

North Carolina
Coastal Federation
Working Together for a Healthy Coast

Shaping Our Economic Future: Offshore Drilling in N.C.

FRIDAY JULY 31, 2015

New Bern Riverfront Convention Center

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Shaping Our Economic Future: Offshore Drilling in N.C.

Welcome to the North Carolina Coastal Federation's Forum, Shaping Our Economic Future: Offshore Drilling in N.C.

To quote Joe Friday, "Just the facts, Ma'am. Just the facts." That's what this forum on proposed oil and gas exploration and development provides.

Its all-star cast of highly seasoned scientific, economic and management experts will share their knowledge regarding potential effects of drilling off our coast.

Here at the North Carolina Coastal Federation we believe getting out the facts on this issue is urgently needed. That's because there has been a dearth of in-depth independent media reporting. We've already addressed this void in news coverage through a recent three-week series in *Coastal Review Online (CRO)* that discusses various viewpoints on drilling.

The federation opposes drilling off our coast. That said, we're not afraid to openly discuss this issue, and to promote a robust dialogue on the key concerns facing our coast. In a recent random poll commissioned by the federation reported in *CRO* on July 10, we found that over the past year public opinion has shifted against drilling. How people feel about this issue depends on whether or not they believe drilling off our coast will:

- Lower the price of energy?
- Make the United States less dependent on foreign for oil?

- Provide revenues for coastal communities that exceed the additional fiscal costs associated with drilling?
- Coexist with the existing tourism, fishing, agriculture, marine science and military economy?
- Harm marine mammals, fish and wildlife?
- Result in economic prosperity for the region?
- Inevitably cause degradation of fisheries, beaches and water quality?

Our goal in presenting this forum is to answer these and other questions in order to give folks accurate and up-to-date information so they can form and express their own opinions to decision-makers.



We are enormously grateful to all of the experts who are presenting their research and experiences here today and hope you find their insight helpful in providing a better understanding of the issues surrounding offshore drilling in North Carolina.

Enjoy the forum and please take time to complete the event survey to let us know if the sessions met your expectations.

Best,

A handwritten signature in black ink that reads "Todd Miller".

Todd Miller, executive director

- 8:30 a.m. **Registration**
- 9 a.m. **Welcome – Goals for the Day**
Ladd Bayliss, coastal advocate, North Carolina Coastal Federation
- 9:15 a.m. **What Does Offshore Drilling Mean For North Carolina?**
Greg “Rudi” Rudolph, shore protection manager, Carteret County
- 9:40 a.m. **History of Oil and Gas Exploration in North Carolina**
Frank Tursi, editor, Coastal Review Online
- 10 a.m. **Federal Review of Potential for Exploration in the Southeast Atlantic**
Renee Orr, strategic resources chief, Bureau of Ocean Energy Management (BOEM)
- 10:25 a.m. **State of North Carolina Assessment of Offshore Drilling**
Donald van der Vaart, secretary, North Carolina Department of Environment and Natural Resources
- 10:50 a.m. **Break**
- 11:10 a.m. **Economic Implications of Oil and Gas Exploration and Development**
MODERATOR: Doug Wakeman, Ph.D. professor, Meredith College
Economic Considerations for North Carolina
Dr. Laura Taylor, professor of Agricultural and Resource Economics, North Carolina State University
Coastal Communities and Tourism Value
Lee Nettles, executive director, Outer Banks Visitor’s Bureau
- 12 p.m. **Lunch**
- 1 p.m. **Environmental Implications of Oil and Gas Exploration and Development**
MODERATOR: Mike Giles, coastal advocate, North Carolina Coastal Federation
What Do We Know? Data Gaps and the Way Forward
Dr. Charles “Pete” Peterson, joint distinguished professor, University of North Carolina Institute of Marine Sciences
- Marine Mammals of the Southeast Atlantic*
Dr. Andy Read, Stephen A. Toth, professor of Marine Biology, Duke University
Seismic Surveys and Marine Mammal Impacts
Dr. Doug Nowacek, associate professor, Duke University
Fisheries of the Southeast Atlantic
Dr. Steve Ross, research professor, University of North Carolina-Wilmington Center for Marine Science
Ocean Currents and Oil
Dr. Len Pietrafesa, professor emeritus, Department of Marine Earth and Atmospheric Sciences, North Carolina State University
Offshore Energy and Ecosystem Services
Dr. Larry Cahoon, research professor, Department of Biology and Marine Biology, UNC Wilmington
- 2:30 p.m. **Break**
- 2:45 p.m. **The Fishing Industry and Oil: Experiences in Coastal Louisiana**
Robert Fritchey, author, Wetland Riders
- 3:15 p.m. **Infrastructure of the Oil and Gas Industry**
Peg Howell, former Chevron employee
- 3:40 p.m. **What Happens Now? Legal Issues after a Disaster**
Steve Roady, managing attorney, Earthjustice, Oceans Program
- 4 p.m. **Pulse of the North Carolina Coast**
MODERATOR: Frank Tursi, editor, Coastal Review Online
April Clark, owner, Second Wind Eco Tours and Yoga
Morty Gaskill, commercial fisherman
Mac Gibbs, retired, Hyde County North Carolina Cooperative Extension
Willo Kelly, consultant, Outer Banks Association of Realtors, Outer Banks Home Builder’s Association
Deborah Dicks Maxwell, president, New Hanover County N.A.A.C.P.
Dan Wilcox, mayor of Carolina Beach
- 4:30 p.m. **Wrap up and adjourn**
Todd Miller, executive director, North Carolina Coastal Federation

Speaker Bios

Ladd Bayliss

coastal advocate, North Carolina Coastal Federation

Ladd joined the federation in 2012. She holds a Bachelor of Arts in political science and environmental studies from the College of Charleston and was a graduate of the School for Field Studies Wildlife Management Program in Kenya. Ladd has a background in field research through work with Oregon State University's Columbia River Avian Predation Project as well as various local research projects focusing on fisheries science and management.

Greg "Rudi" Rudolph

shore protection manager, Carteret County

Greg, or "Rudi" Rudolph coordinates and develops the county's beach preservation program, manages multimillion dollar beach nourishment projects, implements monitoring and maintenance plans, and generally serves as a policy analyst for county governments as it pertains to sea-level rise, endangered species, waterway dredging and a host of other coastal issues. His position was the first of its kind in North Carolina and provides a rare perspective to how coastal projects are funded, permitted, administered, and monitored at municipal, state, and federal levels. Rudi holds three degrees including a M.S. in Coastal Geology and B.S. in Geology from East Carolina University, and a B.A. in Biology from University of North Carolina-Charlotte. He currently serves on the North Carolina Coastal Resources Commission's Science Panel and Coastal Resources Advisory Council in addition to previously serving on the board of directors for the American Shore & Beach Preservation Association, the North Carolina Coastal Resources Law, Planning, & Policy Center, and the North Carolina Sea Grant Outreach Advisory Board.

