Round Weight Conversion Factors for Pacific Ocean Perch *(Sebastes alutus)* Processed by B. C. Freezer Trawlers

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ROUND WEIGHT CONVERSION FACTORS FOR PACIFIC OCEAN PERCH (*Sebastes alutus*) PROCESSED BY B.C. FREEZER TRAWLERS

by

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ABSTRACT

Stanley, R. D. and A. C. C. Otterdyks. 1987. Round weight conversion factors for Pacific ocean perch (Sebastes alutus) processed by B.C. freezer trawlers. Can. MS Rep. Fish. Aquat. Sci. 1925: 28 p.

Two B.C. domestic trawlers, the F/V HOWE BAY and F/V NEMESIS, currently dress and freeze at sea most of their catch of Pacific ocean perch (Sebastes alutus). The Department of Fisheries and Oceans maintains catch statistics in fresh whole weight therefore a conversion factor is required to modify the sales slip data on frozen dressed product for the freezer vessels. Through use of a length/weight formula and a study of the product from these two vessels, a conversion factor of 1.6 was chosen to be representative.

RESUME

Stanley, R. D. and A. C. C. Otterdyks. 1987. Round weight conversion factors for Pacific ocean perch (Sebastes alutus) processed by B.C. freezer trawlers. Can. MS Rep. Fish. Aquat. Sci. 1925: 28 p.

La plupart des prises de sébaste à longue mâchoire (Sebastes alutus) effectuées par le HOWE BAY et le NEMESIS, deux chalutiers canadiens de la C.-B., sont actuellement apprêtées et congelées en mer. Étant donné que les statistiques sur les prises du ministère des Pêches et des Océans sont exprimées en poids entier frais, on a besoin d'un facteur de conversion afin de modifier les données des bordereaux d'achat pour ce qui est des produits parés et congelés préparés par les chalutiers-congélateurs. Suite à l'utilisation d'une formule longueur/poids et à une étude des produits préparés par ces deux chalutiers, on a choisi un facteur de conversion de 1,6.

INTRODUCTION

The purpose of this study was to determine a round weight conversion factor for Pacific ocean perch (Sebastes alutus) processed by domestic freezer trawlers. Both Fisheries Research Branch and Fisheries Branch of DFO maintain catch data bases that require detailed catch by species in round whole weight. The sales slip data for these freezer trawlers, in frozen, glazed and dressed head-off (DHOFF) weight, must be converted to its round weight equivalent to be congruent with the data bases.

The derivation of the conversion factor requires three steps. Firstly, a length-weight formula is required to predict the original round weight from a length measurement obtainable from the processed specimens. The second step is to purchase product from commercial vessels and compare DHOFF thawed weight to the original weight as predicted from the length measurement. The third step is to estimate the added weight from glazing that is included in the sales slip values.

The present report documents the derivation of the length-weight formula for Pacific ocean perch and the estimation of conversion factors for two B.C. freezer trawlers, the F/V HOWE BAY and the F/V NEMESIS.

METHODS AND RESULTS

DERIVATION OF THE LENGTH/WEIGHT FORMULA

The equation relating dressed length to original whole weight for Pacific ocean perch was determined from a length-stratified sample of 93 specimens, collected on the R/V G.B. REED, during an October-November 1985 cruise. The complete data are included as Appendix 1. Marketable size for Pacific ocean perch is $\geq$33 cm.

Sample sizes per interval were as follows:

Size (cm)	n
33-34	8
35-36	15
37-38	15
39-40	13
41-42	14
43-44	14
45-46	14
Total	93

Five length measurements as well as the whole weight in grams (g) and the DHOFF weight (g) were recorded for each fresh specimen (Fig. 1). The

five length measurements were:

1. Fork length (cm)
2. Standard length (cm)
3. Dorsal fin origin to hypural flexion (mm)
4. Anal fin origin to hypural flexion (mm)
5. Dorsal fin origin to anal fin insertion (mm)

Calipers were used to obtain measurements 3, 4, and 5. The specimens were headed, gutted, weighed and placed in aluminum trays. The bodies were packed in 10-kg blocks to simulate the NEMESIS and HOWE BAY procedures and then placed in a sharp freezer (-30°C) for 24 h. The frozen blocks were then glazed with salt water and kept in cold storage (-10°C) for two weeks. Final measurements were obtained after the specimens had been allowed to thaw while covered in a cooler for 72 h. The specimens were re-weighed and lengths #3, #4 and #5 were re-measured.

Each length measurement after thawing was compared with the original fresh weight of the specimens using linear and log-linear predictive regressions. The distance between the dorsal fin origin and the anal fin insertion (DA) was shown to be the best predictor of original whole body weight ($r^2 = 0.96$) (Figures 2 and 3). The post-processing length measurement allowed us to incorporate the effect of shrinkage in that the DA measurement was taken after the specimens had been headed, frozen, stored and then thawed. Shrinkage in length varied from 1 to 6%. Regression statistics are shown in Table 1. The best equation for estimating the original fresh weight (g) from the processed DA measurement (mm) was:

$$\text{Log}_e(\text{fresh weight}) = -10.085 + 3.247 * \text{Log}_e(\text{DA}) \qquad (1)$$

The 95% confidence limits for the exponent and coefficient were 3.247 ± 0.135 and -10.085 ± 0.700, respectively.

RECOVERY RATES FOR COMMERCIAL TRAWLERS

A. HOWE BAY

A sample of frozen DHOFF Pacific ocean perch was obtained on Feb. 21, 1986 from the HOWE BAY. The sample consisted of five, 10-kg blocks (15-24 fish) from each of three size categories, medium, large and extra-large. Each 10-kg block of Pacific ocean perch was weighed before being allowed to thaw while covered in a cooler for 96 h. The fish were then weighed and measured individually (Appendix 2).

The original fresh weight of the HOWE BAY product was back-calculated from the DA length for each specimen, using the length-weight formula determined from the G.B. REED specimens. Recovery rate was calculated as actual DHOFF thawed weight divided by predicted original round weight from equation (1). The mean recovery rate and 95% confidence limits for the Pacific ocean perch sampled from the HOWE BAY was 60.2% ± 0.6.

