Coastal Response Research Center

at the University of New Hampshire

Annual Report
2005

Message from the Center's Co-Directors

This spring, the University of New Hampshire (UNH) Coastal Response Research Center will complete its second year of operation and partnership with the National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration. In this time, the Center has established its competitive grants program, formed working partnerships with other organizations and institutes with similar goals, and focused its outreach agenda.

This past year, we built on the success of existing partnerships and prior Research and Development (R&D) workshops with our Dispersants Research Initiative, a direct response to the National Research Council's recent call for an integrated approach to dispersants research. We are proud to have been a leading force in the formation of the Dispersants Working Group, a collaboration of 14 organizations with resources to fund dispersants research, and to have hosted an R&D needs workshop on dispersants. We are currently funding seven projects on dispersants.

The Center continues to serve as a major resource on spill response and restoration for NOAA, UNH, and the oil spill community. The Center is also a hub for information, resources and research partnerships within the oil spill community.

In the coming year, the Center will continue its efforts serving the needs of NOAA and the oil spill community through support of high quality research, outreach, and R&D needs workshops. Visit the Center's website (www.crrc.unh.edu) to stay informed of upcoming Center activities.

In this report, you will learn about some of the Center's funded research projects and discover the exciting programs the Center has planned for 2006.

As a final note, we are pleased to announce the arrival of David Kaiser, the newest NOAA affiliate to be stationed at UNH. David is the Senior Policy Analyst for the Office of Ocean and Coastal Resource Management (OCRM) within NOAA working on issues such as siting of LNG and wind power facilities. He will assist in the integration of NOAA programs at UNH, interface with the Coastal Center, and participate in marine academic and programmatic matters at UNH.

Best regards,

Nancy E. Kinner, Ph.D.
Professor of Civil/Environmental Engineering
UNH Co-Director

Carol-Ann Manen, Ph.D.
NOAA Senior Scientist
NOAA Co-Director

UNH Co-Director Nancy Kinner.

NOAA Co-Director Carol-Ann Manen.

Activities

Competitive Grants Program

At the heart of the Center's work is its competitive research grants program. The Center administers two competitive grant programs each year: the Annual Request for Proposals (RFP) and the Cold Climate RFP. The Center's Annual RFP focuses on NOAA Trust Resources and improving spill response and restoration decisions.

The Center uses a custom online proposal submittal and review system to manage its funding opportunities. Applicants responding to the Center's RFPs can submit their proposals online, peer reviewers can submit reviews, and final panel reviewers can access proposals, blind peer reviews and applicant rebuttals as well as submit their individual reviews all via the web. The Center is continually improving the system based on user comments and suggestions.

Released in May, the 2005 Annual RFP funded six projects:

- Don Aurand and Gina Coelho, Ecosystem Management Associates, Inc.; *The Relationship Between Acute and Population Level Effects of Exposure to Dispersed Oil, and the Influence of Exposure Conditions Using Multiple Life History Stages of an Estuarine Copepod, Eurytemora affinis, as a Model Planktonic Organism.*

- Ali Khelifa and Merv Fingas, Environment Canada; *Effects of Dispersants on Oil-SPM Aggregation and Fate in U.S. Coastal Waters.*

- Kenneth Lee, Bedford Institute of Oceanography; Albert Venosa, US EPA; Michel Boufadel, Temple University; and Scott Miles, Louisiana State University; *Wave Tank Studies on Dispersant Effectiveness as a Function of Energy Dissipation Rate and Particle Size Distribution.*

- George R. Parsons, University of Delaware; *Monetary Values and Restoration Equivalents for Lost Recreational Services on the Gulf Coast of Texas Due to Oil Spills and Other Environmental Disruptions.*

- James R. Payne, Payne Environmental Consultants, Inc.; Eric Terrill, Scripps Institution of Oceanograph; Deborah French-McCay, Applied Science Associates, Inc., and Walter Nordhausen, CA Dept. of Fish and Game; *Field Verification of Oil Spill Fate and Transport Modeling and Linking CODAR Observation System Data with SIMAP Predictions.*

Members of the Dispersants Working Group at the September 2005 meeting on the UNH campus in Durham, NH.

- Christine Poulos, Research Triangle Institute; *A Convergent Validity Test of the Parameter Updating Method.*

The Cold Climate RFP is a partnership between the Center, UNH's Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), the Prince William Sound Oil Spill Recovery Institute (OSRI), and the Minerals Management Service (MMS). The partnership addresses oil spill response and restoration issues in ice infested coastal areas, including the Great Lakes. The 2006 Cold Climate RFP process is currently underway with up to $1M available in funding. Priority areas for this year's RFP include Detection, Containment and Cleanup of Oil Spills; Exposure and Injury Assessment Tools; Data Development: Processes and Rates Affecting Oil; Human Use Valuation of Ecosystems; and Habitat Recovery and Restoration Technologies. Funding recipients will be announced in Spring 2006.

