



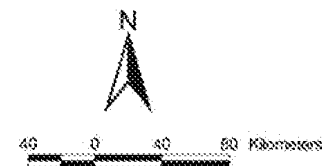
Fraser River sockeye salmon in 2009:

Pre-season run size forecasts & observed survival/returns



Fisheries and Oceans
Canada

Pêches et Océans
Canada



CAN185455_0002

Methods: models

PSARC reviewed

Methodology Review (Cass et al. 2006)

Annual Review (DFO 2007 & 2008)

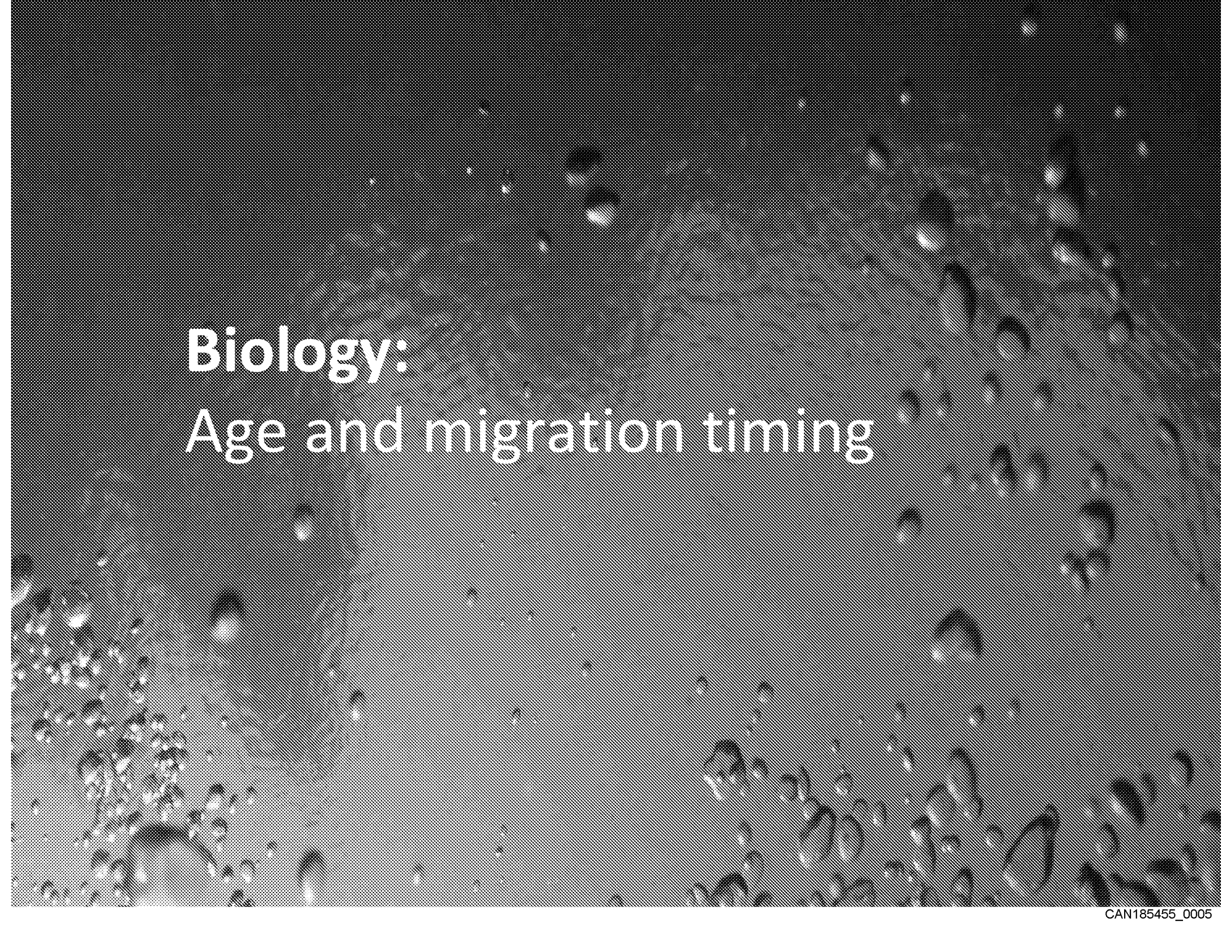
Peer reviewed journal (CJFAS)

Haeseker et al. 2007 & 2008

Note: environmental variables have not generally improved forecast performance quantitatively

Forecast application

1. **Pre-season:** planning & consultation processes
2. **In-season:** forecasts for abundance & run timing is updated with in-season data; in-season management largely based on in-season test fisheries etc.
3. **Fisheries:** based on in-season updates from test fisheries, Mission hydro-acoustic, management adjustments based on environmental conditions in the Fraser, etc.

