

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILE 8672
1829 SCOMM 74: SEN. SPEC. COMM. ON DOMESTIC & INTL. FISH., 1991-92. *6/6*

102	1.86878	1.21355	1.09023	2.45854	1.49380
103	1.82586	1.20151	1.07941	2.42907	1.47463
104	1.86854	1.21348	1.09017	2.45837	1.49369
105	1.90983	1.22506	1.07057	2.48673	1.51213
106	1.95484	1.23769	1.11191	2.51764	1.53224

CASE 3 -- SALMON ENHANCEMENT PROGRAM IS ELIMINATED

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37529	1.20448	1.18535	1.26130	0.94985
94	1.33757	1.17569	1.15320	1.22529	0.92370
95	1.41029	1.23119	1.21520	1.29472	0.97413
96	1.48124	1.28534	1.27569	1.36244	1.02333
97	1.62979	1.39871	1.40234	1.50425	1.12635
98	1.71768	1.47343	1.48581	1.59770	1.19424
99	1.77755	1.51148	1.52832	1.64530	1.22882
100	1.82675	1.54903	1.57027	1.69227	1.26294
101	1.85131	1.56778	1.59121	1.71572	1.27998
102	1.90895	1.61177	1.64035	1.77074	1.31995
103	1.96692	1.65601	1.68978	1.82608	1.36015
104	2.02623	1.70128	1.74035	1.88270	1.40128
105	2.07731	1.74026	1.78389	1.93146	1.43670
106	2.13953	1.78775	1.83694	1.99086	1.47985

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26133	0.23276	0.25250	0.27303	0.26814
94	0.27137	0.24049	0.26222	0.28295	0.27614
95	0.38941	0.33141	0.37645	0.39948	0.37021
96	0.41403	0.35037	0.40027	0.42379	0.38982
97	0.48671	0.40635	0.47060	0.49554	0.44774
98	0.51052	0.42469	0.49364	0.51905	0.46672
99	0.52624	0.43680	0.50886	0.53456	0.47924
100	0.53877	0.44645	0.52099	0.54694	0.48923
101	0.54737	0.45307	0.52930	0.55542	0.49608
102	0.55905	0.46207	0.54061	0.56696	0.50539
103	0.56213	0.46444	0.54359	0.56999	0.50784
104	0.57665	0.47562	0.55764	0.58433	0.51941
105	0.58662	0.48330	0.56728	0.59417	0.52736
106	0.60666	0.49874	0.58668	0.61396	0.54333

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.38845	0.40239	0.34760	0.45186	0.33069
94	0.39956	0.40952	0.35997	0.46335	0.33558
95	0.53024	0.49336	0.50542	0.59847	0.39304
96	0.55749	0.51085	0.53574	0.62664	0.40502
97	0.63795	0.56247	0.62529	0.70984	0.44040
98	0.66431	0.57938	0.65463	0.73709	0.45199
99	0.68172	0.59054	0.67400	0.75509	0.45964
100	0.69559	0.59945	0.68944	0.76943	0.46574
101	0.70511	0.60555	0.70003	0.77927	0.46993
102	0.71804	0.61385	0.71442	0.79264	0.47561
103	0.72145	0.61603	0.71822	0.79616	0.47711
104	0.73752	0.62635	0.73611	0.81279	0.48418
105	0.74856	0.63343	0.74839	0.82420	0.48903

106	0.77075	0.64767	0.77309	0.84714	0.49879
YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82395	0.63304	0.66631	1.09311	0.66270
94	0.80497	0.61961	0.65570	1.06476	0.64750
95	0.84156	0.64550	0.67616	1.11942	0.67680
96	0.87726	0.67075	0.69611	1.17274	0.70539
97	0.95201	0.72363	0.73790	1.28439	0.76525
98	1.00127	0.75848	0.76544	1.35797	0.80469
99	1.02636	0.77623	0.77947	1.39545	0.82479
100	1.05112	0.79374	0.79331	1.43243	0.84461
101	1.06348	0.80248	0.80022	1.45089	0.85451
102	1.09249	0.82300	0.81644	1.49422	0.87773
103	1.12166	0.84364	0.83274	1.53779	0.90109
104	1.15150	0.86475	0.84943	1.58236	0.92499
105	1.17720	0.88293	0.86380	1.62075	0.94557
106	1.20851	0.90508	0.88130	1.66752	0.97064

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59566	1.13694	1.02141	2.27097	1.37179
94	1.55952	1.12680	1.01231	2.24616	1.35565
95	1.62919	1.14635	1.02986	2.29401	1.38677
96	1.69716	1.16541	1.04699	2.34068	1.41713
97	1.83949	1.20533	1.08285	2.43843	1.48071
98	1.93328	1.23164	1.10648	2.50284	1.52261
99	1.98105	1.24504	1.11852	2.53564	1.54395
100	2.02819	1.25826	1.13040	2.56802	1.56501
101	2.05173	1.26486	1.13633	2.58418	1.57552
102	2.10695	1.28035	1.15024	2.62210	1.60019
103	2.16249	1.29593	1.16423	2.66025	1.62500
104	2.21931	1.31187	1.17855	2.69927	1.65038
105	2.26825	1.32559	1.19088	2.73288	1.67224
106	2.32786	1.34232	1.20590	2.77382	1.69887

CASE 4A -- SALMON PRODUCTION FROM ENHANCEMENT PROGRAM IS INCREASED BY 15%

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37639	1.20532	1.18630	1.26236	0.95062
94	1.33850	1.17640	1.15399	1.22619	0.92435
95	1.40331	1.22587	1.20925	1.28805	0.96929
96	1.44121	1.25479	1.24156	1.32423	0.99557
97	1.49531	1.29608	1.28769	1.37588	1.03309
98	1.54486	1.33390	1.32993	1.42318	1.06746
99	1.57654	1.35807	1.35694	1.45342	1.08942
100	1.60937	1.38313	1.38493	1.48476	1.11219
101	1.64187	1.40793	1.41264	1.51578	1.13473
102	1.68369	1.43985	1.44830	1.55571	1.16373
103	1.72695	1.47287	1.48518	1.59700	1.19373
104	1.77688	1.51098	1.52775	1.64467	1.22836
105	1.82103	1.54467	1.56539	1.68681	1.25897
106	1.86767	1.58027	1.60516	1.73134	1.29132

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26626	0.23655	0.25727	0.27790	0.27207
94	0.27726	0.24503	0.26792	0.28876	0.28083
95	0.23266	0.21068	0.22476	0.24473	0.24529
96	0.23852	0.21519	0.23043	0.25052	0.24596
97	0.23766	0.21453	0.22960	0.24967	0.24928
98	0.23265	0.21067	0.22475	0.24472	0.24528
99	0.23427	0.21191	0.22631	0.24632	0.24657
100	0.24182	0.21773	0.23362	0.25377	0.25259
101	0.26145	0.23285	0.25261	0.27315	0.26823
102	0.26054	0.23215	0.25174	0.27226	0.26751
103	0.25690	0.22934	0.24821	0.26866	0.26461
104	0.28501	0.25100	0.27542	0.29642	0.28701
105	0.30371	0.26540	0.29351	0.31487	0.30191
106	0.32020	0.27810	0.30947	0.33116	0.31505

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39391	0.40589	0.35368	0.45750	0.33310
94	0.40609	0.41371	0.36723	0.47010	0.33845
95	0.35671	0.38203	0.31228	0.41904	0.31674
96	0.36320	0.38619	0.31951	0.42575	0.31960
97	0.36225	0.38558	0.31844	0.42477	0.31918
98	0.35670	0.38202	0.31227	0.41903	0.31674
99	0.35849	0.38317	0.31426	0.42088	0.31752
100	0.36685	0.38853	0.32357	0.42953	0.32120
101	0.38858	0.40248	0.34775	0.45199	0.33075
102	0.38758	0.40183	0.34663	0.45096	0.33031
103	0.38354	0.39925	0.34215	0.44679	0.32854
104	0.41467	0.41921	0.37679	0.47897	0.34223
105	0.43537	0.43249	0.39982	0.50037	0.35133
106	0.45362	0.44421	0.42014	0.51925	0.35935

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82450	0.63343	0.66662	1.09394	0.66315
94	0.80544	0.61995	0.65596	1.06546	0.64788
95	0.83805	0.64301	0.67419	1.11417	0.67399
96	0.85712	0.65651	0.68486	1.14266	0.68926
97	0.88434	0.67576	0.70007	1.18332	0.71106
98	0.90928	0.69340	0.71401	1.22056	0.73103
99	0.92522	0.70468	0.72292	1.24437	0.74379
100	0.94174	0.71636	0.73216	1.26905	0.75702
101	0.95809	0.72793	0.74130	1.29348	0.77012
102	0.97914	0.74282	0.75307	1.32491	0.78697
103	1.00090	0.75822	0.76524	1.35742	0.80440
104	1.02603	0.77599	0.77928	1.39495	0.82452
105	1.04824	0.79170	0.79170	1.42813	0.84231
106	1.07172	0.80831	0.80482	1.46319	0.86110

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59672	1.13724	1.02168	2.27170	1.37226
94	1.56042	1.12705	1.01253	2.24677	1.35605
95	1.62251	1.14447	1.02818	2.28941	1.38378

96	1.65882	1.15466	1.03733	2.31435	1.40001
97	1.71065	1.16919	1.05038	2.34994	1.42316
98	1.75812	1.18251	1.06235	2.38255	1.44437
99	1.78847	1.19102	1.06999	2.40339	1.45792
100	1.81992	1.19984	1.07792	2.42499	1.47197
101	1.85106	1.20858	1.08576	2.44637	1.48588
102	1.89113	1.21982	1.09586	2.47389	1.50378
103	1.93258	1.23144	1.10630	2.50235	1.52230
104	1.98042	1.24486	1.11836	2.53521	1.54367
105	2.02271	1.25672	1.12901	2.56425	1.56256
106	2.06740	1.26926	1.14027	2.59494	1.58252

CASE 4B -- SALMON HARVEST FROM ENHANCMENT IS DECREASED BY 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37613	1.20512	1.18607	1.26210	0.95044
94	1.33827	1.17623	1.15380	1.22596	0.92419
95	1.40393	1.22634	1.20978	1.28864	0.96972
96	1.45096	1.26223	1.24987	1.33354	1.00233
97	1.52637	1.31979	1.31417	1.40553	1.05463
98	1.58707	1.36611	1.36592	1.46347	1.09672
99	1.62345	1.39388	1.39694	1.49820	1.12195
100	1.65789	1.42016	1.42630	1.53108	1.14584
101	1.68958	1.44435	1.45332	1.56133	1.16782
102	1.73148	1.47632	1.48904	1.60132	1.19687
103	1.78103	1.51414	1.53129	1.64862	1.23123
104	1.83095	1.55224	1.57385	1.69628	1.26585
105	1.87715	1.58750	1.61324	1.74038	1.29789
106	1.92786	1.62620	1.65647	1.78879	1.33306

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26547	0.23595	0.25651	0.27713	0.27144
94	0.27632	0.24431	0.26701	0.28784	0.28009
95	0.26027	0.23194	0.25148	0.27199	0.26730
96	0.26472	0.23537	0.25578	0.27638	0.27084
97	0.28560	0.25146	0.27599	0.29700	0.28748
98	0.28624	0.25194	0.27660	0.29762	0.28799
99	0.29216	0.25650	0.28233	0.30347	0.29270
100	0.30168	0.26383	0.29155	0.31287	0.30029
101	0.31746	0.27599	0.30682	0.32845	0.31287
102	0.31637	0.27515	0.30576	0.32737	0.31200
103	0.31389	0.27324	0.30336	0.32492	0.31002
104	0.31061	0.29382	0.32922	0.35130	0.33131
105	0.31979	0.30860	0.34779	0.37024	0.34660
106	0.31530	0.32054	0.36279	0.38555	0.35896

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39304	0.40534	0.35271	0.45660	0.33271
94	0.40505	0.41304	0.36608	0.46902	0.33799
95	0.38728	0.40164	0.34630	0.45065	0.33018
96	0.39220	0.40480	0.35178	0.45574	0.33235
97	0.41532	0.41963	0.37751	0.47965	0.34251

98	0.41602	0.42008	0.37829	0.48037	0.34282
99	0.42258	0.42429	0.38559	0.48715	0.34570
100	0.43312	0.43105	0.39732	0.49804	0.35034
101	0.45059	0.44226	0.41676	0.51611	0.35802
102	0.44938	0.44149	0.41542	0.51486	0.35749
103	0.44663	0.43972	0.41236	0.51202	0.35628
104	0.47621	0.45870	0.44528	0.54260	0.36929
105	0.49745	0.47233	0.46892	0.56457	0.37862
106	0.51462	0.48334	0.48803	0.58232	0.38617

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPD
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82437	0.63334	0.66655	1.09374	0.66304
94	0.80532	0.61986	0.65590	1.06529	0.64778
95	0.83836	0.64323	0.67437	1.11464	0.67424
96	0.86203	0.65998	0.68760	1.14999	0.69319
97	0.89997	0.68682	0.70881	1.20667	0.72358
98	0.93052	0.70842	0.72589	1.25229	0.74803
99	0.94882	0.72137	0.73612	1.27963	0.76269
100	0.96616	0.73364	0.74581	1.30552	0.77657
101	0.98210	0.74491	0.75472	1.32933	0.78934
102	1.00318	0.75983	0.76651	1.36083	0.80622
103	1.02812	0.77747	0.78045	1.39807	0.82619
104	1.05324	0.79524	0.79449	1.43559	0.84630
105	1.07648	0.81168	0.80749	1.47031	0.86492
106	1.10200	0.82973	0.82175	1.50843	0.88535

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59646	1.13716	1.02161	2.27153	1.37215
94	1.56019	1.12699	1.01248	2.24662	1.35595
95	1.62310	1.14464	1.02833	2.28982	1.38405
96	1.66816	1.15727	1.03968	2.32076	1.40418
97	1.74041	1.17754	1.05788	2.37038	1.43645
98	1.79856	1.19385	1.07254	2.41032	1.46243
99	1.83341	1.20363	1.08132	2.43425	1.47800
100	1.86642	1.21288	1.08963	2.45692	1.49274
101	1.89677	1.22140	1.09728	2.47777	1.50630
102	1.93692	1.23266	1.10740	2.50533	1.52423
103	1.98439	1.24597	1.11936	2.53794	1.54544
104	2.03222	1.25939	1.13141	2.57078	1.56681
105	2.07648	1.27181	1.14256	2.60118	1.58658
106	2.12506	1.28543	1.15480	2.63455	1.60828

CASE 5 -- PINK SALMON ENHANCEMENT PROGRAM IS ELIMINATED

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37613	1.20512	1.18608	1.26211	0.95044
94	1.33829	1.17624	1.15381	1.22598	0.92419
95	1.41108	1.23179	1.21587	1.29547	0.97468
96	1.45144	1.26260	1.25028	1.33400	1.00267
97	1.51564	1.31159	1.30502	1.39528	1.04719
98	1.57372	1.35592	1.35453	1.45072	1.08746
99	1.60732	1.38156	1.38318	1.48280	1.11077
100	1.64219	1.40818	1.41291	1.51609	1.13495
101	1.67526	1.43341	1.44111	1.54765	1.15788

102	1.72102	1.46834	1.48013	1.59135	1.18962
103	1.76771	1.50398	1.51993	1.63591	1.22200
104	1.81922	1.54329	1.56385	1.68508	1.25772
105	1.86645	1.57934	1.60412	1.73018	1.29048
106	1.92216	1.62185	1.65161	1.78335	1.32911

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26136	0.23278	0.25253	0.27306	0.26816
94	0.27140	0.24052	0.26225	0.28298	0.27617
95	0.38945	0.33144	0.37649	0.39952	0.37024
96	0.41363	0.35006	0.39988	0.42339	0.38950
97	0.42511	0.35890	0.41099	0.43472	0.39365
98	0.43010	0.36275	0.41582	0.43965	0.40263
99	0.43723	0.36824	0.42272	0.44669	0.40831
100	0.44733	0.37602	0.43250	0.45667	0.41636
101	0.45543	0.38226	0.44034	0.46466	0.42282
102	0.46705	0.39121	0.45158	0.47613	0.43207
103	0.47019	0.39363	0.45462	0.47923	0.43458
104	0.48479	0.40487	0.46875	0.49364	0.44621
105	0.49496	0.41271	0.47859	0.50369	0.45432
106	0.51511	0.42823	0.49809	0.52358	0.47038

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.392013	0.404683	0.351578	0.45555	0.332263
94	0.40383	0.412258	0.364723	0.467763	0.33746
95	0.41881	0.42187	0.381395	0.48325	0.344048
96	0.429438	0.42869	0.393223	0.494243	0.348723
97	0.441105	0.436175	0.406208	0.506303	0.353848
98	0.440888	0.43604	0.405968	0.50608	0.353755
99	0.446868	0.439873	0.412628	0.51226	0.356388
100	0.457118	0.44645	0.424028	0.522855	0.360885
101	0.47208	0.45605	0.44069	0.538335	0.367468
102	0.475858	0.458473	0.444883	0.542235	0.369128
103	0.474793	0.457785	0.443698	0.541133	0.368663
104	0.50056	0.47432	0.472375	0.567773	0.379988
105	0.519568	0.486513	0.49353	0.587433	0.38835
106	0.538525	0.498678	0.514633	0.607028	0.396683

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82437	0.63334	0.66655	1.09375	0.66304
94	0.80533	0.61987	0.65590	1.06530	0.64779
95	0.84196	0.64578	0.67638	1.12001	0.67712
96	0.86227	0.66015	0.68773	1.15035	0.69339
97	0.89457	0.68300	0.70579	1.19860	0.71925
98	0.92380	0.70367	0.72213	1.24225	0.74265
99	0.94071	0.71563	0.73158	1.26751	0.75619
100	0.95825	0.72804	0.74139	1.29371	0.77024
101	0.97489	0.73982	0.75069	1.31857	0.78357
102	0.99792	0.75611	0.76357	1.35297	0.80201
103	1.02141	0.77273	0.77670	1.38806	0.82082
104	1.04733	0.79106	0.79119	1.42677	0.84158
105	1.07110	0.80787	0.80448	1.46228	0.86061
106	1.09913	0.82770	0.82015	1.50414	0.88306

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59647	1.13717	1.02161	2.27153	1.37215
94	1.56021	1.12700	1.01248	2.24663	1.35595
95	1.62995	1.14656	1.03005	2.29452	1.38711
96	1.66862	1.15740	1.03980	2.32108	1.40438
97	1.73012	1.17466	1.05529	2.36332	1.43186
98	1.78577	1.19026	1.06931	2.40153	1.45671
99	1.81796	1.19929	1.07742	2.42364	1.47110
100	1.85137	1.20866	1.08584	2.44658	1.48602
101	1.88305	1.21755	1.09382	2.46834	1.50017
102	1.92690	1.22985	1.10487	2.49846	1.51976
103	1.97163	1.24240	1.11614	2.52917	1.53974
104	2.02098	1.25624	1.12858	2.56306	1.56178
105	2.06623	1.26893	1.13998	2.59414	1.58200
106	2.11960	1.28390	1.15343	2.63080	1.60584

CASE 6 -- SOCKEYE SALMON ENHANCEMENT PROGRAM IS ELIMINATED

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.31900	1.16152	1.13736	1.20757	0.91082
93	1.39366	1.21850	1.20102	1.27884	0.96260
94	1.36540	1.19693	1.17692	1.25186	0.94300
95	1.43587	1.25072	1.23701	1.31914	0.99187
96	1.49413	1.29518	1.28668	1.37475	1.03227
97	1.58648	1.36566	1.36542	1.46291	1.09632
98	1.66728	1.42733	1.43431	1.54004	1.15235
99	1.70029	1.45252	1.46245	1.57155	1.17524
100	1.74431	1.48611	1.49998	1.61357	1.20577
101	1.76693	1.50338	1.51926	1.63517	1.22146
102	1.82020	1.54404	1.56469	1.68602	1.25840
103	1.87327	1.58454	1.60993	1.73668	1.29520
104	1.92519	1.62417	1.65420	1.78625	1.33121
105	1.97229	1.66012	1.69436	1.83121	1.36388
106	2.02096	1.69726	1.73585	1.87767	1.39763

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27604	0.24409	0.26673	0.28755	0.27986
93	0.26623	0.23653	0.25724	0.27787	0.27204
94	0.27742	0.24515	0.26808	0.28892	0.28096
95	0.25637	0.22894	0.24770	0.26814	0.26419
96	0.26157	0.23294	0.25273	0.27327	0.26833
97	0.27260	0.24144	0.26340	0.28416	0.27712
98	0.27146	0.24056	0.26231	0.28304	0.27621
99	0.27648	0.24443	0.26716	0.28799	0.28021
100	0.28566	0.25150	0.27604	0.29705	0.28753
101	0.30076	0.26313	0.29066	0.31196	0.29956
102	0.30150	0.26370	0.29138	0.31269	0.30015
103	0.29929	0.26199	0.28923	0.31051	0.29839
104	0.32547	0.28216	0.31457	0.33636	0.31925
105	0.34490	0.29713	0.33338	0.35554	0.33474
106	0.36090	0.30945	0.34885	0.37133	0.34748