The recovery rate by size category (M, L, XL) was examined with analysis of variance (ANOVA) to test whether the recovery rate varied with category (Appendix 3). Even though the computed F-value was large, indicating a significant difference among recovery rates by size category, an average recovery rate from all the fish sampled was chosen because there was no obvious trend among the three categories and the variation was not large. Table 2 lists the mean recovery rate by size category treating each specimen separately.

The following equation was used to determine the percentage that glazing represents in the weight of the frozen block:

$$\% \text{ glazing} = \frac{\text{frozen block weight} - \text{thawed block weight}}{\text{frozen block weight}} \times 100 \qquad (2)$$

The percentage of glazing by block of the HOWE BAY Pacific ocean perch is listed in Appendix 4. ANOVA was used to determine if there were significant differences in the amount (%) of glazing among the three different market sizes. The F value from the ANOVA was 0.29. The $F_{0.05}$ was 3.22, therefore the null hypothesis that there was no significant difference in the proportion of glazing per block by size category was accepted (Appendix 5). Glazing contributed an average of 6.2% ± 1.0 ($\alpha = 0.05$) to the weight of the frozen product.

B. NEMESIS

Four blocks (19-21 fish per block) of frozen Pacific ocean perch (DHOFF) were obtained from the commercial fishing vessel NEMESIS, on April 28, 1986. There was only one size category. Results by individual specimen are included as Appendix 6. The mean recovery rate among specimens for the NEMESIS product was: 56.1% ± 0.1 ($\alpha = 0.05$). Mean per block ranged from 53.8% to 56.9%. The percentage of glazing per block is included as Appendix 7. The mean was 8.1% ± 3.4 ($\alpha = 0.05$).

CONVERSION FACTORS

The final conversion formula to back-calculate fresh round weight from frozen DHOFF-glazed product on sales slips was estimated as:

$$\text{Predicted round weight} = \frac{(\text{DHOFF weight}) \times (1.0 - \%\ \text{glazing})}{\text{recovery rate}} \quad (3)$$

HOWE BAY

$$\text{round weight} = \text{DHOFF weight} \times (1.0 - 0.062) \times \frac{1}{0.602}$$

$$\text{round weight} = \text{DHOFF weight} \times \underline{\underline{1.558}}$$

NEMESIS

$$\text{round weight} = \text{DHOFF weight} \times (1.0 - 0.081) \times \frac{1}{0.561}$$

$$\text{round weight} = \text{DHOFF weight} \times \underline{\underline{1.638}}$$

DISCUSSION AND CONCLUSIONS

Landings of frozen DHOFF Pacific ocean perch from the NEMESIS and HOWE BAY will be multiplied by a factor of 1.60 to enter the round weight equivalent in the DFO groundfish catch statistics. The value represents the mean of the two vessels. The factor will be reviewed periodically or if processing methods change.

The reciprocal of the conversion factor minus the glazing represents the actual recovery rate of heading and dressing Pacific ocean perch at sea. According to data collected in this study, the HOWE BAY and NEMESIS recover 60% and 56% respectively of the initial round weight prior to freezing and glazing.

Future rockfish research will collect more background information with which to verify the present length-weight formula for Pacific ocean perch. In the interim, equation (1) will be assumed to be representative for Pacific ocean perch and other rockfish, and will be used to estimate initial whole weight from thawed processed weight. We will collect similar data for other groundfish species as they become popular targets for processing at sea.

ACKNOWLEDGMENTS

We wish to acknowledge the assistance of Dick Nagtegaal and Bruce Leaman for measuring and processing the G.B. REED sample. Janice Leaman, Jeff Fargo and Bill Shaw kindly reviewed the manuscript.

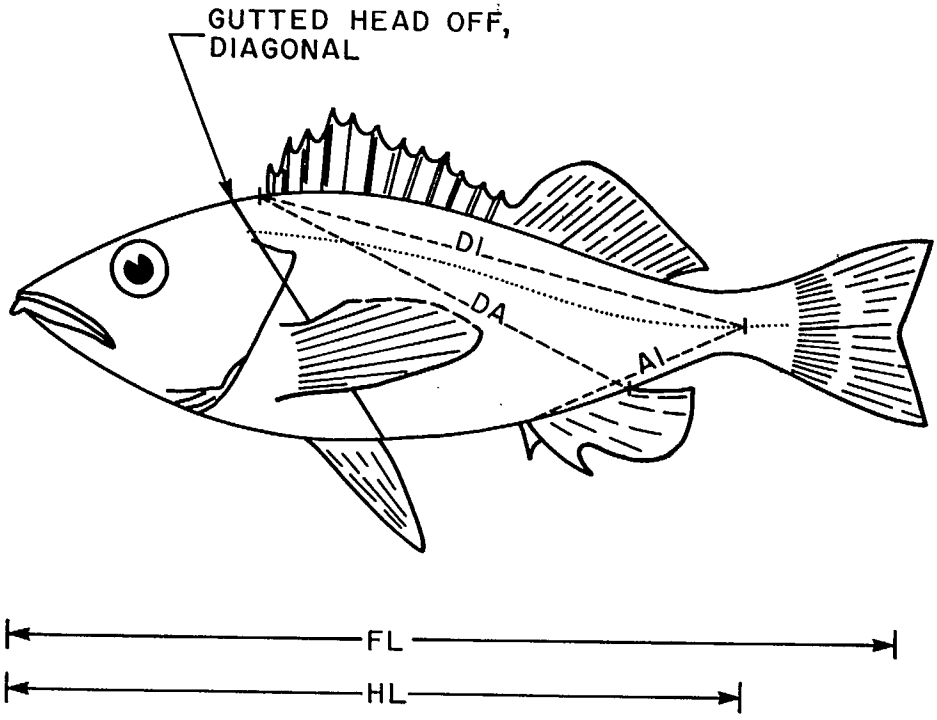
Table 1. Parameter estimates for the regression of $\log_e$ fresh weight versus $\log_e$ DA from G.B. REED specimens.

Variable	DF	Parameter estimate	Standard error	t for Ho: parameter = 0	Prob>|t|
intercept	1	-10.085	0.352	-28.676	0.0001
Log_eDA	1	3.247	0.068	47.897	0.0001

Table 2. Mean recovery rate per size category of Pacific ocean perch processed by the HOWE BAY.

