“What are the impacts of salmon farming on wild Pacific Salmon ?”

Brian Riddell, Science Advisor

Pacific Fisheries Resource Conservation Council

"Global production of farmed salmon has consistently exceeded the global catch of wild salmon since 1997."

"The total footprint of the B.C. salmon farming industry currently amounts to only about 14 km^2."

"Escapes from salmon farms have been reduced significantly since the early 1990s, and have been maintained at or below 1% of production since 1995."

"A multi-stakeholder Advisory Council provides input to the B.C. government on the ongoing development and implementation of its Salmon Aquaculture Policy Framework."

"Despite intensified survey efforts, no indications of successful spawning on the part of escaped Atlantic salmon were found in B.C. streams and rivers in 2001."

B.C. Salmon Farmers Association

Where ever it is practiced, net-cage salmon farming is controversial and raises serious environmental concerns.

CAAR

Think Twice About Eating Farmed Salmon

PACIFIC FISHERIES RESOURCE CONSERVTION COUNCIL … 2002 Advisories:

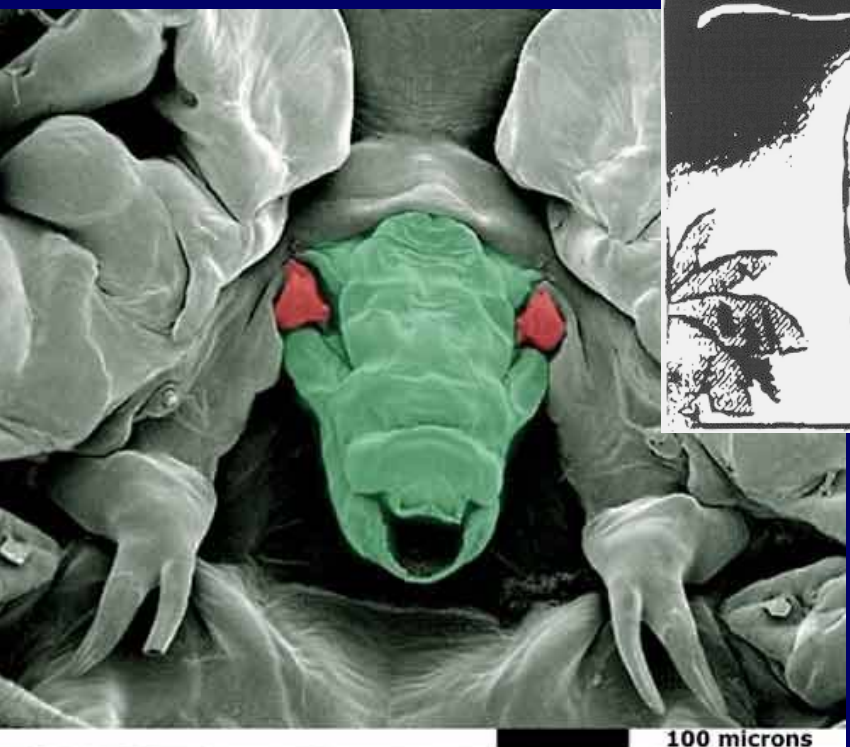
1. The Protection of Broughton Archipelago Pink Salmon Stocks (Nov. 2002)
2. Making Sense of the Salmon Aquaculture Debate. Analysis of issues related to net cage salmon farming and wild salmon in British Columbia (Jan. 2003) … contractor report to PFRCC
3. Wild Salmon and Aquaculture in British Columbia (Jan. 2003)

Website: www.fish.bc.ca

You know an issue is in the public eye when Editorial cartoons use Sea Lice as a topic!

