THE CRISIS IN CANADIAN FISHERIES

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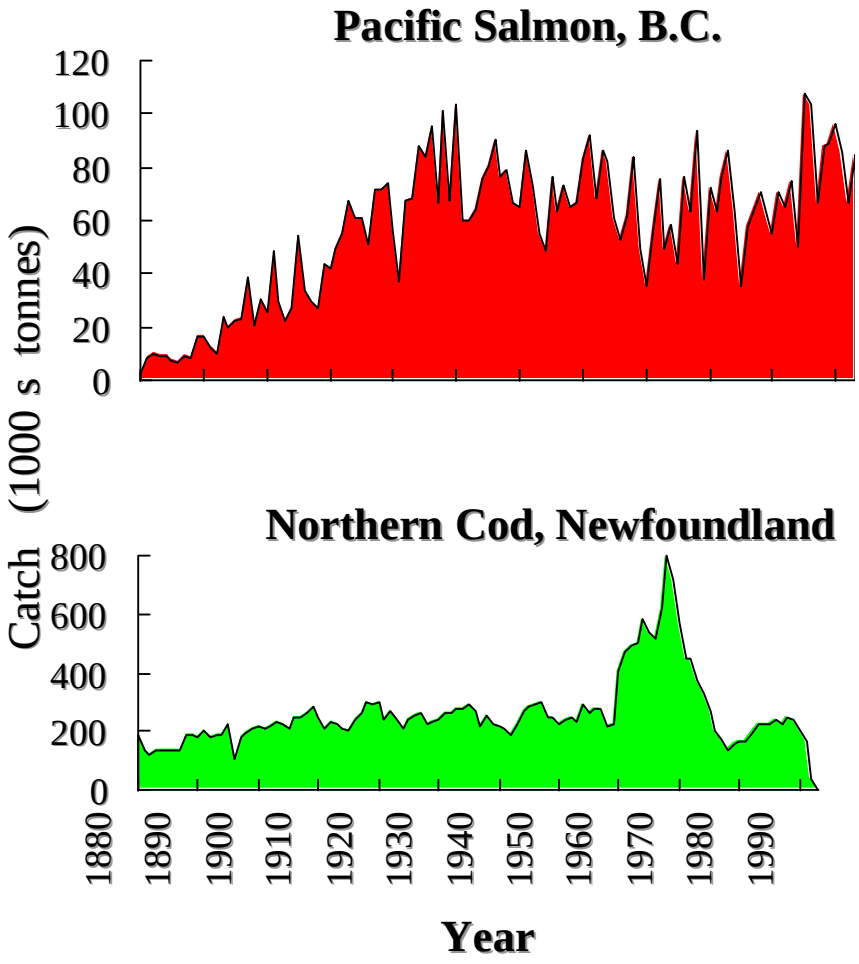
Biographical Note: Since coming to UBC in 1969, Dr. Walters has worked mainly on Pacific salmon and other marine fisheries, with emphasis on the development of methods for managing sustainability in the face of high uncertainty and limited information. He has been active in public debates about management and conservation of Pacific salmon, and has advocated major changes in management approaches to meet biological and institutional requirements for conservation.

This paper will provide an academic perspective on the status and future of Canadian fisheries. It tries to draw some lessons about what the people of Canada will probably have to do if we want to maintain those precious resources. Fish touch all of us in Canada. There are a very few Canadians who are not deeply interested in one way or another in fish — whether fish to eat, fish to catch for recreation, fish as an industry, or fish as the basic support for key parts of our culture. I do not think that any Canadian was untouched three years ago with the closure of the East Coast Cod Fisheries and the enormous social and economic devastation that caused for people in Newfoundland and the Maritimes. The key principle I will follow here is that when we talk about fisheries, we are talking about a public resource, a heritage to all Canadians and to our children. Much of my work and my perspective is drawn from the notion that we deserve better.

Much of this presentation is drawn from my attempts to understand the data represented in Figure 1. This figure compares trends in harvest of the two most valuable fisheries in Canada. On the east coast, we are looking at about 100 years of history of the Newfoundland Cod Fishery, from 1880 until it was finally closed in 1992. In stark contrast is the history of our salmon fisheries on the Pacific

FIGURE 1



coast where not only have catches been sustained, but in the last thirty or forty years we have actually seen increasing abundance of some salmon stocks. We need to stop and ask how it could be that these two situations could diverge so dramatically. How could it be that in a system that has the same system of governance, the same public policy conservation objectives, the same laws, the same massive Fisheries and Oceans bureaucracy, we could end up with two such starkly different outcomes? And we must also ask whether the

east coast outcome is in our future here in British Columbia. We cannot explain this monstrous difference as being due to any of the simple things you read about in newspapers, like massive fishing technologies and the power of fishermen to destroy the resources. Our British Columbia salmon fishermen, since at least 1930, have had the technology to destroy our salmon resource in BC in about a week or two of fishing, radically faster than the cod resource was destroyed, yet it is has not happened.

Further we cannot explain the cod-salmon difference as being due to simple matters of salmon being visible and easy to count, or because they come into streams to spawn. They come into streams to spawn after we do the damage to them, after they are harvested. So the best we can do with salmon from a knowledge perspective that is different from the east coast, is to know a little sooner how bad a job we did. Being able to count salmon in spawning streams does not help us to manage them except by making it a little easier to see over many years how many spawners are needed for good production