Size	n	Mean recovery rate	Confidence limits (α=0.05) for the mean recovery rate
Medium	116	0.594	±0.009
Large	105	0.632	±0.011
Extra-large	85	0.575	±0.011

FIG. 1 LENGTH MEASUREMENTS TAKEN FROM THE PACIFIC OCEAN PERCH



KEY

DA - DORSAL FIN ORIGIN TO ANAL FIN INSERTION (mm)

AI - ANAL FIN ORIGIN TO HYPURAL FLEXION (mm)

DI - DORSAL FIN ORIGIN TO HYPURAL FLEXION (mm)

FL - FORK LENGTH (cm)

HL - STANDARD LENGTH (cm)

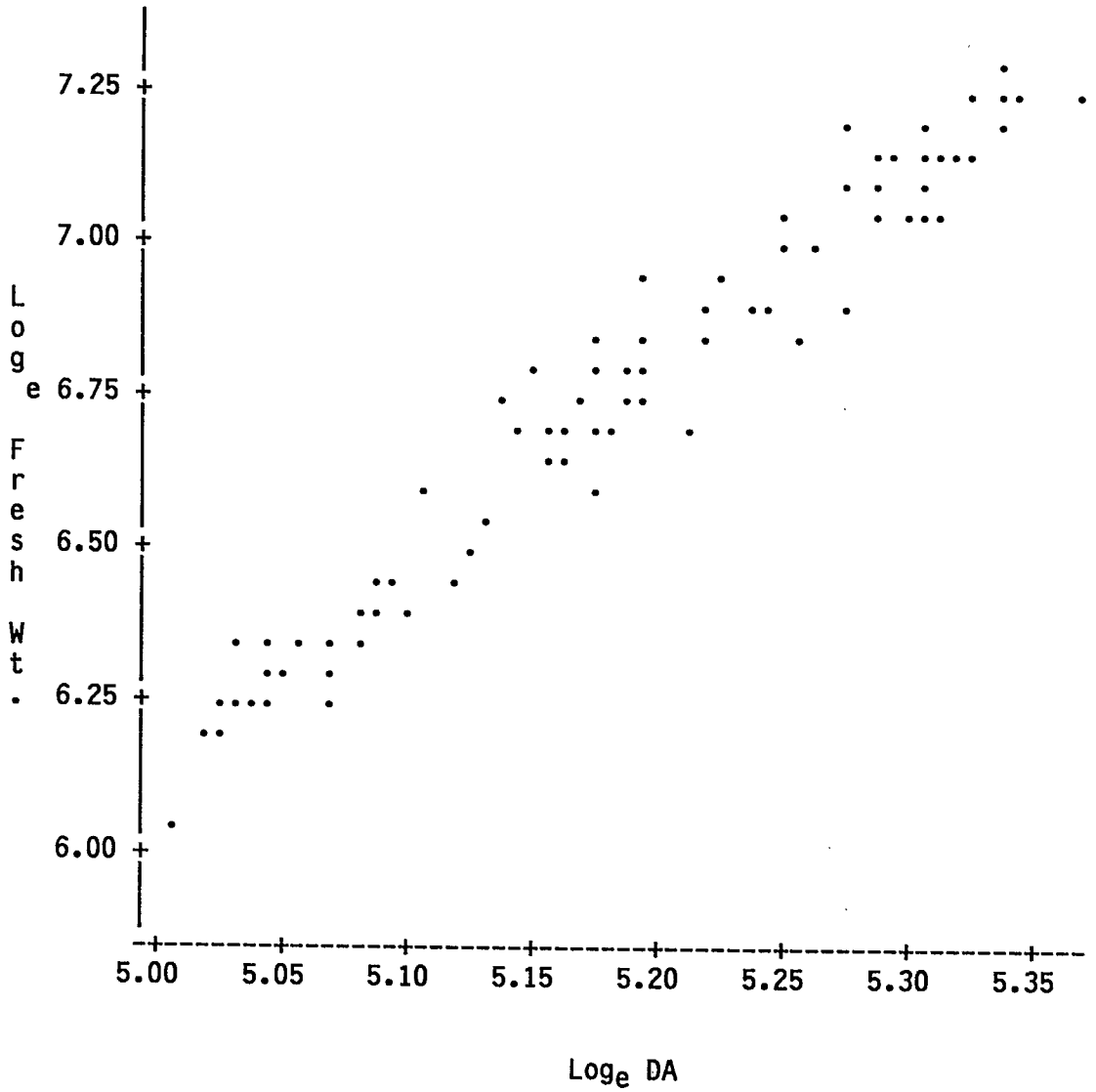


Figure 2. Plot of the $\log_e$ fresh weight versus $\log_e$ DA for the G.B. REED Pacific ocean perch. (17 observations hidden.)

