Christopher Craft, Jonathan Clough, Jeff Ehman, Samantha Joye, Richard Park, Steve Pennings, Hongyu Guo, and Megan Machmuller. 2009. Forecasting the effects of accelerated sea-level rise on tidal marsh ecosystem services. *Frontiers in Ecology and the Environment* **7**: 73–78. http://dx.doi.org/10.1890/070219

Research Communications

Forecasting the effects of accelerated sea-level rise on tidal marsh ecosystem services

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We used field and laboratory measurements, geographic information systems, and simulation modeling to investigate the potential effects of accelerated sea-level rise on tidal marsh area and delivery of ecosystem services along the Georgia coast. Model simulations using the Intergovernmental Panel on Climate Change (IPCC) mean and maximum estimates of sea-level rise for the year 2100 suggest that salt marshes will decline in area by 20% and 45%, respectively. The area of tidal freshwater marshes will increase by 2% under the IPCC mean scenario, but will decline by 39% under the maximum scenario. Delivery of ecosystem services associated with productivity (macrophyte biomass) and waste treatment (nitrogen accumulation in soil, potential denitrification) will also decline. Our findings suggest that tidal marshes at the lower and upper salinity ranges, and their attendant delivery of ecosystem services, will be most affected by accelerated sealevel rise, unless geomorphic conditions (ie gradual increase in elevation) enable tidal freshwater marshes to migrate inland, or vertical accretion of salt marshes to increase, to compensate for accelerated sea-level rise.

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Cited by

Simon N. Gosling. (2013) The likelihood and potential impact of future change in the large-scale climate-earth system on ecosystem services. *Environmental Science & Policy* **27**, S15-S31
Online publication date: 1-Mar-2013.
CrossRef

Florian T. Wetzel, Helmut Beissmann, Dustin J. Penn, Walter Jetz. (2013) Vulnerability of terrestrial island vertebrates to projected sea-level rise. *Global Change Biology*n/a-n/a
Online publication date: 1-Mar-2013.
CrossRef

Rebecca K. Runting, Kerrie A. Wilson, Jonathan R. Rhodes. (2013) Does more mean less? The value of information for conservation planning under sea level rise. *Global Change Biology* **19**:2, 352-363
Online publication date: 1-Feb-2013.
CrossRef

William J. Mitsch, Maria E. Hernandez. (2013) Landscape and climate change threats to wetlands of North and Central America. *Aquatic Sciences* **75**:1, 133-149
Online publication date: 1-Jan-2013.
CrossRef

H.-P. Plag, S. Jules-Plag. 2013. Sea-Level Rise and Coastal Ecosystems. , 163-184.
CrossRef

Luke P. Shoo, Julian O'Mara, Karin Perhans, Jonathan R. Rhodes, Rebecca K. Runting, Susanne Schmidt, Lochran W. Traill, Lui C. Weber, Kerrie A. Wilson, Catherine E. Lovelock. (2012) Moving beyond the conceptual: specificity in regional climate change

adaptation actions for biodiversity in South East Queensland, Australia. *Regional Environmental Change*
Online publication date: 12-Dec-2012.
CrossRef

Christopher B. Craft. (2012) Tidal freshwater forest accretion does not keep pace with sea level rise. *Global Change Biology* **18**:12, 3615-3623
Online publication date: 1-Dec-2012.
CrossRef

Gregory B. Noe, Ken W. Krauss, B. Graeme Lockaby, William H. Conner, Cliff R. Hupp. (2012) The effect of increasing salinity and forest mortality on soil nitrogen and phosphorus mineralization in tidal freshwater forested wetlands. *Biogeochemistry*
Online publication date: 6-Nov-2012.
CrossRef

Elizabeth McLeod, Alison Green, Edward Game, Kenneth Anthony, Joshua Cinner, Scott F. Heron, Joanie Kleypas, Catherine E. Lovelock, John M. Pandolfi, Robert L. Pressey, Rodney Salm, Steve Schill, Colin Woodroffe. (2012) Integrating Climate and Ocean Change Vulnerability into Conservation Planning. *Coastal Management* **40**:6, 651-672
Online publication date: 1-Nov-2012.
CrossRef

