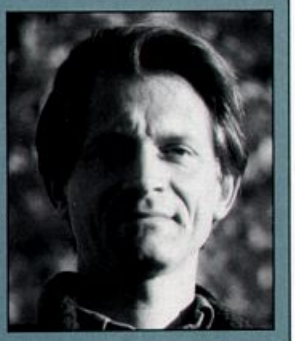
J. P. Myers

FACTS, INFERENCES AND SHAMELESS SPECULATIONS



Rosemary's Babies (and Sue's and Trish's and Jessica's and...)

IF YOU WANT TO SEE the real problems driven by pesticide abuse, PCB contamination, dioxin doses, and a host of related compounds, come vacation in the Great Lakes this summer.

Spend time poking around a Forster's Tern colony. Survey a few Double-crested Cormorant nests. Or for that matter, study babies born to human mothers eating fish caught from the Great Lakes.

What to look for is not always obvious nor what you might immediately associate with compounds feared for their potential carcinogenicity. Yet devastating impacts are occurring today at dosage levels far below those required to cause cancer. Our nation's obsession with cancer has blinded us to huge risks and the toll is beginning to mount.

Begin your ecotour of the Great Lakes with wildlife because that's where the science is best understood. Start with Forster's Terns and look first at the adults. They demonstrate a fundamental lesson of the tour: The adults are eating fish contaminated with all sorts of noxious chemicals, but show few, if any, signs of illness.

Spend time with the adults. Enjoy their calls and flight. Savor the vision while you remember Mia Farrow's—Rosemary's—grace. Then look beneath the adults at a wasted field of eggs and malformed chicks, whose failures and deformities stem from the acute sensitivity of developing vertebrate embryos to human-made compounds now pervading our air and water.

What this brief comparison—adults *versus* offspring—teaches is that the place to find the main impacts of PCBs, dioxin, pesticides, and related compounds is not in the immediate consumer of contaminated food. True—dose them up heavily enough and you can induce all sorts of dismaying effects. But the main victim in this chemical act of ecoterrorism is the developing embryo, within the adult's body (or egg), that inherits part of the contaminated body load of the parent, a body load of chemicals built up by a lifetime of consumption and exposure *prior to fertilization.*

Why are embryos more vulnerable? Their function in life is to take chemical signals (which normally come from within) and convert them into patterns of growth and development. The contaminants that lace the Great Lakes are functional teratogens—they mimic, replace, mask, block, or interfere with the normal signals and thereby distort embryonic and perinatal development—not just (or even necessarily) the embryo's ultimate body form, but its endocrine, immune, metabolic, and neurological functions as well. The results are birth defects, mostly not directly

Toxic chemicals are having a devastating impact on wildlife surrounding the Great Lakes at dosage levels far below those required to cause cancer.

Mothers who consume Great Lakes fish even before pregnancy run the risk of passing toxins along to their progeny.

visible, that degrade the organism's ability to function naturally in life.

Part of the impact of many functional teratogens derives from their chemical similarity to estrogen and other vertebrate hormones. Hormones play a crucial role in directing embryonic development. Very small differences in how much hormone is present within a cell, organ, or body fluid determines how development proceeds, from things as basic as organ size and shape to matters as behavioral as sexual choice and dominance. The insidious impact of these contaminants has to do with their ability to mimic or inhibit the effects of vertebrate hormones at comparable dosage levels—levels on an order of magnitude lower than what it takes to induce cancer.

Consider Michael Fry's American Kestrels: Fry found experimentally that male offspring of female kestrels grow up behaviorally subordinate and reproductively impaired if the female's bloodstream, at the time of fertilization, carries a modest load of dicofol (a commonly used pesticide, analogous to many Great Lakes contaminants). [The narrow conclusion here for academics is that any study of vertebrate social behavior being carried out in an area where contaminants are present—*i.e.*, just about anywhere on the planet—must assume the behavior is chemically distorted, and that the burden of proof lies with the investigator.]

