Research on Contaminants in Farmed Salmon: Science or Marketing?

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DISCLOSURE

Vivian Krause worked in the salmon farming industry between 1 January 2002 and 13 October 2003.

In January of 2007, she served as a consultant to Millerd Holdings Ltd., which has interests in processing farmed salmon on Vancouver Island. In July of 2007, she served briefly as a consultant to an international salmon farming trade organization.

Vivian Krause has not worked for the salmon farming industry since 31 July 2007.
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Summary

Facing stiff competition from farmed salmon and many other difficulties, the value of Alaskan salmon collapsed. From an average of $738 million per year during the 1980s, Alaskan salmon lost 75 percent of its value over the 1990s. Since 2002, the ex-vessel value of Alaskan salmon has more than tripled from $125 million to $409 million in 2008.

It has been said that the turning point for Alaskan salmon was bad press about PCBs in farmed salmon after a study by Hites et al. (2004). Negative media coverage about farmed salmon increased three-fold for about two years. Ninety percent of the news mentioned cancer risks. The Hites study and its publicity was funded with $5.5 million from the Pew Charitable Trusts.

The Hites study was harshly criticized for flawed sampling, inappropriate application of guidelines from the Environmental Protection Agency, unconventional presentation of the findings, and for failing to put the findings into proper context. Hites et al. (2004) failed to compare contaminant levels in salmon of the same species; in essence, they compared apples and oranges. Moreover, the dichotomy that is presented between “wild” and farmed salmon is flawed in the sense that it over-looks hatchery-born, “ranched” salmon which account for about one third of Alaskan salmon.

Hites et al. (2004) found that farmed salmon contain only 3 percent of what the U.S. Food and Drug Administration defines as the intolerable level of PCBs. And yet, on the basis of the Hites study, environmental organizations have issued “health alerts” and “consumption advisories” to severely limit farmed salmon consumption. U.S. tax returns show that these same organizations and their campaigns were heavily funded to sway consumers and retailers towards “wild” fish certified by the Marine Stewardship Council (MSC) — most of which is Alaskan.

When Hites et al. (2004) was published in Science, the Editor-In-Chief was a trustee of the David and Lucile Packard Foundation. Since 2000, the Packard foundation has granted about $57 million to support the MSC and promote MSC-certified “wild” fish while “reforming” aquaculture and demarketing farmed fish — especially farmed salmon.

In light of the analysis presented, it does not appear to the author that Hites et al. (2004) was published on the basis of scientific merit. It does appear that the worldwide publicity of this study was part of a well-planned, well-funded marketing campaign.

This paper calls for the American Association for the Advancement of Science (AAAS), the Pew Charitable Trusts, and the David and Lucile Packard Foundation to ensure that the public is informed that contrary to the false claims of Pew-funded and Packard-funded scientists and environmental organizations, Hites et al. (2004) does not show that farmed salmon is high in PCBs.

For more information: www.fair-questions.com

Note: All dollar figures are U.S. dollars unless otherwise noted.
At the time that Hites et al. (2004) was published in *Science*, the Editor-in-Chief, Dr. Donald Kennedy, was a trustee of the David and Lucile Packard Foundation. Since 2000, the Packard foundation has granted about $57 million to support the Marine Stewardship Council (MSC) and promote MSC-certified “wild” fish — much of which is Alaskan.

### 1. Background

Facing stiff competition from farmed salmon and many other difficulties, the value of Alaskan salmon collapsed. From an annual average of $738 million during the 1980s, Alaskan salmon lost 75 percent of its value over the 1990s. Since 2002, the ex-vessel value of Alaskan salmon has more than tripled from $125 million to $409 million in 2008. This remarkable improvement was likely due to multiple factors including the $50 million Salmon Revitalization program of the State of Alaska.

In 2006, the Executive Director of the Alaska Seafood Marketing Institute (ASMI) reported what he called the “secrets to success” for Alaskan salmon. He said, “The infusion of dollars wasn’t the sole driver; we need to be honest here. It wasn’t the only thing that changed market conditions. There was some bad press for farmed salmon, and there was the health issue and people wanting more seafood in their diets. All these things kind of came together like the perfect storm.”

According to Steve Wilhelm, an analyst for the Puget Sound Business Journal, the “turning point” for the Alaskan salmon industry came in 2004 when a study of contaminants of farmed salmon by Hites et al. (2004) (“the Hites study”) was published in the journal *Science*.

At the time that the Hites study was published, the Editor-In-Chief of *Science* was Dr. Donald E. Kennedy, a former president of Stanford University. Dr. Kennedy is a trustee of the David and Lucile Packard Foundation (“the Packard foundation”). According to an extensive analysis of on-line information, at least 56 Packard-funded organizations are involved in various ways in swaying consumers and retailers towards Alaskan salmon and away from the competition: farmed salmon. Calculations based on U.S. tax returns and information in the foundation’s on-line database suggest that between 2000 and 2009, the Packard foundation granted $788 million to these 56 organizations. Since 2000, the Packard foundation has granted about $57 million for projects specifically to support the Marine Stewardship Council (MSC) and sway the global market towards MSC-certified fish — most of which is Alaskan. Over the same period, the Packard foundation granted about $16 million for aquaculture “reform” and demarketing farmed salmon.

The Hites study was authored by Dr. Ronald Hites, professor at Indiana University, along with others from Cornell University, and Dr. Donald Carpenter of the State University of New York at Albany. One of the findings of the Hites study is that levels of polychlorinated biphenyls (PCBs) were roughly eight-fold higher in farmed salmon than in what Hites et al. (2004) referred to as “wild” salmon.

