

# The Networker



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## PCBs: banned but not forgotten

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Global pollution is very important to Dr. Paul Jones of the National Food Safety and Toxicology Center (NFSTC).

Dr. Jones, who works in the NFSTC's

Aquatic Toxicology Program, monitors the concentrations of PCBs

(polychlorinated biphenyls) in creatures from different parts

of the world. Before joining the NFSTC from his home in New Zealand, he took samples from many long-finned pilot whales involved in stranding events (beachings).

Dr. Jones and his MSU student, Caren Schröder, wanted to know if concentrations of PCBs varied by location and if gender or age played a role in PCB contamination. He also had questions about the Southern Hemisphere whales as a population. Using tissue samples from 61 pilot whales that died in seven strandings on New Zealand's coast, Dr. Jones found answers.

Because PCBs are "persistent" (they do not break down easily), examining the PCB levels can suggest some life history parameters for those marine mammals. This study was able to show some general population characteristics, such as when females first give birth and the fact that females continue to live on after their breeding days are over. Before this study, researchers could only assume that Southern Hemisphere whales were like Northern Hemisphere whales. Jones' data fit very well with what was already known about Northern Hemisphere whales. Gender appeared to affect contamination patterns. Male pilot whales showed a relatively uniform increase in PCB levels with age, but females showed a less uniform age-dependent decrease in PCB concentrations once they started breeding.

"We had a couple of young male whales that didn't fit the pattern," Dr. Jones said. "They had much higher concentrations than the others. Through modeling about how PCBs accumulate in the females and transfer to calves, we were able to determine that those males were

probably the firstborn calves of females."

He explained that young female pilot whales show steady accumulation of PCBs, but when they begin breeding at around eight years of age, their levels decrease.

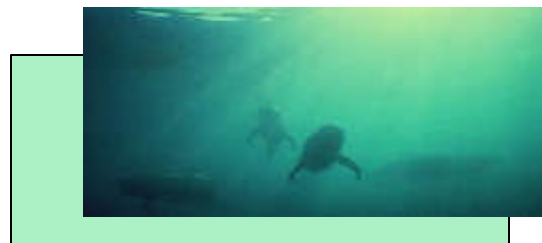
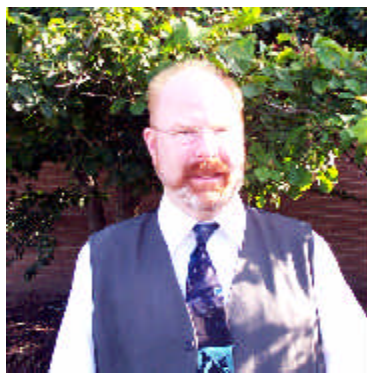
The researchers believe that there are PCBs in the milk the females produce for their calves, with the highest concentrations given to the firstborns. When reproductions tapers off after 25 years, PCB levels in female whales increase again.

PCBs have been banned since the late 1970s, but prior to that industrial countries used the chemical in cutting fluids, lubricants, hydraulic fluids and carbonless copy paper. Dr. Jones estimates that 95 percent of the PCBs ever produced are still in the environment; most of it in relatively safe landfills, but the life of a safe landfill can vary depending on how well it is tended.

PCBs can also get into the air--that is how they're transported into the open ocean. Small fish carry low doses, and the levels increase up the food chain (known as biomagnification). Because whales ingest large quantities of contaminated fish and because PCBs dissolve better in fat, the whales, with their fatty blubber layer, retain high concentrations.

Southern ocean pilot whales were found to accumulate PCBs in a similar fashion as Northern Hemisphere whales, but PCB concentrations are lower in New Zealand than in Northern Hemisphere pilot whales. Comparison of whale tissue concentrations in likely food items suggest, however, that biomagnification factors are higher in the southern ocean marine environment than those found in the Northern Hemisphere.

The health effects of PCBs on whales are largely unknown. "Even though PCBs are banned, it doesn't mean we don't have to worry about them," said Dr. Jones. "They're still out there causing problems. We need to make sure those problems aren't getting worse by making sure they (PCBs) are stocked in safe landfills and don't get released into the environment."





## The Director's View

Dr. Ed Mather

Water is a basic component of life. It is the most abundant compound in the human body, adding up to about half of each person's body weight. There is no life (as we know it) without it. Often, though, we don't think about water as a "food," and many of us don't really think about it at all.

