

**COMMISSION OF INQUIRY INTO THE DECLINE OF SOCKEYE SALMON
IN THE FRASER RIVER**

In the matter of Her Excellency the Governor General in Council, on the recommendation of the Prime Minister, directing that Commission do issue under Part 1 of the Inquiries Act and under the Great Seal of Canada appointing the Honourable Bruce Cohen as Commissioner to conduct an inquiry into the decline of the sockeye salmon in the Fraser River

AFFIDAVIT OF DENNIS BROWN

I, DENNIS BROWN, of 102 North Warwick Avenue, Burnaby in the Province of British Columbia, researcher, AFFIRM THAT:

1. I am a former fisherman, former UFAWU officer, writer and researcher in fisheries matters, and as such have direct knowledge of the matters deposed to herein, except where stated to be on information and belief..

2. I attended a large seminar at UBC in the fall of 2010. It was part of the UBC Fisheries Institute Lecture Series. About 100 to 150 people were in attendance. Dr. Carl Walters spoke for at least an hour with the aid of a power point presentation. Copies were handed out. I obtained one. The document entered as exhibit "Y" in this Commission (Ringtail CAN315587) is a copy of that slide show.

SWORN (OR AFFIRMED) BEFORE ME at)
Vancouver, British Columbia, on)
16 June, 2011.)
)
A commissioner for taking affidavits for)
British Columbia)



DENNIS BROWN

Where have all the sockeye gone?

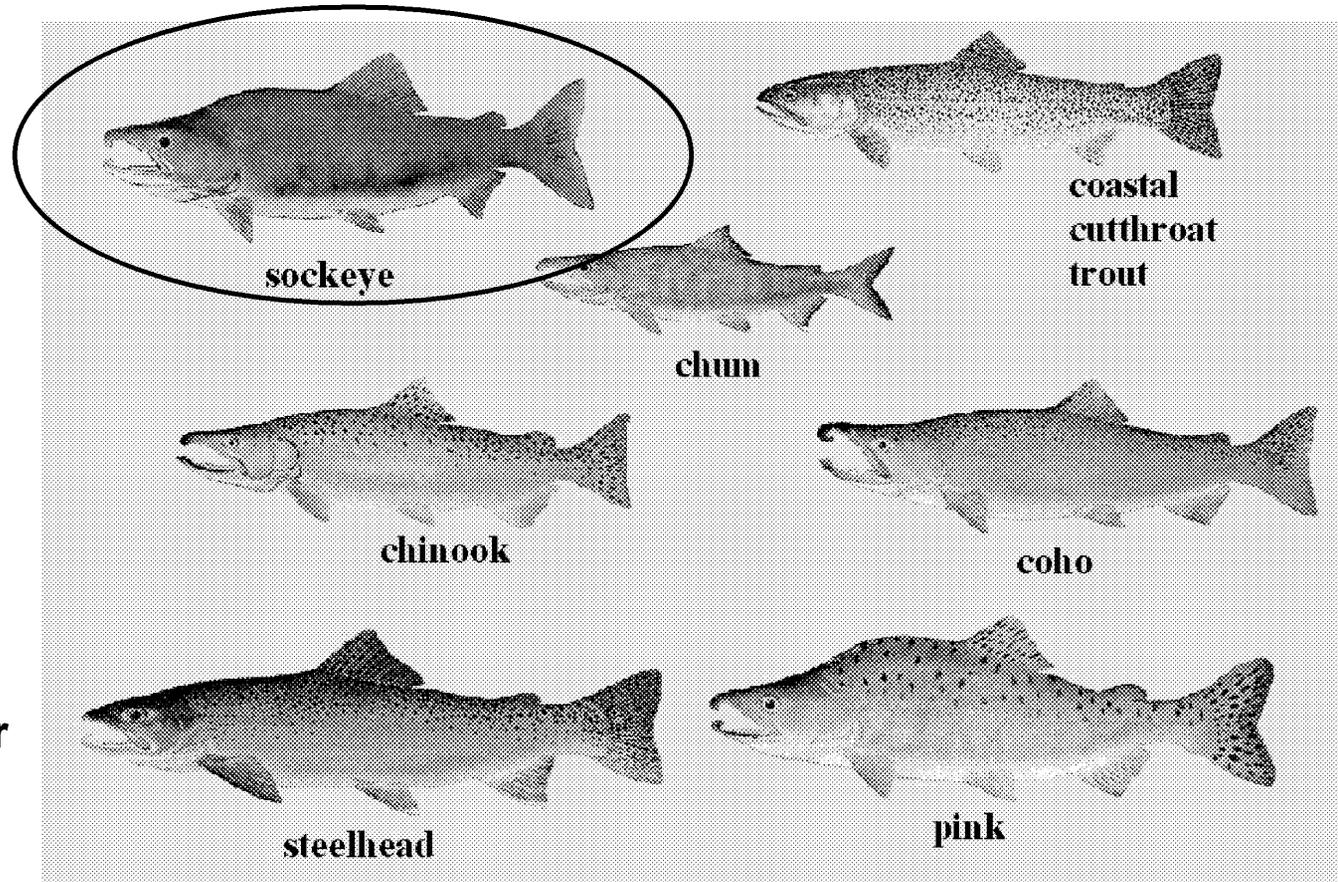
Carl Walters
Fisheries Centre, UBC

This talk is dedicated to the staff of the Pacific Salmon Commission, who provided almost all of the information that you will see, and who have done a truly remarkable job over the years

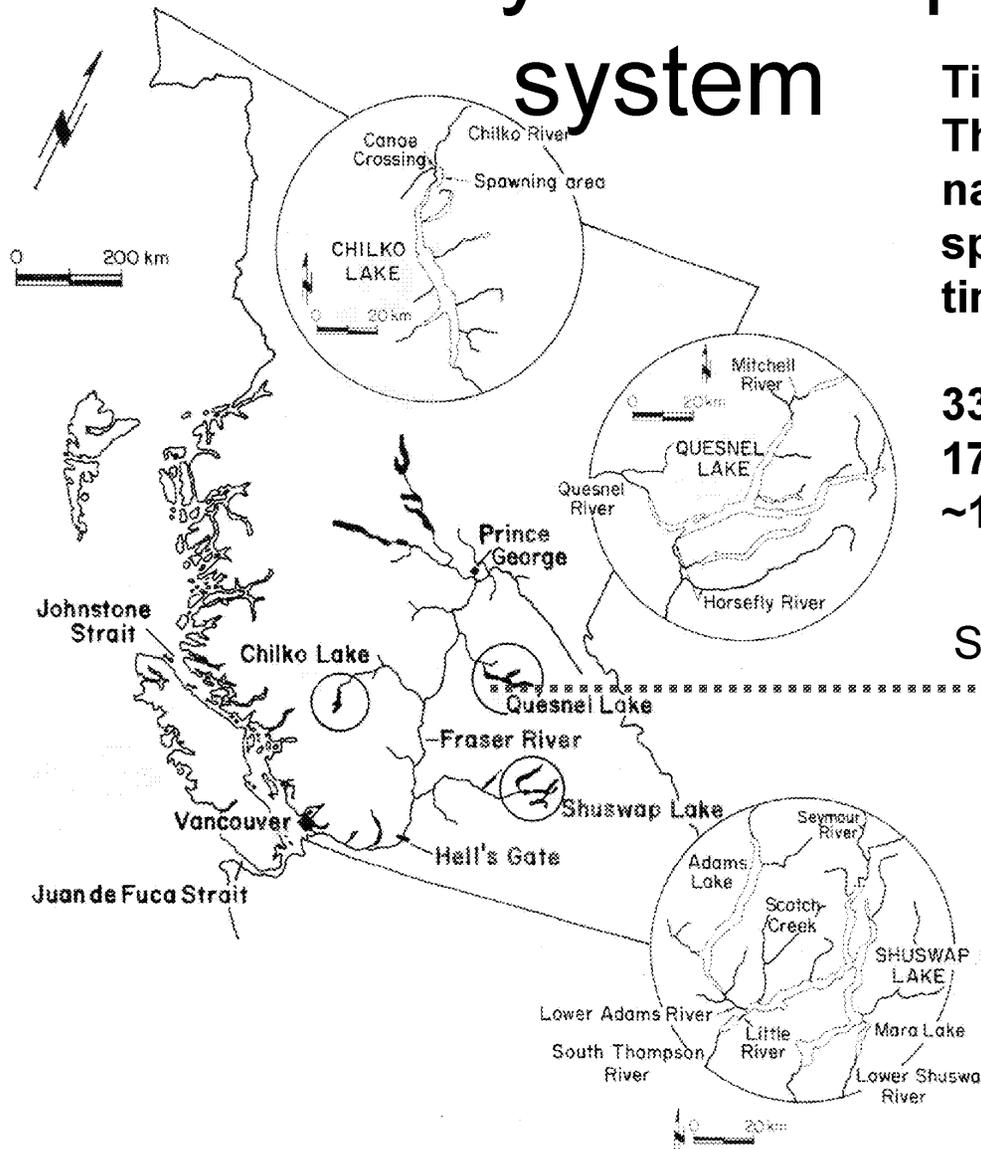
The Pacific salmon are a diverse collection of species with widely different life histories and status

SOCKEYE:

- 1) Live 4 years**
- 2) Die after spawning**
- 3) Migrate long distances**
- 4) Are the tastiest salmon**
- 5) Are the third most abundant species (after chum and pink)**



A wonderfully diverse production system



Timing is everything!
 There is very harsh natural selection to spawn at just the right time in each stream.

339 recognized locations
 173 with 10+ yrs data
 ~100 distinct "stocks"

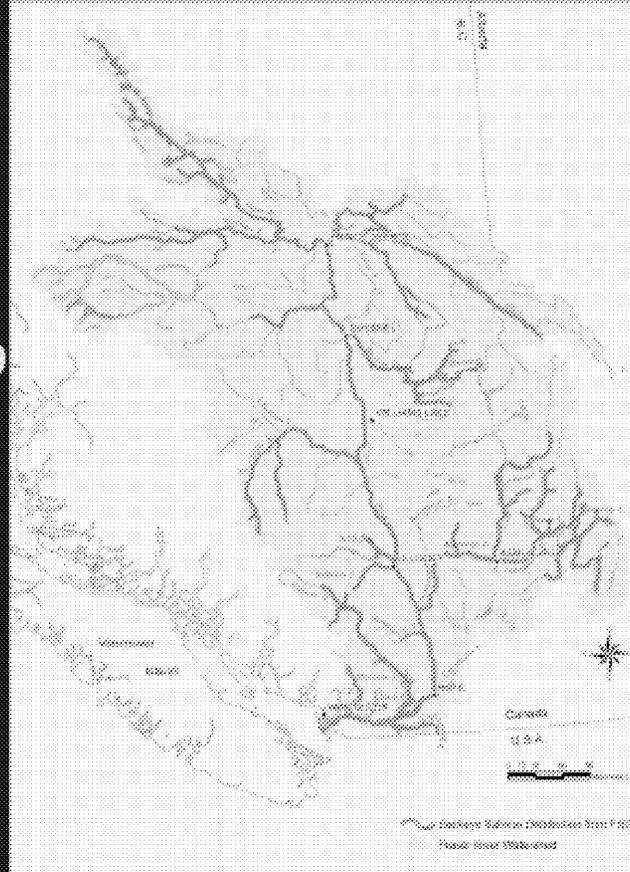
September spawning

October spawning

DFO sockeye “Conservation Units” for wild salmon policy

Fraser River Sockeye Salmon

- 229 spawning locations / streams
- 41 Lake-based CU's (ESTU - 3, ESum -16, Sum - 9, Lates - 13)
- 5 Ocean-type CU's
- Compares to 151 “Stocks” in four Run-timing groups in previous management groupings.



