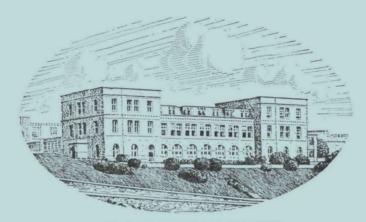
JOURNAL OF THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM



THE PLYMOUTH LABORATORY

VOLUME 52, No. 2 (issued May 1972)

CAMBRIDGE
AT THE UNIVERSITY PRESS
1972

Price £6.00 net (U.S.A. \$19.00)

Annual Subscription for Volume (of four parts): £22.00 net (U.S.A. \$70.00)

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: Sir Alan L. Hodgkin, K.B.E., Sc.D., P.R.S.

Vice-Presidents

Prof. A. V. HILL, C.H., O.B.E., Sc.D., LL.D., F.R.S.

Sir EDWARD J. SALISBURY, Kt., C.B.E., D.Sc., LL.D., F.R.S.

Prof. Sir James Gray, Kt., C.B.E., M.C., Sc.D., LL.D., F.R.S.

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 Frederick S. Russell, Kt., C.B.E., D.S.C., D.F.C., D.Sc., LL.D., F.R.S. Sir EDWARD R. CHADWYCK-HEALEY, Bt., M.C.

Honorary Members

Prof. Sir James Gray, Kt., C.B.E., M.C., Sc.D., LL.D., F.R.S.

Prof. Sir Alister C. Hardy, Kt., D.Sc., F.R.S. E. H. E. HAVELOCK, C.B., C.B.E.

Prof. A. V. HILL, C. H., O.B.E., Sc.D., LL.D., F.R.S. Dr A. G. HUNTSMAN Dr A. C. REDFIELD Sir C. MAURICE YONGE, Kt., C.B.E., D.Sc., F.R.S.

COUNCIL

Elected Members

P. F. BAKER, Ph.D. Prof. H. CHARNOCK Prof. D. J. CRISP, Sc.D., F.R.S. R. I. CURRIE Sir GEORGE DEACON, Kt., C.B.E., D.Sc., F.R.S. M. R. DROOP, D.Sc. J. A. B. GRAY, M.B., Sc.D., F.R.S.

Prof. O. E. LOWENSTEIN, D.Sc., F.R.S. C. E. LUCAS, C.M.G. D.Sc., F.R.S. N. B. MARSHALL, Sc.D., F.R.S. Prof. D. NICHOLS, D.Phil. Prof. T. I. SHAW, Ph.D., F.R.S. H. G. VEVERS, M.B.E., D.PHIL. Prof. J. Z. Young, D.Sc., F.R.S.

Governors

J. GRAHAM (Ministry of Agriculture, Fisheries and Food) The Worshipful Company of Fishmongers:

Sir EDWARD R. CHADWYCK-HEALEY, Bt., M.C. Col. Sir John G. CAREW POLE, Bt., D.S.O., T.D. The Hon. HUGH WALDORF ASTOR, J.P.

Rear Admiral Sir EDMUND G. IRVING, K.B.E., C.B.

Prof. J. W. S. PRINGLE, M.B.E., Sc.D., F.R.S. (Oxford University)

M. J. Wells, Sc.D. (Cambridge University) EDWARD HINDLE, Sc.D., F.R.S. (British Association)

Prof. G. P. Wells, Sc.D., F.R.S. (Zoological Society) Prof. Sir Bernard Katz, Kt., M.D., D.Sc., F.R.S. (Royal Society)

Prof. E. J. DENTON, Sc.D., F.R.S. (Physiological Society)

Hon. Treasurer: The Hon. HUGH WALDORF ASTOR, J. P., 14 Culross Street, London, W1Y 3HN Secretary: J. E. SMITH, Sc.D., F.R.S., The Laboratory, Citadel Hill, Plymouth, PL1 2PB

SCIENTIFIC STAFF

Director: J. E. SMITH, Sc.D., D.Sc., F.I.Biol., F.R.S.