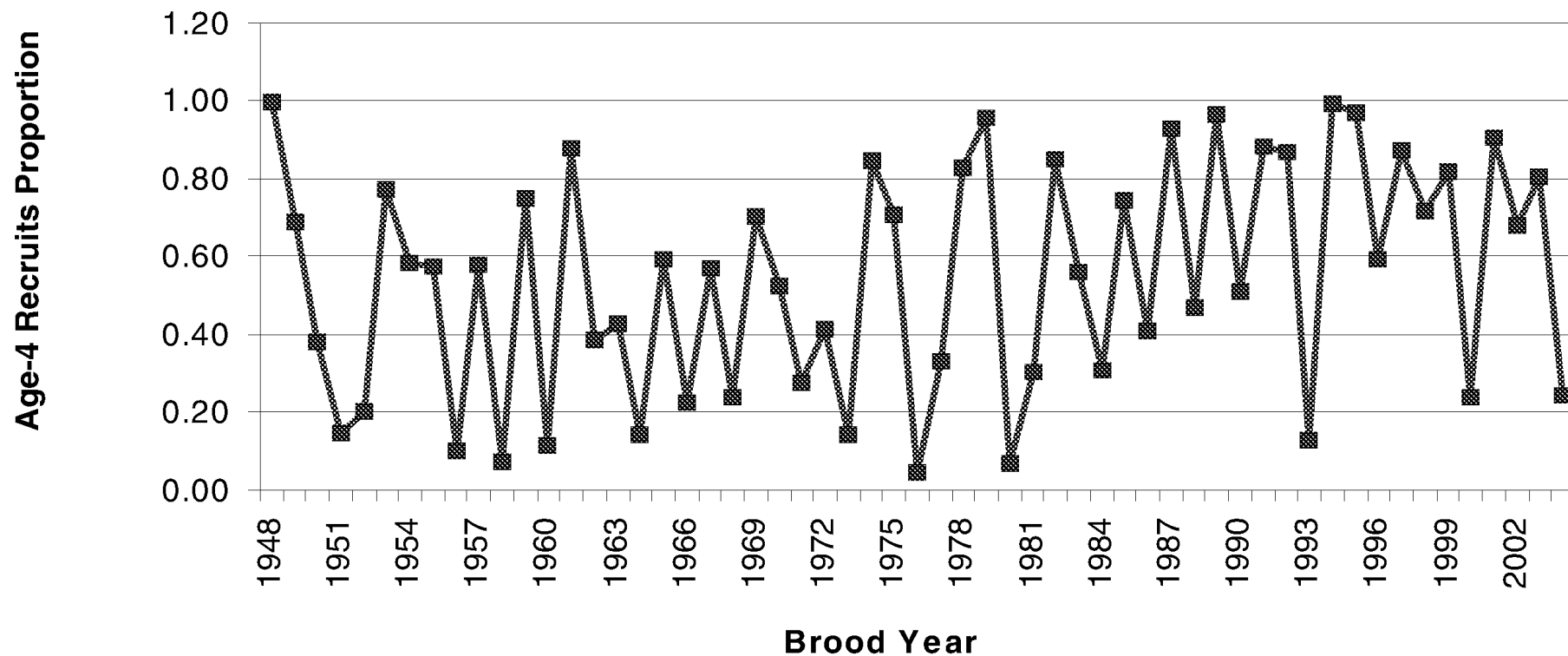


Biology: Age and migration timing

Biology: ocean entry

Age	Proportion	Brood Year	Ocean Entry
Age-4 (4_2)	80% (40% Pitt)	2005	2007
Age-5 (5_2)	20% (60% Pitt)	2004	2006
Age-3 (3_1)-Harrison	10-90%	2006	2007
Age-4 (4_1)-Harrison	10-90%	2005	2006

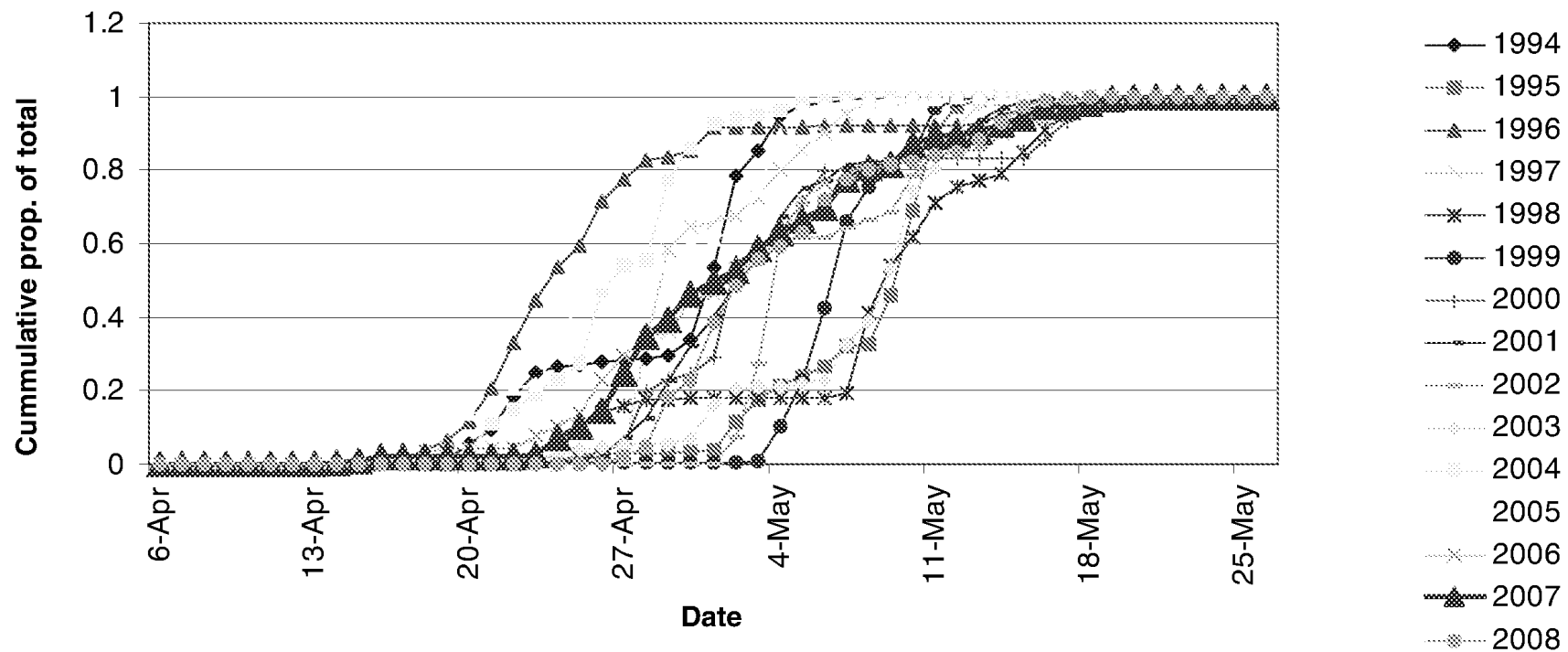
Biology: Harrison age-4 recruits prop.



