NCSR NEWS

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NORTHWEST CENTER FOR SUSTAINABLE RESOURCES

The NCSR NEWS critter has been choosen. The dragonfly pictured here has replaced the little ladybug that once flittered about the pages of the newsletter. We have also re-designed the layout of the newsletter, thanks to new and more powerful software. You may also notice, the NCSR logo has been replaced with a nicer, cleaner version that features a new designed eagle.

The Missisippi River dead zone is overloaded with nutrients from upstream sources. This photo shows the color change between the hypoxic (brown) and oxygen-rich (blue) waters. Photo courtesy of NOAA.

SUMMER 2007: FIRE ECOLOGY INSTITUTE AUGUST 5-10, 2007 AT THE H.J. ANDREWS EXPERIEMENTAL FOREST This institute will feature a week-long classroom and field experience related to the role of fire in forest ecosystems. With emphasis on "the science behind wildfire issues", it will assist college faculty in integrating this information into their courses. Participants will receive lodging and meals during the institute and will be paid a stipend for attending.

To receive information on this activity please contact NCSR by clicking here.

Dead Zones

by Wynn W. Cudmore, Ph.D.

Like "manna from heaven" crabs, eel and flounder approach the eastern shore of Mobile Bay in Alabama where they are scooped up by eager fishers poised along beaches and docks. Known to locals as a "jubilee", the event is caused by the leading edge of an approaching area of hypoxic (low oxygen) water brought on-shore by a gentle east wind. The bounty that appears in shallow waters is attempting to escape the toxic wave. Bottom-dwelling fish and invertebrates are particularly susceptible and aquatic organisms that are unable to escape quickly succumb.

Although the details may vary, these events in Mobile Bay represent a much broader phenomenon characterized by large areas of low oxygen levels that result in the death of aquatic organisms. Most are seasonal, appearing for a time and then disappearing only to re-appear when the appropriate conditions prevail. These so-called "dead zones" – coastal waters with too little oxygen to sustain life – are located in near-shore marine ecosystems across the globe. Over 146 coastal dead zones have been identified and their numbers are increasing, doubling each decade since the 1960's. Coastal areas near the mouths of large rivers and inland seas are particularly susceptible. In the United States, 43 dead zones have been reported for near-shore marine ecosystems including Chesapeake Bay, Long Island Sound and, the largest of U.S. dead zones in the Gulf of Mexico.

The Gulf of Mexico dead zone first appeared in the mid-1970's and extends from the Mississippi Delta to the Texas Coast. Historically, the area has supported a diverse marine ecosystem as well as a lucrative commercial fishing industry. Both have been impacted by the expansion of a hypoxic zone that has varied in size from 4000 to 20,000 km^2 over the past decade.

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Cutting the use of fossil fuels could slow the rate of climate change.

Economic Impact of Global Climate Change

by Lester W. Reed, Jr., Ph.D.

The potential effects of global climate change (GCC) are framed mainly in terms of environmental impact and the impact's consequences to human populations. Whether in the popular media or in scientific writings, the public, including students, is exposed primarily to discussions of how the GCC phenomenon may affect the physical and biological environment and impact current human activities. Today, there is a general acceptance that GCC is occurring and that human activity, mainly in the industrial economies, are a significant, but technically controllable factor. However, major players such as the United States are not willing to fully engage in restricting contributing activities. Additionally, emerging industrial mega-populations in China and India are increasingly contributors to the greenhouse gas concentration of the Earth's atmosphere. The argument against taking aggressive action primarily rests on the concept that such action will result in unacceptable costs to (industrial) economies.

Newer projections on the negative economic consequences of GCC challenge the premise that "the economy can't afford to aggressively combat the causes of GCC." Although not entirely new, a recent approach attempts to take into account the cost of aggressively limiting human activity that contributes to GCC versus the cost of current limited strategies. For example, a review commissioned by the United Kingdom's government and authored by former World Bank chief economist Sir Nicholas Stern, concludes that the world must act now to curb climate change, as doing nothing will cost more in the long-term.

(http://news.bbc.co.uk/2/hi/business/6096084.stm) In the overview, Stern states:

"Using the results from formal economic models, the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more. In contrast, the costs of action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year. " (See link below for complete Review.)

www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

Stern's report turns the prevailing economic argument about global warming, that it costs too much to combat, on its head by insisting that fighting global warming will save industrial nations money.

Although these and other studies show a greater cost to the world's economy by not restricting human activity –particularly carbon emissions- than the cost of taking aggressive action now, not all experts accept them. Attempts to analyze these issues are complicated by disagreements on appropriate frames of reference and analytical methods. Many studies of the costs (and benefits) of climate change have been prepared, with major differences in assumptions about specific impacts of climate change and measures to mitigate it, as well as those about the evolving impacts of such measures on social and political forces. Disagreements are particularly acute on the probability of climate change and the possible rate and magnitude of change. Also, assumptions on the development and adoption of energy-using technologies by businesses and households with respect to efficiency and alternative energy sources are disputed. These disparities result in a wide range of opinions illustrated in the link below:

www.ncseonline.org/Nle/Crsreports/briefingbooks/climate/

Faculty can engage students on the economic implications of GCC based on the assumptions made in various studies and reports. Students can research the issue and evaluate various projections and underlying assumptions. This type of exercise can strengthen both understanding of the debate surrounding GCC and the general principle of the relationship between assumptions and conclusions. Search "Global Climate Change Economic Impact" for more information.

Measuring Student Understanding of the Process of Science

NCSR's Principal Investigator, Wynn Cudmore, has designed a questionnaire to measure student understanding of the process of science. Unlike instruments designed to measure knowledge of specific scientific content, this instrument measures a student's ability to interpret and judge the validity of scientific data as well as to distinguish between science and non-science. The instrument was administered to a first term environmental science class as a pre- and post-test. The results (shown below) of this effort show an increase in understanding the scientific process by students in the course. The questionnaire and associated information, including the scoring guide, can be found on the NCSR website (www.ncsr.org) under Instructional and Educational Materials at Curriculum Development and Application Guides.

