ISSN 1198-6727

Reinventing Fisheries Management

Fisheries Centre Research Reports
1996 Volume 4 Number 2

ISSN 1198-6727

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Reinventing Fisheries Management

Fisheries Centre, University of British Columbia, Canada

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published by

The Fisheries Centre, University of British Columbia
2204 Main Mall
Vancouver, B.C., Canada

ISSN 1198-6727

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ACKNOWLEDGEMENTS

This symposium, which was larger than the normal workshops mounted by the UBC Fisheries Centre, was capably organised by the Fisheries Centre's Events Officer, Ying Chuenpagdee. Many other graduate students freely gave of their time and enthusiasm to make the symposium a success. In particular we are grateful to those who acted as Rapporteurs for the discussion sessions and produced their report files to a tight deadline after the meeting

The Fisheries Centre would like to thank the financial sponsors of this meeting:

Faculty of Graduate Studies, UBC
Vice President Academic's Office, UBC
Ministry of Environment, Lands & Parks, Government of British Columbia
(Fisheries Research Branch)

DEDICATION

This report volume is dedicated to the memory of Dr Peter Larkin, who sadly passed away in 1996 after a lifetime of contributions to a Reinvented Fisheries Management.

Edited by Tony J. Pitcher

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OVERVIEWS OF REINVENTING FISHERIES MANAGEMENT

Reinventing Fisheries Management: the Symposium

Tony J. Pitcher
Director, UBC Fisheries Centre, Canada

From February 21st–24th 1996 over 100 fishery researchers gathered at the Fisheries Centre, UBC, Vancouver, to discuss the reinvention of fisheries management. This *Fisheries Centre Research Report* volume provides the abstracts of papers presented that meeting, together with edited reports of discussion concerning the questions and issues raised.

Revised symposium papers (with some others that have been solicted) have been submitted for a peer-reviewed book entitled *Reinventing Fisheries Management* in the *Chapman & Hall Fish & Fisheries Series* edited by Tony Pitcher, Paul Hart and Daniel Pauly. The volume is scheduled to appear in 1997.

Judged by its recent track record, fisheries management certainly seems to need reinventing. Recently, the reputation of fisheries scientists has suffered a serious downturn. It seems that, despite our best efforts, fisheries world-wide have become severely depleted and, along with reductions in the size of fish harvested, fish communities shift towards small rapid growing species. These symptoms have been accompanied by a series of fisheries collapses that have not only been largely unforeseen even by our most advanced assessment methods, but have also brought about disastrous economic consequences. Such things have even occurred in Canada, a nation with probably more top-rate fishery scientists *per capita* than any other. Confidence in our discipline has been eroded at the very time when we need it most if we are to do anything to make fish harvests sustainable in the overpopulated world of the coming century.

So fisheries science is in now a state of flux and many feel that we are at a cross-roads where new paradigms compete for attention and evidence of their utility. Some of the world leaders in our subject have expressed the pessimistic view that no fishery has ever been properly understood or managed. Some consider that we have to conduct experiments with our fishery resources in order to hope to do any better. Some see a solution in quantifying our ignorance. Others look to the social sciences to bring salvation by trying to understand people as well as manage fish. This symposium seeks the new paradigm that will place these ideas in perspective and make them work.

New ways of looking at things entail interdisciplinary synergy between biological, ecological, social, and economic foci. This is a most difficult thing to achieve not least because exponents of these disciplines find it difficult to step outside of their walls are they are invariably rewarded in their careers only for staying securely within them.

The symposium focusses on 6 theme areas, each led by a member of UBC Fisheries Centre's International Advisory Council.

- Understanding of the production base and the ecological impact of harvesting in freshwater and marine ecosystems. (Dr Jim Kitchell)
- Assessing fisheries intelligently, quantifying risk and learning to make management adaptive. (Dr Keith Sainsbury)
- Shaping policy to make fishing responsible and fit both the sustainable limits of the resource and the ambitions of humans (Dr Kevern Cochrane).
  Reducing conflict and fostering consensus by understanding fishing communities (Dr David Policansky)
  Mitigating resource depletion through innovative and appropriate economic instruments (Dr Rognvaldur Hannesson)
- Fostering sustainable development and the key research by encouraging the right kind of institutions. (Dr Meryl Williams)

By attempting to integrate across these multidisciplinary themes, our ambitious objective is to help create a fresh synthesis and a new paradigm for the management of fisheries.

In addition, the symposium included the second Larkin Lecture, covering the same

broad 'Reinventing' theme, delivered by Dr John Caddy.

This report gives three overviews of the symposium from participants. An abstract the Larkin Lecture abstract appears next. (The full Larkin Lecture is to be published after peer review in *Reviews in Fish Biology and Fisheries*.)

The major section of the report comprises abstracts of the papers presented each followed by discussion collated by rapporteurs and edited. Rapporteurs, who worked in pairs, were chosen from among the Fisheries Centre graduate students. The pairs of rapporteurs have had the opportunity to submit synopses of the main points raised in discussion of their sessions as Points of View for the *Reinventing Fisheries Management Book*, co-authored with the Chairs of their session

Each of the six symposium themes opens with an abstract of the Keynote Address, followed by questions and discussion of the paper. Points of View papers appear next, each with its associated questions. Most theme end with a general discussion.

The report concludes with brief biographies of the keynote speakers, the programme of the symposium, and addresses for the registered participants.