From Riddell, Holtby, and Ciruna (2008)

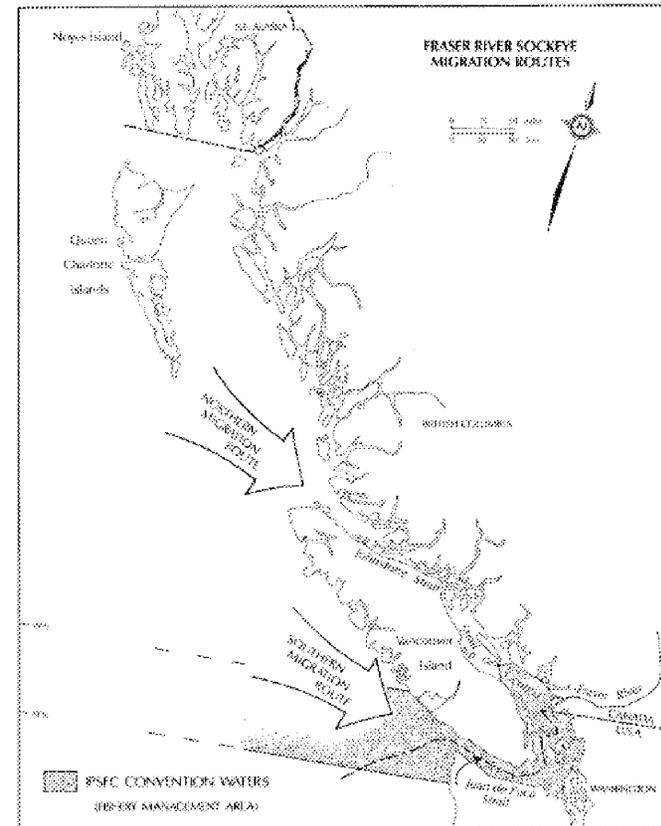
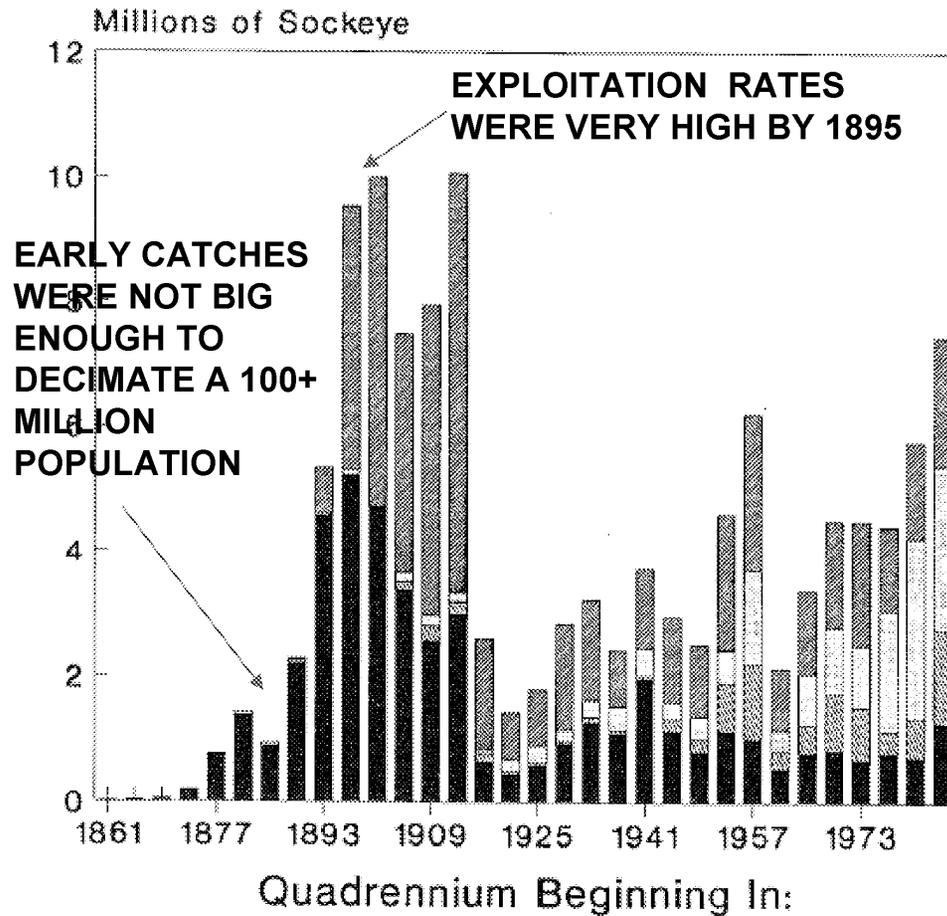
Key questions about Fraser sockeye

- What is the current status of the stocks relative to their historical abundance?
 - Are they actually much less abundant?
 - What is the main limiting factor for abundance?
- What has caused declines in survival since 1990?
- How has DFO policy contributed to the decline of the fishery as opposed to the stocks?
 - Long term escapement goals and harvest performance
 - Inseason management practices
- Has there been a major loss of stock structure that would warrant severe restriction of the fisheries?
- Should research investment be on causes of variation or methods to better cope with that variation (better inseason management and selective fishing practices)?

There were never many more sockeye than in recent years

- Runs in the 1990s were similar to those in the late 1800s
- Large aboriginal fisheries likely prevented much larger spawner abundances
- There are definite limits on the capacity of the Fraser River Lakes to produce sockeye smolts, and smolt production is at capacity for at least the larger lakes

Gilhousen's catch reconstruction



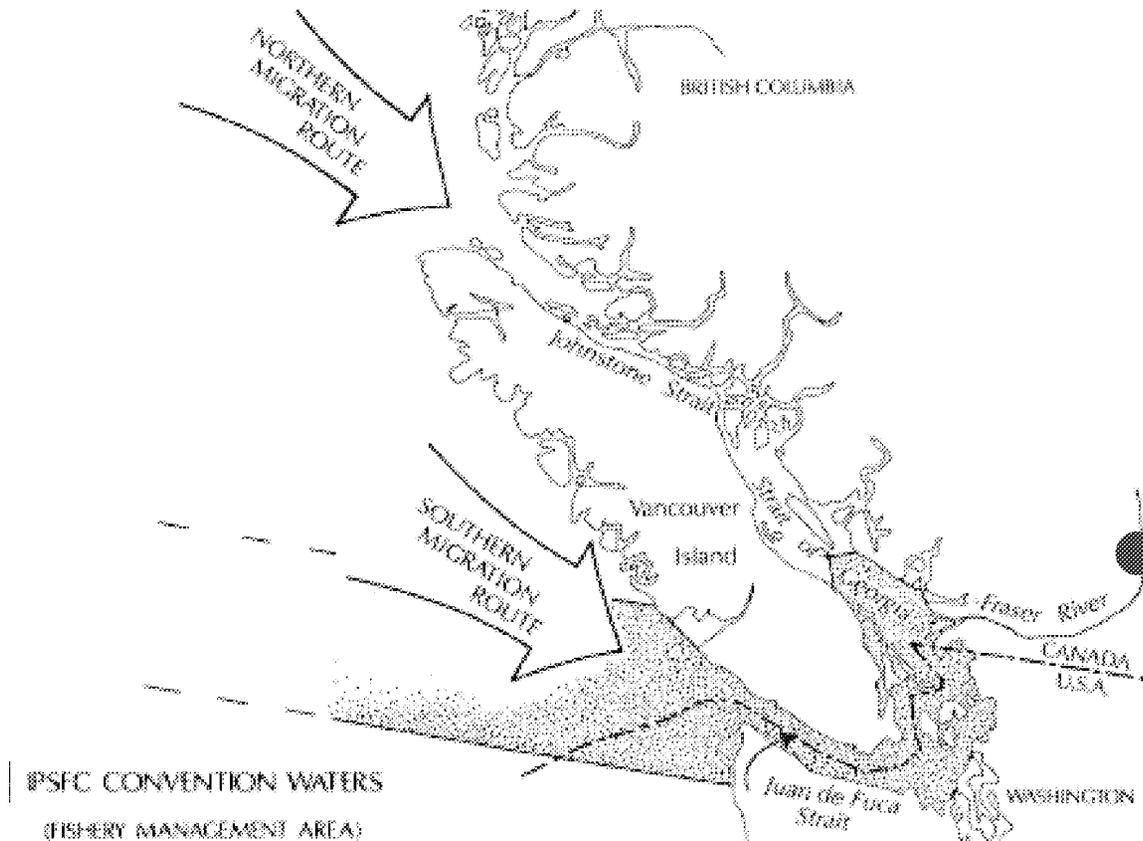
- Can. Area 29
- Can. Non-Convention
- ▨ Can. Juan de Fuca
- ▩ United States

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Spatial development of the fishery

1860

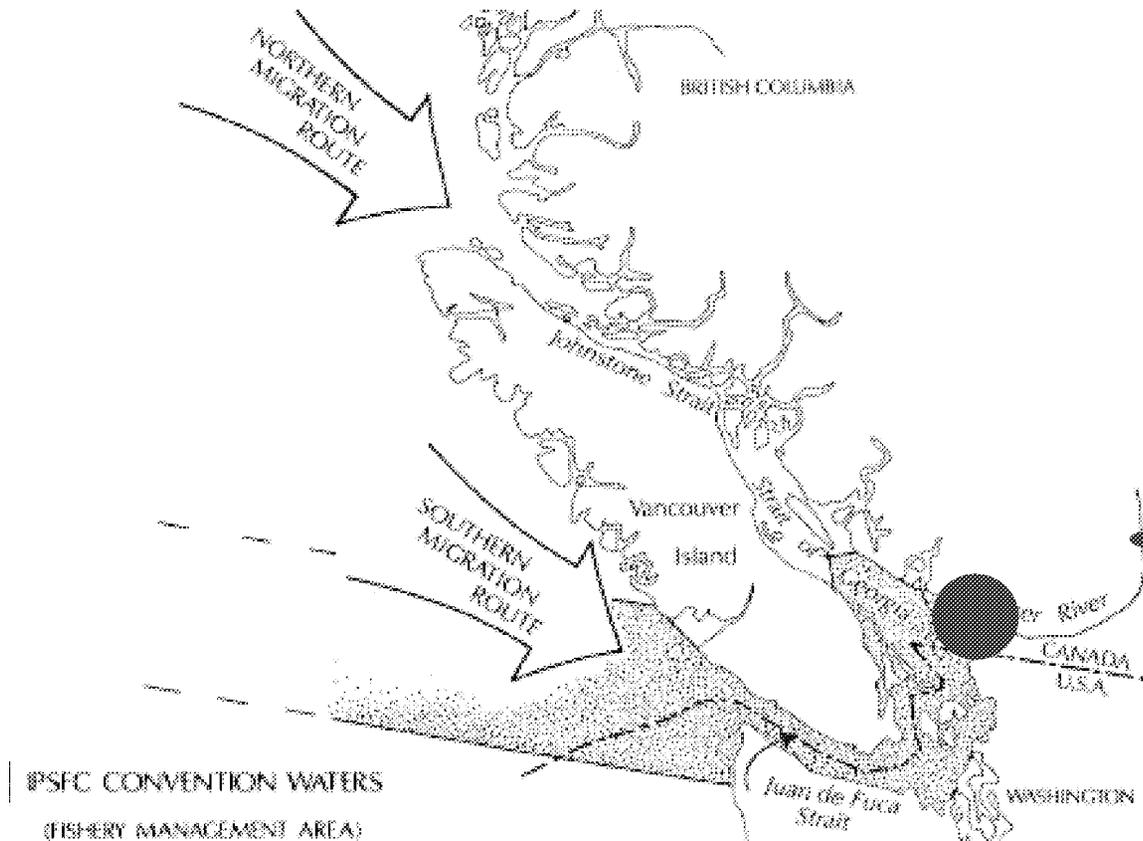
**First Nations
fisheries in
Fraser Canyon
supply
Hudson's Bay
Company**



