Cercetări marine	I.R.C.M.	Nr.14	249-257	1981

TRACE METALS IN CERTAIN CRUSTACEANS FROM LEBANON – A REVIEW

John G.Shiber

c/o I.C.S., Apartado 271, La Cala, Estepona (Malaga), Spain

ABSTRACT:

Pachygrapsus transversus, Eriphia verrucosa, Palaemon elegans, Penaeus japonicus and Scyllarides latus, collected from various locations on the coast of Lebanon between July 1977 and May 1978, were analysed for trace elements. Cadmium,copper and zinc concentrations in all were similar to levels reported in species from other areas, whereas nickel, lead and chromium appeared to be higher.Of the five crustaceans,the prawns had the highest average copper levels. In fact,copper was generally higher in the prawns than in any of the organisms which were analysed at different times during this series of studies, including other invertebrates, fish and algae. The metal levels seen in these crustaceans suggest that some contamination might exist here and warrant further more extensive studies of this nature in the eastern Mediterranean area.

The great volume of domestic and industrial waste entering the eastern basin of the Mediterranean Sea, particularly from Lebanon and Israel, has increased the threat of heavy metal and other types of contamination to marine life there (Unesco, 1977), yet few studies have been conducted in that region with regard to contamination of any kind.Hence,a series of preliminary investigations into the metal content of coastal organisms, sediment, and seawater from Lebanon, primarily around the city of

Beirut where sewage input is very heavy, was undertaken between July-1977 and May-1978. Discussed here are the results of the metal analyses of the following five crustaceans which were among the various biota collected: the shore crabs, Pachygrapsus transversus (GIBBES, 1850) and Eriphia verrucosa (FORSKAL, 1775), the prawn, Palaemon elegans RATHKE, 1837, the shrimp, Penaeus japonicus BATE, 1888, and the Mediterranean locust lobster, Scyllarides latus LATREILLE, 1803. The prawns and crabs are quite abundant along the coast of Beirut. This may not be unusual since some prawns, i.e., Palaemon squilla, and crabs, i.e., Pachygrapsus crassipes, have been reported to occur with some frequency in areas polluted by sewage and other waste materials (8, 11). In contrast, the shrimp and lobster have become less common in Lebanese coastal waters in recent years. Over-fishing and/or fishing by dynamiting (an illegal practice still employed by many) may be partially responsible, but other factors, such as contamination by wastes from anthropogenic activities, might also be contributing to their scarcity, since decreases in species abundance and diversity have been reported in heavily polluted areas by many investigators (1, 8, 9, 11).

Figure 1 indicates the approximate locations where collections of the crustaceans took place. Eriphia verrucosa and Pachygrapsus transversus were collected on the rocky terraces of Ras Beirut at stations # 1, 3, 5 and 7 in Fall-1977. P. transversus was also sampled in Spring-1978 at the same locations. Palaemon elegans was collected with aquaria nets in shallow pools of the terraces at stations # 1-8 in Summer-1977 and at # 2, 3, 5 and 7 in the Fall and Spring. In late Spring-1978, samples of Penaeus japonicus and Scyllarides latus were collected in trawling nets at depths ranging from 25-35 meters, within 1000 meters of Ras Beirut and several other coastal towns along Lebanon (refer to Figure 1). The average measurements of the crustaceans and the number of individuals comprising each sample are included in Table 1. For further details on sampling, see Shiber (13, 14, 16).

Whole crabs, prawns and the exoskeletons and edible muscle tissue of the shrimp and lobster were processed by wet-digestion (4) and analysed for trace elements on a flame atomic ab-

sorption spectrophotometer using standard conditions. The average metal concentrations of the crustaceans collected in each season are shown in Table 1. Readings for the individual samples can be found in SHIBER (13, 15: crabs; 14: prawns; 16: shrimp, lobster). Also analysed was one sample each of strictly ovigerous and strictly nonovigerous prawns in Summer-1977, one sample of molted crabs (Pachygrapsus transversus) in Fall-1977, and one sample each of strictly ovigerous crabs and prawns in Spring-1978. Those results appear in Table 2.

