Interview Transcripts

Program I: "Empty Oceans, Empty Nets"

Program II: "Farming the Seas"

Program III: "Restoring The Oceans"

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INTERVIEW TRANSCRIPTS - Dr. Daniel Pauly

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What in your opinion is the most grave problem we face regarding the conduct of world fisheries?

It's a different facet of the same problem. Some people say it's overcapacity, there are too many boats. Some people say it's too much fishing effort, which is another way of saying the same thing. Some people say it's the damage that boats do upon the ecosystems, but all of this is the same thing. Some people say it's open access, really anybody can start fishing or invest into fisheries. But these are all different aspects of the same thing.

We hear and read a lot that the total world catch has plateaued at around 90 to 100 million tons a year. What do you think it really is when you take by-catch into account?

That is a really important issue. There are two processes here. You find that lots of people say, "Oh there are a hundred million tons we have now that are sustainable" because this is what in the past people estimated to be the potential yield. You'll find that estimates of potential yields from scientists in the 50's and 60's range from 60 million tons per year to several billion tons per year. That's the optimistic outlook. And the reason why there are lots of estimates around 100 million pounds is because the people could see the catch were going that way. In other words, people have adjusted their estimates of potential yield. Actually, the catch globally is not 100 million tons at all. It's probably around 150, because to the 90 million tons that are caught, you have to add the estimate of roughly 30 million tons that is being discounted. So you have to add that. And it's quite clear that in addition to the catch being reported by the FAO, the Food and Agricultural Organization of United Nations, the FAO can only report what the member countries report to it. And it's quite clear that a large fraction of the catch is not reported. And large could be 20% or so.

Because in many case the countries are not looking, for example, at small scale fisheries, inshore fisheries, they are not including discounts. They are obviously not including illegal catch which is a size of the fraction, so you are easily getting 250 million tons. Therefore the impact is much stronger than you think it is. And we have a project here, a research project here at the center to try and address the issue, of how much is the real catch. But most fishery scientists working in government labs, and I don't want to put them down, but they really cannot come up with high estimates of illegal catch because it would make a very strong statement to what the governments are doing. So illegal catches is a very difficult issue. Even though in some places it's staring at you, you're not supposed to write about it.

In what way do you think it might be possible for the total world catch to actually grow in a sustainable manner?

It is one of the strange things about fishery science or one of the paradoxes about fisheries. That is that the catch could be increased by fishing less. It has to do with the nature of fisheries that basically are not harvesting something that you have sewn like a farmer does but you are really grabbing a part of natural production. Now if your grabbing is in excess of what the system produces, then you're depleting stock, so the trick is to really adjust the level of fishing to that amount that is being produced, exactly. If you go beyond that, you reduce your stock. So I think that globally if each of the fish populations

were exploited at its potential level, you would actually see an increase. Now when I say that, then it looks like, it sounds like I am saying we can fish more, but it's not what I'm saying.

We should fish less. We should re-establish some of the population, as many as possible of the population of fish that we have devastated. That would require less fishing for longer term but I think we could then increase catches quite a bit and also we would also increase the value of the catches enormously which is a different story. See the value would increase because we would catch different fish, bigger fish, higher value fish, but we would also increase the value of the catch because it would cost less to go catch them. And so the cost, the net value would increase enormously. This is not science fiction. It could be done quite straightforwardly and everywhere it has been possible to break this cycle of despair and it has been possible to massively increase catches, and so in a sense it's possible in fisheries to eat your cake and have it too but for this you have to break this notion that fishing more is the thing.

Could you speak about how excessive fishing capacity and new government subsidies have defeated the potential benefits of establishing total allowable catches?

The best way to represent the tragedy of over fishing is to take an analogy that everybody will understand. You have some money in the bank, let's be modest, you have $1000 in the bank. Now you can extract out of this if this is well invested, maybe $100 a year right, you get 10%. Now you can also get far more, you can take $300 but then the interest rate will not support that, therefore your capital will go down. So if you do that after a short while you will end up with a very small capital. Now the capital is the fish that you have in the water. So if you leave as much as possible of the fish in the water and you extract the growth rate and only the growth rate of that capital, you get the maximum interest you can get.

Now, subsidies is the transfer of value, essentially from one sector of the economy to another. If fisheries are subsidized, the cost of fishing declines. That means the individual fishers can earn money exploiting over fished stock because a fish population is very much reduced, it becomes very difficult to exploit its profitably. So at some point, you have what is known as a commercial extinction. It's not worth it to continue exploiting that stock because it's so depleted. That's what they teach us (I will get back to that) but if you

subsidize the fishery it continues to be worth it, exploiting that depleted stock. Now there is another problem which is what we're told about commercial extinction. It doesn't apply in the first place because once a stock is say, commercially extinct, say a population of large fish, the fishery will tend to create for itself a market of say small fish. Now as it catches the small fish, it will have a by-catch of large fish rather than juveniles of large fish and it will actually continue to exploit that large fish population and prevent its recovery. So it is not even true that the fishery, as it renders one population after the other commercially extinct, moves on to another one, it continues to keep it down. That is a tragedy that is due to the un-selective nature of the gear that is being used in many cases.

Do you care to comment on how banks and funding agencies seem to ignore the resource scarcity and continue to bankroll?