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40473	0.41284	0.36573	0.46869	0.33786

93	0.39387	0.40587	0.35364	0.45747	0.33308
94	0.40627	0.41382	0.36743	0.47028	0.33853
95	0.38296	0.39887	0.34150	0.44618	0.32828
96	0.38871	0.40256	0.34790	0.45213	0.33081
97	0.40092	0.41039	0.36149	0.46476	0.33618
98	0.39967	0.40959	0.36009	0.46346	0.33563
99	0.40522	0.41315	0.36627	0.46920	0.33807
100	0.41538	0.41967	0.37758	0.47971	0.34254
101	0.43210	0.43040	0.39619	0.49699	0.34989
102	0.43292	0.43092	0.39710	0.49784	0.35025
103	0.43047	0.42935	0.39437	0.49531	0.34917
104	0.45946	0.44795	0.42664	0.52528	0.36192
105	0.48097	0.46175	0.45058	0.54752	0.37138
106	0.49867	0.47311	0.47028	0.56583	0.37916

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPD
92	0.789478	0.60865	0.647035	1.04162	0.6351
93	0.82662	0.63493	0.667805	1.09711	0.664843
94	0.808778	0.622305	0.65783	1.070448	0.65055
95	0.842363	0.646065	0.6766	1.120613	0.677443
96	0.86572	0.66259	0.68966	1.155505	0.696153
97	0.901458	0.687873	0.70964	1.208883	0.724768
98	0.93299	0.710175	0.72727	1.255975	0.750015
99	0.949495	0.72185	0.736493	1.280638	0.763233
100	0.967655	0.734698	0.746653	1.307763	0.777775
101	0.982845	0.745443	0.755143	1.330448	0.78994
102	1.00559	0.76153	0.767853	1.364413	0.808145
103	1.029545	0.778478	0.781245	1.400198	0.827328
104	1.05473	0.79629	0.795328	1.43781	0.8475
105	1.077943	0.812715	0.8083	1.472493	0.86609
106	1.10262	0.83017	0.822105	1.509355	0.88585

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.530023	1.118533	1.004873	2.2259	1.34243
93	1.60075	1.13837	1.022693	2.274473	1.374063
94	1.56677	1.128835	1.01413	2.251135	1.35889
95	1.630713	1.14677	1.030243	2.295053	1.387453
96	1.675193	1.15925	1.041453	2.325598	1.40732
97	1.743235	1.17833	1.058598	2.372318	1.437715
98	1.80326	1.195175	1.07372	2.413545	1.464533
99	1.834695	1.203985	1.081638	2.435133	1.478573
100	1.869275	1.213685	1.090353	2.458885	1.49402
101	1.89819	1.221798	1.097635	2.47874	1.506935
102	1.94149	1.23394	1.108545	2.50848	1.526278
103	1.987103	1.246738	1.120043	2.539808	1.546655
104	2.035053	1.260188	1.132125	2.57273	1.568073
105	2.07926	1.272583	1.143263	2.603083	1.58782
106	2.126248	1.285768	1.155103	2.635358	1.608808

CASE 7A -- PRODUCTION FROM PINK SALMON ENHANCEMENT IS INCREASED BY 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37627	1.20523	1.18620	1.26224	0.95054
94	1.33840	1.17632	1.15390	1.22608	0.92427
95	1.40320	1.22578	1.20915	1.28794	0.96921
96	1.44596	1.25842	1.24561	1.32877	0.99887

97	1.50970	1.30706	1.29995	1.38961	1.04307
98	1.56627	1.35024	1.34819	1.44362	1.08230
99	1.59883	1.37508	1.37594	1.47469	1.10488
100	1.63214	1.40051	1.40434	1.50649	1.12798
101	1.66502	1.42560	1.43238	1.53788	1.15078
102	1.70718	1.45778	1.46832	1.57813	1.18002
103	1.75283	1.49262	1.50725	1.62171	1.21168
104	1.80206	1.53019	1.54922	1.66871	1.24582
105	1.84743	1.56482	1.58790	1.71201	1.27728
106	1.89633	1.60214	1.62959	1.75870	1.31120

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26626	0.23655	0.25727	0.27790	0.27206
94	0.27726	0.24503	0.26791	0.28876	0.28083
95	0.23266	0.21067	0.22475	0.24473	0.24529
96	0.23859	0.21524	0.23050	0.25059	0.25002
97	0.24639	0.22125	0.23805	0.25829	0.25623
98	0.24431	0.21965	0.23603	0.25623	0.25457
99	0.24721	0.22188	0.23884	0.25910	0.25689
100	0.25514	0.22799	0.24651	0.26692	0.26321
101	0.27487	0.24319	0.26561	0.28641	0.27893
102	0.27391	0.24244	0.26467	0.28545	0.27816
103	0.27026	0.23963	0.26114	0.28185	0.27525
104	0.29834	0.26127	0.28832	0.30958	0.29763
105	0.31700	0.27564	0.30637	0.32799	0.31250
106	0.33347	0.28832	0.32231	0.34425	0.32562

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.393368	0.405553	0.353085	0.456953	0.332858
94	0.40545	0.413295	0.366525	0.469438	0.338173
95	0.375415	0.39403	0.3331	0.438383	0.324968
96	0.380995	0.39761	0.339308	0.444153	0.327423
97	0.391643	0.40444	0.35116	0.45516	0.332098
98	0.38947	0.40305	0.34874	0.452915	0.331148
99	0.394278	0.406133	0.354098	0.457885	0.333263
100	0.403928	0.412325	0.364828	0.467855	0.337498
101	0.422108	0.423988	0.385073	0.486665	0.345495
102	0.422403	0.424175	0.38539	0.486965	0.345625
103	0.419458	0.422283	0.382115	0.48392	0.344333
104	0.44896	0.441213	0.414945	0.51442	0.357298
105	0.470315	0.454913	0.438713	0.536505	0.366693
106	0.488253	0.466425	0.45868	0.555048	0.374578

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82444	0.63339	0.66659	1.09385	0.66310
94	0.80538	0.61991	0.65593	1.06538	0.64784
95	0.83799	0.64297	0.67416	1.11409	0.67395
96	0.85951	0.65820	0.68619	1.14623	0.69118
97	0.89158	0.68088	0.70412	1.19413	0.71686
98	0.92005	0.70102	0.72004	1.23666	0.73966
99	0.93642	0.71261	0.72919	1.26112	0.75277
100	0.95319	0.72447	0.73856	1.28616	0.76619
101	0.96974	0.73617	0.74781	1.31087	0.77944
102	0.99095	0.75118	0.75967	1.34256	0.79643

103	1.01393	0.76743	0.77252	1.37687	0.81483
104	1.03870	0.78495	0.78637	1.41388	0.83466
105	1.06153	0.80110	0.79913	1.44797	0.85294
106	1.08614	0.81851	0.81289	1.48473	0.87265

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22722	1.34073
93	1.59660	1.13720	1.02165	2.27162	1.37221
94	1.56031	1.12703	1.01251	2.24670	1.35600
95	1.62240	1.14444	1.02815	2.28934	1.38373
96	1.66337	1.15593	1.03847	2.31748	1.40204
97	1.72443	1.17306	1.05386	2.35941	1.42932
98	1.77864	1.18826	1.06752	2.39663	1.45353
99	1.80982	1.19701	1.07537	2.41805	1.46746
100	1.84174	1.20596	1.08342	2.43997	1.48172
101	1.87324	1.21480	1.09135	2.46160	1.49579
102	1.91363	1.22613	1.10153	2.48934	1.51383
103	1.95737	1.23840	1.11255	2.51938	1.53337
104	2.00454	1.25163	1.12444	2.55178	1.55444
105	2.04800	1.26382	1.13539	2.58163	1.57386
106	2.09486	1.27696	1.14719	2.61380	1.59479

CASE 7B -- PRODUCTION FROM PINK ENHANCEMENT IS DECREASED BY 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37624	1.20520	1.18616	1.26220	0.95051
94	1.33837	1.17630	1.15388	1.22606	0.92425
95	1.40465	1.22688	1.21039	1.28932	0.97021
96	1.44688	1.25912	1.24640	1.32965	0.99951
97	1.51085	1.30794	1.30094	1.39071	1.04387
98	1.56753	1.35120	1.34926	1.44482	1.08318
99	1.60044	1.37631	1.37732	1.47623	1.10600
100	1.63405	1.40197	1.40598	1.50832	1.12931
101	1.66660	1.42681	1.43373	1.53939	1.15188
102	1.70944	1.45950	1.47025	1.58029	1.18159
103	1.75538	1.49456	1.50942	1.62414	1.21345
104	1.80523	1.53261	1.55192	1.67173	1.24802
105	1.85122	1.56771	1.59113	1.71563	1.27991
106	1.90043	1.60527	1.63309	1.76261	1.31404

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26498	0.23557	0.25603	0.27664	0.27105
94	0.27573	0.24385	0.26644	0.28725	0.27961
95	0.27722	0.24500	0.26788	0.28872	0.28080
96	0.28341	0.24976	0.27387	0.29483	0.28573
97	0.29401	0.25793	0.28412	0.30529	0.29418
98	0.29205	0.25642	0.28223	0.30336	0.29262
99	0.29793	0.26095	0.28792	0.30917	0.29731
100	0.30757	0.26837	0.29725	0.31868	0.30499
101	0.31943	0.27750	0.30872	0.33039	0.31443
102	0.32140	0.27903	0.31063	0.33234	0.31601
103	0.32020	0.27810	0.30947	0.33116	0.31506

104	0.34638	0.29827	0.33481	0.35700	0.33592
105	0.36511	0.31269	0.35293	0.37549	0.35084
106	0.37888	0.32330	0.36626	0.38909	0.36182

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.393015	0.405325	0.352693	0.456585	0.332703
94	0.405028	0.413025	0.366055	0.469	0.337988
95	0.387748	0.401943	0.346825	0.451135	0.33039
96	0.393398	0.405568	0.353113	0.456978	0.332875
97	0.40482	0.412895	0.365828	0.468785	0.337893
98	0.40268	0.411528	0.363445	0.466575	0.336958
99	0.408315	0.415138	0.36972	0.4724	0.339435
100	0.418438	0.421633	0.380978	0.48286	0.343878
101	0.434438	0.431898	0.398795	0.499415	0.350915
102	0.435548	0.43261	0.40002	0.500558	0.351405
103	0.433283	0.431153	0.397498	0.498213	0.35041
104	0.462255	0.449743	0.429743	0.528165	0.363145
105	0.48363	0.463455	0.453533	0.550273	0.372548
106	0.500823	0.47449	0.47267	0.568045	0.380105

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82442	0.63338	0.66658	1.09382	0.66308
94	0.80537	0.61990	0.65592	1.06536	0.64782
95	0.83872	0.64349	0.67457	1.11518	0.67453
96	0.85998	0.65852	0.68645	1.14692	0.69155
97	0.89216	0.68129	0.70445	1.19500	0.71732
98	0.92069	0.70147	0.72039	1.23760	0.74016
99	0.93724	0.71318	0.72965	1.26234	0.75342
100	0.95416	0.72515	0.73910	1.28760	0.76697
101	0.97054	0.73674	0.74826	1.31207	0.78008
102	0.99209	0.75198	0.76031	1.34426	0.79734
103	1.01521	0.76834	0.77323	1.37879	0.81585
104	1.04029	0.78608	0.78726	1.41626	0.83594
105	1.06344	0.80245	0.80020	1.45083	0.85447
106	1.08820	0.81997	0.81404	1.48781	0.87430

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59657	1.13719	1.02164	2.27160	1.37220
94	1.56028	1.12702	1.01250	2.24668	1.35599
95	1.62378	1.14483	1.02850	2.29029	1.38436
96	1.66425	1.15618	1.03869	2.31808	1.40243
97	1.72554	1.17337	1.05414	2.36017	1.42981
98	1.77984	1.18860	1.06782	2.39747	1.45407
99	1.81137	1.19744	1.07576	2.41912	1.46815
100	1.84358	1.20648	1.08388	2.44123	1.48254
101	1.87476	1.21523	1.09174	2.46265	1.49647
102	1.91580	1.22674	1.10208	2.49083	1.51480
103	1.95981	1.23908	1.11317	2.52106	1.53446
104	2.00757	1.25248	1.12520	2.55386	1.55580
105	2.05164	1.26484	1.13630	2.58412	1.57548
106	2.09879	1.27806	1.14818	2.61650	1.59654

CASE 8A -- SALMON PRODUCTION FROM SOCKEYE ENHANCEMENT IS INCREASED 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37627	1.20523	1.18620	1.26224	0.95054
94	1.33841	1.17633	1.15391	1.22609	0.92428
95	1.40390	1.22632	1.20975	1.28862	0.96970
96	1.44513	1.25778	1.24490	1.32797	0.99829
97	1.50006	1.29971	1.29174	1.38041	1.03639
98	1.55235	1.33962	1.33632	1.43033	1.07265
99	1.58423	1.36395	1.36350	1.46076	1.09476
100	1.61891	1.39041	1.39306	1.49386	1.11880
101	1.65147	1.41526	1.42083	1.52495	1.14139
102	1.69334	1.44722	1.45653	1.56492	1.17042
103	1.73726	1.48073	1.49397	1.60684	1.20088
104	1.78677	1.51852	1.53618	1.65411	1.23522
105	1.83255	1.55346	1.57521	1.69781	1.26696
106	1.87963	1.58939	1.61535	1.74275	1.29961

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26562	0.23606	0.25665	0.27727	0.27155
94	0.27650	0.24444	0.26718	0.28801	0.28022
95	0.25519	0.22803	0.24656	0.26697	0.26324
96	0.25990	0.23166	0.25112	0.27163	0.26700
97	0.26990	0.23936	0.26079	0.28149	0.27497
98	0.26779	0.23773	0.25875	0.27941	0.27328
99	0.27254	0.24139	0.26335	0.28410	0.27707
100	0.28153	0.24831	0.27205	0.29297	0.28423
101	0.29687	0.26013	0.28690	0.30812	0.29646
102	0.29754	0.26065	0.28755	0.30879	0.29700
103	0.29518	0.25883	0.28526	0.30646	0.29512
104	0.32135	0.27899	0.31059	0.33229	0.31597
105	0.34087	0.29402	0.32948	0.35156	0.33153
106	0.35696	0.30642	0.34505	0.36745	0.34435

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39320	0.40544	0.35289	0.45677	0.33278
94	0.40524	0.41316	0.36629	0.46922	0.33808
95	0.38165	0.39803	0.34004	0.44483	0.32771
96	0.38687	0.40138	0.34585	0.45023	0.33000
97	0.39793	0.40848	0.35816	0.46167	0.33487
98	0.39560	0.40698	0.35556	0.45925	0.33384
99	0.40086	0.41035	0.36141	0.46469	0.33615
100	0.41081	0.41674	0.37249	0.47498	0.34053
101	0.42780	0.42764	0.39140	0.49254	0.34800
102	0.42854	0.42811	0.39222	0.49331	0.34832
103	0.42593	0.42644	0.38932	0.49061	0.34717
104	0.45490	0.44502	0.42156	0.52057	0.35991
105	0.47651	0.45889	0.44561	0.54291	0.36941
106	0.49432	0.47032	0.46543	0.56132	0.37725

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.6072	0.64589	1.03856	0.63346
93	0.824433	0.633383	0.666583	1.093843	0.663093

94	0.805383	0.619903	0.65593	1.065375	0.647833
95	0.838343	0.643223	0.674353	1.114605	0.674223
96	0.859555	0.65823	0.686215	1.146298	0.691215
97	0.890585	0.68018	0.703563	1.192643	0.716063
98	0.918533	0.699948	0.719188	1.234383	0.738438
99	0.934895	0.711523	0.72833	1.25883	0.75154
100	0.95188	0.72354	0.737833	1.2842	0.765143
101	0.968323	0.735168	0.747023	1.308753	0.77831
102	0.98963	0.75024	0.75893	1.340575	0.795368
103	1.012435	0.766375	0.77168	1.374643	0.813628
104	1.037318	0.783973	0.785595	1.411803	0.833555
105	1.060363	0.80028	0.798473	1.446233	0.852013
106	1.08484	0.817593	0.812165	1.4828	0.871613

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.596585	1.1372	1.021643	2.271613	1.372203
94	1.560305	1.127023	1.012503	2.246695	1.356003
95	1.623055	1.144623	1.028313	2.289793	1.384033
96	1.663455	1.155958	1.038495	2.317535	1.402078
97	1.722535	1.172525	1.053383	2.358103	1.428468
98	1.775733	1.187453	1.066785	2.394643	1.452235
99	1.806895	1.196188	1.074633	2.41604	1.466155
100	1.839238	1.20526	1.082785	2.43826	1.480605
101	1.870538	1.21404	1.090668	2.459748	1.49458
102	1.911105	1.225418	1.10089	2.487613	1.512703
103	1.954525	1.2376	1.111835	2.517435	1.532103
104	2.001898	1.250888	1.12377	2.549963	1.553263
105	2.045788	1.263195	1.13483	2.580098	1.572868
106	2.092395	1.276273	1.146573	2.61211	1.593685

CASE 8B -- SALMON ENHANCEMENT FROM PINK DECREASED 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37624	1.20520	1.18616	1.26220	0.95051
94	1.33836	1.17629	1.15387	1.22605	0.92425
95	1.40386	1.22628	1.20971	1.28857	0.96967
96	1.44733	1.25946	1.24678	1.33008	0.99982
97	1.52184	1.31633	1.31030	1.40120	1.05149
98	1.58036	1.36099	1.36020	1.45706	1.09207
99	1.61373	1.38646	1.38865	1.48892	1.11522
100	1.64888	1.41329	1.41862	1.52248	1.13959
101	1.68001	1.43704	1.44516	1.55219	1.16118
102	1.72380	1.47046	1.48249	1.59399	1.19154
103	1.77111	1.50657	1.52284	1.63916	1.22436
104	1.82069	1.54441	1.56510	1.68649	1.25874
105	1.86666	1.57950	1.60430	1.73037	1.29062
106	1.91704	1.61795	1.64725	1.77847	1.32556

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26562	0.23606	0.25665	0.27727	0.27155
94	0.27649	0.24444	0.26718	0.28801	0.28022
95	0.25519	0.22803	0.24656	0.26697	0.26324
96	0.25996	0.23170	0.25117	0.27168	0.26704
97	0.27044	0.23977	0.26131	0.28203	0.27540

98	0.26867	0.23841	0.25961	0.28028	0.27399
99	0.27354	0.24216	0.26432	0.28509	0.27787
100	0.28256	0.24911	0.27304	0.29399	0.28505
101	0.29785	0.26089	0.28784	0.30909	0.29724
102	0.29852	0.26140	0.28849	0.30975	0.29778
103	0.29622	0.25963	0.28626	0.30748	0.29594
104	0.32239	0.27979	0.31159	0.33332	0.31680
105	0.34188	0.29480	0.33045	0.35256	0.33233
106	0.35800	0.30722	0.34605	0.36848	0.34518

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39319	0.40544	0.35289	0.45677	0.33278
94	0.40524	0.41316	0.36629	0.46922	0.33808
95	0.38165	0.39803	0.34004	0.44483	0.32771
96	0.38693	0.40142	0.34591	0.45029	0.33003
97	0.39853	0.40886	0.35883	0.46228	0.33513
98	0.39658	0.40761	0.35665	0.46026	0.33427
99	0.40197	0.41107	0.36265	0.46584	0.33664
100	0.41195	0.41747	0.37376	0.47616	0.34103
101	0.42888	0.42833	0.39260	0.49366	0.34847
102	0.42962	0.42881	0.39343	0.49443	0.34880
103	0.42707	0.42717	0.39059	0.49179	0.34768
104	0.45605	0.44576	0.42284	0.52175	0.36042
105	0.47762	0.45960	0.44685	0.54406	0.36991
106	0.49547	0.47106	0.46672	0.56252	0.37775

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.6072	0.64589	1.03856	0.63346
93	0.824428	0.63338	0.66658	1.093835	0.653088
94	0.805378	0.619898	0.655928	1.065365	0.647828
95	0.838335	0.643218	0.67435	1.114595	0.674218
96	0.859833	0.658425	0.68637	1.146713	0.691438
97	0.893325	0.68212	0.705095	1.196735	0.718255
98	0.922055	0.70244	0.721158	1.239643	0.741258
99	0.938605	0.714148	0.730405	1.261373	0.754513
100	0.95565	0.726208	0.739943	1.289833	0.768163
101	0.97191	0.737708	0.74903	1.314115	0.781183
102	0.993463	0.75295	0.761073	1.346298	0.798435
103	1.016695	0.769388	0.77406	1.381005	0.817038
104	1.041583	0.78699	0.78798	1.418175	0.836973
105	1.064655	0.803315	0.800873	1.452643	0.855448
106	1.089548	0.820923	0.814795	1.48983	0.87538