Spatial development of the fishery

1890

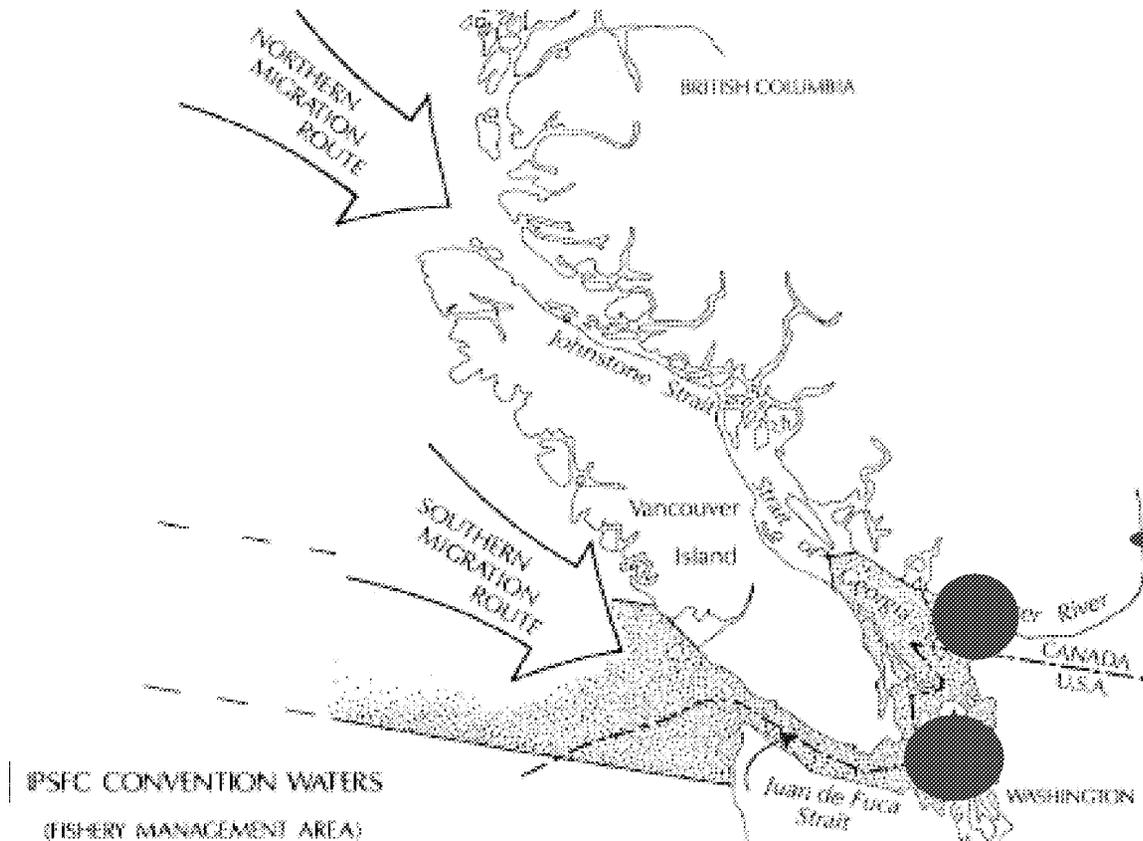
Gill net fishery develops, moves down to river mouth, harvest rates on summer run stocks approach 70-90%



Spatial development of the fishery

1900

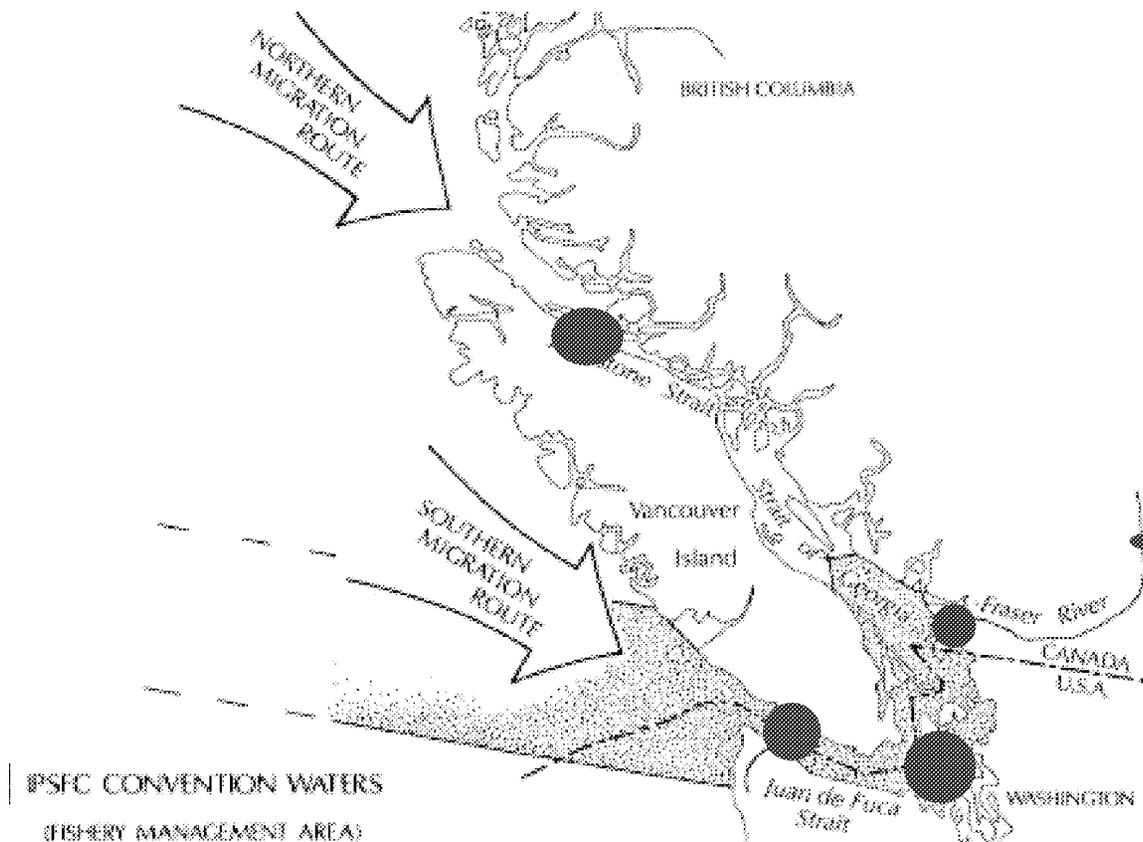
US approach fisheries develop, mobile outside gears start to take majority of catch, harvest rates exceed 90%



Spatial development of the fishery

1950

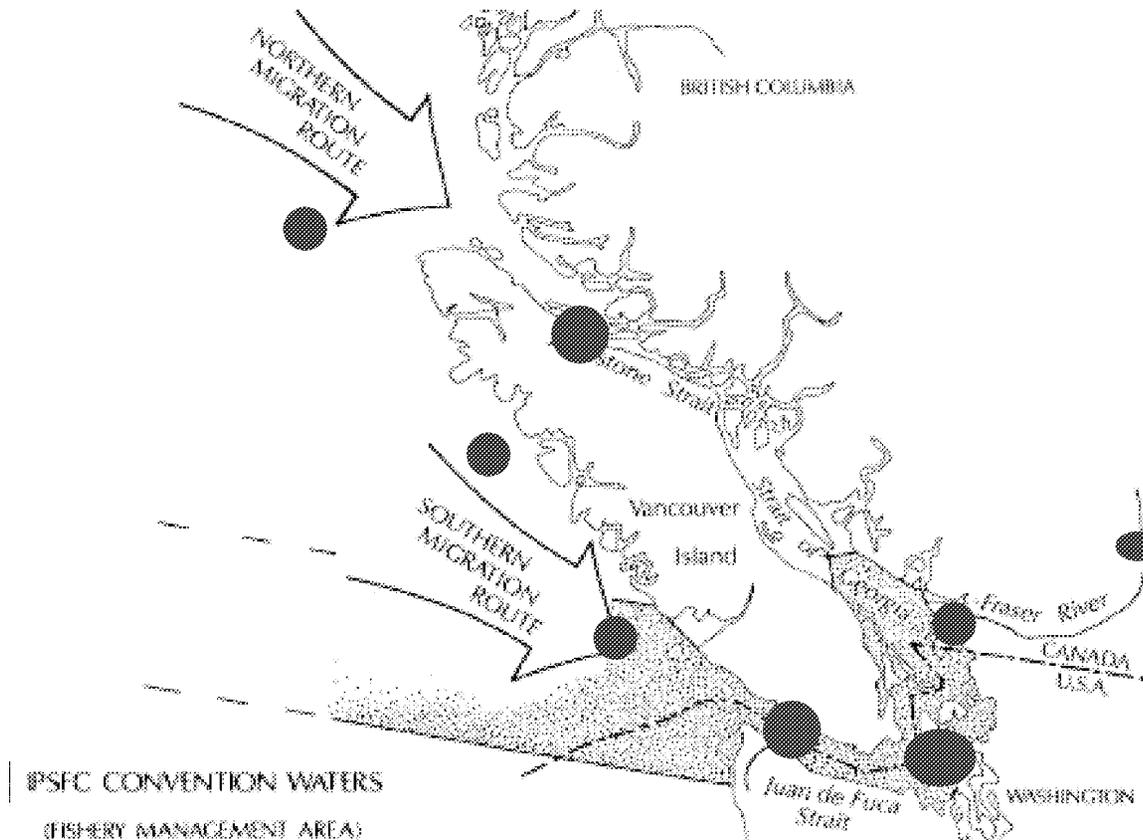
Large US and Canadian fisheries, river fishery begins to be seen as “cleanup” area



Spatial development of the fishery

1980

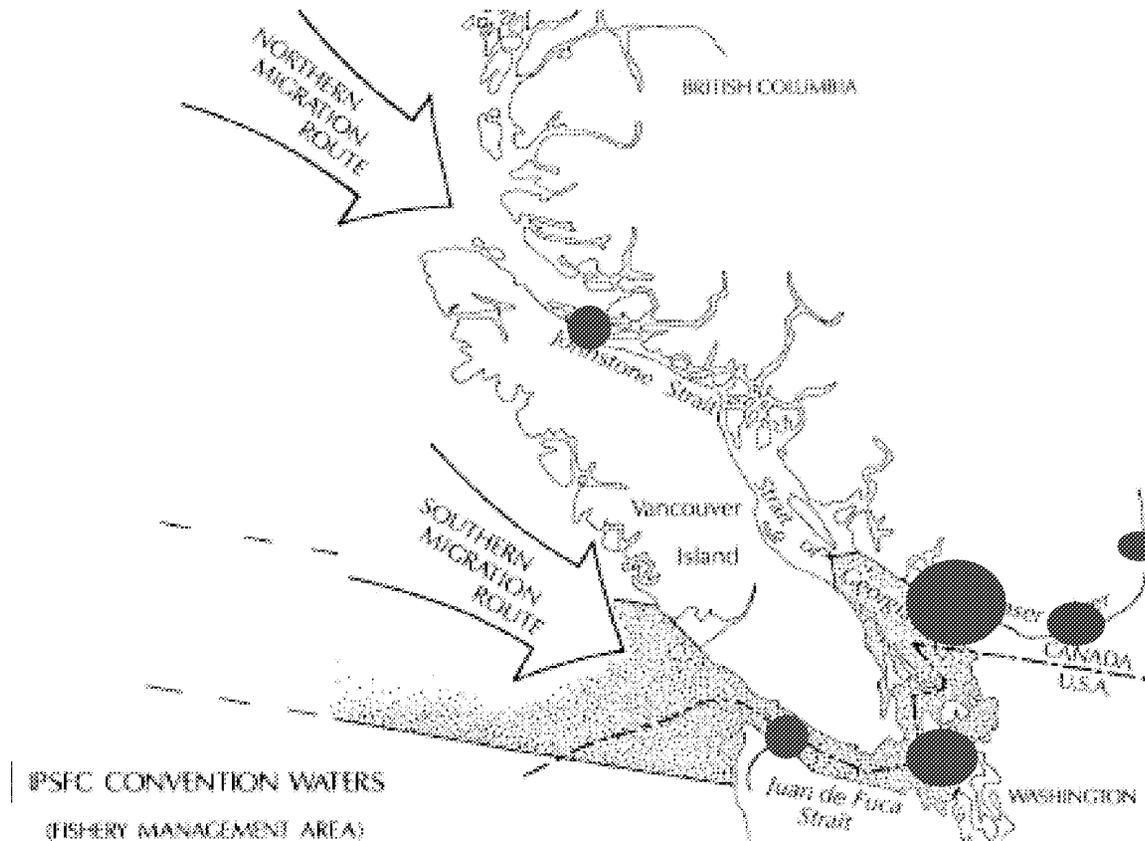
Gauntlet fishery structure and inseason management systems fully developed, average cyclic yields (4 yrs) approach historical levels