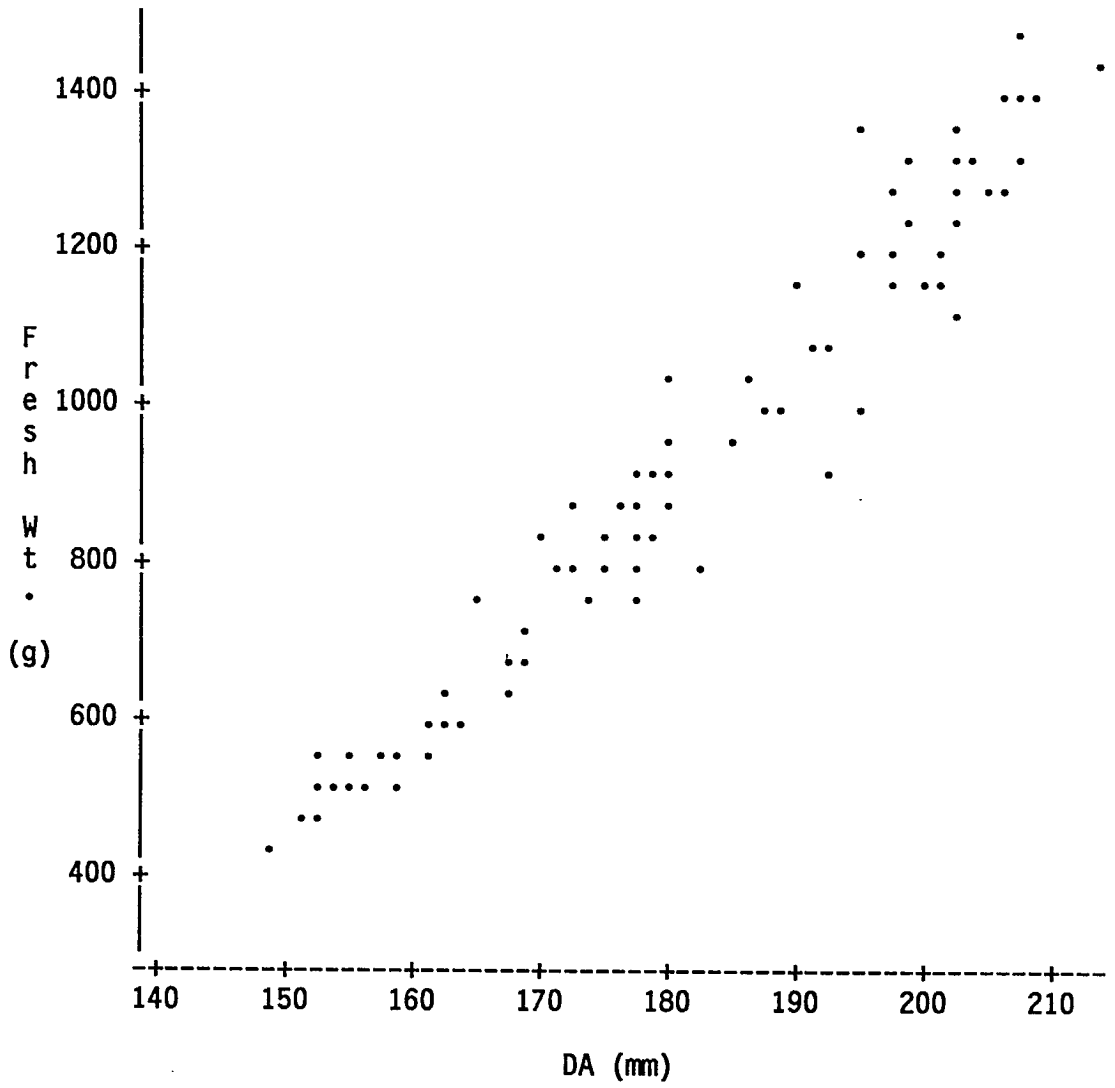


Figure 3. Plot of fresh weight (g) against the DA (mm) for the G.B. REED Pacific ocean perch. (Note: 18 observations hidden.)

Appendix table 1. Pacific ocean perch length-weight data from the G.B. REED.

Fresh							After thawing			
Fork length (cm)	Standard length (cm)	Dorsal fin to hypural flexion(mm)	Anal fin to hypural flexion(mm)	Dorsal Fin to anal fin (mm)	Round wt. (g)	DHOFF wt. (g)	Dorsal fin to hypural flexion(mm)	Anal fin to hypural flexion(mm)	Dorsal to anal fin (mm)	DHOFF wt. (g)
33	29	203	107	152	428	234	202	100	149	231
34	30	200	111	152	494	288	194	99	151	287
33	29	210	110	161	516	291	203	106	155	280
34	29	225	116	157	523	293	199	101	154	277
34	29	217	101	158	489	264	197	97	152	254
34	30	212	110	159	534	305	207	109	155	268
34	29	217	112	160	508	282	201	102	154	269
34	30	202	106	160	507	277	201	98	153	265
35	30	211	107	163	537	302	202	110	156	298
36	31	212	114	165	564	321	207	105	155	307
35	30	209	111	166	574	313	205	106	161	303
36	31	215	115	164	576	319	207	114	159	306
35	30	201	115	160	487	278	197	101	151	279
36	31	216	113	167	610	347	217	110	164	337
35	30	212	110	161	523	290	206	104	159	271
35	30	209	114	162	574	326	208	110	157	320
35	31	217	117	173	630	338	209	106	167	324
36	31	214	110	165	625	347	209	106	163	336
36	31	211	116	167	608	343	209	107	161	328
35	30	205	110	159	545	290	207	107	159	274
35	30	202	111	157	529	284	203	109	152	271
36	31	209	111	166	614	328	207	106	162	317
36	31	210	103	158	560	309	202	99	153	295
38	33	237	113	181	809	470	236	113	178	471
38	34	232	134	180	743	382	232	114	177	371
37	32	221	110	167	617	343	218	110	164	321
38	33	233	111	177	793	416	228	108	173	399
37	32	217	112	166	629	347	211	105	162	332
38	33	234	120	178	832	439	226	115	175	430
38	34	239	121	188	819	421	236	119	183	416

Appendix table 1 (cont'd)

Fresh							After thawing			
Fork length (cm)	Standard length (cm)	Dorsal fin to hypural flexion(mm)	Anal fin to hypural flexion(mm)	Dorsal Fin to anal fin (mm)	Round wt. (g)	DHOFF wt. (g)	Dorsal fin to hypural flexion(mm)	Anal fin to hypural flexion(mm)	Dorsal to anal fin (mm)	DHOFF wt. (g)
38	33	226	151	178	785	425	226	106	175	410
37	32	224	113	171	634	344	216	110	162	326
38	33	220	113	170	696	389	221	111	169	379
38	33	228	119	178	770	391	224	117	174	367
38	33	228	118	170	666	362	224	119	168	331
38	34	224	120	175	712	384	217	113	169	368
38	33	219	114	172	709	384	217	112	169	376
38	33	228	123	180	745	390	218	120	165	375
39	34	228	114	185	913	473	225	111	179	459
39	34	232	116	181	825	422	227	113	177	412
40	35	235	118	183	864	458	232	115	176	445
39	33	222	118	174	841	420	218	114	170	410
39	34	225	119	175	800	418	223	114	171	394
39	34	239	116	183	815	415	230	116	177	401
40	35	249	124	189	875	447	240	119	180	430
39	34	235	123	182	885	451	218	115	172	371
40	35	241	117	189	907	459	231	116	180	456
40	34	232	130	183	884	455	228	122	177	442
40	35	238	119	187	963	510	238	116	180	495
40	35	237	127	183	908	465	236	119	179	452
39	34	238	119	184	836	436	232	116	179	412
41	35	251	125	195	967	549	241	123	185	525
42	37	252	132	194	1013	511	249	126	189	497
42	36	255	120	194	1026	516	243	121	186	493
42	36	249	133	194	1011	537	244	123	188	513
41	35	252	127	197	1091	576	246	119	191	544
42	36	256	132	198	1085	564	255	126	193	541
42	36	228	124	179	923	470	229	119	177	446
42	37	254	131	195	937	469	252	130	192	449
42	37	250	132	200	1010	533	244	124	195	523

