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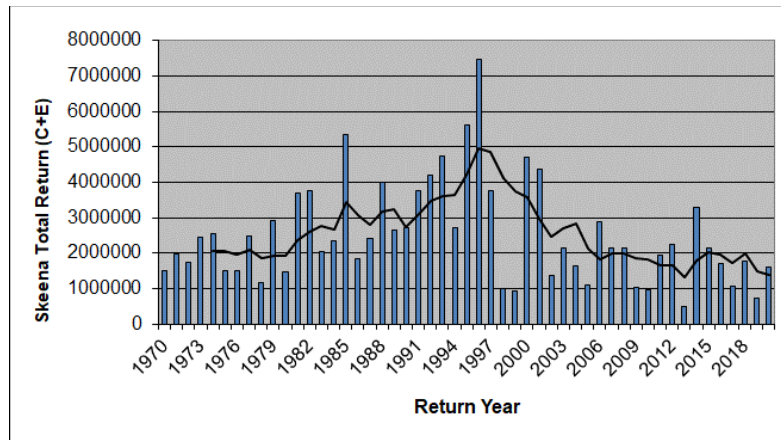
PRELIMINARY 2021 SKEENA SOCKEYE FORECAST

Security Classification - Classification de sécurité UNCLASSIFIED
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Date November 16, 2020

- **Summary of Skeena Sockeye forecasts for 2021:**

2021 Skeena Pre-season Forecast				2021 Forecasts for reference probabilities				
Species	Stock	Escapement Target	Median					
			10%	25%	50%	75%	90%	
Sockeye	Skeena	1,050,000	5 yr average	2,330,799	1,695,511	1,258,913	934,741	679,966
			Sibling Mode	3,614,662	2,518,754	1,696,972	1,143,310	796,676

Historic Skeena Total Return Trends: 1970-2020 (2020 return was 1.6m)



5yr Average Run Size Model for 2021: 50% Probability = 1.26m)

2016	1697838	14.34487
2017	1054111	13.86821
2018	1775394	14.38953
2019	617616	13.33362
2020	1611326	14.29257
mean		14.04576
s.d		0.402
transform		1258913

d.f.	4				Arithmetic
Mean	14.046 Ref		Critical	Ln Run	Run
s.d	0.401802 Prob	Prob level	t		
0.9995	0.0005	8.61	10.58625	39587	
0.999	0.001	7.175	11.16283	70462	
0.9975	0.0025	5.598	11.79647	132783	
0.995	0.005	4.604	12.19586	197969	
0.99	0.01	3.747	12.54021	279347	
0.975	0.025	2.776	12.93036	412651	lower 95% c.l
0.95	0.05	2.132	13.18912	534517	
0.9	0.1	1.533	13.4298	679966	
0.75	0.25	0.741	13.74802	934741	
0.5	0.5	0	14.04576	1258913	
0.25	0.75	0.741	14.34349	1695511	
0.1	0.9	1.533	14.66172	2330799	
0.05	0.95	2.132	14.9024	2965039	
0.025	0.975	2.776	15.16116	3840685	upper 95% c.l.
0.01	0.99	3.747	15.55131	5673466	
0.005	0.995	4.604	15.89565	8005625	
0.0025	0.9975	5.598	16.29505	11935717	
0.001	0.999	7.175	16.92869	22492384	
0.0005	0.9995	8.61	17.50527	40035330	

