

JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

CHEF-HERAUSGEBER

EDITOR-IN-CHIEF

EDITEUR-EN-CHEF

Charles W. Finkl, Jr.

Coastal Education and Research Foundation, Inc. [CERF]

Editorial Offices:

Post Office Box 210187
Royal Palm Beach, FL
33421-0187, USA

1656 Cypress Row Drive
West Palm Beach, FL
33411, USA

e-mail: cfinkl@gate.net
(Editorial Office, West Palm Beach)
CERF/JCR Website: <http://www.CERF-JCR.com>

DEPUTY EDITOR-IN-CHIEF

Gregory W. Stone

Coastal Studies Institute, Louisiana State University, Baton Rouge, LA 70803

BOOK REVIEW EDITOR

J.A.G. Cooper
University of Ulster
Coleraine, N. Ireland

JCR PUBLICATIONS MANAGER

Sabrina Mowry
P.O. Box 1897, Lawrence, KS 66044, USA
Telephone: (785) 843-1235/FAX (785) 843-1274

CONSULTING EDITORS

Rhodes W. Fairbridge
NASA, GISS
New York, New York

Per Bruun
Hilton Head, South Carolina

MITHERAUSGEBER

BIOLOGICAL SCIENCES
Ad H.L. Huiskes
Yerseke, The Netherlands

COASTAL GEOLOGY
Frank Stapor
Cookville, Tennessee

COASTAL DYNAMICS
Joseph F. Donoghue
Tallahassee, Florida

ASSOCIATE EDITORS

ENGINEERING & TECHNOLOGY
Nobuhisa Kobayashi
Newark, Delaware

ENGINEERING & TECHNOLOGY
Pravi Shrestha
Mahwah, New Jersey

COASTAL GEOLOGY
Duncan M. FitzGerald
Boston, Massachusetts

COASTAL DYNAMICS
Robert J. Nicholls
Middlesex, U.K.

MANAGEMENT
David W. Fischer
Ensenada, BC, Mexico

COASTAL PROCESSES
Charitha Pattiaratchi
Perth, Western Australia

COMITÉ DE REDACTION

REMOTE SENSING
Elijah W. Ramsey III
Lafayette, Louisiana

MARINE GEOLOGY
Terry R. Healy
Hamilton, New Zealand

COASTAL ENGINEERING
Marcel J.F. Stive
Delft, The Netherlands

REDAKTIONSKOMMITEE

T. Aanand
Dona Paula, India
Edward J. Anthony
Dunkerque, France
Mytheenkhan Baba
Trivandrum, India
Cecile Baeteman
Brussels, Belgium
James H. Balsillie
Tallahassee, Florida
Daniel F. Belknap
Orono, Maine

Eric C.F. Bird
Black Rock, Vic., Australia
Charles Birkeland
Mangilao, Guam

Kerry Black
Hamilton, New Zealand
Clinton J. Dawes
Tampa, Florida

Robert Dean
Gainesville, Florida
Ron DeLaune
Baton Rouge, Louisiana

Reinhard Dieckmann
Bremerhaven, Germany
Jean-Claude Dionne
Québec, Canada

Yuri Dolotov
Moscow, Russia
Ken Dunton
Port Aransas, Texas

Lionel N. Eleuterius
Ocean Springs, Mississippi

EDITORIAL BOARD

Michael S. Fenster
Richmond, Virginia
Donald L. Forbes
Dartmouth, Canada
Cyril Galvin
Springfield, Virginia
F. Gerritsen
Hilton Head, South Carolina

Edgardo D. Gomez
Quezon City, Philippines
Gary B. Griggs
Santa Cruz, California

Lee E. Harris
Melbourne, Florida
Bruce Hayden
Charlottesville, Virginia

Carl H. Hobbs, III
Gloucester Point, Virginia
David Hopley
Townsville, Qlds., Australia

Per Roed Jakobsen
Lemvig, Denmark
Saskia Jelgersma
Bergen, The Netherlands

Paul Kaplin
Moscow, Russia
Dieter Kelletat
Essen, Germany

Joseph T. Kelley
Orono, Maine
Syed Khalil
Calcutta, India

Vic Klemas
Newark, Delaware

N. Kobayashi
Newark, Delaware
Pierre Lasserre
Paris, France
S.P. Leatherman
Miami, Florida
Ioannis Liritzis
Rhodes, Greece

Jeffrey H. List
Woods Hole, Massachusetts
Gerd Masselink
Loughborough, U.K.

M. Anwar Maun
London, Ontario, Canada
Nobuo Mimura
Ibaraki, Japan

Robert A. Morton
St. Petersburg, Florida
Robert Nicholls
Middlesex, U.K.