Contaminants are found in trace amounts in all foods. The U.S. Food and Drug Agency sets limits at which concentrations of contaminants are considered tolerable. In both the U.S. and Canada, the tolerable level for PCBs in fish is 2.0 parts per million (ppm). For red meat, the tolerable level for PCBs is 3.0 ppm (fat basis). If the eight-fold difference in PCBs levels of “wild” and farmed salmon had been between 0.5 ppm and 4.0 ppm, or between 0.05 ppm and 0.4 ppm, the findings would have been consequential to human health. However, the eight-fold difference was between 0.0366 ppm and 0.0048 ppm. Since the levels of PCBs were so much lower than 2.0 ppm in both farmed and “wild” salmon, the eight-fold difference is inconsequential.
In a newswire that dismayed scientists, the American Association for the Advancement of Science (which publishes the journal *SCIENCE*), reported, “Farmed Salmon More Toxic Than Wild.” Following suit, the media reported the Hites study with alarming headlines. In Canada the Globe and Mail reported, “Farmed salmon: laced with toxins, study finds.” Fox News reported, “European Farmed Salmon Pose Cancer Risk.”

The same day that the Hites study was published, the Alaskan Governor issued a press release. He said, “It is important to note that this study is not telling people not to eat fish. It is telling them to eat more wild Alaskan salmon.” Dr. David Carpenter of the State University of New York told the Seattle Post Intelligencer, “We hope it does not turn people away from fish, we hope it turns people away from farmed salmon.”

The Hites study was funded by the Pew Charitable Trusts (“Pew”). According to its on-line database, Pew granted a total of $5.5 million for the Hites study; $2,530,000 was granted to the State University of New York and $2,530,000 to the Tides Center. Pew also granted $140,000 to Dr. David Carpenter “to develop a plan for communicating the findings.” For a study of its kind, a $5.5 million budget was unusual. The $440,000 for publicizing the findings — even before the paper was submitted for publication — was also unusual. Moreover, how were these funds actually spent?

The same day that the Hites study was published, The Ottawa Citizen quoted Dr. Daniel Pauly of the University of British Columbia as saying, “I would tell my daughter if she were pregnant not to eat salmon more than once every few months.” Calculations based on U.S. tax returns and the on-line database of the Pew Charitable Trusts indicate that Pew has granted $14.2 million to Sea Around Us at the University of British Columbia. Dr. Pauly is also a “science advisor” of COMPASS, a SeaWeb program heavily funded by the Packard foundation. The Los Angeles Times quoted Dr. Pauly as likening salmon farms to pig farms. “They make a terrific mess,” he said. Three days later, Pew granted $300,000 to Dr. Pauly “to disseminate balanced and accurate information to the public regarding the results of a scientific study on contaminant levels in farmed-raised and wild-caught salmon.” What Dr. Pauly said may have been his opinion, but was it accurate and balanced?

Some time after the Hites study, the Pure Salmon campaign issued a statement by Dr. Carpenter. He said, “Because of the very high levels of contaminants it contains, Norwegian farmed salmon is dangerous because it increases the risk of cancer. Farmed salmon is an especially dangerous food for women of child-bearing age, developing fetuses and children because some of these contaminants have been demonstrated to cause cognitive deficits such as reductions in IQ.”

Dr. Carpenter is quoted by the media as having said, “women should avoid eating farmed salmon at all, from the day they are born through menopause,” “one should avoid farmed salmon like the plague,” and “in farmed salmon, the cancer risk dominated the health benefits.” In January 2007, Dr. Carpenter wrote, “Our results indicate elevated cancer risk from one meal (of farmed salmon) or even less per month.”

The problem is, Dr. Carpenter’s claims are not congruent with the actual research findings of the Hites study. In light of the points noted ahead in this paper, it is undeniably clear that the actual research findings of Hites et al. (2004) do not indicate that farmed salmon is so high in contaminants that it should be avoided.
At Idaho University, Dr. Ronald Hardy estimated that the average yearly PCB intake is about 30 ug from farmed salmon, 200 ug from pork, 300 ug from poultry, 700 ug from milk, and 2,400 ug from beef. Evidently, farmed salmon is not a significant source of PCB exposure compared to other foods. Dr. Hardy concluded, "Even if Americans doubled their intake of farmed salmon, the contribution of this consumption on total yearly PCB intake would still be 40–80 times less than the amount from beef. No matter how the data is calculated and no matter who's PCB values for salmon are used, the amount of PCBs contributed to the diet from farmed or most wild salmon is truly insignificant in the context of overall PCB intake of the average American."

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2. Peculiarities

According to various sources, several aspects of the Hites study were peculiar:

a. As per the specifications of the Pew Charitable Trusts, contaminant levels were compared in farmed Atlantic salmon and wild Pacific salmon. By not sampling wild Atlantic salmon or farmed Pacific salmon, Hites et al. (2004) precluded comparisons of contaminant levels in the same species of salmon. In essence, they compared apples to oranges. Wild Atlantic salmon are well known to have higher levels of contaminants than other salmon.
Hites et al. (2004) grouped the five Pacific salmon species together into one category. And yet, chinook and sockeye salmon are known to have PCB levels three to five times higher than pink and chum salmon. Inter-species differences in contaminant levels may well exceed the differences between “wild” and farm-raised salmon of the same species.

Mitchell (2005) notes that pink and chum salmon are rarely found in grocery stores in the form of fresh fillets and yet they predominated the sample that was collected and analyzed by Hites et al. (2004). Pinks and chum are more planktivorous and therefore have lower contaminant levels. Sampling predominantly pinks and chums, may have contributed towards skewing the results towards lower contaminant levels in “wild” salmon.

