Skeena Sockeye Juvenile Assessments and Potential Status Benchmarks

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This talk

- Productivity of Skeena Sx Lakes
- Juvenile Production and Rearing Capacity
- Monitoring status
- Benchmarks based on juveniles?

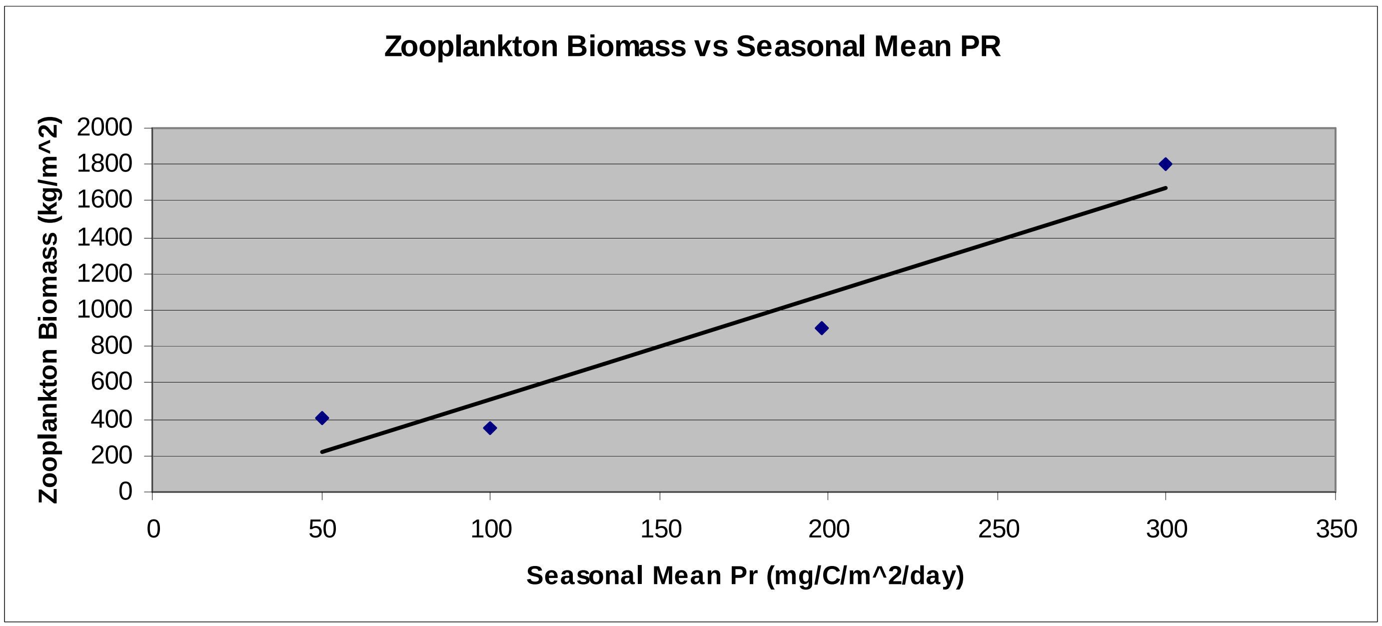
Holt et al 2009.

-In data uncertain systems, may be able to use Juvenile Abundance as an indicator…

For sockeye, look at lake productivity…

Food supplies in Sx lakes are related to Mean Photosynthetic Rates (PR)

Shortreed et al (1998)



Research has shown…

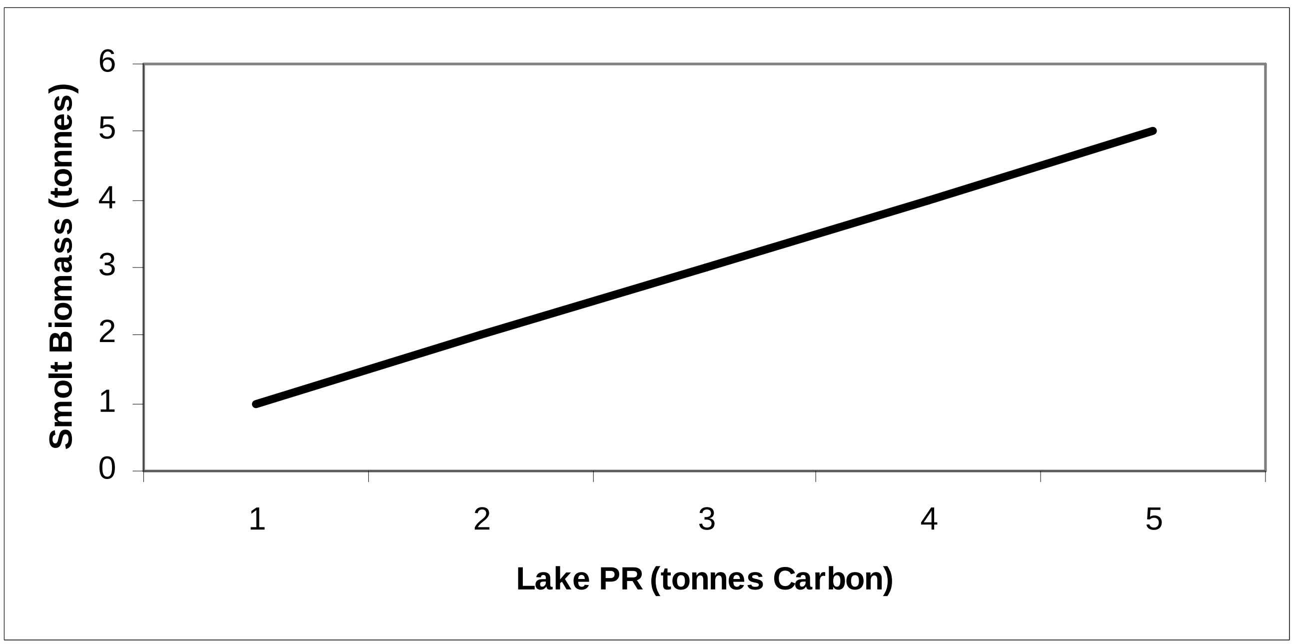
- Mean photosynthetic rate (Pr) is the parameter to use to show inherent lake productivity because it integrates all the factors that affects variability in phytoplankton growth and productivity.