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.596575	1.137198	1.02164	2.271608	1.3722
94	1.560295	1.12702	1.0125	2.246688	1.355998
95	1.623045	1.14462	1.02831	2.289785	1.384028
96	1.663983	1.156105	1.038628	2.3179	1.402315
97	1.727753	1.173988	1.054698	2.361685	1.430798
98	1.78244	1.189335	1.068475	2.399248	1.455233
99	1.813963	1.19817	1.076413	2.420893	1.46931
100	1.846418	1.207273	1.084595	2.44319	1.483813
101	1.877373	1.215958	1.09239	2.464443	1.497635
102	1.9184	1.227463	1.102728	2.492623	1.515963
103	1.962635	1.239875	1.11388	2.523003	1.535725

104	2.010023	1.253183	1.125818	2.55534	1.558893
105	2.053958	1.265488	1.136888	2.585703	1.576518
106	2.101358	1.278788	1.14883	2.618265	1.597688

CASE 9A -- CHUM SALMON HARVEST FROM ENHANCEMENT INCREASED BY 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37625	1.20521	1.18618	1.26222	0.95053
94	1.33838	1.17631	1.15389	1.22607	0.92426
95	1.40388	1.22630	1.20973	1.28859	0.96968
96	1.44636	1.25872	1.24595	1.32915	0.99914
97	1.51011	1.30737	1.30030	1.39000	1.04335
98	1.56681	1.35065	1.34865	1.44413	1.08268
99	1.59958	1.37566	1.37658	1.47541	1.10540
100	1.63302	1.40118	1.40510	1.50734	1.12859
101	1.66570	1.42612	1.43296	1.53853	1.15125
102	1.70821	1.45856	1.46920	1.57911	1.18074
103	1.75400	1.49352	1.50825	1.62283	1.21249
104	1.80335	1.53117	1.55031	1.66993	1.24671
105	1.84911	1.56610	1.58934	1.71362	1.27845
106	1.89823	1.60359	1.63121	1.76051	1.31251

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26562	0.23606	0.25665	0.27727	0.27155
94	0.27649	0.24444	0.26718	0.28801	0.28022
95	0.25519	0.22803	0.24656	0.26697	0.26324
96	0.25993	0.23168	0.25115	0.27166	0.26703
97	0.268053	0.237935	0.259008	0.279678	0.273498
98	0.265485	0.235958	0.256518	0.277133	0.271448
99	0.27001	0.239443	0.2609	0.281603	0.275053
100	0.2789	0.24629	0.269503	0.29038	0.282138
101	0.294203	0.258078	0.284315	0.305485	0.294335
102	0.294883	0.258595	0.284965	0.30616	0.294873
103	0.29256	0.256813	0.282723	0.303863	0.293028
104	0.318733	0.276973	0.308045	0.329703	0.31388
105	0.338243	0.292	0.326933	0.34897	0.329428
106	0.354373	0.30442	0.342535	0.364885	0.342278

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39319	0.40544	0.35289	0.45677	0.33278
94	0.40524	0.41316	0.36629	0.46922	0.33808
95	0.38165	0.39803	0.34004	0.44483	0.32771
96	0.38690	0.40140	0.34588	0.45026	0.33002
97	0.38892	0.40270	0.34813	0.45235	0.33090
98	0.38390	0.39948	0.34254	0.44716	0.32870
99	0.38793	0.40206	0.34703	0.45133	0.33047
100	0.39750	0.40820	0.35768	0.46122	0.33468
101	0.41436	0.41901	0.37644	0.47865	0.34209
102	0.41513	0.41951	0.37731	0.47945	0.34243
103	0.41260	0.41789	0.37448	0.47683	0.34131
104	0.44157	0.43648	0.40673	0.50679	0.35405
105	0.46321	0.45035	0.43081	0.52916	0.36357

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82443	0.63338	0.66658	1.09384	0.66309
94	0.80538	0.61990	0.65593	1.06537	0.64783
95	0.83834	0.64322	0.67435	1.11460	0.67422
96	0.85971	0.65834	0.68630	1.14653	0.69134
97	0.89179	0.68103	0.70424	1.19444	0.71702
98	0.92032	0.70121	0.72019	1.23706	0.73987
99	0.93681	0.71288	0.72941	1.26169	0.75308
100	0.95364	0.72478	0.73881	1.28683	0.76655
101	0.97008	0.73641	0.74801	1.31139	0.77972
102	0.99147	0.75155	0.75996	1.34334	0.79685
103	1.01452	0.76785	0.77285	1.37776	0.81530
104	1.03935	0.78541	0.78673	1.41484	0.83518
105	1.06238	0.80170	0.79960	1.44924	0.85362
106	1.08709	0.81919	0.81342	1.48616	0.87341

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59658	1.13720	1.02164	2.27161	1.37220
94	1.56030	1.12702	1.01250	2.24669	1.35600
95	1.62305	1.14462	1.02831	2.28979	1.38403
96	1.66375	1.15604	1.03857	2.31774	1.40221
97	1.72482	1.17317	1.05396	2.35968	1.42949
98	1.77915	1.18841	1.06765	2.39699	1.45376
99	1.81054	1.19721	1.07556	2.41855	1.46778
100	1.84259	1.20620	1.08363	2.44055	1.48210
101	1.87389	1.21498	1.09152	2.46205	1.49608
102	1.91462	1.22641	1.10178	2.49002	1.51428
103	1.95850	1.23871	1.11283	2.52016	1.53387
104	2.00577	1.25197	1.12475	2.55262	1.55499
105	2.04962	1.26427	1.13579	2.58274	1.57458
106	2.09668	1.27747	1.14765	2.61505	1.59560

CASE 9B -- CHUM SALMON HARVEST FROM ENHANCEMENT DECREASED 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37625	1.20521	1.18618	1.26222	0.95053
94	1.33838	1.17631	1.15389	1.22607	0.92426
95	1.40388	1.22630	1.20973	1.28859	0.96968
96	1.44636	1.25872	1.24595	1.32915	0.99914
97	1.51044	1.30762	1.30058	1.39031	1.04358
98	1.56694	1.35075	1.34876	1.44426	1.08277
99	1.59965	1.37572	1.37665	1.47548	1.10545
100	1.63312	1.40126	1.40518	1.50743	1.12866
101	1.66584	1.42623	1.43308	1.53867	1.15135
102	1.70834	1.45867	1.46932	1.57924	1.18083
103	1.75413	1.49361	1.50836	1.62295	1.21258
104	1.80363	1.53139	1.55056	1.67020	1.24691
105	1.84949	1.56639	1.58966	1.71399	1.27872
106	1.89873	1.60397	1.63164	1.76099	1.31286

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
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93	0.26562	0.23606	0.25665	0.27727	0.27155
94	0.27649	0.24444	0.26718	0.28801	0.28022
95	0.25519	0.22803	0.24656	0.26697	0.26324
96	0.25993	0.23168	0.25115	0.27166	0.26703
97	0.27226	0.241175	0.26308	0.28383	0.27685
98	0.271	0.240208	0.261853	0.282578	0.27584
99	0.276118	0.244145	0.26681	0.28763	0.279918
100	0.28517	0.25112	0.27557	0.29657	0.287135
101	0.300525	0.262948	0.290433	0.311728	0.299373
102	0.301188	0.263453	0.291068	0.312388	0.299898
103	0.298848	0.261655	0.288808	0.31007	0.298038
104	0.325018	0.281813	0.314128	0.335908	0.318888
105	0.34451	0.296828	0.332998	0.355158	0.334423
106	0.360615	0.309228	0.348578	0.371048	0.347253

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33756
93	0.39319	0.40544	0.35289	0.45677	0.33278
94	0.40524	0.41316	0.36629	0.46922	0.33808
95	0.38165	0.39803	0.34004	0.44483	0.32771
96	0.38690	0.40140	0.34588	0.45026	0.33002
97	0.40755	0.41465	0.36887	0.47161	0.33910
98	0.40832	0.41514	0.36972	0.47241	0.33944
99	0.41497	0.41941	0.37712	0.47928	0.34236
100	0.42527	0.42602	0.38859	0.48993	0.34689
101	0.44236	0.43698	0.40760	0.50760	0.35440
102	0.44306	0.43743	0.40838	0.50832	0.35471
103	0.44044	0.43575	0.40546	0.50561	0.35355
104	0.46941	0.45433	0.43771	0.53556	0.36629
105	0.49096	0.46816	0.46169	0.55785	0.37577
106	0.50874	0.47957	0.48149	0.57624	0.38359

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82443	0.63338	0.66658	1.09384	0.66309
94	0.80538	0.61990	0.65593	1.06537	0.64783
95	0.83834	0.64322	0.67435	1.11460	0.67422
96	0.85971	0.65834	0.68630	1.14653	0.69134
97	0.89195	0.68115	0.70433	1.19469	0.71716
98	0.92039	0.70126	0.72022	1.23716	0.73993
99	0.93685	0.71290	0.72943	1.26175	0.75311
100	0.95369	0.72482	0.73884	1.28690	0.76659
101	0.97016	0.73646	0.74805	1.31149	0.77978
102	0.99154	0.75159	0.76000	1.34344	0.79690
103	1.01458	0.76789	0.77288	1.37785	0.81535
104	1.03949	0.78551	0.78681	1.41506	0.83530
105	1.06257	0.80184	0.79971	1.44953	0.85378
106	1.08734	0.81936	0.81356	1.48654	0.87362

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59658	1.13720	1.02164	2.27161	1.37220
94	1.56030	1.12702	1.01250	2.24669	1.35600
95	1.62305	1.14462	1.02831	2.28979	1.38403
96	1.66375	1.15604	1.03857	2.31774	1.40221
97	1.72514	1.17326	1.05404	2.35990	1.42963

98	1.77928	1.18844	1.06768	2.39708	1.45382
99	1.81062	1.19723	1.07557	2.41860	1.46782
100	1.84268	1.20623	1.08365	2.44062	1.48214
101	1.87403	1.21502	1.09155	2.46215	1.49614
102	1.91475	1.22644	1.10181	2.49011	1.51433
103	1.95862	1.23875	1.11287	2.52024	1.53393
104	2.00604	1.25205	1.12482	2.55281	1.55511
105	2.04999	1.26437	1.13589	2.58299	1.57474
106	2.09716	1.27761	1.14777	2.61538	1.59582

CASE 10A -- SALMON ENHANCMENT FROM COHO HARVEST INCREASED 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.303588	1.149758	1.124225	1.192855	0.900128
93	1.37701	1.205793	1.186828	1.262945	0.951055
94	1.338073	1.176075	1.153628	1.225775	0.924048
95	1.404775	1.226983	1.210495	1.289445	0.970303
96	1.44568	1.258203	1.24537	1.3285	0.99867
97	1.509798	1.30713	1.300038	1.3897	1.043133
98	1.565343	1.349528	1.347393	1.442725	1.081655
99	1.599108	1.375298	1.376183	1.474963	1.105073
100	1.632025	1.400423	1.40425	1.506385	1.127905
101	1.664845	1.425465	1.43223	1.537718	1.15066
102	1.706485	1.457248	1.467738	1.577468	1.179543
103	1.753243	1.492935	1.507603	1.622108	1.211965
104	1.802373	1.530435	1.549485	1.669003	1.24604
105	1.847978	1.565233	1.588363	1.712538	1.277663
106	1.897258	1.602845	1.630385	1.759583	1.31184

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27576	0.24387	0.26646	0.28728	0.27964
93	0.26577	0.23617	0.25679	0.27741	0.27167
94	0.27650	0.24444	0.26718	0.28801	0.28023
95	0.25532	0.22813	0.24668	0.26710	0.26335
96	0.25996	0.23171	0.25118	0.27169	0.26705
97	0.27015	0.23955	0.26103	0.28174	0.27517
98	0.26809	0.23796	0.25904	0.27970	0.27352
99	0.27301	0.24175	0.26380	0.28456	0.27744
100	0.28194	0.24863	0.27244	0.29338	0.28456
101	0.29728	0.26044	0.28729	0.30852	0.29678
102	0.29784	0.26088	0.28783	0.30908	0.29723
103	0.29562	0.25917	0.28568	0.30688	0.29546
104	0.32177	0.27931	0.31099	0.33271	0.31630
105	0.34126	0.29432	0.32985	0.35194	0.33183
106	0.35738	0.30674	0.34545	0.36786	0.34468

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40442	0.41264	0.36536	0.46837	0.33772
93	0.39336	0.40554	0.35307	0.45694	0.33286
94	0.40524	0.41317	0.36630	0.46922	0.33808
95	0.38179	0.39812	0.34020	0.44498	0.32777
96	0.38694	0.40142	0.34592	0.45030	0.33003
97	0.39821	0.40866	0.35847	0.46195	0.33499
98	0.39593	0.40719	0.35593	0.45959	0.33398
99	0.40138	0.41069	0.36199	0.46523	0.33638
100	0.41126	0.41703	0.37300	0.47545	0.34073
101	0.42824	0.42792	0.39189	0.49300	0.34819

102	0.42887	0.42832	0.39259	0.49365	0.34847
103	0.42640	0.42674	0.38985	0.49110	0.34739
104	0.45536	0.44532	0.42208	0.52104	0.36012
105	0.47693	0.45916	0.44608	0.54334	0.36960
106	0.49478	0.47061	0.46595	0.56181	0.37745

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78919	0.60845	0.64688	1.04120	0.63487
93	0.82596	0.63446	0.66744	1.09612	0.66431
94	0.80476	0.61946	0.65558	1.06444	0.64733
95	0.84014	0.64449	0.67536	1.11729	0.67566
96	0.85834	0.65737	0.68554	1.14449	0.69024
97	0.89092	0.68041	0.70375	1.19314	0.71633
98	0.91726	0.69905	0.71848	1.232	0.73742
99	0.93582	0.71217	0.72885	1.26020	0.75228
100	0.95156	0.72331	0.73765	1.28372	0.76489
101	0.96826	0.73512	0.74699	1.30866	0.77826
102	0.98791	0.74903	0.75797	1.33802	0.79400
103	1.01290	0.76670	0.77194	1.37534	0.81401
104	1.03719	0.78388	0.78552	1.41161	0.83345
105	1.05981	0.79988	0.79817	1.44540	0.85157
106	1.08477	0.81754	0.81212	1.48269	0.87156

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.5278	1.11791	1.004315	2.224375	1.34148
93	1.59804	1.13761	1.02201	2.27261	1.372855
94	1.55971	1.126855	1.01235	2.246285	1.355735
95	1.624765	1.145105	1.028745	2.290965	1.384795
96	1.66245	1.155675	1.03824	2.316845	1.401625
97	1.724075	1.17296	1.05377	2.35916	1.429155
98	1.77627	1.1876	1.06692	2.39501	1.452475
99	1.809615	1.19695	1.07532	2.41791	1.46737
100	1.84063	1.20565	1.083135	2.439215	1.481225
101	1.87219	1.214505	1.091085	2.460885	1.49532
102	1.91126	1.22546	1.10093	2.48772	1.512775
103	1.956985	1.23829	1.112455	2.51912	1.5332
104	2.00378	1.251415	1.124245	2.551255	1.5541
105	2.047265	1.26361	1.1352	2.581115	1.57353
106	2.094585	1.276885	1.147125	2.613615	1.594665

CASE 10B -- SALMON ENHANCEMENT FROM COHO DECREASED 15 PERCENT.

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.37625	1.20521	1.18618	1.26222	0.95053
94	1.33838	1.17631	1.15389	1.22607	0.92426
95	1.40388	1.2263	1.20973	1.28859	0.96968
96	1.44726	1.259405	1.246718	1.330008	0.999765
97	1.511265	1.308253	1.30129	1.391103	1.044153
98	1.567885	1.351468	1.349558	1.445153	1.083418
99	1.600648	1.376473	1.377495	1.47643	1.10614
100	1.634125	1.402025	1.40604	1.508388	1.12936
101	1.666845	1.426993	1.433935	1.539625	1.152048
102	1.709373	1.459453	1.4702	1.580223	1.181545
103	1.755193	1.494425	1.509265	1.62397	1.213318
104	1.804648	1.53217	1.551425	1.671175	1.247618

105	1.850498	1.567155	1.590513	1.714943	1.27941
106	1.8997	1.60471	1.63247	1.761915	1.313533

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26562	0.23606	0.25665	0.27727	0.27155
94	0.27649	0.24444	0.26718	0.28801	0.28022
95	0.25519	0.22803	0.24656	0.26697	0.26324
96	0.25998	0.23171	0.25119	0.27170	0.26706
97	0.27025	0.23963	0.26114	0.28184	0.27525
98	0.26834	0.23816	0.25929	0.27996	0.27373
99	0.27317	0.24188	0.26396	0.28472	0.27757
100	0.28214	0.24879	0.27264	0.29358	0.28472
101	0.29746	0.26059	0.28747	0.30871	0.29693
102	0.29813	0.26110	0.28812	0.30937	0.29747
103	0.29580	0.25931	0.28586	0.30707	0.29561
104	0.32197	0.27947	0.31118	0.33290	0.31646
105	0.34147	0.29449	0.33006	0.35216	0.33200
106	0.35759	0.30690	0.34565	0.36806	0.34484

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39319	0.40544	0.35289	0.45677	0.33278
94	0.40524	0.41316	0.36629	0.46922	0.33808
95	0.38165	0.39803	0.34004	0.44483	0.32771
96	0.38695	0.40143	0.34594	0.45031	0.33004
97	0.39833	0.40873	0.35860	0.46207	0.33504
98	0.39621	0.40737	0.35624	0.45989	0.33411
99	0.40155	0.41080	0.36219	0.46541	0.33646
100	0.41149	0.41717	0.37324	0.47568	0.34083
101	0.42845	0.42806	0.39213	0.49322	0.34828
102	0.42919	0.42853	0.39295	0.49398	0.34861
103	0.42661	0.42688	0.39008	0.49132	0.34748
104	0.45558	0.44546	0.42232	0.52127	0.36021
105	0.47717	0.45931	0.44635	0.54360	0.36971
106	0.49501	0.47076	0.46620	0.56204	0.37755

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.60720	0.64589	1.03856	0.63346
93	0.82443	0.63338	0.66658	1.09384	0.66309
94	0.80538	0.61990	0.65593	1.06537	0.64783
95	0.83834	0.64322	0.67435	1.11460	0.67422
96	0.86152	0.65962	0.68731	1.14923	0.69279
97	0.89387	0.68250	0.70540	1.19756	0.71869
98	0.92238	0.70267	0.72134	1.24013	0.74152
99	0.93891	0.71437	0.73058	1.26483	0.75476
100	0.95579	0.72630	0.74001	1.29003	0.76827
101	0.97228	0.73797	0.74924	1.31467	0.78148
102	0.99372	0.75314	0.76122	1.34670	0.79865
103	1.01683	0.76948	0.77414	1.38121	0.81715
104	1.04177	0.78712	0.78808	1.41845	0.83712
105	1.06488	0.80347	0.80100	1.45298	0.85563
106	1.08969	0.82102	0.81487	1.49004	0.87550

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073

93	1.59658	1.1372	1.02164	2.27161	1.3722
94	1.5603	1.12702	1.0125	2.24669	1.356
95	1.62305	1.14462	1.02831	2.28979	1.38403
96	1.66461	1.15628	1.038788	2.31833	1.402595
97	1.725935	1.173478	1.05424	2.360438	1.429985
98	1.780175	1.1887	1.067903	2.397693	1.45422
99	1.811573	1.1975	1.07581	2.419253	1.468243
100	1.84364	1.206495	1.083895	2.441283	1.48257
101	1.87499	1.21529	1.09179	2.462808	1.49657
102	1.915738	1.226718	1.102058	2.490795	1.514773
103	1.959635	1.239035	1.113123	2.520945	1.536385
104	2.00702	1.252323	1.125063	2.553478	1.55555
105	2.050945	1.264543	1.136128	2.58364	1.575173
106	2.09809	1.27787	1.148008	2.61602	1.596228

CASE 11A -- SALMON PRODUCTION FROM CHINOOK ENHANCEMENT UP 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.376278	1.20523	1.186203	1.262245	0.950548
94	1.338403	1.176328	1.153908	1.22609	0.924275
95	1.403903	1.226318	1.20975	1.288613	0.969698
96	1.446375	1.258733	1.245963	1.329163	0.999153
97	1.51024	1.307468	1.300413	1.390123	1.04344
98	1.56614	1.350135	1.34807	1.443485	1.082208
99	1.598885	1.375128	1.375993	1.474748	1.104918
100	1.631933	1.400353	1.40417	1.506295	1.12784
101	1.664598	1.425275	1.43202	1.53748	1.150488
102	1.707195	1.45779	1.468343	1.578145	1.180035
103	1.752878	1.492658	1.50729	1.62176	1.21171
104	1.802503	1.530533	1.549598	1.669128	1.246133
105	1.848055	1.56529	1.58843	1.71261	1.277718
106	1.897223	1.60282	1.630358	1.75955	1.311815

