

COVER PHOTOGRAPH AND FRONT MATTER: FORMER DUTCH DUNES, NOW BULBFIELDS, BETWEEN HAARLEM AND THE HAGUE IN FULL BLOOM

Source: Journal of Coastal Research, 28(4)

Published By: Coastal Education and Research Foundation

URL: <https://doi.org/10.2112/1551-5036-28.4.ii>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.



www.JCRonline.org

COVER PHOTOGRAPH



FORMER DUTCH DUNES, NOW BULBFIELDS, BETWEEN HAARLEM AND THE HAGUE IN FULL BLOOM

The dunes along the Dutch mainland coast consist of Old Dunes (*ca* 5000-0 BC) and Young Dunes (*ca* 0-1200 AD), which have been partly deposited over the Old Dunes. The Old Dunes consist of low parallel beach barrier ridges with old dune deposits and intermittent troughs. Since the 1850s large parts of the Old Dunes were excavated. Much of the sand was used to raise the soil for the layout of new extensions of growing cities like Haarlem and Amsterdam, which lie in the low polderland behind the dunes. The sand was sometimes mixed with peat and clay to form man-made culture soils that now lay between the dunes and the polderlands. The elevation of the flat lands is at a particular height above ground water. The soils proved to be very suited for the cultivation of various species of bulb plants, such as daffodils, tulips and hyacinths. In springtime these former dune areas turn into colourful blankets of red, yellow, purple and blue. The landscape is world famous and visited by many tourists. (Photograph by Frank van der Meulen, Delft, The Netherlands, Spring 2012.)

JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

CHEF-HERAUSGEBER

EDITOR-IN-CHIEF

RÉDACTEUR-EN-CHEF

Charles W. Finkl

Coastal Education and Research Foundation, Inc. [CERF]

Editorial Offices:

1656 Cypress Row Drive
West Palm Beach, FL
33411, U.S.A.

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

BOOK REVIEW EDITOR

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

MANAGING EDITOR

Tracy Candelaria
Allen Press Publishing Services
810 E. 10th Street
Lawrence, KS 66044, U.S.A.
tcandelaria@allenpress.com

PUBLISHING MANAGER

Christopher Makowski
CERF
1656 Cypress Row Drive
West Palm Beach, FL 33411, U.S.A.
cmakowski@cerf-jcr.com

EDITORIAL ASSISTANT

Barbara Russell
CERF
1656 Cypress Row Drive
West Palm Beach, FL 33411, U.S.A.
barbara@cerf-jcr.com

MITHERAUSGEBER

Edward J. Anthony
Coastal Geomorphology,
Beach Morphodynamics
Dunkerque, France
Cecile Baeteman
Holocene Coastal Dynamics,
Sea-Level Change
Brussels, Belgium
Kenneth Banks
Coral Reef Geomorphology,
Habitat Mapping
Plantation, Florida
Patrick Barnard
Coastal Geomorphology
Santa Cruz, California
Lindino Benedet
Oceanography, Modeling
Florianópolis, Santa Catarina, Brazil
David M. Bush
Coastal Geology & Hazards
Carrollton, Georgia
Ilya V. Buynevich
Coastal Geology
Philadelphia, Pennsylvania
Javier A. Carrió
Sediment Processes, Marine Geology
Valencia, Spain
Roger Charlier
Ocean Energies, Coastal Erosion
Brussels, Belgium
Paolo Ciavola
Coastal Engineering,
Sediment Transport
Ferrara, Italy
Mark Crowell
Coastal Zone Management,
Coastal Erosion
McLean, Virginia
Bijan Dargahi
Sediment Transport,
Numerical Modeling
Stockholm, Sweden
Robert Dean
Coastal Engineering & Processes
Gainesville, Florida
Omar Defeo
Sandy Beach Ecology, Invertebrates
Montevideo, Uruguay
Reinhard Dieckman
Coastal Engineering & Geomorphology
Arnis/Schlei, Germany
Joseph F. Donoghue
Coastal Morphology & Hazards
Tallahassee, Florida
Michael S. Fenster
Shoreline Change,
Barrier Island Morphodynamics
Richmond, Virginia
Oscar Manuel Ferreira
Storm Impacts,
Beach Morphodynamics
Faro, Portugal
Chip Fletcher
Coastal Geology
Honolulu, Hawaii