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Hites et al. (2004) calculated what they considered to be the number of “safe meals” of farmed salmon that could be consumed per month. In keeping with the Environmental Protection Agency, Hites et al. (2004) defined a standard meal as eight ounces. However, the EPA’s guidelines are intended for populations that rely heavily on fish. For the general population, a three or five ounce portion is more typical. By using 8 ounces as the portion size instead of 3 or five ounces, Hites et al. (2004) deflated their number of so-called “safe meals” by about half.

A more appropriate application of the EPA guidelines is made by the Alaska Department of Environmental Conservation (ADEC). ADEC note that the EPA guideline incorporates a 300-fold safety factor. As shown on the next page, the Alaska Division of Public Health and ADEC jointly recommend unlimited consumption of salmon from Alaska waters — despite the fact that Chinook and sockeye salmon exceed EPA cut-off points for unrestricted consumption.
Hites et al. (2004) miss or ignore the scientific literature which reports that PCB levels in wild salmon vary up to ten-fold due to diet, location, maturity and other factors.

Comparison of PCB Levels in Salmon with the EPA Guideline for Unrestricted Consumption (chronic) — ADEC Fish Monitoring Project

- Sheefish
- Sablefish
- Halibut
- Sockeye Salmon
- Chinook Salmon
- Chum Salmon

EPA screening guideline: 6.9 ppb

EPA advice for Chinook and Sockeye Salmon: 16 meals/month (6 oz.) OK

Our Advice: Unlimited Consumption OK

Mean total PCBs, ppb wet wt in skinless fillet


e. Hites et al. (2004) report that they “analyzed over 2 metric tons of farmed and wild salmon.” They may have collected that but the portion analyzed was likely only a small fraction of that.

f. Hites et al. (2004) describe farmed salmon as “contaminated.” This wording fails to convey that contaminants in virtually all foods is a matter of degree, not of presence or absence. In their graphics, Hites et al. (2004) used red for farm-raised salmon and green for “wild” salmon. This may have conjured unwarranted visual associations of stopping consumption of farmed salmon. The paper reports on contaminants in both wild and farm-raised salmon yet the title mentions only contaminants in farmed salmon.

g. Hites et al. (2004) missed or ignored the scientific literature which reports that PCB levels vary up to ten-fold in wild salmon due to diet, location, maturity and other factors.\(^{38,39,40}\) Wild salmon act as bulk-transport vectors of PCBs, which they assimilate from the ocean. Alaskan and Canadian scientists estimate that one million wild Alaskan sockeye salmon transport more than 0.16 kg of PCBs to their spawning grounds. This is comparable to the amount of PCBs released annually from hazardous waste incinerators.\(^{41}\) The point is, PCB levels in wild Alaskan salmon are not immaterial.

3. Criticism

The peculiarities of the Hites study have not gone unnoticed:

- Kenneth Green wrote, “Hites et al. draw a great deal of attention to one particular food — farmed salmon — and single it out for consumption advisories. But the study lacks a rationale for selecting health standards, lacks context, and lacks an awareness of trade-offs, all of which are key elements in enabling people to manage their risks based on reason and logic.”\(^{42}\)
The night that the Hites study was published, Mr. Peter Howgate, from the U.K., posted a critique at the web-site of the University of California. Howgate wrote, “…Do I smell a campaign behind this paper?… it seems to me this study was initiated as part of such a campaign rather than to objectively examine the risk to human health of contaminants in fish.”

From Chicago, Rick Nichols wrote, “Sometimes, though, it’s not the food marketers that confuse science, it’s scientists themselves. Let us travel back to 2004, when the journal SCIENCE published a paper by an environmental research group underwritten by the Pew Trust. It suggested that farmed salmon was so laced with cancer-causing PCBs and dioxin that eating more than a serving a month was to risk catastrophe. It caused a panicky retreat from farmed salmon. But its findings have been widely criticized. It might have been a wake-up call about environmental threats, but its scary Henny-Penny assessment of threats to human health — especially in light of salmon’s considerable health benefits — seems widely overblown in retrospect.”

In the London Times, Magnus Linklater described the Hites study as “a sorry saga of flawed science, selective research and hidden commercial bias.” Linklater writes, “That it was allowed into the pages of the apparently respectable journal SCIENCE is inexplicable. This worldwide promotion by an organization with a vested interest in undermining farmed Atlantic salmon in favor of the wild Alaskan variety, is a scandal.” Linklater reported, “David Carpenter, one of the scientists who conducted the research, was remarkably frank about his funders. While insisting that his own work was purely scientific, he said of the Pew Charitable Trusts, ‘There may be some legitimacy in saying the reason they chose to fund this study was that they had another agenda well beyond the health effects.’

Sandy Szwarc wrote, “An ulterior motive may be at work. As a less expensive, more tender and less fishy-tasting product with year-round availability, farmed salmon has superseded demand for wild salmon…. Facing competition from aquaculture, the wild salmon industries of California, British Columbia, and Alaska have allied themselves with environmental groups to promote wild salmon as the healthier and environmentally-friendly choice.”