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26562	0.23606	0.25665	0.27727	0.27156
94	0.27650	0.24444	0.26718	0.28801	0.28023
95	0.25519	0.22803	0.24656	0.26698	0.26325
96	0.25994	0.23169	0.25115	0.27166	0.26703
97	0.27015	0.23955	0.26104	0.28174	0.27517
98	0.26814	0.23800	0.25909	0.27975	0.27356
99	0.27293	0.24170	0.26373	0.28449	0.27738
100	0.28185	0.24856	0.27236	0.29329	0.28449
101	0.29716	0.26035	0.28717	0.30841	0.29669
102	0.29784	0.26088	0.28783	0.30908	0.29723
103	0.29550	0.25908	0.28557	0.30677	0.29537
104	0.32170	0.27926	0.31093	0.33264	0.31625
105	0.34118	0.29426	0.32978	0.35187	0.33177
106	0.35730	0.30668	0.34537	0.36778	0.34462

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39320	0.40544	0.35289	0.45677	0.33278
94	0.40524	0.41317	0.36629	0.46922	0.33808
95	0.38165	0.39803	0.34004	0.44483	0.32771

96	0.38691	0.40140	0.34589	0.45026	0.33002
97	0.39821	0.40866	0.35847	0.46196	0.33499
98	0.39598	0.40723	0.35599	0.45965	0.33401
99	0.40129	0.41063	0.36190	0.46514	0.33634
100	0.41116	0.41696	0.37288	0.47534	0.34068
101	0.42811	0.42784	0.39175	0.49287	0.34814
102	0.42887	0.42832	0.39259	0.49365	0.34847
103	0.42628	0.42667	0.38971	0.49098	0.34733
104	0.45529	0.44527	0.42199	0.52097	0.36008
105	0.47685	0.45911	0.44599	0.54326	0.36957
106	0.49469	0.47056	0.46585	0.56171	0.37741

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.6072	0.64589	1.03856	0.63346
93	0.824445	0.63339	0.666588	1.093858	0.6631
94	0.80539	0.619908	0.655935	1.065388	0.647838
95	0.83835	0.643228	0.674358	1.114618	0.67423
96	0.859718	0.658345	0.686305	1.14654	0.691345
97	0.891855	0.681078	0.704273	1.194538	0.717078
98	0.919988	0.700975	0.72	1.236555	0.739603
99	0.936465	0.712633	0.729208	1.261173	0.752798
100	0.953088	0.724395	0.73851	1.286005	0.766113
101	0.96953	0.736023	0.7477	1.310558	0.779278
102	0.990968	0.751188	0.759678	1.342573	0.796438
103	1.013955	0.767448	0.772528	1.376913	0.814845
104	1.038928	0.785113	0.786495	1.414208	0.834845
105	1.061843	0.801328	0.7993	1.448445	0.853198
106	1.086583	0.818828	0.813138	1.485403	0.873008

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59668	1.13723	1.02167	2.27168	1.37225
94	1.56038	1.12704	1.01252	2.24675	1.35603
95	1.62314	1.14465	1.02834	2.28985	1.38407
96	1.66381	1.15605	1.03858	2.31778	1.40223
97	1.86	1.17318	1.05397	2.35970	1.42951
98	38	1.18763	1.06695	2.39509	1.45252
99	30	1.19644	1.07486	2.41666	1.46656
100	27	1.20499	1.08254	2.43759	1.48017
101	947	1.21374	1.09040	2.45901	1.49410
102	91056	1.22527	1.10076	2.48724	1.51246
103	1.95402	1.23746	1.11171	2.51708	1.53188
104	2.00216	1.25096	1.12384	2.55014	1.55338
105	2.04503	1.26298	1.13464	2.57958	1.57253
106	2.09213	1.27620	1.14651	2.61193	1.59357

CASE 11B -- SALMON PRODUCTION FROM CHINOOK PRODUCTION DECREASED 15 PERCENT

YR	PWRZ	CIRZ	KRZ	JRZ	AKORPZ
92	1.30271	1.14909	1.12348	1.19202	0.89952
93	1.376225	1.205193	1.186158	1.262195	0.95051
94	1.33836	1.176295	1.153873	1.22605	0.924245
95	1.403858	1.226283	1.20971	1.28857	0.969665
96	1.446345	1.258708	1.245938	1.329135	0.99913
97	1.510433	1.307615	1.300578	1.390308	1.043575
98	1.567453	1.351138	1.34919	1.444738	1.083118

99	1.600908	1.37667	1.377718	1.47668	1.10632
100	1.634155	1.402048	1.406065	1.508415	1.12938
101	1.666953	1.427073	1.434028	1.539728	1.15212
102	1.708998	1.459165	1.46988	1.579865	1.181285
103	1.755285	1.494495	1.509343	1.624058	1.21338
104	1.804693	1.532205	1.551463	1.671218	1.24765
105	1.850528	1.567178	1.590538	1.71497	1.27943
106	1.899728	1.60473	1.63249	1.76194	1.313553

YR	PWPZ	CIPZ	KPZ	JPZ	AKOPPZ
92	0.27563	0.24377	0.26634	0.28715	0.27953
93	0.26561	0.23606	0.25665	0.27726	0.27155
94	0.27649	0.24443	0.26717	0.28800	0.28022
95	0.25518	0.22802	0.24655	0.26697	0.26324
96	0.25993	0.23168	0.25115	0.27165	0.26702
97	0.27017	0.23957	0.26106	0.28177	0.27519
98	0.26832	0.23814	0.25927	0.27994	0.27371
99	0.27325	0.24194	0.26404	0.28481	0.27764
100	0.28223	0.24885	0.27272	0.29366	0.28479
101	0.29756	0.26067	0.28756	0.30881	0.29701
102	0.29817	0.26113	0.28815	0.30941	0.29750
103	0.29589	0.25937	0.28594	0.30715	0.29568
104	0.32206	0.27953	0.31127	0.33299	0.31653
105	0.34156	0.29455	0.33014	0.35224	0.33207
106	0.35767	0.30696	0.34573	0.36815	0.34491

YR	PWCZ	CICZ	KCZ	JCZ	AKOCPZ
92	0.40428	0.41255	0.36522	0.46822	0.33766
93	0.39319	0.40543	0.35288	0.45676	0.33278
94	0.40523	0.41316	0.36628	0.46921	0.33808
95	0.38164	0.39803	0.34003	0.44482	0.32770
96	0.38690	0.40140	0.34588	0.45026	0.33001
97	0.39824	0.40867	0.35850	0.46198	0.33500
98	0.39619	0.40736	0.35622	0.45986	0.33410
99	0.40165	0.41086	0.36230	0.46551	0.33650
100	0.41158	0.41723	0.37335	0.47578	0.34087
101	0.42856	0.42813	0.39225	0.49333	0.34833
102	0.42923	0.42856	0.39300	0.49403	0.34863
103	0.42670	0.42694	0.39018	0.49141	0.34752
104	0.45568	0.44552	0.42243	0.52137	0.36026
105	0.47727	0.45938	0.44646	0.54369	0.36975
106	0.49510	0.47082	0.46631	0.56214	0.37759

YR	PWSZ	CISZ	KSZ	JSZ	AKOSPZ
92	0.78743	0.6072	0.64589	1.03856	0.63346
93	0.824405	0.633365	0.666565	1.0938	0.66307
94	0.805355	0.619885	0.655915	1.06534	0.64781
95	0.838315	0.6432	0.67434	1.114565	0.6742
96	0.859695	0.65833	0.686295	1.146505	0.691325
97	0.892035	0.681205	0.70437	1.194805	0.71722
98	0.920935	0.701645	0.72053	1.23797	0.74036
99	0.938135	0.713815	0.73014	1.26367	0.754135
100	0.954755	0.72557	0.73944	1.28849	0.767445
101	0.97131	0.73728	0.748695	1.313215	0.7807
102	0.99224	0.752085	0.76039	1.344475	0.797455
103	1.01578	0.76874	0.77355	1.37964	0.81631

104	1.040635	0.78632	0.78745	1.416765	0.836215
105	1.063705	0.80264	0.800345	1.451225	0.85469
106	1.088475	0.820165	0.814195	1.48823	0.874525

YR	PWKZ	CIKZ	KKZ	JKZ	AKOKPZ
92	1.52612	1.11744	1.00389	2.22322	1.34073
93	1.59648	1.13717	1.02162	2.27154	1.37216
94	1.56022	1.12700	1.01248	2.24664	1.35596
95	1.62296	1.14460	1.02829	2.28973	1.38399
96	1.66369	1.15602	1.03855	2.31770	1.40218
97	1.72560	1.17339	1.05415	2.36021	1.42984
98	1.78141	1.18904	1.06821	2.39854	1.45477
99	1.81555	1.19862	1.07682	2.42199	1.47002
100	1.84679	1.20738	1.08469	2.44344	1.48397
101	1.87849	1.21627	1.09268	2.46521	1.49814
102	1.91747	1.22720	1.10250	2.49198	1.51555
103	1.96325	1.24005	1.11403	2.52342	1.53600
104	2.01054	1.25331	1.12595	2.55590	1.55713
105	2.05450	1.26564	1.13702	2.58609	1.57676
106	2.10172	1.27889	1.14892	2.61852	1.59786



UNIVERSITY OF ALASKA FAIRBANKS

School of Management
Fairbanks, Alaska 99775-1070

DATE: April 29, 1992
TO: Ginny Fay
FROM: Mark L. Herrmann *MLH*
Department of Economics
Re. Statewide Salmon Grant

I am faxing you the short report on the salmon demand project. I will look forward to your comments. I am also sending you the longer version of the report. I have put it in Fed Express this morning. There may be a few errors in the longer report but it is just a draft. I am sending you the original (which is why it is not copied two-sided). I have a backup on disk.

The conference call for Monday 1:00 is fine. I'll try to contact you before then. When I am not in my office I am usually working at home at 455-9073.

Give me a call if you have any questions.

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

*DIVISION OF FISHERIES REHABILITATION,
ENHANCEMENT & DEVELOPMENT (FRED)*

WALTER J. HICKEL, GOVERNOR

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JUNEAU, ALASKA 99802-5526
PHONE: (907) 465-4160
FAX: (907) 465-4168

December 11, 1992

Ms. Molly McCammon
Legislative Hatchery Research
Group Coordinator
P.O. Box V
Room 510
State Capitol
Juneau, AK 99801-1182

Dear Ms. McCammon:

This provides further comments on, "A Benefit-Cost Analysis of the Alaska Salmon Hatchery Program," in reference to Ms. Ginny Fay's deadline for final input from the Fisheries Rehabilitation, Enhancement and Development (FRED) Division. These comments are divided into two areas: (1) General concerns with the completion of the study and policy implications, and (2) further technical comments provided to me by the division's economist, Mr. Jeff Hartman (enclosed).

I first want to state my high level of concern at the abbreviated review process that has been applied to the University of Alaska-Fairbanks (UAF) work products. This is one of the most complicated fisheries studies that the State of Alaska has ever commissioned, and has potentially large policy impacts. I realize your time constraints, however, our review of the draft study, and associated draft technical reports is simply not complete. We have been working hundreds of hours on reviewing an intermittent supply of related work products from UAF over the last three weeks, and are still identifying significant problems with the overall simulation models and documentation. Releasing the full study results before a complete review and correction of the work products have occurred could easily lead to a later retraction of some portion of the results, and seriously deteriorate the confidence of the fishery industry in this endeavor.

To illustrate the very real probability of this occurrence, I call to your attention a recent problem which Mr. Jeff Hartman identified in the simulation model that resulted in the cost-benefit analysis' (CBA) incorrect assumption that the enormous cost-recovery harvest of private sector enhancement groups occurs in and are subjected to the same harvesting costs of the common-property fishery. In the current simulation model, costs of harvesting the cost-recovery fish are first accounted for appropriately in the operators' budgets, and again inappropriately in the fishing cost model for the common-property fishery.

I do not know how much of a difference this structural error will make in the final results (because we do not have the models form), but that is not the problem. I cannot imagine explaining this assumption to the private nonprofit (PNP) operators, fishermen, or anyone in the fishing industry. Would you just say that instead of resimulating the results that some other conservative assumption was balancing the overstated costs somewhere else? This problem should be corrected by resimulating the results of the overall CBA cases, and not by the caveats of the study.

A second reason for citing this example is that it illustrates that the documentation for the simulation model (dated 18 November 1992) is not complete and not in a form that the RSA requires. The RSA explicitly requires a standard scientific report with a description of the methods and results. Nowhere in the documentation for the overall CBA, by Dr. John Boyce, do we see any algorithm of how the basic cost-benefit identities were estimated. Unlike the demand study, there is no listing of variables and no equations. Had these basic components been included, it would have been obvious when we first reviewed this manuscript that the producer surplus estimates for the common-property fishery inappropriately aggregated the cost-recovery and common-property harvests.

I do not support submission of the author's Recommendations Section in the simulation report. The recommendations in the report do not reflect a sound understanding of how the statewide fishery enhancement program is financed and how it currently operates. Terms such as privatization are used without any description of what the authors are explicitly suggesting. The comments on alternative investment strategies are offered without any supporting evidence. It is almost as though once the more time-consuming technical analysis was completed, the critical step of developing an explanatory report for the final, combined CBA was secondary to the process.

Aside from our best effort to comment on the report of the overall simulations by today, we still have additional questions on the technical manuscripts that are to be completed by 10 January 1993. We would like to be able to forward our editorial comments to the contractors.

Related to the above problem is the need for completing other parts of the RSAs. I have had our contract staff review the language on the requirement for a users manual for each of the simulation models in the system. My staff believes that the RSA is clear on the point that each analyst was to provide full SAS software with clear documentation that could be used by the State of Alaska for policy analysis. I see no transmittals to the authors that indicate they must fulfill these requirements. Particularly for the very complex demand models, this is essential. Without user-friendly simulation model software and equally clear documentation, we have no way of knowing whether the models could ever be updated or used again by other economists, as the authors may not be willing to update the models or simulations in the future.

The various fishing interest groups were promised the opportunity to review the entire legislative hatchery research study, including the results of the economic studies. I understand that the public review process has now been eliminated. I would encourage you to keep this commitment, if at all possible.

December 11, 1992

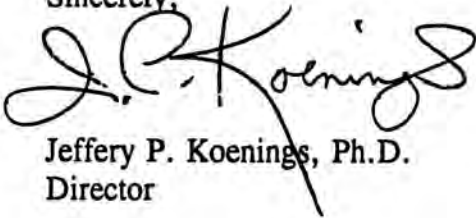
The FRED Division previously provided numerous written comments to Ms. Fay that were not summarized in her 25 November 1992 letter to Mark Herrmann and John Boyce. The 8 December 1992 phone conference with UAF staff helped answer a few of these questions. Many others remain unanswered and, as far as I and my staff are aware, these questions have not been transmitted to the authors.

This study can be narrowly viewed as a CBA of the enhancement program, and misconceptions of the results and conclusions could have far reaching impacts on Alaska's fisheries policy. For example, they may (1) impact government perception and support of all of Alaska's fisheries programs, (2) influence fishing and investment decisions of thousands of entry permit holders and their lenders, (3) impact salmon bycatch issues at a national level, and (4) impact Pacific Salmon Commissioner policies.

I clearly want to be on the record as encouraging you to not release any portion of the studies until our existing questions have been answered, problems in the models corrected, manuscripts rewritten, and final deliverables of the RSA clearly identified. The rewritten reports and materials then should be given a final error check before they are released.

If these steps require additional funds to complete, then we need to identify those funding requirements as quickly as possible. Alaska's fishery resources deserve nothing less.

Sincerely,



Jeffery P. Koenings, Ph.D.
Director

Enclosure

cc: Ginny Fay
Jeff Hartman
✓ Mary McDowell

TECHNICAL COMMENTS

The following comments on the UAF study entitled, "A Benefit-Cost Analysis of the Alaska Salmon Hatchery Program," were constructed following a three-hour phone conference between the UAF contractors, Ginny Fay, Kurt Schelle, Ben Muse, and Jeff Hartman. Ms. Fay stated that she needed to receive any further comments on the UAF economic studies by Thursday, 10 December 1992 in order to provide final comments to the contractors by 14 December 1992. The majority of these comments are new, but a few questions from a previous memo are repeated since they were never addressed.

1. It appears that the simulation model assumes that fishers in the common-property fishery are also incurring the cost of harvesting fish destined for harvest in the facility cost-recovery zones. I did not realize this until our last conference call and after verifying the outputs that Jeremy Collie supplied to John Boyce. This is a difficult model logic error to just explain away and probably warrants some additional simulations. It also implies that John Boyce included the fish ticket observations of the PNP operators in his cost models. In a cost-recovery harvest such as occurs in Prince William Sound, hundreds of thousands of salmon (instead of thousands of salmon) could be recorded in an observation. I have no idea what this did to John's fishing cost model, but it is clear that the overall simulation model results were negatively biased by this action. The fix for the overall simulation model problem is rather simple. Total revenue numbers used in the overall simulation model need to be stratified into the proportion that is not cost recovered (and subject to common-property harvesting costs) and the proportion (of total revenue) that is cost-recovered by species and region. The cost-recovery harvests are provided in the operators' surveys, and the operators' harvesting costs are already accounted for in the operators' cost data.
2. The equations and variables used for the overall CBA need to be listed in the manuscript prepared by the team. While these descriptions of how the present value of the benefits and costs are undoubtedly the simplest step in the analysis, it is an important one. I cannot determine if the data was used in the way intended without this sort of information. I might have detected the odd treatment of portion of the revenues attributed to the cost-recovery harvest sooner if this step had been taken.
3. The CBA manuscript includes results and conclusions but very little about the general methods used or where the data came from. The RSA calls for a report written in standard scientific format. To me this means methods, results, conclusions, and discussion of errors and biases. This report has a way to go before it will become a very finished document.
4. The sources for the production-related variables came from several sources which I have listed. These sources should be properly cited in the overall CBA documentation written by the UAF team. They include:
 - A. The original RFP explained that some simulations would be made with the assumption of a 10-, 15-, and 20-year mean background harvests of wild fish. The contractors requested the use of one background level of catches to achieve

their deadline. The report should note that the project manager released them from this prior obligation and set background catches for non-intensively modeled sites at the 10-year mean.

- B. Production numbers for juvenile releases at intensively modeled sites and adult returns at non-intensively modeled sites came from a survey administered by the Legislative Research Agency to the PNP operators.
- C. A similar survey was developed by the CBA project manager for ADF&G and FRED Division staff. Field and regional office staffs completed the surveys.
- D. Jeremy Collie applied the intensively modeled site releases to population/exploitation models to determine catches. The operators' estimates of adult harvest from the intensively modeled sites were not simulated in any of the cases.
- E. Mark Herrmann made determinations following interviews with other farmed salmon producers and agency people familiar with the wild and ranched production of other countries.

I do not believe the current document makes it clear on where each of the sets of production assumptions originated from. These will be important issues for the readers of this study, and the origin of the assumptions should be accurate and occur in one location in the report.

- 5. The manuscript does not describe that the basic intent of the CBA study is to look at the most global salmon production questions only; that is, it considers the entire salmon fishery and does not attempt to evaluate every project individually or multiple production levels. Some projects, undoubtedly, have higher or lower net benefits than others.
- 6. It is not clear from our 8 December 1992 telephone conference of whether Mark Herrmann will really provide the information necessary for us to operate the SAS program. The response letter from Mark Herrmann to Ginny Fay of 6 December 1992 apologizes for making an "extremely user unfriendly software package." I suggest that he provide the cleaned up software with as many explanatory statements in the code as possible, along with a users guide. Also, to truly operate the models, I believe that a demonstration of the steps required to edit all input files and run each of the modules of the model will be required.

Mark Herrmann also conveyed in our telephone conference that he would be making further changes in the model, including making the software operation less cumbersome. Since the RSA calls for a users manual and documentation that was intended for subsequent ADF&G CBA, I would like to have a copy of the improved software and documentation.

- 7. The project manager released the contractors from some of the requirements in the original RSA. These should be noted in an appendix of this report.

- Jeremy Collie was to carry out initial simulations in SAS.

