Sea Lice Research: Science or Marketing?

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Updated 12 March 2010

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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.

Sea Lice Research: Science or Marketing?

Summary

Note: All dollar figures are U.S. dollars unless otherwise noted.

Since 2005, the Centre for Mathematical Biology (CMB) at the University of Alberta has published a series of research papers claiming to show that sea lice originating from salmon farms put wild salmon at serious risk of extinction in the Broughton Archipelago of British Columbia.[1,2,3] In 2008, the University of Alberta awarded the lead researcher, Dr. Martin Krkosek, the Gold Medal of the Governor General of Canada.[4]

Senior scientists and experts have noted peculiarities and serious flaws in the CMB's sea lice research: lack of adequate baseline data, selective use ("cherry-picking") of data, flawed assumptions, selective and inaccurate reporting, and unsubstantiated claims.[5,6,7,8,9,10,11] In stark contrast to the CMB, 20 scientists have endorsed the view that wild salmon returns in the Broughton appear to be *increasing*.[12]

According to Dr. Krkosek, more than 500 news stories have reported the CMB's findings.[13] In the wake of extensive bad press over sea lice, a "war on fish farmers" has been declared and more than 20,000 people have signed a petition to close salmon farms.[14,15] David Suzuki, Alexandra Morton and others have petitioned the King of Norway to stop salmon farming in British Columbia.[16]

The CMB has or had a "research partnership" with SeaWeb, an American organization.[17,18] According to the author's calculations based on U.S. tax returns, since 2000 SeaWeb has been paid in excess of $8.5 million to co-ordinate **Seafood Choices**, a marketing strategy to get Wal-Mart and other large U.S. retailers to preferentially sell fish that is certified by the Marine Stewardship Council (MSC).[19] A substantial number of MSC-certified products are Alaskan salmon.[20,21,22,23,24]

SeaWeb was also paid to co-ordinate an "antifarming campaign" involving "science messages" and "earned media" to shift consumer and retailer demand away from the competition: farmed salmon.[25,26] SeaWeb reports that the international publicity of the CMB's sea lice research findings is one of SeaWeb's "top accomplishments."[27] "Even a single louse can spell disaster," says SeaWeb.[28]

Since 2003 and the bad press over farmed salmon, many consumers and restaurants have switched to "wild" salmon.[29,30,31] The ex-vessel value of Alaskan "wild" salmon has more than tripled from $125 million in 2002 to $409 million in 2008.[32,33]

According to the CMB, its sea lice research was funded by the Natural Sciences and Engineering Research Council of Canada, the B.C. Pacific Salmon Forum, Mathematics for Information Technology and Complex Systems (MITACS), the David Suzuki Foundation and other sources.[34] Funds granted through the David Suzuki Foundation originated from the same source as funds for SeaWeb's "antifarming campaign."[35] This was not mentioned in published papers nor in press releases.

This paper raises questions and calls for proper disclosure of the origins of the research funding, and clarification of the actual findings in the scientific literature and in the media.

For more information: www.fair-questions.com

1. Background

In 2000, after 13 years of salmon farming in the area, 3.1 million wild pink salmon returned to spawn in the Broughton Archipelago. According to Fisheries and Oceans Canada (DFO), this exceptionally high return was roughly eight times the historical average and higher than all previous returns observed in the past 50 years.[36] As sometimes occurs after an extremely large return, the return of the offspring of 2000 was extremely low: 147,000 fish in 2002. Extremely low returns also followed extremely high returns in the 1970s and 1980s.[37,38] Wild pink salmon returns are known to vary widely from year to year. In Alaska, for example, the return of pink salmon in 2006 was less than 10 percent of the average, the lowest return since 1975.[39,40]

Of the many possible causes of the low return in 2002, the Centre for Mathematical Biology (CMB) at the University of Alberta honed in on only one possibility: sea lice from salmon farms. Since 2005, the CMB has published a series of papers claiming to show that sea lice put wild salmon at serious risk of extinction.[41,42,43] The lead author is Dr. Martin Krkosek, a graduate student. His professor was Dr. Mark Lewis. In 2008, the University of Alberta awarded Dr. Krkosek the Gold Medal of the Governor General of Canada.[44]

In addition to research on sea lice, the CMB has done work on pine beetle, West Nile virus, wolves and polar bears.[45] According to Dr. Krkosek, more than 500 news stories have reported his sea lice research.[46]

- BBC World News reports that Dr. Krkosek said, "Sea lice production from the farm we studied was four orders of magnitude — 30,000 times — higher than natural."[47] BBC World News also reports that Dr. Krkosek said, "'It means that the probability of extinction is 100 percent and the only question is how long it is going to take."[48]
- The Express News of the University of Alberta reports that Dr. Mark Lewis said, "Everyone knows that only a small fraction of juvenile salmon survive to return as adults. The fish-farm sea lice are killing those survivors."[49]
- The Globe and Mail reports that Dr. John Volpe said, "This is the smoking gun. There is no ambiguity in the data whatsoever. It's very, very definitive… it's clean and it's conclusive."[50]
- In full-page advertisements published 27 August 2009 and 3 September 2009, Alexandra Morton urges British Columbia to "Speak Now or Forever Lose Your Fish!"[51] Morton says, "The science is conclusive: where salmon farms exist, wild salmon and trout are in exceptionally steep decline."[52]