Odd year proportion of age-4 recruits: **64%**

Even year proportion of age-4 recruits: **45%**

Biology: Chilko migration timing



50% migration date for 2007: May 1

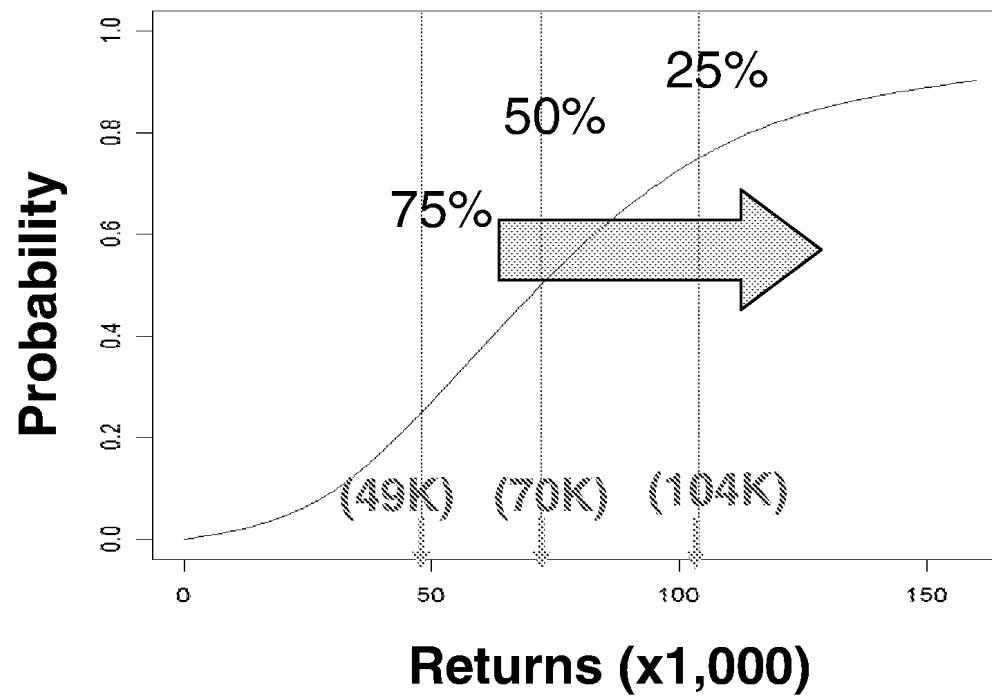
A black and white photograph of water droplets on a textured surface, possibly a car windshield or a piece of fabric. The droplets are of various sizes and are scattered across the frame. The background is a dark, textured surface. The text "2009 Forecast" is overlaid in the center in a white, sans-serif font.

2009 Forecast

2005 Brood Year Escapement

- Above or close to average for 14 out of 19 stocks on 2005 brood year
- Below average for 4 out of 19 stocks: Early & Late Stuart, Bowron, Seymour and Birkenhead

Probabilistic forecast



2009 Forecasts: Sockeye

Probability of Exceeding Specified Run Sizes

Sockeye run timing group	10%	50%	90%
Early Stuart	645,000	255,000	107,000
Early Summer	2,284,000	739,000	264,000
Summer	31,813,000	8,677,000	2,858,000
Late	2,875,000	907,000	327,000
Total	37,617,000	10,578,000	3,556,000

S.Grant & A.Cass (DFO Can. Sci. Advis. Rep. 2009/022)

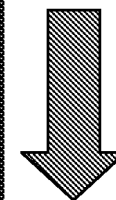


Forecast Performance

Forecast performance

Probability of Exceeding Specified Run Sizes

Sockeye run timing group	10%	50%	90%	In-Season Returns
Early Stuart	645,000	255,000	107,000	85,000
Early Summer	2,284,000	739,000	264,000	175,000
Summer	31,813,000	8,677,000	2,858,000	650,000
Chilko	9,466,000	4,175,000	1,857,000	~200,000
Quesnel	18,037,000	3,575,000	724,000	~200,000
Late Stuart/Stellako	4,310,000	927,000	277,000	~150,000
Late	2,875,000	907,000	327,000	460,000
Harrison	373,000	69,000	33,000	220,000
Birkenhead	704,000	297,000	124,000	70,000
True Lates (exl Birkenhead)	1,798,000	541,000	170,000	120,000
Total	69,430,000	19,255,000	6,414,000	1,369,999



Forecast uncertainty: Harrison & Chilko

Harrison: large brood year escapements; well above average
forecasting largely outside the observed SR data range
extremely high productivity in recent years

Chilko: unprecedented large number of smolts for Chilko
(however, not outside the range of smolts entering the SOG)
forecasting outside the observed SR data range

Forecast range:	90%-10% p-level:	1.9M to 9.5M
Preliminary return marine survival:	0.4%	200K
Lowest marine survival on record:	1.3% (1957 brood):	1M
1990-present average marine survival:	6%:	5M
1948-present average marine survival:	9%:	7M

Forecast uncertainty: Quesnel

Quesnel: pooled Larkin and Power (fry) forecast

Probability of Exceeding Specified Run Sizes

Model	10%	50%	90%
Pooled Larkin & Power	18,037,000	3,575,000	724,000
Power (fry)	23,322,000	4,508,000	871,000
Ricker (eff)	14,633,000	4,080,000	1,250,000
Larkin (eff)	5,508,000	1,363,000	375,000

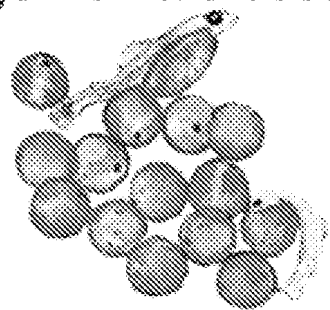


Preliminary Survival

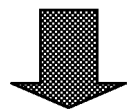
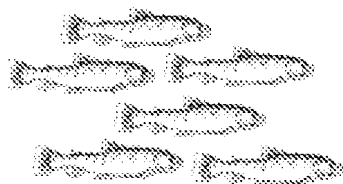
(does not include age-5 recruits from 2005
brood returning in 2010)

