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ON THE COVER
Remarkable advances in analytical chemistry make it possible to measure minute levels of both natural and synthetic compounds of the incredibly complex human body.

By The Numbers

Beyond propaganda and rhetoric, numbers tell the real story

APICULTURE, OR BEEKEEPING, is a $14.6 billion industry, and the nation's 2 million commercial hives pollinate many fruit- and nut-bearing crops. Beekeepers are accustomed to off-season losses of up to 20 percent, but 36.1 percent of commercial bee colonies were lost last year, according to a study by the Apiary Inspectors of America. This is the second straight year of elevated hive loss. About a third of these hive failures were attributed to colony collapse disorder, a poorly understood phenomenon in which bees seem to abandon their hives and disappear.

For more information, visit *www.cnn.com/2008/TECH/05/06/disappearing.bees.ap.*

ACCORDING TO THE U.S. Centers for Disease Control and Prevention, 13,293 cases of tuberculosis — or 4.4 per 100,000 of the nation's population — were reported last year in the United States. This is a 4.2 percent decrease from 2006 and a record low since the CDC began tracking TB cases in 1953. Among the U.S.-born population, the TB rate has declined more than 68 percent since 1993 to 2.1 cases per 100,000. Though the national (including foreign-born population) TB incidence is still well above the CDC's interim target of 3.5 cases per 100,000 by 2000, 26 states reached that goal as of 2007. With 242 (2.3 per 100,000) reported cases in 2007, Michigan's tuberculosis rate is nearly half the national average.

For more information, visit *www.cdc.gov/mmwR/preview/mmwrhtml/mm5711a2.htm* or *www.michigantb.org.*

U.S. CORN PRODUCTION has increased from 11.8 billion bushels in 2004-05 to an estimated 13 billion bushels in 2007-08, according to U.S. Department of Agriculture estimates. However, this growth of 1.2 billion bushels is accompanied by a 1.9 billion bushel increase in corn used for ethanol. A reduction in the amount of corn available for livestock feed and human consumption could play a role in retail food prices, which rose 4 percent in 2007 and are expected to do the same in 2008.

For more information, visit *www.siteresources.worldbank.org/NEWS/Resources/Developmentcommittee_note_Apr11.doc.*

EMERALD ASH BORERS, tree-damaging Asian insects, have killed more than 30 million ash trees in Michigan since 2002. A new pesticide called Tree-age (pronounced "triage") may stop the spread of the insects. Tree-age works by killing the insect during its larval stage, when the borer cuts off the flow of nutrients by eating through tissue just under the bark. Trials at Michigan State University demonstrated Tree-age to be 99 percent effective against the emerald ash borer, compared with 80 percent effectiveness for other insecticides. Available for the first time in May, Tree-age has only been approved for administration by certified arborists, and will cost about $200 for application to a single tree.

For more information, visit *www.mlive.com/environment/index.ssf/2008/04/new_treatment_shows_great_succ.html*
www.emeraldashborer.info.

SCIENTISTS RECENTLY DISCOVERED the Milky Way galaxy's youngest supernova, generated by the explosion of a dying star about 140 years ago. Though the existence of supernova G1.9+0.3 was known as early as 1985, original estimates placed it between 400 and 1,000 years old. Astronomers estimate that two to three stars explode and become supernovas each century, but most known supernovas are closer to 10,000 years old. The discovery of such a young specimen will help astronomers better understand the processes that guide the life cycles of stars.

For more information, visit *ap.google.com/article/ALeqM5hknRfAWE0K_rr3WgdudRSIHMOJ5wD90LLLQO4.*
NASA image, available as a hi-res TIF at www.chandra.harvard.edu/photo/2008/g19/more.html.

*Just the Facts

By Deneen Borelli

DEFEATED LAST JUNE in the U.S. Senate, "America's Climate Security Act" (S. 2191), introduced by Sens. Joe Lieberman I-CT and John Warner R-VA, would have penalized companies that emit greenhouse gases. Called a "cap-and-trade" program, the bill was basically a tax on the fossil fuels that currently provide about 85 percent of America's energy.

According to Senate testimony by Charles River Associates International, S. 2191 would have cost up to $6 trillion nationally over 40 years. CRAI also estimates that up to 3.4 million jobs may disappear by 2020 if such "global warming" regulations are enacted.

The economic cost of a cap-and-trade bill would hit Michigan especially hard. The increase in energy costs would compound the loss of manufacturing jobs in the state and reduce the disposable income of Michigan residents.

A study of S. 2191 conducted by the American Council for Capital Formation found that "Michigan would lose 37,400 to 56,260 jobs in 2020 and 91,490 to 121,786 jobs in 2030." The job loss was attributed to "lower industrial output due to higher energy prices" and "greater competition from overseas manufacturers with lower energy costs." In other words, multinational corporations would avoid the compliance costs of regulations by exporting jobs out of Michigan and the United States altogether. The auto industry, already burdened with job cuts and a downturn in the economy, would be severely challenged to comply with the consequences of global warming regulations.

Higher energy prices also reduce the amount of disposable income in households. The ACCF study reported "Michigan would see disposable household income reduced by $933 to $3,024 per year by 2020 and $3,867 to $7,051 by 2030."

The impact on utility rates was recently quantified by Duke Energy — a major supplier of electricity to Midwestern states such as Indiana and Ohio. Duke Energy's analysis of S. 2191 "estimated its customers' power bills could increase

continued on page 13

Field Trips

Area science museums host special programs of interest for budding scientists and their families

ZAP! Surgery Beyond the Cutting Edge

Prep for surgery! Visitors of all ages can investigate technology that helps doctors diagnose and treat people more easily (and less painfully) in this interactive exhibit at the Alden B. Dow Museum in Midland. Combining hands-on demonstrations and role-playing activities with personal stories from patients and health professionals, the exhibit delves into the science behind ultrasound, endoscopy, laser surgery, cryosurgery and the Gamma Knife.

May 31- Aug. 31, 2008, Alden B. Dow Museum, 1801 W. St. Andrews, Midland, Mich. (inside the Midland Center for the Arts), 989-631-5930. Museum open Tuesday through Saturday, 10 a.m.-5 p.m.; Sunday, 1 p.m.-5 p.m. Exhibit free with regular admission.

