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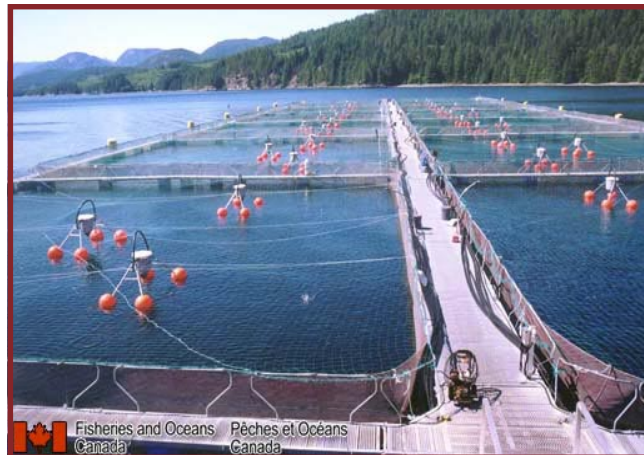
Special Issue: Salmon Aquaculture

Is there a Bottom Line in the Wild Salmon - Farmed Salmon Debate?

Otto Langer

Introduction

Despite early attempts to farm salmon in British Columbia's marine environment, the industry did not take hold until some 20 years ago. Many looked upon this new industry as a gold mine and a near gold-rush mentality prevailed. Floating net-cage farms popped up along the BC coastline. The industry largely concentrated on raising coho and chinook salmon in their ocean feed lots. Pacific salmon did not take well to 'domestication' and the industry largely switched to Atlantic salmon production. With government approving this move, the lines of authority and responsibility were blurred between fish farmers and government regulators, who some believed were acting more like industry promoters. Fishermen, environmental groups, and the concerned public became outraged at this relationship and thus began an acrimonious rap-



Salmon farm showing automatic feeders.
(from http://www.pac.dfo-mpo.gc.ca/aquaculture/images_e.htm)

port between all of the interests. In the early 1990s, the industry, which then was run mostly by small BC companies, ran into difficulties and some farms disappeared. As a result of this, several large, multinational corporations (mostly from Norway) consolidated farms along the coast and they now dominate the industry in BC (Keller and Leslie 1996, EAO 1997).

As the salmon-farming industry

has developed here, there has been an obvious lack of meaningful government control and regulation. The Provincial and Federal Governments have promoted the industry at a cost to the environment. The federal Department of Fisheries and Oceans (DFO) has a particularly clear terms of reference, but they have been less than diligent to enforce their legal

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The Association has as its purposes to encourage the development and application of sound biological principles in the management and conservation of resources and to ensure the development and maintenance of high professional standards in management, research and education related to the biological resources of British Columbia.

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Editorial

Paul McElligott

A heated debate over salmon aquaculture in British Columbia has been ongoing since the first fish farms were opened here in the early 1980's. Periodically, this debate enters the public arena, as it has done recently with the lifting of the provincial moratorium on salmon aquaculture in September 2002, and coincident concerns over the impact of sea lice from fish farms on the survival of juvenile pink salmon that migrate through Broughton Archipelago.

As is often the case with deeply emotional environmental issues, the salmon aquaculture debate has become highly polarized, with many misunderstandings and derogatory remarks originating from both sides. This animosity has severely compromised the public's ability to gain a balanced perspective on aquaculture's pros and cons.

As professional biologists, we have a responsibility to inform the public about complex biological issues, and

salmon aquaculture is no exception. In an effort to improve our members' understanding of this complex issue, the APBBC in November 2002 invited members from both sides of the debate to submit articles to include in a special edition of BioLine. This special issue presents the four articles that were submitted in response to our invitation.

The limited number of articles that were submitted means that not all sides of the debate are equally represented, and publication of an article in this issue does not necessarily indicate endorsement of the author's views by the APBBC. However, it is hoped that through reading these articles, the reader will gain an appreciation of some of the environmental concerns associated with aquaculture, and also of the roles and responsibilities of professional biologists in the aquaculture debate. Readers wishing to obtain a more thorough understanding of issues surrounding

aquaculture debate are urged to read a recent analysis by Gardner and Peterson (2003)¹.

Any reader who feels that the content of this issue of BioLine is skewed toward one side of the debate at the expense of the other is welcome to submit an article summarizing their own viewpoint, which will be considered for publication in the next BioLine issue.

Sincerely yours,
Paul McElligott, Ph.D., R.P.Bio.

¹Gardner, J., and D.L. Peterson. 2003. *Making Sense of the Aquaculture Debate, Analysis of issues related to netcage salmon farming and wild salmon in British Columbia*. Consultant's report prepared for the Pacific Fisheries Resource Conservation Council. 151 p.

Available online at
http://www.fish.bc.ca/reports/pfrcc_making_sense_report.pdf. □

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mandate - the protection and conservation of wild fish and their habitat.

The introduction of Atlantic salmon to this coast is a case in point. In the 1990s, the Fisheries Director of the then provincial Ministry of Environment, Lands and Parks and the DFO Regional Director General did not support the introduction of Atlantic salmon to this coast. Despite that, they were given a political directive to allow the introduction with the provision that it be done so as to protect wild salmon (D. Narver, 1995). Also, from the onset, the industry was prone to countless violations of the federal Fisheries Act. This has included the escape of hundreds of thousands of fish including Atlantic salmon, harmful

alteration of habitat including the smothering of the benthos under the net pens with fish wastes, unapproved facilities that interfere with navigation, and illegal deposit of deleterious substances. Despite this, government agencies did not put this industry on an even playing field with other industries that would be held responsible for similar actions.

Concerns related to Salmon Farming

Open net cages: The use of net-pen technology in the ocean environment is the root cause of many environmental problems and the issue that most requires resolution (Staniford 2002). The

problem with this technology is that what is put into the sea pen will, in certain quantities, eventually spread beyond the pen and affect the ocean environment. Farmed salmon are also susceptible to disease and predators from the marine environment outside of the cage.

Disease: One of the greatest threats to wild salmon is the introduction and/or the enhancement (i.e. numbers and strains) and spread of diseases from salmon farms. Of special concern is the fact that a monoculture of salmon crowded into a net pen is a prime candi-

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date for disease epidemics and the enhancement of sea lice populations that can harm wild fish populations. The use of Atlantic salmon further exacerbates this problem in that they can have less resistance to natural diseases or parasites indigenous to the Pacific coast. Studies indicate that fish farm sea lice populations in the Broughton Archipelago, off the northeast coast of Vancouver Island, were the most probable cause for a large loss of juvenile pink salmon in 2001. This was a major contributor to the catastrophic collapse of returning adults in the fall of 2002 (PFRCC 2002).

Waste Discharges: An obvious impact of a salmon farm is the production and deposition of fish feces and excess food products on the ocean bottom. This impact is local in scope and can smother the benthic environment. Reducing food waste and fallowing sites has been applied to mitigate these impacts. Unfortunately, the problem still exists and provincial Ministry of Agriculture, Food and Fisheries regulations, which specify the sampling and testing for sulfide generation, are overly simplistic and will not adequately protect the benthic life under a fish farm (Levings et al 2002). DFO has indeed disagreed with this approach but has yet to define what is a harmful alteration of the ocean bottom habitat, as is required, if the federal Fisheries Act is to be properly applied as a regulatory tool.