- Collie did not have to write a final report, only a summary.
 - John Boyce did not have to carry out the simulations for the policy analysis in SAS, but did have to make the final model in SAS.
 - The UAF team was told that they could truncate the change in annual net present value at 15 years instead of estimating the model using the production data provided from 16 years to 30 years, as called for in the RFP.
8. Table 8. In the 8 December 1992 telephone conference, it was pointed out by Kurt Schelle that the simulations in Table 8 show that the king salmon program has positive net benefits if you increase or decrease production in comparison to the current program. No clear explanation was offered except to say that the differences were small and not significant. This may be the case, but readers of this manuscript will want to have answers to these types of questions. Some clear answer should be offered in the text.
 9. In the 8 December 1992 telephone conference, John Boyce presented a reason for keeping his recommendation of "privatizing" the program in his report. First, I would argue that policy recommendations of this type should be made after John spends more time learning about the financing of the PNP program. The 8 December 1992 telephone conference demonstrated that he was not aware of the extent of the enhancement program financing that currently comes from the fleets, as well as how fishermen decisions are translated into the decisions of the regional associations. Secondly, I am not sure that the subsidy-removing actions he refers to would achieve the option 5 result that the authors seem to feel most comfortable with. The pink salmon programs in the state are largely supported by cost recovery and, to a lesser extent, by loans. A complete elimination of the PNP loan program, as John implies, would first reduce production of the species which are difficult to cost recover in the existing fisheries. Much of the pink salmon production would initially be left in tact, in contrast to the UAF study results which imply that pink salmon production has the lowest net benefits.
 10. John Boyce states in the CBA documentation (page 5, single-spaced version), "...We assumed that the strength of the substitution effect between pink and chum salmon to be one quarter of the strength imposed in the model..." It was clarified in the 8 December 1992 telephone conference that the adjustments in the "strength" of the model were actually adjustments to the change in total revenue, so that price-response effects would be reduced to 25%. The description in John's text does not make this clear.
 11. It is difficult to determine where the revenue loss is being distributed between each species in the simulations. I tried to generate my own price elasticity from the revenue tables in the simulations and could not do it because there are no tables of annual ex-vessel prices generated for the cases. It would be helpful to see a table of the point prices estimated for each year of the simulations by species so that we can determine which species are bearing the revenue loss when another species is enhanced. John Boyce included such a table for the salmon demand studies for the State of Alaska in 1990, and it was very helpful for understanding how the revenue changes are distributed.
 12. There is no rationale given for using the real interest rates specified in the text. I agree that 4% and 7% are reasonable alternatives, but there should be some explanation of why these were used instead of, say, 3% and 6%.

13. Page 7 (footnote). The text and footnote read that the ending revenues at year 15 are too high, so the authors estimated a mean from year 10 to 15. Why is the mean used here? I do not recall any discussion along these lines. Even if revenues were higher at the end of the 15-year period, that is what happens with some enhancement programs in the brood stock development process. The footnote reads that the rankings from highest to lowest NPV may not be affected with this assumption; I believe that the total NPV may be. If revenues are expressed as a mean, shouldn't costs be as well? This is a departure from what I thought the contractors had initially proposed to use for projecting year 16 to 30 NPV in our September meeting, and from what seems to make sense based on my understanding of the operators' production plans.
14. There are a number of syntax errors in the manuscript that makes the document difficult to understand and detracts from the overall study. These should be corrected.
15. Page 16. The text reads, "To get a measure of the cost of a 15% decrease, we took 15% of the reported costs of a 100% decrease." This is different than the instructions given to the contractors by the project manager, Ginny Fay, in the September meeting at UAF. The decrease was to be equivalent to the increment used for the 15% increase case.
16. I generally believe there needs to be further clarification of what was included in the operators' serves, at least by including a copy of the survey instruments in the appendix.



Alaska State Legislature

SENATE

Official Business

P.O. Box V
State Capitol
Juneau, Alaska 99811

December 14, 1992

Drs. Mark Herrmann and John Boyce
Department of Economics
University of Alaska Fairbanks 101 Bunnell Building
Fairbanks, Alaska 99775-1070

Dear Drs. Boyce and Herrmann:

Here are some general comments to address in the rewriting of the benefit- cost analysis report.

First, you will notice that I have used editor's license and not been at all shy about my mark up. I hope you are not offended but quite frankly, the draft warranted it. As with any editing of these proportions, it will probably need some reworking when changes are made. I have already found myself editing my editing. I have tried not to radically change style but cushioned the results in the context of the limitations of the analysis. I have also added explanatory material that was wanting in the first draft. I sincerely hope that you will incorporate all my proposed changes because in the interest of time, I have only proposed changes that are really needed.

I've added a new subsection entitled "Research Scope." I think it is very important that the audience clearly understand the limited scope of the analysis. Some material from the old "Caveat and Assumptions" section are moved to the scope section. Another entirely new section is added called "Assumptions." It is insert 2. The "Caveats and Assumptions" section has been renamed "Caveats and Technical Limitations of the Models." My logic for this reorganization is that there are three levels of limitations of the study. First, is the scope limitation that was imposed by the Committee, at least in terms of commercial fisheries. The second limitation is based on one's inability to precisely predict the future and the value of exogenous variables. The third limitation is the technical limitations of modeling. I think the current organization makes it a little easier for the lay reader to understand.

December 14, 1992

Page 2

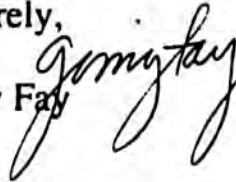
In what is now the "caveats" section, there is a disproportionate amount of discussion on the fishing cost model. The assumption section adds a little more background on the demand and population models but my guess is that there is still too little on these models and maybe too much on fishing costs. Please keep this point in mind when doing the rewrite and adjust as necessary.

I have highlighted in the text all the numbers that I am not able to correct because I do not have sufficient information. I am leaving these corrections up to you.

This editing should be considered a second draft because of uncertainty regarding some of the outstanding numbers. Once all the numbers become final, we can do a final draft. I am still hoping that can occur by the end of this week.

Sincerely,

Ginny Fay

A handwritten signature in cursive script, appearing to read "Ginny Fay", written over the printed name.

insert #1

In addition, the analysis makes no attempt to discern whether fishermen ~~benefitting~~ from the enhancement program are residents or nonresidents. To the extent that benefits accrue to nonresidents, the benefits will "flow" out-of-state --- this is especially true without a state income tax.

As is standard methodology of benefit-cost analyses, this analysis only considers direct benefits and costs. Indirect primary and secondary benefits and costs such as fish processing employment and service sector support are not considered.

At the direction of the legislature,

The analysis we conducted concentrates only on the commercial fisheries. We separated out the ^{enhanced} hatchery returns and costs that went to other uses (i.e., sport and subsistence) from the analysis. This means that the benefits of production of kings, silvers, and reds that goes to sport fish purposes (especially in Southeast) and the species, especially chum, that goes to subsistence purposes are ^{not included} ignored by our analysis. We have also ^{did not include enhancement} ignored the hatchery costs associated with these uses.

be subject to take it the on the Alaska enhancement program. The law individual fishermen or facilities. The results apply to the state and private programs and not individual facilities.

There may be some problems with the way we did that. We assumed that if 75% of the fish were ~~intended~~ for commercial catch (including the commercial share of the cost recovery catch), then 75% of the hatchery costs could be attributed to the commercial catch. This may be untrue in the sense that the costs of production of sport and subsistence fish may in part be reduced by the costs incurred producing commercial catch.

John - This is not true. We asked for total commercial production, total costs, and the % of total costs attributable to commercial ^{harvest} ~~harvest~~. Therefore, costs should be properly allocated between ~~uses~~ ^{uses}. This was purposefully done because, for example, sport fish species are generally more costly to produce. J.

Insert #2

The reliability of the results of this analysis depend on the extent to which 1) future international salmon markets reflect current markets, 2) assumptions regarding the future values of exogenous variables are accurate (an exogenous variable is a variable we have no control over such as Norwegian farmed-salmon production and exchange rates), and 3) the model structure is accurate.

The assumption regarding international salmon markets means that the research results reflect the relative value of changes in enhanced salmon production if international salmon markets remain unchanged. However, Alaska fishermen, processors, and enhanced salmon producers are actively attempting to recapture Alaska's salmon markets. Therefore, the extent to which these efforts are successful, the research results will underestimate potential net benefits to Alaska. Conversely, if Alaska's share of world salmon markets continues to erode, as it has during the last decade, the research results will overestimate potential net benefits to Alaska.

All modeling efforts used to project future values require assumptions regarding exogenous variables. The complicated nature of this study required numerous modeling assumptions regarding events in the future. This section summarizes some of the most significant assumptions of the population, demand and fishing cost models. For a more detailed discussion of modeling assumptions, see the individual reports.

Salmon Population and Exploitation Model. It was assumed that the Alaska Department of Fish and Game (ADF&G), Division of Commercial Fisheries would continue to utilize current 1) wild stock escapement targets and 2) fisheries management practices. In addition, it was assumed that all stocks available for harvest by common property fisheries and cost recovery fisheries were harvested. The model used ADF&G biologists' estimates of enhanced production survival rates.

International Salmon Demand Model. This modeling effort required a considerable number of assumptions. Some of the most significant assumptions are provided below.

Future values of these variables were estimated using ordinary-least-squares on the basis of observed 1983 to 1991 growth rates---

- population of the EEC, 0.32% annual growth rate;
- population of the Japan, 0.43 % annual growth rate;
- population of the United States, 0.92% annual growth rate;
- the "real" food consumption expenditure in Japan, 0.29%

- the "real" private consumption expenditure in Japan, 2.9%

Future values of these variables, as well as consumer price indexes and tariffs, are held constant at 1991 levels as is usual practice in benefit - cost analysis---

- European Currency Unit(ECU)/U.S. exchange rate, 0.7968
- Norwegian kroner/U.S. dollar exchange rate, 6.3549
- Japanese yen/U.S. dollar exchange rate, 129.50
- Norwegian kroner/Japanese yen exchange rate (NORUSA/JAPUSA)
- Norwegian kroner/ECU exchange rate, 7.9755

Future values for these variable are based on expert opinion---

- the "real" United States personal disposable income, 2.5% annually

A 3% annual growth rate for U.S. real personal income growth was specified. The total supply of farmed Atlantic salmon was held at its 1991 level, coinciding with the opinion of many experts that growth has reached its maximum sustainable level. However, there are some current indications that the industry may expand in the future, especially with a recent court decision regarding U.S. tariffs on Norwegian imports of farmed salmon. Farmed salmon production in Canada and Chile were allowed to grow at 3% annually despite there much higher rates of growth in recent years. No Russian production was included in the analysis. Therefore, background levels of farmed-salmon production are quite conservative. To the extent to which world farmed-salmon production exceeds these estimates, Alaska net benefits will be overestimated and visa versa.

All wild salmon harvests for Canada, Washington, Oregon, and California were estimated based on 10-year historical averages. All Alaska non-hatchery wild salmon harvests were estimated on the same basis, with the exception of Prince William Sound pink salmon, Cook Inlet sockeye salmon, Kodiak sockeye and pink salmon, and Southeast Alaska king salmon. Wild and enhanced harvests for these salmon species were predicted by Dr. Jeremy Collie in the population modeling portion of this analysis. It has been argued that the ten-year average for Alaska wild salmon stocks is both too high and too low. Similar to assumptions regarding farmed salmon production, the extent to which wild harvests are overestimated, resulting net benefits will be underestimated and visa versa.

Fishing Cost Model. The primary assumptions of the fishing cost model are that future harvests are distributed similarly to 1990 harvests, that fishing and management patterns remain similar, that the number of permit-holders remains near 1990 levels, that fishing costs of particular gear types are similar between regions, and that no dramatic changes in ex-vessel prices occur that would significantly alter participation rates.

As mentioned about enhanced stock production estimates not provided by Collie were provided by enhancement project operators

As a result of the uncertainty regarding actual values of exogenous variables, sensitivity analysis was conducted to simulated high-, mid- and low-salmon-price scenarios. Study results are presented using each of these price scenarios to show the extent of variations in benefits possible as a result of actual price outcomes.

UNIVERSITY OF ALASKA - FAIRBANKS
A BENEFIT-COST ANALYSIS
OF THE Enhancement
ALASKA SALMON HATCHERY PROGRAM

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A Report to the Legislature of The State of Alaska

November, 1992

DRAFT: NOT FOR QUOTATION WITHOUT WRITTEN
PERMISSION FROM THE AUTHORS

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A BENEFIT-COST ANALYSIS OF THE ALASKA SALMON HATCHERY PROGRAM Enhancement

Introduction

The hatchery program in Alaska was created in the early 1970's. At that time, ^{initiated} Pacific salmon dominated the world salmon markets. Since then, there has been a rapid rise in the supply of salmon world-wide. In Alaska, this has been in large part due to production from the hatchery program. However, the increase in production has been worldwide, ^{as well as increases in wild stocks.} and it appears that supplies of salmon on the world market are more likely to continue to increase than to decrease. Given this backdrop, the Legislature of the State of Alaska asked for a cost-benefit analysis of the state-funded hatchery program. ^{The results of this analysis is intended to assist policy makers in their deliberations regarding the level of continued state support of the program.} This report summarizes the findings of that study.

Scope of the Research

This analysis uses a state accounting stance which means that since the hatchery program is funded by the State of Alaska, we considered only the interests of the state in our analysis. This means, for example, that benefits to consumers either in the U.S. or in other world markets were ignored not considered. This is not to imply that these benefits do not exist but is recognition ^{recognizes that} of the fact that they are not benefits that are captured by the State of Alaska. ^{these benefits are not captured} The

Research Methods

benefits to the state were measured primarily by two variables. First, we were interested in what the net benefits to the fishermen were from the hatchery program. That is, we wanted to estimate the return to fishermen above their costs that occurs under different hatchery production output levels. ^{assumptions regarding enhanced salmon} Second, we wanted to estimate the cost of producing these benefits to the fishermen, which is the cost of running the hatchery program. ^{enhancement} These costs include enhancement facility costs, as well as Alaska Department of Fish and Game administrative, support and management costs.

* First the term Alaska and state of Alaska are used broadly to reflect the public of Alaska and not just the state government.

at the beginning of this I would add a new section heading:
Research Methods

...determine their current actual costs and their expected costs. Fishermen were surveyed to find out what they expected their costs to be if the catch for a particular species were increased or decreased. While there is some difficulty in interpreting these numbers in certain instances, the costs of the hatchery program are relatively straightforward.

The benefits to fishermen are not as easily determined. We considered the ^{the} producer's surplus to be the appropriate measure of benefits to the fishermen. Producer's surplus measures the return above opportunity costs to the fisherman. If the fisherman does not expect to earn revenues higher than his or her next best alternative (their "opportunity cost"), then they choose not to fish. Any returns they get above the minimum required to attract them into the fishery are what we measure as the surplus. ^(analogous to profits) The surplus benefits may differ across fishermen because some fishermen may be willing to fish even when revenues are low, and others may not.

^{enhancement} /The net benefits to the state of the hatchery program are the net benefits to the fishermen as measured by producer's surplus minus ^{enhancement} the hatchery costs. /This measure indicates the net benefits to fishermen above the costs of providing these benefits.

The calculation of the producer's surplus to the fishery is by no means a straight forward procedure. The request for proposals required that we consider a number of alternative management plans for the ^{enhancement} hatchery program. These management alternatives are described below in Table One. Each management plan was to be considered over a 15- and a 30-year planning horizon. To imagine that we can precisely predict events 15 or 30 years in advance based on a decade

of data from an industry in transition is, of course, precarious at best.¹ However, given the world-wide trends in demand and supply as suggested by the events over the past several decades, we do have a rough idea of the direction in which the fishery is heading. Our estimates are likely to be very inaccurate within particular years, but should, on average, capture the trend. Since we ^{were} asked to conduct a cost-benefit analysis of the hatchery program over a long lifetime, the trend will be much more important than specific yearly predictions.

The model used to generate our projections for these 15- and 30-year planning horizons use results from three other parts of this study. For each management

alternative, ^{projections} projections about the biological stocks were generated (Collie, 1992) ^{developed the population} estimates for Prince William Sound pink salmon (Cook Inlet ed.) used in. These biological projections were then put into an international salmon demand model to make projections about the prices for each ^{salmon} species in each area by Alaska regions

(Herrmann and Greenberg, 1992). The quantity and price projections were then used to estimate the costs to fishermen of participating in the fishery (Boyce,

1992). Each of these models are described in the ~~citations~~ ^{cited reports and one appendix}

A, B, and C, ^{respectively,} to this summary report.

Research objectives

The request for proposals outlined seventeen alternatives to consider. These are given in Table One.

Our complete reported findings are contained in Appendix One, Two, Three and Four. We report fifteen year projections for catch, revenues, producer's surplus, hatchery costs, and net benefits. For each management alternative, we report projections for Western Alaska and AYK ^{referred to as "other Alaska,"} combined (the part of the state

¹While data for annual prices and quantities exist for several decades, inventory and export data restrict us to the years 1980 and beyond.

^{enhancement}
with no hatchery program), and for Cook Inlet, Kodiak, Prince William Sound, Southeast, and for the state total. Thus, in each Appendix there are six tables on three pages for each alternative. At the bottom of each table we report the ¹⁵⁻fifteen year sum, the ³⁰⁻thirty year sum, and the present value of the ³⁰⁻thirty-year sum discounted at 4% real rate of interest.² The difference between the Appendices is that Appendix One reports the estimate of returns using our midpoint price estimates from the demand model, Appendix Two reports the estimates of returns under optimistic price projections, and Appendix Three reports the estimates of returns under pessimistic price projections. The data reported in the Appendices is aggregated to the regional level. In the actual simulations, *fleet* specific estimates of returns and costs were calculated. However, this data is too voluminous to be included in the report. Appendix Four contains summary data for present value calculations at 0, 4 and 7% discount rates. ✓ ✓

²We examined the cases of four and seven percent real rates of interest (i.e., we removed the inflation part of the interest rates since all dollars are expressed in real 1992 dollars). The seven percent discount rate figures are not contained in Appendix One, but do appear Appendix Four.

Table One: The Alternatives Considered in the Policy Analysis

Case 1.	Maintain current hatchery production
Case 2	Planned hatchery production levels
Case 3	Eliminate entire hatchery program
Case 4a	Increase entire hatchery production level by 15%
Case 4b	Decrease entire hatchery production level by 15%
Case 5	Eliminate entire pink salmon hatchery production
Case 6	Eliminate entire red salmon hatchery production
Case 7a	Increase pink salmon hatchery production level by 15%
Case 7b	Decrease pink salmon hatchery production level by 15%
Case 8a	Increase red salmon hatchery production level by 15%
Case 8b	Decrease red salmon hatchery production level by 15%
Case 9a	Increase chin salmon hatchery production level by 15%
Case 9b	Decrease chin salmon hatchery production level by 15%
Case 10a	Increase silver salmon hatchery production level by 15%
Case 10b	Decrease silver salmon hatchery production level by 15%
Case 11a	Increase king salmon hatchery production level by 15%
Case 11b	Decrease king salmon hatchery production level by 15%

The revenue data in each table represents the projected *gross* returns to the region or to the state from the salmon fishery. We estimated the costs to the fishermen as the minimum level of returns required before the fishermen would participate. Thus part of the revenues was the cost of hiring the resources away from their next best alternative. Since they would have earned returns equal to the value of their next best alternative, these costs are real economic costs.³ The *producer's surplus* is the difference between the estimated revenues and costs. The producer's surplus measures the net benefits to the fishing sector. Again, the cost of providing these net benefits to the fishermen is the cost of the *enhancement*

³It is inappropriate to simply view the cost part of the revenues as benefits because they represent expenditures to the other sectors of the state. While it is true that they represent expenditures to other sectors, they also represent what was foregone by the fishermen if they had been engaged in their next best alternative.

program. To ^{estimate} get the net benefits to the entire ^{enhancement} hatchery program, we subtracted the hatchery costs from the producer's surplus. Alaska Department of Fish and Game fisheries management, administrative, and support costs were included in enhancement program costs and provided by Division of Commercial Fisheries and Fr

Caveats and Assumptions Technical Limitations of the Models

Before we explore the actual findings, let us explain why we believe our estimates must be treated with some caution. First, these predictions are based on models using data from only a small number of years. The demand data uses quarterly data from 1982 to 1991. The ^{holding} cost data was generated entirely from data for 1990. To extrapolate 15 or 30 years based on such a short time series is very dangerous. Certainly projections made in the 1960's could not have foreseen the changes that occurred one or two decades later.

The analysis we conducted concentrates only on the commercial fisheries. We separated out the hatchery return and costs that went to other uses (i.e., sport and subsistence) from the analysis. This means that the benefits of production of kings, silvers, and reds that goes to sport fish purposes (especially in Southeast) and the species, especially chinook, that goes to subsistence purposes are ignored by our analysis. We have also ignored the hatchery costs associated with these uses. There may be some problems with the way we did that. We assumed that if 75% of the fish were reared for commercial catch (including the commercial share of the cost recovery catch), then 75% of the hatchery costs could be attributed to the commercial catch. This may be untrue in the sense that the costs of production of sport and subsistence fish may in part be reduced by the costs incurred producing commercial catch.

All of our analysis is based on point estimates. Even though we predict high, mid, and low prices, we are still comparing revenue cases against the base cases

for average vs. average prices, high vs. high prices, and low vs. low prices. In addition, ~~our~~ ^{would} predictions of total revenues and producer's surplus are missing confidence levels which could make some of our findings insignificant. // ✓

In addition, ~~the~~ ^{old} production levels under each of the elimination alternatives are vastly different from the production levels we observed in the historical time period used to estimate our demand and fishing cost models. // All of our estimation of ~~demand~~ ^{salmon} and fishing cost parameters occurred with ~~hatchery~~ ^{enhanced} and production figures that were considerably higher than the levels considered in Cases 3, 5 and 6. ^(Table one) It is less true for Case 6 because ~~hatchery~~ ^{enhanced} production of red salmon is small relative to the total quantity of wild stocks of red salmon. ^{However, it} This is particularly true for Cases 3 and 5, which involve drastic reductions in the pink salmon catches. ✓

Because of this, we are forced to extrapolate well beyond the data in our analysis.