For more information, visit *www.mcfta.org/A_ABDow or www.zapsurgery.org.*

Bats: Myths and Mysteries

Explode some common bat misconceptions while learning about the fascinating ways these flying mammals experience the world around them at an exhibit developed by the Organization for Bat Conservation at the Cranbrook Institute of Science. Visitors can enter a live bat area for a close-up view of these much-maligned creatures of the night.

June 6, 2008 – Jan. 7, 2009, Cranbrook Institute of Science, 39221 Woodward Ave., Bloomfield Hills, 248-645-3200. Museum is open Saturday through Thursday, 10 a.m.-5 p.m.; Friday, 10 a.m.-10 p.m. Exhibit free with regular admission.

For additional information, visit *www.batconservation.org/ or www.science.cranbrook.edu.*

Shipwreck! Pirates & Treasure

Featuring more than 14,000 artifacts from a Civil War-era shipwreck, the Detroit Science Center's newest exhibition cuts through the Hollywood hype and explores the real history and science behind piracy, buried treasure and deep-sea exploration. The exhibit's highlights include a real robot submarine and a "hurricane tube" where guests can experience winds of 75 mph.

Through Sept. 1, 2008, The New Detroit Science Center, 5020 John R St., Detroit, 313-577-8400. Center is open Monday through Friday, 9 a.m.-3 p.m.; Saturday 10:30 a.m.-6 p.m.; and Sunday, 12 p.m.-6 p.m. Exhibit free with regular admission.

For more info, visit *www.detroitsciencecenter.org.*

The Third Degree

Test your reading of this issue of MichiganScience.

Students in grades six through 12 can compete for a $100 gift certificate from Edmund Science Kit. The winner will be determined by a random drawing from entries with all the correct answers. Please send entries to walker@mackinac.org.

1. **What percentage of Montmorency County's wolf habitat is expected to be lost by 2050?**
   A. 80 percent.
   B. 42 percent.
   C. 23 percent.
   D. None — wolf habitat is predicted to increase.

2. **What are metabolites?**
   A. Chemicals from the environment that remain in the body forever.
   B. Chemical markers that indicate past exposure to a certain compound.
   C. Lamps powered by glowing algae.
   D. Tiny fragments of meteor dust.

3. **Which of the following tissues is *least* commonly used in biomonitoring?**
   A. Blood.
   B. Urine.
   C. Saliva.
   D. Hair.

4. **How many waste sites were identified in the Centers for Disease Control and Prevention's abandoned Great Lakes study?**
   A. 24.
   B. 71.
   C. 4.
   D. 15.

5. **In 2001, how much did the CDC distribute in grant money for biomonitoring?**
   A. $10 million.
   B. $25 million.
   C. $100 million.
   D. $1.3 billion.

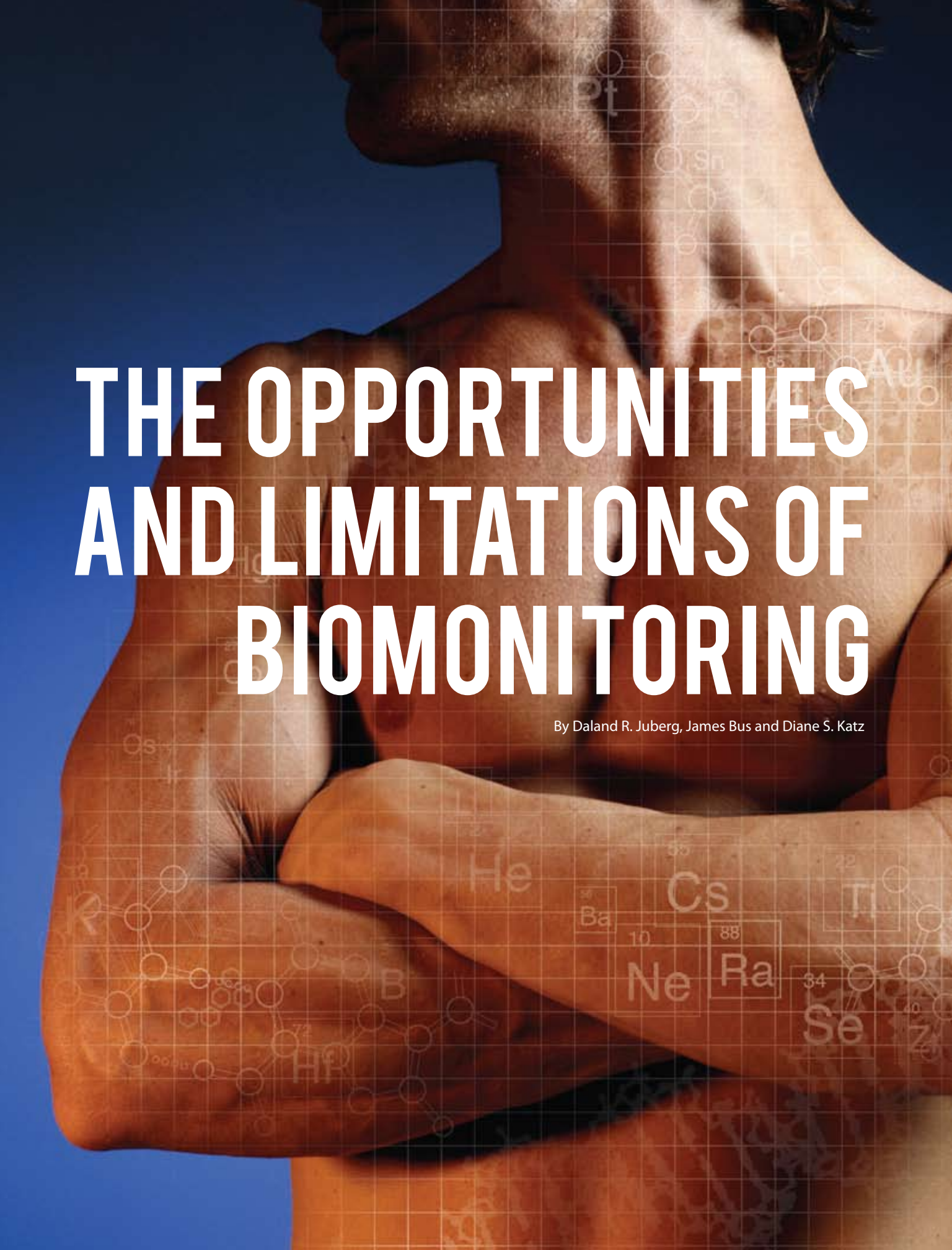
6. **How many pounds of PCBs were removed from the Shiawassee River in 1982?**
   A. 300.
   B. 2,600.
   C. 1,900.
   D. 100,000,000.