Appendix table 1 (cont'd)

Fresh							After thawing			
Fork length (cm)	Standard length (cm)	Dorsal fin to hypural flexion(mm)	Anal fin to hypural flexion(mm)	Dorsal Fin to anal fin (mm)	Round wt. (g)	DHOFF wt. (g)	Dorsal fin to hypural flexion(mm)	Anal fin to hypural flexion(mm)	Dorsal to anal fin (mm)	DHOFF wt. (g)
42	36	243	135	194	999	520	242	125	189	504
42	36	239	128	191	1059	557	232	121	180	543
41	35	236	120	185	890	468	230	125	177	457
41	35	235	126	186	902	440	232	120	180	423
41	36	242	121	188	975	498	237	125	185	484
44	38	252	134	202	1203	644	249	125	195	626
44	38	271	140	209	1267	703	265	127	205	679
43	37	265	131	204	1086	629	249	127	193	626
44	39	268	131	210	1276	725	265	129	206	748
44	39	269	132	213	1472	801	264	122	208	782
43	38	267	125	208	1170	626	249	118	200	566
44	38	262	131	212	1251	710	257	135	199	699
44	38	276	130	210	1238	705	263	128	202	688
43	38	266	121	208	1238	688	259	122	202	663
43	37	252	125	200	1174	672	249	114	198	670
44	38	262	131	211	1215	670	255	126	201	668
44	38	261	124	205	1279	702	255	124	198	672
44	39	265	129	212	1305	717	255	121	204	706
43	37	255	135	197	1170	627	251	127	190	597
45	39	182	127	211	1134	566	256	127	203	530
45	39	259	135	203	1366	746	256	126	195	690
45	39	272	134	215	1408	747	266	127	209	704
45	39	257	131	208	1301	692	256	121	202	708
45	39	272	133	213	1328	702	263	130	208	668
45	39	262	133	208	1161	594	255	127	201	562
45	39	266	131	209	1261	662	252	128	203	690
45	39	267	135	212	1381	785	264	127	208	780
45	39	274	135	211	1274	712	261	130	203	699
45	39	270	133	217	1434	820	265	128	214	816
45	40	270	132	211	1414	817	266	130	206	777
45	39	269	133	212	1358	757	263	128	202	724
45	39	267	131	207	1301	701	256	124	199	674
45	39	266	143	203	1201	633	257	136	198	612

Appendix table 2. Length-weight data for Pacific ocean perch processed by the HOWE BAY, Feb. 1986. (Dash indicates no measurement taken.)

Container	Category	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
1	Medium	28	178	542	845.92	0.641
1	Medium	27	165	387	661.29	0.585
1	Medium	26	169	470	714.77	0.658
1	Medium	26	168	497	701.13	0.709
1	Medium	28	183	574	925.54	0.620
1	Medium	26	167	423	687.67	0.615
1	Medium	25	162	414	623.04	0.664
1	Medium	26	163	440	635.61	0.692
1	Medium	26	171	496	742.60	0.668
1	Medium	27	172	474	756.80	0.626
1	Medium	28	183	499	925.54	0.539
1	Medium	29	180	521	877.18	0.594
1	Medium	28	178	524	845.92	0.619
1	Medium	28	178	509	845.92	0.602
1	Medium	25	162	404	623.04	0.648
1	Medium	-	182	550	909.22	0.605
1	Medium	27	166	420	674.39	0.623
1	Medium	26	169	420	714.77	0.588
1	Medium	25	165	376	661.29	0.569
1	Medium	28	175	450	800.50	0.562
1	Medium	27	173	476	771.18	0.617
1	Medium	26	159	359	586.35	0.612
1	Medium	27	175	425	800.50	0.531
1	Large	28	179	523	861.45	0.607
1	Large	27	177	541	830.59	0.651
1	Large	28	179	521	861.45	0.605
1	Large	27	181	510	893.10	0.571
1	Large	28	177	523	830.59	0.630
1	Large	28	177	518	830.59	0.624
1	Large	28	180	537	877.18	0.612
1	Large	29	185	561	958.79	0.585
1	Large	28	174	536	785.75	0.682
1	Large	29	185	521	958.79	0.543
1	Large	29	189	644	1027.75	0.627
1	Large	30	192	560	1081.67	0.518
1	Large	29	187	560	992.86	0.564
1	Large	27	177	534	830.59	0.643
1	Large	30	193	578	1100.07	0.525
1	Large	29	186	515	975.72	0.528
1	Large	29	182	509	909.22	0.560
1	Large	29	182	489	909.22	0.538
1	Large	30	191	589	1063.48	0.554
1	Large	28	179	573	861.45	0.665
1	Large	29	184	560	942.06	0.594

Appendix table 2 (cont'd)