We also cannot explain the difference between BC and the east coast just by the enormous biological diversity of our salmon population. If you look at a map of BC, and blow up any part of our province like Vancouver Island, what you see is an extraordinarily network of streams and waterways — most of which support salmon that are genetically adapted to the particular conditions they find in those streams. We guess that there are roughly three to five thousand genetically distinct races of salmon in British Columbia. You might argue that the big difference between us and Newfoundland is just that we have so many stocks of fish. Well, that's not true at all, because we do not manage all of those thousands of stock separately. Instead, what we do is to harvest them mainly in a few very large areas when they're mixed together off the west coast of Vancouver Island, or in the Georgia Strait, or up by the Queen Charlottes. And practically nothing that we do is aimed at trying to maintain that extraordinary diversity. In fact, we are gradually eroding the diversity away over time, managing a few populations well and most very poorly. If I had been able to draw a picture of it to show the situation

here in BC, I think a good image to provide you might have been one of you driving out to Fraser Valley, and seeing a beautiful new factory with two floors. Behind this factory is a large line of trucks—with their engines roaring, horns honking — and it is clear that there's a great deal of industrial activity going on in the plant. You see a beautiful big sign at the front of the factory saying: BC Toy Company, with the slogan underneath: "Pursuit of Excellence." A sign at the door directs you: "inquiries upstairs." Instead of a factory, what you see on this second floor is dozens and dozens of desks with administrators, and accountants, and managers sitting at their computers exchanging e-mail. And as you ask them what this factory is about, you go from desk to desk and all you can get is shrugs — no one seems to know what is happening. So you decide to explore a little further and you walk downstairs. There you find a factory floor with just a few dozen people in it, working frantically with faulty equipment that is breaking down all the time, desperately trying to make the system work, hopelessly inadequate in terms of the task, equipment and facilities. But they are producing a few cartons of toys, and each time a carton of toys comes off the conveyor belt they run with it out to the loading bay where there is a mad scramble amongst the truckers waiting there. And the box is grabbed by the nearest trucker and he roars away. And there is a man standing on the loading dock with a clipboard in hand and a big smile on his face and you think, oh maybe this person knows what is going on. When you ask, he replies "Well, I'm the union shop steward, aren't we doing a wonderful job for providing employment for truckers here in British Columbia." So you move on to the truckers and ask them what they think about this situation. They say, "Well, there's too many truckers out here, but this is a wonderful lifestyle — we're free and easy, we can travel as we wish, we have the freedom of the land like fishermen have the freedom of the sea. This is a wonderful situation for us and while it doesn't really provide a great deal of employment, Canada's social safety net takes care of that problem for us." So what we see in British Columbia hidden behind the magnificent diversity of fisheries opportunities is a system that is pathologically unhealthy in terms of social and economic structure.

People who write about sustainability, a word that I have never really quite been able to understand even though I am supposed to be a scientist in that field, really talk about two things. They talk about ecological sustainability, the maintenance of biodiversity and the habitats for producing organisms that we enjoy by limitation of the harvests that we take. But they place equal weight, and rightly so, on economic management — on self-sufficiency, on community-based and localized management systems that can deal with the complexity in nature down at the scale where we see it developing, and on avoiding unnecessary waste. Well maybe here in British Columbia we are not doing too bad on the ecology side of sustainability. We certainly are not doing well on the economic side. I will return to that issue later.

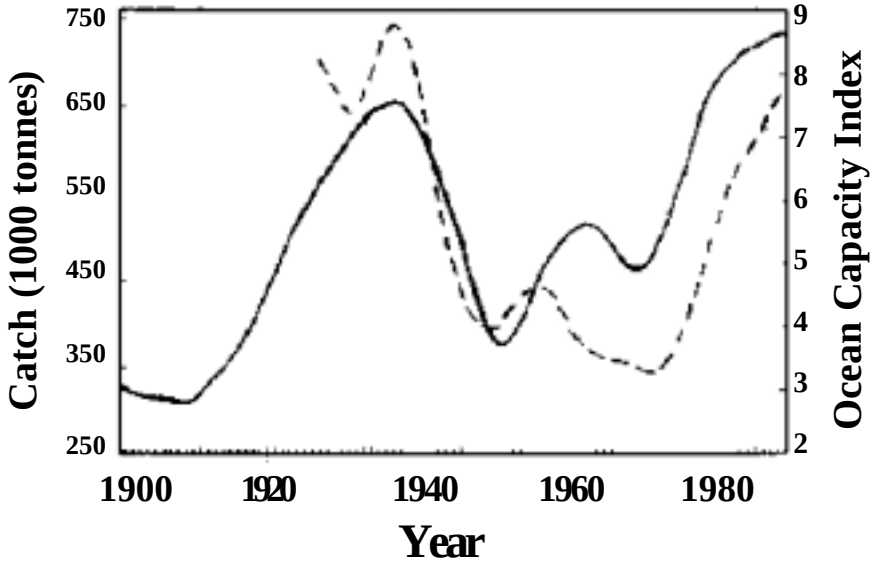
Now let me review in general what we know about why fisheries collapse. There have been enough of these horrible disasters around the world. The first really big one was the Peru Anchovy fishery that collapsed in 1970 and 1971, virtually destroying the economy of the nation of Peru. This was every bit as bad a disaster as our Newfoundland Cod collapse. And there have been enough such disasters that we can actually develop a fairly elaborate taxonomy of them, which is not saying much for our ability to manage sustainably. When we cut through the complexities of that taxonomy there are really three things that go wrong in different circumstances. The first and perhaps most widely recognized is failure in the governance system — failures of our administrative and bureaucratic systems to manage effectively even when adequate information is available. The second is much less well known to the public: bad science. I will show you what to someone in my profession is the worst possible nightmare that could ever happen. I will show you that the Newfoundland Cod disaster was caused in part by my own particular scientific speciality of stock assessment — the errors that we made. Third, there are cases, the easiest cases really to deal with, that just involve bad luck. And let me talk about that a little bit because it had something to do with difficulties in developing good policies.

There are enormous changes going on the world around us

— the marine climates that produce fish and the fresh water climates that produce them are undergoing violent changes, both natural and man-made. The effects of these huge changes on abundance of fish are confounded with the effects of our management; that is, when we see a population of fish collapsing in nature, we very often cannot tell, until the collapse is well along at least, whether it was caused by something natural or something we did, and whether remedial actions have changed the course of the collapse in any significant way. The effects of changes in the environment and the impacts of fishing and other human activities all compound and confound one another. So a major discipline in fish research in recent years has developed to study what is called "fisheries oceanography," to basically document the massive changes in the carrying capacity and capability of the oceans.