In stark contrast to Alexandra Morton and Krkosek et al. (2007), Brooks and Jones (2008) find that wild pink salmon populations are actually *increasing* in the Broughton Archipelago. Twenty scientists from Canada, the U.S. and Europe, have endorsed the conclusions of Brooks and Jones (2008).[53] The 2009 returns were strong enough that on 30 August 2009, DFO allowed commercial fishing of wild pink salmon in the Broughton.[54,55] In Alaska where there are no salmon farms, returns of wild pink salmon are unexpectedly low.[56]

An important question that needs to be asked is this: Are the consequences of the sea lice controversy warranted by the actual research findings publicized by the CMB, Alexandra Morton, the David Suzuki Foundation and SeaWeb?

2. What Has Happened in British Columbia

In the wake of extensive, negative media coverage of the CMB's sea lice research findings, what has happened in British Columbia has been harsh. For example:

1. A "war on fish farmers" was declared by a sport fisherman in response to what he refers to as "undisputed scientific evidence condemning this despicable industry."[57] More than 20,000 people have signed Alexandra Morton's petition to close salmon farms.[58] However, as of 13 August 2009, the names of Dr. Martin Krkosek and Dr. Mark Lewis are not among the signatures on the petition.[59] Why not?
2. On 14 August 2009, David Suzuki, Alexandra Morton and others petitioned the King of Norway to "stop the killing of wild fish" by salmon farms.[60] Again, the names of Dr. Krkosek and Dr. Lewis are not on the letter to the King of Norway.[61]
3. The provincial government put a moratorium on the expansion of salmon farming in northern British Columbia. Legal action was taken against the provincial government and the largest salmon farming company operating in British Columbia.
4. Port McNeill lost one of its largest employers when a fish processing plant closed because the expansion of salmon farming ground to a halt.
5. Many employees of the salmon farming industry fear for their jobs and feel that their work is unfairly maligned. Some of Canada's best aquatic veterinarians and aquaculture technicians have moved to other places (eg. Tasmania). Perhaps they saw a grim future for aquaculture in Canada.
6. Limited resources are being directed to research on sea lice and development of so-called "closed containment" technology instead of other priorities. A Special Committee of the government of British Columbia recommended legislating a transition to "closed containment." The David Suzuki Foundation has called for the closure of salmon farms and $CAN 10 million in government funding for "closed containment."[62]

An important question that needs to be asked is this: Are the consequences of the sea lice controversy warranted by the actual research findings publicized by the CMB, Alexandra Morton, the David Suzuki Foundation and SeaWeb?

3. Apparent, Serious Deviations from Good Scientific Practices

Senior scientists and experts have noted peculiarities and serious flaws in the CMB's research and its reporting of some of the findings: lack of adequate baseline data, selective use ("cherry-picking") of data used in mathematical modelling, flawed assumptions, selective and inaccurate reporting, and unsubstantiated claims.[63,64,65,66,67] For example:

- Groves (2006) finds that "the (Krkosek) model does not actually describe the biological reality of sea lice dynamics or wild or farmed salmon dynamics." "This appears to result not from mathematical errors … but from oversights, omissions and inaccuracies in the biological assumptions on which the model is based," says Groves.[68]

Wild pink salmon returns to the Glendale increased from about 18,000 in 2002 to about 662,000, two years later. That was one of the highest returns on record.[72]

- Brooks and Jones (2008) suggest that the conclusions of Krkosek et al. (2007) rest on questionable analytical procedures and unsubstantiated assumptions.[69]
- Riddell et al. (2008) note that the extinction prediction is "only possible with highly selective use of the available data."[70]
- According to DFO scientists, the "striking consistency" in patterns of sea lice — which is fundamental to the mathematical modeling done by the CMB — was *not* evident in extensive surveys conducted by DFO in the same areas and during the same time periods.[71]

In *SCIENCE*, the prestigious journal of the American Association for the Advancement of Science (AAAS), Krkosek et al. (2007) claim, "the louse-induced mortality of pink salmon is commonly over 80%." "If outbreaks continue, then local extinction is certain," they predicted. Their prediction used data going back only as far as 2000, the year of the highest return on record. Data for Glendale Creek, the watershed that accounts for the largest proportion of wild pink salmon in the Broughton Archipelago, was excluded. Wild pink salmon returns to the Glendale increased from about 18,000 in 2002 to about 662,000, two years later. That was one of the highest returns on record.[72]

During part of the CMB's data collection, there were apparently *no fish at the farm* under study.[73] Brooks (2005) reports "Doctor Islets (the salmon farm studied for the paper by Krkosek, Lewis and Volpe (2005)) was being harvested in the spring of 2003 and it was fallow on and after May 19, 2003. Therefore, there were *no farmed fish containing gravid sea lice* (egg-bearing sea lice) in this area during their final sample period when Krkosek et al. (2005) again reported peak abundance adjacent to the farm" (italics added).[74]

Krkosek, Lewis and Volpe (2005) identified the species of only 65 of the 3,645 sea lice that they observed. The Association of Aquatic Veterinarians of British Columbia (AAVBC) commented, "*Lepeoptheirus* and *Caligus* species have different biology, ecology and pathology and the species effects must be separated whereas in this paper (Krkosek, Lewis and Volpe, 2005) the lice species are combined together. This is a serious flaw in the study." "The conclusions of the article are too sweeping and not supported," noted the AAVBC.[75]

The CMB's mathematical modeling produced an extinction prediction which is at odds with the very good returns of 2000, 2004 and 2009. Moreover, the marine survival of the offspring of 2002 was estimated at an unprecedented high of 34 percent.[76] If 34 percent of the offspring of 2002 survived, it is *mathematically impossible* that "up to 95 percent" were killed by sea lice from salmon farms as claimed by Krkosek et al. (2006).