Dispersants Research Initiative

In May, the National Research Council (NRC) published its report on dispersants, which recommended that funding agencies work together to establish an integrated research plan to collect and disseminate peer-reviewed information about key aspects of dispersant use in a scientifically robust, but environmentally meaningful context. This year, the Center spearheaded efforts that have resulted in the creation of the Dispersants Working Group (DWG), whose 14 members represent the major funding entities in the oil spill community. DWG partners have agreed to work toward a coordinated research plan in order to eliminate the duplication of research efforts, make the most of available research dollars, and address priority topic areas in their RFPs. The Center is coordinating DWG activities and providing the mechanism by which reports, RFPs and other elements of interest are distributed and shared among DWG members and the oil spill community.

As the inaugural DWG event, the Center hosted the "Research and Development Needs for Making Decisions Regarding Dispersing Oil" workshop in September to develop a list of priority topics that could serve as a basis for a coordinated dispersants research plan. The workshop brought together more than 30 representatives from federal and state agencies, industry, academia, and the private sector for small group and plenary discussions of the effectiveness and effects of dispersant use. The dedication and hard work of the participants resulted in an impressive list of research topics which will serve as the basis for RFPs in 2006 and beyond to be used by the Center and its DWG partners.

Outreach

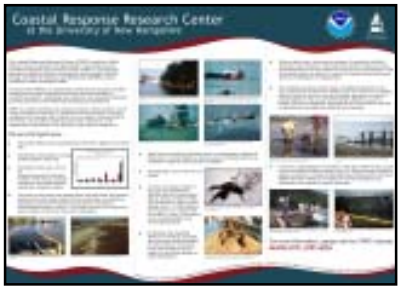
The Center expanded its outreach efforts in 2005. In March, the Center hosted the "Emerging Research in Oil Spill Response and Restoration Workshop" at NOAA Headquarters (Silver Spring, MD) featuring presentations by Center-funded researchers. The workshop gave researchers the opportunity to interact directly with members of the spill response community and get direct input from them on their research. The Center hosts similar workshops every two years.

Nancy Kinner (right) discusses the Center's research with Robin Jamail and Jim Payne at the March 2005 workshop.

In May, the Center participated in the International Oil Spill Conference (IOSC). The Center's booth saw a great deal of activity from prospective funding applicants as well as state and federal agency representatives and international colleagues. Center Co-Director, Nancy Kinner, presented a paper at the conference highlighting *Research Needs in Oil Spill Response*.

The Center Co-Directors participated in RRT meetings in Regions 1, 3, 4 and 5 with talks scheduled for RRTs 2, 6, 9, 10, and the Caribbean in 2006.

The Center's booth backdrop, developed for IOSC 2005.



A promotional poster for the Center.

IN THE FIELD

Last summer, Whitney Blanchard, UNH Environmental Engineering Program '06, got to see for herself the effects of an oil spill. The environmental engineering major was at the end of her summer internship with NOAA in New Orleans, Louisi-ana, when a nearby pipeline ruptured in the lower Mississippi Delta. During a day out on the water, she watched clean-up crews putting out the bright orange booms used to control spilled oil and she saw, up close, the dark ring of residue left behind on the aquatic plants in the marsh. "The spill wasn't that big, as spills go," she says, "but you could definitely see an impact."

Blanchard has had her eye on a career in environmental science since she was a kid being raised in an environmentally conscious household. She chose UNH, she explains, for its excellent reputation, which includes hands-on learning opportunities outside the classroom. "My internship was a great experience," she says of her summer spent shadowing NOAA's Regional Scientific Support Coordinator, Charlie Henry, and learning more about the complexities of oil spill response. Whitney's advisor, Nancy Kinner, UNH Co-Director of the Coastal Response Reseach Center worked with NOAA to arrange for Whitney's internship.

Whitney Blanchard participates in training exercises with U.S. Coast Guard representative during 2005 internship with NOAA.

When Blanchard returned to UNH in the fall, she was able to take advantage of another unique learning opportunity when she was invited to participate in the Center's workshop entitled "Research and Development Needs for Making Decisions Regarding Dispersing Oil." "Lots of the people I had met last summer were participating," she says. "I was able to hear everyone discuss the pressing needs for dispersants research. It was a great chance to see experts coming together and to see how different parties interact."

Blanchard, who will start a master's degree in environmental engineering at UNH as soon as she graduates, is looking forward to another internship this year through the Coastal Center and NOAA—and to more hands-on learning out in the field, one of her favorite classrooms.