Dr. Hugh Mitchell wrote, “With its 100-year old monopoly threatened, the commercial salmon fishery has realized that the power of ‘branding’ can help stave off the ‘newcomer’…. The PCB study in SCIENCE (Hites et al., 2004), is a prime example of how they will even dupe or hire the scientific community to further their goals… In all the critiques about the significance of the findings presented, what has been lost is that it is simply bad science: bad experimental design and bad analysis! Furthermore, there is ample evidence that this bad science was not inadvertent but was carefully crafted with a clear agenda towards this branding concept. The science was bad because it tried to draw conclusions about all of farmed salmon and all of wild salmon with experimental design and poor sampling technique…. In addition, any conclusion that is made should be put in context with previous research and findings on the subject. None of this was done in the study, and the editors of SCIENCE should be ashamed for either not spotting this, or worse, being willing participants in the branding game.”
“That well-planned and funded assault on the global seafood trade has European nations eyeing the credibility of the United States research community.”

— The International Foundation for the Conservation of Natural Resources.

The International Foundation for the Conservation of Natural Resources wrote, “That well-planned and funded assault on the global seafood trade has European nations eyeing the credibility of the United States research community. Imperious, incompetent, arrogant, and erroneous are reflective of the invectives being hurled at the so-called U.S. study.”

4. History

According to The David Suzuki Foundation, the Hites study was a follow-up to an earlier study by Easton et al. (“the Easton study”) published in Chemosphere, in 2002. The Easton study was funded and publicized by the David Suzuki Foundation based in Vancouver, British Columbia. The David Suzuki Foundation claims that it is the most credible voice in Canada on major environmental issues.

On the basis of the Easton study of merely eight fish, the David Suzuki Foundation published an article with the headline, “BC’s Farmed Salmon Contain High Levels of Contaminates.” (The term “contaminants” was spelled incorrectly). On 21 May 2002 — eleven days after the Easton study was accepted for publication — David Suzuki personally mailed a form letter to thousands of his supporters — including the author of this paper. His letter began, “This may be one of the most unusual ‘Thank you’ letters you’ve ever received, but here goes... I want to say thank you for helping me to uncover the fact that B.C. farmed salmon is heavily contaminated with PCBs and other toxins... I really do mean Thank you,” he wrote. He asked for support for a new campaign: “Encouraged by the incredible response to our ‘Why You Shouldn’t Eat Farmed Salmon’ brochure,” David Suzuki wrote, “I want to take this next phase right into the supermarket, and right onto the dinner table. In other words, I want you to help me make this issue a part of your everyday lives. There is science in the plan, of course. All campaigns at the David Suzuki Foundation begin with good science.” Good science? The fact is, scientists and experts noted serious shortcomings and peculiarities in the Easton study, and the reporting of the findings:

- The sample size was extremely small: four “wild” salmon compared to four farmed salmon. The results, therefore, are not representative of either farmed or wild salmon as a whole.

- Mercury levels were higher in “wild” salmon than in farmed. In fact, they were nearly twice as high. And yet, this was not mentioned in the text of the paper.

- The whole fish were analyzed, including the inedible parts which are known to be higher in contaminants. This likely skewed the observed contaminant levels higher in both wild and farmed salmon.

- According to Dr. Charles Santerre of Purdue University, the Tolerable Daily Intake (TDI) for PCB congeners was not presented in the conventional manner. The TEQ was calculated based on lipid concentration instead of fresh weight of the fish tissue, thereby inflating the PCB values in both wild and farmed salmon.

- Rather than the conventional manner of reporting the results in parts per million (ppm), the PCB concentrations were reported in parts per trillion (ppt), making the numbers seem much larger: eg. 51,216 ppt instead of 0.051 ppm.

* The David Suzuki Foundation did not report funding from the Lazar Foundation in its press release about the Easton study.
In view of the aforementioned points, it is evident that Easton et al. (2002) did not show that B.C. farmed salmon is heavily contaminated with PCBs and other toxins. It follows that David Suzuki did not uncover the “fact” that he said he did in his letter of 21 May 2002.

Despite the Easton study’s egregious limitations, its publicity resulted in international news coverage. BBC World News reported, “Farmed Salmon ‘Contaminated.’” The BBC reported that Dr. Easton said, “The results were very, very clear.”

The publicity of the Easton study appears to have been done on the heels of market research by SeaWeb, conducted in the spring of 2001. A few months later, on 21 September 2001, the Pew Charitable Trusts made two grants for a project titled, “Farmed Salmon Contaminant Study.” Indeed, that is hardly the title that one would expect for a comparative study of contaminant levels in wild vs. farm-raised salmon. On the very same day, Pew granted $181,000 for the David Suzuki Foundation to do a project titled, “Environmental impacts of farmed salmon in British Columbia.”

One of SeaWeb’s market research findings was that health risks — not health benefits or environmental concerns — are the most compelling reason why people might avoid a certain fish. The least important factor to consumers was whether the species is overfished.

According to its on-line database, the Lazar Foundation funded both SeaWeb’s market research and a contaminants study by the David Suzuki Foundation. In 2000, the Lazar Foundation granted $11,500 to the David Suzuki Foundation “for testing of farmed salmon and their feed for residue contamination, and for publishing the test results.” Again, that is hardly the title that one would expect for a comparison of contaminant levels in “wild” vs. farm-raised salmon. The same year, the Lazar foundation granted $9,000 to SeaWeb to conduct market research on consumer preferences for “wild” vs. farmed salmon. The Lazar Foundation also paid the David Suzuki Foundation $12,500 “for legal action challenging the expansion of salmon feedlots in British Columbia.”

The Lazar Foundation states that it does not accept proposals on “toxics” and that it will not usually fund conservation-based scientific research. So why did the Lazar Foundation fund the David Suzuki Foundation to analyze and publicize research findings on contaminants in farmed salmon?