Frank Tursi

editor, Coastal Review Online

The author of three books, Frank is a 30-year newspaper journalist. Before joining the North Carolina Coastal Federation in 2002, Frank was the senior environmental reporter in North Carolina. His environmental journalism has won numerous awards, including three Public Service Awards from the North Carolina Press Association and the Scripps-Howard National Environmental Journalism Award.

Renee Orr

chief, Office of Strategic Resources, Bureau of Ocean Energy Management

Renee Orr is Chief of BOEM's Office of Strategic Resources. She is a senior executive on the Bureau of Ocean Energy Management leadership team with more than 25 years of experience with the Department of the Interior. In her role, Renee oversees development and implementation of the nation's offshore oil and gas and marine mineral leasing program. She oversees the assessment of the nation's offshore oil and gas resources, ensuring that the financial risks associated with offshore lease activities are identified and mitigated. Renee was the Department of Interior lead during negotiation of the U.S.-Mexico Transboundary Agreement and now guides BOEM's implementation of the Agreement. She earned her Bachelor of Arts degrees in Economics and History from Metropolitan State College in Denver.

Donald R. van der Vaart

secretary, North Carolina Department of Environment and Natural Resources

Gov. Pat McCrory named Donald R. van der Vaart Secretary of the North Carolina Department of Environment and Natural Resources effective Jan. 1, 2015. Since Aug. 2014, Donald has served as DENR's deputy secretary, and as the department's energy policy adviser. Before this appointment, he worked as an engineering supervisor and later as program manager for the North Carolina Division of Air Quality. Donald also teaches environmental policy and law at North Carolina State University. His previous work includes scientific research at Virginia Polytechnic Institute and State University and at Research Triangle Institute. In addition, he has experience in research and regulatory positions for energy and utility companies in the private sector. He holds a doctorate in Chemical Engineering from the University of Cambridge (England), a law degree from North Carolina Central University, a master's degree in Chemical Engineering from NCSU, and a bachelor's degree in Chemistry from the University of North Carolina at Chapel Hill. He is a licensed professional engineer and attorney in North Carolina. He has published numerous technical and legal articles and holds two patents.

Doug Wakeman

professor, School of Business (Economics), Meredith College

Doug is an economics professor at Meredith College in Raleigh. He has a Ph.D. from the University of North Carolina at Chapel Hill and is a current board member with the North Carolina Coastal Federation. He is an active member of the Pamlico-Tar River Foundation, Haw River Assembly, Apalachicola River Keeper and the North Carolina League of Conservation Voters. He's also on the board of North Carolina Greenpower. Doug enjoys biking, boating, photography and fishing. Doug wants to ensure that his granddaughter is able to enjoy the beauty of the North Carolina Coast in the future.

Dr. Laura Taylor

professor of Agricultural and Resources Economics, N.C. State University

Laura Taylor is Director of the Center for Environmental and Resource Economic Policy and a Professor in the Department of Agricultural and Resource Economics at North Carolina State University. In policy advisory roles, she has served as a member of the Science Advisory Board for the U.S. Environmental Protection Agency, the North Carolina Legislative Research Commission Advisory Subcommittee on Offshore Energy Exploration, and the North Carolina Task Force for the Bureau of Ocean Energy Management. She is a recent recipient of the Aldo Leopold Leadership Fellowship and the American Council on Education Fellowship. She teaches undergraduate and graduate courses at North Carolina State University in environmental economics and policy. She received degrees in economics from NCSU (Ph.D.), Duke University (M.A.), and the University of North Carolina at Asheville (B.S.).

Lee Nettles

executive director, Outer Banks Visitor's Bureau

Lee Nettles is the Executive Director of the Outer Banks visitors bureau, the lead marketing and promotional agency for Dare County's Outer Banks. He has held the position since September 2009. Lee is responsible for planning, organizing and directing the daily operation of the Visitors Bureau, which includes four local welcome centers, 11 full-time and 25 part-time staff members and integrated marketing outreach campaigns. He is also heavily involved in the development of the Outer Banks event site

in Nags Head, Before the Outer Banks, Lee worked for the Wilmington Convention & Visitors Bureau where he served as the vice president of marketing. Lee began his career in advertising, working for agencies in Los Angeles, Charlotte and Wilmington assisting brands ranging from Microsoft to Pat's Tire and Auto. He is a graduate of the University of North Carolina at Chapel Hill.

Mike Giles

coastal advocate, North Carolina Coastal Federation

A North Carolina native, Mike served as the open-space land manager for Durham County for five years, before joining the federation in 2006. Mike has extensive stewardship, enforcement and advocacy experience, gathered from positions with the National Park Service and the Army Corps of Engineers and as chief park ranger for Mecklenburg County. He studied wildlife management at North Carolina State University, which included additional research and coursework in coastal ecology. Mike monitors the Southeast coastal counties from the Wrightsville Beach office.

Dr. Charles "Pete" Peterson

joint distinguished professor, University of North Carolina at Chapel Hill

Charles "Pete" Peterson was trained as an undergraduate working under Robert MacArthur at Princeton University, as a graduate student by Joe Connell at the University of California at Santa Barbara and as a postdoctoral scholar with Bill Murdoch also of UCSB. His research interests can perhaps be best described as interdisciplinary marine conservation ecology. In his academic persona, Pete has published 240 papers in peer-reviewed journals, book chapters and governmental reports. He has helped train and facilitate the careers of nearly 80 professors, researchers, teachers, natural resource managers, and NGO conservation advocates. Peterson himself is most proud of the impacts his efforts have had to shape and implement conservation.

He has worked since 2008 on evaluating the feasibility of developing offshore wind power. His efforts on renewable energy complement his long involvement in evaluating ecological impacts of oil spills, from the Santa Barbara spill in 1969 through the Exxon Valdez and most recently the DeepWater Horizon blowout. His research on oil spill impacts in the marine environment is among the most cited publications on the topic.

Dr. Andy Read

research professor, Duke University

Andy is the Stephen A. Toth professor of Marine Biology at the Duke University Marine Laboratory, in Beaufort. He was born in Southampton, England and educated in Canada. He received his Ph.D. from the University of Guelph in 1990 for research conducted on the life history and bycatch of harbor porpoises in the Bay of Fundy, working under the supervision of Dr. David Gaskin. He has conducted field research on marine mammals, seabirds and sea turtles in North and South America, Europe, Asia and the Antarctic. You can access his papers through Google Scholar.

Andy is active in the conservation of marine vertebrates at the national and international levels. He has acted as a member of the Cetacean Specialist Group of the IUCN, the Scientific Committee of the International Whaling Commission, the International Committee for the Recovery of the Vaquita and several federal marine mammal Take Reduction Teams. He has also served on the Editorial Boards of Marine Mammal Science, The Journal of Cetacean Research and Management and Endangered Species Research. And from 2008-2010 he was President of the Society for Marine Mammalogy.