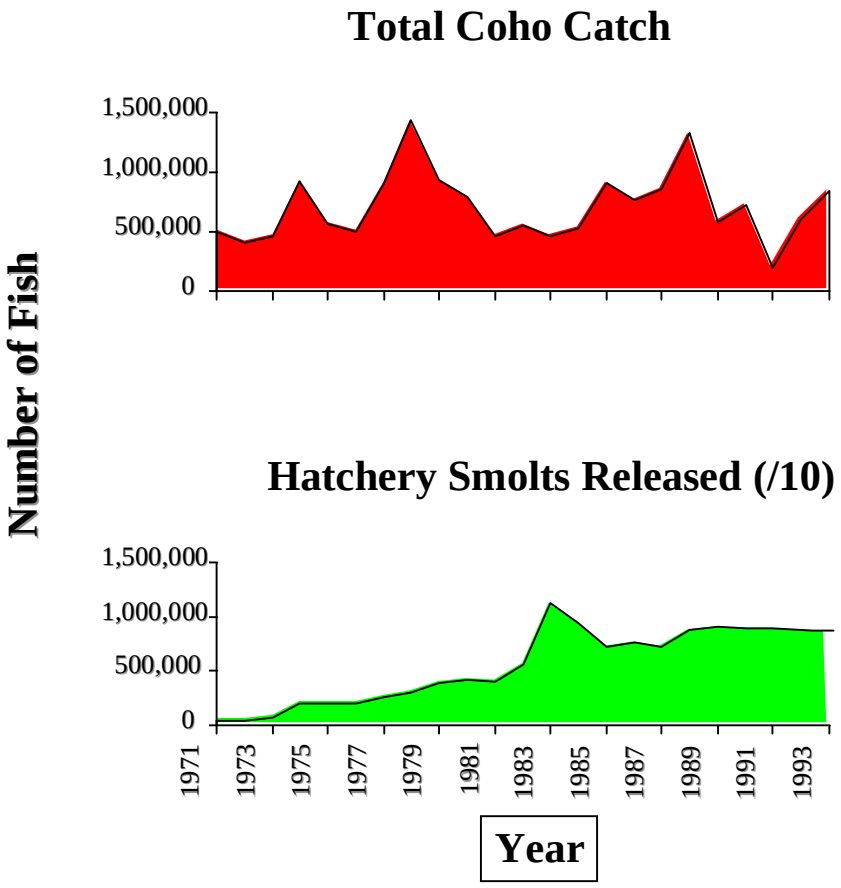
Figure 2 shows that the capacity of the north Pacific Ocean to grow salmon has fluctuated through this century by a factor of almost three, with huge ups and downs on decadal time scales. When we see the down side of one of these massive fluctuations, we cannot

FIGURE 2



tell in principle whether the decline is due to something wrong in the way we manage, or to nature getting back at us. We have tried to deal with a lot of that natural variability with technological fixes — we have tried to use hatchery production systems to stabilize survival rates of fish in the ocean. It hasn't worked at all, as you can see from Figure 3 which shows hatchery releases into the Georgia Strait of juvenile salmon that support one of our more valuable BC fisheries, a recreational fishery for Coho salmon. Over the last 25 years we have increased the number of fish released from hatcheries to be about equal to the wild production of Coho salmon by all the hundred odd streams that produce them around the Georgia Strait. You

FIGURE 3



can see in the figure how well we have done from that programme; catches of Coho salmon in the Georgia Strait have not increased at all, and in fact have even declined in recent years. Environmental factors are often blamed by those who want to keep our hatcheries going despite this catastrophic failure. As scientists we simply cannot say this is wrong; we cannot reject the hypothesis that we have just been unlucky, that hatcheries, perhaps if we just keep them going for a year or two longer, will start working, and it is all a just a matter of us being patient with our hatchery administrative systems. So bad luck causes us big problems because it makes us unable to really say what is causing some of the changes that we measure.

Bad governance could arise in principle from just plain incompetence. I think we have examples in fisheries here in Canada where the people who are managing and administrating our fisheries — largely people trained as biologists — just do not understand how to step beyond the fish and understand fisheries as systems that involve both people and fish. We also have things going wrong that you see everyday in the newspapers involving the capture of our management agencies by industry. Our fishing industries here in Canada are some of the most vociferous interest groups that any politician would have to face. These interest groups are extraordinarily effective at disinformation campaigns, at the "not me" business. You can hardly pick up a newspaper with a quote from a Canadian fishing interest here in Vancouver, without seeing that fishing interest blame someone besides themselves. If you are a commercial fishermen, you blame habitat destruction, you blame sport fisherman, and you blame natives (those are the three scapegoats for commercial problems these days). If you are a sport fisherman, you blame natives, and habitat, and commercial fisherman. It just goes on and on and on like that. Government administrators are barraged with this kind of disinformation.

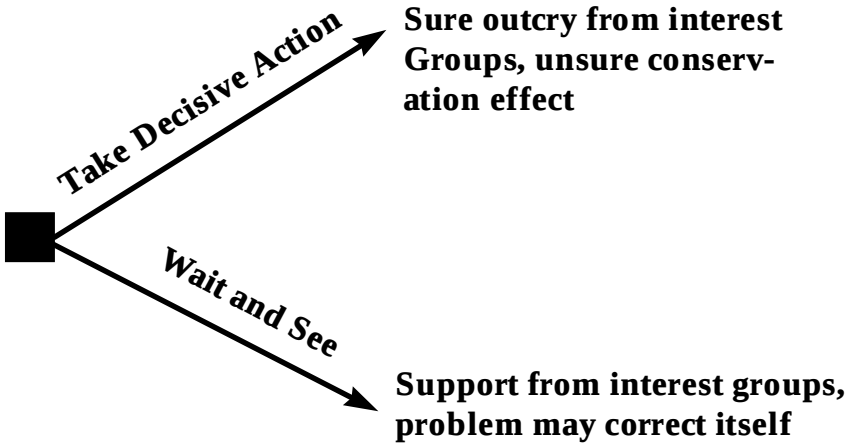
What happens in our decision making system in the face of uncertainty about environmental effects and disinformation campaigns? Decision makers are faced with a hard choice, to conserve fish (cut back on fisheries), or to wait and see in hopes that the problem will correct itself. Decision makers know that decisive action

