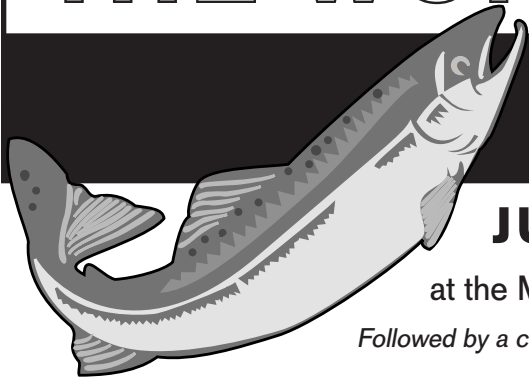


# THE WORLD SUMMIT ON

# SALMON



**JUNE 10–13, 2003 • VANCOUVER**

at the Morris J. Wosk Centre for Dialogue, Simon Fraser University

*Followed by a community workshop on Vancouver Island, June 14–16, 2003*

## program

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### **Summit Sponsors**

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# introduction

This summit, part of the Speaking for the Salmon series ([www.sfu.ca/cstudies/science/salmon.htm](http://www.sfu.ca/cstudies/science/salmon.htm)), will examine the current status of global fisheries<sup>1</sup>, the recent collapse of coastal ecosystems<sup>2</sup> (e.g. the North Atlantic cod fishery) and the future prospects of endangered and depleted fish stocks<sup>3</sup>, and apply the lessons learned to improve the prognosis for wild salmon in the Atlantic and Pacific. The summit will be held in Simon Fraser University's Morris J. Wosk Centre for Dialogue, a venue particularly well-suited for face-to-face indepth discussion and dialogue.

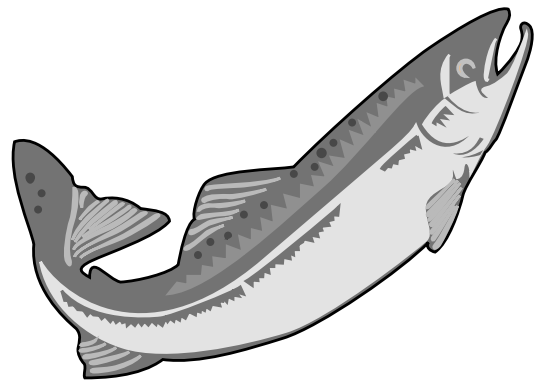
A combination of discussion papers, commissioned for the summit, and invited synthesis papers, together with a diversity of science-based posters, will assist participants to identify factors that represent threats to the future of salmon, and future actions and management strategies that might mitigate these threats and ensure the conservation of wild salmon. A limited number of posters will be accepted and prizes will be awarded for best posters.

Leading experts and participants will discuss current stock status for salmon in the Pacific and North Atlantic; knowledge gaps in salmon science; factors threatening the future of wild salmon including climate change, aquaculture and hatchery policies, overfishing, habitat destruction, urbanization and pollution. Salmon conservation solutions to be discussed include: government policies for the protection of wild salmon; application of the precautionary principle and approach; marine reserves; full-cost accounting; incentives to prevent overfishing; and other management strategies. All participants will have the opportunity to contribute to an analysis of current salmon management strategies and offer suggestions for future improvements.

Following the Vancouver portion of the summit, the West Coast Vancouver Island Aquatic Management Board will host a community meeting and series of tours. This less formal venue will provide participants with the opportunity to observe first hand some of the issues raised in the dialogue sessions, and to network with community representatives (including First Nations) who are involved in salmon protection at the local level. Field trips including salmon and fly fishing, whale watching, sea kayaking, visits to logging and salmon farming sites, will be arranged. Please note that there will be additional costs to participate in the community meeting and field trips.

## Footnotes

- 1 Pauly et al., Towards Sustainability in World Fisheries, *Nature*, August 2002; Conover and Munch, Sustaining Fisheries Yields Over Evolutionary Time Scales, *Science*, July 2002
- 2 Myers et al., Why do fish stocks collapse? The example of cod in Atlantic Canada, *Ecological Applications*, 1997; Jackson et al., Historical Overfishing and the Recent Collapse of Coastal Ecosystems, *Science*, July 2001
- 3 Hutchings, Collapse and recovery of marine fishes, *Nature*, August 2000



[www.sfu.ca/cstudies/science/salmon.htm](http://www.sfu.ca/cstudies/science/salmon.htm)

# speakers

Xanthippe Augerot, Director of Conservation Programs, Wild Salmon Center, Portland, Oregon

Donna Darm, Assistant Regional Administrator, Protected Resources, Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington

Carole Eros, Coordinator, Species at Risk Recovery Plan, Fisheries and Oceans Canada, Vancouver, British Columbia

Stephen Farber, Graduate School of Public and International Affairs, University of Pittsburgh, Pennsylvania

John Fraser, Chair, Pacific Fisheries Resource Conservation Council, Vancouver, British Columbia

Terry Glavin, Marine Conservation Advisor, Sierra Club of BC, Victoria, British Columbia

Ray Hilborn, Professor, Fisheries Management, School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington

Kjetil Hindar, Senior Research Scientist, Norwegian Institute for Nature Research, Trondheim, Norway

Jeff Hutchings, Canada Research Chair in Marine Conservation and Professor, Biology Department, Dalhousie University, Halifax, Nova Scotia

Fred Kircheis, Executive Director (Retired), Maine Atlantic Salmon Commission, Carmel, Maine

Jan Konigsberg, Director, Alaska Field Officer, Trout Unlimited, Anchorage, Alaska

Robert Lackey, Chief, Watershed Ecology Branch, Western Ecology Division, Environmental Protection Agency, Corvallis, Oregon

Dave Marmorek, President, ESSA Technologies Ltd., Vancouver, British Columbia

Mitsuhiro Nagata, Research Scientist, Hokkaido Fish Hatchery, Department of Fisheries and Forestry, Hokkaido Government, Hokkaido, Japan

Arnie Narcisse, Chair, BC Aboriginal Fisheries Commission, North Vancouver, British Columbia

Jennifer Nielsen, Fisheries Supervisor and Research Biologist, USGS Alaska Science Centre, Anchorage, Alaska

Randall Peterman, Professor, Fisheries Risk Assessment and Management, School of Resource and Environmental Management, Simon Fraser University, Burnaby, British Columbia

John Pierce, Dean of Arts, Simon Fraser University, Burnaby, British Columbia

John Post, Chair, Division of Ecology, Biological Sciences, University of Calgary, Alberta

Guido Rahr, President, Wild Salmon Center, Portland, Oregon

Bill Rees, Professor, School of Community and Regional Planning, University of British Columbia, Vancouver, British Columbia

Brian Riddell, Science Advisor, Pacific Fisheries Resource Conservation Council, Vancouver, British Columbia

Mark Saunders, Coordinator, Wild Salmon Policy, Fisheries and Oceans, Nanaimo, British Columbia

Jack Stanford, Jessie Bierman Professor of Ecology and Director, Flathead Lake Biological Station, University of Montana, Polston, Montana

Greg Taylor, Ocean Fisheries Ltd., Vancouver, British Columbia

Carl Walters, Professor, Fisheries Centre, University of British Columbia, Vancouver, British Columbia

Reg Watson, Senior Research Fellow, Fisheries Centre, University of British Columbia, Vancouver, British Columbia

Fred Whoriskey, VP Research and Environment, Atlantic Salmon Federation, St. Andrews, New Brunswick

Noel Wilkins, Professor, Biology Department, National University of Ireland, Galway, Ireland

Ken Wilson, Scientific Advisor, Marine Committee, Sierra Club of BC and Stock Management Coordinator, Fraser First Nations, Vancouver, British Columbia

Malcolm Windsor, Secretary, North Atlantic Salmon Conservation Organization (NASCO), Edinburgh, Scotland  
Representative from Environment Canada

# workshop agenda

## ■ Tuesday, June 10

Segal Centre, Room 1400

Simon Fraser University at Harbour Centre  
515 West Hastings Street, Vancouver

7:00–9:00 pm

Registration / welcoming reception / poster viewing

## ■ Wednesday, June 11—Day 1

Asia Pacific Hall

Morris J. Wosk Centre for Dialogue  
580 West Hastings Street, Vancouver

### **Problems and lessons learned**

*Moderator: Craig Orr, Associate Director, Centre for Coastal Studies*

8:30–8:45 am

Welcome

*John Pierce, Dean of Arts, Simon Fraser University*

Introduction

*John Fraser, Chair, Pacific Fisheries Resource Conservation Council*

8:45–9:30 am

State of world's fisheries

*Reg Watson, Senior Research Fellow, Fisheries Centre, University of British Columbia*

9:30–10:15 am

Interactions among collapse, recovery and extinction risk in marine and anadromous fishes

*Jeff Hutchings, Canada Research Chair in Marine Conservation, Department of Biology, Dalhousie University*

10:15–10:45 am Dialogue session

10:45–11:00 am Refreshment break

11:00–11:30 am

Can ecosystem-based management save the day?

*Carl Walters, Professor, Fisheries Centre, University of British Columbia*

11:30 am–12:00 noon Dialogue session

12:00 noon–1:00 pm ICBC Concourse

Lunch and poster viewing

### **State of salmon stocks and habitat**

*Moderator: Craig Orr, Associate Director, Centre for Coastal Studies*

#### **Atlantic salmon**

1:00–2:00 pm

Wild Atlantic salmon in Europe: status and perspectives

*Kjetil Hindar, Senior Research Scientist, Norwegian Institute for Nature Research*

Wild Atlantic salmon in North America: status and perspectives

*Fred Whoriskey, Vice President Research and Environment, Atlantic Salmon Federation*

2:00–2:30 pm Dialogue session

#### **Pacific salmon**

*Moderator: John Fraser, Chair, Pacific Fisheries Resource Conservation Council*

2:30–4:15 pm

State of salmon and their habitats: Canada and the United States

*Brian Riddell, Scientific Advisor, Pacific Fisheries Resource Conservation Council*

Salmon stocks and habitat in the Russian Far East

*Xanthippe Augerot, Director of Conservation Programs, Wild Salmon Centre and*

Salmonid status and conservation in Japan

*Mitsubishi Nagata, Research Scientist, Hokkaido Fish Hatcher, Department of Fisheries and Forestry, Hokkaido Government*

3:30–3:45 pm Refreshment break

3:45–4:15 pm

#### **Pacific salmon (continued)**

4:15–4:45 pm

Dialogue on salmon stocks and habitat

4:45–5:30 pm

MSY, No net loss and status compared to what?

*Ken Wilson, Scientific Advisor, Marine Committee, Sierra Club of British Columbia and Stock Management Coordinator, Fraser First Nations, Vancouver, British Columbia*

Dialogue session

6:00–8:00 pm Poster session and reception

*hosted by the Office of the Dean of Science, Simon Fraser University*  
Presentation of “Best Poster” prizes

*We wish to acknowledge the BC Aboriginal Fisheries Commission for its generous donation of the poster prizes.*

## ■ Thursday, June 12—Day 2

Asia Pacific Hall

### **State of salmon stocks and habitat (continued)**

Moderator: John Fraser, Chair, Pacific Fisheries Resource Conservation Council

8:30–9:00 am

State of Canada's freshwater fishes

John Post, Chair, Division of Ecology, Department of Biological Sciences, University of Calgary

9:00–9:30 am

Variability in salmon river landscapes: factors affecting restoration strategies

Jack Stanford, Jessie Bierman Professor of Ecology and Director, Flathead Lake Biological Station, University of Montana

9:30–10:00 am Dialogue session

10:00–10:15 am Refreshment break

### **Potential threats to wild salmon and solutions**

Moderator: Malcolm Windsor, Secretary, North Atlantic Salmon Conservation Organization

10:15–10:45 am

Net-Pen salmon farming: failing on two fronts—an eco-footprint analysis

Bill Rees, Professor, School and Community Regional Planning, University of British Columbia

10:45–11:15 am

History and effects of hatchery salmon in the Pacific

Jennifer Nielsen, Fisheries Supervisor and Research Biologist, US Geological Survey, Alaska Science Centre

11:15 am–11:45 pm Dialogue session

11:45 am–12:30 pm ICBC Concourse

Lunch and poster viewing

12:30–1:00 pm

A salmon-centric view of the twenty-first century in the western United States

Bob Lackey, Fisheries Biologist, National Health and Environmental Effects Research Laboratory, US Environmental Protection Agency

1:00–1:30 pm Dialogue session

### **Solutions**

Moderator: Malcolm Windsor, Secretary, North Atlantic Salmon Conservation Organization

#### **How do we value wild salmon?**

1:30–2:00 pm

First Nations and wild salmon

Arnie Narcisse, Chair, BC Aboriginal Fisheries Commission

2:00–2:30 pm

Valuing wild salmon: the economic approach

Steve Farber, Director, Public and Urban Affairs, Graduate School of Public and International Affairs, University of Pittsburgh

2:30–3:00 pm Dialogue session

3:00–3:15 pm Refreshment break

3:15–3:45 pm

Perspective of the commercial salmon fishery

Greg Taylor, Ocean Fisheries Ltd., British Columbia

3:45–4:15 pm

Valuing wild salmon: who gets to decide?

Jan Konigsberg, Director, Alaska Field Office, Trout Unlimited

4:15–4:45 pm

Wild Salmon Strategy

Terry Glavin, Marine Conservation Advisor, Sierra Club of BC

4:45–5:30 pm Dialogue session

# workshop agenda

## ■ Friday, June 13—Day 3

Asia Pacific Hall

8:30–9:00 am

Synopsis of day two and highlighting of posters\*

*Terry Glavin, Marine Conservation Advisor, Sierra Club of BC*

### **Solutions (continued)**

*Moderator: Fred Whoriskey, Vice President Research and Environment, Atlantic Salmon Federation*

### **Management solutions: application of precautionary principle/approach case study**

9:00–9:30 am

An overview of the precautionary approach in fisheries

*Randall Peterman, Professor, School of Resource and Environmental Management, Simon Fraser University*

9:30–10:00 am

Application of the precautionary approach to the conservation of wild Atlantic salmon stocks

*Malcolm Windsor, Secretary, North Atlantic Salmon Conservation Organization*

10:00–10:30 am Dialogue session

10:30–10:45 am Refreshment break

10:45–11:15 am

Protected areas for native salmon: a strategy for protecting salmonid biodiversity across the northern Pacific Rim

*Guido Rabr, President, Wild Salmon Centre*

11:15–11:45 am

Dialogue session: Are marine reserves a potential conservation tool for salmon?