ASSOCIATE EDITORS

Gary B. Griggs
Coastal Engineering & Hazards
Santa Cruz, California
Pramod Hanamgond
Coastal Geomorphology,
Sedimentology
Belgaum, India
Hans Hanson
Coastal Protection,
Numerical Modeling
Lund, Sweden
Simon Haslett
Paleoceanography, Coastal Evolution
Wales, United Kingdom
Michael Hilton
Dune Geomorphology & Ecology
Dunedin, New Zealand
Carl H. Hobbs, III
Coastal Geology, Sand Mining
Gloucester Point, Virginia
Wenrui Huang
Coastal Hydrodynamics & Hazards
Tallahassee, Florida
Michael G. Hughes
Coastal Morphodynamics,
Shelf Processes
Canberra, ACT, Australia
Federico I. Isla
Sea-Level Change, Remote Sensing
Mar Del Plata, Argentina
Derek W.T. Jackson
Aeolian Sediment Transport,
Beach Morphodynamics
Coleraine, Northern Ireland
Nancy L. Jackson
Coastal Geomorphology
Newark, New Jersey
Markes E. Johnson
Paleoshores, Coastal Sand Dunes
Williamstown, Massachusetts
Dieter H. Kelletat
Coastal Geomorphology,
Sea-Level Change
Essen/Cologne, Germany
Joseph T. Kelley
Sea-Level Change,
Salt Marsh Ecogeomorphology
Orono, Maine
Syed Khalil
Coastal Geology & Geophysics
Baton Rouge, Louisiana
Antonio H.F. Klein
Coastal Morphodynamics & Hazards
Florianópolis, Santa Catarina, Brazil
Vic Klemas
Remote Sensing,
Global Environmental Change
Newark, Delaware
Nobuhisa Kobayashi
Coastal Engineering
Newark, Delaware
Vladimir N. Kosmynin
Coral Reefs, Coastal Ecology
Tallahassee, Florida

Joseph L. Kowalski
Estuarine Plant Ecology
Edinburg, Texas
Michael J. Lace
Coastal Landforms & Processes
West Branch, Iowa
Stephen P. Leatherman
Barrier Islands, Beach Erosion
Miami, Florida
Charles Lemckert
Environmental Fluid Dynamics
Queensland, Australia
Ioannis Liritzis
Geophysical Proxy Data
Rhodes, Greece
Jeffrey H. List
Shoreline Change Processes
Woods Hole, Massachusetts
Christopher Makowski
Coastal Benthic Ecology,
Marine Ecosystem Monitoring
West Palm Beach, Florida
Ashish J. Mehta
Coastal & Oceanographic Engineering
Gainesville, Florida
Nobuo Mimura
Global Environmental Engineering
Ibaraki, Japan
Robert Nicholls
Global Climate Change,
Sea-Level Change
Southampton, United Kingdom
Karl F. Nordstrom
Coastal Geomorphology &
Dune Processes
New Brunswick, New Jersey
Julian Orford
Gravel Beaches, Storm Events
Belfast, Northern Ireland, UK
Phil D. Osborne
Sediment Dynamics,
Beach Morphodynamics
Shoreline, Washington
Hugh Parker
Airborne Lidar Bathymetry
Adelaide, South Australia, Australia
Charitha B. Pattiaratchi
Physical Oceanography
Crawley, Western Australia, Australia
Michael Phillips
Coastal Geomorphology
Swansea, Wales, United Kingdom
Orrin H. Pilkey, Jr.
Coastal Geology
Durham, North Carolina
Paolo A. Pirazzoli
Sea-Level Changes
Paris, France
Nobert P. Psuty
Coastal Geomorphology
New Brunswick, New Jersey
Ulrich Radtke
Coastal Geomorphology
Duisburg-Essen, Germany

COMITÉ DE REDACTION

Elijah W. Ramsey, III
Coastal Image Processing
Lafayette, Louisiana
Richard C. Raynie
Wetland/Marsh Restoration,
Coastal Erosion
Baton Rouge, Louisiana
Kirt Rusenko
Sea Turtles, Dune Restoration
Boca Raton, Florida
Andrew D. Short
Coastal Geomorphology,
Beach Morphodynamics
Sydney, New South Wales, Australia
Pravi Shrestha
Coastal Engineering
Irvine, California
Tom Spencer
Biogeomorphology,
Wetland Morphodynamics
Cambridge, United Kingdom
Marcel Stive
Coastal Hydrodynamics,
Sediment Dynamics
Delft, The Netherlands
Vallam Sundar
Coastal Engineering
Chennai, India
E. Robert Thieler
Marine Geology
Woods Hole, Massachusetts
Frank Van Der Meulen
Coastal Zone Management,
Climate Change
Delft, The Netherlands
Henk Jan Verhagen
Coastal Protection & Structures
Delft, The Netherlands
Ian J. Walker
Coastal Dunes, Sediment Transport
Victoria, British Columbia, Canada
Ping Wang
Beach Morphodynamics,
Sediment Transport
Tampa, Florida
Allan Williams
Coastal Geology
Swansea, Wales, United Kingdom
Harry F. Williams
Hurricane Sedimentation,
Paleotempestology
Denton, Texas
Colin D. Woodroffe
Coastal Geomorphology,
Sea-Level Change
Wollongong, Australia
Philip L. Woodworth
Sea-Level Change
Liverpool, United Kingdom
Donald R. Young
Coastal Plant Ecology
Richmond, Virginia
Robert S. Young
Coastal Processes & Management
Cullowhee, North Carolina