Studies from the 1960s — when there were no salmon farms — found that between 59 and 77 percent of juvenile salmon die within the first 40 days after entering the ocean from their natal streams.[77] And yet, Krkosek et al. (2007) claim that sea lice from salmon farms commonly kill "over 80 percent" of juvenile wild salmon. Again, the numbers don't ring true.

"It is bizarre in the extreme to make conclusions on the transmission of sea lice from farm to wild salmon without including any information on the infection status of the farm involved at the time of study."

— Alistair McVicar

4. Claims Made by the CMB

The University of Alberta's press release of 27 October 2006 is titled, "Wild Salmon Mortality *Caused* By Fish Farms" (italics added).[78] And yet, Dr. Krkosek admitted to a Special Committee of the Legislative Assembly of British Columbia, that his results are "all correlative."[79] A correlation is not evidence of causality.

USA Today reports that Dr. Krkosek said, "We see them before they get to the farm with no lice, and then *we see them being colonized with lice at the farm"* (italics added).[80] Dr. Alistair McVicar, a Scottish sea lice expert noted that Krkosek, Lewis and Volpe (2005) did not report any data on sea lice levels at salmon farms. "It is bizarre in the extreme to make conclusions on the transmission of sea lice from farm to wild salmon without including any information on the infection status of the farm involved at the time of study," noted Dr. McVicar.[81]

With the use of the terms "farm-origin," "farm-induced," "farm lice," and "sea lice from salmon farms," the sea lice researchers associated with the CMB imply that their findings show that sea lice observed on wild salmon actually did originate from salmon farms. And yet, in the CMB's published papers, there is no empirical evidence as to the origin of the lice observed on juvenile salmon from the wild.

Sea lice are found on many species of wild fish, including herring.[82,83] A method to trace the origin of sea lice is under development but currently does not exist.[84,85] At present, it is *impossible* to distinguish between sea lice that originate from farm fish and those that originate from wild fish. It follows that the CMB's many claims about "farm-origin" sea lice and "sea lice from fish farms" are false in the sense that these claims are inaccurate or untrue. False claims are claims that are not properly or honestly made.

In the Science Bulletin of the David Suzuki Foundation, Dr. Krkosek writes, "These data, due to the massive sampling effort and the unequivocal nature of the conclusions, satisfy even the most conservative benchmark for proof — this is the definitive work on the issue."[86] According to Dr. Krkosek himself, the "massive sampling effort" was done over 14 days.[87] In the author's opinion, that's hardly a "massive effort" by the standards of the scientific community.

An Alaskan scientist reports a study which found that approximately 25 percent of juvenile pink salmon had sea lice, ranging from one to six lice per fish.[88,89] Another team of Alaskan scientists found that the percentage of juvenile salmon that carry sea lice was 2–3 percent for pinks and chums, 8 percent for sockeye and 53 percent for coho.[90] And yet, Dr. Krkosek claims that sea lice are "naturally rare on wild juvenile Pacific salmon."[91]

In Krkosek et al. (2006), the published mortality prediction was *9 – 95 percent*. Such a broad estimate is virtually meaningless. The CMB and the David Suzuki Foundation selectively publicized the prediction of high mortality but not the published prediction that the percentage of juvenile salmon that "*survived parasitism from farm-origin lice*" was 49 to 78 percent for pink salmon and 69 – 91 percent for chum salmon from Knight Inlet.

The Globe and Mail reported, "Sea lice killed up to 95% of salmon, team finds."[92] CBC's headline was, "Fish farms kill wild salmon, study finds."[93] These and other

Most experts who have criticized the CMB's sea lice research are government scientists or industry consultants. Their criticisms have gone largely unnoticed. And yet, the peculiarities and flaws noted in the CMB's sea lice research appear to be serious deviations from the commonly accepted good practices of the scientific community.

headlines did *not* convey that the actual research results were computer-generated, hypothetical predictions.

Riddell et al. (2008) report that there are no detectable genetic differences between some of the wild pink salmon populations in the Broughton Archipelago.[94] Consequently, pink salmon from some streams can re-colonize others without loss of genetic diversity. Even if salmon in some streams were lost, the extinction of the entire species would not occur. According to Riddell et al. (2008), the use of the term "extinction" is, therefore, inappropriate.