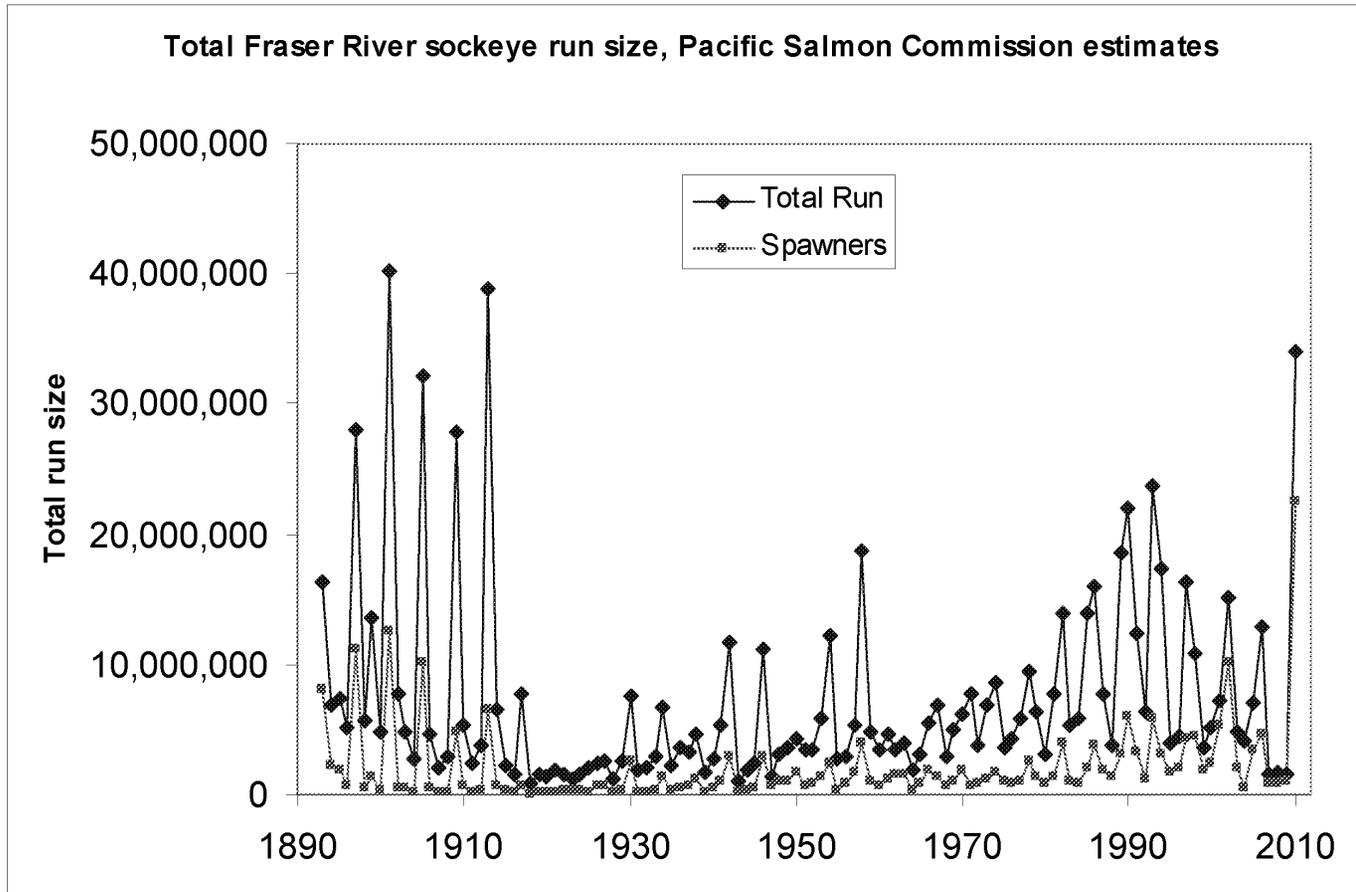
Spatial development of the fishery

2010

**Precautionary
decision
making and
allocation
changes result
in retreat to
inside fisheries**

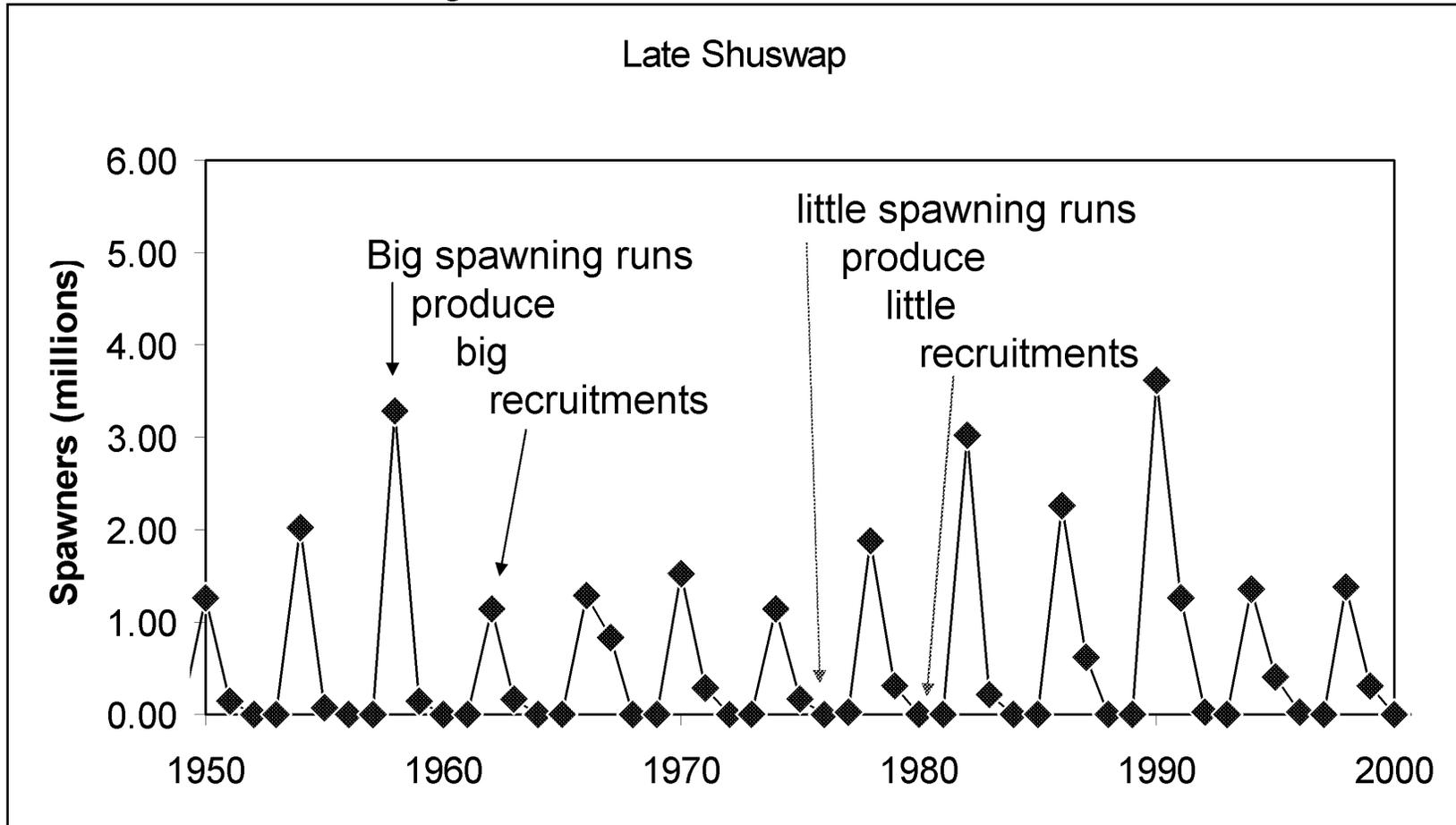


It looks like runs have not returned to historical peak levels, and there has been a worrisome decline since 1990

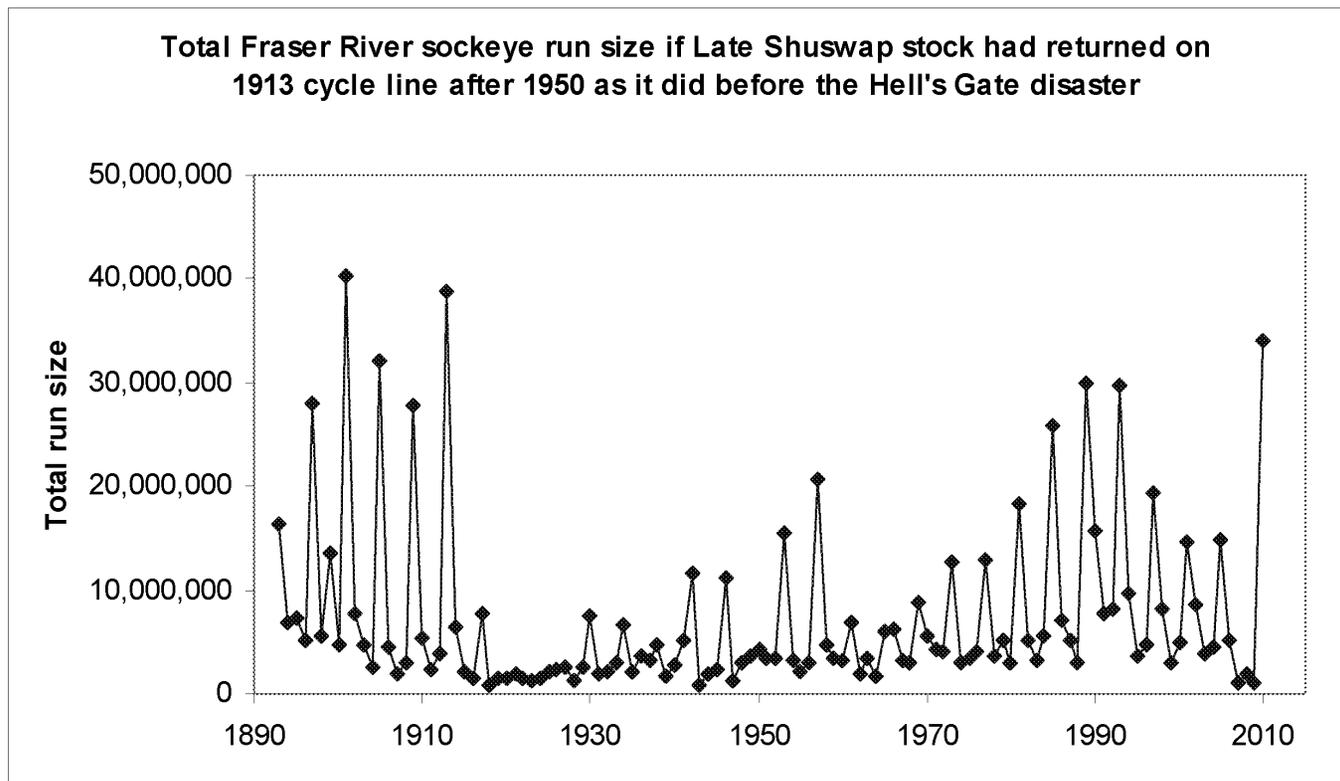


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But major stocks have “cyclic dominance”

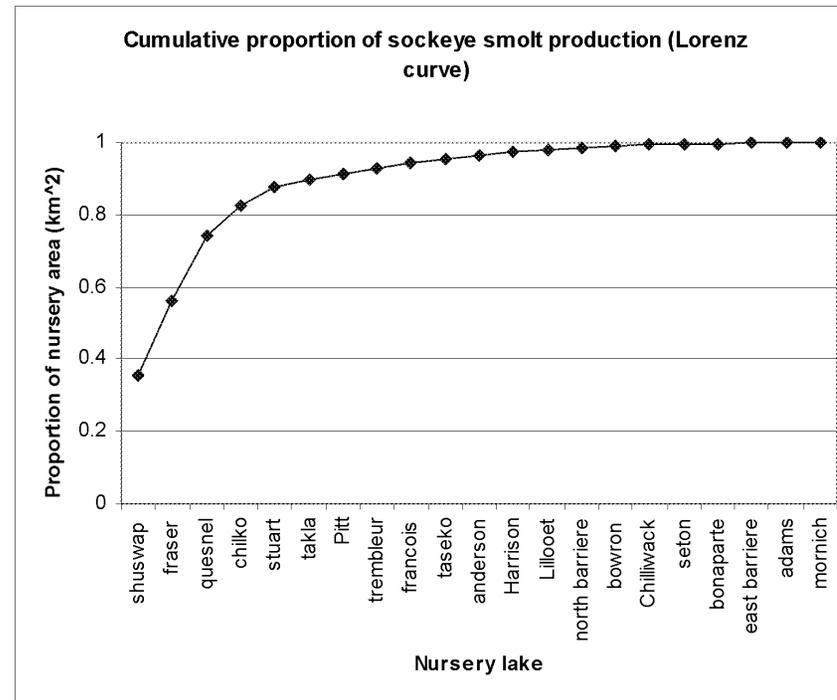
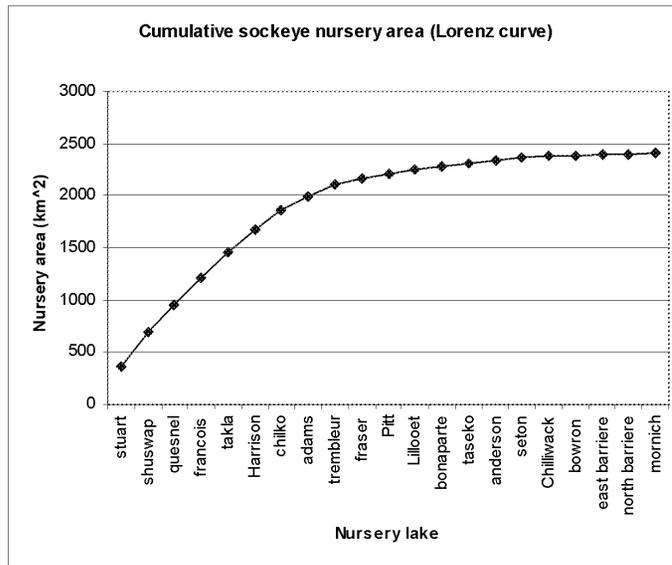


