ENVIRO DECISIONS

Volume 2, Number 3 *A Publication of The Audubon Institute*

PEOPLE WHO DRIVE ON GLASS BRIDGES...

Very soon, bridges will be made of glass. And plastic. And carbon.

Scientists and engineers around the world are working on a new generation of construction materials for bridges that will resist corrosion and last longer with less need for repair. Canada, China, Japan and Scotland are among nations that have built or are about to build bridges using polymer composites. In the near future, the suspension cables, support girders and main deck of many bridges will be made of millions of braided, woven and fused strands of composite materials cooked up in laboratories by engineers. There's an international race to develop these materials because bridges everywhere are crumbling from the effects of weather, pollution and age, says John Scalzi, a structural engineer at the National Science Foundation (NSF). Scalzi says the United States, which has lagged dangerously behind, urgently needs to catch up with advances in construction materials achieved in other countries for at least two reasons: First, he says, the civil infrastructure in the U.S. is in bad shape. The Federal Highway Commission reports that 42 percent of bridges need repair and are obsolete; the cumulative repair bill by the year 2010 is estimated to reach $50 billion. New, low maintenance materials are needed immediately to repair a long list of existing bridges in every state of the union. Second, on the global scale, the nations with the most advanced design and manufacturing programs will dominate the world export market for the new polymer materials.

On Scalzi's desk lies a stack of 18-inch rods in various colors and shapes. They are samples of new building materials under development in university laboratories through projects underwritten by NSF grants. If the rods were made of standard metal alloys, they would weigh at least twice as much. Multiplied by miles of rods and cables that go into a two-to-four-lane bridge, the weight reduction means a significant contribution to the long life of a structure. Also, metal rods, imbedded in concrete for reinforcement, age and corrode over time from exposure to the acidic concrete and moisture collecting in the cracks, whereas plastic and glass fiber rods are expected to last 10 to 100 times longer without maintenance.

The current research in polymer composite materials grew out of earlier aerospace efforts to find radar-evading, stealth materials, says Scalzi, "which is a perfect example of military research spinning off into unforeseen civilian uses." He says continued research into new uses for these polymers will not only lead to better bridges, roads and buildings, but along the way provide new, diversified commercial ventures for the struggling aerospace firms that first developed these materials. Nearly 40 laboratories across the U.S. are developing and testing these new materials through programs underwritten by NSF.

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ENVIRODECISIONS

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The Audubon Institute seeks to cultivate awareness and an appreciation of life, the interdependence of all living things and to help conserve and enrich our natural and human-made world. This publication seeks to impart knowledge and understanding of nature and humankind and promote a balanced approach to understanding increasingly complex environmental and social issues.

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Editor's Corner

Several readers have written to me concerning my last editorial. As you may remember I recounted my boat trip through the LaBranche wetlands, to view an illegal tire dump site where, rumor had it, hundreds of tires had been dumped from the Interstate Highway. I wanted to see the tires first hand to decide whether our office should sponsor a community awareness, clean-up day to pull the dumped tires out of the wetlands and haul them to a state-approved disposal site. At issue, you will remember, was a debate over whether the tires should be removed because they are unsightly and potentially dangerous, or left in place because they stabilize the lakeshore and could possibly offer protection from wetland erosion — a severe problem in southeast Louisiana.

The question many of you asked — did our office sponsor the cleanup or not! I must apologize for leaving you hanging.

Our office will be sponsoring a wetland awareness and tire cleanup day in the spring soliciting help from local citizens groups and high school environmental clubs. Our goal is more to forge an awareness of the value, beauty, and complexity of our wetland resources than to remove the greatest number of tires. This is, in part, because of the underlying disagreement about the need and/or benefit of removing the tires in the first place. Sponsoring this event will also increase the level of understanding of the fragile network of swamps and marshes fringing our home, New Orleans. Of equal importance, however, is the opportunity this event offers to educate people about the greater issue: environmental problems are complex, and what seems straight forward (remove dumped tires) isn't always (they may afford needed wetland protection). Decisions are often based on desired outcomes — very often there are competing outcomes which need to be resolved. How do we balance one need against another? Making a good environmental decision is not always clear. Environmental action is dependent upon the context, or the environmental conditions, within which the situation occurs (see *Washable vs. Disposable Diapers,* page 3). The clean up day gives us the opportunity to highlight a very important point: making environmental decisions and taking environmental action often involves balancing contradictory outcomes and competing needs. Lida

WASHABLE VS. DISPOSABLE DIAPERS

by Robert A. Thomas
The Audubon Institute
and
Paulette J. Thomas
The University of New Orleans

In 1970 when our first child was born, the first Earth Day had occurred just four months before. Diaper choice was easy: disposables were wasteful, so we chose washables. Life was simple!