11:45 am–12:15 pm

Incentives: the key to solving fisheries problems

*Ray Hilborn, Professor, School of Aquatic and Fishery Sciences, University of Washington*

12:15–12:45 pm Dialogue session

12:45–1:30 pm ICBC Concourse

Lunch and poster viewing

### **Policy and legislative initiatives (panel)**

*Moderator: John Fraser, Chair, Pacific Fisheries Resource Conservation Council*

1:30–2:45 pm

An overview of Canada's Species at Risk Act

*Representative from Environment Canada*

Endangered species listing process and status of Atlantic salmon in the US

*Fred Kircheis, Executive Director (Retired), Marine Atlantic Salmon Commission*

A strategy for recovery planning in the Pacific Northwest US

*Donna Darm, Assistant Regional Administrator, Protected Resources, Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration, Seattle, Washington*

Strengths and weaknesses of the Endangered Species Act: some insights from the Columbia Basin

*Dave Marmorek, President, ESSA Technologies Ltd.*

The Species at Risk Act and recovery planning

*Carole Eros, Coordinator, Species at Risk Recovery Plan, Fisheries and Oceans Canada*

2:45–3:15 pm Dialogue session

3:15–3:30 pm Refreshment break

### **Wild salmon policy (panel)**

#### **Presentations and panel discussion**

3:30–4:00 pm

Language, logic and legislation: the recent Irish experience of Atlantic salmon management

*Noel Wilkins, Department of Zoology, National University of Ireland*

4:00–4:30 pm

The status of Canada's wild salmon policy

*Mark Saunders, Coordinator, Wild Salmon Policy, Fisheries and Oceans Canada*

4:30–5:00 pm Dialogue session

5:00–5:30 Closing

*John Pierce, Dean of Arts, Simon Fraser University*

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\* Note on knowledge gaps and recommendations for future action: A list will be compiled by graduate students, with input from participants throughout the three days of discussion. They will be grouped and presented for review in the opening sessions of Day 2 and Day 3 and available for viewing and input at all lunch and poster sessions. A final document will be mounted on the website at the completion of Day 3.

# presenter biographies and abstracts

**Xanthippe Augerot** is the Director of Conservation Programs at the Wild Salmon Center's home office in Portland, Oregon and the Co-chair of the IUCN Species Survival Commission's Salmon Specialist Group. Dr. Augerot earned a Masters of Marine Affairs from the University of Washington, and a PhD in Geography from Oregon State University. She honed her Russian language skills and became interested in fisheries policy while working for the first US-Soviet joint venture company, Marine Resources International. Augerot spent a year in Washington, DC working for the Senate Commerce Committee on a Knauss Fellowship, which led to a five-year tenure at the Washington Sea Grant Program, in Seattle. She founded the Russia Far East Salmon Biodiversity Program at the Wild Salmon Center and, in addition to oversight of the conservation programs, is now the Co-Director of the joint Ecotrust (Portland, OR)-Wild Salmon Center State of the Salmon Program.

## **Salmon Stocks and Habitat in the Russian Far East**

Xanthippe Augerot, Director, Conservation Programs, Wild Salmon Center, 721 NW 9<sup>th</sup> Avenue, Suite 290, Portland, Oregon, USA 97209, email: xaugerot@wildsalmoncenter.org and Vladimir Radchenko, Research Scientist, Sakhalin Research Institute of Fisheries and Oceanography, Russia

Salmon stock assessments in the Russian Far East are conducted by specialists based at regional branches of the Federal Applied Fisheries Research Institutes (TINRO system) on the basis of catch, escapement, and juvenile data collected by TINRO specialists and regional branches (rybvods) of the Federal Fishery Conservation, Management and Enhancement Agency (Glavrybvod) on a series of index rivers. Assessments are conducted to derive Total Allowable Catch values each year. Pink salmon pre-season forecasts are improved by immature fish sampling on their migratory pathways at sea. In some fishery districts, forecasts are augmented by parameters representing cyclic environmental variability. Catch has been the most consistent data input over time, with other data collection hampered by the turmoil associated with the collapse of the Soviet Union, under-funding of federal agencies, and rapid privatization of the fishing industry.

The Pacific Rim Project (Oregon State University, Oregon Department of Fish and Wildlife, Wild Salmon Center) conducted a best expert judgment survey of salmon status by species across the North Pacific. Stocks were ranked for extinction risk (low, moderate and high) based upon total current abundance and spawner to recruit ratios. Despite regional differences in perception of risk, there is a clearly evident pattern of increased risk of extinction in the southern versus northern Russian Far East. Pink salmon are at the lowest risk of extinction and chinook at the greatest risk. Chum salmon are the only species with reported local extinctions. The Wild Salmon Center-Ecotrust State of the Salmon Program has created an international working group to develop a standard international monitoring protocol for adult abundance and for biodiversity, and we intend to have consistent quantitative status assessments

by species for representative river systems around the North Pacific within the next two years.

With isolated exceptions, freshwater and estuarine habitat for salmon is in good to excellent condition across the Russian Far East. However, as in North America, habitat alteration is proceeding most rapidly from the southern edge of the range. New harvest technology and access to Asian markets have accelerated the rate and extent of timber harvest in the southern Russian Far East, affecting food web dynamics, stream flow and geomorphology, and increasing public access to once remote salmon streams. Mining, oil and gas development are the major threats to salmon habitat in the northern Russian Far East, and pose risks in the south as well. There are less than a dozen hydroelectric dams in this region, and they have marginally diminished the range of anadromous fish.

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**Donna Darm** is a Northwest native and graduate of the University of Washington Law School. She spent 5 years as a lawyer at the State Department in Washington, DC before returning to the Northwest to continue her work on fisheries issues. She has been with NOAA Fisheries since 1992 in a variety of policy positions. Currently she is the Assistant Regional Administrator for Protected Resources, responsible for managing the agency's listing decisions, critical habitat designations, and 4(d) rules under the ESA. Prior to formation of a new Salmon Recovery Division, she was involved in the agency's recovery planning efforts.

## **Recovery Planning for Pacific Salmon**

Donna Darm, Assistant Regional Administrator, Protected Resources, Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington. Tel. 206.526.6150. Email: Donna.Darm@noaa.gov

In 1992 NOAA Fisheries convened its first blue ribbon Recovery Team to develop a recovery plan for Snake River chinook and sockeye salmon. The Team was comprised of well-respected fisheries biologists and engineers, an ecologist and an economist. It held 27 public meetings over 2 years and compiled extensive collections of documents in five locations throughout the Northwest. Yet when the Team delivered its recommendations in a 400-page report, plus appendices, few embraced them. There had been plenty of public outreach and opportunity for comment. The plan reflected the best thinking of a respected group of scientists. Although NOAA Fisheries issued a draft recovery plan based on the Team's recommendations, it never finalized the plan, in part because of scientific criticism, but more because of popular controversy and resistance.

Tackling salmon recovery is unlike most efforts to save endangered species, partly because of biology and partly because of psychology. Salmon are widely distributed throughout the Pacific Northwest and spend their lives migrating from small headwater streams through lowland rivers and estuaries, to the ocean and back. Salmon are almost everywhere water is, and

# presenter biographies and abstracts

almost everything humans do on the land affects the water, whether it's harvesting timber, building a housing development, or fertilizing a lawn. As for the people of the Northwest, just about everyone wants to save salmon.

Because people care about saving salmon, and because efforts to save them will directly or indirectly affect so many different interests, recovery efforts must be highly participatory to be successful. They must also be scientifically credible and take into account the numerous existing efforts of state and local governments and watershed groups. The challenge: to build a scientifically credible plan focused on the most important recovery actions, that has enough public support to actually be implemented across the vast geographic range of salmon and cultural range of the people trying to recover them. My talk will focus on NOAA Fisheries' creative approach to this challenge.

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**Carole Eros** is responsible for species at risk recovery planning for Fisheries and Oceans Canada, Pacific Region and is currently initiating recovery planning processes for three populations of Pacific salmon. Eros has a Masters degree in marine biology from James Cook University, Australia. After completing her Masters degree, Eros held a research position in the School of Tropical Environment Studies and Geography developing national and international management and conservation strategies for dugongs, a threatened marine mammal throughout the Indo-Pacific. She joined Fisheries and Oceans Canada (DFO) in 2000 and has held positions within Fisheries Management including Aboriginal Fisheries and was directly responsible for managing the Canadian Pacific halibut and sablefish fisheries.

## The Species at Risk Act and Recovery Planning

Carole Eros, Species at Risk Recovery Plan Coordinator, Fisheries and Oceans Canada, 200-401 Burrard St 200-401, Vancouver BC, V6C 3S4. Email: ErosC@pac.dfo-mpo.gc.ca  
Phone: 604-666-3610 / Téléphone: 604-666-3610  
Fax: 604-666-3341 / Télécopieur: 604-666-3341 Vancouver, BC and Chris Wood, Head Conservation Biology Section, Stock Assessment Division, Fisheries and Oceans Canada, Nanaimo BC.

The *Species at Risk Act* (SARA) passed the Senate in December 2002, and will be coming into force in 2003. The purposes of SARA are "to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened." Under SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) will be the formal body established to assess the status of species at risk in Canada. Species designated by COSEWIC may then, by order from Governor in Council, be included onto the Schedules of SARA, resulting in legal protection and recovery requirements for species designated as

"Extirpated, Endangered and Threatened" and management requirements for species designated as "Special Concern".

The Minister of Fisheries and Oceans, as a "responsible minister" under SARA for aquatic species covered by the *Fisheries Act*, has considerable responsibilities and accountabilities for the *survival* and *recovery* of *aquatic* species-at-risk as well as their protection. A key SARA requirement pertaining to species' survival and recovery is the development of "recovery strategies" and "action plans" for each of the legally listed species under the Act through specified processes and within defined timelines for each species. To date, 110 aquatic species are listed under SARA. Four salmon populations (three Pacific salmon populations, Cultus Lake sockeye, Sakinaw Lake sockeye, Interior Fraser coho, and Inner Bay of Fundy Atlantic salmon) have been designated as "endangered wildlife species" by COSEWIC. While the Atlantic salmon population is on Schedule I of SARA, the three Pacific salmon populations have not yet been legally listed. Although the Pacific populations are currently not listed under SARA, recovery planning is currently underway.

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**Stephen Farber** is the Director of Public and Urban Affairs, Graduate School of Public and International Affairs, University of Pittsburgh. Dr. Farber has a PhD in economics from Vanderbilt University. His research and policy interests are in valuing and managing natural capital. He has particular interests in the valuation and management of wetlands systems. He has served as consultant and advisory board member for coastal management and watershed management organizations.

## Valuing Wild Salmon: The Economic Approach

Steve Farber, Graduate School of Public and International Affairs, University of Pittsburgh, WWPH 3E32, PA, 15260, USA. Email: eofarb@vms.cis.pitt.edu

This presentation addresses the issue of how to evaluate wild salmon. The sources of value include economic commodity, biological, recreational, and cultural. We will explore how economists typically develop measures for these sources of value. These values can be divided into user and non-user values, each one of which is very important to understanding the value of wild salmon. They each present unique valuation problems. Examples from valuation studies in the Pacific Northwest will be used to illustrate these value concepts. Valuation analysis will be contrasted with impact analysis.

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**The Hon. John Fraser** is the Chair of the Pacific Fisheries Resource Conservation Council. He was born in Yokohama, Japan and raised in Vancouver. He graduated from the University of British Columbia and practised law until his election to the House of Commons. During his years in Parliament, John Fraser served in key positions, including Minister for the Environment and Minister of Fisheries. He was the first person to have been elected Speaker of the House of Commons by his

# presenter biographies and abstracts

peers, a practice instituted in 1986. In 1994, John Fraser was selected to head the Fraser River Sockeye Public Review Board investigating the salmon fishery. He subsequently represented Canada as Ambassador for the Environment, responsible for Canadian follow-up to commitments made at the United Nations Rio Conference on Environment and Development. John Fraser is a Queen's Counsel, an officer of the Order of Canada, and a member of the Order of British Columbia and he holds the Canadian Forces Decoration. In 1999, he was awarded honorary Doctor of Laws degrees by Simon Fraser University and St. Lawrence University for his contributions to environmental causes.

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**Terry Glavin** is a Canadian conservationist and the author of several books whose most recent major work, *The Last Great Sea: A Voyage Through the Human and Natural History of the North Pacific Ocean*, won the 2001 Hubert Evans Prize as well as the Roderick Haig-Brown conservation award from the North Pacific chapter of the American Fisheries Society. Glavin was a founding member of the Pacific Fisheries Resource Conservation Council and has worked with a variety of conservation organizations in British Columbia. He is currently the marine conservation adviser to the Sierra Club of Canada, BC chapter. He is also the editor of *Transmontanus Books* and a frequent contributor to various newspapers and magazines in Canada.

## Wild Salmon Strategy

Terry Glavin, Marine Conservation Advisor, Sierra Club of BC, 576 Johnson Street, Victoria, BC V8W 1M3.  
Email: [transmontanus@gulfislands.com](mailto:transmontanus@gulfislands.com)

The future of wild salmon on Canada's west coast will depend largely on nurturing and maintaining the complex non-economic relationships that have developed between people and salmon in British Columbia, Canada's Pacific province. Throughout the North American range of wild salmon, the general public has developed a deep appreciation of the many public values wild salmon represent. These values are not solely economic or extractive, but include aesthetic, genetic, educational, and community values. Ordinary citizens are beginning to understand the important role salmon play in maintaining the functioning of healthy terrestrial ecosystems, and conservation organizations must be prepared to play key roles, as co-authors, with government and industry, of a future that includes an abundance and diversity of wild salmon.