Fraser Sockeye survival

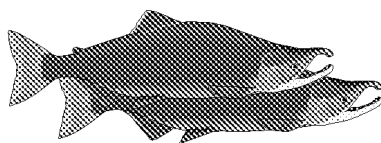
Eggs: female escape x success x fecundity



freshwater

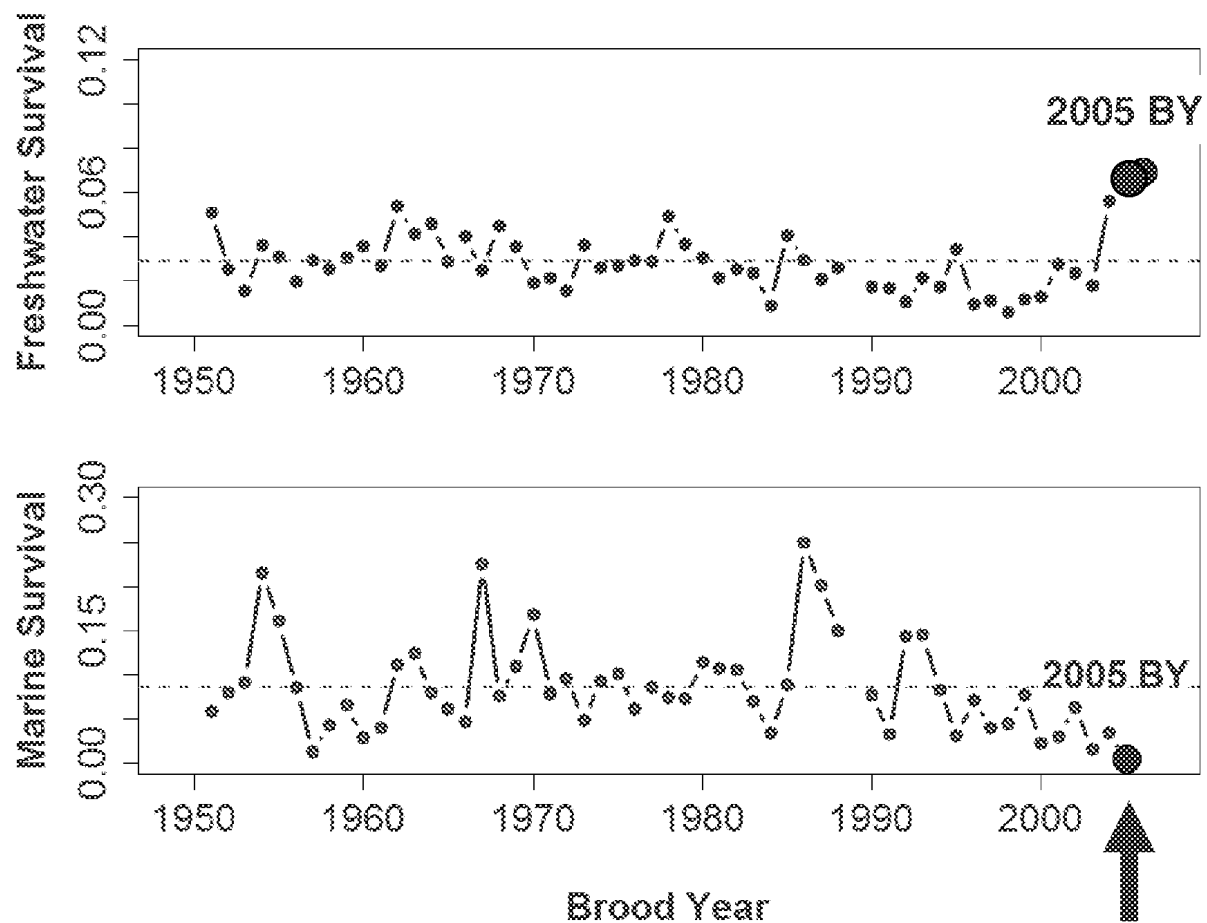


marine

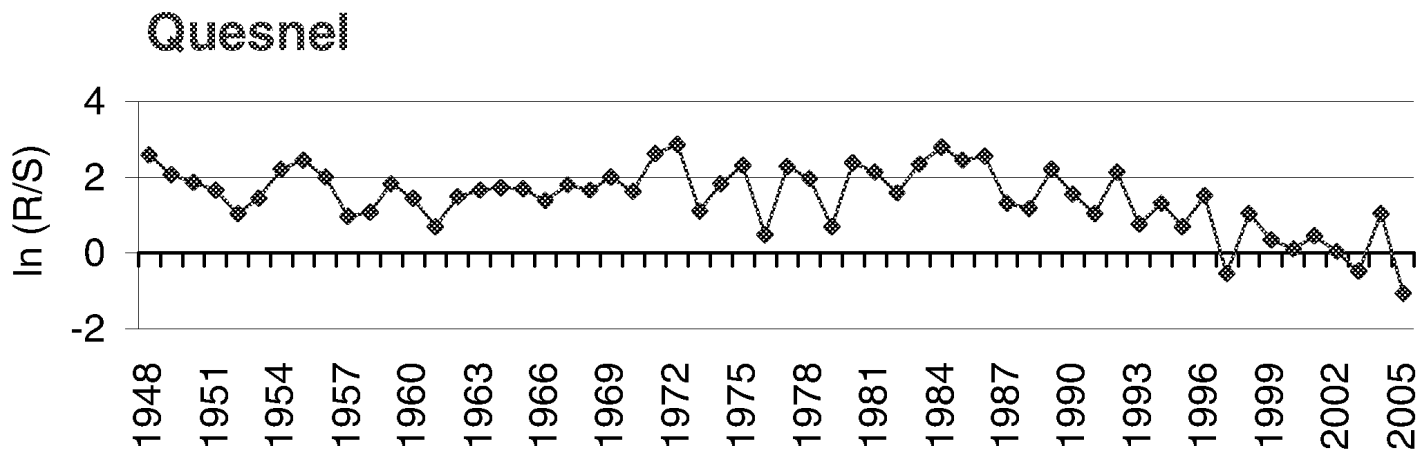


Returns: escapement + catch

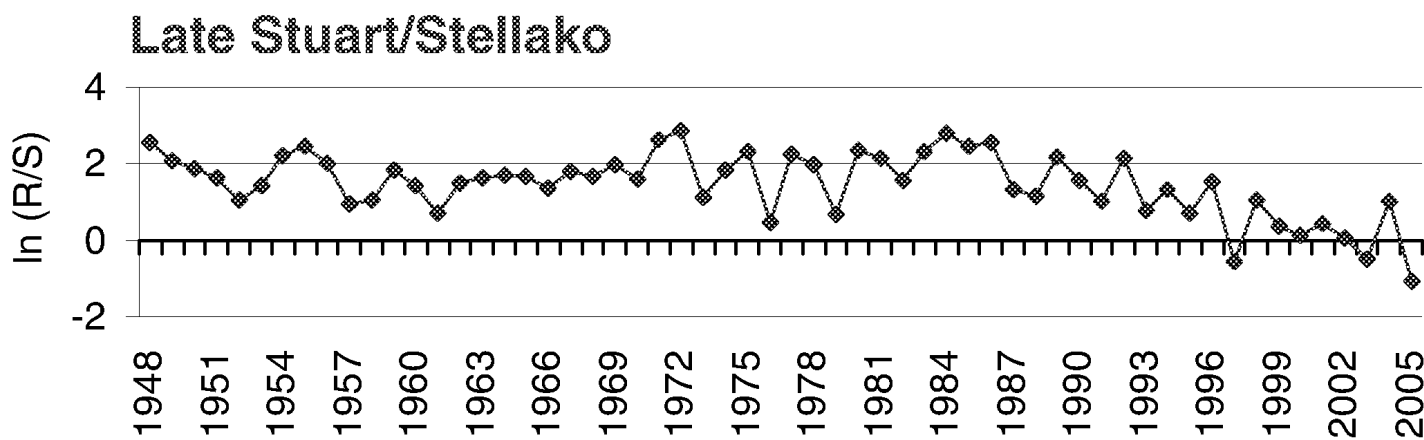
Chilko Sockeye Salmon Survival



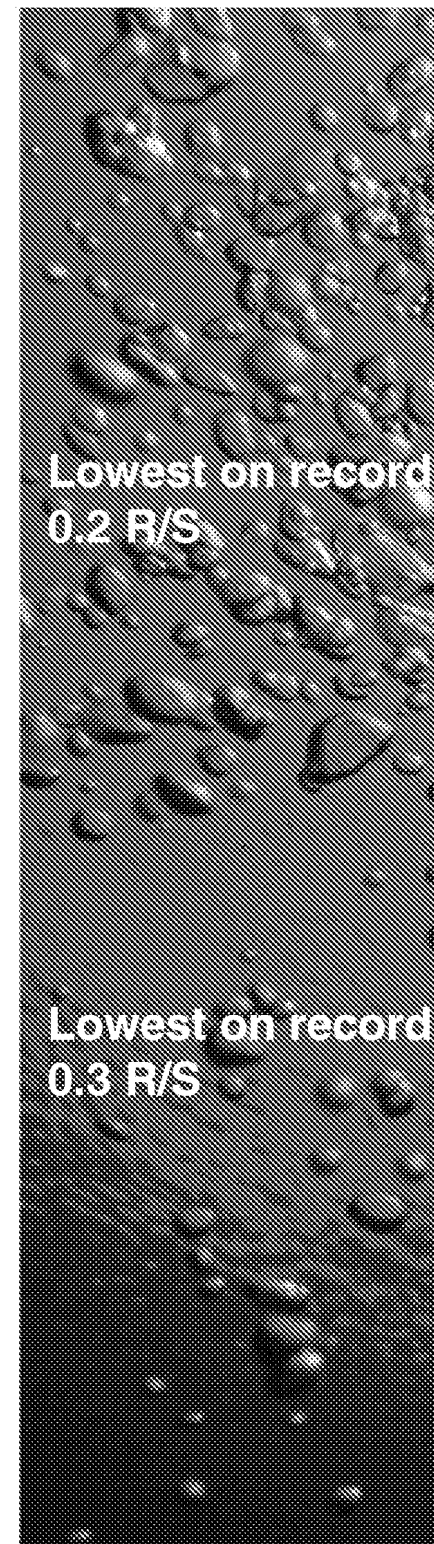
Lowest marine survival
on record at 0.04%



