CRUSTACEA DECAPODA ASSEMBLAGE OF THE WESTERN POMO PIT. II - REPRODUCTION

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Between December 1992 and April 1994, fishery investigations were carried out in the Western basin of the Pomo pit, the main Nephrops fishing ground of the central Adriatic, using an experimental prawn trawl with cod-end meshes of 12 mm stretch. The small mesh size of the gear made possible to gather ancillary data on the biology of the decapod species associated with *Nephrops norvegicus*. Reproductive strategies adopted by different species (see the review by WENNER & KURIS, 1991) may be responsible of their relative abundance in a particular environment. Therefore we considered worthwhile to summarize data on reproductive biology of the most common species in the decapod assemblage, gathered within this project and previous investigations, started over 20 years ago in the Western Pomo pit (FROGLIA, 1976).

In decapod crustaceans, Penaeoids excluded, females carry fertilized eggs underneath the abdomen untill the hatching of the larva. The period of incubation, characteristic of each species, is influenced by water temperature. Bottom temperature in the Pomo pit is rather constant and ranges between 10 and 11°C. Under these conditions the incubation period extends for 6 -7 months in the case of *Nephrops norvegicus* and for 3 months in the case of *Munida intermedia*.

The presence of ovigerous females in the trawl catches has been used to define the seasonality of the reproduction (TAB. 1). Ovigerous females of *Processa canaliculata* and *Chlorotocus crassicornis* were found all the year round suggesting the lack of an annual cycle. Other species have a marked annual cycle. For example females with ripe ovaries of *N. norvegicus* and *M. intermedia* were found respectively from late-spring to summer and in early autumn and the occurrence of ovigerous females was restricted to part of the year. The presence of mature ovaries in females carring eggs in advanced stage of development, was assumed as an indication of the possibility of multiple broods within the spawning season, as in the case of *Pandalina profunda*.

SPECIES	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Alpheus glaber	◆		◆		◆	◆	◆		◆			
Processa canaliculata	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	
Processa nouveli	◆	◆	◆	◆	◆		◆	◆	◆		◆	◆
Chlorotocus crassicornis	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆
Pandalina profunda	◆	◆	◆	◆	◆		◆				◆	◆
Plesionika antigai		◆	◆	◆	◆		◆					
Plesionika heterocarpus	◆	◆	◆	◆	◆		◆		◆	◆	◆	◆
Philocheras echinulatus			◆	◆	◆	◆					◆	◆
Pontophilus spinosus	◆		◆	◆								
Nephrops norvegicus	◆	◆	◆			◆	◆	◆	◆	◆	◆	◆
Munida intermedia	◆	◆								◆	◆	◆
Liocarcinus depurator			◆	◆			◆		◆	◆	◆	

Tab. 1 - Reproductive season of the most common species of Decapoda in the Western Pomo pit (based on the presence of ovigerous females)

Minimum and maximum size of ovigerous females are indicative respectively of the onset of first maturity and of the maximum size reached by the females in the area. Size is expressed as carapace length (c.l.) measured from eye socket to mid-posterior margin of carapace.

During the incubation period a percentage of developing eggs are lost from the pleopods. GRAMITTO & FROGLIA (1981) estimated that the number of hatching eggs is only 1/3 of the number of oocites for *Nephrops norvegicus*. Therefore only potential fecundity has been estimated, for comparative purposes between the most common species, by counting newly laid eggs (without evidence of embryo ocular pigment) in ovigerous females. In decapod crustaceans egg production is an exponential function of female length and in this preliminary note only minimum and maximum egg counts are given (Tab. 2).