will bring outcries from industry (Figure 4). And yet we as scientists cannot assure them that decisive action will really do any good. If they wait and see, they will get support from fishing interest groups. And there is always the possibility that nature will take care of the problem, that it was caused by an environmental factor. If you look at this decision choice objectively, I think you will see that it is actually fully rational for ministers of fisheries and fisheries bureaucrats not to act decisively in the face of advice and warning — it is much easier, much simpler, and much safer from their perspective to wait. That is especially true when by waiting to see, you may pass the burden of the decision on to your successor, so you do not have to feel the brunt of it at all.

Probably the best example we have locally of what happens when this kind of indecision problem is repeated over and over again has been with British Columbia's most valuable fishery (Figure 5). The most valuable fish is not our commercial fishery, it is the recreational fishery for Chinook and Coho salmon in the Georgia Strait. The total economic value of that recreational fishery, bringing in

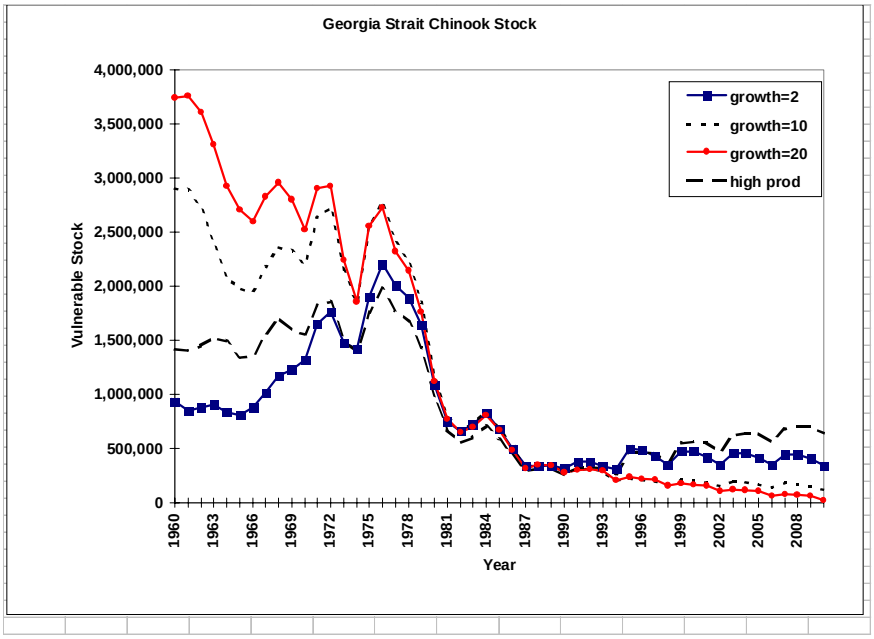
FIGURE 4

Indecision as rational choice



tourist dollars from Americans, easily exceeds the total value of all of our commercial salmon fisheries. Well, that Chinook stock is collapsing and we are almost sure that the basic reason for this collapse is overfishing. We are almost sure, in fact, that the stock has been over-fished since the mid-1970s. I do not think there is disagreement among scientists about this at all, but as the collapse has proceeded (to something in the order of ten percent of the fish that we had just a couple a decades ago in the Georgia Strait), our government, instead of taking any serious action, has put on a series of what we call "band-aids." These are silly little pseudo-conservation measures like closing the spring commercial troll fishery (which actually increased the harvest by making it more attractive for sportsmen to go out); a sports spot closure that protects salmon for a few weeks at a time so they are caught a little later in the year than they were before; a twenty-six inch size limit that protects Chinook salmon for an extra three weeks or four weeks each spring before they reach

FIGURE 5

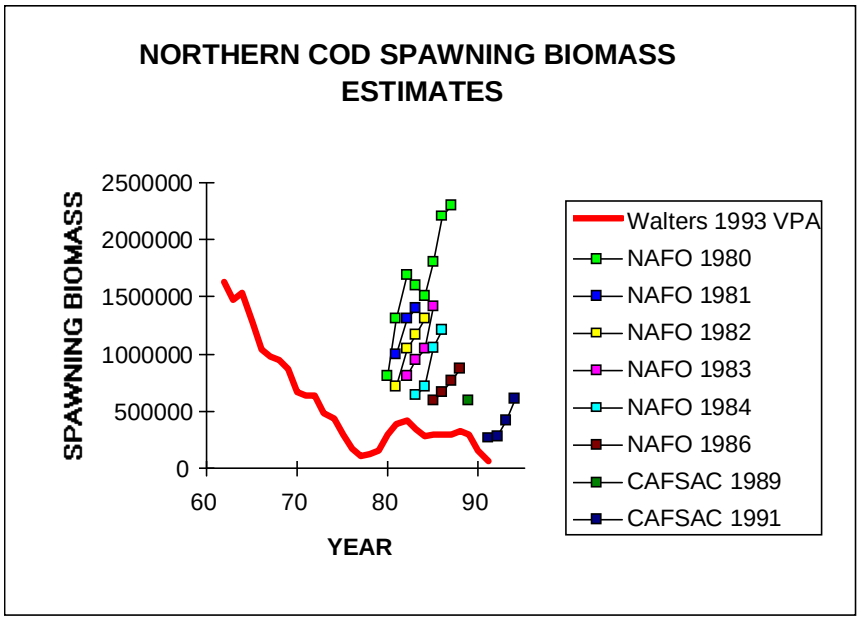


the size when they can be harvested. Nonsense regulations like these provide the political appearance of decisive action, without the substance needed to do any real good.