Lowest on record
0.2 R/S



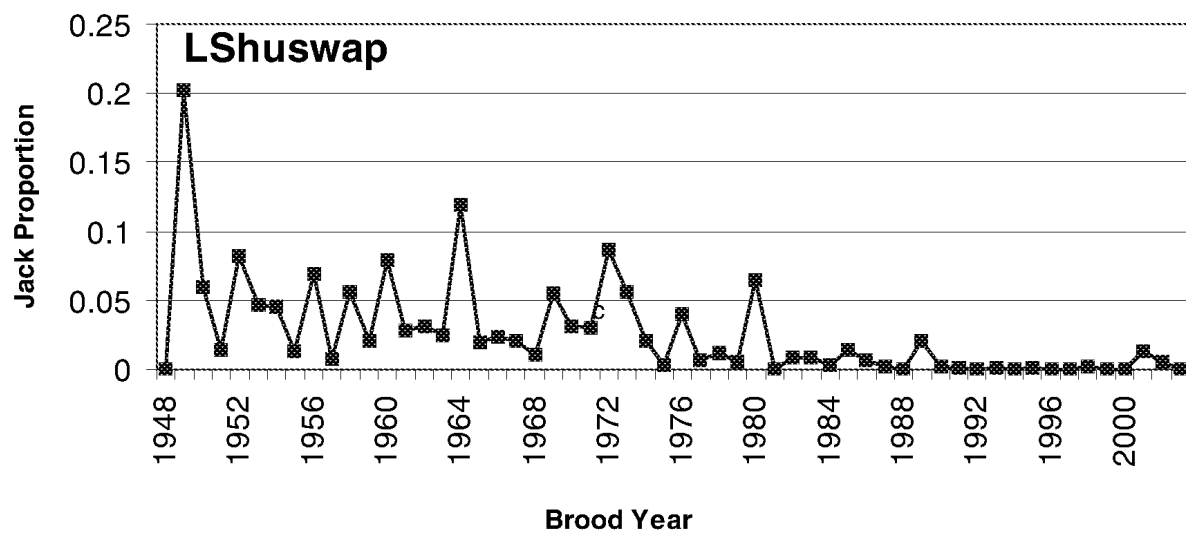
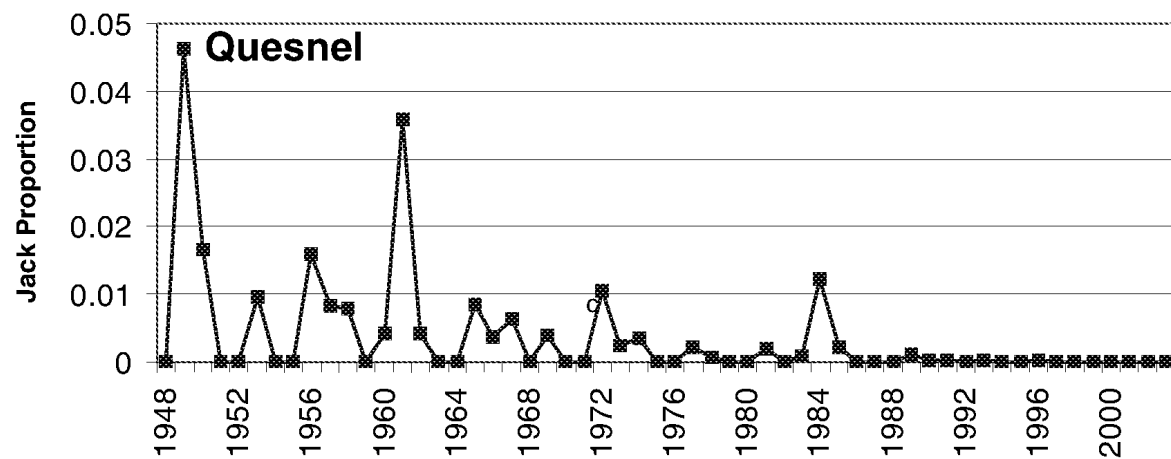
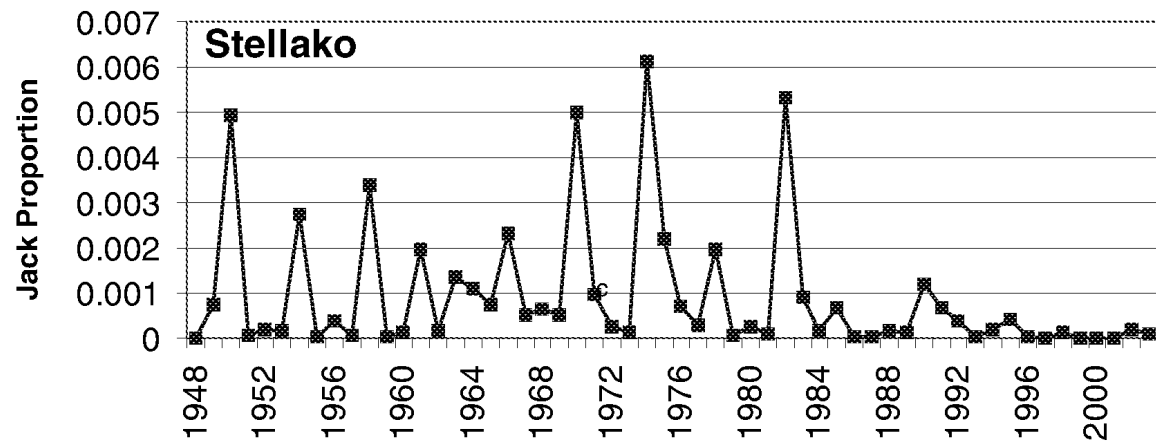
