

CHAPTER 17

Dialogue following Potential Threats to Wild Salmon

Are there incentives to change behaviour to be more salmon-friendly?

Randall Peterman asked *Bob Lackey* for suggestions on how we might create the appropriate incentives for people to change their collective behaviour in the direction that might be more salmon friendly, noting that a set of incentives might be something to overcome the tendency to go around regulations.

Bob Lackey replied that his approach on that is two-fold. Firstly, he is not convinced that the public's behaviour does not reflect their true priorities. The second point is that he believes that we need to be brutally honest with people, from a technical standpoint, and tell them what will or will not work. He noted that all too often, has been in meetings where they have had the daytime discussions where the plans might work, and in the evening they sit around the table and say there is not a prayer that this will work. Somehow, that information does not get out to the public at large.

Are there any recovery strategies underway already that address the four drivers?

Morris Sydor commented: I know that there are a number of salmon recovery strategies in different regions in the US. Is there one that you can point to that actually addresses these four drivers that you referred to?

Bob Lackey replied that there is not.

Are there lessons that can be learned from Japan?

Xanthippe Augerot thanked *Bob* for his presentation and commented that it contributes a candor that we really need to take to heart. She posed a question to *Mitsuhiro Nagata*: If we look around the North Pacific, Japan is our future in some ways. Population densities are very high, and there is already a very strong consumer culture that values many other things but not necessarily wild salmon. What recommendations do you have for us in this region as we plan to try to maintain wild salmon populations?

Mitsuhiro Nagata answered that this is a very difficult question to answer. In Japan, there is a very large population and they also have a very unique history for chum salmon enhancement. The commercial fishermen believe that hatchery salmon have a higher survival in the wild because there are no wild chum salmon in Hokkaido. Somehow they have to change these ideas for the commercial fishermen. To do this they will have look at hatchery origin wild fish.

In recent years, some of the commercial fishermen have been worried about water quality conditions around Hokkaido and they know that good water quality is needed to operate the hatchery. Generally, in Hokkaido there is a lot of aquaculture and breeding and the environmental conditions are getting worse. Some of the salmon fishermen are opposed to aquaculture because of its impact on the quality of the water. Now they are thinking about the recovery of a wild fish hatchery. Commercial fishermen are also looking at the enhancement programs sector and are catching more of the chum salmon in the mouths of the river by using weirs. Maybe, in the future, some of the chum salmon will go up the stream for natural spawning. It is possible that they will have a wild conservation program. He noted that it will be very important to have harmony between wild and hatchery salmon to sustain the salmon resources in the future.

Everyone needs to come to the table to discuss the solutions

Randall Lewis commented: It has only been in the 150 years since contact with Cook and Vancouver that we started witnessing impacts within the lands that sustained us (Aboriginal peoples) for thousands of years. We look, for example, at the way of the wild Indians of the United States where, once the buffalo disappeared, they were decimated in terms of their values of life and how they sustained their customs, and the values and spiritualities of the indigenous peoples of their lands. We are looking at the impacts on the fish and the fisheries, in our respective traditional territories, and we are witnessing in our elders and with the society of the day, a lot of different diseases and sicknesses that we have never encountered before. Before it was the epidemics but today we have diabetes and a lot of other different things that are impacting our elders. Our elders, before contact, lived to be 90 and 100 years old.

We have personally witnessed what has happened here with regards to ‘contact’ on the lands and the fisheries. It is interesting to hear because we are dealing with different governmental jurisdictions, federally and provincially, within our territories and lands. We look at federal and provincial jurisdictions, municipalities and regional districts and we, as First Nations, have to deal with any and all issues that come across our tables. Certainly, we look at the policies and regulations of the day that do not adequately meet the requirements. For example, at a recent community meeting about the 2010 Olympics coming to Vancouver and Whistler we discussed what archaeological impact assessments, and traditional-use land studies there are. We learned that they are very inadequate to meet our needs as First Nations in regard to the potential impact of this event. Since then we have created, along with the Province of BC, an Aboriginal Indigenous Use Study which will look at the impacts on fish and other wildlife of the highway, and new trails and roads being built through our territory. We have to look at how we can participate meaningfully and, hopefully, use the science and technology, which has destroyed our way of life in the past, to help us heal what has been inflicted on the environment within First Nations’ territories.

He commented: You talked about how we look at developing harmonization with different governmental jurisdictions that we look at electing to represent our interests as constituents in our municipalities and regional districts and within the larger constituency of BC and Canada. We have to get these people to a table - this workshop is good but, at the end of the day, we walk away wondering about the solutions. We know what some of the solutions are and we have to get these people to the table and but show them some very important facts. The indigenous peoples know the facts and they are very close and near and dear to our hearts and it is important to get these decision-makers to the table after a forum such as this. You are correct, we have to be blatantly up front with them and tell them this is what we need to do and this is how we need to do it and we know how to do it. There are a lot of experts present at this workshop that can begin to develop a plan of attack for the future.