Our second child was born in 1973. By this time, the buzz word among environmentalists was "eutrophication." Basically, eutrophication is a situation in which oxygen is depleted from a water body. In the 1970s and before, virtually all detergents were rich in phosphates, one of the components that kept the dirt in suspension once it was removed from the clothing. When we washed clothes, our washing machines would flush phosphate-rich water through our waste treatment system into our rivers, bayous, and lakes. These phosphates caused rapid growth in various plants (especially algae) that, after death, consumed all the oxygen in the water as they decayed. Since eutrophic water can't support animal life, it is to be avoided, so we who were striving to be good environmentalists had to avoid "eutrophication." We chose disposable diapers for our second child.

In 1979, our last was born. By this time, environmental pressure had caused most detergent producers to reduce their use of phosphates to a minimum. Again, the choice was easy - washables. Unfortunately, we soon learned that this child had very sensitive skin and washables invariably caused painful rashes. We found that we were consuming oodles of gasoline and skin medications to make the correct environmental choice. **But was our choice the environmentally correct decision?**

At the time, we were not faced with a crisis in our landfill. Our child was miserable, even at risk of complications. We were consuming all sorts of packaging with medication and associated materials. We were expending lots of money and energy going to the doctor. We reluctantly decided to go with disposables. In retrospect, we made the best choice for our situation. **We found that the proper environmental choice may depend on the circumstances of the time!**

Virtually every book that tells you how to be a good envirocitizen will inform you that you should opt for washables. It has become the conventional wisdom.

People did question the balance of using washables once you factor in the energy consumed by your washing machine and dryer, the energy used by the treatment plant, the cost of maintaining a sewer or septic tank system, the enormous cost of producing detergents and cotton (don't forget that the cotton industry consumes loads of pesticides, herbicides, fertilizers, electricity, gasoline, etc.), and more. Recently, one of our leading national environmental organizations commissioned a study to compare washables with disposables.

What they found was astounding, yet it demonstrates why we need to analyze each issue. They found that if you live in California where there is no water but still landfill space, the proper environmental choice is disposables. If you live in New York, however, where there is plenty of water and they have to send their garbage to landfills, the proper choice is washables. ***They found that the proper environmental choice may actually depend on where you live!***

Environmental decisions are rarely easy. It is extremely important that you consider each on its own merits and analyze all the variables of your situation at the time that you must make the decision. ⚖

Water Quality of The Mississippi River: Reputation and Reality

by Dennis Demcheck, U. S. Geological Survey

There is a consensus among scientists and managers that, in principle, controlled diversions of the Mississippi River are needed to slow or reverse wetlands losses in the Mississippi River deltaic plain. This consensus unfortunately conflicts with the widespread perception among many private citizens that the Mississippi River is highly contaminated by a wide variety of toxic compounds, and that the adverse effects of these pollutants would outweigh the benefits of additional freshwater, sediments, and nutrients.

The U.S. Geological Survey (USGS) has studied the water quality of the Mississippi River, both independently and in cooperation with the U.S. Army Corps of Engineers, since 1905. Since 1967, the USGS has intensively studied travel times, water chemistry, bacterial contamination, and sediment transport characteristics of our nation's largest river, in cooperation with the Louisiana Department of Transportation and Development. Results of these studies have been used by industry to evaluate the quantity and suitability of river water for industrial use, by state and local governments in response to spills of hazardous chemicals, and by citizens' groups interested in the health of the river.

There is a comprehensive and long-term database on the river water quality of the Mississippi River, equal to or exceeding databases on riverine systems anywhere in the Nation.

Over the past nine years, USGS research scientists have also completed several intensive studies concerning the transport of sediments in and the water quality of the Mississippi River from Minneapolis-St. Paul to Belle Chasse, LA. Results of these studies are being used to identify contaminants from nonpoint sources in river water and the potential of these contaminants to affect drinking-water supplies and aquatic environments. There is, therefore, a comprehensive and long-term database on river water quality, equal to or exceeding databases on riverine systems anywhere in the Nation.