Now this business about development agencies and development banks funding the development of fisheries is something that is extremely puzzling. And the notion that if fishers had more boats they would catch more, right? And this assumes that the fishers don't know what they're doing. It's kind of a very strange notion. Just imagine you had a large field with a population of rabbits and you have a few hunters and they reduce the population of rabbits such that the catch per day of rabbits declines to a very low amount. What the bank would do then, in analogy to fisheries, is issue some machine guns. Because the perception is they are not earning enough because the guns they are using to catch those rabbits…they do not conceive that the natural production of rabbits is a limiting factor. So there is all this implied stuff. If you ask yourself, where does this come from, one reason is that the people in the banks are either engineer types or agronomist types who are used to production functions that increase, as one can say, monotomically — that increase if you're increasing the input.

See in a farm or in a manufacturing plant, if you have more input you will have more output, not necessarily in proportion, but you can expect that a bigger plant produces more of whatever it is you are doing. And in agriculture it's true. The more input you have in a farm, the more output there will be. And at the end of the day you can even add to the duration of the day by putting in electrical lamps, so that the plants can grow longer, you can add water, you can even put a greenhouse on top of everything so you have all that carbon dioxide. In other words essentially there is no limit to how much input you can put to get more output. That notion cannot be translated though. It does not

translate with fish population because it's not *you*, it's not your inputs that generate the output. It's the sea. And all you're doing is harvesting or killing. Hence my analogy with the guns.

Having bigger guns is not going to produce more rabbits, but a boat is nothing but a gun in that context. And so when we have a bigger boat, we have a bigger gun, and that's not going to generate more rabbits, but the analogy makes it that the boat corresponds to fertilizer in a plant, or a tractor. Now a tractor increases the fertility by bringing nutrients deeper into the earth when you plow. But a boat ripping up the bottom of the ocean does not increase its fertility, it reduces it. And that is the false analogies that I made. And essentially it also assumes this incompetence of the fishers. The fishers don't know. They don't have the means, let's give them the means. The fact that they are too efficient and that's the reason why there's no fish left doesn't seem to work out.

Why is it that small scale fishers tend to pay more attention to resource abundance when they're planning?

Now one reason why small scale fisheries tend to have, let's say, a better environmental record and less insanity in the way they operate is because they tend to suffer the results of the action. At least that is what happened in principle, until now. If you have more or less a close community and a few members of that community rip up that resource and other small fishers suffer from it, these fishers may have means of social pressure. However, the small scale fishers of the world are increasingly disconnected from one another. They are increasingly less homogeneous and if a few fishers within these communities connect themselves with the world market, they can establish a pipeline between the resource and the world market that bypasses the neighbor. So this privileged role that small scale fishers were playing or continue to be playing is being questioned by these communities or members that are plugging themselves into the global economy.

But on a whole, small scale fisheries are more rational. They use less energy per amount of fish that is landed, they discard far less because the fish is closer inshore. They don't burn that much. They tend to use passive gear, where it's the fish that do the moving to get caught, as opposed to trawlers for example, overwhelming the fish. So in terms of social benefits, the small scale fisheries are clearly better. But there are resource types that are not accessible to them and that's where the industrial fishery has a role to play. However, quite often what you have is the industrial fisheries unleashed into areas where

the small scale fisheries could do the job very well so they superimpose on top of each other. And because the large scale industrial fishery very often has political access, it's also favored in location so the small scale fisheries suffer a lot.

Now there is the additional problem that in developing countries the small scale fisheries are a social dump where lots of landless farmers end up working. And that undermines the environmental credibility or sustainability of small scale fisheries because these fishers that come from non-fishing backgrounds don't have the knowledge. They don't have the skills, they don't have even the ethics of the small scale fisheries. They also are not embedded in the same type of communities so they are the ones likely to break the taboos, or to break laws. They are the ones likely to use dynamite and so on, and to be unrestrained by these traditional arrangements. And so, I call this "Matthusian Overfishing"; when you have population growth pushing people from the land to the coast where they overwhelm the established local and traditional fisheries . This process is going on throughout the developing world. When ones speaks about small scale fisheries being sustainable, I'm talking about small scale fisheries communities that are not rapidly expanding such as we have in a developed world. In the developing world, essentially the problem is un-retractable as long as the population problem is not addressed.

- **How would you define a "precautionary approach?"**

There are different interpretations of what the precautionary approach is. But basically it's the notion that absence of knowledge is the reason for restrain rather than for moving ahead. It's the much-needed reversal of the burden of proof.

Until recently you had this absurd situation where you had to prove that fishing had an impact on the population…a deleterious impact before you could propose that fishing should be restrained. It's an absurd proposition. Obviously fishing must have an impact on the population because that is the very way it is meant to be! It's meant to kill fish. If it doesn't then the fisher is not fishing. And so to revert the burden of proof and to show that forcing those who *will* intervene, who *will* impact on the population, to actually provide evidence that their impact is not going to be deleterious to others and also to themselves, it's a good thing. And it's going to be very hard. Because there is this notion that anything goes.