7. **How does Michigan's 2007 rate of tuberculosis compare with the rest of the nation?**
   A. Half the national average.
   B. Twice the national average.
   C. The same as the national rate.
   D. There were no cases of TB in Michigan last year.

8. **How many Michigan ash trees have been killed by the emerald ash borer since 2002?**
   A. 2,000.
   B. 2 million.
   C. 30 million.
   D. 4.6 million.

9. **How old is supernova G1.9+0.3?**
   A. 400-1,000 years old.
   B. 140-1,000 years old.
   C. 1,000-5,000 years old.
   D. 10,000-14,000 years old.

10. **Which was not part of the megalodon's diet?**
    A. Whales.
    B. Fish.
    C. Other sharks.
    D. Plankton.



THE OPPORTUNITIES AND LIMITATIONS OF BIOMONITORING

By Daland R. Juberg, James Bus and Diane S. Katz

Remarkable advances in analytical chemistry now make it possible to measure minute levels of both natural and synthetic compounds in human tissue and body fluids. This "biomonitoring" allows researchers to determine more precisely than ever the degrees to which individuals have been exposed to specific chemicals in the environment, and how exposures change over time. Consequently, federal and state officials increasingly regard biomonitoring as a potential new underpinning of environmental and public health regulations.

There is a great deal to be said in favor of basing regulations on actual exposure data, rather than relying on hypothetical modeling or extrapolations of animal studies, as currently is the case. But while biomonitoring certainly offers enormous opportunities for increasing our knowledge and understanding of chemical exposures, caution must be exercised in its application and interpretation. There are limitations to what biomonitoring can reveal, and its misuse will sow confusion, fear and misguided policies.

WHAT IS BIOMONITORING?

Biomonitoring is the analysis of human body fluids and tissues for purposes of measuring people's exposure to chemicals. Chemicals leave "markers" in the body that can be measured. Moreover, if a compound has already been processed by the body, researchers can also measure "metabolites," which are the byproducts of the body's absorption and processing of chemicals. The most advanced analytical tools can precisely detect chemicals in amounts as minuscule as one part per trillion, which equates to one particle of a compound for every 999,999,999,999 other particles. Put another way, one part per trillion is equal to a single drop of liquid in 12 million gallons.

Biomonitoring can involve a variety of body fluids and tissues. Blood, urine, saliva and breast milk are most commonly tested for the presence of chemical markers. Hair, nails, semen, fat and bone also may be sampled.[1]

Biomonitoring dates to the 19th century, when it was used to monitor the treatment of rheumatism with salicylic acid[2] and to test factory workers for exposure to lead.[3] Until recently, biomonitoring was largely conducted in occupational settings to monitor workers' exposure to industrial compounds.

The presence of a chemical in human tissues or body fluids does not presage illness or disease. As noted by Dr. Julie Gerberding, director of the Centers for Disease Control and Prevention: "[W]hen we measure exposure, what we're measuring is the presence or absence of the amount of various chemicals in the blood. That does not in any way directly correlate with a particular health effect or set of health effects …"[4] It is also important to note that the vast majority of chemicals — both naturally occurring and synthetic — currently tracked in

1 Michael A. Kamrin, "Biomonitoring Basics," (Environmental Health Research Foundation 2004), biomonitoringinfo.org/images/What_is_Biomonitoring.pdf (accessed January 3, 2008).

2 David A. Galbraith, "Human Biomonitoring: An Overview (ISRTP Workshop)," (ChemRisk, 2005), 6, www.isrtp.org/nonmembers/Human%20Biomonitoring%206-05/Galbraith%20Biomon.pdf (accessed January 3, 2008).

3 Dennis Paustenbach and David Galbraith, "Biomonitoring: Measuring Levels of Chemicals in People — and What the Results Mean," (American Council on Science and Health, 2005), 4. The full text of this article can be found on www.acsh.org/docLib/20050721_biomonitoring.pdf (accessed January 3, 2008).

4 "Telebriefing Transcript: Third National Report on Human Exposure to Environmental Chemicals, July 21, 2005," Centers for Disease Control and Prevention, www.cdc.gov/od/oc/media/transcripts/t050721.htm (accessed January 3, 2008).

biomonitoring studies do not produce adverse health effects.[5] The "dose" received is typically far below the level at which health effects occur.

The failure to detect a chemical in body tissues or fluids does not mean that exposure has not occurred. The human body is remarkably efficient at ridding itself of foreign substances; the evidence of exposure may simply have dissipated by the time biomonitoring is conducted. Thus, an accurate interpretation of biomonitoring data requires an understanding of how chemicals are eliminated from the body.

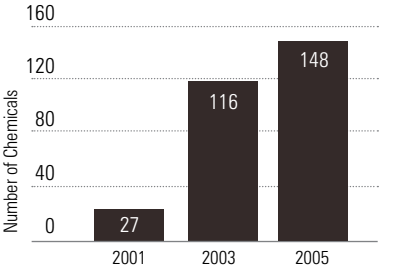
The health consequences, if any, of chemical exposures are determined by a variety of factors, including the toxicity of a particular compound, the actual "dose," and the route and timing of contact (i.e., exposure). The utility of biomonitoring thus rests on an understanding for each chemical the precise relationship between various pathways of exposure, the levels of exposure and the actual effects on the body. Simply put, biomonitoring data, in and of itself, cannot reveal the health effects of exposure.

Research is underway to understand more fully the complexities of chemicals in the human body. For example, the nonprofit International Life Sciences Institute has established a biomonitoring technical committee to standardize both the proper methodology for biomonitoring and the interpretation of biomonitoring results. The committee is composed of representatives from five universities, 11 companies and six government agencies. Additionally, researchers are investigating the interplay in the body between various chemical exposures. Collectively, these efforts can improve our understanding of health effects associated with chemicals in the environment and help determine whether regulatory controls are effective or unduly restrictive.

CURRENT BIOMONITORING PROGRAMS

The CDC conducts the most extensive biomonitoring program. Most recently, it released its Third National Report on Human Exposure to Environmental Chemicals, which includes the results of testing for 148 chemicals in blood and urine samples from 5,000 people selected randomly nationwide.[6] As the above graphic indicates, the number of chemicals included in the CDC's biennial testing, which began in March 2001, has increased dramatically.[7]

Number of Chemicals in CDC Biomonitoring



Source: Centers for Disease Control and Prevention, "Frequently Asked Questions: CDC's Third National Report on Human Exposure to Environmental Chemicals," 2005.