Water plays a key role in the digestion, absorption, transportation and use of nutrients in the body, and it is the medium for the elimination of toxins and waste products. It is also the primary way that bodies are heat-regulated. From energy production to joint lubrication to reproduction, there is no system in the body that does not depend on water.

Researchers have recognized links between water intake and disease. Risk of developing kidney stones has been shown to drop with an increased intake of water. It also appears that people who drink more water have a lower risk for cancers of the breast, colon and urinary tract.

At the NFSTC, many researchers are interested in how water, at every step along the food chain, influences our health. Our scientists investigate global water issues such as reduced production and limitation of flexibility in agriculture, and increased health problems. They examine toxins, such as PCBs, in the water and how those contaminants affect certain animal life (see front page article about Dr. Paul Jones' research) and study the sources and effects of many microbial pollutants from foods, both plant and animal. NFSTC scientists also study surface and groundwater supplies, improperly treated drinking water and agricultural, human and animal wastes to find ways of improving the water supply.

NFSTC's Dr. Tim Zacharewski has examined how endocrine disruptors, which have been detected in drinking water, affect human and wildlife health. The endocrine system is comprised of all the glands and organs within an animal that are



involved in the production, secretion and response to hormones. It serves essential roles in normal development, behavior and reproduction, as well as in the general well-being of an animal.

Dr. Zacharewski's research shows that hormonally active chemicals, commonly referred to as endocrine disruptors, are found throughout the environment and have been detected not only in our drinking water but also in human and wildlife tissue, food and air. Endocrine disruptors include pharmaceuticals, environmental pollutants, industrial chemicals and natural products produced by plants and hormones produced within and excreted by animals. His study also points out that despite weak activity of endocrine disruptors, some epidemiological studies have reported that exposure to these compounds during development may contribute to the increased incidence of reproductive tract abnormalities and hormone-dependent cancers of the breast, prostate and testes, and decreases in sperm counts in humans.

Overall, the research highlights significant knowledge gaps and makes specific research recommendations that need to be undertaken in order to fully assess the effects of endocrine disruptors. According to Dr. Zacharewski, many of these research priorities are being investigated as part of an international effort to identify and assess the potential health consequences of exposure to endocrine disruptors on human and wildlife health.

As the NFSTC forges ahead in fulfilling its mission to increase understanding of chemical and microbial hazards in foods, we must continue to think of water as an invaluable "food" source--one that must be safeguarded and protected.

It has been theorized that there is the same amount of water here on Earth now as there was billions of years ago. Because of the water cycle--evaporation, condensation and precipitation--the water we drink or water our gardens with is the same water with which our distant ancestors drank and watered their gardens. As long as we remain watchful guardians and stewards of this precious resource, that same water will keep our great-great-grandchildren and their gardens alive and well in the future.





# NFSTC doctor works to prove grandmother was right

By Tisa Vorce and Pat Stewart

**D**r. James Trosko has been studying the causes of human diseases for more than 35 years and has developed a hypothesis about why they happen. His research has led him to hypothesize that there is a common mechanism shared by disease processes leading to birth defects, cancer, cardiovascular diseases, cataracts, and reproductive and neurological disorders. The interaction of genetic and environmental factors, like diet and lifestyle choices, are the basis for his research at the National Food Safety and Toxicology Center (NFSTC).



Humans start out as one cell, the fertilized egg. After nine months, the baby is born with more than 100 trillion cells. This is accomplished by a homeostatic process by which cells “communicate” with each other to control the four basic functions that all cells must do: multiply, differentiate (become specialized), die at the appropriate time, and adaptively respond when they are already differentiated. The cell’s functions are basically the result of the genetic information (genes) inherited from the parents and the environmental factors to which the cells are exposed.

“We inherit about 100,000 genes, but not all of these genes are active in every cell all of the time,” said Dr. Trosko. “For example, the genes that may be expressed (turned on) in your neurons (nerve cells), are very different from the genes turned on in your liver cells, and that’s what makes the neuron different from the liver cell--they have two different functions. What allows those genes to be

turned on or turned off are usually these environmental factors we get

Foods are made up of certain chemicals and are considered part of the environmental factors that have an effect on health. The impact of food on the body can be large or small

and can happen at any stage of life, from the fetus to the adolescent to the mature adult. Foods are mostly natural, but can contain synthetic chemicals as well, such as pesticides, which can be a contributing factor in their effect on people. One reason the relationship between food and people is changing is because people are exposed to many more different kinds of foods than ever before.