Synopsis of the Symposium

Craig Harris
Department of Sociology
Michigan State University, USA

The symposium began on Tuesday 20 Feb 1996 with the Larkin Lecture, presented by Dr. John F. Caddy, Director of Marine Resources Section in the Division of Fisheries, United nations Food and Agriculture Organization, Rome, entitled Fisheries Management After 2000: Will New Paradigms Apply? Caddy noted the current situation of over-exploitation and over-capitalization, growing demand and prices, and ecosystem impacts of population increase. He suggested that improved fisheries management would be based on co-existing multiple paradigms which incorporate ecosystem consid-erations, environmental fluctuations, and socio-economic factors. Academic instit-utions can contribute to improved fisheries management by a more participatory approach, by promoting inter-disciplinary teamwork with stakeholders in fisheries, and by breaking down specialization and regionalization within fisheries studies. Management institutions can contribute to improved fisheries management by constructing consultative management frameworks that incorporate watchdog functions and implement precautionary principles. Governments can contribute to improved fisheries management by devolving management responsibility to appropriate levels in society, including coastal communities and individual use rights. The extension of modern technology from fisheries exploitation to improved fisheries management will make possible geo-temporally defined access rights to near-shore and shelf resources. Despite many previous, current and emerging international agreements, concern remains about the control of exploitation in international waters.

The symposium was organized as a series of keynote addresses, each followed by several points of view, with evenings allocated for unstructured discussion.

Theme 1: The production base and ecosystem management

The first keynote on Wed 21 Feb 96 was presented by James F. Kitchell from the Centre of Limnology at the University of Wisconsin at Madison, who talked about the Production Base and Ecosystem Management. it is a very important top examine the phenomenon of trophic cascade, the feedback from higher levels of aquatic food webs to lower levels. By knowing this, once can, for example, manipulate piscivory to alter cladocera (daphnia) populations, and thus control algal blooms. human causes of trophic cascades include nutrient loading (which can be controlled by land use controls, buffers, and sewage treatment), exploitation (Which can be altered by information and catch limits), and species

introductions. Bodies of water demonstrate a tipping point between algal bloom and non-bloom.

Pierre Magnan from Department de Chimie-biologies, Universite du Quebec a Trois-Rivieres, presented a point of view about the Control of Undesirable introduced Species In Small Freshwater Lakes. he advocated an approach based on the principles of integrated pest management developed in aquaculture. This approach will be used by the Quebec Government to control white sucker in brook char lakes of eastern Canada.

Bill Neill from the Fisheries Centre at the University of British Columbia presented a point of view about Constrains on the Intensity of Trophic Linkages In Food Webs. models of food web structure permit ecosystem-scale fisheries management to maximize energy flows and in turn maximize yields of target species at upper levels. The major constraint to maximizing energy flow and in turn maximize yields of target species at upper levels. The major constraint to maximizing yield is not thermodynamic efficiency but predictive uncertainty. Uncertainty is greater for the effects of bottom-up perturbations than for top-down perturbations. For either type of perturbation, uncertainty of effect is greatest in the intermediate levels which are most important for affecting yield. Uncertainty is proportional to system productivity and biodiversity. given current knowledge, predicting, regulating, or at least tolerating large variance in food web responses become necessitates if fisheries are to be managed near maximal production capacity using ecosystem approaches. As a specific example, algae which are edible by zooplankton respond more to an increase in phosphorous than do larger algae; thus, smaller grazers displace larger grazers (Daphnia). Unfortunately, smaller grazers are not as interesting to planktivorous fish so their populations decline.

The third point of view was presented by Daniel Pauly of the International Centre for Living Aquatic Resource Management at Manila and the Fisheries Centre, University of British Columbia, Vancouver, on Ecosystem Management: The Next Step. Multispecies modeling efforts will lead to a consensus on the need to include both environmental fluctuations and level of harvesting and perdition in management models. Only marine protected areas allow reconciliation of the different natural time scales with those of fishers and markets, By way of illustration, he discussed a model of Lake Turkana (East Africa). He suggested that a mature system is characterized by the retention of detritus, and that carrying capacity is equal to respiration plus detritus import.

The fourth point of view was presented by James Scandol of the Fisheries Centre at the University of British Columbia at Vancouver, on The Understanding and Prediction of Marine Production: Considerations for the Future. To make predictions of more applicability to management, scientists need to pay more attention to the role of physical and biological scale in production, to quantify the consequences of animal behavior for production, and to understand the relationship between understanding and prediction within science and management. he suggested that fractals may be useful for modeling across scales.

In the discussion which followed, Tony Charles suggested a distinction between ecosystem management versus ecosystem-based management.

Theme 2: Assessment, risk and adaptive management

The afternoon session on 21st Feb. 96 began with the key note address by Keith Sainsbury of the Pelagic Fisheries Resources program of the Commonwealth Scientific and Industrial Research Organization in Hobart, Tasmania, Australia, on Rediscovering Adaptive Management: A Framework Linking Science and Decision Making in a Reinvented Fisheries Man-agement. Adaptive management has been developed and applied in only a few fisheries, and most of these have relied on passively adaptive, rather than actively adaptive, management regimes. Formal applications of adaptive management include a passively adaptive regime in the Australian orange roughy fishery, an actively adaptive regime in the north-western Australian multispecies

trawl fishery, and soon-to-be-implemented actively adaptive management regime in the Great Barrier reef. The use of adaptive management requires a significant and sustained effort to contain and maintain the mutual commitment of stakeholders in the fishery. The major constraints to greater use of adaptive management are (1) the reluctance of management agencies to commit to an explicit management strategy, (2) the reluctance of industry to accept catch reductions without a high level of proof, and (3) the difficulty for scientific institutes to maintain a focus for lengthy periods (institutional attention deficit disorder).