The CDC selects chemicals for analysis from among hundreds nominated by scientists and the general public. The factors considered in the selection include:

- The potential for human exposure.
- The seriousness of health effects from exposure.
- An adequate number of testable people.
- The availability of testing methods with adequate performance and acceptable costs.

The CDC analyses demonstrate how biomonitoring data can inform environmental and public health policy. The data reveal a significant decline in the blood concentrations of many chemicals. This indicates the benefits of new technologies that reduce or eliminate emissions and discharges of chemicals, and the success of other pollution prevention efforts. Among the declines noted in the CDC's latest exposure report:

- Only 1.6 percent of children ages one through five had "elevated" blood levels of lead, down from 88.2 percent between 1976 and 1980.
- From 1988 to 2002, the median levels of cotinine, a marker of "second-hand smoke," decreased 68 percent for children, 69 percent for adolescents and 75 percent for adults.
- There are now undetectable or very low levels of the pesticides Aldrin, Endrin and Dieldrin — all of which have been discontinued in the United States.
- All women of childbearing age had mercury levels

5 Paustenbach and Galbraith, "Biomonitoring: Measuring Levels of Chemicals in People — and What the Results Mean," 2.

6 "Frequently Asked Questions: CDC's Third National Report on Human Exposure to Environmental Chemicals," Centers for Disease Control and Prevention, www.cdc.gov/exposurereport/pdf/faq.pdf (accessed January 4, 2008).

7 Ibid.

below the concentration associated with neurological effects in a fetus.

Other federal agencies involved in biomonitoring include the National Institutes of Health, the Environmental Protection Agency, the Agency for Toxic Substances and Disease Registry, and the National Institute of Environmental Health Sciences.

Biomonitoring capabilities are not widely available in most commercial laboratories, nor does the CDC perform laboratory tests at the request of individuals. A physician may be able to test blood or urine for lead, mercury and a few other chemicals that have known health consequences. If necessary, doctors can refer patients for further evaluation to a toxicologist or a physician who specializes in occupational and environmental medicine.

California established the nation's first state biomonitoring program when Gov. Arnold Schwarzenegger signed Senate Bill 1379 on Sept. 29, 2006. The California Environmental Contaminant Biomonitoring Program will screen 2,000 volunteers every two years for a variety of compounds and in the future conduct smaller, community-based studies.

In 2001, the CDC began distributing $10 million in grants to 25 states and regional groups for planning biomonitoring programs. The Michigan Department of Community Health was among the recipients. In 2003, Gov. Jennifer Granholm requested the state's Environmental Science Board to evaluate the scientific validity of the compounds targeted for testing in the state's draft biomonitoring plan. Among its findings, the board concluded: "As currently written, the Draft Report does not provide a credible source of rationales for including or excluding many of the identified toxic substances for biomonitoring. In addition, most of the discussions presented are lacking in rigor, clarity, and coherence."[8] In response to the evaluation, the Michigan Department of Community Health declined to pursue the establishment of a biomonitoring program.

BENEFITS OF BIOMONITORING

Current environmental and public health regulations are largely based on a theoretical calculation of risk associated with human exposure to chemicals in air emissions, water discharges, soil contamination and consumer products. That is, risks of exposures are based on the concentrations of chemicals in the *environment*, rather than in our bodies. Biomonitoring offers the opportunity to analyze the relationship between chemicals in the environment and actual bodily uptake.

Most regulations rely heavily on animal research to estimate potential human health effects. Such studies typically involve exposing rats and mice to chemicals at constant levels every day (often for a lifetime and at concentrations that are substantially above real-world exposures). But the relationship between the level of exposure to a chemical and the amount that ends up in fluids and tissues is complex; to extrapolate from animals to humans is even more so. As noted by Michael Kamrin, a professor emeritus of toxicology at Michigan State University, "[U]nless adequate toxicokinetics data are available, it is very difficult to compare the dietary levels used in laboratory experiments to fluid and/or tissue levels measured in biomonitoring studies."[9] Thus, toxicologists are taking steps to better understand how chemical exposures equate to blood or tissue concentrations, which will help to make biomonitoring data more meaningful.

Biomonitoring involves measuring actual levels of exposure *within* the body, which can help to make risk assessments far more accurate. In the case of phthalates, for example, the CDC's biomonitoring is helping researchers differentiate among the various sources of exposure and determine how environmental exposures translate into actual body concentrations. As noted by Dr. James Pirkle, deputy director for science at the CDC's National Center for Environmental Health: "[I]t has helped us clarify some understanding about the relative exposure that are, say, in cosmetics and personal care products compared to, say, phthalates that are in soft vinyl plastic products like in toys or in vinyl tubing or things like this … [T]here is much greater detail … separating out those different kinds of sources and how those sources relate to different levels in people."[10]

LIMITATIONS OF BIOMONITORING

Useful as biomonitoring can be, there remain significant challenges to improving its utility. Largely missing are precise assessments of risk that are necessary to determine the health consequences of exposures. In other words, biomonitoring reveals the amount of a chemical in an individual's body, but such knowledge is meaningless unless we know the levels at which health consequences occur. As noted by Dr. David Galbraith in his 2005 presentation to the International Society of Regulatory Toxicology and Pharmacology: "Our vastly improved abilities to detect have often outstripped our abilities to detect meaning."[11]

8 Raymond Y. Demers et al., "Critical Review of a Proposed List of Toxic Substances to Biomonitor in Michigan Residents," (Michigan Environmental Science Board, 2003), vii, www.michigan.gov/documents/MESB_Biomonitoring_Report_69163_7.pdf (accessed January 4, 2008).

9 Kamrin, "Biomonitoring Basics," 8.

10 "Telebriefing Transcript: Third National Report on Human Exposure to Environmental Chemicals, July 21, 2005."

11 Galbraith, "Human Biomonitoring: An Overview (ISRTP Workshop)," 27.

Biomonitoring can improve risk assessments by enabling researchers to couple direct observations of physical symptoms or effects with measurements of chemical uptake. But establishing the correct relationship is no easy task. Biomonitoring data only reflect the amount of a chemical in the body at the time of testing, which may differ from the original exposure. "One sample reading could represent exposure from yesterday, last week, or 30 years ago," Dr. Galbraith has observed.[12]

Moreover, health consequences, if any, may result either from the original exposure or from the presence of the compound in the body over time. Nor is the source of exposure always apparent, further complicating the interpretation of biomonitoring results.[13]

Uncertainties also arise when exposure measurements approach the minimum levels that can be detected, or when the test for detecting a particular chemical is complex or unproven. Chemical levels may also vary depending on the type of tissue or body fluid tested. In addition, there may be questions about which form of a compound (or combination of forms) is most appropriate to measure.