Kerrylee Rogers, Neil Saintilan, Craig Copeland. (2012) Modelling wetland surface elevation dynamics and its application to forecasting the effects of sea-level rise on estuarine wetlands. *Ecological Modelling* **244**, 148-157
Online publication date: 1-Oct-2012.
CrossRef

Thomas J. Minello, Lawrence P. Rozas, Philip A. Caldwell, Christopher Liese. (2012) A Comparison of Salt Marsh Construction Costs with the Value of Exported Shrimp Production. *Wetlands* **32**:5, 791-799
Online publication date: 1-Oct-2012.
CrossRef

John A. Turck. (2012) Where Were All of the Coastally Adapted People During the Middle Archaic Period in Georgia, USA?. *The Journal of Island and Coastal Archaeology* **7**:3, 404-424
Online publication date: 1-Sep-2012.
CrossRef

Michael Oppenheimer. (2012) Climate change impacts: accounting for the human response. *Climatic Change*
Online publication date: 29-Aug-2012.
CrossRef

Thomas S. N. Oliver, Kerrylee Rogers, Chris J. Chafer, Colin D. Woodroffe. (2012) Measuring, mapping and modelling: an integrated approach to the management of mangrove and saltmarsh in the Minnamurra River estuary, southeast Australia. *Wetlands Ecology and Management* **20**:4, 353-371
Online publication date: 1-Aug-2012.
CrossRef

D.A. Friess, T. Spencer, G.M. Smith, I. Möller, S.M. Brooks, A.G. Thomson. (2012) Remote sensing of geomorphological and ecological change in response to saltmarsh managed realignment, The Wash, UK. *International Journal of Applied Earth Observation and Geoinformation* **18**, 57-68
Online publication date: 1-Aug-2012.
CrossRef

Matteo Convertino, Paul Welle, Rafael Muñoz-Carpena, Gregory A. Kiker, Ma.L. Chu-Agor, Richard A. Fischer, Igor Linkov. (2012) Epistemic uncertainty in predicting shorebird biogeography affected by sea-level rise. *Ecological Modelling* **240**, 1-15
Online publication date: 1-Aug-2012.
CrossRef

William J. Mitsch, Blanca Bernal, Amanda M. Nahlik, Ülo Mander, Li Zhang, Christopher J. Anderson, Sven E. Jørgensen, Hans Brix. (2012) Wetlands, carbon, and climate change. *Landscape Ecology*
Online publication date: 12-Jun-2012.
CrossRef

Mihee Jun, Anne E. Altor, Christopher B. Craft. (2012) Effects of Increased Salinity and Inundation on Inorganic Nitrogen Exchange and Phosphorus Sorption by Tidal Freshwater Floodplain Forest Soils, Georgia (USA). *Estuaries and Coasts*
Online publication date: 15-May-2012.
CrossRef

John M. Marton, Ellen R. Herbert, Christopher B. Craft. (2012) Effects of Salinity on Denitrification and Greenhouse Gas Production from Laboratory-incubated Tidal Forest Soils. *Wetlands* **32**:2, 347-357
Online publication date: 1-Apr-2012.
CrossRef

Peter J. Sharpe, Andrew H. Baldwin. (2012) Tidal marsh plant community response to sea-level rise: A mesocosm study. *Aquatic Botany*
Online publication date: 1-Apr-2012.
CrossRef

Scott Ensign, Kaylyn Siporin, Mike Piehler, Martin Doyle, Lynn Leonard. (2012) Hydrologic Versus Biogeochemical Controls of Denitrification in Tidal Freshwater Wetlands. *Estuaries and Coasts*
Online publication date: 16-Mar-2012.
CrossRef

Mark S. Woodrey, Scott A. Rush, Julia A. Cherry, Bryan L. Nuse, Robert J. Cooper, Anna Joy J. Lehmicke. (2012) Understanding the Potential Impacts of Global Climate Change on Marsh Birds in the Gulf of Mexico Region. *Wetlands*
Online publication date: 25-Jan-2012.
CrossRef

Armel Dausse, Angus Garbutt, Louiza Norman, Stathys Papadimitriou, Laurence M. Jones, Peter E. Robins, David N. Thomas. (2012) Biogeochemical functioning of grazed estuarine tidal marshes along a salinity gradient. *Estuarine, Coastal and Shelf Science*
Online publication date: 1-Jan-2012.
CrossRef