// The result of the extreme extrapolation may be to predict prices which are above their historical levels. 4 // ^{old} ✓

^{in the international salmon demand model} Also, it was necessary to aggregate Pacific salmon into high-valued (sockeye, king, and coho) and low-valued salmon (chum and pink) in the demand side of the model. This was due to the need to simplify the number of specified species in order to estimate the model. However, because of this, there are no empirical estimates of cross-price effects between species within an aggregate grouping. As a result, ad hoc assignments to substitution effects between species within each aggregate grouping were made. For example, we assumed that the strength of the substitution effect between ✓

*This occurs with some extent to our predictions of pink salmon prices. If the pink salmon program is eliminated, we estimate pink prices to average about \$0.46 per pound ex vessel. Over the period 1980 to 1991, nominal prices averaged only \$0.31 per pound, although in approximately one-third of the years the real 1992 dollars prices rose to this level. The two most recent cases, 1987 and 1988, are years for which pink salmon volumes were at their lowest over the period.

(25%)

pink and chum salmon to be one-quarter of the strength imposed in the model, and vice versa. The assumed cross-price effects were kept fairly low in order to err on the side of conservatism.⁵ Similar assumptions were made for other species. We do have empirical cross-price effects for species within the low-valued grouping on species within the high-valued grouping, and vice versa. These are reported and discussed in the demand model report (Herrmann and Greenberg, 1992).

As a result of species aggregation in the demand model,

It was not possible to use the ad hoc cross-price effects between species within a particular grouping when there were simultaneous changes to

salmon species within the aggregate groupings because, in these cases, the movements of own-price effect and cross-price effect could not be sorted out. *Because of* *could not be imposed*

For example, if Coho and King salmon production were simultaneously increased or decreased, a portion of the resulting change in Coho prices would be from the change in King production (own-price effect), while a portion would be from the change in price effect.

As a result *enhanced* *for all species*
an accurate estimation of cases 2-4, where there were simultaneous changes in hatchery production, was not possible. Because the model-imposed cross-price effect within the groupings are overstated, the revenues assigned to cases 2, 3, and 4a will be understated. For this reason, only the cases of 1 and 5-11, when the ad hoc cross-price effects within the aggregate salmon groupings can be imposed, offer realistic revenue forecasts. The

losses found in cases 2-4 must be seen as absolutely worst case scenarios and *probably should not be taken seriously.* *Because we have less confidence in the results of cases 2-4, these results are segregated from the main body of the report and presented in the front section.*

The fishing cost data was calculated as follows. *For* In the fishing cost model, we estimated a model predicting the number of fishermen participating in a particular opening based on the total run strength as measured by the total revenues earned

⁵We presented the results using the full own-price effect. The result was that a decrease in pink salmon caused chum salmon revenues to increase dramatically. This made the effect of valuing the pink salmon program even less costly since there was a large compensation due to an increase in chum revenues. It appears that the relationship between chum and pink salmon revenues is an issue which deserves more research.

the changes in the costs of harvesting changes in enhanced salmon production, the producers' surplus is estimated underestimate true long-term costs.

There are a lot of limitations to the fishing cost model. In particular, it is a novel, previously unused approach to the extremely difficult task of modeling commercial fishing costs. The model

developed is based on *participation*. Costs such as loan payments on vessels and licenses do not vary with participation, these costs are not taken into the estimated costs. In fact, variable costs, including alternative fishing or employment opportunities, are not included.

in the opening. We found a very consistent relationship that as total revenues rise, the number of fishermen also increased. The relationship also indicated that to add another fisherman, the revenues would have to rise by a larger amount than was required to attract the previous fisherman. This suggested that fishermen have different costs of fishing and that those with the lowest costs entered first. The cost equation was then derived from the participation equation by solving for the average revenue given the number of fishermen predicted to participate. The behavioral assumption was that the last fisherman to enter expected to earn just enough in revenues to cover his costs of fishing. Thus, the average revenues for each opening gave us a measure of the fishing cost of the last fisherman participating in the opening. Since we observed a large number of openings with different numbers of fishermen, we obtained an estimate of fishing costs as a function of the number of participants.

In the extrapolation of the fishing cost model to future years, we took the 1990 run for the fishery as our guide for how the run would be dispersed over time and across the statistical areas within the fishery. If the future year showed an increase over the 1990 data for a particular species of, say, 10%, then we inflated the catch of that species by 10% for each opening over the season. Having done this for each species, we then multiplied the estimated catch by the price per pound for each species. We then used the data on percentage by species of the catch and of total revenues per opening to make a prediction of the number of fishermen participating in each opening throughout the season using the parameters of our participation model estimated on 1990 data. To obtain our estimate of fishing costs for the opening, we utilized the relationship between average revenues and the number of fishermen and the behavioral assumption that the last fisherman to enter earned revenues equal to their fishing costs. The fishing costs for the entire

opening were obtained by summing the fishing costs for each fisherman up to the estimated number of participants. The fishing costs for the season were simply the sum of these fishing costs over all of the openings. Producer's surplus was estimated as the difference between the fishing cost estimates and the revenue estimates.

One problem with our extrapolation is that we did not have estimates of which statistical areas would be affected by the changes in the hatchery stocks production. Thus we used the average cost over all statistical areas weighted by the distribution of 1990 catch over those areas. ^{therefore} Thus if the distribution of catch changes or if the 1990 catch was aberrant in the distribution of returns, we would introduce error. ✓

A more serious problem which is consistent across all of the analyses of alternatives is the problem of extrapolating cost data from one fishery to another. In particular, the estimates of fishing costs was conducted for only a select number of fisheries. For all other fisheries, we used the average estimate of fishing costs for similar gear type fleets elsewhere in the state. In particular, this problem is acute for Western Alaska. The main problem here occurs in the drift net fleet. The Bristol Bay drift net fleet is about 2,000 vessels strong. None of the other drift net fleets are anywhere near the size of this fleet. Thus our estimates of producer's surplus in Western Alaska may be off by an order of magnitude. While it is true that the relative error should be constant across the alternatives, the magnitude of that error may be considerable. We doubt, however, that it accounts for the results of our analysis with regard to the elimination of all, or portions, of the ^{enhancement} hatchery program. ??

John, I
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to rework this!
are we off a billion
fold or what??

A technical caveat on the interpretation of producer's surplus should also be mentioned. Producer's surplus in essence measures the "skill rents" to fishermen. That is, given the common property ownership in the fishery, the reason economic rents even exist at all is because of differences in the fishermen. These differences are measured as the minimum amount of revenues per fishermen that are required before a particular fisherman decides that it is profitable to participate in an opening. If these rents are transferable, then the present value of the producer's surplus should equal the value of the permits in a particular fishery. However, if the skills are not transferable, then the correlation between the producer's surplus and the value of the permits will be dampened. (The correlation should be positive under any conditions.) If the economic skill rents are not transferable, then the present value estimates of producer's surplus should be in excess of the value of the permits.

im not sure this should stay in given differences are attributable to more than just skill rents. if u want to keep it pls. modify to more correct.

Finally, our estimates of catch, revenues, and producer's surplus for the second 15 years of the planning horizon are based on the average of years 10 to 15 (2001-2006). The cost estimates from the hatcheries were provided by the hatcheries for those years.⁶

Results

net benefits to Alaska

Returns to the state if hatchery production continues at current levels

Under current hatchery production levels (Case 1) we estimated the net benefits to the state to be on the order of \$100 million (m = million) in 1992. The net benefits were projected to rise steadily in real (1992) dollars over the 30-year planning

of Alaska's salmon fisheries

⁶We were requested to use the 15th year to predict the final 15 years in the PSA. However, we found that our demand model predictions for the 15th year were quite a bit higher than previous years, so we used the 3 year average instead. The relative effects that all revenues are slightly lower than would have occurred if we had used the 15th year. However, none of the relative rankings of the alternatives is affected by this change.

10-15-

We believe this is a better estimate of potential net benefits and has no effect on the relative ranking of the alternatives.

because of the model's behavior projecting beyond a 40-year horizon given the relatively short time-series data available for estimating the model.

horizon. By 2006 we projected the net benefits to the state to be \$154.37 m. per year. The thirty year average was estimated to be \$140.32 m. Over thirty years, we

estimated that the salmon fishery with the enhancement program at its current levels would bring in \$4.001 b. (b. = 10⁹) in net benefits (\$2.329 b. in present value at 4% discount rate) to the Alaskan Economy on revenues of \$1.672 b. The

difference over the thirty-year planning horizon between the gross revenues and the net benefits was made up of hatchery costs (\$2.329 b.) and fishery costs (\$1.672 b.). This data is based on the midpoint price estimates from the demand

model (Appendix One). The optimistic price estimates (Appendix Two) yielded an undiscounted return of \$4.731 b. and the pessimistic price estimates yielded an undiscounted return of \$3.548 b. over the 30 years. In present value of 1992

dollars discounted at four percent, the estimates for current production levels are

\$2.329 b. for the midpoint, \$2.746 b. for the optimistic, and \$2.071 b. for the pessimistic price predictions. Thus, our estimates vary by about 1.2 b. 675 million

undiscounted dollars to about 700 million discounted dollars over the thirty-year planning horizon. This magnitude of prediction error is present in all our analysis.

re-focusing the distribution whether low, high, or mid-level salmon prices actually materialize in the future.

The distribution of the undiscounted \$4.001 b. net benefits over the next thirty

years under current hatchery production levels was as follows. The largest share

is in Western Alaska (dominated by Bristol Bay), with about \$933.4 m. in net benefits per year over the next thirty years, for a total of \$1.706 b. (present value

of \$933.4 m. at 4% discount rate). The next largest share went to Southeast, with

\$422.1 m. per year for a total of \$1.261 b. over the thirty year lifetime (present value of \$422.1 m. at 4% discount rate). Kodiak had net benefits of \$288.5 m. per year for a thirty

30-year total of \$865.5 m. (PV of \$288.5 m. at 4% discount rate). Cook Inlet had net benefits projected to be \$239.9 m. per year for a thirty year total of \$719.7 m. (PV of \$239.9 m. at 4% discount rate).

Prince William Sound had net benefits projected to be \$271.08 m. per year for a

less is not error, it is variation, the potentiality of variation in exog. variable

1	993.40	239.93	288.53	55.63	662.31	2239.81
5	1016.91	236.92	312.48	35.82	810.81	2412.90
6	1036.43	226.06	253.76	23.77	712.29	2252.32
7A	990.19	240.66	280.99	50.16	635.02	2197.02
7B	996.61	240.49	293.38	61.88	685.12	2277.48
8A	987.77	242.27	291.21	56.74	648.94	2226.93
8B	999.17	237.72	283.91	52.00	669.82	2242.61
9A	992.53	236.54	287.30	51.19	672.29	2239.85
9B	994.43	244.13	289.88	59.67	649.27	2237.39
10A	991.88	238.87	288.09	54.31	662.93	2236.08
10B	994.02	240.50	288.89	55.35	662.55	2241.31
11A	992.97	238.69	288.32	54.04	664.88	2238.91
11B	993.94	240.79	288.73	55.83	658.53	2237.83

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Thirty Year Present Values by Region, by Case (4% discount rate)
Optimistic Price Prediction Levels

CASE	WESTERN	COOKINL	KODIAK	PWS	SOUTHEAS	TOTAL
1.00	1173.08	289.06	341.07	91.96	761.01	2656.19
5.00	1200.71	285.83	366.71	63.88	919.00	2836.13
6.00	1209.47	270.44	296.80	48.08	776.28	2601.06

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Thirty Year Present Values by Region, by Case (4% discount rate)
Pessimistic Price Prediction Levels

CASE	WESTERN	COOKINL	KODIAK	PWS	SOUTHEAS	TOTAL
1.00	886.98	210.46	255.20	31.32	597.36	1981.32
6.00	923.13	192.27	213.74	-21.64	566.08	1873.58

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more to the issue of the distribution and the reasons for the distribution below.

Table Three contains summary statistics for the 30 year sums (undiscounted) for the current hatchery output levels (Case 1) as well as each of the three cases where ^{a portion of the} some (Case 5, elimination of pinks, and Case 6, elimination of reds) or the entire program is eliminated (Case 3). Looking at the statewide total net benefits under each program, it is clear that elimination of all of some portion of the program ^{from a strictly economic perspective,} results in the largest net benefits to the state. ^{enhancement} In particular, the ³⁰⁻year sum of ^{undiscounted} net benefits under the current hatchery output levels is estimated to be \$4,001.8. ^{Table 3}

(Case 1) Base Case: Current Hatchery Production

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4167.79	993.40	0.00	993.40
Cook Inlet	1702.43	971.00	311.34	71.41	239.93
Kodiak	2425.80	859.36	317.38	28.85	288.53
Prince Wm	5215.02	1428.06	311.80	256.17	55.63
Southeast	6153.45	2065.68	909.34	247.03	662.31
Grand Total	23332.47	9491.89	2843.27	603.46	2239.81

(Case 5) Eliminate Entire Pink Salmon Program

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4263.68	1016.91	0.00	1016.91
Cook Inlet	1362.23	934.06	295.95	59.03	236.92
Kodiak	2135.11	901.06	334.69	22.21	312.48
Prince Wm	2199.21	995.61	198.25	162.43	35.82
Southeast	5920.16	2309.83	1031.25	220.43	810.81
Grand Total	19452.47	9404.23	2877.04	464.10	2412.95

(Case 6) Eliminate Entire Red Salmon Program

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4354.59	1036.43	0.00	1036.43
Cook Inlet	1604.31	931.62	297.47	71.41	226.06
Kodiak	2266.73	768.07	277.49	23.73	253.76
Prince Wm	4988.08	1236.60	276.32	252.54	23.77
Southeast	6122.87	2067.53	910.82	198.53	712.29
Grand Total	22817.76	9358.41	2798.53	546.21	2252.32

(Case 7a) Pink Salmon Production Increases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
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^{commercial} Elimination of the pink salmon program also reduces total estimated catch, although not by as much as elimination of the entire hatchery program. ^{commercial and cost recovery harvest} The reduction in the catch due to the pink salmon hatchery program would be a drop to 19,452^b pounds over thirty years from the 23,332^b under current output levels, or a reduction by 16.6% in catch. Revenues (undiscounted) would drop to \$11,404^b from revenues of \$16,491^b under the current output levels, or a drop of only 1.0% over the thirty years. ^{gross? need to be explained} If the red salmon hatchery enhanced production is eliminated, total catch drops by a much smaller amount, down to 22,817^b pounds over thirty years from the 23,332^b under current output levels. This drop of 2.2% causes a reduction in revenues to \$15,834^b dollars over thirty years from \$16,491^b under current output levels. The percentage reduction in revenues is 1.4%. The reduction in revenues appears to occur because of cross-price effects on the lower-valued species.

The net return to the fishermen measured by producer's surplus is a much better measure of the value of the ^{enhancement} hatchery program to fishermen. We find that relative to the current production level of Case 1, producer's surplus actually increases by \$2,000 under Case 5, the elimination of the pink salmon hatchery program. The increase is relatively small, \$2,000³⁰ over thirty years, or \$2.00³⁰th.

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per year. Producer's surplus is estimated to decrease if either the red salmon program is eliminated ^{or} if the entire hatchery program is eliminated. While the producer's surplus for the entire state increases if the pink salmon program is eliminated, not every region has gains under the elimination of the pink program. In particular, producer's surplus decreases in Prince William Sound and Cook Inlet under each of the elimination ^{alternatives} ^{of pinks or sockeyes} relative to current levels. Western Alaska gains producer's surplus in each elimination scenario relative to the current levels, and Southeast gains big if pinks are eliminated, ^{substantially} ^{enhancement} ^{and} slightly if reds are eliminated, and loses if all species are eliminated. Kodiak gains if pinks are eliminated, but loses if reds or all species are eliminated.

It is only in the elimination of pink salmon that the net change in producer's surplus summed over all of the regions is positive. That is, in the elimination of pink salmon alternative, we estimate that the gains in producer's surplus to regions gaining are more than sufficient to compensate the losses in Prince William Sound and Cook Inlet. This is not true of either the elimination of the entire salmon hatchery program or the elimination of the red salmon hatchery program alternatives. In each of those cases, the increase in producer's surplus benefits to the gaining regions is less than the loss in producer's surplus to the losing regions.

Under the elimination of reds alternative, we find that fishermen's producer's surplus decreases to \$4,116.6 from the ~~current level~~ ^{enhance} under the current hatchery output levels, or a decrease of ~~the current level~~ ³⁰ in over thirty years, or ~~the current level~~ ^{per year}.

It should be noted that these changes in producer surplus are relatively small in magnitude and undoubtedly within the margin of modeling error. However, they do help explain the results of the analysis.

From a state-wide perspective, the changes in producer's surplus is only one part of the equation. The other part is the ^{enhancement production and management} hatchery costs. Under the current production levels, to produce \$4,860 b. in producer's surplus over the next thirty ³⁰ years, the state spends \$8,990 ^{there are expenditures of} for a net benefit of \$4,000. In fact, we find that when changes in the ^{enhancement} hatchery costs are taken into account in addition to the changes in the producer's surplus, ^{the pink and sockeye} each elimination alternative dominates the current output level alternative. Furthermore, the net effect by region shows that each region also gains with the exception of Cook Inlet, in the cases where either pink or red salmon are eliminated, and for Kodiak in the case where red salmon is eliminated. The biggest surprise in this result is our finding that when hatchery costs are included, Prince William Sound also gains in net by eliminating each of the programs. *this latter result is probably due to the*

relatively high cost for producing, harvesting, and managing enhanced pink salmon as compared to their value. This is discussed in more detail in the next section.

In summary,
 Under the elimination of the pink salmon program, there are two sources of gain. First, producer's surplus actually increases by \$60,220 m. Secondly, the ^{production and management} costs of the ^{enhancement} hatchery program declines by \$400.11 m. over the ³⁰⁻ thirty year planning horizon. This says that by saving itself ^{enhancement} \$400.11 m. in hatchery costs, the state of Alaska ^{million} could actually increase fishermen's producer's surplus by \$60,220 m. over the next ³⁰ thirty years. Of course, not all regions gain by the increase in producer's surplus, but the losses to the regions that do lose is \$40,000 m. less than the gains to regions that gain, i.e., the net change in benefits is positive.

Under elimination of the red salmon program, the fishermen suffer net losses in producer's surplus of \$84.62 m. However, this is more than offset by the \$106.7 m. in savings from ^{closing} the red salmon ^{enhancement} hatchery program. The net effect of eliminating the red salmon program is an increase in net benefits to the state of Alaska of \$21.34 m., or about \$0.71 m. per year.

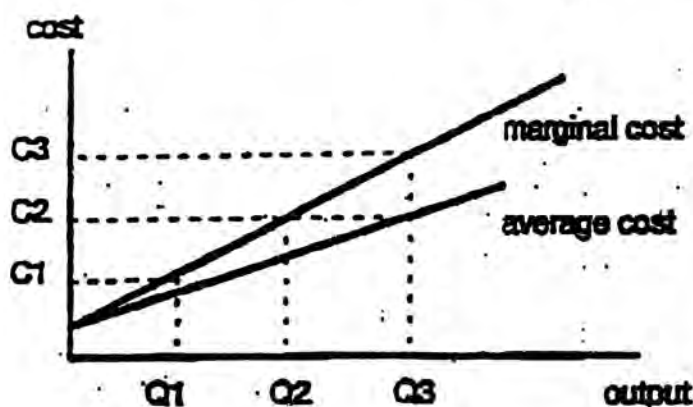
The cost per fish of the hatchery program

Our analysis of the potential effects of elimination of the hatchery program, or of some of its parts, reveals some interesting information about the cost per pound of fish of the hatchery program. Eliminating the pink salmon program shows that the estimated catch over thirty years will drop by 3,880 b. pounds. The reduction in hatchery costs due to eliminating the pink salmon hatchery program causes hatchery costs to decline by \$400.11 m. Thus the cost per pound of the pink hatchery program is roughly 10.3 cents per pound. This is less than 2 cents per pound below the price being offered in 1991 when pink salmon were left to rot. Given that fishermen could not afford to fish at 12.1 cents per pound, it suggests that pink salmon prices have to be over 22.4 (= 10.3 + 12.1) cents a pound before producing hatchery fish is profitable.

I have not edited this section because I have insufficient information to know how the PWS costs changed w/ the addition of Valdez costs

A similar comparison can be made for the red salmon program. The reduction in catch due to eliminating the red salmon program is 514.71 m. pounds over thirty years. The estimated savings in costs due to the elimination of the red salmon program are \$106.00 m. undiscounted dollars over ³⁰thirty years. Thus the estimated cost of producing a hatchery raised red salmon is 20.6 cents per pound on average.

Figure One: Marginal and average hatchery costs



Two points should be made about the foregoing analysis. First, ^{bdd}the cost of producing a pound of red salmon by the hatchery program appears to be almost twice as much as the cost of producing a pink salmon. This explains why it is that the elimination of the some red salmon hatchery production may possibly be a good idea. A second point has to do with the way in which we have measured the change in hatchery costs. The survey filled out by hatchery producers asked the question of what would be the change in their operating costs if either the red or pink salmon programs were eliminated.

