Nuclear transfers between more widely separated species, for example, *A. dubia* and *A. proteus*, have proved unsuccessful so far[8]. Prior injection of non-homologous cytoplasm and its successful assimilation, even in a very low percentage of cells, would be a means of obtaining clones of a mixed type able to accept foreign nuclei. Experiments of this type are in progress.

This work was supported by grants from the Royal Society.

SHIRLEY E. HAWKINS

Department of Zoology, King's College,
Strand, London, W.C.2.

[1] Hawkins, S. E., Cole, R. J., and Danielli, J. F., *Nature*, **196**, 396 (1962).
[2] Hawkins, S. E., and Cole, R. J., *Exp. Cell. Res.* (in the press).
[3] Danielli, J. F., *Ann. N.Y. Acad. Sci.*, **78**, 675 (1959).
[4] Cole, R. J., and Danielli, J. F., *Exp. Cell. Res.* **29**, 199 (1963).
[5] Tartar, V., *J. Exp. Zool.*, **124**, 63 (1953).
[6] Briggs, R., and King, T., *Proc. U.S. Nat. Acad. Sci.*, **38**, 455 (1952).
[7] Comandon, J., and de Fonbrune, P., *C.R. Soc. Biol.*, **130**, 740 (1939).
[8] Hawkins, S. E. (unpublished results).

Moulting Frequency of a Deep-sea Crustacean, *Euphausia pacifica*

MOST of the observations on moulting in crustaceans have been confined to littoral animals kept in aquaria[1]. Because planktonic, deep-sea crustaceans are difficult to maintain in the laboratory there has been virtually no information available on moulting frequency in these forms. In connexion with experiments designed to determine filtering rates and the quantitative aspects of carbon metabolism in the deep-sea planktonic euphausiid shrimp, *Euphausia pacifica*[2], observations were made on the moults and moulting frequency of this animal.

E. pacifica is an important and ubiquitous component of the deep-sea plankton in a broad oceanic region ranging from the north of Japan across the Bering Sea to Baja, California, Mexico[3]. In the laboratory *E. pacifica* has been kept alive for more than 7 weeks on a diet of the green flagellate *Dunaliella primolecta* and/or *Platymonas subcordiformis*.

Each animal, ranging in dry weight from 1·2 to 4·8 mg, was kept in 1 l. of sea water and the water changed every three days. One drop of algal suspension was added daily, but no attempt was made to determine how much food was actually ingested by the euphausiids. All containers were examined daily for cast moults. Recovered moults were rinsed in distilled water, dried at 80° C on a microscope slide and weighed with a Cahn electrobalance to ±0·002 mg. Temperature was not rigidly regulated but normally held within narrow limits. Only those animals which had moulted more than once are included in this work.

The results summarized in Table 1 show that within the range of experimental temperatures (9°–14° C) the moulting frequency was 5 days with a standard deviation of one day (range 4–7 days). Each cast moult averaged 10 per cent of the animal's dry weight. There is no apparent correlation of moulting frequency with temperature or age of the animal, although it is quite likely that furcilia and calyptosis stages have more frequent moults as do most developing crustaceans[1]. Temperature may have had a small effect, but because observations were made daily and not hourly these may have been masked.

One animal lived 50 days in the laboratory and had passed through 11 moults, while another of similar size (1·3 mg) went through 10 moults in 36 days. Ash weights averaged 54·4 per cent of the moult dry weight (range for four determinations 52·9–56·9 per cent) and the organic components 45·6 per cent by difference. Nitrogen was 1·5–2·5 per cent of the moult dry weight or between 3 and 5 per cent of the ash-free moult dry weight.

There are large populations of euphausiid shrimps throughout the deep oceans. If moulting occurs in the sea as frequently as it has been observed in the laboratory, the moults represent a tremendous amount of organic material added daily to the rain of materials known as detritus in the sea. For example, each euphausiid contributes its full body-weight in cast moults every 50 days. The importance of organic detritus in the sea was discussed by Parsons and Strickland[4]. The results presented here show that the moults of planktonic crustaceans could contribute a substantial portion of this material.

REUBEN LASKER

U.S. Bureau of Commercial Fisheries,
Biological Laboratory,
La Jolla, California.

[1] Kurata, H., *Bull. Hokkaido Reg. Fish. Res. Lab.*, No. 24 (1962).
[2] Lasker, R., *Science*, **131**, 1098 (1960).
[3] Brinton, E., *Bull. Scripps Inst. Oceanog.*, **8**, 51 (1962).
[4] Parsons, T. R., and Strickland, J. D. H., *Science*, **136**, 313 (1962).

Table 1. MOULTING FREQUENCY OF *Euphausia pacifica*
(*S.D.*, standard deviation)

Euphausiid	Temperature range	Final animal dry weight (mg)	No. of moults produced	Average weight moult	Time (days) alive in laboratory	Average moulting frequency (days)	Moults = percentage of animal dry weight
1	9·5–12·5	2·333	2	0·247	10	5	10·6
2	9·8–11·2	2·143	2	0·182	14	7	8·5
3	9·8–11·2	4·810	2	0·479	8	4	10·0
4	9·8–13·7	4·800	3	0·416	18	6	8·7
5	9·8–13·7	—	3	—	15	5	—
6	10·8–14·5	1·541	2	0·198	10	5	12·9
7	10·8–14·5	1·975	3	0·167	12	4	8·4
8	10·8–14·5	—	2	0·187	14	7	—
9	10·8–14·5	—	2	0·109	12	6	—
10	10·8–14·5	1·244	2	0·157	9	4	12·7
11	12·3–13·2	—	3	0·249	13	4	—
12	12·3–13·2	—	2	0·263	12	6	—
13	12·5–13·2	4·798	2	0·327	9	5	6·8
14	12·5–13·2	—	2	0·161	7	4	—
15	12·6–14·3	1·300	11	0·128	50	5	9·8
16	12·8–14·2	3·476	3	0·380	12	4	10·9
17	15·4–17·5	—	2	0·146	8	4	—
18	15·4–18·9	1·305	10	0·211	36	4	16·1
19	15·4–18·9	1·326	8	0·121	40	5	9·1
						Av. 5 ± 1 (*S.D.*)	Av. 10·4 ± 2·4 (*S.D.*)

Body Temperature of Yellowfin and Skipjack Tunas in Relation to Sea Surface Temperature

TUNAS are frequently cited as the exception to the generality that fishes are poikilothermic. These references to temperatures higher in tunas than in their environment are mainly based on measurements made with mercury thermometers on isolated specimens at one or two sea temperatures[1], circumstances which result in less-than-accurate temperature measurements, and which fail to describe adequately the body temperature–sea temperature relation over the thermal range of the tunas. The single report[2] of tuna body temperatures over a wide range of sea temperatures is based on measurements made with the mercury thermometer.

In the course of other investigations, we had the opportunity of measuring, with thermoelectric techniques, the