L. H. N. COOPER, D.Sc., F.R.I.C., F.G.S., F.I.Biol., G. W. BRYAN, B.Sc., Ph.D. (Zoologist) F.R.S. (Chemist)

G. M. SPOONER, M.B.E., M.A., F.R.E.S. (Zoologist) MARY W. PARKE, D.Sc., Ph.D., F.L.S., F.I.Biol.,

F.R.S. (Phycologist) P. G. CORBIN, B.A. (Zoologist)

N. A. HOLME, 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) J. V. HOWARTH, B.Sc. (Physiologist)

Q. Bone, M.A., D.Phil. (Zoologist)

G. T. BOALCH, B.Sc., Ph.D. (Phycologist)

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. (Zoologist)

H. MEVES, M.D. (Physiologist)

M. WHITFIELD, B.Sc., Ph.D. (Physical Chemist) M. R. CLARKE, B.Sc., Ph.D. (Zoologist)

J. H. WICKSTEAD, D.Sc., Ph.D., F.I.Biol., Foreign and Commonwealth Office (O.D.A.) (Zoologist) Prof. E. J. DENTON, Sc.D., F.I.Biol., F.R.S. (Physiologist), Royal Society Research Professor of Bristol University MOLLY F. SPOONER, Ph.D. (Special Appointment: oil pollution)

INSTRUCTIONS FOR THE PREPARATION OF MANUSCRIPTS

TITLE

The title of the paper should be kept as short as

The name of the author at the beginning of the paper should be followed only by senior qualifi-

TEXT

Manuscripts must be typed (double-spaced) on one side of the paper, leaving ample margins, with the folios numbered. 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).

Manuscripts should be as concise as possible. Undue length will undoubtedly lead to delay in publication as the paper will be returned to the author for shortening.

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.

TEXT-FIGURES

Text-figures should be in black ink. It is important to make the lines sufficiently black. Areas to be mechanically stippled should be indicated by lightblue pencil shading.

No drawing should be so large that it must be reduced to less than one-third of its original size. The degree of reduction need not be inserted by the author.

Illustrations requiring lettering should not be drawn on Ethulon.

The size of the printed area of the Journal page is 18 × 12 cm. The maximum size for a full-page figure (with legend) is $19\frac{1}{2} \times 13\frac{1}{2}$ cm.

Lettering, numerals, etc., should be marked clearly in blue pencil and indicating the position in which they are to be inserted by an arrow in blue pencil. This should be kept to a workable minimum, all details being included 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.

Text-figures are numbered in arabic numerals, and referred to in the text as 'Fig. 1', etc. Where there is a plate containing several figures, the text-figures are referred to as 'Text-fig. 1', etc.

All line-drawings are printed as text-figures, as well as photographs for which fine detail is not required.

PLATES

Photographs should be on smooth-surfaced paper, semi-matt or glossy. The edges of the photograph must be trimmed square. It is important that the background in the photograph be of a uniform tone and free from blemishes.

Divisions of plates, or separate figures on one plate, are indicated by capital letters.

SUMMARY

Each paper must be accompanied by an informative Summary, giving the main results of the work published.

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 abbreviated as in the World List of Scientific Publications (4th ed., 1963 on). Volume (Vol.), Band (Bd.), or Tome (T.) numbers are in Arabic numerals. 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:

MARSHALL, S. M., NICHOLLS, A. G. & ORR, A. P., 1939. On the growth and feeding of young herring in the Clyde. J. mar. biol. Ass. U.K., Vol. 23, pp. 427-55. 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 corrections exceeds a reasonable figure, the author is liable to be charged the full extent of the excess.

SUBSCRIPTIONS

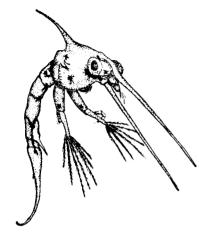
Journal of the Marine Biological Association of the United Kingdom is published quarterly. Single parts cost £6.00 net (\$19.00 in the U.S.A.) plus postage.