5. Impact

Amberg and Hall (2008) from the University of Idaho published an in-depth analysis of the newsprint stories about contaminants in farmed salmon over a five year period encompassing the Hites study. They found 206 news items in newspapers alone, including 145 news features, 36 news wires and 25 editorials. Following the publication of the Hites study, negative publicity about farmed salmon increased by more than three-fold. For two years there was sustained media attention to severe or dreadful health risks from farmed salmon. About 90 percent of the news items highlighted cancer risks.
According to Amberg and Hall (2008), following the publication of the Hites study, negative publicity of farmed salmon increased by more than three-fold. For two years, there was sustained media attention to severe or dreadful health risks from farmed salmon. About 90 percent of the news items highlighted cancer risks.

Following the publicity of the Hites study, sales of farmed salmon plummeted and demand shifted towards wild salmon. Imports of farmed salmon into the U.S. dropped from approximately 14,000 metric tons (MT) in January to about 10,000 MT in February of 2004. In stark contrast, according to the Alaska Seafood Marketing Institute, the value of Alaskan wild salmon increased by 23 percent in 2004 alone. The Associated Press reported, “Wild salmon prices rise as consumers turn away from farmed fish.” Ecotrust reported, “Wild Salmon Prices Boosted by Campaigns.”

The New York Times reported that the smoked salmon industry went from “near-exclusive use of wild salmon in the 80’s to farmed salmon in the 90’s to the current resurgence of wild salmon in the wake of negative publicity about farmed fish.”

In selling off its salmon farming operations, George Weston Ltd., reported in 2004 that it “faced depressed fresh salmon market prices and demand impacted by the negative publicity directed towards the salmon farming industry.” Heritage Salmon owned by George Weston Ltd. was once Canada’s largest producer of farmed salmon.

Highliner Foods reported, “The salmon industry was hurt by negative publicity following publication in the scientific press earlier this year of studies alleging certain health risks associated with farmed salmon. This general perception affected both our retail and food service salmon sales, even though the majority of salmon sold by High Liner is wild pacific salmon.”

A Rutgers University study of major U.S. supermarket clientele found that 72 percent of those surveyed indicated that their customers prefer “wild” seafood while only 19 percent preferred farm-raised. Next to lack of consumer knowledge, negative media coverage was the single biggest barrier to seafood sales. Many consumers felt that farm-raised seafood was getting too much negative press.

Amberg and Hall (2008) conclude that it is likely that the negative image conveyed through extended media attention has had impacts on how the public perceives salmon as a healthy food and their personal risk from eating it. They also concluded that it is possible that the public may associate a negative image of farmed salmon with other forms of aquaculture and farmed fish in general.

6. So-called “Consumption Advisories” and “Health Alerts” from Environmental Organizations

In stark contrast to the harsh criticism of the Hites study, some environmental organizations applauded it. The Endangered Fish Alliance (a project of the Environmental Defense) described the Hites study as a “ground-breaking study” and warned, “consuming more than one serving of farmed salmon per month could pose unacceptable cancer risks...”

Advice to avoid farmed salmon is flagrantly out of line with the world’s leading health authorities:

- The European Food Safety Authority says, “There are no consistent differences between wild and farmed fish both in terms of safety and nutritional contribution.”
In the U.K., the joint committee of the Scientific Advisory Committee on Nutrition and the Committee on Toxicity recommends, “Everyone should eat at least two portions of fish a week, including one portion of oily fish.” The U.K. expert committee says, “The advice on farmed salmon is the same.”

In the U.S., the Institute of Medicine recommends that females who are or may become pregnant or who are breastfeeding can safely consume 12 ounces of fish per week. Farmed salmon is not excluded from the fish recommended for weekly consumption.

Agriculture Canada says, “Consuming farmed salmon does not pose a health risk to consumers.”

In disregard of these health authorities, since the Hites study the Monterey Bay Aquarium, Environmental Defense, SeaWeb, the Blue Ocean Institute, the David Suzuki Foundation and SeaChoice have issued “Health Alerts” or “Consumption Advisories” to avoid or limit farmed salmon consumption because of “high” levels of contaminants.

All of these organizations are heavily funded by the David and Lucile Packard Foundation. According to calculations based on U.S. tax returns and the foundation’s on-line database, since 2000 the David and Lucile Packard Foundation has granted at least $20.7 million to SeaWeb, $19.8 million to Environmental Defense, $1.5 million to the David Suzuki Foundation, $14.1 million to Tides Canada Foundation (which re-grants to the David Suzuki Foundation and other organizations), $1.5 million to the Blue Ocean Institute, and $700,000 to the Canadian Parks and Wilderness Society (which produces SeaChoice, the so-called Canada’s Seafood Guide.)

In 2004, after Alaskan salmon prices had started to markedly improve, the Pacific Coast Federation of Fishermen’s Associations wrote, “A lot of folks can take credit for the improved market for wild salmon, from the California Salmon Council and the Alaska Seafood Marketing Institute, to the chefs that revolted at serving farmed salmon, but the programs Packard helped fund (the David and Lucile Packard Foundation) played a big part in boosting our markets and no one in our industry should ever forget that.”

As part of the Seafood Watch program, the Monterey Bay Aquarium produces and distributes the Seafood Watch guide which green-lists Alaskan salmon and red-lists farmed salmon. After the publication of Hites et al. (2004), the Monterey Bay Aquarium re-wrote this guide to include a “Health Advisory” for farmed salmon because of “high” levels of PCBs. The aquarium has distributed over 32 million Seafood Watch guides. Since 1999, the David and Lucile Packard Foundation has granted at least $407 million to the Monterey Bay Aquarium, and is its largest source of grant funds.