Escape of Farmed Fish: Many are very concerned with the escape of Atlantic salmon and their possible colonization of West Coast habitats and competition with Pacific salmon. This is a legitimate concern (Volpe 2001). However, the escape of farmed Pacific salmon may be as great or greater threat



Future Sea technologies salmon pen system.
(from http://www.pac.dfo-mpo.gc.ca/aquaculture/images_e.htm)

to the health of wild salmon stocks. They are most often hybridized and will readily cross with local salmon, thereby altering their genetic makeup.

Predator Control: Fish farmers can obtain a DFO Predator License to kill seals and sea lions that threaten their farmed fish. Such licensing has been abused, and control over the killing and the mandatory reporting provisions have not been enforced. Although it is believed that the kill rate has been greatly reduced in recent years, reporting provisions continue to be largely ignored.

In 2002, DFO did not receive a single sample from killed pinnepids as is required under their permits. DFO has argued that seal and sea lion populations are healthy (Morgan 2003), but they seem to have forgotten about the Stellar sealion whose populations are Red Listed under provincial wildlife legislation (Cannings 1999).

Fish Food: As much as 10 years ago, warnings were issued that fish farms were consuming more and more of the world's diminishing fish meal resources (Rumsey 1993). The fish meal fishery has long over-exploited global fish stocks (Naylor 2000). The practice of taking fish from a protein-poor Third World country's fishery to produce salmon for

wealthy North American and European consumers raises not only concerns for ecosystem integrity, but also significant ethical issues.

Salmon Quality: Much controversy is associated with the quality of farmed salmon. The farmed product is generally softer in texture and is an unappetizing grey colour. The latter problem is overcome by pigment addition to the food to colour the flesh to a predetermined red tone. Although some indicate that this is not a concern in farmed salmon, high doses of these colorants can harm the human retina (Baker 2001). The European Union has just recommended the reduction of the pigment Canthaxanthin in fish food from 80 mg/kg to 25 mg/kg (SCAN 2003).

The proportion of beneficial omega-3 to omega-6 fatty acids is reduced in farmed salmon when compared to wild salmon, and many health experts consider this a health issue (Bell and Paone 2002). However, of greater concern to human health is that most farmed fish have up to 10 times the levels of persistent organic compounds such as PCBs in their tissue over that found in wild fish (Easton, 2001).

Price Impacts: Some argue that salmon farms will take the pressure off

wild salmon and allow wild populations to recover. This is misleading, as globally, salmon farming now out produces the wild fishery. This has resulted in a glut of salmon on the world market and depressed prices for salmon. Wild salmon prices are approximately 20 percent of what they were 10 years ago, and farmed salmon prices have also declined, reducing industry profits. Fishermen can no longer make a living because they cannot compete with cheap farmed Atlantic salmon that is available year-round. Where fishing is possible, this has put more pressure on fishermen to increase their catch. In BC, government agencies are now putting less effort into conserving wild salmon as they believe it is no longer an economic driver. Unfortunately, the greater value of salmon in ecosystem functioning is not taken into account. This leads to an ever-tightening downward spiral for the future of wild salmon and those that depend upon them. This dependence, of course, includes the aquatic and terrestrial ecosystems (Grende et al 2002).

Discussion

Most jurisdictions, other than Chile, boast that they have the most-stringent salmon farming regulations in the world. BC is no exception (Van Dongen 2002). Despite the mandates of the provincial Ministry of Water, Land and Air Protection, MAFF, DFO and the federal Department of the Environment, government promotion of this industry far outstrips the necessary research, regulations, and enforcement that are necessary to allow salmon farmers to adopt techniques and operating procedures that are environmentally sustainable. This was confirmed by recent studies by the Pacific Fisheries Resource Conservation Council (2003), which is a federally appointed body.

There has been little objective assessment of the environmental impacts caused by the salmon farming industry or how government does its job to manage the industry. Day-to-day decisions by government agencies have been inequitable in that they insist that fish farms cause no or little risk to the environment. The information available simply does not support such a politically motivated agenda. This conclusion is confirmed by one of the most recent and objective reviews conducted to date (Federal Office of the Auditor General 2000, Gardner and Pederson 2003, PFRCC 2003). MAFF has concluded that the recent PFRCC report did not conclusively indicate that salmon lice are a threat to the wild fishery, and the provincial Minister has indicated his department will continue to operate as they have in the past (van Dongen 2003). This demonstrates the need for a change in short-term thinking that violates the precautionary principle and undermines ecosystem health.

Government and industry have been very reluctant to objectively review many of the problems outlined above. Indeed, as time passes and more information becomes available, many of the issues that biologists and environmentalists have predicted have indeed come true. The industry claimed that escapes of Atlantic salmon were not an issue. If they escaped they would not survive. If they survived they would not migrate into our rivers and spawn (McMullan, 2000, 2001). They have indeed done that (Volpe 2001, Gardner and Peterson 2003). Also, the impacts of sea lice were totally dismissed despite solid European research that indicated salmon farms greatly enhance sea lice populations. There is a high probability that the 2002 pink salmon runs in the Broughton Archipelago collapsed due to a high level of infestation of the ocean-bound juvenile pink salmon as they migrated past the numerous fish farms in that area.

Conclusions

Salmon farming based on net-cage technology is a definite threat to local environments, ecosystem functioning and regional wild salmon populations. The risk to wild salmon and general ocean environments varies with the specific fish farm threat and the local environment. Currently, sea lice impacts caused by the enhancement of natural sea lice populations by fish farms has reached a crisis level of concern in the Broughton Archipelago. Unfortunately, government agencies (i.e. DFO and MAFF) have been less than diligent in protecting the natural environment and associated wild species. They, in cooperation with the industry, have promoted salmon farming at the cost of not doing the necessary research, regulation development and enforcement to protect the natural ecosystem and our West Coast legacy. The lifting of the moratorium by the BC government to allow salmon farm expansion along the BC coast was premature because it was not supported by solid science that took a risk-adverse approach. If politicians and our government agencies believe that the protection of wild salmon and the salmon fishery is truly important then a much more objective approach to fish farming must be implemented in order for the natural environment to be sustained. Although there has been some positive dialogue between the protagonists, the wild salmon-farmed salmon controversy is alive and well in British Columbia, and for now, it appears there is no foreseeable bottom line in this debate.

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When Hope Dictates Conclusion

Jim Powell

Salmon farming is controversial. Many people of science, the public, non-governmental organizations and government have polarized the issues by making claims that simply cannot be substantiated. This is not unusual and it is even understandable since we often form opinions and conclusions without necessarily considering all the facts. By way of example, the following is a review of two pioneering scientific minds who were globally respected and remembered but who also made conclusions ahead of time without the arguable benefit of their own common sense and training. In this article there are obvious parallels between the examples noted from these two great minds and the emotional rhetoric surrounding salmon farming. The intent here is not to convert or change opinions, but rather to examine how we can approach controversial issues with common sense and without predisposed judgments.