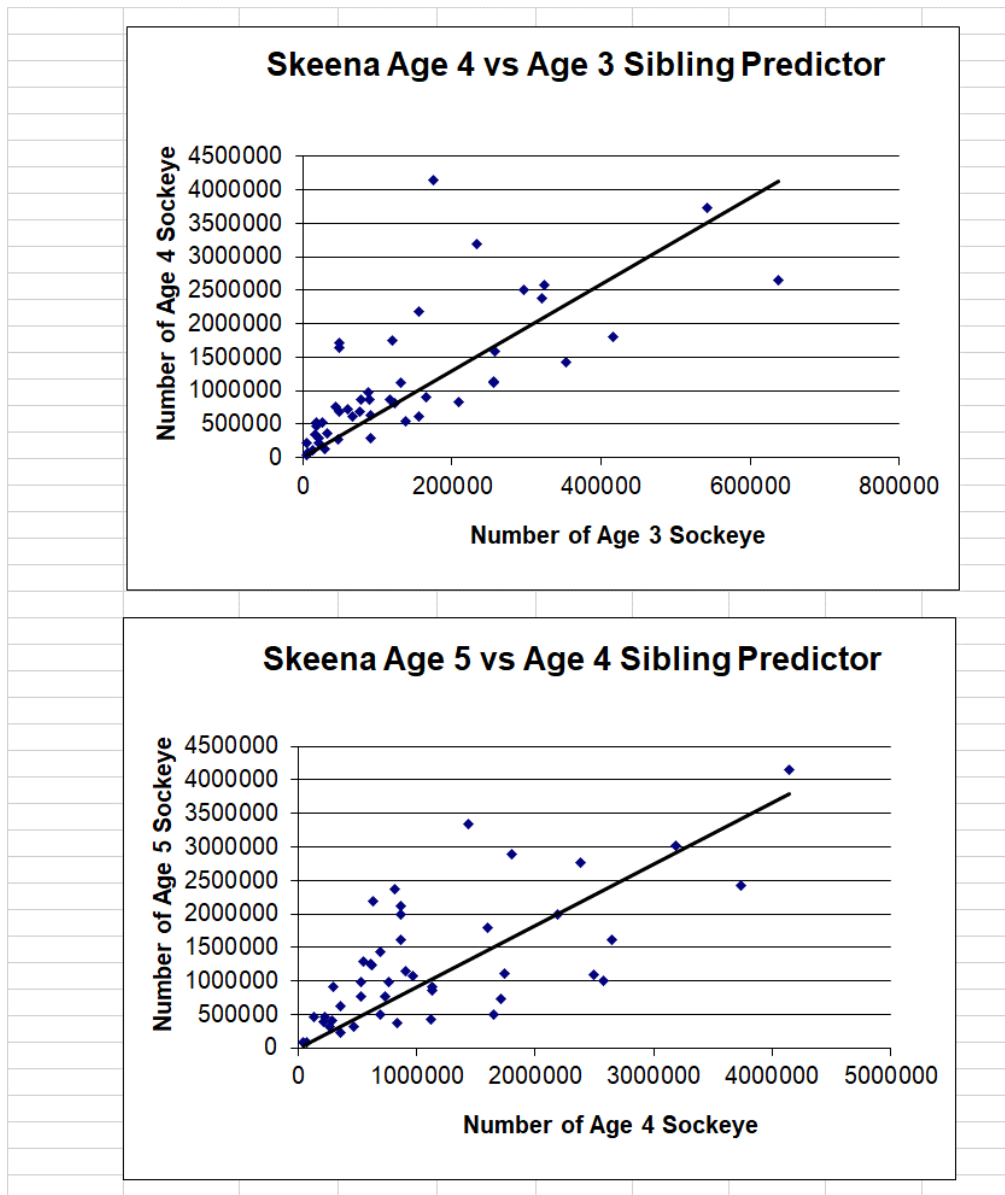
- 1) Sibling Model: 18743 age 3 jacks in 2020 predicts **275k** age 4 in 2021
 1.45m age 4 adults in 2020 predicts 1.42m age 5 adults in 2021
Total = 1.69m