Since the Hites study, Environmental Defense and SeaWeb have been advising that the maximum number of safe meals of farmed salmon is half a meal per month for adults and older children and for younger children, zero meals. SeaWeb provides a fridge chart with this misinformation. Who’s going to eat half a meal, leaving the rest because half is safe and half isn’t?*

The Pure Salmon campaign produced a poster titled, “Enough to make you sick” and sub-titled, “Ocean-farmed salmon can be dangerous to your health.”

While the maximum number of meals recommended by Environmental Defense and SeaWeb is 0.5 meals for farmed Atlantic salmon, it is 1.0 for marlin, swordfish, and shark. And yet, these species are well known to have far higher levels of mercury than farmed salmon.

The David and Lucile Packard foundation granted at least $346,500 to start the Coastal Alliance for Aquaculture Reform, and has granted at least $1.6 million for the Farmed and Dangerous campaign (www.farmedanddangerous.org) and $1.2 million for the Pure Salmon campaign (www.puresalmon.org). These campaigns extensively publicize the research findings of Hites et al. (2004) as well as the sea lice research by Krkosek et al. (2007). Of course, if these papers hadn’t been published in a prestigious journal such as SCIENCE, these campaigns couldn’t publicize this research in the name of credible, peer-reviewed science.

The Pure Salmon campaign produced a poster titled, “Enough to make you sick.” This poster cites Hites et al. (2004) as the reference. The poster is sub-titled, “Ocean-farmed salmon can be dangerous to your health.” It says, “Ocean-farmed salmon worldwide contain much higher levels of PCBs and other dangerous contaminants than wild salmon. So high, in fact, that women should stringently limit their intake before and during pregnancy. Ocean-farmed salmon is definitely not ‘what the doctor ordered,’ especially if you’re pregnant or ever expect to be.” In 2006, the David and Lucile Packard Foundation granted $250,000 to the National Environmental Trust (NET) for the Pure Salmon campaign. In 2004, the Packard foundation granted $1 million to the National Environmental Trust “for a three year market campaign to reform the salmon aquaculture industry.” According to U.S. tax returns, the Packard foundation also granted $500,000 to NET “for a wise seafood initiative, a consumer education project.” Advising pregnant women to avoid farmed salmon and associating farmed salmon with cancer, as the Pure Salmon campaign is doing, is hardly a wise seafood initiative.

The day the Hites study was published, SeaWeb issued a press release which included the comment, “This study provides us with an opportunity to focus on the differences between wild and farmed salmon.” Between April 2004 and April 2006, SeaWeb was paid $560,000 to co-ordinate an “antifarming campaign” involving “science messages,” “earned media” and “co-ordination of media for antifarming ENGOs (environmental organizations).” According to U.S. tax returns for 2004 and 2005, SeaWeb was paid $560,000 “To provide a high quality tool-kit and co-ordination infrastructure for use by ENGOs in their campaigns to shift consumer and retailer demand away from farmed salmon.”

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**Purpose**
This grant helps SeaWeb provide a toolkit and coordination for salmon aquaculture campaigns. Outcomes for this grant include identification of antifarming audience and issues, integration of aquaculture science messages into antifarming campaign, standardization of antifarming messaging tool-kit, creation of an earned-media campaign, and coordination of media for antifarming ENGOs.

**Grantee Websites**
SeaWeb
Between 2000 and 2008, the David and Lucile Packard Foundation paid SeaWeb $8,515,000 to co-ordinate a market intervention strategy called “Seafood Choices.” According to the Packard foundation, Seafood Choices involves 1) Marine Stewardship Council (MSC) certification, 2) Large U.S. buyers, and 3) “Context Setting.” In 2007, more than 60 percent of MSC-certified products was Alaskan salmon.

Seafood Choices and the “antifarming campaign” appear to be related; one is to sway consumers and retailers towards wild fish (most of which is Alaskan) and the other is to demarket the competition: farmed salmon. SeaWeb has been paid to co-ordinate both.

SeaWeb has a history of promoting Alaska salmon and demarketing farmed salmon. For example, “Be sure the can says “wild” it’s the healthiest by far,” said Seaweb, adding, “The alternative is “atlantic salmon,” which is the farmed salmon that has problems with a type of industrial pollution known as PCBs.”

In 2003, the Packard foundation paid Environmental Defense $750,000 “To encourage seafood consumers and purveyors to favour products from sustainable fisheries, and establish new marine reserves on the West Coast of California” (italics added). Indeed, it wouldn’t be easy to get consumers to favour wild fish if one were to highlight the risks of over-fishing, ghost-nets, by-catch, and that some wild fish (eg. Alaskan halibut) have far higher levels of mercury (25 times higher) than farmed Atlantic salmon. It would be much easier to sway market demand towards wild fish by depositioning and demarketing the competition (farmed fish) — which is precisely what Environmental Defense has been doing.

On 8 January 2004 — even before the Hites study was officially published, Environmental Defense issued a press release titled, “Environmental Defense Praises New Study On Farmed Salmon Contaminants.” Environmental Defense reported:

“Environmental Defense has long advised consumers to choose wild salmon from Alaska, rather than farmed salmon, because of ecological harm caused by salmon farming. Now scientists have clearly shown that choosing wild salmon over farmed is also better for consumers’ health.”

Environmental Defense describes Alaskan salmon as “Eco-Best” and farmed salmon as “Eco-Worst.” “Avoid or eat infrequently,” says Environmental Defense about farmed salmon. Environmental Defense provides recipes for Alaskan salmon while issuing a “Health Alert” about farmed salmon because of PCBs.