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**Ray Hilborn** is the Richard C. and Lois M. Worthington Professor of Fisheries Management in the School of Aquatic and Fishery Sciences, University of Washington. His general areas of research are fisheries population dynamics, management, and natural resource conservation, and he has worked extensively on the fishery resources of the West Coast of the US and Canada

as well as New Zealand and Australia. He currently serves on the scientific advisory panel for the President's Commission for Ocean Policy, the Editorial Board of the *Canadian Journal of Fisheries and Aquatic Sciences* and the Independent Advisory Panel for the Commission for the Conservation of Southern Bluefin Tuna and has worked with a number of other national and international fisheries management organizations. He is the co-author of 5 books and monographs on natural resource management, as well as 100 articles. His long-term areas of research have been explicit spatial modeling of populations, design of adaptive management systems for natural resources, the behavior and dynamics of fishing fleets, relating models to data using maximum likelihood and Bayesian methods, fisheries stock assessment and population viability analysis. He currently has major projects on salmon in Western Alaska; salmon and marine fishes on the west coast of the lower 48 states; and stock assessments and marine mammal interactions in New Zealand marine fisheries.

## Incentives: the Key to Solving Fisheries Problems

Ray Hilborn, Professor of Fisheries Management, School of Aquatic and Fishery Sciences, University of Washington, Seattle Washington, USA, 98195. Email: [rayh@u.washington.edu](mailto:rayh@u.washington.edu)

Studies of the micro behavior of fishing fleets show that fishermen act in a way to maximize their benefits from the fishery. This rule also applies to fishing fleets as a whole; fishing fleets behave in a predictable manner given the prices and opportunities available to them. Thus, overfishing is a natural response to the rules our fisheries managers impose. The same applies to fishery managers; given clear objectives and incentives, fishery managers can manage to protect escapement and assure sustainability as has happened in Bristol Bay Alaska. In contrast, where fishery managers are given unclear objectives and few incentives, conservation has suffered. If we wish to understand why fishing fleets are too large, stocks are overfished, and managers are ineffective, we need to look at the incentive systems in place for the fishermen and managers. If we look to successful fisheries, we find strong financial incentives for fishermen to avoid overcapitalization and overfishing, and clear objectives and incentives for managers to produce outcomes that are in society's interest.

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**Kjetil Hindar** is a Senior Research Scientist with the Norwegian Institute for Nature Research in Trondheim, Norway, a leading center in Europe for research on applied ecology and natural resource management. His research focuses on the population genetics and ecology of salmonid fishes, and on the effects of releasing non-native fish into natural environments.

## Wild Atlantic Salmon in Europe: Status and Perspectives

Kjetil Hindar, Norwegian Institute for Nature Research (NINA), Trondheim, Norway

# presenter biographies and abstracts

Despite its status as a flagship species, with a lot of good intentions attached to it, wild Atlantic salmon have been on decline in Norway, as in most of Europe, for the last 3–4 decades. Better catch records during this period, and increasing numbers of escaped farm salmon, suggest that the actual decline in wild salmon abundance has been stronger than that estimated from total catches. The decline has been particularly strong in some rivers producing high proportions of late-maturing salmon.

The causes for the decline are manifold and include both natural environmental variation and man-made changes. Among the former, marine conditions are believed to have been unfavorable for both growth and survival of salmon since the early 1980s. Among the latter, negative (and sometimes, unforeseen) effects associated with the build-up of salmon farming, such as the spread of diseases and escape of farm fish, are believed to be major contributors, together with the more “traditional” causes like pollution and watercourse regulation. Moreover, by-catches of salmon at sea may contribute to the decline of some populations. There are, however, some positive trends, in particular in rivers previously affected by local or long-transported pollution.

The future of wild Atlantic salmon seems to depend on better inter-departmental co-operation in recognizing and controlling the man-made factors affecting wild populations, and on research which improves our understanding of the regulating factors in salmon populations. A major challenge lies in developing salmon farming into a sustainable industry.

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**Jeffrey Hutchings** is an evolutionary ecologist whose research focuses on the life history, behaviour, population dynamics, and conservation biology of marine and anadromous fishes, particularly Atlantic cod, Atlantic salmon, and brook trout. A member of faculty at Dalhousie University since 1995, he is a Non-Government Member on COSEWIC and Editor of *Canadian Journal of Fisheries & Aquatic Sciences*.

## Interactions Among Collapse, Recovery and Extinction Risk in Marine and Anadromous Fishes

Jeffrey A. Hutchings, Canada Research Chair in Marine Conservation, Department of Biology, Dalhousie University, Halifax, Nova Scotia, B3H 4J1. Email: jhutch@msc.dal.ca

The past decade has been witness to unprecedented collapses of marine fish populations worldwide. Most prominent among these are the declines experienced by Atlantic cod (*Gadus morhua*). The magnitude of these population declines has been staggering. In the Northeast Atlantic, cod in the North Sea and adjacent waters are at historical lows, having declined almost 90% since the early 1970s, representing a reduction in breeding population size of more than 200 million individuals. Considerably more dramatic is the collapse experienced by Newfoundland’s northern cod stock. Once accounting for 75 to 80% of Canada’s cod, the stock declined more than 99% between 1962 and 1992, representing a loss of 1.7 billion breeding

individuals. The lack of recovery of Atlantic cod in Canadian waters is not unprecedented; based on comparisons worldwide, it appears to be more representative of the rule than the exception. Historically unprecedented declines in population size may well have increased extinction risks faced by marine fishes and have almost certainly lowered the probability that collapsed populations will ever recover to economically and ecologically meaningful levels of abundance.

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**Fred Kircheis** is a Certified Fisheries Scientist and Life Member of the American Fisheries Society, and a Fellow of the Americana Institute of Fishery Research Biologists. He was a Fishery Biologist with the State of Rhode Island and a Fishery Research Biologist with the State of Maine. He specializes in all aspects of landlocked Arctic charr, and management and conservation issues. Other research interests include brown trout, lake trout, and diadromous species such as American eel, alewives, and smelt. Fred was the Executive Director of the Maine Atlantic Salmon Commission from 1999 to January 2003 when he retired to pursue other interests including spending time with his grandchildren, boating and outdoor recreation.

## Endangered Species Listing Process and Status of Atlantic Salmon in the United States

Frederick W. Kircheis, Executive Director (Retired), Maine Atlantic Salmon Commission, RR3 Box 1488, Carmel, Maine, USA 04419. Email: fred.kircheis@worldnet.att.net

The range of anadromous Atlantic salmon, *Salmo salar*, in the United States has been continually shrinking since the 1800s. Once distributed in suitable habitats as far south as Long Island Sound (Connecticut and New York) the current range of wild stocks in the United States is restricted to a few small drainages in coastal eastern Maine. Numbers of Atlantic salmon in these few remaining drainages have also declined to the point where, in some years, no adults enter rivers from the sea for spawning. Year classes of freshwater life stages are also missing in some rivers.

The United States Fish and Wildlife Service (USFWS) and the National Oceanographic and Atmospheric Administration (NOAA) jointly listed United States populations of anadromous Atlantic salmon as “Endangered” in November 1999.

Development of a Recovery Plan, required by Endangered Species Act (ESA) legislation, has been a joint effort between USFWS, NOAA, and the State of Maine Atlantic Salmon Commission (ASC). Plagued by bureaucratic hurdles, budget shortfalls, litigation and all of the normal pitfalls typical to large committees, the Recovery Plan is many months behind the legislated schedule for completion. Critical Habitat designation is also required by the ESA but work on this aspect of the listing has not even begun.

Listing of the Atlantic salmon has brought more people and more money into the effort to understand causes for decline and to help affect population recovery. It may well be that more

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money and more people studying and working on the problem would not result in more fish in the rivers but the lack of an approved Recovery Plan certainly doesn't help either. Meanwhile, numbers of fish continue to decline with no Recovery Plan in place, no Critical Habitat designation and no clear picture of which agency is responsible for all the various aspects of research and management needed for saving this important species from extinction in the United States.

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**Jan Konigsberg** established Trout Unlimited's Alaska field office in 2000 to direct the Alaska Salmonid Biodiversity Program. Prior to his Trout Unlimited work, Konigsberg served several years as executive director of Alaska Conservation Foundation. He has a Masters in Philosophy from the University of Montana.

## Valuing Salmon: Who Gets to Decide?

Jan Konigsberg, Director, Alaska Field Office, Trout Unlimited, and 1399 West 34th Avenue, Suite 205, Anchorage, AK 99503-3655. Email: jkonigsberg@tu.org

Alaska has long wagged its finger at Canada and the Pacific Northwest for their failure to sustain their wild salmon populations. Alaska resents having to accommodate its salmon fisheries to manage for the mistakes committed elsewhere. Now the State of Alaska has been wringing its hands over the danger salmon farming down South poses to wild salmon populations, all the while turning a blind eye to the more significant danger posed by its ranching of 1.5 billion juveniles annually.

With the extirpation of wild salmon populations throughout the Pacific Rim, the Alaska region is now the greatest collection of geographically diverse refugia for Pacific salmon and the largest reservoir of genetic diversity. The problem is that Alaska's salmon fishery managers manage for abundance, not for biodiversity. Ironically, Marine Stewardship Council's blessing of Alaska salmon fishery management may have created greater demand for Alaska salmon in the market place, but it has inhibited demand for the changes promised by the state's Sustainable Salmon Fishery Management Policy. This is because MSC subscribes to the traditional paradigm of sustainability in which the conservation algorithm is fit to the fishery rather than to the complex of salmon and their ecosystems. The choice of paradigm is fundamentally about who decides how salmon are to be valued. Generally salmon are esteemed for their pecuniary function and this way of valuing salmon is the same path-dependent behavior common to other natural-resource industries in which the management agency inevitably conflates its public trust role with serving industry.

The State of Alaska brags about its salmon and its salmon industry. No doubt about it, Alaska has a lot of salmon. In fact, of all the major salmon-producing regions, it produces the most, with a record harvest of nearly 218 million in 1995 with an ex-vessel value approaching \$500 million. With numbers like these and certification from the Marine Stewardship Council,

the State of Alaska claims bragging rights for its salmon fishery management. Trout Unlimited's Alaska Salmonid Biodiversity Program doesn't dispute that the state's management thus far has been better than Canada's and the Pacific Northwest, but TU contends that Alaska is heading down the same path that led the Pacific Northwest to the Endangered Species Act. Alaska and its admirers can no longer afford to measure its success by comparison with others. This presentation is suffused with the caution that *those of us who live in glass aquaria should not throw stones.*

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**Robert T. Lackey** is a fisheries biologist at the US Environmental Protection Agency's research laboratory in Corvallis, Oregon, and is also courtesy professor of fisheries science and adjunct professor of political science at Oregon State University. For the past 35 years, he has dealt with a range of natural resource issues from positions in government and academia. Among his professional interests are natural resource ecology and the interface between science and public policy. He has written 100 scientific journal articles. His current professional focus is providing policy-relevant science to help inform ongoing salmon policy discussions. He is a Certified Fisheries Scientist and a Fellow in the American Institute of Fishery Research Biologists.

## A Salmon-Centric View of the 21<sup>st</sup> Century in the Western United States

Robert T. Lackey, National Health and Environmental Effects Research Laboratory, US Environmental Protection Agency, 200 SW 35<sup>th</sup> St, Corvallis, Oregon, USA 97333. Email: lackey.rober@epa.gov

Throughout the far western United States (California, Oregon, Washington, and Idaho), many wild salmon stocks have declined, and some have disappeared. The decline has taken place over the past 150 years, but there have been decades when the pattern has been upward, but, overall, wild salmon runs generally are now less than 10% of 1850 levels. The decline was caused by an extensively studied, but still poorly understood, combination of factors, including: unfavorable ocean or climatic conditions; intense commercial, recreational, and subsistence fishing; freshwater and estuarine habitat alteration due to urbanizing, farming, logging, and ranching practices; dams built and operated for electricity generation, flood control, irrigation, and other purposes; water diversions for agricultural, municipal, or commercial requirements; stream and river channel alteration, especially diking; hatchery production to supplement diminished runs or produce salmon for the retail market; predation by marine mammals, birds, and other fish species; competition, especially with exotic fish species, many of which are better adapted to the altered aquatic environment; diseases and parasites; loss of marine-derived nutrients to watersheds, replenished annually from the decomposition of spawned salmon and likely important for helping sustain healthy salmon runs; and possibly others. The runs remain

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relatively low for many of the same factors that caused the original decline. In spite of the failure of most efforts to restore runs of wild salmon, the policy (and legally mandated) goal of restoring runs of wild runs appears still to enjoy widespread public support. Billions of dollars continue to be spent in a so-far failed attempt to reverse the long-term overall decline. How can it be that the *direct* causes of the decline are reasonably well known, have been studied in great detail, and the public appears to be supportive of changing the downward trajectory for wild salmon, yet the long-term prognosis is poor for California, Oregon, Washington, and Idaho? The answer is that effecting any change in the long-term downward trend for wild salmon is probably futile in the absence of substantial shifts in the *core* drivers. Except for climate and ocean conditions, two core drivers over which society has minimal control, the other core drivers are ones society *can* control: (1) the economic rules of the game, especially the international and domestic drive for economic efficiency; (2) the increasing scarcity and competition for key natural resources, especially for high quality water; (3) the rapidly increasing numbers of humans in the region and the requirement to meet their basic needs; and (4) individual and collective life style choices and priorities. Without substantial changes in these four, interrelated core drivers, the status of wild salmon through this century will likely follow the well-documented path of the past 150 years. An impartial assessment of current individual and societal priorities, as revealed by actual choices and behavior to date, provides little indication that the public appears willing make substantial changes in any of the *core* drivers. Not all salmon restoration options require draconian changes in these drivers. There are options that are likely to be ecologically achievable and appreciably less socially disruptive than current strategies, but these options also have much more modest restoration objectives, require extensive hatchery or other aquacultural intervention, and/or involve creating protected areas.

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**David Marmorek** is an aquatic ecologist, and President of ESSA Technologies Ltd., a company based in Vancouver, BC. He enjoys combining his technical knowledge (modelling, experimental design, adaptive management, decision analysis) with people skills (facilitation, team leadership) to tackle problems dealing with fish populations and habitat at various spatial scales. He's also an Adjunct Professor in the School of Resource and Environmental Management at Simon Fraser University.