Now we cannot say exactly what is happening in situations like this. We can pin down fairly precisely for the period where we have accurate statistics, from 1975 to about 1990, what the stock of Chinook salmon was actually doing — we have pretty accurate estimates of the percentage of fish being caught and what that catch represents in terms of abundance. But we do not know what went on earlier. We don't know how severely the stock was collapsing before we started to gather good information, and when we do not have that longer history we cannot, in consequence, say very much what the future will bring, particularly if harvests are reduced. Almost all of our scenarios and calculations indicate that the stock is going to remain very low or continue to collapse into the future unless something major is done. But we cannot prove that, and as long as we cannot, there will excuse for inaction.

Scientists who do the assessments (the estimates of abundance of salmon or cod off Newfoundland) are not in any way accountable for the mistakes that we might make. There is no onus on us to do a good job. We make lousy statisticians — those of us who thought we were going to be working on fish when actually we work on population statistics, every bit an area of statistical study as any thing in the field of statistics. And we have been woefully irresponsible about investment in information gathering in fisheries. So how have we paid the price for these things? Let us take a look at the anatomy of the collapse of the cod stocks off Newfoundland. Figure 6 displays cod stock changes since 1962 and shows a collapse down to a low in the late 1970s, then a bit of stable period, then a complete collapse in 1992. This "backcalculation" of the stock history is not disputed; we know pretty well how big the was because practically all the fish that were there each year were caught that year or a few years after. But what happened off Newfoundland was that the cod stock had been harvested and fairly stable by an inshore fishery that persisted for about three centuries. Foreign trawlers arrived off our coast in the late 1950s; they were able to fish out at the edge of the

FIGURE 6



continental shelf where Newfoundlanders had not been able to go, and to fish on spawning aggregations of cod. Their harvests reached enormous peaks and started to collapse in the late 1970s. In 1977, Canada took over extended jurisdiction on the east coast (the 200 mile limit) and we ousted the foreigners. There was a window of opportunity for just a few years, between 1977 and about 1980, when we could have recovered from the nightmare caused by the foreign fishing. It was generally felt amongst people in Newfoundland and by a lot of scientists that the stock had been grossly depleted.

The general view in government at the time was that there would probably have to be a very long and painfully slow period of building the cod stock. But did we get those things? No. In 1980-82 courtesy of the Canadian taxpayer, we got a thing called “enterprise allocation,” in which you and I helped a couple of major Canadian companies build a whole new offshore trawl fleet to replace the foreign fleet. So we went back out to sea and basically repeated exactly what the foreigners had done to us. We took high catches for about

six years through the 1980s and then catch started to fall. In 1992, the last year of the fishery, our fleet removed as much as seventy percent of the total stock of cod left in the ocean, in two months. Over the course of 1992 some estimates suggest they removed over ninety percent of the remaining stock. Today, off Newfoundland, the cod stock is at one tenth of one percent of its abundance in 1950. That stock is very likely not going to come back in our lifetime.

How could this happen? How could we, with the incredible window of opportunity that occurred between 1978 and 1980, have failed so badly? Well, one argument you might see from Canadian officials was that no one was paying attention to the scientists. That is absolute nonsense. The recommended harvest by Canadian scientists was very close to the actual catches taken in the fishery. The fishery took fewer fish, not more, than the scientists recommended. It is not that the scientists were ignored. In fact, the fishermen of Newfoundland took the Canadian government to court in the late 1980s to try to force closure of the fishery; the government won the case and kept the fishery open for a few extra years. So something went very badly wrong, not in the governance of this system — the allowable harvests were followed pretty exactly — but rather in the assessments of the state of the resource and its capability for withstanding harvest. While the stock was collapsing, managers received thick reports from scientists, with vast tables of numbers, statistics, reviews, and analyses all pointing towards a recovering cod stock that would soon be healthy. It is very difficult to dig through such a barrage of information. But what did that information produce? Figure 6 shows what the stock actually did. The declining line shows our best back-calculation of how many cod were actually in the sea. The peculiar little lines pointing away from the actual population are the scientists' estimates and projections of stock size for different years. The peculiar line that begins to shoot upward for 1979 starts with the scientific estimate of the cod stock just after we took over extended jurisdiction — this estimate was three times higher than it should have been. Follow that line for the scientific projection of how the cod stock was going to recover under the enterprise allocation fishing plan. For each year after that you see a similar peculiar

sequence of estimates and projections. There is a gap about 1985 to 1990; this is there simply because the government stopped publishing estimates. During the early 1980s, a few scientists were responsible enough to look back and to see that they had, in fact, been grossly overestimating the stock. This caused a considerable debate and hesitancy about publishing any assessments until the cause of the errors could be determined. But by 1991 the assessment system was back on line, continuing to make exactly the same mistakes as recently as one year before the fishery closed. So they not only overestimated the abundance of fish; they also did not seem capable of learning that they were making the mistake and of doing better in the long term.