There is good reason to believe that the answers given by the hatcheries will tend to understate the cost of an additional hatchery produced fish. Consider Figure One. In Figure One, there are three different levels of output depicted. The marginal cost line measures the cost of an additional unit of output. For example, the cost of the output Q1 is C1. If output were to be increased to Q2, then the cost of the Q2th unit would be C2. The average cost if Q2 is produced would be the mean of C1 and C2. Since the average cost includes units of output that have lower marginal costs, the average cost is less than the marginal cost.

enhancement
To further examine the hatchery cost per pound of various species, we collected data from each of the cases 7a, 7b through 11a, 11b, which considers increases or decreases for the particular species by 15% over current commercial catch. The data in Table Four shows a couple of things. First, the relationship between the cost per pound of an increase and a decrease in hatchery output of each species is consistent with what we would believe to be true of costs for red, chin and coho salmon. However, it does not appear to be true for king and pink salmon. For pink salmon, we have that the marginal cost (on average) of an increase by 15% is 5.6 cents per pound. However, the average cost of pink salmon already produced is 10.8 cents per pound. This is inconsistent with what we have shown to be expected in Figure One. The costs are estimated from the hatchery responses to the question of the change in costs to a 15% increase or a 100% decrease. To get a measure of the cost of a 15% decrease, we took 15% of the reported costs of a 100% decrease. The king salmon data appears to suffer from the same problem. It is our feeling that the cost associated with the increase in 15% is the more reliable figure since it is directly estimated by the hatcheries themselves. However, the figure given for the decrease is obtained by imposing

the restriction that the total commercial share of costs of all species produced add up to the total commercial costs. This restriction is not imposed by the increase in production data.⁹ Again, a problem only appears to occur with the pink and king salmon hatchery costs.

Table Four: The hatchery cost per fish for a 15% change in returns by species

(millions of pounds and millions of 1992 dollars)

	CATCH	HATCHCOST	ACATCH	ACOST	\$/LB
Current Level	23332.47	853.45	****	****	****
Increase Pink	23301.88	853.45	22.59	32.37	0.056
Decrease Pink	23377.05	853.45	34.59	10.08	0.029
Increase Red	23404.68	853.45	72.21	15.90	0.216
Decrease Red	23260.40	853.45	72.07	15.90	0.221
Increase Chin	23615.84	853.45	283.43	24.84	0.083
Decrease Chin	23049.01	853.45	283.43	24.13	0.085
Increase Coho	23357.68	853.71	25.21	10.26	0.407
Decrease Coho	23305.74	853.71	25.73	7.47	0.292
Increase King	23346.81	853.71	14.34	4.26	0.297
Decrease King	23318.08	853.71	14.39	21.59	1.500

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Since the difference in hatchery costs has the greatest effect on our cost-be-refit calculations in the pink salmon case, we consider what would happen if we have overstated our estimate of cost savings from eliminating pink salmon production.

⁹The cost data provided by the hatcheries was not entirely reliable. We found that if we added up the total cost savings for the commercial portion of the hatchery output, we generally got a number that was somewhat less than the total cost of the current commercial portion of hatchery costs. We adjusted the figures so that the sum of the 100% reductions would add up to the current hatchery costs attributable to commercial catch (i.e., including the commercial share of the cost recovery catch). For example, the total cost reduction from eliminating all commercial hatchery programs in Prince William Sound accounted for only about 50% of the total current level of commercial hatchery costs there. Thus we increased their estimate by a factor of two to get all costs to be accounted for. This adjustment may account for our difference in estimates of cost for increases versus decreases.

We estimated our cost savings to be about 10 cents per pound. Suppose that instead they had been only 5 cents per pound, which is being charitable to the hypothesis that we are wrong. Then under Case 5, hatchery costs would have decreased by \$200 m. over ³⁰thirty years instead of by \$400 m. as we have estimated. Elimination of the pink salmon ^{enhancement} hatchery production would still result in an increase over current hatchery levels of \$260 m. dollars over ³⁰thirty years, undiscounted. Thus, even at 5 cents a pound hatchery production costs for pink salmon, the elimination of pink salmon alternative is ^{still results in an increase in net} considerably more ~~attractive~~ ^{benefits} ~~than any other alternative save the elimination of the entire program~~

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20701 pink salmon production increases by 15%

Western AK	7835.77	4154.82	990.19	0.00	990.19
Cook Inlet	1753.46	972.85	312.24	71.58	240.66
Kodiak	2470.38	849.70	313.05	32.06	280.99
Prince Wm	5656.48	1444.63	317.17	267.01	50.16
Southeast	6188.45	2026.62	889.38	254.36	635.02
Grand Total	23904.53	9448.63	2822.03	625.01	2197.02

(Case 7b) Pink Salmon Production Decreases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western Ak	7835.77	4180.72	996.61	0.00	996.61
Cook Inlet	1651.40	968.08	310.04	69.55	240.49
Kodiak	2385.11	865.61	321.23	27.85	293.38
Prince Wm	4784.22	1403.25	303.99	242.11	61.88
Southeast AK	6118.46	2103.16	928.16	243.04	685.12
Grand Total	22774.95	9520.82	2860.03	582.55	2277.48

(Case 8a) Red Salmon Production Increases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4143.60	987.77	0.00	987.77
Cook Inlet	1718.31	977.08	313.68	71.41	242.27
Kodiak	2447.88	872.09	322.54	31.33	291.21
Prince Wm	5244.94	1450.22	315.66	258.93	56.74
Southeast	6157.58	2065.19	909.05	260.11	648.94
Grand Total	23404.47	9508.17	2848.71	621.78	2226.93

(Case 8b) Red Salmon Production Decreases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4192.13	999.17	0.00	999.17
Cook Inlet	1687.44	965.91	309.13	71.41	237.72
Kodiak	2402.77	845.60	311.99	28.08	283.91
Prince Wm	5185.11	1405.45	307.62	255.62	52.00
Southeast	6149.32	2066.13	909.57	239.75	669.82
Grand Total	23260.40	9475.22	2837.49	594.87	2242.61

(Case 9a) Chin Salmon Production Increases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.81	4163.64	992.53	0.00	992.53
Cook Inlet	1702.43	969.69	310.95	74.41	236.54
Kodiak	2460.86	859.74	317.38	30.08	287.30
Prince Wm	5273.15	1431.51	312.59	261.40	51.19
Southeast	6353.95	2099.98	924.04	251.75	672.29
Grand Total	23625.99	9524.57	2857.48	617.63	2239.85

(Case 9b) Chum Salmon Production Decreases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.73	4171.96	994.43	0.00	994.43
Cook Inlet	1702.43	972.31	311.71	67.58	244.13
Kodiak	2401.04	858.60	317.25	27.37	289.88
Prince Wn	5156.89	1423.79	310.69	251.02	59.67
Southeast	5952.96	2028.44	893.55	244.28	649.27
Grand Total	23049.04	9455.10	2827.64	590.25	2237.39

(Case 10a) Coho Salmon Production Increases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7834.25	4162.83	991.88	0.00	991.88
Cook Inlet	1703.06	970.95	311.30	72.43	238.87
Kodiak	2426.13	859.20	317.29	29.19	288.09
Prince Wn	5222.87	1431.70	312.44	258.13	54.31
Southeast	6171.38	2077.50	914.36	251.43	662.93
Grand Total	23357.68	9502.18	2847.26	611.18	2236.08

(Case 10b) Coho Salmon Production Decreases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4170.04	994.02	0.00	994.02
Cook Inlet	1701.79	971.18	311.31	70.80	240.50
Kodiak	2425.47	859.63	317.52	28.64	288.89
Prince Wn	5207.18	1424.58	311.18	255.83	55.35
Southeast	6136.53	2054.08	904.11	241.56	662.55
Grand Total	23305.74	9479.51	2838.13	596.82	2241.31

(Case 11a) King Salmon Production Increases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7836.81	4165.84	992.97	0.00	992.97
Cook Inlet	1702.55	970.72	311.33	72.64	238.69
Kodiak	2425.80	858.96	317.17	28.85	288.32
Prince Wn	5216.71	1429.03	311.92	257.87	54.04
Southeast	6165.94	2081.42	916.17	251.29	664.88
Grand Total	23346.81	9505.98	2849.55	610.64	2238.91

(Case 11b) King Salmon Production Decreases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.73	4168.87	993.94	0.00	993.94
Cook Inlet	1702.43	971.28	311.71	70.48	240.79
Kodiak	2401.04	859.78	317.25	27.83	288.73
Prince Wn	5213.27	1427.04	311.78	255.95	55.83
Southeast	6160.99	2049.88	902.56	244.03	658.53
Grand Total	23318.08	9477.87	2837.15	599.32	2237.83

We now turn to the consideration of changes in individual species. We find in fact that a 15% increase or a 15% decrease of a particular species has a very small effect (less than 1%) on net benefits for all cases except pink salmon. Even for pink salmon a 15% increase or decrease in hatchery output has only about a 2%

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effect on net benefits. Although we have not calculated variance parameters for our estimates, it is likely that none of these is a statistically significant change from the current hatchery output levels. The summary data for the entire state is given in Table Six. We have not included regional data since the total effect is so small. However, this data can be found in Appendix One.

⁵
Table Six: Comparison of current hatchery production levels with 15% increases and decreases by species for hatchery produced stocks

(millions of pounds and millions of 1992 dollars)

	CATCH	REVENUES	SURPLUS	HATCHCOST	NET BENEFIT
Case 1. Current Level	23332.47	16075.00	4860.79	859.45	4001.34
Case 7 Increase Pink	23904.53	15997.97	4823.10	891.71	3931.39
Decrease Pink	22774.93	16126.83	4890.49	799.44	4091.06
Case 8 Increase Red	23404.47	16105.51	4871.04	894.36	3986.68
Decrease Red	23280.40	16043.79	4849.71	843.55	4006.16
Case 9 Increase Chum	23615.89	16136.18	4887.74	885.79	4001.95
Decrease Chum	23048.04	16006.04	4831.22	835.32	3995.90
Case 10 Increase Coho	23357.68	16094.83	4885.94	869.71	3999.22
Decrease Coho	23305.74	16052.77	4851.12	852.18	3999.00
Case 11 Increase King	23346.81	16102.68	4873.08	853.71	4009.37
Decrease King	23318.08	16047.68	4848.88	897.86	4011.01

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A more interesting comparison is contained in Table Seven. There we calculate the change in producer's surplus resulting from either an increase or decrease in the quantity of salmon produced by the hatcheries. Our numbers suggest that a 15% increase or decrease of pink salmon would result in a 2% change in producer's surplus. This is the same estimate (Table Four)

bold

of the cost per pound to produce a pound of hatchery raised pink salmon was 5.6¢ and [redacted] cents per pound. Thus it appears that the cost per pound of producing pink salmon by hatchery production is greater than the producer's surplus it generates to fishermen. //

This result seems to be true of red salmon also. Our estimate of the cost per pound to raise red salmon in hatcheries ranged from 2.5¢ to 3.4¢ cents per pound. However, our estimate of the average producer's surplus gained by this production is only 1.5¢ cents per pound. Before too much credence is placed on these numbers, however, it must be mentioned that our estimate of producer's surplus for red salmon is mainly from Bristol Bay (recorded as Western Alaska in our tables). Recall that our estimates for producer's surplus for Bristol Bay were made using average data from similar fisheries elsewhere in the state. We have no way of knowing how accurate these predictions are given that they are extrapolating well beyond the data available from fisheries elsewhere in Alaska.

Chum salmon also appears to have hatchery production costs that are roughly equal to the producer's surplus generated by an extra pound produced. We estimate that it costs between [redacted] and [redacted] cents to produce another pound of hatchery raised chum salmon, but fishermen receive producer's surplus of only about [redacted] cents per pound.

Coho is similar. Coho are estimated to cost between [redacted] and [redacted] cents per pound to produce, but generate producer's surplus on the order of between [redacted] and [redacted] cents per pound.

King salmon may be the best bet: If the marginal cost of king salmon based on an increase of [redacted] is accurate, then the cost of a king salmon is estimated to be about [redacted] cents per pound. Our estimate of the return in producer's surplus per

pound of king salmon is between \$2.25 and \$2.50 per pound. However, if the marginal cost of king salmon based on a decrease is correct, then king salmon costs about \$2.50 per pound to produce. If this is true, then even king salmon fails to produce net benefits.

^{SIX}
Table ~~Six~~ Estimates of producer's surplus created by an additional pound of salmon by species

(millions of pounds and millions of 1992 dollars)

	CATCH	SURPLUS	ΔCATCH	ΔSURPLUS	SURPLUS \$/LB
Case 1 current level	23332.47	4860.79	****	****	****
Case 7					
Increase Pink	23904.53	4823.10	572.06	37.69	0.066
Decrease Pink	22774.95	4890.49	-857.52	-29.70	0.053
Case 8					
Increase Red	23404.47	4871.04	72.00	10.25	0.142
Decrease Red	23260.40	4849.71	-72.07	-11.08	0.154
Case 9					
Increase Chum	23615.89	4887.74	283.42	26.95	0.095
Decrease Chum	23049.04	4831.22	-283.43	-29.57	0.104
Case 10					
Increase Coho	23357.68	4868.94	25.21	8.15	0.323
Decrease Coho	23305.74	4851.17	-26.73	-9.62	0.360
Case 11					
Increase King	23345.81	4873.08	14.94	12.29	0.857
Decrease King	23318.08	4848.88	-14.39	-11.91	0.828

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Conclusions and Recommendations

Our results do not paint a very encouraging picture for the hatchery program.

Based on our point estimates for the alternatives, we believe our models were able to generate accurate results, the best alternative is to actually close the pink salmon hatcheries, or at least considerably scale them back. However, we would not recommend that the state force all hatcheries to shut down. We would

of the change in net benefits relative to the size of the pink program and uncertainty regarding variables that may affect Alaska salmon prices, the best alternative for Alaska would be the curtailment of state subsidies (primarily through the loan program) for continued expansion of the hatched pink salmon production. In addition, study results indicate that shifting hatchery production to king salmon may not be cost effective because of high production costs for king salmon.

recommend that if a region wants to continue with a hatchery program, that it ^{enhancement} would result from ~~an~~ ^{no subsidized} program entirely should be funded by the local user groups rather than by the state. ^{the optimal economic output}

If the fishermen ^{and hatcheries} themselves fund the hatchery program, they will only choose ^{enhancement} projects ^{that} which are cost-effective within their own region. There may still be regional effects in that production in one region causes prices to decline elsewhere, but ^{the} ^{that would} ^{would} whenever hatchery production remains will be cost effective. Table ³⁰⁻ Eight compares the thirty year returns (undiscounted) for each alternative by region. Because we believe that our estimates of net benefits for Cases 2, 3, 4a, and 4b must be viewed with a great deal of caution, ^{they are presented in the final section of this report.} we separate them out in Table ~~Eight~~.

^{shown}
Table Eight: Net Benefits by Region, By Alternative

(millions of 1997 dollars)

CASE	WESTERN	COOK INLET	KODIAK	FWS	SOUTHEAST	TOTAL
1	1700.36	441.79	499.07	158.36	1201.76	4001.34
5	1763.25	413.84	531.77	206.90	1363.88	4461.65
6	1779.38	413.77	422.60	201.97	1203.00	4022.72
7a	1634.53	443.16	483.68	152.87	1155.14	3931.39
7b	1706.17	439.39	506.20	182.35	1256.94	4091.06
8a	1689.64	441.46	506.79	157.25	1191.55	3986.68
8b	1711.29	437.49	488.84	166.35	1202.19	4006.16
9a	1698.72	441.04	494.97	155.98	1211.24	4001.95
9b	1702.31	442.96	498.74	158.16	1193.73	3995.90
10a	1698.45	440.36	498.31	157.17	1204.94	3999.22
10b	1701.52	444.58	499.33	157.63	1196.93	3999.00
11a	1639.58	443.07	488.68	157.80	1210.27	4009.37
11b	1701.62	448.25	506.80	158.31	1196.23	4011.01
2	1626.56	481.57	471.51	228.96	1151.24	3957.84
3	1812.84	467.50	538.37	229.91	1471.58	4621.20
4a	1671.50	436.81	479.91	134.11	1122.38	3844.72
4b	1724.08	445.81	499.93	217.09	1226.90	4113.80

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The net benefit figures in each row of Table Eight² are the returns for each region given that all regions are following the same hatchery production alternative. That is, for the region to get the estimated net benefits listed for a particular alternative, every region has to be following the same alternative.

We have bolded the number in each column that corresponds to the best alternative for the region under the assumption that the region is financing its own hatchery program. In the subset of alternatives for which we express confidence in our net benefits estimates (Cases 1, and 5-11), alternative 5, shutting down the entire pink salmon hatchery production, is the best alternative for Kodiak, Prince William Sound, and Southeast. That is, if these regions could get the rest of the state to agree to follow alternative 5, they would get the highest returns under a self-financed hatchery program.

The question is would the other two regions also want to follow alternative 5? While Western Alaska would benefit if the pink salmon program ^{were} shut down, their first preference would be that the red salmon hatchery production be shut down (Alternative 6). This is because red salmon dominates Western Alaska catch, so if everyone else shuts down red salmon ^{enhanced} hatchery production, Western Alaska red salmon prices rise at no additional cost to them. However, since Western Alaska only has one hatchery, and it produces only chin, it cannot independently influence the behavior of the other regions.

Cook Inlet is the odd-one of the regions. Under a self-financing program, our estimates indicate that Cook Inlet would prefer everyone else shut down their king salmon programs. But since no other region will prefer this option, this alternative is not a feasible solution. If every other region is scaling back pink salmon hatchery production, Cook Inlet is made worse off relative to the current

production levels. The question is could Cook Inlet by itself influence the actions of the other regions? The answer is probably, though not definitely, "no." The reason is this: Prince William Sound is producing currently 124 m. pounds of pink salmon. Cook Inlet is currently producing under 7 m. pounds, of which less than half comes from ^{enhanced} hatchery production. Thus, even if Cook Inlet felt that it could produce pink salmon at a net benefit to its fishermen, it is doubtful that it would have enough of an impact on prices to warrant the other regions changing their minds about scaling back their own pink salmon programs.

Notice that when Alternatives 2, 3, 4a and 4b are included, Kodiak, Southeast, Prince William Sound and Western Alaska all prefer shutting down either all of the pink salmon or shutting down the entire program. This suggests that if the hatcheries are to be ^{completely} self-financed, they will on their own choose to scale back their operations.²⁰ Thus, we view turning over the financing of the ^{enhancement program} hatcheries entirely to the regions as the best alternative for the ^{Alaska} state. The actions we predict the regions to take assumes that our point estimates are correct. If they are not correct, ^{complete} self-financing is still a better idea than continued state funding ^{support} because it makes the regions themselves decide what levels of hatchery production give them the highest returns.

It is likely that enhanced
If our recommendations are followed, hatchery production of fish for sport and subsistence purposes will most likely not continue without some state funding.

We have made no effort to analyze the net benefits from ^{enhanced} hatchery production on other user groups. The way that we have calculated hatchery costs suggests that the same per pound costs obtained in our study are a reasonable approximation in

²⁰ There may be a problem with the information gained by the hatcheries under a self-financing operation. Since the hatcheries generally take fish that are higher quality (because of less handling) and are cheap to harvest (because they are not caught in the hatchery), the price and cost information may be biased. However, as long as the fishermen themselves have a say in the quantity produced by the hatcheries, this bias should not be a problem.

However, Alaska fisheries do compete with farmed-salmon production subsidized in other countries. If the state of Alaska chooses to continue to subsidize enhanced production, more attention should be made to ensuring a more optimal output. Expansion of pink or red salmon production do not appear to meet that

enhanced
enhancement
the range of small changes in hatchery production to the hatchery costs for fish no matter what their use. To estimate more fully the benefits and costs to other user groups, the state would have to determine the net benefits to those groups.

There also may be some strategic reasons for ^{avoiding abrupt reductions in enhanced} maintaining some hatchery production. For example, it appears that hatchery exports of pink salmon may be starting in the former Soviet Union. Chile also appears to have room for expansion of its farmed salmon program. If these countries are able to produce fish less expensively than Alaska, then there will be ^{impossible} no way to stop them from entering in the long run. However, by maintaining ^{Alaska enhanced} some hatchery production, prices may remain depressed enough to prevent ^{or postpone some of} expansions in those areas. As long as the price is not driven down to the level that it would reach if those areas do enter the market, the hatchery dollars spent on prevention of entry may be well spent. However, this is not a strategy which can remain viable over the long run.

There are a number of other things that the state might do with monies saved from the hatchery program. One obvious area is to engage in demand-enhancing activities, such as increased attention to quality and seeking out new product forms. Again, we emphasize that if such activities are truly profitable, then the fishing industry itself should be willing to finance them rather than the state.