Throughout any culture we should really be doing everything. It's only upon demonstrating that there is a negative impact which we should work on, but it is potentially dangerous this thing, because we can easily overwhelm our natural system now. They are small compared with our technology. Natural systems are small. A few hundred years ago, a big tree was a challenge for people who wanted to chop it down, now it's just a question of a few minutes with a chain-saw. So nature is small. This is the potential impact. That's why we have to make sure we don't hurt it. It's kind of absurd, but that's really how it is.

What is the real danger indicated by research that we've begun steadily fishing down the food web?

I think fishing down the food web implies that it's a trend and that if it continues unmodified, unchanged in the next decades it will mean that we will fish plankton soup. Essentially it means that there will be no big fish around. Perhaps its immodest, but I compare it a bit with the increase of carbon dioxide and other greenhouse gases in the atmosphere. You can extrapolate those trends and you can get into Venusian type hot greenhouse runaway effect. I presume we're not going to get there. I don't know why I think that but let's say I'm an optimist at the end of the day. But reversing the trends such as the production of greenhouse gases is a massive undertaking.

Now reversing the trend that tends to eliminate big fish and then suggests that we should go after the smaller fish — reversing that trend is very, very hard. And it is not due to any single country or skipper on a boat having decided to do something or not. It is based on hundreds and thousands of skippers in hundreds of countries, hundreds of fisheries deciding every year, that given the scarcity of the big fish, they will move towards smaller fish. And that is an obvious thing to do — and the overall result is that we're going down.

Now there is a huge variance around this mean that is declining, this mean trophic level that is the average position in the food web, which is declining of the landing. Now there is a huge variance, that means you still get a few big fish. First of all there will be lots of people that will argue this is not the case because these big fish are still around. So, until the last tuna is caught, people will argue that it is not happening. Just like on land, until the last large marine mammal is caught, say a lion or zebra, people will argue that we're doing okay. The people who think that biodiversity can be maintained, they will argue right until the last animal. And so it's very hard to reverse and that is the real danger. It is not something that can be reversed by a few minutes just coming and

writing a declaration. It implies a big change.

The problem is also there is really lots of plankton out there. And so if we have developed technology to catch it, we will. And if we catch the plankton and we find a way to market it, we'll be able to feed lots of people. And if we do that, we'll modify the food web such that the big fish will never re-establish themselves because we will even strain the larvae out of the water, just like when we're catching shrimp, we're catching the juveniles of big fish. If we go from the shrimp to the next lower level to plankton, then we will also catch the larvae of the juveniles and of the shrimps, so it is very hard to get back because there is a whole logic that drags you down. And once you get commercial interest established, say in filtering plankton out of the water, how do you say you're not supposed to do that? They will produce products. This product will require wiping out the big fish but they will have product to say what do we need the big fish for, we can turn this plankton soup into fake big fish, and everything's fine.

After the conference in Lisbon, one of your colleagues wrote in a study on fish and prey species that "fishing down the food web is like eating one's seed corn if you're a farmer, or killing the goose that laid the golden egg." Is this an accurate metaphor?

Actually the notion that you cannot fish a certain kind of fish but also catch their prey, the public at large understand it. That makes sense. It resembles kind of the common sense logic that one applies. It's only in fishery circles that this notion exists that you can do something without influencing something, and that's because our models require this independence of the species from each another. And therefore we make that assumption in order to be able to work. I mean I was taught models that require the species to be disconnected from the rest. We would like to maintain the fiction that the species are not connected.

Last week I was in Iceland. Iceland is a very harsh, as you well know, cold place and the system around Iceland is very simplified. There is cod, there is capelin, a few other things around, but for the first time, I noted, even among fishery scientists, an acceptance of the notion that if you want to have a lot of cod, you cannot also have a capelin fishery because the cod consume huge amount of capelin. Now in that system around Iceland, the players are so few that the players in terms of animals that feed on each other, that people, the scientists can even develop a sense of what it means to have a food web. But in other systems, say of New England or say in the Pacific or somewhere, the

systems are so complicated that you can fool yourself that this animal is not dependent on the others because there are so many others, and there is always uncertainty. In the case of cod and capelin, which incidentally, is also the combination of New Foundland.

But in Iceland they know that if there is no capelin, there would be no cod, because they can see that the cod consumes almost exclusively capelin. So, there is no denying. They know. But I guess if we cannot manage the inter-species fisheries rank, how are we going to manage *that?* In a sense one would not only have to say, "Okay, the cod fishers also have to restrain themselves so there will not be an over fishing of cod", but you also have to say "OK you guys who would like to catch capelin, you have to not fish too much because…" And that kind of arrangement is easy to challenge. You can question the need of capelin by cod, you can argue and argue and argue, especially if the system is complex. When the system is very simple, it's more difficult to argue, but usually the systems are complex enough for people to deny the need for these kinds of arrangements.

Why is fishing down the food web a potential concern to seafood levels? Here I'm getting at the fact that the lower trophic levels might be less appetizing and the fact that the price of smaller fish has been going up pretty rapidly.