- Shortreed, Hume and Stockner (2000) show that mean photosynthetic rate is strongly related to smolt productivity in sockeye lakes.

-this is the PR model developed by Cultus Lab

Shortreed et al (1998)

-PRtotal (or predicted smolt biomass) reflects the effects of lake size and thus estimates the annual smolt production from the lake. Little lakes produce few smolts, no matter what their productivity is.

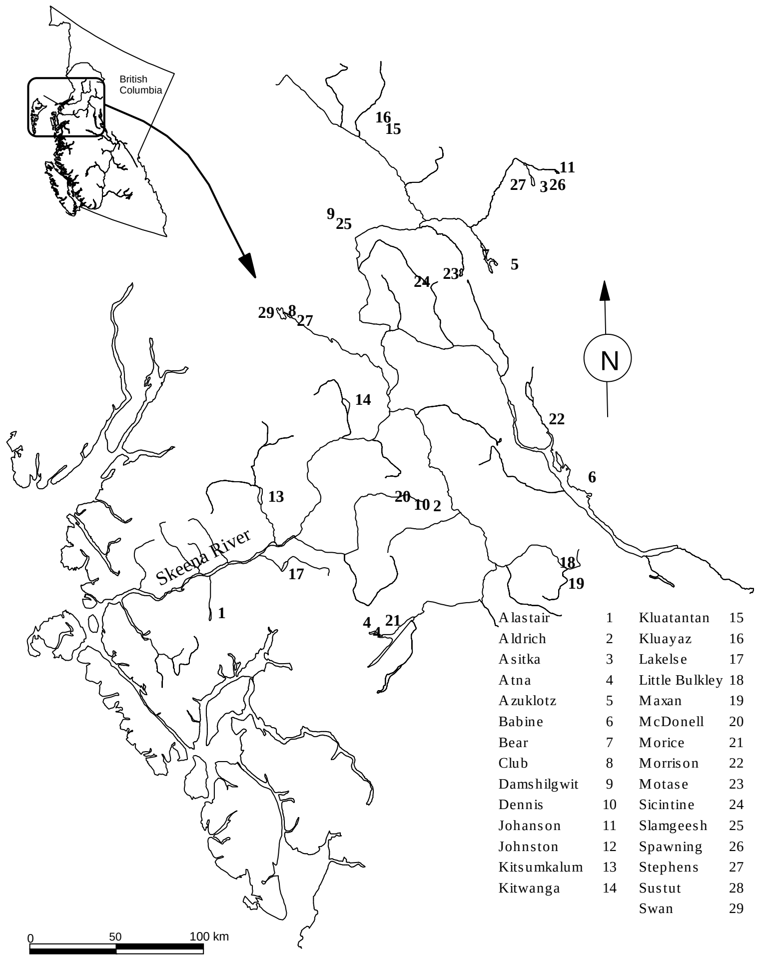


Step 1: Conduct field surveys to establish photosynthetic rates in each lake, as well as survey the zooplankton community

Skeena Sx lakes are very diverse….

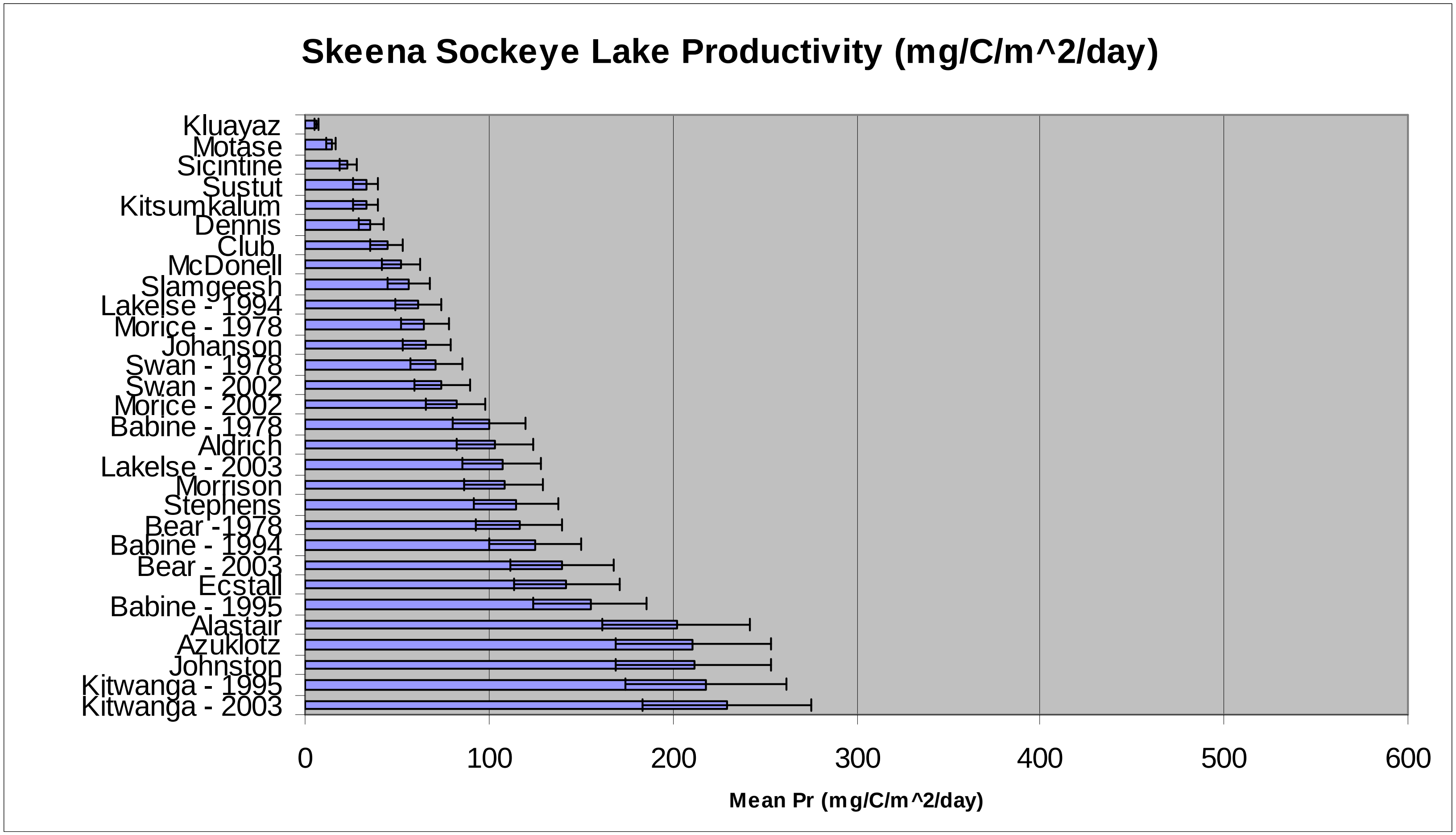
-wide variation in morphometry, geography, and climate and flow/water budgets