Container	Category	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
1	X-Large	-	182	527	909.22	0.580
1	X-Large	30	197	581	1175.84	0.494
1	X-Large	29	182	516	909.22	0.568
1	X-Large	30	197	642	1175.84	0.546
1	X-Large	29	188	565	1010.20	0.559
1	X-Large	32	204	626	1316.99	0.475
1	X-Large	29	185	565	958.79	0.589
1	X-Large	29	182	564	909.22	0.620
1	X-Large	30	192	589	1081.67	0.545
1	X-Large	-	179	535	861.45	0.621
1	X-Large	29	189	522	1027.75	0.508
1	X-Large	28	180	548	877.18	0.625
1	X-Large	30	188	560	1010.20	0.554
1	X-Large	29	185	592	958.79	0.617
1	X-Large	29	191	565	1063.48	0.531
1	X-Large	28	180	570	877.18	0.650
1	X-Large	29	186	539	975.72	0.552
1	X-Large	28	180	504	877.18	0.575
1	X-Large	28	181	516	893.10	0.578
2	Medium	28	172	478	756.80	0.632
2	Medium	28	178	493	845.92	0.583
2	Medium	25	163	414	635.61	0.651
2	Medium	-	166	402	674.39	0.596
2	Medium	28	177	478	830.59	0.575
2	Medium	-	174	436	785.75	0.555
2	Medium	27	171	433	742.60	0.583
2	Medium	26	172	477	756.80	0.630
2	Medium	26	165	376	661.29	0.569
2	Medium	26	168	425	701.13	0.606
2	Medium	27	179	476	861.45	0.553
2	Medium	25	162	365	623.04	0.586
2	Medium	26	164	376	648.36	0.580
2	Medium	26	167	394	687.67	0.573
2	Medium	27	177	513	830.59	0.618
2	Medium	27	179	466	861.45	0.541
2	Medium	24	159	349	586.35	0.595
2	Medium	28	180	487	877.18	0.555
2	Medium	27	171	480	742.60	0.646
2	Medium	25	164	424	648.36	0.654
2	Medium	25	160	396	598.41	0.662
2	Medium	28	181	477	893.10	0.534
2	Medium	24	156	359	551.18	0.651
2	Medium	25	161	405	610.64	0.663

Appendix table 2 (cont'd)

Container	Category	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
2	Large	26	170	459	728.60	0.630
2	Large	27	173	475	771.18	0.616
2	Large	27	168	514	701.13	0.733
2	Large	26	165	426	661.29	0.644
2	Large	25	158	377	574.46	0.656
2	Large	27	176	447	815.45	0.548
2	Large	27	174	500	785.75	0.636
2	Large	27	175	519	800.50	0.648
2	Large	26	169	441	714.77	0.617
2	Large	27	171	445	742.60	0.599
2	Large	27	172	480	756.80	0.634
2	Large	25	160	423	598.41	0.707
2	Large	27	173	504	771.18	0.654
2	Large	25	156	407	551.18	0.738
2	Large	27	172	485	756.80	0.641
2	Large	25	157	361	562.74	0.642
2	Large	25	162	416	623.04	0.668
2	Large	26	164	385	648.36	0.594
2	Large	27	174	454	785.75	0.578
2	Large	27	171	430	742.60	0.579
2	Large	27	173	474	771.18	0.615
2	Large	26	165	427	661.29	0.646
2	X-Large	32	201	711	1255.14	0.566
2	X-Large	30	197	607	1175.84	0.516
2	X-Large	32	206	730	1359.38	0.537
2	X-Large	31	199	633	1215.04	0.521
2	X-Large	32	196	705	1156.57	0.610
2	X-Large	29	187	638	992.86	0.643
2	X-Large	30	193	697	1100.07	0.634
2	X-Large	32	201	537	1255.14	0.428
2	X-Large	30	186	564	975.72	0.578
2	X-Large	30	185	564	958.79	0.588
2	X-Large	30	192	636	1081.67	0.588
2	X-Large	32	205	722	1338.07	0.540
2	X-Large	31	200	654	1234.98	0.530
2	X-Large	31	197	662	1175.84	0.563
2	X-Large	30	189	584	1027.75	0.568
2	X-Large	31	199	619	1215.04	0.509
3	Medium	28	173	441	771.18	0.572
3	Medium	28	167	438	687.67	0.637
3	Medium	-	178	432	845.92	0.511
3	Medium	26	172	449	756.80	0.593
3	Medium	28	179	448	861.45	0.520
3	Medium	27	169	542	714.77	0.758

Appendix table 2 (cont'd)

Container	Category	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt (g)	Predicted whole fresh wt. (g)	Recovery rate
3	Medium	26	173	444	771.18	0.576
3	Medium	30	184	573	942.06	0.608
3	Medium	27	170	375	728.60	0.515
3	Medium	27	168	452	701.13	0.645
3	Medium	28	180	511	877.18	0.583
3	Medium	28	181	486	893.10	0.544
3	Medium	28	182	467	909.22	0.514
3	Medium	28	175	488	800.50	0.610
3	Medium	27	166	409	674.39	0.606
3	Medium	28	176	438	815.45	0.537
3	Medium	28	176	457	815.45	0.560
3	Medium	29	183	519	925.54	0.561
3	Medium	26	168	451	701.13	0.643
3	Medium	27	166	438	674.39	0.649
3	Medium	26	170	444	728.60	0.609
3	Medium	27	175	472	800.50	0.590
3	Medium	27	171	441	742.60	0.594
3	Medium	27	178	475	845.92	0.562
3	Large	27	175	530	800.50	0.662
3	Large	26	167	472	687.67	0.686
3	Large	27	174	514	785.75	0.654
3	Large	26	170	492	728.60	0.675
3	Large	27	171	497	742.60	0.669
3	Large	26	164	489	648.36	0.754
3	Large	26	169	508	714.77	0.711
3	Large	27	171	545	742.60	0.734
3	Large	29	185	560	958.79	0.584
3	Large	27	173	526	771.18	0.682
3	Large	27	172	563	756.80	0.744
3	Large	27	172	519	756.80	0.686
3	Large	27	174	611	785.75	0.778
3	Large	27	170	480	728.60	0.659
3	Large	28	186	552	975.72	0.566
3	Large	28	180	523	877.18	0.596
3	Large	29	184	562	942.06	0.597
3	Large	30	190	579	1045.51	0.554
3	Large	27	172	492	756.80	0.650
3	X-Large	31	202	765	1275.53	0.600
3	X-Large	29	190	571	1045.51	0.546
3	X-Large	31	195	622	1137.52	0.547
3	X-Large	30	200	755	1234.98	0.611
3	X-Large	-	185	539	958.79	0.562
3	X-Large	29	187	675	992.86	0.680
3	X-Large	31	202	753	1275.53	0.590

Appendix table 2 (cont'd)