Time Colonist

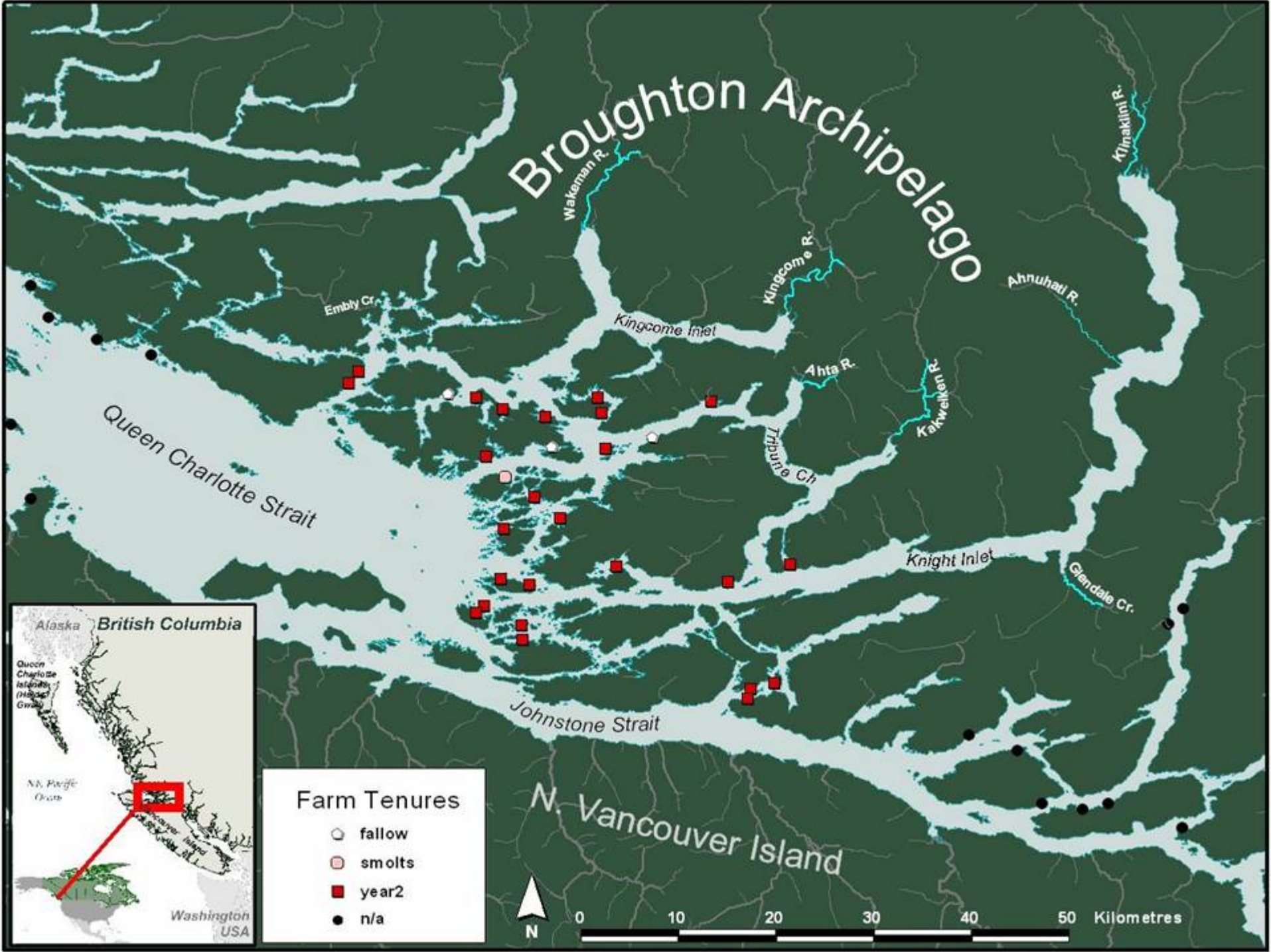
Feb. 8, 2003



… but hardly luncheon type conversation when you really see a lice “close-up”!

