



JMBA

VOLUME 78:1 FEBRUARY 1998

JOURNAL OF THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

SUBSCRIPTIONS

The *Journal of the Marine Biological Association* (ISSN: 0025-3154) is published four times a year in February, May, August and November. The subscription price (excluding VAT) of Volume 78 to non-members of the Association is £237 in the UK and all other parts of the world except North America. Subscription price in the USA, Canada and Mexico is US \$415. Single parts cost £62 (US \$110 in USA, Canada and Mexico). The above prices are payable in advance. Prices include delivery by air where appropriate. EU subscribers (outside the UK) who are not registered for VAT should add VAT at their country's rate. VAT registered subscribers should provide their VAT registration number. Subscriptions may be sent to any bookseller or to the publisher: Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, UK, or in USA, Canada and Mexico, to Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211, USA. Japanese prices for institutions are available from Kinokuniya Company Ltd, PO Box 55, Chitose, Tokyo 156, Japan. Periodicals postage paid at New York, NY and at additional mailing offices. POSTMASTER: send address changes in the USA, Canada and Mexico to *Journal of the Marine Biological Association*, Cambridge University Press, 110 Midland Avenue, Port Chester, NY 10573-4930, USA. All orders must be accompanied by payment.

© 1998 Marine Biological Association of the United Kingdom (Registered charity no. 226063)

PERMISSIONS

Copying

This journal is registered with the Copyright Clearance Center, New York. Organizations in the USA who are registered with CCC may therefore copy material (beyond the limits permitted by sections 107 and 108 of the US © law) subject to payment to CCC of the per copy fee of \$12.50. This consent does not extend to multiple copying for promotional or commercial purposes. Code 0025-3154/98 \$12.50

The Genuine Article®, ISI, 3501 Market Street, Philadelphia, Pennsylvania 19104, USA, is authorized to supply single copies of separate articles for private use only.

Microfilm copies of back numbers are available from University Microfilms International, 300 North Zeeb Road, MI 48106-1346, USA.

Organizations authorized by the Copyright Licensing Agency may also copy material subject to the usual conditions.

For all other use, permission should be sought from Cambridge or the American Branch of Cambridge University Press.

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, CB2 1RP, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge, CB2 2RU, United Kingdom
40 West 20th Street, New York, NY 10011-4211, USA
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

Printed in the United Kingdom by the University Press, Cambridge

Cover: The photograph on the outside of the cover was taken by David Nicholson at Pedney Beach, Cornwall

© 1998 Marine Biological Association of the United Kingdom (Registered charity no. 226063)

JOURNAL OF THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

Editor: Dr Michael Whitfield

Executive editor: Dr Ann L. Pulsford

Editorial assistants: Mrs Belinda T. Tarran and Miss Freyja Lockwood BSc

Address all communications to:

The Executive Editor, Journal of the Marine Biological Association, The Laboratory, Citadel Hill, Plymouth, PL1 2PB, UK

(Tel:+44 (0)1752 633100; Fax:+44 (0)1752 633102; e-mail:journal@mba.ac.uk)

EDITORIAL BOARD

Prof. B.L. Bayne, Centre for Coastal and Marine Sciences, UK

Dr P.J. Herring, George Deacon Division, Southampton Oceanography Centre, UK

Prof. C.C.E. Hopkins, ICES, Copenhagen, Denmark

Dr R.J. Lincoln, Natural History Museum, UK

Dr K. Nagasawa, National Research Institute of Far Seas Fisheries, Japan

Dr M.G. Pawson, Ministry of Agriculture, Fisheries and Food, Lowestoft, UK

Dr D.A. Ritz, University of Tasmania, Tasmania, Australia

Prof. R. Seed, School of Ocean Sciences, University of Wales, Bangor, UK

Prof. M.A. Sleight, University of Southampton, UK

Dr R. Strathmann, Friday Harbor Laboratories, USA

Prof. H. Thiel, Alfred Wegener Institute, Bremerhaven, Germany

Prof. J.S. Wroblewski, Memorial University of Newfoundland, Canada

EDITORIAL POLICY

The *JMBA* publishes papers on all aspects of marine biology and oceanography. Papers should report the results of original research and must not have been published, or be under consideration for publication, elsewhere. Short communications, which may also report on new methods or techniques, should not exceed four printed pages, including tables and illustrations. If there is a particular reason why rapid publication is required this should be stated with the submission. Papers will be accepted only after receiving a satisfactory report from at least two independent reviewers, drawn from an international panel of referees. Any author wishing to write a review should, in the first instance, send a proposal to the editor for consideration by the editorial board.