Container	Category	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
3	X-Large	31	196	659	1156.57	0.570
3	X-Large	31	197	647	1175.84	0.550
3	X-Large	30	194	618	1118.68	0.552
3	X-Large	30	196	640	1156.57	0.553
3	X-Large	30	197	724	1175.84	0.616
3	X-Large	29	182	565	909.22	0.621
3	X-Large	31	199	750	1215.04	0.617
3	X-Large	31	199	750	1215.04	0.617
4	Medium	27	173	484	771.18	0.628
4	Medium	28	175	458	800.50	0.572
4	Medium	27	177	428	830.59	0.515
4	Medium	26	167	432	687.67	0.628
4	Medium	27	166	481	674.39	0.713
4	Medium	27	170	414	728.60	0.568
4	Medium	28	177	487	830.59	0.586
4	Medium	27	168	448	701.13	0.639
4	Medium	28	181	521	893.10	0.583
4	Medium	29	187	546	992.86	0.550
4	Medium	27	179	547	861.45	0.635
4	Medium	27	169	425	714.77	0.595
4	Medium	27	170	428	728.60	0.587
4	Medium	27	172	455	756.80	0.601
4	Medium	26	172	418	756.80	0.552
4	Medium	25	159	387	586.35	0.660
4	Medium	27	176	385	815.45	0.472
4	Medium	27	173	445	771.18	0.577
4	Medium	25	164	387	648.36	0.597
4	Medium	27	174	403	785.75	0.513
4	Medium	28	175	490	800.50	0.612
4	Medium	28	178	466	845.92	0.551
4	Medium	28	182	553	909.22	0.608
4	Medium	28	180	462	877.18	0.527
4	Large	26	169	470	714.77	0.658
4	Large	26	168	438	701.13	0.625
4	Large	28	179	510	861.45	0.592
4	Large	26	163	464	635.61	0.730
4	Large	26	163	423	635.61	0.665
4	Large	26	162	397	623.04	0.637
4	Large	25	161	375	610.64	0.614
4	Large	28	182	528	909.22	0.581
4	Large	27	171	503	742.60	0.677
4	Large	28	181	527	893.10	0.590
4	Large	28	173	516	771.18	0.669
4	Large	27	169	468	714.77	0.655
4	Large	26	166	429	674.39	0.636

Appendix table 2 (cont'd)

Container	Category	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
4	Large	28	181	523	893.10	0.586
4	Large	27	171	472	742.60	0.636
4	Large	27	167	436	687.67	0.634
4	Large	27	172	525	756.80	0.694
4	Large	25	155	385	539.79	0.713
4	Large	29	184	528	942.06	0.560
4	Large	27	168	460	701.13	0.656
4	Large	28	177	487	830.59	0.586
4	X-Large	28	181	663	893.10	0.742
4	X-Large	-	201	708	1255.14	0.564
4	X-Large	30	196	684	1156.57	0.591
4	X-Large	29	188	661	1010.20	0.654
4	X-Large	30	197	695	1175.84	0.591
4	X-Large	31	200	741	1234.98	0.600
4	X-Large	31	200	684	1234.98	0.554
4	X-Large	31	201	746	1255.14	0.594
4	X-Large	31	202	768	1275.53	0.602
4	X-Large	32	210	832	1446.97	0.575
4	X-Large	30	195	674	1137.52	0.593
4	X-Large	29	186	542	975.72	0.555
4	X-Large	32	208	830	1402.70	0.592
4	X-Large	27	178	500	845.92	0.591
4	X-Large	31	196	602	1156.57	0.521
4	X-Large	32	196	614	1156.57	0.531
4	X-Large	31	194	602	1118.68	0.538
5	Medium	26	171	426	742.60	0.574
5	Medium	27	178	515	845.92	0.609
5	Medium	28	179	494	861.45	0.573
5	Medium	27	172	432	756.80	0.571
5	Medium	28	183	485	925.54	0.524
5	Medium	26	169	413	714.77	0.578
5	Medium	26	168	432	701.13	0.616
5	Medium	27	175	458	800.50	0.572
5	Medium	26	167	450	687.67	0.654
5	Medium	27	178	511	845.92	0.604
5	Medium	28	182	492	909.22	0.541
5	Medium	28	176	451	815.45	0.553
5	Medium	27	178	472	845.92	0.558
5	Medium	28	178	505	845.92	0.597
5	Medium	28	179	493	861.45	0.572
5	Medium	26	174	438	785.75	0.557
5	Medium	28	185	518	958.79	0.540
5	Medium	27	173	504	771.18	0.654
5	Medium	28	181	516	893.10	0.578

Appendix table 2 (cont'd)

Container	Category	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
5	Medium	27	172	476	756.80	0.629
5	Medium	26	177	460	830.59	0.554
5	Large	27	175	456	800.50	0.570
5	Large	25	169	442	714.77	0.618
5	Large	28	178	538	845.92	0.636
5	Large	27	171	502	742.60	0.676
5	Large	25	162	386	623.04	0.620
5	Large	26	172	464	756.80	0.613
5	Large	24	156	412	551.18	0.747
5	Large	26	170	477	728.60	0.655
5	Large	26	170	459	728.60	0.630
5	Large	27	177	510	830.59	0.614
5	Large	27	168	441	701.13	0.629
5	Large	27	175	516	800.50	0.645
5	Large	26	172	465	756.80	0.614
5	Large	26	166	416	674.39	0.617
5	Large	26	177	530	830.59	0.638
5	Large	27	171	469	742.60	0.632
5	Large	26	172	456	756.80	0.603
5	Large	28	184	500	942.06	0.531
5	Large	26	169	430	714.77	0.602
5	Large	26	168	429	701.13	0.612
5	Large	24	157	409	562.74	0.727
5	Large	28	181	534	893.10	0.598
5	X-Large	29	185	592	958.79	0.617
5	X-Large	30	194	642	1118.68	0.574
5	X-Large	29	189	607	1027.75	0.591
5	X-Large	29	190	584	1045.51	0.559
5	X-Large	.	176	599	815.45	0.735
5	X-Large	29	191	676	1063.48	0.636
5	X-Large	30	192	572	1081.67	0.529
5	X-Large	30	186	533	975.72	0.546
5	X-Large	31	199	615	1215.04	0.506
5	X-Large	29	188	579	1010.20	0.573
5	X-Large	30	188	582	1010.20	0.576
5	X-Large	29	184	531	942.06	0.564
5	X-Large	29	190	537	1045.51	0.514
5	X-Large	29	182	563	909.22	0.619
5	X-Large	.	189	559	1027.75	0.544
5	X-Large	30	191	535	1063.48	0.503
5	X-Large	29	185	589	958.79	0.614
5	X-Large	30	195	595	1137.52	0.523

Appendix table 3. Analysis of variance examination of the recovery rate by size category for Pacific ocean perch processed by the HOWE BAY.