## **Strengths and Weaknesses of the Endangered Species Act (ESA): Some Insights from the Columbia Basin**

David Marmorek, Calvin Peters, and Ian Parnell, ESSA Technologies Ltd., 1765 West 8<sup>th</sup> Avenue, Suite 300, Vancouver, BC, V6J 5C6. Email: dmarmorek@essa.com

During the 1990s various fish stocks in the Columbia Basin have been 'listed' as threatened or endangered under the United

States' Endangered Species Act (ESA), including stocks of sockeye, spring/summer chinook, fall chinook, steelhead and bull trout. We have been intensively involved since 1994 with multi-agency data analyses and modelling of listed Snake River chinook salmon, and more recently with monitoring and evaluation of listed bull trout. We draw from this experience to consider some strengths and weaknesses of the ESA, and contrast this experience with management challenges to 'unlisted' sockeye in the Canadian portion of the Okanagan River basin, which we have analyzed since 1997. In our experience, ESA listing (and the threat of listing) has the benefit of acting as a "hammer" to force mitigative actions to conserve and recover listed stocks, prevent potentially damaging changes to habitats or populations. It stimulates and provides a funding mechanism for recovery planning, and sharpens efforts at monitoring and evaluation. The ESA can also support innovative, collaborative approaches to scientific analyses (e.g. PATH, reviewed in Marmorek and Peters 2001; [www.consecol.org/vol5/iss2/art8](http://www.consecol.org/vol5/iss2/art8)), and the courts can provide a mechanism for appealing ESA decisions. We note, however, three weaknesses. First, the ESA can skew allocation of management resources towards species- or population-centric rather than ecosystem approaches, and emphasises mitigative efforts for listed stocks at the expense of less costly but potentially more beneficial preventative efforts for weak, unlisted stocks with a greater potential for recovery. Second, the judicial review process has highly variable outcomes, focuses more on administrative procedure than science, and puts many agencies into a 'crisis, adversarial mode' rather than a 'collaborative, learning mode'. Third, the ESA does not deal explicitly with ecological—economic tradeoffs, even though such tradeoffs are implicitly considered in the decision making process.

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**Mitsuhiro Nagata** is a Research Scientist at the Hokkaido Fish Hatchery with the Department of Fisheries and Forestry of the Hokkaido Government. Dr. Nagata's current research includes population dynamics and forecast of Hokkaido salmon (chum, pink and masu), behavioural ecology of masu salmon, monitoring activity for population dynamic, age structure, hatchery programs, and conservation activity for river restoration. He also is involved with forum activity for the restoration of wild salmon and better habitats.

## **Salmonid Status and Conservation in Japan**

Mitsuhiro Nagata, Hokkaido Fish Hatchery, and Masahide Kaeriyama, Hokkaido Tokai University, Sapporo, Japan

Chum salmon, *Oncorhynchus keta*, are found mainly in Hokkaido and northern Honshu. While their population size was less than 10 million from 1900 to 1960s in spite of extensive hatchery activity, they had increased linearly from 10 million in the early 1970s to 40 million in the late 1980s owing to favorable oceanic conditions and successful hatchery programs. During this increasing period, body size of chum salmon at maturity decreased, while average age at maturity in cohorts increased,

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indicating the population density-dependent effect. During the 1990s population size fluctuated between 46 and 89 millions under the conditions that almost the same number of hatchery fry (two billion) have been recruited every year. The body size of chum salmon at maturity in the early 1990s was as small as in the late 1980s, but in the late 1990s, the body size at maturity recovered. Pink salmon, *O. gorbuscha*, which inhabit mainly eastern Hokkaido, remained low—from one million for even-numbered years to two million for dominant odd-numbered years in 1970s-1980s. In early 1990s the numbers increased sharply owing to favorable oceanic conditions and successful hatchery programs. The population size of chum salmon in even-years exceeded 10 million and subsequently a shift from odd- to even-year dominance occurred. More interestingly, this two-year cycle of dominance in even years has been maintained even with almost the same recruitment of hatchery fry every year. Despite these mass-produced chum and pink salmon, numerous wild populations have decreased and disappeared by negative impacts of hatchery activity, habitat loss and so on. In contrast, the numbers of masu salmon, *O. masou*, which occur mainly in Hokkaido, remain low despite many costly efforts to restore them, including hatchery activity. Fortunately, wild masu populations still exist because of spawning in almost all streams, but extreme headwater and difficulty in catching adults in streams makes it difficult to enhance populations. The trend for carrying capacity of Pacific salmon in the North Pacific Ocean will decrease due to the long-term effects of climate change in the near future. Therefore, biological interaction of wild and hatchery salmon should be taken seriously in relation to their biological factors such as ecology, behavior, genetics, physiology, and pathology. Recently, the system to conserve wild salmon and control hatchery activity has been required in Japan. We have undertaken not only monitoring programs to conserve wild salmon and biological diversity of hatchery origin salmon but also restoration programs to rehabilitate freshwater environments to create better fish habitats.

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**Arnie Narcisse** is a Stlatimx-Blackfeet Indian who is the Chairman/Speaker for the BC Aboriginal Fisheries Commission. The Canadian Wildlife Federation recently awarded Narcisse the prestigious “Roderick Haig-Brown” award in June 2000 recognizing his outstanding contribution to resource conservation. He has also worked with Universities on the west coast of BC in an effort to conserve wild salmon and to encourage First Nation students to pursue fisheries, science and education programs. He is a river fisherman and former manager of the Nicola Valley Watershed Stewardship and Fisheries Authority. As manager of the NWSFA, Narcisse was instrumental in bringing the various stakeholders together to work on a number of fisheries projects in the Nicola Valley including construction of a permanent Coho Enumeration fence.

## First Nations and Wild Salmon

Arnie Narcisse, Chairman, BC Aboriginal Fisheries Commission, PO Box 30019, North Vancouver, BC, V7H 2Y8.  
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British Columbia's First Nations have a special relationship with wild Pacific salmon, a relationship forged over nearly 10,000 years. Salmon are an important source of food and commerce for many of British Columbia's 197 First Nations. Our cultures, our languages, and our values are intimately linked to the continued existence of salmon and other marine resources. With recent downturns in salmon numbers, increasing pressures on salmon stocks and habitats, and more humans, the salmon resource has never been under greater pressure. First Nations have responded to the threats facing wild salmon by increasing their involvement in habitat protection and restoration, salmon enhancement activities, and co-management efforts. We also know it is vital that we incorporate our traditional knowledge into how we treat salmon. My grandfather was among the first to decry the hatchery “technofix” first introduced around the turn of the century—a warning ignored by many, but more important today, than ever before.

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**Jennifer L. Nielsen** is Fisheries Supervisor and Research Biologist with the USGS Alaska Science Center, Office of Biological Science. She has conducted salmonid and fisheries research throughout the western Pacific for the past 23 years. Dr. Nielsen holds Associate Faculty positions at the University of Alaska, Fairbanks, School of Fisheries and Ocean Sciences and the Marine Science Institute; the Department of Biology, University of Alaska, Anchorage; and serves on the Graduate Faculty for Fisheries and Wildlife, Oregon State University. From 1995-1999, she was a visiting scientist at Hopkins Marine Station, Stanford University. From 1995-1999, she was an Adjunct Professor in Ichthyology and Fisheries at the University of California, Berkeley and Moss Landing Marine Laboratory, and served on the Scientific Review Board for the Monterey Bay Aquarium. Dr. Nielsen has published over 40 peer-reviewed journal publications and book chapters, numerous technical reports, and gives frequent national and international presentations at scientific meetings addressing research issues in fish conservation, behavior, evolution, and genetics. Her research is recognized internationally for its contribution and focus in fisheries conservation and management.

## History and Effects of Hatchery Salmon in the Pacific

Jennifer L. Nielsen, Fisheries Supervisor, USGS, Alaska Science Center, Biological Science Office, Anchorage, Alaska.  
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There has been a long history of production of hatchery salmon in the Pacific coastal regions from California's first efforts in the 1870s using chinook and rainbow trout to the recent large-scale production of pink salmon in hatcheries in Japan and

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the Russian Far East. The rationale for this production has also varied from replacement of fish lost in commercial ocean harvests to mitigation and restoration of salmon in areas where extensive habitat alteration has reduced salmonid viability and abundance. Over the years, we have become very successful in producing a certain type of product from salmon hatcheries, but until recently we have seldom questioned the impacts the production and release of hatchery fish may have on their freshwater and marine aquatic ecosystems and the sustainability of wild salmon populations. This talk will address the negative implications of hatchery-produced salmon through discussions of biological impacts and biodiversity, ecological impacts and competitive displacement, fish and ecosystem health, and genetic impacts of hatchery fish as threats to wild populations of Pacific salmon.

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**Randall M. Peterman** is a Professor in the School of Resource and Environmental Management at Simon Fraser University in BC. He holds a Canada Research Chair in Fisheries Risk Assessment and Management and is Director of the Cooperative Resource Management Institute, a unit on campus that facilitates collaboration among university researchers, resource management agencies, and industry. Peterman's research focuses on quantitative methods to improve the understanding and management of fish populations, particularly in the presence of uncertainties and conservation risks. His research group specializes in developing and applying quantitative methods to improve fisheries management. Peterman has served on various policy advisory groups and helped to write the 1995 United Nations Food and Agriculture Organization's (FAO) *Precautionary Approach to Fisheries*.

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Research: [www.rem.sfu.ca/fishgrp](http://www.rem.sfu.ca/fishgrp)

## **An Overview of the Precautionary Approach in Fisheries**

Randall M. Peterman, School of Resource and Environmental Management, Simon Fraser University, 8888 University Drive, Burnaby, B.C, V5A 1S6. Email: [randall\\_peterman@sfu.ca](mailto:randall_peterman@sfu.ca)

Large variability, measurement error, and other uncertainties in fisheries systems have necessitated the development of cautious approaches to the exploitation, enhancement, and management of fisheries. For instance, the "precautionary principle" and "precautionary approach" are designed to deal with uncertainties and the resulting risks by giving top priority to maintaining biological productivity. Contrary to popular usage, the "precautionary principle" and "precautionary approach" are not synonymous, and this often creates unnecessary debate. The "precautionary principle" generally implies that someone has assumed the worst-case scenario about the ecological response to human disturbance, whereas the "precautionary approach" reflects a range of only moderately pessimistic effects of human activities on the aquatic system. Implementation of

a precautionary approach can involve choosing appropriate regulations among a range of possible degrees of restrictions on harvesting or other activities. Such choices can be informed by risk assessments and other quantitative analyses that take a range of hypotheses into account to reflect key uncertainties, especially those reflecting broad ecological interactions. Precautionary approaches are also relevant to the fishing industry's goal of maintaining economically viable fisheries. In some cases, certification of fisheries provides incentives to both industry and management to maintain and improve biological productivity. Precautionary approaches have been adopted in numerous fisheries worldwide and are included in guiding principles of several national policies and international agreements.

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**John Pierce** is the Dean of Arts at Simon Fraser University. He is also principal investigator in the Promoting Community Economic Development for Forest-Based communities research project being funded by Forest Renewal BC, and the co-investigator in the collaborative social Sciences and Humanities Research Council funded project, the Georgia Basin Futures Project based at the University of British Columbia. Prior to becoming the Dean of Arts, Dr. Pierce was the Director of the community Economic Development Centre and Chair of the Department of Geography at Simon Fraser University. He is a leading scholar in sustainable land use, food resource and community change.

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**John Post** is Professor and Chair of the Division of Ecology in the Department of Biological Sciences at the University of Calgary. His research program focuses on recruitment dynamics of freshwater fishes, climate impacts on northern fishes and the development of quantitative tools for management policy assessment of recreational fisheries.

## **Canada's Recreational Fisheries: the Invisible Collapse**

John R. Post, Division of Ecology, Department of Biological Sciences, University of Calgary, Calgary, Alberta T2N 1N4. Email: [jrpост@ucalgary.ca](mailto:jrpост@ucalgary.ca)

Fishing for recreation is a popular activity in many parts of the world and this activity has led to the development of a sector of substantial social and economic value worldwide. The maintenance of this sector depends on the ability of aquatic ecosystems to maintain fishery harvest. We are currently witnessing the collapse of many commercial marine fisheries due to over exploitation. Recreational fisheries are typically viewed as different from commercial fisheries in that they are self-sustaining and not controlled by the social and economic forces of the open market that have driven many commercial fisheries to collapse. Here I reject the view that recreational and commercial fisheries are inherently different, and demonstrate several mechanisms that can and indeed should lead to collapse in recreational fisheries. Data from four high profile Canadian

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recreational fisheries show dramatic declines over the last several decades yet these declines have gone largely unnoticed by fishery scientists, managers and the public. Empirical evidence demonstrates that the predatory behavior of anglers reduces angling quality to levels proportional to distance from population centers. In addition, the behavior of many fish species, and the anglers who pursue them, common management responses to depleted populations, and the ecological responses of disrupted food webs, all lead to potential instability in this predator-prey interaction. To prevent widespread collapse of recreational fisheries, fishery scientists and managers must recognize the impact of these processes of collapse and incorporate them into strategies and models of sustainable harvest.

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**Guido Rahr** is the President of the Wild Salmon Center. Rahr earned a Masters of Environmental Studies from Yale University and has more than seventeen years of experience working for regional and international conservation organizations, including Conservation International and Oregon Trout, where his work won the President's Fisheries Conservation Award from the American Fisheries Society. He has also served as a consultant to the United Nations Development Programme. Rahr serves as Chair of the World Conservation Union (IUCN) Salmonid Specialist Group and Chair of the Tillamook Rainforest Coalition, and has published articles on salmon and river conservation in both scientific and popular literature.

## **Protected Areas for Native Salmon: a Strategy for Protecting Salmonid Biodiversity Across the Northern Pacific Rim**

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Anadromous stocks of wild salmonid fish are declining along both sides of the Pacific Rim. In order to protect key centers of salmon biodiversity, we propose the creation of a network of protected basins and sub-basins for native salmon. The network would extend from California to Korea, and include the most robust and species-rich remaining salmon ecosystems within each bioregion of the northern Pacific Rim. Each protected area will contain sufficient protected habitat to ensure the health of native salmon stocks. Land and water resources will be managed for wild salmon reproduction, and fish harvest programs will emphasize native salmon conservation. The objectives of the network are to ensure the survival of (a) native species, races and stocks of salmon, steelhead/trout, taimen and char characterizing the different bioregions of the North Pacific, (b) salmon-dependent aquatic and terrestrial food webs, and (c) human communities depending on salmon for economic and cultural needs.

