

*Member's Privilege Copy for personal use only*

**JOURNAL OF THE  
MARINE BIOLOGICAL ASSOCIATION  
OF THE UNITED KINGDOM**



**THE PLYMOUTH LABORATORY**

**VOLUME 63, No. 1**  
*(issued February 1983)*

**JMBAK 63 (No. 1) 1-246 (1983) 0025-3154**

**CAMBRIDGE UNIVERSITY PRESS**

**1983**

# THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

## PATRON

H.R.H. THE PRINCE PHILIP DUKE OF EDINBURGH, F.R.S.

## OFFICERS AND COUNCIL

*President:* Prof. J. Z. YOUNG, D.Sc., F.R.S.

### *Vice-Presidents*

Prof. Sir ALISTER C. HARDY, Kt., D.Sc., F.R.S.  
Sir C. MAURICE YONGE, Kt., C.B.E., D.Sc., F.R.S.  
Rear Admiral Sir EDMUND G. IRVING, K.B.E., C.B.  
Sir ALAN L. HODGKIN, O.M., K.B.E., Sc.D., F.R.S.

Sir FREDERICK S. RUSSELL, Kt., C.B.E., D.S.C.,  
D.F.C., D.Sc., LL.D., F.R.S.  
Sir J. ERIC SMITH, Kt., C.B.E., Sc.D., F.R.S.  
Prof. O. E. LOWENSTEIN, D.Sc., F.R.S.

### *Honorary Members*

Sir GEORGE E. R. DEACON, Kt., C.B.E., D.Sc.,  
F.R.S.  
Prof. Sir ALISTER C. HARDY, Kt., D.Sc., F.R.S.

Dr A. C. REDFIELD  
Sir C. MAURICE YONGE, Kt., C.B.E., D.Sc., F.R.S.

## COUNCIL

### Elected Members

Prof. J. A. ALLEN, D.Sc.  
Prof. R. I. CURRIE, C.B.E.  
Prof. G. EGLINTON, D.Sc., F.R.S.  
A. D. HAWKINS, Ph.D.  
Prof. D. A. HAYDON, Ph.D., F.R.S.  
D. J. HIBBERD, Ph.D.  
G. LARMINIE, O.B.E.  
A. S. LAUGHTON, Ph.D., F.R.S.

E. D. LE CREN  
Prof. J. E. LOVELOCK, D.Sc., F.R.S.  
Prof. E. NAYLOR, D.Sc.  
Prof. D. C. SMITH, D.Phil., F.R.S.  
Prof. W. D. P. STEWART, D.Sc., F.R.S.  
MARGARET E. VARLEY, Ph.D.  
ANNE WARNER, Ph.D.

## Governors

A. PRESTON (Ministry of Agriculture, Fisheries  
and Food)  
The Worshipful Company of Fishmongers:  
The Prime Warden  
Col. Sir JOHN G. CAREW POLE, Bt., D.S.O., T.D.  
B. M. TILL, T.D.  
H. C. BENNET-CLARK, Ph.D.  
(Oxford University)

M. J. WELLS, Sc.D. (Cambridge University)  
R. H. HEDLEY, D.Sc. (Zoological Society)  
Sir JOHN A. B. GRAY, Kt., M.B., Sc.D., F.R.S.  
(Royal Society)  
Prof. G. E. FOGG, Sc.D., F.R.S.  
(British Association)  
Prof. R. D. KEYNES, Sc.D., F.R.S.  
(Physiological Society)

*Hon. Treasurer:* B. M. TILL, T.D., Pound House, Nether Cerne, Dorchester, Dorset, DT2 7AJ  
*Secretary:* E. J. DENTON, C.B.E., Sc.D., F.R.S., The Laboratory, Citadel Hill, Plymouth, PL1 2PB

## SCIENTIFIC STAFF

*Director:* E. J. DENTON, C.B.E., Sc.D., F.R.S.

N. A. HOLME, Sc.D., M.A. (*Zoologist*)  
G. R. FORSTER, B.Sc. (*Zoologist*)  
E. D. S. CORNER, M.Sc., Ph.D. (*Biochemist*)  
A. J. SOUTHWARD, D.Sc., Ph.D. (*Zoologist*)  
E. I. BUTLER, C.Chem., F.R.I.C. (*Chemist*)  
J. V. HOWARTH, B.Sc., Ph.D. (*Physiologist*)  
Q. BONE, M.A., D.Phil. (*Zoologist*)  
G. T. BOALCH, B.Sc., Ph.D. (*Phycologist*)  
G. W. BRYAN, D.Sc., Ph.D. (*Zoologist*)  
A. G. DAVIES, B.Sc., Ph.D. (*Physical Chemist*)  
P. R. DANDO, B.Sc., Ph.D. (*Biochemist*)  
P. E. GIBBS, B.Sc., M.A., Ph.D. (*Zoologist*)  
B. L. ROBERTS, M.A., Ph.D. (*Physiologist*)