In general

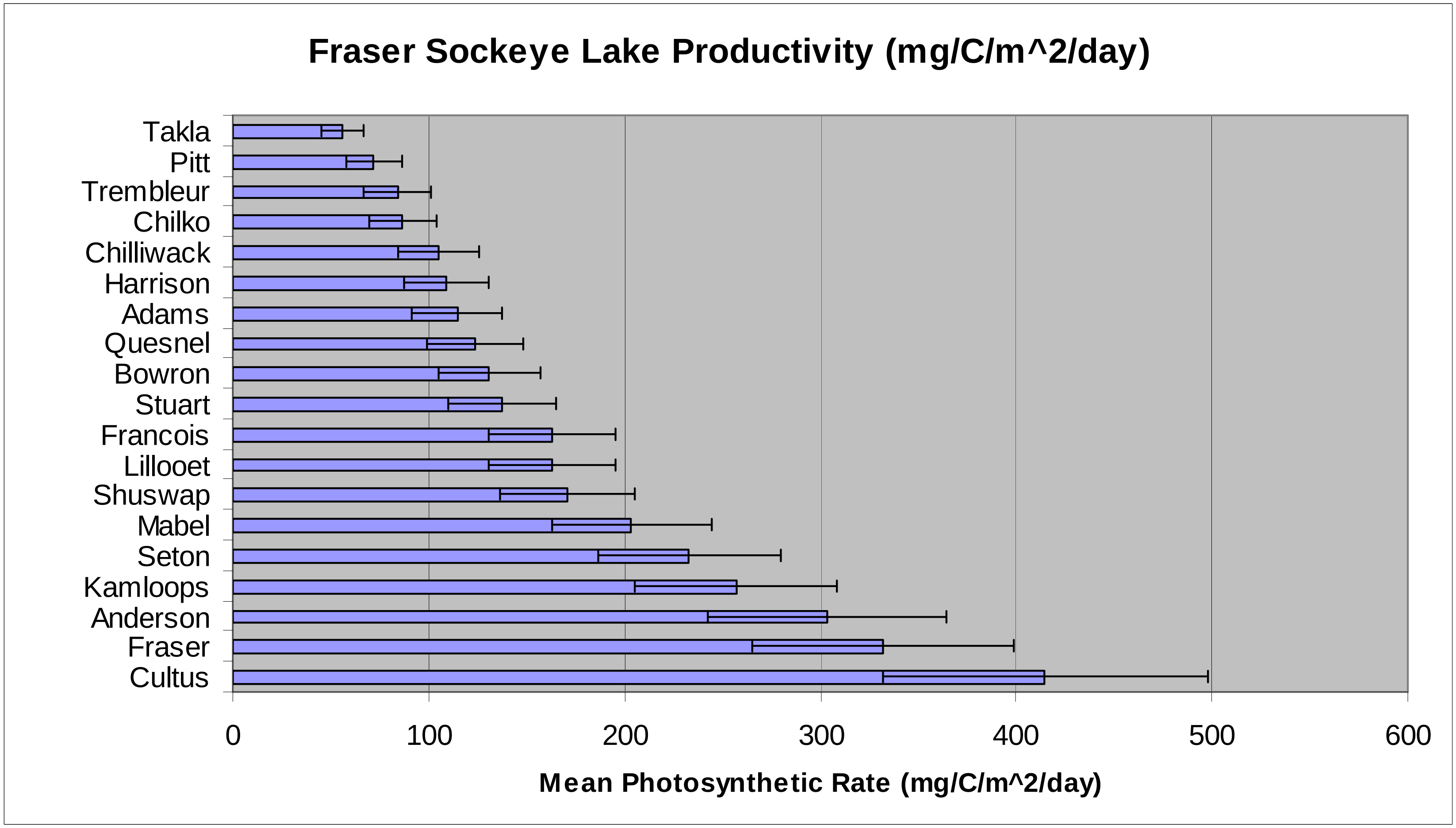


- Interior lakes either clear or glacial: lower rainfall
- Coastal lakes usually stained: higher rainfall
- Occupy sea-level to sub-alpine elevations
- Ice cover and winters get longer as elevation and distance from ocean increases