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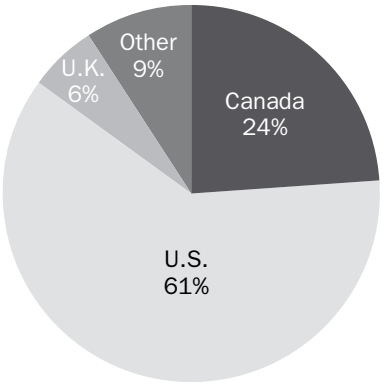
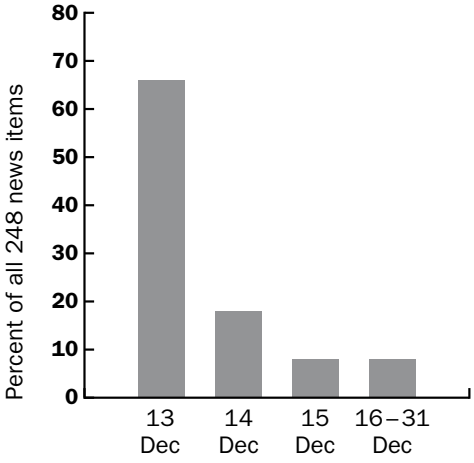
In December of 2007, Google News reported 248 news items about Krkosek et al. (2007). Of those, 61 percent ran in the U.S.[95] "What we are hoping the research will do is to communicate with the industry, with academics and with government," said Dr. Mark Lewis.[96] If so, why so much news coverage in the United States? About two thirds of the news items actually ran *the day before* the paper was published in *SCIENCE* on 14 December 2007.

The day before the CMB's sea lice research was published in the journal *SCIENCE*, the American Association for the Advancement of Science (AAAS) issued a press release titled, "Fish farms drive wild salmon populations toward extinction." In light of the points raised here, it is clear to the author that, surprisingly, the claim in the title of the AAAS's press release, was SeaWeb.*

Reporting of Sea Lice Research Findings by Country, 13–31 December 2007



Reporting of Sea Lice Research Findings by Date, 13–31 December 2007



* Fish farms drive wild salmon populations toward extinction. 13 December 2007
http://www.eurekalert.org/pub_releases/2007-12/s-ffd120707.php

Depending on the year, about a third of Alaskan "wild" salmon is actually ranched-caught salmon. These salmon are hatched in a plastic tray.

5. The Alaskan Situation

The rise of salmon farming had devastating market impacts on the commercial fishing industry, especially in Alaska. As restaurants and grocers switched to farmed salmon over the 1990s, fishermen lost some of their prime markets and the value of Alaskan "wild" salmon collapsed.[97] The Alaska Fisheries Office reported, "Alaska salmon continues to fall well short of the fine quality of farmed Atlantic salmon."[98]

Since 2003 and the bad press over farmed salmon, many consumers and restaurants have shifted to "wild" salmon.[99] The total ex-vessel value of Alaskan "wild" salmon has more than tripled from $125 million in 2002 to $409 million in 2008.[100,101] For example, between 2000 and 2008, the price per pound tripled from $0.10 to $0.33 for pink salmon and increased from $2.50 to $5.87 for chinook salmon from Prince William Sound.[102,103]

Depending on the year, about a third of Alaskan "wild" salmon is actually *ranched-caught* salmon.[104] These salmon are hatched in a plastic tray. They are grown in tanks, fed pellets and raised in net pens before being released into the wild. If Alaska didn't grow *ranched-caught* salmon, its commercial salmon harvest in 2008 would have been approximately 88 million fish instead of 133 million. The ex-vessel value would have been about $299 million, not $409 million. Of the two ways to grow and harvest salmon, farming is more benign than ocean-ranching in the sense that farming avoids the risks of over-fishing, by-catch, straying and the drain of ocean-ranching on the food chain and the carrying capacity of the Pacific ecosystem.

Central to the brand marketing for Alaskan salmon is to position ranched-caught salmon as wild or "wild-caught" and to differentiate "wild" salmon from farmed.[105] This strategy is successful only to the extent that farmed salmon is positioned as inferior. By asserting that farmed salmon is unsafe and unsustainable (eg. due to PCBs and sea lice), environmental organizations facilitate the positioning of Alaskan salmon as safe and sustainable. It has been suggested that this has helped to some degree to soften the market impacts of aquaculture on the commercial fishing industry.[106,107,108,109]

The Alaska Seafood Marketing Institute (ASMI) has acknowledged working with environmental groups and "lots of private foundation money."[110,111] When an angry Alaskan fisherman asked why ASMI doesn't bash farmed fish, ASMI's Executive Director once wrote, "In our case, it is far more credible to leave the attack to third parties, such as environmental groups and newspaper columnists, than it is for us to come out and do it ourselves." He added, "In addition, we are helping the people that sell our products or use them in restaurants understand the differences in wild and farmed fish, which includes showing them the material that is being generated by the environmentalists and the media."[112]

Regarding the improvement in market conditions for Alaskan salmon, ASMI's Executive Director commented in 2006, "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."[113]

In 2006, at the behest of organizations funded by the David and Lucile Packard Foundation, Wal-Mart announced that it would source from MSC-certified fisheries. Of those, 95 percent of the initial volume was Alaskan.