The author will describe salmon bioregions across the Pacific Rim, a strategy for identifying conservation priorities within

each bioregion, and a hierarchy of salmon protected areas ranging from anchor habitats to sanctuaries. The author will outline a five-phase approach to creating salmon protected areas, and use case studies to illustrate the application of the strategy in an unfragmented landscape (Kol River Basin, Russian Far East), and a fragmented landscape (Hoh River Basin, United States Pacific Northwest).

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**William Rees** received his PhD in population ecology from the University of Toronto and has taught at the University of British Columbia's School of Community and Regional Planning (SCARP) since 1969. He founded SCARP's 'Environment and Resource Planning' concentration and from 1994 to 1999 and served as director of the School. Professor Rees's teaching and research focus on the public policy and planning implications of global environmental trends and the necessary ecological conditions for sustainable socioeconomic development. Much of this work is in the realm of human ecology and ecological economics where Professor Rees is best known for inventing 'ecological footprint analysis.' In 1997, UBC awarded William Rees a Senior Killam Research Prize in acknowledgment of his research achievements and in 2000 *The Vancouver Sun* recognized him as one of British Columbia's top "public intellectuals".

## **Net-Pen Salmon Farming: Failing on Two Fronts (An Eco-Footprint Analysis)**

William E. Rees, School and Community Regional Planning, University of British Columbia, 604-433-6333 Memorial Road, Vancouver, BC, V6T 1Z2, Canada. Email: [wrees@interchange.ubc.ca](mailto:wrees@interchange.ubc.ca)

This presentation starts from the premise that *H. sapiens* has a predisposition to expand into all the ecological (and economic) space available to it. Moreover, humans have inherited no inhibition against destroying their own habitats. It follows that if their expansionary predisposition is unconstrained, humans will systematically overexploit the very resources that sustain them. This is unquestionably the history of major fish stocks around the world, including wild salmon. Indeed, wild salmon species/stocks have suffered the negative consequences, not only of over-fishing, but also of human-induced climate change, marine and fresh water pollution, back-firing enhancement programs, logging (habitat destruction), and other consequences of humanity's expansionary activities over much of their historic ranges. To some analysts, the depletion of wild salmon—a prime form of natural capital—is of little consequence, merely the necessary price to pay for the growth in the total stock of human-made capital. Human-made capital of course includes salmon farms. This school further argues that: a) net-pen salmon farming salmon represents a sustainable substitute for the socio-economic losses associated with the decline of the wild fish fleet fishery, and that: b) and farmed salmon are not only a satisfactory substitute for wild fish as source of high-quality human food but that this type of mariculture is essential

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to meeting the nutritional demands of a growing human population. To test these propositions, the study reported here compares the potential relative sustainability of the traditional fleet-fishery and net-pen salmon farming industry using energy and material flows analysis and comparative ecological footprint assessment. The data reveal that net-pen salmon farming as presently practiced is considerably more energy and material intensive per unit product than are conventional (already energy and materially costly) harvest methods. Regardless of species raised, the “ecological footprints” (ecosystem services demanded) per tonne of product generated by salmon farms are therefore considerably larger than those of the fleet fishery. The salmon-farming industry thus contributes disproportionately to global climate change through its considerable carbon dioxide emissions, further increasing humanity’s already dangerous food-dependence on depletable stocks of cheap fossil fuel. More importantly, because salmon feed is produced using fish and fish products imported from other parts of the world, the salmon farming industry actually reduces the total amount of food available for human consumption (particularly in the developing South). From this perspective, net-pen salmon farming can be interpreted as both an ecological and economic failure. Farming salmon is an inherently unsustainable economic substitute for a service that nature once provided free. Most tellingly, the industry exacerbates North-South inequity and fails, even temporarily, in its promise to enhance global food supplies. Meanwhile, salmon farming extends the human ecological footprint and the inexorably increasing total human load on the ecosphere.

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**Brian Riddell** is currently Science Advisor to the Pacific Fisheries Resource Conservation Council and is on assignment from the Canadian Department of Fisheries and Oceans. Riddell has been a research scientist at the Pacific Biological Station since migrating west in 1979 from McGill University and his studies on Atlantic salmon. He has worked extensively in the stock assessment and genetics of Pacific salmon, and in domestic and international salmon management issues. Since 1996, he has also participated on the Independent Scientific Advisory Board and Independent Scientific Review Panel, scientific advisory boards in the Pacific Northwest US providing advice on science programs and salmon recovery initiatives. He has received several awards for his work in salmon management and conservation and his interests continue to be in the population biology and genetics of Pacific salmonids, including conservation genetics of small populations and the impacts of intensive culture on enhanced and wild populations.

## **State of Salmon and their Habitats:**

### **Canada and the United States**

Brian E. Riddell, Pacific Fisheries Resource Conservation Council, Vancouver, BC and

Art F. Tautz, BC Biodiversity Branch, Research and Development Section, BC Ministry of Agriculture Fish and Food, Vancouver, BC

In the duration of this talk, no one could pretend to do justice to the diversity of Pacific salmon spawning from California to Canada and through Alaska, and we won’t. Four brief publications, however, provide an excellent background to the “stocks” (depending on how you define them) and their status into the 1990s (*AFS Fisheries* magazine: Nehlsen et al. 1991 Vol 16(2), Huntington et al. 1996 Vol 21(3), Baker et al. 1996 Vol 21(10), and Slaney et al. Vol 21(10)). These reviews each have their strengths and weaknesses, but each provides a concise summary of the array of spawning populations and the pressures on these species over the past century. Or, an alternative source is Stouder et al. (1997) *Pacific Salmon & their Ecosystems*.

As background, the talk will provide an overview of these stocks, and trends in current status and habitats. But the more important considerations should be “Do we know what determined the present status of a ‘stock?’” and “How should we respond in the future?” The first hundred years of managing Pacific salmon focused on their economic importance, in the later quarter of the 1990s conservation issues lead to substantial allocation debates, and now the focus is clearly on conservation of “wild” salmon, diversity, and ecosystems. The severity of this shift increases from south to north, but problems in the south are likely to be those in the north in the next 20+ years. The focus of this talk then will be what have we learned and what do we need to know to conserve and benefit from Pacific salmon in our future.

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**Mark Saunders** Mark Saunders is the Wild Salmon Policy co-ordinator, working in the Fisheries and Oceans Canada’s (DFO) Policy Branch in the Pacific Region. He has worked as a stock assessment research biologist at the Pacific Biological Station for the past 20 years with recent emphasis on the development of applied technologies for fisheries stock assessment.

## **Development of the Canadian Wild Salmon Policy**

The need for a Wild Salmon Policy was spelled out in DFO’s 1998 policy document entitled “*A New Direction for Canada’s Pacific Salmon Fisheries*”. This “New Directions” document set out 12 principles based upon three elements: conservation, sustainable use and improved decision making. The Wild Salmon Policy is one in a series of papers written subsequent to the release of the New Directions policy paper. A draft Wild Salmon Policy Discussion paper was the subject of extensive consultation in 2000, the results of which have guided revisions to the policy. Currently, work is underway to develop operational guidelines for fisheries management, habitat, enhancement and aquaculture and a decision framework that links these guidelines with the policy principles. The policy is scheduled for release in late 2003.

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# presenter biographies and abstracts

**Jack A. Stanford** is the Jessie M. Bierman Professor of Ecology and Director of Flathead Lake Biological Station (FLBS) at the University of Montana. He has conducted research at FLBS since 1971 and became Director in 1980. His research and education activities have taken him all over the world but his heart is in the Crown of the Continent Ecosystem where he has worked on everything from microbes to grizzly bears. Much of his research has been on the ecology and restoration of salmon rivers. When not fully engaged in ecology, Prof. Stanford is steep and deep in the backcountry, fly fishing the flats, or climbing some ridge or another just to see what's on the other side.

## **Variability in Salmon River Landscapes: Factors Affecting Restoration Strategies**

J. A. Stanford, Director, Flathead Lake Biological Station, University of Montana, 311 BioStation Lane, Polson, MT, 59860-9659, USA. Email: stanford@selway.umt.edu

The ecological structure and function of rivers vary across a hierarchy of landscape scales with different spatial and temporal dimensions. The major linkages within river systems include exchange of water and materials along longitudinal connections from streams to rivers, lateral connections between river and floodplain systems, and vertical surface and subsurface (hyporheic) water exchanges. Strong longitudinal linkages dominate confined river reaches while unconfined floodplain reaches show strong affinities for lateral and vertical exchange. A landscape concept, “the shifting habitat mosaic” (SHM), provides a framework for understanding how these interactions create and maintain the physical and ecological diversity of habitats, biotic communities, and ecosystem integrity. While each river system has unique physical and ecological characteristics, many human actions and ecological effects can be expressed within the SHM concept. For example, societal needs for power generation, transportation, water management, and land uses (e.g., urban and agricultural) often alter natural processes of hydrologic regimes and material transport and deposition. These factors affect interactions between the river channel and the surrounding river-riparian corridor that are crucial to creation and maintenance of salmon habitat. In this paper, I examine salmon ecology and salmon river restoration in the context of the SHM concept. These ideas are based on a co-authored paper in the recent book *Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems* (2003, published by the American Fisheries Society). Restoration strategies should apply the SHM concept by focusing on restoring normative variation in key processes (e.g., hydrologic regimes) that control salmon productivity. Management practices (e.g., dam hydrologic regimes, flood control facilities, levees, land uses) can be modified to restore natural physical and ecological processes (e.g., thermal regimes, water exchange, and animal migrations) that determine quantity and quality of salmon habitat. Normative habitat in the context of the SHM has a high probability of sustaining diversity and

productivity of salmon, if other problems, particularly capricious culture and harvest policies, do not interfere with natural (wild) recruitment.

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**Greg Taylor** graduated from Simon Fraser University with Masters in Resource and Environmental Management. He began his career with the last remaining isolated cannery on the North Coast. He worked on the QCI for two years in the 1980s buying troll fish and clams. Taylor began working for Ocean Fisheries Ltd. in 1985. He participated on the Skeena Watershed Committee Steering Committee and worked with First Nations to develop the first in-river commercial fishery on the North Coast. He is the Co-Chair of the North Coast Advisory Board and Past President, and current spokesman, for the Northern Processor's Association. He is currently Director of Acquiring for Ocean Fisheries Ltd. in Vancouver.

## **Economic Viability Vs. Stock Specific Management: Costs and Consequences for the Skeena River Commercial Sockeye Fishery**

Greg Taylor, Director of Acquiring, Ocean Fisheries Ltd., Box 460 Cow Bay Road, Prince Rupert, BC V6K 1Y5.  
Email: gregt@oceanfish.com

Fisheries and Oceans Canada has developed the Pacific Region Salmon Stock Management Plan during the mid-1980s to guide the management of the salmon fishery. The SSMP presented a balanced policy for managing the salmon fishery that sought to “conserve the resource and provide the highest sustainable contribution to the economic and social development of the people of Canada, especially those resident on the Pacific Coast.” Commercial fishermen, processors and communities made financial and social investments based on the scientific and management doctrine presented in the SSMP. Beginning in the 1990s a new scientific consensus has evolved that focuses almost solely on stock selective management. This new consensus has foregone the balance contained within the SSMP and has tended to ignore the social, economic and social costs of introducing what would be a revolutionary management policy. These costs and consequences include a commercial fishery in jeopardy, the human cost of lost livelihoods and lifestyles, failing rural communities and eroding the social contract that allowed for effective management of the fishery. This presentation examines these issues in the context of the Skeena River commercial sockeye fishery. It also looks at whether a new balance is possible, and if not, what responsibility we have for those impacted by a fundamental change in government policy.

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**Carl Walters** is a Professor at the Fisheries Centre at the University of British Columbia. His areas of research include the development of rapid techniques for teaching systems analysis and mathematical modeling to biologists and resource managers. He mainly works on fish population dynamics, fisheries

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assessment and sustainable management. He believes the heart of fisheries is how to manage harvest: "The main thrust of my research is to figure out how to design management systems that are robust in an area of really high uncertainty."

## Can Ecosystem-Based Management Save the Day?

Carl Walters, Fisheries Centre, University of British Columbia, 2204 Main Mall, Vancouver, BC, V6T 1Z4.  
Email: c.walters@fisheries.ubc.ca

In the last few years there has been a spectacular improvement in our understanding of trophic linkages in marine ecosystems, thanks partly to the emergence of improved models for trophic linkages based on foraging arena theory. These models now allow us to trace the impacts of complex trophic linkages and habitat dependencies on factors such as nutrient upwelling, and could in principle provide the basis for much more informed analysis of ecosystem-scale tradeoffs in fisheries management. Unfortunately, these models will probably never be used, because they will be seen as threats by an assortment of vested interests in fisheries management institutions. The models uniformly predict that much of the public investment in saving salmon has been misplaced, ineffective, or even actively dangerous to long-term sustainability.

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**Reg Watson** is a senior research fellow at the Fisheries Centre at the University of British Columbia. Dr. Watson has expertise in a range of fisheries areas including penaeid biology, trawl fisheries, stock assessment and computer modeling. He has published extensively on the simulation and optimization of trawl fisheries, and on bias in underwater visual census. In addition to scientific journals, his work on global fisheries has recently been published in *Nature*, *La Recherche*, *National Geographic*, and will soon appear in *Scientific American*. An experienced ecological modeler, he was a principal researcher in a study of the impacts of marine protected areas and artificial reefs in Hong Kong. He led a team that developed national marine biodiversity policy for Indonesia. He has 30 years of experience working internationally in fisheries and ecology projects. Dr. Watson is currently involved with the acquisition, management, analysis and visualization of global fisheries data with the 'Sea Around Us' project.