These challenges were recently documented by a committee of the National Academy of Sciences, which concluded that, "The ability to generate new biomonitoring data often exceeds the ability to evaluate whether and how a chemical measured in an individual or population may cause a health risk or to evaluate its sources and pathways for exposure."[14]

AVOIDING ALARMISM

The importance of accurate interpretation and reporting of biomonitoring data cannot be overstated. Erroneous information too often taints public policy debates, resulting in costly and even deadly consequences. The United States' ban on DDT, for example, was based on faulty assumptions about the risks of exposure; whether any lives were saved is questionable. But the ban did reduce the availability of the pesticide overseas, thereby increasing deaths from malaria and West Nile Virus by millions.[15] Similarly, safe genetically modified foods are being withheld from starvation-plagued Africa as a "precautionary" measure.

Graphic 2: Summary of NAS Conclusions

Finding	Recommendation
There has not been a coordinated or consistent strategy for selecting chemicals for testing.	Set priorities for biomonitoring based on health risk and the potential for exposure.
The ability to detect chemicals has outpaced the ability to interpret health risks accurately.	Undertake epidemiologic and toxicological exposure assessments for use in biomonitoring.
The results of biomonitoring are not communicated appropriately or effectively to the public.	Create strategies for reporting biomonitoring results in an accurate and objective manner.
Biomonitoring studies present ethical issues related to informed consent, the interpretation and communication of results, and follow-up with subjects.	Biomonitoring studies must consider ethics and individuals' rights in the development, implementation and reporting of results.

Source: National Research Council, "Human Biomonitoring for Environmental Chemicals," 2006.

Such tragedies occur, in part, as a result of the public's inadequate understanding of science. The National Science Foundation found that less than one-fifth of the U.S. population meets a minimal standard of scientific literacy. Compounding the problem is the tendency of mass media to sensationalize stories by legitimizing unproven notions of risk. Reporters often misinterpret research findings and fail to explore significant uncertainties and limitations in the data. Alarmist interpretations unnecessarily frighten people and provoke calls for unwarranted and costly government action. As attention and resources are diverted to phantom risks, the nation's financial and intellectual resources are less available for genuine threats to public health. Wasted economic resources reduce our collective wealth, which is precisely what defines the difference between environmental well-being and ruin. Underdeveloped nations tend to be the most polluted and sickly.

12 Ibid. 26.

13 Matt Shipman, "New Model Sought to 'Translate' Biomonitoring Data into EPA Risk Levels," Inside EPA, December 12, 2006.

14 National Research Council Committee on Human Biomonitoring for Environmental Toxicants, "Human Biomonitoring for Environmental Chemicals" (The National Academies Press, 2006), 2, books.nap.edu/openbook.php?record_id=11700&page=2.

15 See, for instance, Todd Seavey, "The DDT Ban Turns 30 — Millions Dead of Malaria Because of Ban, More Deaths Likely," (American Council on Science and Health, 2002), www.acsh.org/healthissues/newsID.442/healthissue_detail.asp (accessed January 4, 2008).

RECOMMENDATIONS

There are numerous opportunities for the use of biomonitoring. Well-designed and properly conducted studies can enable scientists and medical professionals to identify and understand exposure trends, and any associative or causal effects of disease.

However, biomonitoring data can be detrimental if misinterpreted and sensationalized. It is essential that biomonitoring data be placed in proper context and that specialists in key scientific disciplines like toxicology and pharmacokinetics participate in interpreting the results. Through adoption of a scientific, objective and inclusive approach, the utility of biomonitoring can be maximized for the benefit of public health and the environment. The following recommendations are intended to fulfill that goal:

- Government biomonitoring programs should be prioritized by genuine health risks and potential exposures. This would help ensure that public resources are deployed in the most productive manner.
- All government biomonitoring programs should undergo nongovernmental peer review prior to implementation. This would help to ensure the integrity of the research.
- Government biomonitoring programs should be conducted in consultation with qualified scientists in the private sector. Such oversight may help protect research from political manipulation.
- Greater research is necessary to understand the interplay between exposure and health effects. The proper interpretation of biomonitoring data requires epidemiologic and toxicologic assessments.
- Biomonitoring should not be commissioned for the specific purpose of advancing a particular policy. Doing so would undermine the credibility of biomonitoring in general.
- Because biomonitoring can be easily misunderstood by the public and policymakers, it is incumbent upon researchers to ensure their methodologies are closely aligned with their specific research questions and any intended use of the biomonitoring data. The costs to human health and well-being can be particularly high when biomonitoring studies are not carefully designed.
- Biomonitoring data should be released only within proper scientific context — that is, accompanied by disclosure of the research methodology; discussion of the findings' relation to the larger body of scientific understanding; and with complete protection of the privacy of the test subjects. ■

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continued from page five

by up to 53 percent when the legislation [becomes] effective in 2012." ACCF also found that electricity prices in Michigan would increase by 126 percent to 177 percent.

High energy prices disproportionately harm low- and fixed-income consumers. A report by the nonpartisan Congressional Budget Office on cap-and-trade states that, "most of the cost of meeting a cap on CO2 emissions would be borne by consumers, who would face persistently higher prices for products such as electricity and gasoline … [P]oorer households would bear a larger burden relative to their income than wealthier households would."

Sen. Lieberman, an official elected to represent the needs of his constituents, admits "it's hard to imagine" how industry and power companies would meet the demands of S. 2191. Clearly, by introducing the bill, he's also admitting he's not concerned about the economic consequences of his "feel good" global warming directive.