Another area that appears to be fruitful for future exploration is the allocation among gear groups. In the cost study we observed that the different gear groups have vastly different levels of producer's surplus. The gear group that does the best is the set net fleets. This is mainly because these fleets have such low capital costs. The bottom line is it is more efficient to let the fish come to the fisherman than to have the fisherman go to the fish.

do not believe the analysis was sufficient
extension to most
this type of
conclusion esp. since
only one set net
fishery was analyzed
none of the
bottom gear fisheries

Finally, let us re-emphasize that our estimates of net benefit are based on parameters estimated from relatively short time periods and were extrapolated well beyond the time horizon for which accurate estimates may be obtained. There are also a number of exogenous factors, such as what is happening in the rest of the salmon suppliers' markets, that have changed far too rapidly over the last decade to allow precise estimates of where the industry will be in one, two or three decades. In spite of this, given our predictions of trends in the rest of the markets, ^{at the very least} we believe that the hatchery program, and especially the pink salmon program, ^{not be expanded and might produce great benefits if it were} should be scaled back. Our estimates suggest that to do so could result in an increase of net benefits to the state on the order of almost a half billion dollars over ³⁰⁻thirty years relative to current and planned production levels.

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Results of Cases 2, 3, 4a and 4b

This section compares current enhanced production levels (Case 1) with operators planned production (Case 2), elimination of the entire program (Case 3), and 15% increase, decrease in entire enhancement program production levels (Case 4a and 4b).

Comparing planned hatchery production with current hatchery production.

The second alternative considered was the "planned hatchery production levels," Case 2. This comparison is made in Table Two. The catch levels projected by the hatcheries were obtained in a survey conducted by the Department of Fish and Game, FRED division. We estimated that if the state follows the planned hatchery production alternative the ³⁰⁻year undiscounted sum is ~~\$3,950m~~ (\$2,303 b) if discounted at 4%, for an average net benefit of \$132m per year. The estimated returns under the current hatchery production levels were ~~\$2,303m~~ per year, or about a million dollars a year higher. Our estimation results of Case 2 should be viewed as a lower bound prediction of net benefits for Case 2. The reason is that the simultaneous large increases in a number of species under the planned output levels forces into play a number of complex cross price effects, which our demand model is not well adapted to consider.

The distribution of net benefits under the planned hatchery production levels also changes from the current levels. Under the planned levels, Prince William Sound will gain almost seventy million dollars over thirty years, up to net benefits of ~~\$2,303m~~ from net benefits of ~~\$1,300m~~ under current levels.⁷ Cook Inlet also gains, increasing to ~~\$9,000m~~ from ~~\$4,000m~~ under current levels.

⁷The figures we are citing are the undiscounted sums. The appropriate measure for cost-benefit analysis is the discounted figures. We found that the discounting did not affect the relative rankings of the various alternatives since costs and benefits are dispersed fairly evenly over the planning horizon. Since the undiscounted numbers are the least confusing to look at, we use them in the analysis.

However, these projected gains are more than offset by the projected losses elsewhere. Western Alaska loses the most, down to ~~\$16,000,000~~ m. from ~~\$17,000,000~~ m. over ²⁷thirty years. Southeast is projected to have net benefits under the planned case of ~~\$10,000,000~~ m., down from ~~\$10,000,000~~ m. under the current levels. Kodiak also loses under the planned alternative relative to the current levels since net benefits drop to ~~\$4,000,000~~ m. from ~~\$10,000,000~~ m. The regions that gain, Prince William Sound and Cook Inlet, gain by an amount less than the remaining regions lose by average of ~~\$1,000,000~~ per year. Thus, our projection suggests that the current hatchery levels are to be preferred over the planned hatchery production levels.//

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It is instructive to look at what is changing under the planned hatchery levels relative to the current hatchery production levels. The thirty year sum (undiscounted) totals for each alternative are given below in Table Two.

The catch differences between the current (Case 1) and the planned (Case 2) production are that Cook Inlet, Prince William Sound, and Southeast all have larger catches under the planned than under the current case. Prince William Sound accounted for the largest share of the increase, adding ~~10~~ million pounds over the thirty year period. Cook Inlet and Southeast increase catch by about ~~5~~ and ~~5~~ million pounds, respectively. The catch in Kodiak and Western Alaska are almost unchanged. In net, there is an increase of ~~20~~ million pounds of fish caught over the thirty years, or about ~~2~~ million pounds per year more in catch.

Table ^H Regional summaries for current (Case 1) and planned (Case 2) hatchery production

(millions of pounds and millions of 1992 dollars)

Case 1: Current Level

	CATCH	REVENUES	SURPLUS	HATCHCOST	NET BENEFIT
Western AK	7835.77	7078.92	1700.36	0.00	1700.36
Cook Inlet	1702.43	1572.88	508.05	66.26	441.79
Kodiak	2425.80	1466.39	548.09	49.02	499.07
Prince Wm.	5215.02	2422.53	536.05	377.69	158.36
Southeast	6153.45	3534.28	1568.25	366.48	1201.76
State Total	23332.47	16075.00	4860.79	859.45	4001.34

living #5

(Case 2) Planned Hatchery Production Levels

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NET BENEFIT
Western AK	7835.79	4061.99	955.09	0.00	955.09
Cook Inlet	1840.07	1034.46	332.27	41.79	290.48
Kodiak	2424.90	833.69	303.21	28.85	274.36
Prince Wm	5702.03	1533.45	352.20	262.05	90.16
Southeast	6268.58	2048.66	893.61	118.82	774.79
Grand Total	24071.37	9512.25	2836.38	451.50	2384.88

Consider how the changes in the catch affected the changes in revenues. In fact, revenues increased to \$16,075 under the planned production levels from \$16,075 under current production levels. This increase of \$35.16 m. over thirty years is relatively small, about \$1,172 per year. The increase in revenues was not uniform across the regions, however. Revenues in Cook Inlet and Prince William Sound increase under the planned hatchery production relative to the current, but all other areas would have a decrease in revenues. Cook Inlet revenues increase by \$158.36, or about \$5.28 per year. Prince William Sound revenues increased by \$158.36, or an average of \$5.28 m. per year. Western Alaska, Kodiak, and Southeast all had reductions in revenues. Western Alaska revenues decreased by \$499.07, or an average loss in revenues of \$6.26

m., per year. Kodiak revenues decreased by \$45.79 m., or by \$1.58 m. per year. Southeast lost an additional \$27.41 m., or about \$0.91 m. per year.

The revenue changes are discussed in more detail in the demand analysis report. However, the main effect on revenues of the increase in production in Prince William Sound, Cook Inlet, and Southeast is to depress revenues in three areas (Western Alaska, Kodiak, and Southeast), and increase revenues in two areas (Cook Inlet and Prince William Sound). In net, the increases in revenues were greater than the losses. The curious finding here is that increases in Southeast, when coupled with the increases in Prince William Sound and Cook Inlet, actually lead to decreases in revenues in Southeast. It is doubtful that taken by itself, an increase in Southeast production would have depressed revenues in Southeast. However, when coupled with the increases in Prince William Sound and Cook Inlet, the net effect was a decrease in Southeast revenues.

The producer's surplus measures the net benefits (revenues minus costs) to the fishermen in each region. If the hatchery program continued at planned levels rather than at current production levels, we estimated that while gross revenues increased by \$35.16 m. over the thirty year period, net revenues to the fishermen measured by producer's surplus actually decreased \$11.39 m. As with the revenues, the distribution of gains and losses was not the same across regions. Cook Inlet and Prince William Sound each experienced gains in producer's surplus. Each of the other regions experienced losses in producer's surplus. The net gains and losses are as follows: Prince William Sound was the biggest gainer, with an increase in producer's surplus of \$80.49 m., or \$2.68 m. per year. Cook Inlet showed gains of \$41.92 m., or \$1.40 m. per year. The total gain of these two areas was \$122.41 m. total over thirty years, or \$4.08 m. per year. The biggest loser was Western Alaska. The losses there would be \$75.80 m. over thirty years,

or \$2.53 m. per year. Southeast lost the next most, having a reduction in producer's surplus of \$30.45 m. over thirty years, or \$1.02 m. per year. Kodiak would lose producer's surplus of \$27.56 m. over thirty years, or \$0.92 m. per year. The totals for the three areas losing producer's surplus are losses of \$133.81 m. over thirty years, or \$4.46 m. per year. Compare this with the total gain per year in Cook Inlet and Prince William Sound, and there is a net loss of \$0.38 m. per year relative to the current case.

While the producer's surplus net gains and losses are almost a wash, with the losers losing about \$0.38 m. a year more than the winners are gaining, the true measure of the difference is in the hatchery costs. Given net losses to fishermen on the order of \$11.69 m. over thirty years, we estimate that hatchery costs will rise by \$32.10 m. dollars over the thirty year planning horizon. That is, in addition to the net losses in producer's surplus by fishermen of \$11.69 m., there is also an increase in hatchery costs of \$32.10 m. The total cost of the planned hatchery output relative to the current hatchery output levels is thus the sum of the reduction in producer's surplus plus the increase in hatchery costs. This sums to a net loss of \$43.79 m. over the thirty year planning horizon, or a net cost of \$1.46 m. per year. In present value terms at a discount rate of 4%, the difference is - \$26.62 m. That is, our estimates say that if we follow the planned levels rather than the current levels, it will be as though we lost \$26.62 m. today.

The direction of the changes is consistent under alternative assumptions about the prices. If prices follow the optimistic projections instead of the midpoints, the current production levels provide an estimated net return to the state over thirty years of \$50.93 m. undiscounted dollars and \$30.17 m. discounted dollars. Under the pessimistic price scenario, the difference is \$41.26 m. undiscounted or \$25.47 m. discounted dollars at a 4% rate of discount.

The next set of alternatives we consider are the alternatives in which either all hatchery production is increased by 15% (Case 4a), or all hatchery production is decreased by 15% (Case 4b). Before we turn to the analysis of the actual alternatives, we want to remind the reader of the main caveat having to do with these alternatives. That is, because all hatchery production for all species are simultaneously increasing or decreasing by 15%, there are a number of complicated interaction effects that are taking place. Our demand models are very weak in this respect. Because we restricted the international level of the demand model to low and high valued species, we do not have estimates of substitution elasticity's that were calculated within each group. To estimate prices by species we used correlation's between the species price and the aggregate price for the group. While these correlation's give us an idea about how the relative prices of the species move in relation to one another, they do not give us a measure of the substitution elasticity between species. Therefore, when all species are simultaneously increasing or decreasing, we end up with a measure of correlation's

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between price movements. The problem is that a salmon is not a salmon. Pink and chum salmon, for example are very different from one another, and there is no a priori reason to believe that the correlation between prices conveys much information about the actual willingness of consumers to substitute between the two as relative prices change. Not only is a salmon not a salmon to consumers, but our analysis on the cost of producing an additional salmon shows that their relative hatchery costs are much different. We will consider below the effect on fishermen's net revenues of increases in each species.

Table Five: Comparison of current hatchery production levels with 15% increases and decreases in all hatchery produced stocks

(millions of pounds and millions of 1992 dollars)

Case 1: Current Level

	CATCH	REVENUES	SURPLUS	HATCHCOST	NET BENEFIT
Western AK	7835.77	7078.82	1700.36	0.00	1700.36
Cook Inlet	1702.43	1572.88	508.05	56.26	441.79
Kodiak	2425.80	1465.33	548.89	49.02	499.87
Prince Wl.	5215.02	2422.83	538.05	377.69	158.36
Southeast	6153.45	3534.28	1568.25	365.48	1201.76
State Total	23332.47	16075.00	4860.79	859.45	4001.34

Case 4(a): Decrease all species by 15%

	CATCH	REVENUES	SURPLUS	HATCHCOST	NET BENEFIT
Western AK	7835.85	6958.94	1671.50	0.00	1671.50
Cook Inlet	1770.18	1574.82	508.85	73.03	435.81
Kodiak	2517.54	1460.58	541.22	61.31	479.91
Prince Wl.	5754.06	2456.17	543.22	409.11	134.11
Southeast	6623.49	3506.01	1547.67	425.29	1122.38
State Total	24801.03	15945.46	4813.45	968.74	3844.72

Case 4(b): Decrease all species by 15%

	CATCH	REVENUES	SURPLUS	HATCHCOST	NET BENEFIT
Western AK	7835.63	7178.62	1724.08	0.00	1724.08
Cook Inlet	1635.65	1563.02	502.13	56.32	445.81
Kodiak	2336.98	1444.22	541.59	41.66	499.93
Prince Wl.	5117.45	2420.15	538.13	321.04	217.09
Southeast	5883.45	3462.62	1538.41	311.51	1226.90
State Total	22809.22	15068.62	4844.34	730.53	4113.80

Having given all of these caveats, let us consider the effect of either an increase or a decrease in the entire hatchery program. Data from Case 4a and 4b is compared with the current hatchery production levels in Table Five.

B.

The results of Table Five can be summarized as follows: Either an increase or a decrease in all hatchery production by 15% will cause both revenues and producer's surplus to decrease. The decrease in revenues and producer's surplus is

Table B

(Case 1) Base Case: Current Hatchery Production

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4167.79	993.40	0.00	993.40
Cook Inlet	1702.43	971.00	311.34	71.41	239.93
Kodiak	2425.80	859.36	317.38	28.85	288.53
Prince Wm	5215.02	1428.06	311.80	256.17	55.63
Southeast	6153.45	2065.68	909.34	247.03	662.31
Grand Total	23332.47	9491.89	2843.27	603.46	2239.81

(Case 4a) All Hatchery Production Increases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.85	4102.64	978.03	0.00	978.03
Cook Inlet	1770.10	972.06	312.23	76.82	235.41
Kodiak	2517.54	850.27	313.51	36.11	277.39
Prince Wm	5754.06	1446.75	315.58	278.67	36.91
Southeast	6423.49	2047.35	896.97	280.81	616.15
Grand Total	24301.03	9419.07	2816.32	672.42	2143.90

(Case 4b) All Hatchery Production Decreases 15%

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.69	4220.93	1005.97	0.00	1005.97
Cook Inlet	1635.65	965.21	308.19	64.20	243.99
Kodiak	2336.98	847.79	313.84	25.39	288.45
Prince Wm	5117.45	1427.09	313.03	235.86	77.17
Southeast	5883.45	2027.96	893.89	224.54	669.35
Grand Total	22899.22	9488.97	2834.92	549.99	2284.93

greater if the hatchery production increases (Case 4a) than if it decreases (Case 4b). If hatchery production increases by 15% for all species, then the estimated increase in hatchery costs is ^{68.9} ~~about~~ ³⁰ \$110 m. over thirty years. The increase in hatchery costs plus the decrease in producer's surplus means that relative to current hatchery output levels, an increase by 15% across the board would cause the state to lose ^{75.9} ~~\$156.62~~ ³⁰ m. (undiscounted) over thirty years, or about ~~\$5.22~~ ³⁰ per year. If all hatchery production decreases by 15%, then producer's surplus is estimated to decrease by ^{6.4} ~~\$16.45~~ ³⁰ m. (undiscounted) over thirty years. However, hatchery costs are estimated to decrease by ^{5.5} ~~\$128.92~~ ^{45.1} m, for a net increase of ³⁰ ~~\$112.46~~ ³⁰ m. (undiscounted) over thirty years. Interestingly, about the only major distributional effect in producer's surplus has to do with Western Alaska, which stands to lose slightly less than a million dollars a year with an increase of 15% of all hatchery stocks and stands to gain less than a million a year with a decrease of 15%.

Again, we want to emphasize that neither of these alternatives are very appealing. The idea of an across the board increase or decrease ignores the fact that the effect of a change in the quantity of one species may be considerably different than for another species both for consumers and hence for ex-vessel prices, and for production since hatchery costs are not identical across species.

Comparison of current production with eliminating the entire enhancement program

Under Case 5,

elimination of the entire pink salmon portion of the hatchery program, we estimate that the state received returns of \$4,461 b. dollars over the thirty year planning horizon. This is \$460 m. more than under the current hatchery output levels, or an increase in welfare of the state of \$5.18 m. per year. *delete*

Under elimination of the entire hatchery program, we find that undiscounted producer's surplus to fishermen over thirty years decreases to \$4,649 b. from \$4,869 b. under the current hatchery output alternative, for a decrease of \$217.41 m., or a decrease of about \$7.25 m. per year.

This is only \$21 m. more than under current production levels over thirty years, or about \$0.70 m. per year.

Case 1, Current production with

Table Three

Comparison of eliminating the entire hatchery program (Case 3), the entire pink salmon hatchery production (Case 5), and the entire red salmon hatchery production (Case 6)

(millions of pounds and millions of 1992 dollars) discount 4%

(Case 1) Base Case: Current Hatchery Production

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.77	4167.79	993.40	0.00	993.40
Cook Inlet	1702.43	971.00	311.34	71.41	239.93
Kodiak	2425.80	859.36	317.38	28.85	288.53
Prince Wn	5215.02	1428.06	311.80	256.17	55.63
Southeast	6153.45	2065.68	909.34	247.73	662.31
Grand Total	23332.47	9491.89	2843.27	603.46	2239.81

AREA	CATCH	REVENUES	SURPLUS	HATCHCST	NETBENFT
Western AK	7835.24	4654.05	1109.59	0.00	1109.59
Cook Inlet	1289.05	925.04	290.69	1.78	288.91
Kodiak	1888.76	844.08	316.86	1.38	309.48
Prince Wn	1548.73	758.25	150.48	5.81	144.67
Southeast	4398.53	1923.53	872.27	8.58	863.69
Grand Total	18960.32	9101.87	2733.88	17.55	2716.33

The differences in total net benefits to the state cannot be explained by catch and revenue data alone. What we find is that elimination of any portion of the program causes catch to decrease. This results in a reduction in revenues relative to the current production levels. Thus, the gain in net benefits is not due to a gain in revenues but to a decrease in costs of running the ^{enhancement} hatchery program. Under the eliminate all alternative (Case 3), catch decreases by 28%, down to 16,802 b. pounds over 30 years from 23,332 b. pounds under the current output level. However, revenues only decrease by 4.6%, down to \$15,335 b. from \$16,075 b. over thirty years.

Thus if the financing for the hatchery program were to entirely be financed within the region, the best alternative to Prince William Sound would be to eliminate the hatchery program given that the same is occurring throughout the rest of the state.

Under the elimination of the entire hatchery program, the producer's surplus decreases by ^{109.4} \$217.41 m. over thirty years, but this is more than offset by a decrease in hatchery costs of ^{585.9} \$837.27 m. Thus the net gain to the state of ^{476.5} \$619.86 m. over thirty years is due to savings in the cost of the hatchery program. In essence, this tells us that the cost to provide fishermen with ^{109.4} \$217.41 m. in additional producer's surplus is an additional ^{585.9} \$837.27 m. in hatchery costs. This means that if the state wishes to increase the producer's surplus of fishermen by ^{109.4} \$217.41 m., by giving a direct subsidy to the fishermen of the \$217.41 m. in lost producer's surplus instead of running the hatchery program, the state would ^{476.5} save \$619.86 m. over the next thirty years.

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International Marketing Model of Alaska Salmon: Progress Report

This research is being conducted by Dr. Mark Herrmann and Dr. Joshua Greenberg, economists at the University of Alaska Fairbanks for the Senate Special Committee on Domestic and International Commercial Fisheries. It is one component of the economic benefit-cost analysis being conducted for the Legislative Review of the Alaska Salmon Enhancement Project. The purpose of the salmon demand and marketing research is to describe the relationship between salmon prices and quantities, and the various market conditions that influence these variables. The following information summarizes some of the preliminary findings.

- * The current economic model is being constructed with the specific objective of developing long-term forecasts for benefit-cost analysis rather than for annual price forecasting.
- * Alaska salmon ex-vessel prices by region, species, and gear type of the harvest fishery will be forecasted to conduct the benefit-cost analysis of the salmon enhancement program.
- * One of the findings was that farmed Atlantic salmon substituted with sockeye, chinook, and coho salmon with a 98.1 percent probability.
- * Ex-vessel price flexibilities measure the percentage change in the ex-vessel price given a one percent change in landings, holding other factors constant. For an increase in landings, a price flexibility of greater than one (in absolute terms) suggests that the percentage decrease in price will more than offset the percentage increase in landings. In such cases, increased landing would result in decreased total revenues to the fishery.
- * Preliminary estimations of the average salmon ex-vessel price flexibilities range between -0.60 and -0.85. this means that a one percent increase in landings results in a 0.60 to 0.85 percent decrease in ex-vessel price. Thus, the increase in landings in the fishery are partially offset by the price reductions. These price flexibilities are higher than those found in previous studies.
- * These preliminary results raise the possibility that very high landings in the Alaska salmon fisheries may decrease revenues to the industry.

- * Preliminary results indicate that the increased supply of world salmon may have shifted the demand curve for salmon inward (see page 9 of the executive summary). This suggests that Alaska salmon prices will face continued downward pressure during years of high production unless market expansions can shift the demand curve outward again.
- * The downward price adjustments are the mechanism through which increased Alaska production is absorbed into the existing world market.
- * These early results indicate that Alaska ex-vessel salmon prices may be more responsive to landings than previously believed. These leaves open the possibility that, in higher yielding years, Alaska salmon hatcheries may be producing near the economic optimum number of salmon. However, given their potential ramifications, these finds should be viewed as strictly preliminary. To evaluate their full implication, they must be integrated with the fishing cost and population project components of the project.