With so much information about water chemistry and contaminants, one would think that answering questions about Mississippi River water quality and its suitability for coastal restoration would be easy and straightforward. However technical data and public perception do not always coincide. And so controversy continues: Is the Mississippi River grossly polluted with toxic compounds, or is it our best hope for restoring healthy and productive coastal wetlands? I will attempt a one sentence answer: The Mississippi River has serious problems with several chemical constituents, but the river is cleaner and healthier than its reputation as *The Sewer of Mid-America* implies. The rest of this article will be an attempt to explain that over-simplified sentence, as water quality is a term that resists simple definitions and explanations.

Problem Compounds in the Mississippi River:

Although the river in many ways has received a "bum rap", it does have problems. The Mississippi River drains 41 percent of the continental United States. This region within the river drainage basin produces

Do you live here? If so, you are part of the Mississippi River drainage basin.

about 80 percent of the corn and soybeans grown in the country. The U.S Department of Agriculture (USDA) and the Environmental Protection Agency (EPA) estimate that more than 100,000 metric tons of pesticides and more than 6.3 million tons of nitrogen fertilizer were applied to cropland in the Mississippi River basin in 1991. The intense use of agricultural chemicals poses potential problems for nonpoint source contamination of streams and groundwater throughout the basin. Closer to home, the Mississippi River between the Louisiana—Mississippi border and the mouth of the river receives municipal sewage waste from forty-five discharge points.

The Mississippi River has serious problems with several chemical constituents, but the river is cleaner and healthier than its reputation implies.

It also seems a common-sense conclusion, to anyone who has observed the dense concentration of industries along the river from Baton Rouge to New Orleans, that Mississippi River water quality would be poor or even highly contaminated. Consequently, people are surprised to learn that there are no documented ***long-term*** problems with heavy metals or hydrophobic (those constituents that are incapable, or only slightly capable, of dissolving in water) synthetic-organic compounds in the lower river (below Vicksburg). Most insecticides, polynuclear aromatic hydrocarbons, and polychlorinated biphenyls are hydrophobic, synthetic-organic compounds. It is important to note that isolated "hits" of these compounds have been recorded, but in general, they are not related to a specific site or time of year and are not considered a long-term event or problem.

These compounds have not become chronic problems primarily because of the physical and chemical characteristics of the river itself — the river has coarse bottom sediments, a relatively low amount of organic matter in the sediments, and a high concentration of dissolved oxygen in the water column from the surface to the bottom. There is a direct relation between decreasing sediment grain size and increasing contaminant concentrations in inorganic sediments. Fine-grained sediments, because of their large, relative surface area, are the primary sites of accumulation and transport of hydrophobic contaminants, including heavy metals. USGS studies have shown that heavy metals in the lower Mississippi River are transported predominantly on the silt/clay fractions of suspended sediment. Other hydrophobic synthetic organic compounds were not found at all. Decaying organic debris also collects and

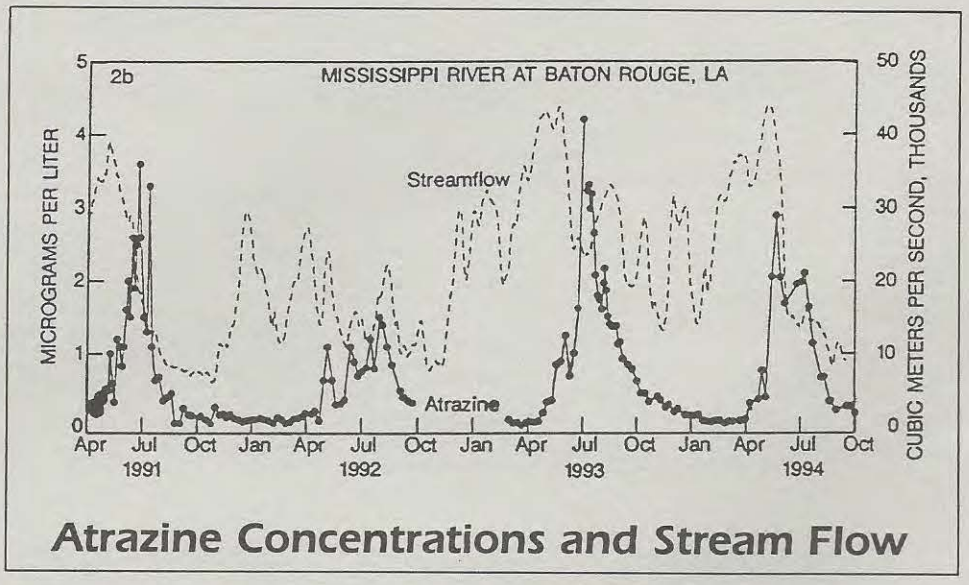
The intense use of agricultural chemicals poses potential problems for nonpoint source contamination of streams and groundwater throughout the Mississippi River basin.