Affordable, plentiful and reliable energy is the foundation of our economy. Rising energy costs will lower the standard of living in the United States and for the residents of Michigan who are already experiencing economic hardship. Given these dire consequences, we shouldn't surrender our freedom and livelihood to unsubstantiated theories about climate change. Let's leave the "Go Green" chant to the confines of Michigan State University's Spartan Stadium. ■

FOR MORE INFORMATION:

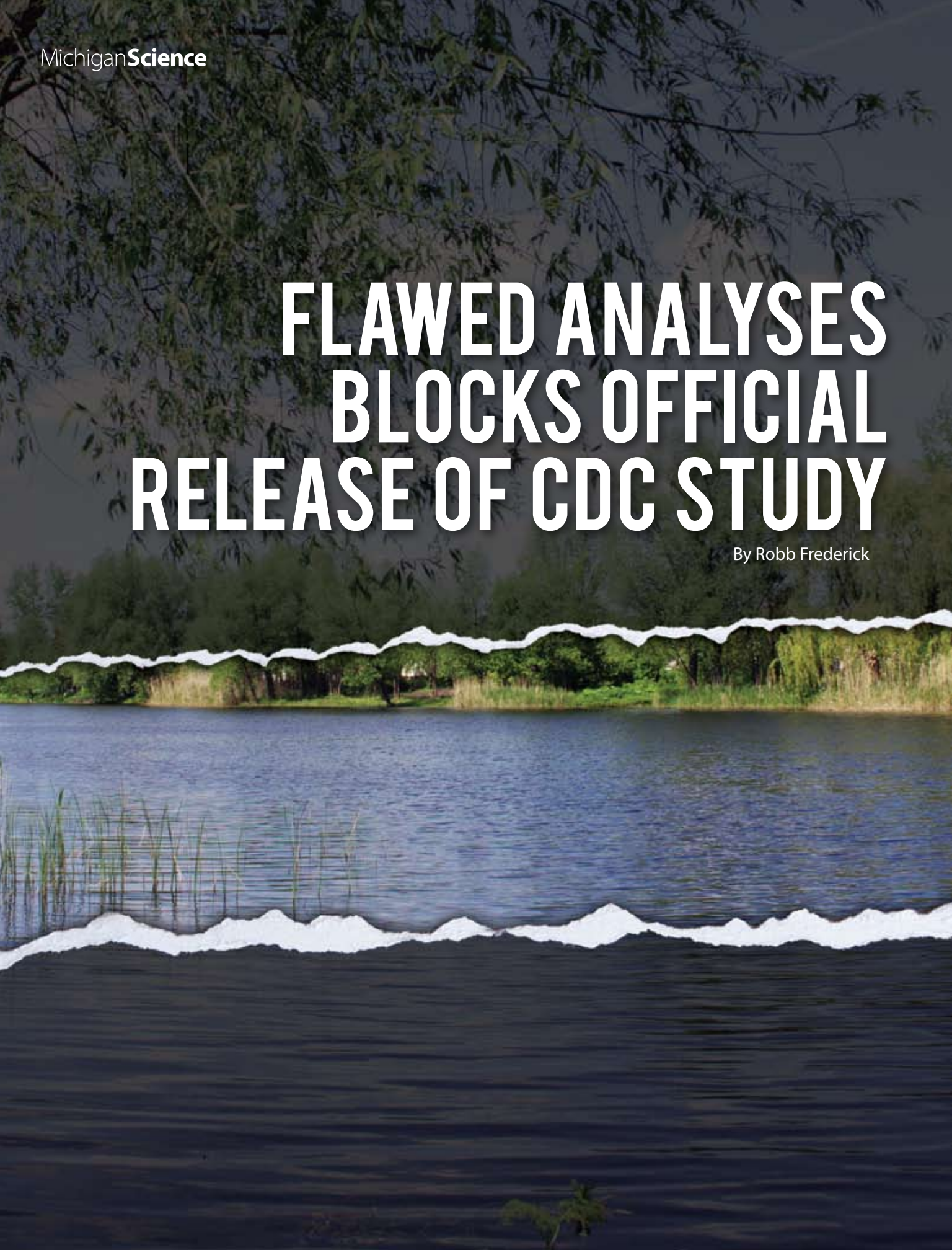
Duke Energy press release
www.duke-energy.com/news/releases/2007111501.asp

Charles River Associates International (CRAI) Analysis of S. 2191
www.crai.com/uploadedFiles/RELATING_MATERIALS/Publications/Consultant_publications/Smith,_A/files/Response%20to%20Lieberman%2012-3-07.pdf

Inhofe Statement on EPA's Analysis of Lieberman-Warner
www.epw.senate.gov/public/index.m?cFuseAction=Minority.PressReleases&ContentRecord_id=aed37405-802a-23ad-4259-0114a3e1d79d&Region_id=&Issue_id=88388d58-7e9c-9af9-7d66-62e366f3f189

American Council for Capital Formation (ACCF) Website
www.accf.org/nam.html

PDF - ACCF Michigan Economic Impact Study
www.accf.org/pdf/NAM/Michigan.pdf



FLAWED ANALYSES BLOCKS OFFICIAL RELEASE OF CDC STUDY

By Robb Frederick

Outdated data fails to reflect subsequent remediation

Hold that call to Erin Brockovich. Allegations that the U.S. Centers for Disease Control and Prevention covered up a damning environmental report says less about science — in this case, pollution in the Great Lakes basin — than the need to politicize and point fingers.

According to the abandoned study, "Public Health Implications of Hazardous Substances in the Twenty-Six U.S. Great Lakes Areas of Concern,"[1] the air near the Saginaw River is thick with paint strippers[2], pesticides[3] and carbon tetrachloride, a compound once used in fire extinguishers. The soil and water are worse. Decades of industrial pollution have fouled them with toluene, which is used to make nail polish, and naphthalene, a key ingredient in mothballs.

And it isn't just the Saginaw River. The study identifies 71 waste sites that could increase the risk of breast, colon and lung cancers in two dozen communities, including Detroit, Chicago and Milwaukee.

Yet a close read of the 400-page study reveals that much of the data is old, drawn from reports filed in 1982 and 1996 by the CDC's Agency for Toxic Substances and Disease Registry. Several of the spill locations, including the E.I. DuPont de Nemours plant in Muskegon County, the Auto Ion Chemicals plant in Kalamazoo County, and the Berlin and Farrow Superfund site in Genesee County[4], have since been remediated and deleted from the Environmental Protection Agency's National Priorities List.[5]

"It's not an epidemiological study," said Hugh McDiarmid, spokesman for the Michigan Environmental Council. "It paints in some pretty broad brushstrokes … If people are going to use it to say the contamination in the Great Lakes is giving people cancer, then that's a stretch."

