

COVER PHOTOGRAPH: WATERFRONT REDEVELOPMENT, VANCOUVER, BRITISH COLUMBIA, CANADA

Source: Journal of Coastal Research, 28(2)

Published By: Coastal Education and Research Foundation

URL: https://doi.org/10.2112/1551-5036-28.2.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 <u>www.bioone.org/terms-of-use</u>.

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.

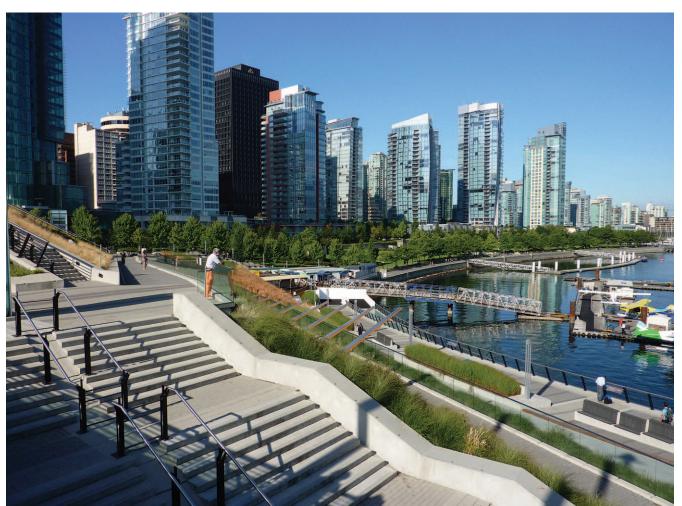
BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.



COVER PHOTOGRAPH







WATERFRONT REDEVELOPMENT, VANCOUVER, BRITISH COLUMBIA, CANADA

This coastal seaport city is the hub of Greater Vancouver. With over 2.3 million residents, it is the third most populous metropolitan area in Canada (after Toronto and Montreal), and the most populous in Western Canada. The city proper has more than 640,000 people, making it the eighth largest in Canada, and the most densely populated Canadian city of over 25,000 residents, with 5,039 people per km² in 2006. Port Metro Vancouver is the busiest and largest in Canada, as well as the fourth largest port (by tonnage) in North America. The steps in the foreground lead up to Canada Place and the Pan Pacific Hotel. The cruise terminal here is the main point of departure for Alaska with more than one million passengers passing through each year. Reclaimed in the 1970s and 1980s, the city and foreshore exploded upwards after Expo 86 with high-rise apartment buildings and other development. The redeveloped shore is a delightful coastal urban park that features walkways, bike paths, scenic overlooks to Coal Harbor, and many rest stops. The boardwalk along the seawall follows the shore to Stanley Park, one of the world's great coastal urban parks. The seaplane harbor on the right hand side of the image is a busy place. Seaplane companies operate frequent scheduled service from the downtown Vancouver harbor direct to Victoria, the capital of British Columbia, on Vancouver Island and other coastal destinations. As seen in this image, the coastal urban landscape is a pleasing sight and with all of the waterside amenities it is easy to understand why Vancouver has ranked highly in worldwide "livable city" rankings for more than a decade. In fact, Vancouver is the first city to rank among the top-ten of the world's most livable cities for five straight years. (Photograph by Charlie Finkl, Coastal Education & Research Foundation, August 2011).

JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

CHEF-HERAUSGEBER

J.A.G. Cooper

MITHERAUSGEBER

University of Ulster

Coleraine, N. Ireland

BOOK REVIEW EDITOR

EDITOR-IN-CHIEF Charles W. Finkl

Coastal Education and Research Foundation, Inc. [CERF] Editorial Offices:

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

MANAGING EDITOR

Allen Press Publishing Services

Lawrence, KS 66044, U.S.A.

tcandelaria@allenpress.com

Tracy Candelaria

810 E. 10th Street

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

> 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

ASSOCIATE EDITORS

Edward J. Anthony Coastal Geomorphology, Beach Morphodynamics Cecile Baeteman Holocene Coastal Dynamics, Sea-Level Change Brussels, Belgium Kenneth Banks Coral Reef Geomorphology, Habitat Mapping Plantation, Florida Patrick Barnard Coastal Geomorphology Coastal Geomorphology Santa Cruz, California **Lindino Benedet** Oceanography, Modeling Florianopolis, Santa Catarina, Brazil David M. Bush Coastal Geology & Hazards Carrollton, Georgia Carrollton, Georgia Ilya V. Buynevich Coastal Geology Philadelphia, Pennsylvania Javier A. Carrió Sediment Processes, Marine Geology Valencia, Spain Roger Charlier Dow Proving Constitute Function Ocean Energies, Coastal Erosion Brussels, Belgium Brussels, Belgium Paolo Ciavola Coastal Engineering, Sediment Transport Ferrara, Italy Mark Crowell Coastal Zone Management, Coastal Zono Management, Mal ean Vircinia 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** Storn Impacts, Beach Morphodynamics Faro, Portugal Chip Fletcher Coastal Geology Honolulu, Hawaii

Gary B. Griggs Coastal Engineering & Hazards Santa Cruz, California Pramod Hanamgond Coastal Geomorphology, Sedimentology Belgaum, India Hans Hanson Coastal Protection, Numerical Modeling Lund Swadan 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 llahassee 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 Dereck W.I. 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** Dieter H. Kelletat Coastal Geomorphology, Sea-Level Change Essen / Cologne, Germany Joseph T. Kelley Sea-Level Change, Salt Marsh Ecogeomorphology Orono Mrine Orono, Maine Syed Khalil Syea Analii 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, Jowa Stephen P. Leatherman Barrier Islands, Beach Erosion Miami, Florida **Charles Lemckert** Environmental Fluid Dynamics Queensland, Australia Geophysical Proxy Data Rhodes, Greece Jeffrey H. List Shoreline Change Processes Woods Hole, Massachusetts **Christopher Makowski** Constal Benthic Ecology, Marine Ecosystem Monitoring West Palm Beach, Florida Ashish J. Mehta Coastal & Ocenographic 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 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 Lafavette, Louisiana Richard C. Raynie Wetland / Marsh Restoration Coastal Erosion Baton Rouge, Louisiana Kirt Rusenko Sea Turtles, Dune Restoration Boca Raton, Florida Andrew D. Short Andrew D. Short Coastal Geomorphology, Beach Morphodynamics Sydney, New South Wales, Australia **Pravi Shrestha** Coastal Engineering Irvine, California Tom Spencer Iom Spencer Biogeomorphology, Wetland Morphodynamics Cambridge, United Kingdom Marcel Stive Coastal Hydrodynamics, Sediment Dynamics Delft, The Netherlands Vallam Sundar Coastal Expinencia 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 Flor Allan Williams Coastal Geology Swansea, Wales, United Ki Harry F. Williams 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 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. Calender-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].

Ownloaded From: https://bioone.org/journals/Journal-of-Coastal-Research on 27 Aug 2024 Terms of Use: https://bioone.org/terms-of-use

RÉDACTEUR-EN-CHEF

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	

Syed Khalil

Secretary: Executive Assistant Heather M. Vollmer Barbara Russell

Board of Directors (Trustees)

Patron Members

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

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.

\Box CERF MEMBERSHIP \Box

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 Symposiums (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 Office of Coastal Protection and Restoration (**OCPR**) [Baton Rouge, Louisiana, U.S.A.; www.ocpr.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*, 1656 Cypress Row Drive, West Palm Beach, FL 33411, 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 & Geoastrophysical Abstracts (ProQuest); Oceanic Abstracts (ProQuest); Coceanographic 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).