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## Banned Chemical Still Contaminating San Francisco Seals

There's a mystery afoot in the Bay Area: A manmade chemical, pulled from production 12 years ago, is still turning up at high levels in seals

Jan 30, 2014 | By Jane Kay and Environmental Health News |

SAN FRANCISCO, Calif. – In a shallow arm of the bay, where Pacific tides cause hardly a ripple, hundreds of harbor seals lounge, mate and bear young. With placid expressions on bewiskered faces and bulky bodies reclining on shorelines, the seals belie a disturbing burden they carry.

Living on the edge of a metropolitan hub, these seals are [under scrutiny](#) by scientists. There's a mystery afoot in San Francisco Bay: A manmade chemical, pulled from production 12 years ago, is still turning up at high levels in the seals.

Once the prime ingredient in Scotchgard, a chemical known as PFOS has remained elevated in these harbor seals even though it has declined in sea birds that share their fish diet.

San Francisco Bay's harbor seals have some of the highest PFOS levels in the world, and the chemical isn't following the pattern of slow decline of other persistent pollutants.




These San Francisco Bay harbor seals are contaminated with some of the world's highest levels of perfluorinated chemicals.

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Yet, despite the high levels of PFOS, virtually nothing is known about whether the

chemical is harming the bay's seals and other creatures. Some scientists cite evidence in other animals – sea turtles, dolphins and sea otters – to suggest that it may be impairing their immune systems.

“We can't get rid of it. It builds up in the environment. It's like filling a bathtub, turning on the water, and walking away,” said Oregon State environmental chemist Jennifer Field.

“Nature can't degrade it, and it ends up in biota. Until we cut off the supply, you just keep adding it to the total burden on the global environment.”

### **A stubbornly persistent chemical**

What makes perfluorinated chemicals (PFCs) so stubbornly persistent is that they contain fluorine bonds, which are the shortest and strongest of chemical bonds. These same characteristics make them popular with manufacturers as coatings because they repel oil and water, stabilize heat and act as leveling agents to ingredients in cookware, textiles, carpeting, paper and other products.

3M Company began selling Scotchgard made with PFOS in 1956. Nearly half a century later, after studies showed it was accumulating in human tissues, the company agreed to stop producing the chemical by 2002.

The halt seems to have been a boon to San Francisco Bay birds. Eggs laid by [double-crested cormorants](#) on south bay islands contained average PFOS levels of 1,250 parts per billion in 2006, among the highest found in wildlife worldwide. Three years later, they remained high, at 1,240 ppb. But by 2012, the level had plummeted by 70 percent to 385 parts per billion.

No one knows why the decline in birds was so steep and so sudden.

In [harbor seals](#), the story was different. The average level of 1,040 parts per billion in the blood of south bay seals in 2004 was also among the highest in the world for marine mammals. But unlike the birds, the levels from 2010 and 2011 have remained high.

“We don't know how they're picking up the PFOS. Is it the food they're eating, the water they're swimming in, the mud they're resting on, the air they're breathing?” said Denise Greig, a marine mammal biologist with the California Academy of Sciences and Sausalito's Marine Mammal Center who took the seals' blood samples.

PFOS has been found in topsmelt and silverside, two fish eaten by seals and cormorants.

Duke University chemist Craig Butt said chemical levels can rise and fall in species depending how they're metabolized, concentrated, degraded and eliminated in animal tissues and the broader food web.

Contaminants can build up in the southern tip of the bay where the seal colony congregates because it doesn't get a vigorous flush of fresh and tidal waters.

“Contamination could be patchy,” Greig said. But the south bay's harbor seals consistently show elevated levels. “It does imply there is a PFOS source in the south bay.”



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Butt agreed, saying that the continuing high levels are a strong sign that local sources remain.

“We can say that the sources of PFCs are still continuing in San Francisco Bay,” he said.

In the rest of the world, PFOS levels in wildlife do not show a consistent trend, at least not yet. The chemical decreased in Arctic [ringed seals](#), leading scientists to credit the phase-out. At the same time, Northwest Atlantic [harbor seals](#) showed no decrease. In [humans](#), PFOS levels have dropped, according to nationwide monitoring.

### **Immune-suppressing effects?**

Biologists have long puzzled over why the harbor seal colony congregating in the bay’s Mowry Slough has remained stable since the 1970s while other California populations are burgeoning.

But no one has evaluated whether PFOS, or other contaminants in the bay, could be to blame. Studying marine animals is difficult and costly, and there are no plans to test them for health effects.

There have been no die-offs, disease outbreaks or reproductive failures among the bay’s seals. But even without dramatic signs of damage, their health could be compromised by PFOS in a serious yet subtle way, said Margie Peden-Adams, a research professor at the University of Nevada at Las Vegas who has studied effects of PFOS on turtles and bottlenose dolphins.

“We don’t have a population where there is clearly something wrong,” she said. “We’re dealing with something that’s ubiquitous but not a spill. The data that we do have suggest it is possible that the bay seals’ health may be impaired.”

One of the rare studies that linked elevated PFCs to immune suppression leading to infectious disease in marine mammals was a case of female [otter deaths](#) on the California coast.

“We’re trying to understand how PFCs affect the immune system,” said Kurunthachalam Kannan, a researcher on environmental pollutants at Wadsworth Center, New York State Department of Health, and professor at SUNY at Albany.