Lowest on record
0.3 R/S



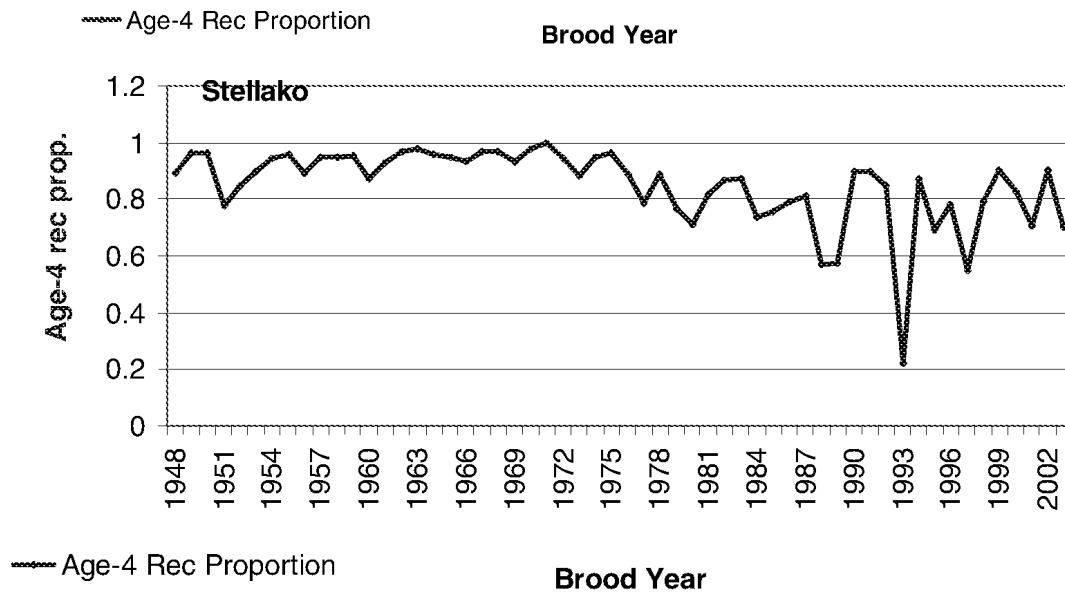
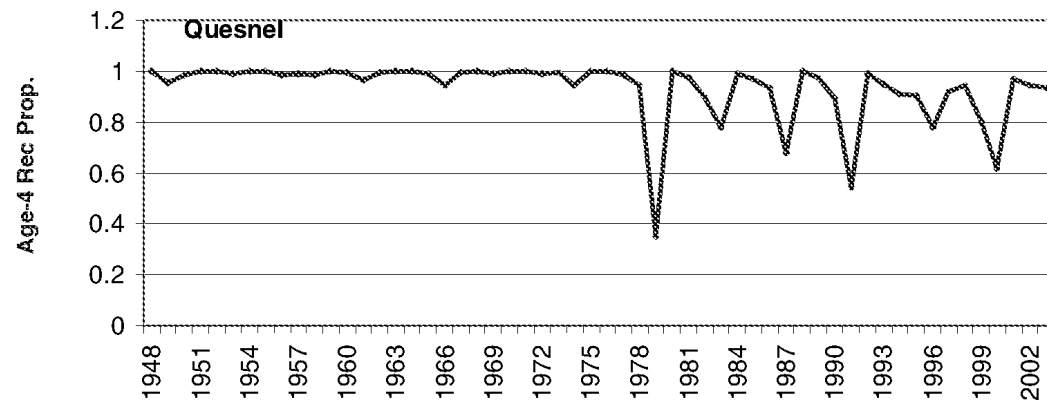
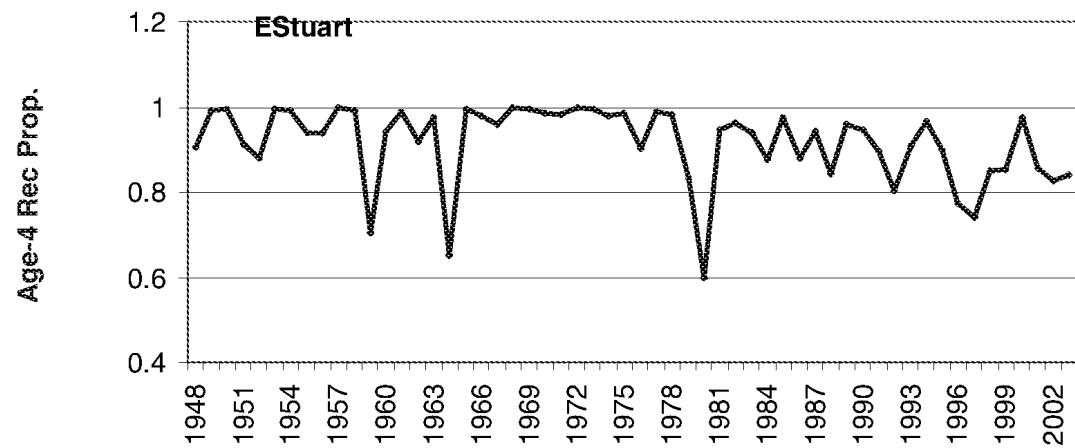


