

Fewer Frogs in Illinois Organochlorines May Be to Blame

To understand the worldwide decline in amphibian populations, many researchers are looking at the current use of industrial compounds that disrupt endocrine function and lead to impaired reproduction. But a group of researchers in Illinois thought a historic perspective might offer some additional clues [*EHP* 113:261–265]. What they found reveals a new possibility as to why the cricket frog, indigenous to the eastern half of the United States, has experienced a marked population decline in recent decades.

Endocrine systems evolved to yield exquisite sensitivity to hormones that normally prompt critical developmental processes and physiologic functions, including sexual behavior and reproduction. Because of this sensitivity, some chemicals—such as the industrial chemicals known as organochlorines—can interfere with endocrine function at extremely low environmental concentrations. Frogs are especially susceptible to developmental abnormalities because embryonic development takes place on the surface of the water, in open contact with any contaminants that may be there. Cricket frogs and other amphibians are therefore valuable sentinels of ecologic change.

The researchers examined museum specimens of cricket frogs that had been collected throughout Illinois for more than 150 years. This time span comprised five periods: a preorganochlorine period (1852–1929); a period of industrial growth and initial use of polychlorinated biphenyls (PCBs; 1930–1945); a period of rapidly increasing DDT use and further industrialization (1946–1959); a period of declining use and the eventual ban of DDT as well as the beginning of industrial pollution controls (1960–1979); and a period of substantial reduction of organochlorines in the environment (1980–2001). The team examined the specimens for evidence of “intersex” gonads—testes that produce egg cells or the presence of both a testicle and an ovary—which are known effects of endocrine disruptor exposure.

Once the most common amphibian in Illinois, cricket frogs have undergone a precipitous decline over the last 25 years to the point that they are now rarely seen in the north of the state. The research team’s findings suggest that increasing contamination with a suite of endocrine-disrupting organochlorine contaminants beginning in the 1930s likely contributed to the decline. Intersex frogs accounted for 1% of samples from 1852 to 1929, 7.5% of samples from 1930 to 1945, 17% of samples from 1946 to 1959, 10% of samples from 1960 to 1979, and 9% of samples from 1980 to 2001. The spatial analysis showed the effects to be the most pronounced in the urbanized, industrialized north of the state, around Chicago.

Furthermore, the researchers concluded that the greatest declines were seen in the areas with the most intersexuality: “The observed decline was evident following a period of sustained

endocrine disruption, as indicated by a large increase in prevalence of intersex gonads and masculinization of the population,” they write. However, they add that they cannot conclude that the era of endocrine disruption in cricket frogs has come to an end, because the number of remaining cricket frogs is insufficient to permit sampling.

—Renée Twombly

Pesticides and SLE Is the Link Estrogenic?

Autoimmune diseases are multifactorial in nature and likely involve both environmental and genetic components. Estrogen is one environmental component that has been studied in relation to systemic lupus erythematosus (SLE) based on a number of clues. Like many other autoimmune diseases, SLE—a chronic disorder of uncertain

cause and a varied clinical course—is more common among women, and onset is especially likely during childbearing years. In the (NZB × NZW)_{F₁} mouse model of SLE, females develop more severe disease and die earlier than males; treating females with androgens (male hormones) slows the disease, while castrating males accelerates it. Several organochlorine pesticides can emulate estrogen in the body. Now a group of Florida researchers has assessed the possible role of these compounds in causing SLE [*EHP* 113:323–328].

The researchers used female (NZB × NZW)_{F₁} mice to study to effects of three estrogenic pesticides. They removed the ovaries of some of the animals to eliminate endogenous

estrogen, while others were left intact. They then dosed the ovariectomized animals with the synthetic estrogen 17β-estradiol or with one of two doses of DDT, methoxychlor, or chlordecone. SLE can result in kidney failure due to glomerulonephritis, a deterioration of the glomerules that “filter” the blood, retaining nutrients and discarding wastes. So the team chose glomerulonephritis as an end point, and determined onset of the condition by measuring protein and blood urea nitrogen in the urine.

All three pesticides accelerated the onset of SLE. DDT and methoxychlor appeared to have roughly the same influence on SLE development as endogenous estrogen. The lower dose of methoxychlor tested—equaling approximately 1.2 milligrams per kilogram per day—produced kidney damage, even though it was fourfold lower than the no-observable-effect level used by the U.S. Environmental Protection Agency to calculate an oral reference dose for methoxychlor. This, the authors wrote, suggests that autoimmunity might be among the most sensitive measures of harm caused by methoxychlor.