AT THE READY

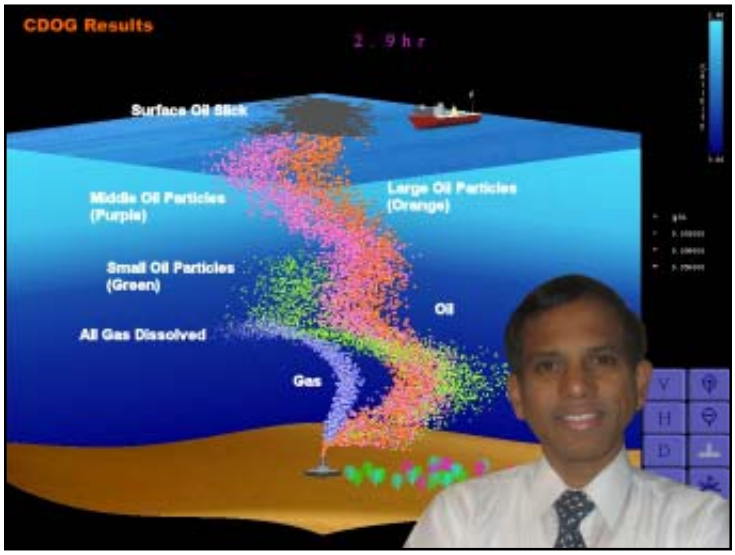
A deepwater blowout model helps responders be prepared.

When C.J. Beegle-Krause is at work, no matter what she's doing, she's always listening, always at the ready in case the phone rings. It's not the one on her desk that makes her jump. It's the one just across the hall in the War Room, the one with the distinctive, insistent ring—the one that alerts her to an oil spill.

A physical oceanographer by training, Beegle-Krause is a lead trajectory analyst for NOAA, and when oil spills somewhere in U.S. waters, she and the rest of the team at the NOAA Office of Response and Restoration in Seattle swing into action. They gather data and begin entering it as fast as they can type it into a computer—spill location and time, release rate, water currents, water temperature, wind direction, wind speed. Their goal: an accurate prediction of where the oil will go and how fast it will get there.

Until recently, the team worked primarily with GNOME (the General NOAA Oil Modeling Environment), a model designed to transform entered data into an oil spill "movie" that simulates the trajectory of a surface spill (from a grounded tanker, for example). But about 10 years ago, Poojitha Yapa, a professor at Clarkson University, and his research team began developing the Clarkson Deepwater Oil and Gas (CDOG) Blowout Model with funding from the U.S. Minerals Management Service and a consortium of oil companies. The Coastal Response Research Center funded Yapa to integrate the two models. Today the response team in the War Room has another critical tool in its arsenal—a way to predict the trajectory of oil spilled in water more than 1,000 feet deep.

"Oil companies have a phenomenal safety record when it comes to deepwater spills," says Yapa. "But more and more deepwater drilling will be taking place in coming years. And as long as we continue to use oil, we always have the risk of having spills. The only thing we can do is to be prepared."



Poojitha Yapa against a backdrop illustrating sample CDOG results.

Which is exactly the idea behind CDOG, a model designed to answer what before were unanswerable questions. "Let's say, for example, that there was a blowout 2,000 feet below the water surface," says Yapa, urgency in his voice. "Without a model, how would you know where the oil would come to the surface? Would it take 15 minutes to get there? Two hours? Two days? And what size will it be when it surfaces?" Yapa pauses just long enough to draw his breath. "You need to know this so you can make decisions about when to send the clean-up people. Or, should you even send them at all? What if methane gas has been leaked? It might, in fact, be too dangerous for any humans to be there cleaning up."

What Yapa designed, essentially, is a way to create a picture of what happens when oil is released under pressure on the ocean floor as it makes its way to the surface. But it wasn't until the Center stepped in with funding that Yapa's deepwater model became integrated with the existing user-friendly GNOME model. "When there's an emergency, we don't have a lot of time," says Beegle-Krause. "We are entering all sorts of data from cubic meters per second to barrels of oil per day. We need the computer to do all the unit conversions, all the mindless calculations they're good at—and not get stuck no matter what piece of information is being entered—so that responders can focus on creating the best forecasts together to make a trajectory prediction."


The Thunder Horse oil rig following a riser break in 2003. Photo courtesy of NOAA/Department of Commerce.

Before the two models were fully integrated, a single inaccurate piece of data could cause critical time to be lost. "CDOG would indicate the problem, but wouldn't point to what, specifically, was wrong. You'd have no idea where to look to figure out what happened," says Beegle-Krause. "We don't have time for that when we're on a deadline and under pressure." Center funding made it possible for Yapa and his research team to carry out the labor-intensive task of creating the computer code that designates precisely where an error occurs, improving the error-trapping capability of the model and making the job of emergency responders that much more effective.

When NOAA's War Room phone rang in the early hours of the morning on May 21, 2003, the alert came from the Gulf of Mexico. A riser had broken on the Thunder Horse oil rig, 6,000 feet down. The problem was under control. No oil had spilled. But Beegle-Krause and her team went right to work. "It was a good opportunity to put CDOG through its paces," she says, "because if Thunder Horse had blown, it would have been bad. It would be sort of like having the Exxon-Valdez happening once a week for several months." An earlier well blowout—the second biggest spill on record—is sobering proof of the potential impact of a "Thunder Horse-type" spill, notes Beegle-Krause. On June 3, 1979, when the IXTOC I exploratory well off the coast of Mexico blew out, it spewed oil into the ocean for months. By the time it was brought under control in 1980, an estimated 140 million gallons had spilled into the waters of the Bay of Campeche.