Delayed Maturation?

Jacks (Age-3) as
a proportion
of total recruits



Age-4 as
a proportion
of total recruits



Knowledge Gaps

- Only 1 indicator system (Chilko)
- limited research on freshwater rearing and migratory conditions on productive capacity
- limited knowledge of smolt & Harrison fry migration timing
- eroding capacity (decreasing budgets) to enumerate salmon on the spawning grounds
- currently environmental variables used don't map onto marine survival for Fraser sockeye
 - pre-season we didn't have info that would have predicted the extremely poor returns of 2009

SUMMMARY

1. Survival estimates are preliminary; still need age-5 recruits from 2005 brood year returning in 2010 to make final estimate of survival. Unlikely, given our past experience, that this would be significant (but not impossible?)
2. Current survival estimate indicates that this is amongst the lowest productivity for all stocks except Harrison; this explains the forecasts in ability to forecast returns.
2. Ground-truthed more uncertain forecasts; however, poor returns could not have been predicted for Quesnel & Chilko in 2009.
3. The only indicator stock (Chilko) suggests that this reduction in productivity occurred somewhere after outmigration through fence on Chilko River (Fraser River, Fraser Estuary, SOG, etc.)
4. Similar reduction in productivity for most stocks suggests related factor?
5. Harrison only stock doing well in recent years
 - Harrison are 3₁ (ocean entry 2007) & 4₁ (ocean entry 2006) (need return age data to confirm final age proportions)
 - Harrison migrates to SOG later than other stocks (rears in sloughs)
 - Rear in SOG for up to a year (Beamish) & subsequently WCVI (Trudel)