DEPENDENT VARIABLE: Recovery rate

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	
MODEL	2	0.161	0.081	31.33	0.0001	0.171	
ERROR	303	0.780	0.003		ROOT MSE		MEAN
CORRECTED TOTAL	305	0.941			0.051		0.602

Appendix table 4. Percentage of glazing by block for Pacific ocean perch processed, by the HOWE BAY.

Block	Category	Wt. of frozen block (g)	Nos. of fish	Wt. of thawed block (g)	Glazing weight (g)	Percentage glazing
1	Medium	11400	23	10650	750	6.579
2	Medium	11185	24	10379	806	7.206
3	Medium	11695	24	11090	605	5.173
4	Medium	11700	24	10950	750	6.410
5	Medium	10480	21	9941	539	5.143
1	Large	12010	21	11402	608	5.062
2	Large	10525	22	9849	676	6.423
3	Large	10750	19	10014	736	6.847
4	Large	10535	21	9864	671	6.369
5	Large	10705	22	10241	464	4.334
1	X-Large	11355	19	10626	729	6.420
2	X-Large	11290	16	10263	1027	9.097
3	X-Large	10980	15	10033	947	8.625
4	X-Large	11755	17	11546	209	1.778
5	X-Large	11350	18	10490	860	7.577

Appendix table 5. The analysis of variance results for percent glazed by size category for Pacific ocean perch processed by the HOWE BAY.

DEPENDENT VARIABLE: PERCENT GLAZED

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	
MODEL	2	2.066	1.033	0.29	0.751	0.047	
ERROR	12	42.345	3.529		ROOT MSE		MEAN
CORRECTED TOTAL	14	44.411			1.878		6.203

Appendix table 6. Length-weight data for Pacific ocean perch processed by the NEMESIS, April 1986. (Dash indicates no measurement taken.)

Box label	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
1U	29	187	505	992.86	0.509
1U	29	185	471	958.79	0.491
1U	31	204	763	1316.99	0.579
1U	27	177	477	830.59	0.574
1U	27	175	487	800.50	0.608
1U	31	202	709	1275.53	0.556
1U	28	184	620	942.06	0.658
1U	30	192	616	1081.67	0.569
1U	28	180	495	877.18	0.564
1U	28	187	562	992.86	0.566
1U	29	187	644	992.86	0.649
1U	25	165	393	661.29	0.594
1U	27	175	450	800.50	0.562
1U	33	225	826	1810.29	0.456
1U	28	183	501	925.54	0.541
1U	30	191	623	1063.48	0.586
1U	30	191	616	1063.48	0.579
1U	31	202	707	1275.53	0.554
1U	28	180	510	877.18	0.581
1U	28	181	521	893.10	0.583
1U	31	195	638	1137.52	0.561
1L	28	181	552	893.10	0.618
1L	28	177	480	830.59	0.578
1L	28	176	484	815.45	0.594
1L	27	174	463	785.75	0.589
1L	28	180	547	877.18	0.624
1L	28	176	458	815.45	0.562
1L	30	189	559	1027.75	0.544
1L	28	176	525	815.45	0.644
1L	28	187	516	992.86	0.520
1L	29	180	559	877.18	0.637
1L	30	190	594	1045.51	0.568
1L	29	187	496	992.86	0.500
1L	30	197	531	1175.84	0.452
1L	28	178	423	845.92	0.500
1L	32	210	861	1446.97	0.595
1L	28	174	421	785.75	0.536
1L	28	180	477	877.18	0.544
1L	28	182	512	909.22	0.563
1L	28	185	533	958.79	0.556
1L	29	185	607	958.79	0.633
1L	31	194	717	1118.68	0.641

Appendix table 6 (cont'd)

Box label	Fork length (cm)	Dorsal fin to anal fin(mm)	Thawed DHOFF wt. (g)	Predicted whole fresh wt. (g)	Recovery rate
2U	28	187	531	992.86	0.535
2U	27	176	438	815.45	0.537
2U	32	213	815	1515.17	0.538
2U	27	181	503	893.10	0.563
2U	-	209	686	1424.72	0.481
2U	29	185	541	958.79	0.564
2U	32	215	828	1561.85	0.530
2U	28	179	477	861.45	0.554
2U	30	189	557	1027.75	0.542
2U	28	185	558	958.79	0.582
2U	31	205	681	1338.07	0.509
2U	28	185	500	958.79	0.521
2U	32	212	803	1492.20	0.538
2U	30	189	584	1027.75	0.568
2U	32	205	750	1338.07	0.561
2U	30	198	684	1195.33	0.572
2U	28	186	498	975.72	0.510
2U	28	176	449	815.45	0.551
2U	29	186	477	975.72	0.489
2U	29	189	551	1027.75	0.536
2U	31	202	645	1275.53	0.506
2L	30	199	683	1215.04	0.562
2L	29	193	614	1100.07	0.558
2L	27	175	436	800.50	0.545
2L	31	203	699	1296.15	0.539
2L	28	180	496	877.18	0.565
2L	29	184	482	942.06	0.512
2L	28	176	473	815.45	0.580
2L	29	182	549	909.22	0.604
2L	28	180	519	877.18	0.592
2L	-	179	538	861.45	0.625
2L	-	194	718	1118.68	0.642
2L	31	196	715	1156.57	0.618
2L	28	177	480	830.59	0.578
2L	-	181	478	893.10	0.535
2L	30	187	590	992.86	0.594
2L	28	180	470	877.18	0.536
2L	29	182	520	909.22	0.572
2L	27	178	438	845.92	0.518
2L	26	168	384	701.13	0.548

Appendix table 7. Percentage of glazing by container for Pacific ocean perch processed by the NEMESIS.

Box label	Weight of frozen block (g)	Nos. of fish	Weight of block (g)	Glazing weight (g)	Percent glazing
1U	12890	21	12134	756	5.865
1L	12560	21	11315	1245	9.912
2U	13456	21	12556	900	6.688
2L	11415	19	10282	1133	9.926