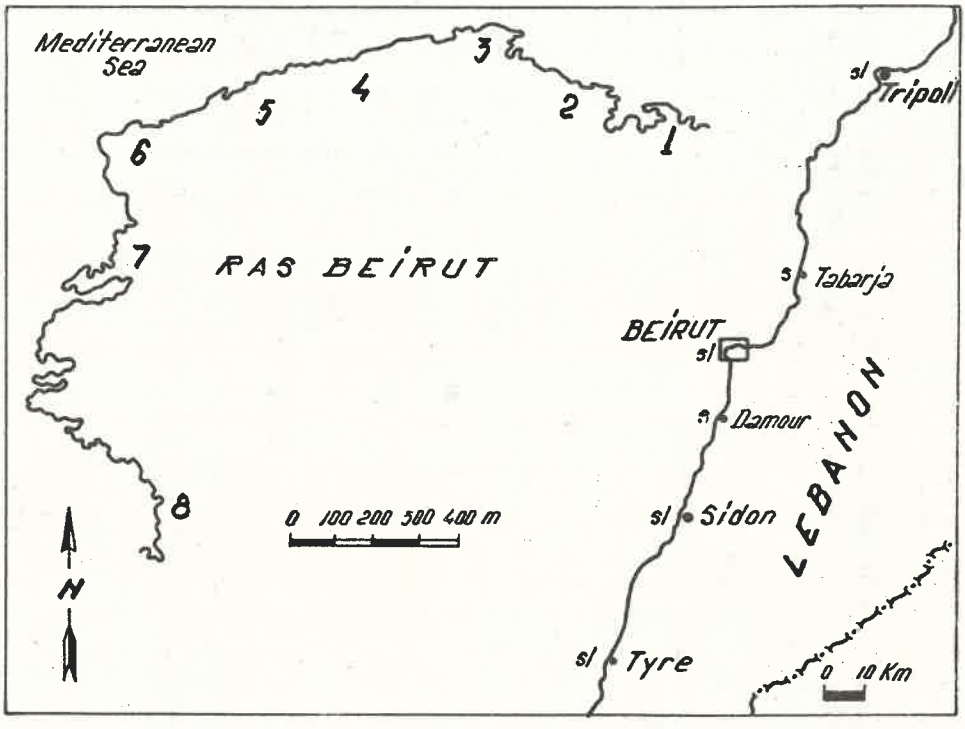

Fig.1 - The coast of Lebanon with the boxed-in area of Ras Beirut enlarged to show the collecting sites of prawns and crabs. The prawns were collected at stations #1-8 in Summer-1977 and at # 2, 3, 5 and 7 in Fall-1977 and Spring-1978. The crabs were collected at stations #1, 3, 5 and 7 in Fall and Spring. The shrimp (s) and lobster (l) were sampled between Tripoli and Tyre in late Spring-1978, at the several points indicated.

Table 1

Approximate average metal concentrations (µg/g dry weight) in crustaceans collected from Ras Beirut, Lebanon in Summer-1977 (Su), Fall-1977 (Fa), and/or Spring-1978 (Sp). Their average measurements appear in parentheses (l: length; w: width).

Species	Individuals in each sample	Number of samples	Season	Tissue analysed	Pb	Cd	Cu	Ni	Fe	Zn	Cr
Pachygrapsus transversus (l: 15.5 mm; w: 18.3 mm)	5	4	Fa	whole	16.9	1.4	58.1	23.2	388.9	6o:7	<1:1
	6	4	Sp	whole	7.5	1.6	1o6.o	11.3	196.9	64.2	4.5
Eriphia verrucosa (l: 32.o mm; w: 42.o mm)	2-3	4	Fa	whole	16.9	o.7	75.o	17.8	33o.5	113.4	6.6
Palaemon elegans (l: 32.6 mm)	3o	8	Su	whole	31.9	o.9	147.6	23.o	79:o	-	-
	2o	4	Fa	whole	33.7	2.4	88:6	9:9	175:8	95:2	4:5
	12	4	Sp	whole	18.8	1.2	172.2	22.5	379.7	112.9	8.3
Penaeus japonicus (l: 154.8 mm)	3	2	Sp	muscle	15.2	1.2	6o.o	2.4	229.7	94.6	3.2
				exosk.	7.9	1.3	74.6	7.1	215.7	41.9	7.o
	1-3	15	Sp*	muscle	8.o	1:o	38:3	2:7	178.9	73.1	4.8
				exosk.	1o.o	1.1	33.1	9.6	172.5	15.8	4.2
Scyllarides latus (l: 252.5 mm)	1	2	Sp	muscle	6.9	1.6	71.3	nd**	7o:4	82:2	1:9
				exosk.	7.2	o.8	16.3	4.9	285.9	1.6	2.6
	1	8	Sp*	muscle	6.9	o.8	41:4	9.2	119.5	66.8	3.8
				exosk.	7.2	1.o	27.3	1o.9	321.1	14.7	6.5

* Average of metal levels in samples collected from Tripoli-Tyre, Lebanon (including Beirut samples)

** not detected

Table 2

Metal concentrations in samples comprising solely of molted crabs (13), ovigerous prawns, nonovigerous prawns (14), and ovigerous crabs (15) collected from the coast of Ras Beirut, Lebanon. Values are given in μg/g dry weight.