Papers describing work involving experimental procedures on living animals will be published only if they comply with the legal requirements of the UK Home Office. In the case of species not covered by the current law, papers will be published only if it is judged that the experiments have been conducted in a humane manner and adequate precautions taken to minimize stress.

Authors may like to know that papers published in the *JMBA* are covered by the following abstracting or indexing services: *Animal Breeding Abstracts*, *ASFA*, *Biological Abstracts*, *Biological and Agricultural Index*, *Chemical Abstracts*, *Current Advances in Ecological Sciences*, *Current Contents*, *Current Titles in Oceanography*, *FISHLIT*, *Geological Abstracts*, *GeoRef*, *Helminthological Abstracts*, *Lead Abstracts*, *Nutrition Abstracts*, *Oceanic Abstracts*, *Selected Water Resources Abstracts*, *Zincscan*.

THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

The Association is a registered charity and was founded in 1884 to promote accurate researches leading to the advancement of zoological and botanical science and to an increase in our knowledge of the food, life, conditions and habits of British fishes. The work of the Association is controlled by a Council elected annually by its subscribing members.

The Plymouth Laboratory was opened in June 1888, and, since that date, considerable additions have been made to the buildings, including a library, lecture-hall, and extensive laboratory accommodation with up-to-date equipment. Additional sea-water reservoirs have also been built, and an aquarium which is open to the public.

The Marine Biological Association, under the direction of its Council, has undertaken research in all branches of marine science and many of the results have been published in this Journal. An account of the history of the first hundred years of the Association and Journal may be found in Volume 67 (pp. 463 and 465). Summaries of the activities and research of the Association are given annually in the Report of the Council, sent to members in April, and to other subscribers with the November issue of the *JMBA*.

Since its foundation the Association has been supported by grants from Research Councils and by subscriptions and donations from private members, universities, learned societies, the Fishmongers' Company and other public bodies.

In 1988 an agreement was reached between the MBA Council and the Natural Environment Research Council to merge a large part of the Plymouth Laboratory with the NERC's Institute for Marine Environmental Research, which had been in Plymouth since 1971. The new laboratory is known as the Plymouth Marine Laboratory and consists of the staff of the two laboratories housed in both buildings.

The Marine Biological Association retains the lease of the building on Citadel Hill and continues as a very active scientific society with a large international membership. The MBA manages a research programme carried out by research fellows and scientific visitors, publishes an International Journal, runs a public Aquarium, and organizes scientific meetings.

TERMS OF MEMBERSHIP FOR 1998

Annual members, receiving the Journal, per annum	£38.00*
Annual members, without the Journal, per annum	£18.00*
Corporate members, per annum	£250.00
Student members, with the Journal, per annum (non-voting)	£15.00
Student members, without the Journal, per annum (non-voting)	£5.00

Annual subscriptions become due on 1 January, student subscriptions on 1 November.
*Subscriptions are £35 and £15 if paying by direct debit (or credit card for overseas members).

Members of the Association have the following rights and privileges: they elect annually the Officers and Council; they are entitled to receive the Journal of the Association at the Members' rate; they are admitted to view the laboratory at Plymouth; they have the first claim to rent a place in the laboratory for research, with use of tanks, boats, etc.; they have the opportunity of occupying a table for one week in each year free of charge; and they have access to the books in the library at Plymouth during working hours. Corporate members have significant additional rights and privileges, details of which can be supplied on request. Student members do not have voting rights and their occupancy of a table at the laboratory must be in collaboration with a full member. The Commissioners of Inland Revenue have approved the Association for the purposes of Section 16, Finance Act, 1958, and that the whole of the annual subscriptions paid by a member who qualifies for relief under the section will be allowable as a deduction from his emoluments assessable to income tax under Schedule E.

All correspondence should be addressed to: The Membership Secretary, Marine Biological Association, The Laboratory, Citadel Hill, Plymouth, PL1 2PB, UK (Tel: +44 (0)1752 633331; Fax:+44 (0) 1752 669762; e-mail: sec@mba.ac.uk).