P. Nielsen
Brisbane, Qlds., Australia
Karl F. Nordstrom
New Brunswick, New Jersey

Patrick Nunn
Suva, Fiji
Randall W. Parkinson
Melbourne, Florida

Roland P. Paskoff
Le Chesnay, France
Orrin H. Pilkey, Jr.
Durham, N. Carolina

Paolo A. Pirazzoli
Paris, France

COMMISSION DE PUBLICATION

Norbert P. Psuty
New Brunswick, New Jersey
Ulrich Radtke
Köln, Germany

Michael R. Rampino
New York, New York
Denise Reed
New Orleans, Louisiana

Bernard Salvat
Paris, France
Toru Sawaragi
Osaka, Japan

Maurice L. Schwartz
Bellingham, Washington
Andrew D. Short
Sydney, NSW, Australia

F. van der Meulen
The Hague, The Netherlands
Herman Th. Verstappen
Enschede, The Netherlands

H.J. Walker
Baton Rouge, Louisiana
Ping Wang
Baton Rouge, Louisiana

John T. Wells
Chapel Hill, N. Carolina
Eric Wolanski
Townsville, Qlds, Australia

P.L. Woodworth
Merseyside, England
Donald R. Young
Richmond, Virginia

Robert S. Young
Stillwell, North Carolina

COPYRIGHT

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by the Coastal Education and Research Foundation (CERF). This consent does not extend to other kinds of copying, such as copying for general distributions, for creating new collective works, or for resale.

It is a condition of publication that manuscripts submitted to this journal have not been published, nor will they be simultaneously submitted or published elsewhere. By submitting a manuscript, the authors agree that the copyright for their article is transferred to the publisher if the article is accepted for publication. Assignment of copyright is not required, however, from authors who work for organizations which do not permit such assignment. The copyright covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproductions, microform or any other reproductions of a similar nature, and translations.

The JOURNAL OF COASTAL RESEARCH (ISSN 0749-0208) is published quarterly by the Coastal Education & Research Foundation [CERF], 810 East 10th St., Lawrence, KS 66044, USA. Subscription rates for 2000 are \$US 145.00 for institutions, \$US 65.00 for individuals and \$US 45.00 for students. Members of the Coastal Education and Research Foundation (CERF) receive the journal for \$US 55.00. All subscribers outside the USA please add \$US 10.00 for surface postage. Single back issues and parts are available at current subscription rates. Second class postage paid at Lawrence, Kansas, USA. POSTMASTER: Send address changes to JOURNAL OF COASTAL RESEARCH, P.O. Box 368, Lawrence, KS 66044, USA.

Claims for Missing Issues: No claims allowed for (1) insufficient notice of address change; (2) issues lost in mail unless claimed within (a) 90 days for USA, or (b) 120 days for other countries, from last day of month of publication; or (3) such reasons as "missing from files."

© 2000, the Coastal Education & Research Foundation [CERF]. Printed by Allen Press, Inc., Lawrence, Kansas, USA.

JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

Supporting Scientific Organizations

- Florida Shore and Beach Preservation Association (**FSBPA**) [Tallahassee, Florida, USA]
- International Union for Quaternary Research (**INQUA**): Commission on Quaternary Shorelines, The Holocene Commission, and The Neotectonics Commission.
- International Geological Correlation Program (**IGCP**) (supported by the International Union of Geological Sciences and UNESCO): Project No. 367 — Late Quaternary Coastal Records of Rapid Change: Application to Present and Future Conditions.
- The International Geographical Union (**IGU**): Commission on the Coastal Environment.
- International Institute for Aerial Survey and Earth Sciences (**ITC**) [Enschede, The Netherlands].
- International Association for Biological Oceanography (**IABO**).
- International Association of Meiobenthologists (**IAM**).
- International Post-Graduate Training Courses on Fundamental and Applied Quaternary Geology (**IFAQ**) [Brussels, Belgium].

Aims and Scope of the Journal

Journal of Coastal Research, an International Forum for the Littoral Sciences, is dedicated to all aspects of coastal research. These include geology, biology, geomorphology (physical geography), climate, littoral oceanography, hydrography, coastal hydraulics, environmental (resource) management, engineering, and remote sensing. Although each field functions effectively within its own purview, the cross-disciplinary nature of coastal studies requires familiarity with other fields as well. Hence, the scope of topics is necessarily broad in order to address the complexity of coastal biophysical and socio-economic interactions. Because of the wide range of interrelated topics, the journal invites original contributions and manuscripts dealing with theory, methodology, techniques, and field or applied topic studies on interdisciplinary coastal issues.

The journal encourages the dissemination of knowledge and understanding of the coastal zone by promoting cooperation and communication between specialists in different disciplines. Natural scientists, for example, are encouraged to collaborate with professionals in other fields to prepare contributions relating to the coastal zone that foster increased appreciation of coastal environments and processes. By means of this journal, with its scholarly and professional papers, systematic review articles, book and symposia reviews, communications and news, and special topical issues, an international forum for the development of integrated coastal research is provided.