Paul Pierre Broca (b. 1824, d. 1880) was a childhood prodigy. He entered medical school at the age of 17 and had simultaneous baccalaureate degrees in literature, mathematics and physics before becoming a physician. Within four years of his graduation, he was professor of surgical pathology and was an award-winning researcher. His first main area of study was histology of bone and cartilage, but he also made contributions to the sciences of cancer pathology, aneurisms and infant mortality. Perhaps his greatest contributions were to neurophysiology where he studied brain function; he penned some 53 books on the subject. His most noteworthy accomplishment was the description of the area of the brain that controls speech and

now bears his name: Broca's area.

Broca also pioneered the science of Physical Anthropometry. In 1859 he founded the Anthropological Society of Paris and in 1872, the *Revue d'Anthropologie* and School of Anthropology in Paris. In these years, Broca defined the field of craniometry: the study of the skull. His physics and mathematics background led him to design instruments and numerical indices to define and describe the cranium. He was a follower of Darwin's theories of evolution, so a natural progression to comparative anatomy of the brain and cranium was easy. He was especially focused on the comparative anatomy of the primates. From this interest stemmed a theoretical relationship of anatomical features to the brain and hence, intelligence.

Noteworthy in the discussion of Broca is the time in which he lived. This was an age of discovery: of new lands, new cultures, new chemicals, and new ideas. It was also a time of rigid social order with deep divisions between classes. Victorian Europe sought to categorize, classify and order all living things in accordance with biological and hereditary lineage. Scientists and academics came from the upper classes and were looked upon as exceptional individuals that would use God's worldly gifts to the benefit of the favoured. It was a time of intense intellectual debate on politics, economy and social order. Broca was a man of his time and regarded as a gifted academic.

It was Broca's interest in comparative anatomy and evolution that directed his efforts to pioneer the measurement of cranial capacity of primates and hu-

mans using lead shotgun shot. This work dovetailed with his interest in the evolution of primates and intelligence where there was a nice correlation between the evolution of apes to humans and the increase in cranial capacity. This fit well with the premise of greater brain size and increased intelligence. After all, humans were more intelligent than apes and their heads were bigger.

With the social order of the day being what it was, and with the colonization of new lands ongoing, justification of imposing social order on the New World was a simplistic thing. Were hereditary African Kings superior beings? Were North American Indian Chiefs? Australian Aborigines? Mongols, Eskimos? Women? A superior being such as a white European male should be the end-point of evolution and therefore represent the standard. As intelligence was measured by cranial capacity, it followed suit that order and rank of races (and gender) could be measured and quantified. Enter the master of craniometry: Broca.

Broca made comparisons of cranial capacity between upper class white males and African slaves. He proclaimed that there was quantitative evidence to support the hypothesis that the European male was superior in intelligence to the African male. Bigger heads: better brains.

All was well with this practice and it was expanded to measure class differences as well. One way or another, the theory was made to fit, often by the exclusion or selection of data. Later, other races were assessed: Asiatics, Mongols, Aborigines, Eskimos and Na-

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tive Americans. However, anthropometric measures of these races did not fit the prescribed dictum. The answer: it was a logical conclusion that these races are a transitional state in the evolutionary progression towards the highly advanced European. In the case of white, upper-class women, their brains were smaller (as measured by post-mortem weight). It was no good trying to qualify them against other races because their brains suffered underdevelopment due to socially enforced underuse.

Little by little, the practice of cramming lead shot or mustard seed into the foramen magnum of a skull lost its allure. Thankfully Broca's good works live on and his other works are interred with his bones. But not his brain, which incidentally, weighed in as average.

Skip forward in time to the next century, the time of pharmaceutical marvels and the Golden Age of Chemistry. One of the most famous chemists in a predominantly European field was the American Linus Carl Pauling. Pauling had two passions in life: discovering the undiscovered and world peace. His primary scientific focus was the nature of the chemical bond for which he was awarded the Nobel Prize in Chemistry in 1954. He studied and lectured on the array of iron atoms and the structure of crystals in addition to the Lewis theory of ion pair sharing. Because Pauling thought war was unacceptable, he organized scientists and academicians worldwide to sign a petition that, when finished, held over 11,000 signatures. On the basis of this and other work for world peace, Pauling was granted the Nobel Peace Prize in 1962. He is the only Nobel Laureate to hold two individual Nobel awards.

Linus Pauling is more recently a notable person for his thoughts on the curative powers of Vitamin C. In 1962, Pauling was introduced to the biochem-

ist Irwin Stone a researcher of ascorbic acid and scurvy. Five years after meeting Stone, Pauling was of the contention that Vitamin C held a primary role in illness prevention. He postulated that Vitamin C was involved in the formation of collagen, a major constituent in connective tissue and blood vessels and this relation was important to disease resistance.

Pauling noted that primates don't produce endogenous Vitamin C, as do most other vertebrates. He proposed that ancestral primates were largely herbivorous with a diet high in fruits and vegetables that contain Vitamin C. Because of this continued presence of Vitamin C, ancestral primates lost the ability to provide it endogenously and thus lost the capability. After adopting other diets, our ancestors (and us) became Vitamin C deficient and in need of supplementary Vitamin C. Note that Pauling was not a contemporary of Lamark.

Linus Pauling also noted that lipoprotein-a is linked to cardiovascular disease (CVD) through plaque formation. Plaque on arterial walls and decreases integrity, elasticity and increases blood pressure. Pauling proposed that lipoprotein-a is a surrogate for Vitamin C, which serves to strengthen and increase collagen in arterial walls. Stop eating vitamin C and substitute lipoprotein-a for Vitamin C and CVD results. After all, animals that produce Vitamin C endogenously have low lipoprotein-a.

In 1970, Pauling penned the book "Vitamin C and the Common Cold" (W.H. Freeman, San Francisco, CA ISBN 0-7167-0160-X). In this book, he purported that humans need 1 mg of Vitamin C per day. This amount would decrease the incidence of the common cold by 45%. The US recommended daily allowance of Vitamin C was and still is 60mg per day.

Six years later Pauling updated the 'Common Cold' to include influenza under the title 'Vitamin C, the Common

Cold and the Flu' (W.H. Freeman ISBN 0-7167-0361-0). Here he proposed that even larger amounts of Vitamin C should be taken to fend off illness. Some years later, Pauling wrote another book "How to Live Longer and Feel Better" (1986, W.H. Freeman and Company ISBN 0-7167-1781-6). In this book Vitamin C was espoused to have curative powers over cancer in addition to slowing the aging process. He himself had a daily intake of 18 grams of Vitamin C and lived to be 93 years old, but died of prostate cancer.

Now consider Pauling and his time. It was the Vietnam War; baby boomers were not accepting the *status quo*, youth felt there was a better way: emancipation from the corporate culture and rigid class structure. Alternative methods were presented from creative minds and thinking people posed critical opinions through freedom of speech. Universities were the generators of liberating thinkers, in particular, the Universities of California. This was the time when Linus Pauling published his ideas on Vitamin C.