## State of the World's Fisheries

Reg Watson, Fisheries Centre, University of British Columbia, 2204 Main Mall, Vancouver, BC, V6T 1Z4.  
Email: r.watson@fisheries.ubc.ca

Recently we have finally been able to put into focus the changes in global fisheries, and indeed in the marine environment itself, that our 'ever more desperate' fishing practices have created over the last century. Now it is possible to examine large-scale data, and see patterns of decline that stand out clearly against a blur of climate change and human development. Instead

of an increasing number of collapses of apparently unrelated fisheries across much of the world, blamed loosely on climate change or vague coincidental inexplicables, we can now see a systematic erosion in the environmental production systems supporting these fisheries, manifesting itself in species change, huge reductions in biomass, general trophic level decline and more frequent blooms of toxic species. While some scheme to eutrophy the oceans and cheat fate, most accept that productivity is ultimately finite, and must be carefully managed even on the high seas. Moving pelagic production to coastal aquaculture sites as fishmeal does not change the end sum. In the famous five stages of grief, most now are prepared to leave 'denial' behind. Many, however, still hover between anger, bargaining and depression. Some of us feel that it is time for acceptance, and with it action. Resistance is futile, the solutions must include substantial fishing effort reductions coupled with generous use of protected areas and seasons. Developed nations must resist the pressure to erode the marine resources of developing nations. Perverse subsidies that maintain false expectations must cease. Approaching a future challenged with topsoil loss and critical shortages of freshwater, we must maintain viable marine systems, if only for the food security they offer us.

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**Fred Whoriskey** is the Vice-President of Research and Environment at the Atlantic Salmon Federation. He received his PhD from l'Université Laval in 1984 and has held various positions at Woods Hole Oceanography Institution (WHOI) in Woods Hole, Massachusetts, the University College of Wales in Aberystwyth, UK and at McGill University. His research interests include fish biology and ecology, and the impacts of exotic species on native ecosystems and is heavily involved in public policy issues, especially with regards to environmental impact assessments. He was appointed Deputy Scientific Coordinator of the Great Whale Scientific Support Office in 1993. He has served as a scientific advisor to the Moose River/James Bay Coalition, the Grand Council of the Cree (Quebec), and the Atlantic Salmon Federation on hydro-electric development on the Moose River, Great Whale River, and Ste. Marguerite/Moisie Rivers respectively. Presently, Whoriskey serves on the Board of AquaNet (Canada's National Centre of Excellence in Aquaculture), the Huntsman Marine Science Centre, the Atlantic Salmon Broodstock Development Program, and the St. Lawrence Valley Natural History Society.

## Wild Atlantic Salmon in North America: Status and Perspectives

Fred Whoriskey, Atlantic Salmon Federation, PO Box 5200, St. Andrews, NB E5B 3S8. Email: asfres@nbnet.nb.ca

Returns of wild Atlantic salmon to their rivers of origin have fallen to some of the lowest levels on record. Evidence is building for a precipitous regime shift in the North Atlantic Ocean that began in the late 1980s or early 1990s, and which continues at present. This shift correlated with declines in smolt survival by as

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much as a factor of 10, but its causal link to salmon has not been identified. All commercial fisheries for North American Atlantic salmon have been closed, but populations have not rebounded. Most populations south of Cape Breton Island, Nova Scotia (roughly the southern third of the species distribution in North America) are depressed to levels where they are officially or unofficially recognized as being endangered. Recovery programs are being implemented where funding permits. In addition, considerable scope exists to improve salmon production in rivers that have been terribly impacted by human activities (e.g., acid rain, hydroelectric dams).

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**Noel Wilkins** is a geneticist and Professor of Zoology in the National University of Ireland, Galway. Previously he was employed by the Department of Agriculture and Fisheries for Scotland studying salmon at West Greenland. Nowadays he runs a salmon-breeding programme in conjunction with the Electricity Supply Board on the River Shannon, the biggest river in Ireland. He was Chair of the Salmon Management Task Force set up in 1996 by the Irish government and first Chair of the National Salmon Commission. He and his students work on all aspects of the Atlantic salmon and on the restoration of stocks to areas where they have become severely reduced.

## **Language, Logic and Legislation: the Recent Irish Experience of Atlantic Salmon Management**

Noel P. Wilkins, Department of Zoology, National University of Ireland, Galway, Ireland. Email: noel.wilkins@nuigalway.ie

In recent years, opposing attitudes to the Irish salmon resource have been articulated in language that is confusing and contradictory. This reflects confusion and ambiguity in the underlying logic espoused by the different (commercial and angling) protagonists, especially the ambiguity surrounding the concept of “conservation of wild stocks”. Paradoxically, the more stringent the definition of this conservation, the less likely it is that any conservation action at all will be implemented. In 1996 the Irish Government set up a Task Force on Salmon Management to plot a way forward that would reduce conflict about the salmon stocks that was then almost at crisis level. Eschewing what may be termed the “calculus of blame”; the Task Force proposed a management strategy that placed the salmon, rather than the fisheries (angling and commercial) at its core. The maintenance, and in due course the augmentation, of the spawning escapement at the best practically achievable level was identified as the most fundamental, inclusive and necessary demand on the resource and all other demands were to be subservient to that. The Task Force identified the legitimate stake-holders—which included anglers, commercial fishermen, fishery owners and the wider economic community—and proposed a mechanism that ensured that any harvestable surplus was shared equitably between the catching sectors. It also provided a regulatory tool (TAC and quotas) in the event that stocks continued to decline. It introduced carcass tagging and fishing logbooks for all catching activities. There could be no gain without some pain for everyone.

The proposals received widespread support, both from the legislature and among the public, as an equitable strategy to untie a Gordian knot. The implementation details of the strategy were developed by fishery managers and formed the basis of new legislation introduced in year 2000. This legislation is now being implemented. It continues to receive the active support of the commercial sector even in the current year in which the TAC and quotas have been significantly reduced. However some leaders of the angling sector remain sceptical, although the anglers themselves are largely supportive. Some of the angling leaders remain rigidly fixed in the language and logic of extreme “conservation” and this causes them to reject not only the most effective regulatory measures for controlling catches but also the best hatchery and management practices available for restoration.

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**Ken Wilson** is a consulting fisheries biologist working as Scientific Advisor to the Sierra Club of BC's Marine Committee, and with Fraser First Nations in the capacity of Stock Management Coordinator. In this capacity, and through the Marine Fish Species Specialist Group of COSEWIC, he is involved in the assessment, listing and recovery planning of BC salmon stocks including Upper Fraser Coho, and Sakinaw and Cultus Sockeye. Wilson's work is primarily concerned with assessing the status of Fraser salmon stocks, and working with First Nations, Environmental Non-government Organizations, and Government management agencies to build stock assessment capacity and address stock management concerns through harvest regulation.

## **MSY, No Net Loss, and Status Compared to What?**

Ken Wilson, Sierra Club of British Columbia, Vancouver, BC. Email: wilsonkh@home.com

Maximum Sustainable Yield (MSY) remains an important and even central management paradigm for Pacific salmon, despite being largely discredited in academic circles. The technical problems with MSY are well documented and stem from the effect of data errors on the fit of stock recruit relationships, and from the assumption that these relationships are stationary over time. Not only does variability in stock productivity and measurement error lead us to regularly overestimate the long term productivity of our salmon stocks, but the politics of fisheries management often result in salmon harvests that exceed our best estimates of MSY.

In a similar vein, habitat management in BC is based on the policy of ‘no net loss of productive capacity’. Productive capacity of any salmon habitat is extremely difficult to measure under any circumstances, and impossible to measure in the absence of salmon. Not surprisingly, without some way to measure productive capacity, our attempts to achieve ‘no net loss of productive capacity’ have failed. Protecting the productive capacity of salmon streams in developed areas frequently involves stabilizing the banks to prevent or mitigate stream channel impacts on streamside properties, while trying to prevent or mitigate fisheries impacts resulting from streamside development

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by installing in-stream improvements to provide habitat. In fact, our attempts to restrict the natural movement of the streambed ultimately undermines the long-term cycles of erosion and deposition which provide the habitat that salmon have adapted to.

Despite their shortcomings, MSY and 'No Net Loss' have been transformed from theoretical constructs into legal management obligations, yet clear definitions elude us. Without a frame of reference for assessing our management progress or the status of the resource, any overview of the status of BC salmon stocks and their habitats is at risk of being little more than a catalogue of opinions about how well the natural world is meeting our needs. Our focus on maximizing yield and manipulating habitat in support of this objective may be self-defeating. Our reliance on simplistic, partial and mechanistic understandings of ecosystem processes to guide management, combined with increasingly inflexible management and allocation arrangements designed to protect existing values, interests, and property rights may be a recipe for stock collapse and catastrophic habitat change. In reality, productive capacity is a function of the fishes' adaptation to the habitat, not a specific attribute of the fish or the habitat alone. The fish we harvest and the habitats that support them are in a state of constant irreversible change; dynamically stable but constantly changing. Our current approach to salmon and habitat management focuses on maintaining yield and productivity at the expense of ecosystem resilience and stability.

If the time is right for a more holistic approach to managing natural systems, what is that approach and how can it be applied? Where will we find our new management paradigm for Pacific salmon? Recent advances in our theoretical understanding of ecosystem processes, (*Panarchy* by Gunderson and Holling 2002) do not provide simple answers, but pose interesting questions and point in useful directions. Human political, economic and social systems must be integrated into our understanding and management of ecological process. Adaptive management must explicitly recognize that change is occurring at varying rates over a huge range of spatial and temporal scales. Perhaps most importantly, rather than relying on complex analysis to simplify the problem, adaptive management relies on strong clearly stated values to navigate through a complex set of objectives.

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**Malcolm Windsor** is the Secretary of the North Atlantic Salmon Conservation Organization (NASCO) based in Edinburgh, Scotland. NASCO is an inter-government organization arising from a Treaty to conserve and internationally manage the North Atlantic Salmon with virtually every North Atlantic nation as a member. Dr Windsor's task was to set up and run this Organization following international concern about the future of the species. One of its tasks is to reach international agreement on regulatory measures based on scientific evidence to conserve stocks. NASCO has developed close links with the International Council for the Exploration of the Sea in setting the scientific questions which must be answered if NASCO is to achieve its aims. The

NASCO Secretariat has recently put significant effort into developing agreements and guidelines on implementation of the Precautionary Approach to fishery management, habitat, introductions and transfers, aquaculture and transgenics. It is also developing approaches to socio economic evaluations of the salmon resources and how such aspects of the resource can be instigated in the Precautionary Approach. Dr Windsor's post has many aspects: diplomatic, scientific, administrative, financial, publishing, legal and other elements.

Previously Dr Windsor was with the British Chief Scientist's Group within the Ministry of Agriculture, Fisheries and Food in London. There he reported directly to the Chief Scientist and his task was to implement, for fisheries research, the UK Government's policies for R&D. Before that he worked as a researcher at the UK's Torry Research Station and was concerned with the food and feed aspects of fishery resources. Earlier he worked in the field of physical chemistry in the US at the University of California. His earlier experience was in industry.

## **Application of the Precautionary Approach to the Conservation of wild Atlantic Salmon Stocks**

Malcolm Windsor and Peter Hutchinson, North Atlantic Salmon Conservation Organization (NASCO), 11 Rutland Square, Edinburgh, Scotland, UK, email: [hq@nasco.org.uk](mailto:hq@nasco.org.uk)

This presentation will outline the principles of the Precautionary Approach as adopted by NASCO. Under this approach, NASCO and its Contracting Parties should be more cautious when information is uncertain, unreliable, or inadequate and the absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation measures. NASCO has defined the respective roles of scientists and managers in applying the Precautionary Approach. The scientific advice should clearly identify areas of uncertainty, and the managers then need to decide how precautionary to be. NASCO's requests for scientific advice have been formulated accordingly. The paper will then describe how the principles of the Precautionary Approach have been translated into action plans and strategies for managing of wild Atlantic salmon and its habitat. NASCO's first task was to apply the Precautionary Approach to management of salmon fisheries and the paper will outline a decision structure developed for this purpose. This requires the definition of reference points (or alternative measures to define adequate abundance) and consideration of diversity criteria. Management of the fisheries should address any failure or trend in abundance or diversity. The next subject tackled was the protection and restoration of salmon habitat. Here, NASCO has the objective of maintaining, and where possible, increasing current productive capacity of the habitat i.e. no net loss. In order to measure and improve progress in meeting this objective, inventories of rivers are being established by NASCO's Parties, including information on current and historic salmon production and on factors affecting production. NASCO's Parties are developing strategies to protect salmon habitat and are identifying and prioritizing

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restoration requirements. NASCO has most recently looked at the application of the Precautionary Approach to aquaculture, introductions and transfers, and transgenics. Here, a Resolution covering how all these activities might be conducted in a manner that safeguards the wild stocks consistent with the Precautionary Approach has just been developed and will be described. Transparent and detailed reporting procedures are being developed for each aspect of the Precautionary Approach. Progress in considering how social and economic issues can be incorporated into the Precautionary Approach without negating its effectiveness will be described.

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**Chris Wood** is a research scientist with Fisheries and Oceans Canada and head of the Conservation Biology Section at the Pacific Biological Station, Nanaimo, BC. He has over 20 years experience in research on population and evolutionary biology of Pacific salmon. He chaired the Science Branch committee that drafted DFO's Wild Salmon Policy Discussion Paper released for consultation in 2000. He also serves on the Marine Fish Species Specialist Subcommittee of COSEWIC and holds an adjunct faculty position at the University of Victoria.

*See abstract for Carole Eros on page 8.*

## poster abstracts (listed alphabetically by presenter)

### **Fish, Folks and Forests**

**Brown, Terry L.**, FINS, 876 W 19th Ave, Vancouver, BC.  
Email: Fins@alternatives.com

“Fish, Folks and Forests” is an evocative slide/sound journey into the Salmon Forest of coastal BC. This is an inspiring 17 minute journey into the freshwater/forest home of salmon, with photos of salmon underwater, and stunning images which are half under and half above the water, graphically portraying the connection between the terrestrial and aquatic realms. The recorded nature sounds (including underwater hydrophone recordings) provide the feeling of being right there in the water with the female digging her nest in the gravel, or experiencing a thunderous raincoast downpour. An original improvised musical soundtrack sweeps listeners along with the river in a style which is not your typical nature show stuff. “Fish, Folks and Forests” was photographed, recorded, and produced by Terry L. Brown and Judy Abrams.

