

## **COVER PHOTOGRAPH AND FRONT MATTER: LYTTELTON HARBOUR, CHRISTCHURCH, NEW ZEALAND**

Source: Journal of Coastal Research, 30(3)

Published By: Coastal Education and Research Foundation

URL: <https://doi.org/10.2112/1551-5036-30.3.ii>

---

BioOne Complete ([complete.BioOne.org](https://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](https://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.



**Lyttelton Harbour, Christchurch, New Zealand.** Mechanics Bay on the north side of the entrance to Lyttelton Harbour at Christchurch, New Zealand. The photograph shows a plume of dredgate following the trailer suction dredge 'Pelican.' The split hopper is closing as 'Pelican' moves off from the designated dump location having released 965 m<sup>3</sup> of silt size sediment. Concerns of the behavior and possible further transport of the dredgate once deposited on the bottom were addressed by the Port and are discussed in this issue of the JCR (McLaren and Teear, 2014). The 'Pelican' is one of two trailer suction dredges used for the maintenance dredging of the Lyttelton Harbour navigation channel. (Photograph taken in 2010 by Gary Teear, OCEL Consultant to the Port of Lyttelton at Christchurch, and caption by Patrick McLaren, SedTrend Analysis Limited, Brentwood Bay, British Columbia, Canada.)

McLaren, P. and Teear, G., 2014. A Sediment Trend Analysis (STA®) in support of dredged material management in Lyttelton Harbour, Christchurch, New Zealand. *Journal of Coastal Research*, 30(3), 438–447.

# JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

CHEF-HERAUSGEBER

25 Jake Ridge Trail  
Fletcher, NC  
28732, U.S.A.

## BOOK REVIEW EDITOR

J. Andrew G. Cooper  
School of Environmental Sciences  
University of Ulster  
Coleraine, N. Ireland  
jag.cooper@ulster.ac.uk

## EDITOR-IN-CHIEF

**Charles W. Finkl**

Coastal Education and Research Foundation, Inc. [CERF]

Editorial Offices:

5130 NW 54th Street

Coconut Creek, FL

33073, U.S.A.

(Editorial Office, Coconut Creek)

CERF/JCR Website: <http://www.CERF-JCR.org>

e-mail: [cfinkl@cerf-jcr.com](mailto:cfinkl@cerf-jcr.com)

RÉDACTEUR-EN-CHEF

## PUBLISHING MANAGER

Christopher Makowski  
Coastal Education and Research  
Foundation, Inc. [CERF]  
5130 NW 54th Street  
Coconut Creek, FL 33073, U.S.A.  
[cmakowski@cerf-jcr.com](mailto:cmakowski@cerf-jcr.com)

## EDITORIAL ASSISTANT

Barbara Russell  
Coastal Education and Research  
Foundation, Inc. [CERF]  
5130 NW 54th Street  
Coconut Creek, FL 33073, U.S.A.  
[barbara@cerf-jcr.com](mailto:barbara@cerf-jcr.com)

## WEB DESIGN & DEVELOPMENT

Jon Finkl  
Media Mine  
111 W Washington, Suite 1100  
Chicago, IL 60602, U.S.A.  
[jon@mediamine.net](mailto:jon@mediamine.net)

## MITHERAUSGEBER

**Edward J. Anthony**  
Coastal Geomorphology  
Dunkerque, France  
**Cecile Baeteman**  
Holocene Coastal Dynamics  
Brussels, Belgium  
**Kenneth Banks**  
Coral Reef Geomorphology  
Plantation, Florida  
**Patrick Barnard**  
Coastal Geomorphology  
Santa Cruz, California  
**Lindino Benedet**  
Oceanography, Modeling  
Florianopolis, SC, Brazil  
**David M. Bush**  
Coastal Geology & Hazards  
Carrollton, Georgia  
**Ilya V. Buynevich**  
Coastal Geology  
Philadelphia, Pennsylvania  
**Javier A. Carrió**  
Sediment Processes  
Valencia, Spain  
**Mark Crowell**  
Coastal Zone Management  
McLean, Virginia  
**Robert Dean**  
Coastal Engineering & Processes  
Gainesville, Florida  
**Omar Defeo**  
Sandy Beach Ecology  
Montevideo, Uruguay  
**J. Javier Diez**  
Coastal Geomorphology  
Madrid, Spain  
**Joseph F. Donoghue**  
Coastal Morphology & Hazards  
Tallahassee, Florida  
**Oscar Manuel Ferreira**  
Storm Impacts  
Faro, Portugal  
**Duncan M. FitzGerald**  
Sediment Transport  
Boston, Massachusetts  
**Chip Fletcher**  
Coastal Geology  
Honolulu, Hawaii