“Until now, huge populations of people grew up in areas where their health and disease status was determined by the foods that they had access to,” said Dr. Trosko. “More recently, because of the mobility of people to move anywhere in the world, (they are) being exposed to foods they had never eaten before. Vice versa, people who stay where they are eat foods that are shipped to them, and they don’t even know what they are or how to prepare them. This exposes people to natural chemicals in these foods that their bodies have never been exposed to, as well as the synthetic pesticides that may be on the food.”

The research Dr. Trosko leads at the NFSTC focuses on how the communication between cells becomes disrupted and keeps them from performing their designated tasks. He works on all of the levels by which food factors can influence human health, including the consumption of too much or the wrong kinds of foods,

typical of the American diet, and too little food consumption, a problem in many third world countries.

Dr. Trosko uses an orchestral analogy to describe food effects and cell responses. In an orchestra, music is made when all of the musicians play the music they are supposed to and follow the lead of the conductor. When one player or section quits playing, or plays something different from the rest of the orchestra, the music becomes noise. The human body normally operates like a well-practiced orchestra, and foods can influence this harmony. But when a food contains a toxin, which interrupts a single or group of cell’s normal ability to communicate, the body is discordant, and disease can occur.

Dr. Trosko warns that there are alarmists out there who do not understand one of the basic principles of toxicology: dose makes the difference. Too much or too little of any substance, or the wrong kind of chemicals in the environment, can disrupt the cell’s normal behavior and lead to disease. His work focuses on the amounts and types of substances that affect how chemicals and genes influence cell-to-cell communication.

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*“The human body normally operates like a well-practiced orchestra, and foods can influence this harmony.”*

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“My grandmother was not a Ph.D. in toxicology,” said Dr. Trosko, “nor were the ancient Chinese 4,000 years ago. But, they knew that too much or too little of anything is bad for you. What I’m doing in the lab, using sophisticated science, is an intellectual exercise to understand why too little or too much can be harmful to people’s health. I’m finding a scientific basis for why my grandmother and the ancient Chinese were correct.”

## PICNIC TIPS

Summer picnics and barbecues can be great times, but they can also be breeding grounds for the germs that cause foodborne illnesses. To keep foods safe on your outings, follow these tips from the National Food Safety and Toxicology Center (NFSTC):



- ❖ Make sure you allow cooked foods enough time to chill thoroughly. Then leave food in the refrigerator until it is time to pack it into the iced cooler and go.
- ❖ Keep hot foods hot and cold foods cold. NFSTC scientists warn that foods kept in the danger zone between 40 and 140 degrees F for more than two hours are more likely to cause disease.
- ❖ When grilling, make sure the coals are very hot before starting to cook, and cook hamburgers to 160 degrees F and poultry parts to 180 degrees F. Do not return cooked meat to the same dish that held it raw.

- ❖ Keep the cooler in cool places, like inside the air-conditioned car and in the shade. Avoid opening it frequently.
- ❖ If food does not feel “refrigerator cool” back at home, or if the ice in the cooler has melted, throw the food away.

For additional information about safe food handling, visit the MSU Extension website at [www.msue.msu.edu](http://www.msue.msu.edu).

### Dr. John LaPres joins NFSTC

Dr. John LaPres will begin his new post Aug. 16 at the NFSTC as assistant professor of functional genomics in toxicology.

Dr. LaPres has investigated chaperone proteins, which prevent proteins from making improper interactions within the cell and rescuing them if they do, as a postdoctoral associate at the McArdle Laboratory for Cancer Research at the University of Wisconsin. At MSU he plans to continue to apply genomic experimental strategies to his research in the general areas of food safety and toxicology. Dr. LaPres will also participate in campus-wide graduate training programs in cellular and molecular biology, genetics and environmental toxicology.

Dr. LaPres received his Ph.D. in molecular pharmacology at Northwestern University in 1997.

MICHIGAN STATE UNIVERSITY

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