Subscription Information

Editorial, Advertising and Publishing Office: Dr. Charles W. Finkl, Jr., Editor-in-Chief, P.O. Box 210187, Royal Palm Beach, FL 33421, USA. Telephone: (561) 753-7557. FAX: (561) 753-7558. All certified or registered mail should be sent to Dr. Charles W. Finkl, Jr., Editor-in-Chief, Journal of Coastal Research, 1656 Cypress Row Drive, West Palm Beach, FL 33411, USA. Additional information at our website: <http://www.CERF-JCR.com>.

Advertising and Promotion Office: David Wiley, 1041 New Hampshire Street, Lawrence, KS 66044. Telephone: (785) 843-1235. FAX: (785) 843-1274.

Subscriptions Office: Robert P. Kerley, P.O. Box 1897, Lawrence, KS 66044 USA. Telephone: (785) 843-1235. FAX: (785) 843-1274.

Published Quarterly in January, April, July, and October. *Annual Subscription Rate* (1998): \$US 45.00 (Student), \$US 65.00 (Personal), \$US 145.00 (Institution). Subscribers outside of the USA please add \$US 10.00 for surface postage or \$US 50.00 for airmail postage and handling. Back issues (from Volume 3 onwards) are available at current subscription rates.

THE JOURNAL OF COASTAL RESEARCH is surveyed in *Applied Science & Technology Index* (This is a new service of the JCR); *Aquatic Sciences and Fisheries Abstracts*; *Civil Engineering Hydraulics Abstracts*; *Current Awareness in Biological Sciences*; *Current Contents/Agriculture*; *Biology & Environmental Sciences*; *Ecology Abstracts*; *FLUIDEX (British Hydromechanics Research Association)*; *Focus on: Global Change*; *GeoAbstracts (Geographical Abstracts: Physical Geography; Ecological Abstracts; Geological Abstracts; GEOBASE)*; *GeoScience Contents*; *Institute of Scientific Information (USSR)*; *Marine Science Contents Tables*; *Meteorological and Geostrophysical Abstracts*; *Oceanic Abstracts*; *Oceanographic Literature Review*; *Physics Abstracts*; *Pollution Abstracts*; *Selected Water Resources Abstracts (U.S. Geological Survey)*; *UnCover*; *Wetland Values Database (U.S. Fish & Wildlife Service)*; and *SciSearch*.

FLORIDA ATLANTIC
UNIVERSITY

OCT 12 2000

LIBRARY
Boca Raton, Florida

JOURNAL OF COASTAL RESEARCH

SUBSCRIPTION INFORMATION

The **JOURNAL OF COASTAL RESEARCH (JCR)**, official publication of the **Coastal Education & Research Foundation [CERF]** (a non-profit corporation), acts as a basic world publication for coastal research. The journal publishes original contributions that deal with theory, methodology, techniques, and field or applied studies on inter-disciplinary topics. All aspects of coastal research are considered in the fields of biology, geology, geography, oceanography, environmental (resource) management, engineering, and remote sensing, among others. **JCR** is surveyed in: Aquatic Sciences and Fisheries Abstracts; Current Awareness in Biological Sciences; Current Contents/Agriculture, Biology and Environmental Sciences; Ecology Abstracts; FLUIDEX (British Hydromechanics Research Association); GeoAbstracts; Institute of Scientific Information (Russia); Meteorological and Geostrophysical Abstracts; Oceanic Abstracts; Oceanographic Literature Review; Physics Abstracts; and Pollution Abstracts.

JCR is published quarterly in about 1200 volume pages. ISSN 0749-0208.

FOUNDATION MEMBERSHIP BENEFITS

- Our scientific journal (JCR)
- Participation and sharing with a distinguished international group of scholars and scientists
- Foundation newsletter
- Notices of meetings
- Discounts on CERF Books
- State-of-the-art reviews
- Reports of meetings
- Technical communications
- Book reviews
- News from affiliated societies
- Coastal calendar of events

Please enroll me as a member of the Coastal Education & Research Foundation [CERF]

My payment is enclosed for the category marked below:

2000 Volume 16, Numbers 1-4 inclusive

- Regular membership and subscription (1 year) \$60.00/\$70.00 foreign*
- Student membership and subscription (1 year) \$45.00/\$55.00 foreign

* Surface postage is included in the membership and subscription rates.

FOR LIBRARIES, SCHOOLS & ORGANIZATIONS

Subscriptions (when not for individual personal use)

Subscription (U.S.A.—Library)	\$145.00
Subscription (other countries)	\$155.00

PLEASE MAKE CHECK PAYABLE TO: CERF

NAME OF APPLICANT _____ DEGREE _____

ADDRESS FOR MAIL _____

City State or Province Zip Code Country

Position or Title _____ Phone _____

Student Status Certified by: Major Prof _____ Dept. Head _____

MAIL TO:

JOURNAL OF COASTAL RESEARCH

P.O. BOX 1897
Lawrence, KS 66044, USA

Telephone (785) 843-1235

FAX (785) 843-1274

E-mail: am&m@allenpress.com