We may have to have a trade-off

Noel Wilkins referred to the problem, raised by Dr. Lackey, of increasing urbanization, and he noted that we have to look through that problem and try and see the challenges that lie behind it. This is taking place worldwide and there will be a balanced demand for increasing wilderness behind that urbanization. People do not come from nowhere - they come from somewhere to live in these large urban areas and the larger the area, the more the necessity, for example, to have impoundments of water to supply the needs of these very large metropolises. That means two things: it means that our continuing research into the basic biology of the organisms that live in freshwater or organisms that can be adapted to artificial impoundments and to reservoirs becomes even more important than it is today. Secondly, we have to perhaps look at the value of our fish resources and say to ourselves, in Dr. Lackey's scenario, the ones that will lose out will be the catadromous and anadromous fishes. We may have to have a trade-off. We may, with our anadromous salmonids, have to face a future in which we deal entirely with sea-ranched populations, where we produce them in hatcheries close to the coast, ranch them to the sea and catch them back at the hatchery after their period in the sea. We may or may not use some of those fish and transport them up to the reservoirs for 'put and take' fisheries. We may have to develop entirely freshwater fisheries in those reservoirs and impoundments. In that scenario for the future, we can have fishery resources but it may well be slightly different fishery resources and not so much the catadromous and anadromous ones but instead the resident marine fishes and the freshwater fishes. He commented that he would not be entirely pessimistic about the future because to be pessimistic about the future is to deny what is going on today.

What about restoration programs for urban salmon threats?

Jeff Marliave referred to a report published by the Pacific Fisheries Resource Conservation Council on citizen group projects, with an emphasis on urban stream projects (www.fish.bc.ca). Referring to the recent abandonment of watershed restoration in British Columbia he noted that by far the vast majority of tax dollars were expended under Forest Renewal BC on critically important restoration projects on Crown Lands. He described some of the side channels built under this program that he observed in the territory of Randall Lewis's people and he noted that they were, literally, invisible to the public. In contrast, a very small proportional amount of money was expended through Fisheries Renewal BC, largely for citizen and community groups working in more suburban areas and a lot of those projects have taken on 'park' access aspects. In light of what Robert Lackey said about public values, he posed the question: Does he not think that the future for 'SeaVan' should involve restoration programs explicitly aimed towards urban salmon streams so that we can have wild salmon surviving in an urban environment or is that impossible?

Robert Lackey replied that he not think that is impossible and that he does not think we will lose all of our wild runs in Southern BC or for the lower United States. He predicts that by 2100 we will have remnant runs along coastal watersheds of Oregon, possibly the north coast of California, and Washington. We could also have what he would define as 'ornamental' runs in a variety of places including urban areas. However, he predicts that retaining the large fishable runs, for wild fish, is a very tough road to hoe, in this part of the world, in 2100.

Would aboriginal rights through Treaties influence policy decisions with respect to preservation and maintenance of wild salmon?

Martin Weinstein commented on the question that Randall Lewis raised and suggested that we look at British Columbia just in terms of the issue of aboriginal rights and the lack of treaties. He noted that we are in a treaty process right now and First Nations have a special set of rights which are largely undefined, but they certainly have to do with salmon. Could the tie of First Nations in

British Columbia to salmon as an aboriginal right influence the policy decisions along the lines of preservation, restoration and maintenance of salmon populations in to 2100?

Robert Lackey replied that in the U.S. there are mostly signed treaties (the 1855 Treaty) which actually guarantee the usual customary places. However, he does not think in the long run, that treaties are the driving factor because the bottom line is that there are no wild fish. Even though you may have treaty rights in the United States, you have to go to court to defend them and most of the tribes, and he was not speaking for the tribes definitively, are supportive of hatchery operations and supplemental stocking because they recognize that the potential for wild fish recovery is not very good. He suspects that the same pressures drive them on every element as with every other outreach group in the US.

We can do more with the resources we have

Otto Langer referred to comments made by John Post (Chapter 11) that we have too many fish populations and too few fish biologists. He hopes that we will manage the remaining fish populations a lot better. He sees the problem being a lack of will to relate to known trends. The literature provides what we have learned over the last 100 years with respect to fish populations and fishing and a lot of that is related to common sense. We just cannot afford to collect all of those data and we cannot wait until we have really good data in our hands. We have to use the 'precautionary principle' to protect our runs and we need some real leadership and due diligence in fish management.

John Post commented that these remarks hit the problem on the head. There is no question that it would be inappropriate to go out and do stock assessments on all of Canada's recreational fisheries and it would be an impossible thing to do. On the other hand, as we see, dealing with provincial governments budget declines and changing priorities, in many places we are doing a poorer job of assessing the systems we do have and in coming up with imaginative management policy in an attempt to stop or reverse declines. He noted that he has also been frustrated by the seeming lack of understanding about the basic relationships between the dynamics of the fish populations and the dynamics of the anglers. It seems that many management agencies do not keep those two systems together and use quantitative models to do assessments and develop policies that can actually manage the predators in the system, such as the anglers, to preserve the fish stocks. He believes that we can do a lot more with the resources we have. However, the resources are declining and we need a re-prioritization of how we use the resources.

Are there examples of decision-making processes in the US that are going in the right direction?

Brian Riddell commented that he has heard this type of scenario described on numerous occasions and he is always left with the challenge of how you would ever make the social decisions and trade-offs that Robert Lackey and others imply are needed. He posed the question: Do you have any examples of decision-making processes in the US that you think might be going in the right direction? Do you have any sense of what we would be able to actually address and make the proper decisions about?

Robert Lackey replied that making the proper decisions presupposes that they are lined up with your priorities. The process, right now, that seems to be working in the US is that the relative priority of wild salmon is being adjudicated. Many people who are on the side of advocates for wild salmon are very unhappy with this - but it seems that democracy, in some sense, is working. As a taxpayer, you may not be happy that we are spending billions of dollars on programs to achieve certain kinds of things and therefore not convinced that governments will come down on the side of wild salmon.

Does limiting access work to preserve fisheries?

Dave Marmorek referred to John Post's presentation and noted that the damage to fish resources from road access in areas, for example where forestry is going on, is probably a lot greater than indirect effects and sedimentation and even angling pressure. Similarly this would apply to hunting pressure. He raised the question: Do you think we can actually put in place regulations to restrict access along roads, built for logging, mining or seismic exploration, in the same way that we now restrict access to recreational experiences, such as limiting numbers of hikers on the Westcoast Trail?