The CDC never finished the report. In February 2008, a draft copy was leaked by the Center for Public Integrity, a nonprofit watchdog group based in Washington, D.C.[6]

1 Available online at www.publicintegrity.org/GreatLakes/index.htm?source=home

2 Trichloroethylene, a paint stripper and dry-cleaning solvent that also was used to decaffeinate coffee.

3 Chlorobenzene

4 The 40-acre site near Swartz Creek was polluted by a waste incinerator that operated from 1971 to 1978. It was removed from the National Priorities List in 1998.

5 Eighty-four Michigan sites are now on the NPL. The list is available online at www.epa.gov/superfund/sites/npl/mi.htm#statelist

6 Other recent studies by the group examined prescription-drug lobbying and the influence technology companies have at the Federal Communications Commission. Information is at www.publicintegrity.org

The center alleged that the CDC blocked publication of the report and demoted Christopher De Rosa, the scientist who oversaw the work, when he pushed for its release.

The CDC responded that the science was flawed.[7]

The media smelled a scandal. The story was picked up by The Detroit News[8], The Washington Post[9] and the Milwaukee Journal Sentinel.[10] The headlines took a side: "Great Lakes Health Report Withheld by Agency" and "Delay of Report Is Blamed on Politics."

"NO CAUSE AND EFFECT"

The author of CPI's piece was Sheila Kaplan, a journalist whose work has appeared in Mother Jones, U.S. News & World Report and on the PBS series "Frontline."

Her study of the CDC report was funded in part by the Nation Institute, a decidedly partisan nonprofit based in New York.

Kaplan did not return calls for this article.[11]

However, some members of Michigan's environmental-science community questioned the link Kaplan made between the CDC report and cancer rates across the Great Lakes.

"Often when you come out with reports, it's a lot of information to break down in a one-page press release," said Robert McCann, a spokesman for the Michigan Department of Environmental Quality.

"That's usually the biggest issue people have when it comes to pollution: 'How does this affect my family? What does it mean for our health?'" McCann said. "The trick is to put it in context for them, to expand on it and really explain what it means and how it affects people."

He said the department would review the leaked version of the CDC report.

George Wolff, the principal scientist at the General Motors Public Policy Center,[12] found other weaknesses in the research.

"What bothers me about it is they just show two sets of statistics," he said. "One on the chemicals and one on the health effects. But they don't relate them. There's no cause and effect involved.

"They're just out there," he said. "It's just a case of co-location of chemicals."

CARCINOGENS IN DRYER LINT

There is some substance to the CDC report. Several of the waste sites it identifies have polluted communities and put residents at risk. Among the worst:

The Shiawassee River in Livingston County

The Cast Forge Company discharged hydraulic fluids into the South Branch of the Shiawassee River from 1969 to 1973. Approximately 2,600 pounds of PCBs[13] were removed from one mile of the river when it was dredged in 1982. Remediation of the floodplain "will mitigate, but not eliminate, the contamination," the CDC study warns.

Dow Chemical Company, Midland County

Waste ponds on the 1,900-acre Dow property emptied into the Tittabawassee River at regular intervals beginning in 1915. A flood in 1986 overwhelmed the company's wastewater treatment plant and discharged more waste[14] into the river. Tissue cancers among white women living in Midland County were

7 "Significant scientific shortcomings were identified," the agency said in a March 7 "Statement of Scientific Concerns," "Health and environmental data were presented in ways likely to be misinterpreted."

8 Trowbridge, Gordon. "Great Lakes Health Report Withheld by Agency," Feb. 8, 2008. Available online at www.detnews.com/apps/pbcs.dll/article?AID=/20080208/METRO/802080374.

9 Lydersen, Kari. "Delay of Report is Blamed on Politics," Feb. 18, 2008. Available online at www.washingtonpost.com/wp-dyn/content/article/2008/02/17/AR2008021702186.html

10 Rust, Susanne. "Area's Toxins May be Sickening People," Feb. 11, 2008. Available online at www.jsonline.com/story/index.aspx?id=716884.

11 Messages were left at office and mobile phone numbers provided by Steve Carpinelli, the media manager for the Center for Public Integrity. He referred all questions to Kaplan.

12 Full disclosure: Wolff is on the Mackinac Center for Public Policy Science Advisory Board.

13 Polychlorinated biphenyls, oily compounds used as industrial coolants or lubricants until 1977.

14 Polychlorinated dibenzo-dioxins (PCDDs) and polychlorinated dibenzo-furans (PCDFs)

between 3.8 and 4 times higher than the national average between 1960 and 1978, the CDC says. Fish-consumption warnings were issued in 2006.

Allied Paper Inc., Kalamazoo County

This site, which includes a three-mile stretch of Portage Creek, was contaminated with PCBs discharged by the paper-making industry. In 2006 the EPA estimated that 110,000 pounds of PCBs were in the sediment of the Kalamazoo River, which links to Portage Creek. Consumption of fish from the river brought "unacceptable risks to public health," the EPA said in 2006.

Roto-Finish Company, Kalamazoo County [15]

Some 83,000 gallons of industrial waste were pumped into two storage lagoons, which often overflowed beginning in 1960. The soils have been remediated and are being monitored, and the CDC says there is little risk to the community. But a study of the homes of Roto-Finish employees found traces of a suspected bladder carcinogen[16] in vacuum cleaner dust, dryer lint and urine samples.

That's probably not news to people who live near the sites.

"It's not really a surprise that we've got areas of toxic concern," said Jeff Skelding, the national campaign director for the Healing Our Waters-Great Lakes Coalition. "They've been there for a long time. But they need to be cleaned up. Congress needs to act on this soon."

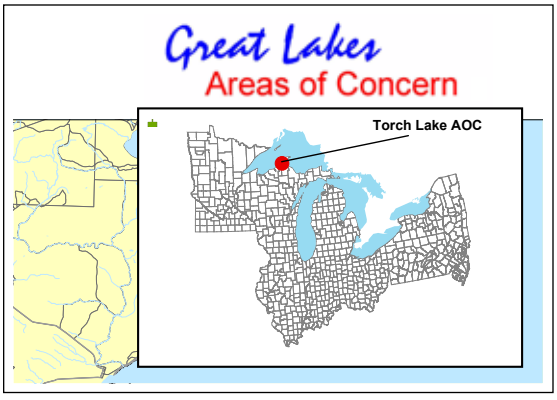
It already has. U.S. Reps. John Dingell and Bart Stupak, both Michigan Democrats, have begun an investigation of the CDC report. They requested the personnel records of De Rosa, the scientist who was demoted, and any record of the requests he made to publicize the study.