IXTOC 1 oil well blowout in Bay of Campeche. Photo courtesy of NOAA/Department of Commerce.

This is the sort of story Beegle-Krause and her colleagues hope they'll never have to tell. "The really big application for CDOG is better planning," she says, "a better understanding of what could happen. It allows you to create a deepwater spill in a safe environment—on your computer." And if the phone does ring in the War Room, the response team will be at the ready, better prepared to make oil spill clean-up as effective and efficient as possible.

FILLING THE VOID

As Roger Helm sees it, there's a critical question at the core of the Coastal Response Research Center's mission: "How is the research going to be used and who is going to use it?" The Chief of Natural Resource Damage Assessment for the U.S. Fish and Wildlife Service in the Portland, Oregon, regional office has reason to be concerned about the answer to this question. It's critical to his ability to do his job effectively.

Roger Helm at the slot canyons in Zion National Park.

"Part of what the Coastal Center is about," he says, "is getting the government agencies responsible for natural resources better at doing injury assessment and scaling that injury into appropriate restoration projects that have a positive effect on the environment."

Helm, who sits on the Center's Science Advisory Panel, applauds its focus. "Not only is the Center promoting more active applied research, they are also involving students, and they look at the practical risk/benefit aspects that are inherent in spill response and damage assessment decisions."

The Center is also unique, Helm believes, in its creation of an independent advisory panel composed of fellow scientists whose sole purpose is to examine the quality and usefulness of the research. "Typically, you have one board that does it all—reviews the proposals, recommends which projects should receive funding, and then reviews the final research. Having a separate advisory panel is a bit of a risk for the Center," he points out. "But it makes for better science in the end." And it meets a need.

"There really aren't many groups out there funding this kind of practical work," says Helm. "Usually practical science in the damage assessment arena is focused on one particular incident, rather than taking a broader look at the issues surrounding injury and damage assessment. There's really a pretty big void out there." The goal of the Coastal Response Research Center is to fill that void.

Bouchard 120 Barge being off-loaded after impact. Photo courtesy of NOAA/Department of Commerce.

The projects funded by the Coastal Response Research Center related to the 2003 Bouchard oil spill in Buzzard's Bay, Massachusetts illustrate the complexity of oil spills – the potential for wide-ranging impacts and the diverse opinions regarding which habitats, resources or species need protection. During any spill response and restoration, there are trade-offs to be made – in resources and species to safeguard and in effective methods of response. Understanding how at risk a population or habitat is can help determine how important it is to protect it. Likewise, understanding the concerns and desires of stakeholders impacted by the spill can influence the response. On pages 6-9, two Center-funded projects related to the 2003 Bouchard oil spill are showcased.

BIRD WATCHING

A research team develops new ways to untangle natural events from the effects of spilled oil on wildlife.

Ian Nisbet is not your typical Cape Cod summer visitor. True, he returns every year to Bird Island, just off the coast. But he's hardly relaxing. For more than four decades the environmental scientist has spent his days studying the terns that nest on these rocky shores. Garbed in rain gear and heavy canvas hat, Nisbet walks among the birds—more than 3,000 common and roseate terns—counting their eggs, noting their hatching success, and recording their foraging habits. He has watched the same individual birds return to the island again and again over the course of their quarter-century lifespan. Over the years he and his colleagues have banded and released thousands of birds.

One of the longest-running studies of sea birds in the world, Nisbet's research and extensive database took on sudden new significance in the spring of 2003 following the Bouchard oil tanker spill. "All the terns in the bay—nearly 20,000 of them—were exposed in one way or another to the oil," says Nisbet, noting that the birds had little drops of oil on their feathers in the days immediately following the spill. A week later, on many

of the birds he examined, the oil was gone. "They'd preened it off and ingested it," says Nisbet, who, along with colleagues Florina Tseng and Victor Apanius, spotted an unprecedented research opportunity.

For years, scientists have agreed that tallying numbers of dead wildlife following an oil spill is only part of the damage assessment picture. "But very rarely do we have an opportunity to study the non-lethal effects of a spill," says Nisbet. "Here we had a place we'd been studying for a very long time—and suddenly we had an oil spill there, which gave us a chance to study the effect of this low-level exposure on the birds."

Examination of a common tern for external signs of oiling.

Apanius, who started working with Nisbet in the mid-1990s, has pioneered the examination of the immune system of wild birds in their undisturbed native habitats. The physiological ecologist has been taking blood samples from the Bird Island terns since 1999. "What's most important," Apanius says, "is that we have pre-spill data, data from immediately after the spill, and data for the year after that, which makes a very good experimental design for examining the impact on the survivors."