Season/ Species	Pb	Cd	Cu	Ni	Fe	Zn	Cr
Summer-1977							
Palaemon (ovigerous)	38.3	<o.4	144.4	nd	nd	-	-
elegans (nonovigerous)	38.3	1.1	144.4	19.7	217.9	-	-
Fall-1977							
Pachygrapsus transversus (molted)	65.6	<o.7	76.9	6.6	48o.5	183.7	<1.1
Spring-1978							
P.transversus (ovigerous)	<7.5	o.8	67.5	nd	174.2	46.6	6.9
Palaemon elegans (ovigerous)	<11.3	<o.8	173.4	14.1	3oo.o	1o7.1	2.3

The prawns were the only crustacean analysed in Summer-1977. Compared to metal levels in molluscs and algae sampled at that time (17, 18), the prawns had the highest copper and the lowest iron, but similar concentrations of the other elements. There is virtually no difference between the lead, cadmium, and copper levels of the ovigerous and nonovigerous prawns, but neither nickel or iron was detected in the ovigerous individuals. The data are too limited, however, to be at all conclusive. Further study of prawns in both physiological states is recommended.

The average metal levels of the two crabs analysed in the fall did not differ substantially, except for zinc, which was considerably higher in Eriphia verrucosa. In fact, E. verrucosa had the highest zinc and chromium of the three crustaceans studied in the fall, although levels in the prawns were similar. The prawns had the highest lead and cadmium. The crab Pachygrapsus transversus had the highest nickel, and both crabs had higher iron than the prawns. The sample of P.transversus which was comprised solely of molted specimens had higher lead, iron and zinc than the

crabs processed with their exoskeletons, but any possible significance of this can only be determined through more extensive sampling and analysis of both molted and unmolted specimens.

Except for cadmium, which was slightly higher in the shore crab and lobster, it is clear that all elements, especially copper and iron, were higher in the prawns than in any of the other crustaceans collected in the spring. It must be remembered, however, that both the prawns and crabs were analysed in their entirety, whereas only the exoskeleton and edible muscle of the shrimp and lobster were analysed, so comparisons must be made cautiously. All metals but cadmium and chromium were higher in the ovigerous prawns than in the ovigerous crabs collected in the spring.

Iron was much higher,but the other metal concentrations in the shrimp muscle were generally similar to those found in the lobster muscle. When the average metal levels in the exoskeletons of the two are compared, the shrimp exoskeleton had much higher copper and zinc than the lobster, but the lobster exoskeleton had higher iron. Both animals had higher zinc in the muscle than in the exoskeleton, and in the lobster, iron was much higher in the exoskeleton than the muscle.Otherwise,there was little difference between the metal concentrations in the exoskeleton and muscle of either crustacean.

In general, the prawns had higher average copper levels than most of the organisms (including molluscs, echinoderms, polychaetes, coelenterates, fish, algae)analysed in this series of studies. This may indicate that prawns have a particular affinity for copper accumulation. Moreover, the shallow pools,or potholes, which the prawns often inhabit on the coast of Beirut may differ in salinity from the surrounding seawater due to many environmental factors (e.g., rainfall, evaporation, etc...). Raw sewage which flows over the rocks at several points along Ras Beirut undoubtedly contributes to salinity changes in the potholes.Several investigators (5, 7, 12, etc.) have noted increases in the uptake of certain metals by invertebrates which have been subjected to decreases in the salinity of their environments.

FUKAI and BROQUET (6) determined the iron and chromium content of crabs, shrimp, and other invertebrates from the Mediterranean coasts of France and Monaco. While the whole crabs they analysed had similar chromium and higher iron than the crabs from Ras Beirut, the soft tissue of the shrimp they studied had lower concentrations of both elements than the muscle tissue of the shrimp analysed here. The carapaces of their shrimp, however, had iron levels similar to those in the exoskeletons of the Lebanese shrimp.