John Post replied that it is his understanding that, at least in some areas, once the logging activities end, there are attempts at reducing access to these areas. Certainly direct access control is something that North Americans are adamantly opposed to. We only have to go to Europe to see a very different management framework for fisheries, or to look at how we manage 'big game' with limited access. Certainly, access provides one tool for preserving fisheries. The question is: How palatable is it and would the public allow those sorts of controls of their 'right' to fish and hunt?

We should also consider the spiritual dimension

Paul Kariya commented that some of the points raised by Robert Lackey made him feel very uneasy and noted that in his day job, working for an NGO, one thinks through what the future of salmon would be. He believes that Robert Lackey has described a challenge where if we do not get to the point of connecting with that spiritual dimension, of how we live, then we are not going to make the changes. He noted that he was saying this out of optimism and not pessimism and he referred to a conference that he attended in the 1970s, when Malcolm Muggeridge gave a presentation on the human condition and was talking about depletion of resources and population. When asked about being terribly pessimistic about the future and if he could ever be optimistic, his response was, "You are right, I cannot be optimistic, but you know what I am...I am 'insanely' optimistic." If you know the writings of Muggeridge and where he has come from, he was talking about a spiritual dimension. If we are really going to think about salmon and their future, then we need to think about people - and people have to matter. If we are going to get to that point, then we are talking about things like sacrifice, greed and values. If we do not deal with those issues and if they do not underpin what we do, then we will face a pessimistic future.

How to bring the public into the discussion

Jessica Bratty referred to comments made by John Fraser and by Randall Lewis with respect to how we must bring the wider public into the discussion. She noted that she was putting some thought towards what we can do, in a specific way, to improve this connection with wider public values. She referred to John Post's focus on specifically addressing what the management and public response was to his work and suggested that scientists should think about this and ask themselves about how often they actually carry out evaluations of this and actually incorporate this evaluation stage into their study design. As a way of widening the dialogue, she also questioned whether or not improving this, as scientists, would actually improve the way that science is included, in decision-making and wise policy development.

A positive example of public influencing policy

John Gibson cited an example of where scientists did just this. They conducted a study a year ago on the effects of the new Labrador Highway and found that half the culverts on this highway (approximately 200 kilometres) were barriers to fish migration. He noted that this problem is not new – it happens all across Canada and was even described for eastern Russia. In Newfoundland hundreds of small streams have been lost; streams that used to have trout and salmon runs, and

now the salmon runs are down for no other apparent reason. He noted that something that may look trivial, such as culverts, are in fact probably just as important as overfishing and yet they seem to be overlooked. He has been working on this issue for many years in Newfoundland and nothing has happened; there is a very strong Fisheries Act but it is not always enforced. However, the study in Labrador was done in partnership with the Labrador Metis Nation and, as they have a higher profile, the result was that they secured a meeting with DFO which then resulted in the culverts being monitored and remediation planned for next year in Phase 2. If it had not been for the Labrador Metis Nation, nothing would have happened. This illustrates how important it is to have participants involved, as John Post pointed out with the anglers. This is an example that shows the importance of having the public involved in decisions related to policy.

John Fraser commented that the Premier of Newfoundland and Labrador has recently been exhorting other provincial premiers to let him take over the management of the fisheries in Newfoundland and Labrador, as the result of the recent decision by the federal Department of Fisheries and Oceans to finally close the last of the cod fishing in the region. The Premier took the position that this was a terrible thing and it neglected the hopes and aspirations of the people who fish for the cod and therefore that Newfoundland should take over the fisheries from the federal department. Yet, this is the same Premier who, apparently, had to be pushed by a native organization to put decent culverts in the highway. He stressed that premiers and departmental deputy ministers should be at the current workshop instead of getting briefings from somebody else later.

Attitudes may change rapidly

Malcolm Windsor commented on Robert Lackey's presentation. He noted that the same pattern applies in Europe where human population densities are probably greater than in North America. It is quite noticeable that salmon populations are being lost in France, Spain, Southern England, Denmark, and Germany where human populations are greatest. If you go to the Kola Peninsula in Russia or to Iceland, then the salmon are at their highest and the human populations are at their lowest and the pattern is the same. He believes that Robert Lackey made two assumptions. First of all, much was said about attitudes but he noted that attitudes can change faster than we think. For example, two hundred years ago, most people in this room may have supported slavery, and 50 years ago many countries in the world thought the best way to run their economies was by a socialist/communist systems. Thirty years ago, we started to have departments of the environment, and now most governments have those departments in their ministries. Further, the River Thames used to be a sewer and now there are salmon migrating up the river. This means then that attitudes can possibly change quicker than we think and that big human populations could actually put down a lower footprint if they put their minds to it. The second assumption, made by Robert Lackey, is that human populations will continue to grow - he wonders about this statement. Maybe a hundred years from now, there may be some problem with disease or fertility or even, war, which might greatly affect the size of human populations. That is a rather depressing thought but, if you think of it in a good way, the salmon will be happier.

Hatcheries as a reason for the decline of wild salmon

Wayne Harling referred to Dr. Lackey's presentation where he listed hatcheries as a reason for the decline of wild salmon and the general consensus that hatchery salmon are 'bad' and wild salmon are 'good'. If the human population projections are accurate, then it may be that the only choice we may have is hatchery salmon or else no salmon at all, at least in the southern half of BC. Rather than just rail against hatcheries and close them down, he believes that we have to work at ways of making them more effective because we may need them, if we want to have any reasonable scale of salmon fisheries in the future. He suggested that the South Thompson Basin would probably be the best place to start in BC.