Four parts form a volume. The subscription price of a volume (which includes postage) is £22.00 net (\$70. ∞ in the U.S.A.).

Second class postage paid at New York, N.Y.



CAMBRIDGE UNIVERSITY PRESS



Fourth European Marine Biology Symposium

D. J. CRISP, FRS

This volume, resulting from the Symposium, gives up-todate specialist information on the behaviour and structure of the animals that attach themselves to rocks, pilings, ships' hulls, etc. The biology of these animals becomes important in the consideration of ship fouling and mariculture.

The second part of the volume is concerned with the measurement of submarine illumination and the effect of light on the growth of marine algae and on the behaviour and reproduction of marine animals.

£12.40 net

DISCOVERY REPORTS, VOLUME XXXV Pages 199-358

Sperm Whales off Durban

RAY GAMBELL

Studies of the sperm whale population in the south-western Indian Ocean, including analyses of the seasonal movements and social behaviour of the whales, detailed investigations of the male and female reproductive organs, the foetal growth leading to definition of the four-year breeding cycle and the age composition of the population. This information is combined to estimate the size of the total sperm whale stock in the area and the catch yield it will sustain.

£10.00 net

DISCOVERY REPORTS, VOLUME XXXVI Pages 1–94

Life Cycle of Antarctic Krill in Relation to Ice and Water Conditions

N. A. MACKINTOSH

The Antarctic krill constitutes the staple diet of whales and is of interest as a potential source of protein and other materials. This report supplies new information on the spawning season and distribution of larvae in relation to currents, and shows how reproduction and rates of growth vary with latitude, pack ice distribution and sea temperatures.

£.7.00 net

Underwater Science

An Introduction to Experiments by Divers

Edited by J. D. WOODS and J. N. LYTHGOE

Marine scientists are devising new methods of performing experiments under the sea with the same scientific rigour as those performed on a ship or in the laboratory. In this book, nine experienced British divers write about the impact of these new techniques on their scientific disciplines, ranging from archaeology and geology to fish behaviour and fluid dynamics. Psychological aspects of man's behaviour under the sea are reviewed, and an introductory chapter by the editors summarizes the problems that confront all underwater scientists and describes apparatus and techniques that successfully overcome them. The emphasis throughout the book is on the practical aspects of underwater experimentation. 104 textfigures, 1 in colour £4



OXFORD UNIVERSITY PRESS

PROCEEDINGS OF THE MALACOLOGICAL SOCIETY OF LONDON

Vol. 40, Part 1, April 1972

£2.00 net, or \$6.50 U.S.

- J. W. CRAYTON and M. MIROLLI. Prismatic mitochondria in neurons of *Navanax inermis*: structure and subcellular distribution
- GEORGE M. DAVIS. Geographic variation in Semisulcospira libertina (Mesogastropoda: Pleuroceridae)
- GRAHAM WALKER. The digestive system of the slug, Agriolimax reticulatus (Müller): experiments on phagocytosis and nutrient absorption
- BRUCE RUNNEGAR. Anatomy of *Pholadomya candida* (Bivalvia) and the origin of the Pholadomyidae
- JUNE E. CHATFIELD. Observations on the ecology of *Monacha cantiana* (Montagu) and associated molluscan fauna

Annual subscription (three parts) £5.00 (\$17.00) post free.