Although Pauling continued to publish peer-reviewed literature in chemistry, he pushed his dietary theories of Vitamin C and other supplements with vigor. Double-blind studies, most notably conducted by Anderson and coworkers (1972, 1974, 1975a, 1975b) showed repeatedly that Vitamin C treatment did not prevent or cure the common cold. Further, to test the chance that Vitamin C had curative potential in cancer patients, the esteemed Mayo Clinic conducted three double-blind studies, all of which could not support Pauling's claim (Creagan et al., 1979., Moertel et al., 1985, Tschetter et al., 1983). Furthermore, studies in which Pauling collaborated were criticized for poor design and non-conforming group selection.

Broca and Pauling have much in common. Both were notable authorities

in their day. Both were intelligent, educated and decorated men. They achieved the three important elements in life: to be regarded, respected and remembered. And they both had the same flaw: the blindness of *a priori*.

This article is about salmon farming. We live in a time of increased public input and influence on government, of NGO's as another level of authority, of distinctions between intellectuals and the public at large. We argue semantics and let emotion and ideology interfere with judgment. When we review the history of our profession as biologists, we review success and failure. Experience is the best teacher and to ignore history is to repeat it. When hope dictates conclusion, we suffer the ills of the past, of Broca and of Pauling.

The essence of truth is not dictated by pro-truth or con-truth, not dictated by precaution or recklessness; it is simply truth. How we arrive at truth is the issue. No amount of bad science creates truth; it can only be discovered. As trained professionals within the discipline, we are prepared to accept criticism and defeat and accept truth over fiction.

It is human nature to exclude data, dismiss result, and deny existence. Outliers need not be explained; trends are included as fact; conjecture reigns supreme. Fear becomes a tool, so take your Vitamin C. Rigid discipline does not stifle imagination; it can hone it. Structure and design does not exclude data; it eliminates falsehood. If we are to accurately address the issues of salmon farming, then we must impose all the structure we can to get to the truth, not generate falsehood or false hope.

Hypothesis, design, methodology, stringency and evaluation. These are the tenants of objectivity. It's a matter of determining the truth.

Jim Powell

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Linus Carl Pauling – Biography <http://www.nobel.se/chemistry/laureates/1954/pauling-bio.html> □

Jim Powell received a BSc in Biology at SFU and continued studies at SFU to complete a MSc in smolt physiology. After graduation, Jim pursued a career in salmon aquaculture during the formative years of the industry in BC. During this time he worked in several coastal communities including: Sechelt and the Sunshine Coast, Tofino, Campbell River, Port Hardy, and Denman Island. Jim returned to school after seven years in the aquaculture industry and attained a Ph.D. in molecular evolution of neuropeptides in fish. After his doctorate, Jim conducted contract research in environmental impacts of salmon farming, alternate species development for culture, and controlled maturation of fishes. In the latter subject, Jim is now recognized as an authority on the reproduction of captive and endangered fishes and has lectured in such places as India, China, Iceland, Cuba, Scotland, Ireland and Chile, among others. Jim lives in Victoria and telecommutes to Vancouver where he works for Syndel International as Technical Services Manager. He is also a father, coach and Little League VP baseball, soccer coach, volunteer to the local high school track and field team, and an organic gardener.

B.C. Salmon filled with Parasitic Worms!

Ed Britton

*“Recent studies by food inspectors have shown that B.C. salmon are filled with parasitic worms. Some parasitic worms are known to cause serious human health conditions - even death. Parasitic worms in salmon are found in the skin, mouth, gills, gut, intestine, liver and even in the flesh of the fish. In fact, there is virtually no part of the salmon body where these worms are not found. The worms eat, defecate and reproduce within the fish’s body. They are often translucent and almost microscopic, making them impossible to detect with the untrained, unaided eye. There can be hundreds of worms in one fish. However, inspectors state that a trained individual, with the proper equipment, can detect parasitic worms - as eggs, larvae or adults - in virtually every salmon they examine. If you don’t want to eat parasitic worms, **DON’T EAT B.C. SALMON!**”*

The above paragraph is deceptive, manipulative and irresponsible - in spite of being true, at least on a sentence by sentence basis. I wrote it for the purposes of this article. I suppose I’m taking a risk. Quoted out of context, my name will be mud (or maybe parasite!). If you get the feeling that I’m alluding to the recent controversy over farmed salmon, you’re right. However, I’m doing my best to get everyone mad at the same time (wild or farmed variety) - equal opportunity offender. If you feel left out, drop me a line and I’ll see what I can do.

Just for the record, I believe you’ll be hard pressed to find a better health food than B.C. salmon - wild or farmed. I try to eat salmon at least once a week.

But this is about much more than the B.C. salmon controversy, which is just a blip on the screen. It touches every important environmental and social issue we struggle with in our unimaginably complex and too often adversarial society. As we mature as an Association, we’ll take our focus off a very narrow set of professional problems that we commiserate over, and we’ll struggle with

the differences among ourselves on broader issues.

When asked to contribute to this issue of BioLine, I had to consider if I was up to it. I’ve worked in the salmon industry - both wild and cultured - all my life. Over the past ten years, something like 100 of my students have graduated in environmental technology, and about the same number in aquaculture. I’m in crossfire. I feel my humanness acutely - I don’t have much figured out, make lots of mistakes, don’t have enough time and never seem to do anything perfectly. Anyone else feel that way?

Because of the kind of work I do, people in my little community of Campbell River, who face similar struggles, come for answers. Environmental people (who often work for token payment, if any at all) wonder if they’re at impossible odds, spinning their wheels, being ignored, co-opted and diverted, getting nowhere. Industry people feel they fight simple rhetoric, and that the substantial issues they should be working on are left hanging because they don’t “sell” well publicly.

The truth is, this is really hard. We

wrestle with different worldviews. “*How we understand the knowledge base of fisheries management depends on how we understand the social construction of nature.*” (Wilson, unpubl.). In other words, science isn’t going to resolve this on its own. We’re going to have to be respectful of others’ worldviews, and humble about our own. If a person sees an issue differently than we do, it may not be an ethical problem, and they don’t have to be the enemy.

The people with quiet voices must be heard, the people in the small coastal communities, people without education and without jobs who will never be heard unless we learn how to listen. We have a profound social trust. We need each other.

The broader social and environmental issues that we must unavoidably address among ourselves, as professional biologists, will be a test of our collective mettle. We have a common base of professional learning, and a common set of professional ethics that *all* of us must *rigorously* respect. That should help as we strive to show leadership in the



Implications of Holding Diseased Fish in Open Net-Pen Fish Farms and the Potential Impacts on Wild Fish and Adjacent, Disease-Free Farms, with Particular Reference to *Infectious Hematopoietic Necrosis* (IHN)

John H. Werring

Introduction

Several BC fish farms, some of which are centered in the Broughton Archipelago (Johnstone Strait), have experienced, and are currently experiencing, outbreaks of Infectious Hematopoietic Necrosis Virus (IHNV). In the case of infected farms where fish are (or will soon be) of marketable size (2 kg or larger), the standard practice is to leave infected fish in the water and allow the disease outbreak to run its course. Apparently, this is done to minimize losses to fish farmers, since infected fish that survive the disease outbreaks can be marketed for human consumption once the outbreaks have subsided.