In the first point of view following Sainsbury's talk, Alain Fonteneau of ORSTOM and the Interamerican Tropical Tuna Commission, currently working at La Jolla, offered an Overview of Tuna Assessment and Management Worldwide.

The highly migratory nature of the tuna stocks means that their management must be undertaken by a group of international commissions. For ecological and economic reason, the temperate tuna stocks are fairly fragile whereas the tropical tuna stocks are fairly stable and resilient. Stock assessments of tuna on which to base management are made difficult by the complexity of the tuna migration patterns the difficulty of aging the catch (unlike beef), and the difficulties in measuring trends in abundance. The ecological problems of bycatches, both with purse seines and longlines are of increasing importance.

The second point of view was presented by Jarl Giske of the Dept. of Fisheries and Marine Biology at the University of Bergen in Norway, on Predictive Models of Growth, Survival and Reproduction. A dynamic programming model of Barents Sea capelin provides an example of the use of a predictive model to model historic events in order to reveal causal relationships. The use of predictive models to anticipate the future is currently out of the range of science because of the chaotic nature of the weather. improved understanding of the predictive celestial and planetary events and processes that cause oscillations in ocean climate and fish stocks is needed to enhance the predictive power of scenario of modeling in fisheries biology.

The third point of view was presented by Randall Peterman of the School of Resource and Environmental Man-agement, Simon Fraser University, Burnaby, British Columbia. Large variability and estimation errors in fisheries date make estimating risks and identifying appropriate management strategies difficult. Bayesian statistics can be used to place degrees of belief on different estimates of abundance or on underlying relationships in dynamics of fish and fleet, so that decision analysis can calculate the optimal management action for each specified objective.

Examples applying these methods to choosing appropriate management actions for harvest rates for marine species, for opening an in-river fishery of anadromous species, and for stocking lakes with juvenile trout, illustrate how taking uncertainties into account may affect the appropriate decision about the level of precaution. The expected value of including uncertainty is the difference in expected benefits between the outcome of a full decision analysis versus the outcome of a decision based on best point estimates. The values of improving information through research programs can be calculated by comparing the expected benefits from a decision analysis with the current estimate of variance on some uncertainty versus another with a lower variance.

Laura Richards of the Pacific Region Science Branch of the Dept. Fisheries and Oceans presented the fourth point of view of the afternoon, on Intelligent Fisheries Assessment in an Uncertain World. Although data collection procedures can be improved inter alia through industry partnerships, many types of analyses still require historical time series. In the short term these can be provided by the inclusion of non-traditional data in stock assessments and the analysis of traditional data in novel ways. current investment in database in stock assessments and the analysis of traditional data in novel ways. Current investment in database archives and documentation can be a legacy to the next generation of analysts.

Carl Walters of the Fisheries Centre,

University of British Columbia, Vancouver presented the final point of view of the afternoon on Fixed Exploitation Rate Strategies for Coping With Effects of Climate Change. Harvesting a constant fraction of the stock of a species each year produces harvest that are within 15 percent of the theoretical optimum that could be achieved if all future climatic fluctuations were known in advance. It may be more cost effective to invest in research on how to implement fixed harvest rate strategies than to invest in research on explaining and predicting climatic effects. As an example of the former, research might investigate public attitudes toward fishery management. Successful implementation may require a combination of improved stock assessments, and stringent regulatory measures to restrict substantially the proportion of fish at risk to fishing each year.

Theme 3: The Role of Policy in Responsible Fishing

The second day of the symposium began with a keynote address by Kevern Cochrane of the Fishery Resource and Environmental Division of the United Nationals Food and Agriculture Organization at Rome, on People, Purses and Power: Some features of the Debate Surr-ounding a developing Fisheries policy for South Africa. He joined FAO at the end of last year after 17 years in South African Fisheries Management, and it was on the basis of the south African experience that he talked. Although the adoption of a limited entry approach has had substantial advantages for fisheries utilization and conservation, with the democratization of South African the current system is being challenged by many who had previously been excluded on political grounds. In the past, South African fisheries management has placed very happy emphasis on analyses of the status of the resources and their potential productivity. In an environment in which access may be broadened substantially, with a definite shirt toward greater involvement of smaller-scale operator, the human considerations and impacts could become even more pronounced. Far greater emphasis that in the past, therefore, needs to be placed on analyzing the social and economic dynamics of fisheries, and incorporating these into management procedures and approaches. This will inevitably also require greater participation by users in the management of fisheries.

The first point of view following Cochrane's talk was presented by Craig Harris. Michigan State University, on Regime Formation and Community Participation in Fisheries Management. Whereas the traditional view of fisheries management invested authority in local communities, in the modern view authority is invested in that nation-state, whence it is partially transferred to international treaty organizations. The nation-state destroys the authority of the local communities and implements hierarchical, top-down, command and control regulation, relying on science to determine best management Practice and advise mangers accordingly. In one post-modern view of management, Regime Formation, at least three major views of the goals of management compete for primacy; each view is advocated by powerful trans-national and national actors who attempt to establish formal organizations of control by enrolling local actors in the particular view. In the other post-modern view of management, community part-icipation, an assemblage of stakeholders, both local and non-local cooperate in managing the fishery.