Water Quality continued on page 6.

Water Quality continued from page 5.

concentrates heavy metals and hydrophobic synthetic organics. The relative lack of a complex organic "muck", especially as compared to other Louisiana streams, partially accounts for the lower than expected concentrations of contaminants in Mississippi River bed sediments.

The river also contains a large amount of dissolved oxygen at all depths and all seasons. In fact, the dissolved oxygen concentrations in the river exceed 75 percent saturation nearly 90 percent of the time. Therefore, just as the river has an extremely large capacity for aerobic bacteria to break down and assimilate organic wastes such as sewage, the relative abundance of dissolved oxygen also creates conditions that tend to keep those synthetic contaminants, that do occur, tightly bound to sediment particles and therefore unavailable for uptake into biological systems where they can do great harm.



Atrazine Concentrations and Stream Flow

Areas of intensive agricultural cultivation, especially near the Illinois River and the Mississippi River upstream from the confluence owith the Missouri River, are the major sources of triazine herbicides into the river.

With this information in mind, those constituents in the Mississippi River which threaten to become, or could potentially become, long-term problems can be separated into three major categories: ***sewage waste***, ***pesticides***, and ***nutrient enhancement***.

Sewage wastes

With the exception of increases in fecal-coliform bacteria concentrations, the input of municipal sewage wastes into the Mississippi River appears to have had no significant effect on water quality. Fecal-coliform bacteria have long been used as indicators of the sanitary condition of waters because they originate from the intestinal tracts of warmblooded animals. As fecal-coliform bacteria are not in themselves pathogens — a distinction that causes confusion among the general public — efforts are underway to develop a better indicator of water quality that contains pathogenic bacteria or viruses. However, extensive long-term fecal-coliform databases exist. The difficulty of replacing these databases, as well as those state and Federal standards and criteria based on fecal-coliform concentrations, indicates that fecal-coliform bacteria will continue, for the foreseeable future, as the primary indicator of the sanitary condition of waterbodies.

The most notable feature of all the regional-scale studies of river water quality is the large increase in herbicide concentrations that occurs during storm runoff — the "spring flush."

Fecal-coliform bacteria concentrations in the lower Mississippi River have been steadily decreasing over the past 20 years. This drop is primarily due to improved sewage treatment by cities throughout the upper drainage basin that discharge wastes into the river. Decreases in agricultural runoff into the river may account for some of the differences, but the relative amounts are unknown. The most dramatic fecal-coliform decrease in the lower Mississippi River occurred after 1984 when the City of New Orleans began secondary treatment of its sewage discharged into the river. In conclusion, efforts to reduce fecal-coliform concentrations in the Mississippi River are succeeding, and this constituent should not be

Water Quality continued on next page.

a major factor in the debate over the suitability of the river for coastal restoration efforts.

Pesticides

Both insecticides and herbicides fall under the rubric of pesticides in the USGS classification system. USGS and EPA databases show that concentrations of the persistent organochlorine insecticides, such as DDT and chlordane, continue to decline. DDT (banned in 1972) and chlordane (banned in 1988) are no longer routinely detected in water or bottom material, although DDT breakdown products and some chlordane are occasionally found in low (less than 0.5 ppb) concentrations in bottom material. The broad-spectrum herbicide 2,4-D is now rarely found in the water, and was not detected at all from October 1991 through September 1994. During the 1970s and early 1980s, 2,4-D was detected in almost all samples in low concentrations (around 0.2-0.5 ppb).

Nutrients needed for enhanced wetlands productivity, also contribute to excessive algal growth, which can create hypoxic zones in lakes, streams, estuaries, and the Gulf of Mexico.

However, triazine herbicides are a different story. This water-soluble group, chiefly atrazine, is the major herbicide type used on agricultural crops, particularly corn, in the midcontinent. Triazines are by far the major pesticides transported by the river. Studies from eight water quality monitoring sites on the Mississippi River and its tributaries conclude that areas of intensive agricultural cultivation, especially near the Illinois River and the Mississippi River upstream from the confluence with the Missouri River are the major sources of triazine herbicides.