Dr. Douglas Nowacek

associate professor, Duke University

Dr. Douglas Nowacek started his career in marine science with a summer trip to the Duke Marine Lab when he was an undergraduate at Ohio Wesleyan University. After finishing his bachelor's degree in 1991, Doug returned to Duke Marine Lab for another summer; this time starting his work in bioacoustics and behavioral ecology of marine mammals. In 1993, Doug started his graduate work in the MIT-Woods Hole Oceanographic Institution Joint Program in Oceanography studying under Dr. Peter Tyack. Upon finishing his Ph.D. in 1999, he was awarded a National Research Council postdoctoral fellowship, working with Dr. Phil Clapham at the National Marine Fisheries Service. A second postdoc took Doug to Sarasota, F.L., to Mote Marine Laboratory to work with Dr. Randy Wells in the place where he had conducted his Ph.D. research on the bottlenose dolphins. In 2003 Nowacek moved to the Oceanography Department at Florida State University, then, in 2008, to the Nicholas School of the Environment and the Pratt School of Engineering at Duke.

In addition to his work on bioacoustics and behavioral ecology of marine mammals, Doug's focus also includes technology development for marine conservation research. In his joint appointments in the Schools of Environment and Engineering, he works to bring new technologies to compelling marine conservation research questions. One of the current marine conservation issues that is an emphasis for Doug is ocean noise and its impacts on marine animals, particularly mammals but also fish and turtles. He is also focused on ocean energy as a marine conservation issue. He has served for nearly 10 years on an international panel at the International Union for the Conservation of Nature that works with the oil and gas industry off Sakhalin Island, Russia, specifically working to minimize and mitigate risks to western gray whales of oil and gas development on the Sakhalin shelf.

Dr. Steve Ross

research professor, University of North Carolina at Wilmington, Center for Marine Science

Dr. Steve Ross is a native of North Carolina and has spent most of his career involved in marine science of the southeast region. He earned a BS degree in zoology from Duke University, a master's degree from UNC-Chapel Hill, and a Ph.D. from North Carolina State University. He was the Research Coordinator for the North Carolina Coastal Reserve Program for 13 years. He is currently a research faculty at University of North Carolina-Wilmington and also has led offshore studies for the U.S. Geological Survey. His area of specialization is ichthyology (fishes), particularly in areas of ecology and life history studies (age, growth, feeding, reproduction).

His current work involves assessment of the fish communities of unique deep water habitats off the southeastern U.S., in the Gulf of Mexico, and in the Middle Atlantic Bight. Steve is also involved with European scientists in conducting deep-sea, trans-Atlantic ecosystem studies. One ultimate goal of this research program is to provide information for these poorly known areas that will facilitate management and protection of productive and vulnerable habitats.

Dr. Len Pietrafesa

professor emeritus, Department of Marine Earth and Atmospheric Science, North Carolina State University

After receiving his Ph.D. in Geophysical

Fluid Dynamics in 1973 from the University of Washington, Len joined the faculty at North Carolina State University and was made full professor in 1980. He has served as the Head of the Department of Marine, Earth and Atmospheric Sciences, Director of the University Honors Council and Dean for Research and Director of the Center for Severe Storms in the Southeast. Presently he is Associate Dean for External Affairs, College of Physical and Mathematical Science and Director of the National Oceanic and Atmospheric Administration (NOAA) Cooperative, Climate and Weather Impacts on Society and the Environment.

He is widely published (more than 170 publications), his sponsored research awards total more than \$25 million, and his service includes being Chair of the NOAA Science Advisory Board, a member of the board of trustees of the University Corporation for Atmospheric Research, former Chair of the USA-Peoples Republic of China Steering Committee on Virtual Collaboratories, former Chair, National Association of State Universities and Land Grant Colleges Board on Oceans and Atmosphere and present Secretary of the Commission on Environment, Food and Renewable Resources, former Chair of the Council on Ocean Affairs, the precursor to the Consortium for Oceanographic Research and Education (an organization he helped form), former Chair of the American Meteorology Society Educational Advisory Committee, and a member of the American Geophysical Union Committee on Public Affairs.

Dr. Larry Cahoon

research professor, University of North Carolina at Wilmington

Larry Cahoon is currently professor of Biology and Marine Biology at University of North Carolina-Wilmington. He teaches courses in Biological Oceanography, Limnology, Forensic Environmental Science, the Oceans and Climate Change, and Coastal Ocean Science & Policy. His research interests include biological oceanography, particularly sediment-water column interactions in continental shelf waters, as well as a broad range of topics related to water quality in oceanic, estuarine, and freshwater ecosystems. Larry earned his B.S. in Biology (*summa cum laude*) at Washington & Lee University in 1975 and his Ph.D. in Zoology at Duke University in 1981. He joined the faculty at UNCW in 1982. Larry has served on

the North Carolina Marine Science Council (1985-1990), the North Carolina Ocean Affairs Council (1991-1993), as Chair of the North Carolina Ocean Resources Task Force (1993-1996), as a member of the North Carolina Division of Coastal Management's Ocean Policy Advisory Council in 2007-2008 and as a member of the legislative study subcommittee on offshore energy (2009-2010).

Robert Fritchey

author, "Wetland Riders"

Robert Fritchey considers any day not spent outdoors to be a wasted day. Born in Pennsylvania in 1950, he completed his master's degree in Tropical Medicine & Medical Parasitology at Louisiana State University Medical Center in New Orleans in 1978. Apparently born to fish, he traded microscopes for nets to become a commercial fisherman in South Louisiana's fertile coastal marshes where he became an activist for the restoration of the state's rapidly vanishing wetlands. A passion for netting redfish landed him in the middle of the 1980s controversy over that contested species. Frustrated with media coverage of the issue, he wrote and published "Wetland Riders" in 1994 to inform consumers that their access to seafood was threatened by an exploding recreational fishery. Put out of business by Louisiana's 1995 legislative net ban, Robert had nothing better to do than write a sequel called "Gulf Wars." "Gulf Wars" is a series of e-books that recount the fish fights that occurred across the Gulf of Mexico in the mid-1990s. The first in that series, called "Missing Redfish, The Blackened History of a Gulf Coast Icon," is scheduled for release on August 1, 2015.

Peg Howell

former Chevron employee

Peg Howell holds a B.S. in Petroleum Engineering, *cum laude* from Marietta College. She worked summers during college for Marathon, Mobil (as a "roustabout" in south Louisiana) and Chevron (as a drilling intern on drilling rigs in the Gulf of Mexico). She joined Chevron USA full time in New Orleans as a petroleum engineer in June 1977. Peg worked as a production engineer, then as a drilling engineer in the Gulf of Mexico and in the North Sea until late 1981. Peg was the first female "Company Man" (rig supervisor) in the Gulf. She completed graduate coursework in petroleum engineering and economics at Louisiana

State University, and then attended Harvard Business School where she earned her MBA in 1984. During the next decade she was an Assistant Dean at HBS, then a strategist for a specialty chemical company and a marketer and instructor for Outward Bound USA. Since 1994, she has been a business consultant and executive coach to many executive teams in a variety of industries.