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."[114]

6. The Seafood Choices Strategy and the "Antifarming Campaign"

The CMB has or had a "research partnership" with SeaWeb.[115] The day before Krkosek et al. (2007) was published in *SCIENCE*, SeaWeb sent out an e-mail announcing an upcoming press conference. SeaWeb wrote:[116]

> "Good afternoon! As you may know, a group of researchers have a new paper coming out in *SCIENCE* tomorrow: Declining wild salmon populations in relation to parasites from farm salmon. We at COMPASS have been working with the authors on media outreach for their paper, and we hope it will get good coverage."

SeaWeb also wrote, "We also worked with the authors to assemble a website with photos, video, maps and a summary of the research." SeaWeb provided the following link: http://www.math.ualberta.ca/~mlewis/SeaLice/protected/. This link is now inactive.

As part of the Marine Fisheries program, since 2000 the David and Lucile Packard Foundation ("the Packard foundation") has paid SeaWeb to implement a market intervention strategy called **Seafood Choices**. The Marine Fisheries program has a focus on "the U.S. Arctic" which presumably is Alaska.[117]

According to one of the Packard foundation's own diagrams, **Seafood Choices** involves 1) Marine Stewardship Council (MSC) Certification, 2) Large U.S. Buyers, and 3) "Context Setting."[118] As of 2007, more than 60 percent of MSC-certified products was Alaskan salmon.[119]

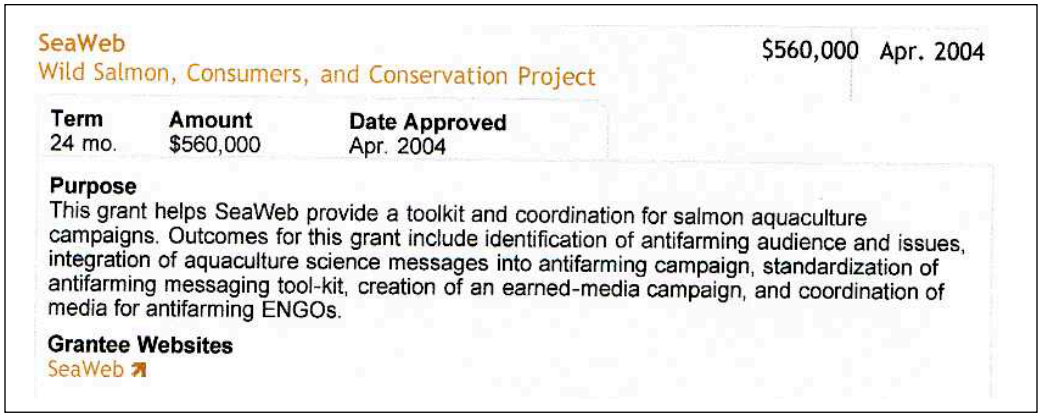
According to the author's calculations based on U.S. tax returns and on-line databases, since 2000 the Packard foundation granted about $57 million to support certification by the Marine Stewardship Council (MSC) and promote MSC-certified wild fish products through Seafood Choices and the so-called "sustainable seafood" movement. In 2006, at the behest of Packard-funded organizations, Wal-Mart announced that it would source from MSC-certified fisheries of which Alaska accounted for *95 percent* of the volume.[120]

The Packard Foundation says that its "major buyer" strategy starts by defining "a consistent and feasible seafood purchasing policy that can be used to coordinate and align the Foundation's support for market interventions."[121] "Promoting and facilitating the implementation of this "coordinated *'Ask'* " is the centre-point around which the foundation supports the work of its grantees," says the Packard foundation in one of its strategy papers.[122]

According to U.S. tax returns, Living Oceans Society, a member of the Coastal Alliance for Aquaculture Reform (CAAR) was paid $453,400 "to educate *major* buyers of farmed salmon."[123,124] CAAR now offers "Supermarket Solutions" and promotes high-end restaurants that sell "wild" salmon" in New York, Miami Beach, Las Vegas, and other American and Canadian cities.[125,126]

U.S. tax returns show that between 2000 and 2006, SeaWeb paid $4,849,851 to "consultants."

At the same time that SeaWeb was paid to co-ordinate **Seafood Choices**, the Gordon and Betty Moore Foundation ("the Moore foundation") paid SeaWeb $560,000 to co-ordinate an "antifarming campaign" involving "science messages" and "earned media."



SeaWeb
Wild Salmon, Consumers, and Conservation Project
$560,000 Apr. 2004

Term	Amount	Date Approved
24 mo.	$560,000	Apr. 2004

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

According to U.S. tax returns, the $560,000 paid to SeaWeb was "To provide a high quality tool-kit and co-ordination infrastructure for use by ENGOs (environmental organizations) in their campaigns to shift consumer and retailer demand away from farmed salmon."[127,128]

Dr. John Volpe and Ms. Alexandra Morton are profiled as photographers at SeaWeb's web-site.[129,130]

U.S. tax returns show that between 2000 and 2006, SeaWeb paid $4,849,851 to "consultants." Who are SeaWeb's consultants? Does SeaWeb pay photographers? Does SeaWeb pay the "science advisors" to COMPASS?