Robert Lackey replied that the issue of hatcheries in the U.S. is really a fundamental issue where, currently, on the average, the runs are 80% hatchery. Therefore, these are not large runs, but are substantial runs and that, of course, is pressure to allow fishing. When you allow fishing on those kinds of runs, then that is pressure for the wild runs. He noted that his comment on hatcheries, relative to the US, is more in the context of maintaining relatively large runs, which creates problems for the wild runs. He agreed that if you are going to have runs in the Columbia River, then you are going to have to use hatcheries.

Hatchery production in Russia

Xanthippe Augerot commented in reference to Jennifer Nielsen's presentation, that they are starting to untangle the question of marine-carrying capacity and the influence of hatcheries on some of their wild stocks in other places around the Pacific Rim. These questions come up all the time in her discussions with colleagues around the North Pacific. She noted that the Kamchatka hatcheries rear chum salmon and therefore it must be the Sakhalin hatcheries that were involved in this analysis. Jennifer Nielsen agreed.

What would happen if you factored the impacts of aquaculture and related diseases into the analysis?

Craig Orr referred to Bill Rees' presentation and commented that salmon farms are tremendous sources for concentrating diseases, such as IHN and ISA, and noted that we also know that the parasites themselves on the farms cause losses for the farmers. For example, the average farm in New Brunswick is estimated to lose approximately \$350,000 per year because of sea-lice parasitism and the cost of sea-lice, in Scottish fish farms, is estimated at \$50-70 million per year. Another line of evidence is the impact of sea-lice outbreaks on wild stocks of fish. This suggests that the footprint may be even higher than was suggested in the analysis provided by Dr. Rees.

Bill Rees agreed that this is very likely. However, he noted that they did not look at those factors because the study was already so exceedingly complicated that it was difficult to manage, and both of these factors are rather unpredictable. Their intent here was to be conservative and if they were to add these kinds of factors, and there are others that people have raised, it simply makes the picture look worse than the one that they came up with. In other words, once you start getting into the 'ifs' and 'maybes' and 'what ifs', then you begin to get into a domain that softens the immediate credibility of the argument. They believe that they can stand absolutely on the ground with these data and these kinds of amendments make it actually worse than the situation they have described.

How much live food is consumed by wild salmon?

Jeff Marliave commented on the model presented by Bill Rees and noted that he completely agrees with putting humans squarely inside of nature. However, it seems in the model that the salmon farming box is squarely inside nature's ecosphere, whereas the wild fishery box is somehow outside the ecosphere. He asked: Do you have an estimate of the number of kilograms of live food that the wild salmon has to consume in the high seas to put on a kilogram of weight?

Bill Rees replied that the ecological footprint of the wild fish fishery includes a contribution of the average productivity of ocean required to sustain the feed stock for the wild salmon. The comparative analyses are absolute parallels.

Are we moving forward in a way that is sustainable?

Frank Heinzelmann questioned whether, in fact, the rise of the salmon farm industry really had anything to do with the decline in wild salmon abundance because in the 1980s and 1990s there

were record yields of wild salmon from Alaska and hatchery salmon from Japan. He speculated that it was just more economic opportunity rather than the decline of wild salmon yields.

Bill Rees noted that they were not trying to say that, in particular, the BC hatchery industry arose because of declining wild salmon, or that aquaculture, generally, is a defense against the vagaries of nature. Their point in undertaking this comparative analysis was to ask a simple question, "Are we moving forward in a way that is more or less sustainable given future population demands, energy requirements and so on?" This analysis was simply to say, given that we need, globally, to reduce our total ecological footprint, is this kind of intensive aquaculture moving us in the right direction and the answer is, "no, it is not".

How do aquacultural and agricultural practices compare in terms of sustainability?

Sandy Fraser commented that although the argument was interesting he could not help but think that several thousand years ago, perhaps an analyst back in Neolithic times looked at terrestrial agriculture and said, "Well, you know, that is not sustainable at all." He asked the question: How do you square your conclusion that aquaculture is unsustainable with the fact that terrestrial agriculture and, specifically, the raising of herbivorous animals for consumption by humans, appears to have survived and appears to have thrived over several thousand years?

Bill Rees commented that there are a number of differences. First, between trying to manage marine species and terrestrial ones, we need to go back to the basic question of terrestrial agriculture. For example, in a recent edition of the newspaper the *Globe and Mail*, it says that in North America we have run out of readily accessible natural gas. The United States' reserves have been in decline since 1967 and Canada since 1984. The Canadian gas production, this year, will decline by about 5% and our exports to the United States will actually decline for the first time in 20 years of continuous increase, particularly since the implementation of NAFTA. Why is this relevant? Because we are constructing an agricultural system increasingly dependent to sustain around 6-9 billion people on the continued abundance of natural gas as a feedstock for fertilizers. People are not generally aware that, at the same time as the fish catches began to decline, in adjusted terms (using the calculations of Daniel Pauly) around 1985, green production, per capita, peaked and has also been in decline for about 15 years. We do not notice these things in North America or Europe because, whatever the situation, we have the wealth to maintain our supplies. However, if we go back to the 1987 and 1988 crop years, those were the first years in the history of North America that we did not grow enough food to sustain ourselves. Again, we did not notice this in the market place because we had about 250 days of grain stores in lockup and we were able to supply, not only our basic needs, but also our export markets. We have never recovered from that slump and we are down to less than 40-45 days of grain stores in the world today, at the same time as the fossil fuel basis, for much of that production, seems to be coming into jeopardy, certainly in the North American context.