Pink salmon from non-exposed control site
Bond Sound salinity 25%
June 2001

Chinook salmon smolt
July 31,2001
Broughton Archipelago


Broughton Archipelago
Wakeman R.
Kimaklini R.
Kingcome R.
Ahnuhati R.
Embly Cr.
Kingcome Inlet
Ahta R.
Kakweiken R.
Tribune Ch
Queen Charlotte Strait
Knight Inlet
Glendale Cr.
Johnstone Strait
N. Vancouver Island
Alaska
British Columbia
Washington
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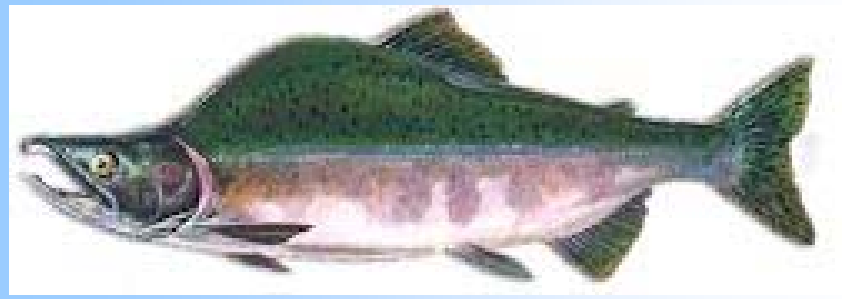
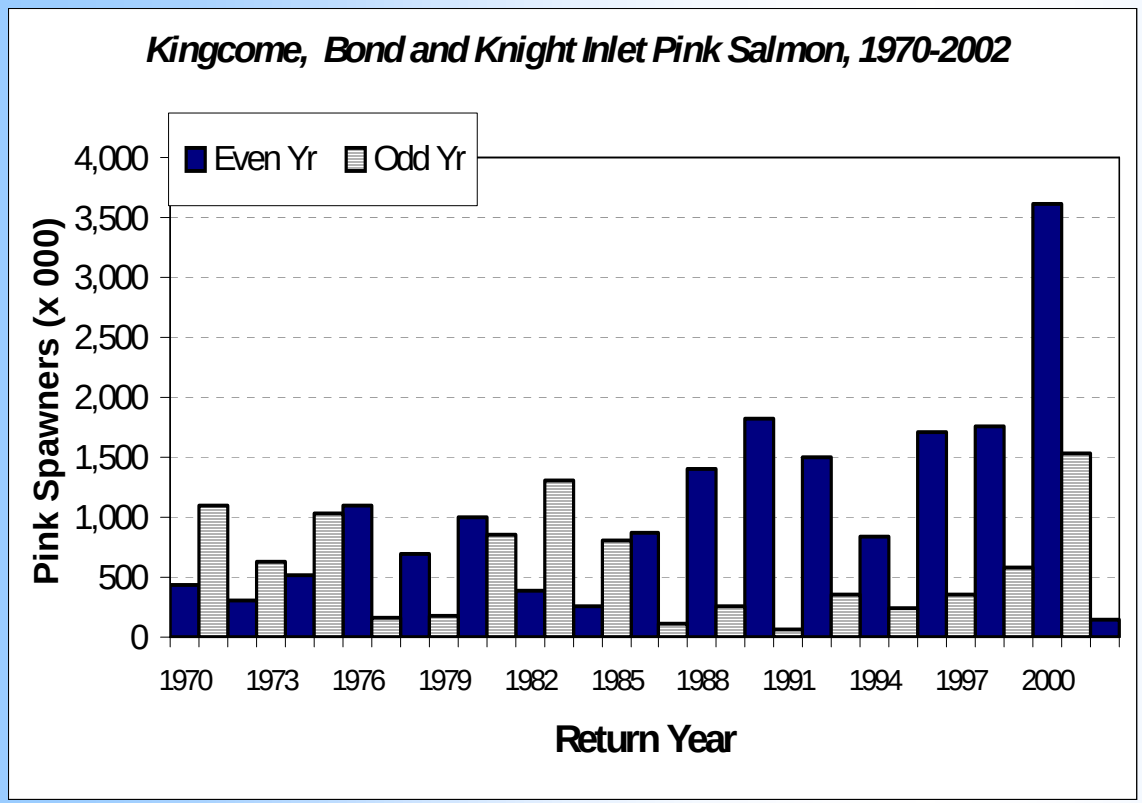


Pinks are so variable between years, how do we know when a return really is unusual?



Returns of Pacific salmon are highly variable due to the numerous sources of variation … climate, fishing, developmental impacts, etc.

However, FOC does have a long time series of spawning observations over many streams and years … these can be used to determine when an unusual event has likely occurred.

B. Riddell, PFRCC 10/27/2002

Year-to-Year Differences in Escapements (Deviations)

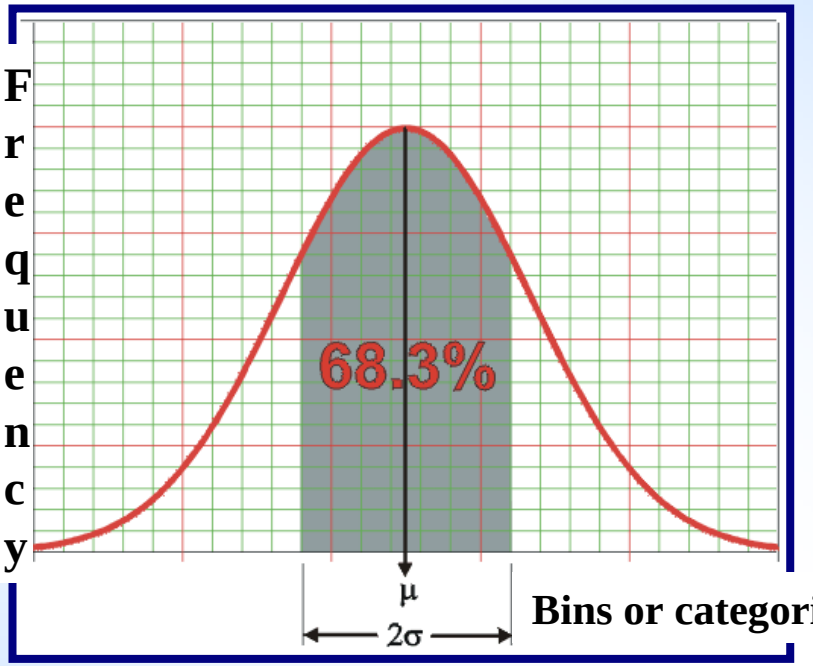
Stream: Pink Creek		
Year	Spawners	Deviation
1970	2,500	
1972	5,000	2
1974	1,000	0.2
1976	10,000	10
1978	25,000	2.5
1980	5,000	0.2