The most notable feature of all the regional-scale studies is the large increase in herbicide concentrations that occurs during storm runoff — the "spring flush." These conditions generally do not persist past mid-summer. Unfortunately, drawing conclusions from the fact that atrazine concentrations exceed the Maximum Contaminant Level (MCL) at times is complicated by the consideration that MCL's for drinking water, for example, are based on *average annual concentrations* and not concentrations of short duration.

Nutrients

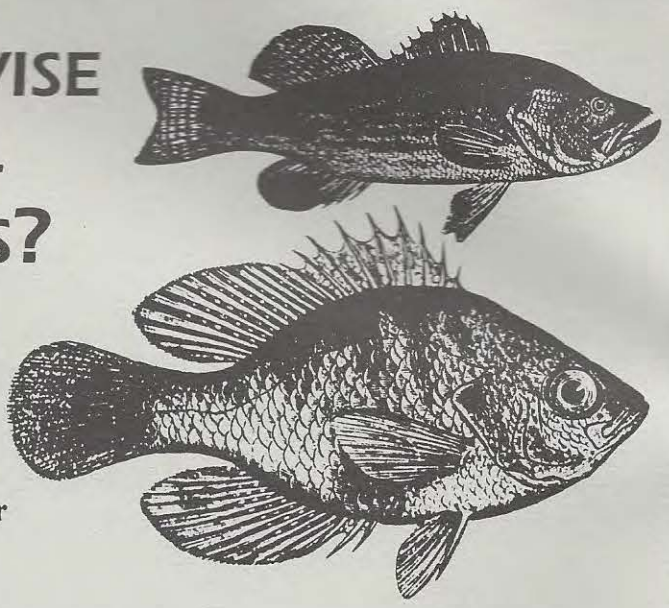
Nutrients (the various forms of nitrogen and phosphorus) in the Mississippi River are a classic case of good news and bad news. The good news is that nutrients, particularly nitrates, are the basis of almost all food webs and are needed for enhanced wetlands productivity. Nitrates are those nitrogen compounds containing three oxygen atoms. The bad news — they also contribute to excessive algal growth, which in turn can create or enlarge hypoxic zones in receiving waters (e.g., lakes, streams, and estuaries) and in the Gulf of Mexico. The seasonal distribution for nitrate concentrations in the River results from a combination of factors including assimilation of nitrate by aquatic and terrestrial plants and reduced seasonal inflows. Nitrate input comes from fertilizer-laden run-off, as well as from a variety of natural sources (e.g., decomposing organic matter and lightening storms). The predominant source area for nitrate discharged into the Gulf of Mexico is the upper Mississippi River basin. This area, which excludes the Ohio and Missouri River basins, constitutes about 22 percent of the Mississippi River drainage basin but contributes about 59 percent of the nitrate transported by the River.

All the available evidence leads to the conclusion that the water quality of the Mississippi River is suitable for coastal restoration uses.

All the available evidence leads to the conclusion that the water quality of the river is suitable for coastal restoration uses. Excessive nutrients may cause local algal blooms and enhanced seasonal hypoxic zones, but the existing data indicate that atrazine is the chemical that raises the most questions of toxicity to biota and human health. Research in the environmental effects of atrazine is a major topic of study. The papers published on environmental toxicity of atrazine at the concentrations encountered in the lower Mississippi River state that little or no adverse effects to plants and animals have been observed. However, studies implicating atrazine as a xenoestrogen (a chemical mimicking or altering the effects of estrogens; see the Oct 1995 issue of *Scientific American* for an excellent overview of this subject) show that there is still a lot to learn about long term, low-level exposure to pesticides. ⚖

HOW TO SPAWN WISE ENVIRONMENTAL DECISION MAKERS?

Take a Kid Fishing!



by Loren W. Lustig, Director
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"*Turn Off the TV and Walk Downhill.*" This is the daily prescription given by me, "Ranger Loren" to children coming to Hashawha Environmental Center for nature-related exploration, adventure & programming. At the bottom of every hill in this county is a creek, and in that creek are crayfish, minnows, frogs, hellgrammites, and other fascinating creatures awaiting capture, examination, and release. Indeed, anthropologist Loren Eisley wisely noted, "If there is magic in the universe, it is contained in water."