Or consider Western Gulls breeding in the Los Angeles bight and afflicted by DDT contamination dating from that compound's production in the region. During the 1970s, breeders in the bight dropped from 2500 to 7 pairs and the sex ratio shifted to 3 females for every male. Fry showed that the estrogenic effects of this hormonal mimic so distort the developmental process that some birds, which, by their chromosomes ought be male, instead grow up feminized. The degree of feminization was highly dose-dependent with Fry reporting gross distortions in gonad morphology including "ovo-testes." Up to 40% of the males had either left or right oviducts in various stages of development. Fry postulated that the missing males in the population were chemically neutered and never bothered to return to the breeding colony.

The mind boggles, rebounds, and quickly focuses on the next question: What about mammals? Here the epidemiology is in its infancy (distorted by pesticide companies instead of by their pesticides). Experimental studies of humans are

This deformed Double-crested Cormorant was poisoned by toxic PCBs. Photograph/Thomas A. Schneider.

FILMING "GREAT LAKES, BITTER LEGACY"

Who can forget that day in June, 1969, when an oil slick on the Cuyahoga River in Cleveland, Ohio, suddenly caught fire? To people all around the Great Lakes, the fire seemed the last gasp of a dying environment.

Throughout the spring and summer of 1990 an Audubon Productions crew, led by the talented director and producer Thomas Lucas, traveled around America's "fifth coast" to film people and wildlife. *Great Lakes, Bitter Legacy* shows that a new generation of environmental laws has restored much of the Lakes' beauty. Gone are the putrid waters, the piles of dead fish, the raw sewage, and oil slicks that ravaged the Great Lakes.

Nonetheless, decades of industrial and urban growth have left behind a deadly, lingering threat—industrial chemicals, heavy metals, and pesticides—in the mud beneath rivers and harbors. This chemical stew is not only difficult and dangerous to remove, it's having long-lasting effects on wildlife and humans, as Lucas and the Audubon crew so successfully portray. Young lake trout convulse as they die, deformed cormorants and bald eagles lose their ability to produce, and children do not perform well on cognitive tests.

Finally ridding the Great Lakes of toxic chemicals will not be easy, but as the film stresses, the greatest hope may lie in a strong new wave of protest beginning to rise among citizens all around the region.

–Christopher N. Palmer
Executive Producer and
President, National Audubon
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out, for obvious reasons, but some good work has been done with mice. The basic finding is that developing mammalian embryos too are acutely sensitive to *in utero* variations in hormone levels, and to hormonal mimics. And with regard to neurotoxic effects, humans appear to be four orders of magnitude more sensitive to PCBs than are rodents.

The best human information to date comes from work on children born to fish-eating mothers in Grand Rapids, Michigan. The children in question are not yet adolescent, so all the effects have not been seen, but what has been observed is not pleasant. Depending upon how much Great Lakes fish (and PCBs) their mothers ate in their lifetime prior to pregnancy, skull circumference at birth and birth weight are reduced, and cognitive, motor, and behavioral competency are degraded compared to children whose mothers had a non-fish diet. The affected children showed measurable deficits up to the age of four (the most recently published report). What this means about the childrens' ability to meet normal expectations as they reach adulthood has not been determined.

Unfortunately, there is nothing magical about the fish-consumption pathway. Get these goodies into your bloodstream and body fat prior to pregnancy and you pass them along to your progeny. The impact on your offspring is a question of amount and timing.

As I write this, a new story is developing in the Florida Keys. Pesticides banned in the United States for 20 years have been discovered in local coral reefs, apparently transported there from other countries by ocean and atmospheric currents. The concentrations of nine chlorinated hydrocarbons, including DDT, heptachlor, and chlordane—real nasties—are up to 25 times the allowable levels in seafood. The discoveries are too new to know what sort of bioaccumulation is taking place within the reef ecosystem, or whether fish from the region represent a hazard to anyone's health, be it a Sooty Tern, a Monroe County resident, or a fertilized embryo reading chemical signals to define its future life.

Too new to know, but worthy of thought...worthy of reflection about the abandon with which we allow compounds to be spread around the landscape, worthy of concern about their pervasive chemical assaults, worthy of distress about what the costs to nature and society have been and may become.

There must be a better way. ■

–J.P. Myers is Director of the W. Alton Jones Foundation.