Brood Yr	Smolts	Age 3	Age 4	Age 5
		Returns	Returns	Returns
1970	50.81	208350	832560	364351
1971	105.24	256772	1127519	918877
1972	106.2	137396	544756	1291903
1973	38.1	255458	1129887	863534
1974	45.62	47697	263423	313467
1975	64.72	296274	2498755	1095404
1976	90.37	90509	288607	411933
1977	121.54	233886	3182751	3021288
1978	57.51	155395	618162	1238674
1979	192.04	60223	729422	775824
1980	136.57	353135	1432854	3346569
1981	146.25	120752	1740910	1108142
1982	94.61	66714	607723	1254186
1983	49.84	88125	967641	1079371
1984		638641	2646485	1611282
1985	125.63	77631	866353	1616827
1986	82.34	122711	814116	2361087
1987		89631	865543	2109589
1988	68.84	416049	1797485	2882665
1989	53.39	258240	1593694	1795016
1990	99.65	90580	628574	2196606
1991	83.09	320804	2377904	2761171
1992	194.13	542895	3734236	2426181
1993	34.79	43476	765837	975561
1994	18.09	6348	68632	83092
1995		48627	688004	501969
1996	135.5	174687	4148319	4149292
1997	82.24	17068	352837	632023
1998	25.57	76335	690955	1439181
1999	41.35	18398	468901	325514
2000	114.88	131655	1116050	418853
2001		18103	530220	758619
2002		155249	2184822	1988598
2003		28858	130206	458273
2004		48616	1705014	722348
2005		20852	214304	385535
2006		26747	530111	989425
2007		116594	866705	1988639
2008		32163	359393	225372
2009		5380	220473	466241
2010		323733	2579868	1009265
2011	123.4	165544	903760	1146176
2012	94.7	21838	295070	902759
2013	21.7	5435	35364	86818
2014	58.0	49212	1649360	590093
2015	104.8	12683	132771	128337
2016	200.0	57491	1447412	
2017	100.0	18743		

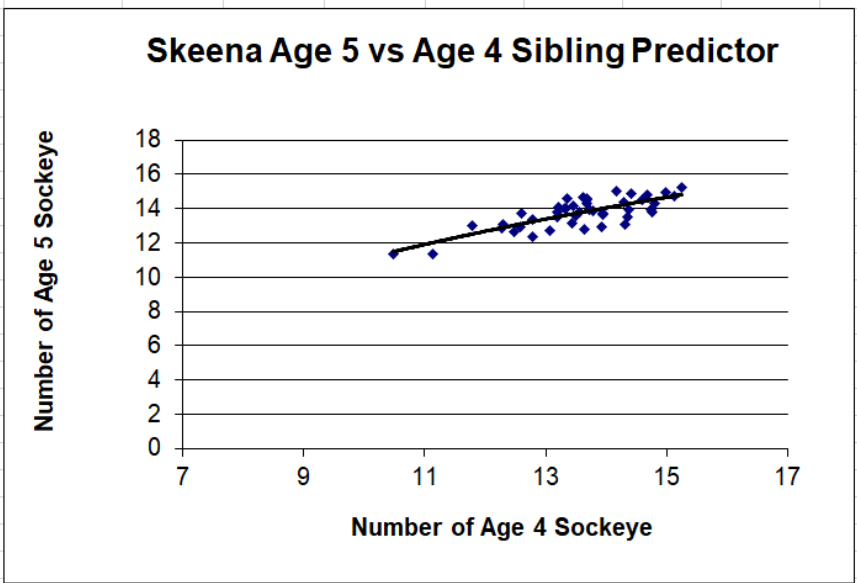
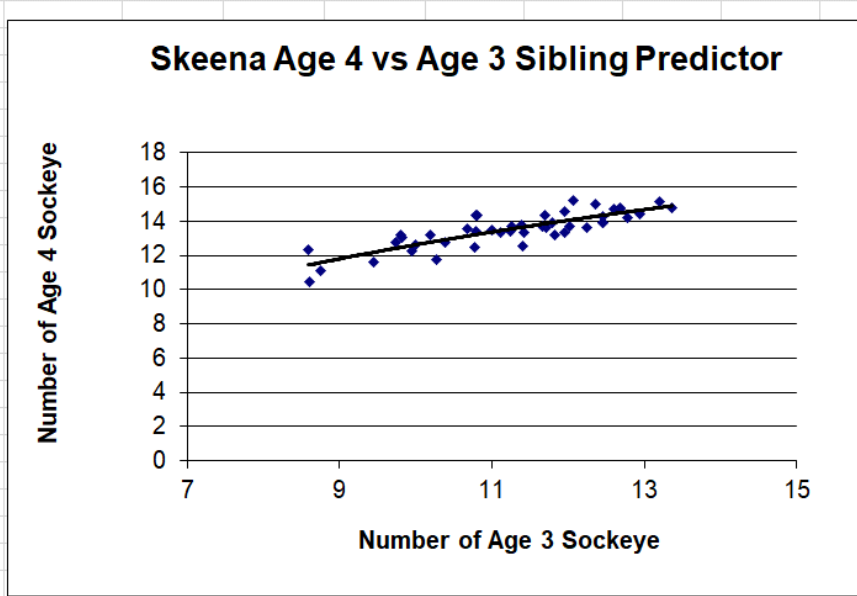
Sibling Model probability distribution for 2021 (age 4 + age 5)

