* SOME OBSERVATIONS ON THE UPTAKE AND EFFECTS OF AMERICIUM 241 ON A BRACKISH WATER AMPHIPOD

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Summary

As a part of an on-going programme investigating the behaviour and effects of transuranium nuclides in estuarine and coastal waters on certain marine invertebrates, experiments have been performed on the accumulation and effects of americium-241 on the survival of Gammarus duebeni. A synergism between alpha radiation and physiological stress is reported.

Resumé

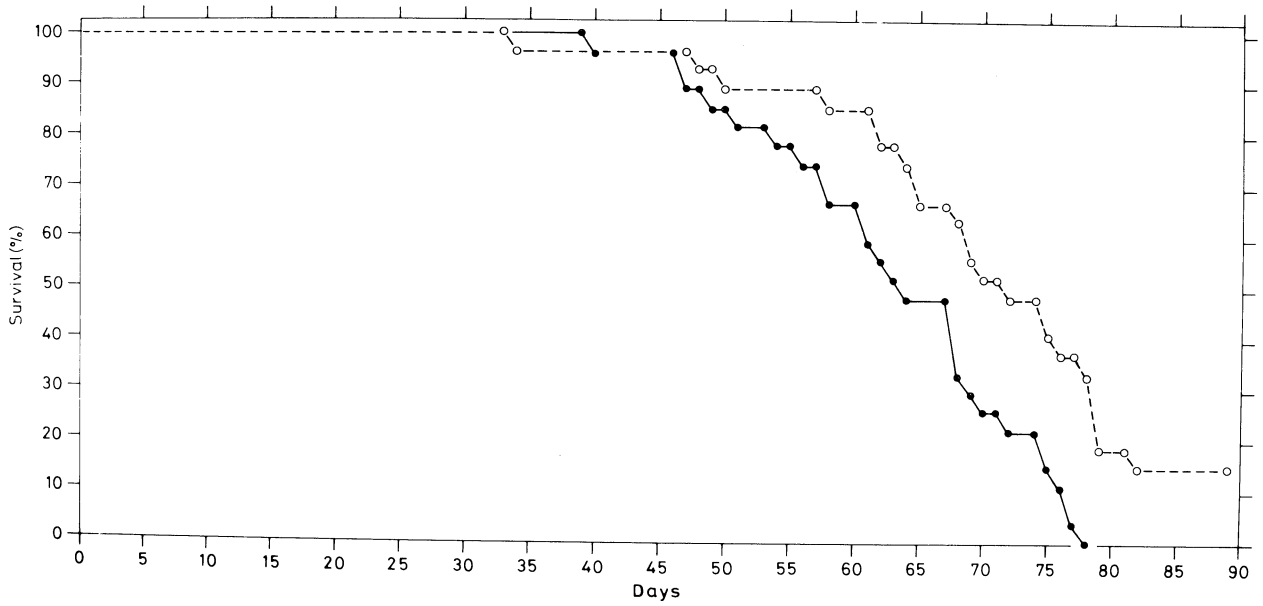
S'insérant dans le programme de recherche au cours du comportement et des effets de nucleides transuraniens présents dans les eaux des estuaires et du littoral sur certain invertebrés marins, des expériences ont été réalisés sur l'accumulation et les effets de l'américium-241 sur la survivance du Gammarus duebeni. Un synergisme entre la radiation alpha et la tension physiologique est signalé.

An experimental programme studying the behaviour and effects of transuranium nuclides in estuarine and coastal waters on certain marine invertebrates is being undertaken with the following aims (1) development of methods for determination of physical-chemical states of actinides in experimental medium (2) study of accumulation and retention in relation to environmental factors (3) investigation of alpha radiation effects and (4) estimation of absorbed doses to the species under investigation.