If the dominant return of the “late Shuswap” (Adams) stock had not shifted to even years, the total runs would have looked like this:



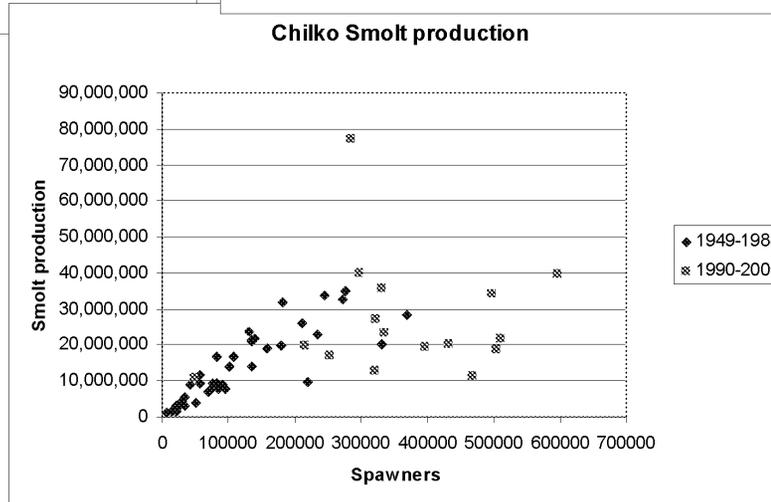
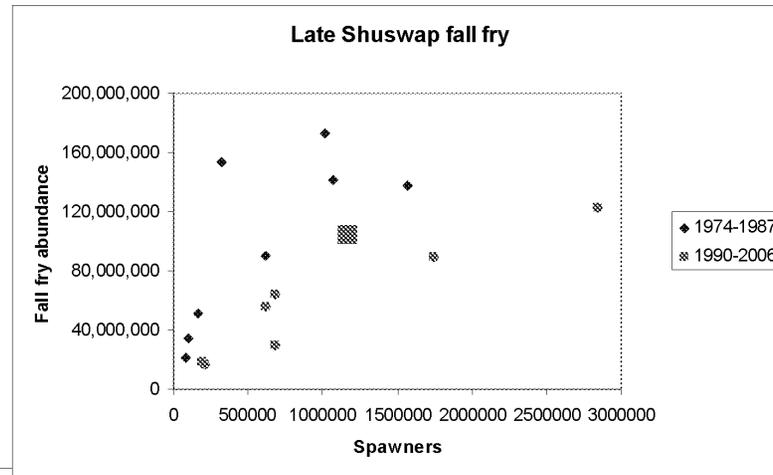
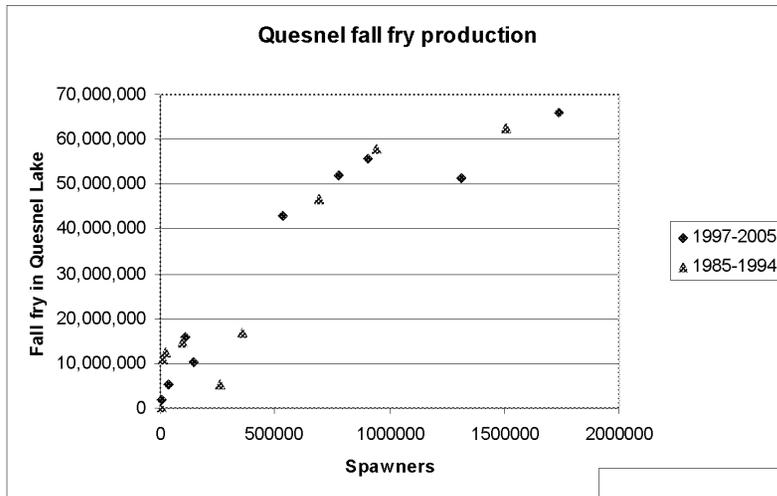
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Most of the sockeye smolts are produced in a few large lakes



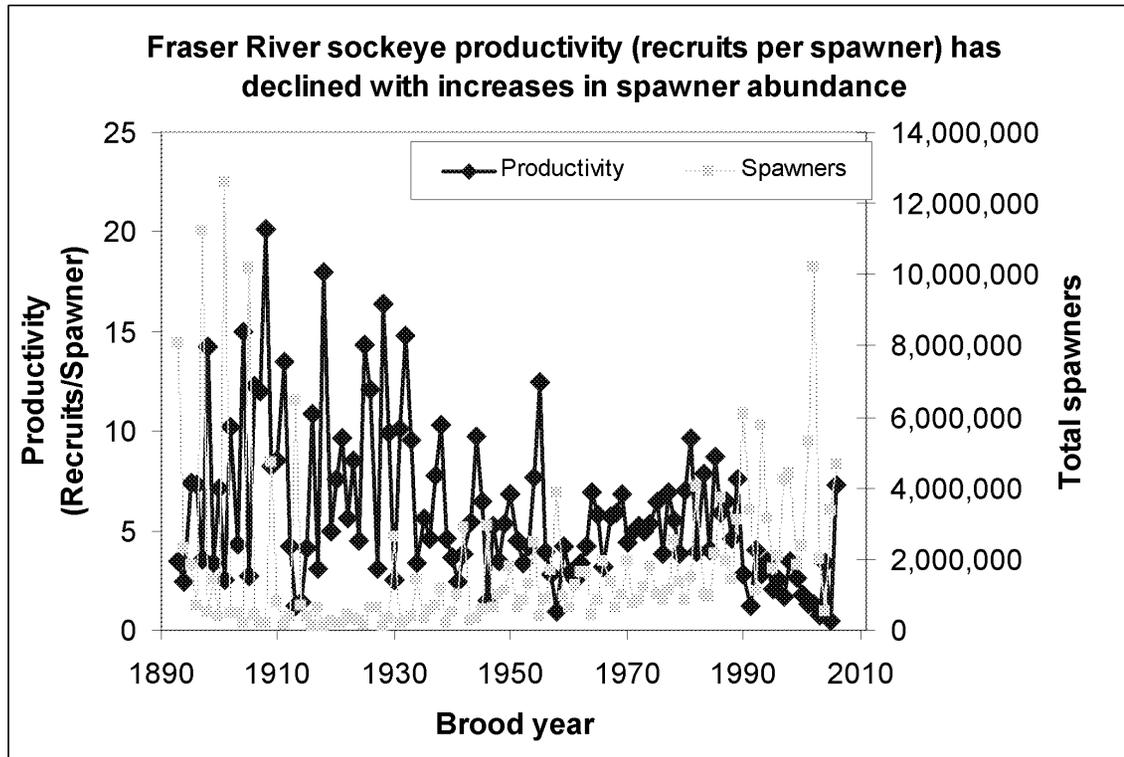
Lake data from
Shortreed et al
CSAS Res. Doc.
2001/098

There is clear evidence of an upper limit (carrying capacity) for smolt production from Quesnel, Chilko, Shuswap Lakes