The *JOURNAL OF COASTAL RESEARCH* (ISSN 0749-0208) is the official peer-reviewed publication of The Coastal Education and Research Foundation [CERF] and is published bimonthly in January, March, May, July, September, and November. The journal is available online at www.jcronline.org and subscriptions can be placed through www.CERF-JCR.org. Publishing services are currently available through CERF, 1656 Cypress Row Drive, West Palm Beach, FL 33441. Calendar-year (2012) print and online subscription prices for the JCR are: \$115.00 for US CERF members/\$125.00 for International CERF members (\$95.00 for online only), and \$519.00 for US Institutions/\$541.00 for International Institutions (\$437.00 for online only). Additional surface charges may apply to subscribers located outside of the USA. For additional subscription information, please go to www.CERF-JCR.org. Subscriptions, changes of address, and requests for missing issues should be sent to the JCR Subscriptions Office, Allen Press, P.O. Box 7065, Lawrence, Kansas 66044 or CERF@allenpress.com. Claims for copies lost in the mail must be received within 90 days (180 days foreign) of the issue date to insure replacement at no charge. Access to the archived JCR is available through JSTOR at <http://www.jstor.org/>.

Periodicals postage paid at Lawrence, KS, and additional mailing offices. POSTMASTER: Send address changes to *Journal of Coastal Research*, Allen Press Association Management, P.O. Box 1897, Lawrence, KS 66044.

© 2012 The Coastal Education & Research Foundation [CERF].

© This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

THE COASTAL EDUCATION AND RESEARCH FOUNDATION

1656 Cypress Row Drive
West Palm Beach, FL 33411, U.S.A.

Officers of the Foundation

Founded in 1983 by: Charles W. Finkl, Sr.,
Charles W. Finkl, Jnr., Rhodes W. Fairbridge,
and Maurice L. Schwartz

President & Executive Director:

Charles W. Finkl

Senior Vice President & Assistant Director:

Christopher Makowski

Vice President:

Syed Khalil

Secretary:

Heather M. Vollmer

Executive Assistant:

Barbara Russell

Board of Directors (Trustees)

Andrew Cooper	Victor Klemas	Maurice L. Schwartz
Robert Dean	Christopher	Andrew Short
Charles W. Finkl	Makowski	Daniel J. Stanley
Gary Griggs	Michael Phillips	Marcel Stive
Jim Houston	Orrin Pilkey	Allan Williams
Robert Huff	Norb Psuty	
Joseph Kelley	Elijah W. Ramsey, III	

Patron Members

Luis Antonio	Bijan Dargahi	Giovanni Randazzo
Buenfil-Lopez	German Flor-Blanco	Adam Weir
Gustavo Bujalesky	Carl H. Hobbs, III	Harley Winer
Nicholas K. Coch	Timothy W. Kana	Robert S. Young
Mark Crowell	Norbert P. Psuty	

The Coastal Education and Research Foundation [CERF] is a nonprofit corporation dedicated to the advancement of the coastal sciences. The Foundation is devoted to the multi-disciplinary study of the complex problems of the coastal zone. The purpose of CERF is to help translate and interpret coastal issues for the public and to assist professional research and public information programs. The Foundation specifically supports and encourages field and laboratory studies on a local, national, and international basis. Through the medium of scientific publications, television, and radio CERF brings accurate information to the public and coastal specialists on all aspects of coastal issues in an effort to maintain or improve the quality of shoreline resources.