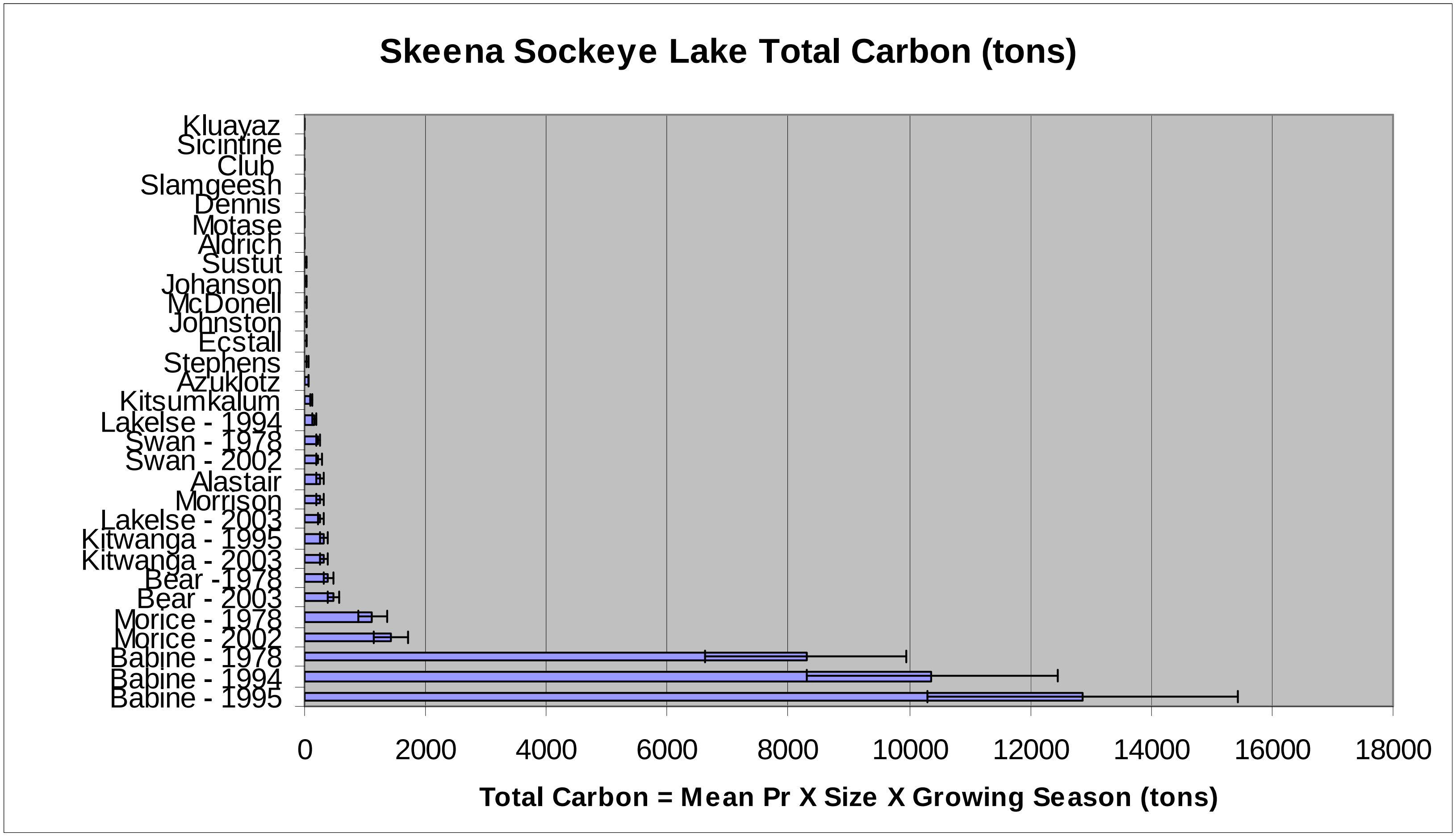
Mean Photosynthetic Rates vary from low to high in the Skeena…



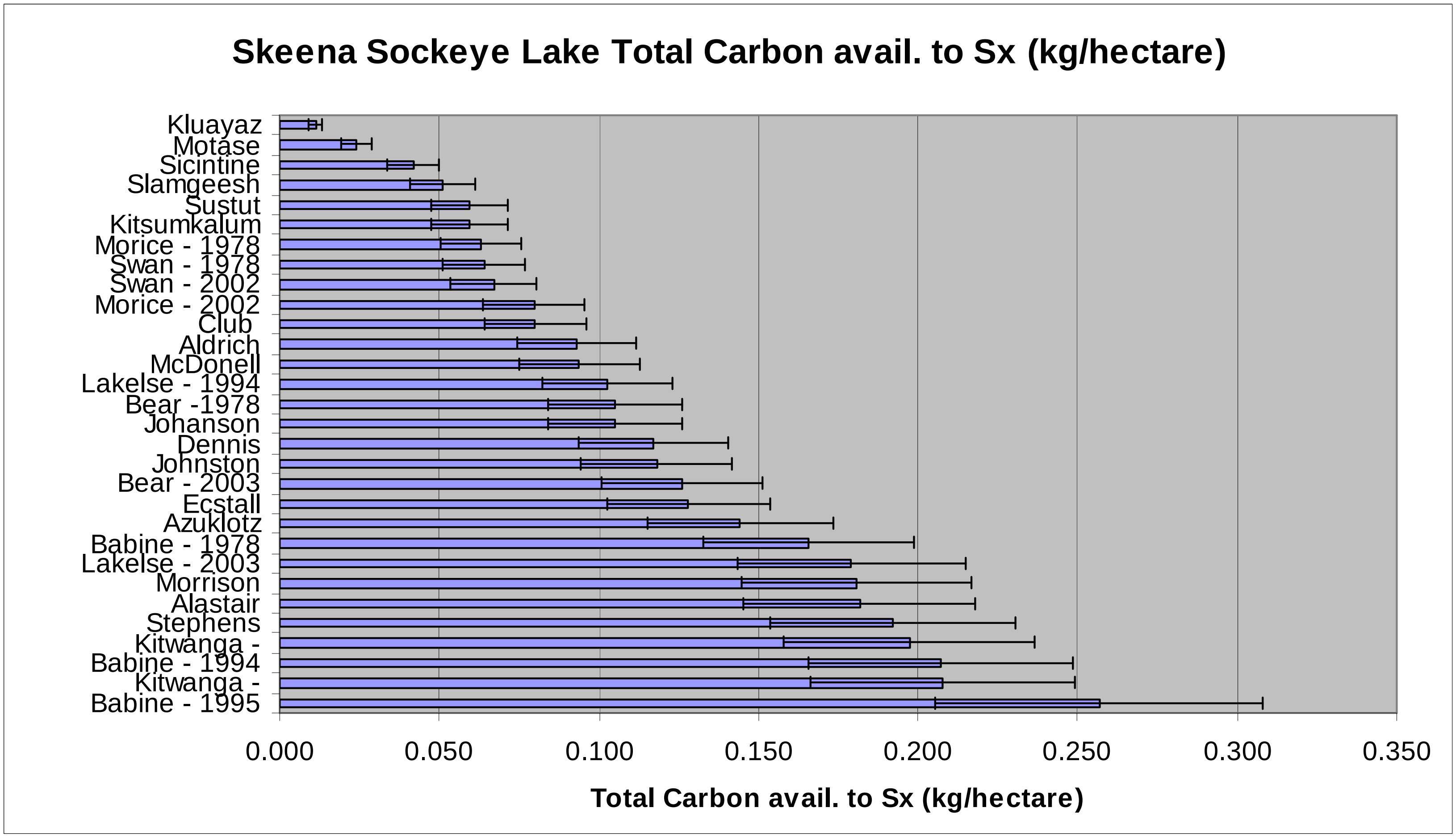
Same pattern for Fraser Lakes, but we generally see more lakes with higher photosynthetic rates than Skeena Lakes