**Kazimierz K. Furmańczyk**  
Marine Cartography  
Szczecin, Poland  
**Gary B. Griggs**  
Coastal Engineering & Hazards  
Santa Cruz, California  
**Pramod Hanamgond**  
Coastal Geomorphology  
Belgaum, India  
**Hans Hanson**  
Coastal Protection  
Lund, Sweden  
**Simon Haslett**  
Paleoceanography  
Wales, United Kingdom  
**Michael Hilton**  
Dune Geomorphology & Ecology  
Dunedin, New Zealand  
**Carl H. Hobbs, III**  
Coastal Geology, Sand Mining  
Gloucester Point, Virginia  
**James R. Houston**  
Sea-Level Change  
Vicksburg, Mississippi  
**Wenrui Huang**  
Coastal Hydrodynamics  
Tallahassee, Florida  
**Michael G. Hughes**  
Coastal Morphodynamics  
Canberra, ACT, Australia  
**Federico I. Isla**  
Sea-Level Change  
Mar Del Plata, Argentina  
**Nancy L. Jackson**  
Coastal Geomorphology  
Newark, New Jersey  
**Markes E. Johnson**  
Paleoshores, Coastal Sand Dunes  
Williamstown, Massachusetts  
**Timothy R. Keen**  
Waves & Circulation  
Stennis Space Center,  
Mississippi  
**Dieter H. Kelletat**  
Coastal Geomorphology  
Essen / Cologne, Germany

## ASSOCIATE EDITORS

**Joseph T. Kelley**  
Sea-Level Change  
Orono, Maine  
**Syed Khalil**  
Coastal Geology & Geophysics  
Baton Rouge, Louisiana  
**Jack Kindinger**  
Oceanography  
St. Petersburg, Florida  
**Vic Klemas**  
Remote Sensing  
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  
**Michel M. de Mahiques**  
Sediment Processes  
São Paulo, Brazil  
**Ashish J. Mehta**  
Coastal Engineering  
Gainesville, Florida  
**Nobuo Mimura**  
Environmental Engineering  
Ibaraki, Japan  
**Robert Nicholls**  
Global Climate Change  
Southampton, United Kingdom

**Karl F. Nordstrom**  
Coastal Geomorphology  
New Brunswick, New Jersey  
**Julian Orford**  
Gravel Beaches, Storm Events  
Belfast, Northern Ireland, UK  
**Phil D. Osborne**  
Sediment Dynamics  
Shoreline, Washington  
**Hugh Parker**  
Airborne Lidar Bathymetry  
Adelaide, SA, Australia  
**Charitha B. Pattiaratchi**  
Physical Oceanography  
Crawley, WA, Australia  
**Michael Phillips**  
Coastal Geomorphology  
Swansea, Wales, UK  
**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  
**Elijah W. Ramsey, III**  
Coastal Image Processing  
Lafayette, Louisiana  
**Kirt Rusenko**  
Sea Turtles, Dune Restoration  
Boca Raton, Florida  
**Anja Scheffers**  
Coastal Evolution  
Lismore, NSW, Australia  
**Andrew D. Short**  
Coastal Geomorphology  
Sydney, NSW, Australia  
**Pravi Shrestha**  
Coastal Engineering  
Irvine, California  
**Carlos Pereira da Silva**  
Coastal Zone Management  
Lisbon, Portugal

## COMITÉ DE REDACTION

**Alejandro J. Souza**  
Coastal & Sediment Processes  
Liverpool, United Kingdom  
**Tom Spencer**  
Biogeomorphology  
Cambridge, United Kingdom  
**Marcel Stive**  
Coastal Hydrodynamics  
Delft, The Netherlands  
**Vallam Sundar**  
Coastal Engineering  
Chennai, India  
**Adam D. Switzer**  
Coastal Hazards, Sea-Level Change  
NTU, Singapore  
**E. Robert Thieler**  
Marine Geology  
Woods Hole, Massachusetts  
**Arthur C. Trembanis**  
Coastal Morphodynamics  
Newark, Delaware  
**Frank Van Der Meulen**  
Coastal Zone Management  
Delft, The Netherlands  
**Ping Wang**  
Beach Morphodynamics  
Tampa, Florida  
**Allan Williams**  
Coastal Geology  
Swansea, Wales, UK  
**Harry F. Williams**  
Paleotempestology  
Denton, Texas  
**Colin D. Woodroffe**  
Coastal Geomorphology  
Wollongong, Australia  
**Robert S. Young**  
Coastal Processes  
Cullowhee, North Carolina  
**Guoliang Yu**  
Sediment Transport  
Shanghai, China