	Mean	SD	Range (%)	N
Environmental Science Pre-test (9/06)	65.2	10.8	35-85	36
Environmental Science Post-test (11/06)	79.4	6.0	67-92	30

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C404 on the Hit List

by Lester W. Reed, Jr., Ph.D.

C404, dubbed "Cecil" by the press, has been placed on the Oregon's and Idaho's Fish and Wildlife Department's hit list. If the National Marine Fisheries Service agrees, the sea lions congregating at the Columbia River's Bonneville Dam will be subject to lethal removal. Cecil and some 100 fellow sea lions have been found guilty of eating about 3,000 spring chinook salmon and steelhead per year. The application for killing of the sea lions has been made under Section 120 of the Marine Mammal Protection Act, which allows killing of specifically identified marine animals proven to be eating protected fish. Working in favor of Cecil and his buddies is the complexity of winning approval for the kill. The review process is expected to take several years, so until then C404 and friends will continue to dine on chinook and steelhead. (The sea lion issue was initially reported in the spring 2006 issue of the NCSR Newsletter.)

NCSR Newsletter Survey

In the last edition of our Newsletter we asked for your opinion of the value of its content. The response clearly indicated that recipients find the content valuable. We also asked what topics would be most useful in future editions. The percentage of respondents' favoring topical areas is shown below (respondents could indicate more than one topic):

TOPIC AREA	PERCENTAGE
General environmental science	28
Fisheries & wildlife	22
Strategies for developing & teaching	20
Internet-linked short topics	17
Forestry	13

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Researchers link the creation of most dead zones to the process of eutrophication – excessive enrichment of aquatic environments by nutrients such as nitrogen and phosphorus. Heavy nutrient loading results in unusually high levels of plant and algal growth. As this material is consumed by organisms such as zooplankton and herbivorous fish or ultimately decomposes on the ocean floor, oxygen is consumed. Hypoxic conditions result and in some cases, oxygen levels decline to the point that aquatic organisms can no longer survive, creating a dead zone.

The most common sources of excess nutrients are runoff from agricultural operations, untreated sewage and nitrogen compounds created from burning fossil fuels that make their way into natural waterways. In the Mississippi River drainage basin, nutrient runoff is highly correlated to land use where animal feedlots and agricultural fields are the primary contributors. The basin includes 31 states and more than 55% of the agricultural lands in the contiguous United States. Application of nitrogen fertilizers is used to maximize crop yields but uptake by plants is inefficient and may be as low as 20%. Since 1980, the two major river systems that drain the basin – the Mississippi and Atchafalaya - have discharged at least 1.6 million metric tons of nitrogen and 100,000 metric tons of phosphorus into the Gulf of Mexico.

While the majority of dead zones have been linked to cultural eutrophication, at least one, off the Oregon Coast appears to be caused by an intermittent upwelling of deep, nutrient-rich waters driven by strong northerly winds. When these nutrients reach the upper layers of coastal waters, phytoplankton populations explode. As these phytoplankton die, they sink to the bottom where they decompose, consuming oxygen. Underwater video recordings of large numbers of dead rockfish, crabs and other marine organisms first alerted researchers to low oxygen levels in 2002. Changes in ocean currents, perhaps caused by global climate change, have resulted in a greater frequency, earlier appearance and longer duration for this dead zone.

Although dead zones degrade marine ecosystems as well as economies that are supported by them, there is some evidence that these areas can be recovered. The Black Sea, for example, was near collapse in the 1970's and 1980's due to the impacts of eutrophication. Conditions persisting since the 1960's resulted in the decline of the largest red algae community on Earth, which supported enormous beds of mussels and other marine invertebrates and a variety of fish species. The primary culprit was a heavy nutrient load in the Danube River, which drains watersheds in 11 countries across central Europe. Algae blooms were common in summer months followed by declining oxygen levels, fish kills and decomposition. Today, the Black Sea appears to be on the road to recovery with a shrinking dead zone and the return of mussel beds wiped out in previous decades. In this case, restoration was achieved as an unintended consequence of the collapse of communism in 1989. For decades, large-scale livestock operations and heavy application of nitrogen- and phosphorus-based fertilizers had been heavily subsidized by communist governments resulting in the formation of a dead zone in the late 1980's. Agricultural subsidies and excessive nutrient input into the Black Sea came to an abrupt halt in 1989 and the recovery was underway.

The Black Sea experience underscores the need to reduce agricultural, sewage and other nutrient runoff from land if dead zones are to be restored to health. According to a recent report by the United Nations, overall outflow to oceans from human activities is expected to increase by an additional 65% by 2050. Thus, it is likely that dead zones will become even more widespread unless prompt action is taken. We now know how these systems might be recovered. Whether or not we can muster the political will to make the necessary changes to reduce nutrient input into waterways, remains to be seen.

The causes, consequences and recovery of dead zones provide interesting entry points for discussion of topics routinely covered in natural resource and environmental science courses. Nutrient cycling, commercial fishing, biodiversity, natural resource policy, and agricultural impacts become especially relevant to students when applied to real environmental challenges such as this one.

For additional information on the Gulf of Mexico dead zone, see:

http://serc.carleton.edu/microbelife/topics/deadzone/index.html

http://www.cop.noaa.gov/stressors/pollution/current/gomex-factsheet.html

http://www.epa.gov/msbasin/index.htm

http://www.sciencenews.org/articles/20040605/bob9.asp

http://www.sciencenews.org/articles/20040612/bob9.asp