Swaying Demand To Alaskan Salmon by Demarketing the Competing Product

Demarketing is reducing or shifting demand.[131] Depositioning is instilling fear, uncertainty and doubt about the competitor's product.[132] Depositioning and demarketing farmed salmon sways market share towards "wild" salmon. In the U.S., 95 percent of "wild" salmon is Alaskan.[133]

Selling Alaskan salmon fits nicely with Wal-Mart's goal of sourcing American products. "American caught, Wal-Mart bought," says a Wal-Mart document about seafood sustainability.[134]

Seafood Choices and the "antifarming campaign" appear to be related. One is to sway market demand primarily towards Alaskan fish and the other is to demarket the competition. SeaWeb has been paid to co-ordinate both.

According to calculations based on U.S. tax returns and on-line information, since 2000 the David and Lucile Packard foundation has granted at least $20.7 million to SeaWeb. Of that, $8,515,000 was for **Seafood Choices** and $4,889,249 was for **COMPASS**, the SeaWeb program which publicized the sea lice research.

According to the CMB, SeaWeb generated 148 news stories following the publication of Krkosek, Lewis and Volpe (2005).[135] SeaWeb reports that the international

Are the Farmed and Dangerous campaign and the Pure Salmon campaign part of the "Context Setting" of Seafood Choices? Are these campaigns what the Packard foundation refers to as grantee work "to influence non-responsive buyers" and "pressure recalcitrant firms?"

publicity of the CMB's sea lice research is one of the "top accomplishments" of COMPASS.[136] Sea lice are "one of the largest threats (to salmon) in the Northern Hemisphere," reports SeaWeb.[137]

SeaWeb has a history of promoting Alaskan salmon as does Environmental Defense, another Packard-funded organization that has publicized the CMB's sea lice research findings.[138,139,140,141,142,143,144,145,146,147] SeaWeb and Environmental Defense provide recipe cards for Alaskan salmon.[148,149] SeaWeb calls wild salmon "the white truffle of seafood."[150]

Since 2000, the Packard foundation and the Moore foundation have granted more than $12.7 million to "reform" salmon farming and demarket farmed salmon through the Farmed and Dangerous campaign and the Pure Salmon campaign. Are these campaigns part of the "Context Setting" of **Seafood Choices** and what the Packard foundation calls grantee work to "influence non-responsive buyers" and "pressure recalcitrant firms?"'[151,152]

With experience, new technologies and new techniques, the salmon farming industry has markedly reduced escapes, benthic impacts, marine mammal deaths and other environmental impacts.[153] The list of alleged reasons to demarket farmed salmon was coming to an end — until the very low return of wild pink salmon in the Broughton Archipelago, in 2002.

Sea lice is now at the top of the list of concerns cited by the Farmed and Dangerous campaign.[154] The alleged impact of "farm-origin" sea lice is the basis of "Ingredients for Extinction," the tag-line of a campaign called "Smarten Up Safeway."[155,156] CAAR reports that the CEO of Safeway has been sent more than 30,000 faxes telling Safeway to stop selling farmed salmon.[157,158]

Fenton Communications advises, "To move an industry, target one company" and "make your case with hard science."[159] Since 2001, the Packard foundation has paid Fenton Communications at least $546,863 for communications counsel.[160]

In the author's opinion, without the CMB's sea lice research published in a prestigious journal such as *SCIENCE*, the Farmed and Dangerous campaign and the Pure Salmon campaign would not have a seemingly credible basis for demarketing farmed salmon, least of all for the tag-line of the Smarten Up Safeway campaign. Furthermore, without a marked difference in the perceived sustainability and safety of "wild" salmon vs. farmed salmon, it would be much more difficult to shift consumers and retailers away from farmed salmon — which is what SeaWeb and the campaigns that publicize the CMB's sea lice research findings were paid to do.

Without a marked difference in the perceived sustainability and safety of "wild" salmon vs. farmed salmon, it would be much more difficult to shift consumers and retailers away from farmed salmon — which is what SeaWeb was paid to do.

7. Funding

According to the CMB, funding for its sea lice research was as follows:[161]

- 29% from the Natural Sciences and Engineering Research Council of Canada
- 20% from the B.C. Pacific Salmon Forum
- 19% from Mathematics for Information Technology and Complex Systems (MITACS)
- 13% from the David Suzuki Foundation
- 13% from the University of Alberta, the National Geographic Society and other sources.
- 6% from the Canadian Sablefish Association and Finest At Sea Ocean Products.

In November of 2007, the CMB added information to its web-site about funds from Finest At Sea Ocean Products.[162] The CMB did so *after* the author wrote to ask questions about its funding.[163]

On 12 June 2009, the Moore Foundation confirmed to the author that it granted funds to the David Suzuki Foundation and that the David Suzuki Foundation then re-granted part of those funds ("less than $100,000") for the CMB's sea lice research.[164] Both the Packard foundation and the Moore foundation also fund the environmental organizations that have supported the CMB's sea lice research through MITACS.[165,166]

Not only the Moore foundation funded SeaWeb's co-ordination of an "anti-farming campaign," and funded the CMB's sea lice research, the Moore foundation also funded COMPASS, the program of SeaWeb which publicized the CMB's sea lice research in 2005 and 2007. According to U.S. tax returns and on-line databases, the Moore foundation granted $710,262 for **COMPASS**.[167]

Alexandra Morton is director of Raincoast Research Society (RRS). According to online information provided by Revenue Canada, RRS had total revenues of $CAN 627,683 between 2000 and 2008. Of that, $CAN $14,674 (2.3 percent) was from tax-receipted gifts, $153,400 was from other charities, $340,938 was from other gifts and $118,671 was other revenues. Where did the $613,009 originate (97 percent of total revenues) that was not from tax-receipted gifts? Every year since 2000, Raincoast Research Society has reported to Revenue Canada that it had *one* paid employee. Salaries and wages for that employee were a total of $161,000 since 2000. Annual wages increased from $5,000 in 2003 to $24,000 in 2005, $36,000 in 2006 and then to $48,000 in 2008.