$$\frac{5{,}000}{25{,}000} = 0.2$$

A deviation is simply one year divided by the previous

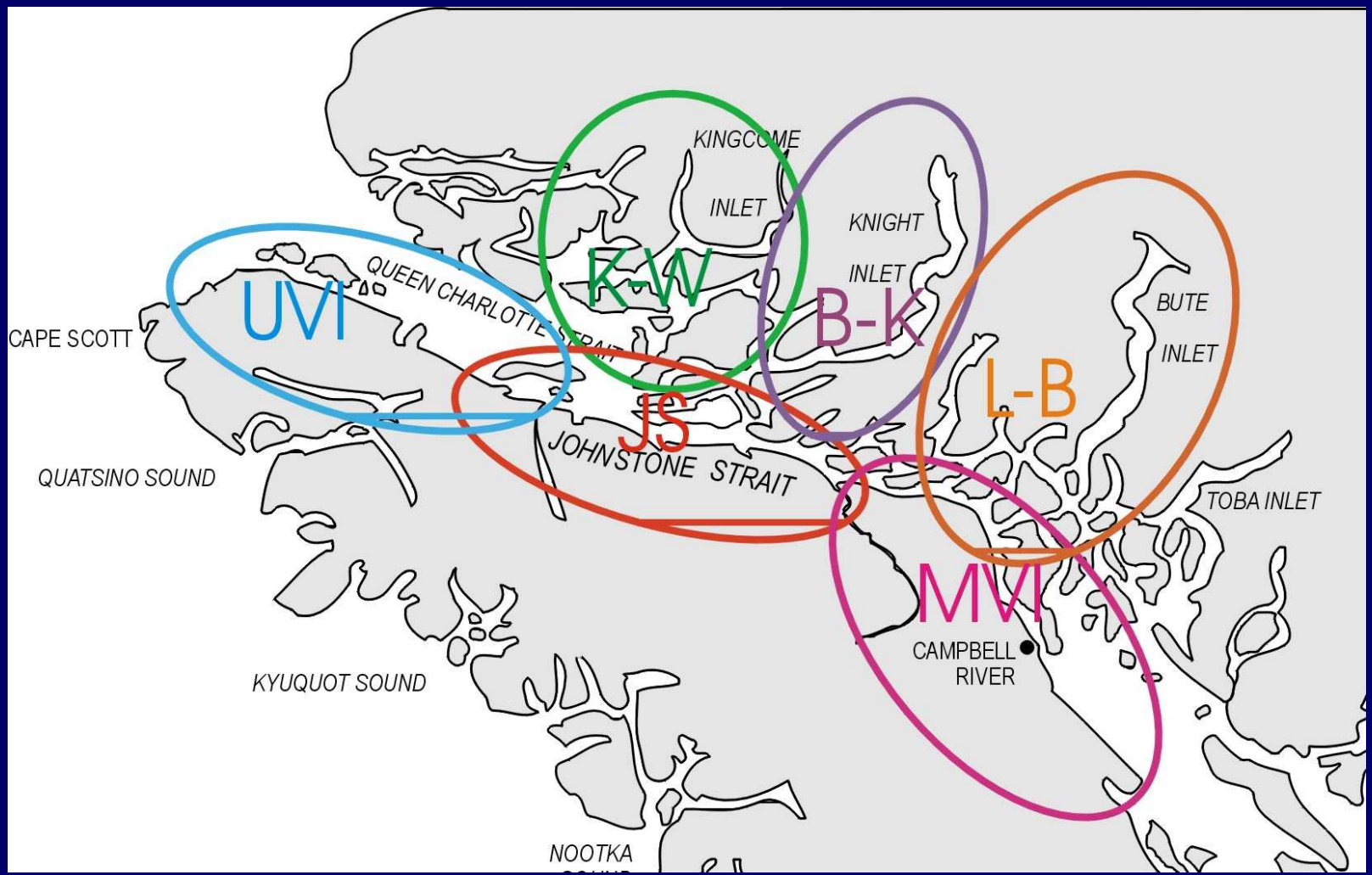
If we accumulate deviations over all years and streams, they form a distribution of past observations

… these can be used to estimated the expected frequency of future events.