Even a few hundred parts per billion in a marine mammal can cause immune suppression, Kannan said.

Atlantic [bottlenose dolphins](#) from South Carolina and Florida that carried high concentrations of PFOS showed evidence of altered immune response. And [loggerhead turtles](#) along the southeast U.S. coast contaminated with PFOS contained markers in their blood indicative of liver damage and impaired immunity, researchers found.

“It’s hard to measure altered immune responses in wildlife. We only have correlations and not evidence of causation,” Peden-Adams said.

So, Peden-Adams and others backed up the loggerhead turtle field work with lab study of a surrogate animal, in this case the western fence lizard. They saw the same thing: PFOS suppressed immunity.

However, “the seal’s immune system might respond differently than the dolphin’s. And marine mammals have more complex systems than reptiles,” she said.

In an odd twist, studies of people may offer clues to other, hormone-related health effects in animals. It’s usually the other way around. An investigation of about 47,000 people with drinking water contaminated by a DuPont plant in West Virginia linked PFOS to changes in [liver function](#), [pregnancy hypertension](#), [hormonal effects in women](#) and [high cholesterol](#). Other studies have linked it to [thyroid disease](#), preterm births and lower birth weight.

### **Routes to the bay**

There are many ways perfluorinated compounds enter the bay. Clues compiled from the seals and birds – and research elsewhere – point to local sources from [sewage](#), [military bases](#) and [airports](#), Sedlak said.

Thirty-nine sewage treatment [plants](#) discharge effluent into the bay that likely contains perfluorinated compounds, which leach out of old consumer products or newer products imported from developing countries.

“Because the compound coats fabrics, when clothing gets washed, the chemicals enter the sewage treatment plant,” Field said. “We still have treated articles in our homes, schools and automobiles. I suspect the rinse-off from treated articles is going to last as long as the articles last. They can be in our homes for 20 years and then go to landfills.”

Scientists looking for clues to PFOS sources found high concentrations of [PFHxS](#), an ingredient in carpet treatment, in the bay’s harbor seals and cormorant eggs.

“Just because you stop manufacturing doesn’t mean the perfluorinated compounds immediately disappear. If companies had stockpiles, they just used them,” Field said.

In addition, some fluorinated compounds widely used in industry may be transformed in the environment to PFOS.

The compounds also are caught in sewage sludge. PFOS is so persistent that in one case 30 years after sludge was spread on [cropland](#), it could still be detected. [Tests](#) have found it in every sludge sample and nearly every sediment sample from San Francisco Bay.

Christopher Higgins, an assistant professor at the Colorado School of Mines, suspects ongoing industrial sources in the Bay Area are still contaminating the bay. He found higher PFOS levels near the sewage treatment plants serving high-technology industries.

The lower south bay where the contaminated seals live receives runoff from San Francisco International Airport and effluent from three sewage treatment plants serving Silicon Valley. Three former military installations are there, too.

But pinning down the sources is difficult. Regulators don’t require businesses to monitor and report perfluorinated compounds, and sewage plants aren’t required to measure them in effluent, according to Thomas Mumley, assistant executive officer of the San Francisco Bay Regional Water Quality Control Board.

“We’re scratching our heads trying to figure out where the perfluorinated compounds are coming from and how to stop them,” said Karin North, manager of environmental controls for Palo Alto.

“It’s a great lesson for people who manufacture a chemical. Years after it’s been phased out, it’s still causing a problem.”

Confirmed elsewhere are discharges from airports, military installations and refineries that have used PFOS-rich [firefighting foam](#) during fires and routine practice.

The U.S. Department of Defense is now purchasing formulations of foam that don’t contain PFOS, said Mark Wright, a DOD spokesman at the Pentagon. But the DOD is stuck with nearly 600 contaminated sites nationwide where PFOS-tainted foam was used in fire pits for training exercises, according to a federal database.

In addition, an array of products from overseas also may still contain PFOS. Although banned in the United States, Canada and the European Union, PFOS production began in China in 2003, the year after 3M stopped. PFOS was in widespread use in China in dozens of manufacturing sectors, according to a document submitted to the Secretariat of the Stockholm Convention.

“Perfluorinated compounds are unique in that they combine some of the negative aspects of chemicals such as TCE with the negative aspects of chemicals such as PCBs,” Higgins said. “They don’t just fit into the ‘mobile’ and ‘toxic’ category of TCE, or the ‘bioaccumulative’ and ‘persistent’ category of PCBs. They fit into both.”

### **Living legacies**

Answers to why San Francisco Bay’s seals remain highly contaminated with this banned chemical, and how it may be affecting them, remain locked in their bulky bodies.

Perhaps these urban creatures are destined to serve as living repositories that sound alarms about toxic legacies.


A dozen years ago, studies of this same colony revealed that polybrominated flame retardants had increased 100-fold in 10 years. Based on that information, as well as skyrocketing levels in human breast milk, California in 2003 banned two flame retardants. The levels in these seals, and in wildlife around the world, have now plummeted.

“It's essential we keep monitoring the population. That's the only way we'll see changes in seal health or survival,” Greig said. “Even if we don't get the complete answer [about PFOS], we can start to understand what the risks are to the seals that live in the bay.”

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