

BIORHYTHMS AND CONCENTRATION FACTORS IN BRACKISH WATER PROSOBRANCHS

Mezzadri M.G., Parisi V., Poli P.

Museo di Storia Naturale dell'Università di Parma (Italia)

Abstract - This paper calls attention to the importance of the animals' behaviour, in addition to environmental factors and different ways of uptake, in the determination of concentration factors.

On the basis of the data relevant to Cyclope neritea and Hinia reticulata (Gastropoda, Prosobranchia) we show how the biorhythm alterations may affect the radionuclide uptake.

The limitations of values for concentration factors are well-recognized by persons using them for prediction purposes in the field of radiological protection and carrying out research programs connected with control procedures for waste discharges.

The concentration factor, indeed, as defined at steady state, can be easily evaluated under controlled conditions, but evaluation is extremely difficult in the field.

On the other hand, considering the results of the relatively few comparative field-laboratory experiments (Patel, 1975), any prediction of radionuclide flux rates in the field based solely on laboratory experimental results can be only tentative, unless the field observations prove that laboratory conditions have properly simulated the natural environment in allowing the normal functioning of physiological processes in the organisms in question.

Moreover, the wide range of values reported in literature for the same radionuclide and for the same species suggests that the concentration factor strongly depends upon the environmental factors and upon the demographic structure of the population under study and its environmental and trophic habits.

All these difficulties are increased in the ecotones where the environmental parameters are often unpredictable.

On the other hand, the evaluation of the concentration factors is particularly interesting in the estuarine environments, such environments being a "trap" for many pollutants both conventional and radioactive, and having a monotonous population and a simplified food web. In fact, if an estuarine fauna is compared with that in the adjacent sea and in the flowing river system, it will be seen that the estuarine fauna is generally poor in numbers of species, although it may be rich in numbers of individuals.

In such an environment the scavengers become very important, above all in relation to the great amount of organic matter both autochthonous and allochthonous. Therefore, regarding the concentration factors, it is important to consider the two different ways of uptake, from water and from food (Fowler and Small, 1975; Amiard, 1979). Also it is necessary to consider that, as the estuarine environments are variable and unsteady, most of the organisms adopt behavioural strategies following circadian and/or circatidal rhythms (Naylor, 1977).

We deemed it interesting to study two species of brackish water Protozoans (Cyclope neritea and Hinia reticulata) very important in the trophic web of the Po River Delta lagoons. We analysed their uptake capability of ^{85}Sr as related to the variations of some environmental parameters (temperature, salinity and oxygen concentration) and to their cyclic behaviour.

Since the behaviour of these animals is inscribed in circadian rhythms their exploratory activity is not constant in time; as a consequence there are particular phases acutely affected by changes in the environmental factors.

Our experiments show how the environmental factors can influence ingestion and assimilation activities not only directly but also as a consequence of an alteration of the exploratory rhythm (Mezzadri and Parisi, 1979; Parisi et al.,1977). Moreover, the radioecological approach used has permitted us to show how the concentration factor differs depending on the period (light or dark) of the heat input. These results suggest that altering the circadian rhythm in relation to different periods of heat input (Bedulli et al.,1979) can affect the trophic activity and, as a result, the concentration factor.

Thinking over the role played by these species in salt-marsh environments, we deemed it interesting to analyse also the uptake directly from water and from food.

Our studies show not only the different mechanisms of uptake but also the different ecological meanings of the two ways of contamination (Mezzadri and Poli,1979). From water the radionuclide is accumulated especially by the outer surfaces of the shell with its biological covering and, as a result, at the animals' death the radioactivity is inserted in the microscopical fraction of the detritus web. In the other case (through the food chain), the radionuclide is really assimilated by the animals and, therefore, transfer to the upper trophic levels may occur.

The uptake from food, however, can be affected not only by the change in environmental factors but also by the consequent biorhythm alterations.

Finally, evidence is provided that the radionuclide uptake, and consequently the concentration factor, relating to one level of the trophic web is so affected by interactions of environmental and biological factors that wide range of values for concentration factor may occur both

individually and in the population. Therefore the significance of the concentration factors requires a knowledge of the trophic function and the behaviour of the species under study.

References

- Amiard J.C. (1979) - Modalités de la contamination d'une chaîne trophique marine benthique par l'argent 110m. Part I and II. Cahiers de biologie marine, 20 : 125-136 and 189-199.
- Bedulli D., Mezzadri M.G., Parisi V., Poli P. (1977) - Thermobiology of estuarine Molluscs. Atti Soc.ital.Sci.nat.Milano, 118 (2) : 185-197.
- Bedulli D., Mezzadri M.G., Parisi V., Poli P. (1979) - Osservazioni di ecologia trofica in microambienti salmastri artificiali. Annali di Radioprotezione, AIRP, 1 (fasc.unico), Dic.1979 : 99-114.
- Fowler S.W., Small L.F. (1975) - Procedures involved in radioecological studies with marine zooplankton. in Design of radiotracer experiments in marine biological systems. STI/DOC/10/167 IAEA, Vienna : 63-84.
- Mezzadri M.G., Poli P. (1979) - Influence of temperature and salinity on uptake and loss of radiostrontium in Cyclope neritea (L.)(Gastropoda). Atti XX Congresso AIRP, Palermo 1979 (in press).
- Naylor E. (1976) - Rhythmic behaviour and reproduction in marine animals. in Adaptation to environment.(Newell R.C. Ed.), Butterworths, London.
- Parisi V., Mezzadri M.G. (1979) - Thermal pollution in brackish water environments: an experimental model. Ateneo Parmense, Acta nat., 15 : 181-201.
- Patel B. (1975) - Field and laboratory comparability of radioecological studies. in Design of radiotracer experiments in marine biological systems. STI/DOC/10/167 IAEA, Vienna : 211-239.

MEZZADRI, M.G., PARISI, V., POLI, P.

"Biorhythms and concentration factors in brackish water prosobranchs"

Paper presented by M.G. Mezzadri (Italy)

Discussion

E.H. SCHULTE: Did you acclimate the two experimental species at 30°C and for how long?

M.G. MEZZADRI: No, we did not. All the animals tested at 30°C were acclimated at 23°C.

S.W. FOWLER: Is 30°C above their normal range of temperature and, if so, could this affect their metabolism in a way that the metabolic uptake of the radionuclide is suppressed?

M.G. MEZZADRI: Yes, it could. High temperature alters the exploratory activity of the animals which remain buried in the sand. For this reason direct contact with the contaminated water is decreased and, as a consequence, the possibility for adsorption of radionuclide also decreases.