Infectious Hematopoietic Necrosis (IHN)

IHNV is a naturally occurring pathogen endemic to the Pacific Northwest. It is found in both fresh and marine waters. However, the majority of documented outbreaks of IHNV in wild Pacific salmonids have occurred

in fresh water during spawning (Bootland and Leong 1999).

IHNV can survive in fresh water from three days to several months (depending on temperature, microflora and electrolyte concentration) and in salt water for several weeks (Toranzo and Hetrick 1982; Bootland and Leong 1999). Having said this, sources or reservoirs of IHNV in the marine environment have not been identified in the literature (Bootland and Leong 1999) with the possible exception of some salmonids (sockeye salmon) and marine pelagic fishes (herring) that have, in some instances, been found to harbour the virus. No naturally occurring marine reservoirs, or vectors of transmission, for this disease have ever been found. Quite simply, there is no known marine source for the virus. Further, it is thought that, under natural conditions, it is unlikely that fishes in the sea would become infected simply through contact with ocean water because of the high dilution factor (Bootland and Leong 1999).

Although the epizootiology of IHNV is not completely understood,

and the source of the virus infecting salmonids in the wild is unknown, it is clear from the literature that infection results from exposure to the virus. Fish do not become infected when held in pathogen-free water (Bootland and Leong 1999; St-Hilaire et al. 2001).

Both juvenile and adult fish can become infected when exposed to waterborne viral particles (Bootland and Leong 1999; St-Hilaire et al. 2001). In some cases, exposure to IHNV in water for only short periods of time and at low concentrations can result in rapid and widespread infection (Bootland and Leong 1999). Also, the virus can be transmitted horizontally (from fish to fish) through water (St-Hilaire et al. 2001).

IHNV and Fish Farms

IHNV-infected fish held in net cages shed the pathogen into the environment. This is done through a variety of routes including mucous, feces and decaying dead fish (Ferguson 1989). These shed pathogens then enter the

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broader community. Let's contribute the best part of each of us.

Ed Britton, R.P.Bio.

Reference:

Wilson, D.C. (unpubl.) *Social literature review for the knowledge in fisheries management project*. Institute for Fisheries Management, Willemoesvej, Denmark. □

Ed Britton has worked variously in wild salmon stock enhancement, stream rehabilitation, Federal government fish hatcheries, private fish hatcheries, and in education. Most recently, Ed has worked as a college educator in environmental impact assessment, and he is presently Associate Dean - Trades, Technical and Tourism Programs at North Island College. He has administrative responsibilities for the environmental and aquaculture technologies, nautical sciences, professional diving and drafting programs. Ed researched professional development among professional biologists as part of a Masters in Leadership and Training degree (Royal Road University), and served a term as a member of the Board of Directors of the APBBC.

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water column surrounding the net pens and/or the sediments below them. The pathogens are then free to disperse into the surrounding seawater.

There is uncertainty as to how far and in what concentrations shed virus particles might travel away from infected farms on ocean currents. However, recent research conducted by the federal Department of Fisheries and Oceans in the fall of 1996 and 1997, showed that the dispersion of chemical dyes from open sea pens in New Brunswick ranged from a few hundred metres to a few thousand metres during the first two to four hours after release of the dye (Page et al. unpublished data). These data suggest that viral particles, too, could disperse over long distances away from infected farms in very short time periods. However, unlike the dye experiment, which was designed to mimic a single "chemical" release, viral particles from diseased fish are shed into the water on a continual basis during a disease outbreak (Ferguson 1989). Further, it appears as though IHNV disease outbreaks at fish farms can last for several months (St-Hilaire et al. 2001). Given that viral particles are being shed on a continuous basis during an outbreak and given that the virus can survive in sea water for several weeks, one can assume (based on the DFO dye dispersion studies) that over the course of several months, live IHNV viral particles could be carried several kilometres away from infected farms on ocean currents. Therefore, it is logical to assume that when there is an outbreak of IHNV at any given marine fish farm, a large expanse of the sea surrounding that fish farm will contain an elevated viral load relative to normal background levels.

Thus, by allowing IHNV-infected fish to remain in the water at IHNV-

infected fish farms, it is likely that the farms in question are creating reservoirs for this disease, where such reservoirs have not previously existed (before salmon farming). As a consequence, there is a very real danger that wild fish migrating past the infected farms will be exposed to the virus at levels they would otherwise not encounter in nature. Further, fish farms located several kilometres away from adjacent farms that experience disease outbreaks could themselves become infected by shed particles travelling on ocean currents.

There is also some evidence that strongly suggests that IHNV-infected

the authors provide no explanation for the sudden appearance of IHNV antibodies in the affected chinook. However, the most likely path of exposure of the chinook to IHNV would have been transmission of the virus through water from the sick and dying Atlantic salmon held at the fish farm. After all, Ferguson's work (1989) proves that IHNV infected fish in net cages shed pathogens into the environment and St Hilaire et al. (2001) conclude from their work that such transmission of the virus through water is possible.

In other work, Traxler and Richard (1996) found high titers (the number of

"...it is logical to assume that when there is an outbreak of IHNV at any given marine fish farm, a large expanse of the sea surrounding that fish farm will contain an elevated viral load..."

farmed fish can transmit the virus to nearby, uninfected fish in the marine environment without direct fish to fish contact. St-Hilaire et al. (2001) conducted a study designed, in part, to determine whether fish exposed to IHNV could transmit the virus to other fish while in salt water. One of their conclusions was that transmission of IHNV through water without direct fish to fish contact was possible.

A part of the St-Hilaire experiment included a field study where IHNV-free chinook salmon were held in pens adjacent to a salt water net-pen site where an outbreak of IHNV was occurring in farmed Atlantic salmon. While Atlantic salmon at the infected farm were dying of IHNV, all of the chinook salmon tested were negative for IHNV-specific antibodies. However, at the end of the study at least 22 of the chinook salmon tested seropositive for IHNV antibodies, suggesting that some of the chinook had been exposed to the virus. Interestingly,

infectious virus particles present in a suspension) of the virus in tubesnout and shiner perch collected at a fish farm undergoing an IHNV epizootic. This study also strongly implies that marine fish in close proximity to fish farms experiencing an outbreak of IHNV can become exposed to the virus.

The scientific literature clearly indicates that virtually all species of Pacific salmon are susceptible to IHNV (Traxler and Richard 1996; Bootland and Leong 1999; World Organization for Animal Health 2001). Since the mid 1960s, strains of IHNV have caused epizootics in sockeye, chinook, chum and Atlantic salmon, rainbow trout, cutthroat trout and steelhead in North America (McDaniel et al. 1994; Bootland and Leong 1999). Additionally, several non-salmonid species, including marine resident fish such as herring, tubesnouts and shiner perch are susceptible to this disease (Traxler and Richard 1996; Kent et al. 1998). Further, we know that once

fish have become infected with IHNV, all susceptible species can suffer high mortality rates. Generally, the smaller the fish, the more sensitive it is to the virus (Bootland and Leong 1999). Yolk-sac fry and fish up to two months of age are highly susceptible, with mortality often over 90%. The mortality of older fish up to six months of age is lower but can still be as high as 50% (Bootland and Leong 1999). With respect to non-salmonid marine species, herring were found to suffer mortalities exceeding 25% when exposed to the virus by immersion (Kent and Poppe 1998). Finally, there is strong evidence that fish that do not die from exposure to the virus become carriers for life, and form potential reservoirs of the disease in the marine environment and can pass the disease on to other fish through the water (St-Hilaire et al. 2001).