Thorne. (2012) Ecological Effects of Climate Change on Salt Marsh Wildlife: A Case Study from a Highly Urbanized Estuary. *Journal of Coastal Research*
Online publication date: 1-Jan-2012.
CrossRef

Sigrid Suchrow, Nina Pohlmann, Martin Stock, Kai Jensen. (2011) Long-term surface elevation changes in German North Sea salt marshes. *Estuarine, Coastal and Shelf Science*
Online publication date: 1-Dec-2011.
CrossRef

M.D. Cline, R.A. Feagin, K.M. Yeager, J.M. Van Alstyne. (2011) Fault-induced wetland loss at Matagorda, Texas, USA: land cover changes from 1943 to 2008. *Geocarto International*1-13

Online publication date: 19-Oct-2011.
CrossRef

Ross A. Brittain, Christopher B. Craft. (2011) Effects of Sea-Level Rise and Anthropogenic Development on Priority Bird Species Habitats in Coastal Georgia, USA. *Environmental Management*
Online publication date: 11-Oct-2011.
CrossRef

M. Convertino, G.A. Kiker, R. Muñoz-Carpena, M.L. Chu-Agor, R.A. Fischer, I. Linkov. (2011) Scale- and resolution-invariance of suitable geographic range for shorebird metapopulations. *Ecological Complexity*
Online publication date: 1-Sep-2011.
CrossRef

Bao-shan Cui, Qiang He, Yuan An. (2011) Spartina alterniflora invasions and effects on crab communities in a western Pacific estuary. *Ecological Engineering*
Online publication date: 1-Jul-2011.
CrossRef

Lochran W. Traill, Karin Perhans, Catherine E. Lovelock, Ana Prohaska, Steve McFallan, Jonathan R. Rhodes, Kerrie A. Wilson. (2011) Managing for change: wetland transitions under sea-level rise and outcomes for threatened species. *Diversity and Distributions*no-no
Online publication date: 1-Jul-2011.
CrossRef

Jesper Erenskjold Moeslund, Lars Arge, Peder Klith Bøcher, Bettina Nygaard, Jens-Christian Svenning. (2011) Geographically Comprehensive Assessment of Salt-Meadow Vegetation-Elevation Relations Using LiDAR. *Wetlands* **31**:3, 471-482
Online publication date: 1-Jun-2011.
CrossRef

Daehyun Kim, Jesper Bartholdy, Soohyun Jung, David M. Cairns. (2011) Salt Marshes as Potential Indicators of Global Climate Change. *Geography Compass* **5**:5, 219-236
Online publication date: 1-May-2011.
CrossRef

Trina S. Bayard, Chris S. Elphick. (2011) Planning for Sea-level Rise: Quantifying Patterns of Saltmarsh Sparrow (*Ammodramus Caudacutus*) Nest Flooding Under Current Sea-level Conditions. *The Auk* **128**:2, 393-403
Online publication date: 1-Apr-2011.
CrossRef

Sergio Fagherazzi, Enrique Reyes, Jonathan Clough, Matthew Lynn Kirwan, Simon Marius Mudd, Glenn R Guntenspergen, Stijn Temmerman, Andrea D'Alpaos, Johan van de Koppel, Cristopher Craft, John Rybczyk. (2011) Numerical models of salt marsh evolution: Ecological, geomorphic and climatic factors. *Reviews of Geophysics*
Online publication date: 1-Jan-2011.
CrossRef

M. F. Piehler, A. R. Smyth. (2011) Habitat-specific distinctions in estuarine denitrification affect both ecosystem function and services. *Ecosphere* **2**:1, art12
Online publication date: 1-Jan-2011.
Abstract . Full Text . PDF (3849 KB)

Keryn B. Gedan, Matthew L. Kirwan, Eric Wolanski, Edward B. Barbier, Brian R. Silliman. (2010) The present and future role of coastal wetland vegetation in protecting shorelines: answering recent challenges to the paradigm. *Climatic Change*
Online publication date: 14-Dec-2010.
CrossRef