In Krkosek et al. (2006), Morton acknowledges funding from "Tides Canada." According to calculations based on U.S. tax returns and on-line databases, the Packard foundation has granted at least $14.1 million to Tides Canada Foundation and the Moore foundation has granted at least $9.7 million to Tides Canada Foundation and Tides Canada Initiatives. Tides Canada Foundation has acknowledged that it made the grants to RRS from two sources. Where did those funds originate?

On 15 February 2010, Raincoast Research Society disclosed at its web-site that funds granted through Living Oceans Society and Tides Canada Foundation are from U.S.

Scientists and others who have praised the CMB's sea lice research are involved with SeaWeb or with the American foundations that fund SeaWeb.

sources. Three Canadian organizations that have funded RRS (Watershed Watch Salmon Society, Raincoast Conservation Foundation and West Coast Environmental Law) have themselves received substantial funding from the Packard foundation and the Moore foundation.

8. Praise

Scientists and others who have praised the CMB's sea lice research are involved with SeaWeb or with the American foundations that fund SeaWeb. For example, Dr. Andrew Rosenberg, Dr. Daniel Pauly, Dr. Ransom Myers and Dr. Roz Naylor are "science advisors" of COMPASS, a program of SeaWeb.[168]

- Dr. Andrew Rosenberg called the CMB's sea lice research, "the broadest look so far at the effects on a total population." "We're talking about a possible extinction within the next few years," said Dr. Rosenberg.[169,170]
- Dr. Daniel Pauly has described the CMB's sea lice research as "undeniable" and "definitive" and has praised Alexandra Morton "for dedication to good science, integrity and resolve."[171] According to tax returns and on-line databases, the Pew Charitable Trusts has granted at least $14.2 million to Sea Around Us at the University of British Columbia. Dr. Daniel Pauly is the project's director.[172] Pew also granted $300,000 to Dr. Daniel Pauly to publicize the findings of a controversial study of contaminants in farmed salmon (Hites et al., 2004).[173]
- Dr. Ray Hilborn praised the CMB's sea lice research and said that it raises serious concerns about aquaculture for cod, halibut and sablefish.[174] These species are important to Alaskan commercial fisheries. Dr. Hilborn is involved in the Alaska Salmon Management program at the University of Washington (UW).[175,176] This program receives funds from the Alaska Department of Fish and Game and the Pew Charitable Trusts.[177] The Moore foundation reports that it granted at least $17,614,781 to UW, including $12,521,951 to the School of Aquatic and Fisheries Sciences where Dr. Hilborn is a professor, and $982,530 to the Office of the Provost.[178] Dr. Krkosek is currently at UW as an NSERC-funded post-doctoral fellow of Dr. Hilborn.[179]
- Dr. Neil Frazer, a co-author of Krkosek et al. (2006) is a professor at the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii. The Moore foundation reports that it granted at least $11,942,246 to the University of Hawaii, including $9,642,346 for SOEST.[180,181,182]
- In 2006, the Vancouver Aquarium awarded the Murray Newman prize to Alexandra Morton.[183] The Moore foundation reports that between 2004 and 2006, it granted $6,677,848 to the Vancouver Aquarium as well as $1,113,750 to Middle Bay Sustainable Aquaculture Institute (MBSAI) that is developing so-called "closed containment" technology.[184] Dr. John Nightingale is president of both.[185,186] Dr. Nightingale is also president of The Ocean Project.[187] Through SeaWeb, the Packard foundation has granted at least $767,506 to The Ocean Project.[188]
- The David Suzuki Foundation has described the CMB's sea lice research as "definitive," "far-reaching," "proof," "undeniable" and "irrefutable."[189,190,191]

The peer review of some of the CMB's sea lice papers appears to have failed in the sense that unsubstantiated claims were not nipped in the bud.

According to the author's calculations based on U.S. tax returns and information from the U.S. Center for Consumer Freedom, the David Suzuki Foundation has been paid or granted about $10 million from American sources, including the Packard foundation, the Moore foundation and the Pew Charitable Trusts.[192]

9. Peer Review

Peer review is intended to be a process whereby scientific work is subjected to the scrutiny of others who are independent yet expert in the same field. Peer review is typically anonymous and should prevent the dissemination of unwarranted claims and cronyism in publication decisions.[193] In the author's view, based on the opinions of scientists and experts, the peer review of the CMB's sea lice papers appears to have failed in the sense that unsubstantiated claims were not nipped in the bud.