Florina Tseng, principal investigator on the project, has traveled to oil spill sites around the world during her years working for wildlife rehabilitation organizations—and she has seen her share of oiled animals. "The acute effects of an oil spill have always been obvious," says Tseng, now the assistant director of the Wildlife Clinic at Tufts Cummings School of Veterinary Medicine, where she spends much of her time in the lab, conducting necropsies on dead seabirds. "But there are more subtle physiological changes that continue long term, and there haven't been any ways except looking at population numbers to assess the effects of an oil spill—until now."

The research team's Coastal Center-funded, two-year project will bring together demographic and blood chemistry data to develop a new way to analyze the long-term effects of an oil spill. "Let's say we find fewer numbers of eggs laid and at the same time we're seeing lower total protein levels," says Tseng. "Are these two things related? We know that this can happen under natural circumstances; the key question is whether the blood chemistry can distinguish between a natural downturn in environmental conditions and the pathological effects of oil."

Researchers gather field data on terns at Bird Island.

The project goal, in short, is to identify cause and effect, clarifying the distinction between natural variability and oil spill-related variability. "The big question," says Nisbet, "is how do you decide what's abnormal?" Given the variations that naturally occur in the environment—cold winters, poor food supply, disease—how do you accurately identify change caused by the oil itself? "Think of it like the stock market," Nisbet suggests. "How do you define a recession? We are using exactly the same kinds of statistical techniques to analyze trends in seabird clutch size, productivity, and other data."

Ultimately, researchers hope the study will provide a critical predictive tool for dealing with future spills—none of which will likely happen in a place that has the unusual benefit of many years' worth of data collected prior to the spill.

This study also will provide an accurate understanding of how "at risk" a population is, an important component in determining how a species should be protected and the level of attention they should receive during a spill.

"Our research will help response decision-makers to understand that natural variation in populations makes it difficult to assess the impact of a spill and that hematology can provide new sources of information for assessment," says Nisbet. "We'll be able to say, 'If you want more accuracy, here are the things you should be measuring internally in survivors.'" Adopting this approach, wildlife managers could be prepared for future spills in the same way prudent investors watch the stock market. Hist-orically, up-turns and down-turns always happen, but in this case "insider information" from blood samples is allowed. Which is a good thing, because what's at stake is the environment itself—and the lives of countless creatures whose survival depends on it.

Jeremy Hatch (University of Massachusetts, Boston) collects field data on Bird Island.

FINDING COMMON GROUND

Researchers seek to develop methods to help people understand each other—before an oil spill crisis occurs.

On April 27, 2003, the Bouchard 120 barge was passing along the southern coast of Massachusetts, towed by the Evening Tide, when the giant vessel scraped bottom, tearing a hole in the hull. Unaware of the damage, the tugboat captain continued on, until another vessel reported the telltale sheen traveling in the Bouchard's wake. Before the spill could be contained, an estimated 90,000 gallons of No. 6 heating oil had spilled out into the waters of Buzzards Bay. "Number six is nasty stuff," says Seth Tuler, a research fellow at the Social and Environmental Research Institute (SERI). "It's heavy, globby and difficult to clean up."

The timing couldn't have been worse. It was early spring, right before tourist season—and nesting season. And the spilled oil threatened to have a profound impact on both. The economy in this coastal community is closely tied to the annual influx of summer visitors who come to enjoy the area's beaches. The common terns and the endangered roseate terns who return each year to nest on the islands are dependent, for their very survival, on the waters of Buzzards Bay.

Pretty soon there was lots of noise and arm-waving going on. "People were shouting about the beaches—they wanted to know when crews would start removing the oil and they wanted to know it would be done," notes Tuler. Meanwhile, advocates for the terns were literally waving their arms and making as much noise as possible on the islands, trying to discourage the terns from nesting.

Seth Tuler at hot springs at the Royal national Park in Thailand. Tuler was in Thailand with students from Worcester Polytechnic Institute.

Today, two years later, the Bouchard oil spill (along with the 2000 Chalk Point pipeline spill in Maryland) is providing the basis for Tuler's Center-funded research effort, a first-ever method for measuring the success of an oil spill clean-up. When he looks at the results of a spill, Tuler sees more than an unsightly mess of sticky residue. He sees the complex tangle of socio-economic issues that come with it—and linger long after the waters themselves have been cleared of oil. "The challenge of the research," he says, "is to understand the many perspectives that come with a spill, to understand what people care about and how they make judgments."

It's a daunting task for a number of reasons. First of all, when oil spills occur, tensions run high. Where should the clean-up begin—on the beaches or on the islands? What should take priority—tourists or birds? The economy or the environment? And then there's the question of logistics: How should the clean-up be done? Through his research Tuler's heard plenty of heated arguments, for example, about the best way to boom off a marsh to protect an inlet. "Local folks know a lot about an area—how the winds blow, how the tides act, how the current can be going one way on the coast and another farther out. And then the clean-up crew comes in and pretty soon there are tense conflicts about what should be done."