Ultimately, however, we as environmental educators must ask if the programs we provide are mere recreation, or do they spark an interest which will blossom into commitment, environmental concern, and ultimately, wise decision making. Considering this question, I recall my own childhood, and the beloved father who took me fishing on a frequent, regular basis. Growing up in the 1950s before the popularity of the environmental movement, I nevertheless learned from my father the same basic ecological lessons that he had learned in the wilds of Northern Wisconsin as a part time farmer/ lumberjack & full time outdoorsman. These lessons were presented to me, his eager student, not by theoretical jargon, but rather through observation and participation. We would go "nightcrawler hunting" around midnight in parking lots after a hard rain, saving the worms from death on the macadam and putting them in our vegetable garden. These worms did double duty, first enriching the soil while, second, awaiting their rendezvous with our hooks. ***LESSON #1*** - there *is* life below the soil. Indeed the top soil needs to stay in its place, not get washed away & lost in the creek.

Fishing trips with my father always began well before daylight so as to be able to have "lines out" during those magical minutes at first light. ***LESSON #2*** - creatures feed most avidly at daybreak and dusk). Dad insisted that we always "keep the bait moving" by drifting or rowing over likely spots. Redworms were strung on hooks so as to have as many of those extremely appetizing wiggling ends as possible. ***LESSON #3*** - predator/prey relationships dictate fishing strategies and levels of success. For example, if you want to catch largemouth bass - get your bait tight against the cattails). Pity the poor anglers who arrived as we were leaving (about 10:30 AM). They would anchor in, use huge bobbers, & string worms onto the hook so they assumed a truly odd & lifeless appearance. Their luck was going to be very poor as they gradually cooked in

the midday sun. Instead of fighting fish, they would be combating the waves from speedboats and skiers. Every last bluegill that we caught and saved in our fish basket was taken home in a cooler for a rendezvous with a fillet knife. At home in our basement, Dad and I would listen to the Chicago Cubs play (and loose) as we cleaned fish and swatted yellow jackets. ***LESSON #4*** -environmental ethics dictate that you properly use those fish which you legally caught and removed from the water.

Decision making regarding vocation, life style, habitat management, politics, and religion have all been directly correlated to those invaluable environmental lessons learned on the waters of Illinois, Wisconsin & Minnesota.

By the time that I reached high school, I was an avid environmentalist, and didn't even know it!! What I did know was that I mourned the loss of the trout that must have lived 200 years ago in our nearby streams - those same water courses which were now silt laden, hot, and provided habitat for only carp and cattle. My dream was to one day wear the uniform of the forest/park rangers who so obviously loved the woods, lakes, and rivers that meant so much to me. I was also prepared to assume the pressures, opportunities and responsibilities of adulthood with the basic ecological foundation blocks of awareness & concern in place. Decision making regarding vocation, life style, habitat management, politics, and religion have all been directly correlated to those invaluable environmental lessons learned on the waters of Illinois, Wisconsin & Minnesota.

Having worked now for a quarter century in the environmental field, I have been shocked & dismayed to see the number of children, especially urban kids, who desperately want to go fishing, but who have absolutely no adult interested enough to take them or teach them. For example, several years ago I provided an angling program for 24 eager 5th grade boys. The bargain was: "kids bring the poles, I provide the bait and we all catch bluegills." The boys showed up with copious amounts of eagerness, but with the most wildly inappropriate equipment imaginable — deep sea rigs, surf rods, 4/0 hooks designed for salt water bluefish or fresh water muskellunge. I asked the kids how many of them had ever gone fishing before. Not a one could answer yes. I considered that to be tragic. Where were the dads, the uncles, the friends from down the street? Where even were the older siblings? Exacerbating this dreadful scenario is the question as to what type of adult decision makers these children will become.

Having worked now for a quarter century in the environmental field, I have been shocked & dismayed to see the number of children, especially urban kids, who desperately want to go fishing, but who have absolutely no adult interested enough to take them or teach them.

There are lots of helpful hints on how to encourage kids as they begin their angling careers. Certainly the most important building blocks would include: go with the kid, insure immediate success, and keep it very simple. To abide by these bylaws, I use cane poles, fish with live bait, angle for the ever cooperative bluegills, and select those waters where I have personal experience. I have even teamed up with my wife to have our children play on land at waters edge until the fish are biting heartily. I then paddle to shore, grab the kids, and let them experience fantastic success for a brief but memorable angling adventure. Be sure to give praise to the kid who demonstrates good casting techniques, who catches the unusual fish or the smallest fish of the day, and who releases unharmed the undersized or out of season fish. A friend of mine who has a family with 4 boys started each one of them very early in the wonders of fishing. He would give his 2 year olds a small cane pole with a strong line and a huge bobber (no hook or bait). Those kids would thrash the water, probably scaring every fish in

Fishing continued on page 11.