Comparison data on metals in crustaceans, specifically the types studied in Lebanon, are scarce even in regions outside the Mediterranean. Generally, cadmium, copper and zinc in the five crustaceans discussed here are similar to concentrations in species from other areas, but nickel, lead and chromium seem to be high. The metal concentrations in the Ras Beirut crabs are similar to those reported in crabs from polluted Norwegian fjords by STENNER and NICKLESS (19) and LANDE (9). Shrimp from a marine farm in Somerset, England (3) had lower zinc and iron than the shrimp from Lebanon, but similar levels of the other elements. The soft parts of shrimp from Nieuport, Belgium (2) also had lower iron and zinc but similar chromium. The carapaces of the shrimp BERTINE and GOLDBERG (2) analysed had similar zinc but lower iron and chromium than the exoskeletons of the Lebanese shrimp. Cadmium in the Ras Beirut prawns is higher than levels reported in the same species from the Solent region of the United Kingdom by LEATHERLAND and BURTON (10).

As mentioned earlier, little attention has been focused on the eastern Mediterranean basin with regard to pollution. The data presented here indicate that some metal contamination of crustaceans might exist in this region, and that further studies of this nature are needed in order to obtain a more comprehensive picture of pollution in the Mediterranean as a whole.

LITERATURE CITED:

1. BASSON P., HARDY J. and LAKKIS V., 1976 - Ecology of marine macroalgae in relation to pollution along the coast of Lebanon. Acta Adriatica, 18, 19: 3o7-325.
2. BERTINE K.K. and GOLDBERG E.D.,1972 - Trace elements in clams, mussels and shrimp. Limnol.Oceanogr., 17: 877-884.
3. BOYDEN C.R. and ROMERIL M.G., 1974 - A trace metal problem in pond oyster culture. Mar.Pollut.Bull., 5: 74-78.
4. FOWLER S.W. and OREGIONI B.,1976- Trace metals in mussels from the northwestern Mediterranean. Mar.Pollut.Bull., 7 : 26-29.
5. FRAZIER J.M., 1975 - The dynamics of metals in the American oyster Crassostrea virginica. I.Seasonal effects. Chesapeake Science, 16, 3: 162-171.
6. FUKAI R. and BROQUET D., 1965 - Distribution of chromium in marine organisms. Bull.Inst.oceanogr., 65, 1336: 1-19.
7. HRS-BRENKO M., CLAUS C.and BUBIC S.,1977 - Synergistic effects of lead, salinity and temperature on embryonic development of the mussel Mytilus galloprovincialis.Mar.Biol., 44: 1o9-115.
8. JONES D.J., 1973 - Variation in the trophic structure and species composition of some invertebrate communities in polluted kelp forests in the North Sea. Mar. Biol., 2o: 351-365.
9. LANDE E.,1977- Heavy metal pollution in the Trondheimsfjorden, Norway and the recorded effects on the fauna and flora. Environ.Pollut., 12: 187-198.
1o. LEATHERLAND T.M. and BURTON J.D., 1974 - The occurence of some trace metals in coastal marine organisms with particular reference to the Solent region. J.mar.biol.Ass. U.K., 54: 457-468.
11. LITTLER M.M. and MURRAY S.N., 1975 - Impact of sewage on the distribution,abundance and community structure of rocky intertidal macro-organisms. Mar.Biol., 3o: 277-291.
12. PHILLIPS D.J.H., 1977 - Effects of salinity on the net uptake of zinc by the common mussel Mytilus edulis. Mar.Biol., 41: 79-88.

13. SHIBER J., 1977 - Trace elements in two Ras Beirut crabs. Cercetări marine-Recherches marines, I.R.C.M., 10: 185-192.
14. SHIBER J., 1979 - Heavy metals in Ras Beirut prawns and sea urchin eggs. J.Environ.Sci.Hlth.Part B, 14: 73-95.
15. SHIBER J., 1981 a - Metal concentrations in certain coastal organisms from Beirut. Hydrobiologia, 83: 181-195.
16. SHIBER J., 1981 b - Trace metals in edible molluscs and crustaceans from Lebanon. Hydrobiologia, 83: 465-476.
17. SHIBER J. and SHATILA T., 1978 - Lead, cadmium, copper, nickel, and iron in limpets, mussels and snails from the coast of Ras Beirut, Lebanon. Mar.Environ.Res., 1: 125-134.
18. SHIBER J. and SHATILA T., 1979 - Certain metals in three coastal algae from Ras Beirut waters. Hydrobiologia, 63: 105-112.
19. STENNER R.D. and NICKLESS G., 1974- Distribution of some heavy metals in organisms in Hardangerfjord and Skjerstadfjord, Norway. Water,Air,Soil Pollut., 3: 279-291.