Even when people agree on a particular thing they care about—birds, for example—they can bring a host of different perspectives and countless approaches to judging the success of a clean-up. Tuler reels off a few examples: Some might count the number of dead birds. Others look at whether the nesting season had been disturbed. Some talk about the long-term health of the bird population, while others focus on how many birds were released and survived. These are all people who care about the same thing—but they all use different criteria to measure success.

Cleaning crews work to remove oil from rocks and boulders following the Bouchard 120 oil spill. Photo courtesy of NOAA/Department of Commerce.

Tuler and his team are working to develop a system of metrics, or measurements, to gauge and then describe the effectiveness of a response: Gallons of oil spilled. Miles of shoreline affected. Number of wildlife impacted—or of wildlife rehabilitated and released. Number of lost fishing days. Number of lost recreation days or hours. Tuler's work requires patience and a slew of interviews with everyone from NOAA officials to local harbormasters. "We're trying to gauge their concerns," says Tuler. "How did they think it went? Were there things that could have taken place in a response that would have ameliorated or prevented some of the effects that the oil had? What did they think the public was concerned about?" The list of questions goes on.

The goal is to propose a process that people will actually put into practice—and that can be used in spill-prone areas before a spill occurs. Once the interviews are complete, the team will conduct workshops, developing and testing how the various parties—people who might otherwise never come together to talk to each other—could gather for a dialogue and a deliberative process where they can discuss these issues before they find themselves in the midst of a crisis.

"This project serves everyone involved in a spill," says Tom Seager, assistant professor of civil engineering at Purdue University and Tuler's colleague at SERI. For the public, the research will provide a more structured way to ensure that their concerns are heard by spill managers. For the managers, it will help them define the measures by which success is judged so that they can communicate to the public what they are trying to accomplish and how quickly they're getting there. For contractors, trustee organizations, and other involved groups, it will help everyone stay on the same page about what needs to be done and ensure that they're working together.

While the concept of risk management has been applied in other fields—land-planning, for example—the effort is brand new in the oil spill response community. "Often, spill responses are dominated by people, who view the world from a very scientific, technical vantage point," says Tuler. "But spills by their very nature have social impacts. This study is really about understanding what people care about, how they make judgments and, through a deliberative process, reach some kind of common understanding of what they want." In the end, a successful clean-up effort, Tuler believes, demands more than technical expertise. It emerges from a process based on understanding, collaboration, and compromise—from people working together to find common ground.

A thick band of pooled oil covers a cobbled beach following the Bouchard 120 oil spill. Photo courtesy of NOAA/ Department of Commerce.

LEARNING TO LISTEN

Rebecca Kay is a woman with a mission. She wants real answers to real questions.

It started with a talapia pond. Peace Corps volunteer Rebecca Kay was living in Cameroon, working side-by-side with locals to design and construct a desperately needed new food source—from staking the site and building the pond itself to managing and harvesting the fish. It was hard work, but satisfying. The 1997 graduate of the University of Massachusetts at Amherst was precisely where she wanted to be—out in the field, putting her background in fisheries to work.

Today Kay is pursuing a master's in environmental science and policy through Worcester Polytechnical Institute's Department of International Development, Community and Environment. Her focus is no longer fish. It's oil. But Kay is driven by a single question—a question that is deeply rooted in her African experience: What about the local people—what do they think? "People want to be part of the process," says Kay. "They get angry if they don't feel included."

Working under the guidance of Seth Tuler, a research fellow at the Social and Environmental Research Institute, Kay is undertaking something that's never been attempted before—the creation of a model that will provide a method for measuring the success of an oil spill clean-up effort. Much of Kay's fall semester was spent on the road with her tape recorder conducting interviews with NOAA and Coast Guard employees, and state and local officials, gathering information. Along the way, she determined that something was missing from the big picture—the voices of community members. "My thesis is going to fill that gap," says Kay, who will spend the winter interviewing local citizens in small focus groups, asking questions and listening carefully to their comments and concerns. "My goal is to promote a dialogue," she says, "to give locals a chance to talk and be heard without any officials or experts in the room."

Kay's hope is that someday community dialogue about oil spills will be common practice. She has no illusions that the process will be easy. But she knows from experience the importance of local involvement. "Right now, when oil spills, everyone's trying to work under the gun," she says. "Spill responders are busy dealing with the oil, and meanwhile, the public is wondering what's going on." In short, there's no time to talk. "But people need some way to voice their opinion," says Kay, "they need to be able to make suggestions and say what their concerns are." Kay and Tuler's Center-funded work will help open these lines of communication.

DOWN UNDER

Tiny sediment-dwelling organisms offer big possibilities for assessing chronic oil spill impact on estuaries around the world.

Tom Chandler's lab at the University of South Carolina (USC) is the next best thing to a mudflat—at least for the 100,000 copepods dwelling here. While there's no need to don rubber boots when crossing the threshold, this carefully controlled environment so closely mimics nature's intertidal mudflats and salt marshes that the copepods—microscopic sediment-dwelling organisms—are able to live and reproduce here as if they were really at the ocean's edge. Nowhere else in the world have these conditions been so successfully replicated.