National Science Foundation Scientists to Study Airborne Particles That May Be Cooling the Earth

*Information regarding the causes and consequences of global climate change continues to be generated. It is important to remember that the global climate is a complex system with many feedback loops which makes modelling and prediction particularly challenging. **

The Editor

Scientists now suspect that increasing numbers of small particles of sulfur compounds and other pollutants floating in the atmosphere may affect so-called greenhouse warming in heavily industrialized regions. By reflecting sunlight back to space, these tiny airborne particles, called aerosols, can cool the earth beneath. To learn more about "background" aerosols — the naturally occurring counterparts to these pollutants — researchers from eight universities and the National Center for Atmospheric Research (NCAR) are flying to the remote skies of Tasmania, with stops in Alaska, Hawaii, and other sites along the way.

> Like carbon dioxide, sulfate aerosols are produced by human activity, mainly the burning of fossil fuels. They also exist naturally as sulfur emissions from living organisms and volcanoes.

More than 100 scientists from 57 institutions representing Australia, France, Germany, Italy, Japan, the Netherlands, New Zealand, Sweden, the United Kingdom, and the United States are participating in this major study of airborne particles.

"Existing theories suggest that it should be very hard to create new particles in the lower atmosphere, yet they keep showing up," says researcher Barry Huebert of the University of Hawaii. "We're deploying state-of-the-art instruments to the remote marine atmosphere for the first time to seek the source of these new particles. This is the largest and most comprehensive experiment on natural background aerosols that we have ever done." Experiments will be conducted from a fully equipped C-130 research airplane.

> Until recently all climate models have supposed that the only human activity driving climate change was the production of carbon dioxide and other greenhouse gases ... sulfate aerosols, may be as important.

Research measurements will begin in Alaska with a flight toward the North Pole and back. While in Hawaii, the C-130 will fly through the Kilauea volcano plume to study how its particles form and how much sunlight they reflect. A flight toward the South Pole will complete the study's nearly pole-to-pole measurements.

Called *ACE-1*, the study is the first of the Aerosol Characterization Experiments which will help scientists understand the chemical, physical, and optical properties of aerosols; how they form and grow; and their effect on radiation and climate. Like carbon dioxide, sulfate aerosols are produced by human activity, mainly the burning of fossil fuels, but they also exist naturally as sulfur emissions from living organisms and volcanoes. By scattering incoming solar energy back to space, both the natural and pollutant aerosols directly affect the amount of radiation entering the earth's atmosphere. They also serve as tiny sites on which water vapor can condense, allowing more small droplets to form within a cloud. This change in the droplets' size distribution makes the cloud more reflective, bouncing more solar radiation back to space and cooling the earth below.

In *ACE-1*, scientists will study the natural marine system, as far as possible from sulfate aerosols produced by human activity, to better understand natural processes

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affecting the production of sulfate aerosols. *ACE-2*, scheduled for 1997, will focus on the marine atmosphere near industrialized areas. As scientists learn more about aerosols naturally-occurring in the undisturbed atmosphere, they can better assess the growing influence of human-produced sulfate aerosols on climate.

"Until recently all climate models have supposed that the only human activity driving climate change was the production of carbon dioxide and other greenhouse gases," explains scientist Tom Wigley of NCAR. "We now believe that other factors, particularly sulfate aerosols, may be as important as greenhouse gases." ⚖

* see article on *Climate Change, the Greenhouse Effect, & Global Warming in* ENVIRODECISIONS, Vol 2, No 2.

***Fishing** continued from page 9.*

the county, but each one of them learned the great delight and mystery of angling. A teacher once brought kids to my environmental center to have a fishing lesson, but requested that no hooks be used. We had a delightful time with colored yarn, which the kids used to drive the bluegills crazy.

Izaak Walton has specified that, "Angling deserves commendations: it is an art and an art worthy the knowledge and practice of a wise man." Notice the adjective used, "wise." I am reminded of the Proverb "to be wise is to know and do that which is right." There are many ways to obtain an environmental consciousness which leads to wise environmental decision making. From my personal experience I know that angling is one of the best.