Implications of IHNV exposure to Wild Salmon and Fish Farms

Spring is the time of year when millions of wild salmon are migrating into (adults returning to spawn) and out of (juveniles leaving natal streams to go to the ocean) hundreds of coastal streams. Herring are also migrating to their marine spawning grounds. Millions of fish could be migrating past fish farms that are currently experiencing IHNV outbreaks and where infected fish being held in the water.

There is a substantial risk that both adults and juvenile salmon migrating past fish farms where IHNV epizootics are occurring could come into contact with the virus when passing by the infected farms and can, themselves, become infected or infective. In the case of out-migrating wild juvenile salmon that have not been previously exposed to IHNV, infection could lead to massive mortality (upwards of 50-90%) should an infection become an outbreak. In the case of returning adult salmon, infection

could lead to less drastic mortalities (15-30%). There is the further risk of IHNV being carried by these returning fish into watersheds that have, heretofore, been IHNV free. In doing so, infected fish can then transmit the disease to their offspring (Bootland and Leong 1999). With mortalities as high as 90% being documented in very young fish, it is possible that virtually an entire year class of salmon fry could be destroyed in this way. In the case of both juvenile and adult migrating salmon, fish so infected could survive infection and continue on with their migration passing by IHNV-free fish farms containing Atlantic salmon. This species is known to be highly susceptible to this disease. The result could be catastrophic losses to fish farmers if the disease takes hold on those farms.

Given that Traxler and Richards (1996) and Kent et al. (1998) have shown that non-salmonid marine resident fish species are also susceptible to IHNV, there is also concern that the virus may be spread from farm to farm and/or from fish to fish via such long ranging, pelagic species like herring. In fact, observers of the harvest of juvenile Atlantic salmon from the January 2002 IHNV outbreak at Cliff Bay, Simoom Sound reported that an estimated three tons of herring were found inside the net pens with the infected Atlantics (Art Dick, Hereditary Chief, Musgamagw Tsawataineuk, personal communication). It is obvious that the herring could freely swim in and out of the net pens and thereby come into direct contact with IHNV infected fish (a more likely route of exposure), possibly picking up the virus and then spreading the disease further afield.

In addition to the possible direct impacts on wild stocks and farmed fish due to these wild/farmed fish interactions, there is obvious concern about spread of this disease from farm to farm via transfer of personnel and boats. Currently, there are processes and protocols

in place in BC that call for isolation and management of all IHNV positive fish farm sites to prevent spread of the disease (BC Ministry of Agriculture Food and Fisheries - date unknown). Affected farms are deemed to be isolated sites. Movement of all equipment and vehicles (including boats and planes) and personnel is minimized, if not prohibited. Where staff have to move between sites there are strict disinfection procedures. Boats, float plane floats and equipment must be sterilized. All sick and moribund fish are to be removed and disposed following strict sterile procedures and any mucous, feces, or blood from dead and dying infected fish must not be allowed to enter the water. Finally, affected sites are to remain fallow for up to three months following an outbreak of the disease.

The BC IHNV infection response protocol is in conflict with the current practice of allowing fish farms experiencing IHNV epizootics to keep infected fish in the water. This can last for months at a time, as the disease outbreak runs its course. During this time, virus particles shed by infected fish can be carried through the open net pens and spread on ocean currents. Highly susceptible, migratory, pelagic and benthic fish species can interact with, and come in contact with, sick and dying fish. They are at risk of becoming infected themselves and carrying the disease far afield.

Recommendations

At the present time, aside from the surface quarantine procedures that are put in place on IHNV-infected fish farms, the only real solution to further preventing the spread of IHNV from infected fish farms to the surrounding environment would be to immediately remove all fish from the water at fish farms

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where an outbreak is detected. In the meantime, there is great need for an effective vaccine to prevent infection in the first place. There is currently a program in place to attempt to find a vaccine for IHNV, but researchers have met with little success. In the absence of progress on the vaccine front, one solution would be to move the fish farming industry toward some kind of closed-containment operation and away from open net-pens. However, this would also necessitate the need to develop technology to filter/and or treat effluent water from closed- containment facilities to kill any waterborne virus particles that may be discharged from an infected farm. Another option would be to forgo the culture of species that are highly susceptible to IHNV, like Atlantic salmon, and cultivate less susceptible species like chinook and/or coho. However, even if the latter step is taken, there would have to be measures in place to deal with disease outbreaks should they occur.

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John Werring graduated from the University of British Columbia in 1986 with a Master's degree in Zoology. He worked as an environmental consultant until 1992 when he joined the Sierra Legal Defence Fund, a non-profit environmental law firm, as their staff scientist. Since that time he has used his training as a biologist to assist environmental and public interest groups, private citizens, and First Nations in providing defensible alternative views on the environmental impacts of a host of industrial development projects including aquaculture, timber harvesting, small and large scale hydro-electric power projects, mining ventures, municipal sewage discharges and large industrial and residential development projects. John is often called upon to conduct investigations and gather evidence regarding environmental offences, and he has appeared as an expert witness on several environmental issues before the BC Environmental Appeal Board and in court. John has been a member in good standing of the Association of Professional Biologists of BC since 1986. He currently lives in Surrey, BC and is married with four children.

Scientific Communication

Derek Ellis

Introduction

Why this article? And in this issue of BioLine? It is here because the topic of this issue has generated a great deal of controversy over the past year. The controversy has been not only on the subject matter (sealice and salmon farms) but on how the subject matter has been communicated (conference presentations and on the internet).

As the format of the communications has been an issue, then it is worthwhile to step back and check out why scientists communicate and how we should do so.

Our objective in scientific communication is to pass on credible information obtained by the techniques of science (data gathering and analysis), and to present accurate and precise conclusions based upon the information. We hope that our information and conclusions can, and will be, verified by others, using similar or different protocols. We do our best to obtain verifiable data, to analyse with statistical techniques where appropriate, and to be logical and objective in drawing conclusions. We are aware that sometimes we may have missed certain points, or that further scientific investigation may show that we were wrong (more or less) in our sampling or conclusions. Scientific communication is part of dialogue, not just one way. Dialogue needs to be precise and objective if it is to be informative and useful.

In the current controversy, some of the internet communications have been so non-objective and imprecise that they have verged on "behaviour unbecoming a professional biologist". Others may have overstepped the line between pro-

fessional and unprofessional conduct. BioLine, with this Issue on salmon aquaculture and sea-lice, is raising the level of communication on the topic to that of a refereed scientific journal. It seemed appropriate to me to write this article at this time, and submit it to the Editor of BioLine for this issue. He accepted it, so here it is!

There has traditionally not been much help available to inexperienced scientists in scientific communication. Degree and diploma programmes might require a course in English—often meaning English Literature not Scientific Writing. Some students were lucky in that in their training programmes they were required to undertake a self-directed project, report it in writing, or even make a verbal presentation to the class.