It may be true that we have had agriculture for a very long time but it is implicated in the collapse of many prior civilizations as irrigation and whatever technology was brought to bear to increase production in those days, ran its course through water-logged soil destruction and other forms of landscape deterioration. There are a number of ways of answering the question and, first of all, it is clearly demonstrable that many civilizations have collapsed because of the collapse of agriculture, historically. We now have a global culture and if you plot the expansion and explosive growth of the human population against the use of fossil fuel, the line increases begin around 1850. As fossil fuel has become the dominant means of producing food and therefore human population and enterprise generally, it may well be that the fossil fuel crunch, which will happen in this century, will see a more global phenomenon of failure in agriculture as well as aquaculture. He stressed that we seem to be repeating historical trends, on a much broader scale,

than has occurred in the past. It is demonstrable that agriculture has failed repeatedly and brought whole civilizations down.

Where do we go from here?

Jessica Bratty commented on *Bill Rees*' presentation. She referred to the Peruvian decree. Has that decree been implemented and, if it has, what will be the impact on the fish feed industry? She also asked: Let us assume for a moment that we are in an alter reality and we have adopted your final suggestion that we need to, as you put it, "acknowledge our genetic predisposition". Once we have done that, what is next? Where does it go from there?

Bill Rees replied that he believed that (in October of 2002) Peru proclaimed that they were going to stop this export of these fish but he is not certain as to whether it has actually been implemented.

With respect to the second question, he stressed that we are in a state, as has been said over and over again, of denial. We treat symptoms and do not look at the fundamental problems. If we are going to pull this off, there has to be a raising to consciousness of the authentic origins, at a global level, of the dynamic forces that are pushing global culture ever closer to the resource brinks that we have been talking about here. He cited the example which occurred in the previous week where *Paul Wolfowitz*, the US Under Secretary of Defense, admitted that the recent war in Iraq was about fossil fuel. That is an astonishing admission given what has been going on before. He cited the book, "*The Resource Wars*" written by *Michael Klare* where he predicts that, as populations rise and the competition for energy and other resources intensifies, we are going to see increasing actions, such as the United States took, in a unilateral way, to secure its own future.

The bottom line is that the human brain has evolved in great leaps and bounds but we have a primitive limbic system, where our emotions and our response to certain social circumstances, and our need for prestige and political power and dominance, reside. In the last 100,000 years or so, we evolved the so-called cerebral cortex, where the response to logic, analysis and rational capacities have evolved. A neurologist referred to this as a layering and the way human beings behave is a delicate balance between our limbic emotional senses and our need for dominance, our need for social security, for prestige, and for all of these kinds of emotive things, in balance with our capacity to reason things through and do the right thing. The argument seems to be that, when 'push comes to shove', the evolutionary older part of our behavioural dynamic, in our neural-system, prevails. We will be aggressive in defense of our own needs, regardless of what more we might achieve, were we to come together in ways that recognize we are facing a fundamental, common problem of the global commons being destroyed. He believes that the actions of the United States, recently, represents the coming to the fore of the limbic response - we will go it alone, we will take what we need for our purposes and we will abrogate many international treaties that would otherwise hamper us in ensuring our survival. He argues that this is an example of how humans will behave as the resource situations become more difficult. Conceivably, if we can come together and acknowledge that that kind of behaviour is totally destructive, not only of our fish stocks but for all other resources and ultimately ourselves, then we may be able to develop a form of coercion mutually agreed upon and recognize that we need to create international institutions to regulate our behaviour and to reduce the demand on nature. Our innate response, because of our need to expand, has always been on the supply side. For example, we cannot face that there may not be enough fish, so we build fisheries. We have to begin to work within the limits of nature, which means working more to control demand rather than always trying to increase supply.

The supply increase end of things is not going to wash, in the long run, for 9 billion people and the question is, “What kind of institutional arrangements can we make, at the international level, so that we can adequately share the world’s economic and ecological output in ways that there is sufficiency and, therefore, a means to reduce the propensity for international conflict and the solution of these resource scarcity problems?” There would be plenty to go around if we were more conservative in the use of the resources but if we do not take this kind of step, then we are going to see the emergence of increasing international strife as we squabble over the declining resource base. This is why he has now appealed to the Fisheries Minister in Canada and, perhaps, this conference could endorse this, that Canada call a political meeting, among the world’s fishing nations, to erect precisely this kind of regime to preserve and enhance the world’s fisheries by reducing fisheries’ demand and by creating ‘no fish’ zones needed, over the very long run, to rehabilitate those stocks (see Appendix III).

In his opinion, Canada is partially responsible for the mess we are in and we have a moral obligation, to future generations, to try to solve it. Let us take some leadership and see if we cannot create an international regime to control demand on the fishery, instead of always trying to do things to increase people’s supply, when the production simply is not there to sustain it even if it is enhanced by fish farms and hatcheries. In his view, the general problems we are now discussing, will be the major issues facing us all in the 21st century, not just in the fisheries area, and if we do not pull it off with an international regime level, then we are not going to pull it off.

What have we done right in salmon management?

Fred Whoriskey asked: Did we do anything right?

Carl Walters replied that in his opinion we have been pretty good at dealing with the problems with salmon, that we know about; that is, harvest regulation in the face of declines whether they are caused by overfishing or marine survival changes. We have responded by cutting off fishing mortality and cutting it way back in most of the cases. He referred to the rather sad case presented by Brian Riddell with respect to chinook salmon in Georgia Strait where the regulatory system was not effective at reducing mortality and as the stock shrunk, the remaining fishery shrunk with them but they maintained about as high a mortality rate as always.