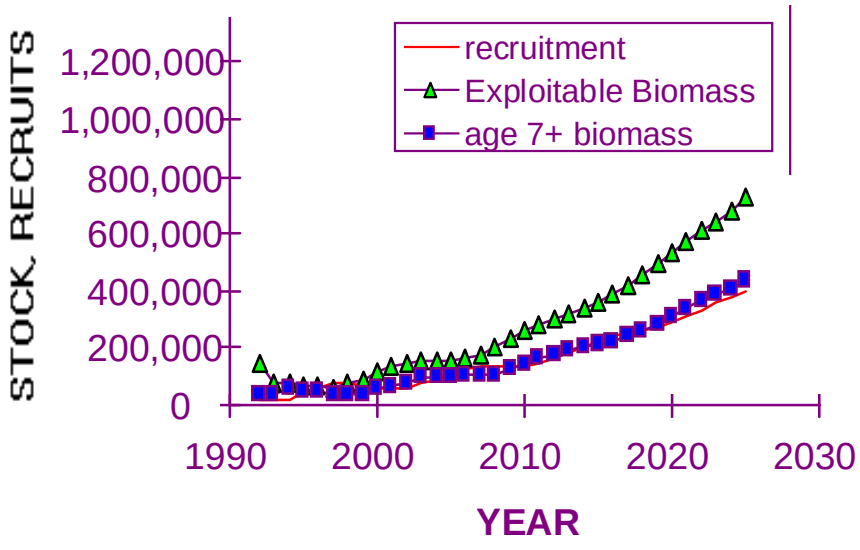
We have been able to reconstruct how and why this mistake was made. It turns out that scientists were trying to use the success rates of commercial fisherman to provide an index of abundance of the cod. These commercial success rates did not drop very fast as the stock collapsed, because commercial fisherman are very good at finding the last fish. And when the scientists made this rather silly assumption, that the commercial fisherman were searching the world at random, they of course overestimated how much was left. Another thing they did, and that I find even more bizarre, is that not until the late 1980's did they look carefully at the relationship between the reproductive success (we call "recruitment") of the cod and the abundance of spawning cod. It was a matter of deeply held dogma — and still is by some scientists — that cod product millions of eggs and so their reproductive success or recruitment does not depend on how many adults there are. Staring the scientists in the face over much of the cod collapse were data showing a very dramatic and profound relationship between how many adults there were and how many babies they produced — something that any school child should be able to tell you we should expect. So, not only did scientists overestimate the abundance of fish, they violently overestimated the reproductive capacity of the cod in the face of harvesting and depletion.

So, to summarize what happened on the east coast, scientists made serious errors by using a bad abundance index and failing to

recognize probably the most serious concern that any biologist involved in the management of fisheries should have — this thing called "recruitment overfishing," not allowing enough fish to spawn. These are not subtle errors. They are the kind of things that warnings have been published in fisheries textbooks since about the 1930's. Yet, our management system was unable to learn those basic lessons. Looking to the future, Figure 7 shows a pathetic best guess of how the cod stock will rebuild if it is not fished at all. We know it needs to be built up to about a million tons of fish, and it very likely will not reach that level before near the middle of the next century, if at all. The projections hint that few Newfoundlanders alive today will be able to live in an outport and fish for cod.

Unfortunately, we are seeing a move today in fisheries management all around the world to try to essentially adopt the same kind of management system that led to the cod disaster. That management system is what's called an "output control" or a "quota management system" that relies on scientists estimating the abundance of fish and then using their estimates of abundance to decide what a

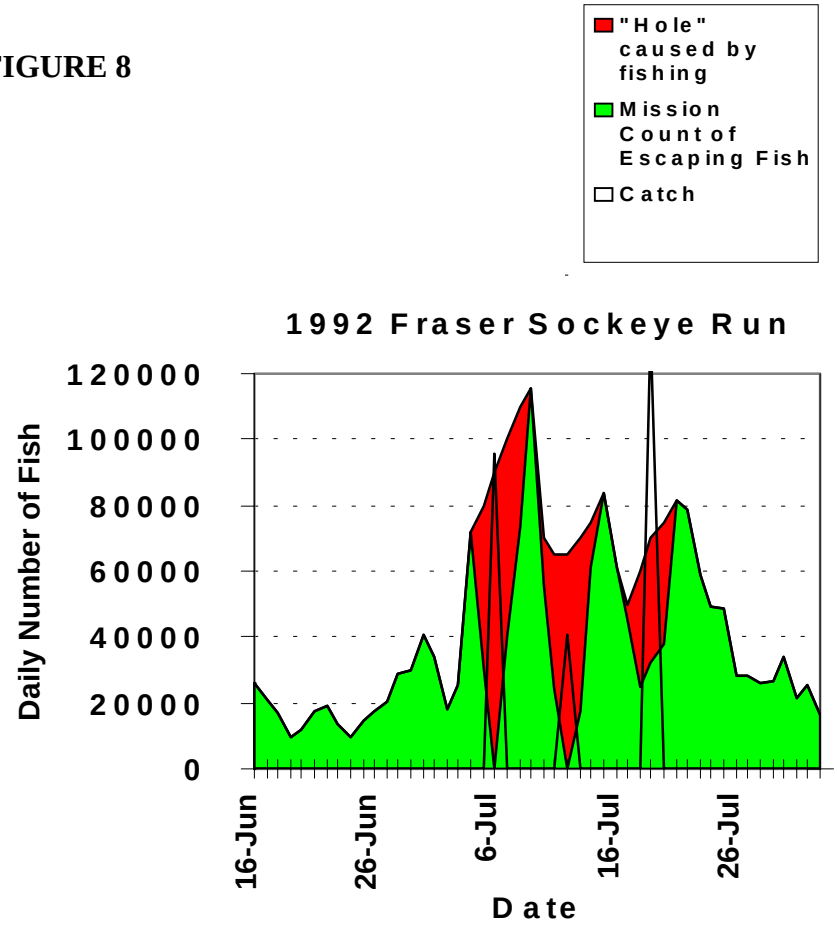
FIGURE 7 - Northern Cod Rebuilding



safe allowable harvest is each year. This approach is simply not going to work. We have no indication that the things that went wrong with the cod fishery can be corrected by any economical investment to gather more information. It is a problem we are going to have to live with.