SPECIES	Size (c.l.) mm min - max	Egg ∅ mm	Egg count min - max
Alpheus glaber	8.0 - 10.0	0.6 x 0.8	110 - 330
Processa canaliculata	13.0 - 21.0	0.5 x 0.7	1220 - 5770
Processa nouveli	6.2 - 11.6	0.4 x 0.5	760 - 1440
Chlorotocus crassicornis	11.5 - 20.5	0.6 x 0.8	240 - 1170
Pandalina profunda	3.9 - 5.5	0.4 x 0.5	110 - 380
Plesionika heterocarpus	9.0 - 17.4	0.5 x 0.7	710 - 4300
Philocheras echinulatus	5.5 - 10.5	0.6	240 - 1170
Pontophilus spinosus	11.0 - 14.5	0.6	1390 - 1990
Nephrops norvegicus	21.2 - 53.0	1.5	400 - 6000
Munida intermedia	9.5 - 21.0	0.7	1300 - 4910

Tab. 2 - Size (c.l.) of ovigerous females, egg diameter and potential fecundity

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SPATIAL AND TEMPORAL VARIABILITY IN BIODIVERSITY IN RESPONSE TO SEWAGE SLUDGE DISCHARGE OFF THE MEDITERRANEAN COAST OF ISRAEL

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Benthic assemblages have provided the most widely used parameters for assessing effects of waste discharges on the marine environment. The benthic invertebrate assemblage is considered an indicator of environmental quality because its components are relatively immobile and long-lived; thus they reflect the cumulative effects of exposure to environmental pollutants.

The Dan Region Wastewater project treats the sewage of the 1.3 million inhabitants of the Tel Aviv metropolitan area. Marine discharge of 14,000 m^3/day of sewage sludge begun in 1987. The outfall is 5 km offshore at water 37 m deep. A baseline survey of the area conducted in 1978 revealed no aberrant conditions. The benthic fauna was diverse and abundant and indicated the disposal area was unpolluted at the advent of dumping.

During Spring 1992, the environmental ministry initiated an improved monitoring program to measure the environmental effects of sludge discharge at the site. Twenty stations along two lines intersecting at the outfall were established, at distances of 50, 100, 200, 500 and 1000 m from the outfall, and triplicate 0.062 m^2 box core samples were taken at each in May and November 1992, October 1993 and May 1994. The samples were washed aboard ship through 0.5 mm screen and preserved in 10% buffered formalin. In the laboratory the samples were washed, preserved in 70% ethanol and stained with Rose Bengal. Organisms were identified and counted. The data have been analysed with the aim of distinguishing different associations of organisms and to examine any gradients through the data.

Sediments in the vicinity of the sewage sludge outfall were nearly devoid of benthic macrofauna, suggesting that accumulating sludge particles have a deleterious effect on the fauna. Further away from the most organically enriched area the assemblage was composed of few pollution tolerant species, including extremely abundant populations of one or two opportunistic species. Beyond the enriched zone assemblages gradualy approach the composition of the assemblage in the unpolluted environemnt and abundance values decline. The benthic assemblages found were dominated by polychaetes and bivalves, with a relative absence of crustaceans. Although the fauna at the sludge disposal site has shown significant degradation indicating modification of bottom environmental quality at and around the outfall, the size of the area affected fluctuated. In spring of 1992, samples collected 50 m from the outfall contained large numbers of capitellid polychaetes and little else, and those collected 100 m from the outfall contained large numbers of the bivalves *Abra alba* and *Corbula gibba*. In fall of 1992 and again in 1993, samples collected within an area delimited by the stations 1000 m north, 200 m east, 500 m south and 100 m west of the outfall, were nearly devoid of life. In spring of 1994, samples collected within 200 m of the outfall were extremely poor.

Available wave data indicate that at 37 m depth, near-bed currents capable of transporting fine sand occur only during particularly stormy winters. During fierce winter storms, wave induced motions near the sea bed rework the surface of the sediments, resuspending and widely dispersing the fine organic particles, sweeping the site clean of dumped material. Undisturbed accumulation of sludge takes place through the quiescent periods of the year. The winter of 1992 was stormy, thus by May 1992 the vicinity of the outfall was only little affected by sludge accumulation. The winter of 1994 was mild and indeed the fauna revealed the effects of increased organic loading. By fall these effects are exacerbated. The dispersive characteristics of the outfall site have prevented the perennial accumulation of organic substances. However, it appears that current rates of disposal have somewhat exceeded the dispersive capacity of the area, placing the fauna under stress and promoting the growth of pollution tolerant species. These changes are limited to a small area, but they suggest that further increases in sludge disposal may lead to more extensive, indicative and readily-identifiable effects.