Stating clear management objectives and the need for audits

Randall Peterman noted that Dr. Walters did not actually use the words ‘clarifying management objectives’. He suggested that what we need to do, is learn about how one would actually do this - that is, someone would lead the dialogue that would get people to clarify what kinds of trade-offs they would be willing to live with. He noted that this would give clear direction to the management agencies and suggested that until that happens, it will not be there.

Carl Walters commented that it appears that what we have now is a lot of clarification of objectives of the very trivial kind – such as, we want more fish - and this is very much the kind of situation that was faced by scientists in the early 1970s in the early development of adaptive management. Then they were trying to say, “Stop this nonsense” when talking about objectives. He suggested that every one of us could agree on what those are in broad terms, but what we really need is to face up to the nasty trade-offs among those objectives. That is what we are not doing – we are not quantifying those trade-offs, partly because of the lack of information and partly because nobody wants to look at them, and we are not forcing a clear public debate on the trade-offs. Also, we are not holding the public agencies accountable for where they allocate resources to issues and problems. For example, no one is asking the Department of Fisheries and Oceans, “Why are you fixing streams that don’t need fixing?” There is a serious lack of auditing.

Is the problem freshwater habitat?

Wayne Harling noted that while logging practices may create a temporary impact, the impact of paving over a stream is permanent. He noted that hundreds of small coastal coho streams have been completely destroyed and even if the ocean survival comes back to the 10-15% range, those streams are still lost. In his opinion is it not entirely correct to say that freshwater habitat is not the problem.

Carl Walters replied that with respect to the loss of coho streams, it is not hundreds, but rather about one hundred streams that are lost and most of these small streams were lost a long time ago and they are not going to be restored because they are in urban areas. Relative to this the recent habitat loss is miniscule and that is out of thousands of streams. Therefore, measured over British Columbia as a whole, habitat loss is a trivial component. When we back-calculate freshwater production of coho to the ocean, that is, the number needed to explain the catches and escapements what we see is that the total wild smolt production by the freshwater systems surrounding the Georgia Strait has actually gone up a small amount, not down.

Are hatcheries the problem?

Wayne Harling also posed the question: If we eliminate hatchery production, would not the impact of predation on wild stocks increase and put them at greater risk?

Carl Walters explained that they have been doing reconstructions of the history of the Georgia Strait by taking many time series of fish data and mammalian data and asking, with an ecosystem model, what it takes to explain the patterns of change that they observe. It looks like there are two major factors involved in that pattern; one is a declining primary productivity over the last decade and the other is they find they cannot leave out of the models and still fit the data, is the massive growth in marine mammal abundance in southwestern BC. If either of those things are taken out, then the models do not fit.

Therefore, the fish are becoming caught in a squeeze between declining food availability on the one side and big increases in predation on the other side. What happens when you put a hatchery into that squeeze is that it makes things worse in two ways; one is it increases the squeeze on the food resources available, and the other is it is a training ground for marine mammals - seals and other creatures are learning how to catch little salmon by having readily available concentrations and naïve fish. The numbers of fish going out are never enough to really satiate the predators, which you have to have to get that protection function - they are coming out over too expanded a period of time. They might be right in the middle of the densest runs out of a few of the rivers where there are tens or hundreds of thousands of fish coming up per day, and there would be a buffering effect with respect to the local mammals. However, that goes away as they spread out and, as you move toward the front or back end of the run, so that the fish are protected in the middle, but it is not helpful.

If a large amount of money was available for research on the oceans, what would you spend it on?

David Einarson commented: I have heard you say before that one of the dangerous things is to have a whole lot of money suddenly available for research. If a lot of money suddenly did become available for research on the oceans, what would you spend it on?

Carl Walters replied that he would put the first \$2 million into a coast-wide intelligence gathering program. He noted that when we see a collapse, such as suddenly occurred with Rivers Inlet sockeye, it is basically ecological detective work to try to figure out what was going on. As soon as we try to do that detective work, what we find is that there is no information at all about what

has been happening to plankton abundance in the coastal areas where the juvenile fish are coming out, there is no information on marine mammals, there is no information on birds, and there is no information on the agents of mortality or the capability of the systems to support fish. That is, there is no basic monitoring program. The first \$2 million could be productively used to put together a coastal ecosystem-monitoring program. The next priority would be to put funding into direct monitoring of distributions and mortality of salmon in the ocean through the new high-technology tagging systems. We need to find out where and when the fish are dying before we can figure out what the causes are and if we initiate experimental programs to try to reduce mortalities, such as seal culling, we have to have monitoring programs in place that can accurately identify where and when the mortalities are occurring. For this we have to have things such as acoustic tags which are very expensive. He concluded that for \$2 million we could put together a good coastal surveillance program for the things that we know to be the major resource factors such as food supplies and predation risk factors for salmon along the coast.

The relationship between habitat loss and marine survival

Jan Konigsberg asked: For the studies of habitat degradation in relationship to salmon production, was there any relationship between the habitat loss or degradation in the stored energy reserves of the smolts, body size, and ability to survive? And, What is the relationship between habitat, fish, smolts and relative health in marine survival?

Carl Walters replied that his presentation showed that we really do not know the answer to this question. He noted that one of the scariest hypotheses, which has been put forward for the progressive pattern of the decline that occurred in coho salmon, is that its origin was actually freshwater. However, the fact that it hits hatchery fish in the same way as wild fish implies that it is not something to do with the food supply in freshwater. Exactly the same pattern of decline occurred in Atlantic salmon, over the same years, on the east coast of Canada and in some of the European systems. What factor gets shared at that scale? Nothing that we know of in the coastal oceans. The only shared factor we know of is ultraviolet (UV) radiation which has increased over that period. It is possible that what we are seeing as increased ocean mortality is actually declining availability of fish in freshwater due to chromosomal damage that is not being repaired because the enzymes aren't being used until they get to the ocean and that the ocean mortality is a symptom of *that* going on in freshwater. The only thing that we know of, that would operate on such a large scale as across the continent and in a particular latitude band where the mortalities are similar, is UV radiation. It is clearly not water flows or any of the other obvious things.