Let me return to the striking difference between B.C. and Newfoundland, and try to answer the question why it is that we have salmon left in British Columbia. We have a technology out there that is every bit as destructive as in Newfoundland. I think the fundamental reason here is an extraordinarily simple one. It is that we manage our pacific salmon, not by knowing or pretending to know, or being so arrogant as to think we know, how many fish there are in the sea. We manage them, instead, by what is called "exploitation rate management." That is, when a run of salmon approaches a fishing area, what we do instead of having the whole ocean open to fishing is to have very short, concentrated fishery openings. So if you have been around Steveston, or the mouth of the Fraser, you will notice that every summer, on Monday mornings or Sunday evenings sometimes, there is a twelve hour or twenty-four hour fishery opening. What such fishery openings do is to cut massive holes in the stock of fish. Figure 8 shows the depth the holes we think were cut by three openings that occurred in 1992 on the Sockeye run entering the Fraser River. Now the key thing about the way we manage salmon is that, without ever knowing how many fish are involved in the total run, without every knowing the area under the curve that measures total abundance passing Mission, we can be pretty confident about what percentage of the run will be removed when we cut holes in the abundance curve by having small fishery openings. Traditionally, we have had very stable exploitation rates over the years in our salmon populations, because of this hole cutting or exploitation rate method of management. What that means to the salmon is that, if the salmon come back in low numbers in some year, the catches are automatically reduced because, when you take the same percentage of smaller stock, you take fewer. So we cut back automatically on our harvesting when there are fewer fish, and we take more when runs are large. That basic feedback confers a resilience on our salmon populations

FIGURE 8



and our management system that is simply not there in a situation like Newfoundland.

Once in a while, we also make big mistakes with salmon management, generally in situations where we have what is called a "gauntlet," in which we harvest a run of salmon at a whole series of locations along the coast. Last year, we very nearly lost the Adams River Sockeye run. We came within one twelve-hour fishery opening of destroying the most magnificent fishery resource in British Columbia. The way that happened, is that as the Adams run approached the coast here in B.C., it made landfall around Noyes Is-

land in Alaska and off the Queen Charlottes, and in those fishing areas a substantial number of sockeye were harvested before we had any idea of how many were there. We had a pre-season forecast of around seven million fish, but we really didn't know; and the fishermen, as the fish concentrated against the coast, handily caught a couple million of them. Then, as the fish migrated down the coast, they came in through the Johnson Straight where another three-odd million of them were harvested by a very intense purse seine and gillnet fishery. Now, all this is perfectly normal. We have been doing this kind of harvesting every year for a long time and have gotten away with it. We cut holes in them in the Johnson Strait, just like I showed you on the Fraser. But we have had, in recent years, a progressively more complicated allocation — a progressively stronger demand on our scientists to provide more accurate assessments of abundance, and to use those to provide more and more small fisheries, and allocations of fish, to natives, to gillnetters and to everybody. So, biologists were forced to use numbers from the harvest in the Johnson Strait to make an estimate of the absolute number of fish that were pooling from the Adams River run at the mouth of the Fraser River. Ordinarily, we would not try to harvest very much at the mouth of the Fraser from the Adams run, because these fish sit at the river mouth in a very concentrated mass and are very vulnerable to overharvesting. But this last year, our government decided that instead of the traditional way of doing things, they would use this estimate that the biologists had produced and go ahead and have an opening or two at the mouth of the river. They had the first of those, and it became really obvious that they had virtually destroyed the run by that point. So they stopped the second opening. But the key thing is that we had violated the basic principle of managing by exploitation rates, and we had become arrogant about our ability to estimate the number of fish.

All this appeared in the newspapers in a very peculiar way — the overestimate that biologists made (about two million more fish than actually passed the Johnson Strait), was widely called in the newspapers "The Missing Two-Million Fish." These fish were not "missing" at all; rather, there was a stock assessment error — a sci-

entific error of a kind that we inevitably will make when we are dealing with highly variable populations in a highly variable environment with incomplete data. It is the style of management that really went wrong, not the assessment system. We cannot run a complex gauntlet fishery safely when there are too many interest group allocations to meet. We cannot satisfy the interests of north coast native fishermen and south coast native fishermen and trollers and seiners and gillnetters, and all the other interest groups that clamour for our attention today with salmon. We have got to have flexibility and make the fisheries smaller and safer, or we will not have them before very long.

The fixed exploitation rate concept is something that just about everybody can understand — if you don't want to catch more than ten percent or fifty percent of the fish, don't expose more than that percentage to the risk of harvest. If we can take a lesson from the salmon, we have a very simple principle upon which we can start to build safer and sustainable systems for managing fisheries throughout the world. So, I see great hope in the lessons we can learn from our Pacific salmon. The hope, actually, goes a little bit beyond that. When we look closely at fisheries that have persisted for a long time around the world (such as tuna, or cod before offshore trawling), we most often find that much of the stock is in places where it is uneconomical to pursue them. Most harvest is taken close to coasts. It is as though there were a closure over much of the ocean to the harvesting.

As an aside, there is something else we have discovered recently. We have been looking from a theoretical point-of-view at simple fixed harvest rate strategies, and we have discovered they are probably the best possible way for us to deal with the huge environmental changes that are going on in the ocean as well. We have used computer models to represent the kind of violent, long term changes in ocean carrying capacity that have been documented in recent years in the North Pacific. We told the computer to calculate for us what the best number of fish to allow to spawn would be each year, knowing the entire future. So we pretend that we know what future environment will actually occur. The result from the computer model is

that if we really knew what the future was going to bring, then we would follow what is called an "anticipatory policy" — we would start to cut back on our harvest just before periods of high ocean capacity in order to have lots of young fish going out into the ocean at just the right time to capitalize on that production opportunity. In other words, we would use our ability to make predictions about the long term to improve the performance of the production system. But constant percentage harvest rate gives a simulated harvest performance about 95% of what we could get if we actually knew what the future was going to bring. What happens is that the natural tracking or feedback capability of a simple harvest rate policy lets the stock build up and go down as the environment becomes better or poorer for production. The simple policy is not quite optimum — it does not quite build up the population as rapidly as it should — but in a world where we are not likely to ever know what the future is going to bring in terms of climate, it certainly is a good second best to perfect knowledge.