Steve Roady

managing attorney, Earthjustice, Oceans Program

Steve Roady manages the Oceans Program at Earthjustice's Washington, D.C. office. He received his B.A. from Davidson College with honors in 1971, and his law degree from Duke University in 1976. He practiced environmental law in Washington, D.C. from 1976 to 1989, and then joined the United States Senate Committee on Environment and Public Works as counsel to Committee Chairman John H. Chafee. After helping draft the Clean Air Act Amendments of 1990, Steve returned to private practice before launching the Ocean Law Project at Earthjustice in 1998. During 2001 and 2002, Steve was the first president of Oceana, an international ocean conservation organization; he rejoined Earthjustice in 2002.

Currently, he is a senior lecturing fellow at Duke Law School and a professorial lecturer at the Johns Hopkins School of Advanced International Studies. He also is a member of the adjunct faculty at Duke's Nicholas School of the Environment, where he recently won an award for his teaching. Harvard Law School named Steve a Wasserstein Public Interest Fellow for 2007-2008. His most recent writings focus on the duty of governments to act as prudent trustees for the environment under the Public Trust Doctrine.

April Clark

owner, Second Wind Eco Tours and Yoga

April Clark is a longtime resident of Onslow County and the owner of Second Wind, an ecotourism business and yoga studio in Swansboro. She holds a Master of Arts degree from University of North Carolina-Wilmington. She's been a member of the Jacksonville Rotary Club for 13 years and currently serves as club president. April is passionate about protecting the environment and is a current member of the federation's board of directors.

Morty Gaskill

commercial fisherman

A seventh generation commercial fisherman and a native of Ocracoke, Morty, at 21 years old, was also one of the youngest in the area. He has been running his own boat since he was twelve years old. He spent his junior and senior years of high school attending the North Carolina School of Science and Mathematics in Durham. After graduating in 2012, he enrolled at North Carolina State University where he studied fisheries biology, and is majoring in history. His dependency on the ocean to pay his college and living expenses has given him a deep appreciation for the coast.

Mac Gibbs

retired, Hyde County North Carolina Cooperative Extension

Mac is the former county extension director for the Hyde County Center of the North Carolina Cooperative Extension Service, which is part of the College of Agriculture and Life Science of North Carolina State University. Before joining the extension service 21 years ago, Mac farmed in Hyde County. He has also worked as a commercial fisherman. He is a graduate from North Carolina State University with a Bachelor of Science in agricultural education and masters in horticulture science.

Willo Kelly

consultant, Outer Banks Association of Realtors, Outer Banks Home Builder's Association

Willo Kelly is a consultant that has been employed by the Outer Banks Association of Realtors and the Outer Banks Home Builders Association for almost 10 years as their government affairs liaison. In addition to advocating the legislative policies of each association, she publishes a weekly Legislative Briefing that is distributed to over 1,500 members, keeping them up-to-date on local and state issues. She is a founding member and Past-President of the organization NC-20, a coalition that has worked to further the common environmental and economic development interests in North Carolina's 20 coastal CAMA counties. She has served on numerous local and regional boards and has been a tireless advocate for fair, affordable and accessible property, wind and flood insurance in North Carolina

Deborah Dicks Maxwell

president, New Hanover County N.A.A.C.P.

Deborah Dicks Maxwell graduated from LaRoche College in Pittsburgh, Pennsylvania, receiving a bachelor's of science degree in Administration and Management. She received a Master's of Social Work degree from East Carolina University. Deborah is the current President of the New Hanover County N.A.A.C.P. and District Director for the Walter B. White District of North Carolina N.A.A.C.P. As a strong advocate for social justice Deborah is employed as a Public Health social worker at Brunswick County Health Services. Public health has been her passion and career for the past 20 years. The North Carolina Public Health Association named her Public Health social worker of the Year in 2009. She was awarded a health Disparities Fellowship for 2010-2012 from the North Carolina Wellness Trust Fund and Duke University Global Institute. She is also an Army veteran having served in Operation Desert Storm and past commander of the Wilmington National Association of Black Veterans. Deborah is very concerned about the coast and works to increase education and advocacy among people of color in Southeastern North Carolina.

Dan Wilcox

mayor, Carolina Beach, North Carolina

Dan Wilcox is a long-standing resident of Carolina Beach and for over 24 years has served the Town. Born in Virginia Beach, Virginia he remains an avid sailor and lover of the ocean. A true family man, Dan shares a deep sense of commitment and pride in Carolina Beach and Pleasure Island. As a contractor and construction consultant, Dan has literally helped shape and build Carolina Beach into a successful and growing community. Dan is active in leadership roles in town government and committees, including serving on the Carolina Beach Town Council from 2008-2010 and as Mayor Pro Tem from 2010 to 2012. Dan was Commissioner and Chair of the Carolina Beach Planning Commission, Carolina Beach Marketing Advisory Committee and numerous other town and community committees and boards.

Apart from his service in town government, Dan is best known for his key leadership role in restoring the Carolina Beach Central Business District and Boardwalk. As co-founder and chair of the Boardwalk

Makeover Group and now the Carolina Beach Downtown Initiative, Dan helped assemble a team of resident volunteers and stakeholders to restore the Central Business District and Boardwalk to its once famous glory. Dan is also working with the North Carolina Coastal Federation on a project team to improve the Special Use Permit process for New Hanover County.

Todd Miller

executive director, North Carolina Coastal Federation

Todd Miller is the founder and executive director of the North Carolina Coastal Federation, a nonprofit membership organization with over 12,000 members and 3,000 active volunteers working for a healthier N.C. coast.

A coastal North Carolina native from Carteret County, it was here in 1982 that Todd found his passion—working to keep the coast a great place to live, work and play. Forming partnerships and rallying volunteers, he grew the organization from a one-man (and a dog) venture in a back room of his house to three-offices covering the N.C. coast. With 30+ staffers and a multimillion dollar budget targeted for educating the public, advocating for a clean coast and restoring the state's wetlands and shorelines, the federation takes on projects, and partners with others in hundreds of endeavors that influence these priorities.

An alumnus of University of North Carolina at Chapel Hill, from which he holds an undergraduate and master's degree, Todd was selected as a distinguished alumnus from the university in 2013. The Peter Benchley Ocean Awards recently honored him with a 2015 "Hero of the Seas" award. Along with numerous other awards and recognitions, Todd is a founding board member of Restore America Estuaries and currently serves on the Board of Visitors for the University of North Carolina Institute for the Environment as well as the past chair of the Policy Committee for the Albemarle-Pamlico Estuary Partnership.

Since the launch of the federation, he has worked tirelessly to raise awareness of the threats to the coast and advocate for access to clean coastal waters. In bringing together like-minded folks from all walks of life, from fishers to paddlers to boaters and beachcombers, the federation under Todd's leadership has succeeded in restoring and maintaining thousands of acres of N.C. coast.