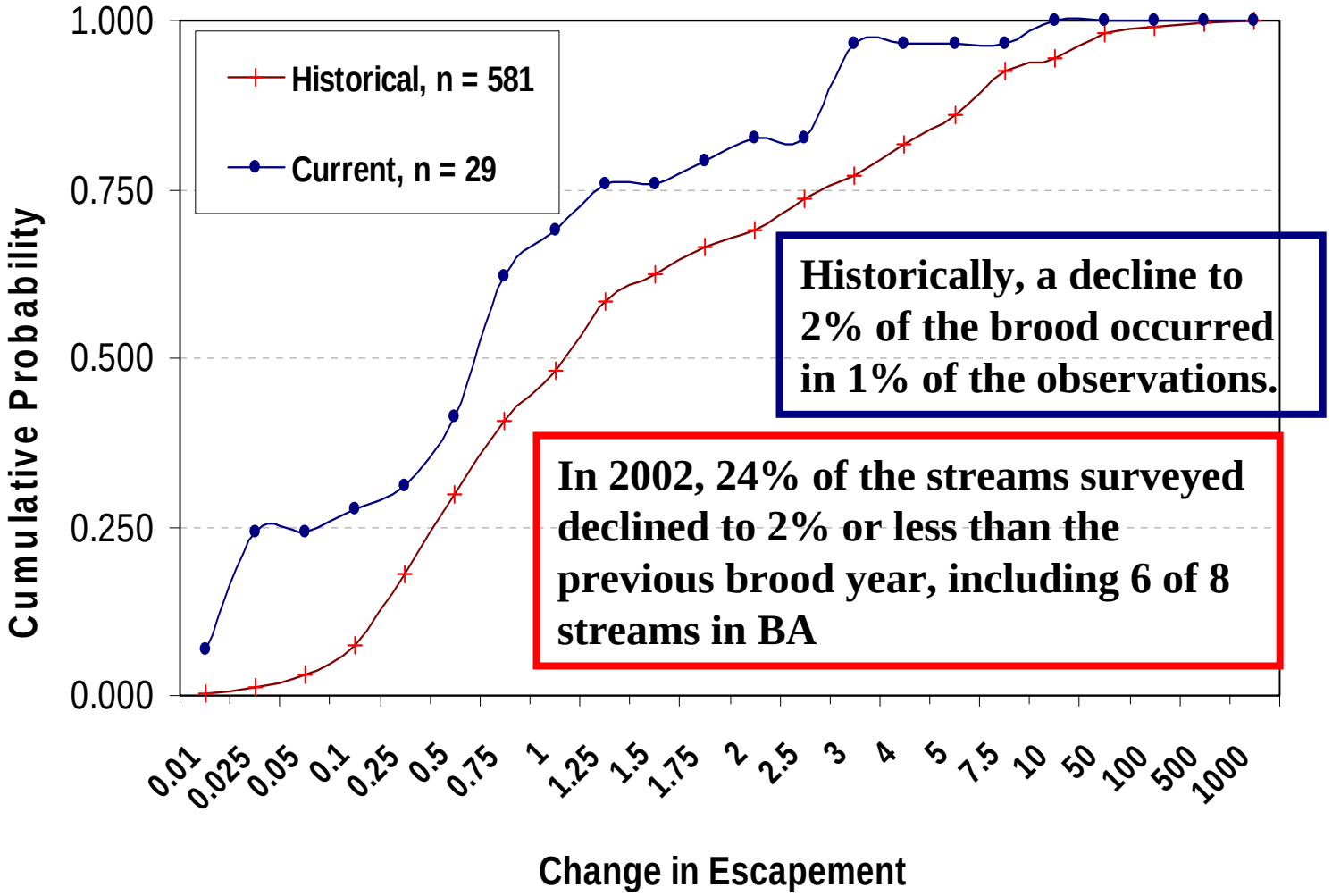


Southern BC – Study Area Pink Salmon Stock

58 different Pink streams and survey records from 1954-2000



Cumulative probability of Even-Year Pink Salmon deviations between years, based on Study Area streams



B. Riddell, PFRCC 10/27/2002

Bases of PFRCC conclusions leading to Broughton Advisory:

1. Change in pink salmon spawning populations was greater than expected based on all previous Departmental observations in Southern BC even-year Pink stock. (NB … no commercial Pink fishing in 2002). Multiple populations effected in local area.
2. Level of infestation on juvenile pink salmon never observed on juvenile salmon in past (including Alaskan programs).
3. Density of salmon net cage farms in B.A. and experience in other salmon farming regions strongly implicated salmon farms as contributors of sea lice to the natural environment.
4. Precautionary approach in face of uncertainty.