Well the big fish that are gradually reduced by fishing are either high energy fish like tuna or sharks which have red flesh which one may or may not like. But most of the big fish actually have very firm white flesh and people like that. They like the fillets. And so very firm white flesh indicates an animal that is very quiet, that it doesn't move much, and it grows very slowly. So these fish are disappearing. They cannot withstand very strong fishing. This long lived firm fleshed fish, and the replacement of fish which are not of very high quality, even though the price of small fish over the last 50 years has increased very rapidly, more rapidly than the price of big fish. Now small fish are quite unappetizing for most people. In America for example, there is no tradition with anchovies nor in fact sardines really, like raw sardine in Spain for example.

So what you do is you process the small fish through another fish, for example, you feed the fish meal to salmon. That becomes then a new value-added product, or you turn it into surimi, that is fish paste. It's actually fish flesh fiber. You scrape off the flesh off the bones and then you actually process the stuff and you end up with some dead paste that you can shape and then you paint it

and it looks like fake crab, fake this, fake that. Now this is a substitute, it is not good quality. And I recently discovered to my horror that in order to prevent surimi from spoiling in cold storage, you have to add up to 15% in sugar to it. I discovered it because I was the chair of a thesis defense in food processing here at UBC and the thesis was about reducing that percentage from 15 or some absurdly high number, 12 or something, to less that 10%, because people who have diabetes, and that is increasingly a large fraction of our population, are affected by eating suremi.

Did you know that surimi contains sugars? They're not sweet, but they are sugars still. They work chemically as sugars. And surimi is not really food, it's junk. That's the way you have to process them in order for them to be marketable. You have to process them and it's like dead cheese. I'm speaking here as a French man, it's like dead cheese. Dead, dead everything, and essentially there is no other way we could process plankton. It would have to be turned into a slurry and then it would have to be processed chemically and then it would have to be shaped to look like fish or like some fake product. And so then you end up with dead product and so I presume that given the changes now that have happened in the perception of the public in GM food, genetically modified food, even though these products will not be genetically modified, they are going to be put in a " franken-food" category. And they probably will have a low level of acceptance. Just imagine if people knew that surimi contains up to 15% sugar. And therefore it's bad for your health if you already have diabetes of something, which incidentally an increasing fraction of the population has, through obesity right, so these are issues that are very grave in a sense. It's much better to eat natural products and the perception that this is so has now left the fringe and gone mainstream, that products should be as natural as possible. Well natural fish is becoming very rare. And there is no way you can process plankton without going into a very unnatural food.

You spoke a little bit about fishing down the food web and the impact its having on commercial fisheries — predators' prey species and so on, but what about the impact it's having on marine wildlife such as Steller sea lions?

I don't want to speak specifically about Steller sea lion because it's a very generalized issue. It's obvious that the animals are deprived of their food. I think it's unavoidable and it's already happening…that we are now fishing the food of large marine mammals from right under their nose. You could call them anecdotal information that this is happening, that the animals are responding in

all kinds of weird ways. You have dolphins starting to attack seals. This never happened before. That's a report from the North Sea that I read about. You have animals that are very thin outside of the season where they are supposed to be thin.

Maybe the Steller sea lion is a story of inadequate food. And you have this story of as the marine mammals decline, you have the killer whale shifting their food away from the normal food that they're supposed to eat which is marine mammal, large marine mammal and starting to eat otters. They eat otters, the otters are not there to eat sea urchin and the sea urchin take over the place and there is no more kelp and the whole system collapses. Now these kinds of changes are very hard to document solidly, convincingly, but you can do a back of an envelope calculation; what does it mean that an animal such as a humpback whale that requires 100 kilograms of herring everyday finds itself in a situation where there is a herring fishery. But it has to imply that the density of food for that animal is diminished. Now reduced food density means longer searching time, for a lactating animal it means that you produce less milk. Less milk means lower survival. Now you combine this with the challenge to the immune system of the animals by PCBs and other toxin in effect and you have a nightmare scenario.

Now there is somewhere in the population where they are increasing and they have to because they have been reduced to such a low level that the carrying capacity is actually unused. But there will be quite soon increasing conflicts between humans on one hand and marine mammal on the other. That is unavoidable. I mean a strategy decision has to be made about what we're going to do about it. We certainly cannot maintain the fiction that we are not going to touch the marine mammal and exploit their food. And last week when I was in Iceland I was confronted with this because the Icelanders, a good fraction of them are fierce marine mammal eaters right, and I was challenged quite a bit there. Can we afford to fish and not touch marine mammal? No we can't. But then again you can have whale watching industries that are more profitable than the fisheries, so that's where the accounting has to be done, what do we really want?

How has the globalized market helped to mask the real economic impacts of diminishing fish stocks?

We have to realize that fish products are the most globalized of the major commodity, for example, rice. Most rice, that means far more than 50% is

consumed within a few kilometers of where it's produced. So rice is a major commodity. A large amount of it is traded, about 10% of it is traded internationally. I mean that's enough to determine the global price, what is traded, but it's not a globalized commodity as fish.

Over 50% of fish is sold in other countries than where it's caught. So it is really a globalized commodity and because it's so globalized, you can have a situation where the price of fish in a certain place is completely in panic of the supply of fish, for example, when cod, in New Foundland collapsed, the price of cod didn't go up at all because there was enough cod to compensate for that scarcity. So there is really no connection between how much you produce. If you ever produce locally, you don't get punished by falling prices because you have essentially insatiable markets. And these markets are Europe, Western Europe, the United States, Japan and increasingly China.

