giving 298/dm², of which 45% were *Mytilus* and 45% *H. arctica*. At 20 m the number of Molluscs was fewer (105 individuals/dm²) with 55% *Hiatella* and 26% *Mytilus*. At 65 m *N. cochlear* dominated the settlement on all kind of substrata covered by a strong layer of calcareous shells and there were no mussels.

Table 2 - Hydrological data at 2 m depth for the three sites

	RAVENNA		CROTONE	
	PCW - A	AGO - A	LUNA - A	LUNA - A
T°C	13.32 ± 7.02	13.88 ± 6.67	17.12 ± 3.66	17.12 ± 3.66
S‰	32.84 ± 2.39	33.73 ± 2.28	38.18 ± 0.24	38.18 ± 0.24
O ₂ mg/l	9.47 ± 1.63	9.06 ± 1.79	7.41 ± 0.32	7.41 ± 0.32
N-NO ₃ ug/l	6.52 ± 5.22	4.72 ± 3.70	3.66 ± 2.89	3.66 ± 2.89
N-NO ₂ ug/l	103.40 ± 98.07	76.26 ± 68.76	22.26 ± 13.83	22.26 ± 13.83
P-PO ₄ ug/l	4.39 ± 2.02	4.44 ± 3.38	4.29 ± 2.20	4.29 ± 2.20

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