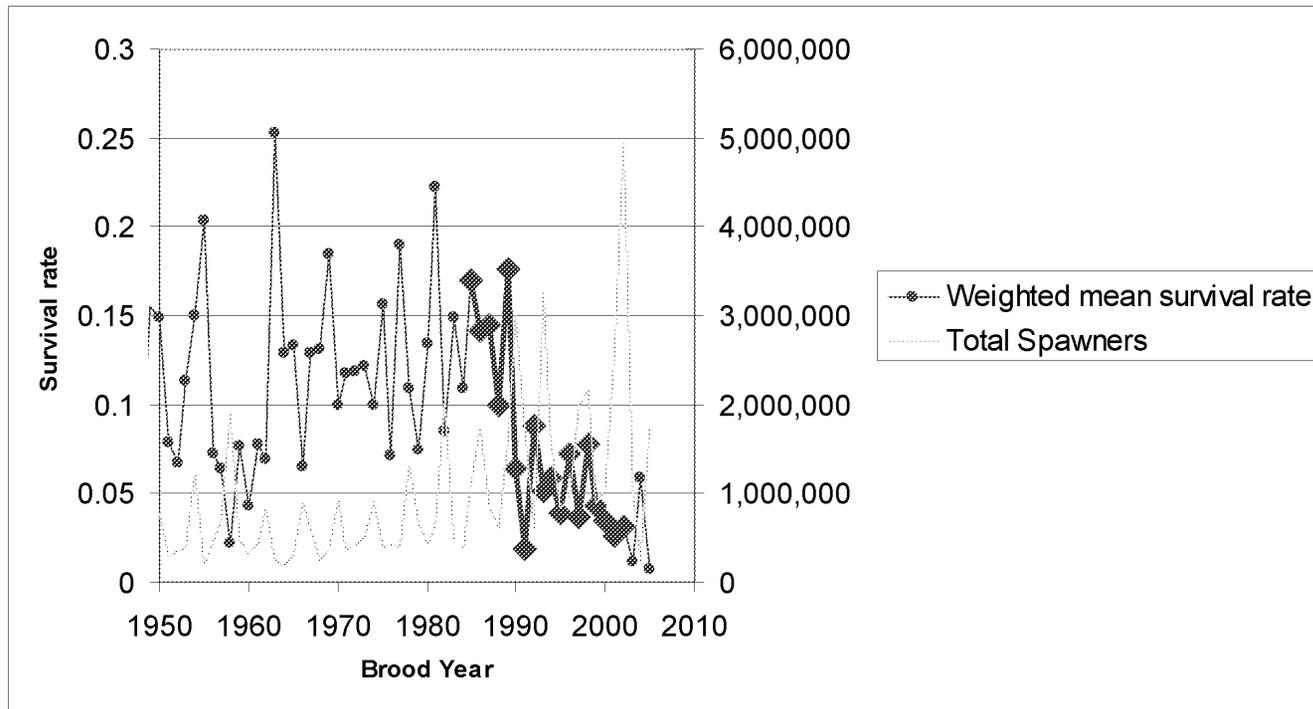


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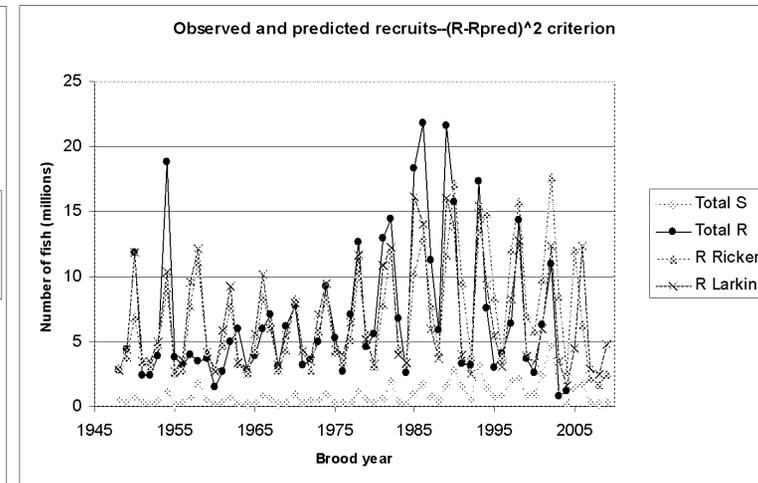
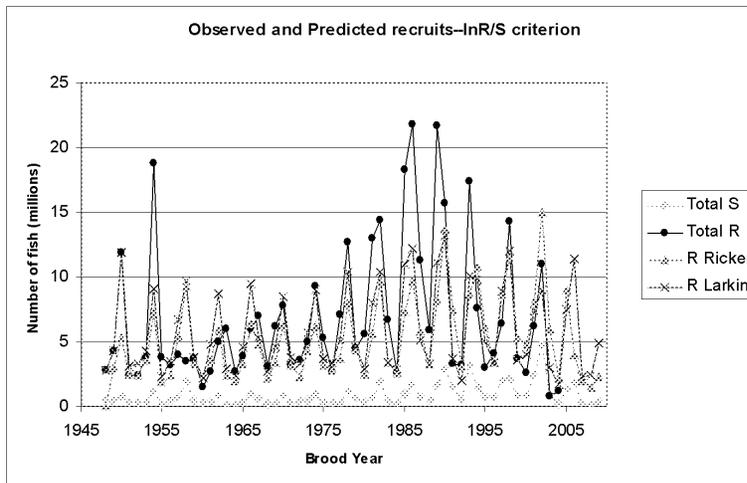
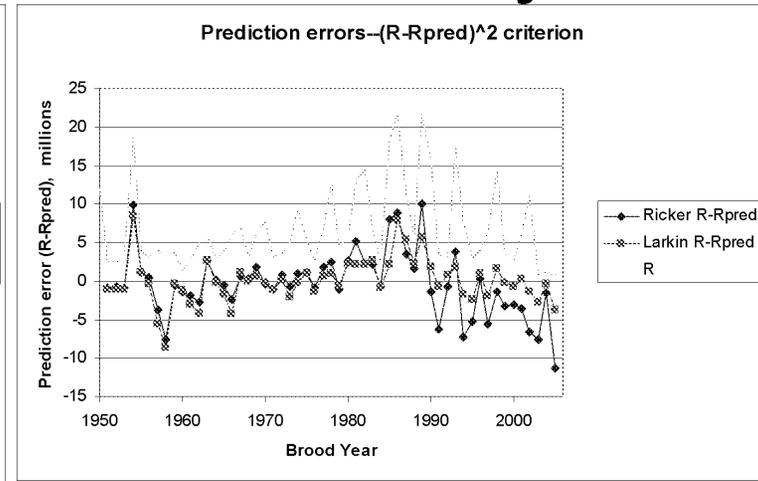
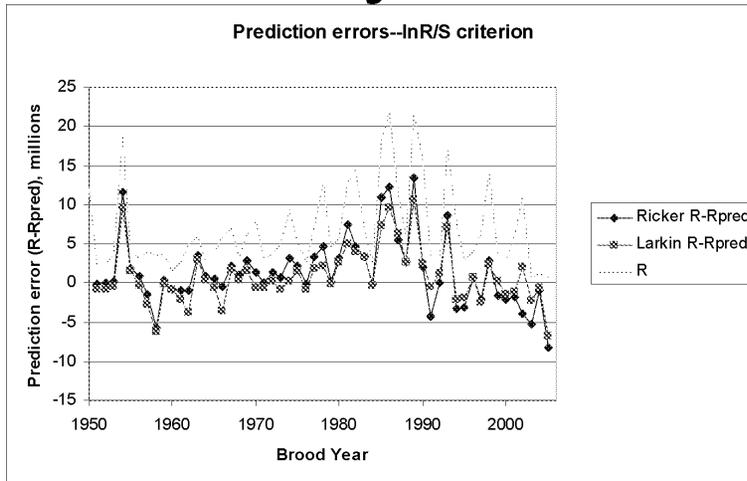
There is an overall negative relationship between productivity and spawner abundance, as is typical in stock-recruitment relationships



Survival declines prior to 2003 can be explained largely by density dependent effects related to increases in spawner abundance

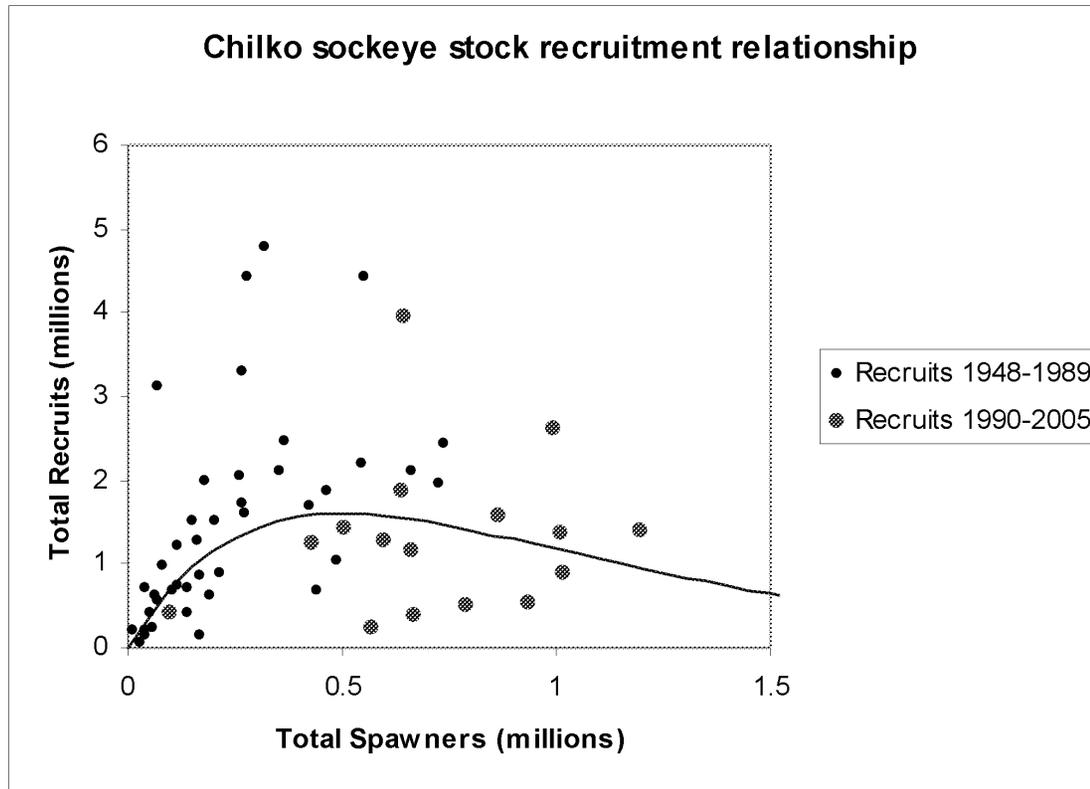


Models with delayed density dependence fit data better than Ricker model, particularly for 1990-2004 brood years

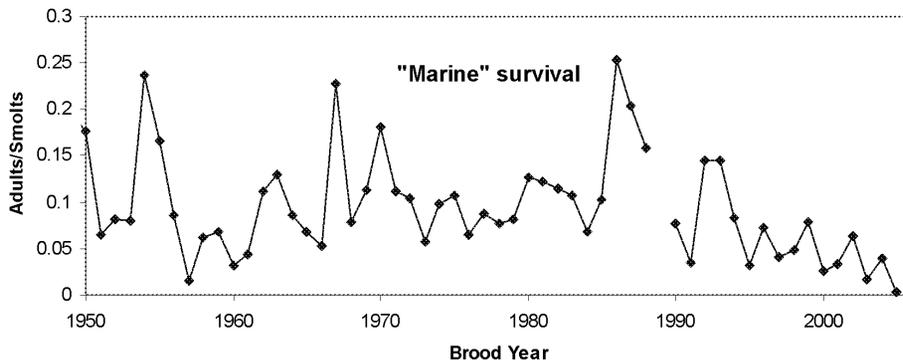
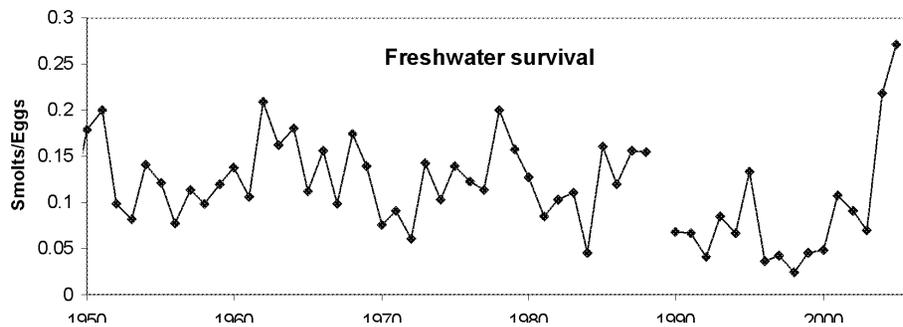
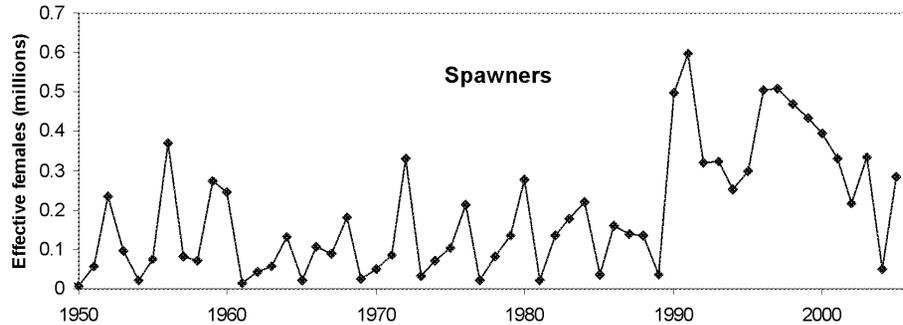


Has there been “overescapement”?

Declines in Chilko sockeye recruitment at high spawning stock since 1990

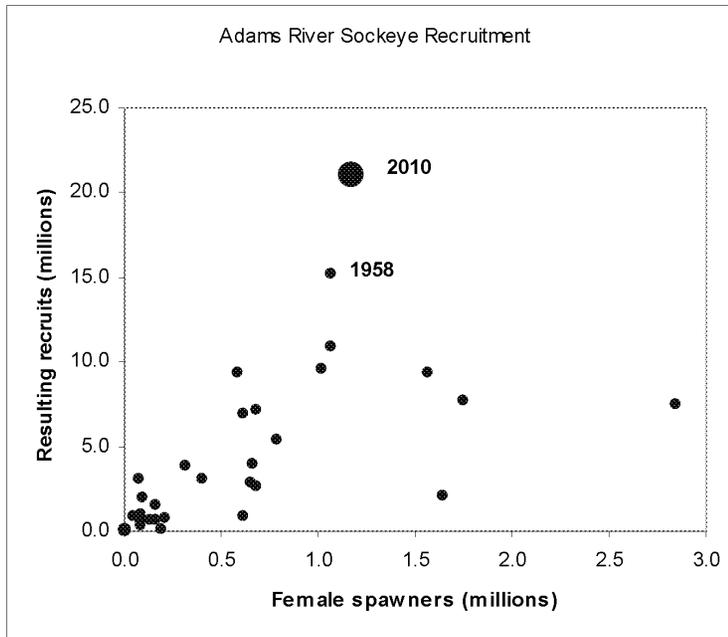


What changed when Chilko spawners increased?