OFFSHORE DRILLING SERIES BEGINS

by Frank Tursi

FIRST OF A SERIES

For the first time in almost three decades, the federal government is considering opening up the Atlantic Ocean off the N.C. coast to oil and natural gas drilling. The first of the many environmental studies has been drafted, the first of the many public hearings has been held. And the first of many questions has been raised.

How much oil or gas is out there? When will they go get it and where will they drill? Will it come ashore somewhere along our coast? Will the price of gasoline drop as a result? Will drilling generate any jobs for local people or much money for the state treasury? Where will that oil go if there is an accident or spill?

Coastal Review Online this week begins to answer those questions and many more. This is the first of more than 40 stories that we will publish over the next two months on offshore drilling and its potential effects on the N.C. coast. In our most ambitious reporting project, seven reporters have spent several months talking to dozens of people trying to determine what drilling might mean to the state's coastal environment, economy and lifestyle.

We'll run the results of all that reporting on alternate weeks, starting this week with stories about the history of drilling in North Carolina, the geology of the Atlantic Ocean and why oil or gas might be out there, the federal process that manages offshore drilling and the politics in Raleigh that are promoting it.

Other stories in the series will explore the potential benefits of drilling to the state's economy and the likely environmental effects on the coast in the event of a spill or accident. We'll poll coastal residents to gauge their support for drilling, and two reporters traveled the coast, from Calabash to Corolla, talking to people about the subject.

SETTING THE STAGE

First, though, let's catch up as to where we are.



The Obama Administration did the expected in late January and announced plans to potentially open portions of the Atlantic coast, including offshore North Carolina, to oil and natural gas drilling for the first time since Mobil Oil proposed an exploratory well off the Outer Banks in the mid-1980s.

In keeping with Obama's all-of-the-above approach to energy development, the federal Bureau of Ocean Energy Management, or BOEM, released a draft five-year leasing plan that would begin in 2017. The plan includes all federal waters 50 miles off the mid- and south-Atlantic coasts, from the mouth of the Chesapeake Bay to the Georgia-Florida border. Also included in the plan are areas in the central and western Gulf of Mexico and off the north coast of Alaska.

The proposed leasing plan is the initial step in a long, tortuous federal permitting and review process for offshore leasing, exploration and finally production. That process for the Atlantic, where no wells exist, will take more than a decade to play out if it continues to move forward.

The announcement followed a decision by the Obama administration last year to allow companies to use sound waves to survey the seafloor in the Atlantic in search

of oil and natural gas. These so-called seismic tests are controversial because critics charge that they can harm marine mammals, such as whale and dolphins.

BOEM has since received 10 applications from companies to conduct the tests. Four of those applicants want to survey off North Carolina's coast and more applications are expected, according to state regulators. The state has approved three of the applications so far, and testing could begin later this year.

BATTLE LINES FORM

Offshore drilling has a contentious history along the N.C. coast, and it soon became clear that a fight is brewing this time as well. The first skirmish was in Wrightsville Beach about a month after BOEM announced the leasing plan. The spark was the first of the agency's two public hearings in North Carolina on the plan.

Drilling proponents gathered that afternoon across the waterway in downtown Wilmington. Over boxed lunches supplied by the country's largest oil industry trade group, the crowd of mostly businessmen listened to speakers extol the benefits of drilling: good-paying jobs, money for state and local budgets, energy independence and strengthened

national security.

The message mirrored the one that Gov. Pat McCrory has been taking all across North Carolina. As the leading drilling cheerleader in the state, McCrory has promoted offshore drilling in testimony before Congress, urged BOEM to allow exploration closer to shore and supported exploring for oil and natural gas within three miles of the state's coastline. He also heads a group of East Coast governors who have been urging Obama to open up the Atlantic to drilling.

Using an industry-sponsored economic study, McCrory has said offshore drilling will provide thousands of new jobs in the state and contribute more than \$9 billion to the state treasury by 2035. In later stories, we'll explore the accuracy of those predictions and the oil industry's close ties to the governors' group that McCrory heads.

There wasn't much talk about jobs at the press conference that 10 environmental groups held at the hotel where BOEM had its meeting that day in Wrightsville Beach. The BP Deepwater Horizon was the featured attraction. One wall was dominated by a huge photograph of the oil rig that exploded in the Gulf of Mexico in 2010 in the worst oil spill in U.S. history. It was engulfed in flames and ringed by fire boats spewing jets of water.

Speaker after speaker raised the specter of oil-encased seabirds, blackened beaches and a dying tourism economy if something like that were to happen here. We'll examine the likelihood of all that during the second week of the series.

More than 400 people attended the BOEM hearing that day in Wrightsville Beach. Almost 700 showed up a month later at a similar hearing in Nags Head, the largest turnout in BOEM's five-year history.

"I would say we have heard from a lot of people who are opposed," an agency spokeswoman said afterwards.

At least a dozen communities along the coast have passed resolutions opposed to offshore drilling, seismic testing or both.

And in Manteo a group of old oil warriors began organizing again for a fight they thought they had won 25 years ago.

THE SCHEDULE

Week 1 — Science, Politics & Process

June 8: General overview of series, introduction of authors.

June 9: The history of oil exploration along the N.C. coast, including Mobil Oil Corp.'s proposal for an exploratory well off the Outer Banks in the 1980s.

June 10: The federal process for leasing and permitting wells offshore and why it will likely take more than a decade to play out. The geology of the continental shelf of the East Coast and why oil or natural gas might lie beneath the sea and in what quantities.

June 11: The politics of oil in the N.C. General Assembly and what drives Gov. Pat McCrory's push for drilling.

June 12: The geology of the continental shelf of the East Coast and why oil or natural gas might lie beneath the sea and in what quantities.

Week 2 — Pros, Cons & Reality

June 22: The pros of drilling: jobs and gas pump relief. Job creation and lower gasoline prices are among the main benefits of drilling, say its proponents. How realistic are their job forecasts and will gas prices fall if oil is found off North Carolina?

June 23: The pros of drilling: money, money, money. An oil industry study that is often quoted by proponents forecasts that North Carolina could reap more than \$9 billion a year by 2035 in oil royalties and increased tax revenue. We take a hard look at the numbers.

June 24: The cons of drilling: oil spills and accidents. How likely is a spill or accident from an offshore rig and where would the oil likely go?

June 25: The cons of drilling. Intense industrialization is required to transport, store and process oil or natural gas. Is that likely to occur in North Carolina and what would the effects be on the coastal environment if it does?

June 26: Tourism and oil. The fear of what an oil spill might do to the coast's tourism industry is at the center of much of the opposition among local governments. In North Carolina, from the Outer Banks in the north to Sunset Beach in the south, beaches and coastal towns draw more than 11 million visitors each year. In 2013 alone, visitors spent just shy of \$3 billion in the eight oceanfront counties, according to the state Department of Commerce.

Week 3 — Pulse of the Coast

July 6-7: Calabash to Morehead City. We poll coastal residents about their support for offshore drilling and send a reporter to spend a week traveling along the southern coast talking to people about the prospects of drilling off our shores.