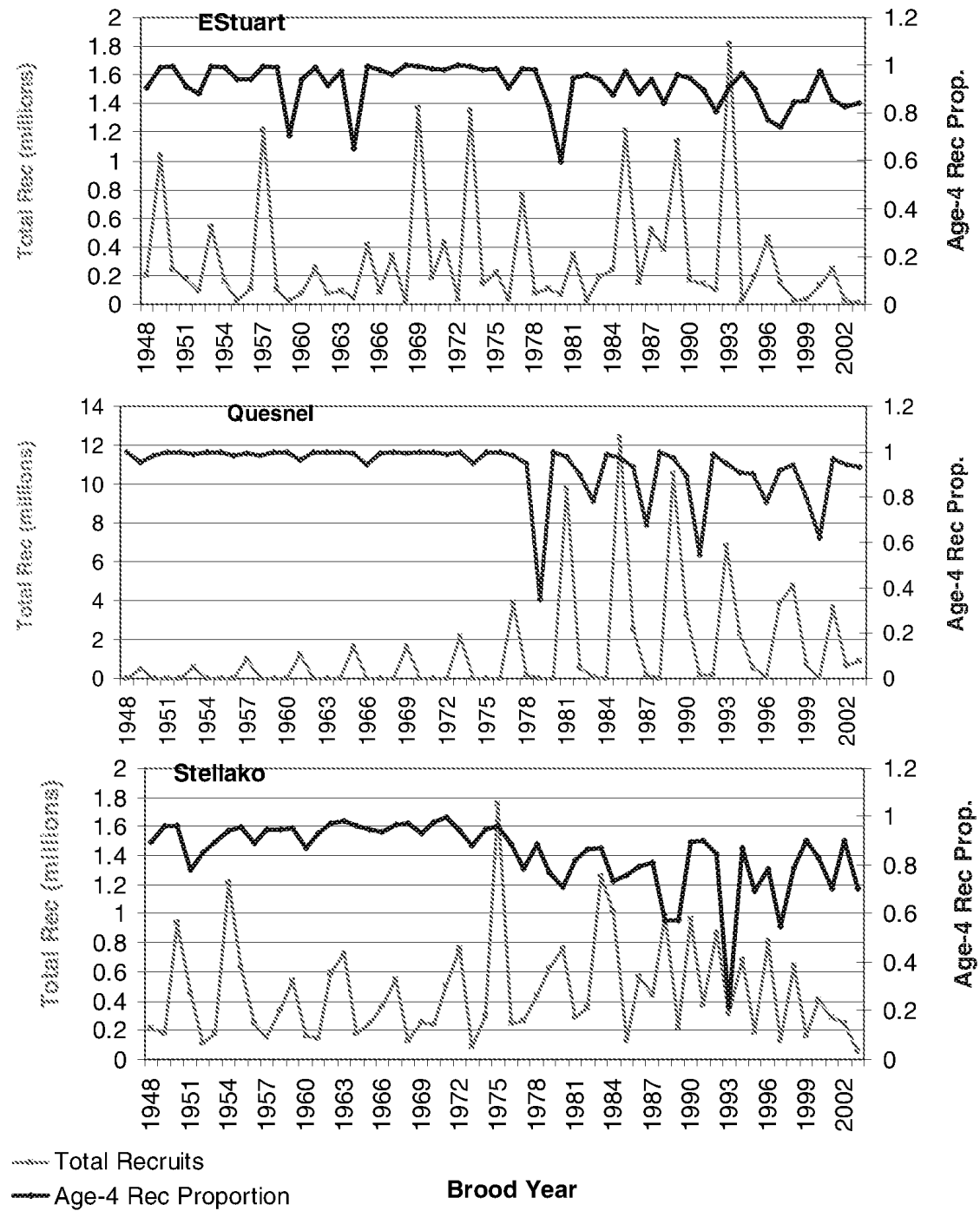
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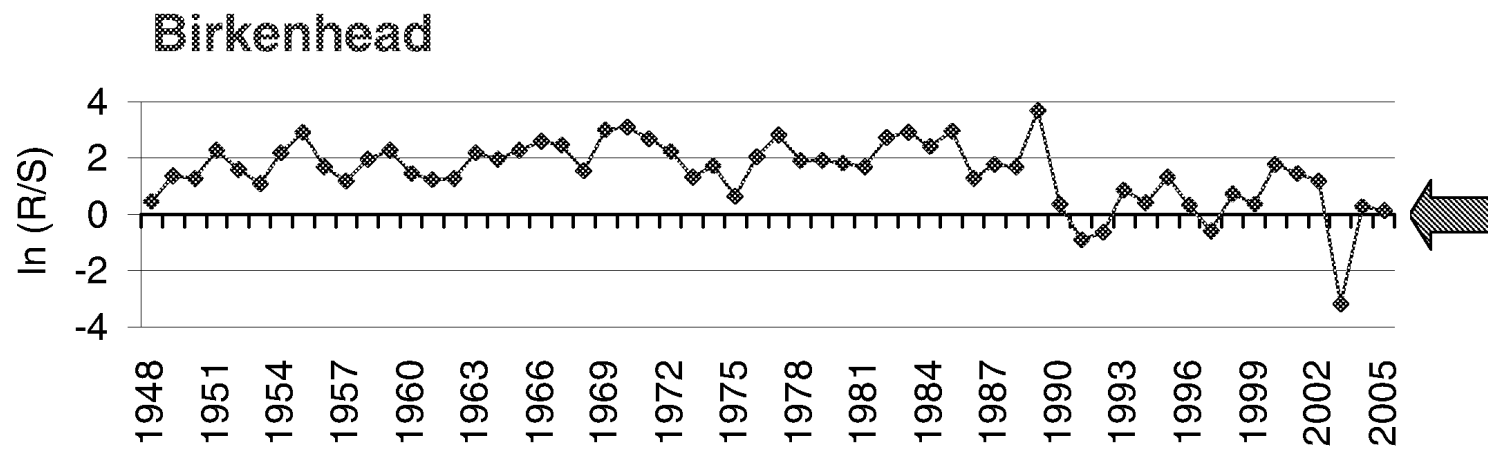
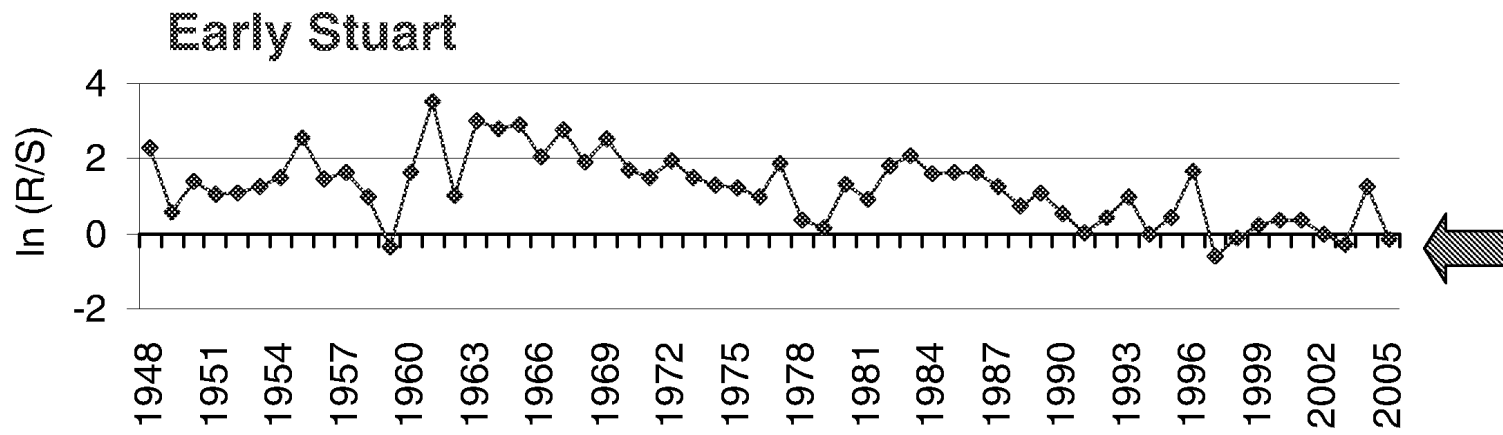
Globe&Mail Aug 12 2009: 'between 10.6 & 13 million sockeye were expected to return to the Fraser '....'more than 9 million sockeye **vanishing**'...'DFO's population estimates [are] generated by someone sitting at a desk instead of tramping the spawning grounds'...'They take a sweet wild-ass guess [referring to forecasts]

Vancouver Sun August 25, 2009: 'Why since the scientists knew about it in 2007, did we only learn about it in 2009 when the overly optimistic miscalculations of the fisheries bureaucrats became undeniable? What does this say about the federal government's policy of muzzling scientists who come bearing bad news'

Globe&Mail Sep 12, 2009: '19.5 million pink were expected on the Fraser River this season, slightly more than the preseason forecast of 17.5 million'

Age-4 as
a proportion
of total recruits





Brood Year