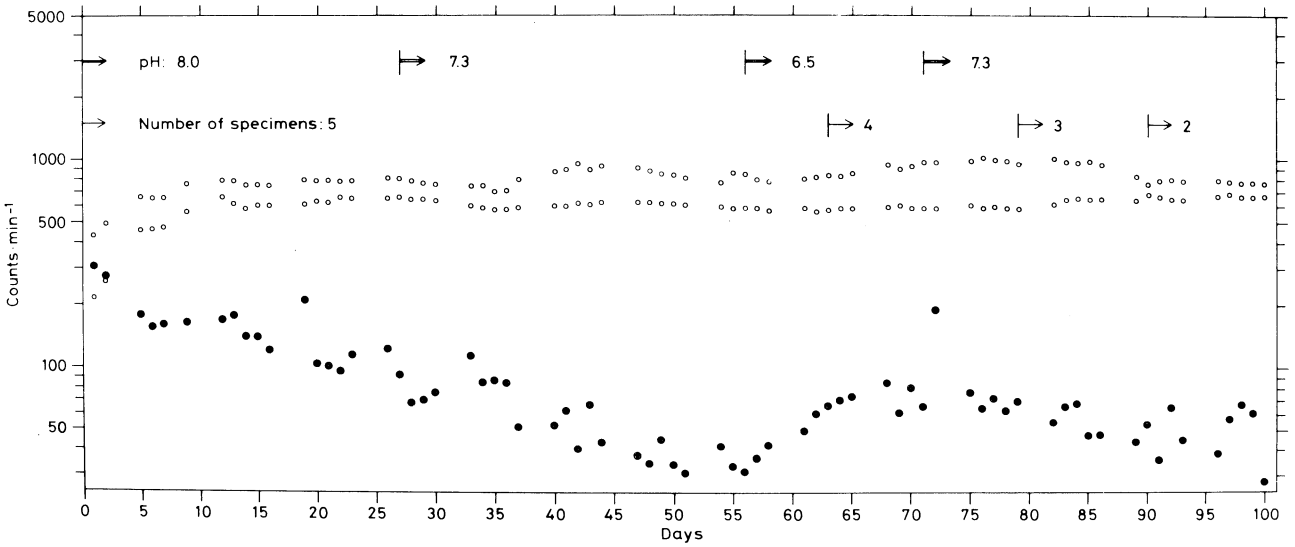
The dependence of the physical-chemical behaviour of actinides with pH (Murray and Fukai, 1975) initiated experiments on the uptake of americium-241 by male Gammarus duebeni duebeni Liljeborg at various pH values in the range 8.0 - 6.5. Figure 1 shows the uptake by specimens during the experimental period of 100 days. Maximum-minimum values are shown. The initial uptake is rapid and the accumulated amount, thereafter, remains almost constant. The pH was controlled twice daily and if necessary adjusted. The pH values chosen were 8.0 and 7.3 for days 0 - 26 and from days 27 - 55 respectively. The results would appear to indicate that at the present activity levels, the specimens' body burden is non-dependent on pH in the range 8 - 6.5. In the specimens that moulted during uptake it was found that 56 and 85% of the total body activity (wet weight) respectively was bound to the moults. Fowler et al. 1975 for plutonium +4 and +6 gave values of 92 - 100% in moults for the benthic shrimp Lysmata seticaudata.

Parallel experiments are being carried out on the radiation effects of americium-241 on the survival of juvenile Gammarus duebeni. In the present work water activity ranged from 1.46 - 0.15 $\mu Ci\ l^{-1}$, this being equivalent to a metal concentration of 450 - - 46 $ng\ l^{-1}$. In studies on chemical toxicity (cf. Blaylock and Trabolka 1978 p. 135) on eggs of carp and fathead minnows using very low specific activity plutonium, Till (1976) found that the metal concentration of plutonium-244 necessary to cause a deleterious effect had to be many orders of magnitude greater ($mg\ l^{-1}$) than the metal concentration of plutonium-238 required to achieve a radiotoxic effect. On the basis of these findings we assume the

1. Uptake of Am 241 from aged water by 5 specimens that had not moulted during the experimental period. Maximum and minimum values are given by O ; water activity o



2. Percentage survival of irradiated and control groups. Twenty seven specimens in each group.



effects observed in the present experiments are mainly due to radiation by 5.48 MeV alpha particles. Figure 2 shows the percentage survival of irradiated and control groups, over a period of 89 days.

It is interesting to note that the hydrogen ion concentration dropped from pH 8.0 (day 1) to about pH 7.2 over the first five days and then remained reasonably constant until day 33, after which it decreased till day 54. This decrease may indicate a change in water quality brought about by, among other factors, the relatively high amount of food offered to specimens living in small volumes of water.

The simultaneous appearence of high mortality and lowered pH in both groups leads us to assume that the observed effect on survival is caused by a synergism between radiation and physiological stress due to unfavorable experimental conditions.

In order to obtain a better insight into possible synergism between ionizing radiation and stress situations due to changes in environmental factors further experiments are planned.

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HOPPENHEIT, M., MURRAY, C.N.

"Some observations on the uptake and effects of Americium 241 on a brakish water amphipod"

Paper presented by C.N. Murray (CCR Euratom)

Discussion

J.C. GUARY: Avez-vous demontrê que le ^{241}Am êtait concentré à l'interieur de la carapace comme il me semble l'avoir compris?

C.N. MURRAY: On the basis of the constant body burden of Americium under different pH conditions it is believed that the Americium is strongly bound to the exoskeleton, possibly to the interior surface where the new exoskeleton is being formed.

R. FUKAI: As you know, ^{241}Am is α-emitter as well as soft γ-emitter. Why are you sure the effect you are observing is the effect of α-radiation? It could be γ-radiation effect.

C.N. MURRAY: Although we are not absolutely certain that this is an alpha radiation effect, we feel that due to the high LET of alpha particles, such as an effect is much more likely due to the α-emitting nature of the isotope than to its soft gamma radiation.

S.W. FOWLER: How do the level you use in your effect studies compare with those you might expect to encounter under a release situation such as around Windscale?

C.N. MURRAY: It is quite clear that the concentrations we are using are many orders of magnitude higher than one would expect to find in controlled releases of low-level radioactivity to aquatic environments. However, in comparison to most levels quoted in the literature, the α-activity levels being used in the present experiment are quite small.