Current Status of Broughton Archipelago Pink salmon response plans:

1. Provincial and Federal plans being implemented but in early stage. Actions generally later than suggested by PFRCC
2. Pink salmon have begun migration and frequency of infection is between 35-55% (very early assessment!)
3. Salmon farms are monitoring for lice incidence have some have treated with SLICE (data on lice levels and treatment frequency not available to-date)
4. B.C. Aquaculture Research and Development request for research proposals (closed March 10)
5. Significant concerns in some sectors about efficacy of treatment with SLICE and impacts on environment
6. Continued need for improved communication/cooperation, to-date no regulations concerning sea lice on BC salmon farms!

Making Sense of the Salmon Aquaculture Debate

Authors: Dr. J. Gardner and D.L. Peterson

Objective: **to expand and deepen the current public understanding about the potential impacts of salmon aquaculture on *wild salmon* by examining, evaluating, and assessing the information and assumptions of opposing interests.**

Topics … risk to wild salmon assessed for each

1. Disease Issues and Fish Health (sea lice, bacteria, viruses)

2. Escapes … Pacific salmon, Atlantic salmon, colonization

3. Habitat Impacts … Seabed impacts, water quality

SEA LICE:

"lice from farms will contribute to lice populations in wild salmonids, but the extent and consequences of this have not been quantified"

What is the incremental natural mortality caused by sea lice?

Issues regarding sea lice:

1. Natural pathogen on salmonids, but sea lice assessed to be most serious immediate disease risk to wild salmonids.
2. Long term challenge to control sea lice on farms, including development of resistance to chemical treatments, not likely to eliminate sea lice problems
3. Increasing evidence that sea lice can transmit other disease
4. Use integrated area management plans to control lice
5. Indirect effects of treatment chemicals increased concern in ecosystem.

Bacteria and Viruses:

Pacific salmon are well adapted to bacteria and viruses endemic to BC

But, can pathogens be transmitted from salmon farms to wild salmon?

Issues related to bacteria & viruses:

1. Vaccines can assist control of bacterial diseases but not viral. Viruses higher risk than bacterial risks to wild fish.
2. Anti-biotic resistance reduces effectiveness of treatments but does not increase risks to wild salmonids.
3. Exotic pathogens presents greatest potential risk, but on the Pacific coast have been controlled to-date.
4. "New" diseases are likely to be detected, but natural incidence of disease in wild stocks is difficult to assess.
5. Significant progress has been made in health management on salmon farms (except recent example of IHN)
6. On the Pacific coast, we have no evidence of disease transfer from farms to wild fish, but the potential does exist.



ESCAPES: WILL EXOTICS COLONIZE BC WATERS? WHAT ARE THE GENETIC, ECOLOGICAL, AND DISEASE RISKS ASSOCIATED WITH ESCAPES? HOW MANY FISH ESCAPE?

Estimates from the Atlantic Salmon Watch indicated that approximately 1 million Atlantics salmon have escaped from BC and Washington State farms since 1991, and an equal number of farm-reared Chinook salmon (minor numbers of Coho included).

While there is some assessment of Atlantic escapes, there is NO assessment of the Pacific's since they cannot be identified!

ASWP reports 1,085 Atlantic salmon observed in 80 streams since 1987.

Do farmed Atlantic salmon survive in the wild? **YES**, but quite poorly based on observed adults.

Will farmed Atlantic salmon return to BC rivers and successfully spawn there? **Yes**, they have returned and "feral" juveniles have been found (Tsitika River 1998)

Do the results of monitoring suggest that colonization by Atlantic salmon is occurring. **NO**, **but possible**. Monitoring is currently inadequate for good information.