### **An Approach to Integrating Salmon Conservation into Landscape-Scale Planning for British Columbia**

**Ciruna, K.A.** (presenter), A. Tautz, R. Jeo, R. Tingey, C. Rumsey  
Nature Conservancy of Canada, 202–26 Bastion Square,  
Victoria, BC V8W 1H9.  
Email: Kristy.Ciruna@natureconservancy.ca

The Coastal Information Team (CIT), is an independent, multidisciplinary team established by the Province of BC, First Nations, the forest industry, and environmental groups to set conservation priorities for BC’s coastal temperate rainforest using a consensus-based, multidisciplinary approach to planning. Through the auspices of the CIT, the Nature Conservancy of Canada and partners have been tasked with delivering an assessment of coastal temperate rainforest biodiversity priorities to land-use planning tables. This assessment will guide the establishment of protected areas and development of an ecosystem-based management framework. Through this process, we are developing an approach for setting priorities for Pacific salmon conservation. Salmon targets are defined at the stock level using DFO escapement data and at the ecosystem level using a hierarchical freshwater ecological classification framework that is currently under development for BC. Stock viability and watershed condition are assessed using trend analyses and an accumulated watershed threats model respectively. This information is used to develop a decision matrix based on stock viability, watershed condition (landscape context), and watershed size to derive a range of conservation opportunities that will guide conservation action for Pacific salmon.

### **Risks to West Coast Vancouver Island (WCVI) Fisheries from a Mega-earthquake at the Cascadia Subduction Zone**

**Dobson, Deirdre**, Department of Geography and Centre for Coastal Studies, Simon Fraser University, Burnaby, BC.  
Email: dedobson@sfu.ca

With an ever-increasing probability for a mega-earthquake at the Cascadia subduction zone, the effects on WCVI marine resource from such catastrophic events are a threat not yet adequately addressed by fishery scientists. As the Alaskan 1964 mega-earthquake (Mw 9.2) showed, sudden changes to shoreline morphology results in population declines for several salmon and clam fisheries. Prince William Sound experienced as much as 50% declines in salmon catch and escapement values as a result of excess fry mortality due to uplift, subsidence and tsunami waves. The region also experienced heavy clam mortality due to beds being shifted out of their ideal intertidal zone.

The predicted Cascadia subduction earthquake will likely be of similar magnitude. Therefore, BC will experience similar losses as large numbers of inter- and sub-tidal organisms are displaced and valuable-rearing habitats are lost or damaged. Unlike Alaska, BC has many salmon species on west Vancouver Island that are considered “at risk” or are of “special concern”, making them more vulnerable to such catastrophic events.

The collapse of resources following a subduction zone earthquake could be detrimental for stocks as well as those reliant upon west coast fisheries. Surveys were completed with managers, fishers and aquaculturists on the west coast to determine stakeholders’ knowledge and awareness regarding mega-earthquakes. It was evident that respondents did not fully realize the risks to the fisheries associated with a mega-earthquake prior to completing the survey.

### **Migration Timing and In-river Survival of Late-run Fraser River Sockeye Using Radio-telemetry Techniques**

**English, K.K.** (presenter), W. R. Koski, C. Sliwinski, A. Blakley, A. Cass, and J. Woodey, LGL Limited for Fisheries and Oceans Canada. Email: kenglish@mail.islandnet.com

In recent years, large numbers of Late-run Fraser River sockeye salmon have died in fresh-water areas before they spawned. We used radio-telemetry techniques to determine the river entry timing and migration rates for Summer-run and Late-run sockeye stocks and to estimate survival from river entry to the spawning areas for 2002. Fishery removals and in-river detections accounted for 62% of the 873 sockeye released in marine areas. The portion of releases accounted for was lowest (35-36%) for the two time-area release groups when sockeye abundance was low at the release sites and consistently higher (73-75%) during the four release groups when sockeye were abundant at the release sites.

Data from 17 fixed-station receivers were the primary information used to determine the timing of river entry, assess in-river migration rates, and confirm entry into spawning areas. The detection efficiencies estimated for each of the fixed-stations deployed at and above Hope were 97-100%. Lower detection efficiency for fixed-stations below Hope were likely due to the width and depth of the river channel and varying degrees of environmental noise due to fishing vessel activity near each site. The median run timing dates for Late-run stocks passing through the Juan de Fuca fishery was 13 August and 12-16 September for these stocks at the Mission hydroacoustic site. These timings were similar to those observed in the previous dominant cycle year (1998) but substantially earlier than the historical median dates.

The median travel times between the release sites and Mission for Summer-run sockeye (6.4-9.1 d) equate to migration speeds of 26-44 km/d through coastal waters. The Late-run sockeye that entered with the Summer-run stocks had similar travel times to those for Summer-run fish. Most of the Late-run fish delayed in the Strait of Georgia and entered the river after the Summer-run migration. The estimated delay for Late-run stocks ranged from 15.5 d to 32.7 d depending on the entry timing group. Between Mission and the Thompson Junction, the median migration speed for Summer-run stocks (33-39 km/d) was much faster than that estimated for Late-run sockeye (17-21 km/d). Detailed tracking data for individual fish indicated that the radio-tagged sockeye maintained essentially the same chronological order as they migrated past the monitoring stations along the Fraser and Thompson rivers.

After removing all the radio-tagged fish classified as potential fishery removals, the survival rate for Summer-run fish was 91.7%. No significant differences were observed between the survival rates for each timing group of Summer-run sockeye. In contrast, the low survival rate for the 1st group of Late-run fish that passed Mission (13.3%) was significantly different from those for all other timing groups and the survival rate for the 2nd and 3rd groups combined (74.0%) were significantly lower than that for the 4th timing group (91.7%). The trend of substantial increases in the survival of Late-run sockeye for each successive group passed Mission was consistent with pre-season expectations; however, the survival rates were definitely higher than estimated for Late-run stocks in 2000 and 2001. Mission sonar abundance estimates for Late-run sockeye were combined with these period specific survival rates to calculate the overall in-river survival rate of 80.6% (STE +2.6%) for 2002 Late-run sockeye. Period specific survival rates were used to define a relationship between river entry timing and in-river survival and identify additional factors that may influence river entry timing for Late-run sockeye. These relationships may be useful in predicting in-river survival rates for Late-run stock in future years.

## **Loss and Fragmentation of Salmonid Habitat Due to the New Trans Labrador Highway**

**Gibson, R. John** (presenter), "Coasts Under Stress" Research Project, Memorial University of Newfoundland, St. John's, Newfoundland, A1B 5S7.

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Rebecca L. Luther, Labrador Métis Nation.

Email: [luther\\_rj@hotmail.com](mailto:luther_rj@hotmail.com)

Richard L. Haedrich, "Coasts Under Stress" Research Project, Memorial University of Newfoundland.

Email: [haedrich@morgan.ucs.mun.ca](mailto:haedrich@morgan.ucs.mun.ca)

In order to assess possible environmental effects on streams of the newly constructed (in 2001 and 2002) Labrador Highway in southern Labrador we conducted a survey of stream crossings over about 210 km of road. We found that 54.5% of crossings on permanent streams presented barriers to fish migration, and only two out of 45 culverts examined were of open bottom types, which are the recommended types by the Department of Fisheries and Oceans (DFO). None of the pipe culverts was embedded, as is required to conserve productive capacity of fish habitat, resulting in the loss of 3000 m<sup>2</sup> of fish stream habitat by the culverts themselves. Loss of spawning and rearing habitat above created barriers was greater. Loss of small streams due to pipe culverts may be as detrimental to salmonid stocks as such factors as over fishing, but appear to have relatively low priority. Major implications of the study are: (1) the study is an example of a widespread problem. (2) It is clear that concern and awareness must exist at a very local level in government if that legislation is to be at all effective. (3) It takes more than good academic science to raise awareness. The present study was undertaken in cooperation with the Labrador Métis Nation, and has resulted in meetings with DFO, and training of Labrador Métis Nation fishery guardians to ensure proper stream crossing techniques for Phase III of the Labrador Highway.

## **Can Wild and Hatchery Salmon Successfully Coexist? Consider the Alaska Model**

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Alaska salmon, focus of major commercial harvesting since the late 1800s, is characterized by cyclic fluctuations in abundance resulting in varied levels of harvest. Poor catches from weak wild stock runs causes statewide socio-economic disruptions. Modern hatcheries, developed in response to record low wild-stock runs in the 1970s now provide important supplements to fisheries even though natural runs have mostly recovered. Hatcheries in Alaska were developed specifically to complement fisheries under management protocols to protect and maintain healthy wild stocks by promoting vigorous habitat protection, avoiding mixed stock fisheries where possible, and where hatchery stakeholders help pay cost. Hatchery siting, capacity, general operations, and

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restricted brood stock origins are carefully regulated through statewide genetic and pathology policies and statutes. The state's 33 production hatcheries are mostly located on non-anadromous water sources not on productive salmon streams. Collectively these policies allow Alaska to maintain robust wild salmon stocks balanced with integrated development of hatchery production to supplement fisheries. A cornerstone of the Alaska model is a priority focus on escapement-based management where wild stocks achieve spawning goals rather than target harvest levels. Some hatcheries release over 100 million juveniles annually; statewide totals are 1.2 to 1.4 billion annually over the last decade. Beginning in the late 1980s commercial harvest of salmon have remained at or near historic high levels although wild stocks in Western Alaska, a region without hatcheries, remain at depressed levels. In the last decade hatcheries have produced 27–63 million adults annually accounting for 14–37% of common-property harvest. Contrary to oft held beliefs about permanence, 13 Alaska hatcheries have closed since 1979 for various reasons. In spite of healthy wild stock fisheries supplemented with hatchery fish Alaska's commercial salmon industry, based on capture fisheries, is economically threatened by continued worldwide production of farmed salmon.

### **Predicting Relative Effects of Forest Management Strategies on Coastal Fish Stream Habitat**

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Relative impacts of forest management options on small and intermediate fish stream habitat in coastal British Columbia are simulated in a strategic level forest planning model. The model uses operationally available ecological information about forest stand dynamics. It simulates storm peakflow events that drive the system. Debris slides as the input mechanism of coarse sediment into the channel network and bedload transport in channels are modelled. The recruitment of large wood into channels from hillslopes, riparian zones, and upstream channels, and the dynamics of log jams as critical elements for channel morphology and aquatic habitat are simulated. Changes in channel morphology are tracked and fish habitat capability is rated, using the example of coho salmon (*Oncorhynchus kisutch*). Forest harvesting is simulated to produce diverse cutting patterns across the landscape. The model produces expected trends in regard to log jam numbers, bedload yield, and fish habitat capability rating. In the absence of riparian buffers log jam numbers decrease with increasing harvest volume. Bedload yield increases with increasing debris slide rates and decreasing log jam numbers. Coho salmon habitat capability rating decreases with decreasing log jam numbers. A demo version of the model is available at [www.forestwerks.ca](http://www.forestwerks.ca).

### **Quesnel River Research Centre**

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The University of Northern British Columbia's new Quesnel River Research Centre is located in Likely, British Columbia, Canada. The 21.5 hectare site on the Quesnel River immediately downstream of Quesnel Lake is ideally situated for both land and aquatic based research and university extension. Although the central focus at the research station is a Chair in Landscape Ecology through the University's College of Science and Management, the Centre provides an opportunity for research and education to be undertaken in a variety of disciplines.

It is the University's vision to create a world-class research centre that provides a setting for collaboration involving researchers from other provincial, national and international universities, government agencies, other research centers, and industry. The Centre also offers field study opportunities to undergraduate and graduate students, summer field schools, as well as extension services and seminar/workshop facilities for non university user groups.

### **Forecasting Age-specific Pacific Salmon Recruitment in a Changing Environment**

**Holt, Carrie** (presenter) and Randall Peterman, Fisheries Research Group, School of Resource and Environmental Management, Simon Fraser University, Burnaby, BC. Email: [cholt@sfu.ca](mailto:cholt@sfu.ca)

Sibling-age-class relationships (SACR) are widely used in Pacific salmon management in models for forecasting age-specific recruitment. These models are based on the relationship between the number of adult recruits in one age class returning in a given year, and adult recruits in the next age class in the subsequent year (i.e. the same brood class). This allows managers to forecast age-specific recruits from previous years' recruits. The principal assumption of this model is that the relative proportion of age-specific recruits is stationary (i.e. the parameters are constant). However, this assumption may be invalid because of changing environmental and ecological conditions in the North Pacific Ocean resulting in temporal variability in ocean productivity, salmon survival and growth. Using a Kalman filter model, we estimated considerable increases over time in the Y-intercept (a parameter) of sibling-age-class relationships for 24 sockeye salmon stocks in British Columbia and Alaska (i.e. fish mature later). The spatial scale of covariation in the a parameter among different stocks can help identify the spatial scale of processes driving changes in a parameters. Large positive covariation in the time series of a parameters among stocks and among regions suggests that changes are driven by ocean basin-scale processes. Increases in sockeye abundance in the North Pacific Ocean and changes in environmental conditions (Pacific Decadal

Oscillation index) occur at similarly large spatial scales and are correlated with changes in a parameters. Both density-dependent ecological interactions and changing environmental conditions may therefore explain non-stationarity of SACR parameters.