"ATSDR's[17] apparent withholding of this report raises grave questions about the integrity of scientific

15 The company manufactures polishing, buffing and grinding machines. Information is available online at jobwerx.com/tooling/directory/Roto_Finish_Company_Inc.htm

16 4,4-Methylene bis(2-chloroaniline), which is used as a curing agent for polyurethane.

17 The Agency for Toxic Substances and Disease Registry



A series of detailed maps created by the CDC labeled "Great Lakes Areas of Concern" were part of the unpublished report.

research at CDC and ATSDR, as well as the treatment of its scientists," the Congressmen wrote in a joint letter.[18] "The validity of the findings of this report deserves a fair and open debate within the scientific community"

That letter, however well-intentioned, reflects a weakness not only in the CDC report, but in the "gotcha" journalism that exposed it: All too often during the environmental review process, as a report passes through state, federal and public-sector checks, science is hijacked for political effect.

There is no doubt that this particular CDC report was flawed. But the response to it — politically charged and spread without benefit of all the facts — was arguably far more harmful. ■

18 February 28 letter to CDC Director Julie L. Gerberding

Sources: Frank Bevacqua, International Joint Commission: 202-736-9024
Steve Carpinelli, Center for Public Integrity: 202-481-1225
Hugh McDiarmid, Michigan Environmental Council: 248-660-4300
Robert McCann, Michigan Department of Environmental Quality: 517-241-7397
Paul Mohai, University of Michigan: 734-763-4598
Jeff Skelding, Healing Our Waters—Great Lakes Coalition: 410-245-8021
George Wolff, General Motors Public Policy Center: 313-665-2498

By Ray Nothstine

CMU Students Win State GIS Competition, Contribute to State Conservation

CENTRAL MICHIGAN UNIVERSITY students showcased their mastery of geographic information systems at a statewide student paper and poster competition held Jan. 24 at Schoolcraft College in Livonia. GIS is used, among other things, for scientific investigations, resource management and development planning. Taking first and second place, respectively, in the graduate student competitions were Maxwell Field and Heather Stricker.

The competition was sponsored by Improving Michigan's Access to Geographic Information Networks. IMAGIN is a nonprofit professional networking organization founded in 1993 to provide professional networking opportunities for its members and to promote GIS use in Michigan.

Field won top honors for a study of "Common Loon Habitat Modeling in Northern Lower Michigan." Field presented additional research for an audience at the IMAGIN Annual Conference in Dearborn in early May. "I am building a habitat model for common loons based on features of inland lakes," said Field. The model will be used to make predictions about the presence or absence of loons and their nesting habits in Michigan lakes. "The final product can hopefully be used as a management tool to help identify and protect common loon habitat in Michigan or other Great Lakes states with a diminishing loon population," he said.

Field's analysis also showed that human shoreline development and watercraft activity do not negatively affect loon presence. He explained this data by noting that loons and humans are most likely to live on inland lakes that are larger and deeper. Field said management strategies can be utilized to foster healthy coexistence between loons and humans.

Stricker's research looked at the future of wolf habitat in Montmorency County in the northern Lower Peninsula. Human population growth has been shown to inhibit the presence and growth of wolves in areas of development. Montmorency County may lose up to 23 percent of suitable wolf habitat by the year 2050. "A predictive model that forecasts available wolf habitats for decades will allow managers to make sound long-term conservation decisions that have ecological reasoning and scientific support," said Stricker.

The top three undergraduate winners in the poster competition, in order of placement, were CMU students Erika Espeland, Joe Polmerville and Ken Robertson. Eight posters were submitted by students from Michigan colleges.

Espeland presented a poster on 3-D mapping of a cloud forest (a forest that contains a fog layer at tree level) in Peru, Polmerville identified the most suitable habitat for the Florida panther, and Robertson looked at African-American migration in the United States.

Dr. Bin Li, chairman of the Department of Geography at CMU, explained why students at the university performed so well: "The university identified GIS as an area to invest in about 10 years ago. The program is designed very well and has the largest number of GIS faculty in the state. Another reason is the close collaboration of GIS with other scientific disciplines at the school, such as biology and ecology." ■

By Lauren M. Ruhland

Mega Discovery

FROM ABOUT 16 million to 2 million years ago, the giant shark megalodon dominated the seas as the largest marine predator to ever live. Despite being extinct for millennia, the megalodon caused a stir in southeast Michigan last August when 15-year-old Port Huron resident David Wentz discovered a fossilized tooth in the St. Clair River.

David Wentz with his recent discovery — proposed to be a tooth of the giant shark megalodon.

"I snorkel all the time out by the Blue Water Bridge," he said, referring to the bridge over the St. Clair River that joins Port Huron with Sarnia, Ontario.

Accompanied by his brother Shaun, 21, Wentz was swimming over the sandy river bottom when a smooth, gray stone caught his eye.

"It was kind of rock colored, but there weren't any rocks around it or anything," said Wentz.

When he presented the find to his family, Wentz's father Craig noticed its similarities to fossilized shark teeth presented on programs like those on the Discovery Channel's "Shark Week."

Wentz said that their whole family enjoys educational television. "We watch a lot of National Geographic and stuff like that around here," he explained.

Sometimes referred to as the "megatooth" or "megamouth" shark, the megalodon is thought to have grown to lengths of up to 60 feet (18 meters), or three times as long as its most famous modern relative, the great white shark. In order to maintain its massive body, the megalodon consumed 1,500 pounds of fish, whales and other sharks each day.

The megalodon's skeleton was made of soft, flexible cartilage. Because cartilage is usually broken down before it can be fossilized, megalodon fossils consist primarily of lost teeth that fell to the ocean floor like the one found by Wentz.

Even so, these tooth fossils provide insight into the nature of the prehistoric fish. For instance, the megalodon is often portrayed as a giant version of the great white, but growing evidence obtained by comparing tooth shape indicates that its nearest extant relative is the less well-known mako shark.

Though the Great Lakes region was once covered by shallow tropical seas, it is unlikely the shark whose tooth was found by Wentz was a prehistoric Michigan resident. Michigan State University paleontologist Dr. Michael Gottfried told the Port Huron Times Herald that it's more likely that the fossil was brought to its location with the help of humans in relatively recent history.

For now, Wentz isn't sure what he will do with the fossil.

"It's really cool just to have and show to people, but I wonder if it might be worth something," he said. "I might sell it someday." ■

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