The David Suzuki Foundation says, “women of childbearing age and young children should avoid the more contaminated species, including shark, swordfish and farmed salmon.” Health authorities do recommend that fish high in mercury should be avoided by women who are pregnant, might become pregnant, or who are nursing mothers. The U.S. EPA/FDA also gives this advice with respect to young children. However, farmed salmon is not one of the few fish that the EPA/FDA and Health Canada advise against. And yet, David Suzuki has described farmed salmon as “filled with toxic chemicals” and “poison.” He is reported to have said publicly that he wouldn’t feed farmed salmon to a child.
7. A Marketing Perspective

One way to look at bad press about farmed salmon is in terms of Blue Ocean marketing. The goal of Blue Ocean marketing is to create uncontested market space. Rather than beating the competition to exploit existing consumer demand for fresh salmon, and rather than growing the salmon category as a whole, Blue Ocean marketing makes the competition irrelevant by creating demand for a product that supposedly, the competition doesn’t even offer, eg. “safe salmon.” The traditional cost/benefit analysis is made irrelevant; if farmed salmon is unsafe and unsustainable due to PCBs and sea lice, whatever benefits it offers (omega-3 fatty acids, affordability, freshness) become irrelevant to the consumer.

Another way to look at efforts to generate bad press about farmed salmon is in terms of what Alan Kelly defines as “playmaking.” Kelly defines a play as a discrete strategic maneuver that a person or an organization employs to improve its relative competitive advantage in a marketplace. As in basketball, trying to run plays alone is likely to limit one’s options and success, explains Kelly. “Finding third parties who will collaborate, evangelize, or even secretly push your cause is an essential skill of every successful playmaker,” says Kelly. Such third parties are referred to as surrogates. They range from “independent” to, as Kelly puts it, “the bought-and-paid-for.”

“Surrogates are particularly useful,” says Kelly, “when they have credibility that the player doesn’t, when your brand isn’t sexy but the surrogate is, when the market is bored of you and your product, when your appeal is limited, when your interests are seen as self-serving and anytime that someone else can say or do things better than you can.”

Memorandums of understanding and agreements for joint research are also plays — ones that tie the opponent’s hands. An example of this type of play is the collaboration agreement between the Coastal Alliance for Aquaculture Reform (which implements the Farmed and Dangerous campaign, the Smarten Up Safeway campaign and a program called Wild Salmon Supporters) and Marine Harvest, the world’s largest producer of farmed salmon. In essence, Marine Harvest collaborates with the campaigners that are depositioning and demarketing its product in the name of reform while promoting the competing product in the name of sustainability.

“More ambitious or better-funded players,” notes Kelly, “might involve eminent scholars.”

In 2003, Greg Rushford wrote, “to some in the Alaskan salmon industry, smart marketing involves frightening consumers with scary-sounding science.” According to Rushford, “The Alaskan salmon folks are enthusiastically supporting some environmentalists who allege that farmed salmon raised in floating cages made of nets spread antibiotic-laden toxic poop around the oceans.” “For example,” notes Rushford, “The David Suzuki Foundation — run by a Canadian environmentalist-broadcaster — has a brochure that purports to explain why farmed salmon is not as good as wild salmon... Whatever the truth, the more one reads the brochure, the less it looks like science and the more it looks like David Suzuki is selling something.”
8. Discussion

On the basis of the information and analysis presented here, it is clear that claims that Easton et al. (2002) and Hites et al. (2004) show that farmed salmon consumption should be limited because it is “high” in PCBs, are false. False claims are claims that are inaccurate, incorrect, mistaken or untrue. False claims are not properly or honestly made.

In science, false claims lack scientific integrity. Getting such claims published in a prestigious journal doesn’t change that. Canada’s Tri-Council on Integrity in Research and Scholarship defines misconduct as any action that is inconsistent with integrity.120

The co-authors of the Hites study were from Indiana University, the State University of New York at Albany and Cornell University — all of which have policies on scientific integrity and academic conduct.

“The search for truth underlies our academic values as an educational institution,” says Cornell University.121

According to the State University of New York at Albany where Dr. David Carpenter is a professor, falsification means “changing or omitting data or results so that the research is not accurately represented in the research record.”122

Indiana University defines falsification or fabrication as dishonesty in reporting research, including manipulating or altering data or other manifestations of the research to achieve a desired result, intentionally falsifying or misrepresenting background information, and selective reporting, including the deliberate suppression of conflicting or unwanted data.123

In the author’s opinion, objective and comprehensive reporting and discussion of the research findings of Hites et al. (2004) would have included stating that 1) the levels of PCBs found in both farmed and wild salmon were less than 2 percent of the action level set by the U.S. Food and Drug Agency, 2) dietary exposure to PCBs from salmon is inconsequential compared to beef, milk, poultry and other common foods, 3) some wild salmon are reported to have higher concentrations of PCBs than Hites et al. (2004) detected in farmed salmon, and 4) the omega-3 fatty acids and other nutrients in salmon — both wild and farmed — confer substantial health benefits. It is unlikely that objective, comprehensive communication of the research findings of Hites et al. (2004) would turn consumers away from farmed salmon — which is what Dr. David Carpenter admitted that the study was intended to do.124

The Hites study was done more than six years ago. After Hites et al. (2004), additional papers were published from the same dataset. The reason that it is still important to clarify the actual findings of Hites et al. (2004) and the subsequent papers, is that Hites et al. (2004) is still being widely cited by environmental organizations and in many on-line articles. In January of 2010, CNN again reported on the Hites study and an earlier study by the Environmental Working Group.125

Since the Hites study, several better-designed studies have been published in the scientific literature.126,127 However, unlike the Hites study with a budget of $440,000 for publicizing the findings, the more recent studies have not been widely publicized.