The second point of view of the morning was present by Tony Pitcher of the Fisheries Center, University of British Columbia, Vancouver, on Measuring the Un-measureable: A Multivariate Inter-disciplinary Method for Determining the Health of Fisheries. To devise a taxonomy of fisheries for the diagnosis of problems the categories of ecological, technological, economic and social attributes must be considered; for each category 15 to 20 attributes are chosen. Principal components analysis within each category and then of the components across the categories permits objective evaluation of the health of fisheries.

Gert Van Santen, the remaining fisheries officer at the World Bank at Washington, D.C., presented the third point of view, on Policies and Fishery. The World Bank started fisheries lending in 1962; since

then, 40 to 50 fisheries loans have been made. The Bank has stayed away from situations where the resource was in question. Eight or nine years ago they were told to pay attention to fisheries management. Fisheries man-agement is foremost a political process among humans in which income and access to the fish resources redistributed between fishers, suppliers, consumers, processors, the State, the scientific community, foreigners, locals, etc. Substantial uncertainty surrounds the economic and social impacts of management measures on each of those stakeholders. Nevertheless, the key constraints to introduction of effective fisheries management are most frequently lack of experience on the part of the Government in managing the political processes or the inability or unwillingness on the part of the authorities to muster sufficient political power to counterbalance private interests who wish to maintain the status quo.

Michael Sinclair of the Canada Department of Fisheries and Oceans, Dartmouth, Nova Scotia, presented the fourth point of view, on Modifications of Scotia Fundy Groundfish Management for Sustainable use. An initial workshop evaluated the problems with the implementation of single-species quota management for multi-species harvesting technology of Scotia-Fundy groundfish. A second workshop, planned jointly with representatives of the fishing industry, discussed the strengths and weaknesses, cost and benefits, of four methods by which conservation objectives can be met (quota, days-at-sea, closed areas, gear restrictions).

The final point of view of the third session was written by Michael Sutton of the Endangered Seas Campaign of World Wildlife Fund International, London, UK, on A New paradigm for Managing Marine Fisheries in the Next Millenium. The paper was delivered by Indrani Lutchman from WWF. Fishery managers more concerned with political than scientific realities have been compelled to ignore the implications of the best available science. Powerful social, economic and political foresees drive unsustainable fishing. Reversing this situation will require harnessing public support for a new paradigm of management, The foundation of this new model must be greater public involvement and accountability in the fishery management process. Social and economic incentives for sustainable fishing must be created.

Theme 4: The role of the interface between social sciences and natural sciences

The fourth session began with a keynote address by David Policansky, the Associate Director of the Board on Environmental Studies and Toxicology at the National Research Council in Washington, D.C.. on Fisheries Management: Science and Decision Making. He discussed the role of science in the shrimp/turtle, tuna/dolphin, pollock/ sea lion, and salmon controversies. In each case, the scientific conclusions were not obvious to at least one party in the dispute; in some cases, they were not clear to nay of them. A good scientific understanding reduces mistrust, saves time and money, and encourages coherent management; scientific uncertainty increases mistrust and incoherent management, and often increases expenditure of time and money., offend much better information would be available if managers would take the time to design data collection into their management regimes.

The first point of view of the afternoon was presented by Tony Davis of the Dept. of Social and Anthropology at St. Francis Xavier University, Antigonish, Nova Scotia, entitled For Fishers or Fishes? A comment on the Development of a Interdisciplinary Science of Fisheries and Fisheries Management. While fisheries-focused social science research has experienced considerable development over the last thirty years, its concerns, methods, findings and analyses appear to have exercised little if any influence with respect to the design and implementation of fisheries management regimes. Further, fisheries social research data and analyses, excepting the work of some resources economists, seems to have revived little systematic attention and consideration by the fisheries natural science research community. The development of an interdisciplinary fisheries science and approach to fisheries management will require considerable shirts in the currently prevailing presumptions and paradigms in natural and social science fisheries

research. In order to accomplish interdisciplinary, familiarity and acquaintanceship, and institutional rearrangements are needed, and philosophical and conceptual perspectives, and methodological and analytical predispositions, will have to be changed.

Lawrence Felt of the Dept. of Sociology at Memorial University in St. John's, Newfoundland, presented the second point of view, on A Bridge Over Troubling waters? Strategies for Integrating Natural and Social Science for Sustainable Fisheries. Because of differences in methodologies, types of data, and interpretive frameworks, integrating natural and social science research within the context of specific fisheries management plans has proven be to be fairly elusive (with the exception of some highly quantifies economic decision-making models). A three year interdisciplinary study of ecological knowledge of fishers and plant works in Newfoundland suggests a number of ways in which natural and social science can be brought together for more effective management, including cost-effective, participatory and inter-disciplinary assessment methodologies. This three-year project has brought together biological scientists, economists and social scientists to conduct interdisciplinary studies of fishers' perception of resources. They work as teams with a member from each discipline; the meaningful incorporation of clients is necessary for effective management.