July 8-9: Corolla to Morehead City. Another reporter travels the northern coast to gauge the sentiments of residents there.

July 10: Morehead City or Wilmington. We explore whether these port cities along the central coast could become a staging and supply port for the drilling rigs and what that mean for a tourist town.

Week 4 — America's Oil Coast

Fall: We send a reporter to the heart of the country's oil region along the Gulf of Mexico where he reports back on life amid the oil rigs and refineries.

Read the whole series at www.coastalreview.org.

BENEFITS BASED ON ASSUMPTIONS

by **Trista Talton**

IT'S ONLY FAIR.

That is the sentiment of coastal states, where politicians say that providing infrastructure and expanding public services to support offshore oil and gas development deserves a cut of the multibillion-dollar pie.

Last year, companies paid \$7.3 billion in royalties to the federal government for oil and natural gas drilled at least three miles from shore.

But if oil or natural gas were now being produced in federal waters off the N.C. coast, the state wouldn't receive a dime. For the state to cash in, Congress would first have to change the law.

With the possibility of the first lease sale in the Atlantic six years away, Republican Gov. Pat McCrory and U.S. Sens. Thom Tillis, R-N.C., and Richard Burr, R-N.C., are joining a chorus of coastal states pushing to secure a share of federal oil royalties.

Their efforts thus far have been met with opposition from the Obama administration, which included in its draft budget plan this year a proposal to spread offshore revenue sharing among all states. The oil and gas are on public property, the administration has argued, and thus any federal fees collected from private companies that drill for it should be used to benefit all taxpayers. Some of it, for instance, could finance research of alternative energies, as Obama has proposed.

Qualifying coastal states have for years received 27 percent of federal oil subsidy revenues generated from offshore production within the first three-mile stretch of ocean seaward of state coastal waters.

The Obama administration included in its draft budget plan this year a proposal to spread offshore revenue sharing among all states.

The administration would like to replace that deal with a broader sharing proposal and do away with the arrangement Congress approved in the 2006 Gulf of Mexico Energy Security Act, which broadened the area

where states receive a cut of federal shares. The law shares 37.5 percent of bonus bids, rentals and production royalties with Alabama, Louisiana, Mississippi and Texas.

Alaska's exclusion from the deal stiffened tensions over offshore oil production in that state.

"It's very contentious," said Jim Stouffer, Alaska Department of Natural Resources royalty accounting manager. "What's on shore, the feds have tied up much of the land so that we can't even drill on it. It's our lifeblood. Over 90 percent of our general fund revenue is in oil and gas. Royalties amount to about 40 percent."

Alabama, Alaska, California, Louisiana and Mississippi take home all of the royalties for oil and gas extracted within their state waters, which extend three nautical miles from shore. Texas' and Florida's waters extend to nine miles offshore.

Revenues disbursed from federal royalties have been significantly less than what Texas receives from shares in its state waters. In Texas, about \$1.2 billion was collected in revenues generated within state waters last year, according to Jim Suydam, a spokesman for the Texas General Land Office. The state received about \$1.5 million last year in federal offshore royalties, according to the U.S. Office of Natural Resources Revenue.

Yet in North Carolina much emphasis is being placed on federal oil royalties expected if drilling occurs off the coast – so much so politicians say they will not support drilling if the state does not get some of the money.

"It is incumbent upon me to take the costs and benefits into account when considering whether to support offshore activity in North Carolina," McCrory said in an April 15 statement to the congressional Subcommittee on Energy and Mineral Resources. "Considering these facts, North Carolina will not support offshore energy development without revenue sharing."

Revenue sharing would be vital to "frontier" coastal states and beach communities in the new areas of energy exploration to help

offset spending on infrastructure, services and the implementation of environmental-protection measures, he said. McCrory's office did not respond to interview requests.

Meanwhile, Tillis told CRO the economic benefits would bring relief to N.C. taxpayers.

"We're talking about billions of dollars of revenue over time that can be used to reduce the tax burden," Tillis said in a telephone interview. "In many ways North Carolina, because we already have such a diversified economy, it could create one of the most diversified economies in the nation. It is a long-term process. In the statutes we have to create how they would be allocated so that we would get the distributions right."

Tillis is one of five cosponsors of the Southern Atlantic Energy Security Act, a bill recently introduced by Sen. Mark Warner, D-Va., to the Senate Energy and Natural Resources Committee. The bill allocates half of offshore revenues to the federal treasury and the remainder to Virginia, North Carolina, South Carolina and Georgia with each state receiving not less than 10 percent of available revenue. States would have to use 10 percent of the money to enhance land and water conservation efforts, improve public transportation, establish alternative energy production and enhance beach nourishment.

"I think that the majority of people in Congress support this not only for the economic benefit but for the strategic benefit of creating a greater stream of revenue," Tillis said. "The challenge is whether we have an administration that's willing to enter into that dialogue."

In response to CRO's query, Burr's office released this statement: "Senator Burr is continuing to engage coastal communities on exploration and believes that revenue sharing must be channeled specifically to our communities along the coast to provide for beach re-nourishment and other important priorities. Senator Burr is committed to ensuring that any exploration off our coasts would protect our coastal communities and our vital tourism industry."

Warner's bill and two others aiming to open more federal waters to oil and gas production and allocate those revenues to states were met with a cool reception from the administration, according to media reports.

The bills are the latest in a lengthy battle over oil revenue allocations.

"Basically up to now we haven't really seen a lot of federal royalties," said Patrick Courreges, a spokesman with the Louisiana Department of Natural Resources. "Starting in 2017, that's when there would actually be some money. It's capped, but it's more than pennies."

Revenue amounts fluctuate based on offshore activity and the price of a barrel of oil. Lower production and oil prices equate to a decline in revenues.

An American Petroleum Institute-funded Quest report released in December 2013 projects offshore oil and gas production resulting from opening the Atlantic outer continental shelf will generate as much as \$51 billion in total cumulative economic benefits to the country from 2017 to 2035. East Coast states would be the biggest recipients of the economic benefits, especially those from capital investment and jobs, according to the report, which also assumes Congress will change the law and that federal revenue shares would be split 37.5 percent to the states. Those states would receive a combined estimated \$4.5 billion a year by 2035.

Revenue sharing is the big assumption here, but industry proponents say even if the law isn't changed, it shouldn't be a deal breaker for offshore drilling in the Atlantic.

"People get so focused on the revenue sharing and that's important," said David McGowan, executive director of the N.C. Petroleum Council. "With the revenue sharing, that's money paid directly to the state government. You see it. The direct and indirect economic impact, it's obviously a little more nebulous. That's really where the most significant benefits lie for the state. Even without that revenue-sharing agreement, taking the Quest numbers at value, it's still \$4 billion a year." ■

Read the whole series at www.coastalreview.org.

POTENTIAL FOR DISASTER: OUR COAST AT RISK

by Brad Rich

On April 20, 2010, a cascading series of errors resulted in the largest oil disaster in history.