THE JOURNAL OF COASTAL RESEARCH (JCR) (ISSN 0749-0208) IS PUBLISHED BIMONTHLY FOR \$115.00 FOR INDIVIDUAL US CERF MEMBERS, \$125.00 FOR INDIVIDUAL INTERNATIONAL CERF MEMBERS, \$519.00 FOR US INSTITUTIONS, AND \$541.00 FOR INTERNATIONAL INSTITUTIONS BY THE COASTAL EDUCATION AND RESEARCH FOUNDATION, INC. (CERF), 5130 NW 54TH STREET, COCONUT CREEK, FL 33073-3713. PERIODICALS POSTAGE PAID AT FORT LAUDERDALE, FL AND ADDITIONAL MAILING OFFICES. **POSTMASTER:** SEND ADDRESS CHANGES TO JOURNAL OF COASTAL RESEARCH, ALLEN PRESS ASSOCIATION MANAGEMENT, P.O. BOX 1897, LAWRENCE, KS 66044-3018.

© 2014 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

5130 NW 54th Street  
Coconut Creek, FL 33073, 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)

J. Andrew G. Cooper	Victor Klemas	Andrew D. Short
Robert Dean	Charles Lemckert	Carlos Pereira da Silva
Charles W. Finkl	Chris Makowski	Daniel J. Stanley
Gary B. Griggs	Michael Phillips	Marcel Stive
James R. Houston	Orrin H. Pilkey, Jr.	Allan Williams
Robert Huff	Norbert P. Psuty	
Joseph T. Kelley	Elijah W. Ramsey, III	

## Lifetime Members

Yong-Sik Cho	Hany Elwany	Charles Lemckert
Nicholas K. Coch	Björn Kjerfve	Ya Ping Wang

## Patron Members

Luis Antonio	Norbert P. Psuty	Robert S. Young
Buenfil-Lopez	Giovanni Randazzo	
Carl H. Hobbs, III	Yung Tseng	

The Coastal Education and Research Foundation [CERF] is a nonprofit society 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 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](http://www.cerf-jcr.org). Subscriptions office: Allen Press, Inc., P.O. Box 1897, Lawrence, KS 66044, U.S.A. [CERF@allenpress.com](mailto: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 30 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.

## CERF International Meetings

### International Coastal Symposium (ICS)

The International Coastal Symposium (ICS) was originally set up by Per Bruun (deceased) and Charlie Finkl as the official meeting of the Coastal Education & Research Foundation (CERF), with the first meeting being held in Hilton Head, South Carolina, in 1993. After the repeated success of these meetings, CERF moved the ICS to the international scene holding these conferences in conjunction with local sponsors in Australia, Brazil, Iceland, New Zealand, Northern Ireland, Poland, and Portugal. The ICS brings together delegates from all over the world to collaborate and discuss the most current coastal research studies and projects. During the ICS 2014, which was held in Durban, South Africa, a grand celebration took place to mark the 30th Anniversary of CERF and the JCR. Our next ICS meeting is scheduled for the spring of 2016 in Sydney, New South Wales, Australia. For more information, please visit [www.cerf-jcr.org](http://www.cerf-jcr.org).



# JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

Supporting Scientific Information



- AZTI - Tecnalia [Pasaia, Spain; [www.azti.es/](http://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/](http://www.conisma.it/)]
- Deltares Institute [Delft, The Netherlands; <http://www.deltares.nl/en/coast-sea>]
- Departamento de Geografia e Planeamento Regional, Universidade Nova de Lisboa [Lisbon, Portugal; <http://www.fcsh.unl.pt/>]
- 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/](http://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/](http://www.mumm.ac.be/)]
- University of Wales Trinity Saint David (Swansea Metropolitan University) [Mount Pleasant, Swansea, Wales, U.K.; <http://www.uwtsd.ac.uk/>]

## 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: 828-333-2300. E-MAIL: [cfinkl@cerf-jcr.com](mailto:cfinkl@cerf-jcr.com).

**Subscription Information:** The *Journal of Coastal Research* is a bimonthly publication. Calendar-year (2014) 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](http://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](http://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*; *BIODISE*; *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).