There are some self-help books and articles available—I wrote an essay on the topic some 15 years ago (see pp 10-12 in Ellis 1989). This however was before the internet and professional registration became important to us. The internet is nowadays very important both as a medium for scientific communication, but also as a source of do-it-yourself help in writing. A search on the web for "Science Writing" will provide you many more helpful references than I can give here.

Generally we are left alone to write our first report (or section of a report largely written by others), and then pass it by friends, mentors or a supervisor. If we were really unlucky (or daring) we sent it (without comments from a friendly reviewer) directly to a client or to a refereed scientific journal. Our manuscript may have got trashed, and we had to start again. Even worse, if accepted by

a client, that first report may come back to haunt us as something that we regret writing—it was so ambiguous, or even wrong. Gradually we got the hang of scientific communication, more or less, some of us better than others.

Also, we all get sloppy sooner or later, and communicate something in a way that we later regret. I hope this article helps the experienced as well as the novice.

Verbal and Written Communication

There is a substantial difference between verbal and written communication. Written communication allows us more time to think about content. Verbal communication, even if read to a Conference or Workshop from a text, sooner or later requires unprepared dialogue.

A Conference requires the most formal verbal communication. You can have a script to glance at now and then. You can also read it; but only do so if you want to bore your audience, especially if they each have a copy of the script! Better yet, have a set of notes with you (in large print). Best of all have audiovisual aides, which you can use as your prompts, and improvise a chat about each one. Your improvised chats will flow easily after several similar presentations. If you do repeat a presentation, make sure that you adapt it to the next audience, making changes as appropriate. Do you remember that Engineer whose identical talk you have heard six or more times?

Power Point presentations look good, but they do inhibit impromptu

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questions. Overheads or (the almost forgotten) 35 mm slides are much less formal. Choose whichever is best for your presentation. In general Power Points are good for Conferences; but not Workshops (unless you are a guest speaker and don't want interruptions until you have finished).

The least formal verbal communication is dialogue (over a drink or whatever). Listening is as important as talking. If you don't listen carefully, and respond precisely, you may give the impression that you are evading the issue raised, or that your data is weak and won't stand close inspection by others.

Written Communication

Credible, possibly credible and non-credible

Credibility is the name of the game for scientific communication. If you get a reputation for non-credible writing, you will eventually be ignored as a scientist. Authors of articles which are only possibly credible (i.e. they have to be read very cautiously to see if they are factually correct rather than being an unsupported opinion statement) will be treated as weak scientists.

The most credible scientific writing is in the refereed technical journals, or in books from the most prestigious scientific publishing houses. This is because any articles, books or book chapters will have been refereed and stated as credible, by one or more referees with experience in the topic addressed.

Note that research papers will only publish original data – once published, the data are no longer original, and won't be accepted for publication again. So beware premature distribution by internet – see below.

There can be a problem in deciding what is a refereed technical journal,

or which sections of a scientific journal are refereed and which are not. The magazine *New Scientist* for example has refereed articles, but also accepts articles from science journalists who make a living writing media-type exposes, without technical documentation. This issue of *BioLine* has had some refereeing, but because the articles were the result of invitations, the Editor has allowed some leeway in the level of support for opinions presented.

A report to supervisor or client should strive to reach the level required by a refereed scientific journal. However, a client is not a specialist (that's why you are the client's specialist consultant). Sometimes your supervisor may be a specialist in a very different field – for example sometimes biologists report to engineers. So a biologist has to be careful that his or her report has had some critical review by an appropriate colleague. As I wrote above, we all get sloppy on occasions.

There is another new problem in report writing for a client or supervisor. Often these days, a consultant or employee is required to present data and conclusions in a format set by government regulators, which may not be really appropriate to a particular site or project. You just have to do your best with the text; and squeeze items which are site-relevant into section headings required by the protocol. Sometimes, needed data or analyses for the argument presented, but not allowed for by the report protocol, can be slipped in as an Appendix.

The least credible reports and reviews are those which are anonymous, as in the public media such as newspapers, radio and television. In anonymous articles no-one is taking responsibility for credibility. In principle, disbelieve anonymous articles. The public media are in the business of selling themselves. Controversy seems to sell better than approval or objectivity, so

expect the media to present a one-sided review.

Legal judgments can be poor in scientific terms. They are based on legally acceptable and documented information. A judgment may reject data which a scientist will accept on the basis that most scientists most of the time do their best to be accurate, precise and objective, rather than whether he or she kept the specimens in a locked closet to which there was only one key and that was held by the scientist, so nobody else could have falsified the specimens or data sheets!

Primary, secondary and tertiary reviews

Written communications tend to come in three levels of data reporting and reviews: original data reporting with some review of the data for analysis and drawing conclusions and/or making recommendations. These can be called primary reports; and should be read, and the data credibility appraised, by anyone interested in a topic. Never forget that a project scientist can make errors in sampling design, data gathering and analysis, and can make logical errors in drawing conclusions or making recommendations.

There are also reviews of primary reports, best written by someone who has written some of the primary reports. These can be very useful, when written by someone with data-gathering experience, who knows the pitfalls of doing the actual work. These can be called secondary reports.

Finally there are what I call tertiary reviews, written about a topic by someone who is relying on the secondary reports, not the primaries. Tertiary reviews have to be treated very cautiously. Conclusions in the primaries and secondaries can be misunderstood, or even deliberately rephrased to match a tertiary reviewer's preconceptions

A good example, providing a lesson on how a series of primary, secondary and tertiary reviews can misleadingly escalate perceptions of impact, comes from environmental assessment of the submarine tailings management system at the Misima mine in Papua New Guinea. NSR's (1997) primary review of the data showed that the greater part of all the tailings discharged 1989-1996 had deposited, as predicted, in a bed >1.5 m thick extending over ~20 km². A small area, measurable from NSR's charts, of ~0.1 km² had tailings 30-75 m thick. Core surveys revealed bacteria and meiofauna on the tailings not statistically distinguishable from reference stations.

Pearce (2000), in a secondary "perceptions" review, at a time when the mine was preparing to close, exaggerated this to "*A carpet of tailings up to 75 metres thick already covers 20 square kilometers of seabed, obliterating all life.*" Moody (2001) in a tertiary "perceptions" review, based substantially on Pearce's secondary review, escalated his comments to "...*a carpet of tailings 75 km thick ...*" (Note that the maximum depth of the ocean is ~11 km!).

Reviewers and critics of environmental issues must use and refer to original data, not other persons' prior reviews, otherwise they are liable to base their opinions on other persons' misunderstandings or exaggerations.

The Moody (2001) article is also polemical in form, and provides more lessons in scientific communication. Scientists should not write polemically, as they will inevitably generate polemical responses. However, in controversial environmental topics, even if they write in the most objective fashion, they must be prepared for personal attacks on their credibility.

Readers of this article might like to read the other articles in this issue and decide whether they are primary, secondary or tertiary; and treat them ac-

cordingly.

The Internet

There is a new force in scientific communication these days, and all scientists should be aware of its benefits and limitations.

This new force is the internet. It has two formats of interest and concern to scientists. First is email, second is the web.