Step 2: Expand PR by Lake size and Growing Season to Calculate Total Carbon avail. to food chain = Pr Total

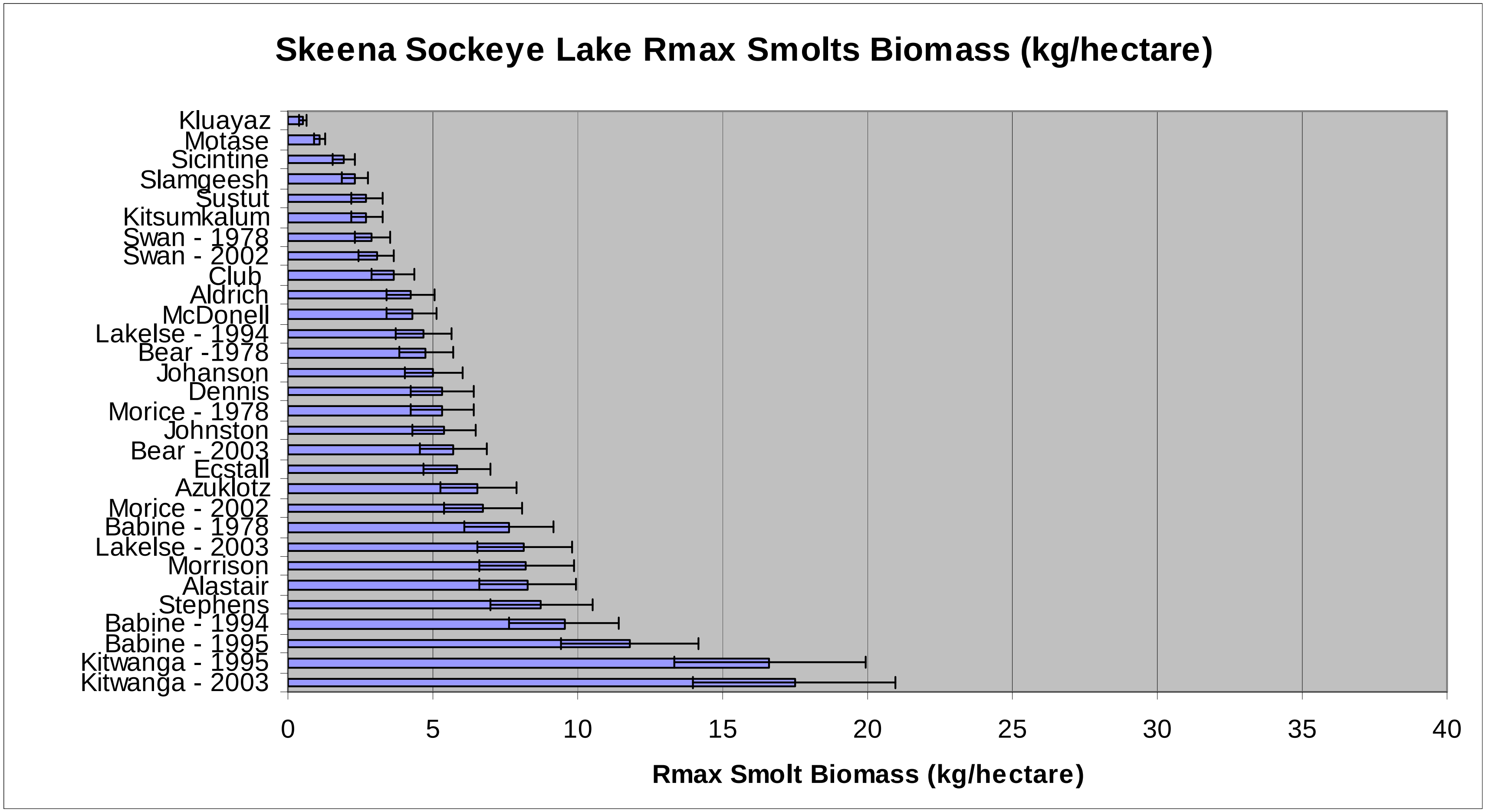


Step 3: Adjust Carbon budget for sockeye competitors, age structure, etc. Now have an index of lake productivity specific to sockeye