Because CERF is concerned with broad environmental issues, our efforts concentrate on significant problems such as maintenance of good quality (potable) water with adequate supply, and hazards associated with potential beach erosion, flooding, and susceptibility of developed shorelines to storm surge and wave attack. By focusing attention on these potential man-made and natural hazards, it is hoped that our research efforts will help others improve the quality of life in diverse coastal areas. CERF thus aims to stimulate awareness of coastal (marine and freshwater shorelines) land and water problems; initiate and foster research and innovation to promote long-term coastal productivity; establish an educational forum for the debate of contentious coastal issues; and develop new principles and approaches for enlightened coastal management, and encourage their adoption and use.

CERF is associated with the Department of Geosciences at Florida Atlantic University (FAU) in Boca Raton, Florida, and one of the main editorial offices for the *Journal of Coastal Research* (JCR) is located at the University. This partnership provides a basis for cooperative investigation, in private and public sectors, of biophysical resources found in open and naturally protected coastal regions, estuaries, large inland bodies of water bounded by shorelines, wetlands, and other coastal environments. Multidisciplinary studies at FAU's Department of Geosciences brings together experts from various fields in remote sensing, geographic information science, spatial ecology, environmental studies, marine biology, coastal geology, geography, and coastal engineering. Scientific investigative efforts by faculty, students, and staff span a wide and diversified range of interrelated topics that are relevant to solutions of today's dynamic problems. It is hoped that these combined attempts to better understand the nature of coastal processes will help forestall what may become contentious issues of tomorrow.

□ CERF MEMBERSHIP □

Members are individuals that support the aims of the foundation through personal and group efforts or by donations. Memberships are available in different categories with privileges.

Subscription information is available online at www.cerf-jcr.org. Subscriptions office: Allen Press, Inc., P.O. Box 1897, Lawrence, KS 66044, U.S.A. CERF@allenpress.com

Editor-in-Chief

Charles W. Finkl Ph.D., CSci, CMarSci, FIMarEST, CPGS, CPSSc, PWS

Dr. Charles W. Finkl is President and Executive Director of the Coastal Education & Research Foundation [CERF], publisher of the JCR. Charlie, a founding editor of the *Journal of Coastal Research*, has served as Editor-in-Chief for the past 27 years. He is a Research Professor in the Department of Geosciences at Florida Atlantic University in Boca Raton, Florida. He received his Bachelor and Master of Science degrees from Oregon State University and the Ph.D. from the University of Western Australia. He is a member of more than 20 professional societies and has published more than 200 professional papers, books, and reports. He is a Chartered Marine Scientist (CMarSci) [Institute of Marine Engineering, Science and Technology], Certified Professional Geological Scientist (CPGS) [American Institute of Professional Geologists (AIPG)], Certified Professional Soil Scientist (CPSSc) [American Registry of Certified Professionals in Agronomy, Crops, and Soils], and a Professional Wetland Scientist (PWS) [Society of Wetland Scientists]. Charlie has field experience in parts of the USA, Caribbean area, Brazil, Honduras, Russia, South Africa, Western Europe, Australasia, and South Pacific islands. He is also the Series Editor of the Encyclopedia of Earth Sciences Series that is published by Springer (Germany). There are more than twenty-eight volumes in the Series and about twenty-five are available online. Charlie also serves on the Editorial Board of the *International Journal of Environmental Studies* (Routledge) and is an occasional peer reviewer for many other professional journals.

Charlie has interests and expertise in the general areas of surficial geology, coastal and marine geomorphology (including coastal classification), coastal/marine biophysical environments, exploration geochemistry, soils and weathering (regolith geology), coastal zone management and engineering applications or impacts on natural systems (including erosion control and shore protection), coastal hydrology including submarine freshwater and mineralized seeps, subaerial and marine structural geology, natural hazard mitigation in coastal zones, marine environments and coastal wetland protection and restoration, and remote sensing (e.g. land cover classification in coastal wetlands, advection-diffusion turbidity plumes in coastal waters, delineation of bottom types and sand resources), effluent disposal and pollution of wetlands and estuaries, water resources mapping and conservation, time series studies of wetland hydroperiod and soil moisture.

Foundation Meetings

International Coastal Symposia (ICS)

The International Coastal Symposium (ICS) was set up by Per Bruun (deceased) and Charlie Finkl, the first meeting being held in Hilton Head, South Carolina, in 1993. Since then these CERF meetings were held a second time in Hilton Head and then in Palm Beach, Florida. With the success of these meetings, CERF moved the ICS to the international scene holding meetings in conjunction with local sponsors in Australia, Brazil, Iceland, New Zealand, Northern Ireland, and Portugal. Forthcoming meetings will be held in Szczecin, Poland (11th ICS hosted by Dr. Kazimierz Furmanczyk at the University of Szczecin), and Plymouth, United Kingdom (12th ICS hosted by Dr. Gerd Masselink at the University of Plymouth). The ICS deals with all aspects of the coastal zone and attracted more than 600 delegates to the 10th ICS, organized by the Faculdade de Ciências Sociais e Humanas – UNL in Lisbon, Portugal. For more information, please visit www.cerf-jcr.org



JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences



Supporting Scientific Organizations

- **AZTI** - Tecnalia [Pasaia, Spain; www.azti.es/]
- Coastal and Hydraulics Laboratory (**CHL**), US Army Corps of Engineers® [Vicksburg, Mississippi, U.S.A.; <http://chl.erdc.usace.army.mil/>]
- Coastal and Marine Geology Program (**CMGP**), U.S. Geologic Survey (USGS) [Reston, Virginia, U.S.A.; <http://marine.usgs.gov/>]
- Coastal Research Laboratory (**CRL**), University of South Florida [Tampa, Florida, U.S.A.; <http://crl.usf.edu/>]
- Commission on Coastal System (**CCS**), International Geographical Union (**IGU**) [<http://www.igu-ccs.org/>]
- Consorzio Nazionale Interuniversitario per le Scienze del Mare (**Co.N.I.S.Ma.**) [Rome, Italy; www.conisma.it/]
- Deltares Institute [Delft, The Netherlands; <http://www.deltares.nl/en/coast-sea>]
- Department of Geosciences, Florida Atlantic University (**FAU**) [Boca Raton, Florida, U.S.A.; <http://www.geosciences.fau.edu/>]
- e-Geo Center for Geographical and Regional Planning Studies [Lisbon, Portugal; <http://e-geo.fcsh.unl.pt/>]
- Institute of Marine and Coastal Sciences (**IMCS**), Rutgers University [New Brunswick, New Jersey, U.S.A.; <http://marine.rutgers.edu/main/>]
- Louisiana Coastal Protection & Restoration Authority (**CPRA**) [Baton Rouge, Louisiana, U.S.A.; www.coastal.louisiana.gov/]
- Royal Belgian Institute of Natural Sciences: Management Unit of the North Sea Mathematical Models (**MUMM**) [Brussels, Belgium; www.mumm.ac.be/]

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.

Advertising, Editorial, and Subscription Information

Advertising and Editorial Office: All advertising and editorial correspondence should be sent to Dr. Charles W. Finkl, Editor-in-Chief, *Journal of Coastal Research*, 5130 NW 54th Street, Coconut Creek, FL 33073, U.S.A. PHONE: 561.313.0926. E-MAIL: CFinkl@CERF-JCR.com.

Subscription Information: The *Journal of Coastal Research* is a bimonthly publication. Calendar-year (2012) print and online subscription prices for the JCR are: \$115.00 for US CERF members / \$125.00 for International CERF members (\$95.00 for online only), and \$519.00 for US institutions / \$541.00 for International institutions (\$437.00 for online only). Additional surface charges may apply to subscribers located outside of the USA. For additional membership and subscription forms and information, please go to www.CERF-JCR.org. To obtain a membership or subscription form by mail, please send request to *Journal of Coastal Research*, P.O. Box 7065, Lawrence, KS 66044. Back Issues and Special Issues of the JCR, when available, can be directly purchased at www.CERF-JCR.org.

The *Journal of Coastal Research* is currently surveyed in *Applied Science & Technology Abstracts*; *Applied Science & Technology Index* (H.W. Wilson); *Aquatic Sciences & Fisheries Abstracts*; *BIOBASE*; *Biological Abstracts*; *BIOSIS Previews* (Thomson); *CAB International Abstracts* (CABI); *CSA Civil Engineering Abstracts* (ProQuest); *Current Awareness in Biological Sciences* (Elsevier); *Current Contents/Agriculture, Biology, & Environmental Sciences* (Thomson); *Ecology Abstracts* (ProQuest); *Environmental Sciences & Pollution Management*; *GeoAbstracts* [Geographical Abstracts: Physical Geography; Ecological Abstracts; Geological Abstracts; *GEOBASE*] (Elsevier); *GeoRef*; *Meteorological & Geostrophysical Abstracts* (ProQuest); *Oceanic Abstracts* (ProQuest); *Oceanographic Literature Review* (Elsevier); *Physical Sciences Digest* (CSA, Ebsco); *Pollution Abstracts* (ProQuest); *Referativnyi Zhurnal*; *Science Citation Index*; *SciSearch* (Thomson); *SCOPUS*; *Water Resources Abstracts* (Bethesda); *Zoological Record* (Thomson).