Eleven people died when BP's Deepwater Horizon rig exploded, causing the worst oil spill in U.S. history. Photograph: AFP/Getty Images

The Deepwater Horizon, a British Petroleum well 50 miles offshore in the Gulf of Mexico in 5,000 feet of water, exploded and began discharging oil. The federal government estimated that by the time the well was finally capped almost five months later, 4.9 million barrels of oil, or 210 million gallons, had leaked into the Gulf. A 2015 court proceeding put those numbers at 3.19 million barrels, or 134 million gallons.

The report by a national commission appointed by President Barack Obama to determine the cause of the worst oil spill in the history of the petroleum industry put the blame on a host of human and mechanical mistakes and failures. BP tried various measures to stop it, used 1.86 million gallons of a toxic chemical dispersant and eventually spent billions of dollars on cleanup, mitigation and compensation efforts that continue to this day.

Hundreds of miles of Gulf shoreline were oiled. Beaches were closed because of health threats, thousands of birds and marine mammals were sickened or killed and tourism and commercial fishing were disrupted in countless communities heavily dependent on them.

Time passed. The Gulf and its shoreline at

least partly healed. And, eventually, in a world and nation still heavily dependent upon petroleum, thoughts of tapping the oil and gas believed to be in the Atlantic became less unpalatable. Finally, in July 2014, the Obama Administration, committed to an "all of the above" energy strategy, announced that it had given the go-ahead for a program that might lease tracts of the Atlantic beyond 50 miles from shore, including off North Carolina, for oil and natural gas drilling.

COULD IT HAPPEN HERE?

The announcement triggered praise from many, but the words on the lips of countless others were largely only two: "Deepwater Horizon." And as companies gear up to test the waters off the Tar Heel state for oil and gas, the lingering question is: Could it happen here?

Harvey Seim, chairman of the Department of Marine Sciences at the University of North Carolina at Chapel Hill and a man who was on the Deepwater Horizon response team, said that the 50-mile buffer offers some protection from potential problems if a disaster were to happen north of Cape Hatteras, in the area believed most likely to hold commercially significant undersea oil and gas deposits.

But, he said recently, there's no guarantee, and there are many factors that would come into play, the largest of which are the position and flow of the Gulf Stream at the time accident and afterward.

The river of water flowing north off the East Coast could in theory take spilled oil thousands of miles to the English coast ... or just a few miles away to Cape Hatteras.

"There are eddies, or rings, off the Gulf Stream every week," Seim said. "They push water onto the continental shelf. If it (a spill) happens north of Hatteras, the chances are lower than south of Hatteras, but there is definitely chance oil will get in to our shores."

Eddies off the Gulf Stream – although

farther south, near Carteret County – brought North Carolina's first known toxic red tide ashore in 1987, he noted.

The dinoflagellate algae bloom came in on Halloween day, brought from the Gulf off Florida, where red tides are common. While it's a wholly different kind of event than an oil spill or oil well blow-out, it illustrates that potential transport mechanism.

Generally speaking, the Gulf Stream passes closest to shore off North Carolina's Outer Banks. The exact distance varies, but can be as little as 12 miles.

OIL ON THE BEACHES

Larry Cahoon, a marine biologist at UNC-Wilmington, said it was once thought highly unlikely that oil from a spill outside the Gulf Stream, north of Hatteras, would make it to the N.C. shore and its estuaries. But more recent studies indicate there is at least a 30 percent chance.

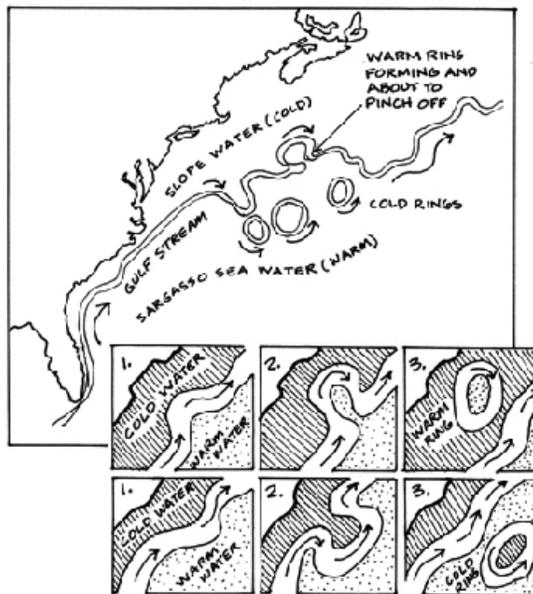
"I wouldn't put a number on it," Seim said, "and it depends on the character of the oil, and the wind direction and speed at the time, what kind of weather you're having. It also depends on how you try to clean it up."

After the Deepwater explosion, cleanup crews sprayed almost 2 million gallons of a chemical dispersant called Corexit on the surface to break up oil slicks. The oil, though, likely ended on the bottom of the Gulf, and the chemical was still being found in oil on Louisiana beaches months later.

That's important, Seim said, because there are times when wind direction would push surface oil in to shore, and times when the same wind might push subsurface oil ashore.

Where that oil might come ashore is even more problematic. Seim thinks it would likely end up south of Oregon Inlet if the rigs were north of Cape Hatteras because since water over the continental shelf "generally" moves north to south.

The risk of oil making it to the North Carolina shore after a major spill "is significant," he said.



Like an oxbow lake on land, sometimes a loop of the meandering Gulf Stream becomes cut off from the main current. This forms an eddy of water that may move at speeds of 2-3 knots and may occasionally persist for 3-5 years. Eddies can be up to 200 miles in diameter. Eddies or "rings" are features that are easily seen from space by infrared sensors. Illustration: NASA

Seim also thinks that drilling 50 miles off the N.C. coast will be technically challenging, especially north of Cape Hatteras. "That's going to put you in waters 2,000 meters deep, maybe as deep as 3,000," he said. "Deepwater Horizon was about 1,500 meters. And the Gulf of Mexico is like a bathtub compared to the Atlantic off North Carolina."

Seim said that until recently, there was little urgency to determine where spilled oil might go in the Atlantic.

"I still don't think we have a very good sense of that circulation at times," he said. "And I think there were a lot of people who were surprised at the results of what has been done recently."

Charles "Pete" Peterson of the UNC Institute of Marine Sciences in Morehead City cited a simple rule to determine the potential for spilled oil reaching N.C. beaches: If you see sargassum on your beach, you could see oil.

Sargassum is a brown algae found in large masses in the Sargasso Sea, a region in the middle of the Atlantic Ocean, and in tropical waters around the world. It is distinguished

by its brown color and small leaves resembling appendages that allow it to float. A cursory Google search shows that it's found on virtually all of the state's beaches at times, especially in the summer, when prevailing winds are south and southwest.