These are essentially insatiable markets. These are the how much the system can produce, and essentially if a certain area, say a village that was producing reef fishes for the fresh fish market in Hong Kong, if that village has no fish, then that market can just go somewhere else. I mean the demand will pop up somewhere else. And so you have these waves of expansion, a wave of destruction that sweeps over entire areas. The consumers never notice because they are confronted with ever-renewed apparently wealth of new products. They don't know that the fish that they were used to consuming from a certain place does not exist anymore. They don't know that. And they cannot. Because one is used to all this diversity. One doesn't know that this diversity actually implies the destruction of lots of local stocks.

- **What is the "shifting baseline" syndrome?**

Well the shifting baseline syndrome is the title of an essay. One time I was asked to write something for a magazine called "Tree" and I had been brooding over an issue. And that was the fact that we do not complain much over what we have lost, in fisheries specifically. And I was wondering why. And basically it's because we don't know about it. And then I thought about why we don't know about it and that's because from one generation to the other, the knowledge about it has not been passed on. So shifting baseline means that over time, if the supplier of goods from a natural resource declines we end up unaware of it because we don't know that this resource was available before. We don't know about it anymore. If we read now, the accounts say, from colonial Canada, about how it was then, it just sounds incredible and infact it is

treated as anecdotes. So the title of my essay was called "Anecdotes and Shifting Baseline Syndrome of Fisheries". It sounds like stories that shouldn't be believed.

Now if we moved even to the beginning of the century, you have accounts of lots of fish. But the scientist's method, the discipline that we're using at the beginning of the century is very different from the ones we're using now. So we can pretend that their work is not really relevant because they weren't as precise. And so we move on from one generation to the other. I mean it is also a personal thing. When I was a young student in fisheries, the world fisheries had certain resources that I knew of for having seen them. For example, I was in Indonesia in the boom of the trawler industry. Now I'm older and in a few years I will retire. But my students will know of the abundances that are now the case. When they get old they will have missed something but it is not the same thing they will have missed that I have missed. And that which I have missed is not what my predecessors have missed. And so we live like the fire in a cigarette, you know how that moves, and the ashes of the past. They are just ashes of the past, we have no return to them. We don't look back.

Sometimes the stuff is written, the ancient accounts are written in languages we don't understand, whether it's Latin or the language of the colonial characters that were there in the developing countries that are not accessible. For example in Indonesia, I lived two years there, the accounts of the fishery were written in Dutch. Well the young in Indonesia do not speak Dutch. The books are not available anywhere what the Dutch wrote. So what they wrote becomes irrelevant. So for a young Indonesian, the fisheries now in their depleted state are the abundance that they start from. To me that shifting baseline has become a major explanation for why we tolerate or why we end up accepting by default this immense destruction because we don't know about the past. And because we think it was in there, we think it's a story.

You have said that we have just 10% of the fish in the sea that were once there. Can you explain?

Essentially, if we compare the amount of fish, the biomass of fish before the introduction of industrial fishing in various parts of the world, what is left, the relationship is about 1 to 10 roughly; that is you go into the Gulf of Thailand, you catch if you're 20 kilograms per hour with a standard trawl. Then in the 60s you would catch 200, 300 kilogram per hour with a standard trawl so you have a fact of 10. And this fact of 10, that's what you find in a lot of fisheries.

They say the economics of the present fisheries we have, given the subsidies and technology, that they kind of break even with biomasses that are about one tenth of what was the case before the industrialization. However before industrialization, there were already humans operating with small scale fisheries . And the small scale fisheries were catching things of easier access, an example would be sea cow which went extinct before industrialization came in. But sea cow is an animal that would shape the environment and probably turtles and other things that are more accessible were probably reduced even in pre-contact or pre-industrialization time by local Aboriginal communities or small scale fishery communities. So ten percent is an underestimate of the average probably.

For things like seabirds and sea turtles and large marine mammals, we probably have much less than 10%, perhaps 1%, perhaps even less. Turtles, it's a disaster. Some species of marine mammals are extinct. Caribbean Monk Seal is extinct for example. So that is like a big ratio and for the large whales, I think the ratio is also of that order, except for gray whale which is approaching current capacity. So I think the rule of thumb would be 1/10 but that's an underestimate.

- **What evidence is there that today there are fewer fish in the sea than a century ago?**

I would say that overall fisheries of the world or all species that are affected directly or indirectly by humans, I would say that we have at present about a tenth left in the sea of what we had before industrial fisheries began. That is about 100 years ago. That is not a guess. But that is kind of a generalization based on lots of observation. Now this is a precise figure when you look at, say the gulf of Thailand where, within 15 years the amount of fish that you would catch per hour which is a measure of its abundance, went from about 300 to about 20 kilograms per hour. So from 300 kilograms in about 15 years…so it's a factor of 1 to 10. Now that factor is different when you're looking at very vulnerable species such as turtles or certain marine mammals, but I think overall that figure is something that one can remember and use for orientation. It has to do with the level of catch per unit of fishing that commercial fisheries find profitable. When the catch goes lower than that they cannot continue or they do not start an operation in the first place. So, one in ten.

- **How about the impact of distant water fleets on coastal, artisenal**

fisheries in West Africa or elsewhere?