J. C. GREEN, B.Sc., Ph.D. (*Phycologist*)  
D. K. GRIFFITHS, M.Sc. (*Physical Oceanographer*)  
G. W. POTTS, B.Sc., Ph.D. (*Zoologist*)  
J. B. GILPIN-BROWN, B.Sc., Ph.D. (*Bursar and  
Zoologist*)  
M. WHITFIELD, B.Sc., Ph.D. (*Physical Chemist*)  
M. R. CLARKE, D.Sc., Ph.D., F.R.S. (*Zoologist*)  
R. P. HARRIS, B.Sc., Ph.D. (*Zoologist*)  
P. M. HOLLIGAN, M.A., Ph.D. (*Biochemist*)  
L. MADDOCK, B.Sc., Ph.D. (*Zoologist*)  
J. A. NOTT, Ph.D. (*Zoologist*)  
C. BROWNLEE, Ph.D. (*Plant Physiologist*)

R. D. PINGREE, B.Sc., Dip. Ed., Ph.D., Institute of Oceanographic Sciences (*Oceanographer*)

February 1983

## INSTRUCTIONS FOR THE PREPARATION OF MANUSCRIPTS

### TITLE

The title of the paper should be kept as short as possible.

The name of the author at the beginning of the paper should be followed only by senior qualifications.

### TEXT

Two copies of the typescript should be provided, double spaced throughout, on one side of quarto or A4 paper. Tables and legends for illustrations should be typed separately at the end of the manuscript. All pages should be numbered serially and fastened together securely. Words to be printed in *italic* should be underlined. The first mention of Latin names of species should be followed by the authority except where reference is made to a work in which the authority appears (e.g. *Plymouth Marine Fauna*).

All linear measurements and weights should be in the metric scale.

For symbols and abbreviations, the recommendations of the Royal Society (1951) are followed.

### TABLES

Tables should be set out on separate sheets numbered in Arabic numerals, and given a concise heading.

### FIGURES

Figures should be in black ink. It is important to make the lines sufficiently black.

All illustrations will be reduced to a size not exceeding 20 × 14 cm. No illustrations should be submitted which will not fit into an envelope 30.5 × 40.7 cm (12 × 16 inches).

Lettering, numerals, etc. should be marked clearly in pencil and the exact position in which they are to be inserted should be indicated. Symbols on the figure should be kept to a minimum and details given in the legend.

Axes and graduation marks on graphs must be inked in. The lines on graph paper are not normally reproduced, and should be blue or faint grey.

Legends for figures must be typed all together on a separate sheet, and not inserted on the actual illustrations.

Figures are numbered in arabic numerals, and referred to in the text as 'Fig. 1', etc. Where a figure comprises two or more distinct components they are distinguished by capital letters.

Half-tone photographs will normally be reproduced in the text pages and will be referred to as 'Figures'. Photographs should be printed on smooth-surfaced paper.

### ABSTRACT

Each paper must be accompanied by an informative Abstract, giving the main result of the work and such other information as to make it suitable for publication without change in abstracting journals.

### REFERENCES

References are listed alphabetically at the end of the paper. The full title of the paper must be given. Titles of papers, but not of books, are decapitalized. Titles of Journals are given in full. Where a volume appears in parts the part need only be specified where each has separate pagination. References to books should include the publisher. Citations in text to be given by author's name followed by date in brackets.

#### Examples:

- GOLDBERG, E. D., 1965. Minor elements in sea water. In *Chemical Oceanography*, vol. 1 (ed. J. P. Riley and G. Skirrow), pp. 163-196. New York: Academic Press.
- MARSHALL, S. M., NICHOLLS, A. G. & ORR, A. P., 1939. On the growth and feeding of young herring in the Clyde. *Journal of the Marine Biological Association of the United Kingdom*, **23**, 427-455.
- RUSSELL, F. S. & YONGE, C. M., 1928. *The Seas*. 379 pp. London: Frederick Warne.

**Authors are requested to see that their manuscripts are in finished form and completely ready for publication so that corrections may be reduced to a minimum, and these are confined as far as possible to the first proof. If the cost for correction exceeds a reasonable figure, the author is liable to be charged the full extent of the excess.**

#### SUBSCRIPTIONS

*Journal of the Marine Biological Association of the United Kingdom* is published quarterly. Single parts cost £25.00 net (\$66.00 in the U.S.A. and Canada) plus postage.

Four parts form a volume. The 1983 subscription price of a volume (which includes postage) is £86.00 net (US \$225.00 in the U.S.A. and Canada).

Second class postage paid at New York, N.Y., and at additional mailing offices.

© The Marine Biological Association of the UK 1983

#### PERMISSIONS

##### *Copying*

This journal is registered with the Copyright Clearance Center, New York. Organizations in the U.S.A. who are also registered with C.C.C. may therefore copy material (beyond the limits permitted by sections 107 and 108 of U.S. © law) subject to payment to C.C.C. of the per-copy fee of \$05.00. This consent does not extend to multiple copying for promotional or commercial purposes. Code 0025-3154/83/2828-0001 \$05.00.

*ISI Tear Service*, 325 Chestnut Street, Philadelphia, Pennsylvania 19106, U.S.A., is authorized to supply single copies of separate articles for private use only.

*Microfilm copies* of back numbers are available from Microform Limited, East Ardsley, Wakefield, West Yorkshire, WF3 2AT.

*For all other use*, permission should be sought from the Cambridge or New York offices of the Cambridge University Press.