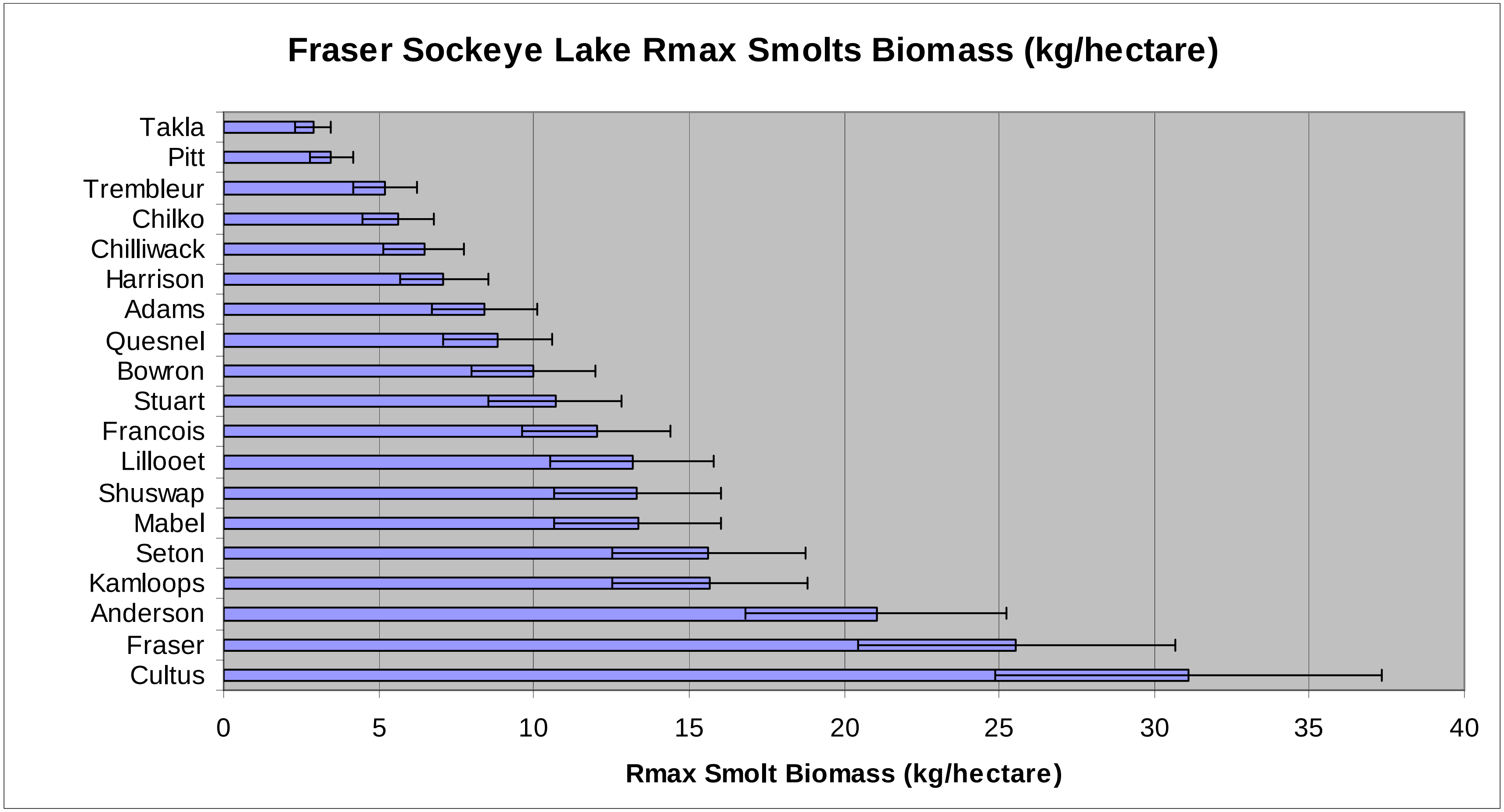


Step 4: Relate adjusted Carbon budget to maximum smolt biomass each lake can produce. This is the rearing capacity (Rmax).

-Biostandards convert smolt biomass to smolt numbers, with new conversions for lake-specific smolt size (Cox-Rogers et al 2004)



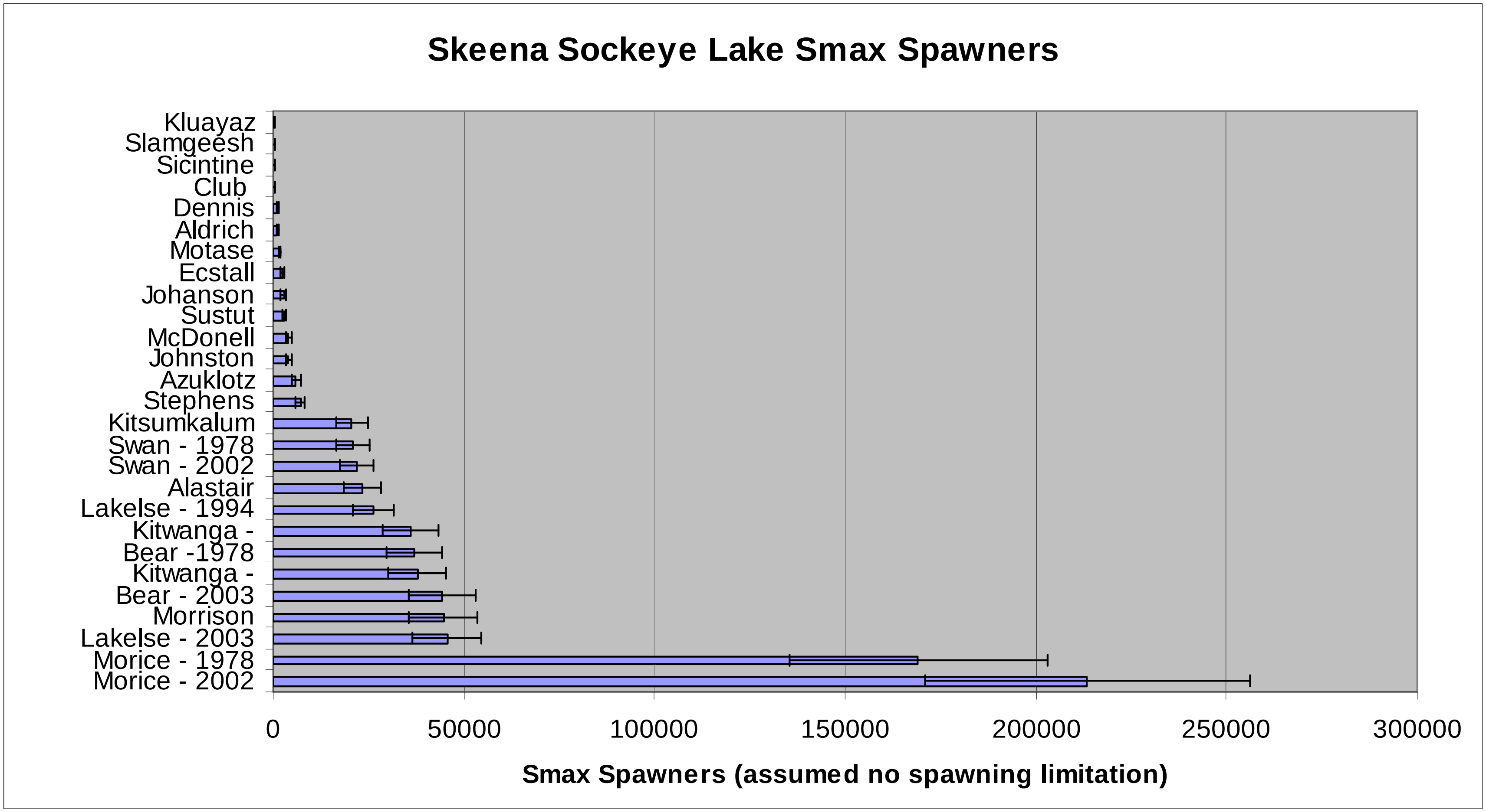
Because Fraser Lakes are generally more productive, they can generally produce more smolt biomass per hectare than Skeena Lakes



Step 5: Convert Rmax smolts to number of spawners (Smax) likely producing them (biostandard calculation)

-this is the prior info on Smax used by Josh Korman

-assumes spawning habitat is not limiting smolt production so in lakes where it does, need to downward adjust predictions



Monitoring Status?