Chlordecone produced the strongest response, so the team experimented further with lower doses of this compound. Chlordecone was commonly used in agriculture and some household products to



Cricket frog swan song? A new examination of historical data shows the decline of cricket frogs in Illinois correlates with organochlorine pesticide use.

kill ants and roaches in the 1960s and early 1970s. It was banned in the United States in the late 1970s, but it degrades slowly and still persists at some contaminated sites.

Examination of the kidney revealed a deterioration characteristic of the usual course of SLE, including the appearance of immune complexes of antibodies and target cells, even at the lowest chlordecone dose—a dose that would usually be considered a no-observable-effect level. Chlordecone also raised levels of antibodies to native, double-stranded DNA, another specific marker for SLE.

Despite evidence that all three pesticides accelerated the course of SLE, the chemicals did not increase uterine weight, which is a normal result of estrogen treatment. The authors speculate, therefore, that uterine hypertrophy might be a poor measure of the estrogenic effects of these pesticides, or that estrogenicity is not the mechanism that links pesticide exposure to SLE and renal failure.

Interestingly, the organochlorines caused about the same level of disease as the synthetic estrogen used as a positive control. However, because the mice studied almost always develop SLE, the research did not demonstrate that the organochlorines would cause SLE in animals that would not otherwise get the disease.

—David J. Tenenbaum

Choosing Safe Fish Too Little Data on the Menu

In recent years, both the benefits and the potential health risks of eating certain types of fish have been well publicized. Consumption advisories by government agencies as well as media reports have raised public awareness of high mercury concentrations in certain fish, particularly swordfish, shark, king mackerel, and tilefish. In this month's issue, scientists at Rutgers University, the Environmental and Occupational Health Sciences Institute, and the New Jersey Department of Environmental Protection contend that such efforts still are not enough to allow consumers to make truly informed decisions about which fish to eat, how often, and in what quantities [*EHP* 113:266–271].

With the overall objective of exploring how the information communicated in public health advisories might be enhanced, the group looked at the potential variation in fish mercury levels between regions within a state, between neighborhoods of different economic strata, and between types of stores. They also wanted to determine whether regional levels were significantly different from reported national levels posted by the Food and Drug Administration (FDA) online at <http://www.cfsan.fda.gov/~frf/sea-mehg.html>.

For the statewide comparison, the investigators analyzed the mercury content of samples of three types of fish commonly available in New Jersey—tuna, flounder, and bluefish. The fish were purchased between July and October 2003 from grocery stores and fish markets in regions throughout the state, and in both high- and low-income communities.

The species—as expected—varied significantly in their mercury content, with large predatory tuna containing the most and bottom-feeding flounder the least. Mercury content did not vary significantly among store types or economic areas. Just one regional difference emerged: flounder purchased at fish markets along the Jersey shore had higher mercury levels than flounder from markets in other areas, possibly due to the fish coming into the stores from different sources, such as regional distribution centers.

To compare actual mercury measures against data reported by the FDA, the team purchased and assayed samples of six additional types of fish (Chilean sea bass, porgy, red snapper, croaker, cod, and whiting) and two types of shellfish (shrimp and scallops) from central New Jersey markets. These species were chosen because of their wide availability in the state.

Mean levels of mercury were higher in the sea bass, croaker, whiting, and shrimp available in New Jersey—as well as the tuna sampled in the first tier of the study—than predicted by the FDA's data; the actual mean for one fish, croaker, was nearly three times the FDA estimate. The authors say these discrepancies show that the FDA should update its database (the data provided were collected mainly from 1990 to 1992). They also suggest that the agency consider providing regional breakdowns of aggregate mercury levels so state agencies can evaluate possible risks for their citizens.

According to the researchers, this was the first study of mercury levels in commercial fish that included examination of fish availability, cost, and consumer preference as variables in consumer choice. Flounder struck the best balance between ready availability, affordable cost, and low mercury content. The authors suggest that state agencies responsible for health risk communication conduct more comprehensive studies and disseminate findings on consumers' fish preferences as well as fish cost, availability, and contamination, including data on commercial fish species with low levels of mercury. Such information would enhance consumers' ability to make rational decisions about fish consumption.

Fish clearly can be a healthful food providing a relatively low-fat protein source as well as beneficial nutrients that protect against cardiovascular disease, the authors point out. They are pursuing studies that more clearly portray the balance between benefits and risks associated with eating different types of fish. —Ernie Hood



Buyer beware. Researchers say consumers' ability to choose the safest seafood is hampered by a lack of reliable, accurate data on mercury levels in locally sold fish.