## **Feasibility of Reintroducing Sockeye and Other Species of Pacific Salmon in the Coquitlam Reservoir, BC**

**Gaboury, Marc**, Fisheries Biologist, LGL Limited, Environmental Research Associates, 9768 Second Street, Sidney, BC, V8L 3Y8. Tel. 250-656-0127. Email: mgaboury@lgl.com

Construction of the 30 metre high Coquitlam Lake dam in 1914 effectively blocked passage of anadromous salmon. A feasibility assessment sponsored by BC Hydro's Bridge-Coastal Restoration Program found no serious impediments to the reintroduction of sockeye, coho, steelhead and anadromous cutthroat to the Coquitlam Lake reservoir. However, a number of baseline research studies will be required to confirm the assumptions of the feasibility assessment. Re-introduction of sockeye salmon will require propagation of the stock, while coho salmon, steelhead and anadromous cutthroat would likely colonize the watershed naturally over time. It is estimated that the reservoir has the capacity to support a spawning population of about 50,000 sockeye and around 200 coho salmon. The availability of suitable spawning habitat for sockeye needs further investigation, but given the presence of shore-spawning kokanee, there is a reasonable probability that sufficient habitat exists. The re-introduction of sockeye will have a small, likely imperceptible, effect on water quality of Coquitlam Lake, a source of drinking water for the Greater Vancouver Regional District. Constructing a fish ladder at Coquitlam dam to allow for upstream and downstream migrations should be feasible from an engineering perspective. A multiple orifice vertical slot fishway exit with a conventional pool and weir fishway could accommodate the wide fluctuations in reservoir water levels. A reduction or elimination of flows diverted to Buntzen Lake for power generation during the smolt migration period (i.e., April to mid-June) appears likely under revised reservoir and flow management proposed in the Coquitlam-Buntzen Water Use Plan. Reduced flows to Buntzen would preclude smolts exiting the reservoir through the Buntzen diversion and promote smolts exiting at the dam.

## **Greater Georgia Basin Steelhead Recovery Plan**

**Lill, Alan**, A.F. Lill and Associates Ltd. Email: alanlill@shaw.ca

Wild steelhead stocks in 48 of the 58 highest priority watersheds in the Greater Georgia Basin (East coast of Vancouver Island, adjacent mainland inlets, and the lower Fraser River) are now in decline or at very low levels. Fifty of the 54 winter-run and all but one or two of the 27 summer-run steelhead stocks are at or below "conservation concern" status in most recent years. They have been the most affected of all steelhead in British Columbia by downturns in marine survival since 1990. Many stocks also suffer from significantly impaired freshwater habitat capability.

Recent field results are demonstrating that a combination of habitat restoration and stream enrichment (in selected watersheds) can increase steelhead freshwater productivity significantly and greatly offset declines in marine smolt survivals.

The primary objective (Lill 2002) is to stabilize and restore wild steelhead stocks and habitats to healthy self-sustaining levels in the highest priority watersheds. We also wish to maintain and restore angling opportunities, which benefit both local communities and the provincial economy. While the focus is on steelhead, improved protection and additional fish habitat restoration will have significant benefits for other species of salmon and trout.

While work has been underway since 1997, the required level of steelhead recovery requires a long-term comprehensive effort with increased resources and new funding partners.

Greater Georgia Steelhead Recovery Action Plan, AF Lill PEng, September 2002, Pacific Salmon Foundation  
www.psf.ca or www.SteelheadRecoveryPlan.ca

## **The Role of Hatcheries in Salmon Stock Recovery: Two Case Studies from BC's Central Coast**

**MacLaurin, Sandie**, Community Advisor, North Central Coast, Fisheries and Oceans Canada, Oceans and Community Stewardship, Hagensborg, BC, V0T 1H0. Email: MacLaurinS@pac.dfo-mpo.gc.ca

Dramatic declines in several salmon stocks in the Central Coast have necessitated Recovery Planning and action to prevent further stock decline and avoid extirpation. Recovery plans consider all aspects of resource management and are based on the best science possible coupled with traditional ecological knowledge. A key aspect of recovery action plans can be Strategic Enhancement. It is important to acknowledge that any decision to consider strategic enhancement can only be made after applying the Wild Salmon Policy, the precautionary principle and SEP enhancement guidelines to the individual situations to confirm the appropriateness of intervention. Modern strategic enhancement complements other conservation measures by:

- reducing the risk of stock extirpation during the period where bottlenecks to survival are identified and dealt with
- reducing the risk of extirpation when stock levels are so low natural rebuilding may not be possible even if there are no serious bottlenecks to survival or bottlenecks are no longer present
- allowing for assessment (stock recovery, contribution of enhanced fish and changes to genetic diversity)

Strategic enhancement can employ several methodologies. These are chosen based on biological information for each salmon stock such as life history, habitat, survival impacts (if known), species interaction, migration timing, sex ratio, access to broodstock etc. Our poster will look at two case studies from the Central Coast. One will describe the role Snootli Hatchery has played in Rivers

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and Smith Inlet sockeye salmon recovery planning and detail the guidelines followed and methods used to preserve bio-diversity and minimize impacts on the remaining wild fish. The second case study will review the involvement of Quinsam Hatchery with Campbell River chinook where a variety of techniques that blended habitat restoration, fish culture and water use planning have resulted in successful rebuilding of this stock.

### **Huu-ay-aht First Nation (HFN) Enhancement and Watershed Restoration Efforts**

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Thirty-five rivers and streams run in the traditional territory of the HFN on the central west coast of Vancouver Island (Bamfield). Logging left little or no riparian buffer along most of the fish bearing portions of the stream. This resulted in channel widening, channel/bank instability, infilling of pools, reduced surface flow, and loss of wood. Other factors contributing to the decline of salmon stocks include over-fishing, increased predation in El Nino years, global warming etc. From 1997 to 2001, over \$800,000 was invested (FRBC funding) in restoration projects (over 100 LWD structures, 2 side channels, fish ladders, etc.) in the Sarita and Klanawa watersheds. In 2002, due to both federal and provincial government funding cuts, no funding was made available for watershed restoration projects. Nevertheless, there is at least \$1.5 million worth of watershed restoration work left to complete in the Sarita River, the same amount in the Klanawa and \$1 million in all other rivers and streams.

In collaboration with DFOs Nitinat Hatchery, the HFN embarked on a Sarita River chinook stock-rebuilding program in 1983. Millions of fry have been released. For example, from 1997 to 2003, between 180,000 and 550,000 chinook fry were released annually. The number of chinook returning to spawn in the Sarita River has increased slowly with over 2000 fish returning to spawn in 1998 and again in 2002. From otholith and code wire tag information, it was found that approximately 90% of Chinook returning to the Sarita River come from enhancement efforts. From 1997 to 2003, the HFN-run Sugsaw Hatchery has produced from 8,000 to 230,000 chum fry.

For more information, please contact Stefan Ochman, HFN Fisheries Manager at Tel. 250.728.3080, Fax. 250.728.3081.  
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### **Can Science Speak for the Salmon? Developing a Framework for Improved Monitoring Protocols of Coho (Onchorynchus kisutch), Chinook (O.tshawytscha) and Chum (O. keta) Salmon at Goldstream River and Saanich Inlet, South Vancouver Island, British Columbia**

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*Project Sponsored by the Sierra Club of BC, 2003.*

In these critical times of wild salmon population declines, strategies for wild salmon conservation require our immediate attention: How can we effectively monitor abundance of naturally spawning salmon in British Columbia?

This Master's project is a comprehensive case study of wild coho (*Onchorynchus kisutch*), chinook (*O. tshawytscha*), and chum (*O. keta*) salmon at Goldstream River, and Saanich Inlet, South Vancouver Island, British Columbia.

Quantitative inventory data such as direct count survey data, historical escapement records, and native harvest statistics from Fisheries and Oceans Canada's government files have been compiled and are being analyzed. This research uses ecological surveying methods and population models for assessing and monitoring past, present and future abundances of "wild" coho, chinook, and chum salmon at Goldstream River. This study integrates information collected from modern, western scientific methods of salmon stock inventories with the Saanich First Nations fishing community's accounts of traditional ecological knowledge, identified through questionnaire surveys.

I am compiling and analyzing bio-data, and escapement data required for determining what the relative abundance of these threatened salmon species were prior to salmon hatchery enhancement initiatives introduced at Goldstream River spawning grounds in the 1970s.

Part of my research also involves Catch Per Unit Effort analysis of chum fished by Saanich fishers at Goldstream River and Saanich Inlet. A goal of this research is to assess whether the Saanich Tribal Fishery is "sustainable" in its current state.

This assessment of wild salmon stock abundance is being undertaken in order to develop a more complete set of salmon population monitoring protocols. An end goal is to determine how best to monitor declining stocks of coho, chinook, and chum salmon at Goldstream River and Saanich Inlet.

## **Protecting the Public's Interest in the Conservation of Wild Salmon in British Columbia—A Strategy for the Conservation of Pacific Salmon**

**Symington, Keith** (presenter) and Glavin, Terry, Sierra Club of Canada, BC Chapter.  
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Despite years of attempts, the federal government remains without a clearly-articulated policy regarding the conservation of wild salmon in British Columbia. In response to this continuing policy vacuum, the Sierra Club of Canada, BC Chapter, in consultation with several senior Fisheries and Oceans scientists and key independent salmon biologists on Canada's west coast, began developing a broad policy framework for the conservation of Pacific salmon.

The result was the report, "Protecting the Public Interest in the Conservation of Salmon in British Columbia: A Strategy for the Conservation of Pacific Salmon." With this report, the Sierra Club of British Columbia has produced the first modern strategic overview of wild salmon in the province: historical and social, ecological and economic. This study has been done in hopes of catalyzing broad strategic initiatives by the federal government and other responsible parties.

This poster will present the major findings and recommendations of the Wild Salmon Strategy report and will discuss current opportunities in British Columbia for ensuring that federal fisheries policy is reformed to meet the goals articulated. The example of recent successes in changing the decision-making structure for salmon to include full "conservation sector" participation will be highlighted. Emerging challenges for the conservation sector in reforming salmon policy will be identified and discussed—including the development of an accountable and representative framework for effective public participation in the new decision-making structure.

## **Take All That You Need and Use All That You Take**

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Teslin Tlingit Council is a self-governing first nation that manages the use of the resources in our traditional territory. Teslin Tlingit Traditional Territory is located at the headwaters of the Yukon River.

Our Elders tell stories of times when creeks turned red and they could walk across the backs of the salmon because the numbers of salmon returning to the streams were plentiful. Our people fish for Chinook in July and August and in September and October they used to harvest chum. We harvest salmon by drift netting, hook and line, setting nets and have used fish traps and gaffs. There is an unwritten law used by Teslin Tlingit Citizens.

*Take all that you need and use all that you take.*

In 1996 TTC put into effect a two day conservation closure on

our citizens in an attempt to conserve spawners that come to our traditional territory. TTC is one of the only First Nations along Yukon River drainage that attempts to reduce our subsistence harvest. This reduction is to increase a stock that provides salmon for hundreds of other users such as; Aboriginal, Non-Aboriginal, Subsistence and Commercial.

In order for TTC to do our part in building capacity and restoring and enhancing Chinook stocks in the Yukon River drainage we have become proactive in management of the stocks. We have participated in a tagging program, created a beaver management initiative, fry counting, incubation sampling, scale sampling and the effects of boats on smaller tributaries. On an annual basis TTC puts proposals into different funding agencies for these projects.

Our goal is preserve the salmon so that our children and grandchildren to come can practice our traditional lifestyle and harvest and enjoy the salmon as our ancestors did and we still do.

Gunalchish.

## **Spawner Residence Times and Their Influence on Escapement Estimation for Chinook Salmon (*Oncorhynchus tshawytscha*) on the Lower Shuswap River, BC**

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Helicopter visual enumeration is the most efficient method to estimate spawner abundance for many upriver Fraser chinook salmon (*Oncorhynchus tshawytscha*) populations including the Lower Shuswap River. Spawner residence time is a key factor in the area-under-the-curve (AUC) method for calculating population escapement of Pacific salmon. Currently, the knowledge of spawner residence times for Pacific salmon is very limited. The current spawner residence time used by Fisheries and Oceans Canada (DFO) in calculating chinook salmon AUC estimates is seven days for Lower Shuswap River chinook and is based on a study from the Nichola River. This study used telemetry and observation towers to determine the 2000-2002 mean spawner residence times for Lower Shuswap River male and female chinook salmon. The telemetric, mean spawner residence times for females were significantly lower than DFO's current spawner residence time of seven days; however, all the other mean spawner residence times were not significantly different than DFO's current spawner residence time of seven days. Based on preliminary data, the Lower Shuswap River chinook AUC escapement estimates calculated using this study's mean spawner residence times are significantly different when using the 2002 female spawner residence times than when using DFO's current spawner residence time of seven days. Using all the other mean spawner residence times determined in this study, preliminary Lower Shuswap River chinook escapement estimates are not significantly different than when calculated using DFO's current seven day spawner residence time.

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## **Impact of Domestication on Growth and Behaviour of Coho Salmon (*Oncorhynchus kisutch*)**

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Several coho salmon crosses were reared to enhance current understanding of how genetic variability relates to behavioural and physiological differences between slow-growing and fast-growing strains of fish. Crosses ranging from pure domestic to pure wild were reared as homogenous groups (a single family per group) and as four heterogenous groups (15 fish from each family). Two heterogenous groups were reared under culture conditions and were fed to satiation, and two were reared under semi-natural conditions with an enriched environment and limited food resources. After six months of growth, the mean size of the crosses increased with an increase in the proportion of domestic genes in the genotype. The domestic genotype produced even larger fish in the heterogenous group under culture conditions, however the relative differences between domestic and wild fish were reduced in the heterogenous groups grown under semi-natural conditions. Preliminary studies indicate that anti-predator behaviour is reduced with an increase in domestic contribution to the genotype. Occurrence of BKD within the pre-smolt fish demonstrated that the domestic fish were more susceptible to mortality from this disease.

## **A Sample of Reports from the Speaking for the Salmon workshop series**

*Nutrients and Salmon Production Seminar*  
November 2002

*Summit of Scientists on Sea Lice*  
July 2002

*Hatcheries and the Protection of Wild Salmon*  
June 2001

*Aquaculture and the Protection of Wild Salmon*  
March 2000

*Pacific Coast Salmon: Status of Stocks and Habitat*  
June 1999

*Thompson Steelhead: A resource in crisis?*  
October 1998

*Summit of Scientists on the Scientific Underpinning of the 1998 Management Decisions for Pacific Coho Salmon*  
June 1998

*Speaking for the Salmon Harvesting Workshop*  
May 1998

*Speaking for the Salmon*  
January 1998

For reports and proceedings from these events please visit our website at  
[www.sfu.ca/cstudies/science/salmon.htm](http://www.sfu.ca/cstudies/science/salmon.htm)









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