-Done with Hydroacoustic surveys

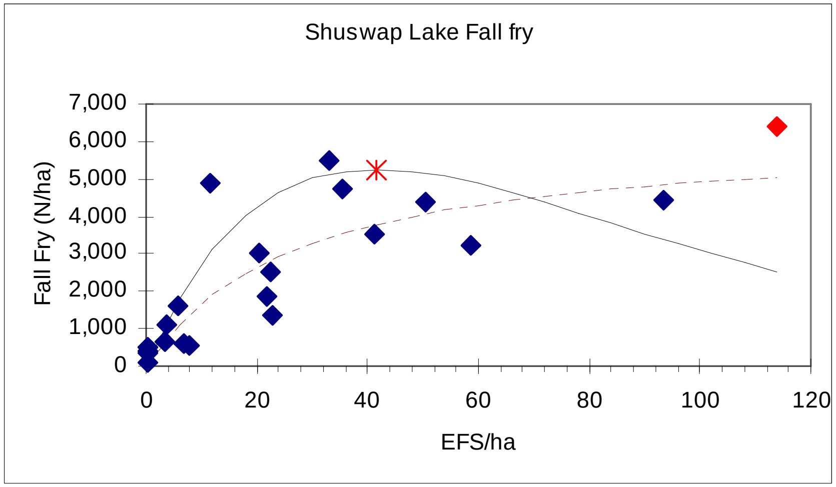
-i.e. conduct rotational juvenile density surveys in each lake and

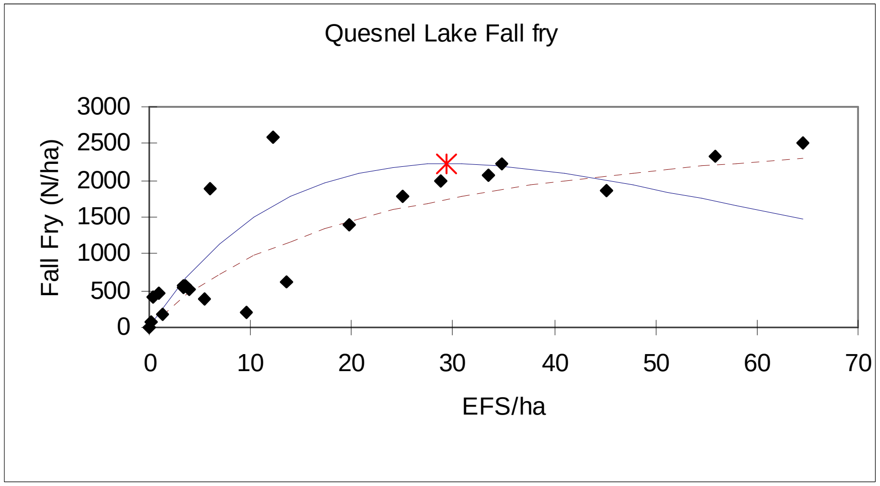
compare to the capacity estimates

Observed Fall fry densities are generally correlated with previous year adult spawners

-but in some lakes acoustics does not work

e.g some shallow lakes, shoreline juveniles etc





Acoustics also helps with snap-shot assessment of juvenile status

- Low #'s observed ~ Poor status

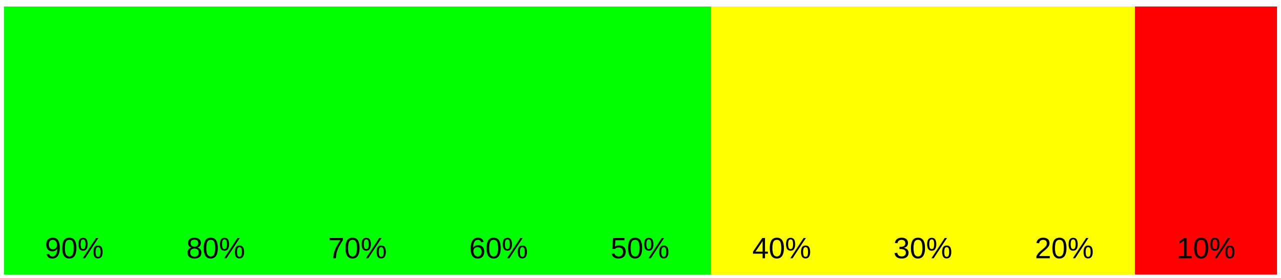
- High #'s observed ~ Better status

Possible Benchmark #1

-observed juveniles as proportion of Rmax juveniles

Red Zone after Wood (2004) ~ 15% of Capacity
Green Zone after Holt et al (2009): MSY ~ 40% of Capacity

Calculated Proportions of Rmax/ha Smolt Biomass (kg) for WSp Benchmark Evaluations



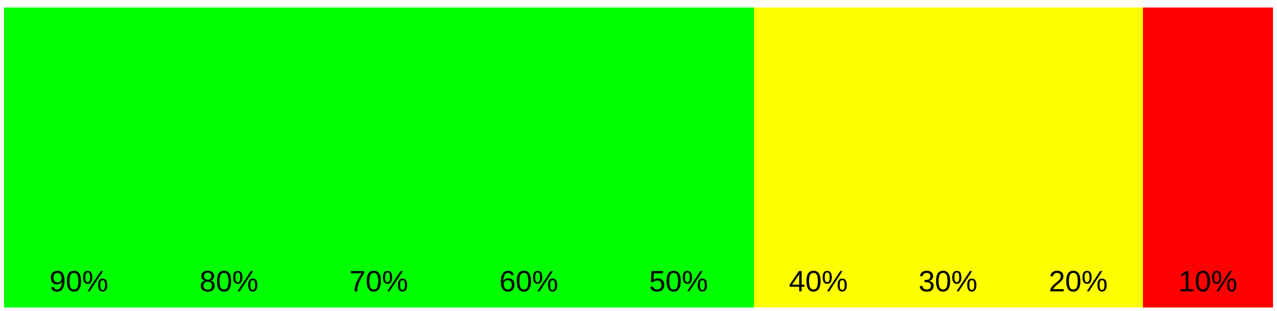
Alastair	7.4	6.6	5.8	5.0	4.1	3.3	2.5	1.7	0.8