A professor of environmental health sciences in the Arnold School of Public Health at USC, Chandler specializes in estuarine ecotoxicology and the use of small, bottom-dwelling organisms as potential biomonitors for toxic compounds. His Coastal Center-funded work focuses on oil specifically and its effects on the copepod *Amphiascus tenuiremis*. "Think of them as microscopic shrimp," says Chandler of his research subjects. "They spend all day munching on sand grains and eating mud and algae." Barely visible to the naked eye, copepods are often the first or second most abundant multi-celled organism in the ocean, and they are found just about everywhere around the globe—which makes them unique in their importance. "If you have pollution that knocks their population down," says Chandler, "you have a situation where you're directly affecting the base of the food chain."

Gravid female copepod showing co-planar egg sacs with egg yolk vitellin (green on red cytoplasm).

Tom Chandler examines copepods under his microscope.

The question, stresses Chandler, isn't what will kill them. The lethal effects of high-level oil exposure are clear. "What we don't have a very good understanding of," he says, "is the effects of continuous low-level exposure to toxic substances. With these little bugs, we have a unique capability to assess this issue." The goal of Chandler's year-long project was to determine the effect of the water soluble components of oil, many of which are toxic.

SPREADING THE WORD

There's an awful lot of good oil response research out there, according to Robin Jamail, Director of Research and Development Oil Spill Prevention and Response for the Texas General Land Office. Finding it is another matter.

"Excellent research has been going on for many years," she notes. "But nowhere can you see what was done in, say, 1972 or 1999. There's no repository for all this work." That's where the Coastal Response Research Center comes in. The Center is helping to unify the main players (with its leadership of the Dispersant Working Group, for example) and funding cutting-edge research in the world of oil spill response and assessment.

Jamail, who sits on the Center's Advisory Board, feels the Center is in a unique position. "It's not often that a university gets the kind of dollars they have—and a mission to go forth. Usually there's a middleman. This gives them a kind of objective approach. There's no bias. They just want to do good solid research."

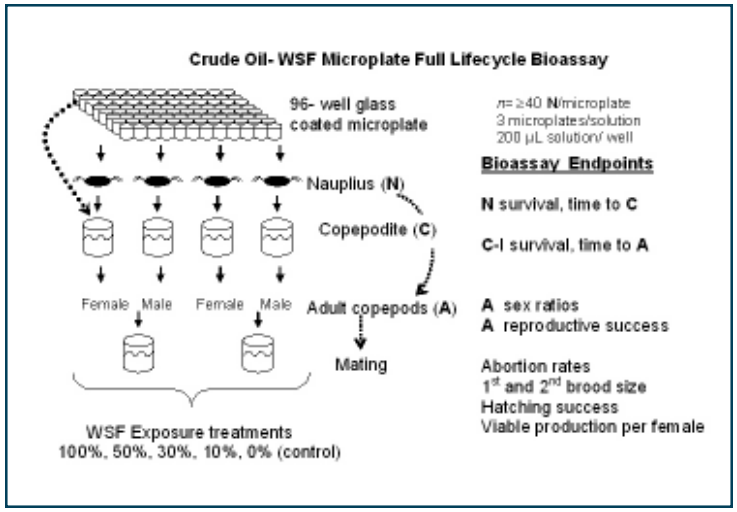
For Jamail, who oversees a $1.25 million research budget in the state that refines much of this country's oil, there's a certain urgency about producing good science. "We don't want redundant research," she says. "We want to learn how we can work together. In that respect the Coastal Center is filling an important niche."

In keeping with its goal of objectivity, the Center manages to make room for all the voices in the oil spill response dialogue. "They're working with the smartest people in the country," says Jamail, "and they've tapped into every kind of expertise: academic institutions, industry, government, and the private sector." These researchers are working together and finding solutions—which means, ultimately, better, real-life applications for those in the field cleaning up oil.

Copepods have a number of characteristics that make them uniquely suited for study. Their microscopic size means that, in the lab, they can live in 4x6-inch plastic microplates at up to 96 copepods to a plate. Each organism lives in about a quarter of a milliliter of solution in its own tiny well, about the size of a depression made by your pinky finger. During the study, each copepod was checked every day and its vital information recorded: Is it still alive? What life stage is it in? Can it reproduce? How many offspring does it produce? "Each individual becomes a data point that can be used to predict future population growth and size," says Chandler.

Chandler's study also involved an innovative test method that would have been impossible to carry out with a larger organism. Instead of doing only a clean water control, he ran a second control using oil from the National Institute of Standards and Technology (NIST). "So along with the clean water control," says Chandler, "you can benchmark your findings against this crude NIST oil—the most well-characterized crude oil on the planet." Using the NIST standard was a critical quality control step. "It's a more statistically robust way of doing assessment of toxicity than using some uncharacterized crude oil," Chandler says, noting that if he'd used bigger organisms for the bioassay—shrimp for example—he would have needed far more NIST oil to conduct his work. "And at $40 per milliliter—that's $40,000 per liter—it's a bit pricey."