Summary of Escape Issues with Pacific and Atlantic Salmon:

TOPICS	PACIFIC SALMON	ATLANTIC SALMON
GENETIC	***Potentially significant, but can not quantified***	**Very low risk with Pacific salmon, my increase with other species**
ECOLOGICAL	**Would likely occur, but low risk of impact**	**Potential impact, but would vary depending on status of other species**
DISEASE	**Low risk assuming no exotic diseases occur**	**Risk associated with escapes very low assuming no exotic diseases occur.**
MONITORING PROGRAMS for Adults	***NONE, may use DNA or tagging to identify***	***INADEQUATE, no statistical design or dedicated resources***
Escape Trends	**NUMBERS OF ESCAPES DECREASED RECENTLY**	

Habitat issues associated with the seabed, water quality, ecosystem function, and "Performance-based Standards"

Seabed Issues:

-proximity to farm (impacts ~ 30m)

-Sedimentation rates (localized effect at farms, no measures)

-Feeding efficiency (food wt : fish wt gain)

-Recovery time after fallowing (varies)

- BC Waste Control Regulation, basis of Standard value?

Effect of lights on salmon farms not reported on.

Water Quality issues:

-nutrient loading and algal blooms … no evidence of impact

-Antibiotic residues, unlikely to effect migratory fish, other impacts possible

-Blood water, mortality disposal, and Net cleaning … limited effect on migratory fish via avoidance.

… background setting to third PFRCC report …

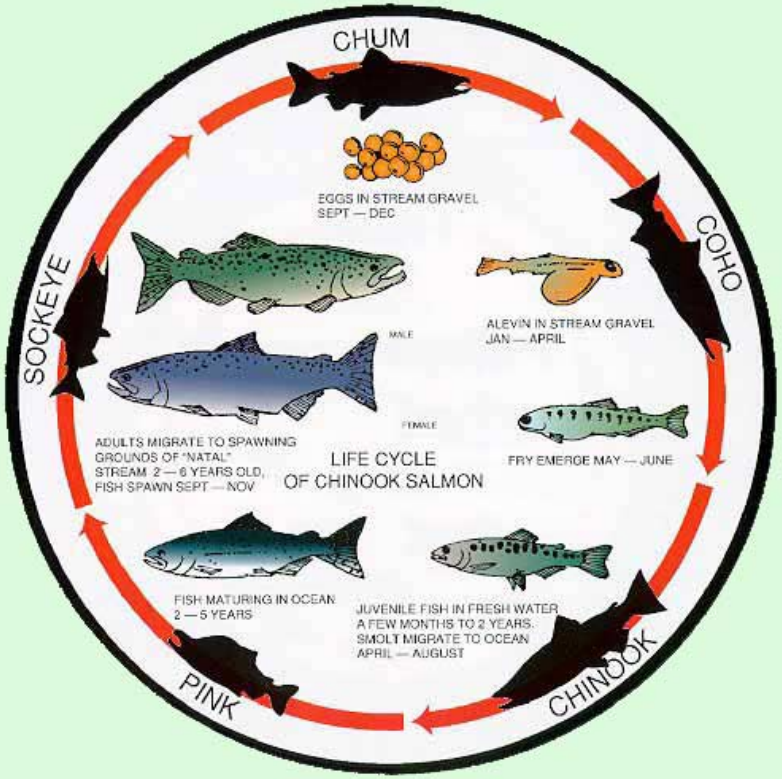
1. **There are recognized risks to wild salmon associated with net cage salmon farming, but they could be managed … depends on risk assessments, social choices, and compliance. High levels of uncertainty associated with most issues.**

2. **A major issue for salmon aquaculture in BC is that there is very strong cultural and social ties to Pacific salmonids and their conservation. In the BA, there are very strong feelings that people's concerns have not been heard.**

3. **This report only addressed salmon farming and wild salmon. The report notes many other issues including other forms of aquaculture, other impacts on wild salmon, economic issues, etc.**

PFRCC 3rd report is more process oriented than scientific … 5 recommendations presented.