8.3

Possible Benchmark #2

Inferred S (from juvenile densities) or measured S compared to Smax

Calculated Proportions of Smax Spawners for WSp Benchmark Evaluations



e.g. Alastair	21093	18750	16406	14062	11719	9375	7031	4687	2344

23437

Example Juvenile status to date? (subject to revision)

Lake	Date of last Cultus Lab Limnological Assessment	Date of last Cultus Lab Juvenile Assessment	**Rmax estimated (2012) Sm. Biomas (kg/ha)**	Rmax 95% lower Sm. Biomas (kg/ha)	Rmax 95% upper Sm. Biomas (kg/ha)	if no spawner limit. Smax estimated (2012) spawners	Smax 95% lower spawners	Smax 95% upper spawners	Brett Smax estimated (1952) spawners	1998 Shorteed Cultus Lab Surveys reported Sm. Biomas (kg/ha)	2007 Shortreed Cultus Lab Surveys reported Sm. Biomas (kg/ha)	2008 SFC Surveys reported Sm. Biomas (kg/ha)	2009 SFC Surveys reported Sm. Biomas (kg/ha)	2010 SFC Surveys reported Sm. Biomas (kg/ha)	2011 SFC Surveys reported Sm. Biomas (kg/ha)	Obs S vs Est S? English Expand. 2011 Spawners 2005-2010
Alastair	1996	1994	8.27	6.65	9.89	23437	18843	28031	37000	3.39			1.77		1.9	16044
Lakelse	2003	2003	6.00	4.82	7.18	35916	28877	42956	95000	1.90	0.95	0.80	1.10	0.60	0.70	7395
Swan	2002	2002	2.95	2.37	3.53	21432	17231	25633	15000	0.63	0.38			0.10		2896
Stephens	2002	2002	8.70	6.99	10.41	7069	5683	8455			1.88			3.10		10826
Club	2002	2002	3.60	2.89	4.31	589	474	704			0.11					
Morice	2002	2002	6.00	4.82	7.18	191362	153855	228869		0.17	0.16		0.13			19462
Atna	no	no														
Maxan	no	no														
Slamgeesh	2001	2001	2.30	1.85	2.75	423	340	506			1.96					
Kitwanga	2003	2003	17.00	13.67	20.33	36984	29735	44233		0.18						5229
Kalum	1996	1993	2.70	2.17	3.23	20531	16507	24555	42000	0.20			0.50		0.2	16047
McDonnel	2001	2002	4.30	3.46	5.14	4072	3274	4870			0.90	2.00	1.00	1.20	2.00	3911
Dennis	2001	2001	5.30	4.26	6.34	1091	877	1305								
Aldrich	2001	2001	4.20	3.38	5.02	1116	897	1335								
Johanson	2004	2004	5.00	4.02	5.98	2723	2189	3257		0.37	2.41			0.60		
Sustut	2004	2004	2.70	2.17	3.23	2775	2231	3319		1.58	0.10			1.20		
Bear	2003	2003	5.30	4.26	6.34	40532	32588	48476	16000	0.36	0.38	0.10				
Asitka	no	no		0.00	0.00		0	0								
Morrison	1996	1994	8.20	6.59	9.81	44587	35848	53326		1.62						6456
Babine	1995	1995	10.00	8.04	11.96	1808245	1453829	2162661								
Azuklotz	2003	2003	6.60	5.31	7.89	5933	4770	7096			1.82		0.50			3549
Damshilgwit	2001	2001	2.30	1.85	2.75	423	340	506			1.96					
Johnston	2005	2005	5.40	4.34	6.46	4125	3317	4934			3.04			5.10		3525
Kluatantan	no	no														
Kluayaz	2004	no														
Sicintine	2004	no														
Spawning	no	no														
Motase	2003	2003	1.10	0.88	1.32	1764	1418	2110			0.06		0.40			
Bulkley	no	no														

	1998 Shortreed	2007 Shortreed	2008	2009	2010	2011	Obs S vs Est S?
	Cultus Lab Surveys	Cultus Lab Surveys	SFC Surveys	SFC Surveys	SFC Surveys	SFC Surveys	English Expand.
	reported	reported	reported	reported	reported	reported	2011 Spawners
Lake	Sm. Biomas (kg/ha)	Sm. Biomas (kg/ha)	Sm. Biomas (kg/ha)	Sm. Biomas (kg/ha)	Sm. Biomas (kg/ha)	Sm. Biomas (kg/ha)	2005-2010
Alastair	3.39			1.77		1.9	16044
Lakelse	1.90	0.95	0.80	1.10	0.60	0.70	7395
Swan	0.63	0.38			0.10		2896
Stephens		1.88			3.10		10826
Club		0.11					
Morice	0.17	0.16		0.13			19462
Atna							
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Slamgeesh		1.96					
Kitwanga	0.18						5229
Kalum	0.20			0.50		0.2	16047
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Dennis							
Aldrich							
Johanson	0.37	2.41			0.60		
Sustut	1.58	0.10			1.20		
Bear	0.36	0.38	0.10				
Asitka							
Morrison	1.62						6456
Babine							
Azuklotz		1.82		0.50			3549
Damshilgwit		1.96					
Johnston		3.04			5.10		3525
Kluatantan							
Kluayaz							
Sicintine							
Spawning							
Motase		0.06		0.40			
Bulkley							

Next Steps

- Incorporate benchmark probabilities
- Adjust Rmax/Smax for spawner limitation?
  -Should juveniles be used for benchmarks?
- Rectify lake productivities and status based on Pr with adult SR estimates of CU productivity and status:
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