The impact of distant water fleets, obviously on small scale fisheries in coastal areas, for example West Africa, is devastating because they *are* exploiting the same stock. And so you cannot have both fleets and any semblance of sustainability.

I must add though that the small-scale fisheries in some parts of West Africa are ill-named. They are small scale in terms of the origin but they have grown to absolute monsters. Monsters in the sense that they are unmanageable by the countries. They are the typical social dumps that I was talking about, in that lots of young men are coming that are not traditional fishers at all. They are completely unregulated. The government is completely unable to control them. It is like riding a tiger, you just can't. And they exert immense pressure on the stocks. And that pressure is obviously compounded by the presence of foreign fleet, but even if you got rid of the fleet you would just gain five years of time and then you hit the wall. So, for example in Senegal that problem of so called small scale fisheries is immense, and the boats are absurdly big but they don't have what you expect boats to have, such as safety equipment for the crew. None of them. It's just big canoes that go way off shore and put themselves in enormous danger and just wipe out the resource. And for a country like Senegal, it's almost impossible to manage.

And the only hope is that young men get attracted out of fishing. We're talking jobs, and these jobs would have to be in agriculture but that's precisely where they come from because they don't have land. So it's a nightmare, it really is a nightmare.

- **Is it possible for developing nations to work with distant water fleets in a sustainable way that will enable the fishermen to benefit? Is there a way out?**

Well in principle the law of the sea that emerged in the 70's and early 80's does provide a context for developing countries to benefit from distant water fleets. If, for example, there is a large resource there and it can't be exploited by local fleets, then in principle you should be able to *let* the surplus be cropped by foreign fleet and that foreign fleet then pays you. I have seen such arrangements work in Mozambique. There was a very effective little institute that was evaluating the total allowable catch. In this case it was a Korean fleet. And the European advisors of that institute had no commercial or national

interest at stake. The European advisors were Scandinavians and Scandinavia was not fishing. So Mozambique was benefiting quite substantially from that arrangement because at the time no small-scale fisheries were developed. So this was an arrangement that worked.

On the other hand in Sierra Leone, I remember there was a distant water fleet that was operating. The company that had been hired to watch them was in cahoots with them. So the government was not getting anything out of that foreign fleet operating. On the other hand it wasn't losing much because the small-scale fishery was not in direct competition with them. However as Sierra Leone becomes more peaceful, the Civil War is over, the fisheries develop, they obviously cannot afford to have their resource pillaged that way.

So it really depends on the strength of the national government, on the honesty of the ministers - whether they will go in cahoots with the companies or whether they will defend their countries. Interesting. The international organizations play very important roles because they can provide advisors that will tell for example, the small countries that do not know what the big companies are doing, they can tell them the implication of certain policies.

When a fishery is mismanaged, do the lost revenues translate into a lack of money for infrastructures, for example schools?

We have to realize that potentially, fisheries, for countries that have them, are a social revenue. You have nature producing fish, you don't do anything except catch them. So that should be a money generating revenue. It's like a press; the permission to print your own money in a sense. Now very few countries benefit from these fisheries and that's one of these paradoxes.

I said that I was in Iceland last week. Iceland is one of the very few countries that has a net gain from having a fishery. Most countries in the world, including developing countries, lose by having fisheries. They lose because these fisheries, in order to have them, must be provided with infrastructure. Not only infrastructure in terms of ports and roads and refrigeration but also a financial infrastructure; they have to have capital, they have to have a tax break on this and import duty breaks on that. At the end, the countries end up losing money because they subsidize them. This is particularly tragic in countries that are poor because that machine that should be generating money for hospitals and schools and things is not.

And since agriculture, in many countries also does not generate money, no sector generates money. Sometimes the only sector that generates money is the mining sector because it's very difficult to not make money when you have diamond fields. But then that money is realized by just a few accolades of the ones in charge. That really is a tragedy. But mind you, this is not something that is specific to developing countries. Throughout the world fisheries are really a losing sector. The world would gain by not having them. It's an absurdity.

Mind you, it's the same thing in this province. Even the logging industry is not making money. Can you imagine? You have this tree standing there and all you have to do is harvest them reasonably? And you still manage to lose money on it? I don't know. Fisheries are like that. Very few countries make money out of having fisheries and it has to do with the subsidies, too many fishers. I mean in a sense you could even say that poverty subsidizes fisheries. See, if you view subsidies as the transfer of wealth from one sector to the other, and because fisheries have no alternative, even catching a few fish is a net profit, so they will continue fishing and attract people. Now in economic terms, the cost of fishing and the cost of labor is a cost of fishing. When this costs stands to zero because there is no effective alternative, then you end up with a big social disaster. Now how do you prevent that disaster from spilling over into an uprising?

As I saw in the Philippines you have to have lots of police, you have to put the army there. You have to maintain all sorts of operations that are a drag on the general economy. And that is really an absurdity. I remember one of the fisheries in the Philippines that I studied very well, called San Miguel Bay Fishery in northern Luzon. There were 5000 families in that fishery. 85% of the net benefits obtained by the fishery was appropriated by 25 families and the rest of the 5000 households appropriated the remaining 15%. Now that absurd distribution of benefits within that community was the core reason why they had to station a division of the army in there because the whole province was in uproar all the time. Infact with a study we did in the mid-80s, we were not able to go there, because the province was in uproar and people were being killed. There is a price to pay to maintain this poverty.