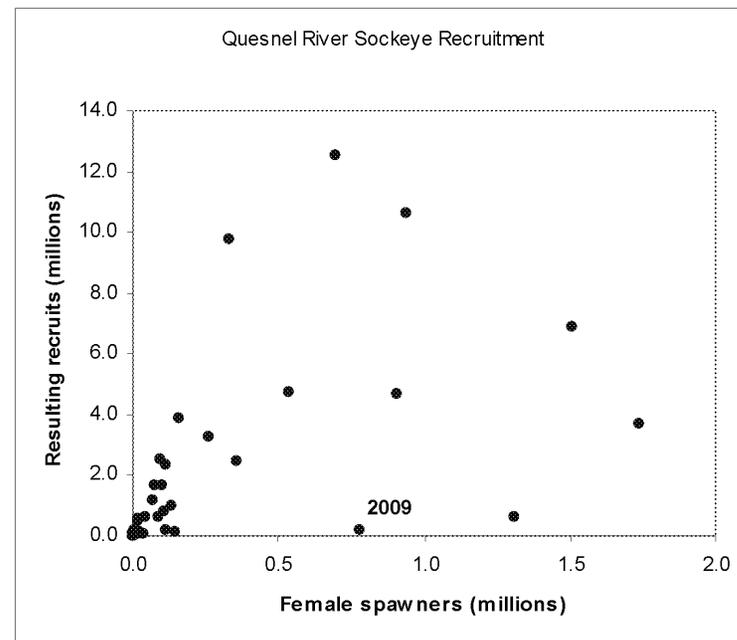


- Spawners increased in 1990
- Freshwater survival dropped immediately
- Inverse relationship between freshwater and marine survival in recent years

The monster Adams run of 2010 was produced by an intermediate spawner abundance



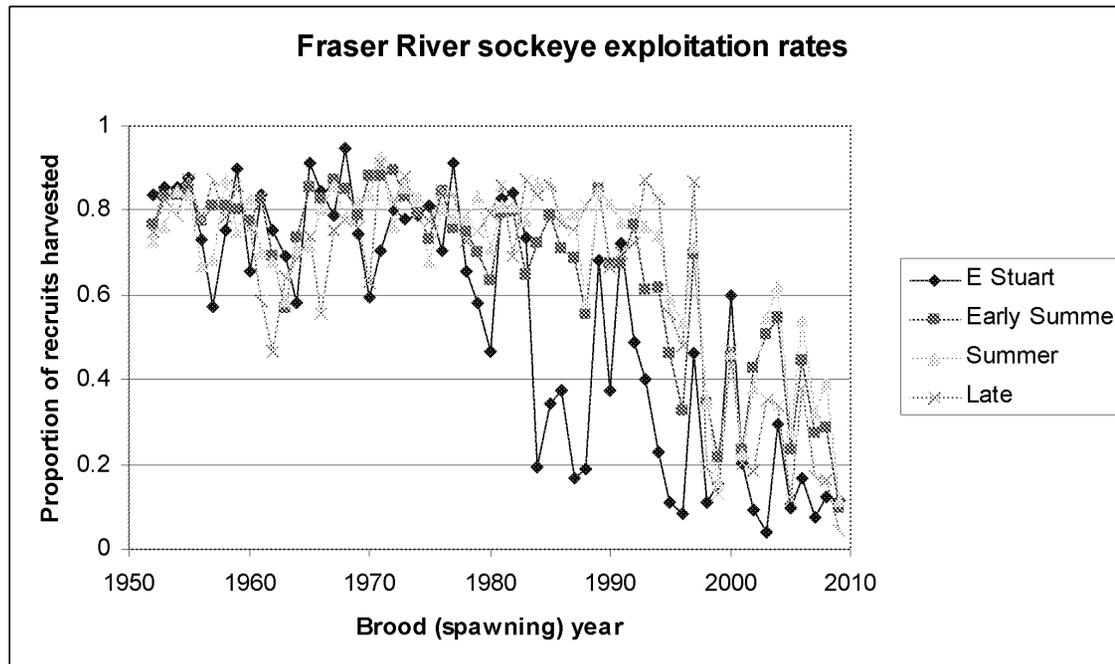
And the Quesnel stock has also shown maximum recruitments at intermediate spawner abundances



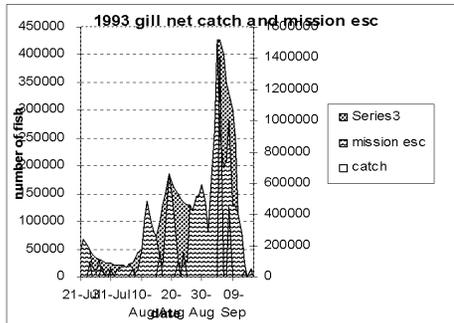
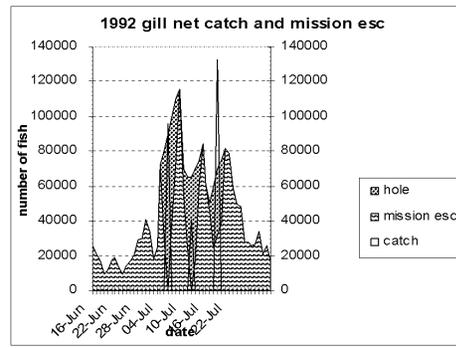
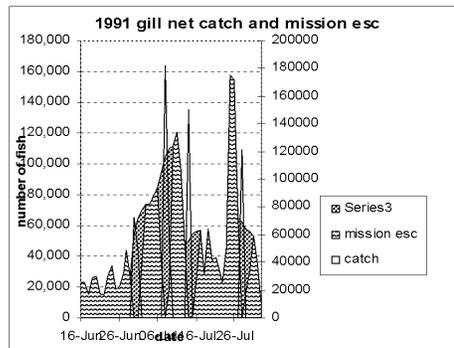
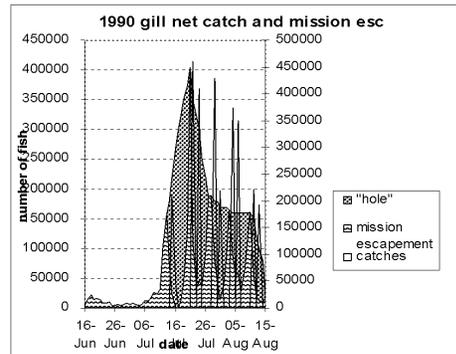
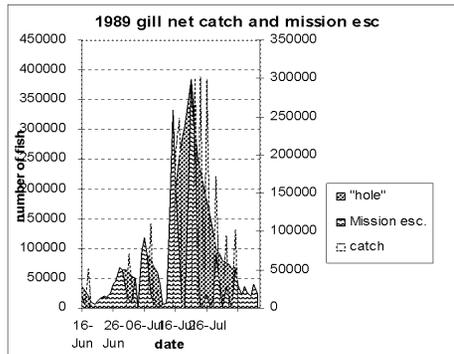
What is the right “precautionary” approach?

- Reduce fishing to insure high spawning abundances and restoration of biodiversity
- Increase fishing to return stocks to historical levels where they were more productive, i.e. reduce effects of delayed density dependence

Decline in stocks vs decline in the fishery: DFO has cut harvest rates severely since 1995, due to concerns about pre-spawning mortality and protection of weak stocks



Why the sockeye haven't been wiped out: we don't have to know how many salmon are coming in order to manage harvest rates safely



Intensive fisheries in small areas cut “holes” in migrating salmon stocks, as shown here for fisheries in the mouth of the Fraser River. The size of these holes, as proportions of the stock harvested, are predictable from run timing curves, without knowing the total number of fish arriving.

It is much safer to have more small fisheries rather than a few large, late ones

Fishery losses due to the harvest rate reductions can be estimated with “retrospective analysis”

- Use population models to predict what would have happened if harvest rates had not been reduced so severely
- Drive those population models with observed:
 - Recruitment variation (production anomalies)
 - Pre-spawning mortality rates
 - Age composition of recruitment

Retrospective analysis indicates considerable “unnecessary” loss in harvest since 1995, much higher if the delayed density dependence models are correct

1995-2009 Catch, millions of sockeye

Correct model

Assumed Model

Ricker

Larkin

Harvest strategy

historical

34.4

34.4

U=0.6 (Ricker optimum)

44.7

51.4

U=0.75 (Larkin optimum)

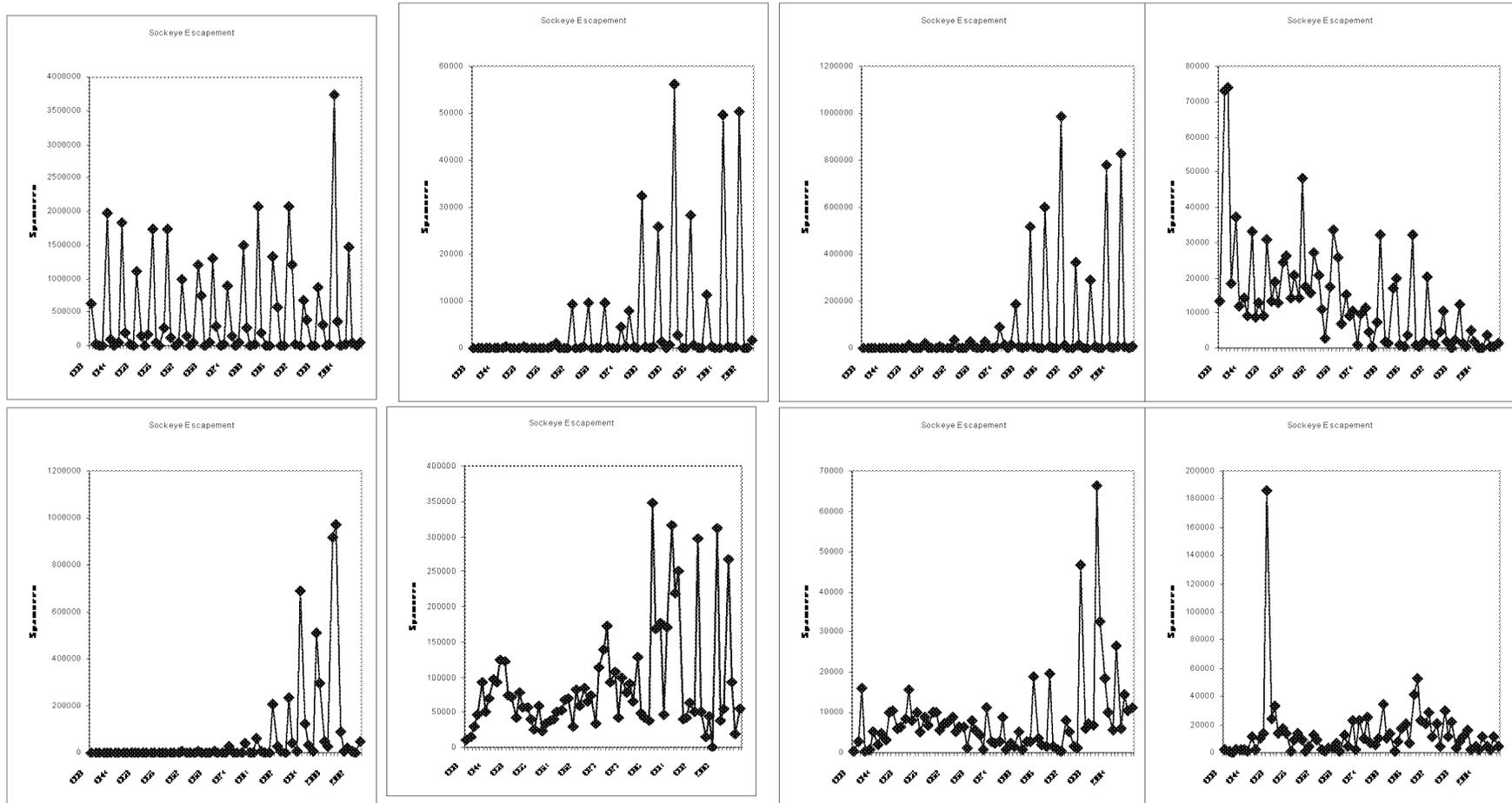
48.9

59.2

But if the more conservative Ricker model is correct, higher harvest rates would also have resulted in longer term losses in catch

1995-2017 Catch, millions of sockeye	Correct model	
	Ricker	Larkin
harvest strategy		
historical	58.00	61.50
U=0.6 (Ricker optimum)	60.41	78.03
U=0.75 (Larkin optimum)	57.51	82.11

What is happening to biodiversity? A smorgasbord of patterns since 1938

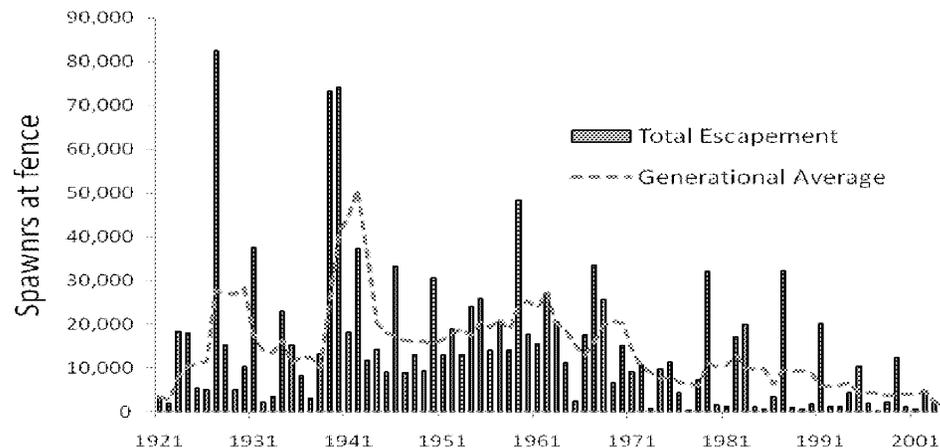


I CLASSIFIED 106 OF THESE BY TREND FOR 1950-95 AND AFTER 1995

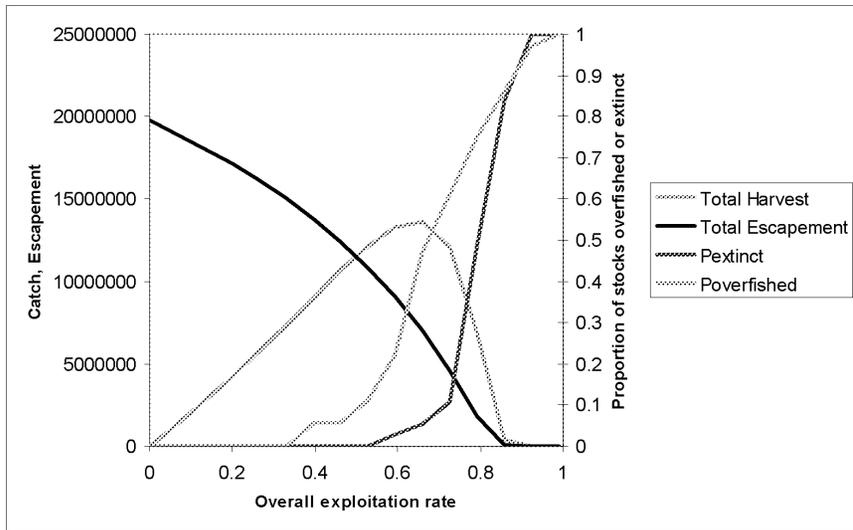
Was it wise to reduce harvest rates to protect weak stocks?