Joy B Zedler. (2010) How frequent storms affect wetland vegetation: a preview of climate-change impacts. *Frontiers in Ecology and the Environment* **8**:10, 540-547
Online publication date: 1-Dec-2010.
Abstract . Full Text . PDF (1156 KB)

Matthew L. Kirwan, Glenn R. Guntenspergen, Andrea D'Alpaos, James T. Morris, Simon M. Mudd, Stijn Temmerman. (2010) Limits on the adaptability of coastal marshes to rising sea level. *Geophysical Research Letters* **37**:23, n/a-n/a
Online publication date: 1-Dec-2010.
CrossRef

Lochran W. Traill, Corey J. A. Bradshaw, Steven Delean, Barry W. Brook. (2010) Wetland conservation and sustainable use under global change: a tropical Australian case study using magpie geese. *Ecography* **33**:5, 818-825
Online publication date: 1-Oct-2010.
CrossRef

Bo Tian, Liquan Zhang, Xiangrong Wang, Yunxuan Zhou, Wen Zhang. (2010) Forecasting the effects of sea-level rise at Chongming Dongtan Nature Reserve in the Yangtze Delta, Shanghai, China. *Ecological Engineering* **36**:10, 1383-1388
Online publication date: 1-Oct-2010.
CrossRef

Kevan B. Moffett, Adam Wolf, Joe A. Berry, Steven M. Gorelick. (2010) Salt marsh-atmosphere exchange of energy, water vapor, and carbon dioxide: Effects of tidal flooding and biophysical controls. *Water Resources Research* **46**:10, n/a-n/a
Online publication date: 1-Oct-2010.
CrossRef

Lochran W. Traill, Matthew L. M. Lim, Navjot S. Sodhi, Corey J. A. Bradshaw. (2010) REVIEW: Mechanisms driving change: altered species interactions and ecosystem function through global warming. *Journal of Animal Ecology* **79**:5, 937-947
Online publication date: 1-Sep-2010.
CrossRef

Michael J. Conroy, Robert J. Cooper, Scott A. Rush, Kirk W. Stodola, Bryan L. Nuse, Mark. S. Woodrey. (2010) Effective use of Data from Marshbird Monitoring Programs for Conservation Decision-Making. *Waterbirds* **33**:3, 397-404
Online publication date: 1-Sep-2010.
CrossRef

Lynn Scarlett. (2010) Climate change effects: the intersection of science, policy, and resource management in the USA. *Journal of the North American Benthological Society* **29**:3, 892-903
Online publication date: 1-Sep-2010.
CrossRef

A. Townsend Peterson, Shaily Menon, Xingong Li. (2010) Recent advances in the climate change biology literature: describing the whole elephant. *Wiley Interdisciplinary Reviews: Climate Change* **1**:4, 548-555
Online publication date: 1-Jul-2010.
CrossRef

Donald Morrisey, Andrew Swales, Sabine Dittmann, Mark Morrison, Catherine Lovelock, Catherine Beard. 2010. The Ecology and Management of Temperate Mangroves. , 43-160.
CrossRef

Kazimierz Więski, Hongyu Guo, Christopher B. Craft, Steven C. Pennings. (2010) Ecosystem Functions of Tidal Fresh, Brackish, and Salt Marshes on the Georgia Coast. *Estuaries and Coasts* **33**:1, 161-169
Online publication date: 1-Jan-2010.
CrossRef

Ken W. Krauss, Jamie A. Duberstein. (2010) Sapflow and water use of freshwater wetland trees exposed to saltwater incursion in a tidally influenced South Carolina watershed. *Canadian Journal of Forest Research* **40**:3, 525-535
Online publication date: 1-Jan-2010.
CrossRef

2010. References. , 719-786.
CrossRef

Gianluca Sará. (2009) Variation of suspended and sedimentary organic matter with depth in shallow coastal waters. *Wetlands* **29**:4, 1234-1242
Online publication date: 1-Dec-2009.
CrossRef

Michael R. Lowe, Dennis R. DeVries, Russell A. Wright, Stuart A. Ludsin, Brian J. Fryer. (2009) Coastal largemouth bass (Micropterus salmoides) movement in response to changing salinity. *Canadian Journal of Fisheries and Aquatic Sciences* **66**:12, 2174-2188
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