THERE ARE MANY WAYS TO OBTAIN AN ENVIRONMENTAL CONSCIOUSNESS WHICH LEADS TO WISE ENVIRONMENTAL DECISION MAKING. ... ANGLING IS ONE OF THE BEST.

Aldo Leopold, perhaps the most important American environmentalist of the 20th century said, "Conservation is a state of harmony." Why not introduce children to the harmony that we hear singing to us when we find ourselves on the water. ⚖

Our world is in desperate need of that type of chorus.

REPORT UNVEILS NEW APPROACH TO UNDERSTANDING AND PROTECTING BIODIVERSITY IN THE SEA

Images of burning and cleared tropical rainforests often are used to elicit public support for ecological conservation. But a lesser-known and no less important trove of biodiversity lies beneath the sea. Like the rainforests, the ocean, too, is in jeopardy.

A new report from the National Research Council describes how human activities have led to dramatic and possibly irreversible changes in ocean biodiversity-- reductions in popular edible fish and shellfish species and reduction or loss of species with important potential for biomedical products. Dredging, filling, and other development have altered many coastal habitats, including coral reefs, bays, marshes, rocky shores, and beaches.

Unfortunately, the ability of scientists to evaluate the scale and consequences of these changes is seriously compromised by inadequate knowledge of the basic processes that control the diversity of life in the sea. The report calls for a new approach to measuring and studying marine biodiversity. It argues that scientists should pursue interdisciplinary research that examines multiple sites within a larger regional system, such as the numerous interconnected bays and estuaries found from Cape Cod to North Carolina. This strategy is now possible because of recent advances within the ecological, molecular, and oceanographic sciences, and a new commitment to linking these disciplines. ⚖

Understanding Marine Biodiversity: A Research Agenda for the Nation is available from the National Academy Press. To order contact:

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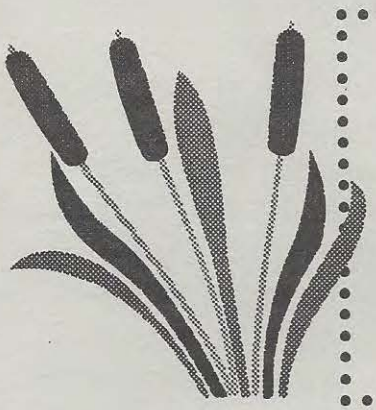
The National Research Council is the principal operating arm of the National Academy of Sciences and the National Academy of Engineering. It provides independent advice on science and technology issues under a congressional charter.

Tallgrass Prairie Ecosystems Threatened by Atmospheric Nitrogen Deposition

Perhaps one of the best documented but least discussed components of global change, say scientists, is the recent increase in atmospheric nitrogen deposition from modern agriculture.

In a series of 13 year-long experiments, researchers at the National Science Foundation's Cedar Creek, Minnesota Long-Term Ecological Research site are studying the consequences of long-term nitrogen additions to the ecosystem dynamics of grasslands and oak savannahs. Their results show a pattern of terrestrial eutrophication similar to the well described phenomenon of aquatic eutrophication — as availability of nitrogen increases, productivity increases, the dominant species change, and the overall species diversity of the ecosystem drops dramatically.

Thus say these ecologists, nitrogen deposition is a significant threat to one of North America's most endangered ecosystem types, the tallgrass prairie. Just ten years of nitrogen addition, at rates comparable to those found today in the Ohio valley, are leading to the displacement of native grass species by non-native grasses. Because many rare species and much of North America's biodiversity exists in relatively nutrient-poor, unproductive habitats — ranging from peatlands and bogs to open "balds" of the Appalachian mountains, to the sand plains of the coastal plains — the threat of nitrogen deposition to biodiversity is not limited to the tallgrass prairie ecosystem, these researchers believe. ⚖



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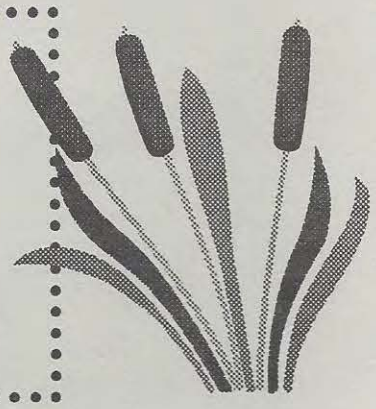

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