- Of the 34 spawning units for which we have long term data, 31 were stable (8) or increasing (23) under the high harvest rates of the 1980-95 period (of 106 spawning sites: 56 increasing, 38 stable, 8 declining)
- Two of the three stocks that were declining have shown recovery, but the stock of most concern (Cultus) has not:

A “conservation hatchery” in operation since 2002 has probably insured the demise of this stock

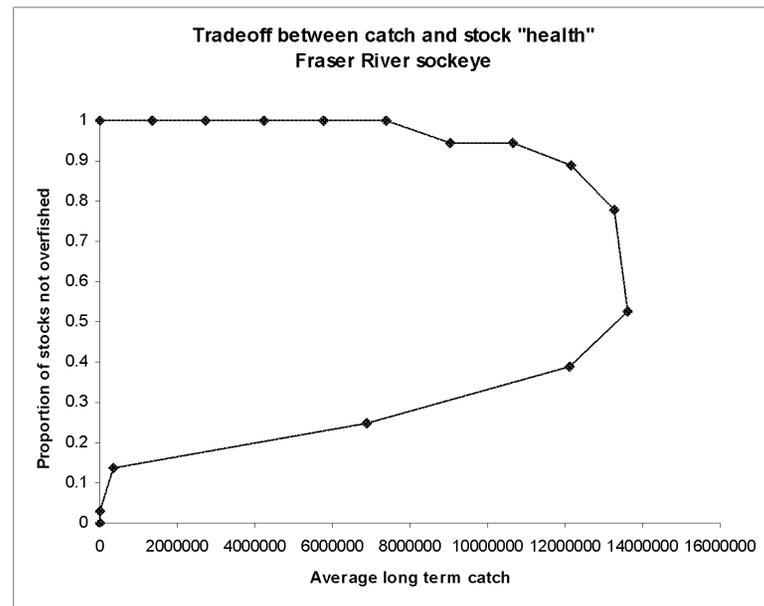


There is a severe tradeoff between harvesting and maintenance of stock structure (biodiversity)



At the harvest rate expected to produce maximum average yield, about 50% of the (mostly small) stocks would be overharvested, and about 10% would be threatened with extinction

Is it wise or just for people who will not pay the bill to demand that fishers give up 50% of their income as an insurance policy for biodiversity?



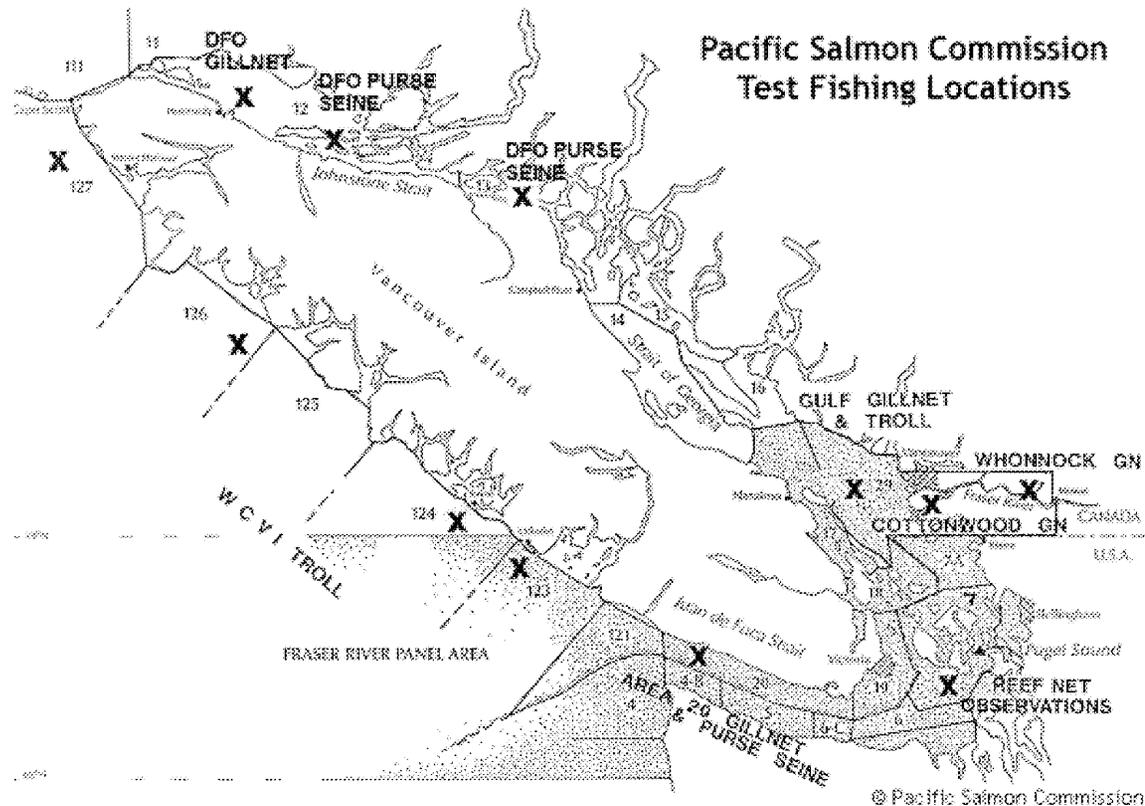
What value biodiversity?

- **Are all spawning stocks unique and irreplaceable?** Mostly yes, with remarkable local adaptations, but there is much fine-scale dispersal and some are maintained by spillover spawners from nearby large stocks, none are irreplaceable on long (1000yr+) time scales
- **Is there high portfolio value in maintaining all stocks to reduce variability, provide cushion in event of large stock collapse?** Absolutely not! Most small stocks rear in smaller lakes with low smolt production capacities, do not and could never make large catch contributions.
- **Could small stocks be used to restock major production areas in event of large stock collapse?** This has been tried, but with only very limited success; the local adaptations are just that, and are not widely transferrable.
- **Might some small stocks harbour unique genetic traits that could provide new values and opportunities outside the realm of traditional fisheries, e.g. for medicine or aquaculture?** There is no way to rule out this possibility, but it is a very poor gamble.
- **Have biodiversity issues been ignored in past management?** Absolutely not! Restoration of stock structure has been a major concern over the years. It was recognized that development of the Weaver Creek spawning channel population would very likely lead to overharvesting and eventual extinction of the Cultus Lake stock.

The 2010 fishery exposed a dangerous change in in-season management practice

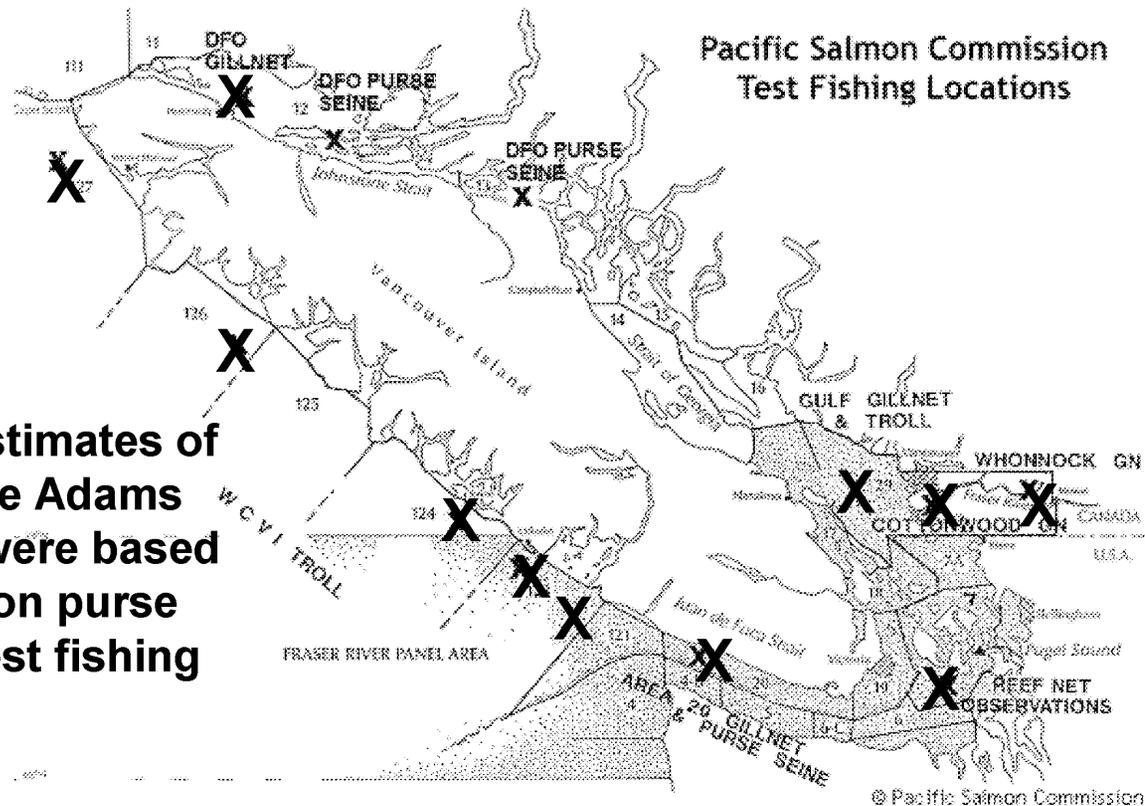
- Historically, sockeye were fished along a gauntlet of areas: outside troll, Johnstone Strait nets, Fraser mouth and inriver nets, First Nations fisheries, spread across the migration timing
- DFO has mainly shut down the outside fisheries, causing “tail end loading” of the harvesting
- Tail-end loading is a dangerous practice:
 - Delay in estimation of run sizes (fisheries are informative)
 - Selection against later spawning
 - Increased interception of non-target stocks, species (like Interior coho, steelhead)

In-season assessment and management depend on combining information from the fisheries with information from test fishing; test fishing produces only noisy indices, so the best information (before acoustic counts are made in the River) has come from fisheries



The inseason monitoring system did not function properly in 2010: fishery closures, change to ITQ management of purse seine fishing, high northern diversion rate, and gear saturation of gillnet and troll test fisheries

Early estimates of the large Adams return were based mainly on purse seine test fishing



What next?

- Demand clear public policy decisions about the tradeoff between production and biodiversity: are small stocks really worth saving, when they have no potential for significant contribution to future fisheries?
- Demand wise decisions about acceptable risk; the only really safe fishery is none at all
- Rebuild the gauntlet fishery structure for better information and higher value to all fishing interest groups, and provide incentives for selective fishing practices (e.g. traps)
- Spend research resources wisely:
 - Avoid fisheries oceanography research programs that have little chance of determining causes of variation
 - Make major investments in improving the in-season assessment and regulatory process
 - Create incentives for development of selective fishing practices