Ocean productivity cycles and the need to protect freshwater habitat

Guido Rahr noted that ocean productivity has fluctuated over thousands of years and so have salmon populations. However, if you assume that there is a relationship between healthy habitat and the health of the salmon populations and the number of smolts that are delivered to the ocean, then would not the fact that ocean productivity fluctuates be the best argument for protecting healthy habitat in that it would carry the stocks through periods of higher mortality in the ocean?

Carl Walters replied that he contends, based on his examination of a lot of actual population performance data, that the problem with this argument is whether or not habitat is unhealthy in the first place. If we could demonstrate that we really do have severe survival problems in freshwater then he would agree that we should fix part of the system that we can fix. However, we cannot even demonstrate that the problems are that severe in the first place - certainly not in situations like Rivers Inlet where we see the stock declining by 90% in one year and there is no freshwater habitat associated incident that happened prior to that. You can fix all the freshwater habitat you want but with current marine survival conditions, we are still going to be losing stocks. Moreover, with the regularity with which these big marine survival changes have been

occurring across species and over time, we can expect to see more of them - and we are going to be looking for more scapegoats and we are going to be trying to apply more bandaids in the wrong part of the ecosystem or the wrong part of the lifecycle of the fish. In his opinion, we are spending money in the wrong places.

Overall effects of fishing on the northwest Atlantic ecosystem and competition-predator interactions

John Gibson commented: The closure of the Atlantic salmon fisheries in 1992 resulted in an increase in returns to the rivers. This may not have resulted in more smolts and, in fact, for one river there was no increase in smolt output so there probably was already carrying capacity - but there has been a dramatic decline in ocean survival. You made the point that fishing was not the problem. However, I would suggest that fishing probably *has* been the problem because it has completely messed up the northwest Atlantic ecosystem. The data are not there and the work (which I have previously criticized with DFO) is mainly put into assessment and counting fences rather than what is actually going on. Jeff Hutchings pointed out in his presentation that some of these pelagic fish have recovered and there may be interactions that involve competition with the smolts. Another point is: You did mention lowered productivity in the Pacific coast, and it may be more resilient, but in the Atlantic, is it possible that reduction, generally, has decreased because the general efficiency in the food chain has decreased?

Carl Walters replied with respect to the latter point, that this is referred to as the jellyfish argument; that is, has the food chain efficiency gone down because of other things? The answer to that is 'no'; in fact, all the calculations indicate the opposite - that the food chain, as an energy transfer unit out in the ocean, is becoming more efficient.

With respect to the first point, in the case of both Atlantic salmon and coho salmon, there are a lot of data on smolt outputs vs egg deposition. On the Pacific coast with regard to coho, there are only three observations that show any effect on egg deposition on the smolt numbers, so almost all the coho streams are saturated. There is one place where virtually no fish returned – that was Snow Creek near Port Angeles, WA, and there was smolt failure after that. There is one year in the history of the Carnation Creek (Vancouver Island) long-term study when there was a low enough spawning run that there was a recruitment decline and one year on Black Creek (Vancouver Island). The other 100 or more observations are exactly the same as Dr. Gibson described.

He noted that in the last six or seven years, they have been building ecosystem models of virtually every large marine area in the world and trying to fit them to historical data as a way of seeing if their structure is a reasonable explanation for what they are seeing. One of the things that has come out of these models is something referred to by Jeff Hutchings; that is, what we call a 'cultivation depensation effect'. If you take a big dominant creature, such as a cod or Pacific salmon or the elephant tunas of the equatorial Pacific, and if you fish it down really far and then look at what it does, the models all predict that it will recover much more slowly than thought from the productivity when it was being knocked down, and that is what Jeff described. What the models indicate cause us to pose the question, "Why is the elephant tuna, or salmon, or cod the dominant species out there?" The argument is that they are dominant because they cultivate their ecosystems. As the cod population builds up, it knocked down a lot of potential competitors and predators, as well as juveniles. When it goes down, that protection or cultivation effect on its own reproductive success, goes away. It then becomes very much more vulnerable to impacts of intense specific competition. One of the great unexplained declines combined with the failure to recover in the area around Vancouver, of the type described by Jeff Hutchings, is chinook salmon. In the mid-1970s it was possible to catch 500,000 - 700,000 chinook salmon a year out of

Georgia Strait. Currently, we would be lucky to catch 30,000. There has been a massive decline and we cannot show that there is anything obviously wrong with the food supply out there. There are a lot of herring and a lot of prey - yet these stocks are not only *not* recovering, but they are continuing on down slowly just as the cod did. That has to be an ecological interaction of some kind and it has to be a competition–predation interaction. It is not ocean temperature. Something has gone wrong in the trophic interaction structure of that system.

How the different users regard the risk evaluation and the trade-offs

Noel Wilkins noted that with respect to the decline being observed in the hatchery-reared salmon as well as the wild salmon, he has for a number of years been ranching Atlantic salmon in Ireland, and the decline in the ranch stock mirrors the decline in the wild fish - so it is obviously something in the sea.

With respect to how the tax dollar is being spent, is there a mixed message here? You talk about allocating money to the problems we have - it seems that there is an implication there that all the different users will regard the risk evaluation and the trade-offs in the same way. He believes that is not true. For example, the commercial fisherman will want to maximize the catch he makes at sea whereas that may be in direct conflict with the anglers. The requirement of the conservationist, who wants to maintain the birds and the mammals, will also have a different trade-off.