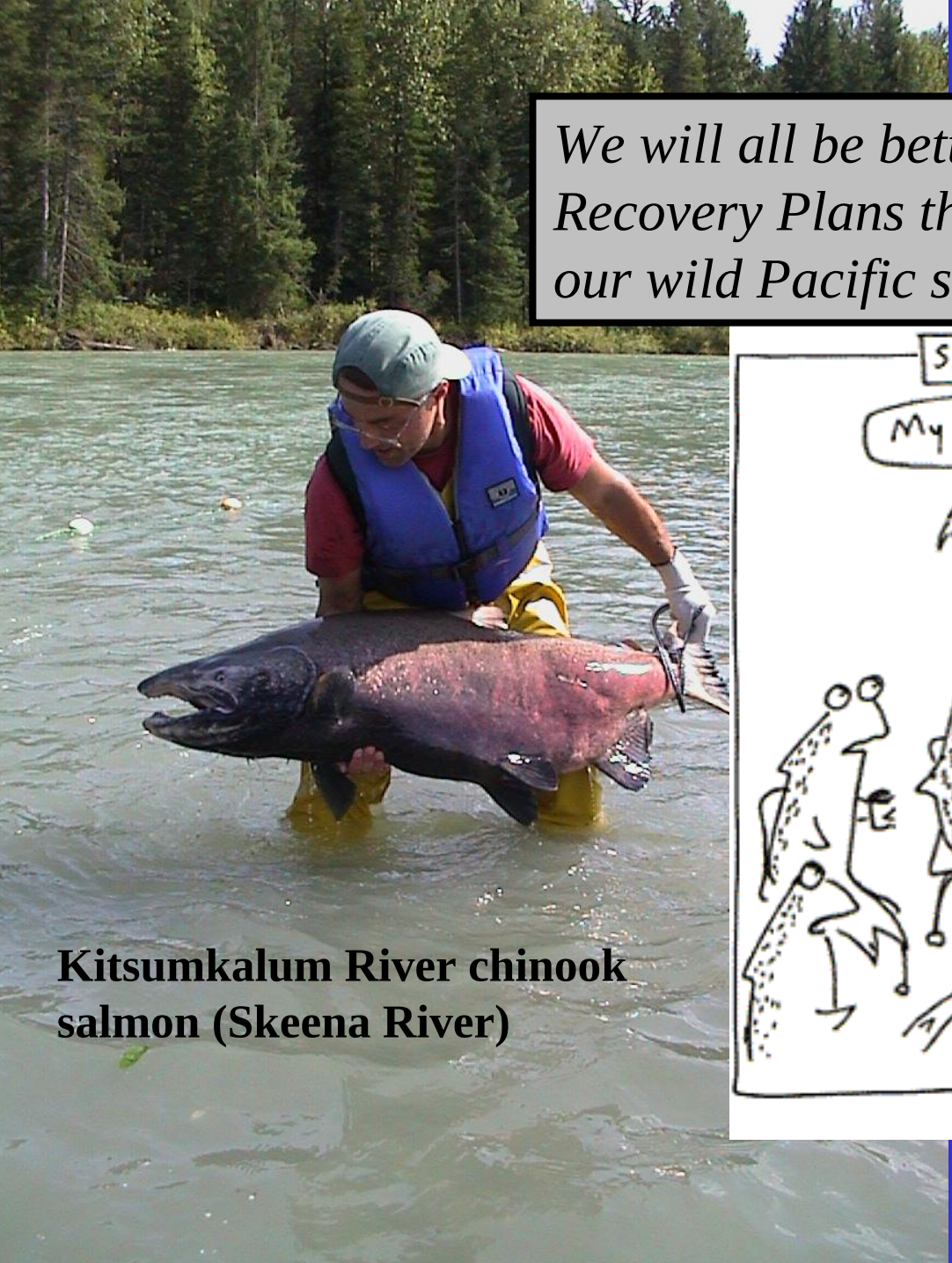
1. **Given extensive uncertainty, apply the precautionary principle more rigorously.**
2. **Undertake research and monitoring to address these uncertainties.**
3. **Government of Canada should complete the Wild Salmon Policy (establish priority for wild salmon)**
4. **Regulation of wild and farmed salmon should be integrated into single-bay or area management units.**
5. **Proposed a Salmon Aquaculture Forum, including a scientific panel, to develop public consensus on issues.**



My personal summary on the aquaculture issue is this:

1. Defensive posturing is not conducive to objective evaluation … wild salmon must be considered with aquaculture.
2. Extensive mistrust has developed and there is a critical need for effective dialogue and dedicated research programs.
3. Science can address technical or biological issues, but resolution of value-based decisions requires appropriate public processes which are not functioning now.
4. Aquaculture may have an important role in food production and employment, but it should not be at the expense of wild salmon, cultures, and other public values.
5. Conservation of salmon requires diversity and healthy ecosystems (maybe now more than ever in our time).

We will all be better off if we can avoid Salmon Recovery Plans through careful management of our wild Pacific salmonids …



Kitsumkalum River chinook salmon (Skeena River)

Spawning Chronology on Pacific Coast … Atlantic salmon may not interbreed with Pacific's but could compete with them through "prior residency" effect.

NOTE: Atlantic salmon in the Pacific seem to spawn after Pacific salmon but before Steelhead salmon. Atlantic juveniles may then establish territories before Steelhead and could compete in freshwater. However, whether this would really reduce Steelhead produce is unknown at this time.

Slide prepared by Dr. J. Volpe, Univ. Alberta