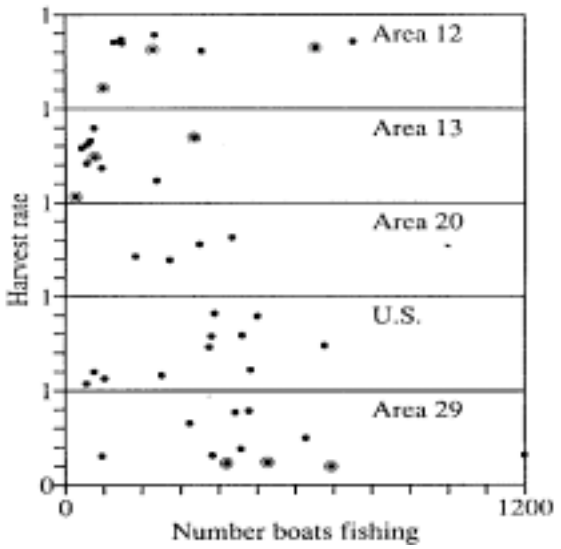
I have now pretty much finished the fisheries/scientists/biologist part of my talk and I want to speculate about that factory here in British Columbia — the factory that has far too many fisherman chasing the available stock to fish, that is hideously inefficient from an economic point-of-view, and is hideously wasteful. I personally think the key to our future is not so much the way we manage our harvest biologically, but rather what we do with that economic monster. Around the world today, the developed countries put more money into our fisheries than come out. The fisheries agencies' management costs, combined with the cost of harvesting, exceed the value of our fisheries throughout the developed world. That means we, as taxpayers, are carrying the burden of sustaining a system that cannot pay for itself. This is not fair to us and it is certainly not sustainable in the long term as we begin to find other pressing needs for public financial resources. Our salmon fishery is a catastrophic loser. It brings in a gross of about 250 million dollars a year to commercial fishing. The operating costs each year to the industry, the costs for keeping their boats, and operating them, and hiring crew and burning gas and chasing each other around the ocean, use up more than

half of that income immediately. It costs us somewhere between 70 and 100 million dollars, depending on how you partition the Department of Fisheries and Oceans budget for this region, to manage the fishery, to run around and enforce and enhance and all the other public management functions we pay for. And then we pay the fishermen an additional 60 million dollars of seasonal unemployment insurance. So, when you add the plusses and the minuses, our current commercial fishery is operating about 40 million dollars in the hole.

So anything that a commercial fisherman tells you is his net earning is coming not from the resource, but rather from your pocket and my pocket. The key reason for this is that we have something in the order of 3 to 4 times the number of commercial fishing vessels out there than we should. Perhaps the best signal of this is what scientists see when they examine the harvest rate, the percentage of fish that are removed from the water each year in different areas along the coast in relation to the number of boats fishing. [See Figure 9]. What the scatter of dots in Figure 9 says, is that, over a very wide range of number of boats showing up at fishing areas, we harvest the same percentage and same number of fish. We have many times the capacity out there than is needed to harvest what is available. What this means in a fishing area like the Johnson Straight or at the mouth of the Fraser River, is that most of the time, when a fisherman is out there burning up fuel, burning up time, he is not really fishing at all. He is sweeping water that has already been swept by the person who was there a few minutes before him. When a gillnet opening occurs now at the mouth of the Fraser River, we estimate that something like 80 percent of the sockeye salmon in the river are removed in the first few hours of the opening. So, most of the time that you see the boats sitting out there, they are literally sitting idle. The cost is there for all of us, but the production, the value, is not.

So what I claim must be a key step to the future for Canadians, to begin to recapture the values of the fishery resource and to manage it more wisely and safely, is to drastically cut back the size of the commercial fishing fleet, and to begin to implement cost recovery systems. I calculate that Canada could end up with some-

FIGURE 9



thing like a net positive value of about 90 million dollars that could then be put into the very real and enormous costs of producing and protecting the fish. Right now, we have thousands and thousands of people catching fish, and a few overworked people producing them; we should have a few *hundred* people catching the fish, and *thousands* producing and protecting them. And this we can do fairly easily if we can break the deadlock that our current licensing system has on access to harvesting. Simple spreadsheet calculations can be used to show how the future might look under tactics like putting a landing tax on the harvest (as in the forest industry), and then using that landing tax to buy back or get rid of fishing licenses. Such calculations indicate that we could reduce the size of the fishing fleet by about 60 percent over the next ten years with a landing tax smaller than the royalties we now impose on the forest industry. A landing tax somewhere in the order of 20 percent would do the job quite nicely. We would be left with a leaner, smaller, safer fishing industry, that would really be earning a living – with fishers left in the industry genuinely being able to say they are employed in it, rather than seasonally and partially employed in it. Over time, the tran-

sient in earnings versus cost would not all be positive. There would be a substantial loss period, during which the public would have to continue to provide income assistance for at least the costs of transition, retraining, and all the other things that are going to happen when an industry loses a large part of its employment. But it strikes me that if we are talking about a future for Canadian fisheries, the long term gains in financial resources and human resources made available to produce and protect the fish is well worth the transition cost.

In summary, my vision of the future is that we will change our fisheries in two very fundamental ways. The first is to require industries to pay for themselves, to force the recognition that the public, the owners of the resource out there, should not bear the costs of protecting and maintaining our own resource in the face of the damages that potentially are brought on by industry of others. And second, I think we need to develop very clear standards of safety and husbandry — what we are willing to live with in terms of our government bureaucracies, their inefficiencies, their errors, and their scientific mistakes. I think we can begin to move this way in fairly simple steps. The whole matter of industrial reorganization, the buyback programs and the other alternatives for reducing the sizes of our fishing fleet here in B.C. are already underway. There is a round table process, in which the fishing industry in B.C. is looking very hard at ways to help to pay for itself and to reduce its size to a manageable level. I think we need to begin to recognize that we have been making gross scientific blunders — a good part of the reason for those blunders is hopelessly inadequate investment and information gathering — and a key reason for not making that investment and information gathering is that the public can not afford it anymore. But with a sensible, sane, and smaller fishing system, we can begin to make those investments in information that are so badly needed. And then, finally, I think that we need a lot of just plain down-to-earth standards for safety and design in our regulatory systems, just making sure that the holes that we cut in the stocks are acceptably small.