The third point of view of the afternoon was presented by Paul Hart of the Dept. of Zoology at the University of Leicester, UK, on Enlarging the Shadow of the Future: Avoiding Conflict and Conserving Fish in a Novel Management Regime off South Devon. A voluntary system for partitioning the inshore area between the crab pot fishery, the trawlers and the scallop dredges off South Devon has been effective for the past 20 years. The agreement works because the fishery is composed of people who repeatedly interact over in indefinite period (from fishing communities, and/or form families that have fished for generations) sot that cheaters are likely to be identified and punished readily. Such a system can best be modeled using the Prisoner's Dilemma with long term interaction between the participants. Once the factors determining cooperation are properly understood, the Devon management system could be used in other areas where a fishery is prosecuted by members of a closely knit community interact with each other indefinitely and repeatedly.

Svein Jentoft of the Institute of Social Science at the University of Tromso, Norway presented the fourth point of view, on Fisheries management: A Role for Social Science?. If social scientists were to become fully involved in the fisheries management decision-making process, they would contribute to the design of management institutions, and as providers of critical feedback to the management process particularly on social impacts. They would function both within management councils and an analysts of the management council process. However, fisheries management could also benefit from the purely intellectual role of social science as independent, critical skeptic. (This provoked an ongoing discussion as to whereto it was better to be inside the tend pissing out, or outsider the tent pissing in. Some wanted to be outside the tent pissing in). There is a tendency of managers to ask social scientists to speak for the fishers; but suppose fish could talk - would the management process then need biologists? There is also a tendency for social scientists to play a Mephisto role, helping Faust to deny his guilt.

The final point of view of the afternoon as presented by Thomas McGuire of the Bureau of Applied Research in Anthropology at the University of Arizona, on Observations of the Social Science of Fleet Dynamics and Local Knowledge. Reviewing several contested issues in maritime social science - the skipper effect and fleet dynamics, folk management, adaptation to chaotic systems - suggests that the debates, and much of the fine-grained empirical work underlying them, evolved in the context of largely academic contests over paradigms such as cultural ecology, political economy, and political ecology. The political ecology approach is actor centered, focuses on strategizing within constraints, examines the limitations of folk management, and is value driven toward social justice. Political

ecology seems to combine prior concerns with individual and household adaptations to ecosystems and environments, and with local knowledge - the domain of cultural ecology - with the problematic of political economy - relations of production, lass formation, the penetration of capital, and the loss of local power and autonomy. This developing paradigm offers the potential for close interface with the natural sciences, both theoretical and applied.

Theme 5: The Role of Economic Tools in Reinventing Fisheries Management

The Friday morning session began with a keynote address by Rognvaldur Hannesson of the Norwegian School of Economics and Business Administration, Bergen, on Fisheries Management, Politics and Markets. The experiences of Newfoundland, Norway, Iceland and the Faroe Islands since the establishments of the 200 mile limit show that degree of dependency on the cod fishery is not clearly related to degree of responsibility in the conduct of the fishery. All four have suffered greater or lesser stock depletion, apparently in part as a result of their own policies. (Newfoundland has been managed by Ottawa; the Faros illustrates the mismanagement of experts; Iceland illustrates user management). The cause of this mismanagement is the predominance of political considerations in fisheries management. This can be remedied by market driven process with built-in mechanisms to correct for over-exploitation, Economic goals should be the primary goals for fishery management, Economic tools should be used to establish incentives for conservation in fisheries management.

In a comment after Hannesson's talk, Carl Walters noted that a computer simulation of anchoveta shows the need to maintain a large window of variability.

The first point of view of the morning was presented by Tony Charles, Dept. of Finance and Management Science, St. Mary's University in Halifax, Nova Scotia, on New Directions in Fishery Management: Lessons from the Collapse of Atlantic Canada's Groundfishery. At the roots of the collapses of the Atlantic Canadian groundfishery in the 1990's lie a set of entrenched attitudes about (1) the appropriate roles of regulators and stakeholders, (2) the burden of proof in balancing risks of lost benefits versus of stock collapse, (3) the postponability of conservation actions, (4) the fundamental effectiveness of the current system of management. While the first three have undergone some modification, the fourth remains firmly entrenched. Fisheries management must recognize the need for multidimensional solutions to multi-dimensional problems. And must realize that the answer to the problem depends on the biological, economic and social context. It is necessary to separate fishery conservation from the other issues. Efficiency equals the maximum benefit form the minimum opportunity cost.

Philip Neher of the Dept. of Economics, University of British Columbia, Vancouver presented the second point of view, on Natural Assets and National Wealth. Natural assets should be managed by nations as components of the portfolio of national wealth which yields real income to benefit real people. It is not always the case that natural assets actually do this because institutions are not in place to minimize transactions costs, free riding, and rent seeking. For fisheries, the challenge is to craft management regimes which have the paramount objective of maximizing wealth: the net present value of future cash flows. The right incentives must be in place to motivate people to think forward. Wealth maximization is a necessary primal condition for achieving other objectives such as community development, acceptable working conditions for fishers and conservation. These other objectives will not be realized if they are pursued at the expenses of the primal one. For a rights based fishery to work, the rights have to be high quality, secure, durable, and transferable. The model of Japanese community control meets these criteria for effectiveness.