d.f.	43					Arithmetic
Mean	14.34436	Ref	Critical	Ln Run	Run	
s.d	0.580762	Prob	Prob level	t		
	0.9995	0.0005	3.532	12.2931	218186	
	0.999	0.001	3.291	12.43307	250965	
	0.9975	0.0025	2.959	12.62588	304334	
	0.995	0.005	2.695	12.7792	354762	
	0.99	0.01	2.416	12.94123	417164	
	0.975	0.025	2.017	13.17296	525948	lower 95% c.l
	0.95	0.05	1.681	13.36809	639278	
	0.9	0.1	1.302	13.5882	796676	
	0.75	0.25	0.680	13.94944	1143310	
	0.5	0.5	0	14.34436	1696972	
	0.25	0.75	0.68	14.73927	2518754	
	0.1	0.9	1.302	15.10051	3614662	
	0.05	0.95	1.681	15.32062	4504637	
	0.025	0.975	2.017	15.51575	5475280	upper 95% c.l.
	0.01	0.99	2.416	15.74748	6903080	
	0.005	0.995	2.695	15.90951	8117323	

Sibling Model Predictive Relationships (non-log): note the sib model data used for forecasting use a domestic as well as an updated 1982-present PSC reconstruction series. There is little difference between data sets in terms of forecast performance. Sibling pre-season forecasting (the 50% probability estimate) is highly uncertain and is best used to indicate potential low, average, or high returns. The actual calculations are computed in log space.



In log space...



Preseason vs post season TR							
Year	Est. p50 TR	Actual TR	Raw Error	%Raw Error	Absolute Error	Absolute % Error	
2005	1534000	1032000	-502000	-48.6%	502000	48.6%	
2006	1850000	3034475	1184475	39.0%	1184475	39.0%	
2007	2495923	2152162	-343761	-16.0%	343761	16.0%	
2008	1279285	2166000	886715	40.9%	886715	40.9%	
2009	2000000	994000	-1006000	-101.2%	1006000	101.2%	
2010	663450	964000	300550	31.2%	300550	31.2%	
2011	1669697	1931275	261578	13.5%	261578	13.5%	
2012	1443483	2260350	816867	36.1%	816867	36.1%	
2013	685283	480087	-205196	-42.7%	205196	42.7%	
2014	2255671	3274851	1019180	31.1%	1019180	31.1%	
2015	3485358	2146295	-1339063	-62.4%	1339063	62.4%	
2016	1281546	1697838	416292	24.5%	416292	24.5%	
2017	594678	1054111	459433	43.6%	459433	43.6%	
2018	645112	1775394	1130282	63.7%	1130282	63.7%	
2019	1713846	617616	-1096230	-177.5%	1096230	177.5%	
	MAPE					51.5%	
	MAA					48.5%	

Actual TR vs Forecast TR %Error

Year	%Error
2005	-48.6%
2006	39.0%
2007	-16.0%
2008	40.9%
2009	-101.2%
2010	31.2%
2011	13.5%
2012	36.1%
2013	-42.7%
2014	31.1%
2015	-62.4%
2016	24.5%
2017	43.6%
2018	63.7%
2019	-177.5%

Appendix Figure 1. Pre-season p50 Total Return forecasts for Skeena sockeye (second column) vs actual Total Returns (third column) calculated post-season: 2005-2019. The Mean Absolute Percent error (MAPE) is about 51%; however, the actual retrun typical falls with the forecast range of error provided pre-season.