Email allows direct communication from one person to another, or to many others. It is possible to communicate results of your science directly in this way, but you give the receiver a problem. The receiver needs to know something about the credibility and authority of whoever is sending the email. In general, if you as reader don't know the sender, be cautious about content, and especially the conclusions. If the sender appears to represent an agency either unknown to you or known to have little prior credibility, be cautious. If the sender gets emotional be very cautious. In short, an emailed communication is almost certainly not a refereed document.

The web is even trickier. It is possible for a web-site to be formatted to appear that it is a credible agency. I have seen a web-site formatted to represent that it was by the US Environmental Protection Agency. Its content on the topic was so different from what I knew was the EPA's conclusions, that I looked carefully, and finally realized it was a fake. I have also accessed the website of the Minerals Policy Institute. The name makes it sound respectable and credible. However, it is basically an anti-mining website, containing polemics against the mining industry, and presents opinions based on non-checkable information.

There is currently no universally accepted agreement whether distribution by internet comprises publication or not. Scientists who distribute their

data and conclusions by internet are at risk of having later publication in a refereed research journal denied on the grounds that the data is no longer original. This is especially likely if one or more of the referees has received the internet communication.

There is another risk to using the internet for distributing your scientific data. Your original results may get stolen or plagiarized. They can be published by another author, and even if he or she references you as the source, you have lost the opportunity to publish your data.

In principle, use of the internet for communication of original data is inadvisable. It follows that scientists should be careful how they express conclusions and opinions on the internet based on data which they are not providing at the time. It also follows that if it becomes urgent to publish your data, you should submit a short original note to a refereed journal such as "Nature" with a fast-track section. If you don't use a fast-track publication route with results that you consider predict important unexpected consequences in the near-term, you are at risk of being disbelieved if you present them verbally soon after reaching your conclusions.

Professional Registration

Professional registration is largely an unrecognised force in scientific communication. But professionally registered Biologists, Engineers, Lawyers, Physicians, etc are bound by codes of conduct. These codes apply to whatever they write (as well as their behaviour). Particularly the codes apply to documents to which professionals attach their name and stamp.

Conventionally, professionally registered authors do not stamp a manuscript which is sent to a scientific press

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for publication as a refereed article, book or book chapter. In contrast, a professionally registered biologist (RPBio) signs and stamps reports directed to clients or supervisors. The stamp shows that the author has been judged competent and is following a code of conduct.

However there appears to be a long-term trend in the community recognition of professional registration. It has long been recognized that a blueprint of a bridge or building (over a specific size) must be signed by a professional engineer. In British Columbia, a College of Applied Biology (CAB) is now taking over registration of biologists through an Act of the Legislature. In future, an applied biology proposal or report that requires government accept-

ance will be recognized in a new way. The stamp of an RPBio on a document will mean that a professional biologist is stating that to the best of his or her knowledge the document meets the relevant government requirements, as well as being good biology and good science.

What this means in practice is that RPBios, in their scientific communication, should have been following the Code of Conduct of the College of Applied Biology. The stamp of an RPBio on a document will have significantly more meaning than in the past.

Derek Ellis, Ph.D., R.P.Bio.
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Guidelines for Scientific Communication

1. Every time you write a biological document, or open your mouth to pronounce on a biological topic, your credibility is on the line. Think first, then write or speak.
2. Write every report on your data, or any review of your's and others' data, with as much care as you would for a refereed publication, whatever is the medium or format that you are using or are required to use.
3. Never treat your first draft as your final copy. Always rework the first draft; preferably several times.
4. Don't distribute original data by internet. Do submit important new data and conclusions to the fast-track section of a refereed journal.
5. Never write an anonymous article or opinion piece. If you are not prepared to put your name to what you write, your brain is telling you something important. Don't write that article – or if you draft it, then put it aside to read it in a year's time.
6. Be careful when interviewed by the media. The interviewer is seeking sales-promoting stuff. If you can't resist opening mouth without thinking, don't open mouth.
7. When reading articles, or listening to other scientists, cautiously appraise their credibility in scientific terms, especially if your preconceptions match what they have written or are saying. It is easy to let your critical facilities slip when someone seems to be supporting what you have believed so far.
8. If invited to write an article on a controversial topic, and on which you claim to have data and have expressed an opinion, accept the invitation. If you don't accept, you give the impression that you are not prepared to allow your data to be critically appraised.
9. Be prepared to change your opinion when new credible data is presented.

2003 APBBC Annual General Meeting

May 8th, Dunsmuir Lodge, North Saanich, BC

“Getting Our Act Together”

8:00 – 9:00 am	Registration and Coffee
9:00 - 9:15	Minister of Forest’s Welcome – Hon. Michael de Jong
9:15 - 9:30	APBBC President’s Welcome – Mel Kotyk, RPBio.
9:30 - 10:30	The Future and the APB - Panel, discussion and membership
10:30 - 10:50	Refreshment break
10:50 - 12:00	APBBC Business Meeting
12:00 - 1:30	Lunch
1:30 - 2:00	Legal Implications of the CAB Act - Roberta Reade
2:00 - 3:00	Insurance Implications - Ken Kehler, Morris & Mackenzie
3:00 - 3:20	Refreshment Break
3:20 - 3:45	The Act and the <i>“Voice of Science”</i> - Ed Britton. RPBio.
3:45 - 4:15	Panel Discussion : <i>“Biologists and Legislative Implications – From Streams to Sewage</i> - Karen Calla, RPBio., Dept. of Fisheries & Oceans; Christine Houghton and Andy Witt, Ministry of Water, Land & Air Protection
4:15 - 4:30	Wrap Up and Review
4:30	No Host Bar



Ken Kehler of Morris & Mackenzie gave an interesting presentation on the insurance implications of the College of Applied Biology (CAB) Act.



Participants in a panel discussion regarding the legislative implications of the CAB Act. They are: Karen Calla, R.P.Bio., Fisheries and Oceans Canada; Christine Houghton, BC Ministry of Water, Land, and Air Protection; Andy Witt, BC Ministry of Water, Land, and Air Protection (not shown). Paul McElligott, R.P.Bio. (standing), APBBC, served as moderator.

2003 APBBC Annual General Meeting



Douglas C. Morrison, R.P.Bio. (centre) is presented with the Bill Young Award for Excellence in Integrated Forest Management by Mel Kotyk, R.P.Bio. of the APBBC (left) and Phil Blanchard, R.P.F. (right) of the Association of Professional Foresters.

Mel Kotyk, R.P.Bio., presents a token of appreciation of Linda Michaluk, R.P.Bio., the APBBC's Executive Director, in recognition of her efforts on behalf of the Association, particularly her efforts in support of the passage of the CAB Act.



Mel Kotyk, R.P.Bio., presents the long-service pin to members in recognition of 10 years of Membership in the APBBC. They are (left-right): Doug Morrison (R.P.Bio. No. 152), David Polster (R.P.Bio. No. 148), Donald Eastman (R.P.Bio. No. 147), Linda Michaluk (R.P.Bio. No. 146), Maureen Ketcheson (R.P.Bio. No. 160), and Bruce Pendergast (R.P.Bio. No. 162).