The third point of view was presented by Anthony Scott of the Dept. of Economics. University of British Columbia, Vancouver, on Cooperation and Quotas. Although fisheries cooperatives have the potential to benefit fishers, fishers do not support their formation. While it has been proposed that diversity among fishers prevents the trust needed for cooperation,

it is not diversity but the fear of loss that prevents cooperation. Even if a cooperatives brings aggregate benefits to fishers, fishers fear that some members will be disadvantaged by the rest. Members need the assurance that comes from fixed percentages shares in the catch and in other benefits and costs. ITQ's automatically provide the fixed-share building blocks that are needed. There are tow types of obstacles to getting to fishery cooperative self government. Permanent obstacles take the form of internal resistance to power redistribution and lifestyle change. Transitional obstacles include the free rider problem. For cooperative self government to work, fishers need assurance and security, for example, protected percentage shares.

The fourth point of view of the morning was presented by John Sproul of the Sustainable Development Research Institute, University of British Columbia, Vancouver, on Linking Fish Price and Fishery Practice Through Eco-Certification, Labeling and Crediting. A growing need exits in many world fisheries to initiate long-term market-based changes to counter environmentally destructive economic forces. The market-place today fails to incorporate social and environmental practice information associated with the processes used to bring commodities from their points of extraction to consummation. It is necessary to transform environmental and social information in a primary value-added component of seafood and create market mechanisms that endorse fishery sustainability, social and environmental education, and consumer responsibility. Locally appropriate and internally recognized criteria would be used by a third party co-audits can be used to create a green chain). Information rating an activity's quality would be conveyed by means of a fishery eco-label. Government policy such as an eco-credit system could further encourage market demand of sustainable fishery practices.

Rashid Sumalia of the Dept. of Economics, University of Bergen, Norway presented the final point of view of the morning, on Uncertainty and the Role of Economics In Reinventing Fisheries management. Most of the problems in world fisheries today emanate from two broad sources -- the lack of adequate and correct information about how fisheries work, and the inadequacy of current institutional arrangements to deal with the problems at hand. The former problem, the problem of uncertainty in fisheries management, exists both (1) because the fishery is a dynamic enterprise, and (2) because monitoring and control are imperfect. First degree uncertainty, or stochastic variability of parameters of well-developed model, can be incorporated into management. True uncertainty, the lack of a well-developed model, is difficult to incorporate into management. One example of this distinction occurs in calculating the optimal size of protected marine reserves where tradeoffs have to be made.

In discussion following the points of view, it was noted that different groups have different views of a desirable future and that different groups have different views of what is the current problem. It was also noted that there are also differentiated interests within the ecosystem: (1) the components of the ecosystem (e.g. sea lions, sea birds), versus (2) the systemic interest (e.g. stability, diversity).

New Contexts, New Tools

Nigel Haggan
Fisheries Centre, UBC, Canada

"When you open a can of worms, the only way to recan it is to use a bigger can" (Caesar, J., De Bello Gallico*).*

This can has to be big enough to include resource interests as well as all relevant branches of science.

The Closed World Scenario

It is notable that there were three presentations on Marine Protected Areas (Pauly, Paisley and Walters). There appears to be broad agreement that refugia are vitally important to maintain spawning populations and biodiversity. There is less agreement on the size, ofthe protected area, except that it will vary with the nature of the ecosystem. Nonetheless,

there is no doubt that MPAs are an important piece of the puzzle.

Data Management

Data are the zooplankton of fisheries management, as one conference participant (*Jake Rice*) remarked. The key to voluntary compliance is confidence in the information used to make management decisions. The level of confidence is directly related to the degree of trust which participants have in the source of the information. As discussed above, participants are much more likely to trust data which they have collected. The problem is to move beyond the hoarding of data for use as a weapon at the allocation table. The tool here is an independent forum. David Policansky's comment that the credibility of any scientific organization decreases as its involvement with management increases is particularly timely.

Independent scientific bodies such as universities, can provide data standard-ization and analytic tools to integrate these different, but vital streams of knowledge. The work and input of social scientists evaluating local knowledge, as reported by Lawrence Phelps, and new tools such as FISHBASE which facilitate integration of local and indigenous knowledge are imp-ortant contributions. The next stage is to work with the participants on data quality. Identify gaps and conflicts in the data and design new data collection programs (or expand existing programs). In other words, to involve all stakeholders in the adaptive management cycle.

Coming to Grips with Whole Ecosystem Approaches

Until recently, science tended to shy away from whole ecosystem approaches. Lip service was paid to holistic approaches and integrated resource management, but, in reality, the concepts were too diffuse to grasp. The trophic cascades work reported by Jim Kitchell is a notable exception. The ECOPATH model developed by Daniel Pauly and Villy Christensen, now in its second generation, provides a way to quantify and evaluate what is happening at all trophic levels from phytoplankton and bacteria to whales and birds. This will speak to the hearts and minds of fishing communities and indigenous people who tend to view the world as a whole anyway. The ECOSIM spinoff (*see p29*) which Carl Walters described as the most exciting development he had ever worked on, adds some predictive ability to the Pauly - Christensen model.

The most exciting aspect of these tools is that they provide a framework upon which to hang other streams of knowledge. Relational database tools such as FISHBASE on CD-ROM developed by Rainer Froese and Daniel Pauly, also provide a way to integrate meteorological and other databases which can provide important insights to what is happening in an ecosystem.

The real challenge is to apply these and the next generation of tools to the integration of human communities into a whole ecosystem approach. To paraphrase Werner Heisenberg, the modeller is not the system.