- **How can marine protected areas be a plus for fisheries?**

I would say they're not a plus, I would say they are a necessary condition for the continued existence of fisheries. Fisheries means catching fish. And if we

exclude for a second the notion of catching zoo plankton, given that our fishing effort is really too strong for the ability of the fish to sustain that, if we want to sustain to keep some of the big fish, we have to give them places where they are not exposed to fishing. It's quite simple. If I may make an analogy. Fishing is like people running around with chain-saws. If you want to have trees that are not cut down, given the existence of people running around with chain-saws, you have to have areas where you may not go with a chain-saw. And so all kinds of parks, national parks, these trees can only keep standing and survive if no chain-saws are allowed. It's not a question of having a few chain-saws, or every second Sunday, the point is, no chain-saws in the park. There is no way a chain-saw and the park can be mutually accommodated. Now trees take many hundred years to grow and if you want them, no chain-saw.

Same thing for some of the very big fish we have. They take decades and decades to grow. The mortality we can inflict through fishing is very fast and the benefits we hope to get are essentially infinite. I mean greed, or needs, are infinite relative to what the resource can produce. So what you end up with is a complete mismatch between what the fish can produce for us and what we want from them. And the only way to kind of accommodate that mismatch is to create areas where the fish are not caught at all. And one must point out that this is not crazy, in the sense that first of all, in the past, we couldn't fish everywhere. In other words, we used to rely on the fact that we were not fishing *everywhere*, so marine protected areas is another way of saying let's not fish everywhere. That's the number one point.

And until very recently we could not fish everywhere. Now we can fish everywhere because we have these big boats and they even break the ice and fish under the ice water. There is nothing new about marine protected areas. This is the reason why fisheries were sustainable in the past.

The second point about marine protected areas, and this is the crazy part really, is that they do benefit the fisheries. It's not only that they benefit the animals - in the sense that they grow the continued existence. But it also benefits the fisheries because you end up catching more. That obviously is more in the long term. So unless we find a way to regulate our fisheries such that the long term becomes the present, we cannot avail of the benefits that the marine protected areas are giving.

Look at terrestrial systems. Do we have a set up in any country, including the States where people can fish anytime, anywhere? No. Essentially what we

have on land is that you do not hunt. That's the default setting. And then some areas are open sometimes. In other words the default setting is no hunting, right? The world is closed to hunting and then you hunt in certain periods in certain places. Now the seas, they inverse, right? There are certain areas where you cannot fish during certain periods but you can otherwise go everywhere. Now why do we have a few mammals left in a few trees? Because really on land we perceive going after animals as the extraordinary thing and not going after them as the normal thing. But in the sea, it's not going after them that is perceived as the extraordinary thing. Small wonder there is nothing around, right?

So what we have to do is we have to realize, as I was saying before, that nature is small relative to our capability now. I mean I know it sounds crazy but really nature is small vis-à-vis what we can do to it. So really if nature is small, we have to step back and that's the precautionary principle. We have to anticipate what our impact is going to be. And that's the impact that we limit. It's not the non-impact that is to be limited. That's about the ideal marine protected areas. Now the implementation of marine protected areas is a whole different story because it's going to be difficult to get this change in our heads.

Could you state what percentage of the oceans are currently protected by actual "no-take" zones?

Well the area protected by no take zone in the world ocean is less than 1%. I mean it's ridiculously small. It's almost not worth talking about it. It's like these major fashion trends and when you try to find out who does it, it turns out there's two designers, one in New York and one in Milan and the rest of the world is completely untouched by it, so everybody is doing this. It turns out nobody is doing this really, except 2 or 3 persons. And it's the same thing with marine protected areas, we talk about them, and the public thinks there must be lots of them.

Fisheries say "Oh marine protected areas, they're going to ruin our existence". Where are there marine protected areas? No no-take ones, no permanent ones, none. Just think about how much land has trees on them that you're not supposed to go chop. Right? I don't know how it is in areas between North America and Europe, perhaps between 30% of the land is not available for chopping down. Well, on shelves around the continent, how much is protected from us going and grabbing and removing everything? Literally, almost nothing, perhaps .1%, .2%. It's an absurdly small number. It's not even worth talking

about. Why are we talking about MPA's in the first place? There aren't any really.

- **What about the notion of the advocates of Marine Protected Areas trying to make them a reality, to get a start somewhere, in addressing the fisheries crises?**

Now one issue that comes up all the time when we talk about marine protected areas, and remember, all we do about marine protected areas is talk about them right? So when we talk about these areas, one point that always comes as objection is "Can you demonstrate they will have a spill-over effect?" Now, just go back in time to Roosevelt I think it was who created all these National Parks in North America. You say to him, "Well Mr. Roosevelt, can you prove that if you create those parks, the seeds of the trees from those parks will actually benefit the forest outside the park?" He would say "But that's not the point. The point is to actually keep the trees alive that are inside the park." The spill-over effect is the part that deals with "Will the fishery benefit from this?" Now if the fishery catch the fish, do they have any spill over? No they don't. So it's quite clear that having the fish is better than not having them in the first place, since really the alternative to protecting them is eradicating them. So the next one is how about the spill over effect. How can you get an idea about what a spill over effect will be? Well, just have a marine protected area and do experiments with it.