BP SPILL AS A YARDSTICK

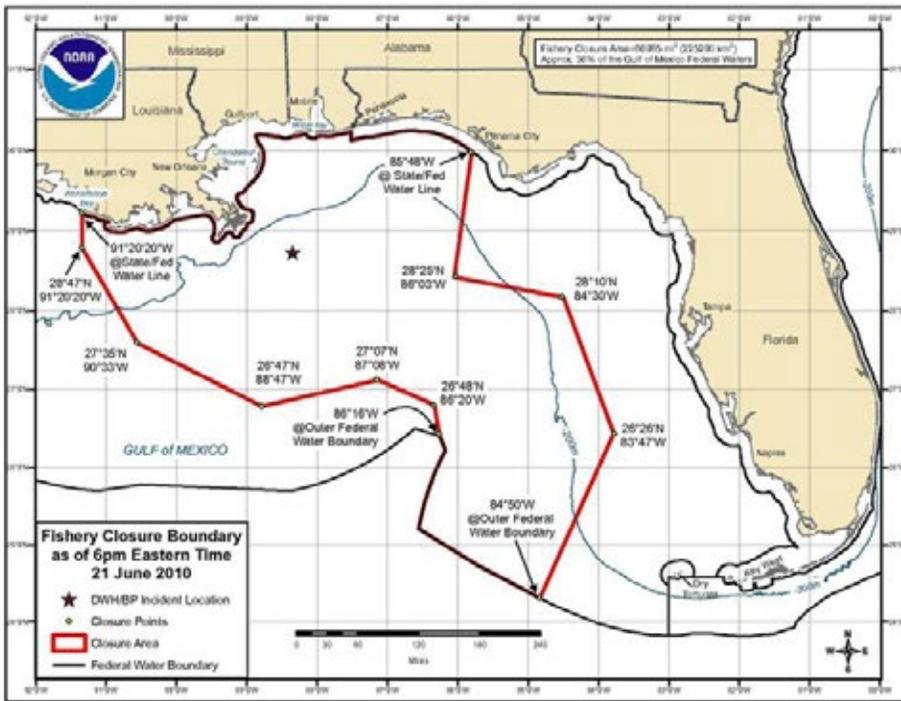
So what could one reasonably expect if oil entered the Gulf Stream, crossed onto the continental shelf and made it to North Carolina's estuaries and beaches?

Bob Deans, associate communications director of the Natural Resources Defense Council and author of the book, *Deepwater Horizon: The Oil Disaster, Its Aftermath, and Our Future*, said one can't assume any disaster would be as bad as that one. But he said it's fair to look to Deepwater as a harbinger of the kinds, if not the extent, of damage likely to occur.

"With Deepwater, you had 1,100 miles of shoreline impacted," he said. "On the East Coast, that's from Savannah to Boston. If you ask me if it's worth the risk, I'd ask you to ask someone walking on the beach at Holden Beach or Nags Head if they'd like to see a 25,000-pound tar mat roll upon the beach, like happened 50 miles or so from New Orleans in March, five years after the blow-out."

"I'd suggest that you ask them how they'd like to see dead dolphins, and oil-covered sea birds, and bluefin tuna with birth defects and abnormalities in their hearts. I'd suggest that you ask them how things like these are going to help the tourism industry or the commercial and recreational fishing industries in North Carolina."

Since the BP blowout, nearly 1,200 dolphins have been found dead in the affected area. Experts estimate that as many as 800,000 seabirds died, including 12 percent of the brown pelican population and 15 percent of the royal terns. Some say 25,000 marine mammals might have died. Hard figures are difficult to obtain.



Maximum area of federal waters closed to fishing after the Deepwater Horizon oil spill, 2010

The National Wildlife Federation, Deans said, reported that strandings of endangered and threatened sea turtles jumped from an average of about 100 per year before the spill to more than 500 a year for several years after the disaster.

"I'd just ask people in North Carolina if they think it's worth risking these kinds of things for what most say could - could - be a six-month supply of oil, about 3.3 billion barrels," Deans said.

Peterson is also worried about activities that might disrupt avian and marine life off Cape Hatteras, which is the area in which the Gulf Stream separates from the continental slope to the deep ocean, and where southward-flowing continental shelf water from the Middle Atlantic Bight converges with northward-flowing continental shelf water from the South Atlantic Bight, resulting in an up-welling of nutrient-rich water.

Marine mammals, such as bottle-nosed dolphin, tend to congregate in the area. Sea birds flock there in large numbers at certain times of the year, Peterson said. It's also where northern marine fish species and southern species overlap, a big reason North Carolina has such rich commercial and recreational fisheries.

SEAFOOD AND OIL

It's difficult to ascertain impacts an oil spill would have on fishing and fish.

Maximum area of federal waters closed to fishing after the Deepwater Horizon oil spill, 2010

Seafood safety is one issue. On May 3, 2010, less than two weeks after the BP spill, the National Oceanic and Atmospheric Administration, or NOAA, closed more than 6,800 square miles of the Gulf of Mexico to commercial and recreational fishing. The closure centered largely between the mouth of the Mississippi River and Pensacola Bay in Florida. By June 2, the area closed to commercial and recreational fishing grew to more than 88,000 square miles, or more than a third of Gulf of Mexico's federal waters. NOAA started reopening waters a month later.

Generally, according to a NOAA fact sheet, fish are less likely to become contaminated or tainted because they typically are either not exposed or are exposed only briefly to the spilled oil.

The legacy of oil production, though, has plagued some areas of the Gulf Coast well before the BP disaster. For example, Texas health officials, advise against eating speckled trout and red drum caught in Galveston Bay because of PCB

contamination. And Louisiana occasionally issues consumer advisories based on the presence of PCBs.

Shellfish are more likely than fish to become contaminated from spilled oil because they are more vulnerable to exposure and less efficient at metabolizing petroleum compounds once exposed. Shellfish are generally less mobile and have more contact with sediments, which can become contaminated and serve as a long-term source of exposure.

Among crustaceans, species that burrow are at the highest risk of exposure at spill sites where bottom sediments are contaminated, followed by species that use nearshore and estuarine benthic habitats, according to NOAA's National Marine Fisheries Service.

Bivalves - oysters, clams, scallops - are at the highest risk of contamination because they are filter feeders and live primarily in shallow tidal and intertidal areas that are more likely to become contaminated.

However, just because fish and shellfish are eventually deemed safe to eat, that doesn't mean their stocks won't suffer long-term consequences from Deepwater Horizon or another major oil spill.

DISTURBING RESEARCH

Field and lab studies published in 2013 by Fernando Galvez and others at Louisiana State University found that oil buried in sediments in the shallow waters of the Gulf triggered genetic reactions in the gills and livers of local populations of killifish, a prey for marine species vital to the region's economy.

Embryos that were exposed to oiled sediments hatched at a rate 40 percent lower than those cultivated in samples from oil-free sites, and those that did hatch were smaller than they should be and had little "vigor."

Galvez said this month that his team has continued its research primarily in the lab, and the evidence of effects has continued to mount. He also noted that some of his research indicates some organisms have started to develop a tolerance of hydrocarbons, "but we're trying to tease out what the costs of that tolerance might be. Is there going to be reduced fecundity (reproductive rate)? They do seem to be