In light of the information and analysis presented in this paper, it appears that the Hites study and its drawn out, inaccurate and misleading publicity is doing nothing to protect wild salmon or human health. In fact, it may be doing just the opposite.
In 2006, the Alaska Seafood Marketing Institute reported that since the market for “wild” salmon improved, 863 more boats are fishing for them.\textsuperscript{128}

Experts — including Alaskans — have advised against misinformation and bad science. “Attacking farmed fish — doing it ourselves or letting others do it — is a risky strategy for wild fish,” advises Dr. Gunnar Knapp of the University of Alaska at Anchorage. “Attacking farmed fish on the basis of bad science is especially risky,” he advised.\textsuperscript{129} Dr. Bruce Babcock and Dr. Quinn Weninger of Iowa State University write, “If scare tactics are based on misinformation, it is unlikely that they will have lasting impacts.”\textsuperscript{130}

At the Children’s Hospital in British Columbia, Innis and Friesen (2008) found that Canadian infants of well-educated mothers are born with deficiency in omega-3s because their mothers didn’t get enough while pregnant.\textsuperscript{131} The infants’ eyesight was compromised. Their brain development may have been adversely affected. The newswire of the American Association for the Advancement of Science reported the findings of Innis and Friesen (2008) with the headline, “Typical North American Diet Is Deficient In Omega-3 Fatty Acids.”\textsuperscript{132} This situation is not helped by well-funded organizations that discourage people from eating farmed salmon. According to a report published under the auspices of the U.S. Institute of Medicine, farmed Atlantic salmon is higher in omega-3 fatty acids than any other commonly-consumed fish, and very low in contaminants — especially mercury.\textsuperscript{133}

Dr. Dariush Mozaffarian and Dr. Eric Rimm of Harvard University warn, “the avoidance of modest fish consumption due to confusion regarding risks and benefits, could result in thousands of deaths every year due to cardiovascular disease, and the suboptimal neurodevelopment in young children.” — Dr. Dariush Mozaffarian and Dr. Eric Rimm, Harvard University.

9. Conclusion

In view of the flawed sampling, the unconventional presentation of the findings, the inappropriate use of E.P.A. guidelines and the absence of important contextual information in the discussion, it does not appear that Hites et al. (2004) was published in \textit{SCIENCE} on the basis of scientific merit. It does appear that the worldwide publicity of Hites et al. (2004), like the extensive media coverage of sea lice research, is part of the “context setting,” the “science messages” and the “earned media” of an on-going, well-funded marketing campaign. Flouting the integrity of science to sway market share should not be tolerated nor ignored.

At the very least, the American Association for the Advancement of Science, the scientists, the Monterey Bay Aquarium, Environmental Defense, SeaWeb, and the David Suzuki Foundation could clarify that contrary to some of their claims, the actual research findings of Hites et al. (2004) do not show that farmed salmon consumption should be limited because of dangerously high levels of contaminants. The Pew Charitable Trusts states that it holds itself to the highest standards of integrity, transparency and effectiveness.\textsuperscript{135} If so, it behooves the Pew Charitable Trusts to clarify the actual findings of the Hites study for which it granted $5.5 million. Not only that, the Pew Charitable Trusts and the David and Lucile Packard Foundation should spend at least as much to inform the public that contrary to the false claims of Pew-funded and Packard-funded scientists and environmental organizations, farmed salmon is not high in PCBs.

For more information: \texttt{www.fair-questions.com}
About the Author

Vivian Krause has a B.Sc. and an M.Sc. in Nutrition from McGill University and l’Université de Montréal, respectively. From 1990–2000, she worked with the United Nations Children’s Fund (UNICEF) on programs for maternal and infant nutrition, in Guatemala and Indonesia. During 2002 and 2003, she was Corporate Development Manager for North America for one of the world’s largest producers of farmed salmon and salmon feed.

This document stems from a two-part submission given on 24 November 2006 to the Special Committee on Sustainable Aquaculture of the Legislative Assembly of B.C. See http://www.leg.bc.ca/cmr/38thparl/session%2D2/aquaculture/hansard/W1124am-29.pdf. Vivian Krause resides in North Vancouver, B.C. She can be reached at vivian.krause@mac.com.

SOURCES


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In April of 2009, the author wrote to David Suzuki to raise concerns about information provided to the public about contaminants in farmed salmon. At the time, the SeaChoice card indicated that farmed salmon poses a “health threat” because of high levels of PCBs, dioxins or pesticides. A second version of the SeaChoice card has since been issued. This version indicates that farmed salmon “could contain” high levels of PCBs, dioxins and pesticides. [http://seaweb.org/resources/documents/SeaChoice_Alertcard.pdf] To the best of the author’s knowledge, SeaChoice did not publicly advise consumers that it has revised its advice. As of the writing of this paper, both versions of this guide titled, “Canada’s Seafood Guide” are in circulation.


http://www.pcfa.org/fn-nov04.htm Text in brackets added.


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The 2004 tax return filed with the U.S. Internal Revenue Service by the Gordon and Betty Moore Foundation. Page 8 of Statement 16A. A hard copy is available.


Seafood.com. MSC pledges improvements as it certifies Alaska Salmon Fishery in process that was seriously flawed. 6 November 2007. http://www.seafoodnews.com/

In the summer of 2007, after the author wrote to Seaweb and to the David and Lucille Packard Foundation, the blog entry with this comment was removed from SeaWeb’s web-site. A printed copy is available.


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Research on Contaminants in Farmed Salmon: Science or Marketing? 20


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