Words of Caution

It is unlikely that any number of new tools and approaches will provide enough fish to come up with expectations. The presentation on the Agreement in Principle between the Nisga'a Nation of BC and the governments of Canada and BC as reported by Mike Link, meets this challenge head-on. In brief, the Nisga'a are prepared to give up their small boat fishery in favour of harvesting salmon by traps and fish wheels. Money made by this fishery will be re-invested in fish production. This will create jobs, but will not re-create hunting lifestyle which goes along with chasing fish on the ocean. This tradeoff must be faced by all fishing communities in one way or another.

New tools must also come with a foolproof idiot's guide to what they should be used for, when and how to use them, and their limitations in terms of reliability and safety. This is not to say that stakeholders and the public need to understand the math behind complex computer models. After all, a carpenter doesn't need to know the physics behind an electric saw, just not to use it under water.

Re-inventing the Tree

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Introduction

This essay takes a slightly irreverent look at the notion of re-inventing fisheries management, as stimulated by the symposium. The argument is that fisheries management grew organically as the realization dawned that human intervention could drive fish stocks to the brink of extinction. Fisheries management never was invented, it grew like a tree. The first shoot on Canada's west coast sprang with declining salmon catch. It has since sprouted almost as many roots and branches as there are stocks and species. The trees of Europe are much, much older. Indeed, there is a small, but vocal group which claim that the Canadian tree is a European transplant.

Seeds from this ancient stock are now sprouting throughout the developing world. Whether they should be fertilized with science or subjected to the Hack and Squirt regime used by BC Ministry of Forests to extirpate unwanted growth is a question well worth asking.

The growth of fisheries management and *ab extensio*, the complex symbiosis of scientists and government, is traced, with due apologies to the English poet William Blake, from the Age of Innocence to the Age of Experience. Our collective ability to re-invent fisheries management depends on how successful we can become at learning from experience without repeating past errors.

The Age of Innocence

There are plenty of fish in the sea. Oral history abounds with tales of abundance. A vast Middle Ages trading empire was founded on the amazing productivity of the Baltic Sea herring. Old people in Ireland and First Nations in BC talk about being able to cross rivers dryshod on the backs of returning salmon. There was no need for management in those early days because marine productivity was far in excess of catching capacity. Government involvement in fisheries was limited to annual catch reports.

A Good Time for Scientists

Technological change and the growth of local and world markets for fish led to significant improvements in catching ability. This phase was characterized by Meryl Williams of ICLARM as a time when fisheries scientists were naturalists. They went out on fishing vessels exploring new ground, developing fish-finders, testing and developing new gear, etc. All in all, it was a lot of fun. The Age of Innocence was also a time of aggressive expansion. Government agencies virtually threw subsidies and low interest loans at fishers and processors. Vessels grew in size and power. Fishing became increasingly lucrative. As a correlative, it is worth noting Gert van Santen's comment that reducing the world's fishing fleet by 50% would only achieve a 10% drop in catch.

The Age of Experience

Powerful vessels and onboard processing allowed fishing at great distances and in weather and sea conditions which would have tied up earlier fleets. Fish were found throughout their range. As a simple example, BC abalone were abundant until the 1970s when the entire sub-tidal spawning population became accessible to a SCUBA fishery. In a few years, spawning biomass was reduced to a point where all abalone fisheries are closed and will remain so for a long time to come. In the example of North Sea plaice cited by Paul Hart, stocks which had recovered during World War II, were fished down. To counter this, a juvenile rearing area or Plaice Box was set aside off the Dutch coast. What this didn't do was protect adults. As Carl Walters remarked, the only sustainable fisheries are those where a natural or established refugium exists. It is clear that these refugia must exist for both adults and juveniles.

Increasing pressure on fish stocks between the 1970s and early 1990s mark the time when the naturalist was upstaged by the statistician and stock modeller. This

period is best characterized by Peter Pearse' famous phrase, *Too many boats chasing too few fish* (Pearse, 1982). Computer models, harvest rates and quota setting became the order of the day. In recent years, the mathematical approach has come into question. The masking of declines in real abundance by stable or increasing CPUE and incorrect estimates of average age, e.g. the Pacific Ocean perch fishery cited by Laura Richards are significant factors in this falling off among the faithful. To quote Carl Walters at the conference: *We don't know enough about what's happening under the surface to give quota advice.*

Community Outrage and Political Heat

One important effect of a major stock collapse is to bring fisheries management and science into disrepute. This is most obvious amongst the fishing communities (local or geartype) affected. The community outrage provoked by loss of livehihood and lifestyle has prompted a move to get social scientists to clean up the mess left by biologists, economists and mathematicians. This is rejected by social scientists, at least in the person of Tony Smith, who feels strongly that fisheries scientists have not reciprocated the effort made by social scientist to learn the language and tools of fisheries science. Smith also takes a strong position on involving communities in the dialogue. It is less clear, at least to this writer, how one group of scientists learning another's secret language, will make science more relevant or accessible to the grassroots.

To summarize. Over the last 30 years, many of the world's great fisheries have gone from enormous abundance to depletion. At the same time, fisheries science has cycled from the generalist approach of Meryl Williams' naturalist, through a long affair with economics and mathematics, to today's tendency to look to social scientists and fishing communities for answers. Depletion reduces or negates returns to the country as a whole. More importantly, it impacts the livelihood and lifestyle of communities. The collapse of Canada's northern cod fishery destabilized whole communities and has cost $2billion so far with no end in sight.

Pruning The Tree

Management and science are most needed when stocks are depleted or endangered. Most governments are in a lean, tightfisted mode compared to the expansionist times of the 50s and 60s. The days are over when bad news for fish was good news for fisheries science. This vicious cycle where depletion prompts more management and a greater need for science at a time when financial returns are down is a major consideration for policy makers and scientists.