Because copepods have a short, 50-day life-cycle and rapid reproductive capacity, Chandler and his colleagues could gather a great deal of information in the relatively short one-year span of their project, enter it into a mathematical model, and make accurate predictions about what the population size would be over multiple generations. "If this crude oil reduces reproduction by 20 or 40 or 60 percent, for example, what would be the impact down the road on the population? That's what we were after, and that's the kind of information spill managers need," says Chandler, "because it allows you to tell, over the longer term, whether you're going to have an impact on the marine resource. But you can't generate this information without lots of life cycle information."



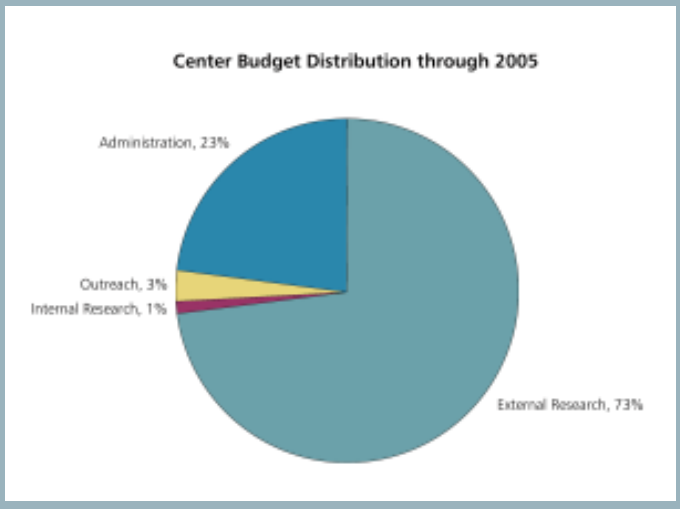
Schematic of Copepod WSF Bioassay.

Among other things, Chandler's findings showed that the South Louisiana crude oil he was testing was one-and-a half times more toxic than the NIST standard. He also found that toxicity was greatly enhanced if organisms are exposed to UV light (a component of sunlight), as they would be in their natural setting. "We get lots of sunshine here in the south," says Chandler. "And when you throw solar UV into the mix, you get a much stronger toxic response."

Chandler's long-term goal is to examine a broad spectrum of crude oils and, ultimately, build a library of comparative toxicities. "This would make it possible for spill responders to pull up a data set and do a projection of what type of mortality rate and reproductive impact would lead to a meaningful depression in population size and how that might affect future generations of copepods—and thus the organisms who depend on them," says Chandler, whose recent research is a first step toward this goal. In the end, his work provides another tool for keeping tabs on the health of the coastal environment in the face of potential oil spills—making Chandler's lab one of the most important mudflats in the world.

Chandler, Chris Hintz, Ryan Templeton and Lee Ferguson sieve copepods from mud at the USC Baruch Field Laboratory in North Inlet, SC.

Jacqui Michel (Research Planning, Inc.) visits a marsh oiled as a result of Hurricane Katrina.



Upcoming Events in 2006

2006 is shaping up to be the Center's busiest year to date, with continued focus on providing funding opportunities through RFPs, two new workshop initiatives, and a research institute planned.

Requests for Proposals

The 2006 Annual RFP will focus on the research priorities developed in the Center's previous workshops, with emphasis on dispersants, stemming from the NRC report and the Center's 2005 Dispersants workshop, and submerged oil. The Center will continue its participation in and administration of the Cold Climate RFP along with fellow partners at CICEET, OSRI and MMS.

Social, Economic and Political Aspects of Oil Spills Workshop

The Center will host a workshop entitled "Research Needs on Social, Economic and Political Aspects of Oil Spills" in Summer 2006. The workshop will be held at UNH and bring together oil spill practitioners and researchers specializing in the fields of socioeconomics, risk assessment, and communication. Together, participants will develop a list of priority R&D needs. Participants will include representatives from federal and state agencies, the private sector, and academia.

Innovative Approaches to Integrating Coastal Oceanography, Biology, and Ecology in Support of Decision Making for Oil Spills

In 2006, the Center will hold a 3 day institute during which spill modelers will work with toxicologists and resource managers. This will offer fate and transport modelers and toxicologists an opportunity to interact and develop a better appreciation and understanding of one another's disciplines, with the goal to develop better integrated models for predicting impacts of spills to NOAA trust resources. This institute will offer a unique opportunity to create a framework for the next generation of forecast models for emergency spill response.

Submerged Oil Workshop

The Center is planning a three day workshop in Fall 2006 to develop a list of R&D needs in the area of submerged oil. Participants will include experts from the spill response community and scientists from the ocean observing and ocean mapping communities who have familiarity with monitoring technologies in coastal and marine environments.

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