BLACKWELL SCIENTIFIC PUBLICATIONS LTD

Oxford London Edinburgh Melbourne

THE JOURNAL OF ANIMAL ECOLOGY

EDITORS: H. N. SOUTHERN and E. BROADHEAD

Vol. 41, No. 1

FEBRUARY 1972

- J. L. Harley. Fungi in ecosystems.
- Yoram Yom-Tov. Field experiments on the effect of population density and slope direction on the reproduction of the desert snail *Trochoidea* (Xerocrassa) seetzeni.
- P. B. Heppleston. The comparative breeding ecology of oystercatchers (*Haematopus ostralegus* L.) in inland and coastal habitats.
- **Roger Kitching.** Population studies of the immature stages of the tree-hole midge *Metriocnemus martinii* Thienemann (Diptera: Chironomidae).
- J. H. Sudd. The distribution of spiders at Spurn Head (E. Yorkshire) in relation to flooding.
- W. R. Siegfried. Aspects of the feeding ecology of cattle egrets (Ardeola ibis) in South Africa.
- Myrfyn Owen. Some factors affecting food intake and selection in white-fronted geese.
- **Dale Straughan.** Ecological studies of *Mercierella enigmatica* Fauvel (Annelida: Polychaeta) in the Brisbane River.
- **Douglas E. Gill and Nelson G. Hairston.** The dynamics of a natural population of *Paramecium* and the rôle of inter-specific competition in community structure.
- P. M. Greenham. The effects of the variability of cattle dung on the multiplication of the bushfly (Musca vetustissima Walk.)
- T. G. Piearce. The calcium relations of selected Lumbricidae.
- R. N. Gibson. The vertical distribution and feeding relationships of intertidal fish on the Atlantic coast of France.
- J. A. Bishop. An experimental study of the cline of industrial melanism in *Biston betularia* (L.) (Lepidoptera) between urban Liverpool and rural North Wales.

Subscription price £14.00 per volume of three parts (single parts £5.25 each)

BLACKWELL SCIENTIFIC PUBLICATIONS LTD
OSNEY MEAD · OXFORD

THE JOURNAL OF ECOLOGY

EDITORS: A. J. WILLIS and P. J. GRUBB

Vol. 60, No. 1

MARCH 1972

- J. A. Rogers and J. King. The distribution and abundance of grassland species in hill pasture in relation to soil aeration and base status.
- **Graham P. Harris.** The ecology of corticolous lichens. III. A simulation model of productivity as a function of light intensity and water availability.
- Hikmat A. Al-Ani, B. R. Strain and H. A. Mooney. The physiological ecology of diverse populations of the desert shrub *Simmondsia chinensis*.
- J. G. Jones. Studies on freshwater bacteria: association with algae and alkaline phosphatase activity.
- M. A. Ross and John L. Harper. Occupation of biological space during seedling establishment.
- Nancy N. Shontz and John P. Shontz. Competition for nutrients between ecotypes of Galinsoga ciliata.
- **A. Gigon and I. H. Rorison.** The response of some ecologically distinct plant species to nitrateand to ammonium-nitrogen.
- A. J. C. Malloch. Salt-spray deposition on the maritime cliffs of the Lizard Peninsula.
- **P. D. Putwain and John L. Harper.** Studies in the dynamics of plant populations. V. Mechanisms governing the sex ratio in *Rumex acetosa* and *R. acetosella*.
- **R. Jones.** Comparative studies of plant growth and distribution in relation to waterlogging. V. The uptake of iron and manganese by dune and dune slack plants.
- **R. Jones.** Comparative studies of plant growth and distribution in relation to waterlogging. VI. The effect of manganese on the growth of dune and dune plants.
- Rexford Daubenmire. Phenology and other characteristics of tropical semi-deciduous forest in north-western Costa Rica.
- N. J. Grundon. Mineral nutrition of some Queensland heath plants.
- Hilary H. Birks. Studies in the vegetational history of Scotland. II. Two pollen diagrams from the Galloway Hills, Kirkcudbrightshire.
- **R. K. Robinson.** The production by roots of *Calluna vulgaris* of a factor inhibitory to growth of some mycorrhizal fungi.
- John Miles. Experimental establishment of seedlings on a southern English heath.

BIOLOGICAL FLORA OF THE BRITISH ISLES

- A. D. Horrill. Melampyrum cristatum L.
- P. W. Richards and G. B. Evans. Hymenophyllum tunbrigense (L.) Sm. and H. wilsonii Hooker.

Subscription price £14.00 per volume of three parts (single parts £5.25 each)

BLACKWELL SCIENTIFIC PUBLICATIONS LTD OSNEY MEAD · OXFORD