Sustainable Fisheries Management

Sustainable mangement is the key to sustainable fisheries. One way to approach the design of fisheries management for the 21st Century is to ask three simple questions: What are the elements of a sustainable fishery? Who participates in the development of policies and delivery systems? and, How will it be done? The answers must address the Politician's Dilemma of balancing long-term conservation against the immediate needs of voters and/or powerful interests. Fisheries man-agement must become workable, affordable and acceptable. Failing that, the late Peter Larkin's axiom *You can't get there from here* will be the epitaph of fisheries as we know them.

What defines a sustainable fishery?

While it is neither possible nor desirable to create a rigid formula for the world's fisheries, it seems likely that some basic criteria could be applied. These might include a definition of sustainability which includes the ecosystem and environment as well as targeted stocks. Put another way, the maintenance of biodiversity. Making maximum use of the productive capacity of the system. Ensuring that high quality benefits continue to flow to stakeholders and the general public and harmonization with other resource sectors. This last is particularly important for coastal or freshwater fisheries which must compete with other industry, but has implications for oceanic fisheries also.

Recent work reported at the conference by Dr Tony Pitcher, is a start to quantify and analyze the attributes of different

fisheries.

How to Make Policies for Sustainable Fisheries?

The old expansionist policies of government or government-sponsored development agencies spawned the fleet expansion/stock depletion cycle. New policies must speak to the hearts and minds of both consumptive and non-consumptive interests. The only way this can happen is to include these interests at the policy table. New policies need to be road tested and illustrated by specific and relevant example to determine whether they meet the tests of workability, affordability and acceptability. The bare essentials of policy making are inclusivity, perspective and clarity.

Inclusivity

Fisheries policy decisions involve people, fish and the environment. People have some ability to represent themselves. The question of who speaks for fish and environment is much thornier. The old answer was government, but questions persist about the relationship between government and industry. Tradeoffs between different resource sectors and other countries are also an issue.

Another answer is by one or more of the organizations who have appointed themselves as the conscience of the environment. Not everyone is happy with that. Yet another answer is by the fishers themselves, after all who has most to lose? In the absence of consensus, the developed world has reverted to the animal trials of mediaeval Europe (where, for example, rats could be brought into court for damaging a grain crop). The US Endangered Species Act and the spotted owl is a case in point. There are two problems with this. First, the courts are a win or lose option. Second, court decisions are long on don'ts but devoid of direction or resources for implementation.

The real issue, however is that the approach is dualistic, people vs fish, one gear type vs another, logging vs fishing, environment vs people, and so forth. The principle of inclusivity requires the presence of every group who believes that they have an interest. No doubt this will create cumbersome bodies and tedious processes, but is this any worse than the current system where stakeholders compete for public support and the one with the deepest pockets wins?

Clarity and Perspective

The secret languages of biology, economics, mathematics, social and other sciences are virtually impenetrable even between disciplines. It would be tempting for the experts to reach a consensus amongst themselves first. The downside is that it would present stakeholders and the public with yet another *fair accompli.* If the design process for new fisheries management systems is to succeed, it must go beyond the mixing of indigestible ingredients in the mere hope of a new recipe. It must achieve an element of synergy which has proved elusive.

The principle of clarity requires the translation of these secret languages. This demystification need not trivialize science, nor talk down to fishers and their communities. It is rather a broadening of the scope of science to include non-traditional data sources and the intuition of those who spend their lives on or beside the water. After all, the idea of intuition is acceptable in the scientific community too.

Each branch of formal science, and equally importantly, community pers-pectives, local environmental knowledge and the insights and experience of community members can be seen as a lens. The challenge, in the case of a specific fishery, is to find the right lenses and focus them correctly. This will require the participation of skilled facilitators and mediators, at least until the participants get to know and understand each other.

Workability - The Perception of Fairness

Cops and Robbers systems do not work outside of a police state with limitless resources and dire penalties. Voluntary compliance is the core of workable management systems. Voluntary compliance can only exist in a system which is perceived to be fair. Although fairness is an essentially subjective quality, the following elements must be present:

- a sense of participation in system design;
- trust in the information which underpins the system;
- participation in information gathering and analysis
- assurance that the system provides the best possible guarantee of sustainable, high-quality benefits.

Affordability

One key to affordability is to transfer the responsibility for data collection from government to the fishing community. They know where the fish are. They know the local conditions. They have better boats. Above all, there are more of them. The best of all arguments is that fishers will put faith in data they have a hand in collecting. This is not to let government off the hook. Profitable fisheries generate downstream employment and wealth for the nation. Government has a role in generating economic development and a responsibility to re-invest revenue from taxes paid by fishers in the resource. That said, the relative contributions need to be defined. At a minimum, government has a responsibility to lead or participate in the design of science and the audit the results of management.

The problem of depleted resources is much more complex. This does call for a long-term investment by government. Regardless of *shoulds* and *oughts*, government is unwilling to carry the cost of stock rebuilding and science in times of severe fiscal restraint. There is an old adage that you catch more flies with honey than vinegar, i.e. that incentive is better than threat. Tony Pitcher's notion of Primal Abundance, (defined as the amount any system produced prior to modern industrial fisheries) can set a target which government and stakeholders can work towards (*pers. comm.*).