Krkosek, Lewis and Volpe (2005) was published in PNAS where the authors recommend reviewers to the journal.[194] Krkosek et al. (2006) states that it was edited by Dr. Stephen Carpenter.[195] He reports having received funds from both the Packard foundation and the Pew Charitable Trusts.[196]

According to the author's calculations based on U.S. tax returns and the foundation's on-line database, between 2000 and 2006 Packard grants accounted for 43 percent of SeaWeb's total revenues. The Pew Charitable Trusts (Pew) granted a total of $4,343,000 to initiate SeaWeb in the late 1990s.[197]

Pew also granted $5.5 million for the controversial study by Hites et al. (2004) on PCBs in farmed salmon, and its publicity — not including $181,000 granted to the David Suzuki Foundation *on the same day*. At the time that both Hites et al. (2004) and Krkosek et al. (2007) were published in *SCIENCE*, the Editor-In-Chief, Dr. Donald E. Kennedy, was a trustee of the David and Lucile Packard Foundation.[198]

A sea lice paper by Ford and Myers (2008) was edited by Dr. Callum Roberts, a member of the board of directors of SeaWeb and a fellow of the Pew Charitable Trusts.[199,200] Ford and Myers (2008) was published in PLoS, a journal created with $9 million from the Moore foundation.[201] Both Krkosek et al. (2007) and Ford and Myers (2008) were reported in Conservation Biology, a journal created with $250,000 from the Packard Foundation.[202,203,204]

At the time that both Hites et al. (2004) and Krkosek et al. (2007) were published in *SCIENCE*, the chairman of the board of the AAAS was Dr. David Baltimore, a recipient of a Nobel Prize. During the 1990s, Dr. Baltimore was at the centre of a high-profile case of alleged scientific misconduct. He was exonerated but before that it cost him the presidency of Rockefeller University.[205] After Dr. Baltimore lost his job at Rockefeller University, he became the president of the California Institute of Technology (CALTECH), the alma mater of Dr. Gordon Moore. Dr. Moore was the chairman of CALTECH's board for 18 years and inaugurated Dr. Baltimore as president.

The actual research findings do NOT show that sea lice originating from salmon farms put wild salmon at risk of extinction in British Columbia.

10. Conclusion

Considering that 1) sea lice levels at salmon farms were not reported, 2) a technique for tracing the origin of sea lice does not yet exist, 3) much of the CMB's data is correlative and inconclusive, 4) the use of data in the CMB's mathematical modelling was selective and 5) senior scientists and experts have noted serious flaws in the assumptions on which the CMB's modelling is based, it is abundantly clear to the author that some of the claims made by Krkosek, Lewis and Volpe (2005), Krkosek et al. (2006) and Krkosek et al. (2007), are flagrantly unsubstantiated and false.

In science, unsubstantiated claims lack scientific integrity. Getting such claims published in a prestigious, peer-reviewed journal does not change that. The Natural Sciences and Engineering Research Council of Canada (NSERC) states that any action that is inconsistent with integrity is regarded as misconduct.[206]

In reflecting on his "lessons learned," Dr. David Baltimore wrote in 2003:[207]

> "In protecting the reputation of science, we must be careful to preserve the distinction between error and misconduct. Error is unavoidable, and misconduct is intolerable. Error in science will be found out because of the self-correcting nature of the scientific process. This process can be slow and often is not transparent, but the self-correcting function of science is one of its strengths. To preserve the health of science, diligent action must be taken to discover, expose, and punish scientific misconduct. Unless perpetrators of scientific fraud are exposed, they are likely to continue their wrongdoing where they are or at another laboratory."

NSERC states that it holds researchers and scholars responsible for using scholarly and scientific rigor and integrity in obtaining, recording and analyzing data, and in reporting and publishing results.[208] The University of Alberta states that researchers are expected to apply stringent standards of honesty in the dissemination of information. The University of Alberta specifically mentions that this applies to all means of transmitting research information, including newspapers, magazines, television and radio.[209]

In the author's opinion, these questions are fair: Is the "antifarming campaign" part of the "Context Setting" of Seafood Choices? In other words, was the sea lice controversy manufactured as part of the "Context Setting" of a well-funded marketing strategy to get Wal-Mart and other "major buyers" to preferentially sell Alaskan fish under the banner of the Marine Stewardship Council? Have public funds from NSERC and the B.C. Pacific Salmon Forum been used to further the demarketing of Canadian farmed salmon in favour of Alaskan fish?

If the David Suzuki Foundation and the Centre for Mathematical Biology at the University of Alberta had accurately and comprehensively reported and publicized their actual findings and how some of them were computer-generated in Edmonton using selective data and questionable assumptions, would British Columbia have the sea lice controversy that is diverting limited resources and bringing an important industry to its knees?

In the author's opinion, there is no doubt that the Centre for Mathematical Biology and the David Suzuki Foundation should properly disclose the origins of their funding and should publicly clarify that contrary to earlier claims in published papers and press releases, the actual research findings do *not* show that sea lice originating from salmon farms are putting wild salmon at risk of extinction in British Columbia.

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. Prior to that she worked on diabetes with the Algonquin people in the region of northern Quebec. 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/cmt/38thparl/session%2D2/aquaculture/hansard/W1124am-29.pdf. Vivian Krause can be reached at vivian.krause@mac.com.

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