Carl Walters replied that there are a number of issues here. One of them is: How do we obtain a clear public policy regarding tolerable risk when most consumptive users are willing to take a lot higher risks than are people with conservation interests? That is a matter for public debate and discourse - getting the trade-off out on the table for discussion. It is a very different matter to discuss how DFO uses the public's tax dollar. When DFO goes out and tells the public that habitat management is the most important thing to be doing with tax dollars, I consider that is not so and it does not have anything to do with risk management or anything to do with trade-offs. Rather, it has to do with the lack of analyses and a bunch of people wanting to attack the 'easy' problem rather than the 'real' problem. He commented, "I do not mind my money being spent on public discourse and democratic debate but what I do object to is my money being spent with public approval when the public is being misinformed about what the problem really is".

The need for re-profiling the existing resources and for more resources

Maurice Coulter-Boisvert commented: Although most people probably accept your premise that more investment should be made in the marine environment, I think it is largely irresponsible for you, and not aimed at solution seeking, to suggest that this should be done at the expense of habitat protection or habitat restoration when your main beef is with fish restoration policies of the major facilities' departments. The bottom line is that there is a greater need for re-profiling of the existing resources and possibly the realization that more resources are needed to study the sorts of things that you need to study.

An example of the importance of habitat restoration

Stefan Ochman commented: I work with the Huu-ay-aht First Nation (on west coast Vancouver Island) and Carnation Creek is in Huu-ay-aht First Nation Territory. There are some effects that were not presented that have been observed for some of the streams on the west coast of Vancouver Island. For example, during the summer period, the Sarita River flow goes from an average of 400 cubic metres per second to less than 1 cubic meter per second - where there is a trickle of water flowing under a few feet of gravel and there is no fish habitat. The result is the coho are stuck in a few pools and the water temperature increases and some of them die. There is definitely a need to continue some habitat restoration. From the Sarita River, they have found that

90% of the coded wire tagged fish that returned were from the efforts of the hatchery – that is, if not for the hatchery efforts, there would probably be very few, or no, fish coming back.

Carl Walters replied: You might want to ask yourself what the wild fish would do if you shut down the hatchery in some sort of experimental way. He commented that it is hard to say whether the hatchery fish have impacted the wild survival. One thing you never want to do is assume that you, as a person, are a good judge of what fish need. They have had streams where they put in smolt fences and counted the smolts where during the previous summer the streams went dry and they still produced smolts, meaning that juvenile coho, at least, are either moving down into the estuary part of the time to deal with some of that habitat variability which is there naturally, as well as due to other effects, or else they are managing to stay alive in habitats that we do not understand yet, such as in the interstitial gravel which is where a lot of the fish probably go during those harsh times. If there is any lesson from Carnation Creek, it is that, you should not assume that you know what the fish need. In some ways coho are ‘tough as nails’ and in other ways they are amazingly vulnerable; for example, the situation where half of each coho smolt run was wiped out probably mostly by birds during the first mile or two of downstream migration, and the fact that we do not understand why they are so vulnerable for a short time in healthy or unhealthy environments. We are not getting that basic knowledge anymore and our monitoring programs and the research programs that would allow us to get this information are being shut down.

Habitat restoration effects for the ecosystem of the Squamish valley rivers

Randall Lewis commented that he agreed with Dr. Walters with regard to the interceptive fishery and the ocean mortality. However, with respect to the work that the Squamish First Nation have carried out with chinook, coho and chum enumeration over the last seven years, the increases they have observed can be attributed to the habitat restoration that they have carried out in the past on the Chekamus River side channels. In the case of the Mamquam River and the Stawamus River, Squamish First Nation elders remember playing on the rail cars in Valleycliffe where they used to do the heavy logging. Then Valleycliffe used to be the largest producing salmon tributaries in the watershed. Now all the tributaries have been built over. As a result of doing a lot of restoration work on the Upper Squamish, there are increased salmon returns - in the seven years from when they first started they have gone from 2,000 - 3,000 coho, to two years ago approximately 14,400 coho, and last year there were 23,000 to 24,000. That is observed in the mouth of the Cheakamus River, where it comes out as a tributary of the Squamish River. This area was known as the ‘eagle capital’ of Canada - there were 4,000 or more eagles in one area. The reason they were there was because of traditional salmon spawning grounds - there aren’t any fish there now and they are saying the eagles are disappearing because of this. This is not true however, they are just moving up to the areas where the restoration work has been carried out and to the spawning grounds in these different watersheds. The eagles are dispersing and going to where the fish are spawning again in the historic channels where the groundwater channels exist now. You can also see that the forests are becoming healthier in and around that area where the fish are frequenting these waters again because the bears are also coming down and removing those fish and taking them into the forest and the eagles are taking them up into the trees again. There is evidence of return, directly related to the habitat restoration that has been conducted in this area and, the Squamish First Nation considers that there is a lot more of this work that needs to be done in the future. If you have more fish reaching the headwaters, then there will be a lot more returning back to the ocean. He commented: You are right when you point out the ocean mortality and we need to understand what that is but I would not discount the importance of habitat restoration.

Carl Walters replied that only time will tell as to whether or not any of that restoration activity can overcome the effects of the marine mortality. In his opinion, they need to be prepared with policy formulation on analyses for dealing with this very large issue of a whole new competitor for the fish out there. The First Nation traditions involve helping to get rid of that competitors, such as the marine mammals. The best candidate we have for why those ocean survivals have not turned around a lot more than they have, especially considering some of the changes in ocean conditions in the last few years, is because of this persistent ecological variable.