Now are these experiments being done? No. Why? Well because it would remove fish, it would prevent fishing everywhere. So you are in a vicious circle where the proponents of marine protected areas have to prove an effect *additional* to the one they would like to do - that is, at the minimum, protecting what it is meant to protect. They must demonstrate that it will benefit the fisheries - the fishery will wipe out those animals anyway if they are not protected. It's an intellectual debacle if you think about it. What has to follow from it, is that we have to set up marine protected area, as many as possible, in as many different places as possible, evaluate the effects of having them and from that modify the next move or from that, derive where we should put the next ones, so that they will protect more and the fishery will benefit more. But if these things are raised as an objection, to having them in the first place we'll never find out, and we will never be able to protect.

- **Can you speak about potential benefits of marine protected areas?**

Now, one question that one could come up is, "Why does nature put those big fish there?" The point of being a big fish, or a big animal in general, is that you can afford to lose part of your brood one year because you are going to survive to the next and to the next and to the next. So what you have is that big fish occur in the habitat in which variability is such that you cannot guarantee your brood surviving next year. Animals that are big have reserves that enable them to withstand bad conditions. Furthermore, if you have a large biomass, you can afford to lose a certain amount because there will be enough next year. Now, eliminate the big fish, the long-lived fish and reduce the biomass. What do you get? You get a biomass that is driven mainly by young fish and you get a low biomass. OK, you reduce the biomass through fishing, you eliminate the big fish from the population. Now you throw in an environmental variation. What does it do?

It reduces the biomass further if it's a negative one, the population crashes and because it doesn't have fish that can withstand one year with no eggs that survive into young fish, the crash can be long-lasting until the area is reinvented. So what you have is that the variability that seems to come from the environment, actually does not come from the environment, it comes from you having reduced the biomass of fish and having turned it into a thing that is mainly a function of small animals, short lived animals. Marine ecosystems before industrial fisheries were dominated by big fish. So what it meant was that it could afford to not bring their young through. That means unfavorable environmental conditions had no effect on the biomass because it consisted mainly of big fish that would last. Now with the biomass consisting of one year old or two year olds, it swings with their environment. And so this whole discussion in fishery science about the complexity of marine ecosystems and the fact that is environmentally driven is largely missing the point. The point is that we have created that variability. We have made the system susceptible to environmental crashes.

- **Earlier you talked about the idea of fishing at a level where you're harvesting the interest rather than by the principle. Could you elaborate on that.**

Well you have to realize that fishing is essentially a question of extracting just the right amount, so the best is to use an analogy. Let's imagine your fish population is a certain amount of money in the bank, let's say $1000. Now if it's wisely invested, it will yield say $100 a year. Now that's how much you can get without risking too much. Now you *can* obviously catch more, you can extract

more than $100, but what you have to do is go into the capital. You can catch $300, $400 or whatever dollar a year but you can do that only for two years. Then the capital is gone, or maybe not completely, maybe you still have $10 in the bank, which will again yield $1 which is the situation of fisheries. Because they're greedy, they do not want to depend only on the interest, but rather on the capital. And so we have eaten up the capital of fisheries and if we really want to maximize on the long term return from fishery, we have to rebuild the capital in the bank. That means letting the fisheries rebuild, hence this talk we have that we can ensure the future of fisheries but rebuilding them as they were before.

- **With such a bleak picture painted, what keeps you going?**

It's funny, I travel a lot. I've been going to South East Asia from Europe so much that I can actually see the difference from the plane in the forest cover of different places in South East Asia. So here is the shifting baseline, I can see it. Indeed what I see around is very bleak in terms of the same nonsense happening everywhere and the same people in the same situation doing the same mistakes. On the other hand over my life, my professional career, Marine Protected Areas have emerged, the ability to understand what has happened to the system, the species modeling type has emerged, people realize there is a serious problem, intervention by the public has become national. Last year, big companies got really hit hard and they seem to be ruling the world — toying with the genes etcetera, and they seem to be ruling the world, what has happened to their stocks? They just disappear!

OK, I'm going to be a bit pathetic in a sense of pathos, but I've been very much influenced by a previous generation which went through the bleak 40's in Europe where fascism was running and it was far worse as a threat to humanity than our bad ecological ways. Far worse. And what is it that stopped it? We're lots of people. It was like a big machine. And lots of people threw themselves, or were thrown into this big machine like sand grains. And there were so many sand grains the machine came to a halt. There were no heroes. I mean it's not Saladine or Charles the Great or something. It was lots of people. Lots of people throwing themselves in that machine which then came to a halt in Stalingrad or Omaha Beach or whatever. Now it's a bit pathetic what I'm saying, but that previous generation, it solved a problem that was there. A monstrosity in its amorality and we are now as humans faced with a similar challenge which is how are we going to live on earth together, without trashing and destroying the base of our life? And basically all you can do is decide to be

a sand grain and throw yourself into the big machine.

top

Program One | Program Two | Program Three

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